(Laughter) "I'm going to many places.

(Laughs) When I went to Sainsbury's the other day, there were about 30 varieties.

You can also chop carrots for dipping.

Solomon, have you ever done that? ”

(laughter) He said, "I need to go to bed."

(laughter) (applause) "Until tomorrow.

Have a nice dream. ”

I didn't know what to say!

I said, "Good evening, gold nuggets, good evening."

(Laughter) I want you all to understand that this has been going on for weeks and it's been the best few weeks of my life so far, and I had to bang my head.

It's getting a little out of hand.

My friend said, "James, do you want to come for a drink?"

I thought, "No, I'm waiting for an email about money."

So I thought I should hit my head.

I had to take it to a ridiculous conclusion.

You must use the code when emailing each other. ”

And he agreed.

(Laughter) I said, 'Solomon, I spent the night figuring out this code and I'm going to have to use it in all future communications: Attorney: Gummy Bear.

Bank: Cream Egg.

Legal: A bottle of fizzy cola. Claim: Peanut M&Ms.

Document: Jellybean.

Western Union: Giant gummy lizard. ”

(Laughter) You knew those were all the words they used, right?

I said, "Please call me KitKat in future correspondence."

(Laughter) There was no reply. I thought I had gone too far.

I have gone too far. So I had to backpedal a bit.

I said, "Solomon, are you still under contract?"

KitKat. "

(Laughter) Because you have to be consistent.

After that I got an email from him.

He said, ``The business is up and running and I'm trying to figure it out...''

What followed was the best email I have ever received.

(Laughter) No kidding, this just landed in my inbox.

Today was a good day.

"Business continues.

I'm trying to balance Gummy Bear -- (laughter) so he can submit all the fizzy cola bottle jelly beans he needs to Kreme Egg to start the process of Peanut M&Ms.

(Laughter) Send me £1,500 in giant gummy lizards. ”

(Applause.) It was so much fun that I thought, For example, what if you spend as much time as possible responding to as many scam emails as possible?

That's what I've been doing for you for three years.

(Laughter) (Applause) When you start replying to scam emails, crazy things happen.

It's really hard and I highly recommend doing it.

There are many people who do mean things to scammers.

All I'm doing is wasting their time.

And I think the time they're spending with me is not the time they're spending scamming vulnerable adults out of their savings, right?

And if you're going to do this, which I highly recommend you do, get a pseudonymous email address.

Do not use your own email address.

That was the first thing I was doing and it was a nightmare.

I woke up in the morning with 1,000 emails about penis enlargement, and only one was a legitimate answer to a medical question (laughs).

But, but, folks, what I'm trying to say is, any day is a good day. Any day is a good day when you get a starting email like this: (Laughter) "I am Winnie Mandela, second wife of former South African President Nelson Mandela."

I oh! --That Winnie Mandela.

(laughs) I know a lot.

"Because of my husband Nelson Mandela's health, I need to transfer $45 million out of the country."

Let's figure it out.

She sent me this and it's hysterical.

(laughs) And this.

And this looks like a pretty legit one, this is a power of attorney.

But honestly, nothing written is just a form!

(Laughter) I said, 'Winnie, I'm so sorry to hear this.

Considering Nelson passed away three months ago, we can say that his health is pretty serious. ”

(Laughter) It's the worst health condition you could ever have, and you can't say you're alive.

"Follow the banker's instructions," she said.

one love. "

(Laughter.) I said, "Of course not. No women, no crying."

(Laughter) (Applause) She said, "My banker needs $3,000 to transfer. One love."

(Laughter) I said, 'No problem.

I shot the sheriff. ”

[(But I didn't shoot the Vice President)] (laughter) Thank you.

(applause)

French fries are delicious.

The ketchup-drenched fries are a bit of heaven.

The problem is that it's basically impossible to pour exactly the right amount.

We're so used to pouring ketchup that we don't realize how strange the behavior is.

Imagine a ketchup bottle filled with a straight solid like steel.

No matter how much it shakes, the steel will not come off.

Now imagine the same bottle filled with a liquid like water.

It will rain down like a dream.

But Ketchup seems indecisive.

solid? Or liquid?

The answer is that it depends.

The world's most common fluids, such as water, oil, and alcohol, respond linearly to force.

Press twice as hard to move twice as fast.

These fluids are called Newtonian fluids because Sir Isaac Newton of apple fame first proposed this relationship.

But ketchup is part of a hilarious group of linear rule-breakers called non-Newtonian fluids.

Mayonnaise, toothpaste, blood, paint, peanut butter, and many other liquids respond non-linearly to force.

In other words, the apparent thickness changes depending on the strength, length, and speed of pressing.

And ketchup is actually non-Newtonian in two different ways.

Method 1: If you press hard, the ketchup will appear to thin.

Below a certain pressing force, ketchup basically behaves like a solid.

But once you cross that breaking point, it shifts gears and makes you 1000 times less than before.

Sound familiar?

Method 2: Press with force below the threshold and eventually the ketchup will start flowing.

In this case, time, not force, is the key to freeing ketchup from its glass prison.

So why does ketchup behave so strangely?

That's right, tomatoes made from tomatoes, crushed, crushed, smashed, completely destroyed.

Can you see this tiny particle?

This is what the tomato cells are left after going through the ketchup process.

And the liquid around those particles?

Mostly water, vinegar, sugar and spices.

Tomato particles are evenly and randomly distributed just by putting ketchup on it.

Now suppose we apply a weak force quickly.

The particles hit each other, but they can't get in each other's way, so the ketchup doesn't flow.

Now let's say we apply a very quick and strong force.

That extra force is enough to squash the tomato particles, so they're probably squashed into tiny ellipses instead of tiny spheres, Dawn!

Now there is enough space for one group of particles to flow past the others and for the ketchup to flow.

Now let's say we apply a very weak force for a very long time.

Ultimately, we don't know exactly what will happen in this scenario.

One possibility is that the tomato particles near the walls of the container slowly collide toward the center, leaving the soup they were dissolved in (remember, it's basically water) near the edges.

The water acts as a lubricant between the vial and the ketchup stopper, allowing the ketchup to flow.

Another possibility is that the particles slowly rearrange themselves into many small groups and then pass each other.

Scientists who study fluid flow are still actively studying how ketchup and its merry companions work.

Ketchup basically gets thinner the harder you press, but other substances like oobleck and some natural peanut butters actually get thicker the harder you press.

Once started, some people climb the spinning bar or keep pouring from the beaker.

But from a physics point of view, ketchup is one of the most complex mixtures.

And as if that wasn't enough, it means that two different ketchups can behave quite differently due to the balance of ingredients and the presence of natural thickeners like xanthan gum, which is also found in many fruit drinks and milkshakes.

However, most often exhibit two prominent characteristics. It thins abruptly at a threshold force, and thins more gradually after a small force is applied for a long period of time.

So there are two ways to get the ketchup out of the bottle. Either a long, slow, slow shake, or a single very hard hit on the bottle to keep the force applied.

What the real pros do is hold the lid closed and give the bottle a few short, sharp shakes to wake up all the tomato particles, then remove the lid and pour it over heavenly fries with good control.

I have been a police officer for a very long time.

And because I am also a black preacher, I see these notes in my hands.

(Laughter) And if any of you know anything about black preachers, I'm going to stop and continue for another 20 minutes.

(Laughter) We need this to keep this thing moving forward.

I've been a police officer for a very long time, and I was a police officer long before technology.

This is a story before the pager.

(Laughter) Laugh if you want, but I'm telling the truth.

I was in a war with my peers, which predates the war on drugs.

I have known all this before.

I've been through a lot, I've had my ups and downs, ups and downs, but I still really love being a police officer.

I love being a police officer. Because it's always been a vocation for me, never a job.

Nevertheless, my personal truth is that law enforcement is in danger.

This is an invisible crisis and it has been going on for years.

Even though we law enforcement say, 'Did you know? We can't arrest the way out of this situation.'

We say things like, "Yeah, profiling is illegal," in law enforcement.

you know what?

We agree that law enforcement agencies need to adopt this mindset and place more emphasis on community policing.

Yet all the while, we keep going in the same vein, in the same vein that contradicts everything we have just admitted.

That was the reason for me a few years ago.

Because I was tired of racism, discrimination, "isms" and divisions.

I was so tired.

I was sick of that vicious circle, and I was sick of my favorite office in my still favorite department.

So my wife and I sat down and set a goal for our retirement date.

We retired, I went out into the sunset, probably served full time, and loved my wife for a long time.

Guys, you know what I'm talking about.

(laughs) But I decided to retire.

But there was a power that surpassed me.

It was the city I loved, the city I grew up in, the one I was educated in, and the one that pulled my heart back into the system.

So we didn't retire.

We didn't retire, so what happened was, for the next 18 or 19 months, I had a passion for doing radical policing.

And now, over the next 19 months, I was ready to shift, move beyond drug sergeant, ready to retire as drug sergeant, climb from level to level, and find myself district commander, the worst district commander in Baltimore City.

We call it the Eastern District. The most violent district and the poorest district. The district's unemployment rate is 46 percent.

At the time, the National Rating, AIDS and Tuberculosis [Rating], was consistently in the top 10 list of city zip codes, or simply national zip codes, nationwide.

The top 10 are smaller regions, not states or cities.

And I said, do you know? you have to do something different.

you have to do something different. You have to think fundamentally.

You have to think outside the box.

And I had to start listening to that inner spirit to bring about the change I longed for and felt so desperately in my heart.

I had to start listening to my inner man, which went against everything I was trained to do.

But still we made it.

We continued to do so because we listened to that inner spirit, and I realized that: If we want to see real police reform in the communities where I held public safety authority, we must change our stinking mindset.

I needed to change that.

So we started thinking holistically rather than paramilitary.

So we thought differently.

And we began to realize that there can never and never should be us versus them.

So I decided to come to a crossroads where I could meet every class, every race, every creed, every skin color. There I met businesses, faith-based people, educational institutions, medical institutions, and all those who made up the community for which I had authority.

So I started meeting them and listening to their stories.

You see, the police have a problem.

In short, we want to bring things to the community and come up with these extravagant strategies and deployments, but we don't discuss them with the community.

And we push them into the community and say 'accept it'.

But we said we were going to get rid of that stinky idea, and we talked it over with the community.

We said, 'This is your community table.

We pull up our chairs. we would like to hear from you

What will work in your community? ”

And then some great things started happening.

I had to find a way to convert the 130 police officers under my command from occupiers of the community to partners.

I had to come up with a way to do that.

Because there's something crazy here. In law enforcement, we are incredibly evolved.

Listen, we have become great guardians.

we know how to protect you

But we have trained that arm very, very well.

If I were a natural police officer and representative of the police department, I would see this incredibly beautiful 23 inch arm.

(laughs) It's beautiful. It's clipped.

No fat. Hmm, looks good. It just looks good!

(Laughs) That's a great arm, defensive power!

That's who we are, but sometimes we overuse it and it leads to abuse.

It has brought ruthlessness and callousness to us, dehumanizing us.

And we forget that the tenet of this entire nation is to protect and serve.

Don't you know that? protect and serve

(Laughter) So you look at the other arm, and then you look at it... it's there.

(Laughs) Yes, it's a little weak.

looks sick.

We have invested so much in the conservation sector that it is declining and dying.

But we forgot to treat our community like our customers. As if they were our sons and daughters, brothers and sisters, mothers and fathers.

And somehow, along the way, I lost my balance.

And because we are a proud profession, it is very difficult to look in the mirror and see our mistakes.

Making change is even harder.

So, in rushing to get over this issue, I have to say this: But this is not just law enforcement.

Because each of us constitutes a community.

Everyone forms a community.

And as a community, can we say this? --We have placed too much responsibility on law enforcement.

too much.

(Applause.) And we have the audacity and the nerve to anger law enforcement when we take action.

Nowhere in the world do we, as a community, see children playing ball in the street and call the police.

You don't need to call the police just because your neighbor's music is too loud, or because your neighbor's dog came into the yard and did a second thing. I can't call the police.

But we have given up many of our responsibilities.

Listen, when I was a little kid when I first came to Baltimore, we used to play rough in the streets and I never saw the police come and break us up.

do you know who came? It was the elders.

It was a picture of the parents in the community.

It was the guardians, the village spirit.

They came over and said, "Stop!" and "do this". And then, "Please stop doing that."

We had leaders throughout our community.

So it takes all of us, all of us.

And when I say community, I'm talking about everything that makes up a community.

I think in the last 10, 20 years they've moved away from being community churches where you walk out the door and you're in church around the corner.

From there they transitioned and became a regular church.

In other words, there are churches that are by default disconnected from the very community in which they are founded.

And they don't value that community.

I could go on and on, but I'd like to conclude with this.

Communities and Police: We are all missing that precious gift. I call it relational fairness.

we lost it to each other.

It's not anyone else's fault, it's all our fault.

We are all responsible for this.

But I say this. It is never too late for all of us to build our cities and nations to be great again.

It's never too late.

You know, after three years of four-and-a-half years in command in that district, three years after getting pastors into the police car, I knew this—it's a little secret—I knew this—that it's hard to be a mean cop while riding around with a clergyman.

(Laughter) (Applause) You'll get in and out of your car, turn to your right, and say, 'Father, forgive me, I've sinned' all day -- you can't do that!

So we've come up with some great initiatives and initiatives with communities and police to restore that trust.

We began to face our young people and those we thought were on the other side of the fence.

We knew we were in trouble financially, so we started creating jobs.

We knew that the disease was prevalent in our community and that there was no access to proper medical care, so we decided to work together.

We got to that juncture, partnered with anyone who wanted to partner with us, never once thought about crime, and discussed what we needed to do overall.

After all, if people's needs are addressed and the root causes are addressed, crime will naturally be solved.

it will take care of itself.

(Applause.) So, three years into my four-and-a-half-year term, I look back and see that our country is at its lowest level in 40 years. The number of crimes, the number of murders, everything was down until the 1970s.

It might go back even further, but the problem is that we only started keeping data after 1970.

The crime rate was so low for 40 years that I had other commanders call me, "Hey Mel, what are you doing?"

what are you doing'? Gotta get some of it! ”

(Laughter) So we gave them part of it.

And in a short period of time, the city's crime rate reached its lowest level in 30 years.

For the first time in 30 years, the city of Baltimore has fewer than 200 murders (197 to be exact).

And because we learned to be great ministers, we celebrated being great ministers first.

But this much must be said. Over the last few years we have learned to be good proactive cops, good relational cops, not passive, but the last few years have let me down.

they broke my heart.

The rebellion still hurts.

It still hurts me because I really don't think that should happen.

I believe none of this would have happened if we had been allowed to continue along the lines of what we have been doing: serving our communities, treating them as human beings, treating them with respect, loving them first.

If I had continued like this, none of this would have happened.

But somehow we got back to business as usual.

But I'm excited again!

I am excited again. Because now we have a police commissioner who doesn't just talk about the local police, he understands it perfectly and, more importantly, he embraces it.

So I am very excited now.

Listen, I'm excited about Baltimore today. Because, like many cities, we believe we will rise from the ashes.

I believe -- I really believe -- (Applause) I believe we will be great again.

Because if we keep putting our arms around each other and saying, "We're in this together," it's not just a crossroads. When we meet, we must follow the same path towards the same goal. Then this city will be great again.

This country will be great again.

Because we all have the same goal of wanting peace.

We all want to respect each other.

we all want love

And we believe we are back on that track and we are very excited.

Listen, thank you for taking a few minutes.

God bless you.

(Applause.) God bless you.

(applause)

When the Persian army laid siege to the Greek city of Potidaea in 479 BC, the tide receded far more than usual, leaving a convenient route of entry.

However, this was not lucky.

Before they were halfway through, the water returned in waves never seen before, drowning the attackers.

The Potidaians believed they were saved by Poseidon's wrath.

But what really saved them was probably the same phenomenon that destroyed countless others: the tsunami.

Tsunamis, commonly known as tidal waves, are actually unrelated to tidal activity caused by the gravitational forces of the Sun and Moon.

In many ways, a tsunami is just a magnified version of a normal wave.

They have valleys and peaks and consist not of the movement of water, but of the movement of energy through water.

The difference is where this energy comes from.

For normal sea waves it comes from the wind.

This only affects the surface, thus limiting the wave size and speed.

However, tsunamis are caused by energy generated underwater, such as volcanic eruptions, submarine landslides, or most commonly, submarine earthquakes, which occur when a surface plate slides and releases large amounts of energy into the water.

This energy travels to the surface of the earth, displacing the water and raising it above normal sea level, but gravity pulls the water back, causing the energy to ripple outward horizontally.

This creates a tsunami that travels at over 500 miles per hour.

When far from the coast, tsunamis travel the entire depth of the water and are barely detectable.

However, once it reaches shallow water, a phenomenon called wave shallowing occurs.

This huge amount of energy is compressed because less water passes through.

Waves slow down and rise to heights of up to 100 feet.

The word tsunami, which means "harbor wave" in Japanese, comes from the fact that it only appears near the coast.

If the tsunami trough reaches the shore first, it can be misleading as the water retreats farther than usual before the wave hits.

The tsunami not only drowns people near the coast, but also destroys buildings and trees more than a mile inland, especially in low-lying areas.

As if that wasn't enough, the water then recedes, dragging with it any new debris or whatever or whoever is unluckily caught in its path.

The 2004 Indian Ocean Tsunami was one of the worst natural disasters in history, killing more than 200,000 people across South Asia.

So how can we protect ourselves from this destructive force of nature?

In some areas, people are trying to stop the tsunami by building seawalls, locks and diversion channels.

However, these are not always effective.

In 2011, a tsunami overcame the barriers protecting Japan's Fukushima power plant, killing more than 18,000 people and triggering a nuclear disaster.

Many scientists and policy makers are instead focusing on early detection, monitoring underwater pressure and seismic activity, and establishing global communication networks for rapid distribution of warnings.

When a force of nature is too strong to stop, the safest way is to leave it out of its way.

Studies have shown that taking vitamins can be good or bad for your health.

The newly discovered herb may improve memory and destroy the liver.

Headlines tout a promising new cancer treatment, but never mention it again.

Every day we are bombarded with headline-grabbing news backed by scientific research, but what is that research?

how are they executed?

And how do we know if they are trustworthy?

The first thing to remember about dietary and medical information is that while studies on animals and individual cells can point the way to further research, the only way to know how something affects humans is through human studies.

And when it comes to human research, the scientific gold standard is the randomized clinical trial, or RCT.

An important aspect of RCTs is that subjects are randomly assigned to study groups.

It is often blinded for greater rigor.

This process attempts to ensure that the only difference between the groups is the difference the researchers are trying to study.

For example, when testing a new headache drug, a large group of people with headaches are randomly divided into two groups, one receiving the drug and one receiving a placebo.

With proper randomization, the only major overall difference between the two groups was whether they received medication and not other differences that could have affected the outcome.

Randomized clinical trials are a great tool, and in fact the US Food and Drug Administration often requires at least two clinical trials before new drugs go on the market.

The problem is that RCTs are often not possible because they are either impractical or require a large number of volunteers.

In such cases, scientists use epidemiological studies. Rather than randomly assigning active participants to a static control group, this study simply observes people behaving normally.

Suppose you want to study whether an over-the-counter herbal ingredient causes nausea.

Rather than intentionally giving people something that can make them nauseous, you will find people already taking the ingredient in their daily lives.

This group is called a cohort.

You will also need a comparison group of people who have never been exposed to the ingredient.

and compare the stats.

A higher rate of nausea in the herbal cohort suggests an association between herbal supplements and nausea.

Epidemiological research is an excellent tool for studying the health effects of almost anything without directly interfering with people's lives or exposing them to potentially dangerous exposures.

So why can't we rely on these studies to establish causal links between substances and their health effects?

The problem is that even the best-conducted epidemiological studies have inherent flaws.

Exactly because subjects are not randomly assigned to groups.

For example, if our herbal study cohort consisted of people who took supplements for health reasons, they may have already had higher rates of nausea than others in the sample.

Alternatively, the cohort group could have consisted of people who shopped at health food stores, had a variety of diets, and had good access to medical care.

Those factors that may influence the outcome in addition to the factor under study are known as confounding variables.

These two major pitfalls, combined with more general hazards such as conflicts of interest and selective use of data, can render the results of certain epidemiological studies questionable, and good studies must go to great lengths to demonstrate that authors have taken steps to eliminate these types of errors.

But even if it were done, the very nature of epidemiological studies, which examine differences between pre-existing groups rather than deliberately inducing change within the same individuals, means that a single study can only demonstrate correlations between substances and health outcomes, not true causation.

After all, epidemiological studies have served as excellent guides to public health, warning us of serious health hazards such as smoking, asbestos and lead.

However, they have been substantiated through well-conducted epidemiological studies, all pointing in the same direction.

So the next time you see headlines about new miracle cures or the horrific dangers posed by everyday substances, try to learn more about the original research and the inherent limitations of epidemiological studies and clinical trials before jumping to conclusions.

It was the same night as usual, but here I was climbing a platonic mountain like Romeo on my second date.

(Oh) I was there for women.

She had imaginary eyes and everlasting curves.

She said she wanted to go home.

I said I can help you.

He said the salary was good.

You didn't say anything about climbing...

Voice: "Who's there?"

Manny Blott: "Manny Blott, this is my opinion."

Voice: "What are you doing here?"

"Quite a few numbers have been sent to me looking for stolen dingus."

Voice: "Well, you must answer my three riddles to enter the cave."

What was the riddle, and why did I always get three?

"Is it an egg?"

"No, why eggs?"

"Usually eggs."

"What can you hold in your hand that has zero area?"

"Is it a dodo egg?"

"It's not an egg!"

I took out the stone that had bothered me before and thought about it.

I could tell from the size of the raised ridges on my conch that this object had area and lots of it.

But what happens if we carve a triangle from this side here?

As any mook will tell you, the area of ​​this triangle is 1/4 that of a perfect triangle.

I did the same thing again for each of the smaller triangles.

Again, a quarter of the remaining area is gone.

And I just kept going.

After infinitely repeating the cuts, I was satisfied that the area of ​​the triangle was zero.

A bounded shape with zero area.

I don't often surprise myself now, but my own two mitts were creating something crazy new.

"Very good. (Ahem) Now, show me a figure that has a finite area but an infinite perimeter."

"Let's make this clear.

If you want to cut into the border of this shape, smooth it out and put it on the ground..."

it will last forever. ”

"Are you done yet?"

"yes."

"Then please show me the shape."

Well... I haven't been this stuck since the 1958 Rubik's Cube debacle.

Every shape I knew had boundaries.

Circle: 2πr. Triangle: sum of sides.

What is this?

is the angle.

Angle from heaven.

What happens if you pinch both sides like this?

We're about a third done.

And do it over and over and over again.

Each time there was a pinch, there were 4 where there were 3 line segments, so the perimeter was 1/3 longer.

As for area, I got more triangles with each pinch, it's true.

But those triangles kept getting smaller and smaller.

You could say that while the area is converging and approaching a certain number, the perimeter is getting bigger and bigger, bloating out of control like a birthday clown on a birthday.

Infinite pinch, after Flim Flam, there was a finite area, an infinite perimeter.

The work is now complete.

"Oh, it's okay. (Ahem) Riddle 3: Show me a picture that if you magnify it with a microscope, you can still see the original image no matter how much you magnify it."

"You are a strange little man."

"thank you."

Running out of ideas, I turned to my muse, Dora of the Complex.

Voice: "Who is the young lady?"

And it shocked me.

"She's a heartbreaker, my fractal femme fatale.

does she do ”

"Yes, she will do well."

(Lightning bolt) It was dark and at first I thought there was no one in the cave, but I soon realized it was a box.

The young lady was treating me like a love triangle.

She told me she wanted to go home.

(Lightning bolt) All she really wanted was to bring me back here.

Fractals are everywhere.

Like Dora's headshot, most of them are the same no matter how deep you look.

Some have infinitely long perimeters, others have no area or volume, and they were all created by infinite repetition.

So you wanted to know what fractals are?

Well, kid, those are what dreams are made of.

(music)

Light: Light is the fastest thing in the universe, but you can still measure its speed by slowing down the animation. Space-time diagrams can be used to analyze the movement of light. This takes a flipbook of animation panels and flips them over.

In this lesson, we'll add one experimental fact: measuring the speed of light always gives the same answer. 299,792,458 meters per second. This means that when drawing light on a space-time diagram, its worldlines should always appear at the same angle.

But we've seen before that the speed, or the angle of the world line, changes when you look at things from another person's point of view.

To explore this contradiction, let's see what happens if I start moving while I'm still and lasering Tom.

First, we need to create a space-time diagram.

Yes, that means taking all the different panels showing different moments and stacking them up.

When viewed from the side, the world lines of the laser light are displayed at the correct fixed angle, as before.

So far, so good.

But that space-time diagram represents Andrew's point of view.

what does it look like to me

In the last lesson, we showed you how to move all the panels slightly in Tom's view until his worldline is perfectly vertical.

But look closely at the world line of light.

Changing the placement of the panels creates too much tilt.

I measure light traveling faster than Andrew.

But every experiment we've ever done, and one we've tried very hard to show, is that everyone measures light to have a constant velocity.

So let's start again.

In the 1900s, a clever man named Albert Einstein figured out how to see things right from Tom's point of view while getting the speed of light right.

First you need to glue the separate panels together into one solid block.

This gives us space-time, turning space and time into one smooth, continuous material.

And now here's the trick.

What you do is stretch the space-time block along the light worldline, then squash it by the same amount but at right angles to the light worldline, and Abracadabra!

Tom's world line is vertical, so this represents the world from Tom's point of view, but most importantly, the light world line never changes its angle, so light is measured by Tom traveling at the correct speed.

This wonderful trick is known as the Lorentz transformation.

Yes, more than tricks.

Slicing space-time into new panels gives physically correct animations.

I'm stationary in my car, everything else is passing in front of me, and I find that the speed of light is the same fixed value that everyone measures.

On the other hand, something strange happened.

The fence posts aren't even a meter apart anymore, so my mom would be worried I'd look a little skinny.

But it's unfair. Why can't I look skinny?

I thought physics should be the same for everyone.

Yes, no, and so are you.

The stretching and shrinking of space-time is just a mixture of what we thought of as space and time separately.

This particular crushing effect is known as Lorentz contraction.

Yes, but you look like you haven't lost weight yet.

No, that's right.

Now that I know more about space-time, I need to redraw what that scene looked like to me.

To you it looks like Lorenz has signed the contract.

Ah, but to you it looks like Lorenz signed.

yes.

Well, at least it's fair.

When it comes to fairness, just as space is confused with time, time is also confused with space, resulting in an effect known as time dilation.

No, at everyday speeds such as Tom's car can reach, the overall effect is actually much smaller than described here.

Ah, yet careful experiments, such as observing the behavior of small particles flying around the Large Hadron Collider, have confirmed that the effect is real.

And now that space-time is experimentally confirmed to be part of reality, we can be a little more ambitious.

What if we started playing with the material of space-time itself?

You'll find out all about it in the following animation.

We think of romantic feelings as something spontaneous and indescribable that springs from the heart.

But really, it's your brain that performs a series of complex calculations within seconds that determines the attraction.

Not very poetic, is it?

But just because the math is done in your head doesn't mean that all that warm, hazy feeling is in your head.

In fact, all five senses play a role, and each can vote for or veto an up-and-coming attraction.

Eyes are the first element of attraction.

While many standards of visual beauty vary between cultures and times, signs of youth, fertility, and good health, such as long shiny hair and smooth, scar-free skin, are almost always in high demand as they are related to fertility.

And when we find something our eyes like, our instinct is to move it closer so our other senses can investigate.

The role of the nose in love goes beyond just noticing perfumes and colognes.

It can sense natural chemical signals known as pheromones.

These not only convey important physical or genetic information about their source, but can activate physiological or behavioral responses in the recipient.

In one study, a group of women at different times in their ovulatory cycle wore the same T-shirt for three nights.

When male volunteers were randomly assigned to smell either a worn shirt or a new, unworn shirt, saliva samples from those who smelled the shirt worn by an ovulating woman showed an increase in testosterone.

A boost in testosterone like this can give men an impetus to pursue women they might otherwise not have noticed.

A woman's nose is particularly sensitive to MHC molecules that are used to fight disease.

In this case, opposites are attracted.

In one study, when women were asked to smell T-shirts worn by different men, they found that the MHC molecules preferred the scents of men different from their own.

Meaningful.

Genes that confer more diverse immunity may confer greater survival advantages on offspring.

Our ears also determine attractiveness.

Males prefer females with high-pitched, breathy voices and wide formant intervals, which correlate with smaller body size.

Females, on the other hand, prefer lower-pitched voices with narrower formant intervals, suggesting greater body size.

And not surprisingly, touch turns out to be very important in love.

In this experiment, participants were asked to hold hot or iced coffee for a short period of time, unaware that the study had started.

Participants were then asked to read a story about a fictional character and rate the character's personality.

Those with hot coffee perceived the characters in the story to be happier, more sociable, more generous, and better-tempered than those with iced coffee, and those with iced coffee rated them as cold, stoic, and lacking affection.

Even if a potential spouse manages to pass all these tests, there is one more thing. The infamous first kiss, a rich and complex exchange of tactile and chemical cues such as the smell of your breath and the taste of your mouth.

This magical moment is so important that a majority of men and women report losing their attraction to someone after a failed first kiss.

Once the attraction is confirmed, the bloodstream fills with noradrenaline and the fight-or-flight system is activated.

When your heart beats faster, your pupils dilate, and your body releases glucose for more energy, it's not because you're in danger, but because it's telling you something important is happening.

To improve concentration, norepinephrine creates a kind of tunnel vision, blocking out surrounding distractions, possibly distorting your sense of time, and enhancing your memory.

This may explain why people never forget their first kiss.

The idea that much of our attraction is influenced by chemicals and evolutionary biology may seem cold and scientific rather than romantic, but the next time you see someone you love, understand how your entire body plays a matchmaker to decide if that beautiful stranger is right for you.

When you hear the word symmetry, you probably think of simple geometric shapes such as squares and triangles, or the intricate patterns of butterfly wings.

If you have an artistic bent, you might think of the subtle modulations of Mozart's concertos or the effortless poise of a prima ballerina.

When used in everyday life, the word symmetry represents vague notions of beauty, harmony and balance.

In mathematics and science, symmetry has another very specific meaning.

In this technical sense, symmetry is a property of objects.

Almost any kind of object can have symmetry, from concrete like butterflies to abstract like geometric shapes.

So what does it mean for an object to be symmetrical?

Here is the definition: Symmetry is a transformation that leaves an object unchanged.

Okay, that sounds a bit abstract, so let's unpack it.

It's helpful to look at specific examples like this equilateral triangle.

A triangle rotated 120 degrees around access through its center is identical to the original triangle.

In this case the object is a triangle and the transformation that leaves the object unchanged is a 120 degree rotation.

Therefore, an equilateral triangle is said to be symmetrical about a 120 degree rotation about its center.

Instead, if you rotate the triangle by say 90 degrees, the rotated triangle will look different than the original triangle.

In other words, an equilateral triangle is not symmetrical about a 90 degree rotation around its center.

But why do mathematicians and scientists care about symmetry?

After all, they turned out to be essential in many areas of mathematics and science.

Let's take a closer look at an example of symmetry in biology.

You may have noticed that there is a very familiar kind of symmetry that we haven't touched on yet, namely right and left side symmetry of the human body.

This symmetry-giving transformation is a reflection in an imaginary mirror that cuts the body vertically.

Biologists call this bilateral symmetry.

Like all symmetries in living things, it's only rough, but it's still a hallmark of the human body.

We humans are not the only bilaterally symmetrical creatures.

Many other animals also have this kind of symmetry, such as foxes, sharks, beetles, and the butterflies we just mentioned, as do some plants like orchids.

Other organisms have different symmetries, which become apparent only if the organism is rotated around its center point.

This is very similar to the rotational symmetry of the triangle we saw earlier.

However, when it occurs in animals, this kind of symmetry is known as radial symmetry.

For example, some sea urchins and starfish have pentaradial symmetry, that is, symmetry about a 72 degree rotation about their center.

This symmetry also appears in plants. You can tell by slicing an apple horizontally.

Some jellyfish are symmetrical when rotated 90 degrees, but sea anemones are symmetrical at any angle.

On the other hand, some corals have no symmetry at all.

They are completely asymmetrical.

But why do organisms exhibit such different symmetries?

Can body symmetry tell us anything about an animal's lifestyle?

Let's look at a particular group, bilaterally symmetrical animals.

This camp has foxes, beetles, sharks, butterflies and of course humans.

What unites the bilaterally symmetrical animal is that its body is designed around movement.

If you want to pick one direction and move there, it's nice to have a frontend that allows you to group sensory organs like eyes, ears, and nose.

Food and enemies are likely to be encountered from this end, so having a mouth there is helpful.

You are probably familiar with the group of organs and mouths on the front of an animal's body.

called the head.

When you hold your head, you naturally develop left-right symmetry.

It also helps build streamlined fins for fish, aerodynamic wings for birds, and well-tuned legs for running for foxes.

But what does this have to do with evolution?

After all, it turns out that biologists can take advantage of these different body symmetries to work out which animals are related to which.

For example, we found that starfish and sea urchins have 5-fold symmetry.

But what really should have been said was the adult starfish and sea urchins.

In the larval stage, they are bilateral, just like us humans.

For biologists, this provides strong evidence that we are more closely related to starfish than to corals or other animals that do not exhibit bilateral symmetry at any stage of development.

One of the most fascinating and important problems in biology is reconstructing the tree of life and discovering when and how the various branches diverged.

Thinking about simple things like body symmetry helps us delve deeper into our evolutionary past and understand where we as a species came from.

Welcome to Bayek, a riverside community in Ikorodu, Lagos. It is a vivid representation of several riverside communities across Nigeria, where waterways are being eroded by invasive aquatic weeds. Communities where economic livelihoods such as fishing, maritime transport and trade are disrupted. Communities with reduced fish yields. Areas where school children are out of school for days or even weeks.

Who would have imagined that this plant with round leaves, swollen stems and showy lavender flowers would wreak so much havoc in these communities.

The plant is known as water hyacinth and its scientific name is Eichhornia crassipes.

Interestingly, in Nigeria this plant is known not only in mythology, but also by other names, those associated with historical events.

In some places this plant is called babangida.

Babangida reminds me of a military coup.

And you think: fear, self-control.

In parts of the Niger Delta, Nigeria, this plant is also known as Aviola.

When you think of Aviola, you think of voided elections and of dashed hopes.

In the southwestern part of Nigeria, this plant is known as gubeborn.

Gbe'borun means "gossipers" or "gossipers" in Yoruba.

When you think of gossip, you think of rapid reproduction, destruction.

And in the Igala-speaking regions of Nigeria, the plant is known as 'A Kp'iye Kp'oma'. And when you hear it, you will think of death.

Literally translated, it means "death of mother and child".

I met this plant in 2009.

That was shortly after I immigrated to Nigeria from the United States.

I quit my job at an American company and decided to take this big leap of faith. This was a leap of faith born of a deep conviction that Nigeria has much to do in the area of ​​sustainable development.

So, in 2009, actually at the end of 2009, I was on the 3rd Mainland Bridge in Lagos.

And when I looked to the left, I saw this very striking image.

It was an image of a fishing boat fringed with a dense mat of water hyacinth.

And when I saw that scene, it really broke my heart. I wondered, "How are these poor fishermen going to live their daily lives under these restrictions?"

And I thought, "There must be a better way."

It's a win-win solution, as removing weeds protects the environment and provides economic benefits to the communities most affected by weed infestation.

I can say it was my spark moment.

So I did some more research to find out more about the beneficial uses of this weed.

Among the several, there was one that left the biggest impression on me.

It was the use of plants as handicrafts.

And I thought, "What a great idea."

I personally love handicrafts, especially handicrafts that interweave stories.

So I thought, 'Wouldn't this be easy to implement within the community, with no technical skills required?'

And I thought, "3 easy steps to a big solution."

First step: Hit the waterways and harvest the water hyacinths.

This will give you access.

Next, dry the water hyacinth stems.

And thirdly, water hyacinth is woven into the product.

The third step was a challenge.

See, I'm a computer scientist, not a creative person.

So I started exploring how I could learn to weave.

And this quest brought me to a community called Sabo in Ibadan where I lived.

Sabot means "stranger's quarters".

And the community consists mainly of people from the northern part of the country.

So I literally picked up some dry weed and had some more. And I knocked from house to house to find someone who could show me how to weave these water hyacinth stems into rope.

Then I was led to the Hut of Malam Yahaya.

But the problem is Malam Yahaya doesn't speak English and I don't speak Hausa either.

But little children came to the rescue and helped translate.

And so began my journey to learn how to weave this dried water hyacinth stalk into a long rope.

A long rope in hand and ready to make a product.

And that was the beginning of the partnership.

We think about products in cooperation with rattan basket craftsmen.

So, having this in hand, I am confident that I can bring this knowledge back to river area communities and help them turn adversity into prosperity.

So we actually weave these weeds into a product that we can sell.

So there are pens, tableware, wallets and tissue boxes.

This will allow the community to see the water hyacinth from a different perspective.

We consider water hyacinth valuable, beautiful, durable, strong and resilient.

Change your name, change your life.

From the gossip Guveborn to the storyteller Orsotan.

And from A Kp'iye Kp'oma, meaning 'mother and child killer', to Ya du j'ewn w'Iye kp'Oma, meaning 'he who feeds mothers and children'.

I would like to end with a quote from Michael Margolis.

“If you want to know about culture, listen to me,” he said.

And if you want to change the culture, change the story. ”

And from the Makoko community to Abobiri, Ewoi, Koro, Owawa and Esaba, we have changed the story.

Thank you for listening.

(applause)

For most of history, humans did not know what purpose the heart served.

In fact, the organ confused Leonardo da Vinci so much that he gave up studying it.

Everyone could feel their own heartbeat, but it wasn't always clear what each beat was accomplishing.

Now you know that the heart pumps blood.

However, that fact was not always clear. Because if the heart is exposed or removed, the body will perish immediately.

Also, it is impossible to see through the blood vessels, and even if it were possible, it would be difficult to see the heart valves working because the blood itself is opaque.

Even in the 21st century, very few surgical teams have ever seen a heart in action.

Searching the internet for how the heart works will show crude models, diagrams, or animations that don't really show how it works.

It is as if a conspiracy has existed for centuries between teachers and students to accept that the heart cannot function.

So the next best thing is to simply cut open and label the parts.

In doing so, students may not fully understand how it works, but they can get a superficial understanding of how it works by learning concepts such as the heart being a four-chambered organ, and potentially misleading expressions such as that mammals have a double circulation, one that the blood goes to the lungs and back, and the other that the blood goes to the body and back.

In fact, mammalian circulation is a figure eight.

Blood is pumped from one heart pump to the lungs, back to the second heart pump, pumped to the body, and then back to the first pump.

This is an important distinction as it presents two completely different morphologies.

This confusion has caused many students to be wary of the heart in biology classes, believing that the heart represents a frightening subject full of complicated names and diagrams.

Only those who end up studying medicine understand how it really works.

A doctor's observation of the movement of the heart valves reveals their function.

Now imagine you were a doctor for a day.

All you need to get started is a fresh heart, like sheep's or pig's.

If you submerge this heart in water, you will find that the pump does not work even if you squeeze it with your hand.

That's because the water doesn't enter the heart cleanly enough for the pump mechanism to work.

This problem can be solved in a very simple way.

Identify and cut the two atria and trim to the top of the ventricle.

The atria are connected by several inflow veins, so the heart doesn't look too complicated.

Without them, therefore, the only remaining vessels are the two main cardiac arteries, the aorta and the pulmonary artery, which rise like columns of white from between the ventricles.

It looks, and in fact, very simple.

When you run water from the faucet into the right ventricle (the left ventricle also works, but less flashy), you'll see the ventricular valves try to close against the incoming flow.

And the ventricle swells with water.

When the ventricle is compressed, water jets out of the pulmonary artery.

Through clear water, the ventricular valves, called the tricuspid valve in the right ventricle and the mitral valve in the left ventricle, open and close like a parachute when the ventricle is rhythmically compressed.

This flow of water mimics the flow of life's blood.

The valve is fully efficient.

It can be seen that there is no leakage at all when the ventricle is compressed.

And over time they will come closer together with little wear or damage. This explains how this mechanism continues to work seamlessly during the more than 2 billion beats the heart gives in a lifetime.

Anyone who studies the heart can now hold it in their hand and actually pump it to see how it works.

Place your hands on yourself and feel the rhythmic beat.

Understanding how this trusty internal pump works will give you a new ring to the feeling you get when you've run a race, overdosed on caffeine, or caught the eye of a loved one.

Let's say you have 10 minutes to solve this puzzle.

How long would it take if you received continuous electric shocks to your hand?

Longer, right?

This is because when you are in pain, you cannot concentrate on your work.

Well, maybe not. It depends on how you deal with pain.

Some people are distracted by pain.

It takes a long time to complete the task and it doesn't work.

While some people use tasks to distract themselves from pain, they actually perform tasks faster and better when they are in pain than when they are not.

Some people just let their mind wander to distract themselves from the pain.

Why do people feel pain so differently when exposed to the exact same painful stimulus?

Why is this important?

What is pain, anyway?

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage.

Pain is something we experience, so it's best to determine what it is.

There is strength in pain. You can describe it on a scale from 0, no pain at all, to 10, the most painful imaginable.

But pain can also be characterized as sharp, dull, burning, and painful.

So what is it that creates this perception of pain?

When you are injured, specialized tissue damage-sensing nerve cells called nociceptors fire and send signals to the spinal cord and then to the brain.

The processing work is done by cells called neurons and glia.

This is your gray problem.

And highways in the brain carry information as electrical impulses from one area to another.

This is your white matter.

The superhighway that carries pain information from the spinal cord to the brain is a sensory pathway that ends in the cortex, the part of the brain that determines how pain signals are processed.

Another system of interconnected brain cells called the saliency network determines what to pay attention to.

Pain signals can quickly activate the saliency network because pain can have serious consequences.

Now you are paying attention.

The brain also responds to pain and has to deal with these pain signals.

So, for example, the motor path is activated when you take your hand off a hot stove.

But the regulatory networks that deliver endorphins and enkephalins, chemicals released during pain and extreme exercise, are also activated, triggering a runner's high.

These chemical systems help regulate and reduce pain.

All these networks and pathways work together to create the experience of pain, prevent further tissue damage, and help us cope with pain.

The system is similar for everyone, but the sensitivity and efficiency of these brain circuits determine how much pain we feel and how much we deal with.

This is why some people have more pain than others, and why some develop chronic pain that does not respond to treatment, while others respond well.

Variations in pain sensitivity are not that different from variability in responses to other stimuli.

Some people love roller coasters, while others suffer from severe motion sickness.

Why is it important to have diversity in our pain brain circuits?

Well, there are many treatments for pain that target different systems.

For mild pain, over-the-counter drugs act on the cells that initiate pain signals.

Other powerful analgesics and anesthetics work by decreasing the activity of pain-sensing circuits or by enhancing the coping system or endorphins.

Some people can deal with their pain using methods that include distraction, relaxation, meditation, yoga, or taught strategies such as cognitive-behavioral therapy.

For people with severe chronic pain, that is, pain that persists months after the injury should have healed, none of the usual treatments work.

Traditionally, medicine aimed to test treatments on large groups to determine what would work for the majority of patients.

However, this usually leaves people who do not respond to treatment or who experience side effects.

New treatments are now being developed to directly stimulate or block specific pain-sensing attentional and regulatory networks using tools such as magnetic resonance imaging that map brain pathways, as well as ways to tailor treatments to individual patients.

Understanding how your brain responds to pain is key to finding the best treatment for you.

That is true personalized medicine.

How can I know what's going on in my world?

The amount of information available at a click may be infinite, but the time and energy required to assimilate and appreciate it is not.

All the information in the world is useless if you don't know how to read the news.

To your grandparents, parents, and even older siblings, this idea will sound strange.

Until just a few decades ago, the news was widespread.

Choices were limited to two popular magazines and newspapers, and three or four television networks with reliable newscasters delivering the day's news at the same time each night.

However, as mass media became more popular, the problems with this system quickly became apparent.

Authoritarian states were known to control and censor information, but a series of scandals showed that democratic governments often enlisted the help of the media to mislead the public.

Covert wars, covert assassinations, and revelations of political corruption have undermined public confidence in the official narrative presented by mainstream sources.

This erosion of trust in media gatekeepers leads to alternative newspapers, radio programs and cable news competing with the mainstream news outlets to cover events from different perspectives.

These days, the internet has doubled the amount of information and perspectives, and social media, blogs and online videos have turned every citizen into a potential reporter.

But is everyone a reporter?

So how do we get the truth, or something close to it?

One of the best ways is to get original news without the filtering of middlemen.

Instead of articles interpreting scientific research or politicians' speeches, we can often find actual sources and judge for ourselves.

Follow reporters on social media for the latest happenings.

During major events such as the Arab Spring and the Ukrainian protests, newscasters and bloggers have posted updates and recordings amidst the turmoil.

Many of these will later appear in articles and broadcasts, but keep in mind that these refined versions often combine the voices of people who were there with the opinions of editors who weren't there.

At the same time, the more chaotic the story becomes, the less you need to try to follow it in real time.

In events such as terrorist attacks and natural disasters, today's media continually seeks to report even when no reliable new information is available, sometimes leading to misinformation and false accusations of innocent people.

Events like this can be disconcerting, but check for updates several times a day, not every few minutes, to allow time for full details to emerge and false reports to be refuted.

Good journalism strives for objectivity, but media bias is often unavoidable.

If you don't get a direct story, read coverage from multiple news outlets using different reporters and interviewing different experts.

By listening to different sources and noting the differences, you can combine the pieces to get a more complete picture.

It is also important to distinguish between fact and opinion.

Words like "think," "could," and "probably" imply that the outlet is being cautious, or worse, making assumptions.

Also, beware of reports that rely on anonymous sources.

These may be people who have little to do with the article, or who are interested in influencing the coverage, and because they are anonymous, they cannot be held responsible for the information they provide.

Finally, and most importantly, try to verify the news before spreading it.

Social media has allowed the truth to reach us sooner, but it has also allowed rumors to spread before they have been tested and falsehoods to linger long after they have been refuted.

So before you share that incredible or outrageous news item, do a web search to find any additional information or background you may have missed and what other people are saying about it.

Today, we are freer than ever before from the old media gatekeepers who controlled the flow of information.

But with freedom comes responsibility. It is our responsibility to organize our own experiences and ensure that this stream does not flood us with less information than before we took the plunge.

There are good reasons to switch completely to solar power.

It is often cheaper and arguably more sustainable than relying on conventional power plants that use depleted resources like coal.

So why not replace these traditional plants with solar energy?

Because there is one factor that makes solar power so unpredictable. It's cloud cover.

As the sun's rays travel toward the Earth, some are absorbed by the Earth's atmosphere, some are reflected back into space, while the rest reach the Earth's surface.

Those that do not deviate are called direct radiation.

What is reflected by clouds is called diffuse radiation.

And the light rays that are first reflected off a surface, such as a nearby building, before reaching the solar energy system are called reflected irradiance.

But before we look at how clouds affect the sun's rays and power generation, let's see how these solar energy systems work.

The first is the solar power tower.

These consist of a central tower surrounded by huge mirrored surfaces that track the orbit of the sun and concentrate only the light directly to a single point on the tower, much like an avid beachgoer.

The heat produced by these rays is so enormous that it can boil water to produce steam and drive conventional turbines to produce electricity.

However, solar energy systems usually refer to photovoltaics or solar panels, which are the most commonly used systems for photovoltaics.

In a solar panel, photons from the sun's rays hit the surface of the panel, releasing electrons and causing current to flow.

Solar panels can utilize any kind of radiation, while solar towers can only utilize direct radiation. Clouds are important here. This is because the amount of power produced can increase or decrease depending on the type of cloud and its position relative to the sun.

For example, even a few cumulus clouds in front of the sun can result in near-zero power output from solar power towers due to their reliance on direct sunlight.

For solar panels, these clouds also reduce energy output, but not by much as solar panels can utilize all kinds of irradiance.

However, this all depends on the exact position of the clouds.

Reflection, or a specific phenomenon called Mie scattering, can actually cause the sun's rays to be focused forward by the clouds, increasing the amount of solar radiation reaching the solar panel by 50% or more.

If this potential increase is not taken into account, it can damage the solar panel.

Why is this important?

Well, you don't want to stop this lesson just because a cloud passed over your roof panel.

Solar towers can use huge tanks of molten salt or oil to store excess heat and use it when needed. So a way to manage the problem of fluctuating solar radiation to smooth out electricity production is thus realized.

However, for solar panels, there is currently no affordable way to store additional energy.

This is where conventional power plants come into play. This is because additional power from conventional sources must always be available to compensate for fluctuations in these solar power plants.

But why, then, do we humans not rely on these traditional power plants as our primary source of energy, but only as a backup?

This is because it is impossible for coal-fired and nuclear power plant workers to scale their power production up or down according to the number of clouds in the sky.

Response time may be too slow.

Instead, additional power is constantly being generated from conventional power plants to meet these fluctuations.

On sunny days the extra power can be wasted, but on cloudy skies the power makes up for the shortfall.

We currently rely on it for our energy security.

For this reason, many researchers are interested in predicting cloud movement and formation through satellite imagery and cameras looking up at the sky in order to maximize energy from solar power plants and minimize energy waste.

If we can do that, we'll be able to enjoy this video with just sunlight, regardless of the weather. However, if the sun is shining, you may be tempted to venture outside and look at a different type of cloud.

I'm an underwater explorer, more specifically a cave diver.

When I was little, I wanted to be an astronaut, but I grew up in Canada when I was a little girl, so that wasn't a reality.

But, after all, we know far more about space than we know about Mother Earth's lifeblood, the underground waterways that run through it.

So I decided to do something even better.

Rather than exploring space, I wanted to explore the wonders of inner space.

Well, many would say that cave diving is probably one of the most dangerous activities.

So, imagine yourself in this room. If you were suddenly plunged into darkness and your only job was to find an exit, sometimes swimming through this vast space, sometimes crawling under your seat, following thin guidelines and just waiting for life support to give you another breath.

Well, that's where I work.

But what I want to teach you today is that our world is not one big solid rock.

It's more like a sponge.

I can swim through the many pores of the Earth's sponge, but where I cannot swim, other life forms and other matter can make that journey without me.

And my voice will tell you about the inner part of Mother Earth.

When I decided to be the first to cave dive into an Antarctic iceberg, there were no guidebooks available.

As of 2000, it was the largest moving object on Earth.

Since it separated from the Ross Ice Shelf, we went there to investigate ice edge ecology and look for life under the ice.

We use a technology called Rebreather.

It is very similar to the same technology used for spacewalks.

This technology allows us to go deeper than we could have imagined ten years ago.

We use exotic gases and can even go on missions up to 20 hours underwater.

I work with biologists.

The cave turned out to be a treasure trove of amazing life forms, species we never knew existed before.

Many of these life forms live in unusual ways.

Often without pigment or eyes, these animals are also very long-lived.

In fact, the animals swimming in these caves today are the same as those described in the fossil record before the extinction of the dinosaurs.

Please try to imagine. These are like little dinosaurs that swim.

What can they tell us about evolution and survival?

If you see this Remipede-like animal swimming in a bottle, he has huge fangs with poison.

He can actually attack and kill things that are 40 times his size.

If he was the size of a cat, he would be the most dangerous being on earth.

And these animals live in very beautiful places, sometimes in caves like this, and although they are very young, they are ancient.

how did they get there?

I also work with physicists, and they are often interested in global climate change.

They can take a rock inside a cave, slice it up, and observe the layers of rock inside, like the rings of a tree, and they can go back in history and learn about the Earth's climate at very different times.

The red color you see in this photo is actually dust from the Sahara Desert.

In other words, they rode the wind across the Atlantic Ocean.

In this case, it rained on Abaco Island in the Bahamas.

It seeps through the ground and deposits on the rocks within these caves.

And looking back at these rock layers, we can find times when the climate on Earth was very dry, going back hundreds of thousands of years.

Palaeoclimatologists are also interested in where sea level was at other times on Earth.

Here in Bermuda, my team and I embarked on the deepest manned dive ever undertaken in the region, looking for a place where the sea level once loomed over the coastline, hundreds of feet below the current level.

You can also work with paleontologists and archaeologists.

In places such as Mexico, the Bahamas, and even Cuba, we observe cultural sites and human bones in caves that tell us a lot about the early inhabitants of these regions.

But my favorite project was more than 15 years ago when I was part of the team that produced the first accurate 3D maps of the subsurface.

The device I was driving in the cave was actually creating a 3D model as I was driving.

It also used infrasound radio to broadcast its exact location inside the cave to the surface.

So I swam under homes and businesses, under bowling alleys and golf courses, and even under Sony's BBQ restaurant. It was pretty amazing, and what it taught me is that everything we do on the surface of the earth comes back to us as a drink.

Our water planet is more than just rivers, lakes and oceans. It is this vast network of groundwater that connects us all.

It's a shared resource that we all drink from.

And if we can understand the connection between humans and groundwater and all water resources on earth, we will be able to tackle perhaps the most important problem of our century.

So, I wasn't the astronaut I always wanted to be, but this mapping device designed by Dr. Bill Stone will be.

It's actually deformed.

Now it's a self-swimming autonomous robot with artificial intelligence, whose ultimate goal is to travel to Jupiter's moon Europa and explore the oceans beneath its body's frozen surface.

That's great.

(applause)

Think about food security, building shelters, raising children, and all the other things that need to happen for human settlements to thrive.

You need a way to divide resources, organize major efforts, and allocate labor efficiently.

Now imagine having to do this without any planning or higher communication.

Welcome to the ant colony.

Ants have the most complex social organization in the animal kingdom, living in structured colonies containing members of different types who perform specific roles.

However, while this may sound similar to some human societies, this organization is part of a biologically programmed cycle rather than born out of higher level decisions.

In many species, all winged males and winged virgin queens from all nearby colonies within a population emerge from separate nests, converge in a central location to mate, and use pheromones to guide each other to breeding grounds.

After mating, the male dies and the female tries to establish a new colony.

A few successful individuals settle in suitable locations, lose their wings, begin laying eggs, and selectively fertilize some using stored sperm stored from mating.

The fertilized egg develops into a queen bee and a female worker ant who takes care of the egg.

They then guard the colony and forage for food, while the unfertilized eggs develop into males whose only job is to leave the nest and wait until they are ready to breed, and the cycle begins again.

So how do worker ants decide what to do and when?

Well, not really.

Ants have no intentional method of communication, but individual ants interact through touch, sound, and chemical signals.

These stimuli serve a variety of roles, from alerting other ants if an ant is killed to letting them know that the queen is nearing the end of her reproductive life.

But one of the most impressive overall capabilities of ant colonies is their ability to explore large areas thoroughly and efficiently without prior planning.

Most species of ants have little or no vision and can only smell nearby objects.

Combined with a high level of lack of coordination, it seems like ants would be terrible explorers, but they have a surprisingly easy way to maximize their exploration efficiency. By changing behavior patterns based on individual interactions.

When two ants meet, they sense each other by touching their antennae.

If there are many ants in a small area, this will occur more often, causing them to move and react in more complex and random paths to explore more thoroughly.

However, in larger areas where there are fewer ants and where such encounters are less common, ants can walk in a straight line to cover more ground.

Exploring the environment in this way, the ants can encounter a variety of threats, enemies, and even alternative nesting sites.

And some species have another ability known as recruiting.

If one of these ants happens to find food, it will return with it and mark its way with a chemical scent.

Other ants then follow this trail of pheromones, updating their trail each time they find food and return.

When the area runs out of food, the ants stop indicating they're back.

The smell is gone and the ants are no longer attracted to its trail.

These seemingly crude search and retrieval methods are so useful in practice that they are applied to computer models to obtain the best solution from distributed elements, acting randomly and exchanging simple information.

It has many theoretical and practical applications, from solving the famous traveling salesman problem, to scheduling computing tasks and optimizing Internet searches, to allowing groups of robots to collectively explore minefields and burning buildings without central control.

But by letting ants invade empty spaces of various sizes and paying attention to their behavior, we can directly observe these fascinating yet effective processes through a few simple experiments.

Ants may not be able to vote, hold meetings, or even make plans, but we humans may still be able to learn something from the way such simple creatures function effectively in such complex ways.

Tattoos are often portrayed in popular media as dangerous, crazy, or as a symbol of youth trends.

But while tattoo styles change and their meanings vary greatly from culture to culture, the practice is as old as civilization itself.

Decorative skin markings have been found on human bones around the world, with the earliest found in Peruvian mummies dating back to 6,000 BC.

But have you ever wondered how tattoos actually work?

As you may know, we molt our skin and lose about 30-40,000 skin cells per hour.

About 1 million per day.

So why doesn't the tattoo gradually fall off?

The short answer is that tattooing involves incorporating pigment deeper into the skin than the outermost layer, which sloughs off.

Throughout history, different cultures have used different methods to achieve this.

However, the first modern tattoo machines were modeled after Thomas Edison's engraving machine and were powered by electricity.

Tattoo machines in use today pierce the skin with tiny dye-laden needles at a rate of 50 to 3,000 times per minute.

A needle penetrates the epidermis, driving the ink deep into the dermis, which is made up of collagen fibers, nerves, glands, and blood vessels.

Each needle penetration creates a wound, alerting the body to start an inflammatory process, summoning immune system cells to the wound site to start repairing the skin.

And it is precisely this process that makes the tattoo permanent.

First, specialized cells called macrophages feed on invading substances to clear the inflammatory chaos.

As these cells migrate through the lymphatic system, some cells are returned to the lymph nodes with pigment-filled abdomens, while others remain in the dermis.

There is no way to dispose of the pigment, leaving the dye in it visible through the skin.

Some of the ink particles are suspended in the gel-like matrix of the dermis, while others are engulfed by dermal cells called fibroblasts.

Initially, the ink also deposits on the epidermis, but as the skin heals, the damaged epidermal cells slough off and are replaced by new, non-pigmented cells, and the top layer flakes off like a sunburn mark.

Professional tattoos do not usually show blistering or crusting and it takes 2-4 weeks for the epidermis to fully regenerate. Meanwhile, excessive sun exposure and swimming should be avoided to prevent fading.

However, dermal cells continue to exist until they die.

Then, the ink, including the ink, will be taken up by nearby young cells, so the ink will remain intact.

However, over time, the tattoo will disappear on its own as the body reacts to the foreign pigment particles, which are slowly broken down and carried away by macrophages of the immune system.

UV light can also contribute to this pigment degradation, but it can be mitigated by using sunscreen.

However, because dermal cells are relatively stable, much of the ink remains deep in the skin for a lifetime.

But if a tattoo is permanently embedded in your skin, is there a way to remove it?

Technically yes.

Currently, lasers are used to penetrate the epidermis and blow out the colors of the underlying pigment at different wavelengths, with black being the easiest to target.

The laser beam breaks the ink globules into smaller particles that are eliminated by macrophages.

However, some color inks are more difficult to remove than others and can cause problems.

For this reason, removing a tattoo is even more difficult than getting one, but not impossible.

So while one tattoo may not actually last forever, tattoos have been around longer than existing cultures.

And their continuing popularity means that the art of tattooing is here to stay.

You've heard that carbon dioxide is warming the planet, but how does it work?

Is it like glass in a greenhouse or like an insulating blanket?

Well, not quite.

The answer involves a bit of quantum mechanics, but don't worry. Let's start with the rainbow.

If you look closely at sunlight separated through a prism, you'll see dark gaps devoid of bands of color.

where did they go

Different gases absorbed specific parts of the spectrum before reaching our eyes.

For example, oxygen gas caught part of the dark red light, and sodium caught two yellow bands.

But why do these gases absorb certain colors of light?

From here we enter the quantum realm.

All atoms and molecules have a fixed number of energy levels that their electrons can have.

A molecule must gain a certain amount of energy in order to transfer an electron from the ground state to a higher level.

Nothing more, nothing less.

It gets its energy from light, which has countless energy levels.

Light is made up of tiny particles called photons, and the amount of energy in each photon corresponds to its color.

Red light has lower energy and longer wavelength.

Violet light has high energy and short wavelength.

Since sunlight provides all the photons in the rainbow, gas molecules can select photons that carry the exact amount of energy needed to transition the molecule to the next energy level.

Once this match is obtained, photons are annihilated as the molecule gains energy, creating a small gap in the rainbow.

If a photon carries too much or too little energy, the molecule has no choice but to let the photon pass by.

This is why glass is transparent.

Photons pass through because the atoms in the glass do not pair well with any energy level of visible light.

So which photons does carbon dioxide prefer?

Where is the black line in the rainbow that explains global warming?

Well, not there.

Carbon dioxide does not directly absorb light from the sun.

It absorbs light from completely different celestial bodies.

The thing that doesn't seem to emit any light at all is the Earth.

If you're wondering why the Earth isn't glowing, it's because it doesn't emit visible light.

Emits infrared light.

Our visible light, which includes all the colors of the rainbow, is just a small part of a larger spectrum of electromagnetic radiation such as radio waves, microwaves, infrared, ultraviolet, X-rays, and gamma rays.

It may seem strange to think of these as light, but there is no fundamental difference between visible light and other electromagnetic radiation.

It's the same energy, but at a higher or lower level.

In fact, it's a bit presumptuous to define the term visible light by our own limits.

After all, infrared rays are visible to snakes, and ultraviolet rays are visible to birds.

If our eyes were adapted to perceive 1900 megahertz light, cell phones would become flashlights and cell phone towers would look like giant lanterns.

The Earth emits infrared radiation because all objects with a temperature above absolute zero emit light.

This is called thermal radiation.

The hotter the object, the higher the frequency of the light it emits.

When iron is heated, it emits more frequencies of infrared radiation, and when it reaches a temperature of about 450 degrees Celsius, the light reaches the visible spectrum.

It looks red at first.

When heated further, it glows white in all frequencies of visible light.

This is why traditional light bulbs are designed to work and why they are so wasteful.

95% of the light they emit is invisible to our eyes.

It will be wasted as heat.

Without the presence of greenhouse gas molecules in our atmosphere, Earth's infrared radiation would escape into space.

Carbon dioxide and other greenhouse gases agree with infrared photons in the same way that oxygen gas prefers dark red photons.

They provide the right amount of energy to shift gas molecules to higher energy levels.

As soon as a carbon dioxide molecule absorbs an infrared photon, it returns to its previous energy level and exhales the photon in random directions.

Some of that energy then returns to the surface and causes warming.

The more carbon dioxide in the atmosphere, the more likely infrared photons will return to Earth and change the climate.

I do a lot of motion and animation work, and I'm also a DJ and musician.

So I always thought music videos were funny, but they always seem so reactive.

So I wondered if we could get rid of us as creators and let the music be the voice and the animation follow suit.

So, in my office with two designers, Tolga and Christina, we created the track. Most of you are probably familiar with it. About 25 years old, David Byrne and Brian Eno created this little animation.

And I think it's probably interesting that this work deals with two issues: rising water and religion.

Song: God warned Noah to build an ark before he destroyed the people of the earth.

And I think after Noah built the ark, he told Noah to warn him that he must change all his wicked ways before he overwhelms the people and destroys them.

And I understand someone started singing when Noah finished building the ark.

And I knew it was like this when the song started to go.

And when Noah finished building the ark...

Go ahead...actually...concerned...

So they were tired, it was getting dark, and it was raining. They get tired and tired.

Then he went and knocked on an old lady's house.

Then the old lady ran to the door and said, "Who is it?"

Jack said, "Mommy, can I spend the night here?"

I am very tired because it is far from home. ”

Then the old woman said, "Oh, yes, please."

It's getting dark and it's raining, so you'll be tired and tired.

(applause)

We have evolved with our tools, and our tools have evolved with us.

Our ancestors created these hatchets 1.5 million years ago, shaping them not only to suit the task at hand, but also to fit our hands.

But as the years went by, the tools became more and more specialized.

These engraving tools evolve as they are used, and their shapes differ according to their functions.

And we use our manual dexterity to manipulate things more precisely.

But as tools become more and more complex, more and more complex controls are needed to control them.

So designers have become very adept at creating interfaces that let you manipulate parameters while doing other things like taking pictures or changing focus and aperture.

But computers are dynamic in their calculations and have fundamentally changed the way we think about tools.

That means you can do a million different things and run a million different applications.

However, the computer has the same static physical form and has the same static interface elements for all these different applications.

And I think this is fundamentally the problem. This is because it does not allow us to actually interact with our hands and capture the rich dexterity of our bodies.

And our belief is that we need new types of interfaces that capture these rich abilities that we possess and that physically adapt to us and allow us to interact in new ways.

That's what I've been working on at the MIT Media Lab and now at Stanford.

So, together with my colleagues Daniel Leisinger and Hiroshi Ishii, we created inFORM, where the interface can actually be physically manipulated off-screen.

Alternatively, 3D information can be physically visualized, touched, and understood in new ways.

Or you can interact through gestures and make direct transformations for sculpting digital clay.

Alternatively, interface elements may arise from the surface and change as needed.

And the idea is that for each individual application, the physical form can be adapted to the application.

And I believe this represents a new way in which we can interact with information by making it physical.

So the question is, how can this be used?

Traditionally, city planners and architects build physical models of cities and buildings in order to better understand them.

So, together with Tony Tang from the Media Lab, we created an interface built on inFORM to allow city planners to design and view entire cities.

And now you can walk around it, but it's dynamic, it's physical, and you can interact with it directly.

Alternatively, you can see different views such as population or traffic information, but it's physical.

We also believe that these dynamically shaped displays have the potential to profoundly change the way people collaborate remotely.

So when you're working together in person, you're not just looking at your face, you're gesturing and manipulating objects, which is very difficult to do when you're using a tool like Skype.

And with inFORM, you can reach out from your screen and interact with things at a distance.

So, we used the pins on the display to represent human hands, allowing us to actually touch and manipulate distant objects.

You can also manipulate and collaborate on 3D data sets, so you can gesture around as well as interact with them.

This will enable people to collaborate on these new types of 3D information in richer ways than was possible with traditional tools.

So you can also take in existing objects and they will be captured on one side and sent to the other side.

Alternatively, you can link an object between two locations so that moving the ball on one side also moves the ball on the other side.

We accomplish this by using a depth-sensing camera like the Microsoft Kinect to capture the remote user.

Now, in case you're wondering how this works, essentially there are 900 linear actuators connected to these mechanical linkages that allow downward motion to be propagated to the upward pins.

So it's not that complicated compared to what's going on at CERN, but it took a long time to build.

So I had to start with a single motor, a single linear actuator, and design a custom circuit board to control them.

And I had to make a lot of it.

So the problem with having 900 of something is that you have to run every step 900 times.

That meant we had a lot of work to do.

So we set up a mini sweatshop in the Media Lab and convinced them to bring in undergraduates and do some "research." (Laughs), I spent late nights watching movies, eating pizza, and tightening thousands of screws.

You know, research.

(Laughter) But anyway, I think they were really excited about what inFORM could do for us.

We are increasingly using mobile devices to communicate on the go.

But mobile devices, like computers, are used in a variety of ways.

So we talk on the phone, surf the web, play games, take pictures and even use them for a million different purposes.

But again, each of these applications has the same static physical shape.

So we wanted to see how some of the same interactions we developed for inFORM could be brought to mobile devices.

So Stanford University developed this haptic edge display, a mobile device with a series of linear actuators that can change shape. This allows you to feel where you are in your hand while reading a book.

Or you can feel a new type of tactile sensation in your pocket that is richer than vibration.

Alternatively, the button can emerge from the side so that you can operate it wherever you want.

Alternatively, you can use the actual buttons to play the game.

We were able to do this by embedding 40 tiny linear actuators inside the device. This allows you to not only touch the actuator, but also backdrive it.

However, we have explored other ways to create more complex shape changes.

So I used pneumatic actuation to create a morphing device out of something very similar to a phone.

Use it as a wristband on the go.

So we worked with Ken Nakagaki from the Media Lab to create this new high-res version that transforms from an interactive wristband to a touch input device to a phone using a series of servo motors.

(Laughter) And we're also interested in looking at how users can actually morph the interface and shape it into the device they want to use.

You create something like a game controller and the system knows what shape it is and changes it to that mode.

So where does this point?

How do I proceed from here?

In fact, I think we are in this new era of the Internet of Things, where computers are everywhere, in our pockets, in our walls, and in just about every device we buy in the next five years.

But what if we stopped thinking about the device and started thinking about the environment instead?

So how can we have smart furniture, smart rooms, smart environments, or cities that physically adapt to us, allowing us to collaborate with people in new ways and perform new kinds of tasks?

So for Milan Design Week we created TRANSFORM, an interactive table-scale version of these geometric representations. It can move physical objects on the surface. For example, to notify you to pick up your keys.

But it can also be transformed to suit different ways of interacting.

So, if you want to work, you may need to organize your work schedule.

So bringing in your device creates all the affordances you need and also provides other objects to help you reach those goals.

In conclusion, I really think we need to think of new, radically different ways of interacting with computers.

We need computers that can physically adapt to us, adapt to the ways we want to use them, and really take advantage of our rich manual dexterity and ability to think spatially about information by making it physical.

But looking to the future, I think we need to look beyond this, beyond devices, and really think about new ways in which we can connect people and bring our information to the world, and think about smart environments that can physically accommodate us.

So I'm breaking up with you

thank you very much.

(applause)

Check this out: this is a grid. Nothing special. It's just a basic grid, very grid-ish.

But take a closer look. Look at this white dot in the middle where the two central vertical and horizontal lines intersect.

Please take a good look. Notice anything strange about this place?

Yes nothing.

But keep looking. Please look at it with a sense of wonder.

Now keep your gaze fixed on this white dot and see what is happening in your peripheral vision.

Are other parts still white? Or do you see weird gray flashes?

Then take a look at this mold for baking muffins.

Oh sorry one of the cups is upside down. Instead of falling down, jump out.

Wait, don't turn the pot. Are the remaining five domed now?

Either way, this pan is defective.

Here's a picture of Abraham Lincoln and here's a picture upside down.

Nothing strange is happening here.

Wait, turn this over right side up. What did they do to Abe?

These are just three optical illusions, images that seem to trick us.

how do they work?

Is there something magical happening within the image itself?

Sure, there could be flashes of gray sneaking into the white spots around the animated grid, but first off, I promise you that's not the case.

You can see the same effect if you print the grid on old plain paper.

Actually this grid is just a grid. But not for the visual system of the brain.

Here's how to interpret this light information, called the grid.

A white intersection has relatively more white on all four sides than any white point along the line.

Note that the retinal ganglion cells are organized to enhance contrast through lateral inhibition, so there is more white around the crossing points.

Better contrast means the edges of something are easier to see.

And things are what your eyes and brain have evolved to see.

Retinal ganglion cells are less responsive at intersections compared to black boxed lines due to greater lateral inhibition with more white spots nearby.

This is not just an eye defect. If you can see, wearing glasses or holding this piece of paper or computer screen in your face can fool you into an optical illusion.

Optical illusions show us how photoreceptors and the brain assemble visual information to construct the three-dimensional world we see around us. You should pay special attention to edges, as anything with edges can help you or even kill you.

Look at that muffin pan again. Do you know what causes confusion here?

The visual cortex of the brain works on assumptions about the illumination of this image.

We expect the light to pour down from above from a single light source.

These shading patterns could therefore have been caused only by light falling on the sloping sides of the dome or the bottom of the hole.

When we carefully recreate these hints by drawing shading patterns, even on flat paper, our brain reflexively creates 3D reliefs.

Now about that creepy upside-down Lincoln face.

Faces trigger activity in areas of the brain that have evolved specifically to recognize faces.

Similar to the fusiform facial region and other regions of the occipital and temporal lobes.

It should come as no surprise, we are very social animals that interact with each other in very complex ways.

When we see a face, we need to recognize it as a face and quickly understand what it represents.

And it's the eyes and mouth that we pay the most attention to.

By doing so, we determine if someone is angry with us or wants to be friends with us.

I didn't notice anything wrong with the upside-down Lincoln's face, because the eyes and mouth actually point up.

But when I flipped the whole image over, I noticed that the most important parts of the face, the eyes and mouth, were upside down, and there was something fishy about it.

You realized that your brain was taking shortcuts and overlooking something.

But your brain isn't actually lazy, it's just super busy.

As such, it consumes cognitive energy as efficiently as possible, using assumptions about visual information to create a coordinated, edited vision of the world.

Imagine your brain summoning these edits instantly. "Okay, these rectangles could be objects.

Let's use lateral suppression to enhance the black and white contrast on the sides.

Darken the corners!

Dark gray fades out to light gray?

Assume that overhead sunlight hits a slanted curve. Next!

The eyes look like most eyes I've ever seen, but nothing strange is happening. ”

look? Our visual tricks reveal your brain's work as a hectic director of 3D animation in a studio in your skull, allocating cognitive energy and building worlds on the fly using tried and mostly (but not always) unique true tricks.

How do you know you are real?

It's an obvious question until you try to answer it, but let's take it seriously.

How can we truly know our existence?

Rene Descartes tried to answer that very question in his Meditations on First Philosophy, breaking down all preconceptions and opinions and starting from the ground up.

All his knowledge came from his sensory perception of the world.

Are you the same?

I know you've seen this video with your eyes and heard with your ears.

Your senses show the world as it is.

They aren't cheating on you, but they can be tricked sometimes.

You may mistake someone in the distance for someone else, or try to catch a fly ball that falls to the ground in front of you.

But come on, here and now, I know what's in front of me is real.

Your eyes, your hands, your body, that's you.

Only a crazy person would deny it, and you know you're not crazy.

Anyone who doubts it must be dreaming.

No, what if I'm dreaming?

Dreams feel real.

When your real body lies on your bed, you can believe that you are swimming, flying, or fighting monsters with your bare hands.

No no no.

ah! But when he is not, he cannot prove that he is not dreaming, because he does not realize that he is not dreaming.

Maybe the body you think you are doesn't really exist.

Perhaps everything in reality is false, even abstract concepts such as time, shape, color, and number, and everything is just a deception concocted by an evil genius.

No, seriously.

Descartes asks if you can disprove the idea that an evil genius devil tricked you into believing reality was real.

Perhaps this diabolical scammer has tricked you.

The world, your perception of it, and your body itself.

You can't disprove that they're all just hoaxes. And how can we exist without them?

I could not do it! Well, it's not.

Life is just a dream, and you probably don't enjoy rowing your boat, do you?

No, you are rowing exhausted like a deceived, non-existent fool.

Do you think it is convincing?

Are you persuaded?

If not, that's okay. By being persuaded, you can prove that you are the one who was persuaded.

If you think that you are something, even if you think that something is nothing, you are indeed so because you are the one who thinks, or, as Descartes said, "I think, therefore I am."

Consider throwing a ball straight into the air.

Can you predict the movement of the ball after it leaves your hand?

Sure, it's easy.

The ball travels upwards until it reaches the highest point, then descends and rests in your hands again.

Of course, that's what happens, and you know it because you've witnessed events like this countless times.

All your life you have observed the physics of everyday phenomena.

But suppose we consider a question about the physics of atoms, such as what does the motion of electrons around the nucleus of a hydrogen atom look like?

Can you answer that question based on your everyday physics experience?

Definitely not. why?

Because the physics governing system operation at such a small scale are very different from the physics of the macroscopic objects you see around you all the time.

The everyday world you know and love operates according to the laws of classical mechanics.

But atomic-scale systems operate according to the laws of quantum mechanics.

This quantum world turned out to be a very strange place.

Quantum weirdness is explained by the famous thought experiment "Schrodinger's cat".

A physicist who doesn't really like cats puts a cat in a box with a bomb that has a 50% chance of detonating when the lid is closed.

Until the lid is opened again, there is no way of knowing if the bomb has detonated, and therefore no way of knowing if the cat is alive or dead.

In quantum physics, we can say that the cat was in a superposition before we observed it.

It wasn't alive or dead, it was a mix of both possibilities, each with a 50% chance.

The same thing happens in quantum-scale physical systems, like electrons orbiting in a hydrogen atom.

Electrons don't really orbit at all.

It is, in a sense, everywhere in the universe at once, more likely to be in some places than others, and only after measuring its position can it be pinpointed exactly where it is at any given moment.

It's a lot like when you didn't know if your cat was alive or dead until you opened the box.

This leads to the strange and beautiful phenomenon of quantum entanglement.

Suppose instead of putting one cat in a box, you put two cats in two different boxes.

If we were to repeat the Schrödinger cat experiment with this pair of cats, the outcome of the experiment could be one of four possibilities.

Either both cats are alive, both are dead, or one is alive and the other is dead, or vice versa.

Both cat systems are again superimposed, with each outcome having a probability of 25% instead of 50%.

But here's the cool thing. Quantum mechanics shows that it is possible to erase from the superposition the result that both cats are alive and both cats are dead.

In other words, we have a system of two cats, and the result is that one cat will always live and the other will die.

In technical terms, the cat's condition is intertwined.

But there is something truly amazing about quantum entanglement.

If you set up a system with two cats inside this tangled box, and move the box to opposite ends of the universe, the results of the experiment will always be the same.

Before measuring the results, it is completely unknown which cats will live or die, but one cat will always come out alive while the other will always end up dead.

How is this possible?

Why are the states of cats on opposite sides of the universe so intertwined?

They're too far away to communicate in time, so why do the two bombs always conspire, one detonating and the other not?

You might think, "This is just theoretical nonsense.

This kind of thing doesn't happen in the real world. ”

But it turns out that quantum entanglement has been confirmed in real-world laboratories.

Two subatomic particles that are entangled in an overlapping state must rotate in one direction and the other must rotate in the other direction, even though there is no way for one particle to pass information indicating which direction to rotate in order to obey the laws of entanglement.

It is therefore not surprising that quantum entanglement is at the core of quantum information science. Quantum information science is a growing field that studies how to exploit the strange laws of the quantum world in the macroscopic world, such as quantum cryptography, so that spies can send secure messages to each other, or use quantum computing to crack secret codes.

Everyday physics may look a bit like the strange quantum world.

Quantum teleportation will go even further, and one day your cat may escape to a safer galaxy where there are no physicists and no boxes.

I have a question.

Can computers write poetry?

This is a provocative question.

After thinking about it for a moment, a lot of questions suddenly pop up: "What is a computer?"

What is Poetry?

What is Creativity?

But these are questions that people spend their lives trying to answer, not one TED talk.

So you should try another approach.

Here are two poems.

One is written by a human and the other is written by a computer.

Let me tell you which is which.

Try it: Poem 1: Little fly / Your summer play / My thoughtless hand / Swept away.

Am I not a fly like you? / Or is it not you / A man like me?

Poem 2: We can feel / throughout your life / are activists / in the morning / stop and look, Pope, I hate / don't start all night / otherwise it's great (...) Now time's up.

Raise your hand if you think verse 1 was written by a human.

Yes, most of you.

Raise your hand if you think verse 2 was written by a human.

Very brave, because the first was written by the human poet William Blake.

The second one was written by an algorithm that one day took all the languages ​​from my Facebook feed and regenerated them algorithmically, following a method I'll explain a bit later.

So let's try another test.

Again, you're not old enough to read this yet, so trust your intuition.

Verse 1: Lions howl, dogs howl. It is interesting / and attractive that birds fly / do not roar or bark. Enchanting stories about animals are in my dreams, and if I'm not tired I'll sing them all.

Verse 2: Oh! Kangaroos, sequins and chocolate soda! / You are so beautiful!

Pearls, harmonicas, jujubes, aspirin! All the things they always talk about (...) Okay, time's up.

So if you think the first poem was written by a human, raise your hand.

OK。

And if you think the second verse was written by a human, raise your hand.

More or less here, it's a 50/50 split.

It was much more difficult.

The answer is that the first poem was generated by an algorithm called Racter that was created in the 1970s, and the second poem was written by a guy named Frank O'Hara, who happens to be one of my favorite human poets.

(Laughter) So what we've just done is the poetry Turing test.

The Turing test was first proposed by Alan Turing in 1950 to answer the question Can computers think?

Alan Turing believed that a computer could be said to be intelligent if it could have a text-based conversation with a human, with such proficiency that a human could not tell if he was talking to a computer or a human.

So in 2013, my friend Benjamin Laird and I created an online Turing test for poetry.

Call it a bot or not, you can actually go and play it yourself.

But basically, it's the game we just played.

You are presented with a poem, but you don't know whether it was written by a human or a computer, and you have to guess.

Thousands of people have taken this test online and now we have the results.

and what is the result?

Turing said that a computer would pass the Turing test of intelligence if it could fool humans 30% of the time.

There is a poem in the bot or not database that has convinced 65 percent of human readers that it was written by a human.

So I think we got the answer to our question.

According to Turing test logic, can a computer write poetry?

Well, yes it is possible.

But if you feel a little uncomfortable with this answer, it's okay.

That's not the end of the story, so if you have a lot of intuitive reactions, that's fine.

Let's play the third and final test.

Again, read on and let me know which one you think is human.

Verse 1: Red flags are the reason for clean flags. / And a ribbon.

The flag ribbon/and what you wear/why you wear it. (...) Verse 2: The wounded deer soars high / I heard the daffodils Today I heard the flag / I heard the hunter say;

So if you think Poem 1 was written by a human, please raise your hand.

Raise your hand if you think verse 2 was written by a human.

Oh, the number of people has increased considerably.

So it would be surprising to learn that Poetry 1 was written by a very human poet, Gertrude Stein.

And Poem 2 was generated by an algorithm called RKCP.

Before we move on, let's briefly explain how RKCP works.

So RKCP is an algorithm designed by Google's Director of Engineering, Ray Kurzweil, who is a strong believer in artificial intelligence.

So, when you give RKCP a source text, RKCP analyzes the source text to see how you use the language and regenerates the language emulating the original text.

So in the poem you saw earlier, poem 2, the poem you thought was human, we were given a bunch of poems by a poet named Emily Dickinson, and we looked at her use of language, learned a model, and regenerated the model according to the same structure.

But the important thing to know about RKCP is that it doesn't know the meaning of the words it uses.

Languages ​​are just raw materials, they could be Chinese, they could be Swedish, they could be languages ​​collected from Facebook feeds for a day.

It is a raw material.

Nevertheless, it can produce poetry that is more human than Gertrude Stein's, and Gertrude Stein is human too.

So what we've done here is more or less a reverse Turing test.

So a human, Gertrude Stein, could write a poem that tricked the majority of human judges into thinking it was written by a computer.

So, according to the logic of the reverse Turing test, Gertrude Stein is a computer.

(laughs) Confused?

I think that's fair enough.

So far, there have been humans that write like humans, computers that write like computers, computers that write like humans, and perhaps most confusingly, humans that write like computers.

So what does all this tell us?

Do we think William Blake is somehow more human than Gertrude Stein?

Or is Gertrude Stein closer to computers than William Blake?

(Laughter) These are the questions I've been asking myself for about two years, and I don't have the answers.

But what I do have is a lot of insight into our relationship with technology.

My first insight is that for some reason we associate poetry with being human.

In other words, when asked, "Can a computer write poetry?"

We are also asking, "What does it mean to be human, and how do we set boundaries for this category?"

How can we say who or what can be in this category?”

I believe this is an inherently philosophical question that cannot be answered with a yes or no test like the Turing test.

Also, Alan Turing understood this, and I believe he did it as a philosophical provocation when he devised the test in 1950.

My second insight is that when you take the Turing test for poetry, you're not really testing your computer's abilities. This is because the algorithms for generating poetry are very simple and have been around since the 1950s, more or less.

Rather, what we are doing in the Turing Test of Poetry is collecting opinions about what constitutes human nature.

So what I understand is that I saw this earlier today when you said William Blake was more human than Gertrude Stein.

Of course, this doesn't mean that William Blake was actually more human, or that Gertrude Stein was more computer-like.

It simply means that the human category is unstable.

From this, I understood that humans are not cold and hard facts.

Rather, it is constructed by our opinions and is subject to change over time.

So my final insight is that computers more or less act like mirrors that reflect the human ideas we show them.

We show it to Emily Dickinson, and it gives Emily Dickinson back to us.

We show it to William Blake, that's what it reflects on us.

If you show Gertrude Stein, it's Gertrude Stein that comes back.

Computers, more than any other technology, are mirrors that reflect every human idea we teach.

Recently, many people have heard a lot about artificial intelligence.

And a lot of the conversation is about whether it can be built.

Can we build intelligent computers?

Can you build a creative computer?

The question we ask all too often is, can we build computers that look like humans?

But what we have seen so far is that man is not a scientific fact, but an ever-changing, interconnected concept that changes over time.

So when we start working on artificial intelligence ideas in the future, we can't just ask ourselves, "Can we build it?"

But at the same time, we also need to ask ourselves, "What kind of human thoughts do we want to reflect?"

This is an inherently philosophical thought, one that cannot be answered by software alone, but which I believe requires species-wide existential considerations.

thank you.

(applause)

On September 1, 1953, William Scoville used a hand crank and a cheap drill saw to cut a hole in the young man's skull, cut out a significant portion of his brain, and sucked it out through a metal tube.

But this wasn't a scene from a horror movie or a gruesome police report.

Dr. Scoville was one of the most famous neurosurgeons of his time, the young man was a famous patient, Henry Molaison, known as "H.M.", and his case gave us amazing insight into how our brain works.

As a young boy, Henry suffered a cracked skull in an accident that quickly caused him to have a seizure, lose consciousness, and lose control of his bodily functions.

After enduring years of frequent seizures and dropping out of high school, the desperate young man turned to Dr. Scoville, a daredevil known for his dangerous surgeries.

Partial lobotomy surgery has been used for decades in the treatment of psychiatric patients, based on the idea that mental functions are strictly localized to corresponding brain regions.

Having successfully used them to reduce seizures in psychotic patients, Scoville decided to remove H.M.'s hippocampus, a part of the limbic system associated with emotions but whose function was unknown.

At first glance, the operation appeared to be a success.

H.M.'s seizures have virtually disappeared, his personality has not changed, and his IQ has improved.

There was one problem though. His memory is lost.

Not only has H.M. lost most of his memory from the past decade, he has been unable to make new comments, forgot what day it was, repeated comments, and even ate multiple meals in a row.

When Scoville informed another expert, Wilder Penfield, of the results, he sent a doctoral student named Brenda Milner to study H.M. He spent his days at home doing chores and watching classic movies for the first time on repeat.

What she discovered through a series of tests and interviews not only contributed significantly to the study of memory.

It even redefined what memory means.

One of Milner's findings was that H.M. could not form a new memory, but retained information from moment to moment long enough to finish a sentence or find the toilet.

Milner gave him a random number and he managed to remember it for 15 minutes by repeating it to himself constantly.

But just five minutes later, he forgot the test even took place.

Neuroscientists believed that memories were monolithic, all essentially the same, stored throughout the brain.

Milner's findings not only provided the first clues to the now-famous distinction between short-term and long-term memory, they also show that each uses different brain regions.

We know that memory formation involves several stages.

Direct sensory data are temporarily transcribed by cortical neurons before traveling to the hippocampus, where specialized proteins act to strengthen synaptic connections in the cortex.

If the experience was intense enough, or if you recalled it regularly during the first few days, the hippocampus puts the memory back into the cortex and stores it permanently.

H.M.'s mind was able to form first impressions, but without the hippocampus to consolidate this memory, they would erode like messages scribbled in sand.

But this wasn't the only memory difference Milner discovered.

In the now-famous experiment, she asked H.M. Paper and pencil tracked a third star in the narrow space between two concentric star outlines, visible only through a mirror.

Like others new to such clumsy work, he did a terrible job.

But surprisingly, despite having no memory of his previous attempts, he improved with repeated experiments.

His unconscious motor center remembered what his conscious mind had forgotten.

What Milner discovered was that declarative memory for names, dates and facts is different from procedural memory for riding a bike or signing a name.

And we now know that procedural memory relies more on the basal ganglia and cerebellum, structures that were intact in H.M.'s brain.

This distinction between ``knowing it'' and ``knowing it'' has underpinned all memory research ever since.

H.M. died at the age of 82 after living a mostly peaceful life in a nursing home.

Over the years, he has been examined by over 100 neuroscientists, making his psyche the most studied in history.

After his death, his brain was preserved and scanned, then cut into over 2,000 individual slices and photographed to form a digital map down to the level of individual neurons, all of which was broadcast live to 400,000 people.

H.M. Most of his life was spent forgetful, but he and his contributions to our understanding of memory will be remembered for generations to come.

How many times does the chorus repeat in your favorite song?

And let's think for a moment, how many times have we heard that?

You've probably heard that chorus repeated dozens or even hundreds of times. It's not just Western popular songs that are frequently repeated.

Repetition is a common feature of music in cultures around the world.

So why is music so dependent on repetition?

Part of the answer comes from what psychologists call the mere exposure effect.

In other words, people tend to prefer things they have been exposed to before.

For example, you hear a song on the radio that you don't particularly like, and then you hear it at the grocery store, at the movie theater, and again on the street corner.

Soon we will be tapping to beats, singing lyrics, and even downloading tracks.

This mere exposure effect is not limited to singing.

And it can be used for everything from shapes to Super Bowl ads.

So why is repetition so uniquely prevalent in music?

To investigate, psychologists asked people to listen to songs that avoided exact repetitions.

They listened to excerpts from these songs in their original form, or versions digitally altered to include repeats.

Although the original version was composed by some of the most revered composers of the 20th century, and the iteration was assembled by heavy-handed audio editing, people appreciated the iteration as being more fun, more interesting, and likely composed by a human artist.

Musical repetition is very convincing.

Consider the Muppets classic "Mahna Mahna."

If you've heard it before, you know it's nearly impossible not to respond "du du du du du" after I sing "mana mana".

Repetition irresistibly connects each piece of music with the next piece of music that follows it.

Therefore, when we hear some sounds, we already imagine what will happen next.

Your heart is subconsciously singing along, and you may start humming loudly without realizing it.

Recent studies show that people are more likely to move or tap to a piece of music that is repeated.

Repetition invites us to music not as passive listeners but as imaginary participants.

Studies have shown that listeners shift their attention to each repetition of music, focusing on different aspects of the sound with each new listen.

At first, you may notice the melody of the phrase, but as it repeats, your attention shifts to how the guitarist bends the pitch.

This also happens in language, and there's something called semantic satiety.

Repeating a word like "atlas ad nauseam" makes you stop thinking about the meaning of the word and instead focus on the sound, the strange sound of a "T" followed by an "L".

In this way, repetition can open up new worlds of sounds that are inaccessible on the first listen.

An 'L' following a 'T' may not be aesthetically related to an 'atlas', but a guitarist's pitch bending can be very important expressively.

The speech-to-song illusion captures how simply repeating a sentence over and over shifts the listener's attention to the pitch and temporal aspects of the sound, making it sound as if the repeated spoken words were actually being sung.

A similar effect occurs with random sound sequences.

People rate a random sequence heard in a repeated loop as more musical than a random sequence heard only once.

Repetition creates a kind of direction for sounds that we think are uniquely musical, where we listen with them and let our imagination run wild with what is to come.

This method of listening ties in with our sensitivity to musical earworms, where snippets of music get stuck in our heads and play over and over again as if they were on repeat.

Critics often perplex the repetitive nature of music, considering it childish or regressive, but repetition is nothing to be ashamed of, and is in fact an important feature that creates the kind of experience we think of as music.

The Heisenberg Uncertainty Principle is one of the few ideas in quantum physics that extends into popular pop culture.

It states that you can never know the exact position and exact velocity of an object at the same time, and it appears as a metaphor in everything from literary criticism to sports commentary.

Uncertainty is often described as the result of measurements that the act of measuring the position of an object changes its velocity, and vice versa.

The true origin is deeper and more wonderful.

The Uncertainty Principle exists because everything in the universe behaves as if it were both a particle and a wave at the same time.

In quantum mechanics, an object's exact position and exact velocity are irrelevant.

To understand this, we need to consider what it means to behave like a particle or a wave.

Particles, by definition, always exist in one place.

This can be represented by a graph showing the probability of finding an object at a particular location. This looks like a spike, 100% at one particular location and 0 elsewhere.

Waves, on the other hand, are disturbances that spread through space, like ripples on the surface of a pond.

The features of the waveform as a whole, most importantly the distance between two adjacent peaks or the distance between two adjacent troughs, are clearly identifiable wavelengths.

But I can't assign a single position.

It appears in various places with a high probability.

Wavelength is essential to quantum physics because the wavelength of an object is related to its momentum, which is the product of mass and velocity.

Fast-moving objects have a lot of momentum, which corresponds to very short wavelengths.

Heavy objects have a lot of momentum even if they aren't moving very fast. This again means that the wavelength is very short.

This is why we are unaware of the wave nature of everyday objects.

If you throw a baseball in the air, its wavelength is one billionth of a meter, too small to be detected.

However, small things like atoms and electrons can have wavelengths that are large enough to be measured in physical experiments.

So if you have a pure wave, you can measure its wavelength, or momentum, but not its position.

We know the position of the particle well, but we don't know the momentum because the particle has no wavelength.

To get a particle with both position and momentum, we need to blend the two images to produce a graph with waves only in a small area.

How can I do this?

By combining waves of different wavelengths, this means giving quantum objects the possibility of having different momentums.

If you add the two waves together, you can see that there are places where the peaks line up to create a big wave, and where one peak fills the valley of the other.

The result will be areas where waves are visible separated by empty areas.

Adding a third wave makes the area where the waves cancel out larger, and the fourth wave makes it even larger, narrowing the area where it ripples.

As we continue to add waves, we can create wave packets with well-defined wavelengths within a small area.

This is a quantum object with properties of both waves and particles, but achieving this required the loss of certainty about both position and momentum.

Positions are not limited to one point.

It is likely to be found within a certain range from the center of the wavepacket, and the wavepacket was created by adding many waves. That is, there is some chance of being found with momentum corresponding to any of them.

Both position and momentum are uncertain now, and uncertainties are connected.

If you want to create smaller wave packets to reduce position uncertainty, you need to add more waves. This means that the momentum uncertainty will be greater.

If we want to know the momentum better, we need a larger wave packet. This means that the position uncertainty will be larger.

It is the Heisenberg uncertainty principle, first stated by the German physicist Werner Heisenberg in 1927.

This uncertainty is not a matter of good or bad measurements, but an inevitable consequence of the combined properties of particles and waves.

The uncertainty principle is not just a practical limit on measurements.

It's a limit on the properties an object can have built into the basic structure of the universe itself.

I believe the secret to producing extreme drought tolerant crops, which should contribute in some way to global food security, lies in the extreme drought resurrection plant pictured here.

These plants may look dead, but they are not.

Once watered, it will revive, turn green and start growing within 12-48 hours.

Now, why do I propose that the production of drought-tolerant crops will lead to food security?

Well, the current world population is about 7 billion.

And by 2050 the population is estimated to be between 9 billion and 10 billion, with most of this increase occurring in Africa.

The Global Food and Agriculture Organization suggests that current farming practices will need to increase by 70% to meet that demand.

Given that plants are at the base of the food chain, most of it should come from plants.

This 70% percentage does not take into account the potential impact of climate change.

This is taken from Dai's research published in 2011, in which he considered all the potential impacts of climate change and, among other things, expressed increased aridity due to lack or infrequent rainfall.

The red areas shown here were until recently very well used for agriculture, but are no longer available due to lack of rainfall.

This is the situation predicted to occur in 2050.

Much of Africa, indeed much of the world, will be in trouble.

We will have to think of very clever ways to produce food.

Among them, drought-tolerant crops are desirable.

Another thing to remember about Africa is that most of Africa's agriculture is rain-fed.

Now, growing drought-tolerant crops isn't the easiest thing in the world.

And the reason is "water".

Water is essential for life on this planet.

From microbes to you and me, all actively metabolizing organisms are primarily composed of water.

All life reactions take place in water.

And the loss of even a small amount of water leads to death.

You and I are 65% water, and if we lose 1% of that, we're dead.

But you can change your behavior to avoid it.

Plants cannot do that.

they were buried in the ground.

So in the first stage they have a little more water than we do, about 95 percent, but depending on the species, they can lose a little more than we do, say 10 to about 70 percent, but only for a short period of time.

Most of them resist or try to avoid water loss.

Thus, extreme examples of resistors are found in succulents.

They tend to be small and very attractive, but grow very slowly due to the great cost of retaining water.

Examples of avoiding water loss are found in trees and shrubs.

They have very deep roots, mining groundwater and keeping them constantly drained to keep them hydrated.

The one on the right is called Baobab.

It is also called an upside-down tree because the root-to-shoot ratio is so large that it looks like the tree was planted upside down.

And, of course, roots are necessary for plant hydration.

And perhaps the most common avoidance strategy is found in annuals.

Annuals make up the majority of our plant food.

On the west coast of my country, we don't see much plant growth for most of the year.

But when spring rains come, flowers bloom in the desert.

The strategy for annuals is to grow only during the wet season.

At the end of the season they produce seeds. The seeds are dry, contain 8-10 percent moisture, but are very viable.

And those that are still alive even though they are dry are called drought tolerant.

The only thing a dry seed can do is be left in extreme conditions for a long period of time.

When the next rainy season comes, the buds will sprout and grow, and the cycle will begin again.

It is widely believed that the evolution of drought-tolerant seeds enabled the settlement and dispersal of flowering plants or angiosperms on land.

But let's go back to our main form of food supply: annuals.

Wheat, rice and corn make up 95% of our plant-based food supply.

This was a great strategy as it produced a large amount of seed in a short amount of time.

Seeds are high in energy, so the food is high in calories and can be stockpiled abundantly in case of starvation, but there are drawbacks.

Vegetative tissues such as roots and leaves of annual plants do not have many inherent resistance, evasion, or tolerance traits.

They just don't need it.

They grow during the rainy season and have seeds that help them survive the rest of the year.

So, despite concerted efforts in agriculture to create crops with improved resistance, avoidance and tolerance traits, we still get such a picture, especially for resistance and avoidance, because we had better models to understand how they work.

African maize crops die after two weeks of no rain.

There is a solution. It is a resurrection plant.

These plants lose 95 percent of their cellular water, remain dry and dead for months to years, turn green when watered, and begin to grow again.

Like seeds, these are drought tolerant.

Like seeds, they can withstand extreme environmental conditions.

And this is a really rare phenomenon.

Only 135 flowering plants can do this.

We will introduce these three types of resurrection processes in order in the video.

And there's a timeline at the bottom so you can see how quickly it happens.

(Applause) Great.

So I've spent the last 21 years trying to understand how they do this.

How do these plants dry out without dying?

And I've been working on a variety of resurrection plants, shown here in hydrated and dry states, for a variety of reasons.

One is that each of these plants serves as a model for the crops we hope to grow into drought tolerant crops.

For example, the top grass on the far left is a grass called Eragrostis nindensis, which has a related species called Eragrostis teff, which many of you may know as "teff", which is a staple food in Ethiopia, gluten-free, and what we want to make drought tolerant.

Another reason for observing many plants is that, at least initially, I wanted to know, "Do they do the same thing?"

Do they all use the same mechanism to lose all their water and not die?

So I took what I call a systems biology approach that looks at everything from molecules to whole plants to the ecophysiological level for a comprehensive understanding of drought tolerance.

For example, we examine changes in plant anatomy and ultrastructure during desiccation.

We turn our attention to the transcriptome. This is just the term for techniques that examine genes that are switched on or off in response to desiccation.

Since most genes code for proteins, we will focus on the proteome.

What proteins are made in response to drying?

We focus on the metabolome because some proteins encode enzymes that generate metabolites.

This is important because the plant sticks to the ground.

They use what I call highly tuned chemical weapons to protect themselves from all the stresses in their environment.

Therefore, it is important to pay attention to the chemical changes that accompany drying.

Finally, at the molecular level, we focus on lipidomes that undergo lipid changes in response to desiccation.

This is also important because all biological membranes are made of lipids.

Since it is in water, it is retained as a membrane.

When the water is removed, those membranes fall apart.

Lipids also act as signals to turn genes on.

We then use physiological and biochemical studies to try to understand the function of the putative protective agents that we actually discovered in other studies.

And we use all that to try to understand how plants are coping with their natural environment.

I have always had the philosophy that we need a comprehensive understanding of the mechanisms of drought tolerance in order to make meaningful proposals for biological applications.

I'm sure some of you are wondering, "Does bio-use mean making genetically modified crops?"

The answer to that question depends on your definition of genetically modified.

The crops we eat today, wheat, rice and corn, are all highly genetically modified from our ancestors, but we don't consider them genetically modified because they are produced by conventional breeding.

As to whether you plan to incorporate the resurrection plant genes into your crops, the answer is yes.

Due to the nature of the time, we tried that approach.

More appropriately, some of my collaborators at UCT, Jennifer Thomson and Suhail Rahdeen, have spearheaded that approach, and I'll be presenting some data soon.

But we are embarking on a very ambitious approach that aims to activate a whole set of genes already present in every crop.

It never works in extreme drought conditions.

I'll leave it up to you if you should call them GMs.

Here are some of the data from the first approach.

To do that, we need to explain a little about how genes work.

So you probably know that genes are made of double-stranded DNA.

It is very tightly wrapped around the chromosomes present in every cell of the body and in plants.

If you unwrap the DNA, you get the gene.

And each gene has a promoter (just an on-off switch), a gene coding region, and a terminator, which marks the end of this gene and the start of the next.

Now, promoters are not simple on-off switches.

There are usually a lot of tweaks that need to be made before a gene is switched on and there are many that need to be fixed.

So what is usually done in biotechnology research is using an inducible promoter and knowing how to turn it on.

We combine it with the gene of interest and introduce it into plants to see how the plants respond.

In the study I will now discuss, my collaborators used a drought-induced promoter found in resurrection plants.

The good thing about this promoter is that it does nothing.

The plant itself senses dryness.

And we used it to drive antioxidant genes from revived plants.

Why antioxidant genes?

All stresses, especially drought stress, lead to the formation of free radicals or reactive oxygen species that can be very harmful and cause crop mortality.

The job of antioxidants is to stop that damage.

Here is some data from a very popular maize strain in Africa.

The left side of the arrow is a plant without the gene, and the right side is a plant with the antioxidant gene.

Those with the gene thrive much better after three weeks without water.

This is the final approach.

My research has found considerable similarities in the mechanisms of drought tolerance in seeds and resurrection plants.

So my question is, are they using the same genes?

Or, to put it a little differently, is it a resurrection plant with genes that evolved drought tolerance in roots and leaves?

Did they reassign these seed genes to roots and leaves of resurrection plants?

And as a result of many studies by my group and recent collaborations from the groups of Henk Hilhorst in the Netherlands, Mel Oliver in the United States and Julia Buitinck in France, I answer that question.

The answer is yes. There is a core set of genes involved in both.

I will describe this very loosely for corn. Chromosomes below the off-switch represent all genes required for drought tolerance.

Therefore, when maize seeds dry out at the end of the developmental period, these genes are switched on.

Resurrection plants switch on the same genes when dry.

So all modern crops have these genes in their roots and leaves, but they are never switched on.

They switch on only within the seed tissue.

What we are now trying to do, therefore, is to understand the environmental and cellular signals that switch on these genes in resurrection plants to mimic the crop process.

And one last thought.

What we are going to do very quickly is to repeat what nature did in the evolution of resurrection plants about 10 to 40 million years ago.

My plants and I thank you for your attention.

(applause)

Grief is part of the human experience, but over the centuries there has been great disagreement about what exactly it is and what we should do about it.

At its simplest, grief is considered a natural reaction to difficult situations.

When a friend moves away or a pet dies, we feel sad.

When your friend says "I'm sad", you often ask "What happened?"

But your assumption that grief has external causes outside the self is a relatively new idea.

Ancient Greek physicians did not think of grief that way.

They believed it was a black fluid inside the body.

According to the humoral system, the human body and soul are controlled by four bodily fluids known as humors, the balance of which directly affects a person's health and temperament.

Melancholia is derived from melanachor, which means black bile, a humor thought to cause grief.

Changing your diet and performing medical procedures can help balance your body's fluids.

Although we now know more about the systems that govern the human body, these Greek ideas about grief resonate with current views of clinical depression rather than the grief we all occasionally feel.

Doctors believe that certain long-term, unexplained emotional states are related, at least in part, to brain chemistry, the balance of different chemicals that exist in the brain.

As with the Greek system, changing the balance of these chemicals can dramatically change the way we respond to even the most challenging situations.

There is also a long tradition of trying to determine the value of grief, and in that debate we find a strong argument that grief is not only an inevitable part of life, but an integral one.

If you've never felt depressed, you've missed part of what it means to be human.

Many thinkers argue that melancholy is necessary for wisdom.

Born in 1577, Robert Burton spent his life studying the causes and experiences of grief.

In his masterpiece, The Anatomy of Melancholy, Burton writes, "Where wisdom increases, sorrow increases."

Romantic poets of the early 19th century believed that melancholy allowed us to better understand other profound emotions such as beauty and joy.

Understanding the sadness of trees that lose their leaves in the fall leads to a deeper understanding of the cycle of life that blooms in the spring.

Wisdom and intelligence of mind, however, seem to be fairly high on the hierarchy of needs.

Does grief have value on a more basic, concrete, or even evolutionary level?

Scientists believe that crying and feelings of withdrawal originally helped our ancestors secure social bonds and get the support they needed.

In contrast to anger and violence, grief was an expression of suffering and could bring people closer to the suffering person immediately, which helped not only that person but the larger community to thrive.

Perhaps grief has helped create the unity we need to survive, but many are wondering if the suffering others feel resembles the suffering we experience ourselves.

Poet Emily Dickinson wrote, "I measure every sorrow I meet with my thin, searching eyes. Does it weigh as much as I do, or is it an easier size?"

And in the 20th century, medical anthropologists like Arthur Kleinman gathered evidence from the way people talk about pain, suggesting that emotions aren't universal at all, and that culture, especially the way we use language, can influence how we feel.

When we talk about heartbreak, that feeling of heartbreak becomes part of our experience, but in cultures that talk about broken hearts, it actually seems to have a different subjective experience.

Some contemporary thinkers are not interested in the subjectivity and universality of grief, but rather use technology to eliminate all forms of suffering.

David Pierce suggested that genetic engineering and other modern processes should not only change the way humans experience emotional and physical pain, but also redesign the world's ecosystems so that animals do not suffer in the wild.

He calls his project "Paradise Engineering".

But is there anything sad in a world without sorrow?

Our caveman ancestors and favorite poets may not want a piece of paradise like that.

In fact, the only thing that seems to be universally agreed upon about grief is that it has been felt by most people throughout the ages, and that for thousands of years one of the best ways to deal with this difficult emotion is to put it into words, to try to express the ineffable.

In the words of Emily Dickinson, "'Hope' is something with wings - it stays in the soul - 'and sings a song without words - and never stops'."

democracy.

In the West, we are making a big mistake in taking it for granted.

We don't think of democracy as the most fragile flower of fact, but we do think of it as a piece of social furniture.

We tend to think of it as non-negotiable.

We mistakenly believe that capitalism inevitably breeds democracy.

it's not.

Singapore's Lee Kuan Yew and Beijing's great imitators have demonstrated beyond reasonable doubt that capitalist prosperity and spectacular growth are perfectly possible even in the absence of democratic politics.

In fact, here in Europe, democracy is receding in the woods.

Earlier this year, when I was representing Greece, and thus the newly elected Greek government, as Finance Minister at the Eurogroup, I was told in plain terms that our democratic process, the elections, cannot be allowed to interfere in the economic policies being conducted in Greece.

At that moment, I felt that Lee Kuan Yew, the Chinese Communist Party, and indeed some rebellious friends who kept telling me that democracy would be banned if it threatened to change anything could be more right.

Tonight, I would like to present an economic case for true democracy.

Join me again in believing that Lee Kuan Yew, the Chinese Communist Party, and indeed the Eurogroup, are wrong to believe that democracy can go away, that we need a genuine and loud democracy.

And without democracy, our society will be even more miserable, our future will be bleak, and our wonderful new technologies will be wasted.

Speaking of waste, let me point out an interesting contradiction threatening our economy.

I call it the "Twin Peaks Paradox".

One pinnacle that you understand, and you know it, and you recognize it, is the mountain of debt that casts a long shadow over the United States, Europe, and the whole world.

We all know we have a lot of debt.

But few people can tell the twins apart.

Piles of idle cash owned by wealthy savers and businesses. We are too frightened to generate income to pay off our mountains of debt, or to invest it in production activities that can produce green energy and all of humanity's most desperate needs.

Please give me two numbers.

Over the past three months, across the US, UK and Eurozone, we have invested a total of $3.4 trillion in all wealth-creating goods: industrial plants, machinery, business districts, schools, roads, railroads, machinery and more.

$3.4 trillion sounds like a lot of money until you compare it to the $5.1 trillion that was being black-traded in financial institutions in the same countries during the same period, doing nothing but stock market gouging and house price auctions.

As a result, the mountain of debt and the mountain of idle cash form a twin peak that cannot be canceled out by the normal operation of the market.

As a result, wages have stagnated and more than a quarter of 25- to 54-year-olds in the US, Japan and Europe are out of work.

As a result, low aggregate demand reinforces investor pessimism in a never-ending cycle that reproduces demand by not investing in fear of low demand—just as Oedipus' father feared an oracle's prophecy that his son would kill him when he grew up and unknowingly created the conditions under which his son Oedipus would inevitably kill him.

This is my quarrel with capitalism.

That huge waste, all this idle cash, should be harnessed to improve lives, to develop human talent, and indeed to fund all these technologies, green technologies, that are absolutely essential to save the planet.

Is it correct to believe that democracy may be the answer?

I believe so, but before we move on, what does democracy mean?

Aristotle defined democracy as a constitution in which a majority of the free and poor rule the government.

Now, of course, Athenian democracy has excluded too many.

Women, immigrants and, of course, slaves too.

But it would be a mistake to deny its importance based on who the ancient Athenian democracy excluded.

More pertinent to the democracy of ancient Athens, and still so today, was the inclusion of the working poor, who gained not only the right to free speech, but, more importantly, the right of political judgment to be given equal weight in decision-making on national affairs.

Now, of course, Athenian democracy did not last long.

Like a brightly burning candle, it quickly burned out.

And indeed, today's liberal democracy does not have its roots in ancient Athens.

Their roots lie in the Magna Carta, the Glorious Revolution of 1688, and indeed the American Constitution.

Whereas Athenian democracy focused on the Lordless people and empowered the working poor, our liberal democracy is ultimately based on the tradition of the Magna Carta, the Charter of the Lord.

And indeed, liberal democracy emerged only when it became possible to completely separate the political sphere from the economic sphere, enclose the democratic process entirely within the political sphere, and leave the economic sphere, namely the corporate society, as the realm without democracy.

Now, in our democracy today, this separation of the economic and political spheres, the moment it began to occur, has set off a relentless and epic struggle between the two, with the economic sphere colonizing the political sphere and eroding its power.

Have you ever wondered why politicians aren't what they used to be?

It's not because their DNA has denatured.

(Laughter.) Rather, it is because today we can be in government rather than in power, and because power has moved from the political realm to the independent economic realm.

Sure, I talked about my quarrel with capitalism.

If you think about it, it's a bit like a group of predators. Predators succeed in killing large numbers of prey they have to eat, and eventually starve to death.

Similarly, the economic realm colonizes and cannibalizes the political realm, undermining itself and causing economic crises.

Corporate power is growing, the value of political goods is declining, inequality is rising, aggregate demand is declining, and corporate CEOs are too scared to invest their own cash.

In other words, the more successful capitalism is in excluding demonstrations from democracy, the higher the twin peaks and the greater the waste of human resources and human wealth.

Clearly, if this is true, we would be better off reintegrating the political and economic spheres and doing it, like in ancient Athens, with controlled demonstrations, except for the exclusion of slaves, women and immigrants.

Now, this is not the original idea.

The Marxist Left had that idea 100 years ago, but it didn't work very well.

The lesson we have learned from the Soviet debacle is that only by a miracle can the working poor be empowered again, as they were in ancient Athens, without creating new forms of brutality and waste.

But there is a solution. It is to get rid of the working poor.

Capitalism does it by replacing low-wage workers with automatic machines, androids and robots.

The problem is that as long as the economic and political spheres remain separate, automation will lead to higher twin peaks, higher waste, deeper social conflicts, and eventually - I believe - including places like China.

So we need to reorganize, we need to reintegrate the economic and political spheres, but it is better to do so by democratizing the reunited spheres, lest we fall into the surveillance maniac hyperdictatorship that makes The Matrix look like a documentary.

(Laughter.) So the question is not whether we can survive the technological innovation that capitalism is producing.

A more interesting question is whether capitalism will carry over into a society akin to the dystopias of The Matrix, or will it become much more like a Star Trek-like society where machines serve humans, who explore the universe in high-tech agoras like ancient Athens and spend their energies indulging in lengthy debates about the meaning of life.

I think we can be optimistic.

But what would it take, and what would it look like, to achieve this Star Trek-like utopia instead of a Matrix-like dystopia?

From a practical point of view, let me briefly describe some examples.

At the corporate level, imagine a capital market. You get capital while you work, and that capital flows from one job to another, from one company to another. That company is owned exclusively by the people who happened to be working there at that moment, whatever company you happened to be working for at the time.

Then all income will come from capital, profit, and the very concept of wage labor will become obsolete.

You no longer need to separate people who own a company but don't work for it from those who work but don't own a company. No more tug of war between capital and workers. There is no big gap between investment and savings. Certainly no towering twin peaks.

Imagine for a moment that at the level of the global political economy, our national currencies have a floating exchange rate and that there is a universal digital currency issued by the G20, the International Monetary Fund, on behalf of all mankind.

And imagine more. All international trade is denominated in this currency, let's call it "cosmos" in units of cosmos. Each government agrees to pay to the Common Fund a sum of cosmos units proportional to the country's trade deficit, or indeed the country's trade surplus.

And imagine that money being used to invest in green technology, especially in areas of the world where investment capital is scarce.

This is not a new idea.

It was, in effect, proposed by John Maynard Keynes at the Bretton Woods Conference in 1944.

The problem was that at the time we didn't have the technology to implement it.

We are doing so, especially in the context of the reintegration of the political and economic sphere.

The world I am describing to you is at once libertarian in its prioritization of the empowered individual, and at the same time Marxist in trapping the division of capital and labor in the dustbin of history, and also Keynesian, global Keynesian.

But above all, it is a world in which we can imagine true democracy.

Will such a world open up?

Or will we fall into a dystopia like The Matrix?

The answer lies in the political choices we collectively make.

It's our choice, and it's better to decide democratically.

thank you.

(Applause) Bruno Giussani: Giannis ...

You are the one who described yourself as a libertarian Marxist in your bio.

How relevant is Marx's analysis to today?

Yannis Varoufakis: Well, if what I just said is relevant, Marx is relevant.

Because the whole point of political and economic integration is that if we don't do that, technological innovation will cause a big drop in aggregate demand, what Larry Summers calls secular stagnation.

With this crisis now rippling from parts of the world, it will destabilize not only our democracy, but even the emerging nations that are less enthusiastic about liberal democracy.

So if this analysis has any basis, then Marx is perfectly relevant.

But so is Hayek, so I'm a libertarian Marxist, and so is Keynes, so I'm completely confused.

(laughter) BG: Sure, maybe we do, now.

(laughter) (applause) YV: If you're not confused, you're not thinking about anything, do you understand?

BG: That's a very, very Greek philosophical way of saying -- YV: It was Einstein, actually -- BG: In your talk you mentioned Singapore and China, but at the speaker dinner last night you expressed a pretty strong opinion about how the West views China.

Would you like to share it?

YV: Yes, there is a lot of hypocrisy.

In our liberal democracy, there is such a thing as democracy.

That's because, as I said in my speech, we have limited democracy to the political sphere, leaving the only sphere in which all activity takes place, the economic sphere, to be completely non-democratic.

In some ways, China today is akin to England in the 19th century, if you allow it to be provocative.

Because, remember, we tend to associate liberalism with democracy. It's historically wrong.

Liberalism, liberals, like John Stuart Mill.

John Stuart Mill was particularly skeptical of the democratic process.

So what we are seeing in China today is a process very similar to what happened in Britain during the Industrial Revolution, especially the transition from the First to the Second Industrial Revolution.

And it is hypocritical to accuse China of doing what the West did in the 19th century.

BG: I think many here are wondering about your experience as Greek Finance Minister earlier this year.

YV: I knew this would happen.

BG: Yes.

BG: After half a year, how do you look back on the first half of this year?

YV: It's very exciting from a personal point of view, but I'm very disappointed because I had the opportunity to reboot the Eurozone.

Not only in Greece, but also in the euro area.

Moving away from complacency and the constant denial that there are massive structural faults running through the Eurozone that greatly threaten the entire European Union process.

We had an opportunity to set it right based on the Greek plan, which incidentally was the first to express its denial.

And unfortunately, the Eurozone, the Eurogroup powers, have chosen to remain in denial.

But you know what happens.

This is the Soviet experience.

Trying to keep a structurally unviable economic system alive through political will and authoritarianism can be successfully extended, but when change happens, it happens very suddenly and catastrophically.

BG: What changes do you foresee?

YV: Well, there is no doubt that the Eurozone has no future unless the structure of the Eurozone changes.

BG: Did anything go wrong when you were Minister of Finance?

YV: Every day.

BG: For example? YV: Anyone who looks back -- (applause) No, but seriously.

If you're the Minister of Finance, or any other Minister, and six months into the job, if you say, especially in such a stressful situation, that you haven't made a mistake, you're a dangerous person.

Of course I made mistakes.

The biggest mistake was signing a loan extension application at the end of February.

I imagined there was a real interest on the part of creditors to find common ground.

And it wasn't.

They were only interested in crushing our government simply because they didn't want to deal with the architectural fault line running through the Eurozone.

And because they didn't want to admit that they had been carrying out a devastating plan in Greece for five years.

We lost a third of our nominal GDP.

This is worse than the Great Depression.

And no one from the troika, the financiers who have imposed this policy, has confessed that it was a big mistake.

BG: Despite all this, and despite the aggressiveness of your discussion, you still seem to remain quite pro-European.

YV: Of course.

You see, my criticism of the European Union and the Eurozone comes from someone who lives in Europe.

My biggest fear is that the Eurozone will become unviable.

Because otherwise the unleashed centrifugal force will be diabolical and destroy the European Union.

And that would be devastating not just for Europe, but for the global economy as a whole.

We are probably the world's largest economy.

And if we allow ourselves to fall into the postmodern path of the 1930s, which seems to me to be what we do, it will be detrimental to Europeans and non-Europeans alike.

BG: I hope you are wrong on that point.

Giannis, thanks for coming to TED.

YV: Thank you.

(applause)

In the United States and Latin America, many of us grew up celebrating the voyage anniversary of Christopher Columbus, but was he a brave explorer who united two worlds, or a ruthless exploiter who ushered in colonialism and slavery?

And did he discover America in the first place?

It's time to put Columbus in the stands in History vs. Christopher Columbus.

"Order, order in court.

Wait, are you okay with work today? ”

<i>cough</i> "Yes, sir.

Beginning in 1792, Columbus Day was celebrated in many parts of the United States on October 12, the actual anniversary.

However, although the day was declared an official holiday in 1934, individual states are not required to observe it.

Only 23 states have closed public services, and many more are moving away from public services entirely. ”

<i>Cough</i> "I'm sorry.

In the 70's, they changed it to the second Monday in October so people could have a fun three-day weekend, but I guess you just don't like celebrations. ”

"Well, what are we celebrating again?"

"Now, sir, we all learned it in school.

Christopher Columbus persuaded the King of Spain to send him on a mission to find better trade routes to India, sailing west around the world instead of going overland east.

Everyone said it was crazy because he still thinks the world is flat, but he knew better.

And when he sailed the blue sea in 1492, he discovered something better than India, a whole new continent. ”

"How rubbish.

First of all, educated people have known since Aristotle that the world is round.

Second, Columbus discovered nothing.

People have lived here for thousands of years.

Nor was he the first European to visit.

Nordics settled Newfoundland about 500 years ago. ”

"If you don't say so, why aren't we all wearing that cow helmet?"

In fact, they didn't wear much either.

<i>cough</i> "Who cares what the Vikings did when?

These settlements did not last long, but the Columbus settlement did.

And the news he brought back to Europe spread widely and inspired all the explorers and settlers who came after him.

Without him, none of us would be here today. ”

"And it's because of him that millions of Native Americans aren't here today.

Do you know what Columbus did in the colonies he founded?

He took the first natives he met prisoner and wrote in his diary how easily he could conquer and enslave them all. ”

"Oh, come on, everyone was fighting back then.

Didn't the natives also tell Columbus about other tribes' raids and taking prisoners? ”

"Yes, but inter-tribal warfare was sporadic and limited.

Certainly not 90% of the population went extinct. ”

"Hmm. Why is this celebration of Columbus so important to you in the first place?"

"Your Majesty, Columbus' voyage inspired suffering across Europe and symbolized freedom and new beginnings.

And his discovery gave our grandparents and great-grandparents the opportunity to come here and build a better life for their children.

Wouldn't he be worthy of a hero to remind everyone that our country is built on the struggles of immigrants? ”

"And what about the struggles of the nearly wiped out Native Americans, who were displaced to reservations and whose descendants still suffer from poverty and discrimination?

How can a man who has caused so much suffering become a hero? ”

"That's history. You can't judge a fifteenth-century man by modern standards.

People at the time even considered it a moral duty to spread Christianity and civilization around the world. ”

"Actually, he was pretty bad even by old standards.

During his rule on Hispaniola, he tortured and mutilated natives who did not bring him enough money, sold a nine-year-old girl into sex slavery, and was brutal to the other settlers he ruled, to the point of being ousted from power and imprisoned.

When missionary Bartolome de las Casas visited the island, he wrote, "From 1494 to 1508, more than three million people died in war, slavery and mining." Who in future generations will believe this? "Well, I don't know if I believe those numbers."

"Hey, are there other ways to celebrate the holidays?"

"Some countries in Latin America celebrate the same date with different names, such as Día de la Raza.

These places celebrate the indigenous and mixed cultures that survived through colonial times.

Some parts of the United States renamed the holiday Native American Day or Indigenous Peoples Day and changed their celebrations accordingly. ”

"If it's such a problem, why don't you change your name?"

"Because it's a tradition.

Common people need heroes and founding myths.

Without delving into all this serious research, can't we just continue to celebrate the way we've been doing it for a century?

No one is actually celebrating the genocide. ”

“Traditions change, and how we choose to keep them alive changes our values.”

"Well, anyway, giving a tired judge a rest doesn't seem to be one of those values."

Traditions and holidays are important to every culture, but as our knowledge of history expands and our values ​​evolve, the hero of one era can become the villain of the next.

And deciding what these traditions mean today is an important part of putting history on trial.

Austrian physicist Erwin Schrödinger is one of the founders of quantum mechanics, but he is most famous for his never-before-seen thought experiments with cats.

He imagined catching a cat and placing it in a closed box with a device that had a 50% chance of killing the cat in the next hour.

When the hour was over, he asked, "How's the cat doing?"

Common sense suggests that cats are either alive or dead, but Schrödinger points out that quantum physics tells us that just before opening the box, the cat is equally as dead as it is alive.

Only when you open the box will you see a single, definite state.

Until then, the cat has a 50/50 chance and half the other half.

This seems absurd, but that was Schrödinger's point.

He found quantum physics so philosophically uncomfortable that he abandoned the theory he had helped create and turned to writing about biology.

It may seem silly, but Schrödinger's cat is very real.

In fact it is essential.

If a quantum object couldn't be in two states at the same time, the computer we're using to monitor it wouldn't exist.

The quantum phenomenon of superposition is the result of the double particle and wave nature of everything.

For an object to have wavelengths, it must span an area of ​​space. This means that objects occupy many positions at the same time.

However, we cannot completely define the wavelengths of objects confined to small regions of space.

Therefore, it exists in many different wavelengths at the same time.

We do not see such wave properties in everyday objects because the wavelength decreases with increasing momentum.

And cats are relatively large and heavy.

If you blast a single atom to the size of the solar system, the wavelength of the cat escaping the physicist would be as small as the atoms within that solar system.

You can't observe cat waves because this is too small to detect.

However, small particles like electrons can show dramatic evidence of their dual nature.

When electrons are irradiated one by one into two thin slits in the barrier, the electrons on the other side are detected at a specific moment at a specific moment, like particles.

However, if we repeat this experiment over and over again and track every individual detection, we find that it tracks a pattern that is characteristic of wave behavior. It is a region containing many electrons separated by a series of stripes, regions where there are no electrons at all.

Blocking one of the slits makes the stripes disappear.

This indicates that the pattern is the result of each electron passing through both slits simultaneously.

A single electron moves left and right simultaneously instead of choosing to go left or right.

The superposition of this state also leads to modern technology.

Electrons near the nucleus exist in broadened wave-like orbits.

Bringing two atoms closer together allows electrons to be shared between them rather than having to select only one atom.

This is how chemical bonds are formed.

The electrons in the molecule are not on atom A or atom B, but on A+B.

As you add atoms, the electrons spread out further and are shared among a huge number of atoms at the same time.

Electrons in solids are not bound to specific atoms, but are shared among all atoms and spread over a large area of ​​space.

This giant superposition of states determines how electrons move in materials such as conductors, insulators, and semiconductors.

Understanding how electrons are shared between atoms allows us to precisely control the properties of semiconductor materials such as silicon.

By properly combining various semiconductors, it is possible to create transistors on a small scale of millions on a single computer chip.

These chips and their spread electrons power the computer you're using to watch this video.

An old joke says that the internet exists to be able to share cat videos.

But on a very deep level, the internet's existence is thanks to an Austrian physicist and his imaginary cat.

We usually think of rhythm as an element of music, but in reality it is everywhere in the world around us, from the ebb and flow of ocean tides to our heartbeats, and rhythm is essentially an event that repeats regularly over time.

The ticking of the clock itself is also a kind of rhythm.

But a steady string of repeating single beats is not enough for musical rhythm.

For that you need at least one opposite beat with a different sound. It's an unstressed offbeat or an accented backbeat.

There are several ways to articulate these beats, such as using high and low drum notes, or long and short beats.

It's not an exact rule which one sounds like the main beat, but like the famous Rubin vase, it can be reversed depending on cultural perceptions.

In standard music notation, rhythm is indicated by note barlines, but there are other ways.

Do you remember that ticking clock?

Just as a round face follows the linear flow of time, so too can the flow of rhythm be circular.

Wheel continuity provides a more intuitive way to visualize rhythm than a linear score that requires you to move back and forth along the page.

You can mark beats at different positions around the circle with blue dots for main beats, orange dots for off beats, and white dots for secondary beats.

Here's a basic two-beat rhythm consisting of a main beat and an opposite off beat.

Or a 3-beat rhythm consisting of a main beat, an off-beat, and a sub-beat.

Also, the space between each beat can be further divided into subbeats using multiples of 2 or 3.

Layer multiple patterns using concentric wheels to create more complex rhythms.

For example, you can combine a basic 2-beat rhythm with an off-beat to create a 4-beat system.

It is the recognizable backbone of many popular genres around the world, from rock, country and jazz to reggae and cumbia.

Alternatively, you can combine a 2-beat rhythm with a 3-beat rhythm.

Remove the superfluous main beat and spin the inner wheel to get a basic feel 3-4 rhythm.

It is the basis of the music of Warling Darvisch and of a wide range of Latin American rhythms such as the Holopo and Bach's famous Chaconne.

Now, if you recall Rubin's Vase and hear the offbeat as the main beat, you'll get a Six-Eight feeling, like that found in genres like chacalera, Quechua, and Persian music.

In an 8-beat system, there are three layered circles, each rhythm played by a different instrument.

An outermost layer consisting of additional rhythmic components can then be added to strengthen the main beat and add precision.

Now let's remove this combined rhythm and all but the basic 2 beats above it.

This rhythmic composition is found in Cuban cinquillo, Puerto Rican bomba, and northern Romanian music.

And if you rotate the outer circle counterclockwise 90 degrees, you get patterns that are common in Middle Eastern music, Brazilian choro, and Argentine tango.

In all these examples, the underlying rhythm reinforces the basic one-two, but in different ways depending on the arrangement and cultural context.

So it turns out that the wheel method is more than just a nifty way to visualize complex rhythms.

By freeing us from the tyranny of barlines, it allows us to visualize rhythm in terms of time, taking us on a musical journey around the world at the turn of a handle.

Would mathematics exist if there were no humans?

Since ancient times, mankind has hotly debated whether mathematics was discovered or invented.

Have we created mathematical concepts that help us understand the universe around us, or is mathematics the native language of the universe itself, existing whether we discover its truth or not?

Are numbers, polygons, and equations really real, or are they just fantastic representations of theoretical ideals?

The independent reality of mathematics has long-standing proponents.

The 5th-century Greek Pythagoreans believed that numbers were living organisms and universal principles.

They called the number 1 "monad", the creator of all other numbers and the source of all creation.

Numbers were essentially active agents.

Plato argued that mathematical concepts are concrete regardless of our knowledge and are as real as the universe itself.

Euclid, the father of geometry, believed that nature itself is the physical manifestation of mathematical laws.

Some argue that numbers may or may not exist physically, but mathematical descriptions never exist.

Their truth values ​​are based on human-made rules.

Mathematics, therefore, is an invented logical exercise, a language of abstract relations that does not exist outside of mankind's conscious thought, but is based on patterns perceived by the brain, and is constructed to use those patterns to invent useful but artificial order out of chaos.

One of the proponents of this kind of thinking was the 19th-century German mathematics professor Leopold Kronecker.

His belief is summed up in the famous saying, "God created the natural numbers. Everything else is the work of man."

In the life of mathematician David Hilbert there was a movement to establish mathematics as a logical structure.

Hilbert tried to axiomatize all of mathematics, like Euclid did in geometry.

He and others who attempted this viewed mathematics as a highly philosophical game, but a game nonetheless.

Henri Poincaré, one of the fathers of non-Euclidean geometry, believed that the existence of non-Euclidean geometry dealing with non-planes of hyperboloid and elliptic curvature proved that the long-standing planar geometry, Euclidean geometry, was not a universal truth, but one of the consequences of using a specific set of game rules.

However, in 1960, Nobel laureate in physics Eugene Wigner coined the term "the irrational effectiveness of mathematics", strongly promoting the idea that mathematics is real and discovered by humans.

Wigner noted that many purely mathematical theories were developed in a vacuum, often without the aim of describing physical phenomena, and decades and even centuries later proved to be the necessary framework to explain how the universe has worked all along.

For example, British mathematician Gottfried Hardy's number theory boasted that his work could never help explain real-world phenomena, but helped establish cryptography.

Another work of his purely theoretical research, which became known as the Hardy-Weinberg Laws of Genetics, won him a Nobel Prize.

And Fibonacci encountered his famous sequence while observing the growth of an idealized population of rabbits.

Humans then discovered this order everywhere in nature, from the arrangement of sunflower seeds and petals, to the structure of pineapples, and even the bifurcation of the bronchi in the lungs.

Alternatively, there is Bernhard Riemann's non-Euclidean work in the 1850s, which Einstein used in his model of general relativity a century later.

There's an even bigger leap here. Mathematical knot theory was first developed around 1771 to explain positional geometry and was used in the late 20th century to explain how DNA unwinds during the replication process.

It may provide an important explanation for string theory.

Some of the most influential mathematicians and scientists in human history also agree on the issue, often in surprising ways.

So is mathematics an invention or a discovery?

Man-made constructs or universal truths?

Human product or nature, perhaps God's creation?

These questions are so profound that discussions often become spiritual in nature.

The answer may vary depending on the particular concept you are considering, but it can all feel like a twisted Zen koan.

If there are many trees in the forest, but no one counts them, does the number exist?

"I'm sorry, my cell phone is broken."

"Nothing. It's okay."

"These claims are completely baseless."

"The company was not aware of any wrongdoing."

"I love you."

We hear between 10 and 200 lies every day. And from medieval torture devices to polygraphs, blood pressure and breathing monitors, voice stress analyzers, eye trackers, infrared brain scanners, and even 400-pound brain waves, we've spent much of history figuring out how to detect lies.

However, while such tools work under certain circumstances, most can be tricked with sufficient preparation, and none are trustworthy enough to be admissible in court.

But what if the problem isn't the technique, but the underlying assumption that lying promotes physiological changes?

What if we took a more direct approach and used communication science to analyze the lies themselves?

On a psychological level, we partially lie to paint a better image of ourselves, connecting our fantasies to who we want to be rather than who we really are.

But while our brains are busy dreaming, we miss a lot of signals.

Our consciousness controls only about 5% of our cognitive functions, including communication, while the remaining 95% occur beyond our consciousness, and the reality-monitoring literature shows that stories based on imaginary experiences are qualitatively different from those based on real experiences.

This suggests that creating false stories about personal topics takes effort and results in different patterns of language use.

A technique known as linguistic text analysis helped identify four common patterns in subconscious deceptive language.

First, liars don't mention themselves much when they make deceptive statements.

They often write and talk about others and often use a third party to distance or disconnect from their own lies, making it sound more deceitful, like "There was never a party in this house" or "I never hosted a party here."

Second, liars tend to be more negative because they feel guilty about lying on a subconscious level.

For example, a liar might say, "Sorry, stupid cell phone battery died. I hate that."

Third, our brains have a hard time constructing complex lies, so liars usually describe events in simple terms.

Judgments and evaluations are complex things that our brains calculate.

The President of the United States once famously claimed, "I am not having a sexual relationship with that woman."

And finally, liars tend to keep their explanations simple, but insert unnecessary words and irrelevant but fact-sounding details to fill in lies, and use longer and more complex sentence structures.

Another president who faced the scandal declared, "I can say with absolute certainty that this investigation shows that none of the White House staff, or anyone currently employed by this administration, was involved in this very strange affair."

Let's apply linguistic analysis to some famous examples.

Take Lance Armstrong, seven-time Tour de France winner.

Comparing interviews in 2005 in which people denied taking performance-enhancing drugs with those in 2013 when they admitted to taking them, personal pronoun use increased by nearly three-quarters.

Notice the contrast between the following two quotes.

First: "Okay, some French guy in the lab in Paris, Jean Francis, whoever, is going to open the sample and test it.

Then I got a phone call from the newspaper and they said, 'I know you've tested positive for the EPO six times.

Second: "I lost myself in it all.

I'm sure there are other people who can't stand it, but I certainly couldn't, and I was used to having control over everything in my life.

I controlled every outcome of my life. ”

In his denial, Armstrong described a hypothetical situation in which he completely disassociated himself from the situation and focused on someone else.

In his confession, he acknowledged his statements and delved into his personal feelings and motivations.

However, the use of personal pronouns is only one indicator of deception.

Take another example from former Senator and U.S. presidential candidate John Edwards. "All I know is that the alleged father has publicly stated that he is the baby's father.

Also, I am not involved in any activity to solicit, agree to, or assist any type of payment to any woman or person who is believed to be the father of a baby. ”

Not only is this a rather lengthy way of saying "that baby isn't mine", Edwards never called the person by name, instead saying "that baby," "that woman," and "apparent father."

Now, let's see what he had to say when he later admitted to being a father: "I am Quinn's father.

I will do everything in my power to give her the love and support she deserves. ”

The statement is short and direct, calling the child's name and referring to the child's role in life.

So how can you apply these lie-detecting techniques to your own life?

First, remember that many of the lies we encounter on a daily basis are far less serious than these examples and can even be harmless.

But it's still worth keeping an eye out for crucial cues, such as minimal self-references, negative language, simple explanations, and complex expressions.

It may help you avoid overrated strains, ineffective products, and even terrible relationships.

I'm a marine biologist, explorer and photographer for National Geographic, and I'd like to share a secret.

This image is totally wrong, totally wrong.

I could see several people crying behind me saying that I had destroyed the concept of mermaids.

Mermaids are real, sure, but anyone who's ever gone diving knows the ocean is more like them.

That's because the ocean is a huge filter, and as soon as you start submerging in it, it loses its color, quickly turning dark and blue.

But we are humans, we are terrestrial mammals.

And since we have trichromatic vision, we see in red, green, and blue, but we are complete color addicts.

We love eye-popping colors, and we're trying to bring these eye-popping colors into the water.

Thus, bringing color underwater has a long and dark history, beginning 88 years ago with Bill Longley and Charles Martin, who attempted to take the first underwater color photographs.

And they're there in their old-fashioned scuba suits, with pontoons that pump air into it and contain grenade-elastic magnesium gunpowder. And the poor on earth don't know when to pull the strings when their frames are in focus, and Dawn! -- A pound of high explosive can be detonated to cast a bit of light into the water and capture this beautiful scallop-like image.

I mean, it's a gorgeous image, but it's not real.

They create an artificial environment in which we can satisfy our own addiction to color.

Looking at it the other way around, what we've discovered is that instead of bringing color into the water, we've been observing blue waters. It is a crucible of blue, and the animals that have lived there for millions of years have evolved all sorts of ways to capture that blue light and give off other colors.

Here are just a few examples of what this secret world is like.

It's like an underwater light show.

(music) Again, what you're seeing here is a blue light hitting this image.

These animals absorb blue light and immediately convert this light.

So, if you think about it, the ocean covers 71% of the planet, and blue light can reach up to nearly 1,000 meters.

After 10 meters of water all the red is gone.

So if you see something red below 10 meters, it means that the animal has transformed and created its own red.

This is the largest single blue environment on Earth.

And my entry into this world of biofluorescence starts with corals.

And I'd love to do a full TED Talk about corals and how amazing they are.

One of their activities, one of their miraculous feats, is to produce fluorescent proteins, fluorescent molecules in large quantities.

And in this coral, this fluorescent protein may account for up to 14 percent of its body weight.

So you're not building 14% muscle and not using it, it's likely playing a functional role.

For the last 10, 15 years, this has been very special to me. Because this molecule has turned out to be one of the most revolutionary tools in biomedicine, allowing us to see better inside ourselves.

So how do we study this?

To study biofluorescence, we swim at night.

And when I started working, I was just using these blue duct tape filters over my strobes so I could make sure that the light being converted by the animals was actually visible.

We were creating an exhibit for a natural history museum to show off how amazing the fluorescent corals in our reefs are, and something happened that surprised me.

In the middle of our coral is this green fluorescent fish.

This is the first time I've seen a green fluorescent fish, or a vertebrate for that matter.

And while we rubbed our eyes, checked our filters, and thought that someone might be making fun of us on camera, the eel was real.

It was the first green fluorescent eel we found, but this one just completely changed my trajectory.

So I had to ditch the corals and work with ichthyologist John Sparks to launch a survey around the world to find out how prevalent the phenomenon was.

And fish are much more interesting than coral. Fish have very advanced vision, and some fish even have lenses built into their eyes that magnify fluorescence, as I photographed them.

Therefore, I wanted to pursue this further.

So we designed a new set of gears and scoured coral reefs around the world in search of fluorescent creatures.

It's a bit like "E.T. Telephone Home."

We swim outside with this blue light, looking for reactions that animals absorb and send back to us.

Finally, we found a photogenic Kaupikfis eel.

A really shy and reclusive eel who knows very little about us.

They are about the size of my finger and spend about 99.9 percent of their time hiding under rocks.

However, these eels come out to mate on full moon nights. And that full moon night transforms into blue underwater.

Presumably they use this as a way to identify each other, quickly locate and mate, and return to their burrows for the next long period.

But then we started finding other fluorescent marine life. Almost camouflaged with lace stripes along the head and nape, like this green fluorescent snapper, it fluoresces with the same intensity as the fluorescent corals there.

Next to this fish, I was introduced to a red fluorescent scorpionfish that hid itself on top of this rock.

What we witnessed was either red fluorescent algae or red fluorescent corals.

Then we found this stealthy green fluorescent lizard.

There are many types of these lizards and they all look pretty much the same under white light.

But under fluorescent light, you can see a lot of patterns and you can really see the difference between them.

And in total, we just reported this last year, we found over 200 species of biofluorescent fish.

One of my inspirations is the French artist and biologist Jean Painlevé.

He really captures this entrepreneurial and creative spirit in biology.

He designed his own equipment, built his own camera, became fascinated by the seahorse, Hippocampus Erectus, and filmed the birth of a seahorse for the first time.

This is a male seahorse.

They were among the first fish to start swimming upright with their brains on top of their heads.

Males are truly marvelous creatures that give birth.

So he stayed up for days.

He put a shocking electric visor over his head to capture this moment.

In hindsight, I wish I could have shown you the moment when Painlevé discovered a biofluorescent seahorse, exactly the same species he was studying.

And here is our video.

(music) They are the most mysterious fish.

You may not be able to see the seahorse even if you are swimming directly over it.

They quickly blend into the algae, which also fluoresce red, but they have excellent eyesight, and after this lengthy mating ritual, they probably use it to their effect.

But things got pretty nasty when green fluorescence was found in stingrays. This is because stingrays belong to the Elasmobranchidae.

shark.

So I'm kind of a coral biologist.

Someone has to go down and see if the shark is fluorescent.

And there I am

(Laughter) And I thought, 'Maybe I should go back to coral.

(Laughter) Turns out these sharks aren't fluorescent.

And we found it.

In a dark, deep canyon off the coast of California, we spotted the first biofluorescent swell shark right under surfers.

here it is.

It is only about 1 meter long. It's called a swell shark.

And they call them Swell Sharks. This is because when threatened, they can swallow water, swell like an inner cylinder about twice their size, and tuck their bodies under rocks to avoid being eaten by predators.

And here is the first footage of these biofluorescent swell sharks.

Just great. So, sharks exhibit these unique patterns, some that are fluorescent and some that aren't, but also some shimmering spots that are much brighter than the rest of the shark.

But all this is beautiful to look at.

I thought this was great.

But what does that mean for sharks?

can they see this?

I searched the literature and found nothing known about this shark's vision.

So I took the shark to Cornell University ophthalmologist Ellis Lowe, who found that the shark sees separately and sharply at the blue-green interface, probably about 100 times better than we see in the dark, but it only sees blue-green.

So what it's doing is it's taking this blue world and absorbing that blue to create green.

It's creating a contrast that they can actually see.

So we have a model that shows them the ability to recognize all these patterns.

And we find a clear pattern between men and women, too.

But our last discovery was actually in the Solomon Islands just a few miles from where we are now.

While swimming at night, I encountered a biofluorescent sea turtle for the first time.

So now it's moving from fish and sharks to reptiles, again only a month old, but showing how little we know about this hawksbill's vision.

And it makes you think about how much more there is to learn.

And with only a few thousand breeding females of the species left here in the Solomon Islands, this is one of the hotspots for the species.

This shows us how much it is really necessary to protect and understand these animals while they are still here.

When I thought about biofluorescence, I wanted to know how deep it is.

Does this continue to the bottom of the sea?

So we started using submarines, equipping them with special blue lights on the front.

And then we went down, but I realized the important thing is that when you go down to 1,000 meters, you're going down.

Below 1,000 meters there is no biofluorescent marine life, almost nothing, just darkness.

So it's mostly a shallow phenomenon.

Then, at less than 1,000 meters, we encountered a bioluminescence zone. There, 9 out of 10 animals actually emit and flash their own lights.

If you try to dig deeper, this is like slamming a one-man submarine suit. Some call this my "Jacques Cousteau meets Woody Allen" moment.

(Laughter) But while exploring here, I was thinking: How do we interact with life in a sensitive way?

Because we are entering a new era of exploration, and we must be very careful and lead by example in how we explore.

So I've been working with Harvard roboticist Rob Wood to design a floppy underwater robot finger that can interact delicately with underwater marine life.

The idea is that most of our technology for exploring the deep sea comes from oil and gas and the military, but they really don't want to be nice.

Some of the corals are 1,000 years old.

Don't just crush them with your big claws.

So my dream is like this.

At night, I was able to board the submarine, put on force-feedback gloves, and delicately set up a lab on the front of the submarine. There, soft robotic fingers delicately collect and fill jars for research.

Let's go back to the powerful advanced application.

Here we see living brains using fluorescent marine DNA from jellyfish and coral to illuminate living brains and confirm their connections.

Interestingly, we use RGB to satisfy human intuition, so we can see our brains better.

And even more amazing is my close colleague at Yale University, Vincent Pieribone, who has actually designed and engineered a fluorescent protein that responds to voltage.

So we could know when a single neuron would fire.

You are essentially seeing a portal into consciousness designed by marine life.

So this brings me back to all perspectives and relationships.

From deep space, our universe looks like human brain cells, but here in the deep sea we discover marine life and cells that can light up the human mind.

And I hope that with open minds we can ponder the overarching interconnectedness of all life and understand what more awaits us if we can keep our oceans healthy.

thank you.

(applause)

The largest organ of the body is not the liver or the brain.

It's your skin, and its surface area is about 20 square feet in an adult.

Although different areas of the skin have different characteristics, most of this surface performs similar functions, such as sweating, feeling hot or cold, and growing hair.

However, after a deep cut or wound, the newly healed skin looks different than the surrounding area, so all abilities may not be fully restored or not restored for some time.

To understand why this happens, we need to look at the structure of human skin.

The top layer, called the epidermis, consists mostly of hardened cells called keratinocytes that provide protection.

The outer layer is constantly shedding and renewing, so it's very easy to repair.

However, in some cases, the wound may reach the dermis. The dermis contains blood vessels, various glands, and nerve endings that enable the skin's many functions.

And when that happens, it triggers four overlapping stages of the regeneration process.

The first stage, hemostasis, is the skin's response to two imminent threats. This means that blood is being lost and the physical barrier of the epidermis is compromised.

Both threats are averted by the formation of blood clots when blood vessels constrict to minimize bleeding in a process known as vasoconstriction.

A special protein known as fibrin forms bridges across the top of the skin, preventing blood from flowing out and the entry of bacteria and pathogens.

After about three hours, the skin begins to turn red, signaling the next stage: inflammation.

Once the bleeding is controlled and the barrier is secured, the body sends in special cells to fight any pathogens that may have invaded.

The most important of these are white blood cells known as macrophages. In addition to producing growth factors that promote healing, white blood cells prey on bacteria and damage tissue through a process known as phagocytosis.

And as these tiny soldiers have to travel through the blood to reach the wound, previously constricted blood vessels dilate in a process called vasodilation.

About 2-3 days after wounding, a proliferative phase begins when fibroblasts begin to invade the wound.

The process of collagen deposition produces a fibrous protein called collagen at the wound site, forming connective skin tissue that replaces the previous fibrin.

As epidermal cells divide and reshape the outer layer of skin, the dermis contracts to close the wound.

Finally, in the fourth stage of remodeling, the wound matures as newly deposited collagen is reconstituted and converted into specific types.

This process, which takes over a year, improves the tensile strength of the new skin and strengthens blood vessels and other connections.

Over time, depending on the severity of the original injury and the function itself, the new tissue can reach 50-80% of the original healthy function.

However, scarring remains a major clinical problem for physicians worldwide because the skin does not fully heal.

Although researchers have made great strides in understanding the healing process, many fundamental mysteries remain unsolved.

For example, do fibroblasts arrive from blood vessels or from the skin tissue adjacent to the wound?

And why are other mammals, such as deer, able to heal wounds so much more efficiently and completely than humans?

By finding answers to these and other questions, someday we may completely heal ourselves and our scars will be just memories.

Have you ever noticed something swimming in your field of vision?

They look like tiny bugs or transparent blobs that disappear when you look closely and reappear as soon as you look away.

But don't wash your eyes.

What you are seeing is a common phenomenon known as floaters.

The scientific name for these objects is Muscae volitantes, which means "flying fly" in Latin, and as the name suggests, they can be a bit of a nuisance.

But they aren't really bugs or external objects.

Rather, they exist within your eyeballs.

Floaters move and change shape so they look alive, but they are not.

Floaters are small objects that cast shadows on the retina, the light-sensitive tissue at the back of the eye.

They can be tissue debris, red blood cells, or protein clumps.

And because floaters float in the vitreous humor, the gel-like fluid that fills the inside of the eye, it floats with the movement of the eye and appears to bounce a little when the eye stops.

Floaters are almost always barely distinguishable.

Just as shadows become sharper when you bring your hand closer to a table with an overhead light, the closer you get to your retina, the more you see.

Also, floaters are especially noticeable when looking at an even, bright surface such as a blank computer screen, snow, or a clear sky. In this case, the background is consistent and easier to distinguish.

The brighter the light, the more the pupil constricts.

This has the same effect as replacing a large diffuse lighting fixture with a single overhead light bulb, and shadows also appear sharper.

There is another visual phenomenon that looks similar to floaters but is actually unrelated.

If you've ever seen tiny dots of light flying around when you look at a bright blue sky, you've experienced a phenomenon known as bluefield entropia.

In some ways, this is the opposite of the floater outbreak.

Here, instead of seeing a shadow, we see a small moving window that lets light into the retina.

This window is actually caused by white blood cells that migrate through capillaries along the surface of the retina.

These white blood cells can become so large that they nearly fill the capillaries, leaving the plasma space open in front of the white blood cells.

Both space and white blood cells are more transparent to blue light than the red blood cells that normally reside in capillaries, so wherever this happens, you will see a dot of light that follows the path of the capillary and moves with your pulse.

Under ideal viewing conditions, you might even see what looks like a black tail behind the dots.

These are red blood cells that have gathered behind the white blood cells.

Some science museums have exhibits that consist of screens of blue light, allowing you to see these blue sky sprites more clearly than usual.

Everyone sees these effects, but they vary greatly in number and type.

Floaters often go unnoticed because our brains have learned to ignore them.

However, an unusually large number of floaters that interfere with vision or large floaters may be a sign of a more serious condition and should be treated by a doctor immediately.

But most of the time, internal optical phenomena such as planktonic creatures and blue sky sprites are just a gentle reminder that what we think we see depends on our biology and mind as much as it does on the outside world.

Imagine you are in Rome and heading to the Vatican Museums.

And you've been limping down long corridors past statues and frescoes and lots of stuff.

Head to the Sistine Chapel.

At last—long corridors, stairs, and doors.

You are at the entrance of the Sistine Chapel.

So what do you expect?

A towering dome? A choir of angels?

Actually there is no such thing.

Instead, why not ask yourself what do we have?

Now open the curtains of the Sistine Chapel.

It is literally surrounded by painted curtains, the original decoration of this chapel.

The church used tapestries not only to keep the cold out during long masses, but also as a way of representing the great theater of life.

The human drama played out by each of us is a wonderful, all-encompassing tale that unfolds in three stages in the painting of the Sistine Chapel.

Well, this building started out as a space for a small group of well-educated Christian priests.

they prayed there. They elected a pope there.

500 years ago it was the ultimate church human cave.

So you might be wondering how today we attract and delight 5 million people from all backgrounds a year.

For in that compressed space a creative explosion ignited by the electrical excitement of the new geopolitical frontier ignited the Church's ancient missionary traditions and produced one of the greatest works of art in history.

Today, this development has taken place in a major evolution, starting with a few elites and finally being able to speak to audiences from all over the world.

This evolution occurred in three stages, each related to historical circumstances.

The first was rather limited in scope.

It reflected a rather narrow-minded point of view.

The second came after Columbus' worldview changed dramatically after his historic voyage. And the third, when the Age of Discovery was in full swing, and the Church rose to the challenge of global expansion.

The original decoration of this church reflected a smaller world.

There were busy scenes telling the life story of Jesus and Moses, reflecting the development of Jews and Christians.

Commissioning it, Pope Sixtus IV assembled a dream team of Florentine art that included such figures as Sandro Botticelli and Ghirlandaio, Michelangelo's future painting teacher.

They cover the walls with friezes of pure color, and in these stories you will find familiar landscapes, artists using Roman monuments and Tuscan landscapes to represent distant tales, more familiar ones.

Adding portraits of the Pope's friends and family, the work was a fitting decoration for the small court confined to continental Europe.

But with the discovery of the New World in 1492, the horizon had expanded, and this 133-by-46-foot microcosm had to expand as well.

And it did so thanks to a creative genius, a visionary story and a great story.

Well, the creative genius was Michelangelo Buonarroti, who was 33 when he was tapped to decorate the 12,000-square-foot ceiling and decks piled up against him. He trained in painting but quit to pursue sculpture.

Attracted by the prospect of a great sculptural project, he came to Rome, but when the project fell through with a pile of unfinished commissions, there were angry patrons in Florence.

And he was left with the commission to paint the twelve apostles in the decorative background of the ceiling of the Sistine Chapel, which was to resemble any other ceiling in Italy.

But Genius has risen to the challenge.

Michelangelo boldly explored new artistic territories at a time when mankind was daring to cross the Atlantic Ocean.

He, too, was going to tell the story of the great beginning, the story of Genesis, not the Apostles.

It's not something that actually sells easily, it's a story in the ceiling.

How can you read a crowded scene from 62 feet below?

200 years of painting techniques in his Florentine atelier were not capable of telling this kind of story.

But Michelangelo wasn't really a painter, so he played to his strengths.

Instead of being busy and unaccustomed to filling a space, he took a hammer and a chisel and cut through a piece of marble to reveal the person inside.

Michelangelo was an essentialist. He told his story with a huge, dynamic body.

The plan was embraced by the extraordinary Pope Julius II, who was not afraid of Michelangelo's brazen genius.

He was the nephew of Pope Sixtus IV, had been immersed in the arts for thirty years, and knew its power.

And while history has lived up to the moniker of the Warrior Pope, this man's legacy to the Vatican was not fortresses and artillery, but art.

He left us the Sistine Chapel during Raphael.

He left behind an extraordinary collection of Greek and Roman sculpture, distinctly non-Christian works, which became the seedbed for St. Peter's Basilica and the Vatican Museums, the world's first museum of modern art.

Julius was the man who envisioned an everlasting Vatican in grandeur and beauty, and he was right.

Michelangelo and Julius II, the meeting of these two giants created the Sistine Chapel.

Michelangelo was so enthusiastic about the project that he managed to complete the task in three and a half years, using a staff of skeletons and reaching overhead to paint the story on the ceiling, spending hours on most of his time.

So let's take a look at this ceiling and see how storytelling has become a global phenomenon.

No more familiar artistic references to the world around you.

There is only space, structure and energy. Spread over nine panels, the monumental painted framework is driven more by sculptural forms than by painterly colors.

And we stand at the edge of the entrance, far from the altar and from the gated enclosure made for the priests, and look far into the beginning.

And both in scientific research and in the biblical tradition, we think in terms of primal sparks.

Michelangelo gave us the first energy when he gave us the separation of light and darkness, moving figures blurred in the distance and compressed into a narrow space.

The next figure looms large, and we see a figure charging from one side to the next.

He leaves behind the sun, moon and plants.

Michelangelo, unlike all other artists, did not focus on what was being created.

He focused on the act of creation.

Then, like the Caesura of poetry, motion ceases and the Creator floats in the air.

So what is he doing?

Is he making land? is he making the sea?

Or, as Michelangelo must have done, is he looking back at his handiwork, the universe, and his treasures, looking back at his work on the ceiling and declaring, "This is good."

Well, the stage is set and you reach the pinnacle of creation: man.

A bright figure of Adam jumps into the eye against a dark background.

But if you look closely, its feet are pretty limp on the ground and its arms are heavy on your knees.

Adam lacks the inner radiance that makes him great.

That radiance is about to be bestowed by the Creator on Adam's finger, which is a millimeter from his hand.

It puts us on the edge of our seats. Because he is only moments away from that touch that will make him discover his purpose and leap to the pinnacle of creation.

And Michelangelo threw a curve ball.

Who is in the other arm?

Eve, the first lady.

No, she's not on the spur of the moment. She is also part of the plan.

She was always in his heart.

See how she is so intimate with God that she wraps her hand around his arm.

And for me, a 21st century American art historian, this was the moment this painting spoke to me.

Because I realized that representations of this human drama were always about men and women. In other words, I realized that the center of death, the center of the ceiling, was not Adam, but the creation of women.

And the fact is, if you see them together in the Garden of Eden, they will fall together, their proud posture turning into folded-together shame.

You are now at a critical crossroads in the ceiling.

You are just at the point where neither you nor I can go to church anymore.

A gated enclosure keeps us from our inner sanctuary and, like Adam and Eve, we are cast out.

The remaining scenes on the ceiling reflect the crowded chaos of the world around us.

Noah and his ark and the flood.

I have Noah He makes a sacrifice and makes a covenant with God.

Maybe he is the savior.

Oh, but no, Noah was the one who grew grapes, invented wine, got drunk and passed out naked in the barn.

A strange way to design a ceiling that starts with God creating life and ends with a blind and drunk man in a barn.

So compared to Adam, you might think Michelangelo is kidding us.

But he tries to dispel that melancholy by using bright colors such as emeralds, topaz, and the scarlet of the prophet Zechariah, just below Noah.

Zechariah foresaw the coming of the Light from the East, and at this point we will be heading to a new destination with the Sibyl and the Prophet leading the parade.

You have heroes and heroines to blaze a safe path, and we follow our mothers and fathers.

They are the motors of this great human engine and propel it forward.

And now we are at the cornerstone of the ceiling, the apex of the whole. The person appears to be invading our space by falling from his space into ours at any moment.

This is the most important turning point.

The past meets the present.

For Christians, this figure of Jonah, who spent three days in the belly of the whale, is a symbol of humanity's rebirth through the sacrifice of Jesus, but for the multitudes of visitors of various faiths who visit the museum every day, it is a moment when the distant past meets and meets the reality before them.

All this leads us to the yawning arch on the altar wall, where we can see Michelangelo's Last Judgment painted in 1534 after the world has changed again.

The Reformation split the church, the Ottomans made Islam a common language, and Magellan found a sea route to the Pacific.

How does the 59-year-old artist, who has never been to more than Venice, speak to this new world?

Michelangelo chose to portray destiny, the universal desire shared by all of us, to leave a legacy of excellence.

Based on a vision of the Last Judgment, the end of the Christian world, Michelangelo painted a series of figures wearing these astonishingly beautiful bodies.

No more covers or portraits, except for the couple.

It is made up of only 391 bodies, no two are the same and as unique as each of us.

They start under the corner, leave the ground, and struggle to climb.

Those who stand up reach out to help others. And in one great scene, a black man and a white man come together to paint an incredible vision of human unity in this new world.

Most of the space is given to the winning circle.

There were men and women naked like athletes.

They are people who have overcome adversity, and in Michelangelo's vision of people who fight adversity and overcome obstacles, they are just like athletes.

Both men and women bend down and pose in this special spotlight.

This meeting is presided over by Jesus, who was first the tormentor on the cross and is now the glorious ruler in heaven.

And as Michelangelo proved in his paintings, difficulties, setbacks and obstacles do not limit excellence, they make it.

Now this brings us to one weird thing.

This is the Pope's private chapel and is best described as a nude stew.

But Michelangelo wanted to use only the best artistic language, the most universal artistic language he could think of: the language of the human body.

So instead of a way of demonstrating virtues like fortitude and self-control, he borrowed from Julius II's magnificent collection of sculptures to show inner strength as an outer force.

Well, one contemporary wrote that the chapel was too beautiful to cause controversy.

And so it turned out.

Michelangelo soon found his masterpiece of human drama to be labeled pornographic, at which point he added two more portraits. One depicts the man who criticized him, the Pope's courtier, and the other depicts himself as a dry husk, not an athlete, in the hands of a long-suffering martyr.

In the year he died, he saw some of these figures eclipsed, but it was a triumph of petty distractions over great exhortations to glory.

And we are standing here now.

We are trapped in the space between the beginning and the end, the vast totality of human experience.

The Sistine Chapel forces us to look around as if it were a mirror.

who am i in this picture

Am I one of the crowd too?

am i a drunk man

am i an athlete?

And as we leave this uplifting haven of beauty, we are inspired to ask ourselves the biggest questions of our lives. “Who am I and what role do I play in this great theater of life?”

thank you.

(Applause) Bruno Giussani: Thank you, Elisabeth Leff.

Elizabeth, you mentioned the whole problem of porn, too much nudity, too many scenes of everyday life, and inappropriate in the eyes of the times.

But actually the story is much bigger.

It doesn't just modify or obscure part of the numbers.

This work of art was almost destroyed because of it.

Elisabeth Leff: The impact of the Last Judgment was enormous.

The printing press made it available for everyone to see.

So this is not something that happened within a few weeks.

It happened in 20 years of editorials and grievances against the Church, saying, "You can't tell us how to live our lives.

Did you notice that there is porn in the Pope's Chapel? ”

And after complaints and claims to destroy this work, the year Michelangelo died, the church finally found a compromise: a way to preserve the painting. That's what we did to decorate those extra 30 covers. That happens to be the origin of the fig leaf.

That's how it all began, born out of a church that wanted to save a work of art rather than defile it or destroy it.

BG: This, you taught us, is not the classic tour that people get when they go to the Sistine Chapel today.

(laughs) EL: I don't know, is that an ad?

(Laughter) BG: No, no, not necessarily, but it's a statement.

Today's art experience faces problems.

Too many people want to see this out there, and as a result, five million people are going to walk through that little door and experience it in a completely different way than we've ever experienced it.

Elle: Right. Agree. I think it's really great to be able to stop and watch.

But at the same time, think how amazing it is that, in those days of 28,000 people a day, even if you were with other people on a day, you could still look around and paint on the 500-year-old stucco all those people, jaw dropping and looking up next to you.

This is a great representation of how beauty truly speaks to us through time and geospace.

BG: Liz, thank you.

Him: Thank you.

BG: Thank you.

(applause)

For as long as we can trace our existence, humans have been fascinated by death and resurrection.

Nearly every religion in the world has some interpretation, and from early myths to the latest blockbuster movies, the dead keep coming back.

But is resurrection really possible?

What is the actual difference between a living creature and a corpse in the first place?

To understand what death is, we must understand what life is.

One of the ancient theories, called the theory of life, claimed that living things are unique because they are filled with a special substance, or energy, which is the essence of life.

Belief in such an essence, whether it be called qi, lifeline, or bodily fluids, is common throughout the world and is still present in tales of creatures that can somehow suck life from others, or some form of magical source that can replenish it.

After the Scientific Revolution of the 17th century, dynamism began to decline in Western society.

Rene Descartes put forward the idea that the human body is essentially no different from any other machine, animated by a God-created soul located in the pineal gland of the brain.

And in 1907, Dr. Duncan MacDougall even claimed that the soul had mass, weighing patients just before and after death to prove it.

As with any vital theory, his experiments were discredited, but traces of his theory still appear in popular culture.

But where do all these unreliable theories lead us?

What we now know is that life is contained not in some magical substance or spark, but in ongoing biological processes themselves.

And understanding these processes requires zooming down to the level of individual cells.

Inside each of these cells, chemical reactions are constantly occurring, powered by glucose and oxygen, which our body converts into an energy-carrying molecule known as ATP.

Cells use this energy for everything from repair to growth to regeneration.

Not only does it take a lot of energy to make the molecules you want, but it takes even more energy to get them where you need them.

The universal phenomenon of entropy means that molecules tend to randomly diffuse, move from areas of high concentration to areas of low concentration, or break down into smaller molecules or atoms.

Therefore, cells must constantly suppress entropy by using energy to maintain the highly complex structures of molecules required for the development of biological functions.

When the entire cell succumbs to entropy and these arrangements are disrupted, it eventually dies.

This is why once an organism dies, it cannot simply be brought back to life.

We can pump air into someone's lungs, but it's not very useful if the many other processes involved in the respiratory cycle stop working.

Similarly, rather than restarting an inanimate heart, an electrical shock from a defibrillator resynchronizes the abnormally beating heart muscle cells and restores a normal rhythm.

This prevents people from dying, but does not resurrect corpses or monsters stitched together from corpses.

So it seems to me that all our various medical miracles can delay or prevent death, but not reverse it.

But it's not as simple as it sounds. Continuous advances in technology and medicine have led to diagnoses such as coma, a reversible condition previously thought to be fatal.

In the future, the point of no return may go further.

Some animals are known to extend their lifespan or survive extreme conditions by slowing biological processes to a virtual halt.

And cryonics research hopes to accomplish the same thing by freezing dying people and later reanimating them when new technology can help them.

When cells freeze, the molecules have little movement and diffusion effectively stops.

Even if all of the human cellular processes had already been disrupted, a swarm of nanorobots could reverse this, putting all the molecules back in place, injecting all cells with ATP at the same time, perhaps picking up where the body left off.

So if we think of life not as a magical spark, but as an incredibly complex and self-perpetuating state of organization, death is simply a process of increasing entropy that disrupts this fragile balance.

And it turns out that the point at which someone dies completely isn't a fixed constant, it's simply a matter of how much entropy we can currently reverse.

Slavery, the treatment of human beings as property and the deprivation of their individual rights, occurs in many forms around the world.

But there is one institution that stands out for both its global scale and enduring heritage.

The Atlantic slave trade, which spanned three continents from the late 15th century to the mid-19th century, forcibly brought more than 10 million Africans to the Americas.

The impact it had on not only these slaves and their descendants, but also the economy and history of much of the world.

Centuries of contact existed between Europe and Africa via the Mediterranean Sea.

However, the Atlantic slave trade began in the late 1400s with the Portuguese colonies in West Africa, and the Spaniards settled the Americas shortly after.

The crops grown in the new colonies—sugar cane, tobacco, and cotton—were labor intensive, and there were not enough settlers or indentured servants to cultivate all the new lands.

The Native Americans were enslaved, but many died of the new disease, and some resisted effectively.

So Europeans turned to Africa to meet the enormous demand for labor.

African slavery has existed for centuries in various forms.

Some slaves were indentured servants, who had limited terms and were given the opportunity to buy their freedom.

Others resembled European serfs.

In some societies, slaves become members of their master's family, own their own land, and even hold positions of power.

But when white captains supplied their slaves with industrial goods, weapons, and rum, African kings and merchants had little reason to hesitate.

They viewed the people they sold not as fellow Africans, but as criminals, debtors, or captives of rival tribes.

Kings sold them to enrich their territories and strengthen them against neighboring enemies.

The African kingdoms thrived on the slave trade, but fierce competition arose to meet the enormous European demand.

Slavery replaced other criminal penalties, and the capture of slaves became a motive rather than an outcome of war.

To protect themselves from slave raids, neighboring kingdoms needed European firearms, which they also purchased with their slaves.

The slave trade became an arms race that changed the societies and economies of entire continents.

As for the slaves themselves, they faced unimaginable atrocities.

They were marched to slave forts on the coast, shaved to prevent lice, branded, and loaded onto ships bound for the Americas.

About 20% of them will never see land again.

Many captains in those days were tightpackers, cramming as many men as possible under deck.

Many died of disease due to the lack of sanitary facilities, and some were thrown overboard as sickness or chastisement, but the captain secured profits by cutting off the ears of the slaves as proof of purchase.

Some POWs took matters into their own hands.

Many inland Africans, who had never seen white people before, thought of them as cannibals, constantly taking people away and back again.

Fearing being eaten, or to avoid further suffering, they committed suicide or starved to death, believing that their souls would return home after death.

Those who survived were completely dehumanized and treated as mere baggage.

Women and children were held captive on deck and mistreated by the crew, while men were forced to dance to keep the movement alive and suppress mutiny.

What happened to the Africans who reached the New World and how the legacy of slavery still affects their descendants today is fairly well known.

Less discussed, however, is the impact of the Atlantic slave trade on Africa's future.

Not only were tens of millions of able-bodied people lost on the continent, but most of the captured slaves were men, so the long-term demographic impact was even greater.

When the slave trade was finally outlawed in the Americas and Europe, the African kingdoms whose economies the slave trade came to dominate collapsed, leaving room for conquest and colonization.

Increased competition and an influx of European weapons fueled war and instability that continues to this day.

The Atlantic slave trade also contributed to the development of racist ideologies.

Although there was no deeper reason for slavery in most Africa than legal punishment or inter-tribal warfare, the Europeans, who had long ago outlawed the enslavement of their fellow Christians by preaching a universal religion, needed to justify a practice clearly contrary to their ideals of equality.

So they argued that Africans were biologically inferior and destined for slavery, and went to great lengths to justify this theory.

In this way, slavery in Europe and the Americas acquired a racial basis, making it impossible for slaves and their future descendants to attain equal status in society.

In all these respects, the Atlantic slave trade is a massive injustice whose effects have long since been abolished.

The human eye is an amazing mechanism that can detect everything from a few photons to direct sunlight, and switch focus from the screen in front of you to the distant horizon in a third of a second.

In fact, the structures necessary for such incredible flexibility were once thought to be so complex that even Charles Darwin himself admitted that the idea that they evolved there seemed so silly.

But that's exactly what started over 500 million years ago.

The story of the human eye begins with a simple light spot, such as that found in single-celled organisms such as euglena.

It is a cluster of light-sensitive proteins attached to the organism's flagella that activates when it sees light and therefore food.

A more complex version of this light spot is found in the flatworms Planaria.

It's cupped instead of flat, so it has a better sense of the direction of incoming light.

Among other uses, this ability allows the creature to seek shade and hide from predators.

Over the millennia, some organisms have made these light cups deeper, with smaller frontal openings.

The result is a pinhole effect that dramatically improves resolution and reduces distortion by allowing only a narrow beam of light to enter the eye.

The nautilus, the ancestor of the octopus, uses this pinhole eye for improved resolution and direction sensing.

A pinhole eye allows for easy imaging, but as we know the crucial step to the eye is the lens.

It is thought to have evolved with clear cells that line the openings to prevent infection, allowing the interior of the eye to fill with a fluid that optimizes light sensitivity and processing.

A crystalline protein that formed on the surface created a structure that helped focus light to a point on the retina.

It is this lens that is key to the eye's adaptability, changing its curvature to accommodate near and far vision.

This construction of a pinhole camera with a lens was the basis for what would eventually evolve to the human eye.

Further improvements would include a colored ring called the iris that controls the amount of light entering the eye, a tough white outer layer known as the sclera that maintains its structure, and a lacrimal gland that secretes a protective membrane.

Equally important, however, was the evolution of the brain that accompanied it, an expansion of the visual cortex to process the sharper and more colorful images it received.

Our eyes reveal traces of its gradual evolution, far from an ideal masterpiece of design.

For example, the human retina is inverted, with light-sensing cells facing away from the eye opening.

This creates a blind spot that requires the optic nerve to penetrate the retina to reach the deep photosensitive layer.

Similar eyes in independently evolved cephalopods have front-facing retinas, allowing them to see without blind spots.

Eyes of other creatures show different adaptations.

A so-called four-eyed fish, anabrepus has a bipartite eye for observing above and below water, making it perfect for spotting both predators and prey.

Classically nocturnal hunters, cats have evolved with reflective layers that maximize the amount of light their eyes can detect, resulting in excellent night vision and a characteristic glow.

These are just a few examples of the enormous diversity of eyes in the animal kingdom.

So if you could design an eye, would you do it differently?

This question is not as strange as it might seem.

Doctors and scientists are now studying different eye structures to help design biomechanical implants for the blind.

And in the not-too-distant future, machines built on the precision and flexibility of the human eye may even be able to surpass their own evolution.

It was the autumn afternoon of 2005.

I worked at the ACLU as a scientific advisor.

I really loved my job, but I had days where I was a little bit disappointed.

So I wandered down the hallway to my colleague Chris Hansen's office.

Chris has been with the ACLU for over 30 years and has deep organizational knowledge and insight.

I explained to Chris that I was feeling a little stuck.

I was investigating many issues at the intersection of science and civil liberties, and it was very interesting.

But I wanted the ACLU to address these issues in a bigger way, in a way that could really make a difference.

So Chris cut to the chase and asked, "So, of all the issues you've been looking at, what are your top five?"

"Well, genetic discrimination, reproductive technology, biobanking, and...

Oh, I have a really great problem. Functional MRI and its use in lie detection.

Oh, and of course there are gene patents. ”

"Gene patent?"

"Yes, it's a patent on human genes."

"no!

Does that mean the US government issues patents on parts of the human body?

that is not correct. ”

I went back to the office and sent Chris three articles.

And 20 minutes later he came into my office out of the blue.

"Oh my god! That's right! Who should I sue?"

(Laughter) Chris is a really good lawyer, but he knew very little about patent law, and certainly nothing about genetics.

I knew a little about genetics, but I wasn't even a lawyer, let alone a patent attorney.

So it's clear there was a lot to learn before filing a lawsuit.

First, we needed to understand exactly what would be patented when someone patented a gene.

Gene patents typically contain dozens of claims, the most controversial of which relates to so-called "isolated DNA," a piece of DNA that has been removed from a cell.

Gene patent advocates say, "You see? We didn't patent the genes in your body. We patented the isolated genes."

That's true, but the problem is that you have to isolate the gene in order to use it.

And the patent wasn't just for the specific gene they isolated, it was for all possible versions of that gene.

So what does that mean?

This means that without the patent owner's permission, you cannot give your genes to a doctor and ask them, for example, to check the gene for mutations.

This also means that the patent holder has the right to prevent the gene from being used in research or clinical trials.

Allowing patent holders, often private companies, to lock up portions of the human genome was harming patients.

Consider 10-year-old Abigail, who has long QT syndrome. Long QT syndrome is a serious heart condition that can lead to sudden death if left untreated.

A company that has patented two genes associated with the condition has developed a test to diagnose the syndrome.

But then they went bankrupt and never offered it.

So another lab tried to provide the test, but the company that owned the patent threatened to sue the lab for patent infringement.

As a result, I was not tested for two years.

Meanwhile, Abigail died of undiagnosed QT prolongation.

Gene patenting was clearly a problem and harming patients.

But was there a way to challenge them?

It turns out that the Supreme Court has made it clear through a series of lawsuits that certain things are not patent eligible.

You cannot patent products of nature such as air, water, minerals, or elements of the periodic table.

And you can't patent the law of nature, the law of gravity, E = mc2.

These are so basic that they should be offered freely to everyone and not exclusively to anyone.

DNA, the most basic structure of life that codes for the production of all proteins, whether in our bodies or at the bottom of a test tube, seemed to be both a product of nature and a law of nature.

In delving into this issue, we traveled across the country to speak with a variety of experts, including scientists, medical professionals, lawyers, and patent attorneys.

Most of them agreed that we were right, as a matter of policy, and at least in theory, of law.

They all thought we had a near zero chance of winning the gene patent challenge.

why is that?

Well, the Patent Office has been issuing these patents for over 20 years.

There were literally thousands of patents on human genes.

The patent system is so entrenched in the status quo, the biotech industry has grown around this practice, and bills to ban gene patents have been presented to Congress every year with no success.

The bottom line is that the court did not intend to overturn these patents.

Now, Chris and I weren't the type to shy away from a challenge, but hearing the words "just being right isn't enough" seemed to give us even more reason to take up this fight.

So we set out to build the case.

Currently, the trends in patent litigation are as follows: Company A sues Company B over a very specific and obscure technical issue.

We weren't very interested in such cases, so we thought this case was much bigger than that.

It was about scientific freedom, medical progress, and patient rights.

So we decided to develop a civil rights litigation that differs from the typical patent litigation.

We set out to identify gene patent holders who were vigorously enforcing their patents and to organize a broad coalition of plaintiffs and experts who could tell the court how these patents were harming patients and innovation.

We have identified Myriad Genetics, Inc., based in Salt Lake City, Utah, as the frontrunner for litigation.

Myriad held patents on two genes, the BRCA1 and BRCA2 genes.

Women with certain mutations in these genes are thought to have a significantly increased risk of developing breast and ovarian cancer.

Myriad used the patent to maintain a complete monopoly on BRCA testing in the United States.

This forced the suspension of several laboratories that offered BRCA tests.

Testing cost a hefty $3,000+.

The company had stopped sharing clinical data with the international scientific community.

And perhaps worst of all, for several years, Myriad refused to update its tests to include additional mutations identified by a team of French researchers.

Over this period, over several years, it is estimated that as many as 12 percent of women tested received the wrong answer, a negative test result when they should have been positive.

Kathleen Maxian.

Kathleen's sister, Eileen, was diagnosed with breast cancer at age 40 and was tested by Myriad.

The test result was negative.

The family was relieved.

That meant that Eileen's family most likely had never had cancer, and other family members didn't need to be tested.

But two years later, Kathleen was diagnosed with advanced-stage ovarian cancer.

Kathleen's sister was also among the 12 percent who received false-negative test results.

If Eileen had received proper results, Kathleen would have been tested and ovarian cancer could have been prevented.

After agreeing to Myriad, it was necessary to form a coalition of plaintiffs and experts who could clarify these issues.

In the end, we ended up with 20 very dedicated plaintiffs. Genetic counselors, geneticists who have received cease and desist letters, advocacy groups, four major scientific societies representing more than 150,000 scientists and medical professionals together, and individual women who could not afford Myriad's testing or could not get a second opinion because of patents.

One of the big challenges we faced in preparing this lawsuit was finding the best way to communicate the science.

Therefore, to argue that what Myriad did was not an invention, and that the isolated BRCA gene was a product of nature, it was necessary to explain some basic concepts: "What is a gene?" What is DNA?

How is DNA isolated? Why isn't it an invention?

We spent hours with plaintiffs and experts trying to come up with a way to explain these concepts simply and accurately.

And it ended up relying heavily on the use of metaphors such as gold.

So isolating DNA is like extracting gold from a mountain or from the bottom of a river.

You may be able to patent the gold mining process, but you cannot patent the gold itself.

It may have taken a lot of labor and effort to dig gold out of the mountains. It's still gold, even though it hasn't been patented yet.

And it is clear that gold, once extracted, can be used for all sorts of uses that were not possible when it was in the mountains. For example, you can make jewelry out of it, but you can't patent gold yet, but it's still gold.

Well, it's 2009 and I'm ready to file a lawsuit.

We filed a case in federal court for the Southern District of New York, and the case was randomly assigned to Judge Robert Sweet.

In March 2010, Judge Sweet released a 152-page opinion that was a complete victory for us.

When we read the opinion, we did not understand how eloquently he described the science of the case.

I mean, our overview was pretty good, but it wasn't as good as this one.

How did he develop such a deep understanding of the subject in such a short time?

We didn't understand why this happened.

It turns out, then, that the clerk working for Judge Sweet at the time was not just a lawyer, but a scientist.

He was not just a scientist, he had a PhD in molecular biology.

(laughter) What incredible luck!

Myriad then appealed to the Court of Appeals for the Federal Circuit.

And here things got very interesting.

First, at a pivotal moment in this incident, the US government defected.

The government then submitted a brief on Myriad's side to the district court.

But now, the U.S. government has filed a brief against its own patent office, stating that it has reconsidered the issue in the light of the district court's opinion and concluded that the isolated DNA is not patent eligible.

This was a really big deal and totally unexpected.

The Court of Appeals for the Federal Circuit hears all patent cases and is known for its excellent patent protection.

So even with such a great development, we expected to lose.

And we did.

In a way.

In the end, the split decision was 2 to 1.

But the two judges who ruled against us did so for completely different reasons.

The first, Judge Raleigh, came up with a novel biological theory of his own that was completely wrong.

(Laughter) He decided that Myriad had created a new chemical, which made no sense at all.

Myriad didn't even refute this, so it was sudden.

Another Moore said he basically agreed with us that isolated DNA is a product of nature.

But she says she doesn't want to "disrupt the biotech industry."

A third Justice, Bryson, also agreed with us.

Therefore, we have asked the Supreme Court to review the case.

And when you petition the Supreme Court, you have to present the questions you want the court to answer.

These questions usually take the form of very long paragraphs, like whole pages with lots of "where this" and "therefore" clauses.

We submitted probably the shortest question ever posed.

Four words: Are human genes patentable?

Now, when Chris first asked me what I thought of these words, I said,

I think you have to say, "Is isolated DNA patentable?" ”

I want the judges to have exactly the same reaction as when you brought this matter to me seven years ago. ”

Well, we certainly couldn't argue with that.

The Supreme Court only hears about 1 percent of the cases it receives, but they agreed to hear our case.

The day of oral argument has arrived. It was really, really exciting. There was a long queue outside. People had been lining up since 2:30 a.m. to enter the courthouse.

Two breast cancer organizations, Breast Cancer Action and FORCE, organized a demonstration on the courthouse steps.

Chris and I sat quietly in the hallway just before he walked in and discussed the most important case of his career.

I was obviously more nervous than he was.

But when I entered the courtroom and looked around, any remaining panic subsided. The female clients who shared their very personal stories, the geneticists who devoted countless hours from their busy careers to this battle, and the various medical, patient advocacy, environmental, and religious groups who filed their friend's court briefs in this case.

Also in the room were the three leaders of the Human Genome Project. Among them was DNA co-discoverer James Watson himself, who had filed briefs in court in which he called gene patenting "madness."

(Laughter) The diversity of the community that came together in this room and the contributions that each of them made to make this day a reality spoke volumes about what was at stake.

The discussion itself was engaging.

Chris responded brilliantly.

But the most thrilling aspect for me has been watching Supreme Court justices tackle isolated DNA through a series of colorful parables and impassioned exchanges, exactly the way our legal team has done for the past seven years.

Judge Kagan likened DNA isolation to extracting medicinal plants from the Amazon.

Justice Roberts distinguished it from carving a baseball bat out of wood.

And in one of my favorite scenes, Judge Sotomayor declared that the isolated DNA was "only nature is there."

(Laughter.) We walked out of the court that day feeling pretty confident, but with a totally unexpected result: 9-0.

“Naturally occurring DNA segments are products of nature and are not patentable just because they are isolated.

Besides, Myriad didn't make anything. ”

Within 24 hours of the decision, five laboratories announced they would begin offering testing for the BRCA gene.

Some have promised to offer tests at lower prices than Myriad.

Others promised to provide a more comprehensive test than what Myriad had provided.

But of course, this decision goes far beyond Myriad.

This ends the 25-year practice of granting patents on human genes in the United States.

This removes a major barrier to biomedical discovery and innovation.

It also helps ensure that patients like Abigail, Kathleen and Irene get the tests they need.

A few weeks after the court issued its ruling, I received a small package in the mail.

It was from Bob Cookdeegan, a professor at Duke University, who was one of the first people Chris and I visited when we started considering whether to file this lawsuit.

When I opened it, a small stuffed toy came out.

(Laughter) We took a big risk in bringing this lawsuit.

It gave us the courage to take that risk because we knew we were doing the right thing.

This process took almost eight years from start to finish, with many twists and turns along the way.

Sure a little luck helped, but it was the communities we bridged, the alliances we forged that made the pigs fly.

thank you.

(applause)

How does your smartphone know your exact location?

The answer lies in an orbiting satellite 12,000 miles overhead, ticking to the beat of a quantum-mechanical atomic clock.

Phew.

Let's take a closer look at it.

First of all, we are concerned with location information, so why is it so important to know the time on the satellite?

The first thing the phone needs to determine is how far away it is from the satellites.

Each satellite constantly broadcasts a radio signal that is sent from space to your cell phone at the speed of light.

The phone records the arrival time of the signal and uses it to calculate the distance to the satellite using the simple formula distance = c x time. where c is the speed of light and time is the distance traveled by the signal.

But there is a problem.

Light is incredibly fast.

If time could only be calculated to the nearest second, all places on Earth and far away would appear to be the same distance from the satellite.

So calculating that distance to within a few dozen feet would require the best clock ever invented.

In the case of atomic clocks, some of them are so accurate that even if they were to run for the next 300 million years, they would not gain or lose a second.

Atomic clocks work thanks to quantum physics.

All clocks should have a constant frequency.

In other words, the clock must perform some repetitive motion to separate equivalent time increments.

Just as Grandfather's clock relies on the constant swinging of a pendulum back and forth due to gravity, the atomic clock's ticking is maintained by transitions between the two energy levels of the atom.

This is where quantum physics comes into play.

Quantum mechanics tells us that atoms carry energy, but they cannot carry just arbitrary amounts.

Instead, nuclear energy is restricted to a precise set of levels.

These are called quanta.

As a simple analogy, consider driving a car on a highway.

Speed ​​increases are usually continuous, say from 20 mph to 70 mph.

Now, even if we had a quantum atomic car, it wouldn't accelerate in a straight line.

Instead, it instantly jumps or transitions from one speed to the next.

For atoms, when a transition occurs from one energy level to another, quantum mechanics dictates that the energy difference is equal to the characteristic frequency multiplied by a constant, and the change in energy is equal to the frequency multiplied by a number called Planck's constant.

That characteristic frequency is what you need to make a clock.

GPS satellites rely on cesium and rubidium atoms as frequency standards.

For Cesium-133, the characteristic clock frequency is 9,192,631,770 Hz.

That's 9 billion cycles per second.

It's a really fast watch.

All pendulums, spring mechanisms and crystal oscillators resonate at slightly different frequencies, no matter how skilled the watchmaker is.

But all cesium-133 atoms in the universe vibrate at exactly the same frequency.

Therefore, atomic clocks allow us to read time accurately to within a billionth of a second and measure our distance from satellites with great precision.

Let's ignore the fact that you are almost certainly on Earth.

Now you know that you are at a certain distance from the satellite.

In other words, you are somewhere on the surface of a sphere centered on the moon.

Measuring the distance from the second satellite yields another overlapping sphere.

If you keep doing that, you can pinpoint your position to a single point in space with just four measurements and a little correction using Einstein's theory of relativity.

All you need is a multi-billion dollar satellite network, vibrating cesium atoms, quantum mechanics, relativity, your smartphone, and you.

no problem.

"High bob."

"Good morning, Kelly. Your tulips are so beautiful."

Have you ever wondered how your dog experiences the world?

This is what she sees.

Not very interesting.

But what she smells like is a whole other story.

And it starts with her wonderfully developed nose.

Once your dog catches the first hint of fresh air, the moist, spongy exterior of your dog's nose helps capture every scent the breeze carries.

The ability to smell in each nostril separately and in stereo helps to identify the direction of the odor source. So within the first few seconds of sniffing, dogs start not only noticing what kinds of things are out there, but also where they are.

When air enters the nose, a small tissue fold divides the nose into two separate folds, one for breathing and one for smelling only.

This second airflow enters a region filled with highly specialized olfactory receptor cells. That number is in the hundreds of millions compared to 5 million in humans.

And unlike our clumsy breathing method of inhaling and exhaling in the same passageway, dogs exhale through slits on the side of their noses, creating air vortices and drawing in new odor molecules, building up odor concentrations with repeated snuffs.

But its impressive nose structure is of little use without a means to process the mass of information it scoops up.

They found that the olfactory system, which is specialized for processing odors, occupies many times more relative brain area in dogs than in humans.

All of this allows dogs to distinguish and remember an amazing variety of specific scents at concentrations up to 100 million times less than what the human nose can detect.

If a puff of perfume can be smelled in a small room, a dog will have no difficulty in smelling it in an enclosed arena and distinguishing its constituents.

And everything on the street, people and cars passing by, the contents of your neighborhood's trash, trees of every kind, and every bird or insect out there has a unique odor profile that tells your dog what it is, where it is, and in what direction it's moving.

A dog's sense of smell is much stronger than a human's, and they can also smell things that are completely invisible.

A completely separate olfactory system called the vomeronasal organ above the roof of the mouth detects hormones naturally released by all animals, including humans.

This allows dogs to identify potential mates and distinguish between friendly and hostile animals.

It alerts them to our various emotional states and can even let us know if someone is pregnant or sick.

It might even be argued that dog perception is more direct and instinctive than human perception, as smell is more primitive than other senses, bypassing the thalamus and being directly linked to brain structures involved in emotions and instincts.

But the most amazing thing about dog noses is their ability to transcend time.

The past is revealed by the footprints left by passers-by and the warmth of a recently parked car. It will tell you where you've been and what you've done recently.

Landmarks such as fire hydrants and trees are scent bulletin boards that convey messages about who passed by, what they ate, and how they are feeling.

And the future is in the wind, warning them that something or someone is approaching long before you see them.

Whereas we see or hear something in an instant, dogs smell the entire story from start to finish.

A perfect example of dog-human collaboration, dogs help us by sharing their stories and responding to them.

Stress and anger manifests as a hormonal cloud recognizable by a dog's nose Stress and anger manifests as a hormonal cloud recognizable by a dog's nose Stress and anger manifests as a hormonal cloud recognizable by a dog's nose Stress and anger manifests as a hormonal cloud recognizable by a dog's nose So they can respond kindly to people in distress or aggressively to threats. will.

With proper training, they can also warn us of invisible threats, from bombs to cancer.

After all, mankind's best friend is not the one who experiences the same things as we do, but the one whose amazing nose reveals a whole other world behind our eyes.

If you know left-handed seniors, they probably have to learn to write and eat with their right hand.

And in many parts of the world, forcing children to use the "correct" hands is still common practice.

In English as well as many other languages, the word right has the meaning of right or good.

But if being left-handed is so wrong, why is it in the first place?

Currently, about one-tenth of the world's population is left-handed.

Archaeological evidence indicates that this condition has existed for as long as 500,000 years, with about 10% of human remains showing associated differences in arm length and bone density, and evidence of left-handed use in some ancient tools and crafts.

And despite what many people think, the dominant hand is not a choice.

It can even be predicted prenatally based on the position of the fetus in the uterus.

So if handedness is congenital, is it genetic?

Well, yes, no.

Identical twins with the same genotype may have different handedness.

In fact, this happens as often as it does with any other sibling pair.

However, the likelihood of being right-handed or left-handed is determined by the handedness of the parents in a surprisingly consistent ratio.

If the father is left-handed and the mother is right-handed, there is a 17% chance of being born left-handed, but two right-handers have only a 10% chance of having a left-handed child.

Handedness seems to be determined by the roll of the dice, but the odds are set by genes.

All of this suggests that there's a reason evolution created this small number of left-handers and maintained them for thousands of years.

While there are several theories that attempt to explain why handedness exists in the first place, or why most people are right-handed, recent mathematical models suggest that the actual ratio reflects the balance between competitive and cooperative pressures in human evolution.

The benefits of being left-handed are most evident in activities involving opponents, such as martial arts and competitive sports.

For example, about 50% of top baseball batters are left-handed.

why?

Think of it as an unexpected benefit.

Since left-handers are by nature a minority, right-handers and left-handers will spend most of their time playing and practicing against right-handers.

Therefore, when the two face each other, the left-hander will be better prepared for this right-handed opponent, while the right-hander will be shaken off.

The combat hypothesis, in which population imbalance favors left-handed fighters and athletes, is an example of negative frequency-dependent selection.

But according to the principles of evolution, groups with relative dominance tend to grow until that dominance disappears.

If, in the course of human evolution, people only fought and competed, natural selection would lead to more left-handed people, so many left-handed people that they would no longer be a rare asset.

So in a purely competitive world, 50% of the population would be left-handed.

But human evolution has been shaped by cooperation as well as competition.

And cooperative pressure pushes the handedness distribution in the opposite direction.

In golf, where performance is opponent-independent, only 4% of the top players are left-handed, an example of the broader phenomenon of tool sharing.

Just as young would-be golfers can easily find right-handed clubs, many of the important pieces of equipment that have shaped society are designed for the right-handed majority.

Due to their poor use of these tools and their high accident rate, left-handers are less successful in a purely collaborative world and will eventually disappear from the population.

Thus, by accurately predicting the distribution of left-handers in the general population and collating data from a variety of sports, this model shows that the persistence of left-handers as a small but stable minority reflects a balance that comes from competitive and cooperative effects that unfold simultaneously over time.

And the most interesting thing is what the numbers tell us about different populations.

We may even discover that the answers to some of the mysteries of early human evolution are already in our hands, from the skewed distribution of footedness in cooperative animals to the slightly higher proportion of lefties in competitive hunter-gatherer societies.

The code is in the following universal languages:

In the 70s, it was punk music that moved an entire generation.

In the 80's it was probably money.

But for my generation, software is our imagination and our interface to the world.

That means we need a fundamentally more diverse group of people to build those products, who see computers as things that can be tweaked, flipped, and twisted, rather than mechanical, lonely, boring, and magical.

My personal journey into the world of programming and technology began when I was 14 years old.

When I was a teenager, I had a crush on an older man. That older man happened to be the then-Vice President of the United States, Al Gore.

And I did what every teenage girl wants to do.

I wanted to somehow express this love, so I created his website. Here it is.

And in 2001, there was no Tumblr, no Facebook, no Pinterest.

So to express all this longing and affection, I had to learn to code.

That was the beginning of programming for me.

It started as a means of self-expression.

I used crayons and Lego just like I did when I was little.

As an adult, I took advantage of guitar lessons and theater.

But there were other things that got me excited, like poetry, knitting socks, conjugating French irregular verbs, imagining a world of pretend and Bertrand Russell and his philosophy.

And I've come to find computers boring, technical, and lonely.

Here's what I think today.

Little girls don't know they don't like computers.

Little girls are amazing.

They're really good at keeping things focused and precise, and they ask great questions like "what is it?" why? "And how?" and "What if?"

And they don't know that they shouldn't like computers.

Parents do that.

It's us parents who feel that computer science is an esoteric and bizarre field of science that belongs only to mystery makers.

That it is as remote from everyday life as, for example, nuclear physics.

And they are partly right about that.

Programming is full of syntaxes, controls, data structures, algorithms, practices, protocols and paradigms.

And we, as a community, have made computers smaller and smaller.

We've built so many layers of abstraction between humans and machines that we have no idea how computers work or how we interact with them.

And we teach kids how the human body works, how internal combustion engines work, and even tell them that if they really want to be astronauts, they can be.

But when a child comes up to us and asks, "So what is the bubble sort algorithm?"

Or, "How does the computer know what happens when you press play? And how does it know what video to show?"

Or, "Linda, is the Internet a place?"

We adults are strangely silent.

Some say, "It's magic."

"Too complicated," others say.

Well, neither.

It's not magic and it's not complicated.

Everything happened really, really, really fast.

Computer scientists have built these amazing beautiful machines, but they are so unfamiliar to us, and the language we speak to computers also doesn't know how we speak to computers anymore without fancy user interfaces.

That's why no one noticed that when I was conjugating irregular French verbs, I was actually practicing my pattern recognition skills.

When I was excited about knitting, I actually followed a series of symbolic commands involving loops.

And Bertrand Russell's lifelong quest to find a precise language between English and mathematics found its home in computers.

I was a programmer and no one knew that.

Kids today tap, swipe and pinch to navigate the world.

But unless we give them the tools to build with computers, we're only nurturing consumers, not creators.

This whole quest led me to this little girl.

Her name is Ruby and she is 6 years old.

She is totally fearless, imaginative and a little bossy.

And whenever I was trying to learn programming on my own and ran into a question like "What is object-oriented design, what is garbage collection?", I tried to imagine how a 6-year-old girl would explain it.

And I wrote a book about her and illustrated it, and here's what Ruby taught me.

Ruby taught me not to be afraid of bugs under my bed.

And even the biggest problems are made up of smaller problems.

Ruby also introduced me to her friends who are a multifaceted part of internet culture.

She has friends like Snow Leopard who are beautiful but don't want to play with other children.

And she has green robot-like friends who are very friendly but very awkward.

And she has friends like Penguin Linux. Linux is really ruthlessly capable, but a bit hard to understand.

And the idealistic fox and so on.

In the world of Ruby, we learn technology through play.

And, for example, computers are good at repeating things, so here's how Ruby teaches loops:

This is Ruby's favorite dance move: "clapping, clapping, stomping, stomping, clapping and jumping."

Learn the counter loop by repeating it four times.

And learn the while loop by repeating that sequence while I'm standing on one leg.

And it even learns to loop by repeating that sequence until mom gets really mad.

(Laughter) And most of all, we learn that there are no ready-made answers.

When thinking about the Ruby world curriculum, I really needed to ask kids how they see the world and what questions they had, so I organized a playtest session.

Start by showing the children these four pictures.

I showed them pictures of cars, grocery stores, dogs, and toilets.

And I ask, "Which of these do you think is a computer?"

And kids are very conservative and say, 'None of these are computers.

I know what computers are. It's that glowing box that moms and dads spend so much time in front of. ”

However, after some discussion, it was discovered that the car was actually a computer with a built-in car navigation system.

And dogs, dogs may not be computers, but they may have collars and have computers built into their collars.

Grocery stores have computers of all kinds, such as cash register systems and burglar alarms.

And kids, do you know?

In Japan, toilets are computers, and there are hackers who hack them.

(Laughter) I go further and give them a little sticker with an on/off button.

And I say to my children: "Today you have the magical ability to turn anything in this room into a computer."

And again the children say, "This looks very difficult, I don't know the correct answer for this."

But I say, "Don't worry, parents don't know the right answer."

They are just starting to hear about something called the Internet of Things.

But you children will really live in a world where everything is computerized. ”

And then a little girl came up to me and brought me a bike lamp and said, "This bike lamp, if it was a computer, it would change colors."

And I said, "That's a very good idea. What else can we do?"

And she thought, thought, and said: “If this bike lamp was a computer, I could go on a bike trip with my dad and sleep in a tent. And this bike lamp could also be a projector.”

That's the moment I'm looking for, the moment a child understands that the world isn't quite ready yet, that a great way to prepare the world is to build technology, and that each of us can be a part of that change.

Lastly, we also built a computer.

And then we got to know about the bossy CPU and the handy RAM and ROM that help you remember things.

After assembling the computer, we also design the applications for it.

And my favorite story is this little boy. He is 6 years old and his favorite thing in the world is to be an astronaut.

And the boy is completely immersed in his little paper computer with giant headphones. Because he's building his own intergalactic planetary navigation application.

And his father, the only astronaut in Mars orbit, is on the other side of the room, and the boy's key mission is to bring him back to Earth safely.

And these kids will have a wildly different view of the world and how we build it with technology.

Finally, the friendlier, more inclusive and more diverse the world of technology becomes, the more colorful and better the world will be.

So imagine with me for a moment. Imagine a world where the stories we tell about how things are made include not only a 20-year-old boy in Silicon Valley, but also a Kenyan schoolgirl and a Norwegian librarian.

Imagine a world where tomorrow's little Ada Lovelace, living in a perpetual reality of 1's and 0's, grows up to be very optimistic and brave about technology.

They embrace the world's forces, opportunities and limitations.

A wonderful, quirky, and slightly strange world of technology.

When I was a little girl, I wanted to be a storyteller.

I love the world of pretend play, and waking up in Moominvalley in the morning was my favorite.

We spent the afternoon walking around Tatooine.

And at night they fall asleep in Narnia.

And programming turned out to be the perfect profession for me.

I am still creating the world.

Instead of stories, use code to create stories.

Programming gives me the amazing power to build whole little universes with their own rules, paradigms and practices.

Create something out of nothing with the power of pure logic.

thank you.

(applause)

Humans have long been fascinated by speed.

The history of human progress is accelerating, and one of the most important achievements in this historic race was breaking the sound barrier.

Shortly after the first successful flight, pilots became keen to fly their planes faster and faster.

In doing so, however, the turbulence increased and the large force on the plane prevented further acceleration.

Some have tried to circumvent the problem by taking dangerous dives, often with tragic results.

Finally, in 1947, design improvements such as the movable horizontal stabilizer and fully movable stabilizer allowed an American military pilot named Chuck Yeager to fly a Bell X-1 aircraft at 1127 km/h, making him the first person to break the sound barrier and fly above the speed of sound.

The Bell X-1 was the first of many supersonic aircraft, with subsequent designs reaching speeds in excess of Mach 3.

Aircraft flying at supersonic speeds produce thunderous shock waves called sonic booms that can cause pain to people and animals below and damage buildings.

For this reason, scientists around the world are watching sonic booms, trying to predict their path in the atmosphere, where they will land, and how big they will be.

To better understand how scientists study sonic booms, let's start with the basics of sound.

Imagine throwing a small stone into a still pond.

what do you see?

This stone propagates waves in water at the same speed in all directions.

These circles with ever-increasing radii are called wavefronts.

Similarly, although invisible to the eye, a stationary sound source, such as a home stereo, produces sound waves that travel outwards.

The speed of a wave depends on factors such as the altitude it passes through and temperature.

At sea level, sound travels at about 1225 km/h.

But instead of being circles on a two-dimensional surface, the wavefronts become concentric spheres, and sound travels along rays perpendicular to these waves.

Now imagine a moving sound source, such as a train whistle.

As the wave source continues to move in a particular direction, successive waves in front of it gather closer together.

This higher wave frequency is responsible for the well-known Doppler effect, where an object sounds higher as it gets closer.

But as long as the sound source is moving slower than the sound waves themselves, they will remain nested within each other.

When an object becomes supersonic and moves faster than the sound it makes, the image changes dramatically.

The waves are forced to combine, forming a Mach cone, overtaking the emitted sound waves and generating new ones from their current positions.

Since the object is moving faster than the sound it makes, the sound is not heard when it approaches the observer.

Observers can hear the sonic boom only after the object has passed.

Where the Mach cone meets the ground, it forms a hyperbola, leaving a trail known as the boom carpet as it moves forward.

This makes it possible to identify the area affected by the sonic boom.

How about calculating the strength of the sonic boom?

This involves solving the famous Navier-Stokes equations to find the change in pressure in the air caused by supersonic aircraft flying.

This creates a pressure signature known as the N-wave.

What does this shape mean?

Now, sonic booms occur when there is a sudden change in pressure, but N-waves involve two booms. One is the initial pressure rise at the nose of the aircraft and the other is when the tail passes and the pressure suddenly returns to normal.

This produces a double boom, which is normally heard by the human ear as a single boom.

In practice, computer models using these principles can often predict the position and strength of sonic booms in specific atmospheric conditions and flight trajectories, and research is underway to mitigate their effects.

In the meantime, supersonic flight over land remains prohibited.

So, are sonic booms a recent thing?

not exactly.

While we're trying to find ways to silence them, some other animals are also using Sonic Boom to their advantage.

The giant Diplodocus could have split its tail faster than sound, more than 1200 km/h, possibly to deter predators.

Some species of shrimp create similar shock waves in water that can startle prayers or even kill them from a distance simply by snapping their oversized claws.

In short, it turns out that while we humans have come a long way in our relentless pursuit of speed, it was nature that first existed.

The tissue of the neck contains small, modest organs that exert enormous forces throughout the body.

It's called the thyroid gland.

Similar to a company's operations manager, its role is to make sure the cells in the body are functioning properly.

It is done by using hormones to get the message out to everyone.

This higher organ is made up of lobules, each of which contains tiny cells called follicles that store hormones that the thyroid gland pumps into the blood.

Two of the most important hormones it produces are thyroxine and triiodothyronine, or T3 and T4.

The job of hormones as messengers is to tell every cell in the body when to get oxygen and nutrients.

It maintains the body's metabolism, the chain of reactions that cells perform to provide energy.

This hormonal notification from the thyroid makes the heart's pumping function more efficient, allowing cells to break down nutrients faster.

When you need more energy, your thyroid helps by secreting hormones that boost your metabolism.

Ultimately, the thyroid gland allows our cells to use energy, grow, and reproduce.

The thyroid gland is controlled by the pituitary gland, a hormone gland deep in the brain that oversees its role and knows exactly when to send messengers.

The role of the pituitary gland is to sense if the hormone levels in the blood are too low or too high, and in that case send instructions in the form of thyroid-stimulating hormone.

But even this tightly controlled system can sometimes go wrong.

Certain diseases, an overgrowth of the thyroid gland, and chemical imbalances in the body can confuse the organ and deafen the pituitary's guidance commands.

The first problem this causes is hyperthyroidism, which is caused by the organ pumping out too many hormones.

This means that cells are overloaded with instructions to consume nutrients and oxygen.

As a result, people with hyperthyroidism experience an increased metabolism with a rapid heart rate, constant hunger, and rapid weight loss.

They also feel hot and sweaty, feel anxious, and find it difficult to sleep.

The opposite problem is hypothyroidism. This happens when the thyroid gland sends too little hormone. That means the body's cells don't have many messengers to guide them.

In response, cells grow lethargically and their metabolism slows down.

People with hypothyroidism have symptoms such as weight gain, feeling tired, feeling cold, swollen joints, and feeling depressed.

Fortunately, there are medical treatments that can help reactivate thyroid activity and return the body to a stable metabolic rate.

Despite being such a small organ, the thyroid gland exerts a tremendous amount of power.

However, a healthy thyroid gland manages our cells so effectively that we can maintain our smooth functioning without even realizing it's there.

Melati Weissen: Bali -- Island of the Gods.

Isabelle Weissen: Green Paradise.

MW: Or...

paradise lost.

Bali: Garbage Island.

IW: Bali generates 680 cubic meters of plastic waste per day.

It's about the size of a 14-story building.

And when it comes to plastic bags, less than 5 percent are recycled.

MW: I know it will change the image you have of our island.

Our situation also changed when we learned that almost all plastic bags in Bali end up in drains, rivers and oceans.

And what does not reach the sea is either burned or littered.

IW: So we decided to do something about it.

And we've been working for nearly three years to say no to plastic bags on our home island.

And we've had some significant successes.

MW: We are sisters and we go to the best school on the planet, the Green School in Bali.

Green schools are not only different in how they are built with bamboo, they are also different in how they teach.

We are taught to be today's leaders, something that is not achievable with regular textbooks.

IW: One day in class we learned about Nelson Mandela, Princess Diana, Mahatma Gandhi and other important figures.

As we drove home that day, we agreed that we wanted to be important too.

Why should we wait until we grow up to be respectable?

We wanted to do something now.

MW: That night we sat on the couch brainstorming and thinking about all the problems facing Bali.

And the thing that stood out the most to us was the plastic trash.

But that's a big problem.

So we investigated what a realistic target for us children is: plastic bags.

And an idea was born.

IW: We started doing research, and the more we learned, the more we realized there was nothing good about plastic bags.

And what do you know?

You don't even need them.

MW: We've been really inspired by the efforts to say no to plastic bags in many other places, from Hawaii to Rwanda and several cities like Auckland and Dublin.

IW: So the idea turned into starting a "bye-bye plastic bag."

MW: We've been campaigning for many years and have learned a lot.

Lesson #1: You can't do everything alone.

You need a big team of like-minded kids. So we formed the "bye-bye plastic bag" team.

The volunteer team includes children from all over the island, from both international and local schools.

And we are working with them to launch a multi-layered approach based on online and offline signature petitions, educational and inspirational presentations in schools, and raising public awareness at markets, festivals and beach cleanups.

And last but not least, we distribute alternative bags made by local initiatives on the island, such as net bags, recycled newspaper bags or 100% organic bags.

IW: We run a pilot village with 800 households.

The mayor was our first friend and he really liked our T-shirt, so that was very helpful.

We need to make a change there, so we focused on making our customers aware of it.

The village is already two-thirds of the way to zero plastic bags.

Initial attempts to get the Bali government to cooperate failed.

So we thought, 'Well...a petition with a million signatures.

They can't ignore us, can they? ”

MW: Yes!

IW: But who would have thought that 1 million signatures would be 1000 times 1000?

(Laughter) We were stuck -- until we learned lesson two: think outside the box.

Someone said that Bali airport handles 16 million arrivals and departures per year.

MW: But how do you get into the airport?

And here comes lesson number three: persistence.

I left and headed to the airport.

We passed the janitor.

And it's his boss's boss, then the deputy secretary, then the secretary, and then...

We were shuffled down two levels and thought, oh, here comes another janitor.

And after days of knocking on doors and just being a kid on duty, we finally got to the commercial manager at Bali Airport.

And we gave him a 'Plastic Bag Bali' speech, and being so nice, he said [imitating a man's voice], 'I can't believe I'm going to tell you now, but I'm going to give you permission to collect signatures behind customs and immigration.'

(Laughter) (Applause) IW: We received almost 1,000 signatures in the first hour and a half on site.

How cool is that?

Lesson 4: We need advocates at every level of society, from students to business owners to celebrities.

And thanks to the charm of Green School, we were able to meet celebrities one after another.

Mr. Ban Ki-moon taught us that the UN Secretary-General will not sign petitions even if the children ask him to do so (laughs).

But he promised to spread the word and now we are working closely with the United Nations.

MW: Jane Goodall taught us the power of networks of people.

She started with just one Roots &amp; She filmed groups and now has 4,000 groups worldwide.

We are one of them.

She really is a source of inspiration.

Greetings to Rotarians.

We are Interactors, the youngest division of Rotary International.

IW: But we also learned a lot about patience, MW: How to deal with frustration, IW: Leadership, MW: Teamwork, IW: Friendship, MW: We learned more about Balinese people and their culture IW: And we also learned about the importance of commitment.

MW: It's not always easy.

Sometimes it can get a little difficult to get the story going.

IW: But last year we did just that.

We went to India to give a talk and my parents took me to visit Mahatma Gandhi's former private residence.

We learned about the power of hunger strikes that he used to reach his goals.

So, by the end of the tour, when I reunited with my parents, we both made up our minds and said, "I'm going on a hunger strike!"

(laughter) MW: And you can probably imagine their faces.

It took me a long time to persuade not only my parents but also my friends and teachers.

Isabelle and I were serious about doing this.

So we met with a nutritionist and came up with a compromise: not eating from sunrise to sunset every day until the governor of Bali agreed to meet with us to discuss how to eliminate plastic bags in Bali.

IW: "I want to eat" in Indonesian has started.

We used social media to reach our goal and already on the second day the police started coming to our house and school.

What were these two girls doing?

We knew we weren't making the best impression on the Governor by going on this food strike. I could have gone to jail.

But hey, it worked.

Twenty-four hours later, we were picked up at school and escorted to the governor's office.

MW: And he was there -- (applause) waiting for us to meet and talk, fully cooperating and appreciating our commitment to the beauty of Bali and the environment.

He signed a pledge to help Balinese say no to plastic bags.

And we are friends now, regularly reminding him and his team of the promises he made.

And indeed, he recently promised that Bali will be plastic bag-free by 2018.

(Applause.) IW: And at Bali International Airport, one of our supporters is planning to start a plastic bag ban by 2016.

MW: Stop giving away free plastic bags and bring in reusable bags is the next message to change the way people think.

IW: All of our short-term campaigns "One Island / One Voice" fit this bill.

We will check and recognize shops and restaurants that have declared plastic bag free zones, put this sticker at the entrance and put their name on social media and important magazines in Bali.

Conversely, those who do not have stickers are highlighted.

(laughter) MW: So why are we actually telling you this stuff?

Well, that's partly because we're proud of the results we've achieved together with the team.

But it's also because along the way, we've learned that kids can do something too.

we can make things happen.

Isabel and I were only 10 and 12 when we started doing this.

We had no business plan, no set strategy, no hidden agenda. It was just an idea in front of us and a group of friends working with us.

All we wanted to do was stop the plastic bags wrapping and suffocating our beautiful home.

Children have limitless energy and motivation to make the changes the world needs.

IW: Well then, good luck to all the children in this beautiful yet challenging world!

Make that difference.

I'm not saying it's easy.

I'm telling you it's worth it.

We children are only 25 percent of the world's population, but we are 100 percent of the future.

MW: There is still a lot of work to do, but know that it is not over until the first question you are asked when you arrive at the airport in Bali is 'Welcome to Bali, do you have any plastic bags to declare?'

(laughter) Om shanty shanty shanty om.

thank you.

(applause)

You're probably sitting down to watch this video right now, but it's probably fine to sit and watch it for a few minutes.

But the longer you sit still, the more your body gets excited.

It sits there counting down the moments until you get up again and take it for a walk.

It may sound silly.

Our bodies love to sit, right?

not much.

Indeed, sitting for short periods of time can help you recover from stress or recover from exercise.

But today, our lifestyles involve sitting more than moving around, and our bodies are not built for that kind of sedentary lifestyle.

In fact, the opposite is true.

The human body was built to move, and the evidence is in its structure.

There are over 360 joints and about 700 skeletal muscles in our bodies that enable easy, fluid movement.

The body's unique physical structure allows us to stand upright against gravity.

Our blood depends on us being able to circulate properly.

Our nerve cells benefit from movement, and our skin is elastic and changes with our movements.

So what happens when every inch of your body is ready and waiting to move, but it doesn't?

Let's start, literally, at the root of the problem.

The spine is a long structure made up of cartilage plates between bones.

Joints, muscles, and ligaments that attach to bones hold everything together.

A common sitting posture is one with a rounded back and dropped shoulders, which puts uneven pressure on the spine.

Over time, this can wear down your discs, overwork certain ligaments and joints, and strain the muscles that stretch to accommodate the curved position of your back.

This hunched shape also narrows the chest cavity when sitting, leaving less room for the lungs to expand when breathing.

This is a problem because it temporarily limits the amount of oxygen that fills the lungs and gets into the blood.

Around the skeleton are the muscles, nerves, arteries, and veins that make up the soft tissue layers of the body.

The act of sitting itself crushes, presses and compresses, and these more delicate tissues are really impacted.

Have you ever felt numbness or swelling in your limbs while sitting?

In the most compressed areas, nerves, arteries, and veins become blocked, restricting nerve signals and causing numbness, and reducing blood flow to the extremities and causing swelling.

Sitting for long periods of time also temporarily deactivates lipoprotein lipase, a special enzyme in the walls of capillaries that breaks down fat in the blood, so fat isn't burned when you're sitting as much as when you're moving around.

What effect does this stasis have on the brain?

Most of the time you think you sit to use your head, but ironically, sitting for long periods of time actually defeats this purpose.

When you are still, your blood flow is reduced, reducing the amount of oxygen that enters your bloodstream through your lungs.

The brain needs both of these to maintain attention, so less brain activity is more likely to lead to poor concentration.

Unfortunately, the negative effects of sitting are not only short-term.

Recent studies have found that prolonged sitting is associated with certain cancers and heart disease, and can lead to diabetes, kidney and liver problems.

In fact, researchers have found that physical inactivity is responsible for about 9% of premature deaths worldwide annually.

Their number exceeds 5 million.

These seemingly harmless habits actually have the power to change our health.

Fortunately, the solution to this growing threat is simple and intuitive.

If you have to sit down, change your slouching position to straighten your spine. Also, if you don't have to be seat-bound, try to move around more, such as by setting a reminder for yourself to get up every 30 minutes.

But understand that most of the time the body is made to move, not stand still.

In fact, the video is almost over, so why not get up and stretch now?

Take care of your body by taking a walk.

Thank you for that later.

Speaking of Archimedes' "Symphonic Psalm Eureka"! At this moment, you are probably thinking:

After all, it could have been more like this.

In the 3rd century BC, Hieron, king of the Sicilian city of Syracuse, chose Archimedes to oversee an engineering project of unprecedented scale.

Hieron built a sailing ship fifty times larger than a standard ancient warship and named it Syracuse after his city.

Hieron wanted to build the largest ship ever built, which was to be given as a gift to the Egyptian ruler Ptolemy.

But is it possible for a ship the size of a palace to float?

In Archimedes' time, no one had attempted anything like this.

It was like asking, "Can mountains fly?"

King Hieron took great advantage of the question.

Using pine and fir beams from Mount Etna, hemp ropes from Spain and pitch from France, hundreds of workers would spend years building Syracuse.

The top deck, with its eight watchtowers, was to be supported not by pillars, but by a huge wooden statue of Atlas carrying the world on his shoulders.

There is a huge catapult in the bow that can fire 180-pound stone missiles.

For the enjoyment of passengers, the ship was to have flower-lined promenades, covered pools, hot baths, a library full of books and statues, a temple to the goddess Aphrodite, and a gymnasium.

And to make the situation even more difficult for Archimedes, Hieron intended to load the ship with cargo: 400 tons of grain, 10,000 jars of pickled fish, 74 tons of drinking water, and 600 tons of wool.

Well over 1,000 people, including 600 soldiers, would have been on board.

And 20 horses were housed in separate stalls.

Having built something of this scale, how could it sink on its maiden voyage?

Well, let's just say that failure was not a preferred option for Archimedes.

So he tackled the question, "Will it sink?"

Perhaps the inspiration came to him one day when he was sitting in a public bath wondering how a heavy bathtub would float.

An object partially immersed in fluid will float with a force equal to the weight of the fluid displaced by the object.

In other words, if 2,000 tons of Syracuse displaced just 2,000 tons of water, it would barely float.

It can float 4,000 tons of water without any problem.

Of course, Hieron wouldn't be so happy if it only replaced 1,000 tons of water.

This is the law of buoyancy, which engineers still call Archimedes' principle.

This explains why steel supertankers float as easily as wooden rowboats and bathtubs.

If the weight of water displaced by the ship below the keel is equal to the weight of the ship, anything above the keel will remain floating above the waterline.

This sounds like another story about Archimedes and the bathtub, but it could actually be the same story twisted by the whims of history.

Archimedes' classic tale "Symphonic Psalm Eureka"! The stripes that then run through the streets are centered on crowns or coronas in Latin.

At the heart of the Syracusian story is the Greek word 'kir' or 'korone'.

Is it possible that one got confused with the other?

we may never know.

On the day the Syracusia arrived in Egypt on its first and only voyage, one can only imagine how the inhabitants of Alexandria flocked to the harbor to marvel at the arrival of this majestic floating castle.

This extraordinary ship was the Titanic of the ancient world, except it didn't sink thanks to our friend Archimedes.

how does this music make you feel?

do you think it's beautiful?

Are you creative?

Now, would you change your answer if you knew the composer was this robot?

Believe it or not, for over 170 years, people have been wrestling with the problem of artificial creativity alongside that of artificial intelligence.

In 1843, British mathematician Ada Lovelace, considered the world's first computer programmer, wrote that machines cannot have human-like intelligence as long as they only do what humans have intentionally programmed them to do.

For a machine to be considered intelligent, Lovelace said, it must be able to generate original ideas.

The Lovelace Test, formally enacted in 2001, offers a way to examine this idea.

A machine can pass this test if the designer can produce results that cannot be explained based on the original code.

The Lovelace test, by its design, is more of a thought experiment than an objective scientific test.

But that's where it starts.

At first glance, the idea of ​​a machine creating high-quality original music in this way might seem impossible.

Using random number generators, chaotic functions, and fuzzy logic, you can come up with very complex algorithms that generate sequences of notes in an untraceable way.

However, this would result in a myriad of original melodies never heard before, only a few of which are worth listening to.

Computers have no way of distinguishing between what we think is beautiful and what we don't.

But what if we took a step back and tried to model the natural process by which creativity is formed?

We know at least one such process that leads to original, valuable and even beautiful results. It's an evolutionary process.

And evolutionary algorithms, genetic algorithms that mimic biological evolution, are one of the promising approaches to producing original and valuable artistic achievements in machines.

So how does evolution make machines musically creative?

Well, instead of organisms, we can start with an initial population of musical phrases and a basic algorithm that mimics playback and random mutations by switching some parts, combining other parts, and replacing random notes.

Now that we have a new generation of phrases, we can apply selection using an operation called a fitness function.

Just as biological fitness is determined by external environmental pressures, our fitness function is determined by external melodies selected by human musicians, or music fans, to express the ultimate beautiful melody.

The algorithm compares our musical phrases with their beautiful melodies and selects only the most similar phrases.

Once the least similar sequences have been removed, the algorithm reapplies mutation and recombination to the remaining sequences, again selecting the most similar or matched sequences from new generations, and this can be repeated for many generations.

There is so much randomness and complexity built into the process that gets us there that the results could pass the Loveless test.

More importantly, thanks to the presence of human aesthetics in the process, it is possible to generate melodies that are theoretically considered beautiful.

But does this really satisfy our creative intuition?

Is it enough to make something original and beautiful, or does creativity require intention and awareness of what is being made?

Perhaps the creativity in this case actually comes from the programmer, even if they don't understand the process.

What is human creativity in the first place?

Is it more than an interconnected system of neurons developed by the processes of biological algorithms and the random experiences that shape our lives?

Order and chaos, machines and humans.

These are the dynamos at the heart of the machine's creative endeavors that now produce music, sculpture, painting, poetry, and more.

The jury may not yet have decided whether it is fair to call these acts of creation creative.

But if a piece of art can make you cry, shock you, or send shivers down your spine, does it really matter who or what made it?

This is a pull robot.

Pleurobot is a robot designed to closely mimic a salamander species called Pleurodeles waltl.

As you can see here, the Pleurobot can walk. It can also swim, as we'll see later.

So you may be wondering why we designed this robot.

And indeed, this robot is designed as a scientific tool for neuroscience.

In fact, we designed this program in collaboration with neurobiologists to understand how animals move, and specifically how the spinal cord controls movement.

But the more I do biorobotics research, the more I am really impressed with animal locomotion.

Think of a swimming dolphin or a cat running and jumping. And we humans do amazing things when we jog or play tennis.

And indeed, our nervous system is solving very complex control problems.

More or less 200 muscles need to be perfectly coordinated. This is because poor coordination can lead to falls and poor exercise performance.

And my goal is to understand how this works.

Animal locomotion has four main components.

The first component is simply the body, and indeed one should not underestimate how much biomechanics has already simplified animal locomotion.

Then there is the spinal cord, and the spinal cord has reflexes, and multiple reflexes that create sensorimotor coordination loops between neural and mechanical activity in the spinal cord.

The third component is the central pattern generator.

These are very interesting circuits in the spinal cord of vertebrates that can self-generate highly coordinated rhythmic activity patterns while receiving only very simple input signals.

And all these input signals, coming from descending modulations from higher parts of the brain such as the motor cortex, cerebellum, and basal ganglia, modulate spinal cord activity while we move.

But what's interesting is the extent to which the lower-level component of the spinal cord, along with the body, already solves a large part of the movement problem.

You probably know it from the fact that a chicken can cut off its head and still run for a while, which shows that the lower body, spinal cord and torso alone already solve most of the movement.

Now, understanding how this works is very complicated. This is because it is very difficult to record activity in the spinal cord in the first place.

Because the motor cortex is protected by the vertebrae, it is much easier to implant electrodes in the motor cortex than in the spinal cord.

Especially for humans, it is very difficult.

The second problem is that movement is actually due to a very complex and very dynamic interaction between these four components.

That's why it's so hard to find their respective roles over time.

This is where biorobots such as Pleurobot and mathematical models can really help.

So what is biorobotics?

Biorobotics is a very active research field in robotics, and people want to take inspiration from animals to create robots for the outdoors, such as service robots, search and rescue robots, and field robots.

And the big goal here is to take inspiration from animals to make robots that can handle complex terrain (stairs, mountains, forests, places where robots still have trouble, where animals can do a much better job).

Robots can also be great scientific tools.

There are some pretty cool projects where robots are used, including scientific tools in neuroscience, biomechanics, and fluid mechanics.

And this is exactly what Pleurobot is for.

So what we're doing in my lab is collaborating with neurobiologists like Jean-Marie Cabergan, a neurobiologist in Bordeaux, France, to create a spinal cord model and hopefully validate it on a robot.

I want to start simple here.

Therefore, it is better to start with simple animals such as the lamprey, a very primitive fish, and gradually move on to more complex locomotion such as salamanders, but also cats, humans and mammals.

And here the robot becomes an interesting tool for validating the model.

And indeed, for me, Pleurobot is kind of a dream come true.

Nearly 20 years ago, during my PhD, I had already created migration simulations for lampreys and salamanders on the computer.

But I always knew my simulations were just approximations.

For example, underwater, mud, and complex ground physics simulations are very difficult to simulate well on a computer.

Why not use real robots and real physics?

Of all these animals, one of my favorites is the salamander.

You may wonder why, because as amphibians, they are very important animals from an evolutionary point of view.

This provides a wonderful link between swimming, such as that found in eels and fish, and quadrupedal locomotion, such as that found in mammals, cats and humans.

And indeed, modern salamanders are so close to the first terrestrial vertebrates that they are almost living fossils, giving us access to our ancestors—the ancestors of all land tetrapods.

Therefore, salamanders swim in a so-called pyramidal swimming pattern, transmitting good progressive waves of muscle activity from head to tail.

When the salamander is placed on the ground, it switches to a so-called trot gait.

In this case, we see periodic activations of the extremities that are very well coordinated with the standing wave undulations of the body. This is exactly the gait we are seeing here at Pleurobot.

Now, one of the things that is actually quite surprising and interesting is the fact that all this can be produced by the spinal cord and the body alone.

So, if you take a decerebrated salamander and, not so good, remove the head, electrically stimulating the spinal cord induces a locomotion-like locomotion at low levels of stimulation.

A little more stimulation will accelerate walking.

And at some point there is a threshold and automatically the animal switches to swimming.

This is great.

It's as if you're pressing the gas pedal of a descending modulation on your spinal cord, simply changing your global drive will switch you completely between two completely different gaits.

And indeed, the same has been observed in cats.

By stimulating your cat's spinal cord, you can switch between walking, trotting, and galloping.

Birds can switch between walking at low levels and flapping at high levels.

This indicates that the spinal cord is a highly sophisticated motor control apparatus.

So we studied salamander locomotion in more detail and indeed were able to obtain very good X-ray video equipment from Prof. Martin Fischer at the University of Jena in Germany.

Thanks to that, we now have an amazing machine that records every bone movement in detail.

that's what we did.

So we basically decided which bones were important to us and captured their movements in 3D.

And what we did was collect a whole database of behaviors both on land and in water, and really collect a whole database of motor behaviors that real animals can do.

And our job as roboticists was to recreate that in robots.

So we went through a whole optimization process to find the right structure, where to place the motors, and how to connect the motors so that these movements are as reproducible as possible.

Thus Pleurobot was born.

Now let's see how close it is to a real animal.

So what you see here is an almost direct comparison between the gait of a real animal and the gait of a Pleurobot.

It can be seen that the walking gait is accurately reproduced almost 1:1.

If you go slowly backwards, you can see it even better.

But even better is being able to swim.

So we put a dry suit on the whole robot -- (Laughter) and then we go into the water and start recreating the swimming gait.

And this is difficult, so we were very happy here.

The physics of interaction are complex.

Since our robots are much larger than small animals, we had to do so-called dynamic scaling of frequencies to ensure that we get the same interaction physics.

But looking at the end, we were very close and I was very happy with this.

Now let's go to the spinal cord.

Here, Jean-Marie Cabergan and we have modeled the spinal cord circuit.

And what's interesting is that salamanders retain a very primitive circuit. This is very similar to the circuitry we see in the lamprey, a primitive eel-like fish, and it seems that during evolution, new neural oscillators were added to control the limbs and perform leg locomotion.

We know where these neural oscillators are, but what we did was create a mathematical model of how they should be combined to allow the transition between two very different gaits.

Then we mounted it on a robot and tested it.

It looks like this.

So what you see here is a previous version of the Pleurobot, completely controlled by a programmed spinal cord model on board the robot.

And the only thing we do is send the two descending signals that we would normally receive from the upper part of the brain to the robot via the remote control.

And what's interesting is that by manipulating these signals, we have complete control over speed, direction, and type of gait.

For example, a low level of stimulation results in a walking gait, but a high level of stimulation at some point very rapidly switches to a swimming gait.

And finally, you can also rotate very well by simply stimulating one side of your spinal cord more than the other.

And I think it's really beautiful how nature distributes control to give more responsibility to the spinal cord so that the upper part of the brain doesn't have to worry about every single muscle.

You just have to care about this high level of modulation, it's actually the spinal cord's job to coordinate all the muscles.

Let's take a look at locomotion in cats and the importance of biomechanics.

This is another project that studied cat biomechanics, and I wanted to see how well their morphology helps them move.

And I found that there are basically three important criteria for limb characteristics.

The first is that the cat's limbs look more or less like a pantograph-like structure.

A pantograph is therefore a mechanical structure that always keeps the upper and lower segments parallel.

So it's a simple geometric system that slightly adjusts the movement inside the segments.

A second property of cat paws is that they are very light.

This is a good idea because most of the muscles are in the trunk and the limbs have low inertia and can move very quickly.

A final important property is the highly elastic behavior of the cat's limbs to cope with shocks and forces.

This is how we designed Cheetah Cub.

Now let's invite Cheetah Cub onto the stage.

This is Peter Eckhart, who is doing a PhD on this robot. As you can see, this is a cute little robot.

It looks a bit like a toy, but was actually used as a scientific tool to investigate the properties of cat paws.

As you know, it's very docile, very light, and very resilient, so you can easily push it and it won't break.

It actually just jumps.

And this very elastic property is also very important.

We can also see a little of these characteristics of the three leg segments as pantographs.

What is interesting here is that this highly dynamic gait is obtained purely in open loop. That means no sensors or complex feedback loops.

This is interesting. Because only the mechanism already stabilizes this very fast gait, which means that a really good mechanism already fundamentally simplifies locomotion.

As you can see in the following video, you can also impede movement a little. For example, you can prevent the robot from tipping by giving the robot a step-down exercise. This was a surprise for us.

This is a small mess.

With no sensors or fast feedback loops, I expected the robot to tip over quickly.

But no, the robot doesn't topple over, just because the mechanism stabilizes its gait.

Obviously if you have bigger steps or obstacles you need a full control loop and reflexes and everything else.

But the point here is that for even small perturbations the mechanism is correct.

And I think this is a very important message from biomechanics and robotics to neuroscience. Don't underestimate how much your body already contributes to locomotion.

So how does this relate to human migration?

Clearly, human locomotion is more complex than that of cats and salamanders, but at the same time the human nervous system is very similar to that of other vertebrates.

And especially the spinal cord is also an important controller of human locomotion.

That is why any lesion in the spinal cord can have dramatic consequences.

A person can become paraplegic or quadriplegic.

This is because the brain loses communication with the spinal cord.

In particular, this downward adjustment to initiate and coordinate movement is lost.

A major goal of neuroprostheses is therefore to be able to reactivate that communication using electrical or chemical stimulation.

And there are some teams in the world, especially at EPFL, that are doing just that.

My colleagues Grégoire Courtine and Silvestro Micela collaborate with me.

But to do this properly, it is very important to understand how the spinal cord works, how it interacts with the body, and how the brain communicates with the spinal cord.

Here it is hoped that the robots and models I have presented today will play a key role towards these very important goals.

thank you.

(Applause) Bruno Giussani: Oak, I've seen other robots in your lab that swim through pollution and measure pollution as they swim.

But about this, in your story, you said it's kind of like a search and rescue sort of side project, but with a camera in the nose.

Auke Ispiart: That's right. So robots -- there are several spin-off projects that want to use robots for search and rescue inspections. Therefore, this robot will meet you.

And the big dream is, when faced with a difficult situation, like a collapsed building or a flooded building, which is also very dangerous for rescue teams and rescue dogs, why not send out crawling, swimming and walking robots with cameras to conduct inspections, identify survivors, and possibly establish communication links with survivors?

BG: Assuming, of course, that survivors aren't frightened by this shape.

AI: Well, it may need to change its appearance quite a bit. Because here a survivor might die of a heart attack just to worry that this will feed on you.

However, by changing the appearance and making it more robust, I think it will surely be a good tool.

BG: Thank you. Thank you to all of you and the team.

There is a curse that has plagued mankind since time immemorial.

The Greeks countered this by chewing aromatic resins, while the Chinese resorted to egg shells.

It is even considered a legal ground for divorce in the ancient Jewish Talmud.

This terrible plague is halitosis, otherwise known as halitosis.

But what causes it, and why is it so globally terrifying?

Well, think of some of the worst smells imaginable: garbage, feces, rotten meat.

All of these odors come from the activity of microbes, especially bacteria, and as nasty as they may sound, these same bacteria live in the moist environment of your mouth.

Do not panic.

The presence of bacteria in the body is not only normal, it is actually essential for all sorts of things, including digestion and disease prevention.

But like all living things, bacteria also need to eat.

Bacteria in the mouth feed on mucus, food debris, and dead tissue cells.

To absorb nutrients through cell membranes, organic matter must be broken down into smaller molecules.

For example, proteins are broken down into their constituent amino acids, which are further broken down into various compounds.

Some of the foul-smelling byproducts of these reactions, such as hydrogen sulfide and cadaverine, escape into the air and drift toward unsuspecting noses.

Our sensitivity to these odors and interpreting them as foul odors may be an evolutionary mechanism that alerts us to the presence of spoiled food or disease.

Smell is one of our most intimate and primal senses, and it plays a big role in attracting a potential mate.

In one poll, 59% of men and 70% of women said they wouldn't date someone with bad breath, which may be why Americans alone spend $1 billion a year on various bad breath products.

Luckily, most bad breath can be easily treated.

The most foul-smelling byproducts come from Gram-negative bacteria that live between the gums and teeth and on the underside of the tongue.

Brushing and flossing your teeth, using an antibacterial mouthwash at bedtime, gently cleaning the back of your tongue with a plastic scraper, and even eating a healthy breakfast can all eliminate these bacteria and many of their food sources.

In some cases, these measures may not be enough due to dental problems, nasal ailments, or rare ailments such as liver disease or uncontrolled diabetes.

Activities such as smoking and excessive drinking also give off a very recognizable odor.

Regardless of the cause, foul odors most often originate in the mouth rather than the stomach or other parts of the body.

But one of the biggest challenges lies in actually determining what our breath smells like in the first place, and we don't know why.

We may be too accustomed to the smell in our mouths to judge.

Also, hand to mouth, wrist licking and sniffing methods don't work perfectly.

One study found that even when people did this, they tended to subjectively rate the smell according to how bad it was.

But there's one simple, socially difficult way to know what your breath smells like. Take a deep breath and ask a friend.

As the story progresses, legendary archer William Tell is brutally challenged by a corrupt lord.

William's son was to be executed if William could not shoot the apple off his head.

William succeeded, but let's consider two variations of this story.

In the first variation, the lord hires bandits to steal William's trusty crossbow, so he is forced to borrow an inferior crossbow from a peasant.

However, the borrowed crossbow wasn't perfectly adjusted, and William found his practice shot crammed right under the target.

Luckily he has time to fix it before it's too late.

Variation 2: William began to doubt his skills long before the challenge and his hands began to shake.

His practice shots are still clustered around apples, but the pattern is random.

Occasionally it hits an apple, but it's wobbly, so there's no guarantee it will hit.

He must calm his nervous hands and regain confidence in his goal of saving his son.

Central to these variations are two terms that are often used interchangeably: accuracy and precision.

The distinction between the two is of practical importance to many scientific endeavors.

Accuracy is about how close you get to the correct result.

Correctly calibrated and well-trained tools improve accuracy.

Accuracy, on the other hand, is how consistently you can get results using the same method.

Using finer incremented tools requires less estimation and improves accuracy.

The story of the stolen crossbow was a story of accuracy without accuracy.

William got the same wrong result each time he fired.

The change in trembling hands was one of accuracy without accuracy.

William's bolts were clustered around the right result, but there was no certainty that any shot would hit the mark.

For routine tasks, less accuracy may be acceptable.

However, engineers and researchers often require microscopic precision with a high degree of certainty that it will always be correct.

Factories and laboratories improve accuracy with better equipment and more detailed procedures.

These improvements can be costly, so managers must determine the acceptable uncertainty for each project.

But an investment in precision could go beyond what was possible and even reach Mars.

You might be surprised that NASA doesn't know exactly where the probe will land on other planets.

Predicting landing sites requires extensive calculations based on measurements that do not always give an exact answer.

How does the density of Mars' atmosphere change with altitude?

At what angle will the probe hit the atmosphere?

What is the speed of the rover during entry?

Computer simulators run thousands of different landing scenarios, mixing and matching the values ​​of all variables.

The computer considers all possibilities and spits out potential collision areas in the form of impact ellipses.

In 1976, the Mars Viking lander landing ellipse was 62 x 174 miles, roughly the size of New Jersey.

These limitations have forced NASA to ignore many interesting but dangerous landing areas.

Since then, new information about the Martian atmosphere, improved spacecraft technology, and more powerful computer simulations have greatly reduced the uncertainty.

In 2012, the Curiosity lander's landing ellipse was only 4 miles wide and 12 miles long, more than 200 times smaller in area than the Viking.

This allowed NASA to target specific locations in Gale Crater that were of high scientific interest and previously unlandable.

Ultimately we strive for precision, and precision reflects our confidence that we will achieve it.

With these two principles in mind, we can aim for the star and aim for the star with confidence every time.

It's so obvious that it's practically a proverb.

Boiled eggs cannot be opened.

Well, apparently you can.

Mechanical energy can undo the effect that thermal energy had on egg molecules.

Eggs are mostly water and protein.

Proteins are initially folded into complex shapes and held together by weak chemical bonds.

Applying heat breaks those bonds, allowing the protein to unfold, unwind, unwind, and wiggle freely.

This process is called denaturation.

The newly liberated proteins bump into neighboring proteins and begin to form more and more new bonds as the heat increases, eventually becoming highly entangled and gelling into a hard mass, the boiled egg.

This entanglement may seem permanent, but it is not.

According to a chemical idea called the principle of microscopic reversibility, anything that's happening, such as egg protein sticking, could theoretically stop happening if you reversed the original procedure.

But more heat will tangle the protein even more, and cooling will only freeze it, so here's the trick. Rotate proteins at amazing speed.

no kidding.

Here's how it works:

First, scientists dissolve boiled egg whites in water with a chemical called urea. Urea is a small molecule that acts as a lubricant, coating long chains of proteins, making them easier to slide on each other.

Next, the solution is spun in a glass tube at a tremendous speed of 5000 rpm to spread the solution into a thin film.

Now comes the important part.

Solutions closest to the walls spin faster than those closer to the center.

This difference in velocity creates a net stress that causes the protein to repeatedly stretch and contract, eventually returning to its original shape and staying there.

By the time the centrifuge stops spinning, the egg whites have returned to their original non-boiled state.

This technique can be used for any kind of protein.

Large, messy proteins are less likely to pull apart, so scientists attach a plastic bead to one end to add extra stress and encourage the protein to fold first.

This thawing method does not work with whole eggs in shells, as the solution must spread out over the entire cylindrical chamber.

But in any case, the application does more than just cook breakfast.

Many pharmaceuticals are made up of proteins and are very expensive to manufacture. One reason for this is that proteins, much like cooked egg whites, get stuck in tangled aggregates that need to be untangled and folded before they can do their job.

This spinning technology has the potential to be an easier, cheaper and faster way to refold proteins than other methods, thus making new drugs more accessible to more people sooner.

One more thing to keep in mind before you defrost all your food.

Boiling eggs is actually an unusual cooking process. It changes the shape of the protein and how it binds together, but it does not actually change the chemical nature of the protein.

Most types of cooking resemble the famous Maillard reaction, a chemical change that turns sugar and protein into a delicious caramel crunch that is very difficult to undo.

So you may be able to defrost a boiled egg, but unfortunately you can't fry it yet.

Nothing is bigger or older than the universe.

The questions I want to talk about are: First, where do we come from?

How was the universe born?

Do extraterrestrial life exist?

What is the future of mankind?

Until the 1920s, everyone thought the universe was static in nature and did not change over time.

Then it was discovered that the universe is expanding.

Distant galaxies are moving away from us.

Extrapolating the other way around, we find that we should all have overlapped about 15 billion years ago.

But what happened before the big bang?

If not, what created the universe?

Why did the universe come into being like this from the big bang?

We used to think that the theory of the universe could be divided into two parts.

First, there were laws like Maxwell's equations and general relativity that determined the evolution of the universe, considering the state of the universe over all space at once.

And secondly, there was no question of the initial state of the universe.

We have made good progress in the first part and now have knowledge of all but the most extreme conditions of the laws of evolution.

However, until recently we knew very little about the initial conditions of the universe.

However, the laws of evolution and this division into initial conditions depend on separate distinctions between time and space.

Under extreme conditions, general relativity and quantum theory allow time to behave like another dimension of space.

This removes the distinction between time and space, meaning that the laws of evolution can also determine the initial state.

The universe can spontaneously create itself out of nothing.

In addition, we can calculate the probabilities that the universe was created in various states.

These predictions are in good agreement with WMAP satellite observations of the cosmic microwave background, a signature of the very early universe.

I think we have unraveled the mystery of creation.

Perhaps we should patent the universe and charge everyone a royalty for its existence.

Now on to the second big question. Are we alone or is there other life in the universe?

Since we believe that life arose spontaneously on Earth, it must be possible for life to emerge on other suitable planets, which are thought to be numerous within the galaxy.

There are two pieces of observational evidence for the probability of life emerging.

The first is that there are algae fossils that are 3.5 billion years old.

The Earth formed 4.6 billion years ago and was probably too hot for about the first 500 million years.

Therefore, life appeared on Earth within 500 million years, which is short compared to the 10 billion years lifespan of terrestrial planets.

This suggests that the odds of life appearing are fairly high.

If it were very low, it would be expected to take most of the 10 billion years available.

On the other hand, we don't seem to be visited by aliens.

I take UFO reports lightly.

If there is a government conspiracy to suppress the press and keep alien-bred scientific knowledge to themselves, it seems to have been a highly ineffective policy so far.

Moreover, despite extensive research by the SETI project, we have not heard of any alien television quiz shows.

This probably indicates that there are no alien civilizations within a radius of several hundred light years of our stage of development.

Issuing insurance against alien abduction seems like a pretty safe bet.

Here I come to the last big question: the future of humanity.

If we are the only intelligent life in the galaxy, we must ensure that we survive and continue.

But we are entering an increasingly dangerous period in history.

Our population and use of the planet's finite resources are increasing exponentially along with our technological ability to change the environment for better or worse.

However, our genetic code still contains the selfish and aggressive instincts that once favored our survival.

It will be hard enough to avoid disasters in the next 100 years, let alone the next 1,000, 1,000,000 years.

Our only chance for long-term survival is to spread out into space rather than staying inward on Earth.

The answers to these big questions show that we've made tremendous progress in the last 100 years.

But if we want to continue beyond the next hundred years, our future lies in space.

That's why I'm in favor of manned spaceflight.

All my life I have tried to understand the universe and find answers to these questions.

I was very lucky that my disability did not become a serious disability.

Indeed, it has probably allowed me to spend more time in the quest for knowledge than most people.

The ultimate goal is a complete theory of the universe, and we are making good progress.

Chris Anderson: Professor, if I had to guess either way, do you now believe that we are likely to be isolated in the Milky Way galaxy as a civilization with a level of intelligence equal to or greater than ours?

It took me 7 minutes to answer this, but it gave me insight into the amazing acts of generosity that this entire talk has done for TED.

Dr. Stephen Hawking: I think it's very likely that humans are the only civilization within a few hundred light years. Otherwise you would have heard the radio waves.

Another option is that the civilization will not last very long and will perish on its own.

I think the rest of this week's conference will take this as a useful warning.

Professor, thank you very much for your hard work today.

thank you very much.

When I first learned to meditate, my instruction was simply to pay attention to my breathing and undo it if my mind wandered.

Sounded simple enough.

Yet I sat in my quiet retreat, sweating through my T-shirt in the dead of winter.

It was a really hard job, so I took a nap every now and then.

In fact, I was exhausted.

The explanation was very simple, but it missed something really important.

So why is paying attention so difficult?

Studies show that even when we're seriously trying to pay attention to something, at some point about half of us get lost in a daydream or an urge to check our Twitter feed.

So what is going on here?

It turns out that we are at war with the most evolutionarily conserved learning process known to science today, one that is preserved back to the most basic nervous system known to man.

This reward-based learning process is called positive and negative reinforcement and basically looks like this:

When we see delicious-looking food, our brain says, “Calories! … Survival!”

We eat food, we taste it, and it is delicious.

Especially with sugar, our bodies send signals to our brains to "remember what you're eating and where you found it."

We put this contextual memory down and learn to repeat the process the next time.

See food, eat food, feel good and repeat.

Motivation, action, reward.

Simple, right?

Well, after a while our creative brains say:

This can be used for more than just remembering where food is.

Well, the next time you feel sick, why not eat something good to make yourself feel better? ”

We thank our brains for giving us great ideas. Try this and you'll quickly find that eating chocolate or ice cream makes you feel better when you're angry or sad.

Same process, just different triggers.

Instead of this hunger signal emanating from the stomach, this emotional signal, the feeling of sadness, triggers the urge to eat.

Maybe when we were teenagers, we saw kids who were nerdy at school and rebellious outside smoking cigarettes and thought, "Oh, I want to be cool."

So we start smoking.

The Marlborough Man was no fool, and it was no coincidence.

Look cool, smoke to cool down and feel better. repeat.

Motivation, action, reward.

And every time we do this, we learn to repeat the process and it becomes a habit.

Therefore, when you feel stressed later, you will want to smoke or eat sweets.

Now, these same brain processes have moved us from learning to survive to literally killing ourselves with these habits.

Obesity and smoking are among the leading causes of preventable morbidity and mortality in the world.

Now, let's get back to talking about breath.

What if instead of fighting your brain or trying to pay attention to yourself, you tapped into this natural, reward-based learning process...

But with a twist?

What if, instead, we were really interested in what was going on in our momentary experience?

Let's take an example.

In my lab, I studied whether mindfulness training helps people quit smoking.

Now, they may try to force themselves to quit smoking, just like they force themselves to pay attention to their breathing.

And the majority of them have tried this before, failing on average six times.

This time, mindfulness training has stopped coercion and instead focused on curiosity.

In fact we even told them to smoke.

what? Well, we said, ``Go on, smoke it.

And what did they notice?

Well, here's an example from one of our smokers.

she said: "If you smoke consciously, it smells like stinky cheese and tastes like chemicals, nasty!"

Well, she cognitively knew that smoking was bad for her, so she joined our program.

The only thing she found strange while smoking was that smoking stinks.

(Laughter.) Now she has moved from knowledge to wisdom.

She went from mentally recognizing that smoking was bad for her to understanding it to the bone, breaking the curse of smoking.

She became disillusioned with her actions.

Now, on an intellectual level, the prefrontal cortex is the youngest part of our brain from an evolutionary point of view and understands that it shouldn't smoke.

And it goes all out to help us change our behavior, stop smoking, stop eating the second, third, fourth cookie.

This is called cognitive control.

We use cognition to control our behavior.

Unfortunately, this is also the first part of your brain that goes offline when you're stressed, so it doesn't help much.

Well, we can all relate to this in our own experiences.

When we're stressed or tired, we're more likely to yell at our spouses and children, even though we know it won't help.

we can't do anything.

When the prefrontal cortex goes offline, we fall back into old habits. That is why this disillusionment is so important.

Seeing what you get out of your habits can help you understand them on a deeper level. By knowing it to the marrow of the bone, there is no need to forcibly suppress or suppress actions.

We are not really interested in doing that in the first place.

And this is what mindfulness is all about. It's really a clear understanding of what we get when we get caught up in our actions, get disillusioned on an instinctive level, and naturally let go of this disillusioned attitude.

This is not to say that you can magically stop smoking.

But over time, as we see more clearly the consequences of our actions, we let go of old habits and form new ones.

The contradiction here is that mindfulness is only really interested in getting really close and personally knowing what is actually going on in our bodies and minds moment to moment.

This willingness to look to one's experience instead of trying to get rid of unpleasant desires as soon as possible.

And this willingness to open up to our experience is fueled by curiosity, which is naturally rewarding.

What does curiosity look like?

It feels good.

And what happens when we get curious?

We begin to realize that cravings simply consist of bodily sensations. Oh, the feeling of tightness, tension, restlessness, etc. comes and goes.

These are bite-sized experiences that allow you to deal with the moment, rather than being crushed by suffocating, monstrous, terrifying desires.

In other words, when we are curious, we step out of our old fear-based reactive habit patterns and into our own existence.

We become our inner scientist eagerly awaiting the next data point.

Now, this may sound too simple to affect behavior.

However, one study found that mindfulness training was twice as effective as gold standard therapy in helping people quit smoking.

So it actually works.

And when we study the brains of experienced meditators, we find that part of a self-referencing neural network called the default mode network is at work.

One current hypothesis is that an area of ​​this network called the posterior cingulate cortex is not necessarily activated by craving itself, but when we get caught up in it, sucked into it, and take us on a ride.

In contrast, when we let go, that is, when we step away from the process simply by being curiously aware of what is happening, this same brain region quiets down.

We are currently testing an app and an online-based mindfulness training program. The program targets these core mechanisms and, ironically, uses the same technology that causes our distractions to break out of unhealthy habit patterns like smoking, stress eating, and other addictive behaviors.

Now, remember the story about contextual memory?

We put these tools at people's fingertips in the situations that matter most.

So we can help them tap into their natural ability to wonder when urges like smoking or stress-induced appetites arise.

So, if you're not smoking or stressed, the next time you feel the urge to check your email when you're bored, trying to distract yourself from work, or compulsively replying to that text message while driving, see if you can tap into this natural ability. Be curious and aware of what is happening in your body and mind in that moment.

It's just another chance to perpetuate one of our infinite, exhaustive habit loops...

Or get out of there.

Instead of looking at the text message, compulsively reply the text and feel a little better - notice the urge, be curious, feel the joy of letting go, and repeat it.

thank you.

(applause)

How much would you pay for a bouquet of tulips?

a few bucks? Hundred dollars?

What about $1 million?

Probably not.

Now, how much would you pay for partial ownership of this house, or a website that sells pet supplies?

At various points in time, tulips, real estate, and pets.com stock have all sold well in excess of their value.

In each case, the price rose and then suddenly fell.

Economists call this a bubble.

So what exactly is going on in the bubble?

Well, let's start with tulips to get a better idea.

In the 17th century, the Netherlands experienced the Dutch Golden Age.

By the 1630s, Amsterdam had become an important port and commercial center.

Dutch ships imported large amounts of spices from Asia to profit in Europe.

Amsterdam was thus teeming with wealthy and skilled merchants and traders who flaunted their prosperity by living in mansions surrounded by flower gardens.

And there was one flower that was particularly in demand. It's a tulip.

Tulips were brought to Europe on trade ships from the East.

For this reason, tulips were considered a difficult exotic flower to grow, as it takes many years for a single tulip to bloom.

Due to an outbreak of the tulip-destroying virus in the 1630s, the selected flowers became even more beautiful with multicolored fiery stripes on the petals.

Since such tulips were rarer than regular tulips, the price of these flowers started to rise, and with it the popularity of tulips.

It didn't take long for tulips to become a nationwide boom and tulip mania to be born.

Mania occurs when rising prices are combined with the willingness to pay more for something of much lower intrinsic value.

A recent example is the dotcom mania of the 1990s.

The new, exciting website stock was like the tulips of the 17th century.

everyone wanted it.

The more people want the tulips, the higher the price can go.

At one point, a single tulip bulb sold for more than ten times the annual salary of a skilled craftsman.

In the stock market, stock prices are determined based on investor supply and demand.

If a company's future earnings are expected to increase, stock prices tend to rise.

Investors may then buy more shares, and increased demand could drive the price up even further.

The result can be a feedback loop in which investors get caught up in the hype and eventually prices rise well above intrinsic value, creating a bubble.

All it takes for the mania to end and the bubble to burst is a collective realization that stock prices, or tulips, are worth far more than they are worth.

That's what happened to both maniacs.

Suddenly the request ended.

Prices have been pushed to mind-blowing lows and taken a leap!

The bubble burst and the market crashed.

Today, scholars have been working hard for a long time to predict what causes bubbles and how to avoid them.

Tulip Mania effectively illustrates the underlying principles at work in bubbles and helps us understand recent examples like the real estate bubble of the late 2000s.

The economy will continue to go through phases of boom and bust.

So while you wait for the next craze to kick in and the next bubble to burst, treat yourself to a bouquet of tulips and enjoy the fact that you didn't have to pay a limb for tulips.

what is that sound?

Depending on who you ask, the crackling and crackling sound of your joints is either a pleasant soothing sound or the noxious sound of a habit of flipping your stomach.

It's true though. what is that sound?

I mean, why does bending a joint in a certain direction make that popping sound?

Scientists offer several explanations, including rapid stretching of ligaments and, in severe cases, actual bones rubbing against each other.

But the most common explanation for why stretched joints make popping noises is "because there's a bubble there."

Finger joints are most prone to cracking, but many people also crack joints in the neck, between the vertebrae in the back, as well as in the hips, wrists, and shoulders.

All of these joints are synovial joints, the most flexible joints in the body.

The space between the two bones is filled with synovial fluid, a viscous fluid containing long lubricating molecules such as hyaluronic acid and lubricin.

Synovial fluid is more or less yolk-like in texture and its main purpose is to cushion the bones, making them easier to slide over each other.

It also contains phagocytic cells that help remove bone and cartilage debris that has accumulated in joints.

But the reason it's important for cracked joints is that body fluids, like other fluids in the body, contain many dissolved gas molecules.

Knucklecrackers know that the joint needs to be extended farther than normal, such as by bending the fingers back, to produce a satisfying sound.

The bones then move away from each other.

The space between the bones increases, but the amount of synovial fluid remains constant.

This creates a low-pressure zone that draws dissolved gases out of the synovial fluid, much like carbon dioxide bubbles out of a soda when you twist the cap open.

Inside the joint, the leaking gas crackles and forms bubbles.

But bubbles don't last long.

The surrounding liquid squeezes it and eventually collapses.

The gas in the bubbles diffuses throughout the synovial cavity and slowly dissolves back into liquid over a period of about 20 minutes. Therefore, it may take some time before you can play the same joint again.

Some scientists believe there may actually be two pops.

One when the bubble forms and the other when the bubble collapses.

Cracking your knuckles temporarily enlarges them, which may be why people who specialize in crackers for knuckles, necks and backs find their joints looser and more flexible from the practice.

But you may have heard from concerned relatives or frustrated co-workers that cracking your joints can cause arthritis.

A doctor named Donald Unger also heard this.

So determined to disprove his mother's warnings, he repeatedly cracked his left joint over the course of 50 years, but his right joint stopped.

After 36,500 cracks, both hands are arthritic free.

For this selfless act of dedication to science, Dr. Anger was awarded the Ig Nobel Prize. This is a parody of the Nobel Prize, which recognizes quirky yet strangely fascinating scientific achievements.

Anger wrote that the results should prompt research into other parental beliefs, such as the importance of eating spinach.

The jury has not yet decided on it.

As for cracking your knuckles, one study suggests that stretching the joints and bursting air bubbles can cause your hands to swell and weaken your grip.

But the biggest proven danger seems to be annoying those around you.

As far as we know, medieval England wasn't invaded by ice zombies or threatened by dragons, but it was rocked by a power struggle between two generational aristocrats, involving a host of characters with complex motives and shifting loyalties.

If that sounds familiar, it's because the historical conflict known as the Wars of the Roses is the basis for much of the Game of Thrones drama.

The real seeds of war were sown with the death of Edward III in 1377.

Edward's eldest son had died before his father, but his 10-year-old son Richard II succeeded to the throne before Edward's three surviving sons.

This generation-wide skip left claims to the throne to various descendants of Edward, notably the Lancasters, Edward's three-son grandchildren, and the Yorkists, four-son grandchildren.

The war that followed took its name from two family-related symbols: the white rose of York and the red rose of Lancaster.

The Lancastrians first came to the throne in 1399 when Richard II was deposed by his cousin Henry IV.

Despite sporadic unrest, their reign remained secure until 1422, when Henry V died in a military campaign, leaving the young Henry VI on the throne.

Weak-willed and controlled by his advisers, Henry was eventually persuaded to marry Margaret of Anjou in order to win the favor of France.

Margaret was beautiful, ambitious, and ruthless, persecuting all threats to her power, but most of all she distrusted Richard of York.

York was a close aide to the King and a loyal general, but was increasingly sidelined by the Queen, who pushed for favorite supporters such as the Earl of Suffolk and the Earl of Somerset.

York was banished from court and extradited to Ireland for criticizing the inappropriate handling of the war against France.

Meanwhile, growing military failures and the corrupt rule of Margaret and her allies caused widespread discontent, and in the midst of this turmoil Richard of York returned with an army to arrest Somerset and reform the courts.

Initially unsuccessful, he soon gets his chance after Henry's mental breakdown, when he is appointed guardian of the kingdom.

Less than a year later, however, Henry suddenly recovered, and the Queen persuaded him to withdraw the reforms of York.

York fled and raised his army again.

Although he was unable to usurp the throne directly, he managed to restore himself as protector and succeeded in appointing Henry and his heirs as his successors.

However, after York's death in battle with the Queen's supporters, York's head was given a pike instead of a crown.

His young son assumed the title and was crowned Edward IV.

Edward achieved great military success against the Lancastrians.

Henry was captured and Margaret fled with her son, Edward of Westminster, who was reportedly cruel.

But the newly crowned king made the tragic political mistake of canceling an arranged marriage to a French princess and secretly marrying the widow of an underage aristocrat.

This alienated his most powerful ally, the Earl of Warwick.

Warwick allied himself with the Lancastrians, antagonized Edward's jealous brother George, and briefly succeeded in restoring Henry as king, but it did not last long.

Edward regained the throne, the Prince of Lancaster was killed in action, and Henry himself died in captivity shortly thereafter.

The rest of Edward IV's reign was peaceful, but bloodshed resumed when Edward IV died in 1483.

Edward's 12-year-old son was to succeed him, but Edward's brother Richard III declared them illegitimate because of their father's secret marriage.

He made himself regent and imprisoned the boys.

No one knows what became of them in the end, but after a while the princes disappeared and Richard's power seemed safe.

But his downfall would come from across the narrow waters of the English Channel just two years later.

Henry Tudor was a direct descendant of the 1st Duke of Lancaster and was raised in exile after his father died in an earlier rebellion.

As Richard III's seizure of power caused a split in the Yorkists, Henry gained support for the royal cause.

Raising an army in France, he crossed the Channel in 1485 and soon defeated Richard's army.

And by marrying Elizabeth of York, the sister of the disappeared princes, the newly crowned Henry VII joined the two roses and finally brought an end to nearly a century of warfare.

We often think of historical wars as decisive clashes with clearly defined winners and losers.

But the Wars of the Roses, like the fiction they inspired, show us that victory is uncertain, alliances are shaky, and even the power of kings is as fleeting as the seasons.

If someone asked you who is the richest person in history, who would you name?

Perhaps a billionaire banker like Bill Gates or John D. Rockefeller or a large corporation.

What about the African King Moussa Keita I?

Mansa Musa, or King of Kings, who ruled the Mali Empire in the 14th century AD, amassed a fortune that made him perhaps one of the richest men of all time.

But his vast wealth was only a fraction of his rich legacy.

When Mansa Musa came to power in 1312, much of Europe was plagued with famine and civil war.

However, many African kingdoms and the Islamic world were prosperous, and Mansa Musa played a major role in bringing the fruits of this prosperity to his realm.

By strategically annexing the city of Timbuktu and re-establishing power over the city of Gao, he gained control of important trade routes between the Mediterranean and the coast of West Africa, continuing a period of expansion that dramatically increased the size of Mali.

The territory of the Mali Empire was rich in natural resources such as gold and salt.

The world first witnessed its wealth in 1324, when Mansa Musa made a pilgrimage to Mecca.

He is not a budget traveler and brought a caravan as far as the eye could see.

The exact details are difficult to determine, as the account of this journey is based primarily on oral testimony and various written records.

But what most agree on is the gorgeous scale of this trip.

The chroniclers describe tens of thousands of soldiers, civilians, slave entourage, 500 messengers with golden staffs and fine silk, and many camels and horses carrying large amounts of gold bars.

It is said that Mansa Musa stopped in cities such as Cairo and spent large amounts of money, donating to the poor, buying souvenirs, and building mosques along the way.

In fact, his spending may have destabilized the local economy and caused massive inflation.

The journey reportedly took more than a year, and when Mansa Musa returned, tales of his astonishing wealth had spread through the Mediterranean ports.

Mari and her king were elevated to near-legendary status with their inclusion in the Catalan Atlas of 1375.

One of the most important world maps of medieval Europe, it depicts a king with a scepter and a shining gold nugget.

Mansa Musa literally put his empire and himself on the map.

However, the king's interests were not limited to material wealth.

As a devout Muslim, he was particularly interested in Timbuktu, which had already been a religious and academic center before its annexation.

Upon returning from his pilgrimage, he built the great Dzingeber Mosque there with the help of Andalusian architects.

He also founded a major university, further enhancing the city's reputation and attracting scholars and students from all over the Islamic world.

Under Mansa Musa, the empire became urbanized, with schools and mosques in hundreds of densely populated towns.

The king's rich legacy has endured for generations, and to this day remains the mausoleums, libraries and mosques that bear witness to the Golden Age of Mali's history.

A common misconception is that if you like to meticulously organize your belongings, keep your hands clean, and plan your weekends in detail, you may have OCD.

In fact, OCD, short for obsessive-compulsive disorder, is a serious mental illness that is frequently misunderstood by society and mental health professionals.

So let's start by debunking some myths.

Myth 1: Repetitive or ritualistic behavior is synonymous with OCD.

As the name suggests, obsessive-compulsive disorder has two sides. There are intrusive thoughts, images, or urges known as obsessions, and there are behavioral compulsions that people do to alleviate the anxiety they cause.

The types of behaviors commonly associated with OCD, such as excessive hand washing and checking things over and over, can be examples of obsessive or compulsive tendencies that many of us exhibit from time to time.

However, actual disorders are much rarer and can be very debilitating.

Affected people have little or no control over their obsessions and compulsive behaviors, which tend to interfere with work, school, and social life to the point of being time consuming and causing significant distress.

This set of diagnostic criteria distinguishes people who suffer from OCD from people who are a little more meticulous and hygiene-conscious than usual.

Myth 2: Excessive hand washing is a major symptom of OCD.

While handwashing is the most common image of OCD in popular culture, obsessions and compulsions come in many forms.

Obsessions can manifest as fear of contamination or disease, worry about harming others, and preoccupation with numbers, patterns, morals, or sexual identities.

And compulsions range from over-cleaning and double-checking to picky placement of objects and walking in pre-determined patterns.

Myth 3: People with OCD do not understand that they are behaving irrationally.

Many people with OCD actually understand the relationship between their obsessions and compulsions.

The inability to avoid these thoughts and behaviors, even though they recognize them as irrational, is one of the reasons OCD is so distressing.

OCD sufferers report that they experience anxiety based on irrational thoughts and that they find it difficult to control their reactions and go mad.

So what exactly causes OCD?

The frustrating answer is that we really don't know.

However, there are some important clues.

OCD is considered a neurobiological disease.

In other words, research suggests that the brains of OCD patients are actually hardwired to behave in a certain way.

Research suggests that three areas of the brain are differentially involved in social behavior, complex cognitive planning, voluntary movement, and emotional and motivational responses.

Another piece of the puzzle is that OCD is associated with low levels of serotonin. Serotonin is a neurotransmitter that communicates between brain structures and helps regulate important processes such as mood, aggression, impulse control, sleep, appetite, body temperature, and pain.

But are serotonin and the activity of these brain regions the cause of OCD, or are they symptoms of an unknown underlying cause of the disorder?

We probably won't know until we understand more about the brain.

The good news is that OCD has effective treatments. These include drug therapy to increase serotonin in the brain by limiting its reabsorption by brain cells, behavioral therapy to gradually reduce the person's sense of anxiety, and sometimes electroconvulsive therapy and surgery if OCD does not respond to other treatments.

It can be painful to know that your brain is lying to you when it cannot resist its commands.

But knowledge and understanding give us the power to seek help, and future brain research may finally give us the answers we're looking for.

In a match between France and Brazil in 1997, a young Brazilian player named Roberto Carlos scored a 35m free kick.

With no direct path to the goal, Carlos decided to try the seemingly impossible.

His kick sent the ball to the side of the player, but it was hooked to the left just before it left the frame and was sucked into the goal.

According to Newton's first law of motion, an object will move in the same direction and speed until a force is applied.

When Carlos kicked the ball, he gave it direction and speed, but what force changed the ball's direction and scored one of the greatest goals in sports history?

The trick was in the spin.

Carlos kicked the ball into the bottom right corner, sending it high and to the right, but also rotating it around its axis.

The ball started flying on an apparently straight route and was slowed down by the air flowing on both sides.

On one side, the air moved in the opposite direction of the ball's rotation, increasing the pressure, and on the other side, the air moved in the same direction as the spin, creating a region of low pressure.

That difference caused the ball to curve towards a lower pressure zone.

This phenomenon is called the Magnus effect.

Also known as banana kicks, this type of kick is attempted regularly and is one of the elements that make a beautiful match beautiful.

However, it is difficult to bend the ball with the precision required to bend around the wall and return to the goal.

Too high and you'll miss the goal.

Too low and you'll hit the ground before you can turn.

Too wide to reach the goal.

Not wide enough and defenders intercept it.

Too late and it hooks too early or doesn't hook at all.

Too fast and the hook is too slow.

The same physics makes it possible to score another seemingly impossible goal: an unassisted corner kick.

The Magnus effect was first recorded in 1670 by Sir Isaac Newton during a tennis match.

Same goes for golf balls, frisbees, and baseballs.

The same thing happens in every case.

The spin of the ball creates a pressure differential in the surrounding airflow, causing the ball to bend in the direction of its spin.

I have a question here.

In theory, can you kick the ball so hard that it boomerangs back to you?

Unfortunately, it doesn't.

Even if the ball does not collapse on impact or hit an obstacle, as the air slows it down, its deflection angle increases and it circles in smaller and smaller circles before finally coming to rest.

And to achieve that spiral, you'd have to spin the ball more than 15 times faster than Carlos' immortal kick.

Good luck then.

Imagine an island where 100 perfect logicians are imprisoned by a mad dictator.

There is no escaping, except for one strange rule.

Any prisoner can approach the guards at night and ask them to leave.

If you have green eyes, you are free.

Otherwise you will be thrown into the volcano.

Coincidentally, all 100 prisoners have green eyes, but they have lived there since birth, and the dictator ensures they cannot learn their eye color.

There are no reflective surfaces, all water is in opaque containers, and most importantly water is not allowed to communicate with itself.

However, we meet each morning during the head count.

Nevertheless, they all know that no one would risk retirement without absolute certainty of success.

After much pressure from human rights groups, the dictator reluctantly agreed to allow you to visit the island and speak to the prisoners on the following terms: The condition is that you can only speak once and do not give any new information.

What can be said to free a prisoner without incurring the wrath of a dictator?

After pondering, you say to the crowd: "At least one of you has green eyes."

The dictator is skeptical, but reassures himself that nothing you said would have changed anything.

You leave the island, but life on the island appears to continue as before.

But on the morning of the 100th day after your visit, all the prisoners were gone, and each asked to leave the night before.

So how did you outsmart the dictator?

It is good to understand that the number of prisoners is arbitrary.

Let's simplify by imagining just two people, Adria and Bill.

Each sees only one person with green eyes, but as far as they know, that could be the only person.

For the first night, each remains intact.

But in the morning we see each other still there and we get new information.

Adria realizes that if Bill had seen a non-green-eyed person next to him, he would have left the first night concluding that this remark was only mentioned about himself.

Bill realizes the same about Adria at the same time.

The fact that the opponent was waiting tells each prisoner that his eyes must be green.

And on the morning of the second day, both of them were gone.

Now imagine a third prisoner.

Adria, Bill, and Karl each see two green-eyed people, but they don't know if the other people are also seeing two green-eyed people or just one.

They wait outside the first night as before, but the next morning they are still unsure.

Karl muses, "If my eyes weren't green, Adria and Bill would have just stared at each other, and by the second night they'd both be gone."

But on the third morning, when I met them, I realized they must have been watching me too.

Adria and Bill each go through the same process, and they all leave on the third night.

Using this kind of inductive reasoning, we find that the pattern repeats regardless of the number of prisoners.

The key is the concept of "common knowledge," coined by philosopher David Lewis.

The new information was not contained in your statement itself, but in communicating it to everyone at the same time.

Now, not only does each prisoner know that at least one person has green eyes, but he also knows that everyone else is tracking all people with visible green eyes, and that each prisoner knows that too, and so on.

What certain prisoners don't know is if they are one of the green-eyed people that other prisoners are chasing, until as many nights as there are prisoners on the island.

Sure, I could have kept the prisoners on the island for 98 days if I told them that at least 99 had green eyes, but when a deranged dictator is involved, it's better to get a head start.

Semicolons may seem to suffer from an identity crisis.

It looks like a comma and a period are crossed.

Perhaps that's why we toss these punctuation marks like grammatical confetti.

We are confused as to how to use them properly.

In fact, the semicolon half-half status is useful.

More powerful than a comma, but less final than a period.

It's something that fills the space in between, and as such has some specific and important tasks.

One is that it can clarify ideas in sentences that are already enclosed in commas.

"Semicolon: It may seem scary at first, but then it becomes enlightening and eventually you'll become addicted to this fun punctuation mark."

Commas separate different parts of a sentence, but it's easy to lose track of what belongs where.

But then the semicolon comes to the rescue.

In list-like statements, commas are more powerful than commas, dividing statements into compartments and grouping items that belong to the same group.

A semicolon separates the contents, but it also builds a connection.

Another of its tasks is to combine separate clauses.

These statements stand alone, but when connected with semicolons they look and sound better because they are somehow related.

"The semicolon used to be a big mystery to me.

I didn't know where to put it. ”

Nothing is technically wrong.

These two statements can be used alone.

But imagine they are in a long list of other sentences, all of the same length, each separated by a period.

Things quickly get monotonous.

In such cases, the semicolon brings fluidity and variety to the sentence by connecting related clauses.

But semicolons, as useful as they are, don't belong everywhere.

There are two main rules governing its use.

First, unless used within a list, a semicolon should only connect clauses that are somehow related.

For example, "The semicolon used to be a big mystery to me. I really want a sandwich." I wouldn't use it here.

A period works best here because the two are very different ideas.

The job of the semicolon is to recombine two independent clauses that are mutually beneficial because they refer to the same thing.

Second, it is rare to find a semicolon positively placed before coordinating conjunctions, i.e. the words "and", "but", "because", "neither", "or", "so", "yet".

In fact, it's the position of the comma.

However, semicolons can be used in place of conjunctions to shorten sentences or add variation.

After all, this underrated punctuation mark can give your writing clarity, strength, and style, all contained within one tiny dot and squiggle just waiting to be put in the right place.

Our ability to generate and sustain economic growth is the defining challenge of our time.

Of course, there are other challenges, such as health care, the burden of disease and pandemics, environmental concerns, and of course, radicalized terrorism.

But as to whether we can actually solve the growth challenges, we will have a long way to go to solve the challenges I have just identified.

More importantly, unless and until we solve economic growth and create sustainable long-term economic growth, we will not be able to meet the seemingly intractable challenges that continue to permeate the world today, such as health care, education and economic development.

The fundamental question is how to generate economic growth as developed countries like the US and all of Europe continue to struggle to generate economic growth after the financial crisis.

Countries continue to perform poorly, pointing to a decline in the three main drivers of economic growth: capital, labor and productivity.

In particular, these advanced economies have continued debt and deficits, continued declines and erosion of both the quality and quantity of their labor force, and stagnant productivity.

Similarly, how do you generate economic growth in an emerging market where 90 percent of the world's population lives and an average of 70 percent of the population is under the age of 25?

In these countries, growth of at least 7 percent a year is essential to curb poverty and double per capita income in a single generation.

But even today, the largest emerging economies – those with more than 50 million people – continue to struggle to reach that 7 percent magic mark.

To make matters worse, countries such as India, Russia, South Africa, Brazil and even China are below that 7 percent, and in many cases have actually stepped back.

Economic growth is important.

With economic growth, countries and societies enter a virtuous cycle of upward aspirations, opportunities and rising living standards.

Without growth, nations shrink and shrink, not only in terms of economic statistics, but also in the meaning and way of life.

Economic growth is very important to individuals.

As growth falters, societies become darker, coarser, and smaller, with greater risks to human progress and political and social instability.

Context is important.

Also, emerging market countries do not have to grow at the same pace as developed countries.

Now, I'm sure some of you in this room feel that this is a dangerous proposition.

There are people here who are so disillusioned with what has happened in the world that they basically blame it on economic growth.

You worry about overpopulation of the planet.

And with recent United Nations statistics and projections that the world population will hit 11 billion by 2100, we worry about how it will affect natural resources such as arable land, drinking water, energy and minerals.

Environmental degradation is also a concern.

And you worry about how greedy and corrupt the humans embodied in corporate globalism have become.

But I am here today to tell you that economic growth is at the heart of changing living standards for millions of people around the world.

And more importantly, it's not just economic growth that has been driven by capitalism.

The definition of capitalism, quite simply, is that the factors of production such as trade, industry, capital and labor are in the hands of the private sector rather than the state.

What is very important here is that basically the criticism is not about economic growth per se, but about what happened to capitalism.

And as long as we need to generate economic growth over the long term, we need to pursue it with a better form of economic stance.

Economic growth requires capitalism, but capitalism needs to work properly.

And, as I said earlier, the core of the capitalist system has been defined by private actors.

But even this is a very simple dichotomy.

Capitalism: good. Non-Capitalism: Bad.

In practical experience, capitalism is much broader.

And some countries, such as China, practice more state capitalism, while others, like the United States, practice more market capitalism.

But our efforts to criticize the capitalist system have tended to focus on countries like China that are not really overtly market capitalist.

But there are real reasons and real concerns that we should now focus on the purer forms of capitalism, especially the capitalism that the United States embodies.

This is very important as this type of capitalism is increasingly criticized for fostering corruption and, worse, widening income inequality, the idea that the few are profiting at the expense of the many.

The two really important questions we have to grapple with are how we can fix capitalism so that it promotes economic growth while at the same time addressing social problems.

To think about that framework, we need to ask ourselves how capitalism works today.

Very simplistically, capitalism is set up on the basis of individual utility maximizers, selfish individuals who pursue what they want.

And only after maximizing its utility will it decide that it is important to provide support to other social contracts.

Of course, in this system the government taxes and uses part of its revenues to fund social programs, recognizing that the government's role is not only as a regulator but also as an adjudicator of social goods.

But nevertheless, this framework, this two-step framework, is the foundation from which we can begin to think about how the capitalist model can be improved.

I would argue that there are two sides to this challenge.

First of all, we can look to right-wing policies to see what is useful in thinking about ways to improve capitalism.

In particular, right-leaning policies tend to focus on things like conditional transfers that pay and reward people for doing things they actually believe will help boost economic growth.

For example, parents can earn money by sending their children to school, and parents can receive money by sending their children to be vaccinated or vaccinated.

Now, putting aside the debate about whether people should be paid to do what they think they should do anyway, the fact of the matter is that in places like Mexico, Brazil, and pilot programs in New York, performance-based pay actually has some positive results.

But there are benefits to left-leaning policies, and significant changes are underway.

In the wake of China's success, there has been a general argument that government roles and responsibilities should be broadened to be less narrowly defined, and that governments should arbitrage more factors of production.

But we are also starting to debate how the role of the private sector should move beyond being just a profit motive and actually be more involved in the delivery of social programs.

Things like corporate social responsibility programs, albeit on a smaller scale, are moving in the right direction.

Of course, left-leaning policies also tend to blur the lines between government, NGOs and the private sector.

There are two very good examples of this. 19th century USA. At that time, infrastructure deployment was based on public-private partnerships.

More recently, of course, the advent of the Internet has proven to the world that public and private sectors can work together to improve society.

My basic message to you is: We cannot continue to be dogmatic and unnecessarily ideological, trying to solve the challenges of global economic growth.

We will need to take a broader view of what works to generate sustainable long-term economic growth and solve the challenges and social problems that continue to plague the world today.

Ultimately, we must recognize that ideology is the enemy of growth.

thank you.

(Applause) Bruno Giussani: Dambisa, I would like to ask you a few questions, some may respond to your last sentence by saying that growth is also an ideology, and perhaps that is the dominant ideology of our time.

What do you say to those who react like that?

DM: Well, I think that's perfectly valid, and I think there's already been a discussion about it.

Much research has been done on happiness and other indicators used to measure people's success and improvement in their living standards.

So I think we should be open to anything that can continue to improve people's living standards and reduce poverty around the world.

BG: So you're basically calling for a return to growth, and the only way to do that without compromising the capacity of the planet and taking us on a long journey is to somehow decouple economic growth from the underlying resource use.

Can you see it happening?

DM: Well, I'm more optimistic about human capability and ingenuity.

I think that if we start limiting ourselves with scarce and depleting resources as we know them today, we can become very negative and very concerned about the way the world works.

But we have seen the Club of Rome, we have seen previous claims that the world will run out of resources, and we do not argue that they are not justified.

But I think that with some ingenuity, we can desalinate, reinvest our energy, and actually get better results.

In that sense, I'm much more optimistic about what humans can do.

BG: What struck me about your proposal to restore growth and move in a different direction is that you are proposing to fix capitalism with more capitalism. Putting a price tag on good behavior as an incentive or developing a greater role for business in social affairs.

is that what you are suggesting?

DM: I would say you need to be open minded.

There is no doubt that the traditional economic growth model is not working as we would like it to.

And I don't think it's a coincidence that today, the United States, the world's largest economy, has democracy, liberal democracy as its core political position, and free market capitalism as its economic position - as long as it's free.

The second largest economy is China.

Democracy was deprioritized and an entirely different model was introduced: state capitalism.

Although the two countries have very different political and economic models, they share the same income inequality as measured by the Gini coefficient.

I think these are the discussions we should have, as it is not at all clear what model we should adopt. I think we need to debate more and be more humble about what we know and what we don't.

BG: One last question. COP21 is being held in Paris.

If you could send a tweet to every head of state and head of delegation, what would you say?

DM: Again, I really want to be open-minded.

As you know, environmental issues have been on the agenda many times in Copenhagen and Stockholm in 1972, and we are revisiting these issues partly because there is no basic agreement, and because there is indeed a disconnect between what the developed countries believe and want and what the emerging markets want.

Emerging market economies must continue to grow without political uncertainty.

Developed countries recognize that they have a real and important responsibility not only to manage their own CO2 emissions and some of the degradation they contribute to the world, but also as trendsetters in research and development.

Therefore, they also have to get to the table.

Essentially, however, the developed countries themselves cannot be in a position to start attributing policies to emerging markets without giving due consideration to both supply and demand efforts in developed markets.

BG: Dambitha, thanks for coming to TED. DM: Thank you.

(applause)

We hear a lot about calories.

How many calories are in this cookie?

How many people get burned from 100 jumping jacks, long distance runs, and fidgeting?

But what exactly are calories and how many do you really need?

Calories are a way of tracking the body's energy balance.

Putting in about the same amount of energy as you lose will keep a healthy balance.

If you constantly put more energy into your body than it burns, the excess will gradually be stored as fat in your cells, resulting in weight gain.

If you expend more energy than you replenish, you will lose weight.

Therefore, we need to be able to measure the energy we consume and use, and we measure it using a unit called a calorie.

A calorie measured in food, also called macrocalorie, is defined as the amount of energy required to raise the temperature of 1 kilogram of water by 1 degree Celsius.

Everything we consume has a calorie, which describes how much energy the item stores in chemical bonds.

An average slice of pizza has 272 calories, one slice of bread has about 78 calories, and one apple has about 52 calories.

That energy is released during digestion and stored in other molecules that can be broken down to provide energy when the body needs it.

It is used in three ways. About 10% enables digestion, about 20% promotes physical activity, and the largest portion, about 70%, supports the basic functions of organs and tissues.

This third usage corresponds to your basal metabolic rate, or the number of calories you would need to survive if you didn't eat or move around.

Add in physical activity and digestion and you arrive at the official guidelines for how many calories the average person needs each day. 2000 calories for women and 2500 for men.

These estimates are based on factors such as average weight, physical activity, and muscle mass.

Does that mean everyone should be getting around 2000 calories?

necessarily.

If you're doing an energy-intensive activity like cycling the Tour de France, your body can burn up to 9,000 calories per day.

Pregnancy requires slightly more calories than normal, but older people typically have lower metabolic rates and burn energy more slowly, so they need fewer calories.

Before you start counting calories, there's one more thing you should know.

Calorie claims on nutrition labels measure the amount of energy contained in the food, not the amount of energy actually available from the food.

Fibrous foods such as celery and whole wheat require more energy to digest, so 100 calories of celery will actually give you less energy than 100 calories of potato chips.

It goes without saying that some foods contain nutrients such as protein and vitamins, while others have much lower nutritional value.

Eating too many of these foods can lead to overweight and malnutrition.

Also, even if you eat the exact same food, the calorie intake may not be the same for each person.

Variations in enzyme levels, gut bacteria, and even gut length mean that each person's ability to extract energy from food is slightly different.

Calories are therefore a useful indicator of energy, but to accurately calculate the calorie needs of each of us, we need to consider things like exercise, the type of food we eat, and the body's ability to process energy.

Good luck finding all of this on the nutrition label.

When we talk about English, we often think of it as a single language, but what do dialects spoken in dozens of countries around the world have in common with each other and with Chaucer's writings?

And what do any of them have to do with Beowulf's strange words?

The answer is that, like most languages, English has evolved through generations of speakers and has undergone major changes over time.

Reversing these changes allows us to trace the language from modern times to its ancient roots.

Modern English shares many similar words with Latin-derived romance languages ​​such as French and Spanish, but most of those words were not originally part of English.

Instead, the language began to enter with the Norman invasion of England in 1066.

When the French-speaking Normans conquered England and became its ruling class, they brought with them their speech and added a great deal of French and Latin vocabulary to the English spoken there until then.

Today we call that language Old English.

This is Beowulf's language.

It may not be a very familiar word, but if you know some German, you might be able to recognize it more.

Old English belongs to the Germanic language family and was first brought to the British Isles by the Angles, Saxons and Jutes in the 5th and 6th centuries.

The Germanic dialect they spoke became known as Anglo-Saxon.

Viking invasions from the 8th to the 11th century added more borrowings from Old Norse.

It can be difficult to find roots in modern English that underlie all words borrowed from French, Latin, Old Norse, and other languages.

However, comparative linguistics can help by focusing on grammatical structures, patterns of sound change, and specific core vocabulary.

For example, from the 6th century onwards, German words beginning with 'p' systematically transitioned to the 'pf' sound, while the corresponding Old English 'p' remained unchanged.

In another split, words with the "sk" sound in Swedish evolved into the "sh" sound in English.

There are still some English words with ``sk'', such as ``skirt'' and ``skull'', but they are direct borrowings from Old Norse that appeared after the transition from ``sk'' to ``sh''.

These examples show that just as various Romance languages ​​are descended from Latin, English, Swedish, German, and many others, they are descended from a common ancestor known as Proto-Germanic, spoken around 500 B.C.E.

This historical language was never written down and can only be reconstructed by comparing its descendants. This is possible thanks to change consistency.

The same process can be used to go a step further and trace the origins of Proto-Germanic to a language called Proto-Indo-European that was spoken in the Pontic steppes of what is now Ukraine and Russia about 6000 years ago.

It is the reconstructed ancestor of the Indo-European language family, which includes nearly all languages ​​historically spoken in Europe and much of South and West Asia.

With a little more work, you can find the same systematic similarities, or correspondences, between related words in the various branches of the Indo-European language family.

Comparing English and Latin, we can see that English has a ``t'' at the beginning of a word, Latin has a ``d'', and Latin has a ``f'' with a ``p''.

English's more distant relatives include Hindi, Persian, and the Celtic languages ​​that replaced it in modern-day Britain.

The Proto-Indo-European language itself comes from an even older language, which unfortunately goes as far back as historical and archaeological evidence allows.

Many mysteries still remain out of reach, such as whether there is a connection between the Indo-European languages ​​and other major language families, and the nature of the languages ​​spoken in Europe before the arrival of the Indo-European languages.

But the astonishing fact is that nearly 3 billion people around the world speak the same language, shaped by 6,000 years of history, even though many of them cannot understand each other.

Have you ever had someone say, "Stand up!"?

Or have you been scolded for slouching over dinner with your family?

Such comments may be annoying, but they are not wrong.

The way you hold your body when you sit or stand is the basis of all your body movements and determines how well your body can adapt to stress.

These stresses include carrying weight and sitting in an awkward position.

And the big one that we all experience all day every day is gravity.

If your posture is not optimal, your muscles have to work harder to stay upright and balanced.

Some muscles become stiff and inflexible.

Others are suppressed.

Over time, these maladaptations impair the body's ability to cope with the forces exerted on it.

Poor posture puts extra wear on joints and ligaments, increases the chance of accidents, and reduces the efficiency of some organs, such as the lungs.

Researchers have linked poor posture to scoliosis, tension headaches, and back pain, but it's not the only cause of either.

Posture can affect your emotional state and even your sensitivity to pain.

There are many reasons why you should aim for good posture.

But these days it's getting harder.

Sitting in an awkward position for long periods of time can lead to poor posture, as can using a downward-facing computer or mobile device.

Many studies suggest that we have worse posture on average.

So what is good posture?

If you look at your spine from the front or back, you should see all 33 vertebrae aligned in a straight line.

When viewed from the side, the spine should have three curves. One in the neck, one in the shoulder and one in the waist of the back.

You weren't born with this S-shaped spine.

A baby's spine has only one curve that looks like the letter "c".

Other curves are usually developed by 12-18 months as muscles strengthen.

These curves help us stay upright and absorb some of the stress from walking and jumping.

With these in place, you should be able to draw a straight line when standing from a point just in front of your shoulders to behind your hips, in front of your knees, and a few inches in front of your ankles.

This keeps your center of gravity directly above your support base, allowing you to move efficiently with minimal fatigue and muscle strain.

When sitting, keep your neck vertical and not tilt forward.

Bring your arms closer to your core and relax your shoulders.

Keep your knees square and your feet flat on the floor.

But what if your posture isn't so good?

Try redesigning your environment.

Adjust the screen so that it is at eye level or slightly below.

Make sure all parts of your body, such as elbows and wrists, are supported, using ergonomic aids as needed.

Try sleeping on your side with your neck supported and a pillow between your legs.

Wear shoes with low heels and good arch support, and use a headset for calls.

Also, good posture is not enough.

Keeping your muscles and joints moving is very important.

In fact, standing still for long periods of time with good posture can be worse than doing normal movements with bad posture.

Move wisely when you move.

Keep everything you carry close to your body.

The backpack should be worn symmetrically and close to the back.

If you spend a lot of time sitting, get up and move around every once in a while and make sure you exercise.

Using your muscles not only provides a range of benefits for your joints, bones, brain and heart, but also keeps them strong enough to support your body effectively.

If you're really worried, see a physical therapist. That's right, it's better to stand up straight.

When I was a boy in Lima, my grandfather told me the legend of the Spanish conquest of Peru.

Inca emperor Atahualpa was captured and killed.

Pizarro and his conquistadors grew wealthy, and tales of their conquest and glory reached Spain, bringing a new wave of gold and glory-hungry Spaniards.

They went to town and asked the Incas, "Where are there other civilizations we can conquer? Where is more gold?"

And the Incas, out of revenge, said to them, "Go to the Amazon.

You will find all the gold you want there.

In fact, there is a city called Paititi (Eldorado in Spanish), made entirely of gold. ”

The Spaniards leave for the jungle, but the few who return return with tales of mighty shamans, tales of warriors with poisoned arrows, tales of trees tall enough to block the sun, tales of spiders that eat birds, tales of snakes that swallow men whole, and tales of boiling rivers.

All these things became my childhood memories.

And so many years passed.

When I was working on my PhD at SMU and trying to understand the potential of Peru's geothermal energy, I remembered this legend and started asking that question.

Is it possible that boiling rivers exist?

I asked my colleagues in universities, government, oil and gas, and mining companies, and the answer was a unanimous “no.”

And this makes sense.

As you know, boiling rivers exist in the world, but they are commonly associated with volcanoes.

Powerful heat sources are required to trigger such large-scale geothermal phenomena.

And neither the Amazon nor most of Peru have volcanoes, as the red dots here are volcanoes.

So it follows that you shouldn't expect to see a boiling river.

My aunt, who told this same story at a family dinner, told me, "But no, Andrés, I've been there. I've swam in that river."

(Laughter) Then my uncle jumped in.

"No, Andres, she's not kidding.

As you know, you can swim in it only after heavy rains and it is protected by a powerful shaman.

Your aunt is friends with his wife. ”

(Laughter) "Komo?" ["Huh?"] You know, despite my scientific skepticism, my aunt had led me on a jungle hike more than 700 kilometers from the center of the nearest volcano, and I was honestly just preparing to see the fabled "Warm Streams of the Amazon."

But then...

I heard something, a low rumbling sound that grew louder and louder as we got closer.

We could hear the constant crashing of ocean waves, and as we approached we could see smoke and steam rising through the trees.

And then I saw this.

I quickly picked up my thermometer and found that the average water temperature in the river was 86 degrees Celsius.

This isn't boiling to 100°C, but it's definitely close enough.

The river was hot and flowing fast.

I followed it upstream and was actually led by a shaman's apprentice to the most sacred part of the river.

And here's the weird thing -- it starts out as a cold stream.

And here, in this place, is the home of Yakumama, the Water Mother, a giant serpent spirit who produces hot and cold water.

And here are the hot springs, mingling with cold river water under her protective motherly jaws, bringing their legends to life.

The next morning, when I woke up—(laughs) I asked for tea.

I was handed a mug and tea bag and pointed to the river.

To my surprise, the water was clean and had a slightly strange taste for a geothermal system.

What surprised me was that the locals knew about this place all along and as an outsider I wasn't the first to see it.

It was just part of their daily routine.

they drink the water

they inhale that vapour.

They cook with it, clean it, and even make medicine.

I met that shaman and he seemed like an extension of the river and his jungle.

He asked my intentions and listened carefully.

Then, to my great relief – I was stunned, to be honest – a smile began to form on his face and he just laughed.

(Laughter) I had been blessed by the shamans to study the rivers on the condition that they would take samples of water anywhere in the world, analyze it in the lab, and then pour the water on the ground and, as the shaman said, the water would return home.

I have been there every year since my first visit in 2011, and the fieldwork has been exhilarating, demanding, and sometimes dangerous.

An article was also published in National Geographic magazine.

I was stuck in sandals and board pants on a small rock the size of a piece of paper, between an 80-degree river and, well, this kind of boiling hot spring.

And it was in the Amazon rainforest.

It was drizzling rain and I could not see anything.

It turned white because of the temperature difference. It was a whiteout.

concentrated.

Well, after many years of research, I will soon be submitting my geophysical and geochemical studies for publication.

And today, for the first time on the TED stage, I want to share some of these findings with you.

Well, first let me say this is not a legend.

surprise!

(Laughter) When I first started doing research, satellite imagery was too low resolution to make sense.

I just didn't have a good map.

Thanks to the support of the Google Earth team, this was made possible.

Not only that, but the river's indigenous name, Shanai Timpischka, means "boiling in the heat of the sun," indicating that I'm not the first to wonder why rivers boil, and that mankind has always tried to explain the world around us.

So why do rivers boil?

(bummering) It actually took me three years to shoot that video.

A hot spring flowing out of a fault.

Just as hot blood flows through our veins and arteries, the earth also has hot water flowing through its cracks and faults.

Where these arteries, the arteries of the earth, come to the surface, we see geothermal phenomena such as fumaroles, hot springs and, in our case, boiling rivers.

But what's really amazing is the scale of this place.

Think about this the next time you cross the road.

The river runs wider than a two-lane road along most of its route.

Heat currents flow over 6.24 kilometers.

Really impressive.

There's a hot spring pool bigger than this TED stage, and you'll see waterfalls 6 meters high, all with near-boiling water.

We mapped the temperature along the river, which was the most difficult part of our fieldwork.

And the results were just amazing.

I'm sorry, the earth scientist in me came out.

And it showed a surprising trend.

As you know, rivers are cold to begin with.

Then it heats up, cools down again, heats up, cools down again, heats up again, and does this beautiful decay curve until it hits this cold river.

Now, I understand that not all of you are geothermal scientists, but in more mundane terms, everyone loves coffee.

yes? good.

Regular coffee is 54°C, extra hot coffee is 60°C.

So, in coffee shop terms, a boiling river plot would look like this:

There is hot coffee there.

Here's extra hot coffee, but you'll find there are spots where the river is still hotter than extra hot coffee.

And these are average water temperatures.

These were taken during the dry season to ensure the purest geothermal temperatures.

But there is a magic number not shown here. That number is 47 degrees Celsius. Because that's where things start to hurt. I know this from very personal experience.

Above that temperature, you don't want to be in that water.

Caution is required.

It can be fatal.

I've seen all kinds of animals fall, and what's shocking to me is that the process is pretty much the same.

So they fall off and the first thing to go is the eye.

Apparently, the eyes cook very quickly. It will be this milky color.

The river carries them

They try to swim out, but it's so hot that the meat is burnt to the bone.

Therefore, they lose their strength, lose their strength, and eventually reach a state where hot water can enter their mouths and cook them from the inside out.

(laughs) It's a little sadistic.

No.

Let it marinate a little longer.

Again, what is surprising is the temperature.

They are similar to what I have seen in volcanoes around the world, even supervolcanoes like Yellowstone.

But here's the problem. The data show that boiling rivers exist independently of volcanic activity.

This volcano is neither magmatic nor volcanic in nature. It is also more than 700 kilometers from the nearest volcanic center.

How could such a boiling river exist?

I have asked geothermal experts and volcanologists for years and have yet to find another non-volcanic geothermal system of this magnitude.

Unique, isn't it?

Even on a global scale, it is special.

So even then -- how does it work?

Where does this heat come from?

Research is still needed to better constrain the problem and to better understand the system, but from what the data tell us at this point it appears to be the result of large-scale hydrothermal systems.

Basically it works like this: That is, the deeper you go into the earth, the hotter it gets.

This is called a geothermal gradient.

This water may have come from distant Andean glaciers, seeped deep into the earth, been warmed by geothermal gradients, and then emerged to form boiling rivers. All this is due to this unique geological setting.

Well, in and around rivers, we discovered that, in collaboration with colleagues at National Geographic, Dr. Spencer Wells, and Dr. John Eisen at the University of California, Davis, we sequenced the extremophiles that live in and around rivers and discovered a new life form, a unique species, that lives in boiling rivers.

But despite all these studies, all these discoveries, all these legends, the question still remains: what is the meaning of boiling rivers?

What is the meaning of this static cloud that is always hovering over this corner of the jungle?

And what do the details of childhood legends mean?

For shamans and their communities, this is a sacred place.

For me, a geoscientist, this is a unique geothermal phenomenon.

But for illegal loggers and livestock farmers, it is just another resource to exploit.

And for the Peruvian government, it is just another area of ​​unprotected land ready for development.

My goal is to ensure that those who manage this land understand the uniqueness and significance of the Boiling River.

Because that's the important question.

And the point is, we define significance.

it's us. we have that power.

We are the ones who draw the line between the sacred and the trivial.

And I would like to remind everyone that in this information age where everything seems to be mapped, measured and studied, discovery does not just take place in the black void of the unknown, but in the white noise of overwhelming data.

There is still much to explore.

We live in an incredible world.

So go out.

Be curious.

Because we live in a world where shamans still sing to jungle spirits, rivers boil, and legends come alive.

thank you very much.

(applause)

Throughout human history, three little words have sent poets to the blank page, philosophers to the agora, and seekers to the oracle. "Who am I?"

From the ancient Greek maxim inscribed in the Temple of Apollo, "Know thyself," to The Who's rock anthem, "Who Are You?"

Philosophers, psychologists, scholars, scientists, artists, theologians, and politicians have all grappled with the subject of identity.

Their hypotheses are wide-ranging and lack significant consensus.

They are smart and creative people, but is it that hard to find the right answer?

Certainly, one challenge exists with the complex concept of identity persistence.

which one are you?

who are you today

5 years ago?

Who will you be in 50 years?

And when is "am"?

this week?

today?

this time?

this second?

And which side of you is "I"?

are you your body

what are your thoughts and feelings?

what's your behavior?

Because navigating such murky waters of abstract logic is difficult, it is perhaps apt that the Greek historian Plutarch used the story of the ship to explain the complexity.

"What about me?

According to the story, the mythical founder, King Theseus of Athens, single-handedly defeated the evil Minotaur on Crete and returned home by ship.

To honor this heroic feat, the Athenian meticulously maintained his ship in port for 1,000 years, reenacting his voyage each year.

When a part of the ship became worn or damaged, it was replaced with an identical part of the same material until at some point the original part ran out.

Plutarch pointed out that Theseus' ship is an example of a philosophical paradox centered around the permanence of identity.

How can all parts of something be replaced and still be the same?

Let's imagine there are two ships, Ship A, the ship that Theseus docked in Athens, and Ship B, the ship that the Athenians sailed on 1000 years later.

Very simply, our questions are: "Is A equal to B?"

Some say that for 1000 years, There was only one ship for Theseus, and the changes made to the ship were gradual, so that at no point did it cease to be a legendary ship.

Although they have no common parts, we can say that A is equal to B because the two ships are numerically identical, meaning they are identical.

Some argue, however, that Theseus never set foot on Ship B, and that his presence on board was an important qualitative characteristic of Theseus' ships.

can't live without him.

Therefore, although the two ships are numerically identical, they are not qualitatively identical.

Therefore A is not equal to B.

But what if we consider this twist?

What if, as each part of the original ship was cast, someone collected them all and rebuilt the entire original ship?

When that's done, there will definitely be two physical ships. One is docked in Athens and the other is in someone's backyard.

Each can claim the title "Ship of Theseus," but it's the only one that can actually be real.

So which one is it, and more importantly, what does this have to do with you?

Like Theseus' ship, you are a collection of ever-changing parts. Your body, mind, emotions, circumstances, and even habits are constantly changing, but surprisingly, and sometimes in illogical ways, you remain the same.

This is one of the reasons why the question "Who am I?" It's very complicated.

And to answer that, you, like so many great minds before you, must be willing to dive into the bottomless sea of ​​philosophical paradoxes.

Or you might say, "I am a legendary hero on a mighty ship on an epic journey."

It might work too.

What do Charles Darwin, Michael Jordan, and Yoda have in common?

They, like many other historical and fictional characters, are bald, sometimes by their own choice.

For centuries, the shining dome has been a symbol of intelligence, yet many bald people still want their hair back.

Scientists have long wondered, "Why do some people lose their hair and how can we get it back?"

Those of us with round heads have about 100,000 to 150,000 hairs on their scalps, and scientists have discovered two things about this dense bush.

First, most of the sprouted hair we see is made up of keratin. Keratin is a protein left over from dead cells that is pushed up when new cells grow underneath.

The structures that promote hair growth are then called hair follicles. This is a complex network of organs that are formed before we are born and grow our hair in an eternal cycle.

This cycle has three main phases.

The first is the anagen phase, the growth phase that up to 90% of hair follicles are currently experiencing, which pushes the hair up at a rate of one centimeter per month.

Depending on the genes, the growing season lasts from 2 to 7 years.

After this production phase, signals within the skin tell some hair follicles to enter a new phase known as the catagen or catagen phase, causing the follicle to shrink to a fraction of its original length.

The catagen phase lasts about 2-3 weeks and cuts off the blood supply to the hair follicles, producing clubbed hairs. This means that it is ready for hair loss.

Finally, the hair enters the telogen phase, or telogen. The telogen phase lasts 10-12 weeks and affects approximately 5-15% of the hair follicles on the scalp.

During the resting phase, up to 200 club hairs can be shed per day, which is normal.

Then the growth cycle begins anew.

However, not all heads are hairy, and some actually become more and more patchy over time as their bodies change.

95% of male baldness is attributed to male pattern baldness.

Baldness is hereditary, and the hair follicles of people with this condition are highly sensitive to the effects of dihydrotestosterone, a hormone product made from testosterone.

DHT causes these overly sensitive hair follicles to shrink, making hair shorter and thinner.

But loss does not come suddenly.

It happens gradually along a scale known as the Norwood scale of hair loss severity.

First, the hair recedes along the temples, then the hair on the top of the head begins to thin in circular motions.

At the highest ratings, these bald areas contact and expand dramatically, eventually leaving only a sparse ring of hair around the temples and back of the head.

Genetics are not the only cause of hair loss.

Prolonged stress can release shock signals to follicles, forcing them to enter telogen prematurely.

Some women experience this after giving birth.

Follicles can also lose their ability to enter the anagen phase, the growing phase.

People undergoing chemotherapy experience this temporarily.

But while baldness may seem permanent, scientific research has revealed the opposite.

Beneath the surface of the skin, the roots that produce the hair actually live on.

Using this knowledge, scientists have developed drugs that shorten the resting phase and force follicles into the growing phase.

Other drugs fight male pattern baldness by blocking the conversion of testosterone to DHT, leaving sensitive hair follicles unaffected.

Stem cells also play a role in regulating the growth cycle, so scientists are studying whether the activity of these cells can be manipulated to allow the hair follicle to start producing hair again.

And meanwhile, as scientists refine their methods of reviving hair, anyone going or considering going bald can remember that they're in great company.

An internship at a remote mountain institute might not have been the best idea.

Pulling the skull-marked lever just to see what would happen probably wouldn't have been so wise either. But now is not the time to regret. Because you need to escape quickly from these mutant zombies.

With you is a janitor, a research assistant, and an old professor.

You've got a head start, but there's only one way to stay safe. Crossing an old rope bridge over a huge canyon.

You can run through it in 1 minute, but it takes the lab assistant 2 minutes.

The Janitor is a little slower and takes 5 minutes, but the Professor takes a full 10 minutes holding on to the rope for every step.

By the professor's calculations, the zombies will catch up in just over 17 minutes, so that's all they need to cut the rope across everyone.

Unfortunately, no more than two people can be on the bridge at one time.

Worse, it's too dark to see outside, and the old lantern you grabbed along the way only illuminates a small area.

Can you find a way to escape everyone in time?

Remember. No more than two people can cross the bridge together. People crossing the bridge must hold a lantern or stay right next to it. You can safely wait in the dark on either side of the canyon.

Most importantly, everyone must cross safely before the zombies arrive.

Otherwise, the first zombie may step on the bridge while people are still on it.

Finally, there are no tricks available here.

You can't swing across, use bridges as rafts, or befriend zombies.

Pause the video now if you want to figure it out for yourself.

Answers: 3 Answers: 2 Answers: 1 At first it may seem like a minute or two is not enough time to do anything, but there is a way.

The point is that the two slowest people cross together to minimize the time they waste.

In addition, it is necessary to secure the earliest personnel, as it is necessary to make several round trips with the lantern.

So you and the lab assistant will quickly run over with the lantern, but you'll have to slow down a bit to match her pace.

After 2 minutes they both cross and you are the first to run away with the lantern.

Only three minutes have passed.

So far, so good.

Now comes the hard part.

The professor and the janitor cross together with a lantern.

This takes 10 minutes as the janitor has to slow down for the old professor who keeps mumbling that the zombies shouldn't have had night vision.

With only 4 minutes left to cross the bridge, you're still stuck on the other side of the bridge.

But remember, the lab assistant is waiting on the other side and she's the second fastest person in the group.

So she snatched the lantern from the professor and ran back to you.

With two minutes remaining, they cross the final crossroads.

As you step across the canyon, the rope snaps in the nick of time and the bridge behind you collapses.

I will probably go to the library next summer.

You may not have heard of Sierra Leone's Kenema or Nigeria's Arua.

But I know they are two of the most special places on earth.

The hospital there is home to a community of nurses, doctors and scientists who have quietly fought for years against one of the deadliest threats to mankind: the Lassa virus.

Lassa virus is very similar to Ebola hemorrhagic fever.

It can cause severe fever and in some cases death.

But these people risk their lives every day to protect individuals within their communities, and in doing so, protect us all.

But one of the most amazing things I learned about them on my first visit there many years ago was that they begin each morning with a song about their difficult and extraordinary days on the front lines.

They gather together to express their joy.

They show their spirit.

And over the years, every time I visit them and they visit me, I get together with them and sing and write songs and love it. Because it's a reminder that we're not there to pursue science together. We are bound through our common humanity.

And of course, as you can imagine, when things start to change, it becomes very important and essential.

That changed dramatically in March 2014 when an Ebola epidemic was declared in Guinea.

This is the first outbreak near the border of Sierra Leone and Liberia in West Africa.

And it was terrifying and terrifying for all of us.

In fact, we suspected for some time that Lassa and Ebola were more prevalent than we imagined. And I thought that one day it might come to Kenema.

So a member of my team immediately went out and joined Dr. Humar Khan and his team there to set up diagnostic equipment that would allow a highly sensitive molecular test to detect Ebola if it crossed the border into Sierra Leone.

We already have this kind of ability in place against Lassa Virus, we know how to do it, and the team is outstanding.

We just gave them the tools and the place to investigate Ebola.

And unfortunately, that day has come.

On May 23, 2014, a woman checked into the hospital's maternity ward and the team performed critical molecular tests to identify Sierra Leone's first confirmed case of Ebola.

This was a great piece.

They were able to immediately diagnose the case, safely treat the patient, and initiate contact tracing to track what was going on.

something could have been stopped.

But by the time that day arrived, the infection had already been spreading for months.

Hundreds of people were infected, already exceeding previous epidemics.

And it entered Sierra Leone as a tsunami, not as that singular case.

The following week saw 31, then 92, then 147 cases reported, and we had to work with the international community, the Ministry of Health and Kenema to deal with the cases. All were coming to Kenema, one of the only places in Sierra Leone that could address this issue.

And while we worked around the clock trying to do the best we could, helping individuals and trying to get their attention, we also did one simple thing.

Specimens taken from a patient's blood to detect Ebola can obviously be discarded.

Another thing we can do is actually put the chemicals into it and deactivate it, and then just put it in a box and ship it across the ocean. that's what we did.

We sent it to Boston where my team works.

We also worked 24/7 in shifts, and quickly generated 99 Ebola virus genomes.

Here is the blueprint. The viral genome is the blueprint.

we all have it.

It tells us all about who we are and gives us a great deal of information.

The results of this kind of work are simple and powerful.

In fact, we were able to take these 99 different viruses, examine them, and compare them. In fact, when compared to three previously published genomes from Guinea, we were able to show that this epidemic originated in Guinea several months earlier, once entered the human population, and from there spread from person to person.

Now, this is very important when you're thinking about how to intervene, but it's contact tracing that matters.

We also found that the virus mutated as it traveled between humans.

And each of those mutations is very important. Because all the diagnostics, vaccines and treatments we use are basically based on that genome sequence. Because that's what drives genome sequencing.

Therefore, the world's health professionals will need to adapt and develop to recalibrate everything they do.

But the way science works, my position at that point was that I could have had the data, worked in silos for months, carefully and slowly analyzed the data, submitted the paper for publication, had a few back-and-forths, and finally, when the paper came out, I could have released the data.

That's how the status quo works.

Well, at this point it didn't work, did it?

We had friends on the front lines and it was clear that what we needed was help, lots of help.

So the first thing we did was publish the sequence to the web as soon as it got off the machine.

We opened it up to the whole world and said, "Help me."

Then came help.

Before I knew it, I started receiving reports from all over the world saying that they were surprised to see the data coming out and being made public.

The world's leading viral tracker has suddenly joined our community.

We were collaborating in this virtual way, sharing, calling and communicating regularly to track the virus minute by minute and find ways to stop it.

There are many ways to form such communities.

Everyone was reaching out to learn, participate and get involved, especially as the outbreak began to spread globally.

Everyone wants to play a role.

Human capabilities are staggering, and the Internet connects us all.

And can you imagine that, instead of being scared of each other, we all just said, 'Let's do this'?

Let's work together to make this happen. ”

But the problem is that the data we all use, just googling the web, is too limited to do what we need to do.

And so many opportunities are lost when that happens.

So, early in the Kenema epidemic, we obtained 106 clinical records from patients and made them available to the world again.

And in our own lab, we were able to take these 106 records and show that a computer could be trained to predict the prognosis of Ebola patients with near 100% accuracy.

And we created an app that allows you to publish it so that it can be used by healthcare workers in the field.

But 106 is not enough to make it strong and validate.

Therefore, we were waiting for further data to publish it.

And the data is yet to come.

We are still waiting, fine-tuning in silos rather than working together.

And only this - we cannot accept it.

right? Not all of you can accept it.

Our lives depend on it.

And indeed, many lives have been lost, including many health care workers, including five of my beloved colleagues Mubar Fony, Alex Moiboy, Dr. Humar Khan, Alice Koboma and Mohamed Fuller.

These are just five of the many health workers, Kenema and others, who died while the world waited and while we all quietly worked separately.

You see, Ebola, like all threats to humanity, is fueled by mistrust, distraction, and division.

The virus multiplies when we build barriers within ourselves and fight within ourselves.

But unlike any threat to humanity, Ebola is a threat that we are really one and the same.

We are all in this fight together.

An Ebola outbreak in someone's immediate vicinity could soon spread to ours.

I hope that we will work together with joy in this place of the same weaknesses, the same strengths, the same fears and the same hopes.

My graduate student was reading a book on Sierra Leone and discovered that the word "Kenema," the hospital in which we work and the city in which we work in Sierra Leone, was named after a Mende word meaning "clear as a river, translucent and open to the public eye."

It was really deep for us. Because we subconsciously felt that we had to work openly, share, and work together in order to honor the people of Kenema for whom we worked.

and we have to do that.

We all have to demand it of ourselves and others. It's about being open to each other when the pandemic hits and fighting this battle together.

This is neither the first nor the last Ebola epidemic, and there are plenty of other microbes in store, including the Lassa virus.

And the next time this happens, it could happen in millions of cities, and it could start there.

It may be transmitted through the air.

It can also be spread intentionally.

I know it's terrifying, I understand it, but I also know it, and this experience shows that we have the technology and the ability to win this, that we can win this and gain the upper hand against the virus.

But it is only possible if we do it together and willingly.

So for Dr. Khan and all those who have sacrificed their lives on the front lines in this fight against us, let us always join them in this fight.

And let the world not be defined by the destruction caused by one virus, but be illuminated by the billions of hearts and minds working together.

thank you.

(applause)

This may look like a neat pile of numbers, but it's actually a treasure trove of mathematics.

Indian mathematicians called it the Steps of Mount Meru.

In Iran, it is called the Khayyam Triangle.

Yang Hui's triangle in China.

To many people in the western world, this is known as Pascal's Triangle, after French mathematician Blaise Pascal, but this seems a little unfair because he was clearly late to the party, but he still had a lot to contribute.

So what is it about this problem that intrigues mathematicians around the world so much?

In short, full of patterns and secrets.

First and foremost, there are patterns that generate it.

Imagine starting with a 1 and having invisible zeros on either side of it.

Adding them as a pair produces the following line:

Now repeat that over and over.

Continuing, the result looks like this, but in reality Pascal's triangle continues infinitely.

where each row corresponds to what are called the coefficients of the binomial expansion of the form (x+y)^n. where n is the row number, counting from 0.

Therefore, expanding as n=2 yields (x^2) + 2xy + (y^2).

The coefficient, or number before the variable, is the same as the number in that row of Pascal's triangle.

Extending this, we see the same for n=3.

So triangles make it quick and easy to explore all these coefficients.

But that's not all.

For example, summing the numbers in each row gives successive powers of 2.

Or, on a particular line, treat each number as part of its decimal expansion.

So row 2 is (1x1) + (2x10) + (1x100).

We get 121, or 11^2.

See what happens when we do the same on line 6.

Add up to 1,771,561 (like 11^6).

There are also geometric applications.

Look at the diagonal line.

The first two are not very interesting. All 1s, then positive integers, also called natural numbers.

But the next diagonal digit is called a triangular digit because if you take the points of that number, you can stack them into an equilateral triangle.

The next diagonal is numbered for the tetrahedron. This is because, similarly, that number of spheres can be stacked to form a tetrahedron.

Or how about this: Shade all odd numbers.

When the triangle is small it doesn't look that big, but when you add thousands of lines you get a fractal known as Sierpinski's triangle.

This triangle is more than just a mathematical work of art.

It is also very useful, especially when it comes to probabilities and computations in the area of ​​combinatorics.

For example, say you want to have 5 children and want to know the odds of having your dream family of 3 girls and 2 boys.

In the binomial expansion, it corresponds to the 5th power of girls and boys.

So let's focus on line 5. The first number corresponds to the 5 girls and the last number to the 5 boys.

The third number is what we're looking for.

10 from the sum of all possibilities in a row.

So 10/32 or 31.25%.

Or, if you randomly select a 5-player basketball team from a group of 12 friends, how many different groups of 5 are there?

In combinatorial terms, the problem is expressed as choosing 5 from 12, and you can compute with this equation or look at the 6th element in the 12th row of the triangle to get the answer.

Pascal's triangle pattern is evidence of the elegant weaving of mathematics.

And to this day new secrets continue to be revealed.

For example, mathematicians recently discovered a way to extend to this kind of polynomial.

What will you find next?

Well, it's up to you.

A 13,000-mile-long earth and stone dragon meanders through the Chinese countryside and has a history almost as long and tortuous as its construction.

The Great Wall of China began as multiple walls of rammed earth erected by each feudal state to protect against nomadic invaders in northern China and each other during the Spring and Autumn period.

When Qin Shi Huang unified the nations in 221 B.C., the Tibetan Plateau and the Pacific Ocean formed a natural barrier, but the northern mountains remained vulnerable to Mongol, Turkish and Xiongnu invasions.

To protect against them, the emperor extended the small walls built by his predecessors, connecting some and strengthening others.

As the structures grew from Lindao in the west to Liaodong in the east, they came to be collectively known as the "Great Wall".

To accomplish this task, emperors recruited soldiers and commoners, but not always voluntarily.

Of the hundreds of thousands of recorded builders during the Qin dynasty, many were forcibly conscripted farmers and others were criminals serving sentences.

During the Han Dynasty, the walls were even longer, reaching 3,700 miles in length, stretching from Dunhuang to Bohai.

Forced labor continued during the reign of Emperor Wu of the Han dynasty, and the city walls developed a notorious reputation as a place of torment.

Poems and legends of the time tell of workers buried in the nearby mass graves and even within the walls.

No human remains have been found inside, but the graves show that many workers died from accidents, starvation, and exhaustion.

The Wall was formidable, but not invincible.

Genghis and his son Kublai Khan successfully overcame the wall during the Mongol invasion in the 13th century.

After the Ming Dynasty took control in 1368, they began to fortify and further strengthen the city walls using bricks and stones made from local kilns.

The 5,500-mile wall, which averaged 23 feet high and 21 feet wide, was dotted with watchtowers.

Once the raiders were spotted, fire and smoke signals flew back and forth between the towers until reinforcements arrived.

Small openings along the walls allowed archers to fire at intruders, and larger openings were used to drop stones and the like.

But even this new and improved wall wasn't enough.

In 1644, the northern Manchus overthrew the Ming and established the Qing Dynasty, including the Mongols. Thus, for the second time, China was ruled by the very people the wall tried to keep out.

As the borders of the empire extended beyond the Great Wall, the fortress lost its purpose.

And without regular reinforcement, walls fell into disrepair, rammed earth eroded, and bricks and stones were looted as building materials.

But the work was not yet finished.

During World War II, China used some parts to defend against Japanese aggression, and some parts are rumored to still be used for military training.

But today the main purpose of walls is culture.

It was declared a UNESCO World Heritage Site in 1987 as one of the largest man-made structures on earth.

The Great Wall was originally built to keep out Chinese invaders, but now welcomes millions of tourists each year.

In fact, the influx of tourists has accelerated the deterioration of the wall, prompting the Chinese government to take steps to preserve it.

It is also highly regarded as the only man-made structure that can be seen from space.

Unfortunately that is not true at all.

In low Earth orbit, we can see bridges, highways, airports, and all kinds of structures, but the Great Wall of China is barely recognizable.

No chance from the moon.

But in any case, it is the Earth that we should study. For new parts are discovered every few years, branching off from the main body and extending this amazing monument of human achievement.

Recall a really vivid memory.

Did you take it?

Now, try to remember what you had for lunch three weeks ago.

That second memory is probably not as strong, but why not?

Why do we remember some things and not others?

And why do memories fade over time?

First, let's look at how memories are formed.

When you experience something, such as dialing a phone number, that experience is converted into pulses of electrical energy that flow along a network of neurons.

Information is first stored in short-term memory and is available anywhere from seconds to minutes.

It is then transferred through areas such as the hippocampus to long-term memory and finally to several memory areas throughout the brain.

Neurons throughout the brain use specialized neurotransmitters to communicate at dedicated sites called synapses.

Amazing things happen when two neurons communicate repeatedly. This means more efficient communication between neurons.

This process is called long-term potentiation and is thought to be the mechanism by which memories are stored long-term, but how are some memories lost?

Age is also a factor.

As we age, our synapses begin to falter and weaken, affecting our ability to retrieve memories.

Scientists have several theories as to what is behind this deterioration. Because the actual brain shrinks, the hippocampus loses 5% of its neurons every 10 years, for a total of 20% by the age of 80, and production of neurotransmitters such as acetylcholine, which is essential for learning and memory, declines.

These changes seem to affect how people retrieve stored information.

Age also affects our memory.

Memories are encrypted most strongly when we are paying attention, when we are deeply involved, and when the information is meaningful to us.

Mental and physical health problems tend to increase as we age, impeding our ability to pay attention and act to steal our memories.

Another major cause of memory impairment is chronic stress.

When we are constantly overloaded with work and personal responsibilities, our bodies become hyper-alert.

This response evolved from physiological mechanisms designed to ensure our survival in crisis.

Stress chemicals help mobilize energy and increase alertness.

However, when we are under chronic stress, our bodies fill up with these chemicals, resulting in brain cells being lost and new ones not being formed, affecting our ability to retain new information.

Depression is another cause.

People with depression are 40% more likely to develop memory problems.

Low levels of serotonin, a neurotransmitter involved in alertness, can make people with depression less attentive to new information.

Another symptom of depression, ruminating on sad events from the past can make it difficult to pay attention to the present and affect your ability to store short-term memory.

The isolation associated with depression is also a memory thief.

A study by the Harvard School of Public Health found that older adults with higher levels of social integration experienced slower memory decline over six years.

The exact reason is still unknown, but experts believe social interaction may give our brains a mental workout.

Like muscle strength, if you don't use your brain, you risk losing it.

But don't despair.

There are several steps you can take to help your brain retain memories.

Try to stay physically active.

Increased blood flow to the brain helps.

And eat well.

Your brain needs all the right nutrients to keep it functioning properly.

And finally, train your brain.

Exposing your brain to challenges like learning a new language is one of the best defenses against memory loss.

Hello.

My name is Matthew Williams, Champion.

I have won medals in three different Canadian sports and national competitions, competed internationally in basketball, and was proud to represent Canada on the world stage.

(Applause.) I train five days a week in basketball and speed skating, and I work with top quality coaches and mental performance consultants to help me perform at my best in the sport.

By the way, these are all from Special Olympics.

Does that change your view of me and my achievements?

The world doesn't think everyone like me is a champion.

Not long ago, people like me were shunned and hidden.

Much has changed since Special Olympics began in 1968, but people with intellectual disabilities are often invisible to the general public.

People use the R word in front of me and I don't think it matters.

It is the word "retarded" or "retarded" used pejoratively.

They don't care how much it hurts me and my friends.

I don't want people to think I'm here for charity.

I am here because there is still a big problem with how many people view people with intellectual disabilities, or who do not see them at all.

Did you know that the World Games were held this year?

I was one of over 6,500 athletes with intellectual disabilities who competed in Los Angeles from 165 countries.

More than 62,000 spectators watched the opening ceremony, which was also broadcast live on TSN and ESPN.

Did you even know it happened?

What do you think when you see someone like me?

I am here today to plead with you to see us as equals.

Special Olympics transforms the self-identity of athletes with intellectual disabilities and the perception of all spectators.

For those of you who don't know, Special Olympics is for athletes with intellectual disabilities.

Special Olympics is separate from the Paralympics and Olympics.

We offer people with intellectual disabilities year-round quality sports programs that change lives and perceptions.

This movement changed my life and the lives of many others.

And it has changed the way the world views people with intellectual disabilities.

I was born with epilepsy and an intellectual disability.

As an adult, I played hockey until I was 12 years old.

As I got older, it became harder and harder to keep up with everyone, and I felt angry and frustrated.

For a while, I couldn't play sports, I didn't have many friends, and I felt left out and sad.

There was a time when people with intellectual disabilities were hidden from society.

No one thought they could participate in sports, let alone be a worthy member of society.

In the 1960s, Dr. Frank Hayden, a scientist at the University of Toronto, studied the effects of regular exercise on the fitness levels of children with intellectual disabilities.

Based on rigorous scientific research, Dr. Hayden and other researchers concluded that their decline in fitness level was simply due to lack of opportunities to participate.

Many have wondered whether people with intellectual disabilities could benefit from fitness programs and sports competition opportunities.

But pioneers like Dr. Hayden and Special Olympics founder Eunice Kennedy Shriver persevered, and Special Olympics athletes have proven it right 4.5 million times.

(Applause) Before the Special Olympics, I was nervous because I was young, shy, insecure, and didn't have many friends.

But when I got there, everyone was so encouraging, supportive, and allowed me to be myself without judging me.

Now, I am a basketball player and speed skater who has competed in regional and national competitions, and this year I even competed in the World Summer Games in Los Angeles, where I was part of the first Canadian basketball team to compete in the World Games.

(Applause.) I'm one of over 4.5 million athletes around the world, and I've heard many similar stories.

By becoming a Special Olympics athlete, we regain our pride and dignity.

Special Olympics also addresses critical health needs.

Studies show that men with intellectual disabilities die, on average, 13 years younger than men without intellectual disabilities, and women with intellectual disabilities die 20 years younger than women without intellectual disabilities.

Special Olympics keeps us healthy through active participation in sports.

A coach can also teach you about nutrition and health.

Special Olympics also offers free medical examinations for athletes who have difficulty communicating with or accessing medical care.

At the 2015 Summer World Games, my teammates from Canada and I played a basketball team from Nigeria.

The day before our game, the Nigerian basketball team went to the World Games Health Athletes Judging, where 7 out of 10 members were given free hearing aids to hear clearly for the first time.

(Applause.) Their transformation was amazing.

They were more excited, happier, and more confident because their coaches were able to communicate aloud.

And they were emotional because they could hear basketballs, whistles, and fans cheering in the stands, sounds that we take for granted.

Special Olympics doesn't just transform athletes in sports.

Special Olympics is changing life off the field.

The results of this year's survey show that nearly half of adults in the United States don't know anyone with an intellectual disability, and that 44 percent of Americans who have never been in personal contact with an intellectual disability are significantly less receptive and positive.

Then there's the "R-word" that proves that people with intellectual disabilities are still too many to be seen.

People use it as a casual term or an insult.

This tweet was tweeted over 9 million times last year and hurt me and my 4.5 million fellow athletes around the world.

People don't think it's offensive, but it is.

In an open letter to political commentators who used the R word as an insult, my fellow athlete and global messenger John Franklin Stevens wrote: “Would you like to participate in the Special Olympics someday?

See if you walk away without changing your mind. ”

(Applause.) This year at the 2015 Summer World Games, people lined up for hours to get into the final night of the powerlifting competition.

So it was only when teammate Jackie Barrett, a Newfoundland moose, lifted 655 pounds in the deadlift and 611 pounds in the squat — (applause) that he set a major Special Olympics record.

Jackie is the record holder for all powerlifters in Newfoundland, not just the Special Olympics.

Jackie is a big Los Angeles star, and ESPN live-tweeted his record-breaking lift and marveled at his performance.

Fifty years ago, few would have imagined that a person with an intellectual disability could do such a thing.

This year, 60,000 spectators filled the famous LA Memorial Coliseum, watched the opening ceremony of the World Games and cheered on athletes from 165 countries around the world.

Far from hiding, we were cheered and celebrated.

Special Olympics teaches athletes confidence and pride.

Special Olympics teaches the world that people with intellectual disabilities should be respected and accepted.

(Applause.) Now I have dreams and achievements in my sport, great coaches, respect and dignity, improved health, and pursuing a career as a personal trainer.

(Applause) I'm no longer hiding or being bullied, I'm here giving a TED talk.

(Applause) The world has changed thanks to Special Olympics, but there is still a long way to go.

So the next time you meet someone with an intellectual disability, I want you to see their abilities.

Next time someone uses the r-word near you, I want you to tell them how much it hurts.

I hope that you will consider participating in the Special Olympics.

(Applause) I would like to make one final thought.

Nelson Mandela said, "Sport has the power to change the world."

Special Olympics is changing the world by transforming 4.5 million athletes, giving us a place to be confident, meet friends, feel and be champions without judgment.

thank you very much.

(applause)

You and nine others have been captured by a super-intelligent alien overlord.

The aliens think humans look very appetizing, but their civilization forbids them from eating highly logical and cooperative beings.

Unfortunately they don't know if you are eligible so they decided to put everyone to the test.

Through a universal translator, the aliens guarding you say: You will be placed in a single row facing forward in size order so that everyone in front of you can see them.

You cannot turn your back or step out of line.

Each of you will wear either black or white hats on your head, and the hats will be randomly assigned, without saying how many hats of each color you have.

When I say, "Let's go," you have to go to the top row, starting from the back, and guess the color of your hat.

And don't say anything other than black or white, or signal in any other way, such as intonation or volume. Everyone will be eaten in no time.

If at least 9 people can guess correctly, everyone will be saved.

Please take 5 minutes to discuss and come up with a plan. Then I will line you up and assign you a hat. So let's get started.

Can you come up with a strategy that is sure to save everyone?

Pause the video now and find out for yourself.

Answer: 3 Answer: 2 Answer: 1 The point is that the person at the end of the line who can see everyone else's hat can use the word "black" or "white" to convey the coded information.

So what meaning is assigned to these words that allow others to guess the color of their hat?

Not the total number of black hats or white hats.

There are more than two possible values, but the two possible values ​​are the parity of the number, odd or even.

So the solution is for the person who went ahead to agree, for example, to say "black" if they see an odd number of black hats, and "white" if they see an even number of black hats.

Let's see what happens if the hats are distributed like this.

The tallest prisoner sees three black hats in front of him, so he says "black" and tells everyone else that he sees an odd number of black hats.

He gets the color of his hat wrong, but that's okay because only one wrong answer is allowed.

Prisoner 2 also saw an odd number of black hats, so he knew his hat was white and answered correctly.

Prisoner 3 has seen an even number of black hats, so he knows that one of the black hats seen by the first two prisoners must be his.

Prisoner 4 hears this and knows that there is one black hat behind him and that he needs to find an even number of black hats.

But she only sees one, so I presume her hat is also black.

Five to nine prisoners were each looking for an odd number of black hats, and when they saw it, they realized their hats were white.

Now it all depends on you at the front of the line.

If the ninth prisoner sees an odd number of black hats, it only means one thing.

It turns out that this strategy can be applied to any placement of hats.

The first prisoner gives a wrong answer about his hat 50% of the time, but the equivalent information he conveys allows everyone else to guess his hat with absolute certainty.

Each begins by expecting an odd or even number of hats of the specified color to appear.

If your count doesn't match, it means your hat is that color.

And each time this happens, the next person in line ends up switching the parity they expect.

That's it, feel free to go.

It seems that these aliens either need to go hungry or find a not-so-logical creature to kidnap.

You may have heard the advice to “Be more confident” when faced with big challenges where the potential for failure lurks everywhere.

And you probably think when you hear this, "I wish it was that easy."

But what is confidence?

Embrace the belief that you are worthy, worthy, and capable (also called self-esteem), add the optimism that comes when you are confident in your abilities, and be empowered by it to act courageously to face challenges head-on.

This is confidence.

It turns thought into action.

So where does confidence come from?

There are several factors that affect reliability.

The first is something you were born with, such as your genes, which affects things like the balance of neurochemicals in your brain.

2: How you are treated.

This includes surrounding social pressures.

And third, what you can control, the choices you make, the risks you take, and how you think about and respond to challenges and setbacks.

While it's impossible to fully disentangle these three factors, the personal choices we make certainly play a large part in developing our confidence.

So, with a few practical tips in mind, we can actually gain the power to develop confidence in ourselves.

Tip 1: Easy fix.

There are some tricks that can give you a quick confidence boost in the short term.

Imagine your success when you start a difficult task with something as simple as listening to music with heavy bass. It can promote feelings of power.

You can also strike a powerful pose or give yourself a pep talk.

Tip 2: Believe in your ability to improve.

If you're looking for long-term change, consider the way you think about your abilities and talents.

Do you think they are fixed at birth or can they develop like muscles?

These beliefs are important because they can influence how we act in the face of setbacks.

If you're stereotyped, that is, you think your talents are fixed, you might give up thinking you've discovered you're not very good at it.

However, if you have a growth mindset and believe you can improve yourself, challenges are opportunities to learn and grow.

Neuroscience supports a growth mindset.

Connections in the brain are strengthened and grown through learning and practice.

We also found that, on average, growth-minded people were more successful, performed better, and performed better in the face of challenges.

Tip 3: Practice making mistakes.

Let's be honest, sometimes it fails.

everyone does

J.K. Rowling was rejected by 12 different publishers before one picked up "Harry Potter."

The Wright brothers built on historical failed flight attempts, including their own, before designing a successful airplane.

Research shows that people who fail regularly but keep trying are better at responding to challenges and setbacks in a constructive way.

They learn how to try different strategies, ask others for advice, and be persistent.

So think about the challenges you want to take on, understand that it won't be easy, accept that you will make mistakes, and be kind to yourself when you make them.

Encourage yourself, stand up and do your best.

Whatever the outcome, I am thrilled to have gained a deeper knowledge and understanding.

This is confidence.

In the Middle Ages, alchemists tried to achieve the seemingly impossible.

They wanted to turn vile lead into shining gold.

History paints these people as old weirdos, if only they knew their dreams were actually achievable.

In fact, today we can manufacture gold on Earth thanks to modern inventions that medieval alchemists missed for centuries.

But to understand how this precious metal got embedded in the earth in the first place, you have to look up at the stars.

Gold is extraterrestrial.

Rather than originating from the planet's rocky crust, they are actually cooked in space and exist on Earth due to catastrophic star explosions called supernovae.

Most of the stars are composed of hydrogen, the simplest and lightest element.

The enormous gravitational pressure of so much matter compresses and causes nuclear fusion at the core of the star.

This process releases energy from the hydrogen and makes the star shine.

Over millions of years, nuclear fusion transforms hydrogen into heavier elements, helium, carbon and oxygen, burning subsequent elements faster and faster to reach iron and nickel.

However, at that point fusion will not be able to release enough energy and the pressure from the core will subside.

The outer layers collapse into the core and bounce back from this sudden injection of energy, causing the star to explode and form a supernova.

The extreme pressures of a collapsing star are so high that subatomic protons and electrons are forced to combine at the core to form neutrons.

Since neutrons have no repulsive charge, they are easily captured by iron group elements.

Multiple neutron captures allow the formation of heavier elements that stars cannot form under normal circumstances, from silver to gold to lead to uranium.

The formation of the heaviest elements in a supernova occurs in just seconds, as opposed to the million years it takes for hydrogen to transform into helium.

But what happens to the gold after the explosion?

The expanding supernova shock wave propels elemental debris through the interstellar medium, causing a vortex dance of gas and dust that condenses into new stars and planets.

Earth's gold may have been transported in this way before being kneaded into veins by geothermal activity.

Billions of years later, we are now extracting this precious product by mining, but this process is even more expensive due to the rarity of gold, and even more expensive.

In fact, all of the gold we've mined in history can be stacked in just three Olympic-sized pools, which represents a significant mass, as gold's density is about 20 times that of water.

So can we produce more of this coveted commodity?

Actually it is.

Particle accelerators can mimic the complex nuclear reactions that produce gold in stars.

But these machines can only build gold atom by atom.

Therefore, it would take almost the age of the universe to produce one gram at a cost well above the current value of gold.

So it's not a very good solution.

But if we get to the hypothetical point where we've mined all the gold reserves on Earth, there are other places to look.

There is an estimated 20 million tons of dissolved gold in the ocean, but its concentration is so small that it is currently too expensive to recover.

Perhaps one day there will be a gold rush that will exploit the mineral resources of other planets in our solar system.

and who knows?

Perhaps in the future a supernova will occur very close by and its treasures will rain down on us, but I hope it doesn't wipe out all life on Earth in the process.

A few species on Earth share the seemingly mysterious feature of the menstrual cycle.

We are one of the chosen few.

The only menstruating mammals on Earth are monkeys, apes, bats, humans, and possibly elephant shrews.

And despite being a waste of nutrients and a physical inconvenience, we do it more often than other animals.

So what's the point of this unusual biological process?

The answer starts with pregnancy.

This process skillfully utilizes the body's resources to create a favorable environment for the fetus, creating an internal haven for the mother to nurture her growing child.

Pregnancy is awe-inspiring in this regard, but that's only half the story.

The other half reveal that pregnancy puts mother and child at odds.

Like all living things, the human body has evolved to facilitate the spread of genes.

For mothers, it means that they should strive to provide for all offspring equally.

However, mother and fetus do not share exactly the same genes.

Fetuses also inherit genes from their fathers, and those genes can enhance their own survival by extracting more than their fair share of resources from their mothers.

This evolutionary conflict of interest puts women and fetuses in a biological tug-of-war in the womb.

One factor contributing to this internal conflict is the placenta, the fetal organ that connects to the mother's blood supply and nourishes the fetus during its development.

In most mammals, the placenta is trapped behind a maternal cell barrier.

This barrier allows the mother to control the supply of nutrients to the fetus.

However, in humans and some other species, the placenta actually invades the mother's circulatory system directly, giving it direct access to the mother's bloodstream.

The fetus pumps hormones through the placenta into the mother's arteries to keep them open and provide a permanent supply of nutrient-rich blood.

With such unrestricted access, the fetus may manufacture hormones that increase the mother's blood sugar, dilate arteries, and raise blood pressure.

Most mammalian mothers can expel or resorb the embryo as needed, but in humans, once the fetus is connected to the blood supply, bleeding can occur if that connection is broken.

A stunted or dead fetus puts the mother's health at risk.

As the fetus grows, its constant need for resources can lead to conditions such as exhaustion, high blood pressure, diabetes and pre-eclampsia.

Because of these risks, pregnancy is always a huge and sometimes risky investment.

Therefore, it makes sense that the body should carefully screen embryos to determine which ones are worth trying.

Menstruation applies here.

Pregnancy begins with a process called implantation, in which the embryo attaches to the endometrium that lines the uterus.

The endometrium has evolved to make implantation difficult and only healthy embryos can survive.

However, in doing so, the most actively invasive embryos are also selected, forming an evolutionary feedback loop.

The embryo undergoes a complex and exquisitely timed hormonal dialogue that alters the endometrium to enable implantation.

What happens if the embryo does not pass the test?

It may still be attached to the endometrium or partially through it.

Because she is dying slowly, she may be more susceptible to infections and constantly sending out hormonal signals that destroy tissue.

The body avoids this problem simply by removing all possible risks.

Every time ovulation does not result in a healthy pregnancy, the uterus removes the endometrium along with the unfertilized, diseased, dying, or dead embryo.

This protective process is known as menstruation, and menstruation begins.

This biological trait, strange as it may be, puts us on track for human survival.

Cram for testing?

Are you trying to do more than you have time to do?

Stress is an emotion that everyone experiences when facing difficulties or feeling overwhelmed.

However, stress is not just an emotion, it is a physical reaction that is transmitted throughout the body.

Stress can be beneficial in the short term, but when activated too frequently or for too long, the primitive fight-or-flight stress response not only alters the brain, but also damages many other organs and cells throughout the body.

The adrenal glands release the stress hormone cortisol, epinephrine, also known as adrenaline, and noradrenaline.

Because these hormones travel through the bloodstream, they easily reach blood vessels and the heart.

Adrenaline makes the heart beat faster, raises blood pressure, and over time causes high blood pressure.

Cortisol can also cause the normal dysfunction of the endothelium, the inner lining of blood vessels.

Scientists now recognize that this is the initial stage that causes atherosclerosis and the buildup of cholesterol plaques within the arteries.

These changes increase the chance of having a heart attack or stroke.

When the brain feels stress, the autonomic nervous system is activated.

Through this network of neural connections, the large brain communicates stress to the enteric nervous system.

This brain-gut connection not only causes butterflies in the stomach, but it also interferes with the natural rhythmic contractions that move food into the intestines, which can lead to irritable bowel syndrome or increase the gut's sensitivity to acid, making it easier to feel heartburn.

Through the gut nervous system, stress can alter the composition and function of gut bacteria, which can affect digestive and systemic health.

When it comes to digestion, does chronic stress affect your waistline?

Yes, it is.

Cortisol can increase appetite.

It tells your body to replenish its energy stores with energy-dense foods and carbohydrates, making you crave comfort foods.

High cortisol levels can add extra calories as visceral fat or deep belly fat.

This type of fat doesn't just make it harder to button your pants.

It is an organ that actively releases hormones and immune system chemicals called cytokines, which can increase the risk of developing chronic diseases such as heart disease and insulin resistance.

Stress hormones, on the other hand, have different effects on immune cells.

Initially, it helps you prepare to fight invaders and heal from injuries, but chronic stress can weaken some immune cells, make you more susceptible to infections, and slow healing.

Want to live longer?

Chronic stress may need to be curbed.

It even has to do with the shortening of telomeres, the ends of the chromosomal shoelaces that measure a cell's age.

Telomeres cover chromosomes each time the cell divides so that DNA can be copied without damaging the cell's genetic information, and telomeres shorten with each cell division.

If the telomeres become too short, the cell can no longer divide and dies.

As if that wasn't enough, chronic stress can wreak havoc on your health, including acne, hair loss, sexual dysfunction, headaches, muscle tension, poor concentration, fatigue, and irritability.

So what does this mean for you?

Your life will always be filled with stressful situations.

But what matters to the brain and the body as a whole is how it responds to that stress.

If we can view these situations as challenges that we can control and overcome, rather than as insurmountable threats, we will be able to perform better in the short term and stay healthy in the long term.

Why do so many intergalactic races in movies and TV happen to speak perfect English?

Simply put, no one wants to see a crew of spaceships spend years compiling an alien dictionary.

But to keep things consistent, the creators of Star Trek and other sci-fi worlds have introduced the concept of the Universal Translator, a portable device that can instantly translate between any language.

So is a universal translator really possible?

There are already a number of programs out there that claim to do just that: translate words, sentences, or entire books from one language, whether modern English or ancient Sanskrit, into just about any other language.

And if translation simply looked up words in a dictionary, these programs would circle around humans.

However, the reality is a little more complicated.

A rule-based translator uses a lexical database containing all the words found in a dictionary and all possible grammatical forms of those words, as well as a set of rules for recognizing the basic linguistic elements of the input language.

For a seemingly simple sentence like "children eat muffins", the program parses the syntactic or grammatical structure by first identifying the children as subjects and the rest of the sentence as predicates consisting of the verb "eat" and the direct object "muffin".

Next, we need to recognize the morphology of English, or how the language can be broken down into the smallest meaningful units, such as the word muffin and the suffix "s" used to indicate the plural.

Finally, we need to understand the semantics of what the different parts of the sentence actually mean.

To properly translate this sentence, the program looks at different vocabulary sets and rules for each element of the target language.

But here is where it gets tricky.

The syntax of some languages ​​allows the words to be placed in any order, while in others the muffin may eat the child.

Morphology can also pose problems.

Slovenian uses double suffixes, which many other languages ​​don't, to distinguish between two children and three or more children, but Russian doesn't have a definite article, so you might wonder if your children are eating specific muffins or just muffins in general.

Finally, even if the semantics are technically correct, the program can miss small details, such as whether children "mangiano" or "diborano" their muffins.

Another method is statistical machine translation, which analyzes a database of books, articles, and documents that have already been translated by humans.

By finding matches between source and translated text that are unlikely to occur by chance, the program can identify corresponding phrases and patterns and use them in future translations.

However, the quality of this type of translation depends on the size of the initial database and the availability of samples for a particular language or writing style.

Some researchers believe that language comprehension is a unique product of biological brain architecture, due to the computer's difficulties of instinctive exceptions, irregularities, and semantic gradations for humans.

In fact, one of the most famous fictional universal translators, the Babel fish in The Hitchhiker's Guide to the Galaxy, is not a machine at all, but a tiny creature that translates the brain waves and neural signals of sentient species through a form of telepathy.

So far, learning a language the old-fashioned way still yields better results than any computer program currently available.

But this is no easy task. With the vast number of languages ​​in the world and the ever-increasing interaction between people who speak them, automatic translation will continue to advance.

Perhaps by the time we encounter life forms in the galaxy, we may need to be able to communicate with them through a small device or, after all, start compiling a dictionary.

So I come from the tallest people on earth, the Dutch.

It wasn't always like this.

In fact, people are growing taller all over the world.

Over the past 150 years, people in developed countries have grown an average of 10 centimeters taller.

Scientists have many theories as to why, but almost all of them have to do with nutrition: increased dairy and meat.

Over the past 50 years, global meat consumption has more than quadrupled from 71 million tonnes to 310 million tonnes.

The same thing is happening with milk and eggs.

In any society where income increased, protein consumption also increased.

And we know that globally we are getting richer.

And as the middle class grows, so does the world's population, from 7 billion today to 9.7 billion by 2050. This means that by 2050 we will need at least 70 percent more protein than is currently available to humans.

And with the latest projections from the United Nations predicting that population to reach 11 billion by the end of this century, that means we need more protein.

The challenge is so staggering that a team at the Anglia Ruskin Institute for Global Sustainability recently suggested that unless global policies and food production systems change, our society could actually collapse in the next 30 years.

Our oceans are now the main source of animal protein.

Over 2.6 billion people depend on it every day.

At the same time, our global fisheries are 2.5 times more fish than the oceans can sustainably feed, meaning that humans are taking far more fish from the oceans than the oceans can naturally replace.

The WWF recently released a report showing that the planet's marine life has halved over the past 40 years.

Another recent report says that more than 90 percent of the largest predators, such as swordfish and bluefin tuna, have disappeared since the 1950s.

And there are many great sustainable fisheries initiatives around the globe that are geared towards improving fisheries practices and better management.

Ultimately, however, all of these efforts work to keep current catches constant.

Even with the best managed fisheries, it is unlikely that we will get much more from the ocean than we do today.

We must stop plundering the oceans like we used to.

We need to take the pressure off it.

And we are at a point where if we try harder for more produce, we may face total collapse.

Our current system cannot feed the growing world population.

So how do we fix this?

What would the world look like in just 35 years if another 2.7 billion people shared the same resources?

We can all become vegan.

Sounds like a great idea, but it's impractical and impossible to mandate globally.

Like it or not, people consume animal protein.

And if we can't change our ways, failing to meet the demands, we continue on our current path.

The World Health Organization recently reported that 800 million people suffer from malnutrition and food insecurity. This is due to the same global population growth and decreasing access to resources such as water, energy and land.

It takes very little imagination to imagine a world plagued by global unrest, riots and further malnutrition.

People are starving and natural resources are dangerously scarce.

For so many reasons, we need to change the world's food production system.

We have to do better, and we have a solution.

And the solution lies in aquaculture – the farming of fish, plants such as seaweed, shellfish and crustaceans.

The great sea hero Jacques Cousteau once said, "We must start using the sea as farmers, not as hunters.

That's the essence of civilization - farming, not hunting. ”

Fish is the last food we hunt.

And why do we keep hearing phrases like, “Farmed fish have too short a lifespan” or “Of course wild fish!”

About fish we know so little?

We don't know what it ate in its lifetime, nor what kind of contamination it encountered.

And if it's a large predator, it may have passed the coast of Fukushima yesterday.

I do not understand.

Few people realize that traceability in fisheries does not extend beyond the hunters who catch wild animals.

But let's take a step back and talk about why fish is the best food.

It is very different from most other types of meat in that it is healthy, protects against heart disease and contains important amino acids and important fatty acids such as omega-3s.

Not only is it healthier, but it's also much more exciting and versatile.

please think about it. Most animal husbandry is very monotonous.

Cows are cows, sheep are sheep, pigs are pigs, and poultry (turkeys, ducks, chickens) pretty much sums it all up.

And now 500 species of fish are farmed.

Not that Western supermarkets reflect that on their shelves, but that doesn't matter.

And we can farm fish in a very healthy way, which is good for us, good for the planet, and good for the fish.

I know it sounds like I'm obsessed with fish -- (laughter) Let me explain: My wonderful partner and wife, Amy Novograntz, and I got into aquaculture a few years ago.

We were inspired by the 2009 TED Award winner Sylvia Earle.

We actually met at Mission Blue I in Galapagos.

Amy attended as the TED Awards Director. I'm an entrepreneur from the Netherlands who loves diving and has a passion for the sea.

Mission Blue has truly changed our lives.

We fell in love, got married and really inspired and wanted to do something about marine conservation. It's long-lasting, it can make a big difference, and it's something we can do together.

Little did we expect that it would lead to fish farming.

But a few months after getting off the ship, we were at a conference at Conservation International. There, the Executive Director of Worldfish spoke about aquaculture and called on the activist-filled venue to stop ignoring aquaculture, realize what was happening, and get involved seriously because aquaculture could be exactly what our oceans and people need.

We were appalled by the stats about how little we knew about this industry before, and excited about the opportunity to contribute to the right solutions for this industry.

And speaking of statistics, the amount of fish consumed worldwide today (both wild and farmed) is twice as many tonnages as the total amount of beef produced on the planet last year.

All fishing vessels, large and small, around the world produce approximately 65 million tonnes of wild-caught seafood for human consumption.

This year, for the first time in history, aquaculture is actually producing more than what is caught in the wild.

But now demand will increase.

Over the next 35 years, an additional 85 million tonnes will be needed to meet demand. This is almost 1.5 times more than we can catch in the world's oceans.

It's a huge number.

It is safe to assume that it does not come from the sea.

It must come from agriculture.

And let's talk about agriculture. Agriculture requires resources.

Just as humans need food to grow and survive, so do animals.

A cow needs to eat 8-9 pounds of feed and drink almost 8,000 liters of water to produce just 1 pound of meat.

Experts agree that it is impossible to keep cattle for all inhabitants of the planet.

There is not enough food and water.

We cannot continue to cut down the rainforest for that.

And fresh water - the earth's supply is very limited.

Humanity needs something more efficient to survive on this planet.

Now let's compare it to fish farming.

As little as 1 pound of feed can produce 1 pound of fish, sometimes less depending on the species.

why?

Because fish float first.

They don't have to defy gravity and stay on their feet all day like we do.

And most fish are poikilotherms, meaning they don't need to warm themselves.

The fish will cool.

(Laughter) And, counterintuitively, it needs very little water. But as we say, they swim in water, but they drink very little water.

Fish are the most resource efficient animal protein available to humans, other than insects.

How much have we learned since then!

For example, in addition to 65 million tonnes being harvested annually for human consumption, a further 30 million tonnes are harvested for animal feed, mostly sardines and anchovies for the aquaculture industry, which are turned into fishmeal and fish oil.

This is insanity.

Worldwide, 65 percent of these fisheries are poorly managed.

Some of the worst problems of our time are associated with it.

It's destroying our oceans.

The worst slavery issue imaginable has to do with it.

Stanford University recently published an article saying that if 50% of the world's aquaculture industry stopped using fishmeal, our oceans would be saved.

Let's think for a minute here.

We now know there are far more problems in the ocean. Pollution, acidification, destruction of coral reefs, and more.

But it highlights the impact our fisheries have and how everything is interconnected.

Fisheries, aquaculture, deforestation, climate change, food security, and more.

In the search for alternatives, the industry is largely returning to plant-based alternatives such as soybeans, industrial poultry waste, and blood meal from slaughterhouses.

I understand where these choices come from, but this is not the right approach.

It's not sustainable and it's not healthy.

Have you ever seen a chicken at the bottom of the sea?

of course not.

If you feed salmon without any soy, it literally explodes.

Since salmon is a carnivore, it has no way of digesting soy.

Now, fish farming is the best animal husbandry available to mankind.

But it has a really bad reputation.

There is overuse of chemicals, introduction of viruses and diseases into wild populations, destruction and pollution of ecosystems, escaping fish breeding with wild populations, changes in entire gene pools and, of course, unsustainable feed ingredients as I mentioned earlier.

What a happy day when I could just enjoy whatever food was on my plate.

Once you know it, you will understand.

You can't go back.

it's not fun

We really need a trusted and transparent food system that produces healthy food.

But the good news is that decades of development and research have resulted in many new technologies and knowledge that allow us to do much better.

Fish can now be farmed without these problems.

I'm thinking about agriculture before the Green Revolution. We are in an era of aquaculture and the Blue Revolution.

Thanks to new technology, it is now possible to produce a completely natural feed consisting of microorganisms, insects, seaweeds and microalgae on a minimal footprint.

Health of people, health of fish, health of planet.

Microorganisms, for example, can be a perfect substitute for premium fishmeal on a large scale.

Insects, first of all, grow on food waste, so they are perfect recycling. But secondly, think about fly fishing and you'll see how reasonable it really is to use it as fish bait.

You don't need a lot of land to do that, and you don't have to clear the rainforest.

And microbes and insects actually produce water in net.

This revolution is happening as we speak, but it needs scale.

We are now able to farm far more species in controlled natural conditions and produce happier fish than ever before.

For example, imagine a closed system that works more efficiently than insect farming. There, you can produce healthy, happy and tasty fish on natural feeds with little or no wastewater, little energy, little water, and a minimal footprint.

Or a system that mimics nature, growing up to 10 seeds next to each other.

It requires very little feed and very little footprint.

For example, think of seaweed growing from fish wastewater.

Amazing technology is popping up all over the world.

From disease-fighting alternatives that no longer require antibiotics and chemicals, to automatic feeders that can sense when fish are hungry to save food and reduce pollution.

A software system that collects farm-wide data can improve farm practices.

Great things are happening all over the world.

And don't get me wrong. All of this is possible at a cost comparable to what farmers spend today.

Tomorrow there will be no excuse for not doing what is right for everyone.

So someone has to connect the dots and make a big impact on these developments.

That's what we've been working on for the past few years, and what we need to work on together. It's about connecting all of this around the world, with a holistic view of the entire value chain, with great entrepreneurs willing to share a common vision.

Now is the time to create change in this industry and push it in a sustainable direction.

The industry is still young and much of its growth is yet to come.

It's a big job, but it's not as far-fetched as you might think.

It is possible.

Therefore, we need to take the pressure off the ocean.

We want to eat delicious and healthy food.

And if we eat an animal, it must have lived a happy and healthy life.

We need reliable food to live long.

And this applies to all of us, not just San Francisco or Nordics.

Money is not the only problem, even in the poorest countries.

People prefer reliable, fresh, healthy food to unknown, distant sources.

we are all the same.

The day will come when people will recognize that farmed fish that have been farmed properly and healthily will be on their table and will reject anything else.

You can speed this up.

Ask questions when ordering seafood.

Where did my fish come from?

Who raised them and what did they eat?

Information about where your fish came from and how it was produced should be more readily available.

And consumers need to put pressure on the aquaculture industry to do the right thing.

So ask for details with every order to show that you really care about what you eat and what you are given.

And eventually they will listen.

And we will all benefit.

thank you.

(applause)

Imagine an airplane flying 1 millimeter above the ground and circling the earth every 25 seconds, counting blades of grass.

Squeeze all of this into the palm of your hand and you have the equivalent of a modern hard drive: an object that can hold more information than a local library.

So how can you store so much information in such a small space?

At the heart of every hard drive is a stack of rapidly spinning disks, with a recording head flying over each surface.

Each disk is coated with a film of microscopic magnetized metal particles, and no data resides on it in any perceptible form.

Instead, they are recorded as magnetic patterns formed by groups of those tiny particles.

In each group, also called a bit, the magnetization of all particles aligns in one of two possible states, corresponding to 0 and 1.

Data is written to disk by converting a string of bits into a current supplied through an electromagnet.

This magnet produces a magnetic field strong enough to change the direction of magnetization of metal particles.

Once this information is written to the disc, the drive uses a magnetic reader to convert the information back into a useful form, much like the stylus in a phonograph converts grooves on a record into music.

But how can you get so much information from just 0's and 1's?

Well, by combining a lot of them.

For example, a character is represented by 1 byte, or 8 bits, and an average photo occupies several megabytes (8 million bits each).

Since each bit must be written to a physical area of ​​the disk, we are always looking for areal density on the disk, or how many bits we can pack into one square inch.

The areal density of modern hard drives is about 600 gigabits per square inch, 300 million times more than IBM's first hard drive in 1957.

This amazing advance in storage capacity involved multiple innovations, not just a matter of making everything smaller.

A technique called the thin-film lithography process allowed engineers to make readers and writers smaller.

And despite its size, taking advantage of new discoveries in the magnetic and quantum properties of matter has made readers more sensitive.

Bits can also be packed more tightly thanks to a mathematical algorithm that removes noise from magnetic interference and finds the most likely sequence of bits from each chunk of the readback signal.

Placing a heater under the magnetic writer also enabled thermal expansion control of the head, allowing the magnetic writer to fly less than 5 nanometers above the disk surface, about the width of two strands of DNA.

Over the past few decades, the exponential increase in computer storage and processing power has followed a pattern known as Moore's Law. Moore's Law predicted in 1975 that information density would double every two years.

But at about 100 gigabits per square inch, shrinking the magnetic particles further, or bringing them closer together, introduces a new risk called the superparamagnetic effect.

If the volume of the magnetic grain is too small, its magnetization can be easily disturbed by thermal energy, leading to unintentional switching of bits and data loss.

Scientists have solved this limitation in a very simple way. By changing the recording direction from vertical to vertical, we were able to approach areal densities of 1 terabit per square inch.

Recently, heat-assisted magnetic recording has pushed the limits of that possibility even further.

It uses a more thermally stable recording medium, where a laser heats a specific spot to momentarily lower the magnetoresistance, allowing data to be written.

And while these drives are currently in the prototype stage, scientists already have the next potential trick up their sleeve. It's bit patterned media. In bit-patterned media, bit locations are arranged in discrete nano-sized structures, potentially enabling areal densities of 20 terabits per square inch or more.

In short, generations of engineers, materials scientists, and quantum physicists have combined their efforts to bring this incredible power and precision tool to life in the palm of your hand.

muscle.

There are over 600.

They account for 1/3 to 1/2 of our body weight and, together with connective tissue, hold us together, support us, and help us move.

And regardless of whether bodybuilding is a hobby or not, you should always keep an eye on your muscles because how you treat them on a day-to-day basis determines whether they grow or weaken.

Suppose you are standing in front of a door and trying to open it.

Your brain and muscles are perfectly primed to reach this goal.

First, the brain sends a signal to motor neurons on the inside of the arm.

When this message is received, the muscle contracts and relaxes, pulling on the arm bone to produce the desired movement.

The greater the task, the greater the brain signal, and the more motor units the brain must mobilize to accomplish the task.

But what if the door was made of hard iron?

At this point, the arm muscles alone cannot create enough tension to extend the arms, so the brain turns to other muscles for help.

Stepping in, tucking your stomach in, and tensing your back will create enough strength to pull your back open.

Your nervous system is simply utilizing the resources you already have, other muscles, to meet demand.

While all this is happening, another kind of cellular change occurs in the muscle fibers.

When exposed to stress, they experience microscopic damage, which is a good thing.

In response, damaged cells release inflammatory molecules called cytokines that activate the immune system to repair the damage.

That's when the muscle-building magic happens.

The more damage to muscle tissue, the more the body has to repair.

The resulting cycle of damage and repair allows the muscles to adapt to the increasing demands and eventually grow bigger and stronger.

Our bodies are already adapted to most of our daily activities, so they usually don't generate enough stress to stimulate new muscle growth.

So to build new muscle, a process called hypertrophy, our cells need to be exposed to a higher workload than ever before.

In fact, if you don't keep your muscles exposed to constant resistance, they will shrink, a process known as muscle atrophy.

In contrast, exposing a muscle to a high degree of tension, especially during muscle lengthening (also called eccentric contraction), creates conditions that are effective for new growth.

However, activity is not the only way to grow muscle.

Without proper nutrition, hormones and rest, the body cannot repair damaged muscle fibers.

Protein in our diet maintains muscle mass by providing new tissue building blocks in the form of amino acids.

Adequate protein intake and natural hormones such as insulin-like growth factor and testosterone help transition the body into a state of tissue repair and growth.

This important repair process takes place mainly during rest, especially during nighttime sleep.

Gender and age influence this repair mechanism, giving testosterone-rich young men an edge in the muscle-building game.

Genetic factors also affect your ability to grow muscle.

Some people have a stronger immune response to muscle damage and are able to better repair and replace damaged muscle fibers, increasing their muscle-building potential.

The body responds to the demands you place on it.

Breaking muscles, eating right, resting, and repeating it creates the conditions for your muscles to get as big and strong as possible.

Muscles are the same as life. Meaningful growth requires challenge and stress.

Are you sleeping restlessly, feeling irritable and moody, forgetting the little things, feeling overwhelmed and alone?

do not worry. We have all been there.

You're probably just stressed.

Stress isn't necessarily bad.

It's great for a boost of energy and focus, whether you're playing competitive sports or needing to speak in public.

But when conditions like the ones most of us face every day continue, our brains actually start to change.

Chronic stress, such as overwork or family arguments, can affect brain size, structure, and function, down to the genetic level.

Stress starts in something called the hypothalamus-pituitary-adrenal axis. It is a series of interactions between endocrine glands in the brain and kidneys that control the body's response to stress.

When the brain detects a stressful situation, it immediately activates the HPA axis, releasing a hormone called cortisol that primes the body for immediate action.

But long-term high levels of cortisol wreak havoc on the brain.

For example, chronic stress increases the activity level and number of neural connections in the fear center of the brain, the amygdala.

And elevated cortisol levels lower electrical signals in the hippocampus, the part of the brain associated with learning, memory, and stress control.

The hippocampus also suppresses the activity of the HPA axis, so when the HPA axis weakens, so does the ability to control stress.

But that's not all.

Cortisol can literally reduce the size of your brain.

When taken in excess, synaptic connections between neurons are lost and the prefrontal cortex, the part of the brain that controls behavior such as concentration, decision-making, judgment, and social interaction, shrinks.

It also leads to a decrease in new brain cells being made in the hippocampus.

This means that chronic stress can make learning and remembering things difficult, leading to more serious mental problems such as depression and eventually Alzheimer's disease.

The effects of stress can extend to your brain's DNA.

One experiment showed that the amount of nursing a mother rat gave her newborn baby played a role in determining how the baby responded to subsequent stress.

It turns out that puppies of nursing mothers are less sensitive to stress because their brains develop more cortisol receptors that attach to cortisol and dampen the stress response.

Puppies from negligent mothers had the opposite result, becoming more sensitive to stress throughout their lives.

These are considered epigenetic changes, meaning they affect which genes are expressed without directly altering the genetic code.

And these changes can be reversed if the mother is replaced.

But there are surprising results.

Epigenetic changes induced by one mother rat were passed on to subsequent generations of rats.

In other words, the results of these actions were inheritable.

But it's not all bad news.

There are many ways to reverse the effects of cortisol on the stressed brain.

The most powerful weapons are exercise and meditation. Meditation involves taking deep breaths and focusing your attention on your surroundings.

Both of these activities reduce stress and increase the size of the hippocampus, thereby improving memory.

So don't feel overwhelmed by the pressures of everyday life.

Control your stress before it takes over.

Imagine being able to connect your brain to a machine that will bring you ultimate joy for the rest of your life.

If you were given the option to register with such a being, would you do so?

This is a question philosopher Robert Nozick posed through a thought experiment called the Experience Machine.

This experiment asks us to think of a world where scientists have developed machines that simulate real life while ensuring a painless, pleasure-only experience.

catch?

You have to leave reality for good, but you can hardly tell the difference.

Your experience will be indistinguishable from reality.

Life's natural ups and downs are just replaced by an endless series of ups and downs.

It is wonderful.

It may seem like an attractive offer, but it's probably not as ideal as you think.

This experiment was actually designed to deny a philosophical concept called hedonism.

According to hedonists, maximizing pure pleasure is the most important thing in life because pleasure is the greatest benefit that life has to offer.

For hedonists, the best choices a person can make for themselves are those that bring the greatest possible pleasure without causing pain.

Infinite pleasure minus zero pain equals the net maximum pleasure, the exact scenario that the experience machine provides.

So if hedonism is your philosophy of choice, it's easy to plug in.

But what if life wasn't all about fun?

That's what Nozick believed he was demonstrating through the Experience Machine thought experiment.

Like many other experimenters considering this proposition, he found reasons not to plug in, even though this machine was promised maximum net profit.

But what prevents us from choosing a future of ultimate joy?

Consider this scenario.

Betsy and Xander have a loving and devoted relationship.

Betsy is happier than ever.

However, unbeknownst to Betsy, Xander continued his romance with his sister, Angelica, through love letters and secret encounters throughout their relationship.

If Betsy finds out, her relationship with both Xander and Angelica will be destroyed and the experience will be so traumatic that she will never love again.

Betsy is blissfully ignorant about Xander's infidelity, so hedonists would say she'd be better off staying in the dark and maintaining high levels of net pleasure.

As long as Betsy never finds out about the relationship, her life is guaranteed to continue as happily as it is now.

So is it worth it for Bestie to know the truth of her situation?

Imagine you were Betsy.

want to know the truth?

If the answer is yes, then you are choosing options that greatly diminish your pure pleasure.

Perhaps you believe that there is something inherently more valuable in life than pleasure.

Truth, knowledge, true connection with other humans.

These are all things that could be on the list.

By never learning the truth, Betsy essentially lives life in her own personal experience machine, a world of happiness that is not based on reality.

This love triangle is an extreme example, but it reflects many of the decisions we make in our daily lives.

So why do you feel that reality should be a factor when you make choices for Betsy, or for yourself?

Do real experiences, whether pleasant or painful, have intrinsic value?

Are you more valuable to yourself when you are experiencing the joys and pains of real life?

Nozick's experiment may not provide all the answers, but it forces us to consider whether real life, though imperfect, holds some intrinsic value beyond the joy of plugging in.

Fifteen years ago, I volunteered to participate in research involving genetic testing.

When I arrived at the clinic to be tested, I was handed a questionnaire.

One of the first questions asked me to check a box for my race (white, black, Asian, Native American).

I wasn't sure how to answer that question.

Was the aim to measure the diversity of the social backgrounds of the study participants?

In that case, I would answer with my social identity and check the "black" box.

But what if researchers were interested in investigating associations between ancestry and risk for specific genetic traits?

In that case, wouldn't they want to know something about my ancestry, which is as European as African?

And if I deny my social identity as a black woman, how can they make scientific discoveries about my genes?

After all, I consider myself a black woman with a white father, not a white woman with a black mother, for entirely social reasons.

Which racial identity I check has nothing to do with my genes.

Well, despite the obvious importance of this question to the scientific validity of the study, I was told, "Don't worry, write down how you identified."

So I put a check in the "black" box, but I wasn't confident in the research results that treated important variables in an unscientific way.

My personal experience with the use of race in genetic testing has led me to think: Where else in medicine is race being used to make false biological predictions?

Now, it turns out that race is deeply rooted throughout medical practice.

It shapes how doctors diagnose, measure, treat, prescribe, and even define disease itself.

And the more I learned, the more anxious I became.

Sociologists like myself have long explained that race is a social construct.

When we identify people as black, white, Asian, Native American, and Latino, it refers to social groups that have changed over time and have their own boundaries that differ around the world.

As a jurist, I have also studied how legislators, not biologists, came up with legal definitions of race.

And it's not just the view of social scientists.

Remember when the map of the human genome was unveiled at a White House ceremony in June 2000?

President Bill Clinton famously declared, "I believe that one of the great truths that will emerge from this triumphant exploration within the human genome is that, regardless of race, human beings are genetically more than 99.9 percent identical."

And less than 1 percent of genetic variation falls outside the racial box, he may have added.

Francis Collins, who led the Human Genome Project and is now Director of the NIH, agrees with President Clinton.

"I'm glad that the only race we're talking about today is humans."

Physicians should practice evidence-based medicine and are increasingly being asked to participate in the genomic revolution.

But their practice of treating patients based on their race lags far behind.

Estimate glomerular filtration rate (GFR).

Physicians routinely interpret GFR, an important indicator of kidney function, by race.

As this laboratory test shows, the exact same creatinine level, or blood concentration in a patient, automatically produces different GFR estimates, depending on whether the patient is African American.

why?

I've heard it's based on the assumption that African Americans have more muscle mass than other races.

But what does it mean when a doctor automatically thinks I have more muscle mass than the female bodybuilder?

Wouldn't it be far more accurate and evidence-based to determine an individual patient's muscle mass just by looking at it?

Well, doctors say they use race as a shortcut.

It's a crude but useful proxy for more important factors such as muscle mass, enzyme levels, and genetics that you don't have time to explore.

But race is a bad proxy.

In many cases, races do not add any relevant information at all.

It's just a distraction.

But race also tends to overwhelm clinical measures.

More evidence-based than the patient's race—the patient's symptoms, family illnesses, medical history, and possible own illnesses—blinds the eye of the doctor.

Race cannot substitute for these important clinical measures without compromising patient health.

Doctors also say race is just one of many factors to consider, but there are many medical tests like the GFR that explicitly use race to treat black, white, and Asian patients differently because of their race.

Racial medicine also exposes patients of color to particularly harmful prejudices and stereotypes.

Black and Latino patients are twice as likely as whites to go pain-free for the same painful long fracture. This is because of stereotypes that blacks and browns feel less pain, exaggerate pain, and are more prone to drug addiction.

The Food and Drug Administration even approves race-specific drugs.

It's a pill called BiDil for treating heart failure in patients who identify as African American.

Cardiologists developed this drug regardless of race or genetics, but commercial reasons made it convenient to market it to black patients.

The FDA then allowed the pharmaceutical company to test its efficacy in clinical trials involving only African-American subjects.

The researchers speculated that race might play a role instead of some unknown genetic factor affecting heart disease and drug response.

But think about the dangerous message it sent. Black bodies are very substandard, and drugs tested on black people may not work for other patients.

In the end, the pharmaceutical company's marketing plan fell through.

First, I was understandably wary of black patients using black-only medicines.

An elderly black woman stood up at a community rally and yelled, "Give back what white people are taking!"

(Laughter.) And if you think race-specific medicine is amazing, wait until you learn that many doctors in the United States still use the latest versions of diagnostic tools developed by doctors during the days of slavery. This diagnostic tool is closely tied to the justification of slavery.

Dr. Samuel Cartwright graduated from the University of Pennsylvania School of Medicine.

He practiced in the Deep South before the Civil War and was a prominent expert in what was then called "black medicine."

He promoted the concept of racial illness that people of different races suffer from different illnesses and experience illness in general differently.

Cartwright argued in the 1850s that slavery was beneficial to blacks for medical reasons.

He argued that forced labor was good for blacks because blacks have lower lung capacity than whites.

He wrote in a medical journal, "When whites are in control, the red blood that feeds their brains liberates their minds, and when they are free, the lack of red blood binds their minds to ignorance and savagery."

To support this theory, Cartwright contributed to perfecting a respiration-measuring medical device called a spirometer, which indicated presumed defects in the lungs of black people.

Today, doctors still support Cartwright's claim that racially blacks have lower lung capacities than whites.

Some people use modern spirometers that actually have a button labeled "race". This allows the machine to adjust the measurements according to each patient's race.

It is a famous function called "race correction".

The problem of racial medicine goes far beyond patient misdiagnosis.

The focus on innate racial differences in disease diverts attention and resources away from the social determinants that drive horrific racial disparities in health. Food deserts in poor areas. Exposure to environmental toxins. high imprisonment rate. And I feel the stress of racism.

As you know, race is not a biological category that naturally creates these health disparities due to genetic differences.

Race is a social category that has surprising biological effects because social inequalities affect people's health.

But racial medicine pretends that the answers to these gaps in health can be found in race-specific medicines.

It is much easier and more profitable to sell technological solutions to these health inequalities than to address the structural inequalities that create them.

The reason I am so committed to abolishing racial medicine is not just because it is bad medicine.

I am also on this mission. Because the medical practice of doctors continues to promote false and harmful views of human nature.

Despite many visionary advances in medicine that we have learned about, there is a lack of imagination when it comes to race.

Imagine with me for a moment. What if doctors stopped treating patients by race?

Let's assume they rejected the 18th-century classification system and instead incorporated state-of-the-art knowledge of human genetic diversity and unity that humans cannot be classified into biological races.

What if instead of using race as a crude proxy for the more important factor, doctors actually investigated and addressed that more important factor?

What if doctors were at the forefront of the movement to end structural inequalities caused by racism rather than genetic differences?

Racial medicine is bad medicine, poor science, and a misrepresentation of humanity.

It is more urgent than ever to finally abandon this backward legacy and affirm our common humanity by ending the social inequalities that truly divide us.

thank you.

(Applause.) Thank you. thank you.

thank you.

Before turning physics upside down, young Albert Einstein allegedly showed off his genius by devising complex riddles that included this list of clues.

Can you resist tackling a brain teaser written by one of the smartest people in history?

Let's try.

The world's rarest fish has been stolen from the city's aquarium.

The police followed the smell to a street with five similar-looking houses.

But you can't search every house at once, and if you pick the wrong house, thieves will know they're in their tracks.

It's up to you, the best detective in town, to solve the case.

Arriving at the scene, the police will tell you what they know.

First, each house owner has a different nationality, drinks different drinks, and smokes different types of cigars.

2: The interior walls of each house are painted in different colors.

3: Each house has different animals, one of which is a fish.

After hours of research by experts, we gather some clues.

It looks like a lot of information, but there is a clear logical path to the solution.

Solving a puzzle is much like Sudoku, so organizing information in a grid like this can be helpful.

Pause the video on the next screen to examine the clues and solve the mystery.

Answer: 3 2 1 First enter the information for clues 8 and 9.

You also quickly realize that the Norwegian is at the end of the street, so there is only one house next to him and it must be the blue-walled house in Clue 14.

Clue 5 says that the owner of the green walled house is drinking coffee.

It can't be the center house because we already know the owner drinks milk, but neither can it be the second house we know has blue walls.

And Clue 4 says that the green-walled house must be immediately to the left of the white-walled house, so it can't be the 1st or 5th house either.

Only the 4th place is left in the green wall house with coffee drinkers. So the house with white walls is in fifth place.

One clue can tell you nationality and skin color.

The only column missing both of these values ​​is the middle column, so this must be the Englishman's red-walled house.

Yellow is the only unassigned wall color, so this should be applied to the first house. At Clue 7, we learn that Dunhill smokers live there.

And Clue 11 indicates that the horse's owner is next door, but it's only a second home.

The next step is to figure out what Norwegians in the first house are drinking.

It can't be tea. Clue 3 indicates that it is Danish.

According to clue 12, the person smokes Brewmaster, so it cannot be root beer. Also, since we have already allocated milk and coffee, it should be water.

From tip 15, we can see that this Norwegian neighbor, who only lives in the second house, smokes blend.

Now, the only place on the grid without a cigar and drink is row 5, so that must be the home of Clue 12.

And since this leaves only the second house without a drink, the tea-drinking Danes will have to live there.

The fourth house is currently the only one lacking a nationality and a cigar brand, so the German Prince smoking who appeared in Clue 13 must live there.

By process of elimination, we can conclude that the British smoke Pall Mall and the Swedes live in the 5th house. Clue 6 and Clue 2, on the other hand, tell us that these two people have a bird and a dog, respectively.

Clue 10 tells you that the cat owner lives next door to the Dane who smokes the blend and has him live in the first house.

Since there is only one left on the grid, we know that the German in the house with the green walls must be the culprit.

You and the police burst into the house and caught the thief in the hands of a fish.

That was easy to explain, but solving puzzles like this often leads to false starts and dead ends.

One trick is to use a process of elimination and lots of trial and error to focus on the right parts. The more you solve logic puzzles, the more intuitively you can determine when and where you have enough information to make inferences.

And did young Einstein really write this puzzle?

Probably not.

There is no evidence that he did, and some of the brands mentioned are recent.

But the logic here is not that different from what we use to solve equations involving multiple variables, even those that describe the nature of the universe.

What do octopuses have in common with us?

After all, they don't have lungs, they don't have spines, they don't even have plural nouns we can agree on.

But what they do have, like any other animal we know, is the ability to solve puzzles, learn through observation, and even use tools.

And what's amazing about octopus intelligence is that it comes from a completely different biological makeup than ours.

About 200 species of octopuses are mollusks belonging to the order Cephalopoda, the Greek word for cephalopod.

These heads contain surprisingly large brains with brain-to-body ratios similar to those of other intelligent animals, and complex nervous systems with roughly the same number of neurons as dogs.

However, rather than being concentrated in the brain, these 500 million neurons are dispersed in a network of interconnected ganglia that are organized into three basic structures.

The central brain contains only about 10% of neurons, while the two giant optic lobes contain about 30%.

The remaining 60% are tentacles, and to humans it's like the arm has its own mind.

Here's where things get even more interesting.

Vertebrates like us have rigid skeletons that support our bodies and joints that allow us to move.

However, not all types of movement are permitted.

For example, you can't bend your knees back or bend your forearms in the middle.

Cephalopods, on the other hand, have no bones at all and can bend their limbs in any position and in any direction.

So molding their tentacles into any of the virtually infinite possible arrangements is unlike what we're used to.

Consider a simple task like grabbing and eating an apple.

The human brain contains a neurological map of the body.

When you see an apple, the motor centers in your brain activate the appropriate muscles to extend your arm, grab the apple with your hand, bend your elbow joint, or hold the apple in your mouth.

For octopuses, the process is completely different.

Cephalopod brains have a behavioral library, not a body map.

Therefore, when an octopus sees food, its brain does not activate a specific part of its body, but rather the behavioral response of grabbing.

As the signal travels through the network, neurons in the arm receive the message and initiate movement to command movement.

As soon as the arm touches the food, a wave of muscle activation travels through the arm to its base, which then sends another wave back from the base to the tip.

The signal will meet halfway between the food and the base of the arm, signaling the turn at that location.

What this means is that each of the octopus' eight arms is essentially capable of thinking for itself.

This gives you amazing flexibility and creativity when faced with new situations and problems. For example, opening bottles to get food, escaping through mazes, moving around new environments, changing skin texture and color to blend in with the landscape, and even mimicking other creatures to scare enemies.

Cephalopods may have evolved complex brains long before their vertebrate relatives.

And octopus intelligence isn't just for octopuses.

Their radically different nervous systems and autonomously thinking appendages have inspired new research in the development of flexible robots made of soft materials.

And studying how intelligence arises along such diverse evolutionary pathways can help us better understand intelligence and consciousness in general.

No one knows what other forms of intelligent life might exist, or how they process the world around them.

In the 3rd millennium BC, Mesopotamian kings recorded and interpreted their dreams on wax tablets.

A thousand years later, the ancient Egyptians wrote a dream book listing over 100 common dreams and their meanings.

In the years since, we have never stopped in our quest to understand why we dream.

So after a lot of scientific research, technological advances and persistence, we still don't have a definite answer, but we do have some interesting theories.

We dream of fulfilling our wishes.

In the early 1900s, Sigmund Freud proposed that all dreams, including nightmares, are collections of images from our everyday conscious life, while also having symbolic meanings related to the fulfillment of subconscious desires.

Freud theorized that everything we remember upon awakening from a dream is a symbolic representation of our unconscious, primordial thoughts, impulses and desires.

Freud believed that by analyzing memorized elements, the contents of the unconscious could be revealed to the conscious and that psychological problems arising from its suppression could be addressed and resolved.

We dream of remembering

Sleep is good for improving performance on certain mental tasks, but dreaming while you sleep is better.

In 2010, researchers found that subjects were better able to navigate a complex 3D maze if they took a nap and dreamed of the maze before the second challenge.

In fact, they were up to ten times better than those who only thought about the maze while awake between trials, or who took a nap but did not dream of the maze.

Researchers theorize that certain memory processes may only occur when we are asleep, and that our dreams are signals that these processes are occurring.

We dream of forgetting

There are approximately 10,000 trillion neural connections within the structure of the brain.

They are made by everything you think and do.

A 1983 neurobiological theory of dreams, called reverse learning, holds that during sleep, primarily during the REM sleep cycle, the neocortex revisits these neural connections and discards unnecessary neural connections.

Without this forgotten process, dreams can result, the brain can be overwhelmed with useless connections, and parasitic thoughts can block necessary thoughts while awake.

We dream of keeping our brains working.

Continuous activation theory proposes that dreams arise from the need for the brain to constantly reinforce and create long-term memories in order to function properly.

Therefore, when external input falls below a certain level, such as during sleep, the brain automatically triggers the generation of data from memory storage, which manifests itself in the form of thoughts and emotions experienced in dreams.

In other words, dreams can be screensavers that turn on randomly to keep your brain from completely shutting down.

We dream of rehearsing.

Dreams involving dangerous and threatening situations are very common, and the primal instinct rehearsal theory holds that the content of the dream is important to its purpose.

Whether it's an anxious night being chased by a bear in the woods or battling a ninja in a dark alley, having these dreams will help you exercise your fight-or-flight instincts and keep them alert and trustworthy in case real life requires it.

But it doesn't have to be uncomfortable.

For example, dreaming of an attractive neighbor can actually train your reproductive instincts as well.

We dream of being healed.

Because stress neurotransmitters in the brain are much less active during the REM phase of sleep, even during dreams of traumatic experiences, some researchers theorize that one purpose of dreaming is to provide relief from painful experiences and allow for psychological healing.

Reflecting on traumatic events in dreams while reducing mental stress may give you a clearer perspective and improve your ability to process them in a psychologically healthy way.

People with certain mood disorders and PTSD often have trouble sleeping, and some scientists believe that not dreaming may contribute to the illness.

We dream of solving problems.

Unbound by reality or the rules of conventional logic, in dreams the mind can create infinite scenarios, grasp problems, and come up with solutions that are unthinkable in the waking state.

John Steinbeck called it the sleep committee, and research has proven that dreaming is effective in problem solving.

This is also how the famous chemist August Kekulé discovered the structure of the benzene molecule, and why the best solution to a problem is to let it go to sleep.

These are just a few of the more prominent theories.

As technology advances our ability to understand the brain, we may one day discover the ultimate reason.

But until that time comes, we must keep dreaming.

Depression is the leading cause of disability in the world.

Nearly 10% of adults in the United States suffer from depression.

But since this is a mental illness, it can be much harder to understand than something like high cholesterol.

One of the main sources of confusion is the difference between having depression and just being depressed.

Most people get depressed from time to time.

Poor grades, lost jobs, arguments, even rainy days can trigger feelings of sadness.

Sometimes there are no triggers at all.

It appears suddenly.

Then things change and that sad feeling goes away.

Clinical depression is different.

This is a medical illness, and it cannot be cured just because you want to.

The symptoms last for at least 2 consecutive weeks and severely interfere with your ability to work, play, and love.

Depression has a variety of symptoms. These include low mood, loss of interest in activities that you normally enjoy, changes in appetite, feelings of worthlessness or excessive guilt, too much or too little sleep, poor concentration, restlessness or slowness, low energy, and recurring suicidal thoughts.

According to psychiatric guidelines, having at least five of these symptoms qualifies for a diagnosis of depression.

And it's not just behavioral symptoms.

Depression causes physical symptoms in the brain.

First of all, there are changes visible to the naked eye and X-ray vision.

This includes reduced volume of the frontal lobe and hippocampus.

On a more microscale, depression is associated with several things. Abnormal transmission or depletion of certain neurotransmitters, especially serotonin, norepinephrine, and dopamine, sluggish circadian rhythms, or certain alterations in the REM and slow-wave portions of the sleep cycle, and hormonal abnormalities such as high cortisol and thyroid hormone dysregulation.

However, neuroscientists still don't fully understand what causes depression.

It appears to involve complex interactions between genes and the environment, but no diagnostic tools can predict exactly when and where it will manifest.

And because the symptoms of depression are invisible, it's hard to know who's actually suffering, even if they look fine.

According to the National Institute of Mental Health, it takes the average person suffering from mental illness more than a decade to seek help.

However, there are very effective treatments.

Medications and treatments complement each other to increase brain chemicals.

In extreme cases, electroconvulsive therapy, like seizures controlled in the patient's brain, can also be very helpful.

Other promising treatments are also being investigated, such as transcranial magnetic stimulation.

So if you know someone who struggles with depression, kindly encourage them to explore some of these options.

You can even offer to help with specific tasks, like finding a local therapist or making a list of questions to ask your doctor.

For those with depression, these first steps may seem insurmountable.

If you're feeling guilty or ashamed, point out that depression is a medical condition, just like asthma or diabetes.

It's not a weakness or a personality trait. You shouldn't expect yourself to get over it as much as you can get over a broken arm.

If you've never experienced depression yourself, don't compare it to when you're depressed.

When you compare what you're going through to the normal, temporary feelings of sadness, you may feel guilty that you're struggling.

Even just talking openly about depression can help.

For example, research has shown that asking someone about their suicidal thoughts actually lowers their risk of suicide.

Talking openly about mental illness reduces stigma and makes it easier for people to seek help.

And the more patients seeking treatment, the more scientists will learn about depression and the better the treatments.

So I am a neurosurgeon.

And like most of my colleagues, I have to deal with human tragedies every day.

After a major stroke or car accident, we realize that life can change moment by moment.

And what's so frustrating for us neurosurgeons is the realization that, unlike other organs in the body, the brain has very little ability to repair itself.

And after a major injury to the central nervous system, patients often remain severely disabled.

That's probably why I chose to become a functional brain surgeon.

What is a Functional Neurosurgeon?

A physician who attempts to improve neurological function through various surgical strategies.

You've probably heard of one of the famous types of stimulation called deep brain stimulation. Deep brain stimulation involves implanting electrodes deep in the brain to modulate neuronal circuits to improve nerve function.

This is truly amazing technology in that it has improved the fate of Parkinson's patients with severe tremors and severe pain.

However, neuromodulation does not imply neurorepair.

And a functional neurosurgeon's dream is to repair the brain.

I think we are getting closer to that dream.

And I want to show that we are very close to this.

And with a little help, the brain can help itself.

So the story began fifteen years ago.

At the time, I was a chief resident working day and night in the emergency room.

I often had to take care of patients with head injuries.

When a patient with a severe head injury comes to the hospital, you have to imagine a swollen brain and increased intracranial pressure.

And this intracranial pressure must be reduced to save his life.

This may require removing part of the swollen brain.

So instead of throwing away these swollen brain fragments, I decided to study them with my colleague, biologist Jean-François Brunet.

What does that mean?

We wanted to grow cells from these tissue pieces.

It's not an easy task.

Growing cells from a piece of tissue is a bit like growing a very small child away from the family.

So you need to find the right nutrients, warmth, humidity and all other good environments.

So that's exactly what we have to do with these cells.

And after many attempts, Jean-François made it.

And that's what he saw under the microscope.

And it was a big surprise for us.

why?

This is because it looks exactly like a stem cell culture, with large green cells surrounding smaller immature cells.

And you may remember your biology class that stem cells are immature cells that can change into any type of cell in your body.

The adult brain has stem cells, but they are very rare in number and reside in small niches deep within the brain.

It was therefore surprising that this kind of stem cell culture was obtained from the swollen surface of the brain in the operating room.

And then there was another interesting observation. Normal stem cells are very active cells, cells that divide, divide and divide very quickly.

And they never die, they are immortal cells.

But these cells behave differently.

They divided slowly and sometimes died after several weeks in culture.

So we were in front of a strange new population of cells that resembled stem cells but behaved differently.

And it took me a long time to figure out where they came from.

They come from these cells.

These blue and red cells are called doublecortin-positive cells.

You have them in your head too.

They make up 4% of cortical brain cells.

They play a very important role in the development stage.

They helped the brain fold back when you were a fetus.

But why do they stay in your head?

I don't understand this.

We suspect that they may be involved in brain repair because they are found in higher concentrations near brain lesions.

But it's not so certain.

But one thing is clear. That is, stem cell cultures were obtained from these cells.

And we were looking at the potential for a new source of cells for brain repair.

And we had to prove this.

So I decided to design an experimental paradigm to prove it.

The idea was to biopsy a portion of the brain in the non-eloquent region of the brain and culture the cells exactly the way Jean-François did in the lab.

Then label and color it so you can track it in your brain.

And the final step was to reimplant them into the same individual.

We call these autografts autografts.

So the first question we had was, "What if we re-implant these cells into a normal brain, and what if we re-implant those same cells into a damaged brain?"

Thanks to the cooperation of Prof. Eric Louiet, we carried out the study in monkeys.

In the first case scenario, cells were reimplanted into a normal brain and after a few weeks the cells completely disappeared. As if the cells were taken out of the brain, they return home and disappear because the space is already crowded and there is no need for them.

In the second case scenario, we did the injury and reimplanted the exact same cells. In this case, the cells remained and became mature neurons.

This is the image that can be seen with a microscope.

These are reimplanted cells.

And the evidence they carry, these little spots are the cells we labeled in vitro during the culture.

But of course, we can't stop here.

Could these cells also help monkeys recover after injury?

To that end, we trained monkeys to perform manual dexterity tasks.

They had to retrieve food pellets from trays.

they were very good.

And when their performance reached a plateau, they damaged the motor cortex that corresponds to hand movements.

So the monkeys were paralyzed and could no longer move their hands.

And just like humans, just like after a stroke, they recovered spontaneously to some extent.

Patients are completely paralyzed and then attempt to recover by brain plasticity mechanisms, but only to a limited extent. This is exactly the same as for monkeys.

So when we were convinced that the monkey had reached a plateau of spontaneous recovery, we transplanted the monkey's own cells.

On the left you can see a monkey recovering on its own.

He reaches about 40-50% of his pre-lesion performance.

He's not that accurate, he's not that fast.

And look when you reimplant the cells. Two months after reimplantation, the same individual.

(Applause.) That was a very exciting result for us as well.

Since then, we have come to understand more about these cells.

We know we can freeze them and use them later.

It has also been found to be applicable to other neuropathological models, for example Parkinson's disease.

But our dream is still to transplant them into humans.

And I sincerely hope that soon we will be able to show that the human brain is giving us the tools to self-repair.

thank you.

(Applause) Bruno Giussani: Jocelyn, this is great. I'm sure there are dozens of people in the audience right now, probably the majority thinking, "I know someone who can use this."

In any case, I think so.

And, of course, the question is, what are the biggest obstacles before entering human clinical trials?

Jocelyn Block: The biggest obstacle is regulation. (Laughter) Now, with all these exciting results, you'd have to fill out about two kilograms of paperwork and forms to pass this type of exam.

BG: Of course, the brain is delicate.

JB: Yes, but it takes a long time, a lot of patience and almost a professional team to do it.

BG: If you were to project yourself, if you were to do research and get permission to start a trial and projected yourself in time, how many years would it take for someone to get to the hospital and have this treatment available?

JB: So it's very difficult to say.

First, it depends on whether the trial is approved.

Will regulations allow it any time soon?

And there is a need to conduct this type of study in small patient groups.

Therefore, it already takes a long time to select patients, administer treatments, and assess whether doing this kind of treatment is useful.

Now we need to deploy this to a multicentric trial.

Before we can offer this treatment to everyone, we first need to actually prove it works.

BG: Of course it's safe. JB: Of course.

BG: Jocelyn, thank you for coming to TED and sharing this.

BG: Thank you.

(applause)

Which of these has the least carbs?

This bread roll?

This bowl?

Or this can of soda?

This is a trick question.

Fats, vitamins and other nutritional content may vary, but carbohydrates are largely the same.

So what exactly does that mean for your diet?

First of all, carbohydrates are a nutritional category of sugars and molecules that the body breaks down to make sugars.

Carbohydrates can be simple or complex depending on their structure.

This is a monosaccharide, that is, a monosaccharide.

Glucose, fructose, and galactose are all monosaccharides.

Combining the two gives a disaccharide, lactose, maltose, or sucrose.

Complex carbohydrates, on the other hand, have three or more monosaccharides linked together.

Complex carbohydrates with 3 to 10 sugars attached are oligosaccharides.

Those with 10 or more are polysaccharides.

During digestion, the body breaks down these complex carbohydrates into their simple sugar building blocks so that cells can use them as energy.

Therefore, eating carbohydrate-rich foods raises blood sugar levels (usually about 1 teaspoon).

However, the digestive tract does not respond equally to all carbohydrates.

Think about starch and fiber. Both are plant-derived polysaccharides, and both are composed of hundreds to thousands of monosaccharides linked together, but the way they are linked differs, and the effect on the body varies accordingly.

In starch, where plants store energy primarily in roots and seeds, glucose molecules are held together by alpha bonds, most of which can be easily cleaved by enzymes in the gastrointestinal tract.

However, in fibers, the bonds between monosaccharide molecules are beta bonds, which the body cannot break.

The fibers can also trap some of the starch to prevent it from breaking, creating what is called resistant starch.

Therefore, starchy foods such as crackers and white bread are easily digested, quickly releasing large amounts of glucose into the blood. This is exactly what happens when you drink something high in glucose, such as soda.

These foods have a high glycemic index, which is the amount by which a particular food raises sugar levels in the blood.

Since soda and white bread have similar effects on blood sugar levels, so does the glycemic index.

However, when we eat fiber-rich foods such as vegetables, fruits and whole grains, these indigestible beta bonds slow the release of glucose into the blood.

These foods have a low glycemic index, with foods such as eggs, cheese and meat having the lowest glycemic index.

As sugar moves from the digestive tract into the bloodstream, the body transports it to tissues where it is processed and used as energy.

Insulin, a hormone synthesized in the pancreas, is one of the body's primary tools for managing sugar.

When you eat a meal and your blood sugar rises, insulin is released into your blood.

It stimulates muscle and fat cells to take up glucose and start converting it into energy.

The degree to which an insulin unit lowers blood sugar helps us understand what is called insulin sensitivity.

The more a particular unit of insulin lowers blood sugar levels, the more sensitive you are to insulin.

When insulin sensitivity decreases, it is known as insulin resistance.

The pancreas continues to pump out insulin, but the cells, especially muscle cells, are becoming less and less responsive to insulin, so blood sugar levels do not fall and blood insulin continues to rise.

Chronic high carbohydrate intake can lead to insulin resistance, which many scientists believe leads to a serious condition called metabolic syndrome.

This includes a range of symptoms such as high blood sugar, increased waist circumference, and high blood pressure.

It increases the risk of developing diseases such as cardiovascular disease and type II diabetes.

And its prevalence is increasing rapidly around the world.

Metabolic syndrome affects as many as 32% of the population in the United States.

Now let's get back to talking about diet.

Sugar is sugar, whether the food is sweet or not, and too many carbs can be a problem.

So why not skip the pasta, sushi rolls, pita burritos, and donut burger sandwiches?

Statistics are persuasive.

So much so that people, organizations, and whole nations base some of their most important decisions on organized data.

However, there is a problem with that.

There can be something lurking in any statistic that can completely upend the outcome.

For example, imagine you have to choose between two hospitals for your elderly relative's surgery.

Of the last 1,000 patients at each hospital, 900 survived in hospital A, but only 800 survived in hospital B.

So hospital A seems like a better choice.

But before you make a decision, remember that not all patients arrive at the hospital with the same level of health.

And when you divide the last 1,000 patients at each hospital into those who arrived in good health and those who arrived in poor health, things start to look very different.

Hospital A had only 100 sick patients, of whom 30 survived.

But hospital B has 400 and could save 210.

Therefore, for patients who arrive at the hospital in poor health, Hospital B, which has a survival rate of 52.5%, is a better choice.

And what if your relatives were in good health when they arrived at the hospital?

Curiously, Hospital B is still better, with a survival rate of over 98%.

So if hospital B's two groups of patients each have a higher survival rate, how does hospital A's overall survival rate improve?

We encountered a case of Simpson's paradox where the same data set seemed to show opposite trends depending on how they were grouped.

This often happens when conditional variables (also called hidden variables) are obscured in aggregated data. Condition variables are hidden additions that greatly affect the outcome.

The hidden factor here is the relative proportion of patients arriving in good or poor health.

Simpson's Paradox is not just a hypothetical scenario.

It shows up in the real world from time to time, sometimes in important contexts.

A UK study appears to have shown that smokers survived better than nonsmokers over a 20-year period.

That is, until it was found that when participants were divided into age groups, nonsmokers were, on average, significantly older and therefore more likely to die during the trial, precisely because they generally live longer.

Here age group is a hidden variable and essential for correct interpretation of the data.

In another example, an analysis of death penalty cases in Florida found no racial disparity in sentencing between black and white defendants convicted of murder.

But when we break down the cases by the race of the victims, we see a different story.

In both situations, black defendants were more likely to be sentenced to death.

White defendants had slightly higher overall sentencing rates because cases involving white victims were more likely to be sentenced to death than black victims, and most murders occurred among people of the same race.

So how can we avoid falling into a paradox?

Unfortunately, there is no one-size-fits-all answer.

Data can be grouped and partitioned in a variety of ways, and in some cases, overall numbers provide a more accurate picture than data partitioned into misleading or arbitrary categories.

All we can do is carefully study the actual situation that the statistics show and consider whether there are any latent variables.

Otherwise, we remain vulnerable to those who use data to manipulate others and further their own ends.

Symmetry is everywhere in nature and we usually associate it with beauty. For example, perfectly shaped leaves and butterflies with intricate patterns reflected on each wing.

But asymmetry is also very important, and it turns out to be more common than you might think, from crabs with giant pincer claws to snail species whose shells always coil in the same direction.

Some kidney beans only climb the shelf clockwise, while others only counterclockwise. The human body looks pretty symmetrical on the outside, but on the inside it's a different story.

Most of the vital organs are arranged asymmetrically.

The heart, stomach, spleen, and pancreas are on the left side.

The gallbladder and most of the liver are on the right side.

Even the lungs are different.

The left side has two lobes and the right side has three lobes.

The two sides of the brain are similar but have different functions.

It is important to make sure that this asymmetry is distributed in the correct way.

When all the internal organs are turned over, a condition called reversed position, it is often harmless.

However, incomplete recovery can be fatal, especially when the heart is involved.

But where does this asymmetry come from, when a brand-new embryo looks the same on both sides?

One theory focuses on tiny holes on the embryo called nodes.

The nodes are lined with tiny hairs called cilia that tilt away from the head and rotate quickly all in the same direction.

This synchronized rotation pushes fluid from the right side of the embryo to the left side.

On the left edge of the node, other cilia sense this fluid flow and activate specific genes on the left side of the embryo.

These genes tell cells to make specific proteins, and in just a few hours the right and left sides of the embryo are chemically different.

Although visually identical, these chemical differences ultimately translate into asymmetric organs.

Asymmetry first appears in the mind.

Initially, it is a straight tube along the center of the embryo, but when the embryo is about three weeks old, the tube begins to bend into a C shape and rotate toward the right side of the body.

It grows different structures on each side, eventually turning into the familiar asymmetrical heart.

Meanwhile, other major organs emerge from the central tube and grow towards their final position.

However, some organisms, such as pigs, lack embryonic cilia and still have asymmetric internal organs.

Could all cells be asymmetric in nature?

probably.

Bacterial colonies all extend lacy branches that curl in the same direction, and human cells cultured within ring-shaped boundaries tend to line up like cruller ridges.

Further zooming in reveals that many of the basic cellular building blocks such as nucleic acids, proteins and sugars are inherently asymmetric.

Proteins have complex asymmetric shapes that control which direction the cell migrates and which direction the embryonic cilia rotate.

These biomolecules have a property called chirality, which means that the molecule and its mirror image are not identical.

Like my right hand and my left hand, they look the same, but when I put my right hand in my left glove, I see that they are not.

This asymmetry at the molecular level is reflected in asymmetric cells, asymmetric embryos and ultimately asymmetric organisms.

So symmetry may be beautiful, but asymmetry has its own charm, seen in its graceful swirls, organized complexity, and pronounced imperfections.

The slide show we did here two years ago has been done about 2,000 times.

I'm doing a short slide show this morning, and since it's my first time doing it, I don't want to raise the bar, nor do I need to. In fact, we are trying to lower the hurdle.

Because I've put this together to address the challenges of this session.

And I was reminded of Karen Armstrong's wonderful presentation that what religion really gets right is action, not belief.

Perhaps the same can be said of optimism.

How can you be optimistic?

Optimism is sometimes characterized as a belief, an intellectual attitude.

As Mahatma Gandhi famously said, "You must become the change in the world that you desire."

And the outcomes we want to be optimistic about are not the result of beliefs alone, unless those beliefs lead to new behaviors. But I think the word "behavior" is also sometimes misunderstood in this context.

I'm a big proponent of changing light bulbs and buying hybrid cars, and Tipper and I have installed 33 solar panels on our house, drilled a geothermal well, and everything else.

But just as important as changing the light bulb is changing the law.

And when we change our behavior in our daily lives, we sometimes ignore the citizenship part and the democracy part. To be optimistic about this, we have to be incredibly active as citizens in our democracy.

To solve the climate crisis, we must solve the democracy crisis.

And we have one too.

I have been trying to tell this story for a long time.

I was reminded of this recently when a woman walked past the table I was sitting at, just staring at me. He looked like he was in his 70's. I didn't think anything of it until I saw her walking in the opposite direction and just staring at me. So I said, "How are you doing?"

And she said, "If you dye your hair black, you'll look like Al Gore." (Laughter.) Many years ago, when I was a young congressman, I spent a great deal of time working on the subject of nuclear arms control, the nuclear arms race.

And military historians have told me during their exploration that military conflicts usually fall into three categories. These are local wars, regional or theater wars, and the rare but very important global wars, or strategic conflicts.

And each level of conflict requires different resource allocations, different approaches, and different organizational models.

Environmental issues fall into the same three categories, and most of what we think of is local environmental issues such as air pollution, water pollution, and hazardous waste dumping. But there are also regional environmental problems, such as acid rain from the Midwest to the Northeast, Western Europe to the Arctic, and from the Midwest out the Mississippi River into the dead zone of the Gulf of Mexico.

And there are many of them. But the climate crisis is a rare but very important global or strategic conflict.

All are affected. And we need to organize our response properly. We need global mobilization for a global transition to renewable energy, conservation, efficiency and a low-carbon economy.

I have work to do. And we can mobilize resources and political will. But to mobilize resources, political will must be mobilized.

Let me show you these slides here.

I thought I would start with the logo. What's missing here, of course, is the Arctic ice sheet.

Greenland remains. Twenty-eight years ago, at the end of summer and on the autumnal equinox, the polar ice caps looked like this: the Arctic ice caps.

This past fall, I went to the Snow and Ice Data Center in Boulder, Colorado, and spoke with researchers here at the Naval Postgraduate Laboratory in Monterey.

This is what has happened in the last 28 years.

To put it into perspective, 2005 was the record so far.

Here's what happened last fall that really rocked researchers.

The Arctic ice sheets are geographically the same size, but they don't look exactly the same, but they are exactly the size of the United States minus an area roughly equal to the state of Arizona.

The amount lost in 2005 is equivalent to everything east of the Mississippi River.

The surplus that disappeared last fall corresponds to this. It reappears in winter, but is less fragile than permanent or thin ice. The remaining amount may be completely gone in the summer as early as five years.

That puts a lot of pressure on Greenland.

Already around the Arctic Circle, here is a famous village in Alaska. This is a town on the island of Newfoundland. Antarctica. Latest research by NASA.

Moderate to heavy snowmelt in an area the size of California.

"They were the best times, they were the worst times": the most famous opening sentence in English literature. I would like to briefly share the story of two planets. Earth and Venus are exactly the same size. The Earth's diameter is about 400 kilometers larger, but it's essentially the same size.

They have exactly the same amount of carbon.

The difference, however, is that on Earth most of the carbon has been extracted from the atmosphere over a long period of time and deposited underground as coal, oil and natural gas, whereas on Venus most of it is in the atmosphere. The difference is that the temperature averages 59 degrees. On Venus it is 855. This is related to the current strategy of getting as much carbon out of the ground as possible and releasing it into the atmosphere as quickly as possible.

It's not because Venus is a little closer to the Sun.

It's three times hotter than Mercury, which is right next to the Sun. Now, just briefly, here's one of the few old images you've seen, but I wanted to give you a quick rundown on CSI: Climate, so here it is.

The world's scientific community says man-made global warming pollution is being released into the atmosphere, which is thickening and further increasing the amount of infrared radiation emitted.

You all know that. At the last IPCC roundup, the scientists wanted to say, "How sure are you?" They wanted to answer "99 percent".

After the Chinese side objected, a compromise of “more than 90%” was reached.

Now, the skeptics say, "Oh wait, this could be a shift in this energy coming in from the sun." If that's true, the increased influx of the lower atmosphere would also heat the stratosphere.

If you're trapped further on your way out, you'd expect it to be warmer here and cooler here. This is the lower atmosphere.

This is the stratosphere. It is cool.

CSI: Climate.

Well, good news. Currently, 68 percent of Americans believe that human activity is the cause of global warming. 69% believe the earth is heating up significantly. Progress has been made, but here is the key. When given the list of challenges to tackle, global warming still ranks near the bottom.

What is missing is a sense of urgency.

If you agree with the factual analysis but don't feel threatened, what should you do?

Well, the Climate Alliance, which I co-lead with Current TV, did this pro bono, a global competition to do a commercial on how to say this.

Here is the winner.

NBC -- here's all the networks -- NBC's top journalists asked presidential candidates 956 questions in 2007. Two of them were about the climate crisis. ABC: There are 844 questions, two of which relate to the climate crisis.

Foxes: 2. CNN: Two. CBS: Zero.

From laughter to tears, this is one of those old cigarette commercials.

So what we do is:

This is gasoline consumption in all these countries. and we too.

But it's not just developed countries.

Developing countries are now following us and accelerating their pace. And in fact, this year's cumulative emissions are comparable to those of 1965. And they are catching up very dramatically. Total concentrations: By 2025 they will be essentially the same as in 1985.

Even if wealthy countries had completely fallen out of the shadows, the crisis would still continue.

But we have given the developing world the technologies and ideas that are causing the crisis. This has been in Bolivia - over 30 years.

This will be the peak of your fishing within seconds. 60's.

70's. in her 80's. 90's. We have to stop this. And the good news is that it can be done.

we have the technology.

We must have a unified view on how to deal with this. The challenge of fighting global poverty and reducing emissions in rich countries all have a single, very simple solution.

People say, "What's the solution?" here it is.

Put a price on carbon. We need a revenue-neutral CO2 tax to replace the tax on employment that Bismarck invented. Things have changed since the 19th century.

In a poor world, the response to poverty and the solution to the climate crisis must be integrated.

Without solving the climate crisis, Uganda's plan to combat poverty will be moot.

But the response can actually make a big difference in poor countries. This is a much talked about proposal in Europe.

This was from Nature magazine. These are photovoltaic, renewable energy power plants connected in a so-called "supergrid" to supply all electricity (high voltage direct current) to Europe, mainly from developing countries.

This is not killing two birds with one stone. You can do this.

We have to do it for our economy.

The latest figures show that older models are no longer working. There are many great investments. If you invest in tar sands or shale oil, your portfolio is stuffed with subprime carbon assets.

And it's based on an older model.

Drug addicts find veins in their toes when veins in their arms and legs collapse. The same is true for the development of tar sands and coal shale. Here are some investments that I personally think make sense.

I have a stake in these, so I'll put the disclaimer in there.

But geothermal, concentrating photovoltaics, advanced photovoltaics, efficiency and conservation.

We've seen this slide before, but there are changes.

Only two countries have not ratified, and now only one. We had elections in Australia.

And in Australia, a TV, internet and radio commercial campaign was launched to raise public awareness.

We trained 250 people to run slide shows in every town, village and city in Australia.

Many other things contributed, but the new Prime Minister announced that his top priority was to change Australia's position on Kyoto, and he did. Now that they've been hit by a severe drought, they've realized something.

This is Lake Lanier. My friend Heidi Cullen said that if you were to name a drought the way you name a hurricane, you would call what's in the southeast now Katrina and say it's heading to Atlanta.

I can't wait for Australia to experience a drought that will change its political culture.

There is even better news. Cities that support Kyoto in America

Up to 780 -- and I thought I saw it go through there just to localize this -- which is good news.

Now, finally, we heard a few days ago about the value of personal heroism becoming commonplace and becoming mundane or routine.

What we need is a new generation of heroes. Especially those of us living in the United States today, but also people in the rest of the world, somehow need to understand that history presents us with choices. Just as Jill (Bolt) Taylor was preoccupied with the amazing experiences she had gone through, thinking of ways to save her own life.

We now have a culture of distractions.

But we are facing a global emergency.

And we must find ways to create a generational sense of mission in the generation living today.

I wish I could find the words to say this.

This was also the generation of heroes who brought democracy to the planet.

The other is the one that ended slavery. And that gave women the right to vote.

I can do it. Please don't tell us that we don't have the ability to do it.

With just a week's worth of money spent on the Iraq war, we could be well on our way to solving this problem.

we have the ability to do that.

One last thing, I'm optimistic. Because we believe in our ability, when faced with great difficulty, to set aside distractions and meet the challenges that history presents to us.

I sometimes hear people say this to the disturbing fact of the climate crisis. "Oh, this is so bad.

What a burden we carry! And again, how many generations in human history have had the opportunity to meet challenges worthy of our best efforts?

A challenge that could bring us more than we thought we could? I think we should approach this challenge with deep joy and gratitude that a thousand years from now, philharmonic orchestras and poets and singers will be a generation to celebrate, saying that it was within them that they solved this crisis and laid the foundations for a bright and optimistic future for humanity.

Let's do so. thank you very much.

Chris Anderson: For so many people at TED, the basic question of designing a voting form is deeply painful. One of the design issues means your voice hasn't been heard to this degree in the last eight years in a position to make these things happen.

it hurts.

Al Gore: You don't know. (Laughter) CA: When you look at what your party's leading candidates are doing, I mean, they are there, are you excited about their plans for global warming?

AG: The answer to this question is difficult for me. Because, on the one hand, I think we should be very happy about the fact that all three Republican candidates -- a particular candidate -- John McCain, and two Democratic nominee finalists -- all have very different positive stances on the climate crisis. All three have demonstrated leadership, and all three are very different from the approach taken by the current administration. And I think all three of us were also responsible for moving plans and proposals forward. But as indicated by the question, the campaign dialogue put together by the League of Conservative Voters, the analysis of all the questions, incidentally, and the debates, incidentally, are all sponsored by something called Orwell's label "Clean Call." Has anyone noticed that?

All debates are sponsored by Clean Coal.

“Let’s cut emissions even further!”

The richness of dialogue in our democracy has not laid the groundwork for the bold efforts that are really needed.

So they are saying the right thing and may do the right thing whichever one is elected. But let me tell you, when I came back from Kyoto in 1997, with great euphoria at the breakthrough there, and then faced the U.S. Senate, only 1 in 100 senators were willing to vote for confirmation and ratification of the treaty. Whatever the candidate says must go hand-in-hand with what the public says.

This challenge is part of the fabric of our entire civilization.

CO2 is literally the breath our civilization exhales.

And now we have mechanized that process. Changing that pattern requires scope, scale, and speed of change beyond what has been done before.

That's why I started telling you to be optimistic about what you do, but be an active citizen.

Demand -- Don't just change the light bulb, change the law. Change the global treaty.

we have to speak up. We have to solve this democracy, this. Our democracy has sclerosis. And it has to change.

use the internet Please go to the internet.

Connect with people. Be active as a citizen.

I have to pause. We should not build new coal-fired power plants that cannot capture and store CO2. This means that there is an urgent need to build these renewable resources.

No one speaks on that scale now. But I believe it will be possible between now and November.

The Climate Alliance will work with everyone from Girl Scouts to hunters and fishermen to launch nationwide campaigns including grassroots campaigns, television and internet ads, radio and newspapers.

we need help we need help

CA: Regarding your own personal role going forward, Al, is there anything else you would like to do?

AG: I've been praying to find an answer to that question. what can i do?

Buckminster Fuller once wrote, "What would I do if the future of all human civilization depended on me?"

what will happen to me? ' It's up to all of us, but again, it's not just about the light bulb.

Most of us here are Americans. we have democracy.

You can change things, but you have to be willing to change things.

What we really need is a higher level of consciousness.

And it's hard to make it happen, it's hard to create it, but it's coming.

There is an old African proverb that some of you may know: "If you want to go fast, go alone; if you want to go far, go together." I have to go far away soon.

Therefore, we need to change our consciousness.

Change in commitment. A new sense of urgency.

We are once again recognizing our privilege to take on this challenge.

CA: Al Gore, thank you so much for coming to TED.

Ag: Thank you. thank you very much.

On January 26, 2013, a group of al-Qaeda extremists entered the ancient city of Timbuktu, at the southern tip of the Sahara Desert.

There they set fire to a medieval library containing 30,000 manuscripts written in Arabic and several African languages, covering subjects ranging from astronomy to geography, history to medicine. Among them was a book that probably documented the first cure for male erectile dysfunction.

Unknown in the West, this was the collective wisdom of the entire continent, the voice of Africa at a time when Africa was thought to have no say.

The mayor of Bamako, who witnessed the event, said the burning of the manuscripts was a "crime against world cultural heritage."

And he was right – or he would have been right if it weren't for the fact that he was lying too.

In fact, shortly before that, African scholars had randomly collected old books and left them to be burned by terrorists.

The collection is now hidden in Bamako, Mali's capital, where it grows moldy in damp places.

What was saved by trickery is now again endangered by the climate.

But it's not just Africa and remote parts of the world, but not even the major ones, that are at risk for manuscripts that could change the history of world culture.

A few years ago I surveyed European research libraries and found at least 60,000 pre-1500 manuscripts rendered illegible by water damage, discoloration, mold and chemical reagents.

The actual number is probably double that and does not include Renaissance manuscripts, modern manuscripts, maps and other cultural relics.

What if there was technology to recover lost and unknown works?

Imagine how a treasure trove of hundreds of thousands of previously unknown texts across the world could radically change our past knowledge.

Imagine discovering an unknown classic that will rewrite the norms of literature, history, philosophy and music. Or, more provocatively, we could rewrite our cultural identities and build new bridges between people and cultures.

These are the questions that transformed me from a medieval scholar, a reader of texts, to a text scientist.

The word "reader" is a very unpleasant word.

For me, it conjures up a passive image, that of a man sitting idly in an armchair waiting to be imparted with knowledge in a neat little packet.

How good it is to be a past participant, an adventurer searching for hidden texts in undiscovered lands.

As a scholar, I was just a reader.

I read and taught the same classics that people have read and taught for hundreds of years: Virgil, Ovid, Chaucer, Petrarch. And with each scholarly article I have published, I have added a dwindling sliver of insight to human knowledge.

What I wanted to be was the archaeologist of the past, the discoverer of literature, the Indiana Jones without the whip, or indeed the Indiana Jones with the whip.

(Laughter) And I wanted that not only for myself, but also for my students.

So six years ago, I changed my career direction.

At the time I was working on the last important European medieval poem, Chess of Love, which was never edited.

And it was never redacted because the document was so badly damaged in the incendiary bombing of Dresden during World War II that it existed in only one manuscript that generations of scholars had declared it lost.

For five years I've been working with UV lamps to recover writing marks, doing as much as the technology of the time really took me.

So I did what many people do.

I went on the Internet and learned about how multispectral imaging was used to reconstruct two lost papers of the famous Greek mathematician Archimedes from a 13th-century palimpsest.

A palimpsest is a manuscript that has been erased and overwritten.

So I suddenly decided to write a letter of plans and pleas to Professor Roger Easton, the chief imaging scientist of the Archimedes Palimpsest project.

And to my surprise, he actually wrote back.

With his help, I was able to secure a grant from the US government to build a portable multispectral imaging laboratory. And with this lab, it turned a scorched, faded mess into a new medieval classic.

So how does multispectral imaging actually work?

The idea behind multispectral imaging should be readily apparent to anyone familiar with infrared night vision goggles. What you see in the visible spectrum of light is only a fraction of what's actually there.

The same is true for invisible characters.

Our system uses 12 wavelengths of light between the ultraviolet and infrared, which are illuminated onto the manuscript from above by rows of LEDs and another multispectral light source that emerges through individual leaves of the manuscript.

This method uses a high-performance digital camera with a quartz lens to take up to 35 images per sequence per leaf.

There are said to be about five in the world.

Once these images are acquired, software originally designed for satellite imagery and used by people like geospatial scientists and the CIA feeds the data to statistical algorithms to further enhance and clarify the imagery.

You can get great results.

You may have already heard about the slow gelatinization of the Dead Sea Scrolls.

By using infrared light, even the darkest parts of the Dead Sea Scrolls could be read.

But you may not know that other Bible texts are at risk.

For example, here is a leaf from our imaged manuscript, probably the most valuable Christian Bible in the world.

The Manuscript Vercellensis is the oldest translation of the Gospels into Latin, dating from the first half of the 4th century.

It is the closest to the Bible at the time of the Council of Nicaea, at the time of the founding of Christendom under Emperor Constantine, and when the basic tenets of Christianity were being agreed upon.

Unfortunately, the manuscript is so badly damaged that it has been used for oaths and handled in church ceremonies for centuries.

In fact, the purple patch you see in the upper left corner is Aspergillus, a fungus that originated on the unwashed hands of tuberculosis patients.

Thanks to our image processing, we were able to transcribe this manuscript for the first time in 250 years.

However, having a lab that can be moved to any collection you want is only part of the solution.

This technology is expensive and extremely rare, and image processing and image processing skills are esoteric.

That means increased recovery is out of the reach of most researchers and all but the richest institutions.

That's why I founded the Lazarus project. This is a non-profit effort to bring multispectral imaging to individual researchers and small institutions at little or no cost.

Over the past five years, our team of imaging scientists, academics and students have traveled to seven countries to recover some of the world's most valuable damaged manuscripts, including the oldest English-language book, the Vercelli Book, the oldest Welsh-language book, Carmarthen's Black Book, and some of the most valuable early Gospels in what is now former Soviet Georgia.

Therefore, spectral imaging can recover lost text.

But more subtly, we can recapture the second story behind every object: when, by whom, and how the text was created, and in some cases, what the author was thinking at the time of writing.

Consider, for example, the draft Declaration of Independence written by Thomas Jefferson himself. A colleague of mine imaged it at the Library of Congress a few years ago.

The curator noticed that one entire word had been cut and overwritten.

The overwritten text was "National".

You can probably guess what the words underneath are.

"Subject."

Ladies and gentlemen, where American democracy is evolving at the hands of Thomas Jefferson.

Or consider the 1491 Martellus map taken at Yale University's Beinecke Library.

This is the map that Columbus supposedly referenced before traveling to the New World, giving him an idea of ​​what Asia was like and where Japan was located.

The problem with this map is that the inks and pigments have degraded too much over time, making the world look like a giant desert on this large map at about 7 feet.

Until now, we have had little detailed idea of ​​what Columbus knew about the world and how the world's cultures were represented.

The map's primary legend was completely illegible under normal light.

UV light had little effect on it.

Multispectral has given us everything.

In Asia, we learned about monsters with ears so long that they could cover their entire body.

About a snake that can smoke the ground in Africa.

Just as starlight can tell us what the universe looked like in the distant past, multispectral light can take us back to the first faltering moments of object creation.

Through this lens, we witness the errors, perversions, naivety, uncensored thinking, and imperfections of human imagination that make these sacred objects and their authors more real, and bring history closer to us.

What about the future?

There are so many things in the past and few people have the skills to rescue these objects before they disappear forever.

That's why I started teaching this new hybrid discipline I call 'text science'.

Text science combines the traditional skills of literary people—the ability to read old languages ​​and old handwriting, the knowledge of how text is created to locate and date text—with new technologies such as image science, ink and pigment chemistry, and computer-assisted optical character recognition.

Last year, a student in my class, a freshman with a Latin and Greek background, was imaging a palimpsest taken in a famous library in Rome.

As he worked, tiny Greek letters began to appear from behind the text.

All assembled, he read out a passage from the lost work of the Greek comic playwright Menandro.

It was the first time in well over a thousand years that the word had been pronounced aloud.

At that moment he became a scholar.

Folks, it is the future of the past.

thank you very much.

(applause)

Find hidden switches, evade secret traps, and finally the expedition stands at the heart of an ancient temple within the Lost City.

However, while studying the inscription in near-complete darkness, two of the eight graduate students accompanying him stumble upon the altar.

Suddenly, green smoke came out twice and the walls began to shake.

Fleeing for your life, you end up in the room you passed earlier that has five corridors, including one to the altar and one leading back outside.

The giant hourglass in the center is now starting to run, and you're less than an hour away from emptying it, when you hear a rumbling noise that you don't want to be around.

Recalling the journey so far, it takes about 20 minutes to reach the exit at a fast pace.

We know this is the last fork before the exit, but the trail signs have been erased and no one remembers the trail.

If split into 9 people, each group will have enough time to explore 1 of the 4 halls ahead, report back to this room, and everyone will be on the right track.

There is only one problem. The inscription spoke of the curse on the altar. The spirits of the king and queen of the city possessed the intruders and led them to their destruction through deception.

Remembering the green smoke, I realized that two of my students were cursed.

At any given time, either or both of them could lie, but they could also tell the truth.

I know for sure that I'm not under a curse, but I don't know which students can't be trusted. Also, there is no guaranteed way to test which students are cursed, as possessed students only occasionally lie.

Can you find a way to make sure everyone escapes?

You don't have to worry about possessed students attacking or hurting other students.

This curse only affects their communication.

Pause the video now if you want to figure it out yourself.

Answers: 3 Answers: 2 Answers: 1 The first thing to realize is that you can explore one of the halls alone, knowing that you are not possessed.

This leaves 8 students to go down the remaining 3 paths.

Sending a group of 4 down only 2 paths doesn't work. If one group comes back 2 for 2, you have to guess who to trust.

However, splitting them into one pair and two trios works fine every time. Here's why.

Possessed students may or may not lie, but as you know, there are only two of them, the other six always tell the truth.

As each group returns to the hall, all members make the same report or debate whether they have found the exit.

If the trio come back in full agreement, you know no one is lying.

For this pair, we can't be sure either way, but we only need reliable evidence for 3 of the 4 paths.

The fourth can be found by process of elimination.

Of course, if you're lucky enough to find the exit yourself, this shouldn't be a problem, but if you don't, all that leaves you with three possibilities.

If each group gives consistent answers, then either everyone is telling the truth, or two possessed students are paired.

In any case, ignore this duo.

If only one group is arguing, both other groups should be telling the truth. And when there are two conflicts, the possessed students are split into separate groups, and since at least two of each trio are truthful, we can safely trust the majority of both trios.

The temple collapses behind you as greenish steam escapes from the two students.

You are safe and free from the curse.

After that ordeal, you tell everyone in your group that they should be on vacation, but it just so happens that you have another expedition scheduled.

Europe was thrown into chaos when the French Revolution broke out in 1789.

While neighboring monarchs, fearing to share the fate of Louis XVI, attacked the New Republic, extremism and mistrust among factions at home led to bloodshed.

In the midst of all this conflict emerged an influential figure to command France.

But did he save or destroy the revolution?

"Order, order, who is the defendant today? I can't see anyone."

"Your Excellency, this is Napoleon Bonaparte, a tyrant who has invaded most of Europe in order to compensate for his stature-based fears."

"Actually, Napoleon was at least taller than average for his time.

The idea that he was short came only from British wartime propaganda.

And he was no tyrant.

He was protecting the young republic from being crushed by European monarchies. ”

"By overthrowing the government and seizing power yourself?"

"Your Excellency, Napoleon, as a young and successful soldier, was a total supporter of the French Revolution and its ideals of liberty, equality and fraternity.

But the revolutionaries were incapable of real leadership.

Robespierre and the Jacobins, who first came to power, unleashed a reign of terror on the people with anti-Catholic extremism and constant executions of all those who opposed them.

And the directory that replaced them was an unstable and incompetent oligarchy.

They needed a strong leader who could rule wisely and justly. ”

"So did France go through so many revolutions just to get a new, all-powerful ruler?"

"Not yet.

Napoleon's new powers stem from a constitution approved by a popular vote at the consulate. ”

"Ha! The Constitution was in effect enacted at gunpoint in a military coup, and the people accepted tyrants because they were fed up with constant civil war."

"Besides, Napoleon introduced a new constitution and code that preserved some of the most important achievements of the revolution: freedom of religion, the abolition of hereditary privileges, and the equality of all men before the law."

"Sure, they're all men.

He stripped women of the rights conferred on them by the revolution and even reinstated slavery in the French colonies.

Centuries later, Haiti is still recovering from its devastation.

what kind of equality is that? ”

"It was the only kind that could be kept stable at the time, and it was still well ahead of France's neighbors."

"Speaking of neighbors, what the heck was that invasion?"

"That's a great question, sir."

"Which invasion are we talking about?

Twice before Napoleon came to power, it was the neighboring empires that invaded France in an attempt to restore the monarchy and prevent the spread of freedom throughout Europe.

Having defended France as a soldier and as a general in these wars, he knew that the best defense is a good offense. ”

"An attack on an entire continent?

By 1802 peace had been secured, and other European powers also recognized the new French government.

But Bonaparte could not rest without dominating an entire continent, and all he knew was to fight.

He sought to enforce a British blockade across Europe, invading nations that did not comply, and launching more wars to preserve his own interests.

And what happened?

Millions died across the continent and the entire international order collapsed. ”

"You forget that another result, the ideal of democracy and liberalism, will spread throughout Europe.

Thanks to Napoleon, the continent was reshaped from a chaotic patchwork of fragmented feudal and religious territories into efficient, modern, secular nation-states in which people held more power and rights than ever before. ”

"Should we also thank him for the rise of nationalism and the massive increase in military size?

We can see how well it worked a century later. ”

"Then what would the history of Europe have been without Napoleon?"

"Unimaginably good/bad."

Seemingly unstoppable, Napoleon dies in the Russian winter snow, along with most of his army.

However, even after being banished and exiled, he did not give up and escaped from prison and launched a daring attempt to restore his empire before suffering a second and final defeat.

Bonaparte was a contradictory ruler who defended the popular revolution by imposing an absolute dictatorship and promoted liberal ideals through imperial wars. He never achieved his dream of conquering Europe, but he certainly left his mark on Europe, for better or worse.

Oh romantic love. Beautiful and hypnotic, heartbreaking and soul-crushing, often all at the same time.

Why do we choose to subject ourselves to that emotional squeeze?

Does love give meaning to our lives, or is it an escape from loneliness and suffering?

Is love a mask for our sexual desires, or is it a biology trick to get us to have children?

Is that all you need?

Is it necessary in the first place?

If romantic love has a purpose, neither science nor psychology have yet discovered it.

However, in the course of history, some of the most respected philosophers have put forward some interesting theories.

Love makes us whole again.

The ancient Greek philosopher Plato explored the idea that we love in order to be perfect.

In his "Symposium," he writes about a banquet where the comedian Aristophanes entertained his guests with the following story: Man was once a creature with four arms, four legs, and two faces.

One day they incurred the wrath of the gods and Zeus cut them all in half.

Since then, everyone has lost their half.

Love is the longing to find a soulmate who makes us feel whole again. At least Plato believed a drunken comedian would say so at a party.

Love tricks us into having children.

Much later, the German philosopher Arthur Schopenhauer argued that love based on sexual desire is an sensual illusion.

He suggested that we love because our desires make us believe that other people will make us happy, which is a big mistake.

Nature is tricking us into procreating children, and it is in them that the union of affection we seek is completed.

Once our sexual needs are satisfied, we are sent back to a life of anguish, only succeeding in sustaining our species and perpetuating the monotonous human cycle.

Sounds like someone needs a hug.

Love is our escape from loneliness.

According to the Nobel Prize-winning British philosopher Bertrand Russell, we love to satisfy our physical and psychological needs.

Humans are designed to produce offspring, but sex is unsatisfying without the ecstasy of passionate love.

Our fear of a cold and cruel world tempts us to build a hard shell to protect and isolate ourselves.

The joy, intimacy and warmth of love help us overcome our fear of the world, break out of our lonely shells and live life to the fullest.

Love enriches our entire existence and makes us the best in life.

Love is misleading suffering.

Gautama Siddhartha, who came to be known as the Buddha, or the Enlightened One, probably had some interesting discussions with Russell.

The Buddha proposed that we love because we seek to satisfy our primal desires.

But our passionate cravings are flawed, and obsession, even romantic love, is a great source of suffering.

Fortunately, Buddha discovered the Noble Eightfold Path. This is like a program to extinguish the flames of desire so that we can reach Nirvana, the enlightened state of peace, clarity, wisdom and compassion.

Novelist Cao Xueqin portrayed the Buddhist sentiment that romantic love is folly in one of China's greatest classic novels, The Dream of the Red Mansions.

In a subplot, Jia Rui falls in love with Xi-feng, who cheats and humiliates him.

Conflicting feelings of love and hate tear him apart. So the Taoist gave him a magic mirror that could cure him if he didn't look straight ahead.

But of course he's looking ahead.

He meets Shifen.

His soul enters the mirror and is dragged to death by iron chains.

Not all Buddhists think of romantic and erotic love this way, but the moral of the story is that such obsessions lead to tragedy and should be avoided, like a magic mirror.

Love makes us reach beyond ourselves.

Let's end with a little more positive story.

French philosopher Simone de Beauvoir proposed that love is the desire to integrate with others, and that is what gives meaning to our lives.

But she was less concerned with why we love and more concerned with how we can love better.

She thought the problem with traditional romantic love was that it was so seductive that it was tempting to make it its sole raison d'etre.

But relying on others to justify your existence can easily lead to boredom and power games.

To avoid this trap, Beauvoir advised to love sincerely, to love something akin to a great friendship.

Lovers support each other in discovering themselves, beyond themselves, and enriching their lives and the world together.

You may never know why you fall in love, but it sure is an emotional roller coaster.

It's scary and exhilarating.

It torments us and makes us leap.

Maybe we lose ourselves.

Maybe we will find ourselves.

It can be heartbreaking, it can be the best thing in your life.

Why don't you be brave and check it out?

Have you ever discussed an issue with a friend and found that he or she didn't seem to understand why the issue was so important to you?

Have you ever presented an idea to a group and were met with utter chaos?

Or, in the middle of an argument, have you ever suddenly accused your partner of not listening to you at all?

what's going on

The answer is miscommunication, and in one way or another, we've all experienced it.

It could cause confusion, animosity, misunderstanding, and even crash a multi-million dollar rover onto the surface of Mars.

In fact, human communication is incredibly complex, even when you're face-to-face with another person, in the same room, and speaking the same language.

Fortunately, miscommunication can be avoided if you have a basic understanding of what happens when you communicate.

For decades, researchers have been asking, "What happens when we communicate?"

One interpretation, called the transmission model, sees communication as a direct message from one person to another, much like someone throws a ball and walks away.

In practice, however, this simplified model does not take into account the complexity of communication.

With the introduction of a transactional model, we recognize that communication comes with even more challenges.

In this model, it is more accurate to think of communication between people as playing catch.

When we deliver a message, we receive feedback from the other party.

Through transactions, we create meaning together.

However, further complications arise from this interaction.

It's unlike the Star Trek universe, where some characters can fuse Vulcan minds and share their thoughts and feelings perfectly.

As humans, we can't help but send and receive messages through our own subjective lens.

When communicating, one expresses one's own interpretation of the message, and the one communicating hears one's own interpretation of that message.

Our perceptual filters constantly shift meanings and interpretations.

Do you remember that catch ball?

Imagine a lump of clay.

As each person is exposed to it, they shape it to fit their own unique perception based on knowledge, past experience, age, race, gender, ethnicity, religion, family background and other variables.

At the same time, everyone interprets the messages they receive based on their relationship to each other and their own understanding of the semantics and implications of the exact words used.

They may also be distracted by other stimuli, such as traffic jams or rumbling stomachs.

Even emotions can cloud understanding, and the complexity of communication increases exponentially as you add more people to the conversation, each with their own subject.

No wonder, then, that our messages sometimes turn into mushy misunderstandings as clumps of clay move from person to person, reworked, reshaped, and ever-changing.

Fortunately, there are a few simple habits that can help us all navigate our daily interactions for better communication.

The first is to recognize that passive listening and active listening are not the same.

Actively engages in verbal and non-verbal feedback from others and tailors messages to facilitate understanding.

2: Listen with your eyes, ears, and intuition.

Remember that communication is not just words.

3: When you want people to understand, take time to understand.

In our rush to express ourselves, it's easy to forget that communication is a two-way street.

Be open to what the other person has to say.

And the fourth and final thing is to be aware of your perceptual filters.

Factors of experience such as culture, community, and family influence how we see the world.

Say, "I see the problem this way, what do you think?"

Do not assume that your perceptions are objective truths.

That way, you can work on interacting with others to reach a common understanding.

I believe that large organizations have the unique potential to create change, and that we, as individuals, have the unique power to influence the direction they take.

Now, these beliefs did not come naturally to me. Because trusting big institutions was never part of my family legacy.

My mother fled North Korea when she was 10 years old.

To do so, he had to escape all the big institutions of life: repressive governments, occupying forces, and even armed border guards.

Then, when she decided she wanted to move to the United States, she had to rebel against the entire culture that girls were never the brightest and brightest.

She managed to pass government immigration to come to the United States simply because her name happened to sound like a boy.

Because of her courage and passion, I was able to take every opportunity she missed, and that changed my story.

Rather than running away from large organizations, I have run towards them.

Throughout my career, I have had the privilege of working for The Wall Street Journal, The White House, and now one of the world's largest financial institutions, where I lead sustainable investing.

Now, these institutions are like tankers, and working within them, I came to understand how big a trail they could leave, and became convinced that the nearly $290 trillion of equities and bonds in the world, the institutions of the global capital markets, could be one of the most powerful forces for positive social change at our disposal if we wanted to.

Now, I'm sure some of you are thinking about global capital markets, positive social change, not usually in the same sentence or paragraph.

I think a lot of people think of capital markets like the ocean.

It is a vast, impersonal, unsympathetic force of nature, untouched by our wishes and desires.

So the best that our little savings and retirement accounts can do is ride the waves of the good cycle and hope that they don't invade the waves of turbulence, but certainly none of our decisions about how to steer our little retirement accounts will affect the tide or change the shape, size or direction of the wave.

But why?

Because, in reality, one-third of this sea of ​​capital actually belongs to individuals like us, and most of the rest of the capital market is governed by institutions that derive power and authority and capital from us as members, participants, beneficiaries, shareholders or citizens.

So if we are the ultimate owners of the capital markets, why can't we make our voices heard?

Why can't we make waves?

So let me ask you another question. Did anyone buy fair trade coffee the last time they went to a supermarket or Starbucks?

OK. Who would go to a restaurant and order sustainably-farmed trout instead of miso-marinated Chilean sea bass that you really want?

Anyone in a hybrid or electric car?

So why do we do this?

right? One electric car out of 1.2 billion internal combustion engine cars is not a lot.

One fish is just one in the sea.

And in this crazy world, a cup of coffee doesn't turn into a pile of beans.

But we do these things because we believe that they matter, that our actions add up, and that our choices can have a huge impact on others and on the whole.

So, I have a coffee mug in my bag that I bought a few years ago.

A reusable mug. All these are printed.

See some of what is written there.

"You can use this cup as many times as you want."

``This cup may inspire others to try it.''

"This cup will help save the planet."

I didn't expect this plastic cup to be so strong.

(Laughter.) So why do we think it's important to choose $4 shade-grown, fair-trade artisanal coffee in a reusable mug, but not what to do with the $4,000 in the IRA's investment account?

Why can't we tell supermarkets and capital markets that we don't care about fair labor standards, sustainable production methods and healthy communities?

Why don't we vote with our invested money, but with our latte?

So I think it has to do with myths, allegories that we all carry around in our collective consciousness.

Remember Grimm's fairy tales about the magic porridge pot?

Say "boil, small pot, boil" to the pot, and the sweet porridge will be filled.

And if you say, "Stop, little pot, stop," it will stop.

But if you get the words wrong, you won't listen and things can go horribly wrong.

So I think we have a bit of a similar fable in our heads when it comes to markets.

We believe the market is a magic pot that follows only one command. It means "make more money".

Only words so spoken fill the pot with gold.

Adding extra words such as "protect the environment" may prevent the spell from working.

According to this fable, typing the wrong word, such as "promoting social justice," may cause the gold coin to shrink or disappear altogether.

So we asked people what they really think.

And when we actually conducted a survey of 1,000 individual investors, we found something interesting.

By far, people wanted to add an extra word to the formula.

71% said yes and were interested in sustainable investing. We define sustainable investing as taking a best-in-class investment process that is already traditionally followed and adding the additional information available when thinking about the environment, society and good governance.

71% wanted it.

72% said they believed companies that did so would actually be financially better off.

So people really believe that if they do good things, they will do well.

However, I found something strange here. Fifty-four percent of people still believe that investing in such types of stocks will yield less return.

So is it true?

Does investing in coffee instead of drinking shade-grown coffee make your porridge less sweet?

Well, investors in companies like Burt's Bees and Ben & Co., Mr. Jerry wouldn't say that.

right? Both started out as socially conscious small companies, but eventually became so popular with consumers that giants Unilever and Clorox each bought them for hundreds of millions of dollars.

But here's the important thing.

These companies realized they needed to maintain a socially conscious mission if they wanted to protect the value of their investment.

Those brands won't make more money if they don't keep adding the extra words of being green and socially responsible.

But perhaps this is just an exception that proves the rule, right?

The serious companies that fund our economy, fund our retirement, and really run the world need to stick to making more money.

So when Harvard Business School actually looked into this, they found something interesting.

Twenty years ago, if you invested $1 in a portfolio of companies with a narrow focus on increasing revenue each quarter, that $1 would have grown to $14.46.

That's not bad, until you consider that $1 has increased to $28.36 if that same dollar was invested in a portfolio of companies focused on business growth and the most important environmental and social issues.

Almost twice as sweet porridge.

Now let's be clear: they didn't get those results by handing out money to look like good corporate citizens.

They do so by focusing on what matters to their business, such as reducing energy and water waste in the manufacturing process. For example, CEO engagements can allow CEOs to incentivize long-term performance of the company and the communities they serve, not just quarterly performance, or they can build a first-class culture that drives employee loyalty, retention, and productivity.

Well, it's not just Harvard University.

The University of Oxford also conducted a research study, looking at 120 different studies that looked at the impact of sustainability and economic outcomes. Time and time again, we've found that companies that focus on these kinds of important things actually have better operating efficiencies, lower capital costs, and better share price performance.

And then there's Al Gore.

So 20 years ago, when I worked for Al Gore in the White House, he was one of the pioneers in calling on businesses and governments to pay attention to the challenges of climate change.

After working at the White House, he founded an investment firm called Generation, which has incorporated environmental sustainability and other matters into its core investment process.

And at the time, there was a fair amount of skepticism about his views.

Ten years later, his track record is yet another proof that sustainable investing, done right, is a sound investment.

By adding sustainability to the mix, far from making a less sweet porridge, it actually beats the benchmark by a wide margin.

Now, sustainable investing, the good news is that it doesn't require any magic spells, no investment secrets, and isn't just for the elite.

It's not just private equity for billionaires.

It's not just about attractive investments like clean tech or microfinance in emerging markets, or an artisanal bakery in Brooklyn.

It concerns stocks, bonds and Fortune 500 companies.

About investment trusts.

That goes for everything we already see on the market today.

This is why I believe that together we have the power to make sustainable investing the new normal.

First, the evidence is constantly emerging that sustainable investing, done right, pays off while upholding all the good principles of investing in the traditional realm.

It makes sense.

Second, our biggest obstacles may actually only be in our heads.

You just need to let go of the myth that adding your own values ​​to your investment mindset makes the porridge less sweet.

And when we get rid of allegory, we can really start to recognize these facts we've been talking about.

And third, the future is already here.

Sustainable investing today is a $20 trillion market and the fastest growing sector in the investment industry.

In the US, as you can see, we grew significantly.

Currently, under US expert control, this equates to $1 to $6.

So what are we waiting for?

For me, it goes back to my mother's inspiration.

She knew she wanted a life where she had the freedom to make her own choices, have her voice heard, and write her own story.

She was passionate about the cause and made it clear that no army, no obstacle, no large organization would stand in her way.

She emigrated to America, became a teacher, an award-winning author, and a mother, eventually sending her daughters to Harvard University.

And these days, we find her content enough to hold court at the most powerful institution in the world.

It seems too prophetic that her name means "passionate clarity" in Korean.

Passionate Clarity: I think that's what it takes to drive change.

Passion for the change we want to see in the world, and clarity that we can help point the way.

Today, we have more choices than ever before.

We have more power than ever to make our voices heard.

Let's change the point of view.

Please vote with coins.

Invest in the change you want to see in the world.

Change the fable, change the market.

thank you.

(applause)

When we hear the word radiation, we tend to think of big explosions and terrifying mutations, but that's not all.

Radiation also applies to doctors doing rainbows and x-rays.

So what exactly is radiation, and how concerned should we be about its effects?

The answer starts with understanding that the term radiation describes two very different scientific phenomena: electromagnetic radiation and nuclear radiation.

Electromagnetic radiation is pure energy consisting of interacting electric and magnetic waves that oscillate through space.

As these waves oscillate faster, their energy increases.

At the lower end of the spectrum are radio, infrared, and visible light.

At the top are UV rays, X-rays, and gamma rays.

Modern society is shaped by the transmission and detection of electromagnetic radiation.

We may download e-mails to mobile phones over the airwaves and open x-ray images. You can see this because the screen emits visible light.

Nuclear radiation, on the other hand, comes from atomic nuclei, and protons repel each other because they have a mutual positive charge.

A phenomenon known as the powerful nuclear force struggles to overcome this repulsion and keep the nucleus intact.

However, some combinations of protons and neutrons, known as isotopes, remain unstable or radioactive.

It randomly emits matter or energy known as nuclear radiation to increase its stability.

Nuclear radiation comes from natural sources such as radon, a gas that seeps through the ground.

We also refine naturally occurring radioactive ores as fuel for nuclear power plants.

Bananas also contain trace amounts of radioactive potassium isotopes.

So if we live in a world of radiation, how can we escape its dangerous effects?

First, not all radiation is dangerous.

Radiation is dangerous because it strips electrons from atoms upon impact and can damage DNA.

This is known as ionizing radiation because atoms that have lost or gained electrons are called ions.

All nuclear radiation ionizes, but only the highest energy electromagnetic radiation.

This includes gamma rays, X-rays, and the high-energy end of ultraviolet light.

That's why doctors take extra precautions during x-rays, protecting parts of the body that don't need to be examined, and beachgoers using sunscreen.

By comparison, mobile phones and microwave ovens operate at the lower end of the spectrum, so there is no risk of ionizing radiation from their use.

The greatest health risks occur when we are exposed to large amounts of ionizing radiation in a short period of time, also called acute exposure.

Acute exposure overwhelms the body's natural ability to repair damage.

This can lead to cancer, cell dysfunction, and even death.

Fortunately, acute exposures are rare, but we are exposed daily to low levels of ionizing radiation from both natural and man-made sources.

Scientists have a hard time quantifying these risks.

The human body often repairs damage from small doses of ionizing radiation, but if repair is not possible, the effects of the damage may not manifest for decades or more.

One way scientists compare ionizing radiation exposure is in units called sieverts.

Acute exposure to 1 sievert probably causes nausea within hours, and 4 sieverts can be fatal.

But our normal daily exposure is much lower.

The average person receives 6.2 millisieverts of radiation annually from all sources, about a third of which comes from radon.

Only 5 microsieverts each, so more than 1,200 dental x-rays would need to be taken to accumulate annual dose.

And remember those bananas?

Even if you could absorb all the radiation in bananas, you would need about 170 bananas a day to reach your annual intake.

We live in a world of radiation.

However, much of that radiation is non-ionizing.

For the rest, which is ionizing, our exposure is usually low, and options such as getting a radon test at home and applying sunscreen can help reduce the associated health risks.

Marie Curie, one of the early pioneers of radiation, summarized this challenge as follows: "There is nothing to fear in life, just to understand.

Now is the time to understand more and fear less. ”

Every day we face a sea of ​​decisions.

Some are small and insignificant, while others have a big impact on our lives.

For example, which politician should you vote for?

Should I give the latest diet craze a try?

Or can email make you a millionaire?

We face so many decisions that it is impossible to make the perfect choice every time.

But while there are many ways to increase your chances, one particularly effective technique is critical thinking.

It is a way of approaching questions that carefully deconstructs situations, uncovers hidden issues such as bias and manipulation, and allows you to make the best decisions.

Because if the important part sounds negative, it's kind of negative.

Instead of choosing an answer because it feels right, people who use critical thinking subject all available options to scrutiny and skepticism.

They use the tools at their disposal to remove all but the most useful and trustworthy information.

There are many ways to approach critical thinking, but here is one five-step process that can help you solve different problems.

The first is to clarify the question.

In other words, know what you're looking for.

This is not as easy as it sounds.

For example, if you're deciding whether to try the latest diet craze, other factors, such as claims to see results in as little as two weeks, can obscure your reasons for doing so.

But if you approach the situation with a clear vision of what you're really trying to achieve with your diet, whether it's weight loss, better nutrition, or more energy, you'll be able to critically sift through this information, find what you're looking for, and decide if a new fad really meets your needs.

2: Collect information.

There are many questions out there, and having a clear understanding of what the question is asking will help you determine what is relevant.

If you are trying to make dietary decisions to improve your nutritional status, you can seek expert advice or seek testimonials from others.

Gathering information will help you weigh different options and move closer to a decision that meets your goals.

3: Apply information. You do this by asking important questions.

When faced with a decision, ask yourself, "What concepts are at work?"

"What assumptions exist?"

"Is my interpretation of the information logically correct?"

For example, an email promising millions of dollars should ask, "What shapes my approach to this situation?"

"Do you think the sender is telling the truth?"

"Based on the evidence, is it logical to think that I can win the money?"

4: Consider impact.

Imagine it's election time and you've chosen a political candidate based on a promise to make petrol cheaper for drivers.

At first glance, it seems like a great thing.

But what about the long-term environmental impact?

It is important to consider the unintended consequences of easing restrictions on the cost of gasoline use, which could lead to a significant increase in air pollution.

5: Explore other perspectives.

Ask yourself why so many people are attracted to the policies of rival political candidates.

Even if you disagree with everything a candidate says, exploring all perspectives may explain why a policy that seems unreasonable to you is attractive to others.

This will help you consider alternatives, evaluate your choices, and ultimately make more informed decisions.

This five-step process is just one tool, and it doesn't eradicate hard decisions from our lives.

But it helps increase the number of positive choices we make.

Critical thinking gives us the tools to sift through oceans of information and find what we are looking for.

And it has the power to make the world a more rational place if enough of us use it.

Your wealthy and eccentric uncle has died, and you and 99 mean relatives have been invited to read his will.

He wanted to leave you all his property, but he knew that if he did, your relatives would pester you forever.

So he's relying on the fact that he's taught you everything there is to know about riddles.

Your uncle left the following note in his suicide note: "I made a puzzle.

When all 100 people answer together, split the money evenly.

But if you can spot the pattern first and solve the problem without doing all the work, you've got the whole legacy to yourself.

Good luck. "

A lawyer takes you and your 99 relatives to a secret room inside a mansion with 100 lockers. One word is hidden in each locker.

He explains: All relatives are assigned numbers from 1 to 100.

Heir 1 opens all lockers.

Heir 2 then closes every second locker.

Heir 3 changes the status of every third locker. Specifically, it closes the locker if it's open, but opens it if it's closed.

This pattern continues until all 100 people are gone.

The letter in the last locker left open will help you crack the vault code.

Before cousin Thaddeus started work, you stepped forward and told the lawyer that you knew which lockers were left open.

But how?

Pause the video now if you want to figure it out for yourself.

Answer: 3 Answer: 2 Answer: 1 The key is to realize that the number of times a locker has been touched is the same as the number of elements in the locker number.

For example, locker #6 is opened by person 1, closed by person 2, opened by person 3, and closed by person 6.

The numbers 1, 2, 3, 6 are factors of 6.

So if the locker has an even number of factors it will remain closed, and if it has an odd number of factors it will remain open.

Most lockers contain an even number of factors, which is not surprising since factors naturally pair up.

In fact, the only lockers with odd factors are perfect squares. This is because they have one factor that when multiplied together equals that number.

For locker 9, 1 opens, 3 closes, 9 opens.

3 x 3 = 9, but 3 can only be counted once.

Therefore, all perfectly square lockers remain open.

We know these 10 lockers are the solution, so open them up right away and read what's inside. "The code is that the first five lockers have only been touched twice."

Since each rocker has only two factors, 1 and itself, we know that the rockers touched twice must be prime.

So the code is 2-3-5-7-11.

A lawyer will take you to the vault and you will claim your estate.

Unfortunately, your relatives were always too busy cursing each other to pay attention to your wacky uncle riddle.

Water is virtually everywhere, from soil moisture and ice sheets to the cells in our own bodies.

The average human has a water content of 55-60%, depending on factors such as location, fat index, age and gender.

Human babies are even wetter when they are born.

It is 75% water, so it swims like a fish.

However, the water composition drops to 65% by the first birthday.

So what role does water play in our bodies, and how much do we really need to drink to stay healthy?

H20 in our bodies cushions and lubricates joints, regulates body temperature, and nourishes the brain and spinal cord.

Water isn't just in our blood.

Almost three quarters of the adult brain and heart are water.

This is almost the same as the amount of water contained in bananas.

Lungs are 83% apple-like.

And even the seemingly dry human bones are 31% water.

If we are essentially made of and surrounded by water, why do we need to drink so much?

We lose 2-3 liters of water each day through sweat, urine, bowel movements and even breathing.

These functions are essential for our survival, but we need to compensate for fluid loss.

Maintaining a balanced amount of water is essential to avoid dehydration and overhydration, both of which can have devastating effects on your overall health.

Sensory receptors in the brain's hypothalamus signal the release of antidiuretic hormone upon first detecting a drop in water levels.

Once in the kidneys, aquaporins, special channels that allow the blood to absorb and retain more water, are produced, producing concentrated, dark-colored urine.

Progressive dehydration can lead to significant drops in energy, mood, skin hydration and blood pressure, as well as signs of cognitive impairment.

A dehydrated brain works harder to accomplish the same amount of work as a normal brain and may temporarily shrink due to dehydration.

Hyperhydration, or hyponatremia, is usually caused by drinking too much water in a short period of time.

Athletes often fall victim to over-hydration because of the difficulty in regulating fluid levels under extreme physical conditions.

A dehydrated brain promotes the production of antidiuretic hormone, whereas an overhydrated brain slows or even stops antidiuretic hormone production and releases it into the blood.

The sodium electrolytes in the body are diluted and the cells swell.

In severe cases, the kidneys cannot cope with the resulting diluted urine volume.

Water intoxication then develops, which can cause headaches, vomiting, and, in rare cases, seizures and death.

But it's a pretty extreme situation.

For those fortunate enough to have access to clean drinking water, maintaining an adequate hydration system on a daily basis can be easily managed.

For a long time, conventional wisdom dictated that you should drink eight cups a day.

This estimate has since been fine-tuned.

The current consensus is that the amount of water we need to consume is highly dependent on our weight and environment.

The recommended daily fluid intake varies between 2.5 to 3.7 liters for men and about 2 to 2.7 liters for women, but this range can go up and down if you're healthy, active, older, or overheated.

Water is the healthiest hydrator, but other beverages containing caffeine, such as coffee and tea, can hydrate you as well.

And water in food accounts for about one-fifth of the H20 we consume every day.

Fruits and vegetables such as strawberries, cucumbers, and even broccoli are over 90% water and can help supplement your water intake while providing valuable nutrients and fiber.

Drinking well can also have various long-term benefits.

Studies show that optimal hydration may reduce the chance of stroke, help manage diabetes, and reduce the risk of certain types of cancer.

Either way, consuming the right amount of fluid can make a huge difference in how you feel, think, and function on a day-to-day basis.

How do schools of fish swim in harmony?

And how do the tiny cells of your brain generate the complex thoughts, memories, and consciousness that you are?

Oddly enough, these questions have the same general answer. Emergence, or the spontaneous generation of sophisticated behaviors or functions from a large group of simple elements.

Like many animals, fish live in groups, and not just because they enjoy each other's company.

It's a question of survival.

Schools of fish exhibit complex swarming behavior to escape hungry predators, but lone fish are quickly chosen as easy prey.

Now, which good fish leader is responsible?

In reality no one is, and everyone is.

So what does that mean?

While the school gracefully wiggles, turns, and seems to deliberately adjust to avoid the shark, each individual fish simply follows two basic rules that have nothing to do with sharks. One, don't get too close to your neighbor, but don't get too close, and two, keep swimming.

As individuals, fish focus on the details of these local interactions, but when enough fish join a school, something amazing happens.

The movements of individual fish are masked by shoals, an entirely new entity with its own set of behaviors.

A school is not ruled by a single fish.

Only spawns when there are enough fish according to the appropriate local rules.

It's like an accident that repeats itself over and over again, and fish across the ocean can certainly avoid predation.

And it's not just fish.

Emergence is a fundamental property of many complex systems in which elements interact.

For example, the particular way millions of grains of sand collide or roll over each other almost always produce ripples with the same basic pattern.

And when water freezes in the atmosphere, the specific binding properties of water molecules ensure the creation of radial lattices that form beautiful snow crystals.

What makes emergence so complex is that, like a car engine, it cannot be understood simply by taking it apart.

Breaking things down is a good first step towards understanding a complex system.

However, if we limit the fish population to individuals, we lose the ability to escape predators, leaving us with nothing to study.

And reducing the brain to individual neurons leaves nothing resembling how we think and act, which is notoriously unreliable, at least most of the time.

Anyway, what you're thinking right now doesn't depend on a single neuron in the corner of your brain.

Rather, the mind is born from the collective activity of a great many neurons.

The human brain has billions of neurons and trillions of connections between all those neurons.

Turning on such a complex system can lead to all sorts of weird behavior, but it doesn't.

The neurons in our brain follow simple rules, just like fish. So the activity of neurons as a group self-organizes into reliable patterns, allowing us to recognize faces, successfully repeat the same task over and over, and maintain all those silly little habits that everyone likes.

So what are the simple rules for the brain?

The basic function of each neuron in the brain is to excite or inhibit other neurons.

Connecting a few neurons into simple circuits can generate rhythmic activity patterns, feedback loops that increase or block signals, coincidence detectors, and disinhibition. In disinhibition, two inhibitory neurons can actually activate another neuron by releasing their inhibitory brakes.

As the number of connected neurons increases, increasingly complex patterns of activity emerge from the network.

Soon, so many neurons interact in so many different ways at once that the system becomes chaotic.

The trajectory of network activity cannot be easily described by the simple local circuits described above.

Nevertheless, patterns emerge from this chaos and can emerge again and again in reproducible ways.

At some point, these emerging patterns of activity become sufficiently complex that we become curious enough to begin studying their own biological origins, let alone their emergence.

And what we found in emergent phenomena at very different scales are the same salient features that fish exhibited. That is, no one or anything has to be responsible for its appearance.

With the right rules in place and a few basic conditions met, complex systems fall back into the same habits over and over again, turning chaos into order.

It applies to everything from the molecular havoc that powers our cells, to the tangled thickets of neurons that give rise to thoughts and identities, to our networks of friends and family, and even to the structure and economy of our cities on Earth.

In 1996, 56 volunteers participated in a study testing a new pain reliever called trivaricaine.

One index finger of each subject was covered with fresh pain reliever, while the other finger was left intact.

Both were then compressed with painful clamps.

Subjects reported that the treated finger was less painful than the untreated finger.

This is not surprising, but trivaricaine was not really an analgesic, just a bogus concoction with no analgesic properties at all.

Why were the students convinced that this dummy drug worked?

The answer lies in the placebo effect. It is an inexplicable phenomenon in which often counterfeit drugs, remedies and therapies that should not work miraculously make people feel better.

Doctors have used the term placebo since the 1700s when they realized the power of placebos to improve people's symptoms.

These were administered when no suitable medicine was available or when someone imagined being ill.

In fact, the word placebo is Latin for "I will please," suggesting a history of soothing troubled patients.

Placebos had to mimic the actual treatment to be convincing, so they took the form of sugar pills, water-infused injections, and even sham surgery.

Doctors soon realized there were other uses for deceiving people in this way. It's a clinical trial.

By the 1950s, researchers were using placebos as a standard tool for testing new treatments.

For example, to evaluate a new drug, half of the patients in a clinical trial may receive the real drug.

The other half receives a placebo that looks identical.

The researchers believed the results were unbiased because patients did not know whether they received genuine or unexploded items.

And if a new drug shows a significant effect compared to a placebo, the new drug has been proven to be effective.

This use of placebos is now less common due to ethical concerns.

Being able to compare a new drug to an older version or another existing drug is preferable to no treatment at all, especially for people with serious illnesses.

In these cases, a placebo is often used as a control to fine-tune the trial so that the effects of the new and old or alternative drugs can be accurately compared.

But, of course, we know that placebos have an effect of their own too.

Thanks to the placebo effect, patients experience relief from various ailments, including heart disease, asthma, and severe pain, even though they received placebo drugs and surgery.

We are still trying to figure out how.

Some believe that the placebo effect isn't real and is simply confused with other factors, such as patients falsely reporting improvements to please their doctors.

Researchers, on the other hand, believe that the hope of recovery actually triggers physiological factors that improve symptoms when people believe fake treatments are real.

The placebo appears to cause measurable changes in blood pressure and heart rate, and may trigger the release of pain-relieving chemicals such as endorphins.

This explains why subjects in pain studies often say that placebos make them less uncomfortable.

The placebo may also lower levels of stress hormones such as adrenaline, which can delay the harmful effects of the disease.

So shouldn't we celebrate the strange effects of placebos?

necessarily.

People who believe they have been cured by bogus remedies may miss out on proven medicines and treatments.

Additionally, positive effects can, and often do, wear off over time.

Placebos also cloud clinical outcomes, further motivating scientists to discover how placebos exert such power over us.

We know everything about the human body, but there are still some strange and enduring mysteries, like the placebo effect.

So what other undiscovered wonders might it include?

As we explore the world around us, it's easy to forget that one of its most fascinating subjects is right behind our eyes.

You've just reached the best part when you're telling a friend a great story and he suddenly interrupts with "alien and me" instead of "me and alien".

Most of us would probably be annoyed, but aside from the rude interruptions, does your friend have a point?

Was your sentence actually grammatically incorrect?

And if he still understood it, why would it matter?

From a linguistics perspective, grammar is the set of patterns for how words are combined to form phrases and clauses, both in spoken and written language.

Different languages ​​have different patterns.

In English, the subject is usually first, followed by the verb, then the object, but in Japanese and many other languages, the order is subject, object, verb.

Some scholars have attempted to identify patterns common to all languages, but have found few so-called linguistic universals, apart from some basic characteristics such as nouns and verbs.

And while any language needs consistent patterns to function, the study of these patterns provokes an ongoing debate between two positions known as normative and descriptive.

A gross simplification is that normatives think that a particular language should follow consistent rules, whereas descriptives think that variation and adaptation are a natural and necessary part of language.

For most of history, most languages ​​have been spoken.

However, as people became more connected and letters became more important, written languages ​​were standardized to enable broader communication and to ensure that people in different parts of the world could understand each other.

Many languages ​​have come to consider this canonical form to be the only suitable form. Even though it's just one of many types of spoken word (usually those of power).

Language purists sought to establish and disseminate this standard by detailing a set of rules that reflected the established grammar of the time.

And the rules of the written language applied to the spoken language as well.

Speech that deviated from written rules was seen as a sign of corruption or low social status, and many people brought up with such speech were forced to adopt standardized speech.

Most recently, however, linguists have understood that speech is a separate phenomenon from writing, with its own regularities and patterns.

Most of us learn to speak at an early age that we don't remember.

We shape our spoken language repertoire by unconscious habits, not by memorized rules.

Speech also uses mood and intonation to express meaning, so its structure is often more flexible and adapts to the needs of the speaker and listener.

This means avoiding complex phrases that are hard to parse in real time, making changes to avoid awkward pronunciation, or removing sounds to speed up speech.

A linguistic approach that attempts to understand and map such differences without directing the correct differences is known as descriptiveism.

Rather than determining how language should be used, it describes how people actually use language and tracks the innovations they come up with along the way.

However, while the debate between prescriptivism and descriptiveism continues, the two are not mutually exclusive.

At its best, prescriptivism helps inform people about the most commonly established patterns at a given point in time.

This is important not only in formal contexts, but also for facilitating communication between non-native speakers of different backgrounds.

Descriptivism, on the other hand, gives us insight into how our minds work and our instinctive ways of constructing our worldviews.

After all, grammar is best thought of as a set of language habits that are constantly being negotiated and reinvented by the entire group of language users.

Like the language itself, it is a wonderfully complex structure woven with the contributions of speakers and listeners, writers and readers, normists and descriptives from near and far.

There are some things we all need.

We all need air to breathe.

We need clean water to drink.

we need food to eat We need shelter and love.

Look. Romance is great too.

And we all need a safe place to pee.

(laughs) Is that so?

As a transgender person who doesn't quite fit into the gender binary, if I could change the world tomorrow and make it easier for myself, the first thing I would do would be to blink my eyes and create gender-neutral private restrooms in every public place.

(Applause.) Trans people and trans issues have been getting a lot of mainstream media attention lately.

And while this is great and necessary, most of that attention is focused on a very small group of people, most of whom are kind of rich and pretty famous, who probably don't have to worry so much about where to pee between classes at community college or where to change into gym strips at public high school anymore.

Fame and money have shielded these TV star transgender people from most of the mundane challenges other people have to deal with every day.

public restroom.

They've been a problem for me since I can remember, first when I was still a tomboy, and then they were treated as masculine-looking, primarily estrogen-based organisms.

(Laughter) Now, as a trans person, the places where I am most likely to be questioned and harassed are public restrooms and changing rooms.

I was often verbally attacked behind their door.

I was dragged out by security with my trousers half-tucked up.

I've been glared at, yelled at, whispered to, punched in the face with a little old lady's handbag, but from the looks of the polisher I brought home that day, I'm pretty sure it contained at least $70 worth of rolled change and a large collection of hard candy.

(Laughter) I know what some of you are thinking, but you're mostly right.

I can and do use the men's restroom most of the time these days.

But that doesn't solve my locker room dilemma, does it?

And I'm not a man, so I don't have to use the men's restroom.

i am transgender

And now, fear-mongering politicians continue to try to pass toilet bills.

Ever heard of these?

They are trying to enact laws that try to force people like me to use the toilets they deem most appropriate according to the gender I was assigned at birth.

And if these politicians get their way in Arizona, California, Florida, or just last week in Houston, Texas, or Ottawa, using the men's restroom won't be a legal option for me either.

And every time any of these politicians put forward these bills, I can't help but wonder who, and exactly how, would enforce such laws. right?

panty check?

TRUE.

Genital examination outside the public pool changing room?

In any event, there is no legal, ethical, or justifiable way to enforce such laws.

They exist only to foster fear and promote transphobia.

They don't make anyone safe.

But they certainly make the world more dangerous for some of us.

And meanwhile, our trans children suffer.

They drop out of school or withdraw from life entirely.

Transgender people, especially transgender and gender nonconforming youth, face additional challenges not only in swimming pools and gyms, but also in universities, hospitals and libraries.

Don't talk to me about how you treat us at the airport.

If we don't act now to make sure these places are truly open and accessible to everyone, we need to be honest and stop calling them public places.

I just have to admit that this facility is really only for people who fit into one of the two gender categories, but I'm not.

Never.

And this starts very early.

I know a little girl She is my friend's daughter.

She calls herself a tomboy.

I'm talking about cowboy boots and a yellow Caterpillar toy truck and a jar of bugs, all nine yards of it.

One time I asked her what her favorite color was.

She said to me, "It's camouflage."

(Laughter) So, that wonderful girl, she came home from school last October from kindergarten for half a day. I was harassed by other children at school when I tried to use the women's restroom.

And the teacher had already instructed her not to go to the men's restroom.

And she drank two glasses of that red juice at the Halloween party, I mean, who could resist that red juice? very good

And she couldn't hold back her pee.

She and her classmates were 4 years old.

They already felt empowered enough to crack down on her use of so-called public restrooms.

she was 4 years old.

She had already been taught the cruel lesson that kindergartens don't have bathroom doors with signs welcoming people like her.

She already knew the toilet was going to be a problem, but the problem started with herself and was hers alone.

A friend there asked me to talk to her little daughter, so I did.

I wanted to tell her that if me and her mother went to school and talked to the school, the problem would be solved, but I knew it wasn't true.

I wanted to tell her that everything would be fine when she grew up, but I couldn't.

So I asked her to tell me what happened and how it made her feel.

"It's maddening and sad," she told me.

So I told her she wasn't alone and what happened to her wasn't right and she asked me if I ever peeed in my pants.

I said yes I have, but not for really long.

(Laughter) Of course it was a lie. Because I know how I hit 42, 43, etc. Sometimes, I don't know, when I cough or sneeze, when I'm running upstairs, when I'm stretching, I pee a little bit.

don't lie

it happens. right?

I don't think she needs to know that.

(Laughter) I told her that as you get older, your bladder gets bigger.

I promised her that when she was as old as I was, she would be able to hold her pee longer.

"Until you get home?"

she asked me

I said yes, until I got home.

She seemed a little relieved by that.

So let's build a few gender-neutral single-cubicles bathrooms with small benches for changing into gym clothes.

You can't change the world overnight for your children, but you can give them a safe and private place to escape it, even if just for a moment.

This is what we can do.

So let's do it.

If you're sitting there right now already having a list of reasons in your head why this isn't a priority, why it costs too much, or are one of those telling yourself that giving transgender people a safe place to pee and change clothes supports a lifestyle choice that they feel goes against their morals, masculinity, and religious beliefs, let me appeal to the part of your mind that probably cares about the rest of us.

If you can't be bothered to care enough about people like me, what about women and girls with body image issues?

What about those who have body image issues?

What about the boy at school who is a foot shorter than his classmates and still has a lower voice?

Oh, 8th grade, what a cruel master you are.

right?

What about people with anxiety disorders?

What about people with disabilities and those who need help?

What about people whose bodies, for whatever reason, don't fit into the mainstream idea of ​​what a body should look like?

How many of us are still embarrassed or afraid to undress in front of our peers? And how many of us are holding back from doing something as important as exercise because of that fear?

Wouldn't all these people benefit from these single food stall establishments?

We can't change transphobic minds overnight, but we can work to make the world a safer place for all of us by providing a place for everyone to change.

Thank you for listening.

(Applause.) Thank you.

(applause)

Imagine a police line-up. Ten witnesses are asked to identify a bank robber who was spotted fleeing the scene of a crime.

You might think that if 6 people chose the same person, it was likely the real culprit, and if all 10 people made the same choice, the case would be rock solid, but you would be wrong.

For most of us this sounds pretty weird.

After all, much of our society relies on majority rule and consensus, whether in politics, business, or entertainment.

So it's natural to think that having more consensus is a good thing.

And, up to a point, it usually does.

However, in some cases, the closer you get to full agreement, the less reliable your results will be.

This is called the unanimous paradox.

The key to understanding this apparent contradiction is to consider the overall level of uncertainty associated with the type of situation you are dealing with.

For example, if you asked the witnesses to identify the apples in this lineup, you shouldn't be surprised by the unanimous verdict.

But if there is reason to expect some natural distribution, then we should also expect a diverse distribution.

If you toss a coin 100 times, you would expect to get heads about 50% of the time.

But when the results start to get closer to 100% heads, I suspect there is something wrong with the coin itself rather than the individual flips.

Of course, the identification of suspects is not as random as a coin toss, but neither is it as specific as distinguishing between apples and bananas.

In fact, a 1994 study found that up to 48% of Witnesses tended to pick the wrong person from a lineup, even though most of them were confident in their choices.

Fleeting memories can be unreliable, and we tend to overestimate our own accuracy.

Knowing all this, unanimous recognition seems more like a systemic error or lineup bias than some kind of guilt.

And systemic errors do not only appear in human judgment problems.

From 1993 to 2008, the same woman's DNA was found at multiple crime scenes across Europe, blaming the elusive killer known as the Phantom of Heilbronn.

But the reason the DNA evidence is so consistent is precisely because it was wrong.

All of the swabs used to take the DNA samples turned out to have been accidentally contaminated by a woman who worked at a swab factory.

In some cases, intentional fraud leads to systemic error, such as the presidential referendum held by Saddam Hussein in 2002. The referendum had a 100% voter turnout and all voted in favor of a seven-year term.

When you think about it this way, it turns out that the unanimous paradox isn't really all that paradoxical.

Unanimous agreement is ideal in theory, especially if the probability of variability or uncertainty is expected to be very low, but in practice achieving unanimous agreement in situations where full agreement is very low probably reveals hidden factors affecting the system.

We may strive for harmony and agreement, but mistakes and disagreements are to be expected in many situations.

Even if perfect results don't seem to be true, they probably are.

It begins with a tickling feeling in the throat, and then progresses to a cough.

Your muscles start to hurt, you become irritable, and you lose your appetite.

Officially, you have the flu.

It's logical to think that this disastrous combination of symptoms is the result of an infection circulating through the body, but is that really the case?

What actually makes you feel sick?

What if your body itself was causing this vicious onslaught?

We first get sick when a pathogen, like the flu virus, enters the body and infects and destroys cells.

However, this unwanted intrusion also has another effect. It is to inform the body's immune system of the plight.

As soon as an infection is noticed, the body jumps to defense.

Cells called macrophages charge in as the first line of attack, searching for and destroying viruses and infected cells.

Macrophages then release protein molecules called cytokines. The role of cytokines is to recruit and organize more virus-destroying cells from the immune system.

If this concerted effort is strong enough, the infection can be eradicated before it is noticed.

But that's just your body setting the stage for the actual action.

In some cases, the virus spreads further and spreads to the blood and vital organs.

To avoid this sometimes dangerous fate, the immune system must coordinate its activity with the brain to mount a more powerful attack.

There, unpleasant symptoms such as increased body temperature, pain, and drowsiness appear.

So why do we have these experiences?

When the immune system is severely attacked, more cytokines are secreted, triggering two reactions.

First, the vagus nerve, which travels through the body to the brain, quickly carries information to the brain stem, passing near key areas that process pain.

Second, cytokines travel through the body to the hypothalamus. The hypothalamus is the part of the brain responsible for controlling temperature, thirst, hunger, sleep, among others.

Upon receiving this message, the hypothalamus produces another molecule called prostaglandin E2 to prepare for war.

The hypothalamus sends signals directing muscle contraction, causing an increase in body temperature.

It also makes you sleepy and reduces your appetite and thirst.

But what exactly do these unpleasant symptoms mean?

Well, I'm not sure yet, but I have a theory that it helps with recovery.

The increased temperature slows down the movement of bacteria and helps the immune system destroy pathogens.

Sleep allows the body to devote more energy to fighting infections.

When you stop eating, your liver can take in more iron from your blood. Since iron is essential for the survival of bacteria, it effectively starves them.

Less thirst leads to mild dehydration, which reduces infections from sneezing, coughing, vomiting and diarrhea.

But be aware that dehydration can be dangerous if you don't drink enough water.

Even body pain can make you more sensitive, turning your attention to infected cuts that can aggravate or cause symptoms.

In addition to physical symptoms, the illness can also make you irritable, sad, or confused.

This is because cytokines and prostaglandins can reach higher structures in the brain and interfere with the activity of neurotransmitters such as glutamate, endorphins, serotonin and dopamine.

This affects areas such as the limbic system, which governs emotions, and the cerebral cortex, which is involved in reasoning.

So much of the discomfort you feel every time you get sick is actually your body's own immune response.

Unfortunately, it doesn't always work perfectly.

Most notably, millions of people worldwide suffer from autoimmune diseases. In autoimmune diseases, the immune system treats normal body cues as threats and the body attacks itself.

But for the majority of humanity, millions of years of evolution have fine-tuned our immune system to work in our favour, not against us.

The symptoms of our illnesses can be annoying, but taken together they signify an ancient process that keeps our bodies shut off from the outside world for centuries to come.

In many ways, memory shapes us, helps us remember the past, learn and retain skills, and plan for the future.

And memory does much the same for computers, which often act as an extension of ourselves. Everything in a computer's memory, whether it's a two-hour movie, a two-word text file, or the procedure to open one of them, takes the form of basic units called bits or binary digits.

Each of these is stored in a memory cell that can toggle between two possible values, 0 and 1.

Files and programs are made up of millions of bits, all processed by the Central Processing Unit (CPU), which acts as the brain of your computer.

And with the exponential growth in the number of bits that need to be processed, computer designers face a constant struggle between size, cost, and speed.

Like us, computers have short-term memory for immediate tasks and long-term memory for more permanent storage.

When you run a program, the operating system allocates space in short-term memory to execute those instructions.

For example, when you press a key in a word processor, the CPU accesses one of these locations to get a bit of data.

You can also modify them or create new ones.

The time this takes is known as memory latency.

It is also called random access memory because all locations in short-term memory can be accessed in any order, as program instructions must be processed quickly and continuously.

The most common type of RAM is dynamic RAM, or DRAM.

There, each memory cell consists of a small transistor and capacitor that stores a charge, 0 if it has no charge, and 1 if it has a charge.

Such memories are called dynamic because they retain charge for only a short time before the charge leaks out. Regular recharging is required to retain data.

However, even a low latency of 100ns is too long for modern CPUs, so there is also a small, fast internal memory cache made out of static RAM.

It usually consists of six interlocked transistors that do not need to be refreshed.

SRAM is the fastest memory in a computer system, but it is also the most expensive, taking up three times as much space as DRAM.

However, RAM and cache can only retain data while power is applied.

To retain data when the device is powered off, it must be transferred to a long-term storage device. There are three main types of long-term storage devices.

In the cheapest magnetic storage, data is stored as magnetic patterns on rotating disks coated with magnetic film.

However, the latency of such drives is 100,000 times slower than DRAM because the disk must be rotated to where the data is located in order to read it.

On the other hand, optical-based storage such as DVDs and Blu-rays also use spinning discs, but with a reflective coating.

Bits are encoded as light and dark spots using dyes that can be read by a laser.

Optical storage media are cheap and removable, but have even slower latency and smaller capacity than magnetic storage.

Finally, the newest and fastest type of long-term storage is solid state drives like flash sticks.

They have no moving parts, instead using floating gate transistors that store bits by trapping or removing charge within specially designed internal structures.

So how reliable are these billions of bits?

We tend to think of computer memory as stable and permanent, but it actually degrades fairly quickly.

The heat generated by the device and its environment eventually demagnetizes the hard drive, degrades the dyes in the optical media, and causes charge leakage in the floating gate.

Solid state drives also have their weaknesses.

Repeatedly writing to a floating gate transistor corrodes it and eventually renders it useless.

With the lifetime of data on most storage media today being less than ten years, scientists are working to exploit the physical properties of materials down to the quantum level in hopes of making memory devices faster, smaller and more durable.

For now, immortality is still out of reach for both humans and computers.

As a child, I dreamed of the sea.

It was a wild place full of color and life, inhabited by fantastical alien creatures.

I imagined giant sharks dominating the food chain, and I saw sea turtles dancing gracefully over coral reefs.

A marine biologist turned photographer, I've spent most of my career searching for the magical places I dreamed of as a child.

As you can see, I started exploring water bodies at a fairly young age.

But the first time I really went underwater was when I was about 10 years old.

And I still vividly remember using my ferocious fins to reach this old, covered cannon on a shallow reef.

And when I finally grabbed it, I looked up and was instantly surrounded by rainbow colored fish.

That was the day I fell in love with the sea.

Thomas Peschak Conservation Photographer During my 40 years on this planet, I have had the wonderful privilege of exploring some of its most stunning seascapes for National Geographic and the Save Our Seas Foundation.

I've photographed everything from really big sharks to pretty sharks that fit in the palm of your hand.

In the cold waters off Canada's Great Bear Rainforest, I once smelled the fishy breath of a feeding humpback whale a few feet away.

And I am familiar with the green turtle mating rituals in the Mozambique Channel.

Everyone on this planet affects and is affected by the ocean.

And it's getting harder and harder to find the pristine ocean I dreamed of as a kid.

They are becoming more and more compressed and more threatened.

I have witnessed and photographed many of these ramifications firsthand as we humans continue to maintain our role as primary predators on Earth.

For a long time, I thought I had to surprise the indifference of the audience with disturbing images.

This approach has its merits as well, but I've come full circle.

I believe the best way to make a difference for me is to sell love.

As a matchmaker and photographer of sorts, I consider myself blessed with a rare opportunity to reveal animals and entire ecosystems that hide beneath the surface of the ocean.

You can't love something and be its champion if you don't know it exists.

Reveal this, that's the power of archival photography.

(music) I have visited hundreds of marine locations, but only a handful of seascapes have touched me deeply and unbelievably.

The first time I experienced such elation was about ten years ago off the rugged and wild coast of South Africa.

And every June and July, giant shoals of sardines migrate northwards in what we call the 'sardine run'.

So do those fish have a good reason to run away?

Packs of hungry and agile predators are in hot pursuit.

Since common dolphins hunt together, it is possible to separate some of the sardines from the main school and create a ball of food.

They drive the fish upwards to the surface to catch them, and then rush to feast on this pulsing, moving feast.

Right behind you is a shark.

Most people now believe that sharks and dolphins are sworn enemies, but sharks and dolphins actually coexist at Sardine Run.

In fact, dolphins help sharks to feed more effectively.

In the absence of dolphins, the bait balls are more dispersed, and sharks often end up with what is often referred to as a sardine donut, a mouth full of water.

Now, having had some tough moments with sharks on sardine runs, I know they don't see me as prey.

But I, like other guests at this raucous banquet, get bumped and tail-slapped.

Head east from the coast of Africa, across the vast waters of the Indian Ocean, to the coral islands of the Maldives.

And during the stormy southwest monsoon season, manta rays from all over the archipelago come to a small spot called Hanifaru on Baa Atoll.

Large schools of crustaceans, most of which are about the size of a pupil, are the staple diet of manta rays.

When the plankton concentration becomes patchy, the manta ray feeds alone, flipping backwards many times, much like a pup chasing its own tail.

(music) However, as plankton density increases, manta rays line up from head to tail to form long feeding chains, and every delicious bite that escapes from the first or second manta in a row is inevitably eaten by the next manta and the next.

When plankton levels peak in the bay, manta rays swim closer together in a unique behavior called cyclone feeding.

And as the manta rays swarm and swirl, this multi-tiered column of manta rays creates its own vortex, sucking in plankton and sending it into the manta's spongy mouth.

The experience of diving among hundreds of clusters of rays like this is truly unforgettable.

(music) When I first photographed Hanifaru, this place was unprotected and under threat of development.

And working with NGOs like the Manta Trust, my images ultimately helped make Hanifaru a marine sanctuary.

Today, fishermen on neighboring islands once hunted these manta rays to make traditional drums from their hides.

Today, manta rays are among the most passionate conservationists, bringing over $8 million in revenue to the Maldivian economy each year.

I've always wanted to travel back in time to a time when maps were mostly blank or said "there are dragons".

And today, the closest I've ever come is visiting a remote atoll in the western Indian Ocean.

Dive into this area, far from any shipping lanes or fishing fleets, and it's an inspiring reminder of what our oceans once looked like.

Few people have heard of Bassas da India, a tiny patch of coral in the Mozambique Channel.

Its coral reefs form an outer protective barrier, while the inner lagoon is home to Galapagos sharks.

These sharks are never shy, even during the day.

I had a slight hunch that it would be more daring and more abundant at night.

(music) I've never seen so many sharks in one coral outcrop.

Capturing and sharing moments like this reminds me why I chose my path.

Earlier this year, I traveled to Baja California to cover National Geographic magazine.

And about halfway up the Pacific side of the peninsula is the San Ignacio Lagoon, an important birthing ground for gray whales.

For 100 years, this beach was the site of a mass slaughter, killing over 20,000 gray whales and only a few hundred surviving.

Today, the offspring of these same whales sometimes push their young to the surface to play and even interact with us.

(music) This species has really made a remarkable comeback.

Now, on the other side of the peninsula is the quiet fishing village of Cabo Pulmo.

Decades of overfishing have driven them to the brink of collapse.

In 1995, local fishermen convinced authorities to declare the area a marine protected area.

But what happened next can only be described as a miracle.

In 2005, after just 10 years of conservation, scientists measured the largest fish recovery ever recorded.

But don't take my word for it, come with me.

In one breath, dive deep with me into one of the largest and densest schools of fish I have ever encountered.

(music) We all have the ability to be creators of hope.

And through my photography, I hope to convey the message that it is never too late for our oceans.

In particular, we want to focus on nature's resilience in the face of 7.3 billion people.

My hope is that in the future we will have to work much harder to take pictures like this while creating images that show that we coexist in a respectful way with the ocean.

I hope they become a daily occurrence for me.

To succeed and survive in my profession, I must be a truly hopeless optimist.

And I always work on the assumption that the next great situation to affect change is just around the corner, behind the next coral head, in the next lagoon, or perhaps in the next lagoon.

(music)

Suppose you are on a game show.

By reaching the bonus space in the first round, you have already won $1000.

Well, you have a choice.

Receive a guaranteed $500 bonus or flip a coin.

If it's heads, you get a $1000 bonus.

If it's tails, you don't get the bonus at all.

In the second round, if you land in the penalty space, you've won $2000.

Now you have another option.

You can accept the $500 loss or try your luck with a coin flip.

For heads you lose nothing, but for tails you lose $1000 instead.

If you're like most people, you probably chose to take a guaranteed bonus on the first round and flip a coin on the second round.

But on second thought, this makes no sense.

Both rounds have exactly the same odds and results.

So why does the second round look so much scarier?

The answer lies in a phenomenon known as loss aversion.

Under rational economic theory, our decisions should follow simple formulas that weigh the level of risk against the amount of risk.

However, studies have shown that for many people, the negative psychological effects of losing something are about twice as strong as the positive effects of gaining the same thing.

Loss aversion is one of the cognitive biases that arises from a heuristic problem-solving approach based on past experience and intuition rather than careful analysis.

And while these mental shortcuts can lead to irrational decisions like falling in love or bungee jumping off a cliff, they lead to logical fallacies that can easily be proven wrong.

Situations involving probabilities are known to adversely affect the application of heuristics.

For example, suppose you roll a die with 4 green sides and 2 red sides 20 times.

You can choose one from the following set of rolls and if it shows up, you will win $25.

which one would you choose?

In one study, 65% of participants, all college students, chose sequence B, even though A was shorter and more likely to be in B.

This is called the connection fallacy.

Here, we expect to see more green rolls, so our brain can trick us into choosing the less likely option.

Heuristics are also generally bad at handling numbers.

In one example, students were divided into two groups.

The first group asked whether Mahatma Gandhi died before or after the age of nine, and the second group asked whether he died before or after the age of 140.

Both numbers were clearly off by a wide margin, but when the students were then asked to guess how old they actually died, the first group averaged 50, while the second group averaged 67.

The clearly incorrect information contained in the first question should have been irrelevant, but still influenced the student's estimation.

This is an example of the anchoring effect, often used in marketing and negotiations to raise the price people are willing to pay.

So why do heuristics exist if they lead to all these wrong decisions?

Well, because they can be very effective.

For most of human history, survival relied on making quick decisions with limited information.

Heuristics can save lives when you don't have time to logically analyze all possibilities.

But today's environment requires far more complex decisions, and these decisions are more biased by unconscious factors than we realize, impacting everything from health and education to finances and criminal justice.

You can't just turn off the brain's heuristics, but you can learn how to notice them.

When you come across a situation involving numbers, probabilities, or multiple details, pause for a moment and consider that your intuitive answer may not be the right one after all.

Laying out the entire text of Moby Dick, published in 1851, in a giant rectangle, you might notice some odd patterns, like the prophetic words about the assassination of Martin Luther King, and the reference to Princess Di's death in 1997.

So was Herman Melville a secret prophet?

The answer is no, and we know that thanks to a mathematical principle called Ramsey Theory.

This is why we can find geometric patterns in the night sky, why we can know that at least two people in London have exactly the same number of hairs without checking, and why patterns can be found in almost any text, including the lyrics of Vanilla Ice.

So what is the Ramsey theory?

Simply put, given enough elements in a set or structure, certain interesting patterns are bound to emerge within it.

As a simple example, let's look at a classic example of Ramsey theory called the party problem.

Suppose there are at least 6 people in your party.

Amazingly, a group of three of them can be asserted that either they all know each other or they have never met and know nothing about them.

You can demonstrate it by graphing all the possibilities.

Each dot represents a person and lines indicate that the pair know each other.

There are only two possibilities for any pair. Either you know each other or you don't.

There are many possibilities, all of which have the properties we are looking for.

Six is ​​the minimum number of guests we are guaranteed to have, and can be expressed as:

Ramsey theory guarantees that such a minimum number exists for a given pattern, but there is no easy way to find it.

In this case, as the total number of guests increases, the combinations get out of control.

For example, suppose you want to find out the minimum party size for a group of 5 people who all know each other or don't all know each other.

The number 5 is small, but it's virtually impossible to find an answer with such an exhaustive search.

Because the possibilities are vast.

A party with 48 guests has 2^(1128) possible configurations, which is more than the number of atoms in the universe.

Even with the help of computers, as far as we know, the answer to this question is between 43 and 49 guests.

What this shows is that certain patterns with seemingly astronomical probabilities can emerge from relatively small sets.

With a very large set the possibilities are almost endless.

Four stars, three of which are not in a straight line, form some kind of quadrilateral.

Extending that to the thousands of stars visible in the sky, it's no surprise that all sorts of familiar shapes and even creatures can be found if you look for them.

So what are the chances of a prophecy hidden in a document?

Well, it's quite a lot when you factor in the number of characters, the various words that can be related, and all their abbreviations and alternate spellings.

You can also try it yourself.

Just select your favorite text, place the letters in the grid and see what you can find.

Mathematician T.S. Motkin once said that "disorder is generally more likely, but complete disorder is impossible."

The size of the universe ensures that some of its random elements fall into certain arrangements, and as we have evolved to notice patterns and find signals in the noise, we are often tempted to find intentional meaning even where it might not be.

So while we may be awed by the messages hidden in everything from books to toasts to the night sky, their true origin is usually our own minds.

As your nation's top spy, you must infiltrate the Evil Syndicate's headquarters, find a secret control panel, and disable their death rays.

However, all you need to proceed is the following information collected by our monitoring team:

The headquarters is a huge pyramid with one room on the top floor, two rooms on the next floor, and so on.

The control panel is hidden behind a painting on the top floor that: Each room has three doors to other rooms on that floor. However, with the exception of the control panel room, it is only connected to one. There are no corridors and stairs are negligible.

Unfortunately there are no floor plans. You only have enough time to explore one floor before the alarm system kicks in again.

Do you know what floor the control room is on?

Stop now and solve the mystery yourself.

Answer: 3 Answer: 2 Answer: 1 To solve this problem, we need to visualize.

First, there is one room on the correct floor, let's call it Room A. There is one door to the control panel room, one door to Room B, and one door to Room C.

Therefore, there must be at least four rooms, represented by circles, with doorway lines drawn between them.

However, if room B and room C are connected, other connections will not be possible, and the 4th floor from the top will be out.

We know that the control panel needs to be as high as possible, so let's continue down the pyramid.

The 5th highest floor doesn't work either.

You can figure it out by drawing a diagram, but here's another way to make sure you're not missing out on a possibility.

All doors correspond to lines in the graph that adjoin two rooms.

Therefore, no matter how many connections are established, there must eventually be an even number of neighbors.

At the 5th highest floor, to meet the starting conditions, you need 4 rooms with 3 neighbors each and a control panel room with 1 neighbor, for a total of 13 neighbors.

This is impossible as it is an odd number and in fact all floors with an odd number of rooms are also excluded.

Now let's go down one more floor.

If you pull out the room low, you can see that it is arranged like this.

By the way, the study of such visual models that show the connections and relationships between various objects is known as graph theory.

In a basic graph, the circles representing objects are called nodes, and the connecting lines are called edges.

Researchers studying such graphs ask questions like "How far is this node from that node?"

"How many edges does the most popular node have?"

"Is there a route between these two nodes? If so, how far is it?"

Such graphs are often used to map communication networks, but they can represent almost any kind of network, from transportation connections and people's social relationships within a city, to chemical interactions between proteins and the spread of epidemics through different locations.

Now, with these techniques in hand, let's get back to the pyramid.

Avoid the guards and surveillance cameras, sneak up to the 6th floor, find the hidden panel, pull some prominent levers and let the death ray crash into the sea.

Let's solve the mystery why surveillance teams always give you cryptic information.

hello everyone.

If you like this riddle, try the next two riddles.

Okay, I want you to raise your hands, how many people have you unfriended on Facebook for making offensive comments about politics, religion, parenting, or food?

(Laughter) And how many of you know at least one person you avoid because you don't want to talk to them?

(Laughter) You know, I used to have to follow the advice of Henry Higgins of My Fair Lady to have a polite conversation. It said, "Watch out for the weather and your health."

But lately, there's been a lot of talk about climate change and anti-vaccination, and those subjects aren't (laughter) safe either.

So the world we live in, where every conversation can lead to an argument, where politicians can't talk to each other, and where even the most trivial of issues someone is fiercely fighting both for and against, is not normal.

A Pew Research survey of 10,000 American adults found that we are more polarized and divided than ever before in our history.

We are less likely to compromise. This means that we are not listening to each other.

And we make decisions about where to live, who to marry, and who to be friends with based on what we already believe.

Again, that means we are not listening to each other.

Conversation requires a balance between speaking and listening, but that balance breaks down along the way.

Well, part of that is due to technology.

A smartphone that everyone has in their hands or is so close that they can grab it right away.

About a third of American teens send 100 or more text messages a day, according to Pew Research.

And many of them, almost most, tend to text more than talk to their friends in person.

"The Atlantic" has great work.

And he gave the children a communication project.

He wanted to teach his students how to talk about certain subjects without using notes.

And he said, "I just realized..."

(Laughter) “I realized that conversational ability may be the most overlooked skill that we don't teach.

Children spend hours each day brainstorming and talking to each other through screens, but they rarely get the chance to hone their interpersonal communication skills.

It may sound like a silly question, but we have to ask ourselves. In the 21st century, what skill is more important than being able to maintain a consistent and confident conversation?”

Now, I make a living by talking to Nobel laureates, truck drivers, billionaires, kindergarten teachers, heads of state, plumbers and more.

Talk to someone you like. I talk to people I don't like.

I talk to people who deeply disagree on a personal level.

But I still have great conversations with them.

So, in the next 10 minutes, I would like to teach you how to speak and listen.

Many of you have already heard a lot of advice on this. Look the other person in the eye and think ahead of an interesting topic to discuss, look them in the eye and nod or smile to show that you are paying attention, repeat what you just heard, or summarize.

So I want you to forget all that.

that's shit

(Laughter.) You don't have to learn how to show that you're paying attention if you're actually paying attention.

(Laughter) (Applause) Now, I actually use the exact same skills as a professional interviewer in my day-to-day life.

So, I teach you how to interview people, and it actually helps you learn how to be a better conversationalist.

Learn how to talk without wasting time, getting bored, or offending anyone.

We all had really great conversations.

I have eaten there before. We know what it's like.

Conversations where you walk away feeling engrossed and inspired, or ones where you feel a real connection or complete understanding.

There's no reason why most interactions shouldn't be like that.

So I have 10 basic rules. I'll cover all of them, but honestly, if you choose one of them and master it, you'll already be having a better conversation.

Number one: don't multitask.

It doesn't mean just putting down your phone, tablet, car keys or whatever you have in your hand.

In other words, exist.

Stay in the moment.

Don't think about arguing with your boss.

Don't think about what to eat for dinner.

If you want to get out of the conversation, get out of the conversation. But don't be half in and half out of the conversation.

Second, don't be arrogant.

If you want to express your point of view without leaving room for response, debate, backlash or growth, write a blog.

(Laughter) Well, there's a good reason I don't put critics on my show. It's because they're really boring.

If they were conservative, they would hate Obama and food stamps and abortion.

If they were liberal, they would hate big banks, oil companies, and Dick Cheney.

Fully predictable.

And you don't want to be like that.

You should participate in every conversation on the assumption that you have something to learn.

Renowned therapist M. Scott Peck said that true listening requires putting yourself aside.

And sometimes that means setting aside your personal opinion.

He said that feeling this acceptance makes the speaker more vulnerable and more likely to open up to the depths of his heart to the listener.

Suppose, once again, that there is something to be learned.

Bill Nighy: "Everyone you meet knows something you don't."

I said, Everyone is an expert in something.

Third: Use open-ended questions.

In this case, take a tip from a journalist.

Start asking who, what, when, where, why and how questions.

Even if you ask a complicated question, you will get a simple answer.

When asked, "Were you scared?"

Responding to the strongest word in the sentence, 'fear', the answer is 'yes I was scared' or 'no I wasn't scared'.

"Were you angry?" "Yes, very angry."

Let them explain. They know.

Ask something like, “How did it feel?”

"What was it like?"

Then they might need to stop and think about it for a moment, and you'll get a much more interesting response.

Number 4: Go with the flow.

That is, a thought pops into your mind and you need to get it out of your head.

I often hear interviews where guests talk for a few minutes and then the host returns and asks questions that either pop out of nowhere or seem to have already been answered.

So the host probably stopped listening two minutes ago. Because he came up with this really nifty question and was bound and determined to say it.

And we do exactly the same.

We were sitting there talking to someone, and then I remembered meeting Hugh Jackman at a coffee shop.

(Laughter) And we stop listening.

Stories and ideas come to mind.

We need to let them come and let them go.

Tip 5: If you don't know, say you don't know.

Now, people on radio, especially NPR, are more aware that they're on record, so they're more cautious about what they claim to be experts on, or what they claim to know for sure.

do it. Caution is required.

Talk should not be cheap.

Number 6: Don't equate your experience with theirs.

If they're talking about losing a family member, don't start talking about when you lost a family member.

Don't talk about how much you hate your job if you're talking about a problem they're having at work.

it's not the same. It will never be the same.

All experiences are personal.

And more importantly, it's not about you.

You don't have to take the moment to prove how great you are or how much you've suffered.

When someone once asked Dr. Stephen Hawking what his IQ was, he replied, "I don't know. People who brag about their IQ are losers."

(Laughter) Conversation is not a promotional opportunity.

Number 7: Don't repeat yourself.

It's condescending and really boring, which is why we tend to do it so often.

Especially in work conversations and conversations with children, there is something I want to say, so I repeat it over and over again.

Please don't do that.

Number 8: Stay away from weeds.

Frankly, people don't care about years, names, dates, and other details that you have a hard time coming up with in your head.

they don't care You are the one they care about.

They care about who you are and what you have in common.

So forget the details. leave them alone.

Ninth: This is not the last, but the most important.

listen.

I can't count how many important people have said that listening is probably the most important skill you can develop.

Buddha said: “If your mouth is open, you are not learning,” paraphrases it.

And Calvin Coolidge said, "No one listened to me when I quit my job."

(laughter) Why don't we listen to each other?

First, we would rather talk.

When I am speaking, I am in control.

You don't have to ask anything you're not interested in.

I am the center of attention.

You can strengthen your own identity.

But there is another reason. Because it distracts you.

The average person speaks at about 225 words per minute, but we can listen at up to 500 words per minute.

So our minds are filled with the remaining 275 words.

It takes effort and energy to actually pay attention to someone, but if you can't do that, it's not a conversation.

It's just two people shouting mostly unrelated sentences in the same place.

(Laughter.) We have to listen to each other.

Stephen Covey said it so beautifully.

"Most of us don't listen with the intention of understanding," he said.

We are listening with the intention of replying. ”

One more thing, rule number 10. This is a succinct statement.

[A good conversation is like a miniskirt. Short enough to keep you interested, but long enough to cover the subject matter. -- my sister] (laughter) (applause) They all boil down to the same basic concept. It is: "Be interested in other people."

As you know, I grew up with a very famous grandfather and there was some kind of ritual in my house.

People came to talk to their grandparents, and after they left, my mother came to us and said,

She was the Miss America runner-up.

He was mayor of Sacramento.

She won the Pulitzer Prize. He is a Russian ballet dancer. ”

And I grew up thinking that everyone has something wonderful hidden about them.

I think that's what makes me a better host, to be honest.

I keep my mouth shut and my heart open as much as I can, always ready to be amazed and never disappointed.

you do the same.

Get out there, talk to people, listen to people, and most importantly, be prepared to be amazed.

thank you.

(applause)

In 1956, during a diplomatic reception in Moscow, Soviet leader Nikita Khrushchev said to Western ambassadors: "My Vas Pokhoronym!"

His interpreter translated it into English as "We will bury you!"

The statement shocked the Western world and heightened tensions between the Soviet Union and the United States in the midst of the Cold War.

Some believe that this incident alone put East-West relations back a decade ago.

After all, Khrushchev's remarks were translated a little too literally.

Given the context, his words should have been interpreted as "I will live to see you buried", a less threatening comment meaning that communism will outlive capitalism.

Although the intended meaning was eventually revealed, the initial impact of Khrushchev's obvious words set the world on a path that could lead to nuclear Armageddon.

So, given the complexity of language and cultural exchanges, how come this doesn't happen often?

Much of the answer lies in the skill and training of interpreters to overcome language barriers.

For most of history, interpreting was primarily done serially, with pauses to allow the speaker and interpreter to speak to each other.

However, after the advent of radio technology, new simultaneous interpretation systems were developed in the wake of World War II.

In Simultaneous mode, the interpreter instantly translates the speaker's words into the microphone.

Audiences can choose the language they want to hear without interruption.

On the surface, everything looks seamless, but behind the scenes, human interpreters work tirelessly to make sure every idea comes through as intended.

And it's not an easy task.

It takes approximately two years of training for an already fluent bilingual professional to expand their vocabulary and acquire the skills necessary to become a conference interpreter.

To get used to the unnatural task of speaking while listening, the student shadows the speaker and repeats every word as heard in the same language.

Over time, they begin to paraphrase what was said, adjusting the style along the way.

At some point, a second language will be introduced.

Practicing in this way creates new neural pathways in the interpreter's brain, and the constant effort of reformulation gradually becomes natural.

Over time and with a lot of effort, interpreters acquire a vast amount of knack for keeping up with speed, dealing with difficult terminology, and dealing with numerous foreign accents.

You may also rely on acronyms to abbreviate long names, choose general terms rather than specific terms, and refer to slides or other visual aids.

You can also leave the term in its original language while searching for the most exact equivalent term.

Interpreters are great at keeping their cool in the face of chaos.

Remember, they have no control over who says what or how clearly the speaker is heard.

A curveball can be thrown at any time.

They also often perform in front of thousands in very intimidating environments such as the United Nations General Assembly.

To keep your emotions in check, prepare for the assignment carefully by creating a glossary ahead of time, reading voraciously on the subject, and reviewing previous talks on the subject.

Finally, interpreters work in pairs.

While one colleague is busy translating incoming speech in real time, another provides support by searching documents, looking up words, and tracking relevant information.

Simultaneous interpreting requires a high degree of concentration, so the pair will change every 30 minutes.

Success is highly dependent on skilled collaboration.

Languages ​​are complex, and abstract or subtle concepts lost during translation can have devastating consequences.

As Margaret Atwood famously said, "War is what happens when language doesn't work."

All people's conference interpreters are aware of that and work diligently behind the scenes to ensure that never happens.

In 1997, Jeanne Calment, a French woman, died on Earth at 122 years and 164 days, making her the oldest known person in history.

Her age is astonishing, so much so that one billionaire promised $1 million to anyone who broke her record.

But in reality, living this age or beyond is a feat that very few, or perhaps none, can achieve.

The human body is not designed to withstand extreme aging.

Our service life is set at approximately 90 years.

But what does aging really mean, and how does it thwart the body's efforts to stay alive?

We intuitively know what aging means.

For some it means growing up, for others it means growing old.

However, finding a rigorous scientific definition of aging is difficult.

What we can say is that aging occurs when intrinsic processes such as sunlight, air, water, and dietary toxins interact with the environment, causing changes in the structure and function of the body's molecules and cells.

These changes in turn cause the decay of the organism and then the decay of the organism as a whole.

The exact mechanisms of aging are poorly understood.

But recently, scientists have identified nine physiological traits, ranging from genetic alterations to alterations in a central cell's ability to regenerate.

First, over time, our bodies accumulate genetic damage in the form of DNA damage.

They occur naturally when the body's DNA is replicated, but they also occur in non-dividing cells.

Organelles called mitochondria are particularly susceptible to this damage.

Mitochondria produce adenosine triphosphate (ATP), the main energy source for all cellular processes, and mitochondria regulate various cellular activities and play an important role in programmed cell death.

When mitochondrial function declines, cells and even whole organs deteriorate.

Other changes in gene expression patterns, also known as epigenetic changes, are known to occur that affect the tissues and cells of the body.

Genes that are down-regulated or expressed at low levels in newborns become prominent in the elderly, leading to the development of degenerative diseases such as Alzheimer's that accelerate aging.

Even if we could avoid all these harmful genetic changes, even our own cells can't save us.

The fact remains that cell regeneration, the essence of life, declines with age.

The DNA in our cells is packaged in chromosomes, and at the end of each chromosome are two protected regions called telomeres.

These get shorter each time the cell replicates.

When telomeres get too short, cells stop replicating and die, reducing the body's ability to self-renew.

Cell senescence progresses with age, and the cell cycle stops in dangerous situations, such as when cancer cells are proliferating.

However, this response becomes more active with age, and cells stop growing and become less capable of replicating.

Aging also involves stem cells, which are present in many tissues and have the ability to divide endlessly to replenish other cells.

As we age, the number of stem cells decreases and they tend to lose their regenerative capacity, affecting tissue regeneration and maintaining the original function of organs.

Other changes revolve around the ability of cells to function properly.

As we age, protein quality control is compromised, resulting in the accumulation of damaged and potentially toxic nutrients, leading to excessive metabolic activity that can be fatal.

Cell-to-cell communication also slows down, ultimately impairing the body's functional abilities.

There are still many unknowns about aging.

After all, is longevity as we know it due to diet, exercise, medication, or something else?

Will future technologies such as cell-repair nanobots and gene therapy artificially extend our lifespans?

And do we want to live longer than we do now?

Starting with 122 as inspiration, we never know where our curiosity will take us.

Around the world, some 60 million people have been forced from their homes to flee war, violence and persecution.

The majority of them are internally displaced, meaning they have fled their homes but are still in their own countries.

Some have fled the country across the border.

They are commonly called refugees.

But what exactly does that term mean?

Refugees have been known to the world for thousands of years, but the modern definition was drafted in the United Nations 1951 Convention Relating to the Status of Refugees in response to the massive persecution and forced displacement of World War II.

The law defines a refugee as someone who is outside the country of his nationality and is unable to return to his country of origin due to a well-founded fear of being persecuted.

That persecution may be due to race, religion, nationality, membership in a particular social group, or political opinion, and is often associated with war and violence.

Currently, about half of the world's refugees are children, some of whom are unaccompanied, making them particularly vulnerable to child labor and sexual exploitation.

Each refugee story is different, and many have to undergo perilous journeys with uncertain outcomes.

But before I tell you what their journey is like, I want to make one thing clear.

There is a lot of confusion about the difference between the terms "immigrants" and "refugees."

“Migration” usually refers to people leaving a country for reasons unrelated to persecution, such as seeking better economic opportunities or leaving drought-affected areas in search of a better environment.

Many people around the world are displaced by natural disasters, food insecurity and other hardships, but international law recognizes as refugees only those fleeing conflict and violence, good or bad.

So what happens if someone flees the country?

Most refugees' journeys are long and dangerous, with limited access to shelter, water and food.

Departures can be sudden and unexpected, so belongings can be left behind, and people avoiding conflict often do not have the necessary documents, such as visas, to legally enter another country on a plane.

Economic and political factors may prevent travel on standard routes.

This means they can usually only travel by land or sea and may have to entrust their lives to smugglers who can help them cross the border.

Some seek safety with their families, while others try to pass alone, leaving loved ones in hopes of reuniting later.

This breakup can be traumatic and unbearably long.

More than half of the world's refugees live in cities, but refugee camps run by the UN refugee agency or local governments are usually the first stop for those fleeing conflict.

Refugee camps are intended to be temporary facilities that provide short-term shelter until residents are safely returned home, integrated into the host country, or resettled in another country.

However, resettlement and long-term integration options are often limited.

Too many refugees are forced to remain in camps for years, sometimes decades.

Applying for asylum is the first legal step for asylum seekers upon entering a new country.

At the moment they are asylum seekers and cannot be formally recognized as refugees until their applications are received.

Although countries generally agree on one definition of refugee, all receiving countries are responsible for reviewing all asylum applications and deciding whether to grant refugee status to an applicant.

Different countries may have significantly different guidelines.

Host countries have several obligations to those recognized as refugees, including guarantees of minimum standards of treatment and non-discrimination.

The most basic obligation to refugees is non-refoulement, a principle that prevents states from sending individuals to countries where their lives and liberties are threatened.

In practice, however, refugees are often victims of inconsistent and discriminatory treatment.

They are increasingly forced to rebuild their lives in the face of xenophobia and racism.

And in many cases they are not allowed to work in the workforce and are completely dependent on humanitarian aid.

In addition, too many refugee children are out of school due to lack of funding for education programs.

If you trace your own family history, you may find that your ancestors were forced out of their homes at some point, fleeing war, escaping discrimination or persecution.

Now when we hear stories of refugees who are looking for new homes, it is good to remember their stories.

The Brain on Food If you sucked all the water out of your brain and broke it down into its constituent nutrients, what would it look like?

Most of the weight of the dehydrated brain is due to fat, also known as lipids.

The rest of the brain matter includes proteins and amino acids, micronutrients and glucose.

Of course, the brain is more than just a collection of nutritional parts, but each component has distinct effects on function, development, mood, and energy.

Feeling lethargic after lunch or feeling wakeful in the middle of the night may simply be the effects of food on your brain.

Among brain fats, the superstars are omega 3 and omega 6.

These essential fatty acids, which are associated with the prevention of degenerative conditions in the brain, must be obtained from our diet.

Therefore, eating omega-rich foods such as nuts, seeds and fatty fish is very important for the production and maintenance of cell membranes.

And while omegas are good fats for the brain, long-term consumption of other fats, such as trans fats and saturated fats, can harm brain health.

On the other hand, the building blocks of growth and development, the nutrients proteins and amino acids manipulate how we feel and behave.

Amino acids contain precursors to neurotransmitters, which are chemical messengers that carry signals between neurons and affect mood, sleep, alertness, weight, and more.

These are one of the reasons why we feel calmer after eating a large plate of pasta, or more aroused after a protein-rich meal.

A complex combination of compounds found in food stimulates brain cells to release the mood-altering norepinephrine, dopamine, and serotonin.

However, it is difficult to reach brain cells, and amino acids must compete for limited access.

A diet with a variety of foods helps maintain a balanced mix of brain transmitters and prevents one-sided moods.

Like other organs in our body, our brain also benefits from a steady supply of micronutrients.

The antioxidants found in fruits and vegetables strengthen the brain to fight free radicals that destroy brain cells, allowing the brain to function properly for the long term.

And without powerful micronutrients like vitamins B6, B12, and folic acid, our brains are more prone to brain disease and mental decline.

The trace minerals iron, copper, zinc and sodium are also fundamental to brain health and early cognitive development.

Large amounts of fuel are required for the brain to efficiently convert and synthesize these valuable nutrients.

The human brain accounts for only about 2% of body weight, but uses up to 20% of energy resources.

Most of this energy comes from carbohydrates, which our body digests into glucose or blood sugar.

In fact, changes in mental function are one of the main signals of nutrient deprivation, as the frontal lobe is highly sensitive to glucose depletion.

Assuming we are consuming glucose on a regular basis, what effect do the specific types of carbohydrates we eat have on the brain?

Carbohydrates come in three forms: starch, sugar, and fiber.

Most nutrition labels lump them all together into one total carbohydrate amount, but the ratio of sugar and fiber subgroups to total amounts influences how the body and brain respond.

High glycemic foods like white bread cause a rapid release of glucose into the blood, which then lowers blood sugar levels.

Your blood sugar plummets, along with your attention span and mood.

Oats, grains, and legumes, on the other hand, release glucose more slowly, helping you maintain a more steady alertness.

For sustained brain power, choosing a varied diet of nutrient-rich foods is important.

The choices you make about what you chew, chew, or swallow have direct and long-term effects on the most powerful organs in your body.

If you've had surgery, you may remember starting with 10, 9, 8 and waking up to 5 before the surgery was over.

And while it may appear asleep, it really isn't.

You were under anesthesia, which is much more complicated.

You were unconscious, but you couldn't move, you couldn't form memories, you couldn't feel pain.

Without blocking all these processes at once, many surgeries would be too devastating to carry out.

Ancient medical texts from Egypt, Asia, and the Middle East all mention early anesthetics, including opium poppy, mandrake fruit, and alcohol.

Today, anesthesiologists often use a combination of topical, inhaled, and intravenous agents to get the right balance for surgery.

Local anesthesia blocks pain signals from certain parts of the body from reaching the brain.

Pain and other messages travel through the nervous system as electrical impulses.

Local anesthetics work by setting up electric barricades.

They bind to proteins in the cell membrane of neurons that allow charged particles to pass in and out, keeping positively charged particles out.

One compound that does this is cocaine. The analgesic effects of cocaine were accidentally discovered when an ophthalmologist resident applied cocaine to his tongue.

Although it is still sometimes used as an anesthetic, many of the more common local anesthetics have a similar chemical structure and work in the same way.

But for major surgery that requires unconsciousness, you need something that affects the entire nervous system, including the brain.

That's how inhalation anesthetics work.

Diethyl ether was first common in Western medicine.

It was best known as a recreational drug until doctors began to realize that people could be unaware of the injuries they suffered under its influence.

In the 1840s, ether began to be used to sedate patients during tooth extractions and surgeries.

Nitrous oxide became popular in the decades that followed and is still used today.

However, ether derivatives such as sevoflurane are more common.

Inhalational anesthesia is usually supplemented with intravenous anesthesia, which was developed in the 1870s.

Common intravenous drugs include sedatives such as propofol, which cause unconsciousness, and opioids, such as fentanyl, which reduce pain.

These general anesthetics also appear to work by affecting electrical signals in the nervous system.

Normally, the brain's electrical signals are in a chaotic chorus as different parts of the brain communicate with each other.

This connection keeps you awake and conscious.

Under anesthesia, however, these signals became calmer and more organized, suggesting that different parts of the brain no longer interacted with each other.

There's still a lot we don't know about exactly how this happens.

Several common anesthetics bind to GABA-A receptors in neurons in the brain.

They keep the gateway open, allowing negatively charged particles to flow into the cell.

A build-up of negative charge acts like a log jam, preventing neurons from sending electrical signals.

The nervous system is full of these gated channels, controlling pathways of movement, memory and consciousness.

Most anesthetics probably affect more than one nervous system, not just one.

Many anesthetics also affect the heart, lungs, and other vital organs.

Just as early anesthetics contained well-known poisons such as hemlock and aconite, modern drugs can have serious side effects.

Therefore, the anesthesiologist must carefully monitor the patient's vital signs and adjust the drug mix as needed to mix the proper balance of drugs to produce the full range of anesthesia features.

Anesthesia is complex, but understanding how to use it has enabled the development of new and better surgical techniques.

Surgeons can learn how to routinely and safely perform caesarean sections, recanalize blocked arteries, replace damaged livers and kidneys, and many other life-saving surgeries.

And each year, new anesthesia techniques are developed to help more patients survive surgical trauma.

So go to the doctor and get tested.

Your doctor has determined that you have high cholesterol and that medications are effective in treating it.

So get the pillbox.

You have some confidence and your doctor has some confidence that this will work as well.

The company that invented it did a lot of research and submitted it to the FDA.

They studied it very carefully and, though skeptical, approved it.

They have a rough idea of ​​how it works and what the side effects are.

fine.

You have some more conversations with your doctor. And your doctor is a little concerned because you're not feeling well, you're not feeling like yourself, and you're not enjoying things in life as much as you used to.

The doctor says, 'I think you have depression.

I need to give another medicine. ”

Now, let's talk about two drugs.

This pill has been taken by millions of people, has been studied by the company, has been reviewed by the FDA, and all good.

Consider things should be fine.

Consider things should be fine.

Well, wait a minute.

How long have you studied these two together?

Well, it's very difficult to do that.

In fact, it is not traditionally done.

We rely entirely on so-called “post-market surveillance” after a drug is on the market.

How can we tell if something bad is going on between the two drugs?

three? Five? Seven?

Ask your favorite person who has several diagnoses how much medication they are taking.

Why do I care about this issue?

I think it's very important.

I am an informatics and data science expert, and in my opinion the only hope for understanding these interactions is to leverage various data sources to understand when drugs can be safely combined and when they are not so safe.

Now let's talk data science.

It starts with my student Nick.

Let's call him "Nick" because that's his name.

(laughs) Nick was a young student.

I said, 'You know, Nick, we need to understand how drugs work and how they work together and how they work separately, and we don't understand enough.

But the FDA has released an astonishing database.

A database of adverse events.

They literally published hundreds of thousands of adverse event reports from patients, doctors, companies and pharmacists on the web. It is publicly available and available for download now.

And these reports are very simple. It includes all illnesses the patient has, all medications the patient is taking, and all adverse events or side effects experienced.

It's not all of the adverse events happening in America right now, but it's from hundreds of thousands of drugs.

So I said to Nick, "Let's think about glucose."

Glucose is very important and has been found to be associated with diabetes.

Let's see if we can understand the glucose response.

I sent Nick off. Nick is back.

“Russ, I created a classifier that can look at this database and look at the side effects of a drug, and then you can know if the drug can alter glucose,” he said.

he did it In a way it was very simple.

He took all the drugs that are known to alter glucose, and many that don't, and said, "What's the difference between those side effects?"

Difference in fatigue? Do you have an appetite? in urination habits? ”

All these things combined gave him a very good predictive tool.

He said, "Russ, I can predict when a drug will change glucose with 93 percent accuracy."

I said, "Nick, that's great."

Since he is a young student, his confidence must be boosted.

"But Nick, I have a problem.

That means doctors all over the world know all the glucose-altering drugs. That's because glucose is at the core of our medical practice.

So, nice, good work, but not very interesting and not publishable. ”

(Laughter) He said, "I know, Russ. I thought you might say that."

Nick is smart.

"I thought you might say that, so I tried another experiment.

I looked at people on the two drugs in this database and looked for similar glucose change signals in people on the two drugs. Each drug alone did not change blood glucose levels, but both drugs together produced a strong signal. ”

And I said, "Oh! You're smart. Good idea. Show me the list."

There are a lot of drugs, but they are not very interesting.

But what caught my eye were two drugs on the list. Paroxetine, or the antidepressant Paxil. and pravastatin, or pravachol, a cholesterol drug.

And I said, "Hmm. Millions of Americans are taking these two drugs."

In fact, it was later found that 15 million Americans at the time were on paroxetine, 15 million on pravastatin, and 1 million on both.

So, if this machine-learning nonsensical math he did on the FDA database is actually true, it means that 1 million people could have some kind of problem with their blood sugar levels.

But I said, "I can't publish it yet because I love what you've done with machine learning, but that's not the standard evidence we have."

So you have to do something else.

Let's take a look at Stanford's Electronic Medical Records.

We have a copy available for research, but have removed the identifying information.

So I said, "Let's see if people taking these two drugs have problems with their blood sugar levels."

There are now thousands of people in Stanford University medical records taking paroxetine and pravastatin.

But we needed a special patient.

I needed a patient who took one of them to measure their blood sugar, and then went to a second visit to measure another blood sugar. All this within a reasonable period of time (2 months or so).

10 patients were found.

However, 8 out of 10 had elevated blood sugar levels when they took their second P (let's call it P and P).

Either could come first, and when the second came, glucose increased by 20 milligrams per deciliter.

Mind you, unless you're diabetic, you're walking around normally with your blood sugar around 90.

And when it hits 120, 125, doctors start thinking about the possibility of diagnosing diabetes.

So an increase of 20 is pretty significant.

I said, 'Nick, this is so cool.

But sorry, no papers yet. That's 10 patients and -- wait a minute -- you're short on patients. ”

So we said, what can we do?

So we said let's call our friends at Harvard and Vanderbilt. Harvard University in Boston and Vanderbilt University in Nashville have electronic medical records similar to ours.

One P and the other P, let's see if we can find similar patients with glucose readings in the required range.

God bless them, Vanderbilt found 40 such patients in one week with the same trend.

A similar trend was found in 100 patients at Harvard University.

Ultimately, 150 patients from three diverse medical centers were recruited and reported moderately large increases in blood sugar levels in those receiving these two drugs.

More interestingly, diabetics were excluded because they already messed up their glucose.

When the blood sugar level of the diabetic was examined, it was increased by 60 milligrams per deciliter instead of 20 milligrams.

This was a big deal, so we said, "This must be published."

It was all data evidence, FDA data, Stanford data, Vanderbilt data, Harvard data.

We had never run an actual experiment.

But we were nervous.

So Nick went to the lab while he was reviewing a paper.

I found someone who knows a lot about the lab.

I don't do that.

I take care of my patients, but I don't work as a pipette.

They showed us how to give medicine to mice.

We took mice and gave them one P, paroxetine.

Other mice were also given pravastatin.

and a third group of mice received both mice.

And surprisingly, the mice's glucose increased by 20 to 60 milligrams per deciliter.

So the paper was accepted on the basis of informatics evidence only, but I added a small note at the end that said, "By the way, when you give this to mice, the numbers go up."

It was great and the story could have ended there.

But we still have six and a half minutes.

(Laughter) So we sat and thought about this, and I don't remember who thought it, but someone said, 'Do patients on these two drugs notice the side effects of hyperglycemia?

They could and should.

How do you judge that? ”

We said, "So what are you doing?"

Taking a new drug or two makes me feel weird.

What is your occupation?

Go to Google, enter the two medications you are taking, or one, and type "side effects".

So we said, "Okay, let's ask Google if they can share their search logs so we can look at them and see if patients are doing these kinds of searches."

Sorry, Google declined our request.

So disappointed.

As I was having dinner with a colleague who works at Microsoft Research, I said, "We wanted to do this research, but Google said no. It's a shame."

He said, "I have a Bing search."

(Laughter) Right.

That is wonderful.

Now I feel like I was (laughs) I felt like I was talking to Nick again.

He works for one of the biggest companies in the world and I'm already trying to make him feel better.

But he said, "No, Russ, you may not understand.

If you use Internet Explorer to search Google, Yahoo, Bing, etc., not just Bing searches...

We then store the data for research purposes only for 18 months. ”

I said, "Now you are talking!"

This is my friend at Microsoft, Eric Horvitz.

So we did a study to define 50 words that normal people might type when they have high blood sugar, such as "fatigue," "loss of appetite," "polyuria," and "polyuria." I'm sorry, but this is one of the possible words.

So we've prepared 50 phrases that we call "Diabetes Words."

And I created a baseline first.

They found that about 0.5-1% of all searches on the Internet contained one of these words.

This is our base rate.

If you type "paroxetine" or "paxil" (they are synonyms) and either word, the percentage rises to about 2 percent of diabetes-related words if you already know the word "paroxetine."

For 'pravastatin', the percentage rises from baseline to approximately 3%.

When both "paroxetine" and "pravastatin" are present in the query, the search rate rises to 10 percent, and searches with the two drugs we were interested in plus the diabetic or hyperglycemia words increase significantly by a factor of 3-4.

When I published this, it got a lot of attention.

The reason this is noteworthy is that patients indirectly tell us their side effects through searching.

We have informed the FDA of this.

they were interested.

They're working with Microsoft and others, which have good infrastructure to do this, to set up social media monitoring programs, looking at Twitter feeds, Facebook feeds, and search logs, looking for early signs that the drugs, individually or together, are causing trouble.

What does this tell us? Why tell this story?

First and foremost, it promises big and medium-scale data that will help us understand drug interactions, and really underlying drug actions.

How do drugs work?

This has created and has created a new ecosystem for understanding how drugs work and optimizing their use.

Nick continued. He is now a professor at Columbia University.

He did this for hundreds of drugs during his PhD.

He found some very important interactions, so we replicated them to show that this is a method that actually works for finding drug-drug interactions.

However, there are some points.

We don't just use multiple drugs at once.

As I said before, we have patients on drugs 3, 5, 7 and 9.

Have they been studied for 9-way interactions?

Yes, A and B, A and C, and A and D can be paired, but what if A, B, C, D, E, F, and G are all used together, taken by the same patient, and possibly interact in ways that make them more effective, less effective, or cause unexpected side effects?

I really don't understand.

Using data to try to understand drug interactions is a blue sky for us.

Two more lessons: think about the power we were able to create with data from people who volunteered side effects, through pharmacists, through ourselves, through doctors, through those who allowed the Stanford, Harvard, and Vanderbilt databases to be used in their research.

People worry about data.

They worry about their privacy and security. It should be.

We need a secure system.

But you can't have a system that blocks that data. Because data is too much of a source of inspiration, innovation and discovery for new things in medicine.

The last thing I want to say is that in this case we found two drugs and it was a bit of a sad story.

These two drugs really caused problems.

They increased glucose.

The two drugs should be used very carefully, possibly not together, and different prescribing choices should be made because they can cause diabetes in people who are not naturally diabetic.

But there was also another possibility.

We could have found two or three drugs that interacted in a beneficial way.

Either drug could have discovered new effects that do not exist on their own, but in combination they could provide new treatments for untreatable or ineffective ailments, instead of causing side effects.

When we think about drug treatments today, big advances like HIV, tuberculosis, depression, and diabetes are always mixtures of drugs.

The benefits here, and a subject for another TED Talk another day, are: How can we use the same data sources to find new treatments, new insights into how drugs work, and better effects of drug combinations that enable us to better care for our patients?

thank you very much.

(applause)

A weaker team beating a better team.

A penalty shot at the last minute to win the tournament.

A montage of high energy workouts.

Many people love to celebrate victories on the field, cheer for their favorite team, or play sports.

But here a question arises. Should we be so obsessed with sports?

Is playing sports actually as good for us as we think it is, or is it just a fun and entertaining pastime?

What does science say?

First of all, it is widely accepted that exercise is good for the body and mind, and it is absolutely true.

Exercise, especially when you're young, has all sorts of health benefits, including strengthening your bones, removing bad cholesterol from your arteries, and reducing your risk of stroke, high blood pressure, and diabetes.

Our brain also releases many chemicals such as endorphins during training.

These natural hormones regulate pain and pleasure responses in the central nervous system and can cause euphoria, the so-called runner's high.

In general, increased endorphins and consistent physical activity lead to better focus, improved mood and memory.

So does that mean that going to the gym five days a week is as beneficial as joining a team and competing?

Now here's where it gets interesting. Because research shows that if you can find a sport and team you love, there are all sorts of benefits beyond the physical and mental benefits of exercise alone.

Most importantly, there are short-term and long-term psychological benefits.

Some of them stem from the shared experience of being part of a team. For example, we learn to trust and depend on others, to accept help, to give help, and to work together towards a common goal.

Plus, joining a team and doing something fun can help you establish a regular exercise routine.

Participation in school sports has also been shown to reduce the risk of developing depression for up to four years.

Meanwhile, your self-esteem and self-confidence can greatly increase.

There are several reasons for that.

One is found during training.

Just working on and working on your skills, especially under the guidance of a good coach, strengthens the growth mindset within you.

It means, "Even if you can't do it today, you can improve it with practice, and eventually you can achieve it."

That way of thinking is useful in every field.

And one of the most transformative and long-term benefits of playing sport is learning through failure.

The experience of accepting defeat can build the resilience and self-awareness needed to cope with academic, social and physical hurdles.

So even if your team isn't winning all the time, or even never, experience can be of great benefit.

Now, not everyone can enjoy every sport.

Perhaps one team is either too competitive or not competitive enough.

It can also take time to find a sport where you can play to your strengths.

No problem at all.

But if you take your time looking, you can find a sport that fits your needs. Then you will get so many benefits.

Be part of a supportive community, have fun, build confidence, get fit and nourish your mind.

The most basic function of body fat is self-storage of food.

In prehistoric times, natural selection favored genotypes that stored the most fat and could withstand harsh conditions.

Because chronic malnutrition was the norm for most of human history, genetics evolved to favor fat storage.

So when did body fat become a problem?

The negative effects of being overweight were not even noted in the medical literature until the 18th century.

Since then, technological advances and public health measures have increased the quantity, quality and variety of food.

The continued abundance of good quality food has enabled a healthier population to thrive economically.

Production has increased, and with it leisure time and waistlines.

By the mid-nineteenth century, excessive overweight or obesity was recognized as a cause of poor health, and a century later declared fatal.

What is the difference between overweight and obesity?

A calculation called BMI calculates your BMI.

For example, if you weigh 65 kilograms and are 1.5 meters tall, your BMI is approximately 29.

Obesity is a condition of excess body fat that occurs when a person's BMI is above 30, just above the overweight range of 25 to 29.9.

BMI is a useful estimate of your healthy weight, but your true body fat percentage can only be determined by also considering information such as waist circumference and muscle mass.

For example, athletes are naturally born with a high BMI.

So how do people become obese?

At its most basic, obesity is caused by an energy imbalance.

When energy input from calories is greater than energy output from physical activity, the body stores excess calories as fat.

Most of the time, this imbalance is caused by a combination of circumstances and choices.

Adults should exercise at least 2.5 hours each week and children should exercise at least 1 hour per day.

But globally, 1 in 4 adults and 8 in 10 adolescents are inactive.

Eating more, combined with high-calorie processed foods and prevalent marketing, leads to passive overeating.

And scarce resources and lack of access to healthy, affordable food pose an even greater risk in disadvantaged communities.

But our genetic makeup is also involved.

Studies of families and separated twins show a clear causal link between weight gain and genetics.

Recent studies have also found an association between obesity and variations in the bacterial species that inhabit the digestive system.

Whatever the cause, obesity is a global epidemic.

The odds of diseases such as diabetes, heart disease, stroke, high blood pressure, and cancer are greatly increased.

The disease affects virtually all age, gender and socioeconomic groups in both developed and developing countries.

With a 60% increase in childhood obesity globally in just 20 years, the problem is too serious to ignore.

Once obese, the road to recovery becomes progressively more difficult.

Hormonal and metabolic changes make the body less responsive to overeating.

After losing weight, a formerly overweight person will burn fewer calories doing the same exercise as someone who was originally the same weight, and it will be much more difficult to shed excess fat.

And as we gain weight, damaged signaling pathways make it increasingly difficult for the brain to measure food intake and fat stores.

However, there is some evidence that well-monitored long-term behavioral changes can lead to improvements in obesity-related health problems.

Also, weight loss through sustained lifestyle changes and invasive treatments such as bariatric surgery may improve insulin resistance and reduce inflammation.

What was once a survival advantage is now a disadvantage.

As the world's population slows and continues to grow, exercising and eating consciously to reach a healthier weight is essential to our overall well-being.

And with the epidemic affecting all countries of the world for a variety of socioeconomic reasons, obesity cannot be viewed as an isolated problem.

More global precautions are essential to managing the world's weight.

In this dystopian world, the resistance group is humanity's last hope.

Unfortunately, you were captured by an oppressive ruler and brought to the ancient Colosseum for horrifying entertainment.

A numbered corridor can be seen leading outside before being thrown into the dungeon.

However, each exit is blocked by an electric barrier with a compound keypad.

You learn that one of them will be allowed to attempt an escape by passing the challenge, and all the rest will become food for the mutant salamanders the next morning.

With perfect logical reasoning, Zara is clearly chosen.

You hand her a hidden audio transmitter so others can hear along.

As Zara is taken away, her footsteps echo in one of the corridors and she stops.

A voice announces that you must enter a code consisting of three positive integers in ascending order. That is, the second number is greater than or equal to the first number, the third number is greater than or equal to the second number, and so on.

She can ask for up to three clues, but guessing wrong or saying something else will send her back into the dungeon.

For the first clue, the voice says that the product of three numbers is 36.

When Zara asks for the second clue, it turns out that the sum of the numbers is the same as the hallway number she entered.

A long silence follows.

Zara is supposed to remember the hallway number, but there's no way for you to know it and she can't say it out loud.

If Zara could enter the passcode at this point, she would instead ask for a third clue, telling her that the highest number in the combination would appear only once.

After a while, the sound of the electric barrier stopped for a few seconds, and I realized that Zara had escaped.

Unfortunately, her transmitter is no longer in range, so this is the only information we have.

Can you find a solution?

Pause on the next screen to find the solution.

3 2 1 You're worried about the fact that you don't know Zara's hallway number, but you've decided to start over anyway.

From the first clue, calculate all 8 possible combinations that yield 36 products.

One of these should be correct, but which one?

Now comes the hard part.

We don't know what numbers we're looking for, but we decide to calculate the sum of the three numbers in each combination.

Then it hits you.

All but two of the totals are unique, and if the hallway number matched any of these, Zara would have known the correct combination on the fly without asking for a third clue.

Since she asked for clues, the hallway number should have matched 13, the only sum that appears more than once on the list.

But which of the two combinations that add up to 13 is 1,6,6 or 2,2,9?

That's where the third clue comes into play.

It states that the largest number must be unique, so 2, 2, 9 must be the code.

At night, you and the others walk through Hallway 13 and join Zara outside.

You freed yourself through math and logic.

Now is the time to liberate the rest of the world.

What does the French Revolution have to do with when NASA accidentally crashed a $200 million rover onto the surface of Mars?

Actually everything.

This crash was caused by a conversion error between the two measurement systems, US Customary Units and their S.I (metric) equivalents.

So what does it have to do with the French Revolution?

Let me explain.

For much of the recorded history of mankind, units such as the weight of grain and the length of a hand were not exact and varied from place to place.

And it's not just the measurements that are used in different regions that are different.

The numbering system was also completely different.

By the late Middle Ages, the Hindu-Arabic decimal system had largely replaced Roman numerals and fractions in Europe, but efforts by scholars such as John Wilkins to promote a standard decimal-based scale were less successful.

With 250,000 different units in France alone, extensive changes would require massive disruption.

And in 1789 the confusion happened.

The leaders of the French Revolution did more than just overthrow the monarchy.

They sought to completely transform society according to the rational principles of the Enlightenment.

When the new government came to power, the Academy of Sciences was convened to reform the measurement system.

Old standards based on arbitrary authority and local traditions have been replaced by mathematical and natural relationships.

For example, the Greek word for "measure", the meter, was defined as 1/10,000,000 between the equator and the North Pole.

And the new metric system was, in the words of the Marquis de Condorcet, "for all people, eternal."

Standardization of measurements also had political advantages for revolutionaries.

The nobility could no longer manipulate the local units to collect more rent from the commoners, allowing the government to collect taxes more efficiently.

And when we switched to a new 10-day-week Republican calendar, Sunday was removed, reducing the power of the church.

Deploying this new system was not easy.

Actually it was a bit confusing.

Initially, people used the new unit alongside the old one, but the Republican calendar was eventually abandoned.

When Napoleon Bonaparte came to power, he allowed small businesses to use traditional measurements redefined in the metric system.

However, the metric system remained the standard for official use and spread across the continent along with the borders of France.

Napoleon's empire lasted eight years, but his legacy lasted even longer.

Some European countries reverted to old measurements upon independence.

Some have recognized the value of standardization in the age of international trade.

After Portugal and the Netherlands voluntarily switched to the metric system, other countries followed suit, and colonial empires spread the system around the world.

As France's main rival, Britain resisted revolutionary ideas and maintained a traditional force.

Over the next two centuries, however, the British Empire slowly transitioned, first accepting the metric system as an optional choice and then gradually adopting it formally.

But the switch came too late for the 13 former colonies that had already gained independence.

The United States of America adheres to colonial British units and is still one of only three countries that have not fully embraced the metric system.

Despite continued efforts at quantification, many Americans find units such as feet and pounds more intuitive.

And ironically, some see the once-revolutionary metric system as a symbol of global conformity.

Nevertheless, the metric system is almost universally used in science and medicine and continues to evolve according to its original principles.

For a long time, standard units were actually defined by carefully maintained physical prototypes.

But thanks to improved technology and precision, these objects with limited access and unreliable lifetimes are now being replaced by standards based on universal constants like the speed of light.

Consistent measurement is such an integral part of our daily lives that it's hard to see how much of an achievement it is for humanity.

And just as the metric system was born out of political revolutions, it remains important to future scientific revolutions.

I am the textile artist most widely known for starting the yarn bombing movement.

Yarn bombing is about bringing knitting and crocheting materials into the urban environment like graffiti. More specifically, take it out without permission and without permission.

But when I started this over ten years ago, I didn't have the words to describe it, I didn't have an ambitious concept for it, I didn't have a grand vision.

All I wanted to see was something warm and fluffy and human in the cold steel gray façade I saw every day.

Then I wrapped the door handle around it.

I call it Alphapeace.

Little did I know that this little piece of work would change the course of my life.

The reaction was obviously interesting.

It intrigued me, and I thought, "What else could I do?"

Is it possible to do something in the public domain that would get a similar response?

So I wrapped a stop sign pole near my house.

The reaction was wild.

People were parking their cars, getting out of their cars, staring at it, scratching their heads, staring at it, taking pictures, taking pictures next to it. All of that really got me excited and made me want to build a stop sign pole for every single one in my neighborhood.

And the more I did it, the stronger the response.

So at this point I was hooked.

i'm addicted

All this was enchanting.

I found a new passion and the urban environment became my playground.

This is part of my early work.

I was very intrigued by this idea of ​​enhancing the mundane, the mundane, and even the ugly, to simply create a knit and well-tailored suit without stripping it of its identity or functionality.

And this was fun for me.

I really enjoyed bringing inanimate objects to life.

So...

I think everyone understands there's humor in this, but -- (laughter) it was at a point where I wanted to take it seriously.

I wanted to analyze it.

I wanted to know why I was letting this take over my life, why I was so passionate about it, and why other people were responding so strongly to this.

And then I realized something.

We all live in this fast-paced digital world, yet still crave and desire things we can relate to.

I think we've all become desensitized to the overdeveloped cities we live in, the billboards and advertising, and the huge parking lots. And I stopped even complaining about them.

So when I stumbled upon a stop sign pole wrapped in knitting, which seemed very out of place, but gradually – oddly enough – I found a connection with it, that's the moment.

Those are the moments I love and want to share with others.

So at this point, my curiosity was heightened even more.

From fire hydrants and stop sign poles, we explored what else we could do with this material.

Could it be something massive and insurmountable?

Then the bus came.

This was a real game changer for me.

I will always have a soft spot in my heart for this piece.

At this point, my work was recognized, but there were not many large-scale knit wrappings in the world, and this was definitely the first time I had knitted a city bus.

So at the moment I am experiencing or witnessing something interesting.

I may have started yarn bombing, but I certainly don't own it anymore.

It had reached global status.

People all over the world were doing this.

And I know this because while traveling to certain parts of the world I've never been to, I've tripped over a stop sign pole and found I didn't wind it up.

So this has been a lot of my recent work as I pursue my own goals in my art, but so has yarn bombing.

And that experience showed me the hidden power of this craft and that there is a common language that I can share with the rest of the world.

Through this grandma's hobby, this humble hobby, I found common ground with people I never thought I would relate to.

So when I tell my story today, I also want to say that hidden power can be found in the most obscure places and we all have skills waiting to be discovered.

When you think about our hands, these tools that are connected to us, and what they can do—build houses and furniture or paint giant murals—most of the time we're holding onto a controller or a cell phone.

And I am completely guilty of this too.

But come to think of it, what would happen if we put these things down?

what would you make? What would you make with your own hands?

Many people think I'm a master at knitting, but I've never actually been able to knit a life-saving sweater.

But I did something interesting with knitting that I had never done before.

Also, I wasn't supposed to be an artist in the sense that I had no formal training to be an artist. Actually, I'm a math major.

So while I knew this wasn't in the cards for me, I also know I didn't stumble upon this.

And when this happened to me, I held on tight and fought for it, and I'm proud to say I'm a working artist now.

So as we think about the future, know that your future may not be so seamless.

And one day you might get bored as I did and knit a door handle to change the world forever.

thank you.

(applause)

Charles Osborne started getting hiccups after a pig fell on him in 1922.

He was not cured until 68 years later, and is now listed in the Guinness Book of World Records as the world record holder for hiccups.

Meanwhile, Florida teen Jennifer Mee may hold the record for most frequent hiccups at 50 per minute for over four weeks in 2007.

So what causes hiccups?

Doctors point out that hiccups are often caused by stimuli that stretch the stomach, such as swallowing air or eating or drinking too quickly.

Some people associate hiccups with intense emotions and reactions, such as laughter, sobbing, anxiety, and excitement.

Let's see what happens when the hiccups appear.

It begins with an involuntary spasm or sudden contraction of the diaphragm, the large dome-shaped muscle under the lungs that it uses to draw air.

Shortly after this, the vocal cords abruptly close, opening an opening between them called the glottis.

Movement of the diaphragm initiates a rapid inhalation of air, but closure of the vocal cords prevents air from entering the trachea and reaching the lungs.

In addition, a characteristic sound called "hick" is also generated.

To date, there is no known function against hiccups.

They do not appear to offer any medical or physiological benefit.

Why do we suddenly stop actually getting air into our lungs when we start breathing in?

Anatomical structures and physiological mechanisms without a clear purpose pose challenges for evolutionary biologists.

Do such structures serve some hidden function yet to be discovered?

Or are they relics of our evolutionary past, where they once served an important purpose but remain today as relics?

Some believe that hiccups began millions of years before humans appeared.

Lungs are thought to have evolved as a structure that allowed early fish, many of which lived in warm, stagnant waters with little oxygen, to take advantage of the abundant oxygen in the air overhead.

When the offspring of these animals later migrated onto land, they transitioned from gill ventilation to lung air breathing.

This is similar to the more rapid changes that today's frogs face as they transition from tadpoles with gills to adults with lungs.

This hypothesis suggests that hiccups are remnants of ancient water-to-land transitions.

Inhalation, which may move water up the gills, followed by rapid closure of the glottis, prevents water from entering the lungs.

It is supported by evidence suggesting that the neural patterns involved in generating hiccups are nearly identical to those involved in respiration in amphibians.

Another group of scientists believe that this reflex still remains in us today because it actually provides important benefits.

They point out that true hiccups are found only in mammals and not in birds, lizards, turtles, or other animals that only breathe air.

Additionally, hiccups appear in human babies long before birth and are much more common in infants than adults.

Their explanation for this involves mammal-specific nursing activities.

The ancient hiccup reflex may have been adapted by mammals to help remove air from the stomach as a kind of glorified burp.

Sudden expansion of the diaphragm pushes air up from the stomach, and closure of the glottis prevents milk from entering the lungs.

We try home remedies because hiccups can go on and on. Drinking a glass of cold water, holding your breath, taking a sip of honey or peanut butter, blowing into a paper bag, suddenly feeling scared.

Unfortunately, scientists have not yet tested whether one treatment is more effective or more consistently effective than others.

However, I know one thing that will definitely not work.

Imagine you are at a game show and have a choice between two prizes: diamonds or a bottle of water.

It's an easy choice.

Diamonds are clearly more valuable.

Now imagine being given the same choice again. This time it's not a game show, it's when I'm dehydrated in the desert after days of walking around.

would you choose differently?

why? Aren't diamonds still worth more?

This is the value paradox famously explained by the pioneering economist Adam Smith.

And what this shows us is that the definition of value is not as simple as it seems.

In game shows, we were thinking about the exchange value of each item, what it would give us later, but in emergency situations like the desert scenario, much more important than that is their use value — how useful they are in the current situation.

And since you can only choose one of the options, you also have to consider the opportunity cost, what you lose by giving up the other option.

After all, it doesn't matter how much money you make selling diamonds if you can't get out of the desert.

Many modern economists attempt to integrate these considerations under the paradox of value, the concept of utility, the degree to which something satisfies a person's wants and needs.

Utility can be anything from a basic need for food to the joy of listening to your favorite song, but it naturally varies from person to person and situation to situation.

A market economy provides an easy way to track utility.

Simply put, the usefulness of something to you is reflected in how much you are willing to pay for it.

Now imagine yourself back in the desert. This time you will be offered a new diamond or a fresh bottle of water every 5 minutes.

If you're like most people, you'll choose as much water as you can afford to travel, and then as many diamonds as you can carry.

This is due to something called marginal utility, which means that when choosing between diamonds and water, you compare the utility you get for each additional bottle of water to each additional diamond.

And do this every time an offer is made.

Your first bottle of water is worth more than any diamond, but in the end you will have all the water you need.

After a while, each additional bottle becomes a burden.

That's when you start choosing diamonds over water.

It's not just essentials like water.

When it comes to most things, the more you get, the less useful or fun it gets.

This is the law of diminishing marginal utility.

You may happily buy two or three bowls of your favorite food, but by the fourth bowl you will feel nauseous, and by the hundredth bowl it will spoil before you can eat it.

Or you can pay to watch the same movie over and over again until you get bored or run out of money.

Either way, eventually you'll reach a point where the marginal utility to buy another movie ticket becomes zero.

Utility doesn't just apply to buying things, it applies to every decision we make.

And the intuitive way to maximize it and avoid diminishing returns is to change how you use your time and resources.

After your basic needs are met, in theory you decide to invest in options only if they are useful or enjoyable.

Of course, how effectively any of us can maximize utility in real life is another matter.

But it's helpful to remember that the ultimate source of value comes from us, our shared needs, the things we enjoy, and the choices we make.

So I did an experiment a while back.

For a year, I said yes to everything that scared me.

Anything that made me nervous or pushed me out of my comfort zone forced me to say yes to myself.

Did you want to speak in public?

No, but yes.

Want to be on live TV?

No, but yes.

Have you ever wanted to try acting?

No, no, no, but yes, yes, yes.

And then something incredible happened. The very act of doing what I was afraid of took away the fear and made it less scary.

No more fear of public speaking, no more social anxiety.

It's amazing, the power of one word.

"Yes" changed my life.

"Yes" changed me.

But there was one special “yes” that made the deepest impact on my life in a way I never imagined. It started with a question from my toddler.

I have three wonderful daughters, Harper, Beckett and Emerson. As a toddler, Emerson inexplicably calls everyone "Honey."

She looks like a southern waitress.

(Laughter) "Honey, I need milk for my sippy cup."

(Laughter) One night, as I was on my way somewhere, a Southern waitress asked me, ``Let's hang out,'' and I said, ``Yes.''

And that Jesus was the beginning of a new way of life for my family.

I vowed that from now on, if any child asks me to play, no matter what I do or where I go, I will always say yes.

largely. I'm not perfect, but I practice hard.

And it had a magical effect on me, my children, and our family.

But it also has surprising side effects, and it's only recently that I fully understood that saying yes to playing with my kids could save my career.

See, I have what most people call a dream job.

I am a writer. I imagine I make something for a living.

what you really want.

no.

I'm a titan

what you really want.

I am making a TV. I am a television executive producer.

I'm making a TV We make a lot of TVs.

One way or another, this TV season, I am responsible for bringing about 70 hours of programming to the world.

Four TV Shows, 70 Hours of TV -- (Applause) Three shows, sometimes four, are being produced at the same time.

Each show creates hundreds of jobs that didn't exist before.

Budgets for a single episode of network television range from $3 million to $6 million.

Let's say only five.

4 shows with a new episode every 9 days, so every 9 days, $20 million worth of TV, 4 TV shows, 70 hours of TV, 3 shows at a time, sometimes 4, 16 episodes in progress at any given time. 24 episodes of "Grey's", 21 episodes of "Scandal", 15 episodes of "How To Get Away With Murder", 10 episodes of "The Catch", or 70 hours of television. $350 million a season.

On Thursday nights in America my TV shows run in quick succession.

My shows are broadcast in 67 languages ​​in 256 territories around the world and are watched by 30 million viewers.

My brain is global, and 45 out of 70 hours of television are shows I personally created, not just produced. So, more than anything else, you need to find the time to be really quiet and creative, where you gather your fans around the campfire and tell your story.

Four TV shows, 70 hours of TV, three shows produced at the same time, possibly four $350 million productions, and campfires burning all over the world.

Do you know who else does that?

No one, so like I said, I'm a giant.

what you really want.

(Applause.) Now, I'm not saying this to impress you.

I say this because I know what you think of when you hear the word "writer."

I say this because I want all of you hard working people, whether you run a company, run a country, run a classroom, run a shop, run a home, take me seriously when I talk about work. Then you'll understand that I'm not poking around and imagining computers all day. So you'll hear me when I say I understand that dream jobs aren't about dreaming.

It's not all work, all work, all reality, all blood, all sweat and tears.

I work very hard and I love it.

When you're working hard, there are no other emotions.

For me, my job has always been to build a nation out of nothing.

It commands an army. I am painting on canvas.

It makes all the high notes. It's running a marathon.

it's beyonce.

And it's all of them at the same time.

I love working

It's creative, mechanical, exhausting, exhilarating, hilarious, disturbing, clinical, maternal, cruel and thoughtful, and what makes it all so good is the hum.

When things go well, something changes within you.

A hum starts in my brain and it gets louder and louder and that hum sounds like an open road and I can drive it forever.

And when I try to explain this hum, many people think I'm talking about writing, and that my writing is what brings me joy.

Don't get me wrong, it is.

But this hum, I discovered this thing, this topic, this rush, this hum, it wasn't until I started making television, working, making, making, making, collaborating.

A hum is more than writing.

A hum is motion and activity. A hum is a drug.

A hum is music. The hum is light and airy.

This hum is God whispering in my ear.

And when you're humming like that, you can't help but strive for greatness.

The feeling compels us to strive for greatness at all costs.

It's called ham.

Or you might call me a workaholic.

(Laughter) You might call it genius.

You might call it the ego.

Maybe it's just fear of failure.

don't know.

All I know is that I'm not made to fail, and that I love the hum.

But I know I want to say I'm a giant, and I know I don't want to question it.

But the problem is, the more successful I am, the more shows, the more episodes, the more barriers are broken, the more work to be done, the more balls in the air, the more attention I get, the more history I get, the more expectations I have.

The more you work to be successful, the more effort it takes.

And what did I say about work?

I love working, don't I?

The country I'm building, the marathon I'm running, the army, the canvas, the high notes, the hum, the hum, the hum.

I like that hum. I love that hum.

I need that hum. I'm that ham

Am I anything but that hum?

And then the hum stopped.

Overworked, overworked, overworked, burnt out.

The hum has stopped.

By now my three daughters are used to the truth that their mother is a working giant.

Harper tells people, "I don't have a mom, but you can text the nanny."

And Emerson says, "Honey, I want to go to Shondaland."

They are children of giants.

they are baby titans.

They were 12, 3 and 1 when the hum stopped.

The engine hum is gone.

I stopped loving my job. The engine could not be restarted.

The hum did not return.

My hum broke.

I was doing the same things as always, all the same giant jobs, working 15 hours a day, working all weekend, no regrets, never surrendering, giants never sleep, giants never quit, full stomachs, clear eyes, yada, whatever.

But there was no hum.

There was silence inside me.

4 TV shows, 70 hours of TV, 3 shows produced at the same time, sometimes 4 shows.

I was a perfect giant.

I was a giant who could take me home to my mother.

All the colors were the same and it wasn't interesting anymore.

And it was my life.

That was all I did.

I was Ham and Ham was me.

So what do you do when what you do, the work you love, starts to taste like dust?

Now I know someone is thinking 'run the river, stupid writer giantess woman'.

(Laughter) But you know, if you make something, if you work, if you love what you do, if you become a teacher, if you become a banker, if you become a mother, if you become a painter, if you become Bill Gates, if you just love someone and it makes a hum, if you know that hum, if you know what that hum feels like, if you've heard that hum, if that hum stops, who are you?

what are you?

what am i

am i still a giant

If my heart stopped singing, could I live in silence?

And a Southern waitress toddler questioned me.

I was running out the front door, and I was running late, and she said, "Mommy, do you want to play?"

And when I tried to say no, I realized two things.

First, I should say yes to everything, and second, my southern waitress didn't call me "honey."

She no longer calls anyone "honey".

when did that happen?

I have lost it, become a giant and mourn my hum, but here she is changing before my eyes.

So she said, "Mommy, do you want to play?"

And I say yes.

Nothing special.

We played, her sisters joined us and we had a lot of laughs. And I did a dramatic reading of the book "Everybody Poops."

Nothing out of the ordinary.

(Laughter.) Still, it's an anomaly. Because in my pain and panic, in my homeless humility, I have nothing to do but pay attention.

I concentrate

I'm still

There is no country I am building, no marathon I run, no army, no canvas, no high notes.

There are only sticky fingers and sticky kisses and little voices and crayons and songs about Frozen letting go of whatever it takes.

(laughter) It's all peaceful and simple.

The air in this place is so rare to me that it's almost breathless.

I can't believe I'm still breathing.

Play is the opposite of work.

And I'm happy

Something inside me loosens.

The doors of the brain swing open and the energy rushes in.

And it's not instant, but it happens, it happens.

I feel it

A hum creeps in.

It's barely there, quiet, not at full volume, and you have to stay still to hear it, but it's there.

It's a hum, not a hum.

And now I feel like I know a very magical secret.

Well, let's not get carried away.

it's just love. That's all.

No magic. No secrets. it's just love.

It's just something we forgot.

Hum, work hum, giant hum, it's just a replacement.

If I have to ask who I am, if I have to tell you who I am, if I describe myself in terms of shows and hours of TV time and how globally bad my brain is, I forget what the real hum is.

The hum is not a power supply, nor is it a work-specific hum.

The hum is characteristic of joy.

A true hum is unique to love.

The hum is the electricity that comes from the excitement of life.

The real buzz is confidence and peace.

A real hum ignores the gaze of history, balls in the air, expectations and pressures.

A real hum is unique and original.

The real grunt is God whispering in my ear, but maybe God was whispering the wrong words. Because which god said I was a giant?

it's just love.

We could all give a little more love, a lot more love.

Whenever my child invites me to play, I always say yes.

I have a hard rule for one reason. It's about giving yourself permission and being free from workaholic guilt.

It's the law, so you don't have a choice, and if you want to feel the hum, you don't have a choice either.

I wish it was easier, but I'm not very good at playing.

i don't like it.

I'm not interested in doing it the way I'm interested in doing my job.

It's incredibly humbling and humiliating to face the truth.

I don't like to play

I love working, so I work all the time.

I like working more than staying at home.

It's incredibly difficult to face that fact. Because who would rather be at work than at home?

Well me.

To be honest, I call myself a giant.

There's a problem.

(Laughter) And one of those problems isn't that I'm too relaxed.

(laughter) We run around the yard, up and down, up and down.

We are hosting a 30 second dance party.

We sing show tunes. we play with the ball

Blow bubbles and they will burst.

And most of the time I feel stiff, confused and confused.

I'm always itching for a mobile phone.

But it's okay.

My little humans teach me how to live and the murmur of the universe fills me.

I play it over and over until I wonder why I stop playing it in the first place.

You can do it too. Answer "yes" every time your child wants to play.

Maybe you think I'm an idiot with diamond shoes?

You are right, you can still do this.

We have time.

you know why? Because you're not Rihanna or the Muppets.

Your child doesn't think you are that funny.

(Laughter) It only takes 15 minutes.

My 2 and 4 year olds only want to play with me for about 15 minutes before they want to do anything else.

Amazing 15 minutes, but 15 minutes.

If I'm not a ladybug or candy, I'll be invisible after 15 minutes.

(Laughter.) And if my 13-year-old talks for 15 minutes, I'm Parent of the Year.

(Laughter) All it takes is 15 minutes.

Even on the worst of days, you can get 15 minutes uninterrupted.

Uninterrupted is the key.

No mobile phone, no laundry, nothing.

you have a busy life. Dinner must be set on the table.

I have to force myself to take a bath. But I can do it in 15 minutes.

My children are my happy place and my world. But it doesn't have to be your child, the fuel that feeds your hum, the place where life feels better than not.

It's not about playing with children, it's about joy.

It's all about play.

Please allow 15 minutes.

Find something that makes you feel comfortable.

Figure it out and play in that arena.

I'm not perfect at it. In fact, meeting friends, reading books, and staring into space often fails as often as it succeeds.

"Do you want to play?" began to be an abbreviation for indulging myself in ways I had given up on when I first appeared on a TV show, when I became a titan in training, when I started competing with myself in unknown ways.

15 minutes? What's wrong with giving yourself 15 minutes of total concentration?

As it turned out, there was nothing.

The very act of not moving could cause the hum again, as if the hum's engine could only refuel while I was away.

There is no work without play.

It took a while, but one day, a few months later, the floodgates opened and there was a rush in the air, and as I stood in my office, an unfamiliar melody flooded inside and around me, spinning me with ideas, clearing the way for me to hum, drive and drive, and fall in love with my job again.

But now, I like that hum, but I don't like that hum.

You don't need that hum.

I'm not that much of a ham. That hum is not me anymore.

I'm foamy and sticky fingers and dinner with friends.

I'm that ham

growl of life.

hum of love.

Work humming is still a part of me, it is no longer my everything, so I am very grateful.

And I don't mind being a giant, because I've never seen a giant play Red Rover, Red Rover.

I replied that I would work less and play more, but somehow I still run my own world.

My brain is still global. my campfire is still burning

The more I play, the happier I am and the happier my children are.

The more I play, the more I feel like a good mother.

The more you play, the more free your mind becomes.

The more you play, the better your work will be.

The more I play, the more I feel the hum, the country I'm building, the marathon I'm running, the army, the canvas, the high notes, the hum, the hum, another hum, the real hum, the hum of life.

The more I feel that hum, the more I feel like this strange, trembling, uncocooned, awkward, brand new, living non-giant resembles me.

The more I feel that hum, the more I know who I am.

I am a writer and I think I am creating something.

That part of the job is living the dream.

That is my dream for this job.

This is because a dream job must be a dream job.

I replied that I would work less and play more.

Titans do not need to apply.

wanna play?

thank you.

(applause)

Which word in this sentence is the most difficult to translate?

"I know" is easy to translate.

A "push party" has no direct analogue in many languages ​​and cultures, but it can be approximated.

But actually the hardest word is one of the smallest, it's "you".

It seems simple, but accurately translating "you" is often impossible without knowing more about the context in which it is spoken.

First, how well do you know the person you are talking to?

Many cultures have different levels of formality.

A close friend, someone much older or much younger, a stranger, a boss.

Each one may be a slightly different “you”.

In many languages, pronouns reflect these differences through what is known as the T and V distinction.

For example, in French you say ``tu'' when you talk to your friends at school, but you say ``vous'' when you talk to your teacher.

Something similar once happened in English.

Remember the old "Who are you?"

Ironically, this was actually an informal pronoun for someone close, and "you" was the formal, polite version.

That distinction was lost when the British decided to always be polite.

But that's not the only difficulty in translating "you".

In languages ​​such as Hausa and Korana, the form of "you" depends on the gender of the listener.

More often it depends on whether they are one or more, such as "Du" or "ihr" in German.

Even in English, some dialects use words like ``y'all'' and ``youuse'' in the same way.

Plural forms such as "vous" in French and "Вы" in Russian are also used for a single person to indicate that the addressee is more important, as is the royal "we".

And some languages ​​even have specific forms for exactly two people, like 'vidva' in Slovenian.

If it's not complex enough, form, number, and gender can all come into play at the same time.

In Spanish, "tú" is the unisex informal singular, "usted" is the unisex formal singular, "vosotros" is the masculine informal plural, "vosotras" is the feminine informal plural, and "ustedes" is the unisex formal plural.

Phew!

With this in mind, you may take comfort in knowing that second person pronouns are often omitted in some languages.

In languages ​​such as Romanian and Portuguese, pronouns can be omitted from sentences because the way the verb is used clearly implies pronouns.

Also, languages ​​like Korean, Thai, and Chinese allow pronouns to be omitted without grammatical hints.

Speakers often prefer listeners to guess pronouns from context rather than risk being considered rude by using the wrong pronoun.

So if you are working as a translator and come across this sentence out of nowhere, say, "You and you, no, not you, you, your job is to translate 'you' for yourself"...

Good luck then.

And sorry to the community of volunteers who translate this video into multiple languages.

Here's what needs to happen to get pregnant after intercourse.

Sperm must travel up the vagina, through an opening in the cervix, up through the uterus, and into one of the two fallopian tubes.

If the egg released during ovulation that month is in the fallopian tube, one sperm has a chance to be fertilized.

Birth control pills are designed to prevent this process and work in three basic ways.

They block sperm, disable them before they reach the uterus, or suppress ovulation.

Blocks are the simplest.

Male and female condoms prevent sperm from coming into contact with the vaginal space.

This barrier is also why it can prevent transmission of certain STDs unlike other birth control methods.

Meanwhile, the diaphragm, cervical cap, and sponge are placed over the cervix and function to block the entrance to the uterus.

These contraceptives are sometimes called barrier methods and can be used in conjunction with spermicides, which are examples of the second category of neutralizing agents.

Spermicides are chemicals that immobilize and destroy sperm.

Spermicides today come in the form of foams, creams, jellies, suppositories, and even translucent thin films that dissolve in the vagina.

These products can be inserted directly into the vagina before intercourse or combined with blocking methods such as pessaries or condoms for added protection.

The third category for preventing pregnancy works by inhibiting the eggs from maturing within the ovary.

Without an egg available in the fallopian tube, there is no room for sperm to fertilize.

Hormonal contraceptives such as pills, patches, depot shots, and vaginal rings all release synthetic versions of various combinations of progesterone and estrogen.

This hormonal cocktail suppresses ovulation and safely sequesters the immature egg within the ovary.

Synthetic progesterone also has blocking tricks.

The cervical mucus becomes too thick, making it difficult for sperm to swim.

Other contraceptives use multiple approaches simultaneously.

For example, many IUDs, or intrauterine devices, contain synthetic hormones that suppress ovulation.

Some contain copper, which not only prevents sperm from functioning, but also makes it difficult for the egg to implant in the uterus.

Block, Disable, or Suppress: Is One Strategy Better than the Other?

There are differences, but many of them have to do with how convenient and easy it is to use each contraceptive correctly.

For example, male condoms are about 98% effective when used perfectly by everyone.

That 98% means that if 100 couples used condoms correctly for a year, 2 women would get pregnant.

However, not everyone uses them correctly, so the actual effectiveness is only 82%.

Other methods such as patches and pills are also 99% effective when used perfectly.

But in reality it is 91%.

Spermicide is only 85% effective when used perfectly and only 71% effective when used normally.

Another important consideration when choosing a contraceptive is side effects, which almost exclusively affect women, not men.

Hormone therapy, in particular, can cause headaches, nausea, and high blood pressure, but symptoms vary from woman to woman.

Therefore, these methods require a doctor's prescription.

Choosing a birth control method is personal, and the method of birth control that works best for you today may change over time.

Scientists also continue to research new methods, such as the male pill, which prevent sperm production.

In the meantime, there are quite a few options for blocking sperm, disabling them, or suppressing eggs to keep them out of reach.

How can you get what you want with just words?

Aristotle tried to answer that question precisely over 2,000 years ago in his Debate.

According to Aristotle, rhetoric is the art of knowing the available means of persuasion.

And today we apply it to all forms of communication.

However, Aristotle focused on public speaking and described three types of persuasive speech.

Forensics, or judicial rhetoric, establishes facts and verdicts about the past, similar to detectives at crime scenes.

Like wedding speeches, epidemiological or demonstrative rhetoric declares about the current situation.

But the way to achieve change is through deliberative rhetoric, the thimble utikon.

Deliberative rhetoric focuses on the future, not the past or present.

This is the rhetoric of politicians debating new laws imagining what impact they might have, as President Ronald Reagan warned that the introduction of Medicare would lead to a socialist future spent telling our children and their children's children what America was like when men were once free.

But it is also the rhetoric of activists for change, such as Martin Luther King Jr.'s dream that one day his children will live in a country where they will be judged not by the color of their skin, but by their character.

In both cases, the speaker presents a possible future to the audience and seeks the audience's cooperation in avoiding or achieving it.

But what makes good deliberative rhetoric other than the future tense?

According to Aristotle, there are three types of persuasive attraction: ethos, logos, and pathos.

Ethos is how you convince your audience of your credibility.

In his 1941 address to the U.S. Congress, Winston Churchill emphasized his virtues as a man of democracy, declaring, "Throughout my life I have been in perfect harmony with the currents on both sides of the Atlantic against privilege and monopoly."

Long before that, the Roman consul Cicero appealed to his practical wisdom and expertise as a politician in defending the poet Alkias. "It's the result of liberal science research and careful training that I've never been disappointed with in my life."

And finally, you can show that you are indifferent or not motivated by personal gain.

Logos is the use of logic and reason.

This method allows the use of rhetoric such as research and statistical analogies, examples, and citations.

But it's not just facts and numbers.

It is also the structure and content of the speech itself.

The point is, like Sojourner Truth's argument for women's rights, use factual knowledge to persuade your audience. "I have as much muscle as any other man and I can do as much work as any other man.

I have plowed, reaped, peeled, chopped, and mowed, but who can do more? ”

Unfortunately, speakers sometimes manipulate people with misinformation that audiences believe to be true, such as the debunked but still widely believed claim that vaccines cause autism.

And finally, Pathos appeals to emotion. In the age of mass media, it is often the most effective mode.

Pathos is neither inherently good nor bad, but it can be irrational and unpredictable.

It can rally people for peace as easily as it drives them to war.

From beauty products that promise to soothe our physical anxieties to cars that make us feel powerful, most advertising relies on pathos.

Aristotle's rhetorical appeal remains a powerful tool today, but deciding which one to use requires knowing your audience and purpose, as well as the appropriate place and time.

And perhaps just as important is being able to notice when the same persuasion methods are being used against you.

1.3 billion years ago, in a galaxy far, far away, two black holes were trapped in a spiral, mercilessly falling toward and colliding with each other, converting three suns' worth of matter into pure energy in a tenth of a second.

For that split second, its radiance was brighter than all the stars in all galaxies in the known universe.

It was a big shock.

But they didn't release their energy in the light.

In other words, it is a black hole.

All that energy was injected into the fabric of space-time itself, and the universe exploded with gravitational waves.

Let me explain the timescale of the work here.

1.3 billion years ago, Earth had just evolved multicellular organisms.

Since then, the Earth has created and evolved corals, fish, plants, dinosaurs, humans and even the internet.

And about 25 years ago, particularly bold people like Rye Weiss of MIT, Kip Thorne of Caltech, and Ronald Drever decided it would be pretty cool to build a giant laser detector to search for gravitational waves from colliding black holes and the like.

Well, most people thought they were crazy.

But enough people found them to be brilliant lunatics and decided that the US National Science Foundation would fund their crazy ideas.

So, after decades of development, construction, imagination, and breathtaking hard work, they built a detector called LIGO (Laser Interferometer Gravitational Wave Observatory).

Over the last few years, LIGO has greatly improved its accuracy and greatly improved its detection capabilities.

As a result, it is now called Advanced LIGO.

In early September 2015, LIGO began its final test run while some outstanding details were sorted out.

Then, on September 14, 2015, just a few days after the detector went live, gravitational waves from the colliding black hole passed through Earth.

And they went through you and me.

And they passed the detector.

(Audio) Scott Hughes: There are two more emotionally intense moments in my life.

The other was when my father was terminally ill and I had to say goodbye.

Basically, it was my career payoff.

Everything I was working on is no longer sci-fi. (Laughter) Alan Adams: It's a very good friend and collaborator of mine, Scott Hughes, a theoretical physicist at MIT. For the past 23 years, he has studied gravitational waves from black holes and their possible signals to observatories such as LIGO.

So let me explain a little bit about what we mean by gravitational waves.

Gravitational waves are ripples in the shape of space and time.

When a wave passes through it, it stretches space and everything in it in one direction and compresses it in the other.

This has led countless instructors of general relativity to do a really stupid dance to demonstrate in general relativity classes.

"Grow and Grow, Grow and Grow".

So the problem with gravitational waves is that they are very weak. they are terribly weak.

For example, the wave that hit us on the 14th of September, yes each of you stretched and shrunk under the action of the wave, but when the wave came, the average person stretched by a factor of 10-21.

That's a decimal point, 20 zeros, and a 1.

That's why everyone thought the LIGO guys were crazy.

Even with a five-kilometer-long laser detector, it's already crazy. The detector length should measure to less than 1/1000th of the nucleus radius.

It's ridiculous.

So, towards the end of the classic book on gravity, LIGO co-founder Kip Thorne described the quest for gravitational waves:

But physicists are ingenious, and with broad public support, all obstacles will surely be overcome. ”

Thorne published it in 1973, 42 years before its success.

Now back to LIGO, Scott likes to say that LIGO is more like an ear than an eye.

I would like to explain what it means.

The wavelength and size of visible light is much smaller than the surroundings, the features of a person's face, and the size of a mobile phone.

This is very useful as it allows you to create images and maps of your surroundings by observing the light emitted from different locations around you.

It sounds different.

Audible sound wavelengths can reach up to 50 feet.

This makes it very difficult, in fact impossible, to create an image of what you are really interested in.

child's face.

Instead, we use sounds to hear characteristics such as pitch, tone, rhythm, and volume to infer the story behind the sound.

That's what Alice is talking about.

Bob got in the way.

stupid bob.

So the same is true for gravitational waves.

We cannot use them to create a simple image of things in the universe.

But by listening to the changes in amplitude and frequency of those waves, we can hear the stories they tell.

And, at least for LIGO, the audible frequencies are in the audio band.

So if we convert waveforms into pressure waves and air, then into sound, we can literally hear the universe talking to us.

For example, listening to gravity in this way tells us a lot about the collision of two black holes. My colleague Scott has spent a great deal of time thinking about this.

(Voice) SH: When two black holes are not spinning, you hear a very simple chirping sound.

If you had two objects spinning very fast, you would hear the same chirping, but with modulation added on top of it, so it would look something like this:

It's like the spin vocabulary imprinted on this waveform.

AA: So on September 14th, 2015, definitely a day I remember, LIGO heard this: [whistling] So, if you know how to listen, it was -- (audio) SH: ...two black holes, each about 30 masses of the Sun, orbiting at a speed comparable to what's going on inside a mixer.

AA: It's worth stopping here and thinking about what that means.

The two most dense black holes in the universe, one with a mass of 29 Suns and the other with a mass of 36 Suns, orbit each other 100 times a second before colliding.

Imagine its power.

amazing.

And we know it because we heard it.

That is the enduring importance of LIGO.

It's a whole new way of observing the Universe like never before.

It is how we can hear the voice of the universe and hear the unseen.

And there are many things that we cannot see in practice, or even in principle.

For example, a supernova. I would like to know why very massive stars cause supernova explosions.

very convenient. We learned a lot about space from them.

The problem is that all the interesting physical phenomena occur in the core, which is hidden behind thousands of kilometers of iron, carbon and silicon.

It is opaque to light, so you can never see through it.

Gravitational waves pass through iron as if it were glass, making it completely transparent.

The Big Bang: We wish we could explore the first few moments of the universe, but we'll never see the Big Bang itself as it's obscured by its afterglow.

With gravitational waves, we should be able to see it all the way back to the beginning.

Perhaps most importantly, I am convinced that there are things out there that we have never seen, may never see, or even imagine, things that can only be discovered by listening.

And indeed, even at that first event, LIGO discovered something we didn't expect.

This is what my colleague Matt Evans (my colleague at MIT), one of the key members of the LIGO collaboration, says about just that: (audio) Matt Evans: The type of black hole-producing star observed here is a cosmic dinosaur.

Black holes are old, prehistoric giants, like the dinosaur bones we use to do archeology.

So we get a whole other angle on what's in the universe, how stars are born, and of course, how we finally managed to pull ourselves out of this whole mess.

AA: Our challenge now is to be as bold as possible.

Thanks to LIGO, we know how to build sophisticated detectors that can hear the universe, cosmic rustles and chirps.

Our job is to dream and build a new observatory, a whole new generation of observatories on earth and in space.

I mean, what could be better than listening to the Big Bang itself?

Our job now is to dream big.

Dream with us.

thank you.

(applause)

Could human civilization eventually spread across the Milky Way galaxy?

Can we go beyond the small blue planet and establish colonies in the many star systems there?

This question is a rather difficult one.

There are about 300 billion stars in a galaxy with a diameter of about 160,000 light years.

So far, we've sent one spacecraft out of our solar system, trudging along at 0.006% the speed of light.

At this rate, it would take over 2.5 billion years just to travel from one end of the galaxy to the other.

There is also the issue of human survival.

The distance between stars is simply huge.

We cannot live sustainably on most planets and need a lot of resources to stay alive.

However, decades ago, scholars discovered that it was theoretically possible to not only spread human civilization across the galaxy, but very quickly without breaking the known laws of physics.

Their idea is based on the work of a mathematician named John von Neumann, who designed a paper machine that could self-replicate and produce new generations.

These later became known as von Neumann machines.

In the context of space exploration, von Neumann-type machines can be built on Earth and launched into space.

There, self-sufficient machines will land on distant planets.

They then mine available resources to gather energy, build a replica of themselves, and launch it to the nearest planet to continue the cycle.

The result is the creation of millions of probes, spread out into space like a drop of ink in a fishbowl.

Scientists have calculated the numbers and found that a single von Neumann machine traveling at 5% of the speed of light should be able to replicate across the galaxy within 4 million years.

It may sound like a long time, but it's incredibly fast, about 2.5 hours a year, given that our universe is 14 billion years old.

Creating a von Neumann-type machine would require several technologies that we don't yet have, such as advanced artificial intelligence, miniaturization, and better propulsion systems.

Yet another technological leap would be required if we wanted to use them to spread real humans across the galaxy. It is the ability to artificially grow biological organisms and bodies using raw elements and genetic information.

In any case, if an alien civilization had created such machines in the last billion years and set them up to proliferate towards us, our galaxy would be swarming with them by now.

So where are these machines?

Some astronomers, such as Carl Sagan, say intelligent aliens will never build self-replicating machines.

They may get out of control and run amok, scavenging the center of the planet to continue replicating.

Some see the absence of machines as evidence that intelligent alien civilizations do not exist or will become extinct before they develop the necessary technology.

But all this does not prevent people from imagining what it would be like if they were there.

Science fiction writer David Brin writes about a universe in which many different von Neumann machines exist and proliferate simultaneously.

Some are designed to welcome young civilizations, others to find and destroy them before they become a threat.

In fact, in Brin's tale Lungfish, several von Neumann machines are now watching Earth closely, waiting to reach a certain degree of sophistication before we can move on.

For now, all we have is curiosity and theory.

But the next time you look at the night sky, consider that billions of self-replicating machines could be making their way among the stars of our galaxy right now.

If they exist, it is possible that one of them will eventually land on Earth, or perhaps already exist on Earth.

Your favorite band is good at playing music, but not so good at organizing it.

They often leave their instruments behind while on tour, and the manager is furious.

On the day of the big concert, the band wakes up to find themselves locked in a windowless, soundproof practice room.

Their manager explains what's going on.

There are ten large boxes outside.

Each includes one instrument, but don't let the pictures fool you. These are randomly placed.

I will take them out one by one.

While you're out, you can peek inside five boxes before security escorts you back to the tour bus.

You cannot touch the instrument or tell others what you have found.

No markings on boxes, no shouting.

If each of you can find your own instrument, we can play tonight.

Otherwise, it will be overlooked by the label.

Think for three minutes before you start.

The band is in despair.

After all, if each musician picked five boxes at random, they only have a 50% chance of finding their instrument.

And the odds of all 10 succeeding are even lower: only 1 in 1024.

But suddenly the drummer comes up with a viable strategy that has a 35%+ chance of success.

Do you know what it was?

Pause the video at the next screen if you want to see for yourself.

Answer: 3 Answer: 2 Answer: 1 The drummer said: Guys, please open the box with the picture of the instrument first.

If there is an instrument inside, you are done.

Otherwise, see what's in there and then open the box with that picture on it.

Keep going until you find the instrument.

The band members are skeptical, but surprisingly they all find what they need.

And hours later, they're playing in front of thousands of adoring fans.

So why did the drummer's strategy work?

Each musician follows a linked sequence that starts with a box that matches their instrument on the outside and ends with the box that actually contains it.

Note that this is a loop, because if you continue like this you'll end up back at the beginning.

For example, if the boxes were arranged that way, the singer would open the first box to find the drums, move to the eighth box to find the bass, and find the microphone in the third box pointing to the first box.

This is much more effective than random guessing because by starting with a box with a picture of their instrument, each musician limits their search to loops containing their instrument, with a fairly high probability of about 35% for all loops being 5 or less in length.

How should I calculate those probabilities?

For simplicity, let's take a simplified case where each musician is allowed 4 instruments and up to 2 guesses.

Let's start by finding the probability of failure, that is, the probability that someone will have to open 3 or 4 boxes before finding the instrument.

There are 6 different 4-box loops.

One fun way to count is to make a square, place a fixture in each corner, and draw a diagonal line.

See how many unique loops you can find. Keep in mind that these two are considered the same, just starting from a different point.

However, the two are different.

Using triangles, we can visualize eight different 3-box loops.

Four possible triangles are found, depending on the instruments we exclude, each with two different paths.

Therefore, out of 24 box combinations, 14 lead to failure and 10 to success.

This computational strategy also works for an even number of musicians, but it can be generalized into a convenient equation if shortcuts are needed.

If we fit 10 musicians, we get about a 35% chance.

What if there are 1,000 musicians?

1000000?

As n increases, the probability approaches about 30%.

No guarantees, but with a little luck of the musicians, it's not hopeless.

hello everyone. If you like this riddle try to solve these two riddles.

It starts out as a bit of discomfort and quickly becomes a feeling of urgency that you can't ignore.

In the end, that's the only thing I can think of, and out of desperation, I keep looking for the bathroom until I think, "Ah."

Humans need to urinate at least 4-6 times a day, but the pressures of modern life sometimes force us to hold back.

How bad is this habit, and how long can our bodies withstand it?

The answer lies in how the bladder, an oval-shaped bag inside the pelvis, works.

Around this structure are several other organs that together make up the entire urinary system.

It has two kidneys, two ureters, two urethral sphincters, and one urethra.

A yellowish fluid known as urine is constantly flowing out of the kidneys.

The kidneys produce urine from a mixture of water and the body's waste products and channel unwanted fluids down two muscular tubes called ureters.

These carry it down into a hollow organ known as the bladder.

The muscular wall of this organ is made up of tissue called the detrusor muscle, which relaxes and inflates like a balloon when the bladder is full.

When the bladder is full, the detrusor muscle contracts.

The internal urethral sphincter opens automatically and involuntarily to release urine.

Fluid enters the urethra with a hissing sound and quickly stops at the external urethral sphincter.

This works like a tap.

Keep the sphincter closed when you want to delay urination.

You can voluntarily open the floodgates when you want to release them.

But how do you sense when your bladder is full and know when to pee?

Inside the detrusor layer are millions of stretch receptors that are triggered when the bladder fills.

It sends signals along the nerve to the sacral portion of the spinal cord.

A reflected signal returns to the bladder and the detrusor muscle contracts slightly, increasing pressure in the bladder, indicating that the bladder is full.

At the same time, the internal urethral sphincter opens.

This is called the voiding reflex.

If it's a bad time to urinate, the brain can counteract this by sending another signal to contract the external urinary sphincter.

There are about 150 to 200 milliliters of urine inside, and the muscular wall of the bladder is stretched enough that you can feel it inside.

At about 400-500 milliliters, the pressure becomes uncomfortable.

The bladder can continue to stretch, but only to a certain point.

Exceeding 1,000ml may cause rupture.

Most people lose control of their bladder before this happens, but very rarely, such as when they don't feel the need to urinate, the bladder ruptures painfully and requires surgery to repair.

However, under normal circumstances, when you decide to urinate, the brain's signal to the external urinary sphincter stops, causing it to relax and the bladder to empty.

The external urinary sphincter is one of the pelvic floor muscles that supports the urethra and bladder neck.

We are lucky to have pelvic floor muscles like these, because pressure on this pelvic floor muscle from coughing, sneezing, laughing, or jumping can cause a leaky bladder.

Instead, the pelvic floor muscles keep the area sealed until you're ready.

However, holding it for too long, urinating too quickly, or urinating without proper physical support can weaken or overstrain that muscle sling over time.

This can result in pelvic floor hyperactivity, bladder pain, urgency, or urinary incontinence.

Therefore, withholding pee is not a good habit when it comes to your long-term health.

But at least in the short term, your body and brain have you covered so you can conveniently pick your sweet moments of release.

A team of archaeologists recently made an interesting discovery when they uncovered human remains that are about 15,000 years old.

Those ancient man's teeth were full of holes.

Their cavities were caused by the same thing that still plagues us today: certain tiny microbes that live in our mouths.

These microbes are with us right from birth.

We usually pick them up from our mother's mouth when we are babies.

And when our teeth erupt, naturally bacterial communities begin to build up.

Depending on what we eat, especially sugar, certain microbes can overgrow and cause tooth decay.

A diet high in sugary foods triggers an explosion of bacteria in the mouth called Streptococcus mutans.

Like humans, these microbes prefer sugar and use it as their molecular building block and energy source.

When bacteria ingest it, it produces by-products in the form of acids such as lactic acid.

Streptococcus mutans is resistant to this acid, but unfortunately our teeth are not.

Each human tooth is covered with a tough, protective layer of enamel, which cannot withstand acids.

This causes the armor to degrade over time and the calcium mineral to leach out.

The acid gradually wears away bacteria's entryway into the second layer of the tooth called dentin.

Because the blood vessels and nerves are deep inside the tooth, even if the decay spreads at this stage, there is no pain.

However, when damage extends beyond the dentin, bacterial invasion progresses, exposing nerves and causing severe pain.

Without treatment, sugar-loving bacteria can cause the entire tooth to become infected and require removal.

The more sugar in our food, the more our teeth are at risk.

But these cavemen wouldn't have eaten much sweets. So what causes their cavities?

Red meat contains very little sugar, so a meat-heavy diet would have reduced the risk of tooth decay, but it wasn't the only food our early human ancestors ate.

Cavemen also likely consumed carbohydrate-containing root vegetables, nuts, and grains.

When exposed to enzymes in saliva, carbohydrates are broken down into simpler sugars that can feed voracious mouth bacteria.

So even though ancient humans ate less sugar than we do, their teeth were still exposed to sugar.

However, this does not mean that cavities cannot be treated.

Archaeological remains indicate that about 14,000 years ago, humans were already using sharp flint to remove rotting tooth fragments.

Ancient humans even made rudimentary drills to smooth out rough holes left behind, like modern fillings, and beeswax to fill cavities.

Today we have much more sophisticated technology and tools, which is fortunate. Because we also have to fight more harmful and sugar-heavy methods.

After the industrial revolution, suddenly technological advances made refined sugar cheaper and more accessible, causing a sharp increase in the incidence of tooth decay in humans.

A staggering 92% of American adults now have cavities in their teeth.

Some people are prone to tooth decay because of genes that can cause certain weaknesses, such as softening of the enamel, but in most cases, too much sugar is to blame.

However, we have developed other ways to minimize cavities besides reducing sugar and starch intake.

Most toothpastes and many taps contain trace amounts of fluoride.

This strengthens teeth and promotes the growth of enamel crystals that build tooth defense against acids.

If cavities do occur, fillings are used to seal the infected area to prevent further decay.

The best way to avoid cavities is still to reduce sugar intake and good oral hygiene to get rid of bacteria and their food sources.

That includes regular brushing, flossing, and avoiding sugary, starchy, and sticky foods that stick to your teeth between meals.

The number of sugar-loving microorganisms in the mouth gradually decreases.

Unlike the cavemen of old, today we have the necessary knowledge to avoid the calamity of the Hollow.

Just use it.

What began as a hobbyist platform is poised to grow into a multi-billion dollar industry.

Inspection, environmental monitoring, photography, film, journalism: These are some of the potential uses for commercial drones, and the capabilities that enable them are being developed in research facilities around the world.

For example, before air parcel delivery permeated our social consciousness, a swarm of autonomous flying machines built a 6-meter-tall tower of 1,500 bricks in front of a live audience at the FRAC center in France and began flying on ropes a few years ago.

By linking flying machines, you can achieve high speed and acceleration even in very tight spaces.

It can also build tensile structures autonomously.

Skills learned include how to carry loads, deal with obstacles, and generally interact with the physical world.

Today we would like to introduce some new projects that we are working on.

Their aim is to push the limits of what can be achieved with autonomous flight.

Now, for the system to function autonomously, it is necessary to collectively know the position of moving objects in space.

Back in my lab at ETH Zurich, I often use external cameras to locate objects, which allows me to focus on rapid development of highly dynamic tasks.

However, the demo you see today uses the new localization technology developed by Verity Studios, a spin-off from our lab.

No external cameras.

Each flying machine uses onboard sensors to determine its position in space and onboard computing to determine its behavior.

External commands are only high-level ones like "take off" and "land".

It is a so-called tail sitter.

It's an airplane trying to eat with a cake.

Like other fixed-wing aircraft, forward flight is more efficient than helicopters and their variants.

However, unlike most other fixed-wing aircraft, it is capable of hovering, which offers significant advantages in takeoff, landing and versatility.

Unfortunately no free lunch.

One of the limitations of tailsitters is their susceptibility to disturbances such as wind gusts.

We are developing new control architectures and algorithms to address this limitation.

The idea is that the aircraft will recover from any condition and improve its performance over time through practice.

(Applause.) Okay.

When doing research, we often ask ourselves basic, abstract questions to get to the heart of things.

For example, one such question is what is the minimum number of moving parts required for controlled flight.

Well, there are practical reasons for wanting to know the answers to questions like these.

Helicopters, for example, are familiar machines with thousands of moving parts that conspire to harm humans.

Decades ago, it was discovered that a skilled pilot could fly a remotely controlled aircraft with only two moving parts: a propeller and a tail rudder.

I recently discovered that it can be done with just one.

This is the monospinner, the world's most mechanically simple controllable flying machine, invented just a few months ago.

The only moving part is the propeller.

There are no flaps, hinges, ailerons, other actuators or other control surfaces, just a simple propeller.

It's mechanically simple, but there's a lot going on in its little electronic brain that allows it to fly stably and travel anywhere in space.

Still, it doesn't have sophisticated algorithms like the Tailsitter yet, so you have to throw it properly to get it to fly.

And given everyone's attention to me, it's highly unlikely that I'll be thrown right, so instead, I'm going to show you the video we shot last night.

(Laughter) (Applause) If a monospinner is a parsimonious exercise, then this machine, an omnicopter with eight propellers, is an overkill exercise.

What can we do with this surplus?

It should be noted that the symmetry is high.

As a result, the direction becomes ambiguous.

This gives you extraordinary abilities.

You can move anywhere in space, no matter where you're pointing or how you're rotating.

It has its own complexities, mainly related to the interacting flows from the eight propellers.

Some of this can be modeled, but the rest can be learned on the fly.

Let's see.

(Applause.) If flying machines are to become part of our daily lives, they need to be extremely safe and reliable.

This machine here is actually two separate two-propeller flying machines.

I want this to rotate clockwise.

The other wants to rotate counterclockwise.

Combined, they work like one high performance quadrocopter.

However, if something goes wrong, such as motor failure, propeller failure, electronics failure, or even battery pack failure, the aircraft will still be able to fly, albeit degraded.

We'll demonstrate this by disabling one of the halves.

(Applause.) This final demonstration is the search for composite groups.

Numerous autonomous and coordinated entities offer a new palette for aesthetic expression.

By the way, we use off-the-shelf micro quadcopters, each weighing less than a piece of bread and equipped with localization technology and custom algorithms.

Each unit knows where it is in space and is self-controlled, so there's really no limit to their number.

(Applause) (Applause) (Applause) I hope these demonstrations will inspire you to dream up new revolutionary roles for flying machines.

For example, the super safe thing out there dreams of becoming a flying lampshade on Broadway.

(Laughter) The reality is that it's hard to predict the impact of early technology.

And for people like us, the real reward is the act of travel and creation.

It's a constant reminder of how wonderfully magical the universe we live in is, and how creative and clever creatures have allowed us to sculpt it in such stunning ways.

The fact that this technology has tremendous commercial and economic potential is just an added bonus.

thank you.

(applause)

Few people have influenced the world, but many of today's thinkers like Plato.

One 20th century philosopher even described all of Western philosophy as a series of footnotes to Plato.

He founded the first Western university and was a teacher of the great intellects of ancient Greece, including Aristotle.

But even one of the founders of philosophy wasn't perfect.

Along with his great ideas, Plato had some that didn't exactly stand the test of time.

So here's a quick rundown of some of his best and worst ideas.

Plato argued that beyond our imperfect world lies a world of perfect and immutable forms.

Forms are idealized versions of things and concepts that surround us.

They act as a kind of instruction manual to our own world.

In the world of Forms, there are ideal trees, ideal YouTube channels, even ideal justice, or ideal love.

Our own reality consists of imperfect copies of ideal forms.

Plato argued that philosophers should strive to ponder and understand these perfect forms so that we can better navigate our misleading realities.

It may seem silly, but the disconnect between the apparent world and the greater truth behind it is one of philosophy's most vexing problems.

The subject has been addressed thousands of pages by theologians, philosophers, and playwrights.

It raises the question of whether we should trust our senses or our own reason to arrive at the truth.

For Plato, the answer is reason.

That alone at least offers us the possibility to reflect on form.

But reason did not always work for Plato himself.

When he tried to place mankind among animals, he brought us together with birds.

"Wingless Biped" was his official designation.

Angered by this definition, Diogenes broke into Plato's classroom with a chicken plucker in his hand and proclaimed, "Behold, Plato's man!"

But back to some good ideas.

Plato is one of the oldest recorded political theorists and, along with Aristotle, is considered one of the founders of political science.

He reasoned that being a ruler was no different from being a potter or a doctor, and that only those who had mastered it were worthy of leadership.

Governance was the art of contemplating form.

Plato imagined a utopia in a republic where justice was the ultimate goal.

Plato's ideal city seeks a harmonious balance between its individual parts and should be guided by a philosopher-king.

Thousands of years before his time, Plato reasoned that women could rule equally in this model city.

Unfortunately, Plato contradicted women, comparing them to children elsewhere.

He also believed that a woman's womb was a living animal that could roam inside and cause disease.

This bad idea was endorsed by other Plato contemporaries and sadly influenced European medicine for hundreds of years.

Furthermore, he believed that society should be divided into three groups: the producers, the military, and the rulers, and that everyone should be persuaded by the great noble lie to follow this structure.

The noble lie he proposed was that we are all born with a mixture of gold, silver, or brass and iron in our souls, which determines our role in life.

Some thinkers believe that the concept of the sublime lie was the archetype of 20th-century propaganda, and that philosopher kings were the inspiration for the dictators who exploited it.

Should some bad idea undermine Plato's status as one of history's greatest philosophers?

no!

Plato provided a starting point for the leaders and thinkers who followed him.

Over the centuries, we have had the opportunity to test those ideas through writing and experience, accepting some and rejecting others.

We continue to refine, modify and edit the ideas that laid the groundwork for the modern world.

Three lions and three wildebeest escape for their lives as wildfires rage in the grasslands.

To escape Hell, you must cross to the left bank of a crocodile-infested river.

Fortunately, there happened to be a raft nearby.

It can carry up to two animals at a time, and must have at least one lion or wildebeest to paddle across the river.

There is only one problem.

When lions outnumber wildebeests on either side of a river, even for a moment, their instincts kick in and the results aren't pretty.

This also includes animals on boats on certain sides of the river.

What is the fastest way for all six animals to move without the lion stopping for dinner?

Pause here if you want to figure it out yourself.

Answer: 3 Answer: 2 Answer: 1 If you feel stuck in a problem like this, try listing all the decisions you can make at each point and the consequences of each choice.

For example, there are five options for who crosses first: 1 wildebeest, 1 lion, 2 wildebeest, 2 lions, or 1 each.

If one animal goes alone, it should return immediately.

And if two wildebeests cross first, the other one is quickly eaten.

So all those options are invalid.

Sending two lions, or one of each animal, can actually lead to a solution with the same number of moves.

For the sake of time, we will focus on the second.

One of each animal crosses.

Now, if the wildebeest stays and the lions return, there will be three lions on the right bank.

Bad news for the remaining two wildebeests.

Therefore, you should stay on the left bank for lions and return to the right bank for wildebeest.

You have the same 5 choices, but there is already a lion on the left bank.

If two wildebeest go, the remaining one will be eaten, and if each goes one by one, the wildebeests on the raft will be outnumbered as soon as they reach the other side.

This means that only two lions can pass at the third intersection.

One is dismounted, leaving two lions on the left bank.

The third lion rides a raft back to the right bank where the wildebeest await.

what now?

Well, there are two lions waiting on the left bank, so two wildebeests have to cross.

Second, it makes no sense for two wildebeest to retreat. Because it just reverses the last step.

And if two lions return, they will outnumber wildebeest on the right bank.

So one lion and one wildebeest returned on the raft, leaving one each on the left bank and two on the right bank.

Again, there is no point in sending back a lion and wildebeest pair. So your next trip should be either a lion pair or a wildebeest pair.

If the lion goes away, it will eat the wildebeest on the left, so the lions stay there and the two wildebeests cross instead.

The wildebeest need to be in a safe place, so they're pretty close now.

All that remains is for that one lion to come back on a raft and bring his fellow lions one by one.

This makes a total of 11 moves, which is the minimum required for everyone to cross safely.

The solution of sending both lions in the first step works as well, but it also requires 11 crossings.

The six animals narrowly escape the fire unscathed and cross the river to start a new life.

Of course, now that the danger has passed, it remains to be seen how long this unlikely alliance will last.

I was excited to participate in the "dream" theme, but then I realized that I was the protagonist of "Nightmare?". that section.

(Laughter.) And there's certainly something about the climate crisis that applies to that.

There's some bad news, but there's a lot more good news than that.

I'm going to put forward three questions, but the answer to the first one inevitably contains a bit of bad news.

But hold on, because the answers to the second and third questions are very positive.

The first question is, "Do we really need to change?"

And, of course, the Apollo program, among other things, changed the environmental movement and actually started the modern environmental movement.

Eighteen months after this Earthrise photo was first seen on Earth, the first Earth Day was held.

And by looking back at Earth from space, we've learned a lot about ourselves.

And one of the things we learned confirmed what scientists have been telling us for a long time.

One of the most important facts about the climate crisis concerns the sky.

As this photo shows, the sky is not the infinite expanse that appears when looking up from the ground.

It is the very thin shell of atmosphere that surrounds the planet.

That is the open sewer for our industrial civilization as it is now organized.

We're spewing 110 million tons of heat-trapping global warming pollutants out there for free every 24 hours, come on.

There are many sources of greenhouse gases, but I won't cover them all.

I'll focus on the main ones, but agriculture is involved, diet is involved, and population is involved.

Forestry, transportation, ocean management, and permafrost thaw.

But I would like to focus on the crux of the matter. It's the fact that we still rely on dirty carbon-based fuels for 85 percent of all the energy the world burns each year.

From this image, we can see that the emission rate actually started to accelerate after World War II.

And the man-made global warming pollutants that have built up in the atmosphere are now trapping the same amount of excess thermal energy released by 400,000 Hiroshima-style atomic bombs, which explode every 24 hours, 365 days a year.

Conservative, fact-checked over and over again, that's the truth.

It's a big planet now, but—(explosion) It's a lot of energy, especially when it's 400,000 times a day.

And all that extra heat energy is heating the atmosphere, the entire Earth system.

Let's see the atmosphere.

This represents what we thought of as the normal distribution of temperature.

White represents normal temperature days. The years 1951-1980 are chosen arbitrarily.

Blue is cooler than the average day and red is warmer than the average day.

But in the 1980s the whole curve shifted to the right.

And in the lower right corner we can see that a statistically significant number of very hot days have appeared.

In the 90s, the curve changed even more.

And you can see that over the past decade there have been more days that are very hot than days that are cooler than average.

In fact, they are 150 times more common on the Earth's surface than they were just 30 years ago.

As a result, record temperatures continue.

14 of the 15 hottest years ever instrumentally measured occurred in this young century.

Last year was the hottest.

Last month was the 371st straight month warmer than the 20th century average.

And for the first time, January was not only the warmest, but more than 2 degrees Fahrenheit warmer than average.

These high temperatures are affecting animals, plants, people and ecosystems.

Globally, however, 93 percent of the excess thermal energy is trapped in the oceans.

And scientists can now measure heat buildup at all depths, including the deep ocean, the central ocean, and the first few hundred meters, with greater accuracy.

And this is also accelerating.

It dates back over a century.

And more than half of that increase has happened in the last 19 years.

This has consequences.

The first order of impact is that ocean-based storms will intensify.

Super Typhoon Haiyan passed through the Pacific Ocean 5.5 degrees Fahrenheit warmer than normal before hitting Tacloban in one of the most devastating storms ever to make landfall.

Pope Francis visited Tacloban shortly afterwards, bringing about a major shift in the whole matter.

Superstorm Sandy passed through the Atlantic region, which is 9 degrees warmer than normal, and hit New York and New Jersey.

The second stage effects are now affecting all of us.

As ocean temperatures rise, more water vapor evaporates into the sky.

Global average humidity increased by 4%.

And that's what creates this atmospheric river.

Brazilian scientists call them "flying rivers".

Then, all that excess water vapor pours onto land, and storm conditions cause record rainfall.

This is from Montana.

Look at this storm last August.

Passing over Tucson, Arizona.

It literally flies out of the city.

Such heavy rains are really abnormal.

Last July, Houston, Texas, received 162 billion gallons of rain in two days.

That's more than two days' worth of the full amount of Niagara Falls in the city center, which was understandably paralyzed.

These record heavy rains have caused historic floods and landslides.

This one came from Chile last year.

And then you see that warehouse go by.

Cars of oil tankers come and go.

This is from Spain in September last year, but I think you could say it was a car or truck running.

The nightly TV news is now like a nature hike through the apocalypse.

(Laughter) I mean, really.

The insurance industry is certainly noticing growing losses.

They have no illusions about what is going on.

And causality needs some discussion.

We are used to thinking about linear causes and linear effects, one cause and one effect.

This is systemic causation.

The great Kevin Trenberth said, "Every storm is different now.

There's a lot of extra energy in the atmosphere, and a lot of extra water vapor.

Every storm is different now. ”

So the same extra heat robs soil of moisture from the ground, causing deeper, longer and more widespread droughts, many of which are ongoing.

It will dry out vegetation and cause more fires in western North America.

There is certainly plenty of evidence of that.

As more lightning is produced and heat energy builds up, a significant amount of additional lightning is also produced.

These climate-related disasters also have geopolitical implications, creating instability.

The historic climate-related drought that began in Syria in 2006 has destroyed 60 percent of Syria's farms, killed 80 percent of its livestock, and forced 1.5 million climate refugees into Syrian cities, where they clashed with another 1.5 million refugees from the Iraq war.

And along with other factors, it opened the gates of hell, which people are now trying to close.

The US Department of Defense has long warned of the impacts of the climate crisis, including refugees, food and water shortages, and pandemic diseases.

We are now witnessing the spread of tropical microbial diseases to high latitudes. This has a lot to do with the transportation revolution.

However, changing conditions change the latitudes and regions where these microbial diseases can be endemic, as well as the range of vectors such as mosquitoes and ticks that carry them.

Right now we have the Zika epidemic, but North America is still too cool and we have a better public health system, so we're in a better position.

But the recommendation for women in some parts of Latin America not to conceive for two years is new and should draw our attention.

The Lancet, one of the world's two largest medical journals, last summer declared it a medical emergency.

And there are many factors in it.

This is also related to the threat of extinction.

We are in danger of losing 50 percent of all species on earth by the end of this century.

And already, land plants and animals are moving toward the poles at an average speed of 15 feet per day.

Speaking of the Arctic, the same storm that caused historic flooding in the American Midwest last December 29 raised Arctic temperatures 50 degrees Fahrenheit above normal, causing the Arctic to melt in the middle of a long, dark winter polar night.

And when the ice on the Arctic land melts, the sea level rises.

A beautiful photo taken from Svalbard by Paul Nicklen shows this.

Off Greenland, especially Antarctica, is even more dangerous.

The top 10 cities at risk of sea level rise by population are mostly located in South and Southeast Asia.

Miami comes first as measured by assets at risk, with $3.5 trillion at risk.

3rd place: New York and Newark.

I was in Miami last fall during the supermoon, when the tide was at its highest.

And some of the streets in Miami Beach, Fort Lauderdale, and Delray were filled with fish from the sea.

And this now happens regularly during high tide.

It's not rain. They call it the "Sunny Day Flood".

It comes up through the storm drain.

And the mayor of Miami echoes the sentiments of many, saying that the days of this being viewed through a partisan lens are long past.

This is a crisis that gets worse by the day.

We must move beyond partisanship.

And I'd like to pay tribute to the House Republicans here. (Applause.) Those who bravely took political risks and told the truth about the climate crisis last fall.

So the cost of the climate crisis is growing, and there are many aspects I haven't even mentioned.

It's a heavy burden.

I also want to mention that the World Economic Forum in Davos last month said the climate crisis is now the biggest risk to the global economy, according to its annual survey of 750 economists.

This leads central bankers like British central bank governor Mark Carney to argue that the majority of carbon reserves are non-combustible.

subprime carbon.

I'm not going to recall what happened with subprime mortgages, but it's the same thing.

If you look at all the carbon fuel that has been burned since the beginning of the industrial revolution, this is the amount that has been burned in the last 16 years.

Here's $28 trillion of everything that's been proven and on the books.

The International Energy Agency says only this amount can be burned.

The remaining $22 trillion won't burn.

Risks to the global economy.

That's why the divestment movement is practical and not just a moral imperative.

So here's the answer to the first question, "Should I change?"

Yes we have to change.

The second question is "Can you change it?"

This is exciting news!

Sixteen years ago, the best prediction in the world was that by 2010 the world would be able to install 30 gigawatts of wind power.

We beat that mark over 14 and a half times.

We are currently seeing an exponential curve for wind power installations.

You can see that the cost has come down significantly.

For example, in Germany, an industrial powerhouse whose climate is not much different from Vancouver's, one day in December last year, some countries obtained 81 percent of their total energy from renewable sources, mainly solar and wind.

Many countries receive more than half on average.

More good news. Energy storage, especially with batteries, is starting to take off as costs have dropped significantly to solve the intermittent problem.

For solar power, the news becomes even more exciting.

Fourteen years ago, the best prediction was to install 1 gigawatt per year by 2010.

In 2010, it surpassed that mark more than 17 times.

Last year he won by more than 58 times.

This year it is on track to surpass that number 68 times.

We are going to win this.

we are going to win

The solar power exponential curve is even steeper and more dramatic.

It was there when I came to this stage 10 years ago.

We have witnessed revolutionary progress in the emergence of these exponential curves.

(Applause.) And costs have come down 10 percent a year over 30 years.

And it keeps going down.

The business community is certainly aware of this as we are now past the grid parity point.

Inexpensive solar penetration is starting to rise.

Grid parity is understood as the boundary, or threshold, at which renewable power is cheaper than power from burning fossil fuels.

This threshold is a bit like the difference between 32 degrees Fahrenheit and 33 degrees Fahrenheit, or 0 degrees Celsius and 1 degree Celsius.

That's more than a degree difference, the difference between ice and water.

And that's the difference between a frozen market or a liquid capital flow to new investment opportunities.

This is the biggest new business opportunity in world history, with two-thirds of it coming from the private sector.

New investments are exploding.

Since 2010, global investment in renewable power generation has surpassed fossil power generation.

Since then, the gap has continued to widen.

Even though fossil energy is still 40 times more subsidized than renewable energy today, the future projections are even more dramatic.

By the way, adding nuclear projections here could change things even more dramatically, especially given that many are working to break through the safer, more acceptable and more affordable form of nuclear.

So is there any precedent for such rapid adoption of new technology?

Well, there are a lot of them, but let's take a look at mobile phones.

In 1980, AT&T, then Marvel, commissioned McKinsey to study the world market for the clunky new mobile phones that were coming out at the time.

"How many will we sell by 2000?" they asked.

McKinsey came back and said, "900,000."

And sure enough, when the year 2000 arrived, 900,000 were sold in the first three days.

And for the rest of the year, it sold over 120x.

And now there are more mobile phone connections than there are people in the world.

So why were they not only wrong, but very wrong?

I myself have asked myself, "Why?"

(Laughter) I think the answer is threefold.

First, despite the improvement in quality, the cost dropped much faster than anyone expected.

And low-income countries, areas without landlines, have jumped on new technology.

Large expansions are taking place in developing countries.

So what's going on with power grids in developing countries?

Well, not so hot.

And in many areas they do not exist.

There are more people in India without electricity than in the entire population of the United States.

So now we have this. It is a new business model that installs solar panels in grass huts and offers them at an affordable price.

Muhammad Yunus funded the project with microcredits in Bangladesh.

This is the village market.

Bangladesh is currently the fastest-adopted country in the world, averaging two systems per minute day and night.

And we have everything you need. Enough energy from the sun could come to the earth every hour to meet the energy needs of the whole world for a year.

It's actually less than an hour.

The answer to the second question, "Can I change it?"

is clearly a yes.

And it's an increasingly resolute "yes."

The final question is "Will it change?"

Paris is truly groundbreaking and some of the provisions are binding, making regular review very important.

But countries are not waiting, they are moving on.

China has already announced that it will introduce a nationwide cap-and-trade system next year.

It will probably work with the European Union.

America is already changing.

All of these coal-fired power plants were planned and canceled in the next decade.

All of these existing coal-fired power plants have been retired.

All of these coal-fired power plants have been announced for decommissioning.

They were all canceled.

we are moving forward.

Nearly three-quarters of all new power generation investments in the United States last year were renewable, mostly wind and solar.

We are solving this crisis.

The only question is how long it will take to get there.

Therefore, it is important that many organize to advocate for this change.

About 400,000 people marched in New York City ahead of a UN special session on the issue.

Thousands of people marched in cities around the world.

So I am very optimistic.

As I said before, we are going to win this one.

This is the end of the story.

When I was 13, I heard President Kennedy's proposal to land a man on the moon and bring him back safely 10 years later.

And I heard adults at the time saying, "That's reckless, expensive, and might fail."

But eight years and two months later, NASA's control room in Houston erupted in cheers when Neil Armstrong set foot on the moon.

There is a little known fact about this. The average age of the systems engineer who was in charge of the room that day was 26. So, among other things, their age was 18 when they heard the challenge.

We are now facing a moral challenge in the traditions of others that we have faced.

Wallace Stevens, one of America's greatest poets of the last century, wrote a line that stuck with me. "After the last 'no' comes a 'yes'. The future world will depend on that 'yes'."

When the abolitionists started their movement, they encountered one after another.

And then the "yes" came.

The women's suffrage and women's rights movement was met with endless opposition, but was eventually won.

The civil rights movement, the anti-apartheid movement, and most recently, the gay and lesbian rights movement here in the United States and elsewhere.

After the final "no" comes a "yes".

When great moral problems are ultimately resolved by choosing between what is right and what is wrong, the outcome is predetermined by who we are as human beings.

Ninety-nine percent of us, that's where we are now and that's why we win.

Everything you need.

Some still doubt that we have the will to act, but I say that the will to act is itself a renewable resource.

thank you very much.

(Applause) Chris Anderson: You have a great combination of skills.

You have the mind of a scientist who can understand any problem, and the ability to translate it into the most living language.

No one else can do that, which is why you took the initiative.

It looked great 10 years ago, and it still looks great now.

Al Gore: Well, I'm glad you said that, Chris.

But let's be honest, I have a lot of really good friends in the scientific community. They were incredibly patient and would sit there explaining it over and over until they could explain it in simple terms that I could understand.

And that is the key to communication.

CA: So that's your story. First part: terrifying, second part: incredibly hopeful.

How do we know that all these graphs and all the progress are enough to solve what we presented in the first part?

AG: I think it's a crossroads -- you know, I've only been in the business world for 15 years.

But one thing I've learned is that it clearly matters whether a new product or service is more expensive or cheaper than the existing one.

After all, if it is cheap, the meaning is different.

(Laughter.) And when you cross that line, a lot of things really change.

We are regularly amazed by these developments.

The late great economist Rudy Dornbush said: “Things will take longer than you think, but then they will happen much sooner than you think.”

I really think that's where we are.

Some people use the term "solar singularity" now, which means that if we go below grid parity and out of subsidies for most places, it will be the default choice.

Well, one of yesterday's presentations, collective knees, is an effort to use regulation to slow this down.

And I doubt it will work.

There is a woman in Atlanta named Debbie Dooley who is the president of the Atlanta Tea Party.

They enlisted her in this effort to tax solar panels and regulations.

And she had just installed solar panels on her roof and didn't understand the demands.

(Laughter.) So she allied with the Sierra Club and formed a new organization called The Green Tea Party.

(Laughter) (Applause) And they rejected the proposal.

So, finally, the answer to your question, this sounds a bit corny and may be clichéd, but 10 years ago, Christiana also mentioned, there are people in this audience who played an incredibly important role in generating these exponential curves.

It didn't work out financially for some, but that's what sparked this world revolution.

And what is this audience doing now knowing we will win.

But how quickly you win is very important.

CA: Al Gore, that was incredibly powerful.

As you said, when this year becomes the year that partisanship changes, it's no longer a partisan issue, but it's backed by science, backed by this kind of investment opportunity, backed by reason to win the day, bringing people on the other side together, it's really exciting.

Thank you very much.

AG: Thank you so much for bringing me back to TED.

thank you!

(applause)

You work in a university library.

In the middle of a quiet afternoon, 1,280 different books suddenly arrived.

Books fell in a long straight line, but they were all broken, and the automatic sorting system was broken.

To make matters worse, classes start tomorrow, so students will show up in droves to get these books first thing in the morning.

How can we organize everything in time?

One way is to start with the first two books at one end of the column.

If the first two books are good, leave them alone.

Otherwise, replace.

Then look at the second and third books and repeat the process until you reach the end of the line.

At some point, find the book that should be last and keep swapping it with subsequent books, moving down until you reach the end where it belongs.

Then, starting from the beginning, the process of placing the penultimate book in its proper place is repeated until all the books are sorted.

This approach is called bubble sort.

Simple but slow.

The first round makes 1,279 comparisons, then 1,278, and so on for a total of 818,560 comparisons.

Even if each took only 1 second, the process would take over 9 days.

A second strategy is to start by sorting just the first two books.

Then take the third book and compare it with the second.

If they are before the second book, swap them, then compare with the book in the first position and swap again if necessary.

The first three books are now sorted.

Continue adding books to the sorted subline one at a time, comparing and swapping the new book with its predecessor until it is correctly placed among the previously sorted books.

This is called insertion sort.

Unlike bubble sort, you usually don't need to compare all the books.

On average, it is expected that each book will only need to be compared to half of the books that came before it.

In this case, the total number of comparisons is 409,280, which takes almost 5 days.

You are still making too many comparisons.

I have a better idea.

First, choose a book at random.

Call it a partition and compare it to all other books.

Then split the rows by placing all the books before the partition on the left and all the books after it on the right.

It saves a lot of time because you never have to compare the book on the left with the book on the right again.

Now you can look only at the books on the left and again select a random partition of books to separate the books before it from those after it.

You can continue creating subpartitions like this until you have many small subrows. Each subrow can be quickly sorted using another strategy such as insertion sort.

Each round of splitting requires approximately 1,280 comparisons.

If the partitions are balanced, splitting the book into 128 sub-rows of 10 rows takes about 7 rounds, or 8,960 seconds.

Reordering these subrows takes about 22 seconds each.

All in all, this method, known as QuickSort, can sort your books in less than three and a half hours.

But there are pitfalls.

Partitions can become skewed and not save time at all.

Fortunately, this rarely happens.

That's why QuickSort is one of the most efficient strategies used by programmers today.

For example, sorting products in an online store by price, or creating a list of all gas stations near a particular location by distance.

In your case, the classification was completed easily with time to spare.

Another high-stakes day at the library.

With each passing year, machines surpass humans in activities previously thought to be the domain of humans.

Today's computers can beat us at complex board games, transcribe speech in dozens of languages, and instantly identify almost any object.

But tomorrow's robots may go further by learning how to understand what we feel.

And why is it important?

Because if machines and the people who run them can accurately read our emotional states, they may be able to assist and manipulate us on an unprecedented scale.

But before we get there, how can we transform something as complex as emotion into a mere number that only a language machine can understand?

Essentially, it's like interpreting emotions by learning how our own brain perceives them.

American psychologist Paul Ekman identified certain universal emotions whose visual cues are similarly understood across cultures.

For example, a smiling image conveys joy to modern city dwellers and indigenous peoples alike.

And according to Ekman, anger, disgust, fear, joy, sadness, and surprise are equally recognizable.

In fact, thanks to machine learning algorithms such as neural networks, computers are rapidly improving their ability to recognize images.

They consist of artificial nodes that mimic our biological neurons by forming connections and exchanging information.

To train the network, the system is fed sample inputs pre-classified into different categories, such as photos marked as happy or sad.

The network then learns to classify those samples by adjusting the relative weights assigned to particular features.

The more training data you give it, the better the algorithm will be at identifying new images correctly.

This is similar to our own brain learning from previous experiences to shape how it processes new stimuli.

Recognition algorithms are not limited to just facial expressions.

Our emotions come in many forms.

Our writing includes changes in body language, tone of voice, heart rate, complexion, skin temperature, and even word frequency and sentence structure.

You might think that training a neural network to recognize these things would be a long and complicated task until you realize just how much data there is in the world and how fast modern computers can process it.

From social media posts, uploaded photos and videos, and phone recordings to heat-sensitive surveillance cameras and wearables that monitor physiological signs, the big question is not how to collect enough data, but what to do with it.

Computerized emotion recognition has many useful applications.

Robots that use algorithms to identify facial expressions could help children learn or give lonely people a sense of camaraderie.

Social media companies are considering using algorithms to prevent suicide by flagging posts containing certain words and phrases.

Emotion recognition software can also help treat mental illness and even provide people with low-cost automated psychotherapy.

Despite the potential benefits, the prospect of a large network automatically scanning our photos, communications and physiological signs is also very alarming.

What are the implications for our privacy when such impersonal systems are used by companies to exploit our emotions through advertising?

And what would happen to our rights if authorities thought they could identify those who might commit crimes before they made a conscious decision to take action?

Robots still have a long way to go to distinguish emotional nuances such as sarcasm and emotional scales such as how happy or sad someone is.

Nevertheless, they may eventually be able to accurately read and react to our emotions.

Whether or not they can empathize with our fear of unwanted intrusion is another matter.

Professor Fukano, a famous eccentric scientist and adventurer, has embarked on a new challenge of flying non-stop around the world in an airplane of his own design.

Steady enough to fly around the equator at an astounding speed of one degree of longitude per minute, it takes six hours to circumnavigate the globe.

There is only one problem. This plane can carry only 180 kiloliters of fuel, just half the trip.

Let's be honest.

The professor could probably have designed the plane to carry more fuel, but what's the fun in that?

Instead, he devised a slightly more elaborate solution. It's about building 3 identical planes for a mission.

In addition to speed, Professor has equipped them with some other amazing features.

Each plane, as long as they are next to each other, can rotate in 10 circles and instantly transfer any amount of fuel in the air to the other without slowing down.

The professor pilots the first plane, while his two assistants, Fugori and Orokana, pilot the remaining planes respectively.

However, only one airport, located on the equator, has given permission for the experiment, which is the starting point, the finishing point, and the only place on the ground where planes can land, take off and refuel.

How will the three planes be coordinated so that the professor can fly the entire journey and achieve his dream without running out of fuel or crashing?

Pause here if you want to figure it out yourself.

Answers: 3 Answers: 2 Answers: 1 According to the professor's calculations, a single hair should be enough to pull them apart.

The key is not wasting a single kiloliter of fuel and making the most of the support each assistant provides.

You can also think symmetrically, so you can do short moves in either direction while the professor prepares to do long unsupported stretches in the middle.

Here is his solution.

All three planes will take off at noon and fly west with 180 kiloliters of cargo each.

After 45 minutes, or one-eighth of the circumference, each plane has 135 kiloliters left.

Orokana gives 45 to Professor and 45 to Fugori, fully reenergizing them both.

With only 45 left, Orokana returns to the airport and heads to the lounge for a well-deserved break.

After 45 minutes, a quarter of the journey was completed, and Professor and Fugori reached 135 kiloliters again.

Fugori puts 45 in the professor's tank and leaves 90 to return to himself.

Fukano-sensei stretches and puts on her favorite album.

he will be alone for a while.

Orokana meanwhile anxiously awaited Hugori's return, her plane fully refueled and ready to depart.

As soon as his plane touches the ground, she takes off, now flying east.

At this point, exactly 180 minutes have passed and the professor has reached the halfway point of his journey with 90 kiloliters of fuel remaining.

For the next 90 minutes, Professor and Orokana's planes flew towards each other, rendezvous at the three-quarters point.

When the professor ran low on fuel, he saw Orokana's plane.

She gives him 45kl of the remaining 90l, leaving 45kl for each of the two.

But that's only half of what you'd have to pay to get to the airport.

Luckily, this is exactly when the refueled Hugori takes off.

Forty-five minutes later, when the other two were empty and about to run, he joined them at 315 degrees and transferred 45 kiloliters of fuel to each, leaving 45 kiloliters for himself.

All three planes landed at the airport just as their fuel gauges dropped to zero.

As reporters and cameramen cheered, the professor promised that if he could figure out how to keep food from being spilled all over the place, his plane would be ready for commercial flights soon.

what do you think of me

A woman of faith? Expert?

Maybe they are sisters.

Or repressed, brainwashed, made a terrorist.

Or maybe you're just late in the airport security line.

It's actually true.

(Laughter) I don't blame you if your perception is negative.

That's how the media has portrayed people like me.

According to one study, 80% of news reports about Islam and Muslims are negative.

And studies say most Americans don't know Muslims.

I think people don't talk to Uber drivers.

(Laughter) Well, for those of you who haven't met a Muslim, it's nice to meet you.

Let me tell you who I am.

I am a mother and a coffee lover. Double espresso with cream.

I am an introvert.

I want to be a fitness maniac.

And I am a practicing spiritual Muslim.

But Lady Gaga says otherwise, because baby, I wasn't born this way.

it was a choice.

When I was 17, I decided to come out.

No, I decided to start wearing a hijab to cover my head as a Muslim, not as a gay like my friends.

My feminist friends wondered, "Why do you repress yourself?"

Interestingly, it was actually a feminist declaration of independence from the pressure I felt at the age of 17 to conform to perfect, unattainable standards of beauty.

I didn't just passively accept my parents' beliefs.

I wrestled with the Quran.

I read and pondered, questioned, doubted, and ultimately believed.

My relationship with God was not love at first sight.

It was a trust and a slow surrender that deepened with each reading of the Quran.

Its rhythmic beauty sometimes brings tears to my eyes.

I see myself in it. I feel that God knows me.

Have you ever looked at you and felt that someone completely understood you and still loved you?

That's how it is.

And then I got married and, like all good Egyptians, started my career as an engineer.

(Laughter) Then I got married and had kids, but I was essentially living the Egyptian-American dream.

And that dreadful morning in September 2001.

Many of you probably remember exactly where you were that morning.

I was sitting in the kitchen finishing breakfast when I looked up at the screen and saw the words "Breaking news."

Smoke billowed, planes crashed into buildings, and people jumped from them.

what was this?

accident?

Fault?

My shock quickly turned into anger.

who would do this?

And when I switched channels, I heard "...Muslim terrorists...", "...In the name of Islam...", "...Middle Eastern...", "...Jihad...", "...We should bomb Mecca."

oh my god.

Not only was my country attacked, but someone else's actions quickly turned me from a citizen into a suspect.

That same day, we had to drive across Central America to move to a new city for graduate school.

And for the first time in my life, I remember sitting in the passenger seat and silently squatting as low as possible in the car seat while driving, fearing that anyone would find out that I was a Muslim.

That night we moved into a new town apartment that felt like a whole other world.

And I had heard, seen, and read warnings from national Islamic organizations, such as 'beware', 'be careful', 'stay in well-lit areas' and 'do not congregate'.

I stayed indoors all week.

And that same Friday was the day when Muslims gathered for prayer.

And again the warning was "Don't go on First Friday, you might be a target."

And I was watching the news on the wall.

Naturally, the sentiment was so raw that we had also heard of attacks in which Muslims, or people who were perceived to be Muslims, were dragged into the streets and beaten.

The mosque was actually bombed with incendiary bombs.

And I thought I should stay home.

Still, something didn't feel right.

Because those who attacked our country attacked our country.

I know people were angry with the terrorists.

guess what? I was the same.

And it's not easy having to explain yourself all the time.

Feel free to ask questions. I love questions

Accusation is tough.

I actually hear people saying things like this today. "There is a problem in this country and it's called Muslims.

When are you going to kick them out? ”

Some want to ban Muslims from entering the country and close mosques.

They talk about my community as if we were a tumor in America's body.

And the only question is, are we malignant or benign?

Malignant tumors are completely removed, while benign tumors are only monitored.

Your choice doesn't make sense because the question is wrong.

Muslims, like all other Americans, are not tumors on the American body, but vital organs to us.

(Applause.) Thank you.

(Applause.) Muslims are inventors and teachers, first responders and Olympians.

Now, would closing the mosques make America safer?

Some parking spaces may be free, but terrorism cannot be eliminated.

Going to a mosque regularly actually leads to a more tolerant view of people of other faiths and greater civic participation.

And a police chief in the Washington, D.C. area recently told me that people don't actually radicalize at mosques.

They radicalize in basements, bedrooms, and in front of computers.

And what we do know about the process of radicalization is that it starts online, but the first thing that happens is that the person is cut off from their community and even from their family so that extremist groups can brainwash them into believing that they, the terrorists, are true Muslims and that everyone else who detests their actions and ideologies is a traitor or apostate.

So if we want to prevent radicalization, we have to keep people going to mosques.

Now, some will still argue that Islam is a violent religion.

After all, groups like ISIS base their atrocities on the Quran.

Now, as Muslims, as mothers, and as humans, I think we need to do everything we can to stop groups like ISIS.

But if we cast them as representatives of the faith of 1.6 billion people, we're going to give in to their narrative.

(Applause.) Thank you.

ISIS is to Islam as much as the Ku Klux Klan is to Christianity.

(Applause.) Both groups claim that their ideologies are based on their scriptures.

But if you look at them, they are not motivated by what they read in the Bible.

It is their brutality that makes them read such things into the scriptures.

Recently, a prominent Imam told me a truly shocking story.

He said a girl came to him because she was thinking of joining ISIS.

I was really surprised and asked him if she had any contact with radical religious leaders.

And the matter was quite the opposite, he said, every clergy she spoke to silenced her, and her anger, her sense of injustice in the world, only got her into trouble.

As such, with nowhere to channel and understand this anger, she became a prime target for extremists who promised solutions.

What this imam did was bring her back to God and the community.

He wasn't ashamed of her anger, instead giving her a constructive way to bring about real change in the world.

What she learned at the mosque prevented her from joining ISIS.

I talked a little bit about how Islamophobia is affecting me and my family.

But what effect will it have on ordinary Americans?

What effect will it have on others?

What effect does consuming fear 24 hours a day have on the health of our democracy, and the health of our free thought?

Well, some studies, actually some studies in neuroscience, show that at least three things happen when we feel fear.

We become more accepting of authoritarianism, conformity and bigotry.

One study showed that when subjects were exposed to negative news stories about Islam, they became more receptive to military attacks on Muslim countries and policies that suppress the rights of U.S. Muslims.

Now, this is not just an academic story.

If you look at the period when anti-Muslim sentiment surged between 2001 and 2013, it happened three times, but it wasn't about terrorist attacks.

It was just before the Iraq War and during two election cycles.

So Islamophobia is not just the natural response to Islamic terrorism that I expected.

It can actually become a tool of mass manipulation, eroding the very foundations of a free society that is a rational, well-informed nation.

Muslims are like canaries in a coal mine.

We may be the first to feel it, but the toxic air of fear is harming us all.

(Applause.) And inflicting collective guilt isn't just about having to explain yourself all the time.

Dare and his wife Yusol were a young couple living in Chapel Hill, North Carolina, where they both attended school.

Well, he was an athlete.

He went to dental school, was talented, had a promising future...

And his sister told me he was the kindest, most generous person she knew.

She was visiting him there and he showed her his résumé and she was surprised.

She said, "Since when did my baby brother become such a brilliant young man?"

Just weeks after Suzanne visited her brother and his new wife, neighbor Craig Stephen Hicks killed them and Yuseau's sister Razan, who was visiting in the afternoon, in a form of execution in their apartment after posting an anti-Muslim statement on their Facebook page.

He shot Dare eight times.

Prejudice is therefore not only immoral, it can even be deadly.

Now back to my story.

What Happened After 9/11?

Did we go to the mosque or did we stay safe at home?

Well, we talked about it, and it may seem like a small decision, but for us it was what kind of America we wanted to leave for our children. An America where fear rules us, or an America where we are free to practice our religions.

So we decided to go to the mosque.

Then we put him in the car seat, buckled it up and drove quietly and enthusiastically to the mosque.

I took him outside, took off his shoes and entered the chapel, but stopped at what he saw.

The place was completely full.

The Imam then made a presentation, thanking and welcoming the guests. Because half the congregation were Christians, Jews, Buddhists, atheists, some of them believers and some of them non-believers. They came not to attack us, but to join us.

(Applause.) At this point, I broke down in tears.

These people were there because they chose courage and compassion over panic and prejudice.

what would you choose?

What will you choose in this time of fear and prejudice?

Want to play safe?

Or do you join those who say we are better?

thank you.

(Applause.) Thank you very much.

Helen Walters: So, Dahlia, you seem to resonate.

But I wonder, what do you say to people who might claim that you're giving a TED Talk, that you're clearly a deep thinker, that you work at a fancy think tank, that you're the exception, not the rule?

What do you say to them?

Dahlia Mogahed: Don't let this stage distract you, I'm a perfectly normal human being.

I am no exception.

My story is not uncommon.

I am a normal human being just like them.

Looking at Muslims around the world, I've done the largest survey I've ever done on Muslims around the world, people want normal things.

They want their families to prosper, they want jobs, they want to live in peace.

So I am no exception.

When you come across people who seem like exceptions to the rule, it's often not that they're the exception to the rule, but that the rule is being broken.

HW: Thank you. Dahlia Mogahed.

(applause)

Just imagine. Imagine a duck teaching a French class, playing ping pong in orbit around a black hole, or a dolphin balancing a pineapple.

You've probably never seen these things in person, but you can easily imagine them.

How does your brain produce images of things it has never seen?

It may not seem difficult, but only because we are used to it.

It turns out that this is a complex problem that requires a high degree of coordination in the brain.

That's because, like a collage made from photographic fragments, your brain puts together familiar pieces in new ways to create these strange new images.

Your brain must navigate a sea of ​​thousands of electrical signals, all of which must be delivered to their destination with precise timing.

When we look at an object, thousands of neurons in the posterior cortex fire.

These neurons encode various features of objects, such as pointed objects, fruits, browns, greens, and yellows.

This synchronous firing strengthens the connections between neurons in that set, joining them into what is known as a neuron set, in this case that of a pineapple.

In neuroscience, this is called the Hevian principle, neurons that fire together are wired together.

A later attempt to imagine a pineapple brightens up the entire ensemble, assembling a complete mind image.

Dolphins are encoded by a different set of neurons.

In fact, every object you see is encoded by a collection of neurons associated with it, and neurons are wired together by their synchronous firing.

But this principle does not explain the infinite number of objects that we can remember in our imagination without actually seeing them.

There is no neuronal population in dolphins that balances pineapples.

How can you even imagine such a thing?

One hypothesis, called psychosynthetic theory, also says that timing is key.

When the dolphin and pineapple neuronal populations are activated simultaneously, we can perceive two separate objects as one image.

But something in the brain has to coordinate that firing.

One leading candidate is the prefrontal cortex, which is involved in all complex cognitive functions.

Neurons in the prefrontal cortex are connected to the posterior cortex by long, elongated cell extensions called nerve fibers.

Psychosynthetic theory proposes that, like puppeteers pulling strings, neurons in the prefrontal cortex send electrical signals through these nerve fibers to multiple ensembles in the posterior cortex.

This makes them active at the same time.

When the Neuron Ensemble is turned on at the same time, you can experience the composite image as if you saw it in person.

This conscious purposeful synchronization of different neuronal populations by the prefrontal cortex is called mental synthesis.

For psychosynthesis to work, signals must arrive at both neuronal ensembles at the same time.

The problem is that some neurons are farther from the prefrontal cortex than others.

If the signals pass through both fibers at the same speed, they arrive asynchronously.

Although the length of connections cannot be changed, the brain has ways of altering conduction velocity, especially as it develops in childhood.

Nerve fibers are wrapped in a fatty substance called myelin.

Myelin is an insulator and speeds up electrical signals that travel along nerve fibers.

Some nerve fibers have as many as 100 layers of myelin.

There are only a few others.

And fibers with a thick layer of myelin can transmit signals more than 100 times faster than fibers with a thin layer.

Some scientists now believe that this difference in myelination may be the key to uniform conduction time in the brain and thus to human psychosynthetic capacity.

Since much of this myelination occurs in childhood, our active imagination from an early age has a lot to do with building a carefully myelinated brain that can create a creative symphony throughout life.

This morning, I want to talk to you about the future of human transportation. How we can reduce congestion, pollution and parking by putting more people in fewer cars. And how can we do it with the technology we have in our pockets?

Yes, we are talking about smartphones...

Not a self-driving car.

But to get started, we have to go back over 100 years.

Because it turns out there was an Uber road before Uber.

And if it survived, the future of transportation is probably already here.

So, let me introduce you to the boarding ship.

It was created or invented in 1914 by a man named LP Draper.

He was an auto salesman from LA and had an idea.

Well, he was cruising around downtown Los Angeles, my hometown, and saw a trolley with a long line of people trying to get where they wanted to go.

He said, "Why don't you put a sign on my car that will take you where you want to go on a shared trip?" This is slang for one nickel.

And people jumped on it, not just in Los Angeles, but across the country.

And within a year, by 1915, Seattle had 50,000 rides a day, Kansas had 45,000 rides a day, and Los Angeles had 150,000 rides a day.

To give you some perspective, Uber in Los Angeles is currently making 157,000 rides per day...

100 years later.

These were the existing transport monopolies of the time, the Trolleymen.

They clearly weren't happy with the carpooling tycoon.

So they set to work, visiting cities across the country and introducing regulations to slow the growth of shared taxis.

And then there were all kinds of regulations.

There were licenses, but they were often expensive.

In some cities, carpool drivers were required to be in carpools for 16 hours per day.

Other cities required two transfer drivers for one transfer.

However, there was a really interesting regulation that required rear seat lights to be installed in all Jitneys to deter a new harmful innovation called Spooning.

(Laughter) Okay. what happened?

Well, within a year this thing took off.

By 1919, however, carpooling was completely regulated and ceased to exist.

That's a shame...

Because if you can't share a car, you have to own one.

And car ownership has skyrocketed, so it's no surprise that by 2007 every man, woman and child in the United States could own a car.

And the phenomenon has become global.

By 2011, China sold more cars in China than in the United States.

Now, all this private ownership has, of course, come at a public cost.

In the United States, we waste 7 billion hours a year sitting in traffic.

$160 billion in lost productivity, of course we are stuck in traffic, and one-fifth of our carbon footprint is spewed into the air by the cars we drive.

However, this is only 4% of the problem.

Because if you have to own a car, that means it sits idle 96% of the time.

So up to 30 percent of our land and space is used to store these steel chunks.

Skyscrapers are also being built for cars.

That is the world we live in today.

Well, cities have been grappling with this problem for decades.

It is called mass transportation.

And even in cities like New York City, one of the world's most densely populated and one of the world's most sophisticated mass transit systems, 2.5 million vehicles still cross these bridges every day.

why is that?

That's because public transportation hasn't yet found a way to reach everyone's doorstep.

And the situation in San Francisco where I live is getting worse, and in fact it's getting worse around the world.

Uber started in 2010 as wanting to dispatch a ride at the push of a button.

We didn't have grand ambitions.

However, it turned out that many people wanted to press the button and ride, which eventually led to a large number of duplicate rides.

We saw many people pressing the same button at the same time, basically going to the same place.

So we started thinking about how we could turn those two trips into one trip.

Because then the ride will be much cheaper, up to 50% cheaper. And, of course, in cities there are much more people and much fewer cars.

So the big question for us was, will it work?

Can we offer cheaper rides that people are willing to share?

And, fortunately, the answer is a big yes.

In San Francisco, before uberPOOL, everyone drove their car wherever they wanted.

And bright colors are where the most cars are.

With uberPOOL in place, you'll find that there aren't that many bright colors.

More people are moving around the city with fewer cars, and cars are moving off the road.

uberPOOL seems to work.

So we rolled it out in Los Angeles eight months ago.

Since then, we've traveled 7.9 million miles off the road and pumped 1.4 million tons of CO2 out of the atmosphere.

But the real part of me -- (applause) but my favorite stat -- remember, I'm from Los Angeles, and I've been sitting in the back of my car for years of my life thinking, "How do I solve this?" -- What I love most is that after 8 months, we've added 100,000 new people to carpool every week.

Everything is now so massive in China that there are 15 million uberPOOL trips per month, which equates to 500,000 trips per day.

And of course we are seeing exponential growth happening.

In fact, we see it in LA as well.

When I talk to my team, I don't say, "100,000 people carpool every week and we're done."

How can we make it a million?

And in China it could be millions.

uberPOOL is therefore a very good solution for urban carpooling.

But what about suburbs?

This is the street I grew up on in Los Angeles, actually a suburb called Northridge, California. And, look, that mailbox has been around forever.

And at about the same time each morning, the car pulls out of the driveway. Most cars have one person in the car, who drives to work and to work.

So the question for us is, how do we turn all these commuter vehicles into shared vehicles, there are literally tens of millions of them.

Well, there is something we recently launched called uberCOMMUTE for this.

You wake up in the morning, get ready for work, get your coffee, go to your car, fire up the Uber app, and suddenly you're an Uber driver.

It matches people in the neighborhood on the way to work, which is really great.

There's just one problem...

We call it regulation.

So 54 cents a mile, what is this?

That's how the US government determined the cost of owning a car per mile.

For less than 54 cents per mile, anyone in the US can get you where you want to go in no time.

But if you charge 60 cents per mile, you are a criminal.

But what if, at 60 cents per mile, more than half a million people could carpool in Los Angeles?

And what if 50 million people in the US could carpool for 60 cents per mile?

If we can, that's clearly what we should do.

So back to our lesson in carpooling.

Imagine if by 1915 this thing was on track, and if there were no such regulations, it could have continued like this.

How are our cities different today?

Why not make a park instead of a parking lot?

Well, we missed that chance.

But technology has given us new opportunities.

Now, I'm as excited about self-driving cars as anyone else, but do we really have to wait 5, 10, or even 20 years for new cities to become a reality?

With the technology in our pockets today and a little smarter regulation, we can turn every car into a shared car and take back our cities today.

thank you.

(Applause) Chris Anderson: Thank you, Travis.

Travis Kalanick: Thank you.

CA: You know, the company you've built is truly amazing.

I've only talked about a small part of it here, the important part. The idea of ​​turning cars into public transport in this way is great.

But I have some other questions. Because I know they are in people's hearts.

First of all, last week I think, I turned on my phone and tried to book an Uber, but the app was not found.

A very radical, very bold, brave redesign.

TK: Yes.

K: How was it?

Did you notice that other people couldn't find the app that day?

Are you going to dazzle people with this redesign?

TK: Well, first I just want to say what we were trying to achieve.

I think it makes more sense if you know a little bit about our history.

So when we first started it was just a black car.

I literally had an S-Class at the push of a button.

So what we did was more of a naive version of what you would call a luxury brand, like a luxury car badge.

And as we expanded globally and moved from S-Class to Indian auto-rickshaws, it became important to be more accessible, more local and focused on the city we were in. You can see it in patterns and colors.

Even more symbolic, U means nothing in Sanskrit and U means nothing in Chinese.

So, it was a little bit.

Well, when you first roll out something like that, I mean, your hands are sweaty, you know, you're a little worried.

We saw many people. In fact, at first, there were even more people opening the app because they were curious about what they would find when they opened it.

And that number was slightly higher than expected.

CA: Okay, that's good.

Now, I would say that you yourself are something of an enigma.

Your supporters and investors who have worked with you all along believe that your only chance against strong and entrenched interests such as the taxi industry is to have a fierce and unrelenting competitor, and that is what you have proven.

Some people feel you've gone too far with that culture, but you know, there was a big debate a year or two ago that pissed off a lot of women.

How was the atmosphere at the company at that time?

Have you noticed any business loss?

Did you learn anything from it?

TK: Well, you see, I've been an entrepreneur since high school, and I'm sure you are too, but entrepreneurs go through tough times in different ways. For us, that was about a year and a half ago, and it was a difficult time for us as well.

Well, in our hearts we felt like -- I think we felt, after all, that we were good people doing a good job, but on the outside it wasn't obvious.

So we had a lot of work to do -- we started out as a very small company -- so literally two and a half years ago we were 400 people, and now we're 6,500 people.

So when you go through that growth, you have to kind of solidify your cultural values ​​and talk about it all the time.

And make sure people always check, "Are we doing a good job?"

By ticking these boxes, you're making sure you're telling your story next.

And I think we learned a lot of lessons, but I think we came out stronger in the end.

But it was certainly a difficult time.

CA: Everywhere you go you seem to face people who occasionally torment you.

Some Uber drivers, such as New York, are now furious because you changed the fare and can hardly contract anymore.

How -- You know, I said that when I first started doing this, it was just the simple coolness of pressing a button to summon a ride.

This problem has been eliminated and is basically affecting the entire global economy at this time.

You are compelled to become a global visionary who changes the world, whether you want it or not.

So -- who are you?

do you want it

Are you ready to embrace it and become what you want?

TK: Well, there are several things in that question. So -- (laughter) the pricing side of things -- I mean, keep that in mind.

UberX was literally 10-15% cheaper than our black car offering when it first launched.

They are now half the price of taxis in many cities.

And we have all the data to show that divers make more money per hour than taxi drivers.

What happens when prices go down is that people are more likely to take Uber at unusual times and are more likely to take Uber in places that were previously inaccessible.

And what this means for drivers is that no matter where they drop people off, they are much more likely to pick them up and pick them up again.

That means more trips per hour, more productive hours, and real revenue.

And some cities have literally done five or six price cuts and watched those price cuts climb over time.

So, even in New York, there is a blog post called "4 September" that compares September earnings by September.

same month every year.

And we can see that the profit increases over time as the price goes down.

And it has perfect pricing that can't be cut forever.

And in places where lowering the price doesn't make more money, raise the price back.

Now for the first part.

And the mystery and all of this, I mean, I'm the type of entrepreneur who's really excited about solving hard problems.

What I want to describe is like a math professor.

Look? If a math professor doesn't have hard problems to solve, that's a really sad math professor.

So at Uber, I like hard problems and the excitement of solving them.

But we don't want just math problems, we want the hardest problems we can find, and the ones that have an element of surprise when solved.

CA: In a few years, say five years, I don't know, but maybe we'll have amazing self-driving cars for less than what Uber rides today.

What would you say to an army of over a million drivers back then?

TK: Please explain that again -- when?

CA: In the age of self-driving cars -- TK: Sure, sure, sure. sorry i missed it.

CA: What would you say to the driver?

TK: Well, I think the first part will take some time. I think it's going to take a lot longer than the hype and the media anticipate.

That's part one.

Part 2 will also take some time. It will take a long transition period.

These cars work in certain places, but not in others.

It's an interesting challenge for us, isn't it?

Because Google has been investing in this space since 2007, and Tesla, Apple, and manufacturers are all about to do it.

This is the world that will continue to exist, and for good reason.

1 million people die in cars every year.

And we've already seen that people around the world spend billions, if not trillions, of hours sitting in their cars feeling frustrated and anxious.

And think about how giving people back time would make them less anxious and improve their quality of life.

So I think there are many good things.

And our way of thinking is that this is a challenge, but a challenge for optimistic leadership. Instead of resisting technology, like the taxi and trolley industries, we must embrace it or become part of the future.

But how can we get out of this situation with optimism?

Is there a way to partner with cities?

Do you have an educational system or vocational training for the transition period?

The transition period in particular will take much longer than we expected.

But it is a world that will continue to exist and will be a better world.

CA: Travis, what you're building is really cool and I really appreciate you coming to TED and sharing it openly.

Thank you very much. TK: Thank you.

(applause)

Imagine a brilliant neuroscientist named Mary.

Mary lives in a black-and-white room, reads only black-and-white books, and sees only black-and-white on the screen.

But although she has never seen color, Mary is an expert in color vision and knows everything that has been discovered so far about its physics and biology.

She knows how different wavelengths of light stimulate the three types of cone cells in the retina, and how electrical signals travel through the optic nerve to the brain.

There, patterns of neural activity are created that correspond to millions of colors that most humans can discern.

Now imagine that one day Mary's black-and-white screen malfunctions and shows apples in color.

She can experience for the first time what she has known for years.

Did she learn anything new?

Is there anything about color perception that she didn't capture in all her knowledge?

Philosopher Frank Jackson proposed this thought experiment in 1982 called "Mary's Room".

He argued that if Mary already knew all the physical facts about color vision, and that experiencing color was teaching her something new, mental states like color perception could not be fully explained by physical facts.

The Mary Room thought experiment explains what philosophers call the knowledge argument: that there are non-physical properties and knowledge that can only be discovered through conscious experience.

The knowledge argument contradicts the physicalist theory that everything, including mental states, has a physical explanation.

It seems intuitively obvious to most people who have listened to Mary that actually seeing color is very different from learning about it.

Therefore, there must be some quality to color vision that goes beyond physical descriptions.

The knowledge debate is not just about color vision.

Mary's Room uses color vision to represent conscious experiences.

If the physical sciences cannot fully explain color vision, perhaps other conscious experiences cannot.

For example, we can know all the physical details about the structure and function of another person's brain, but we cannot understand how that person feels.

These indescribable experiences have properties called qualia, subjective qualities that cannot be accurately described or measured.

Qualia is unique to those experiencing it, whether it's itching, being in love, or being bored.

Such mental states cannot be fully explained by physical facts alone.

Philosophers interested in artificial intelligence have used the knowledge argument to theorize that recreating a physical state does not necessarily recreate the corresponding mental state.

In other words, building a computer that mimics the functioning of every neuron in the human brain does not necessarily create a conscious computerized brain.

Not all philosophers agree that the Mary Room experiment is useful.

Some have argued that her extensive knowledge of color vision could have created the same state of mind that occurs when she actually sees colors.

Screen failure doesn't show anything new.

Others say that her knowledge was not complete to begin with, as it was based solely on verbal physical facts.

Years after proposing it, Jackson actually reversed his position on his thought experiment.

He determined that even Mary's experience of seeing red corresponded to measurable physical events in the brain rather than unknowable qualia beyond physical explanation.

However, there is still no definitive answer to the question of whether Mary learns anything new when she sees apples.

Isn't there a fundamental limit to what we can know about what we cannot experience?

And does this mean that certain aspects of the universe beyond our comprehension will forever exist?

Or can science and philosophy overcome the limitations of our minds?

what is your signature

In Western astrology, the zodiac sign is determined by when your birthday falls on the calendar.

But according to the Chinese zodiac, or shēngxiào, it's shāxiàng, which means the animal assigned to your year of birth.

And of the many myths that explain the signs of these animals and their placement, the most enduring is that of the Great Race.

As the story goes, the celestial ruler Jade Emperor, or Jade Emperor, wanted to devise a way to measure time and organized a race.

The first 12 animals to cross the river will be registered in the zodiac calendar in order of arrival.

The mouse got up with the sun to leave early in the morning, but on his way to the river he met a horse, a tiger and a cow.

The mouse was too small to swim well, so it turned to a larger animal for help.

The tiger and horse refused, but the kind-hearted cow agreed to carry the mouse across.

But just as they were about to reach the other side, the mouse jumped off the cow's head and secured first place.

The cow took second place, followed by a powerful tiger.

Rabbit was too small to go against the current, so he jumped over stones and logs with agility to take fourth place.

Then came the dragon. I could have flown directly across, but stopped to help some creatures I encountered along the way.

A horse came after her and ran across the river.

But the moment she crossed, a snake slipped past.

The startled horse backed away, allowing the snake to bite into sixth place.

When the Jade Emperor looked out over the river, he saw sheep, monkeys, and chickens working together on a raft to push through the weeds.

Upon their safe crossing, the trio agreed to award eighth place to the most comforting and harmonious sheep of them all, followed by the monkey and the rooster.

Then the dog came and climbed onto the shore.

He was a good swimmer, but he frolicked in the water for too long and managed to finish 11th.

Last place was won by a hungry pig who stopped to eat and take a nap before finally waddling across the finish line.

Each year is therefore associated with one animal in this order, and the cycle begins every 60 years.

Why 60 instead of 12?

Now, the traditional Chinese calendar consists of two overlapping systems.

The animals of the zodiac are associated with the so-called "terrestrial zodiac", or "shí'èrzhī".

Another system, tiāngān, is associated with the five classical elements: metal, mind, wood, wood, water, water, fire, fire and earth.

Each element is assigned a yin or yang and forms a decadal cycle.

When the 12 animals of the earth branch are matched with the five elements plus the yin or yang of the heaven branch, the various combinations of the 60 years known as zodiac signs or zodiac signs are created.

In other words, a person born in 1980 is a Yang Golden Monkey, and a person born in 2007 is a Yin Fire Pig.

In fact, you can also have an inner animal based on your birth month, a true animal based on your birth date, and a secret animal based on your birth time.

It is believed that it was this great race that determined which animals were enshrined in the Chinese zodiac, but as this system spread to Asia, other cultures also made changes to reflect their communities.

So if you look up the Vietnamese zodiac, you might find yourself a cat instead of a rabbit. Also, if you are in Thailand, you will see mythical snakes called Nagas instead of dragons.

So, whether or not your zodiac sign cares about what it says about you as an individual, it certainly reveals a lot about the culture from which that sign originated.

Approximately 7 million people die from heart attacks worldwide each year, and cardiovascular disease, which causes other problems such as heart attack and stroke, is the leading killer worldwide.

So what causes heart attacks?

Like other muscles, the heart needs oxygen, but a heart attack can prevent it from getting enough.

Fatty deposits, or plaques, develop on the walls of the coronary arteries.

These are the blood vessels that supply oxygenated blood to the heart.

These plaques grow with age and can enlarge, harden, and become inflamed.

Eventually, plaque can turn into a blockage.

If one of the plaques ruptures or cracks, blood clots can form around it within minutes, completely occluding a partially blocked artery.

Blood flow to the heart muscle is cut off, and oxygen-starved cells begin to die within minutes.

This is a myocardial infarction, or heart attack.

Without treatment, the condition can deteriorate rapidly.

Damaged muscles can't pump blood well and their rhythms can be disrupted.

In the worst cases, a heart attack can cause sudden death.

And how do you know someone is having a heart attack?

The most common symptom is chest pain caused by oxygen-starved myocardium.

Patients describe it as crushing or vice-like.

It may also radiate to the left arm, jaw, back, and abdomen.

But it's not always as abrupt and dramatic as the movie.

Some people experience nausea and shortness of breath.

Symptoms may not be noticeable in women and the elderly.

For them, weakness and fatigue can be the main signals.

And surprisingly, many people, especially those with diabetes, which affects pain nerves, never have a heart attack.

If you think someone might be having a heart attack, the most important thing is to act quickly.

If emergency medical services are available, call them.

It's the fastest way to get to the hospital.

Taking aspirin, which thins the blood, and nitroglycerin, which widens the arteries, can prevent a heart attack from getting worse.

In the emergency room, doctors can diagnose heart attacks.

They usually use an electrocardiogram to measure the electrical activity of the heart and blood tests to assess damage to the heart muscle.

The patient is then taken to a high-tech heart ward where tests are performed to locate the blockage.

Cardiologists can reopen blocked arteries by inflating them with balloons in a procedure called angioplasty.

A metal or polymer stent is often also inserted to hold the artery open.

For more extensive blockages, coronary artery bypass surgery may be required.

Cardiac surgeons can use part of a vein or artery from another part of the body to redirect blood flow around the blockage.

These procedures reestablish circulation to the myocardium and restore heart function.

Despite advances in heart attack treatment, prevention is key.

Both genetics and lifestyle factors influence risk.

And the good news is that you can change your lifestyle.

Exercise, a healthy diet, and weight loss all reduce your risk of heart attack, whether you've had one or not.

Doctors recommend doing both cardio and strength training and exercising several times a week.

Heart-healthy diets are low in sugar and saturated fats, which are associated with heart disease.

So what should you eat?

Replacing red meat, whole grains, and nuts such as walnuts and almonds with more fiber from vegetables, poultry, and fish all appear to be beneficial.

A good diet and exercise plan can also help keep your weight within a healthy range and reduce your risk of heart attack.

And, of course, drugs can also help prevent heart attacks.

For example, doctors often prescribe low-dose aspirin, especially for people who have already had a heart attack or who are known to be at high risk.

Medications that help manage risk factors such as high blood pressure, cholesterol, and diabetes also reduce the chance of heart attack.

Heart attacks are common, but not inevitable.

Eating healthy, avoiding smoking, staying fit, enjoying plenty of sleep and lots of laughter all go a long way in keeping the body's most important muscles pumping.

Created by logician Raymond Smullyan and popularized by his colleague George Boulos, this riddle has been called the hardest logic puzzle of all time.

You and your team have crash landed on an ancient planet.

The only way is to appease the three alien overlords, Tee, F, and Ah, by giving them the correct artifacts.

Unfortunately, I don't know who is who.

From the inscription, we can see that each lord may be asked three yes or no questions.

Tee's answer is always true, Eff's answer is always false, and Arr's answer is random each time.

But there is a problem.

You've deciphered the language enough to ask any question, but you don't know which of the two words "ozo" and "ur" means yes and which means no.

How can we tell which alien is which?

Pause here if you want to figure it out yourself.

Answer: 3 2 1 At first, this puzzle seems not only difficult, but utterly impossible.

What's the point of asking a question if you don't understand the answer and don't know if it's true?

But it is possible.

The key is to frame your question carefully so that any answer is informative.

First of all, by including the word itself in the question, you don't have to know what "ozo" and "uru" mean. And second, if you put in hypothetical conditions for each question, it doesn't really matter if the aliens are lying.

To see how it works, imagine asking whether 2 + 2 is 4.

Instead of asking directly, say, "If I asked you if 2 plus 2 equals 4, would you say 'ozo'?"

If ``ozo'' means ``yes'' and the overlord is Tee, sincerely respond with ``ozo''.

But what if I ask Ef?

Well, you'll either answer "ulu" or "no" to the embedded question. So lie and answer "ozo" instead.

And if "ozo" actually means no, then the answer to the embedded question would be "uru", with Tee and Ef still answering "ozo", each for their own reasons.

If you don't understand why this works, the reason has to do with the logical structure.

Both double positives and double negatives become positives.

Now, if you ask either Tee or Eff this way, you can be sure that you'll get "ozo" if the hypothetical question is true, and "ulu" if it's false, regardless of the actual meaning of each word.

Unfortunately, this doesn't help Arr.

But don't worry. Using the first question, we can identify one alien lord who is definitely not Arr.

Then you can use the second value to see if it's Tee or Eff.

Once you know that, you can request to identify one of the others.

Let's get started.

Ask the alien in the middle, 'If I ask if the overlord on my left is Earl, will you answer 'Ozo'?'

If the response is "ozo", there are two possibilities.

It's possible that you've already spoken to Arr, in which case your answer is pointless.

But if not, you're talking to either Tee or Eff, and as you know, getting "ozo" from either means your hypothetical question was correct, and the ruler on the left is indeed Arr.

Either way, I'm pretty sure the alien on the right isn't Arr.

Similarly, if the answer is "ulu", we know that the alien on the left is not Arr.

Then go to the Overlord, who you have determined is not Ah, and ask, "If you ask, 'Are you Ehu?'" Would you answer "ozo"?

Either answer establishes its identity because you don't have to worry about random chances.

Now that you know whether the answer is true or false, ask the same alien if the central ruler is Ah.

A process of elimination identifies the remaining one.

A satisfied Overlord will help you repair your ship so it's ready to take off.

One last question please. When I ask Tee how far it is to Earth, he replies "Ozo".

Unfortunately you still don't know what that means.

Whether it's playing a pirouette, playing an instrument, or throwing a baseball, all physical skills require practice.

Practice is the repetition of movements aimed at improvement, helping you perform easier, faster and with confidence.

So what does practice do in our brains to make things better?

Our brain has two types of nervous tissue: gray matter and white matter.

Gray matter processes information in the brain and sends signals and sensory stimuli to nerve cells, while white matter is mainly composed of adipose tissue and nerve fibers.

For our bodies to move, information must travel from the gray matter of the brain, down the spinal cord, and through a series of nerve fibers called axons to the muscles.

So how do practice and repetition affect the inner workings of our brains?

Axons in the white matter are wrapped in a fatty substance called myelin.

And it is this myelin covering, or sheath, that changes with practice.

Myelin is similar to the insulation in electrical cables.

It prevents energy loss from the electrical signals used by the brain and makes them move more efficiently along nerve pathways.

Recent studies in mice suggest that repeated physical actions increase the layers of myelin sheath that insulate axons.

And the more layers, the stronger the insulation around the axonal chains, forming a kind of superhighway of information connecting the brain and muscles.

Therefore, many athletes and performers attribute their success to muscle memory, but muscles themselves do not actually have memory.

Rather, it may be the myelination of neural pathways that gives these athletes and performers the advantage of having faster, more efficient neural pathways.

There are many theories that attempt to quantify the hours, days, or even years of practice required to acquire a skill.

I don't have a magic number yet, but I do know that mastery is more than just the amount of time you practice.

It is also the quality and effectiveness of the practice.

Effective practice is consistent, focused, and targeted to content and weaknesses that are at the limits of your current abilities.

So if effective practice is key, how do you get the most out of your practice time?

Try these tips.

Focus on the task at hand.

Minimize potential distractions by turning off your computer or TV and putting your cell phone in airplane mode.

In one study, researchers observed 260 students studying.

On average, those students were able to work on the task for only 6 minutes at a time.

Laptops, smartphones, and especially Facebook were the most common sources of distraction.

Start slowly or in slow motion.

Right or wrong, coordination is built through repetition.

Gradually increasing the speed of quality iterations increases the chances of correct iterations.

Second, assigning breaks and repeating them often is a common practice among elite performers.

Studies show that many top athletes, musicians and dancers spend between 50 and 60 hours a week doing activities related to their technique.

Many people divide the time they spend practicing effectively into multiple daily practice sessions of limited duration.

And finally, practice the details in your mind vividly.

Somewhat surprisingly, many studies suggest that once established, a physical movement can be reinforced by imagination.

In one study, 144 basketball players were divided into two groups.

Group A practiced one-handed free throws physically, while Group B practiced only mentally.

When tested at the end of the two-week experiment, both groups of intermediate and experienced players improved by about the same amount.

As scientists get closer to unlocking the secrets of our brains, our understanding of effective exercises only grows.

In the meantime, effective practice is the best way to push your personal limits, reach new heights and maximize your potential.

When I moved to Harare in 1985, social justice was at the core of Zimbabwe's national health policy.

The new government emerged from a long war of independence and quickly proclaimed socialist policies. In other words, medical services and primary education are virtually free.

A massive expansion of rural health centers has placed about 80 percent of the population within a two-hour walk of these facilities. This is a truly amazing achievement.

In 1980, the year of independence, 25 per cent of Zimbabwe's children were fully immunized.

By 1990, just ten years later, this proportion had reached 80 percent.

I feel very honored to be a part of this transformation and revolution.

The excitement and camaraderie were palpable.

Working side by side with the best Zimbabwean scientists, doctors and activists, I felt connected not only to the African independence movement, but also to the global progressive public health movement.

However, there was a difficult task.

Zimbabwe reported its first AIDS case in 1985, the year I arrived.

During my medical residency at Harlem Hospital in the early 1980s, I cared for several AIDS patients and had no idea what was in store for Africa.

In the early days I spent there, the infection rate was about 2 percent.

By the time I left Harare 17 years later, this percentage had increased to 1 in 4 adults.

By the mid-1990s, I was telling hundreds of people in their prime that they were HIV positive.

I have seen my colleagues and friends die, my students and hospital patients.

In response, a colleague and I founded a clinic.

I gave a condom demonstration.

We started schooling and workplace interventions.

we did a survey. We advised infected male partners on how to protect themselves.

We worked hard, and at the time I believed I was doing my best.

provided excellent treatment.

But I'm not talking about structural change.

Former UN Secretary-General Kofi Annan has spoken candidly about his failures that led to the Rwandan genocide.

In 1994, he was appointed head of the United Nations Peacekeeping Branch.

At the 10th anniversary of the genocide, he recalled: "At the time I believed I was doing my best, but after the genocide I realized that more could and should have been done to sound the alarm and garner support."

The AIDS epidemic has left the health industry unprepared, and today when the World Health Organization estimates that 39 million people have died from the disease, I am not alone in feeling guilty and regretting that we did not act sooner.

But while living in Zimbabwe, I never considered my role as an advocacy or political role.

I came there for my technical skills, both clinical and epidemiological research skills.

In my mind, my job was to care for patients and conduct research to better understand outbreak patterns, hoping to slow the spread of the virus.

I knew that marginalized people were at a disproportionately high risk of contracting and dying from AIDS.

And in a sugar plantation that looked more like a feudal estate than any modern enterprise, 60 percent of pregnant women tested positive for HIV.

I worked to show how being infected has more to do with male-dominated cultures, forced immigrant labor, and colonialism than moral failure.

The white man was mostly unscathed.

As medical professionals, our tools were pitifully weak. He pleaded with people to change their personal behavior, use condoms and have fewer partners.

As infection rates soared and treatments that remained the most powerful weapon against the virus became available in the West, the public sector across Africa was unable to pay for them.

I did not speak up about the inequalities in access to these life-saving drugs, or the underlying economic and political systems that drive up infection rates in so many populations.

I justified my silence by reminding myself that I was a guest in this country, that sounding the alarm could get me kicked out and even prevent me from doing a good job, caring for my patients, or doing the research I needed.

Therefore, I did not comment on the government's initial stance on AIDS.

I didn't voice my concerns loud enough.

Many doctors and health professionals may think that I have done nothing wrong.

Our patient pact, the Hippocratic Oath and its variants, concerns the sanctity of the patient-physician relationship.

And I did the best I could for each patient.

But I knew that epidemics occurred along the rifts of our societies, reflecting patterns of alienation, exclusion and discrimination related not only to biology but, more importantly, to race, gender, sexuality, class and more.

So was AIDS.

This was the case with the recent Ebola hemorrhagic fever.

Medical anthropologists such as Paul Farmer, who worked on AIDS in Haiti, call this structural violence. It is structural violence because inequality is embedded in the political and economic fabric of the social world, often invisible to those with privilege and power. And violence, because the effects of premature death, suffering, disease, etc. are violent.

Without recognizing these social injustices, we can do little for our patients.

Sounding the alarm is the first step to getting public health right, and that's how we rally our support to breakthrough together and create real change.

That's why I can't keep quiet these days.

I speak up about many things, even if it makes listeners uncomfortable, even if it makes me uncomfortable.

And a lot of it is about racial disparities and institutionalized racism, which should no longer be possible in this country, and certainly not in medical and public health settings.

But we have them and we pay for them with our shortened lives.

That is why sounding the alarm about the health effects of racism in the United States, the ongoing institutional and interpersonal violence faced by people of color, compounded by the tragic legacy of 250 years of slavery, 90 years of Jim Crow and 60 years of imperfect equality, is critical to doing my job right as New York City Health Commissioner.

In New York City, premature mortality before age 65 is 50 percent higher for black men than for white men.

In 2012, a black woman faced 10 times more risk of death related to childbirth than a white woman.

And despite great progress in reducing infant mortality, black babies still face nearly three times the risk of death in their first year of life compared to white babies.

New York City is no exception.

These statistics parallel those for the entire United States.

A recent New York Times analysis reported that 1.5 million black men are missing nationwide.

They noted that more than one in six black men, who should be between the ages of 25 and 54 today, are incarcerated or die prematurely and disappear from everyday life.

There is great injustice in the unwarranted violence young black men face on a daily basis, which has been the focus of recent protests under the banner #BlackLivesMatter.

But we must not forget that the incidence and consequences of common medical conditions such as heart disease, cancer, diabetes, and HIV are permanent, and that their incidence and consequences can slowly and silently kill and prematurely claim the lives of many more black people.

As the #BlackLivesMatter movement unfolded, I was frustrated and angry at the reluctance of the medical community to even use the word “racism” in our research and work.

You've probably felt something every time I said it.

Our medical students wore white coats to protest, but as ongoing discrimination continues to impact disease profiles and mortality rates, the medical community has largely been on the sidelines passively.

And I fear that the trend toward personalized precision medicine, which seeks biological or genetic targets to better tailor treatments, causes us to lose sight of the big picture, where the everyday circumstances of where people live, grow, work, and love most importantly determine population health, and, for too many, poor health.

As medical professionals, whether in the clinic or in research, we see great inequities in our daily work. Transgender youth contemplating suicide because our society is too harsh. A single mother who is persuaded that she is to blame for her child's poor health.

Our role as health professionals is not just to treat patients, but to sound the alarm and advocate for change.

Right or wrong, our social standing gives our voices a great deal of credibility, and it shouldn't be wasted.

I regret not speaking out in Zimbabwe, and as the New York City Health Commissioner, I promised to use every opportunity to sound the alarm and rally support for health equity.

I speak out against racism. I hope you will join me too. And when you speak out against sexism and other forms of inequality, I will join you.

It's time for us to stand up and speak collectively against systemic inequalities.

You don't have to have all the answers to ask for change.

All we need is courage.

The patient's health, and the health of all of us, depends on it.

(applause)

In mythological ancient Greece, Daedalus' son Icarus, who flew over Crete on wings made of wax and feathers, defied the laws of man and nature.

Ignoring his father's warnings, he climbed higher and higher.

To witnesses on the ground he looked like a god, but from above he felt like a god too.

However, in mythical ancient Greece, the line separating gods and humans was absolute, and the punishment for humans who tried to cross it was severe.

So did Icarus and Daedalus.

A few years before Icarus was born, his father Daedalus was highly regarded in his hometown of Athens as a genius inventor, craftsman and sculptor.

He invented carpentry and all the tools used in it.

He designed the first bathhouse and the first dance floor.

He created sculptures so lifelike that Hercules mistook them for real humans.

Daedalus was talented and famous, but he was selfish and jealous.

Worried that his nephew was a more skilled craftsman, Daedalus murdered him.

As punishment, Daedalus was banished from Athens to Crete.

Prior to his storied reputation, Daedalus was welcomed with open arms by King Minos of Crete.

There, Daedalus continued to push the boundaries as technical advisor to the palace.

For the king's children, he made mechanical toys that moved as if they were alive.

He invented the sails and masts of ships, which allowed humans to control the wind.

In each of his creations, Daedalus challenged, and eventually broke, the human limits that had previously held mortals away from the gods.

Pasiphae, the wife of King Minos, was cursed by the god Poseidon to fall in love with the king's treasured bull.

Under this spell, she asked Daedalus to help her lure it.

With peculiar audacity, he agreed.

Daedalus created hollow wooden cows that were so realistic that they could trick cows.

Pasiphae hid in Daedalus' creation and conceived and gave birth to the half-human, half-bull Minotaur.

This, of course, infuriated the king, and he accused Daedalus of enabling such a terrible perversion of natural law.

As punishment, Daedalus was forced to build an impenetrable labyrinth for the Minotaur in the basement of the palace.

After that, Minos imprisoned Daedalus and his only son Icarus on top of the highest tower on the island, where they would remain for the rest of their lives.

But Daedalus was still a genius inventor.

Observing the birds flying around the prison revealed a means of escape.

He and Icarus tried to fly away from prison like only a bird or a god could do.

Using the feathers of the flock perched on the tower and candle wax, Daedalus fashioned two pairs of gigantic wings.

While tying the wings to his son Icarus, he warned that "flying too close to the sea will make the wings too wet and heavy to use."

If you fly too close to the sun, the heat will melt the wax and destroy your wings.

Either way, they will surely die.

Therefore, the key to escape would be to defend the center.

The instructions were clear, so the two men jumped off the tower.

They were the first mortals to ever fly.

While Daedalus cautiously stayed halfway through the course, Icarus was overwhelmed by the ecstasy of flight and the sense of divine power that accompanied it.

Daedalus could only watch in horror as Icarus climbed higher and higher, powerless to change his son's miserable fate.

When the heat of the sun melted the wax on his wings, Icarus fell from the sky.

Just as Daedalus repeatedly ignored the consequences of defying the natural laws of mortals for the sake of his ego, so too was Icarus consumed with his own arrogance.

In the end, both of them paid a great price for leaving the path of sobriety, Icarus with his life and Daedalus with regret.

Anyone who can't imagine life without chocolate is lucky not to have been born before the 16th century.

Until then, chocolate existed only in Mesoamerica in a completely different form than we know it.

As far back as 1900 BC, people in the area learned how to cook the beans of the native cacao tree.

The earliest records indicate that beans were ground and mixed with cornmeal and chilies to make a drink. Rather than a relaxing cup of hot cocoa, it was a frothy, bitter, invigorating drink.

And if you thought we were making a fuss about chocolate today, the Mesoamericans have beaten us.

They believed that cacao was heavenly food given to humans by the feathered serpent god known as Kukulcan to the Mayans and Quetzalcoatl to the Aztecs.

The Aztecs used the cocoa bean as currency, drinking chocolate at royal feasts, giving it to soldiers as a reward for success in battle, and using it in ceremonies.

The first transatlantic encounter with chocolate occurred in 1519, when Hernan Cortes visited the court of Moctezuma in Tenochtitlan.

Cortes' lieutenant recorded that the king had the drink drawn from fifty jugs and poured into golden cups.

When the settlers returned with a load of this strange new bean, the missionaries told salacious tales of local customs, and the bean gained its reputation as an aphrodisiac.

Initially, chocolate's bitter taste made it suitable as a medicine for ailments such as an upset stomach, but sweetened with honey, sugar, or vanilla, it soon became a popular delicacy at the Spanish court.

And soon, no aristocratic home was complete without dedicated chocolate products.

Mass production of this fashionable drink was difficult and time consuming.

This included the use of plantations and imported slave labor in the Caribbean and islands off the coast of Africa.

In 1828, the introduction of the cocoa press by Coenrad van Houten in Amsterdam changed the world of chocolate.

With Van Houten's invention, it was possible to separate the natural fat of cocoa, namely cocoa butter.

This left a powder that could be mixed into a drinking solution or recombined with cocoa butter to create the solid chocolate we know today.

Shortly thereafter, Swiss chocolatier Daniel Peter added powdered milk to the mix and invented milk chocolate.

By the 20th century, chocolate was no longer a luxury item for the elite, but a snack for the common people.

To meet the huge demand, more cocoa, which can only be grown near the equator, had to be planted.

In the future, instead of shipping African slaves to cocoa plantations in South America, cocoa production itself will shift to West Africa, and as of 2015, two-fifths of the world's cocoa will be supplied by Côte d'Ivoire.

But with the growth of the industry has also come horrific human rights violations.

Plantations across West Africa, many of which supply Western companies, use slave labor and child labor, affecting an estimated two million children.

This remains a complex problem despite efforts by major chocolate companies to partner with African countries to reduce child labor and indentured labour.

Today, chocolate is firmly established within the rituals of our modern culture.

Combining colonial and local culture ties with the power of advertising, chocolate is sensual, decadent and forbidden.

But learning more about its fascinating and often brutal history and today's production reveals where these associations come from and what they hide.

So as you unwrap your next chocolate bar, take a moment to think that not all chocolate is sweet.

Without water, humans can live only about 100 hours.

But there are creatures that are resilient enough to live without it for decades.

This one-millimetre animal can survive the hottest and coldest environments on Earth, and can withstand high levels of radiation.

This is a tardigrade, which looks like a fat eight-legged gummy bear, but is one of the toughest creatures on the planet.

Most living things need water to survive.

Water is the process that enables metabolism to occur and facilitates all biochemical reactions that occur within cells.

But tardigrade-like creatures, also known as tardigrades, circumvent this limitation with a process called 'anhydrobiosis', Greek for life without water.

And tardigrades aren't the only ones, no matter how special.

Bacteria, single-celled organisms called archaea, plants, and even other animals can all survive desiccation.

For many tardigrades, this requires going through what is called a tun state.

They curl up into a ball, pull their head and eight legs into their bodies, and wait until the water returns.

It is thought that when water is scarce and the tardigrade becomes tunned, it begins to synthesize special molecules that fill the tardigrade's cells and form a matrix to compensate for the lost water.

Dry-sensitive cellular components such as DNA, proteins, and membranes are trapped in this matrix.

This is thought to lock these molecules in place and prevent them from unfolding, breaking apart, or fusing together.

When the organism rehydrates, the matrix dissolves, leaving intact, functional cells.

Besides desiccation, tardigrades can withstand other extreme stresses such as freezing, heating above the boiling point of water, high levels of radiation, and even the vacuum of outer space.

This has led to the erroneous speculation that tardigrades are extraterrestrial.

It's fun to think about it, but the scientific evidence firmly points to their origin on Earth, where they evolved over time.

In fact, this terrestrial evolution has given rise to more than 1,100 known species of tardigrades, and there are probably many others that have yet to be discovered.

And because tardigrades are so hardy, they are everywhere.

They live on all continents, including Antarctica.

And they inhabit diverse biomes such as deserts, ice sheets, oceans, freshwater, rainforests and highest peaks.

However, tardigrades can also be found in the most common places, such as the moss and lichens found in gardens, parks and forests.

All you need to find them is a little patience and a microscope.

Scientists are now trying to determine whether tardigrades use the tun state, an anti-drying technique, to withstand other stresses.

If we can understand how they and other organisms stabilize sensitive biomolecules, perhaps we could apply this knowledge to stabilizing vaccines or developing stress-tolerant crops that can respond to global climate change.

And by studying how tardigrades survive prolonged exposure to the vacuum of space, scientists can gain clues about the environmental limits of life and how to protect astronauts.

In the process, tardigrades could also help answer important questions about whether life could survive on a planet far more inhospitable than our own.

There are trillions of bacteria, viruses and fungi living on and within us, and it is in our interest to maintain a healthy and balanced relationship with them.

Together these form the gut microbiome, a rich ecosystem that performs a variety of functions in our body.

The bacteria in our gut break down food our bodies can't digest, produce vital nutrients, regulate our immune system, and protect us from harmful bacteria.

While we don't yet have a precise blueprint for the good bacteria needed for a strong gut, we do know that having a diverse range of bacterial species in a healthy microbiome is important.

Many factors influence our microbiome, including our environment, medications such as antibiotics, and even whether we have had a caesarean birth.

Diet is also emerging as one of the major influences on gut health.

You can't control all of these factors, but you can manipulate your microbial balance by paying attention to what you eat.

Dietary fiber from foods such as fruits, vegetables, nuts, legumes and whole grains is the best fuel for your gut bacteria.

When bacteria digest fiber, they produce short-chain fatty acids that nourish the intestinal barrier, improve immune function, and help prevent inflammation, thus reducing cancer risk.

And the more fiber you consume, the more fiber-digesting bacteria colonize your gut.

In a recent study, scientists traded the normal high-fiber diet of rural South Africans for a high-fat, meat-rich diet in a group of African Americans.

After just two weeks on a high-fat, low-fiber Western diet, the rural African group showed increased colonic inflammation and decreased butyrate.

This is a short-chain fatty acid that is thought to lower the risk of colon cancer.

On the other hand, the group that switched to a high-fiber, low-fat diet had the opposite results.

So what happens to your gut bacteria when you eat processed foods that are low in fiber?

Less fiber means less fuel for your gut bacteria, basically starving them to death.

The result is less diversity and less starving bacteria.

In fact, some people start eating the inner layer of mucus.

We also know that certain foods can affect your gut bacteria.

In one recent microbiome study, scientists found that fruits, vegetables, tea, coffee, red wine, and dark chocolate correlated with increased bacterial diversity.

These foods contain polyphenols, which are natural antioxidant compounds.

On the other hand, foods high in milk fat, such as whole milk and sugary sodas, were associated with reduced diversity.

How you prepare your meal is also important.

Fresh foods with minimal processing are generally higher in fiber and provide better fuel.

So lightly steamed, sautéed, or raw vegetables generally work better than fried ones.

There are also ways to prepare foods that can actually introduce good bacteria, also known as probiotics, into your gut.

Fermented foods are rich in beneficial probiotic bacteria such as Lactobacillus and Bifidobacterium.

Fermentation was originally used as a method of preserving food before the invention of the refrigerator, and is still practiced traditionally around the world.

Foods such as kimchi, sauerkraut, tempeh and kombucha add variety and vitality to our diet.

Yogurt is also a fermented food that introduces beneficial bacteria into our gut.

However, not all yogurts are good for you.

A brand with too much sugar and not enough bacteria may not actually help.

These are just general guidelines.

Further research is needed to understand exactly how these foods interact with our microbiome.

Although there is a positive correlation, our gut is a difficult place to observe directly.

For example, it is not currently known if these foods are directly involved in changing diversity, or if there is something more complex going on.

We are just beginning to explore the vast nature of our gut, but we are already getting a glimpse of how important our microbiome is to our digestive health.

The great news is that we have the power to activate the bacteria in our stomachs.

With plenty of fiber, fresh and fermented foods, you can trust your gut to keep you going.

Your research team discovered a prehistoric virus preserved in permafrost and isolated it for study.

After working late into the night, I closed my lab when a sudden earthquake hit and caused a power outage.

When the emergency generator kicked in, the alarm went off and our worst fears came true that all the sample vials had been destroyed.

The virus is contained for now, but unless it can be destroyed, it could soon open a vent and cause a deadly airborne infection.

Without hesitation, you grab your HazMat suit and get ready to save the world.

The lab is a 4x4 building with an entrance in the northwest corner and an exit in the southeast. There are 16 rooms.

Each room is adjacent to each other with an airlock, and the virus is released from rooms other than the entrance.

To destroy it, you must enter each contaminated room and pull the emergency self-destruct switch.

But there are pitfalls.

Due to the security system in place, once you enter a contaminated room, you can't leave without flipping a switch, and once you flip the switch, you can't return to that room again.

I start writing out possible routes on paper, but none seem to get me to the exit without missing at least one room.

So how can you destroy the virus in every infected room and survive to tell the story?

Pause here if you want to figure it out yourself.

Answers: 3 Answers: 2 Answers: 1 If your first instinct is to try to graph possible moves on a grid, you have the right idea.

This puzzle is related to the Hamilton Path Problem, named after the 19th-century Irish mathematician William Rowan Hamilton.

The challenge of the path problem is to find whether a given graph has a Hamiltonian path.

This is a route that visits all points in it only once.

Classified as NP-complete, this type of problem is notoriously difficult when the graph is large enough.

Any of the proposed solutions are easy to verify, but there are no reliable formulas or shortcuts for finding a solution or determining if a solution exists.

And I don't even know if it's possible for computers to reliably find such a solution.

This puzzle adds a twist to the Hamiltonian path problem in that it must start and end at specific points.

But before you waste tons of graph paper, you should know that a true Hamiltonian path is not possible at these endpoints.

This is because the rooms form a grid with an even number of rooms on each side.

A grid with such a configuration would not allow Hamiltonian paths that start and end at opposite corners.

Here's one way to understand why.

Consider a checkerboard grid with an even number of squares on each side.

All roads through it alternate between white and black.

Since even multiples and even numbers are even numbers, the total number of squares in these grids will also be even.

Therefore, a Hamiltonian path on an even-faced grid that starts in black must end in white.

And anything that starts with white must end with black.

However, in a grid with even sides, it is impossible to start and end the Hamiltonian path at opposite corners because opposite corners are the same color.

Unless you look carefully at the rules and notice important exceptions, it seems like you're out of luck.

Indeed, once the switch is turned on in a contaminated room, the switch is destroyed and can never be returned.

But there is one uncontaminated room - the entrance.

This means that you can get out of there once without pulling the switch and return to it when you destroy either of these two rooms.

The corner room may be contaminated through the airlock opening, but that's okay as the entrance can be destroyed after the second visit.

On the way back, you'll get four options for a successful route, and similar options if you destroyed this room first.

congratulation. An epidemic of apocalyptic scale could have been prevented, but a break is needed after such a stressful event.

Maybe you should apply for a recent job opening to become a traveling salesman.

For laboratory worms that can only be seen under a microscope, C. elegans lives for just a few weeks on Earth.

Compare that to turtles, which can be over 100 years old.

Mice and rats live only four years, but bowhead whales, the longest-lived mammals on the planet, can die after 200 years.

Like most living things, the majority of animals gradually degenerate after reaching sexual maturity in a process known as aging.

But what does getting older actually mean?

The factors behind this process are diverse and complex, but senescence is ultimately driven by cell death and dysfunction.

When we are young, we constantly regenerate cells to replace dead or dying cells.

But as we age, this process slows down.

In addition, older cells do not function as well as younger cells.

It causes our bodies to deteriorate, ultimately leading to sickness and death.

But if that's consistently true, why is there such a large variation in aging patterns and longevity within the animal kingdom?

The answer lies in several factors, including environment and body size.

These can exert powerful evolutionary pressures to adapt animals, resulting in species-specific aging processes.

Consider the frigid waters of the Atlantic and Arctic Oceans. There, Greenland sharks can live over 400 years, and arctic shellfish known as quahogs can live up to 500 years.

Perhaps the most impressive of these marine ancients is the Antarctic glass sponge, which can survive in the frigid waters for over 10,000 years.

In such a cold environment, heart rate and metabolic rate slow down.

Researchers theorize that this also slows down the aging process.

In this way, the environment influences longevity.

When it comes to size, larger species often, but not always, live longer than smaller species.

Elephants and whales, for example, live much longer than rats, rats and voles, which live for years on flies and worms.

Some small animals, such as nematodes and flies, are restricted by the mechanism of cell division.

They are mostly made up of cells and cannot divide and replace when damaged, so the body has a faster lifespan.

And size is a powerful evolutionary driver in animals.

Small creatures are prone to predators.

Rats, for example, can hardly be expected to live more than a year in the wild.

As such, they have evolved to grow and reproduce more quickly as an evolutionary defense mechanism against shortened lifespans.

Larger animals, by contrast, are good at fending off predators, so they can afford to grow large and breed multiple times in their lifetime.

Exceptions to the size rule include bats, birds, moles, and turtles, but in any case, these animals have other adaptations that allow them to escape predators.

However, there are still cases where animals with similar characteristics, such as size and habitat, age at very different rates.

In such cases, genetic differences, such as how cells in each organism respond to threat, often account for differences in lifespan.

The variability seen in the animal kingdom is therefore explained by a combination of all these factors acting to varying degrees in different animals.

What about us?

Currently, the average human life expectancy is 71 years. This means that we are still short of the longest-lived inhabitants of the planet.

But we are very good at increasing life expectancy.

In the early 1900s, human life expectancy was only 50 years.

Since then, we have learned to adapt by managing the many factors that cause death, such as environmental exposure and nutrition.

This and other increases in life expectancy make us perhaps the only species on earth capable of controlling the fate of nature.

Why do we buy certain products or choose certain brands?

This is the kind of question advertisers have been asking all the time, and there is no easy answer.

However, there is a useful tool that helps companies consider this and similar questions, called focus groups.

Until the 1940s, market research was mostly quantitative, using sales figures and customer surveys to track consumption.

However, the situation changed completely during World War II.

Sociologists Robert Merton and Paul Lazarsfeld set out to investigate how unprecedented exposure to propaganda during wartime affected the general public.

Instead of surveying large numbers of people with open-ended questions and quantifiable responses, the researchers sometimes conducted face-to-face interviews with small groups and engaged them in a more open discussion.

The technique was then adopted by the advertising industry with the help of consultants like Austrian-born psychologist Ernest Dichter, who first coined the term focus group.

This new method was a type of qualitative research that focused on the nature of people's preferences and ways of thinking.

While we can't tell marketers what percentage of people buy a particular product or brand, we may be able to learn more about who buys, why, and even the unconscious motivations behind those reasons.

Focus groups are used for exploratory research to generate new ideas for products and marketing based on a deeper understanding of consumer habits, rather than providing definitive business or sales conclusions.

For example, early focus groups found that, contrary to popular opinion at the time, wives often had more influence than husbands in choosing which car to buy, so Chrysler switched gears by marketing cars directly to women.

And Dr. Dichter himself conducted focus groups for Mattel to learn what girls wanted from their dolls.

The result is the original Barbie doll.

So how do focus groups work?

First, companies recruit 6 to 10 participants according to specific criteria that are consistent with research objectives.

They could be mothers of children ages 5 to 7, or teenagers planning to buy a new mobile phone within the next three months.

This is often done through professional recruiters who maintain lists of people who have agreed to participate in focus groups for payment or other rewards.

During the session, participants are asked to respond to various prompts from the group's moderators, such as sharing their opinion on a particular product or their emotional reaction to an advertisement.

Sometimes we are asked to do seemingly unrelated tasks, such as imagining the brand as a zoo animal.

The idea is that this reveals useful information about participants' emotions that traditional questions don't.

Beyond these basics, many variations are possible.

A focus group may have two or more moderators, perhaps with opposing views on the question. Alternatively, the researcher may hide in a focus group unbeknownst to other participants to see how their responses are affected.

And researchers can also observe the entire process through a magic mirror.

But while focus groups can provide valuable insight, they have limitations, and one of their main limitations is that the simple act of observing something can change it.

This principle is called observer interference.

The answers participants give may be influenced by the presence of the researcher, social pressure from other members of the group, or simply their knowledge that they are participating in the focus group.

Also, researchers often use small sample sizes in specific environments, making it difficult to generalize results.

Findings that researchers derive from focus groups are often tested through experimentation and data collection.

These give numbers to questions like how many potential customers are there and what price are they willing to pay.

This part of the process changes as technology evolves.

But focus groups have changed little over the decades.

Perhaps there is no substitute for serious dialogue between people on issues of great importance.

Standing in the finish line ready to go, you suddenly feel an intense itching in the back of your head.

We've all experienced the annoyance of itching, but have you ever wondered why it's itching in the first place?

The average person experiences dozens of itches every day.

It can be caused by all sorts of causes such as allergic reactions, dryness and even illness.

And then there are the strange ones that appear for no reason at all or just talking about itching.

Are you scratching your head right now?

Anyway, let's take one of the most common causes: insect bites.

Mosquito bites release compounds into the body called anticoagulants that prevent blood from clotting.

This compound we have mild allergies to causes the release of histamine, a chemical that dilates capillaries.

This increases blood flow and boosts the body's immune response to this perceived threat.

This is the explanation for the swelling, the same reason pollen makes your eyes swollen.

Histamine also activates the nerves associated with itching, which can lead to scratching from insect bites.

However, itch itself is still not fully understood.

In fact, much of what we know comes from studying the mechanisms of itching in mice.

Researchers found that cutaneous itch signals are transmitted through subclasses of nerves associated with pain.

These dedicated nerves produce a molecule called natriuretic polypeptide B, which triggers a signal that travels through the spinal cord to the brain, where it causes itching.

When we scratch our skin, our nails act on the skin to produce low-level pain signals that override the itch sensation.

It's almost distracting and creates a sense of relief.

But does itching actually have an evolutionary purpose, or does it simply exist to annoy us?

A leading theory is that our skin has evolved to be sensitive to touch, allowing us to cope with risks from the outside world.

please think about it.

Our automatic scratch response removes any harmful things that may be lurking on your skin, such as harmful stings, biting insects, and poisonous plant vines.

This might explain why you don't feel itchy in your body, such as your gut, safe from these external threats, but imagine how infuriating it would be.

In some people, abnormalities in the pathways responsible for all of these can cause excessive itching and can actually be detrimental to your health.

One extreme example is a psychological condition called delusional parasitosis. In this condition, people believe that they have ticks and fleas that live on their bodies, crawling on and under their skin, and are constantly itching.

Another phenomenon called hallucinatory itch can occur in patients undergoing amputation.

This injury has severely damaged the nervous system, disrupting the body's normal nerve signals and leaving the limbs numb.

Doctors are now finding ways to treat these itching disorders.

For amputees, a mirror is used to reflect the residual limb scratched by the patient.

It creates an illusion that tricks the brain into thinking that an imaginary itch has been filled.

Oddly enough, it actually works.

Researchers are also searching for genes involved in itch and developing treatments to block the itch pathway in extreme cases.

If the unscraped itch feels like hell on your own, so does Dante.

An Italian poet wrote of a patch of hell where people were punished by being left in a pit forever.

What do these animals have in common?

more than you think.

Like more than 5,000 other species, they are mammals, or members of the class Mammalia.

All mammals are vertebrates. Vertebrates have a backbone.

However, mammals are distinguished from other vertebrates by many common features.

That includes warm blood, fur and fur, the ability to breathe using lungs, and nourishing the young with milk.

However, despite these similarities, these creatures also have many biological differences, one of the most notable being the method of giving birth.

Let's start with the best known placental mammals.

This group includes humans, cats, dogs, giraffes and even the largest animal on earth, the blue whale.

The placenta is a solid disc of blood-rich tissue that attaches to the wall of the uterus and supports the developing embryo.

The placenta is what keeps the calf alive during pregnancy.

Directly connected to the mother's blood supply, it delivers nutrients and oxygen directly to the calf's body via the umbilical cord, and also removes waste products.

Placental mammals can spend much longer in the womb than other mammals.

For example, baby blue whales spend almost a whole year inside their mothers.

The placenta keeps the calf alive until birth when the umbilical cord is severed and the newborn's own respiratory, circulatory and waste disposal systems take over.

Newborn calves, about 23 feet tall, can already swim.

He will spend the next six months drinking 225 liters of rich, fatty mother's milk a day.

On the other hand, in Australia we find a second type of mammals - marsupials.

Marsupial babies are so small and delicate when they are born that they must continue to grow inside their mother's pouch.

Possums are one of the world's smallest marsupials, weighing only 18 milligrams at birth, which is the equivalent of about 30 grains of sugar.

Kangaroos, another marsupial, give birth to one baby at a time, about the size of a jelly bean.

The baby has to crawl through the center of the mother's three vaginas and then climb into the pouch, where it spends the next 6 to 11 months suckling.

After leaving this warm haven, baby kangaroos return to drink milk.

Sometimes she is just one of three babies in her mother's care.

Female kangaroos often support one in the womb and one in the stomach pouch at the same time.

Under unfavorable conditions, female kangaroos may terminate pregnancy.

She will then be able to produce two different types of milk. One for newborns and one for older Joeys.

The word mammal means breast, which is a bit of a misnomer as kangaroos do not actually have breasts, although they secrete milk from nipples in pouches.

Nor is it the third, third, and strangest example of mammalian birth.

Once home to hundreds of monotremes, today only four species of echidna and five species of platypus remain.

The name monotreme means "one hole", referring to the single opening used for reproduction, excretion and oviposition.

Like birds, reptiles, fish, dinosaurs, etc., these species lay eggs rather than give birth to live offspring.

Their eggs have soft shells, and when the babies hatch, they suck milk from the pores of the mother's body until they are big enough to feed themselves.

They are actually mammals, despite adaptations reminiscent of non-mammals, such as egg laying, the webbing and beak of the platypus platypus, and the poisonous spines on the male's feet.

That's because they share defining mammalian traits and are evolutionarily related to the rest of the class.

Whether placentals, marsupials, or monotremes, each of these organisms and their unique birthing methods, however strange, have successfully brought new life and diversity to the mammalian kingdom for thousands of years.

I want to tell you the story of when I was almost kidnapped in the trunk of a red Mazda Miata.

It's the day after I graduated from design school, and I'm having a yard sale.

And this guy got in this red Mazda and started looking through my belongings.

And he buys the art work I made.

And it turns out he was driving cross-country on a road trip before joining the Peace Corps and was in town alone that night.

So I invite him out for a beer and he tells me all about his passion for making a difference in the world.

It's getting late and I'm getting pretty tired.

I made the mistake of asking him with a tab gesture. "So where are you staying tonight?"

And he makes the situation worse by saying, "Actually, I don't have a place."

And I think, "Oh, oh!"

What is your occupation?

Has anyone been there?

Offer to host this guy?

But I just met him -- I mean, he says he's going to the Peace Corps, but I really don't know if he's going to the Peace Corps, and I don't want to end up being kidnapped in Miata's trunk.

It's a small trunk!

Then I hear myself saying,

And I hear a voice in my head saying, "Wait, what?"

That night, as I lay in bed, staring at the ceiling, I thought, "Oh my God, what have I done?"

A total stranger is sleeping in my living room.

What if he's psychotic? ”

My anxiety grew so much that I jumped out of bed, tiptoed to the door, and locked the bedroom door.

It turns out he wasn't psychotic.

We have kept in touch since then.

And the art he bought at the yard sale hangs in the classroom. he is a teacher now

This was my first hosting experience and it completely changed my perspective.

Maybe the people who were taught to be labeled "strangers" in childhood were actually friends waiting to be discovered.

The idea of ​​entertaining people with airbeds gradually became natural to me, and when I moved to San Francisco, I took one with me.

So now it's two years later.

I was unemployed, almost broke, my roommate moved out, and my rent went up.

Then I learned that a design conference was going to be held in town and all the hotels were full.

And I have always believed that turning fear into fun is a gift of creativity.

So here's what I propose to my best friend and new roommate, Brian Chesky. “Brian, I figured out a way to make a few bucks. Turn our home into a 'designer's bed and breakfast,' giving young designers who come to town a place to hang out with wireless internet, a small desk space, a sleeping mat, and breakfast every morning.”

Ha! ”

We built a basic website and Airbed and Breakfast was born.

Three lucky guests were able to stay in a $20 air bed with hardwood floors.

But they loved it, and so did we.

I swear, the ham and swiss cheese omelet we made tasted completely different because we made it for our guests.

We took them on a city adventure and as we said goodbye to our last guest, the door latch clicked and Brian and I just stared at each other.

Did you know that it's possible to make friends while earning rent?

The wheels started turning.

My old roommate Nate Blecharczyk has joined as an engineering co-founder.

And we considered whether we could make this a business.

Here's what we suggest to investors: “We want to build a website that publishes photos of the most intimate spaces people have: bedrooms, bathrooms, and the rooms they usually keep closed when people come over.

Then, over the Internet, you invite strangers to your home.

It's going to be amazing! ”

(Laughter) We sat and waited for the rocket ship to launch.

it didn't.

No sane person would invest in a service that allows strangers to stay in someone's home.

why?

Because we've all been taught in childhood that strangers are dangerous.

Now, when faced with a problem, you rely on what you know, but all we really knew was the design.

In art school, we learn that design is not just about how it looks and feels, it's about the whole experience.

We learned to do it for objects, but here we were aiming to build Olympic trust among people we had never met.

Can design do it?

Is it possible to design trust?

We want you to feel the taste of the trust we aim for.

Here's a 30-second experiment to push you beyond your comfort zone.

Please give me a thumbs up if you like it.

Yes, take out your cell phone.

Unlock your phone after you take it out.

Then hand the unlocked phone to the person on your left.

(Laughter) That little panic you're feeling right now -- (Laughter) It's exactly what hosts feel when they first open their homes.

Because the only thing more personal than your cell phone is your home.

People don't just see your messages, they also see your bedroom, kitchen, and bathroom.

Well, how does it feel to have someone's unlocked cell phone?

Most of us really feel responsible.

Most guests feel that way when staying at the house.

Our company exists because of it.

By the way, who has Al Gore's cell phone?

(laughter) Could you tell Twitter that he's running for president?

(Laughter) (Applause) Okay, you can give me your cell phone right now.

Now that you've experienced the reliability challenges we've faced, we'd like to share some of the discoveries we've made along the way.

What if we changed one small thing about the design of the experiment?

What if your neighbor first introduces himself with his name, where he is from, the names of his children and dogs, etc.?

Imagine there were 150 reviews of people saying, "I'm good at keeping my phone unlocked!"

(laughter) Now, what do you think about giving away cell phones?

We have found that a well-designed reputation system is critical to building trust.

And it didn't really work at first.

It's hard to leave a bad review.

Ultimately, we've learned to wait until both guests and hosts have left reviews before publishing them.

Well, here are the discoveries we made last week.

We collaborated with Stanford University to examine people's willingness to trust someone based on how similar they are in age, location, and geography.

Studies have shown that we naturally prefer people who are similar to us.

The more different someone is, the less we trust them.

This is a natural social prejudice.

But what's interesting is what happens when you add reputation, in this case, reviews.

If there are less than 3 reviews, nothing changes.

But above 10, everything changes.

High reputation beats high similarity.

In fact, good design can help overcome one of our deepest prejudices.

I also learned that building the right amount of trust requires the right amount of disclosure.

This happens the first time a guest sends a message to the host.

Sharing too little information, such as "yes", will lower your approval rate.

And if you share too much, like “I have a problem with my mother,” the acceptance rate will also go down.

But there are also zones that are just right, like, "I love the artwork in your place. I'm on vacation with my family."

So how do you achieve the right amount of disclosure?

It uses the size of the box to suggest appropriate lengths and prompts to share to guide the user.

We're betting company-wide on the hope that with the right design, people will overcome their danger-to-stranger prejudice.

What we didn't realize is how many people were waiting, ready to put their prejudices aside.

Here is a graph showing our adoption rate.

Three things are happening here.

The first is incredible luck.

The second is team effort.

And the third is the existence of unmet needs.

Well, things are going pretty well.

Of course, sometimes it doesn't work.

Guests threw unauthorized parties and vandalized the house.

The host left the guest stranded in the rain.

In the early days, I was in customer service and the call came directly to my cell phone.

I was on the front lines of a trust collapse.

And there's nothing worse than those phones, just thinking about them hurts.

And I'd like to say that the disappointment of someone's voice has always been and is the single biggest motivation for us to keep improving.

Thankfully, less than a small percentage of the 123 million nights we've hosted have had problems.

It turns out that people's trust is justified after all.

And when trust works, it just becomes magical.

I had a guest stay at my host's house in Uruguay and he had a heart attack.

The master rushed him to the hospital.

They donated their blood for his operation.

Read his review.

(Laughter) "It's a great home for a sedentary traveler prone to myocardial infarction.

(Laughter) The area is beautiful and has direct access to the best hospitals.

(laughter) Javier and Alejandra, without you knowing it, will instantly become your life-saving guardian angels.

While you are dying, they will rush you to the hospital in their car and stay in the waiting room until the doctor gives you a bypass.

They don't want you to feel lonely, so they bring you a book to read.

And they will let you stay in the house for an extra night at no extra charge.

I strongly recommend it! "

(Applause.) Of course, not every stay is like that.

But this connection beyond transactions is what the sharing economy is all about.

Now, when I heard those words, I'll be honest, I stumbled.

How do sharing and transactions work together?

Let me be clear. It's about commerce.

But simply calling it a rental economy would be incomplete.

The sharing economy is a commercial transaction that promises people-to-people connections.

People share a part of themselves and it changes everything.

I think most travel today is like fast food. Efficient and consistent, sacrificing authentic local flavors.

What if travel was like a sumptuous buffet of local experiences?

Imagine if everywhere you went there was a central market where locals would go from pub to pub to get you thoroughly drunk in neighborhoods you didn't even know existed.

Or would you like to learn to cook from a five-star restaurant chef?

Today, homes are designed around the idea of ​​privacy and segregation.

What if homes were designed from the ground up to be shared?

What is it like?

What if cities embraced a shared culture?

I envision a future of shared cities that bring community and connection, rather than isolation and isolation.

In South Korea, the city of Seoul has actually started doing this.

They repurpose hundreds of government parking lots for residents to share.

They connect students in need of a place to live with burglars who have extra rooms.

And they launched an incubator to help fund the next generation of sharing economy startups.

Tonight, with our services alone, 785,000 people in 191 countries will either stay in a stranger's house or welcome a stranger into their home.

Clearly, it's not as crazy as we've been taught.

We didn't invent anything new.

Hospitality is forever.

There were many other websites like ours.

So why was our product ultimately successful?

Luck and timing aside, I've learned that I can take an element of trust and design it.

Design can overcome our most ingrained danger-to-stranger prejudices.

It's amazing to me.

surprised.

I think so every time a red Miata passes by.

We now know that design cannot solve all the world's problems.

But if it can help or influence this problem, I wonder what else I could design next.

thank you.

(applause)

Evolutionary tango of animal reproductive organs.

Can you guess what you're looking at?

If you answered "duck vagina", you are correct.

This bird may not look particularly strange, but it breeds using this strange and intricate corkscrew-shaped contraption.

We observe equally incredible reproductive organs in insects, mammals, reptiles, fish, spiders and even snails.

Apparently, no organ evolves into more diverse forms as quickly as those involved in reproduction.

Evolution works through reproduction, so on the surface it makes sense.

The more offspring an animal leaves, the more its genes spread.

And since the reproductive organs are tools for reproduction in animals, any improvement there will have an immediate effect.

But what's the point of having such a decorative underworld?

After all, the function of the genitalia seems simple.

The penis deposits a small amount of sperm and the vagina receives it and sends it to the egg.

Any animal will do, as long as the male has a pipette-like device and the female has a funnel-like device.

But that's not what we see.

For example, a chicken flea's penis looks nothing like a pipette, but rather an exploding old man's clock.

And the wingworm's vagina resembles the one in the Dr. Seuss book.

Throughout the animal kingdom, reproductive organs are a very complex thing, far more complicated than it seems necessary for its purpose.

That's because the reproductive organs don't just deposit and receive sperm.

Many male animals also use the penis as a courtship tool, such as crane flies.

In some South American species, males have small washboards and scrapers on their penises, and their vocalizations echo throughout the female's body during mating.

It is believed that if the female crane fly enjoys this unusual serenade, it will allow the male to have offspring.

This is how the most musical penis genes spread, leading to the rapid evolution of insect phalluses.

Similarly, some beetles have two small drumsticks on either side of their penis.

During mating, these are used to rub, pat, or smack the female.

Also, some ungulate mammals, such as rams and bulls, use a whip-like extension on the left side of the penis for stimulation during mating.

But if males can only be evaluated after mating, how can females actually choose males?

This is where women's adaptability comes into play.

In fact, insemination differs from conception, and the female reproductive system utilizes this distinction.

For example, the vagina of some dung flies contains pockets for separating sperm from different males depending on their attractiveness.

Male use of the penis for courtship and female control of her own sperm management are two reasons why the genitalia have evolved into such a complex shape.

But there are others, as the genitals are also where sexual conflicts unfold.

Female profits are best when they fertilize their eggs with the sperm of the best father, creating genetic diversity among their offspring.

For men, on the other hand, this is bad news.

It would be best for him to have the female use his sperm to fertilize all the eggs.

Thus, we see cycles of adaptation in the evolutionary arms race to maintain control.

Black widow spiders have disposable penile tips that snap off inside the vagina to thwart rival attempts, and bedbug males use syringe-like penises to completely bypass the female's genitalia and inject sperm cells directly into the female's abdomen.

Women have also evolved their own countermeasures so as not to lose to it.

In some species of bedbugs, females have evolved an entirely new genitalia on the right flank, where males normally pierce.

This allows the reproductive organs to maintain their ability to filter unwanted sperm.

And since a duck's vagina is shaped like a clockwise spiral, when a man inflates a long counter-clockwise penis inside her and she objects, all she has to do is flex the vaginal muscles and the penis just pops out.

In this way, the genitals are very different. It is not only because it fascinates us, but because in every species the genitals have been around for millions of years and are the result of a ferocious evolutionary tango of sex that will continue for millions of years to come.

In 1796, Thomas Jefferson received a box of unidentified bones.

The long, sharp claws reminded me of a lion, but the arm bones suggested a much larger animal, about three meters long.

Jefferson thought it might be an unknown giant lion from North America and warned explorers Lewis and Clark to beware of this mysterious predator.

But Jefferson's box of bones did not come from a lion.

They came from the extinct giant sloth.

Prehistoric sloths first appeared about 35 million years ago.

Dozens of species lived in North, Central and South America, along with other ancient creatures such as mastodons and giant armadillos.

Some ground sloths, like megalonychids, were as big as cats, but many were gigantic.

Jefferson's sloth, Megalonyx, weighed about 1 ton, which is small compared to Megatherium, which reaches the same 6 metric ton as an elephant.

Using their strong arms and sharp claws, they roamed forests and savannahs, uprooted plants and climbed trees, and ate grass, leaves, and prehistoric avocados.

In fact, if it weren't for giant sloths, we might not have had avocados today.

Small animals were unable to swallow the giant seed of the avocado, but the sloth was able to do so, spreading the avocado tree over a wide area.

Sloths thrived for millions of years, but about 10,000 years ago they began disappearing along with other giant mammals in the Western Hemisphere.

The researchers believe that ground sloths may have been pushed out by the onset of the Ice Age, or by competition from other species, possibly humans, that arrived in the region around the time sloths were mostly extinct.

Some of the smaller sloths survived and moved to the tops of trees.

Six species currently live in the rainforest canopies of Central and South America.

Staying in the trees is a good way to avoid predators, and there are plenty of edible leaves.

However, this diet also has its drawbacks.

Animals extract energy from food and use that energy for locomotion, maintenance of body temperature, maintenance of organ function, and all other activities necessary for survival.

However, leaves do not contain much energy, and those that do have energy are difficult to extract.

Most herbivores supplement their leafy diet with high-energy foods such as fruits and seeds.

But sloths, especially three-toed sloths, rely almost exclusively on leaves.

They have evolved finely tuned strategies to cope with this restricted diet.

First, they extract as much energy as possible from food.

Sloths have multi-chambered stomachs that cover one-third of their body size, and can take five to seven days, or even weeks, to process a meal, depending on the species.

Another piece of the puzzle is to use as little energy as possible.

One of the ways sloths do this, of course, is by not moving much.

They spend most of their time eating, resting and sleeping.

They come down from the canopy for a potty break only once a week.

When the sloth moves, it's not that fast.

It takes about five minutes for a sloth to cross an average neighborhood road.

This slow lifestyle means sloths don't need as much muscle.

In fact, they have about 30% less muscle mass than other animals of the same size.

Sloths also have a body temperature fluctuation of about 5 degrees Celsius, so they use less energy to keep warm. This is lower than poikilothermic reptiles, but higher than most mammals.

These physical and behavioral adaptations minimize the sloth's energy expenditure, or metabolic rate.

Three-toed sloths have the slowest metabolism among mammals.

Giant pandas are the second slowest, and two-toed sloths are the third.

Moving slowly allowed sloths to thrive in treetop habitats.

However, sloths themselves also provide excellent habitat for other organisms, including algae, providing additional camouflage and even a treat.

Sloths may not be huge anymore, but that doesn't mean they're less popular.

It's a good day to be a pirate.

Amaro and his four companions, Bert, Charlotte, Daniel and Eliza, unearth a box of gold coins - 100 coins.

But now they have to divide their spoils according to pirate regulations.

As captain, Amaro can suggest how the coins should be distributed.

Each pirate, including Amaro himself, would then vote either for or against.

If the vote passes or there is a tie, the coins are split according to the plan.

However, if the majority votes down, Amaro has to walk the plank and Bart becomes captain.

Bart then proposes a new distribution, and all remaining pirates vote again.

If his plan is rejected, he too walks the plank and Charlotte takes his place.

This process repeats, moving the captain's hat to Daniel and then Eliza until the proposal is accepted or only one pirate remains.

Naturally, each pirate wants to survive while getting as much gold as possible.

But being pirates, they can't cooperate beforehand because no one trusts each other.

And being a bloodthirsty pirate, if anyone thinks they can get the same amount of gold no matter which way they fall, they'll vote for making the captain walk the plank just for fun.

Finally, each pirate is good at reasoning, and we know that other pirates are as well.

What distribution should we propose to ensure Amaro's survival?

Pause here if you want to figure it out yourself.

Number of Answers: 3 Number of Answers: 2 Number of Answers: 1 Intuition seems to suggest that Amaro should try to bribe other pirates with most of his money to increase the chances of his plan being accepted.

But it turns out he can do much better than that. why?

Like I said, all the pirates know each other to be first-rate logicians.

Therefore, when each person votes, they are thinking not only about the current proposal, but about all possible future outcomes.

And because the order is known in advance, each person can accurately predict how others will vote in any given situation and adjust their votes accordingly.

Since Eliza is the last, she has the most consequences to consider, so let's start by going through her thought process.

She would deduce this by working backwards from the possible final scenario if only she and Daniel were left.

Daniel would obviously suggest keeping all the money, but Eliza wants to avoid this situation at all costs, as her one vote is not enough to invalidate Daniel.

Now, with the three pirates left and Charlotte making the offer, move to the previous decision point.

We all know that if she loses the vote, the decision will go to Daniel and Daniel will get all the gold and Eliza will get nothing.

Therefore, to secure Eliza's vote, Charlotte needs only to offer her one coin, which is slightly more than nothing.

This ensures Charlotte's support, so Charlotte doesn't have to offer anything to Daniel.

What if there are 4 pirates?

As captain, Bart needs just one more vote to pass the plan.

He knows that Daniel doesn't want to hand the decision over to Charlotte, so he intends to do nothing to Charlotte or Eliza and offer 1 coin in support of Daniel.

Now, back to the first ballot, all five pirates are running.

Considering all other scenarios, Amaro knows that if he goes too far, the decision will fall to Bart, which will be bad news for Charlotte and Eliza.

So he gave them one coin each, leaving 98 for himself.

Bert and Daniel vote against, but Charlotte and Eliza reluctantly vote yes, knowing the alternative will be worse for them.

Pirate games contain some interesting concepts from game theory.

One is the concept of common knowledge, where each person is aware of what the other knows and uses it to predict inferences.

And the final distribution is an example of a Nash equilibrium where each player knows every other player's strategy and chooses his own strategy accordingly.

Individual players will not benefit from changing strategy, although it may lead to worse outcomes for everyone than working together.

So with Amaro now able to keep most of the gold, other pirates may need to find better ways to use their impressive logic skills, such as revising this absurd pirate code.

So a few years ago I did something really brave, or some would say I did something really stupid.

I ran for Congress.

For many years I lived safely behind the scenes in politics as a fundraiser and organizer, but in my heart I always wanted to run for office.

The incumbent has been in my constituency since 1992.

She never lost a campaign, and no one actually ran against her in a Democratic primary.

But in my heart, this was my way of making a difference and disrupting the status quo.

But the polls show something completely different.

The pollsters said I was crazy to run and there was no way I could win.

But I ran anyway and was a novice in the 2012 New York City Council elections.

I swore I would win.

I got endorsements from the New York Daily News, The Wall Street Journal took a picture of me on election day, and CNBC called the election one of the hottest races in the country.

I raised money from everyone I know. Among them was an Indian aunt who was very happy to see an Indian girl running for office.

But on Election Day, the polls were spot on, I had just 19 percent of the vote, and the same newspaper that made me a rising political star now said I wasted $1.3 million with 6,321 votes.

do not calculate.

It was humiliating.

Now, before I get you wrong, this is not about the importance of failure.

Nor is it leaning forward.

I will tell you the story of how I ran for Congress. Because I'm 33 and it was the first time in my life that I didn't care about being perfect and did something really brave.

And I'm not alone. No wonder so many women I talk to are attracted to careers and professions where they know they can do well and they know they can be perfect.

Most girls are taught to avoid risks and failures.

We are taught to smile pretty, act safe and get all the credit.

Boys, on the other hand, are taught to play rough, swing high, crawl to the top of the monkey bar, and jump off their heads.

And by the time we reach adulthood, we've become accustomed to taking one risk after another, whether it's negotiating a raise or asking someone out on a date.

they get paid for it.

It's a common saying in Silicon Valley that nobody takes a startup seriously until it fails twice.

In other words, we raise our girls to perfection and our boys to be brave.

Some people worry about federal deficits, but I worry about lack of courage.

Our economy, our society, is only hurting by not raising our girls to be brave.

It is this lack of courage that underrepresents women almost everywhere: in STEM, in the C-suite, in the boardroom, in Congress.

In the 1980s, psychologist Carol Dweck noted how bright fifth graders handled tasks that were too difficult for them.

She found that smart girls gave up quickly.

The higher the IQ, the more likely they are to give up.

On the other hand, bright boys found the difficult content a challenge.

They found it energizing.

They were likely to double down on their efforts.

what happened?

Well, at the 5th grade level, girls routinely outperform boys in all subjects, including math and science, and this is not a question of ability.

The difference between boys and girls is in how they approach challenges.

And it doesn't just end in fifth grade.

HP reports that men apply for jobs if they meet 60 percent of the qualifications, but women don't apply if they don't meet 100 percent of the qualifications.

100 percent.

This study is usually cited as evidence that women need a little more confidence.

However, this is proof that women have been socialized to aim for perfection, and I think they are being overly cautious.

(Applause.) And whether we're ambitious or lean, our socialization to perfection has made us take less risk in our careers.

And women are being left out of the 600,000 currently open jobs in computing and technology. This means that our economy is left out of all the innovations and problems that women can solve if they are socialized with courage, instead of being socialized for perfection.

(Applause.) So in 2012, I started a company to teach girls to code. And what I realized was that by teaching girls to code, I was socializing them with courage.

Coding is a never-ending trial-and-error process of trying to do the right command in the right place, but sometimes only a semicolon can make the difference between success and failure.

Code breaks and falls apart, requiring you to try again and again until that magical moment when what you are trying to build becomes a reality.

Patience is required.

It requires imperfection.

In our program, we quickly see that girls are afraid of not getting it right and not being perfect.

Girls Who Code teachers all tell the same story.

The first week, while the girls were learning how to code, a student called her over and said, "I don't know what to code."

When the teacher looks at the screen, they see an empty text editor.

If she didn't know better, the student would think she spent the last 20 minutes just staring at the screen.

However, after pressing "undo" several times, I see that the student wrote the code and deleted it.

She tried, got pretty close, but didn't quite get it.

Rather than show her progress, she would rather show nothing.

Perfect or bust.

Our girls turned out to be very good at coding, but teaching them how to code is not enough.

A friend of mine, Lev Brie, a professor at Columbia University who teaches an introduction to Java, told me about office hours with computer science students.

When they were struggling with the assignment, they came up and said, "Professor, there's something wrong with my code."

The girls would come in and say, "Doctor, I have a problem."

We must undo the socialization of perfectionism, but combine it with sisterhood building that lets girls know they are not alone.

Because no matter how hard you try, you can't fix a broken system.

I don't know how many women will tell me, "I'm afraid to raise my hand, I'm afraid to ask a question, because I don't want to be the only one who doesn't understand and I'm the only one struggling."

If we teach girls to be brave and have a supportive network to cheer them on, they will build great things. I see it every day.

For example, consider two high school students who created a game called Tampon Run (yes, Tampon Run) to combat menstrual taboos and sexism in gaming.

Or some Syrian refugees have dared to show their love for their new country by developing an app that helps Americans go to the polls.

Or the 16-year-old girl who built an algorithm to detect whether a cancer is benign or malignant in hopes of saving the life of her father with cancer.

These are just three examples of the thousands of girls who have been socialized to be imperfect and have learned to keep trying and persevere.

And whether they're programmers, the next Hillary Clinton or Beyoncé, they don't put off their dreams.

And that dream has never been more important to our country.

For the American economy, any economy, to grow and truly innovate, we cannot leave half of the population behind.

We need to socialize our daughters to tolerate imperfections, and we must do it now.

I can't wait for them to learn how to be brave like they were when I was 33.

We must teach them to be brave early in school and in their careers, when they are most likely to impact their own lives and the lives of others. They must also show that they are loved and accepted for being brave, not for being perfect.

So I ask each of you to tell every young woman you know—your sisters, nieces, employees, and colleagues—to tolerate imperfections. Because when we teach girls their imperfections and help them take advantage of them, we build a movement of brave young women who will build a better world for themselves and each of us.

thank you.

(Applause.) Thank you.

Chris Anderson: Thank you, Reshma.

It's a very powerful vision. you have a vision

Please let me know how it goes.

How many girls are currently in your program?

Reshma Saujani: Yes. So in 2012 we taught 20 girls.

It will teach 40,000 students in all 50 states this year.

(Applause.) Last year, only 7,500 women graduated in computer science, so the numbers are pretty strong.

For example, the problem is so serious that such changes can be made immediately.

CA: So you are also working with some companies in this room and are welcoming graduates of your program?

RS: Yes, we have about 80 partners. From Twitter, Facebook, Adobe, IBM, Microsoft, Pixar, Disney, you name it.

If you haven't registered, I'll go find you. Because we need every tech company to have Girls Who Code classrooms in their offices.

CA: I've heard from several companies that good things happen when they increase the gender balance in their engineering teams.

RS: Great things happen.

I mean, it's crazy to me to think about the fact that 85 percent of all consumer purchases are now made by women.

Women use social media at a rate 600% higher than men.

We own the internet and we need to build tomorrow's enterprise.

And when a company has a diverse team and has great women as part of the engineering team, they build great things and we see it every day.

CA: Reshma, you saw the reaction there. You have an incredibly important job.

The whole community is rooting for you. Give you more power. thank you.

RS: Thank you.

(applause)

Have you ever wondered what happens after swallowing a pain reliever like ibuprofen?

Drugs that slide down the throat can help treat headaches, back pain, or throbbing ankle sprains.

But how do you get to your destination in the first place?

The answer is that this substance finds its way into the circulating bloodstream and circulates through the body competing to do its job before it can get caught in the trappings of organs and molecules designed to neutralize and eliminate foreign substances.

This process begins in the digestive system.

Suppose you swallow an ibuprofen tablet for a sore ankle.

Within minutes, the tablet will begin to disintegrate in the acidic stomach fluid.

Dissolved ibuprofen travels into the small intestine and then through the intestinal wall and into the vascular network.

These vessels enter the veins and carry blood and everything in it to the liver.

The next step is to pass through the liver.

As the blood and drug molecules in it travel through the liver's blood vessels, enzymes try to react with and neutralize the ibuprofen molecules.

Damaged ibuprofen molecules, called metabolites, can render it ineffective as a pain reliever.

At this stage, most of the ibuprofen passes through the liver intact.

It exits the liver and continues its journey through the veins into the body's circulatory system.

Half an hour after swallowing the tablet, part of the dose has already entered the circulating bloodstream.

This blood loop passes through every limb and organ, including the heart, brain, kidneys, and back through the liver.

When the ibuprofen molecule encounters a place where the body's pain response is in full swing, it binds to a specific target molecule that is part of that response.

Pain relievers like ibuprofen block the production of compounds that help the body transmit pain signals.

As more drug molecules accumulate, the analgesic effect increases, reaching a maximum within about 1-2 hours.

The body then begins to excrete ibuprofen efficiently, and blood volume halves every two hours on average.

Once the ibuprofen molecule leaves its target, it is again carried away by the systemic bloodstream.

Back in the liver, a further portion of the total drug is converted into metabolites that are eventually filtered as urine by the kidneys.

The loop from the liver to the body to the kidneys continues at a rate of about one blood cycle per minute, neutralizing and filtering a little more drug with each cycle.

These basic steps are the same for any drug taken orally, but the speed of that process and the amount of drug that enters the bloodstream varies depending on the drug, the person, and how it enters the body.

Dosages listed on drug labels are helpful, but they are averages based on a sample population and are not representative of all consumers.

And getting the right dose is important.

If it is too low, the effect of the drug cannot be demonstrated.

Too high and the drug and its metabolites can become toxic.

That's true of any drug.

Children are one of the most difficult patient groups to administer adequate doses.

That's because the way we process drugs changes rapidly, and so does our body.

For example, levels of drug-neutralizing liver enzymes fluctuate greatly during infancy and childhood.

And that's just one of many complicating factors.

Genetics, age, diet, disease, and even pregnancy affect how efficiently the body processes drugs.

Someday, regular DNA testing may allow us to adjust the exact dose of the drug for liver efficiency and other factors, but in the meantime, your best bet is to read the label or talk to your doctor or pharmacist and take the recommended amount at the recommended time.

During a long day of roaming the forest in search of edible grains and medicinal herbs, an exhausted Shennong accidentally poisoned himself 72 times.

But a leaf flowed into his mouth before the poison took his life.

When he chewed it, it cheered him up and that's how we discovered tea.

At least that's what the ancient legends say.

Although tea does not actually cure addiction, the story of Shennong, the mythical Chinese agricultural inventor, highlights the importance of tea in ancient China.

Archaeological evidence suggests that tea was first grown here as early as 6,000 years ago, 1,500 years before the Pharaohs built the Great Pyramids of Giza.

Its original Chinese tea tree is the same variety that is now grown around the world, but was originally consumed in a very different way.

It was eaten as a vegetable or cooked with grain porridge.

Tea transitioned from food to beverage only 1,500 years ago when people realized that the combination of heat and moisture produced complex and varied flavors from leafy greens.

After hundreds of years of variations in preparation methods, it has become the norm to heat the tea, pack it into portable cakes, grind it into a powder, and mix it with boiling water to make a drink called muocha or matcha.

Matcha became so popular that a unique Chinese tea culture was born.

Tea was the subject of books and poems, the favorite drink of emperors, and a medium for artists.

They created extravagant paintings in the tea froth, very similar to the espresso art you see in coffee shops today.

In the 9th century Tang dynasty, Japanese monks first brought the tea tree to Japan.

The Japanese eventually developed their own rituals centered around tea, leading to the founding of the Japanese tea ceremony.

And in the 14th century, the Ming Dynasty, the Chinese emperors shifted the standard from extruded cake-shaped tea to loose-leaf tea.

At that time, China still had a virtual monopoly on the world's tea plants, and tea was one of China's three major exports, along with porcelain and silk.

This spread tea drinking around the world and gave China great power and economic influence.

This spread began in earnest around the early 1600s, when Dutch merchants brought large quantities of tea to Europe.

Many credit the Portuguese noblewoman Catherine of Braganza for popularizing tea among the British nobility when she married Charles II in 1661.

At the time, Britain was in the process of expanding its colonial influence and becoming the new dominant world power.

And as Britain grew, interest in tea spread around the world.

By 1700, tea was 10 times more expensive than coffee in Europe, and the plant was still only grown in China.

The tea trade was so lucrative that fierce competition among Western trading companies gave rise to the fastest sailing ships in the world, the Clippers.

All were racing to be the first to bring the tea back to Europe to maximize profits.

Initially, the British paid for this Chinese tea entirely in silver.

When it proved too expensive, they suggested replacing the tea with another substance, opium.

This has caused people to become addicted to drugs within China and caused public health problems.

And in 1839, as a statement of British influence over China, Chinese officials ordered their men to destroy a large shipment of opium from Britain.

This act triggered the First Opium War between the two countries.

Fighting raged up and down the Chinese coast until the defeated Qing dynasty ceded the port of Hong Kong to Britain in 1842 and resumed trade on unfavorable terms.

The war has weakened China's global standing for more than a century.

The British East India Company also wanted to grow their own tea and gain more control over the market.

So they commissioned botanist Robert Fortune to go undercover and steal tea from China.

He disguises himself and makes a perilous journey through the mountainous tea fields of China, eventually smuggling tea trees and experienced tea artisans to Darjeeling, India.

From there the plant spread further and contributed to the rapid growth of tea as a daily commodity.

Today, tea is the second most consumed beverage in the world after water, and there are as many ways to make it as there are cultures around the world, from sweet Turkish Rize tea to salty Tibetan butter tea.

What do fans of atmospheric post-punk music have in common with ancient barbarians?

Not so much.

So why are they both known as goths?

Is it a strange coincidence, or a deep connection spanning centuries?

The story begins in ancient Rome.

As the Roman Empire expanded, it faced raids and invasions from semi-nomadic tribes along its borders.

The most powerful were the Germanic peoples known as the Goths, which consisted of two tribal groups, the Visigoths and the Ostrogoths.

Some of the Germanic tribes were still enemies of Rome, but the empire incorporated others into the imperial army.

As the Roman Empire split in two, these tribal armies played a greater role in its defense and internal power struggles.

In the 5th century, a mercenary rebellion led by a soldier named Odoacer captured Rome and deposed the Western Emperor.

Odoacer and his Ostrogothic successor Theoderic remained technically under the authority of the Eastern Emperor, preserving the Roman tradition.

But the western empires were never united again.

Its territory was subdivided into kingdoms ruled by Goths and other Germanic tribes who assimilated into the local culture, but many of their names are still engraved on maps.

This was the end of the Classical period and the beginning of what many call the Dark Ages.

Although Roman culture was never completely lost, its influence declined and new artistic styles emerged that emphasized religious symbolism and allegory rather than proportionality and realism.

This change also extended to architecture, with the construction of Saint-Denis Abbey in France in 1137.

Pointed arches, flying buttresses and large windows made the structure more skeletal and ornate.

It emphasized its open, bright interior rather than the solid walls and columns of a classical building.

Over the next few centuries, it became the model for cathedrals throughout Europe.

But fashion changes.

As the Italian Renaissance embraced a newfound admiration for ancient Greece and Rome, modern styles began to seem crude and inferior in comparison.

Giorgio Vasari, in his 1550 book The Life of the Artist, first described it as Gothic, a pejorative term for the barbarians who are thought to have destroyed classical civilization.

The name stuck and soon came to describe the whole Middle Ages with its associations of gloom, superstition and naivety.

But times have changed, and so has what is considered fashionable.

The 1700s ushered in an era called the Enlightenment, which emphasized scientific reason above all else.

In reaction, Romantic writers such as Goethe and Byron sought idealized visions of the past of natural landscapes and mystical spiritual forces.

Here the word Gothic was reused again to describe a literary genre that emerged as a darker strain of Romanticism.

The term was first applied by Horace Walpole to his novel The Castle of Otranto in 1764 to refer to the plot and overall atmosphere.

Many of the elements of the novel have become genre staples, inspiring the classic and the countless films that have spawned it.

The Gothic label belonged to literature and cinema until the 1970s, when a new music scene emerged.

Taking cues from artists such as The Doors and The Velvet Underground, British post-punk groups such as Joy Division, Bauhaus and The Cure combined dark lyrics and punk cacophony with imagery inspired by Victorian era, classic horror and androgynous glam fashion.

By the early 1980s, similar bands were consistently described by the music press as Gothic rock, and the popularity of the stye took it from dim clubs to major labels and MTV.

And today, despite the occasional negative attention and stereotypes in the media, gothic music and fashion remain a powerful underground phenomenon.

It has also branched out into subgenres such as cybergoth, gotabilly, gothic metal, and even steampunk.

The history of the word Gothic is embedded in millennia of counterculture movements, from invading outsiders becoming kings, to towering spiers replacing stout pillars, to artists finding beauty in the dark.

At each stage, a revolution of sorts takes place, and civilization tends to reach into the past to reshape the present.

In 1898, Marie Curie and Pierre Curie discovered radium.

Radium was claimed to have restorative properties and was added to toothpaste, medicines, water and food.

It has a bright green color and was used in beauty products and jewelry.

It wasn't until the mid-20th century that we realized that radium's harmful effects as a radioactive element outweighed its visual benefits.

Unfortunately, radium isn't the only pigment historically thought to be harmless or useful, but which has proved deadly.

This lamentable difference includes three colors and pigments that we have long used to decorate ourselves and the things we make: white, green and orange.

Our story begins with white.

Back in the 4th century BC, the ancient Greeks processed lead to create the brilliant white pigment we know today.

question?

In humans, lead is absorbed directly into the body and is distributed in the blood, soft tissues, and calcified tissues.

Once lead enters the nervous system, it mimics and interferes with the normal function of calcium, causing damage ranging from learning disabilities to high blood pressure.

However, the practice of using this toxic dye has persisted across time and culture.

Until the 19th century white lead was the only practical choice for white oil or tempera paint.

To make the paint, the artist crushes the lead mass into powder, exposing highly toxic dust particles.

The heavy use of pigments caused the so-called painter's colic, or what is now called lead poisoning.

Artists who worked with lead complained of paralysis, depression, coughing, retinal enlargement, and even blindness.

But the intensity, opacity, and warm tones of white lead appealed to artists like Vermeer and later the Impressionists.

Its brilliance was unmatched and the pigment remained in widespread use until it was banned in the 1970s.

As bad as that may sound, white's dangerous impact pales in comparison to another more widespread pigment, green.

Two synthetic greens, called Scheele green and Paris green, were first introduced in the 18th century.

They were much more vibrant and showy than the relatively dull greens made from natural pigments, so they quickly became a popular choice for dyes in paints and textiles, wallpaper, soaps, cake decorations, toys, candy, and clothing.

These green pigments were made from a compound called cupric hydrogen arsenic.

In humans, exposure to arsenic can damage cellular communication and function.

And high levels of arsenic are directly linked to cancer and heart disease.

As a result, textile factory workers were frequently poisoned in the 18th century, and women in green dresses reportedly collapsed from exposure to arsenic.

Bed bugs are rumored not to live in green rooms, and it has even been speculated that Napoleon died of slow arsenic poisoning from sleeping in a green-walled bedroom.

The toxic nature of these greens was kept secret until a recipe for arsenic was published in 1822.

And a century later it was repurposed as an insecticide.

Synthetic green was probably the most dangerous color in widespread use, but at least it wasn't as radioactive as radium.

However, another color was orange.

Before World War II, it was common for manufacturers of ceramic tableware to use uranium oxide in colored glazes.

The compound produced bright reds and oranges, and if there was no radiation emitted, it had attractive properties.

Of course, radiation was something we didn't know about until the late 1800s, not to mention the associated cancer risks that were discovered much later.

During World War II, the US government confiscated all uranium for use in bomb development.

However, the Atomic Energy Commission relaxed these restrictions in 1959, and depleted uranium returned to the factory floors of pottery and glass.

Orange dishes made in the next decade may still have dangerous properties on the surface.

Most notably, the radio-positive reaction of vintage Festaware.

Levels are low enough that they pose no official health risk even on the shelf, but the U.S. Environmental Protection Agency warns against eating them.

We still sometimes run into problems with synthetic food dyes, but our scientific understanding has helped rid our lives of dangerous colors.

Deep in Yale's Beinecke Rare Book and Manuscript Library lies the only copy of the 240-page book.

It was recently carbon dated to around 1420. Its parchment pages feature looping handwriting and hand-drawn images that look like they've been stolen from a dream.

The text is accompanied by real and imaginary plants, floating castles, bathing women, astrological charts, zodiac, faceted sun and moon.

This 24x16 cm book is called the Voynich Manuscript and is one of the biggest unsolved mysteries in history.

The reason is?

No one can understand what it says.

The name comes from Wilfrid Wojnich, a Polish librarian who found the document in 1912 at a Jesuit college in Italy.

he was perplexed.

who wrote it

where was it made?

What do these strange words and vivid pictures represent?

What secrets does that page contain?

He bought the manuscript from a cash-strapped priest at the university and eventually brought it to the United States, where experts continued to solve the mystery for more than a century.

Cryptologists say the script has all the characteristics of a real language, and only the characteristics that no one has ever seen.

It looks real because letters or groups of letters appear with a certain frequency in real languages, and the Voynich manuscript language has patterns that random letter generators can't find.

Other than that, we know very little more than what we see.

Character styles and heights vary.

Some are borrowed from other scripts, but many are original.

Tall letters are called gallows.

The manuscript is highly decorated throughout with scroll-like decorations.

It appears to be written by more than one hand, and the painting is drawn by yet another party.

Over the years, three main theories have emerged about the text of this manuscript.

The first is that they are written in cryptography, a secret code deliberately designed to hide secret meanings.

Second, the document is a hoax written in gibberish to make money from gullible buyers.

Some speculate that the author was a medieval impostor.

Another theory is that it was Voynich himself.

A third theory is that the manuscript was written in the actual language, but in an unknown script.

Perhaps medieval scholars were trying to create an alphabet for a language that was spoken but not yet written.

In that case, the Voynich Manuscript might resemble the Rongorongo script invented on Easter Island, but is now unreadable due to the collapse of the culture that created it.

No one can read the Voynich Manuscript, but that hasn't stopped people from guessing what it says.

Those who believe the manuscript is an attempt to create a new form of written language speculate that it may be an encyclopedia containing the knowledge of the culture that produced it.

Some believe the book was written by 13th-century philosopher Roger Bacon, who sought to understand universal grammatical laws, or by Elizabethan mystic John Dee, who practiced alchemy and divination in the 16th century.

There are also derivative theories that the book was written by a group of Italian witches or by Martians.

After 100 years of setbacks, scientists recently shed some light on the mystery.

The first breakthrough discovery was carbon dating.

Modern historians also trace the provenance of the manuscript through Rome and Prague to 1612, when it was probably passed from Holy Roman Emperor Rudolf II to his physician, Jacobus Sinapius.

In addition to these historical advances, linguistics researchers have recently proposed tentatively identifying some of the manuscript words.

Could the letters next to these seven stars spell out Tauran, the name of Taurus, the constellation containing the seven stars called the Pleiades?

Is this word Centauran for the Centaurea plant in the picture?

Perhaps, but progress is slow.

If you can crack the code, what will you find?

The dream diary of a 15th century illustrator?

A bunch of nonsense?

Or is it lost knowledge of forgotten cultures?

What do you think it is?

A shrine maiden walks towards the basement.

People line up in the streets to watch her declare her innocence.

it doesn't matter.

She has already been tried and convicted.

sentence?

Buried alive.

The cellar contains bread, water, milk and some oil.

She has a lamp, a bed, and a blanket, but she never appears alive.

At the threshold the priestess stopped, asserted her innocence one last time, and entered the room, never to be seen again by the Romans.

The priestess is one of Rome's six vestal virgins, each carefully selected as the children of Rome's most aristocratic families.

However, due to her death, there are only five shrine maidens, and a new shrine maiden must be chosen.

Six-year-old Lykinia witnessed the spectacle, but little did she know that in a few days she would be the next Vestal virgin.

Her age, aristocratic ancestry, and apparent health make her a perfect candidate for the service of the goddess Vesta in the eyes of the Romans.

Her parents are proud that their daughter was chosen.

Lycinia is afraid, but she has no choice in this matter.

She must serve the goddess for at least the next 30 years.

During the first ten years of Licinia's ministry, she is believed to have been trained and learning how to become a Vesta virgin.

Her most important duty is to keep watch over the fire of the virgin goddess Vesta in the hearth.

Vesta does not have statues like other Roman gods and goddesses.

Instead, she is represented by a flame that burns day and night in a temple next to the forum in the center of the city.

Like all Vestal priestesses, Lycinia spends part of her day on duty, watching over and tending to the flames.

Flames represent two things.

The first is for Rome to continue as a world power.

The Romans believed that the city would be in danger if the flames were extinguished.

The flame also symbolizes the continued virginity of the Priestess of Vesta.

For the Romans, Westal virginity was a symbol not only of her castita, the modest mind and body, but also of ritual purity.

Therefore, Lycinia knows that the flame should never be extinguished.

Her life, the lives of her fellow Vestals, and the safety of Rome itself are at stake.

Likinia learns to draw water from a nearby fountain each day to purify the temple.

She learns the Fasti, a calendar of sacred rituals, and watches the sacrifices of the senior priestesses.

By the time Licinia completes her training, she will be sixteen.

Lycinia understands that her actions are a reflection of the Goddess she serves.

When it's her turn to fetch water, she keeps her eyes down to the ground.

When she makes sacrifices, she concentrates intently on the task.

Lykinia puts her energy into becoming the best priestess she can be.

She fears that one day the state will take her life for its own sake to protect itself from danger.

Lycinia can be accused of incest, or adultery, at any time, and can be victimized regardless of innocence or guilt.

Ms. Likinia now fully understands why her predecessor was buried alive.

Ten years ago, Vesta's flames went out.

The priestesses knew they couldn't keep it a secret.

The future of Rome depended on it.

They went to the chief priest and began to investigate why the fire had stopped working.

Someone came forward and claimed that one of the Vestals was no longer a virgin.

It was the beginning of the end.

The defendant claimed her innocence, but that was not enough.

She was tried and convicted.

Vestal died to save the city, but Lycinia weeps for what she now knows is lost.

Her own path was blazed by the deaths of others, and her life could easily be taken for something as simple as a flame going out.

Around 1159 AD, a mathematician called the Bhaskaratha Scholar sketched a design for a wheel with curved mercury reservoirs.

He reasoned that as the wheels rotated, mercury would flow to the bottom of each reservoir, making one side of the wheel permanently heavier than the other.

In an unbalanced state, the wheels will spin forever.

Bhaskara's drawing was one of the early designs of a perpetual motion machine, a device that could work indefinitely without an external source of energy.

Imagine a windmill that creates the wind it needs to keep spinning.

Or a light bulb that supplies its own electricity.

These devices have captivated the imagination of many inventors because of their potential to alter our relationship with energy.

For example, if we could build a perpetual motion machine that included humans as part of a perfectly efficient system, we could sustain life indefinitely.

There is only one problem.

they don't work.

All perpetual motion ideas violate one or more of the fundamental laws of thermodynamics, the branch of physics that describes the relationship between various forms of energy.

The first law of thermodynamics states that energy cannot be created or destroyed.

You can't take out more energy than you put in.

Useful perpetual motion machines are quickly ruled out, as machines can only produce as much energy as they consume.

There is no power left to power your car or charge your phone.

But what if you just want to keep the machine running?

Inventors have proposed many ideas.

Some of these are variations of Bascara's overbalanced wheels with spinning balls or weights on the swingarm.

None of them work.

A moving part that weighs one side of the wheel moves the center of gravity below the axle.

The low center of gravity allows the wheels to swing back and forth like a pendulum and stop.

What about another approach?

In the 17th century, Robert Boyle came up with the idea of ​​an automatic watering pot.

He theorized that capillary action, the attractive force between the liquid and the surface that draws water through narrow tubes, could keep the water circulating around the bowl.

But if capillary action is strong enough to overcome gravity and pull the water up, it can also prevent the water from returning to the bowl.

There are also versions with magnets, like this set of ramps.

The ball is pulled upward by the magnet on top and is supposed to fall through the hole and repeat the cycle.

This fails. Because the magnet simply holds the ball on top, similar to the automatic watering pot.

Even if it somehow continues to move, over time the strength of the magnet will decrease and it will eventually fail.

In order for each of these machines to keep moving, additional energy must be generated to push the system past its stopping point, violating the first law of thermodynamics.

Some appear to be continuous, but in fact they always turn out to be drawing energy from some external source.

Even if engineers could somehow design a machine that didn't violate the first law of thermodynamics, it would still not work in the real world because of the second law.

The second law of thermodynamics states that energy tends to diffuse through processes such as friction.

Real machines have moving parts that interact with air and liquid molecules that generate a small amount of friction and heat even in a vacuum.

That heat is energy that escapes and continues to leak out, inevitably reducing the energy available to power the system itself until the machine stops.

So far, these two laws of thermodynamics have hindered all ideas about perpetual motion and the dreams they imply of perfectly efficient energy generation.

But there's so much we don't know about the universe that it's hard to say with certainty that a perpetual motion machine will never be discovered.

Perhaps we will find new and exotic forms of matter that force us to rethink the laws of thermodynamics.

Alternatively, there may be perpetual motion on small quantum scales.

What we are somewhat certain of is that we will never stop looking.

For now, it's our quest that seems truly eternal.

Sometimes I feel very embarrassed to be European.

Over a million people arrived in Europe last year in need of our help, and frankly, our response has been pathetic.

There are just so many contradictions.

Since we mourn the tragic death of 2-year-old Alan Kurdi, more than 200 children have drowned in the Mediterranean Sea.

We have an international treaty that recognizes refugees as a common responsibility, yet we accept that tiny Lebanon hosts more Syrians than all of Europe combined.

We lament the existence of human smugglers, but we consider it the only viable route to seek asylum in Europe.

Despite labor shortages, it excludes people who meet economic and demographic needs from coming to Europe.

Although we proclaim liberal values ​​against Islamic fundamentalism, we have a repressive policy of detaining child asylum seekers, separating children from their families, and confiscating property from refugees.

what are we doing?

What caused the situation to adopt such an inhumane response to a humanitarian crisis?

I don't think it's because people don't care, or at least I don't want to believe it's because people don't care.

I believe it is because our politicians lack a vision of how to adapt the international refugee system, which was created more than 50 years ago, to a changing and globalized world.

So what I want to do is take a step back and ask two really basic questions, two questions we all need to ask.

First, why is the current system not working?

And second, what can be done to fix it?

In short, the modern refugee system was created by them after World War II.

Its basic purpose is to ensure that, should a state fail or, worse, turn against its own people, people will have a place to return and live in safety and dignity until they return home.

It was created for exactly the kind of situation we see in Syria today.

Through the 1951 Convention Relating to the Status of Refugees, an international treaty signed by 147 governments, and the international organization UNHCR, countries have committed to mutual acceptance in their territories of people fleeing conflict and persecution.

But today that system is breaking down.

In theory, refugees have the right to seek asylum.

In fact, our immigration policy is blocking our way to safety.

In theory, refugees have the right to return to their country of origin or on the road to integration.

But in reality, they end up in a near-infinite dangling state.

In theory, refugees are a universal responsibility.

In practice, geographically, this means that countries close to conflict host the vast majority of the world's refugees.

The system is not broken because the rules are wrong.

It's that we haven't applied them properly to the changing world, and we need to rethink that.

So I'd like to explain a little bit about how the current system works.

How does the refugee system actually work?

But it is not from a top-down institutional perspective, but rather from a refugee perspective.

Imagine a Syrian woman there.

Let's call her Amira.

And for me Amira represents many people I have met in the area.

Amira is a woman with children, like about 25 percent of the world's refugees. She cannot return home because she hails from this city in front of her, once beautiful and historic, Homs, now under the rubble.

So Amira can't go back there.

However, Amira has no desire to be resettled in a third country. Because it's a lottery ticket that less than 1 percent of the world's refugees get.

There Amira and her family face an almost impossible choice.

You have three basic options.

The first option is for Amira to take her family to camp.

Help may be available for her in the camp, but Amira and her family have little chance of it.

Camps are located in desolate and arid locations, often in the desert.

In the Zaatari refugee camp in Jordan, the sound of shells can be heard across the Syrian border at night.

Economic activity is restricted.

The quality of education is often poor.

And around the world, about 80 percent of refugees in camps have to stay for at least five years.

It's a dire existence, and perhaps that's why only 9 percent of Syrians actually choose that option.

Alternatively, Amira can head to cities in neighboring countries such as Amman or Beirut.

It is the option chosen by about 75 percent of Syrian refugees.

But there are also big difficulties.

These urban refugees usually do not have the right to work.

They usually don't get enough help.

So when Amira and her family deplete their basic savings, they will likely have little money left and face urban poverty.

So there is a third option, and more and more Syrians are choosing it.

Amira can seek hope in her family by risking her life to travel to another country. That is what we see in Europe today.

Around the world, we present refugees with a near-impossible choice between three options: camps, urban poverty, and dangerous travel.

For refugees, that choice is today's global refugee system.

But I think it's the wrong choice.

I think you may reconsider that choice.

We restrict those options because we think they are the only options available to refugees, but in reality they are not.

Politicians frame the problem as a zero-sum problem: if it benefits refugees, it imposes a cost on citizens.

We tend to share the common assumption that refugees are an unavoidable cost and burden to society.

But you don't have to. they can contribute.

So my argument is that there are ways to expand that choice and still benefit everyone else: host countries and communities, our societies and the refugees themselves.

And I would like to suggest four ways in which we can change the paradigm of thinking about refugees.

All four methods have one thing in common. It is a way to take advantage of globalization, mobility and market opportunities to renew thinking about refugee issues.

The first thing I would like to think about is the idea of ​​enabling environments. It starts with the very basic realization that refugees are human beings just like everyone else, but in extraordinary circumstances.

Together with our colleagues at Oxford, we embarked on a research project to examine the economic lives of refugees in Uganda.

We chose Uganda not because it represents the host country.

it's not. it is exceptional.

What Uganda has done, unlike most host countries around the world, is to give refugees economic opportunities.

It gives them the right to work. It gives them freedom of movement.

And the results will be extraordinary for both refugees and host communities.

In the capital, Kampala, 21 percent of refugees run businesses that employ others, and 40 percent of those employees are nationals of the host country.

In other words, refugees provide jobs for citizens of host countries.

At the camp, too, we found amazing examples of vibrant, thriving and entrepreneurial businesses.

For example, in a settlement called Nakivale, we found instances of Congolese refugees running a digital music exchange business.

We found a Rwandan who runs a business that allows young people to play computer games on recycled game consoles and recycled TVs.

Despite the extreme restrictions, the refugees are innovating, and the gentleman who appears before them is a Congolese man named Demou Kay.

Demow-Kay arrived at the settlement with almost nothing, but wanted to become a filmmaker.

So he started a community radio station with friends and colleagues, rented a video camera, and now makes movies.

He has made two documentary films with and for our team and is a successful business on a shoestring.

Examples like this should guide our response to refugees.

Rather than viewing refugees as necessarily dependent on humanitarian aid, we need to offer them the opportunity to thrive as human beings.

Sure, clothes, blankets, shelter, and food are all important in an emergency, but you need to look beyond that.

We need to provide opportunities for connectivity, electricity, education, the right to work, access to capital and banks.

All the ways we take for granted that we are connected to the global economy can and should apply to refugees.

The second idea I would like to discuss is economic zones.

Unfortunately, not all host nations around the world have taken Uganda's approach.

Most host countries have not opened their economies to refugees in the same way.

But there are still practical alternative options we can use.

Last April, I visited Jordan with my colleague, development economist Paul Collier, where we brainstormed ideas with the international community and the government there to support Jordan's national development strategy and create jobs for Syrians.

The idea concerns an economy that could potentially integrate the employment of refugees alongside the employment of Jordanian host citizens.

And just 15 minutes from Zaatari refugee camp, home to 83,000 refugees, there is an existing economic zone called King Hussein bin Talal Development Zone.

The government spent more than $100 million to connect power and road networks, but it lacked two things: access to labor and inward investment.

So what if instead of being confined to camps, refugees could work there, support their families, and acquire skills through vocational training before returning to Syria?

We recognized that it could be of benefit to Jordan. Jordan's development strategy calls for a leap into manufacturing as a middle-income country.

While that may benefit refugees, it may also contribute to the reconstruction of post-conflict Syria by recognizing that refugees need to be nurtured as the best source for ultimately rebuilding Syria.

We published this idea in Foreign Affairs magazine.

King Abdullah accepted the idea.

It was announced at the London-Syria conference two weeks ago, and is expected to begin testing in the summer.

(Applause.) The third idea I would like to suggest to you is to align preferences between the state and the refugees in order to achieve happy outcomes, such as those seen in selfies featuring Chancellor Angela Merkel and Syrian refugees.

What we rarely do is ask refugees what they want or where they want to go. But we argue that we can do it and still make everyone's life better.

Economist Alvin Ross developed the idea of ​​a matching market, where the ranking of parties' preferences shapes the final match.

My colleagues Will Jones and Alex Teitelboim applied that idea to refugees, exploring how not only can refugees be asked to rank their preferred destinations, but states can also rank and match the types of refugees they want by skill and language criteria.

Of course, you'll need to incorporate quotas on diversity, vulnerability, etc., but this is a way to increase your chances of matching.

This matching idea has been successfully used, for example, to match students with college destinations, or match kidney donors with patients, and is the basis for a sort of algorithm that exists on dating sites.

So why not apply it to give refugees greater choice?

It could also be used at the national level where one of the big challenges we face is convincing communities to accept refugees.

And now, for example, in my country, we often send engineers to the countryside and peasants to the cities, which makes no sense at all.

Matching markets therefore offer a potential way to integrate these preferences and listen to the needs and demands of the host population and the refugees themselves.

A fourth idea I would like to suggest to you is about humanitarian visas.

Many of the tragedies and turmoil we have seen in Europe were entirely avoidable.

It stems from a fundamental contradiction in European asylum policy. That is, in order to seek asylum in Europe, one must undertake the perilous journey I have described and arrive voluntarily.

But in the age of low-cost airlines and modern consular functions, why would such a trip be necessary?

These are totally unnecessary trips that killed more than 3,000 people on European borders and within European territories last year.

If refugees were simply allowed to travel directly to Europe and seek asylum, we would avoid it. There is a way to do that through something called a humanitarian visa. This allows people to pick up their visas at the embassies or consulates of neighboring countries and pay for themselves by ferry or plane to Europe.

It costs around €1,000 to bring smugglers from Turkey to the Greek islands.

A low-cost airline from Bodrum to Frankfurt costs €200.

If refugees were allowed to do so, it would be of great benefit.

It would save lives, undermine entire markets for smugglers, and remove the chaos seen on the European front lines in areas like the Greek Isles.

Politics, not rational solutions, are holding back.

And this is an idea applied.

Brazil has taken a pioneering approach, allowing more than 2,000 Syrians to enter Brazil on humanitarian visas and apply for refugee status upon arrival in Brazil.

And under that plan, all Syrians who went through it were granted refugee status and recognized as genuine refugees.

There is also historical precedent for this.

Between 1922 and 1942, these Nansen passports were used as travel documents by 450,000 Assyrians, Turks and Chechens to travel across Europe and apply for refugee status elsewhere in Europe.

And Nansen International Refugee Office won the Nobel Peace Prize in recognition of this as a viable strategy.

So all four ideas I've presented are ways you can extend Amira's choice set.

These are ways to make life better for others while having greater options for refugees beyond the three basic and impossible options I have described.

In conclusion, we really need a new vision. It's a vision that expands options for refugees but recognizes that they don't have to be a burden.

Refugees are an inevitable cost.

Yes, they have humanitarian responsibilities, but they are human beings with skills, talents, aspirations, and the ability to contribute - if we will.

Immigration will continue in the new world.

What we have seen in Europe will be with us for many years.

People will continue to travel and become displaced. And we need to find reasonable and practical ways to manage this. It needs to be built not on the old logic of humanitarian aid or the logic of philanthropy, but on the opportunities presented by globalization, markets and mobility.

I want to wake you up and urge politicians to wake up to this challenge as well.

thank you very much.

(applause)

If you want to get a glimpse of Madame Curie's manuscript, you'll need to sign a waiver and wear protective clothing to protect yourself from radiation contamination.

Marie Curie's remains were also buried in a lead-lined coffin, well-contained for the radiation that was the focus of her research and was probably responsible for her death.

Growing up in Warsaw, Russia-occupied Poland, young Marie, originally named Maria Sklodowska, was a brilliant student but faced some difficult walls.

Being a woman, Marie was forbidden to receive higher education, so as an act of rebellion, she enrolled in the University of Water, a secret institution providing secret education to Polish youth.

Saving money and working as a tutor and tutor eventually allowed her to move to Paris to study at the prestigious Sorbonne University.

There, Marie earned degrees in physics and mathematics, but survived mainly on bread and tea, sometimes fainting to the point of starvation.

In Paris, Marie met the physicist Pierre Curie and shared her heart with the lab.

But she wanted to go back to Poland.