Well, that's terrible advice.

These are some of the best poker players in the world today.

Do they look like people who live purely on emotion and intuition?

(laughter) Look!

Obviously they are meant to be slow and careful analysis. That's because this game is beyond the times when pure street knowledge and human reading alone can get you to the top.

That's because our intuition isn't as perfect as we'd like to believe.

That is, whenever we are in a difficult situation, it would be wonderful if the answer appeared from some magical source of inspiration.

But in reality, our gut is very vulnerable to all kinds of wishful thinking and prejudices.

So what are our guts good for?

All the research I've read concludes that it works best for everyday events we've been through, such as how to know when your friend is angry without you telling them anything, or whether you can fit your car into a tight parking lot.

But when it comes to really important things like what our career path will be or who we should marry, why should we assume that our intuition is better calibrated than taking the time to properly analyze it?

In other words, there is no data to support it.

So my third lesson is that you shouldn't ignore your intuition, but you shouldn't overestimate it either.

And today, I'd like to summarize those three lessons with my own meme with a poker player twist.

"Success is most compelling when achieved across large sample sizes."

(Laughter) "Guts are your friend, cost-benefit analysis is your friend.

(Laughter) "The future is unknown, but it is quite possible to estimate it."

thank you.

(applause)

Please come visit us on the Dark Continent.

It is a continent hidden beneath the Earth's surface.

It's largely unexplored, little understood, and something of a legend.

But it also consists of dramatic landscapes, such as this huge underground chamber, rich in amazing biological and mineralogical worlds.

Thanks to the efforts of intrepid navigators over the past three centuries, and of course thanks to satellite technology, we actually have a grasp of nearly every square meter of the Earth's surface.

However, we still know very little about what is hidden inside the Earth.

This deep, mine-like cave landscape in Italy is so hidden that the potential for speleology, the geographic dimension, is poorly understood and underappreciated.

Because we are surface-dwelling creatures, our perception of the Earth's interior is distorted in some ways, as is our perception of the depth of the oceans and the upper layers of the atmosphere.

However, since systematic cave exploration began about a century ago, we know that caves actually exist on every continent of the world.

A single cave system, such as Mammoth Cave in Kentucky, can be over 600 kilometers long.

And abysses like Krubera Vologna in the Caucasus are actually the deepest caves ever explored in the world, sometimes reaching depths of more than 2,000 meters below the surface.

This means a trip of several weeks for a cave explorer.

Caves form in the karst zone.

Karst regions are therefore regions of the world where water seeping along fissures and fissures readily dissolves soluble rocks, forming a drainage system of tunnels and conduits, indeed a three-dimensional network.

Karst areas cover almost 20 percent of the continent's surface, and indeed, over the past 50 years, speleologists have been found to have explored some 30,000 kilometers of cave passages around the world, which is a staggering number.

But geologists estimate that the undiscovered and unmapped part lies about 10 million kilometers away.

This means that for every meter of cavern we already know and explored, there are still tens of kilometers of undiscovered passageways.

So this is a truly endless continent that can never be fully explored.

And this estimate is made without considering other types of caves, for example inside glaciers or volcanic caves formed by lava flows rather than karsts.

And if you look at other planets, like Mars, for example, you'll find that this feature isn't so unique to our home planet.

But I will now show you that you don't have to go to Mars to explore the Otherworld.

I am a speleologist, or cave explorer.

And I started with this passion when I was really young, in the mountains of the Alps and the karsts of the Dolomites, not far from my hometown in northern Italy.

But soon, a quest for exploration led me to the farthest corners of the earth in search of possible new entrances to this undiscovered continent.

In 2009, I had the opportunity to visit the Tepuy Table Mountains in the Orinoco and Amazon basins.

These massifs fascinated me from the first time I saw them.

They are surrounded by vertical dizzying rock walls, with silver waterfalls cascading into the forest.

They really gave me the feeling of a wilderness with a soul millions of years old.

And this dramatic landscape, among other things, inspired Conan Doyle's 1912 novel The Lost World.

And they are, in fact, lost worlds.

Scientists believe these mountains are islands that have been cut off from the surrounding lowlands for tens of millions of years.

Surrounded by 1,000-meter-high fortress-like walls, humanity is impregnable.

And in fact, only a few of these mountains have been climbed and explored at their summits.

These mountains also contain scientific contradictions. Mountains are made of quartz, a mineral that is very common in the earth's crust, and rocks made of quartz are called quartzite. Quartzite is one of the hardest and most insoluble minerals on earth.

So don't expect to find a cave there at all.

Nevertheless, over the past decade, speleologists from Italy, Slovakia, the Czech Republic, and of course Venezuela and Brazil have explored several caves in the region.

So how is that possible?

To understand this discrepancy, we need to consider the time factor. Tepuis have a very long history, beginning with rock formation about 1.6 billion years ago and evolving with the uplift of the region 150 million years ago after the collapse of the supercontinent Pangea and the opening of the Atlantic Ocean.

So you can imagine that it took tens or even hundreds of millions of years for water to not only sculpt the most bizarre shapes into the surface of the tepuis, but also open the fissures to form the cities of stone, cities of rock, and fields of towers that characterize the tepui's famous landscape.

But no one could have imagined what was happening in the mountains for such a long period of time.

So in 2010, I focused on one of those massifs, Auyang Tepuy. This mountain is most famous for being home to the world's tallest waterfall, Angel Falls, with a drop of about 979 meters.

And I was looking for hints of the presence of cave systems through satellite imagery. Finally, we identified areas where the surface had collapsed: large boulders and piles of rocks. This means that there was a cavity underneath.

It clearly showed that there was something in the mountains.

So we tried several times to reach the area by land or by helicopter, but it was really difficult. Because you have to imagine that these mountains are covered with clouds and shrouded in fog for most of the year.

With strong winds and an annual rainfall of nearly 4,000 millimeters, good conditions are very difficult to find.

In 2013, we finally landed there and started exploring the cave.

The cave is huge.

This is a huge network under the Tepui Plateau, exploring more than 20 kilometers of cave passages in just 10 days of expedition.

And it's a huge network of underground rivers, aqueducts, large chambers, and very deep mine shafts.

So it's a really great place.

And named it Imawari Yuta.

It means "House of God" in the Pemon Indigenous language.

I have to imagine the natives have never been there.

It was impossible for them to reach this area.

However, there was a legend that a cave exists in that mountain.

So when we started exploring, we had to explore with a great deal of respect, not only because of the religious beliefs of the indigenous peoples, but also because it is truly a sacred place and has never been visited by humans before.

Therefore, we had to use special protocols to avoid contaminating the environment with our presence, and we also sought to share our findings with the community, the indigenous community.

And the cave really represents a snapshot of the past.

The time required to form it could be as long as 50 million, or even 100 million years, making it perhaps the oldest cave to be explored on Earth.

What you find there is truly evidence of a lost world.

When you enter a quartzite cave, you should completely forget what you know about caves, whether they are classical limestone caves or tourist caves that can be visited all over the world.

Because what looks like a simple stalactite here is not made of calcium carbonate, it's made of opal, and it can take tens of millions of years for one of the stalactites to form.

But you can also find more bizarre forms, like silica mushrooms growing on rocks.

And imagine the conversation we had when we were exploring the cave.

We were the first to enter and discover the unknown, like monster eggs.

And we were a little scared because it was all discoveries and we didn't want to find any dinosaurs.

No dinosaur found.

(Laughter) Anyway, as a matter of fact, we know from some studies that this kind of stratum is a living organism.

These are colonies of bacteria that use silica to build mineral structures similar to stromatolites.

Stromatolites are some of the oldest life forms found on Earth.

And what's interesting here on Tepuy is that these bacterial colonies evolved in complete isolation from the outer surface and without human contact.

They have never come into contact with humans.

Therefore, the implications for science are enormous. Because here, for example, we can find micro-organisms that can help solve diseases in medicine, or even new kinds of substances with unknown properties.

And indeed, we discovered in the cave a new mineral structure for science, russiatonite, which is a phosphate sulfate.

So everything you find in caves, even tiny crickets, evolved in complete isolation in the dark.

And indeed, all that can be felt in caves is a real connection between the biological and mineralogical worlds.

Therefore, as we explore this dark continent and discover its mineralogical and biological diversity and uniqueness, we will likely find clues about the origin of life on Earth, and the relationship and evolution of life in relation to the mineral world.

What appears to be a dark, empty environment can actually be a mysterious box full of useful information.

Together with a team of Italian, Venezuelan and Brazilian speleologists named La Venta Terrafosa, we plan to return to Latin America soon as we want to explore other tepuis in the most remote regions of the Amazon.

Lesser-known mountains include Mount Marawaca, nearly 3,000 meters above sea level, and Mount Araca, in the upper part of the Rio Negro River in Brazil.

And there are even larger caves, each with its own undiscovered world.

thank you.

(Applause) Bruno Giussani: Thank you, Francesco. Please tell me that first so I don't forget.

Francesco, you said you don't have to go to Mars to find extraterrestrial life, but in fact the last time we spoke you were in Sardinia training European astronauts.

So, as a speleologist, what do you tell and teach astronauts?

Francesco Sauro: Yes, we are -- this is a cave training program not only for Europeans, but also for NASA, Roscosmos and JAXA astronauts.

There they stay in isolation in a cave for about a week.

They have to work together in a really dangerous environment, which is alien to them.

It's always dark. they have to do science. they have a lot of work to do.

And it's very similar to a trip to Mars or the International Space Station.

BG: In principle. FS: Yes.

BG: I'd like to go back to one of the photos that was in your slide show, but it's just representative of the others -- weren't those photos great?

Audience: Yes!

(Applause) FS: I have to thank the photographers of Team La Venta. Because all these pictures are from photographers.

BG: Actually, you also have a photographer on your expedition.

They are experts, speleologists and photographers.

But looking at these pictures, I wonder if they look incredibly well exposed even though there's absolutely no light underneath.

how do you take these pictures?

How do your fellow photographers take these pictures?

FS: Yes. They basically work in a darkroom so they can open the camera shutter and use the lights to paint the environment.

BG: So basically -- FS: Yes. You can also leave the shutter open for a minute and paint the environment.

The end result is what you want to achieve.

BG: That's what you get when you spray the environment with light.

Maybe one day I can try this at home too, I don't know.

(laughs) BG: Thank you, Francesco. FS: Thank you.

(applause)

Hi. Raise your arm and wave your hand. Shake your royal hand, just like I did.

You can also imitate what you see.

Hundreds of arm muscles can be programmed.

Soon you will be able to look inside your own brain and program and control the hundreds of brain regions displayed there.

Let's talk about that technology.

For thousands of years, people have wanted to look inside the human mind, the human brain.

Well, what's coming out of the lab now is the possibility for our generation to do just that.

People imagine this to be very difficult.

The spacecraft had to be shrunk and injected into the bloodstream.

It was very dangerous. (Laughter) It can be attacked by white blood cells in the arteries.

But now we have the real technology to make this happen.

I will fly into the brain of my colleague Peter.

A non-invasive examination is performed using MRI.

No need to inject anything. No radiation needed.

We will be able to dive into the structure of Peter's brain. You can literally dive inside his body, but more importantly, you can peer into his mind.

When Peter moves his arm, the yellow dot you see is an interface to the workings of his mind.

Now, we've seen before that electrodes can be used to control robotic arms, and brain imaging and scanners can be used to view the inside of the brain.

What is new is that analyzing that process typically takes days to months.

Our technology has compressed it down to milliseconds. This allowed Peter to observe his brain in real time while he was inside the scanner.

He can see 65,000 point activations per second.

If you can see this pattern in your brain, you can learn how to control it.

Three ways have been considered to influence the brain: the therapist's couch, drugs, and knives.

This is the forthcoming fourth option.

We all know that as we form our thoughts, we form deep channels within our minds and brains.

Chronic pain is one example. Retract your hand if it burns.

But if you still have pain after six months or six years, it's because these circuits are producing pain that no longer serves you.

If we can observe the activation of the brain that causes pain, we can create a 3D model, watch how the brain processes information in real time, and select the area that causes pain.

Bring your arms back and flex your biceps.

Now imagine that you will soon be able to look inside your brain and select areas of your brain that do the same thing.

What we are looking at here is that we have selected pathways in the brain of chronic pain patients.

It may come as a shock to you, but we are literally reading this person's brain in real time.

They monitor their own brain activity and control the pathways that produce pain.

They are learning how to flexibly use this system to release their own endogenous opiates.

When they do that, the upper left shows a display tied to brain activation that their own pain is being controlled.

If you can control your brain, you can control your pain.

This is an investigational technology, but clinical trials have shown a 44-64% reduction in chronic pain patients.

This is not a "matrix". You can only do this for yourself. You take the lead.

I've seen inside my own brain. Soon you will too.

If so, what do you want to control?

You will be able to see all aspects of who you are, all of your experiences.

These are some of the areas we are working on today, but I don't have time to go into detail.

But I would like to leave you with one big question.

We are the first generation that can use this technology to penetrate the human mind and brain.

where do you take it

A few years ago I broke into my home.

I was driving home. It was about midnight in the dead of winter in Montreal. I was visiting my friend Jeff across town and the thermometer on the porch read -40 degrees - no need to ask if it's Celsius or Fahrenheit. Minus 40 degrees is where the two scales meet – it was very cold.

And as I stood at the front door searching my pockets, I realized I didn't have the key.

In fact, I could see them through the window lying on the dining room table I left behind.

So I quickly ran around and tried all the other doors and windows, but they were securely locked.

I considered calling a locksmith, but at least I had my cell phone with me, but it was cold in the middle of the night and it could take a while for the locksmith to show up.

I had an early flight to Europe the next morning and needed to get my passport and suitcase, so I couldn't go back to my friend Jeff's house that night.

So, in the hopeless, freezing cold, I found a large stone, broke through a basement window, removed shards of glass, crawled through, found cardboard and taped it to the opening. I called the contractor on my way to the airport in the morning and figured they could fix it.

This will be expensive, but probably no more than a late-night locksmith. So I figured that under the circumstances, I could manage somehow.

Now I am a neuroscientist by training and know a little bit about how the brain works under stress.

It releases cortisol, which increases your heart rate, regulates adrenaline levels, and clouds your mind.

So the next morning, when I woke up from lack of sleep, worrying about the hole in the window, the mental note that I had to call my contractor, the freezing temperatures, and the upcoming meeting in Europe, I had so much cortisol in my brain that my thoughts were clouded, but I didn't realize it was cloudy because my thoughts were clouded.

(Laughs) And it wasn't until I got to the check-in counter at the airport that I realized I didn't have my passport with me.

(Laughter) So, I drove home for 40 minutes through snow and ice, got my passport, rushed back to the airport, and just in time, but my seat had been given to someone else, so I ended up sitting in a non-reclining seat in the back of the plane next to the toilet for the eight hour flight.

Well, those eight hours were sleep-deprived and gave me a lot of time to think.

(Laughter) And I started thinking, is there anything I can do, is there a system I can put in place to prevent bad things from happening?

Or at least if bad things happen, the chances of it being a catastrophe are minimized.

So I started thinking about it, but it took about a month before the idea took shape.

I was having dinner with my Nobel laureate colleague, Danny Kahneman. I told him, a little embarrassed, that I had broken the window and had forgotten my passport. Danny then told me that he practices something called positive hindsight.

(Laughter) That's what I got from psychologist Gary Klein, who wrote about it a few years ago, and it's also called "before death."

Now, you all know what a postmortem is.

After a disaster, a team of experts always comes and tries to figure out what went wrong, right?

Well, as Danny explains, ante-mortem analysis looks ahead and tries to figure out all the things that could go wrong, and then what you can do to prevent them from happening or to minimize the damage.

So what I want to talk to you about today is some of the things we can do in the form of ante-mortem analysis.

Some of them are obvious, some are not so obvious.

Start with the obvious.

Decide where to put things that are easy to lose around the house.

Now, this sounds like common sense, but it really is, and there's a lot of science behind this based on how our spatial memory works.

There is a structure in the brain called the hippocampus that has evolved over tens of thousands of years to record the location of important things, such as where wells are, where fish can be found, where fruit trees stand, and where friendly and enemy tribes live.

The hippocampus is the part of the brain that is bloated by London taxi drivers.

This is the part of the brain that allows squirrels to find nuts.

And, if you're wondering, we did an experiment where someone could actually block the squirrel's sense of smell and still find the nut on the squirrel tree.

They weren't using their sense of smell. It used the hippocampus, an elaborately evolved mechanism in the brain to find things.

But it's very good for things that don't move much, but not so good for things that move around.

This is why we lose our car keys, reading glasses and passports.

Therefore, in your home, designate a place to put your keys, such as a hook by the door or a decorative bowl.

A special drawer for passports.

For reading glasses and a special table.

If you've designated a location and managed it carefully, it should be there when you look for it.

How is your trip?

Take a photo of your credit card, driver's license, or passport with your phone and mail it to yourself so it's stored in the cloud.

If these are lost or stolen, they can be easily replaced.

Well, these are pretty obvious.

Remember, your brain releases cortisol when you're stressed.

Cortisol is toxic and clouds your thinking.

So part of the practice of pre-planning is that you need to recognize that you're not at your best under stress, and have a system in place.

And perhaps no situation is more stressful than a medical decision.

And at some point, all of us will be in a position where we have to make some very important decisions about our own or our loved ones' health care futures and need help with their decisions.

So I would like to talk about it.

And I'm talking about a very specific medical condition.

But it serves as a surrogate for all kinds of medical decision-making, as well as economic decision-making, social decision-making, i.e. any kind of decision-making where a rational assessment of the facts would be beneficial.

So let's say you go to the doctor and the doctor says, "I just got my lab job back, your cholesterol is a little high."

Well, we all know that high cholesterol is associated with an increased risk of cardiovascular disease, heart attack and stroke.

So you don't think it's best to have high cholesterol, so the doctor said, "I'd like to give you a drug called a statin to help lower your cholesterol."

And you've probably heard of statins, you know it's one of the most widely prescribed drugs in the world today, and you probably even know people who take it.

So you think, "Yeah, give me a statin."

But I have a question to ask at this point. Most doctors don't like to talk about it, and pharmaceutical companies even less like it.

number needed for treatment.

Now what is this, NNT?

This is the number of people who need to take drugs, have surgery or undergo some other medical procedure before they can help one person.

And you're thinking, what kind of crazy stat is that?

The number must be 1.

My doctor won't prescribe anything to me if it doesn't work.

However, this is not the case in actual medical practice.

And even if it's not the doctor's fault, it's someone's fault, it's the scientist's fault like me.

The underlying mechanism is not fully elucidated.

But GlaxoSmithKline estimates that 90 percent of the drugs work for only 30 to 50 percent of people.

So what do you think is the number needed to treat the most widely prescribed statins?

How many people must take it before it helps one person?

300。

This is according to research by investigative practitioners Jerome Groopman and Pamela Hartsband and is independently confirmed by Bloomberg.com.

I looked up the numbers myself.

300 people must take the drug for a year before one heart attack, stroke or other adverse event is prevented.

You're probably thinking, "Well, the chances of lowering cholesterol are 1 in 300.

How is it, sir? Get a prescription anyway. ”

However, another statistic needs to be asked at this point. That is, "Please tell me about side effects." right?

Therefore, this particular drug causes side effects in 5% of patients.

These include debilitating muscle and joint pains, gastrointestinal upsets, and other terrible ones.

but please wait a moment.

Note that you may not be able to think clearly under stress.

Therefore, think in advance how you will solve this problem so that you do not have to assemble a chain of reasoning on the fly.

300 people take that drug, right? One person was helped, and 5 percent of those 300 had side effects, or 15.

A drug is 15 times more likely to harm than a drug to help.

Now, I'm not saying whether or not you should take statins.

My point is that you should discuss this with your doctor.

Medical ethics requires it and is part of the principle of informed consent.

You have the right to access this type of information to start conversations about whether to take risks.

Now, you might think I popped this number out of the blue for a shock value, but it's actually pretty typical and this number needs to be treated.

Prostatectomy for cancer is the most common operation for men aged 50 and over, with 49 operations required to treat it.

That's right, 49 surgeries are performed for each person helped.

And those side effects occur in 50 percent of patients.

These include impotence, erectile dysfunction, urinary incontinence, rectal rupture, fecal incontinence, etc.

If you're lucky and you're one of the 50% who have these, they'll only last a year or two.

So the idea of ​​pre-analysis is to think ahead of the questions you might be able to ask to move the conversation forward.

You don't have to manufacture all of these on the spot.

You also need to consider things like quality of life.

Often you have a choice, do you want a short, pain-free life, or a longer life that can be very painful towards the end?

These are things to talk about and think about with your family and loved ones right now.

A brief fever may change your mind, but at least you are trained in this kind of thinking.

Remember, when we are stressed our brain releases cortisol and one of the things that happens in that moment is a massive system shutdown.

There are evolutionary reasons for this.

You don't need your digestive system, libido or immune system when facing a predator. Because if your body's metabolism is spent on these things and you don't react quickly, you could be the lion's lunch, in which case none of those things matter.

Unfortunately, as Danny Kahneman and his colleagues have shown, one thing we forget when we're under stress is rational, logical thinking.

Therefore, we must train ourselves to think about such situations in advance.

I think the key here is to recognize that we are all flawed.

We will all fail at times.

The idea is to think ahead of time what those failures might look like and put systems in place to help minimize the damage or prevent bad things from happening in the first place.

Returning to that snowy night in Montreal, when I returned from my trip, I had a contractor install a combination combination lock next to my door that contained the key to my front door.

And let's be honest, there are still piles of unorganized emails and piles of emails you haven't read yet.

So, I'm not completely organized, but I believe that organizing is a gradual process and we're getting there.

thank you very much.

(applause)

A girl I've never met has changed my life and the lives of thousands of others.

I am the CEO of DoSomething.org.

It is one of the world's largest organizations for youth.

In fact, it's bigger than the Boy Scouts of the United States.

And we are not homophobic.

(Laughter) It's true. Text is the way we communicate with young people. Because that's how young people communicate.

That's why the company plans to run more than 200 campaigns this year, including collecting peanut butter for its food pantry and making Valentine's Day cards for homebound seniors.

And text them.

And the open rate is 97%.

Hispanics and urbanites will be over-indexed.

We've collected over 200,000 peanut butter jars and over 365,000 Valentine's cards.

This is a large scale. OK -- (applause) But there's one weird side effect.

Every time we text, we get back dozens of text messages that have nothing to do with peanut butter, hunger, or old age. However, text messages about being bullied or about cannabis addiction.

And the worst message we ever received was just this: "He won't stop raping me.

is my father

He told me not to tell anyone. are you there? "

I couldn't believe this was happening.

We could not believe that something so terrible could happen to humans. And it's so intimate and personal that she shares it with us.

And we realized we had to stop triaging this issue and build an emergency message line for those who are suffering.

So we very quietly launched Crisis Text Line in Chicago and El Paso, with just a few thousand people in each market.

Four months later, we had access to all 295 area codes in the US.

To put it into perspective, this means zero marketing and faster growth than when Facebook first launched.

(Applause) Text is incredibly private.

no one is listening to you

So we get an email surge every day at lunch. The kids are sitting at the lunch table and we think she's texting the cute boy down the hall, but in reality she's texting us about bulimia.

And I don't say "I love you" or "Eh," nor do I hyperventilate or cry.

we just get the facts.

We want to die

There is a bottle of medicine on the desk in front of me. ”

So the crisis counselor said, "Why don't you put that pill in your drawer while you're emailing?"

And they go back and forth for a while.

And the crisis counselor asks the girl to give her the address. Because if you're texting, you need help.

There she obtains an address, and the counselor begins an active rescue effort while texting back and forth.

And then 23 minutes of silence with no response from this girl.

And the next message – it was her mother – said, 'I had no idea.

As a mother, it's just -- the next message will arrive in a month.

"I just got out of the hospital.

I was diagnosed with bipolar disorder and I think I'll be fine. ”

(Applause.) I would like to say that this is an unusual exchange, but we are doing an average of 2.41 active rescues a day.

30% of our text messages are about suicide and depression, which is huge.

The great thing about Crisis Text Line is that strangers consult other strangers on their most intimate issues, taking them from hot to cold moments.

This is very interesting, and I will tell you that I have sent over 6.5 million total text messages in less than 2 years.

(Applause.) But what really gets me hot and sweaty about this is the data. 6.5 million messages. It's the volume, speed, and variety to provide a highly informative corpus.

You can also do things like predictive work.

You can make all sorts of conclusions and learnings from that dataset.

Then we can be better, and the world can be better.

So how can we use the data to make it better?

Well, there's probably someone here. Anyone watching this has likely seen a therapist or a shrink at some point in your life. No need to raise your hand.

(Laughter.) How do you know he's a good person?

Oh, the Harvard degree on the wall?

Are you sure he didn't graduate in the bottom 10 percent?

(Laughter) When my husband and I met a marriage counselor, and she said, "I'll see you in two weeks, but I need to see you next week," I thought she was a genius.

(Laughter) We have the data to tell us what makes a good counselor.

Texting the words “numb” and “sleeves” has been found to match disconnection 99 percent of the time.

Typing the words "mg" and "rubber band" into a text message has been found to match substance abuse 99% of the time.

And we know that texting "sex," "oral," and "Mormon" will make you wonder if you're gay.

This is interesting information for counselors to understand, but having this algorithm in our hands means an automated pop-up prompting the counselor, "Match 99% cut - try asking one of these questions."

Or, "99 percent match for Substance Abuse. There are 3 drug clinics near the text messager."

That will give you more accurate information.

On the day Robin Williams committed suicide, people flooded hotlines across the country.

It was sad to see an iconic figure, a freak commit suicide, and a 3 hour wait on any phone hotline in the country.

Trading volumes also soared.

The difference is that if you text "I want to die" or "I want to kill myself" the algorithm will read it and you are Code Orange and will be number one on the queue.

So you can handle severity rather than chronological order.

(Applause.) As I sit on the world's first map of real-time crises, this data is also improving the world.

please think about it. These 6.5 million messages, automatic tagging by natural language processing, all these data points - I can assure you that Monday is the worst day of the week for eating disorders.

The time when substance abuse is most likely to occur is 5am.

And while Montana is a beautiful place to visit, I wouldn't want to live there because it's the state with the highest number of suicidal thoughts.

And we made this data open and available for free.

We have extracted all personally identifiable information.

It's located at CrisisTrends.org.

Because we want schools to understand that Mondays are the worst days for eating disorders, so we can plan meals and have guidance counselors come on Mondays.

And I want families to understand that substance abuse questions spike at 5am.

I want someone to take care of a Native American reservation in Montana.

(Applause.) Data, evidence makes everything better: policy, research, journalism, police, school boards.

I don't consider myself a mental health activist.

I consider myself a national health activist.

I'm a bit of a geek, so I'm really excited about this data.

Well, it sounded girly.

I'm an otaku.

(Laughter) I love data.

And the only difference between me and people in hoodies with big-money-funded companies to come is that I'm not inspired by helping you find Chinese food at 2 a.m. in Dallas, or arranging a car as soon as you touch my wrist, or swiping right to have sex.

I'm inspired -- (laughter, applause) I want to use technology and data to make the world a better place.

I want to use it to help that girl who emailed me about being raped by her father.

Because the truth is we never heard from her again.

And I hope she's somewhere safe and healthy. And I hope she sees this talk and knows that her desperation and courage inspired the founding of Crisis Text Line and that she inspires me every day.

(applause)

When I was a kid, my parents used to say, "You can make a mess, but you have to clean up after yourself."

In other words, freedom comes with responsibility.

But my imagination took me to all these wonderful places where everything was possible.

I mean, I grew up in a bubble of innocence. Because adults lie to protect us from ugly truths.

And as I grew up, I realized that adults tend to make a mess and are not good at cleaning up after themselves.

Now that I am an adult, I teach Citizen Science and Invention at Hong Kong Harbor School.

And it doesn't take long before the students are walking along the beach and come across a pile of trash.

So, as good citizens, we clean our beaches. And no, he doesn't drink alcohol, and if he did, I wouldn't give it to him.

(Laughter) Sadly, plastic is in over 80 percent of the oceans today.

That's a scary fact.

Over the past few decades, we've removed big ships and big nets, collected microscopic plastic debris, sorted it, and put the data on the map.

However, it takes forever and is very expensive, so it is very dangerous to let big ships go.

So I dreamed of inventing a better way with my students from 6 to 15 years old.

So we turned a small classroom in Hong Kong into a workshop.

So we started making this little workbench with different heights so that even shorter kids can participate.

And kids with power tools are nice and safe.

(Laughter.) It's not.

And back to plastics.

We collect this plastic and crush it to the size we find in the ocean, but it breaks down into very small pieces.

This is how we work.

I let my students' imaginations run free.

And my job is to take the best of each of the kids' ideas and try to combine them into something that hopefully works.

So instead of collecting pieces of plastic, we agreed to collect data only.

Therefore, we decided to use a robot to acquire an image of plastic. Children are very excited about robots.

What we do next is what we call “rapid prototyping”.

We prototype so fast that it's still in our lunchbox when we're hacking.

(Laughter) And then we hack table lamps and webcams into plumbing fixtures and build them into floating robots that slowly move through water and plastic out there. This is the image we got with the robot.

So we see plastic debris slowly floating through the sensor, and an on-board computer processes this image to measure the size of each particle, so we can get a rough estimate of how much plastic is in the water.

So we documented this invention step-by-step on an inventor website called Instructables in the hope that someone will improve it further.

What's really great about this project is that the students are aware of local issues and trends and are looking to address them immediately.

[Can research local issues] But my students in Hong Kong are very connected children.

And then they saw the news, they looked at the internet, they came across this image.

This was a child, probably under the age of 10, who was cleaning up an oil spill with his bare hands in the world's largest mangrove forest, the Sundurbans, in Bangladesh.

So they were very shocked. For this is the water they drink, this is the water they bathe in, this is the water they fish in, this is where they live.

You can also see that water is brown, mud is brown, and oil is brown. When everything is mixed it becomes very difficult to see what is in the water.

However, there is a fairly simple technique called spectrometry that allows you to see what is underwater.

So we built a rough prototype of the spectrometer. This allows you to shine light through different substances that produce different spectra, thus helping you identify what's in the water.

So we packed the prototype of this sensor and shipped it to Bangladesh.

The great thing about this project was that it not only addressed local issues and raised awareness of local issues, but also the students used their empathy and creativity to help other children remotely.

[Being able to investigate problems far away] So I was very tempted to do a second experiment and wanted to take it further. Perhaps I wanted to tackle the more difficult problems, and that were closer to my heart as well.

I'm half Japanese and half French, but you may remember the big earthquake in Japan in 2011.

It was so violent that it caused several huge waves (called tsunamis), and those tsunamis destroyed many cities on the east coast of Japan.

More than 14,000 people died in an instant.

It also damaged a nuclear power plant in Fukushima, a nuclear power plant in the immediate vicinity of the water.

And today, I read the press, an average of 300 tons is leaking from nuclear power plants into the Pacific Ocean.

And today, traces of cesium-137 contamination remain throughout the Pacific Ocean.

Fukushima can be measured anywhere on the west coast.

But looking at the map, most of the radioactivity was washed off the coast of Japan and most of it now appears to be safe, blue.

Well, the reality is a little more complicated than this.

So, I have been to Fukushima every year since the accident, making measurements on land and in rivers, both independently and with other scientists, but this time I wanted to take my children with me.

Of course, we didn't take the kids, the parents didn't allow that to happen.

(Laughter) But we reported to "control room" every night - they were wearing different masks.

They may not seem to take this job seriously, but they did because they have to live with radiation for the rest of their lives.

So what we did with them was we talked about the data we collected that day, where to go next, strategies, itineraries, etc.

To do so, we created a very rough topographic map of the area around the nuclear power plant.

So we created elevation maps, sprayed pigments to represent real-time radioactivity data, and sprayed water to simulate rainfall.

It was found that the radioactive dust was flowing from the top of the mountain into the river system and leaking into the sea.

So it was a rough estimate.

But with this in mind, we organized this expedition where civilians were closest to the nuclear power plant.

We are sailing 1.5 kilometers away from the nuclear power plant, working with local fishermen to collect sediment from the ocean floor using a custom sediment sampler invented and built by us.

We pack the sediment into small bags, which are then bundled into hundreds of small bags and sent to various universities. We will also create seafloor radioactivity maps, especially in estuaries where fish breed. We hope to improve the safety of our local fishermen and your beloved sushi.

(Laughter) You see progress here. We are moving from local problems to remote problems to global problems.

And it's very exciting to work at all these different scales using a very simple open source technology.

But at the same time, it became more and more frustrating as we were just beginning to measure the damage we had done.

We haven't even started trying to fix the problem.

So I think we need to take the plunge and try to invent a better way to do all these things.

So our classrooms started to feel a little cramped, so we found an industrial site in Hong Kong and turned it into the largest megaspace that focuses on social and environmental impact.

This is in the heart of Hong Kong, where you can work with wood, metal, chemistry, biology, optics, basically pretty much anything you can build there.

It is a place where adults and children can play together.

It is a place where children can make their dreams come true with the help of adults, and where adults can return to being children.

Student: Accelerate! acceleration!

Cesar Harada: We are asking questions like, can we invent the future of mobility using renewable energy?

for example.

Or could turning a very standard wheelchair into a cool electric car help an aging population get around?

So plastic, oil and radiation are a horrible, horrible legacy, but the worst legacy we can leave our children with is lies.

We can no longer afford to shield our children from ugly truths, because it takes their imaginations to come up with solutions.

So citizen scientists, makers, dreamers, we must care about the environment and people and prepare the next generation to actually do something about it.

thank you.

(applause)

I would like to share three stories about the power of human relationships to solve the deep and complex social problems of this century.

As you know, poverty, inequality, poor health, unemployment, violence, addiction, all these problems can seem right there in one person's life.

So I would like to tell you about a similar person I know.

I will call her Ella.

Ella lives in a ruined land in an English city.

Shops are closed, pubs are gone, playgrounds are pretty run down and never used. Tensions are evident in Ella's house, and the noise level is deafening.

TV is on at maximum volume.

One of her sons is arguing with one of her daughters.

Another son, Ryan, continues to receive abuse from the kitchen, and the dogs are locked behind the bedroom door and strained.

Ella is stuck.

For 40 years, she has lived with crisis.

She doesn't know anything else and doesn't know how to get out of it.

She has had a string of abusive partners and tragically has one of her children in social care.

Her three children, who still live with her, have various problems and none of them receive an education.

And Ella told me she was repeating the cycle of her mother's life.

But when I met Ella, with 73 different services offered to her and her family in the city where she lives, 73 different services offered in 24 departments in one city, Ella, her partner, and her children were known to most people.

They think nothing of calling social services to mediate one of the many arguments that have broken out.

The family homes were then visited regularly by social workers, youth workers, health officials, housing officials, tutors and local police officers.

And the government says there are now 100,000 families like Ella in Britain, struggling to break the cycle of economic, social and environmental poverty.

It also said that managing the problem would cost £250,000 a year per family, but nothing would change.

None of these well-intentioned visitors are making a difference.

Here's a chart I made in the same city as another family like Ella.

This marks 30 years of intervention in that family's life.

And as with Ella, none of these interventions are part of the overall plan.

I can't see the end goal.

None of the interventions addressed the underlying problem.

These are just containment measures, a way to manage the problem.

One of the police officers says to me, "Look, I just gave you a message and I'm leaving."

So, I've spent time with families like Ella in different parts of the world. Because I want to know what can be learned from a place where the social system is not working.

I want to know what it's like to live with Ella's family.

I would like to know what is going on and what is different.

Well, the first thing I learned is that cost is a very confusing concept.

Because when the government says it costs £250,000 a year to manage a family like Ella, what they really mean is that the system costs £250,000 a year.

Because not a penny of this money really affects Ella's family.

Instead, the system is like this expensive gyroscope that revolves around the family, keeping them centered, exactly where they are.

Also, I spent time with frontline workers and learned that it is an impossible situation.

So Ella's 14-year-old son, Ryan's social worker, Tom, has to spend 86 percent of his time maintaining the system. Meetings with colleagues, filling out forms, more meetings with colleagues to discuss forms, and perhaps most shocking, 14 percent of the time he has to be with Ryan is spent retrieving system data and information.

So he says to Ryan, "How often do you smoke? Do you drink?"

when did you go to school ”

And this kind of interaction precludes the possibility of normal conversation.

This eliminates the possibility of what it would take to build a relationship between Tom and Ryan.

When we created this chart, the frontline workers, the experts, looked at it in genuine amazement.

It meandered around the walls of their office.

So much time spent and it was done in a good way, but in the end it was very wasteful.

And then there were moments when it completely fell apart, and then moments when it became clear that I needed to work on it differently.

So, in a brave step indeed, the leaders of Ella's city agreed that Ryan's ratio could begin to be reversed.

So Ella and everyone who comes into contact with her family will spend 80 percent of her time working with her family and only 20 percent of her time maintaining the system.

And more fundamentally, families will take the lead and decide who is best positioned to help them.

So Ella and another mother were asked to be part of an interview panel to select from existing professionals to work with.

And so many people wanted to join us. Because you don't do this kind of work to manage a system, you do it because you want to do what you can and make a difference.

So Ella and her mother asked everyone who came through the door, "What if my son started kicking me?"

So the first person to come in says, "Well, I'll find the nearest exit and back away slowly. If the noise continues, I'll call my boss."

And the mothers said, "You are the system. Get out of here!"

And then came the policeman, who said, "Then I'll knock your son to the ground, but I don't know what to do after that."

And the mothers say, "Thank you."

So they chose experts who confessed they didn't necessarily have the answers and who said they weren't going to speak in jargon.

They showed human qualities and convinced mothers that they would stand by them no matter what, even if they weren't nice to them.

So these new teams and their families were given a portion of their previous budget, but they could spend the money however they wanted.

So one of the family went out to dinner.

They went to McDonald's and sat down to talk and listen for the first time in a while.

Another family asked the team if they could help clean up their home.

And one mother took the money and started a social enterprise with it.

And in a really short space of time, something new began to emerge: the relationship between the team and the employees.

And then some amazing changes happened.

Perhaps it should come as no surprise that Ella's journey had big steps forward as well as backwards.

But today, she's completed an IT training course, has her first paid job, her kids are back in school, and her neighbors who previously only wished this family would be moved elsewhere are thriving.

They made some new friendships.

And all the same people have been involved in this transformation, the same families, the same workers.

However, the relationship between them is supported to change.

So I'm talking about Ella because I think relationships are an important resource we have in solving some of these intractable problems.

But today our relationships are mostly ruined by politics, social policies and welfare systems.

And I learned that this really has to change.

So what do we mean by relationship?

I'm talking about a simple human bond between us, a kind of genuine connection and belonging, a bond that makes us happy, changes, brave like Ella, and supports us to try something new.

And you know, it's no coincidence that the people who run and work at the facility that's supposed to support Ella and her family don't talk about relationships. Because relationships are clearly designed around a welfare model formulated in Britain and exported around the world.

Contemporaries of William Beveridge, architect of the first welfare state and author of the Beveridge Report, believed little in what could be called the average sensual or emotional man.

Rather, they believed in the idea of ​​an impersonal system and bureaucrats who would work aloof in this system.

And Beveridge's influence on the way modern nations view social issues can never be underestimated.

The Beveridge Report sold over 100,000 copies in its first few weeks of publication.

On November nights, people queued up in the rain to get their hands on the book, which was read across nations, colonies, Europe, and the United States, and profoundly influenced the way welfare states were designed around the world.

Culture, bureaucracy and institutions are global and have become common sense.

They are so ingrained in us that we actually don't even see them anymore.

And I think it's very important to say that in the 20th century these institutions have achieved remarkable success.

They have led to longer lifespans, eradication of mass disease, mass housing, and near-universal education.

But at the same time, Beveridge sowed the seeds of today's challenges.

So let me tell you the second story.

What do you think causes more death today than smoking in your lifetime?

It's lonely.

According to government statistics, one person over the age of 60, or one in three people, does not speak or see another person in a week.

1 in 10 people, or 850,000 people, don't speak to anyone for a month.

We are not the only ones with this problem. This problem affects the entire Western world.

And the problem is even more acute in countries like China, where the process of rapid urbanization and mass migration has left the elderly stranded in villages.

Therefore, the service designed and exported by Beverridge cannot address this type of problem.

Loneliness is a collective relationship challenge that cannot be addressed by traditional bureaucratic responses.

So a few years ago I wanted to understand this problem and started working with a group of about 60 senior citizens in South London where I live.

We went shopping and played bingo, but mostly just watched and listened.

I wanted to know what the difference was.

And when you ask them, people say they want you to do two things.

They want someone to climb the ladder to change the lightbulb or be there for them when they leave the hospital.

They want hands-on support on demand.

And they want to have fun.

They want to go out, do interesting things with like-minded people, and make friends, just like we make friends at every stage of life.

So we rented a phone line, hired a few handymen, and started a service called "Circle."

The Circle also provides local members with a toll-free 0 800 number they can call if they need assistance.

And people have been calling us for different reasons.

They called because their pets were sick, their DVDs broke, they forgot how to use their cell phones, or they just got home from the hospital and wanted someone to come over.

Circle also offers a rich social calendar with knitting, darts, museum tours, hot air ballooning, and more.

But what's interesting is the really deep changes. Over time, formed friendships began to replace practical offers.

Now let's talk about Belinda.

Belinda was a member of the circle and was going to be in the hospital for hip surgery, so I called the local circle and told them I wouldn't be seeing them for a while.

Then Damon, who runs the local circle, called her back and said, "How can I help?"

And Belinda said, "Oh, no, I'm fine. Jocelyn will be shopping, Tony will be gardening, and Melissa and Joe will be coming home to cook and chat."

So five members of the Circle were organized to take care of Belinda.

Belinda is 80 years old, but says she's 25 at heart, but she also says she felt stuck and pretty depressed when she joined the circle.

But the simple act of inviting her to attend that first event led to the process of developing a natural friendship that today replaces the need for expensive services.

It's the relationships that make the difference.

So I think we've brought together three elements that allow us to put human relationships at the heart of how we solve today's social problems.

First, the nature of problems is changing and requires different solutions.

Second, there are the financial as well as the human costs of doing business as usual.

And the third is technology.

We've covered the first two elements.

It is technology that has enabled these approaches to scale and support thousands of people in the future.

The technology we used is very simple and consists of what is available such as databases and mobile phones.

Circle has a very simple system to power it, allowing a small local team to support up to 1,000 memberships.

Contrast this with neighborhood organizations in the 1970s. This kind of scale was not possible at the time, nor was the quality and longevity that the spine of technology could provide.

In short, it is the relationships fueled by technology that can turn the Beveridge model upside down.

The Beveridge model is all about institutions with finite resources and anonymous access controls.

Working on the front lines, I've seen time and time again how up to 80% of resources are spent keeping people in and out.

Experts therefore have to manage increasingly complex forms of management, which basically shut down users' access to services, manage queues, and more.

And Circle, like relational services we and others have designed, inverts this logic.

In other words, the more people and the more relationships, the stronger the solution.

So I'd like to talk about the third and final story. It's about unemployment.

In Britain, as in most parts of the world, the welfare state was primarily aimed at getting people to work, educating them to do so, and keeping them healthy.

But even here the system fails.

So there was a move to make these old systems more efficient and transactional. That is, in an effort to reduce processing time, group people into smaller categories than ever before, and target services more efficiently. In other words, it's the exact opposite of relational.

But how do most people find jobs today?

Orally.

It turns out that most new jobs in the UK today are not advertised.

In short, it's your friends who tell you about jobs, your friends who recommend you jobs, and the rich and diverse social network that helps you find work.

Maybe some of you here tonight are thinking, "But I found the job through an ad," but in retrospect, it was probably a friend who showed the ad and encouraged him to apply.

But perhaps not surprisingly, it is the people most isolated from this rich and diverse network who need it most.

So, recognizing this, and also recognizing the costs and impediments of the current system, we designed a new one that puts relationships at the center.

We designed a service that encourages people inside and outside the company to come together, collaborate in a systematic way, and take on new opportunities.

And while it's very difficult to compare the results of these new systems to the old transaction model, for the first 1,000 members, they appear to have outperformed existing services by a factor of three at a fraction of the cost.

Technology is used here too, but not to network people like social platforms do.

We've used this to connect people face-to-face, build authentic relationships, and help people find jobs.

At the end of his life in 1948, Beveridge wrote a third report.

And in it he said he made a terrible mistake.

He neglected people and their communities.

And this omission, he said, allowed people to see and see themselves within the framework of bureaucracy and organization.

And human relations were already tenuous.

Unfortunately, however, this Third Report was not as widely read as Beveridge's previous work.

But today, we need to put people and their communities back at the heart of how we design new systems and new services, an approach I call “relational welfare.”

We need to ditch these old, transactional, inappropriate, and outdated models and adopt instead a shared, collective relationship response that can support families like Ella's, address issues like loneliness, help people enter and upskill in modern labor markets, and address many of the issues looming over our societies, such as our education and healthcare systems.

It's all about relationships.

Relationships are an important resource we have.

thank you.

(applause)

A year ago we were invited by the Swiss Embassy in Berlin to present an art project.

We are used to invitations, but this time we were really excited.

The Swiss Embassy in Berlin is special.

This is the only old building in the government district that was not destroyed during World War II and is right next to the Federal Chancellery.

No one is closer to Merkel than a Swiss diplomat.

(Laughter) Berlin's government district also has the Reichstag (the German parliament) and the Brandenburg Gate, and right next to the gate are other embassies, especially the US and British embassies.

Although Germany is an advanced democracy, its citizens have limited constitutional rights in government districts.

It restricts the right to assemble and the right to demonstrate.

And this is also interesting from an artistic point of view.

Opportunities to participate and express yourself are always bound to a certain order and are always subject to certain regulations.

Recognizing these regulatory dependencies provides a new perspective.

The terms and conditions we are given shape our perceptions, actions and lives.

And this is also important in another context.

In recent years, from the rooftops of the US and British embassies, it was discovered that secret agents were listening to voices throughout the district, including Chancellor Angela Merkel's mobile phone.

The British GCHQ's antennas are hidden in white cylindrical radomes, while the US NSA's listening stations are covered with radio-transparent screens.

But how do we deal with these hidden camouflage forces?

Together with my colleague Christoph Wachter, we accepted the invitation of the Swiss Embassy.

And we used this opportunity to take advantage of certain circumstances.

If people are spying on us, it makes sense that they should listen to us.

(Laughter) We installed a series of antennas on the roof of the Swiss embassy.

They were not as sophisticated as those used by the Americans and British.

(Laughter) They were makeshift can antennas, not camouflaged, but perfectly obvious and visible.

The Academy of Arts was also involved in this project, so we built another large antenna on the roof right between the NSA and GCHQ hearing halls.

(Laughter) Never have we been observed in such detail while building an art installation.

Helicopters circled overhead, cameras recorded our every move, and security guards patrolled the roof of the US Embassy.

Government districts are governed by strict police orders, but there are no specific laws related to digital communications.

Our facility is therefore perfectly legal and the Swiss ambassador informed Chancellor Angela Merkel.

We named this project "Can You Hear Me?"

(Laughter) Antenna built an open and free Wi-Fi communications network. The network allows anyone who wants to join, using any Wi-Fi enabled device, to send messages to anyone listening on the intercepted frequency without any hindrance.

Send text messages, voice chats, file shares, and anything else anonymously.

And people communicated.

Over 15,000 messages have been sent.

Here are some examples.

"Hello world, hello Berlin, hello NSA, hello GCHQ."

“NSA personnel, do the right thing! Blow your whistle!”

"This is the NSA. We trust God. Everything else is tracked by us!!!!"

(laughter) "#@noonymous watches #NSA #GCHQ - we are part of your organization.

# You can count on me. We are #shutting down." "This is the NSA's Achilles heel. Open networks."

"Agents, what twisted tale of yourself are you going to tell your grandchildren?"

"@NSA My neighbors are noisy. Send me a drone strike."

(Laughter) "Let's make love, not cyber warfare."

We invited embassies and government agencies to join our open network, and to our surprise, they did.

A file containing confidential documents leaked from the National Diet Investigation Committee appeared on the network, highlighting that the free exchange and discussion of important information is beginning to become difficult, even for members of the Diet.

We also planned a guided tour to experience and confirm the power constellation locally.

The tour visited the restricted area around the embassy and discussed communication possibilities and highlights.

Being aware of our zodiac signs and terms of communication not only broadens our horizons, but also allows us to see behind the regulations that limit our worldview and certain social, political, and aesthetic conventions.

Let's see a real example.

The fate of those who live in makeshift settlements on the outskirts of Paris is hidden and fades from sight.

It's a vicious cycle.

What is new is neither poverty nor racism nor exclusion.

What is new is how these realities are masked and how people become invisible in an age of global and overwhelming communication and interaction.

These makeshift settlements are considered illegal, so people living there do not have a chance to make their voices heard.

On the contrary, every time they appear, every time they are in danger of becoming visible, it only gives grounds for further persecution, expulsion, and repression.

We were interested in how we could know this hidden side.

We were looking for an interface and found it.

It's a physical interface, not a digital one. It's a hotel.

We named this project 'Hotel Gelem'.

We have worked with Roma families to establish several Hotel Guerlems in Europe, for example in Freiburg, Germany, in Montreuil near Paris, and in the Balkans.

These are real hotels.

people can stay there.

But they are not commercial enterprises.

they are symbols.

You can go online and ask for a personal invitation to stay at Hotel Gelem for a few days and eat, work and live with a Roma family.

Here, Roma families are not tourists. So is the visitor.

Roma families are not a minority here. So is the visitor.

The point is not to pass judgment, but rather to find the context that determines these different and seemingly insurmountable contradictions.

In a world of globalization, continents are moving closer together.

Cultures, goods and people perpetually interact, but at the same time the divide between the privileged and excluded worlds is widening.

We were in Australia recently.

For us, immigration was fine.

We have European passports, visas and air tickets.

However, asylum seekers who arrive in Australia by boat are either deported or imprisoned.

The obstruction of boats and the disappearance of people into the detention system has been veiled by Australian authorities.

These procedures have been declared a covert military operation.

Men, women and children who have made dramatic escapes from zones of crisis and conflict are detained in Australia without trial and in some cases for years.

During our stay, however, despite strict screening and isolation, we managed to contact and cooperate with asylum seekers who were imprisoned.

Out of these contexts, an installation was born in Brisbane's Queensland University of Technology art space.

At first glance, it was a very easy installation.

On the floor, a stylized compass indicated the direction to each immigration center, indicating the distance and name of the immigration facility.

However, the exhibition step was realized in the form of connection.

Above each floor mark was a headset.

Visitors were provided with the opportunity to speak directly and have personal conversations with refugees who are or have been held in specific detention facilities.

Within the protected context of an art exhibition, asylum seekers were able to speak freely about themselves, their stories, and their circumstances without fear of consequences.

Visitors were immersed in lengthy conversations about torn families, dramatic escapes from war zones, attempted suicides and the fate of children in custody.

I feel deeply. Many cried.

Some revisited the exhibition.

It was a very powerful experience.

Europe is currently facing an influx of migrants.

The situation of asylum seekers is compounded by conflicting policies and the lure of a militarized response.

It also established communications systems for remote refugee centers in Switzerland and Greece.

All of them are intended to provide basic information such as weather forecasts, legal information and guidance.

But they are important.

Information on the Internet that could guarantee survival on dangerous routes is censored, and providing such information is increasingly criminalized.

This brings us back to our network, the antenna on the roof of the Swiss Embassy in Berlin, and 'can you hear me?' plan.

We should not take for granted that we are infinitely connected.

We should fight for this ideal of an equal and globally interconnected world and start making our own connections.

This is essential to overcome our loss of language and the separation caused by opposing political forces.

It is only through true exposure to the transformative power of this experience that we can overcome prejudice and exclusion.

thank you.

(Applause) Bruno Giussani: Thank you, Matthias.

The other half of your artistic duo is here too.

Christoph Wachter, come on stage.

(Applause) First, please tell me more. The name of the hotel is not a random name.

Gelem means a specific thing in Romani.

Matthias Jad: Yes, "Gerem, Gerem" is the official Romani hymn title, which means "I have walked a long way."

BG: It just adds detail to your story.

But you two have recently traveled to Lesvos and just returned to Greece a few days ago, where thousands of refugees have arrived and have been arriving for months.

What did you see and do there?

Christoph Wachter: Well, Lesvos is one of the Greek islands near Turkey and during our stay many asylum seekers arrived by boat in full dinghies and were left completely alone after landing.

They are denied many services.

For example, many families literally sleep on the streets because they are not allowed to buy bus tickets or rent hotel rooms.

And we set up a network there to allow basic communication. Because I think we not only have to talk about refugees, we need to start talking to them.

In doing so, you can realize that it is about humans, human life, and the struggle to survive.

BG: And let them talk too.

Christophe, thank you for coming to TED.

Matthias, thank you for coming to TED and sharing your story.

(applause)

I am from Egypt, also known as Umm Al-Duniya, Mother of the World.

This country is a rich country full of tales of rebellion, tales of the triumph and fall of civilizations, rich and rich in religious, ethnic, cultural and linguistic diversity.

Growing up in that environment made me a strong believer in the power of storytelling.

I came across graphic design when I was looking for a medium to tell my story.

I would like to share with you a project on how graphic design can bring the Arabic language to life.

But before that, let me tell you why I want to do this.

I believe graphic design can change the world.

At least in my own city of Cairo, it helped overthrow two separate dictators.

As you can see from these photos, the power and potential of graphic design as a tool for positive change is undeniably powerful.

The Egyptian revolution of 2011 was also a grassroots design revolution.

Everyone became a creator.

The real designers are the people, and in just one night Cairo was flooded with posters, billboards and graffiti.

At a time when the voices of a population of over 90 million had been suppressed for almost three decades, visual communication was a medium that spoke far more eloquently than words.

It is precisely this political and social oppression, combined with decades of colonialism and miseducation, that slowly eroded the importance of the Arabic script in the region.

All of these countries once used Arabic.

Now it's just green and blue.

Simply put, the Arabic script is dying out.

In post-colonial Arab countries functioning in an increasingly globalized world, there is concern that fewer and fewer people use the Arabic script for communication.

When I was studying my master's degree in Italy, I realized that I lacked Arabic.

I looked at the letters and forgot to make sense of them.

So one day I went to Italy's largest library in search of Arabic books.

I was surprised to see this in the "Arabic/Middle Eastern Books" category.

(laughter) Fear, terrorism, and destruction.

One word: ISIS.

Even from a literary point of view, it pains me how we are portrayed to the world.

I asked myself. What happened to world-famous writers like Naguib Mahfouz and Khalil Gibran, and iconic poets like Mutanavi and Nizar Qabbani?

Think about this.

Cultural products across regions of the world, despite their richness and diversity, have been viewed as redundant, if not completely neglected.

Local cultural products from all over the world are prohibited from having any substantive influence on global media production or contemporary social discourse.

And I was reminded of my biggest belief that design can change the world.

All you need is someone to see, feel, and connect with your work.

So I started.

I wondered how the world could stop seeing us as the bad guys, terrorists on this planet, and start seeing us as equals, fellow citizens.

How can we preserve, respect, and share the Arabic script with others and other cultures?

And then I had an idea. What if we combined the two most important symbols of innocence and Arab identity?

Then people might resonate.

What could be more pure, innocent and fun than Lego?

A universal children's toy.

Play together, build together, and imagine endless possibilities.

Finding a bilingual solution for teaching Arabic was a breakthrough moment for me because effective communication and education is the way to a more tolerant community.

However, Arabic and Latin scripts not only represent different worlds, they routinely cause technical difficulties for both Eastern and Western communities.

There are many reasons why Arabic and Latin differ, but here are some of the main reasons.

Yes, they both use upward and downward strokes, but they have completely different baselines.

Arabic tends to be calligraphic, and connectivity is important in Arabic, where large chunks of letters need to be joined together to articulate a particular word.

It also uses a completely different system of punctuation and phonetic symbols.

But most importantly, Arabic has no capital letters.

Instead, there are four different character forms: initial characters, middle characters, lone characters, and final characters.

I would like to introduce Arabic to young learners and foreign language speakers, but most importantly, to help refugees integrate into the host society by building a bilingual learning system, a two-way flow of communication.

And I named it "Let's Play".

The idea is to create a fun and engaging way to learn Modern Standard Arabic through Lego.

These two words. "let's play."

Each colored bar represents an Arabic script.

As you can see, the letter is described with examples of shapes, sounds, and words that work, in addition to its Latin equivalent.

Combined, they form a fun pocketbook with 29 Arabic characters in 4 different formats and a 400-word dictionary.

The page looks like this:

There is a letter, a Latin transliteration, and an explanation below.

Let me explain the process.

So I started by creating the characters in a small studio in Florence.

I photographed each letter individually, retouched every letter, and chose the right color background and typeface to use.

In the end, I created a complete letter set consisting of 29 characters x 4 different formats.

In just one week, we created 116 characters.

I believe information should be fun and portable.

This book is the final product and we want to eventually publish this book and translate it into many languages ​​around the world to make teaching and learning Arabic fun, easy and globally accessible.

With this book, I want to save this country's beautiful characters.

(Applause.) Thank you.

Working on this project was a kind of visual meditation, like a Sufi dance, a prayer for a better planet.

Two languages ​​were created with one set of building blocks.

Lego is just a metaphor.

Precisely because we are made up of the same building unit, we can see a future in which all the walls between people are crumbling down.

So no matter how ugly the world around us gets, no matter how many depressing books keep coming out about the terrorist group ISIS instead of the ancient Egyptian goddess Isis, I will keep building a colorful world.

Shukran means "thank you".

(Applause.) Thank you. Thank you very much.

thank you.

(guitar music begins) (music ends) (applause) (distorted guitar music begins) (music ends) (applause) (ambient/guitar music begins) (music ends) (applause)

This is one of the most amazing animals on earth.

This is a tapir.

Well, this is a baby tapir, the offspring of the cutest animal in the animal kingdom.

(laughs) Much more.

There is no competition here.

I have devoted the last 20 years to the research and conservation of tapirs in Brazil, and the results have been truly remarkable.

But now I'm seriously thinking about the impact of my work.

I've been asking myself the real contribution I've made to the protection of these beloved animals.

Will I be effective in protecting their survival?

Am I doing enough?

I think the big question here is, am I studying the tapir and contributing to its conservation, or am I just documenting its extinction?

The world faces many different conservation crises.

we all know that. It's featured in the news every day.

Tropical forests and other ecosystems are destroyed, climate change occurs, and many species are threatened with extinction, including tigers, lions, elephants, rhinos and tapirs.

This is a lowland tapir, the tapir species I study, the largest land mammal in South America.

they are huge. they are powerful.

The weight of an adult can reach 300 kg.

It's half the size of a horse.

It is wonderful.

Tapirs live primarily in tropical forests such as the Amazon, and they desperately need vast habitats to find all the resources they need to breed and survive.

However, their habitat has been destroyed and they are hunted from some areas of their geographic distribution.

This is very unfortunate as tapirs are very important to their habitat.

they are herbivores.

50% of their diet consists of fruit, and when they eat the fruit they swallow the seeds and disperse them throughout their habitat through their faeces.

Tapirs play an important role in shaping and maintaining forest structure and diversity, which is why tapirs are known as forest gardeners.

Isn't that amazing?

If you think about it, tapir extinction would have a serious impact on biodiversity as a whole.

I started researching tapirs in 1996. I was young at the time and had just graduated from college. It was a pioneering research and conservation program.

At that time, information about tapirs was almost zero. The main reason was that it was very difficult to study.

They are nocturnal, solitary, and very elusive animals, and we started to get very basic data on these animals.

But what are conservationists doing?

Well, first we need data.

A site survey is required.

These long-term datasets are required to support conservation efforts. He said that tapir research is so difficult that we must resort to indirect methods to study it.

We need to catch them and anesthetize them so they can have GPS collars attached to their necks to track their movements. This is a technique used by many other conservationists around the world.

And we can gather information about how they use space, how they move through terrain, what their preferred habitats are, and more.

Then you have to disseminate what you have learned.

We must educate people about tapirs and how important they are.

And it's amazing how many people around the world don't know what a tapir is.

In fact, many consider this a tapir.

Let me tell you, this is not a tapir.

(laughs) This is a giant anteater.

Tapirs don't eat ants. I never have. ever.

And then we need to provide training, development.

It is our responsibility to prepare future conservationists.

We are losing some conservation battles and we need more people to do what we do, and they need the skills and passion to do it.

Ultimately, we conservationists must be able to harness data and apply our collective knowledge to support real conservation efforts.

Our first tapir program was conducted in the Atlantic Forest of eastern Brazil, one of the most threatened biomes in the world.

Destruction of the Atlantic Forest began in the early 1500s, when the Portuguese first arrived in Brazil and European colonization began in eastern South America.

This forest has been almost completely cleared for timber, agriculture, animal husbandry and urban building, and today only 7 percent of the Atlantic forest remains.

And tapirs are found in very small, isolated, unconnected populations.

In the Atlantic forest, tapirs were found to migrate from one forest patch to another through pastures and agricultural open spaces.

Therefore, our main approach in this region was to use tapir data to identify potential locations for establishing wildlife corridors between these woodlands, reconnecting habitats so that tapirs and many other animals can safely traverse the landscape.

After 12 years in the Atlantic Forest, in 2008 we expanded our tapir conservation efforts to the Pantanal in western Brazil, near the border of Bolivia and Paraguay.

This is the world's largest continuous freshwater floodplain, an incredible site and one of the most important strongholds of lowland tapirs in South America.

And working in the Pantanal was very refreshing. Because we found a large population of healthy tapirs in this area and were able to study them in the most natural conditions we have ever found, with few threats.

In addition to GPS collars, the Pantanal also uses another technology called camera traps.

This camera is equipped with a motion sensor that captures when an animal walks in front of the camera.

Thanks to these amazing devices, we were able to gather valuable information about tapir breeding and social organization. These are very important pieces of the puzzle when developing a conservation strategy.

And now, in 2015, we are again expanding our activities into the Cerrado, Brazil, the open grasslands and scrublands of central Brazil.

Today, the region has become the very epicenter of our country's economic development, and natural habitats and wildlife populations are being rapidly exterminated by a variety of threats, including cattle grazing again, large sugar cane and soybean plantations, poaching, and road destruction, to name a few.

And somehow Baku is still there, giving me great hope.

However, I have to say that starting this new program at Cerrado was a bit of a challenge.

As I drive around, I find dead tapirs along the highway, traces of tapirs roaming in the middle of sugarcane plantations where tapirs shouldn't be.

The situation in Cerrado gave me a sense of crisis.

Swimming against the tide.

After 20 years of efforts to save these animals, I realized that there is still much work to be done to prevent their extinction.

We have to find a way to solve all these problems.

It really is.

We have really reached a point in the conservation world where we have to think outside the box.

We will need to be much more creative than we are now.

And he said that roadkill is a big problem for Cerrado Baku. So I came up with the idea of ​​putting a reflective sticker on the GPS collar that Baku wears.

These are the same stickers used on large trucks to avoid collisions.

Tapirs cross the highway after dark, so we hope this sticker will help drivers see this glowing object crossing the highway and perhaps slow down a bit.

For now this is just a crazy idea.

I do not understand. Let's see if that reduces the amount of Baku's roadkill.

But the point is, maybe this is what you need to do.

And while I'm wrestling with all these questions in my mind right now, I have a pact with Baku.

I know in my heart that tapir protection is my purpose.

This is my passion.

I'm not alone

I have a huge network of supporters and nothing can stop me.

I will probably continue doing this for the rest of my life.

And I continue this for my namesake Patricia, one of the first tapirs I captured and monitored in the Atlantic Forest many years ago. For Rita and baby Vincent in the Pantanal.

And I will continue this for Ted, a baby tapir I also captured in the Pantanal last December.

And I will continue to do so for the hundreds of tapirs I've encountered over the years and the many others I'll encounter in the future.

These animals deserve to be taken care of.

they need me they need us

you know? We humans, now and in the future, have the right to live in a world where we can go out and see and benefit from not only tapirs, but all other beautiful species.

Thank you very much.

(applause)

I want to demonstrate in public for the first time that I can send video from a standard off-the-shelf LED lamp to a solar cell using my laptop as a receiver.

Wi-Fi doesn't matter, just light.

And you may be wondering what that means.

And the point is this. Massive expansion of the internet will take place to bridge the digital divide and enable what we call the “Internet of Things” – tens of billions of devices to be connected to the internet.

In my opinion, such an expansion of the Internet will only work if it is nearly energy neutral.

This means that existing infrastructure should be used whenever possible.

That's where solar cells and LEDs come in.

At TED in 2011, I first demonstrated Li-Fi, or Light Fidelity.

Li-Fi uses off-the-shelf LEDs to transmit data in an incredibly fast and secure manner.

Data is carried by light and encoded in subtle changes in brightness.

Looking around, we see a lot of LEDs all around us and a rich infrastructure of Li-Fi transmitters all around us.

But so far, we have used special devices to receive the information encoded in the data: tiny photodetectors.

I also wanted to find a way to receive data from my Li-Fi lights using my existing infrastructure.

This is why I have been researching solar cells and solar panels.

Solar cells absorb light and convert it into electrical energy.

This is why solar cells can be used to charge mobile phones.

But here we have to remember that the data is encoded as subtle changes in the brightness of the LED, so if the incident light fluctuates, the energy we get from the solar cell will also fluctuate.

This means that the primary mechanisms for receiving information from light and solar cells are in place, as fluctuations in the energy collected correspond to the data transmitted.

The question, of course, is whether you can receive very fast and subtle changes in brightness, such as those sent by LED lights.

The answer to that is "yes you can".

We have shown in the lab that we can receive up to 50 megabytes per second from standard off-the-shelf solar cells.

And this is faster than most broadband connections these days.

Let's see it in action.

This box contains standard off-the-shelf LED lamps.

This is a standard off-the-shelf solar cell. Connected to laptop.

Also here is an instrument for visualizing the energy obtained from solar cells.

And this instrument shows something at that moment.

This is because solar cells are already collecting light from ambient light.

Well, first I want to switch on the lights. Turn on the light switch for a moment. As you do so, you will notice that the instrument jumps to the right.

Solar cells therefore temporarily collect energy from this artificial light source.

Turn it off and you'll see it drop.

Power up...

So we use solar cells to collect the energy.

Now I want to enable video streaming.

And I pressed this button to do this.

Now, this LED lamp streams video by changing the brightness of the LED in a very subtle way. It is a method that is not perceptible to the eye because it changes too quickly to be perceptible.

But to prove it, we can block the light from the solar cell.

So the first thing you notice is that the energy harvesting drops and the video also stops.

The video resumes when you unblock it.

(Applause) I repeat.

So stop sending video and stop energy harvesting.

This indicates that the solar cell acts as a receiver.

But imagine this LED lamp is a street light and there is fog.

So I brought a handkerchief because I wanted to simulate fog.

(laughs) And let's put a handkerchief over the solar cell.

First, as expected, we notice less energy being collected, but the video still continues.

This means that despite the occlusion, enough light reaches the solar cell through the handkerchief so that it can decode and stream that information (in this case, high-definition video).

What's really important here is that the solar cell has become a receiver of light-encoded high-speed radio signals while maintaining its primary function as an energy harvester.

That's why the existing solar cells on the roof of the hut can act as a broadband receiver from a laser station on a nearby hill, or indeed a lamppost.

And it doesn't matter at all where the beam hits the solar cell.

And the same is true for translucent solar cells in windows, solar cells in street furniture, or indeed in these billions of devices that form the Internet of Things.

Simply because I don't want to charge these devices regularly, or worse, replace the battery every few months.

As I said earlier, this is the first time I've shown this in public.

This is just a laboratory demonstration, a prototype.

But my team and I are confident that we can bring this to market within the next 2-3 years.

And we hope that we can help bridge the digital divide and connect all these billions of devices to the internet.

And thanks to solar cells, we can do all this without causing a massive explosion in energy consumption. Quite the opposite.

thank you.

(applause)

So whenever I visit a school and talk to students, I ask the same question. "Why Google?"

Why is Google your search engine of choice?

Strangely enough, I always get the same answer three times.

One is "because it works". This is a great answer. So I google too.

Second, some people will say, "I really don't know the alternatives."

This isn't a great answer either, and my usual response to it is "Try searching Google for the word 'search engine' and you may find some interesting alternatives."

And last but not least, inevitably some student will raise their hand and say, "I'm sure Google will always give you the best and fairest results."

Ensure that you always get the best and unbiased search results.

Now, as a digital humanities person, I know that even though that trust and unbiased attitude toward search results is the foundation of our collective love and appreciation for Google, it just makes my skin plump.

I'll explain why it's philosophically nearly impossible.

But first, let me explain a little more about the underlying principles behind each search query that we tend to forget.

So when you're trying to Google something, start by asking yourself, "Am I looking for an isolated fact?"

what is the capital of france

What are the constituents of a water molecule?

Great -- Google away.

No group of scientists is closer to proving that it is indeed London and H30.

I doubt there is a big conspiracy in them.

We globally agree on what the answers to these individual facts are.

But let's complicate the question a bit and ask something like, "Why is there a conflict between Israel and Palestine?"

You are no longer looking for single facts, but more complex and nuanced knowledge.

And to gain knowledge, you have to bring 10, 20, or 100 facts to the table, acknowledge them, and say, "Yes, these are all true."

But depending on who I am, young or old, black or white, gay or straight, their values ​​are different.

And I say, "Yes, that's true, but to me this is more important than that."

This is where things get interesting. Because here we become human.

At this time, we start discussing to form a society.

And to really get to your destination, you have to filter all the facts you get here through friends, neighbors, parents and children, co-workers, newspapers and magazines, and finally make educated decisions, which search engines don't help you much with.

So I promise you an example to show why true, clean, objective knowledge is so hard to come by, and food for thought.

Do some simple queries, search queries.

Let's start with Michelle Obama, First Lady of the United States.

Then click to view the photos.

As you can see it works very well.

A more or less perfect search result.

Only she is in the photo, not even the president.

How does this work?

It's very simple.

Google uses a lot of wisdom to achieve this, but quite simply they focus on two things above all else.

First, what do the captions under each website photo say?

Does it say "Michelle Obama" under the photo?

It's a pretty good sign that it's actually her who's there.

Next, Google looks at image files, i.e. filenames uploaded to websites.

Again, is the name "MichelleObama.jpeg"?

It's a pretty good sign that it's not Clint Eastwood in the picture.

So if you get those two, you'll get search results like this:

In 2009, Michelle Obama was the victim of a racist campaign where people tried to insult her through her search results.

A photo of her face distorted to look like a monkey has gone viral on the internet.

And the photo was published everywhere.

And people put it out there very intentionally so that it would show up in search results.

They made sure to write "Michelle Obama" in the caption and upload photos in formats like "MichelleObama.jpeg".

You'll see why you're manipulating search results.

And it worked too.

So in 2009, a Google image search for "Michelle Obama" showed a distorted picture of a monkey among the first results.

Google measures relevance daily and hourly, so the results are automatically purified. This is kind of an advantage.

But Google didn't settle for that this time around and just thought, "This is racist and bad search results, so I'm going to go back and manually clean it up."

I will write the code and fix it," they replied.

And I don't think anyone in this room thinks it's a bad idea.

me neither.

But years later, Anders Bering Breivik, the world's most Googled Anders, has done the same.

This is July 22, 2011, the worst day in Norwegian history.

This man is a terrorist who blew up several government buildings in Oslo, Norway within walking distance of where we are now, then went to Utoya Island and shot a group of children.

About 80 people died that day.

And many people describe this act of terrorism as two steps and that he did two things. They blew up buildings and shot children.

it's not true.

It was 3 steps.

He blew up those buildings, shot those kids, sat and waited for the world to Google him.

And he prepared all three steps equally well.

And if anyone figured this out right away, it was Swedish web developer Nikke Lindqvist, a search engine optimization expert from Stockholm.

He was also a very political figure and was openly active on social media, blogging and Facebook.

And he said to everyone, ``If there's one thing this guy wants right now, it's to control his image.

Let's see if we can distort it.

Let's see if we in civilized society can protest his actions by insulting him in search results. ”

And how?

He told all his readers: "Go to the internet and find a picture of dog poop on the sidewalk. Find a picture of dog poop on the sidewalk and publish it on your feed, website or blog.

Be sure to include the name of the terrorist in the caption and be sure to name the image file "Breivik.jpeg".

Tell Google it's the face of a terrorist. ”

And it worked.

Two years after that campaign against Michelle Obama, this manipulation campaign against Anders Bering Breivik has paid off.

A few weeks after the events of July 22nd in Sweden, a Google search for pictures will show pictures of dog poop at the top of the search results as a small protest.

Strangely enough, Google didn't intervene this time.

They didn't intervene and manually clean up these search results.

So the million dollar question, is there any difference between these two events happening here?

Is there any difference between what happened to Michelle Obama and what happened to Anders Bering Breivik?

of course not.

This is exactly the same thing, but Google intervened in one case and not in the other.

why?

Michelle Obama is a man of honor and that's why, and Anders Bering Breivik is a mean man.

Can you see what happens there?

There is only one power player in the world where people are rated and have the power to say who is who.

"We love you, but we hate you.

We believe in you, but we don't believe in you.

you are right, you are wrong You are true, but you are lying.

You are Obama, you are Breivik. ”

If I've seen it, it's power.

So I want everyone to remember that there is always a human behind every algorithm, a human with a set of personal beliefs that cannot be completely eradicated by code.

And my message is not just for Google, but for all those who believe in code around the world.

You have to identify your own personal biases.

You have to understand that you are human and take responsibility accordingly.

I say this because I believe we have reached a point where it is absolutely necessary to re-tie the ties between the humanities and technology.

Tighter than ever.

And most of all, it reminds us that the wonderfully seductive idea of ​​unbiased, clean search results is and will likely remain a myth.

Thank you for your time.

(applause)

I am happy to be here.

I am honored to be invited, thank you very much.

I like to talk about things that interest me, but unfortunately I'm afraid many other people won't be interested in what I'm interested in.

First, my badge states that I am an astronomer.

I would like to talk about my astronomy, but I doubt there are enough people interested in radiation transfer in the non-gray atmosphere or the polarization of light in Jupiter's upper atmosphere to fit in a bus shelter.

So I'm not going to talk about it.

(Laughter) It would be just as fun to talk about the incidents in 1986 and 1987 when computer hackers broke into our systems at Lawrence Berkeley Lab.

And I caught them, and it turned out that they worked in the KGB in the then USSR, stealing information and selling it.

I'd love to talk about it - and it would be fun - but 20 years later...

Frankly, I find computer security boring.

Hassle.

I -- the first time you do something, it's science.

The second is engineering.

The third time is just a technician.

i am a scientist When you do something, do something else.

So I'm not going to talk about it.

Nor am I going to talk about what I think are the obvious statements in my first book, Silicon Snake Oil, or my second book, or why I believe computers don't belong in school.

It seems to me that there is a huge and fantastic idea going around that we need more computers in schools.

My thought is "No!" no!

Kick them out of school and keep them out of school.

I'd love to talk about this, but I don't think I need to say much because the discussion is obvious to anyone in a 4th grade classroom. But I could be very wrong about this and everything I said.

So please don't go back and read my doctoral dissertation.

It probably contains lies.

That being said, I outlined my talk about five minutes ago.

(Laughter.) And if you look here, the main thing I wrote on my thumb was the future.

We have to talk about the future, right?

Oh yes. And I find it strange that you ask me to talk about the future. I have gray hair, so it's kind of silly to talk about the future.

In fact, if you really want to know what the future holds, I don't think you should ask an engineer, a scientist, or a physicist.

no! Don't ask the person writing the code.

No, if you want to know what society will be like in 20 years, ask your kindergarten teacher.

they know

In fact, don't just ask kindergarten teachers, ask experienced teachers.

They are the ones who know what the next generation of society will look like.

I don't I suspect many others who are talking about what will happen in the future will do the same.

Sure, we can all imagine these cool new things coming out there.

But for me things are not the future.

The question I ask myself is, what would happen to a society where today's kids are amazingly good at text messaging and spend tons of time on screen, but have never gone bowling together?

Change is happening, but the change that is happening is not in software.

But that's not what I'm talking about.

I'd love to talk about it, it would be fun, but I want to talk about what I'm doing now. what am i doing now

Oh, here's another thing I want to talk about. here.

can you see it? What I want to talk about is one-sided.

I would love to talk to you about something that is one-sided.

I love Mobius loops. Not only do I love Mobius strips, but I am one of the few people in the world who make Klein Bottles, if not the only one.

May your eyes light up soon.

This is a Klein bottle.

Anyone in the audience who knows will roll their eyes and say, "Yes, I know all about it."

it is one-sided. A bottle with the inside facing out.

Volume is zero. And it's directionless.

has great properties.

Take two Mobius strips and sew their common ends together to get one of them. I make it out of glass.

I would love to talk to you about this, but I don't have much to say. Because -- (laughter) (Chris Anderson: I have a cold.) But the "D" in TED stands for design, of course.

Just two weeks ago, I made large, medium, and small Klein bottles for commercial use.

But I'm happy to be able to show what I've made here for the first time in public.

This is a Klein bottle wine bottle. Four dimensions shouldn't be able to hold liquids at all, but since our universe only has three spatial dimensions, it can.

And since our universe only has three spatial dimensions, it can hold fluids.

I mean, it's very good.

It was a month of my life.

But I'd love to talk to you about topology, but I'm not going to.

(Laughter) Instead, I'm going to talk about my mother, who passed away last summer.

I used to collect pictures of myself, just like my mother does.

Can someone please put this person up for me?

And I looked through her albums, and she had collected pictures of me standing, or rather, sitting in front of a number of dials in 1969.

So I looked at it and thought, "Wow, this is me when I was working in an electronic music studio!"

As a technician, I repair and maintain electronic music studios at the State University of New York at Buffalo. And wow!

machine long ago. And I said to myself, oh yes!

and it sent me back.

Shortly after, I found my picture among other pictures she had.

This guy here is of course me.

This man is the inventor of the Moog synthesizer, Robert Moog, who died in August of this year.

Robert Moog was a generous and kind man and a very capable engineer.

A musician who spent the rest of his life teaching me as a sophomore and freshman at the State University of New York at Buffalo.

He had come over from Trumansburg to teach me not only Moog synthesizers, and we were sitting there - I was studying physics at the time. This is 1969, 70 and 71.

We study physics, I study physics, and he says, 'That's good.

Don't get caught up in electronic music if you're doing physics. ”

will guide me He came over and spent hours with me.

He wrote a letter of recommendation for me to enter graduate school.

In the background is my bicycle.

I realized this photo was taken in a friend's living room.

Bob Moog came in, brought in a pile of equipment, and told Greg Flint and me about this.

We sat and talked about Fourier transforms, Bessel functions, modulation transfer functions, and more.

It was a great loss to all of us that Bob passed away this summer.

All musicians are heavily influenced by Robert Moog.

(Applause.) So let me tell you what I'm about to do. What We're Going To Do -- As you can see on this Hewlett-Packard oscilloscope, there's a distorted sine wave that's almost triangular.

Cool, cool. You can go here, right?

The kids. I'm going to talk about children -- are you okay?

Kids here, that's what I want to talk about.

I decided my head wasn't big enough, at least for me.

So I think locally and act locally.

I feel the best way I can help out is by helping out very locally.

So Ph.D. degrees this and there, and yadda yadda.

About a year ago, I was talking to some teachers about this.

And one or more of them came to me and said, "So why don't you tell me?"

And I said, "Well, I've taught graduate students, I've taught graduate students, I've taught undergraduate classes."

No, they said, "If you're so interested in children and other things, why aren't you here on the front lines?"

Put your money where the mouth is. ”

It's true. It's true. I teach 8th grade science four days a week.

It doesn't just show up from time to time.

No no no no no. take attendance.

Take lunch time. (Applause.) This is not applause.

I highly recommend that this is good for each of you.

It's not just about showing up to class from time to time.

Please tell us about a productive week. Yes, I teach 3/4 of the time, but that's enough.

One of the things I did to science students was, "Look, I'm going to teach you college-level physics.

No calculus, omit it.

No need to know the trigger.

However, it does require some 8th grade algebra knowledge, so we're going to do some serious experimentation.

Nothing like this, opening up Chapter 7 and doing all the weird stuff.

We are trying to do real physics. ”

And that's one of the things I was thinking of doing right now.

(sheep) Oh, before I turn it on, one of the things we did in class about three weeks ago is through the lens. One of my uses of lenses was to measure the speed of light.

My students in El Cerrito measured the speed of light, with my help, of course, and with the help of a very well-worn oscilloscope.

It was down 25 percent. How many eighth graders do you know who measured the speed of light?

In addition to that, we also measured the speed of sound.

I would like to measure the speed of light here.

I was ready to do it and was thinking, 'Oh, I'm just going to impose existing forces and measure the speed of light.

You are fully prepared. The preparations are complete, but I've found that it takes about 10 minutes to set up here.

And there is no time to do it.

So let's measure the speed of light next time!

In the meantime, let's measure the speed of sound.

Well, the obvious way to measure the speed of sound is to bounce the sound off something and look at the echo.

But perhaps - one of my students, Ariel [unintelligible], said, "Can we measure the speed of light using the wave equation?"

And we all know that the wave equation is the product of the frequency and the wave's wavelength...

is a constant. As the frequency increases, the wavelength decreases. Wavelength goes up and frequency goes down. Suppose there is a wave here. That's what's interesting. When the pitch goes up, things get closer, the pitch goes down, and things stretch.

right? This is simple physics.

You've known this since eighth grade, remember?

They didn't teach me in physics, in 8th grade physics, but they should have taught me, and I wish they had taught me, that when you multiply the frequency of sound or light by the wavelength, you get a constant.

And that constant is the speed of sound.

Therefore, to measure the speed of sound, we only need to know its frequency. Well, it's easy.

There is a frequency counter here.

Set per A, above A, above A. More or less, there is an A.

Now I know the frequency.

It is 1.76 kilohertz. Measure the wavelength.

All that is needed now is to turn on another beam. The bottom beam is what I'm talking about, right?

So whenever I speak, it's on the screen.

put it here. Move this away from the source and you'll notice a spiral.

brilliant movement. We pass through the various nodes of the wave and come out towards us.

Physicists, I can hear you rolling your eyes, but bear with me. (Laughter) To measure the wavelength, just measure the distance from here to here, one wave length.

From here to here is the wavelength of the sound.

Put a measure here, put a measure here, put it back here.

Moved the mic 20 cm.

0.2 meters from here, 20 centimeters back here.

Now, let's go back to Mr. Elmo's story.

And let's say the frequency is 1.76 kilohertz, or 1760.

The wavelength was 0.2 meters.

Let's think about what this is.

(Laughter) (Applause) 1.76 x 0.2 here is 352 meters per second.

When I looked it up in a book, it was actually 343.

But here, with crappy materials and terrible drinks, I was able to measure the speed of sound, which isn't bad. pretty good.

That's all I wanted to say.

Go back to my photo from a million years ago.

In 1971, the Vietnam War was going on and I thought, "Oh my God!"

I study physics: Landau, Lipschitz, Resnick, Halliday.

I'm going home for my midterm exam. There is a riot on campus.

A riot broke out! Hey, Elmo's done, it's off.

There's a riot on campus and the police are chasing me, right?

I'm walking across campus. A policeman comes and looks at me and says, "You are a student."

take out the gun. Go with Dawn!

Then a tear gas canister the size of a Pepsi can passed over my head. Whoosh!

I can't breathe from inhaling tear gas.

This cop is chasing me with a rifle.

He wants to hit me on the head!

I'm saying, "I have to get out of here!"

I run around campus as fast as I can. I dove into Hayes Hall.

It is one of these bell tower buildings.

A policeman is chasing me.

They chase me down the first floor, second floor, and third floor.

Follow me into this room.

Entrance to the bell tower.

I slammed the door behind me, climbed up, and passed this place where I could see the pendulum ticking.

And I'm thinking, "Oh yeah, the square root of the length is proportional to the period." (Laughter) I'm going up and back.

Go to where the dowel breaks.

There are clocks, clocks, clocks, clocks.

Time is running backwards because I am in it.

I'm thinking about Lorentz contraction and Einstein's theory of relativity.

When you climb up, there is a place to climb a wooden ladder all the way back.

There is a cupola when you raise the top.

Dome, one of these ten-foot domes.

Looking outside, they see police hitting students on the head, firing tear gas, and students throwing bricks.

And I ask, "What am I doing here? Why am I here?"

Then I remembered what my high school English teacher said.

That is, when you cast the bell, you write an inscription on it.

So I wipe the pigeon poop off one of the bells and look at it.

I ask myself, "Why am I here?"

So this time, I would like to tell you the words engraved on the tower bell of Hayes Hall. "All truth is one.

From this point of view, may science and religion strive here for the steady evolution of mankind, from darkness to light, from narrowness to breadth, from prejudice to tolerance.

It is the voice of life, calling us to come learn. ”

thank you very much.

Jenny Zhang: When I told my parents that I was gay, the first thing my parents said was, "I'll take you back to Taiwan."

(Laughter.) In their minds, America was to blame for my sexual orientation.

The West has corrupted me with diverse ideas, and if my parents hadn't left Taiwan, none of this would have happened to my only daughter.

I honestly wondered if they were right.

Of course, there are homosexuals in Asia, just as there are homosexuals in every part of the world.

But is the idea of ​​living an "out" life, like, "I'm gay, this is my spouse, and we're proud to be living together," just a Western idea?

If I had grown up in Taiwan or anywhere else outside the West, would I have found a model of happy and prosperous LGBT people?

Lisa Dazols: I had a similar thought.

As an HIV social worker in San Francisco, I met many gay immigrants.

They told me stories of being persecuted in their home country for being homosexual, and why they fled to the United States.

I saw how this beat them.

After 10 years of doing this kind of work, I needed a better story for myself.

We knew the world was far from perfect, but not all gay stories were tragic.

JC: So, as a couple, we had to find a story of hope.

So we embarked on a mission to travel the world and eventually find people who are called "Super Gays".

(Laughter) These would be LGBT people doing something special in the world.

They're brave, they're resilient, and most of all they're proud of who they are.

They would be the kind of people I aspire to be.

Our plan was to tell the world their story through film.

LD: There was just one problem.

We had no interview experience or filmmaking experience.

(Laughter) We didn't even know where we could find super gays. So I had no choice but to believe that I would find out everything along the way.

So we selected 15 countries in various non-Western countries in Asia, Africa and South America on LGBT rights.

We bought a video camera, ordered a book on how to make a documentary (laughs), and you can learn a lot these days. And set off on a trip around the world.

JC: One of the first countries we traveled to was Nepal.

Despite widespread poverty, a decade-long civil war and a recent devastating earthquake, Nepal has made great strides in its fight for equality.

One of the central figures in this movement is Bhumika Shrestha.

A beautiful, vibrant transgender woman, Bumika had to overcome being expelled from school and jailed for expressing her gender.

However, in 2007, Bhumika and Nepal's LGBT rights group successfully petitioned the Supreme Court of Nepal for protection from LGBT discrimination.

Here's Bumika: (Video) BS: What am I most proud of?

i am transgender

I am very proud of my life.

On December 21, 2007, the Supreme Court ruled the government of Nepal to recognize transgender identity cards and same-sex marriage.

LD: I appreciate Bumika's confidence every day.

Even something as simple as using a public restroom can become a big challenge if it doesn't fit people's strict gender expectations.

Traveling all over Asia, I often surprised women in public restrooms.

They weren't used to seeing someone like me.

I had to strategize so I could pee in peace.

(Laughs) So whenever I went into the bathroom, I would stick my chest out to show my feminine side and try to be as non-threatening as possible.

I held out my hand and said hello so my feminine voice could be heard.

This alone is pretty exhausting, but that's who I am.

I cannot be anything else.

JC: After Nepal, we traveled to India.

On the one hand, India is a Hindu society and does not have a homophobic tradition.

On the other hand, it is also a deeply rooted patriarchal society that eliminates anything that threatens the male-dominated order.

When we spoke with activists, they said empowerment begins with ensuring proper gender equality, where women's place in society is established.

In doing so, the status of LGBT people is also affirmed.

LD: There we met Prince Manvendra.

He is the world's first openly gay prince.

Prince Manvendra appeared on the highly international 'The Oprah Winfrey Show'.

His parents disowned him and accused him of bringing great shame to the royal family.

We met Prince Manvendra and talked about why he decided to come out publicly.

See him here: (Video) Prince Manvendra: I felt a great need to break down this stigma and discrimination that exists in our society.

And that's what made me openly come out and talk about myself.

Whether we are gay, lesbian, transgender, bisexual, or from any sexual minority, we all have to come together and fight for our rights.

Homosexual rights are not won in court, but in the hearts and minds of people.

JC: When I was getting my hair cut, the woman who cut my hair asked me, "Do you have a husband?"

Well, this was a dreaded question I was often asked by locals during my travels.

When I explained that I was with a woman and not a man, she was incredulous and asked a number of questions, including how her parents would react and whether she was sad that I couldn't have children.

I told her that my life had no limits and that Lisa and I were going to have a family one day.

Well, this woman was going to throw me off as another crazy westerner.

She could not imagine such a phenomenon in her country.

That was until I showed her a photo of a super gay we interviewed in India.

She recognized Prince Manvendra on television and immediately other hairdressers wanted to meet me.

(Laughs) And that ordinary afternoon, I had the opportunity to introduce the entire beauty salon to the social changes taking place in my country.

LD: We traveled from India to East Africa, known for its intolerance towards LGBT people.

In Kenya, 89 percent of people who come out to their families are disowned.

Homosexuality is a crime and can result in imprisonment.

In Kenya, we met a soft-spoken Mr. David Clear.

David had a great mission to work for the poor and to improve his own government.

So he decided to run for the Senate.

He became Kenya's first openly gay political candidate.

David wanted to campaign without denying the reality of who he was.

However, we were concerned for his safety as he started receiving death threats.

(Video) David Clear: At that point, they were actually asking me to kill them, so it was really scary.

And yes, some do, but they feel they are fulfilling their religious obligations.

JC: David wasn't ashamed of who he was.

In the face of threat, he remained loyal.

LD: At the other end of the spectrum is Argentina.

Argentina is a country where 92 percent of the population consider themselves Catholic.

But Argentina has even more progressive LGBT laws than here in the United States.

In 2010, Argentina became the first country in Latin America and the tenth country in the world to introduce marriage equality.

There we met Maria Rashid.

Maria was the driving force behind the movement.

María Rashid (Spanish): I always say that the reality of marriage equality is not just for married couples.

These are for many people who, even if they never get married, will be viewed differently by their colleagues, family and neighbors than the national message of equality.

I am very proud of Argentina today because it is a model of equality.

And hopefully soon the whole world will have the same rights.

JC: I wish I could have shown my parents what I found there when I visited my ancestral land.

Because here are the people we met: (video) 1, 2, 3. Gay people, welcome to Shanghai!

(Laughter) The whole community of young and beautiful Chinese LGBT people.

Sure, they had their conflicts.

But they fought it out.

In Shanghai, I had the opportunity to speak with a local lesbian group, who told us their stories in broken Mandarin.

In Taipei, I saw another lesbian couple holding hands every time I took the subway.

Then I learned that Asia's largest LGBT pride event was being held just a few blocks away from where my grandparents live.

If only my parents knew.

LD: By the time we finished our not-so-linear trip around the world (laughs), we had traveled 50,000 miles and captured 120 hours of video footage.

We traveled to 15 countries and interviewed 50 supergays.

After all, finding them was not difficult at all.

JC: Yes, there are still tragedies on the bumpy road to equality.

And let's not forget that 75 countries still criminalize homosexuality.

But there are also stories of hope and courage in every corner of the world.

The final takeaway from our journey is that equality is not a Western invention.

LD: One of the key elements of this equality movement is momentum. The momentum that more and more people will fully embrace themselves and use every opportunity to change their part of the world, and the momentum as more and more countries find a model of equality with each other.

India pushed harder for Nepal to protect against LGBT discrimination.

When Argentina embraced marriage equality, Uruguay and Brazil followed suit.

When Ireland said yes equally (applause), the world paused and took notice.

When the U.S. Supreme Court makes a statement to the world that we can all be proud of.

(Applause) JC: When we reviewed our footage, we realized that what we were seeing was a love story.

It wasn't the love story I was expecting, but it was more freedom, adventure, and love than I could have imagined.

A year after we returned from our trip, marriage equality happened in California too.

And we believe love will win in the end.

(Video) By the authority given to me, the State of California, and Almighty God, I now declare you to be spouses for life.

You can kiss me

(applause)

This is the Air Jordan 3 Black Cement.

This may be the most important sneaker in history.

First released in 1988, this shoe marked the beginning of Nike marketing as we know it.

This is the shoe that propelled the entire Air Jordan lineage and probably saved Nike.

The Air Jordan 3 Black Cement did for sneakers what the iPhone did for phones.

It has been resold four times.

Every celebrity has been spotted wearing it.

There is a site about what to wear with Black Cement.

It's been in front of you for decades, but never looked down.

And now, most people are probably thinking, "Sneakers?"

(laughter) Yes.

Yes, sneakers.

Sneakers, data, some surprising things about Nike, and perhaps how they all relate to the future of all things online commerce.

The Jordan 3 Black Cement was last released in 2011, retailing for $160, but sold out worldwide within minutes.

That's because people were camping outside sneaker stores for days before the launch.

And minutes later, thousands of pairs were selling on eBay for double and triple the price.

In fact, four years later, there are over 1,000 pairs of shoes for sale on eBay.

But the problem is that this happens every Saturday.

With one, two, three releases every week, each shoe has a story as rich and compelling as the Jordan 3 Black Cement.

This is Nike and my daughter building a marketplace for sneakerheads.

(laughs) It's an "I love Dad" T-shirt.

For brands, sneakerheads are a very important demographic.

They are sense makers. They are Apple fanboys.

After all, who else would buy an $8,000 Back to the Future sneaker?

(Laughter) Yes, $8,000.

It's obviously an anomaly, but the sneaker resale market is by no means an anomaly.

It took 30 years to create a culture that started as an underground culture with a few people who love sneakers too much -- (Laughter) Now we have a sneaker addiction.

The market has resold more than 9 million pairs of shoes in the last 12 months in the US alone, worth $1.2 billion.

And this is a conservative estimate. You should know that I am a sneakerhead.

this is my collection.

My collection is not listed in the Hall of Fame of Great Collections.

I have about 250 pairs, but believe me, I'm small.

People have thousands.

I'm a typical 37 year old sneakerhead.

I grew up playing basketball when Michael Jordan was playing. I always wanted Air Jordans, but my mom never bought them. I bought Air Jordans as soon as I had the money. We literally all have the exact same story.

But here my thoughts diverged.

After starting three companies, I got a job as a strategy consultant and quickly realized I knew nothing about data.

But I learned because I had to, and I loved it.

So I wondered if I could get sneaker data for my own entertainment.

The goal was to develop a price guide, a view of the market based on real data.

And four years later, we've analyzed over 25 million transactions, providing real-time analytics on thousands of sneakers.

Now, sneakerheads are checking prices while camping for release.

Some are using the data to validate insurance claims.

And the world's top investment banks are now using resale data to analyze the retail shoe industry.

And here's the best part: Sneakerheads have a sneaker portfolio.

(Laughter) Sneakerheads can track the value of their collection over time, compare it to other collections, and access the same analytics as an online brokerage account.

So sneaker-loving Dan builds a collection and identifies which 352 is his.

He found it worth $103,000. It's a modest collection, frankly.

At the asset level, we can see the profit and loss per shoe.

Here he earned more than $600 for one pair.

i have one of them.

(Laughter) So you mean an unregulated $1.2 billion industry that thrived on the streets as much as it did online, creating basic financial services for sneakers?

At some point I asked myself what was really going on in the market and two comparisons emerged.

Are sneakers closer to stocks and drugs?

(Laughter) In fact, one man emailed me that he thought his 15-year-old son was selling drugs, but later found out he was selling sneakers.

(Laughter) And now they're doing it together with that data.

Because sneakers are an investment opportunity like no other.

We're not just talking about kids selling sneakers instead of drugs.

What about your children?

You must be 18 years or older to play on the stock market.

I sold chewing gum in 6th grade, Blow Pop in 9th grade, and collected baseball cards all through high school.

Cards are long gone and candy markets are usually very local.

For many, sneakers are a legitimate and accessible investment opportunity, a democratized but unregulated stock market.

The story you are probably most familiar with is why people kill each other over sneakers.

And while it will undoubtedly happen, and tragically, it's far from trendy as some media outlets would have you believe.

In fact, this is just one part of a much bigger and better story.

As such, sneakers have obvious similarities to both the stock exchange and the illegal drug trade, but perhaps the most fundamental is the presence of a central figure.

Someone is making the rules.

For sneakers, it's Nike.

Let's talk about some numbers.

The resale market as we know it is $1.2 billion.

Nike, including Jordan Brand, accounts for 96% of all shoes sold on the secondary market.

A complete domination.

Sneakerheads love Jordans.

And the profit on the secondary market is about a third.

So sneakerheads made $380 million selling Nike last year.

Let's move on to retail for a moment.

Skechers surpassed Adidas to become the nation's second-largest footwear brand earlier this year — a big deal.

And in the 12 months to June, Skechers made $209 million in net income.

This means that Nike's customers are almost twice as profitable as their closest competitors.

It's -- (Laughter) How is that even possible?

The sneaker market is just supply and demand, but Nike is very good at tapping supply, the limited number of sneakers, and distributing them for its own benefit.

So it's really just supply.

Sneakerheads joke that they would buy limited editions and Nike.

Because shoes that sell for $8,000 are extremely rare.

It's no different than any other collectibles market, but it's not a market at all.

It's a misconception created by Nike to sell more shoes, and it's engineered by Nike in the best of ways.

And in the process, I was able to give tens of thousands of people, myself included, a lifelong passion.

If Nike wants to kill the resale market, it could do so tomorrow. All they have to do is release more shoes.

But we don't want them to do that, nor is it in their best interest.

Unlike Apple, which sells iPhones to people who want them, Nike doesn't make money selling $200 sneakers.

They sell millions of shoes to millions of people for $60.

And sneakerheads are the ones who drive the marketing, hype, PR, and prestige of the brand so Nike can sell millions of $60 sneakers.

It's marketing.

This is marketing like you've never seen it before. This is not in any textbook.

For 15 years, Nike has been propping up the artificial goods market with big, Facebook-level IPOs every weekend.

If you drive past Footlocker at 8am on a Saturday morning, you'll find queues forming around the street and blocks, sometimes with kids waiting there all week.

You know that crazy iPhone line in the biennial news?

The Nike matrix occurs 104 times more frequently.

Nike set the rules.

And we do it by controlling supply and distribution.

But once a pair leaves the retail channel, it's the Wild West.

There are few, if any, legal and unregulated markets of this scale.

So Nike is definitely not a stock exchange.

In reality, there is no central exchange.

At my last count, there were 48 different online markets that I know of.

There are eBay clones, mobile marketplaces, consignment and brick-and-mortar stores, sneaker conventions and resale sites, Facebook, Instagram, Twitter, literally wherever sneakerheads come in contact with one another, shoes will be bought and sold.

But that means a loss of efficiency, transparency, and in some cases even credibility.

Can you imagine if stocks were being bought that way?

What if the way to buy Apple stock was to search 100+ places online and offline every time you walked down the street hoping to pass someone wearing Apple stock?

We don't even know who got the best price, or if the stock we're looking at is real.

With that said, I'm sure you'll say: [What do you mean?] Of course, that's not how we buy stocks.

But what if that doesn't mean buying sneakers?

What if the opposite was true and you could buy sneakers in exactly the same way you buy stocks?

And what if it wasn't just sneakers, but similar items like watches, handbags, women's shoes, collectibles, seasonal items, and discounted items?

What if there was a commercial stock market?

mono stock market.

And not only will you be able to buy in a more knowledgeable and efficient way, but you will also be able to participate in all the sophisticated financial transactions possible on the stock market.

Shorts, options, futures, and well, you might see where this is headed.

Maybe you want to invest in the stock market.

Because if you invested in the Air Jordan 3 Black Cement in 2011, you might have worn it on stage (laughter) or made 162 percent of your return. That's double the S&P and more than 20 percent of Apple's.

(Laughter) That's why we're talking about sneakers.

thank you.

(applause)

Somewhere in that vast universe, there must be countless planets teeming with life, so why haven't we found evidence?

Well, this is the famous question asked by Enrico Fermi in 1950. "Where is everyone?"

Conspiracy theorists claim that UFOs are always there and that the reports are just being covered up, but honestly that's not very convincing.

But it leaves a real mystery.

Last year, the Kepler Space Observatory discovered hundreds of planets around nearby stars, and extrapolating that data makes it appear that there may be 5 trillion planets in our galaxy alone.

Even if 1 in 10,000 could sustain life, there are 50 million potentially life-sustaining planets here in the Milky Way galaxy.

So here is the mystery.

The myriad other planets in our galaxy must have formed billions, or indeed millions of years earlier than they did on Earth, and were given the chance to give birth to life.

If only a few of them gave birth to intelligent life and began to create technology, those technologies would have grown in complexity and power over millions of years.

On Earth, we have seen how dramatically technology can accelerate in just 100 years.

Millions of years later, intelligent alien civilizations might have easily spread across the galaxy, producing giant energy-harvesting artifacts, colonizing fleets of starships, or brilliant works of art that filled the night skies.

At the very least, it would appear that they are revealing their presence through some electromagnetic signal, intentionally or not.

However, no convincing evidence for that has yet been found.

Well, there are many possible answers, some of which are very dark.

Perhaps a single superintelligent civilization has actually taken over the galaxy, imposing strict radio silence for paranoid reasons on potential competitors.

It just sits there ready to wipe out any threat.

Or maybe they're just not that intelligent.

Or perhaps the evolution of intelligence capable of producing advanced technology is much rarer than we assume.

After all, it's something that only happens once every four billion years on Earth.

Maybe even that was incredibly lucky.

Perhaps we are the first such civilization in the galaxy.

Or perhaps civilization harbors the seeds of its own destruction through its inability to control the technologies it creates.

First of all, we haven't looked into it that hard, and we're spending a pathetic amount of money on it.

Only a handful of the stars in our galaxy have been probed for interesting signal signatures.

And maybe we're not on the right track.

Perhaps as civilization develops, we will soon discover communication technologies far more sophisticated and useful than electromagnetic waves.

Perhaps all the action takes place in the recently discovered mysterious dark matter or dark energy, which seems to make up most of the mass of the universe.

Perhaps an intelligent civilization will come to realize that life is, after all, nothing more than complex patterns of beautifully interacting information, which can happen more efficiently on a smaller scale.

So, just as our clunky stereo systems have shrunk into beautiful little iPods on Earth, perhaps intelligent life itself has miniaturized itself to reduce its impact on the environment, so maybe our solar system is teeming with aliens and we just don't realize it.

Well, okay, that's a crazy idea.

Aliens made me say that.

But it's nice when an idea seems to have a life of its own and it outlives its creator.

Well, within the next 15 years we may see real spectroscopic information from promising nearby planets, revealing just how life-friendly they are.

And on the other hand, SETI (Extraterrestrial Intelligence Exploration Agency) is now making its data available to the public, allowing millions of citizen scientists, perhaps including you, to rally the power of the crowd and join the search.

And here on Earth, amazing experiments are taking place to create life from scratch that may be very different from the DNA form we know.

All of this helps us understand if the universe is teeming with life or if it's really just us.

Both answers are awe-inspiring in their own way. Because the fact that we think, dream and ask these questions, even if we are alone, can turn out to be one of the most important facts about the universe.

The quest for knowledge and understanding never slows down.

it's not. The opposite is actually true.

The more you know, the better the world looks.

And what drives us forward is the crazy possibilities, the unanswered questions.

(music) When I'm on a long flight, sometimes I look at mountains and deserts and try to understand how vast the earth is.

Then I remembered that some of the objects we see every day are literally the size of a million Earths.

The Sun looks incredibly big, but in the big picture it's one of about 400 billion stars in the Milky Way galaxy, and on a clear night you can see it as a pale fog that spreads across the sky.

And things get even worse.

There are probably 100 billion galaxies our telescopes can detect, so if each star were the size of a grain of sand, the Milky Way alone would have enough stars to fill a 30-by-30-foot area of ​​a 3-foot-deep sandy beach with sand.

And the entire planet does not have enough beaches to represent the stars of the entire universe.

There are literally hundreds of millions of miles of beaches like this.

St. Stephen Hawking, Ph.D., that's a lot of stars.

But he and other physicists now believe there is an even more unimaginable reality.

So, first of all, the 100 billion galaxies within our telescopes are probably only a small fraction of the total.

The universe itself is expanding at an accelerating rate. Most of the galaxy is moving away from us so rapidly that the light from it may never reach us.

Yet our physical reality here on Earth is inextricably linked to a distant, invisible galaxy.

We can think of them as part of the universe.

They compose a single gigantic structure, obey the same laws of physics, and are all made of the same kinds of atoms, electrons, protons, quarks, and neutrinos that compose you and me.

But recent theories of physics, including one called string theory, tell us that there may be an infinite number of other universes with different kinds of particles, different properties, and constructed according to different laws.

Most of these universes could never sustain life and could come and go in nanoseconds, yet they combine to make up a vast multiverse of possible universes.

Up to 11 dimensions, featuring wonders beyond our imagination.

And the leading version of string theory predicts a multiverse consisting of up to 10 to 500 universes.

It's a number 1 followed by 500 zeros, and this number is so huge that every atom in the observable universe has its own universe, and every atom in all those universes has its own universe, and if you repeat that for two more cycles, you're still only a tiny fraction of the whole, or 1 in 1 trillion 100 billion.

But even that number is very small compared to another number, infinity.

Some physicists believe that the space-time continuum is literally infinite, containing an infinite number of so-called pocket universes with different properties.

how is your brain doing?

But quantum theory adds a whole new wrinkle.

So, while this theory has proven unquestionably true, it's puzzling to interpret it.

And some physicists think that the confusion can only be cleared up by imagining that vast numbers of parallel universes are being generated every second, and that many of these universes are actually very similar to the world we are in, containing multiple copies of you.

In such a world, you would graduate with honors and marry your dream partner.

In other cases, not so much.

Some scientists still call it "silly."

The only meaningful answer to the question of how many universes are there is only one.

And a few philosophers and mystics might argue that even our universe is an illusion.

As you can see, there is no consensus on this matter at this time, and we are not even close to it.

All we know is that the answer lies somewhere between zero and infinity.

Well, one more thing I know is that now is a really great time to study physics.

We may be experiencing the greatest paradigm shift in knowledge that humanity has ever experienced.

Religion is more than just belief.

It is power and influence.

And that impact affects us all every day, regardless of your own beliefs.

Despite the enormous impact of religion on the world today, we subject religion to a different standard of scrutiny and accountability than other sectors of society.

For example, today we would be outraged if a multinational organization, government, or corporation claimed that women could not sit on leadership boards, that no women could have decision-making authority, or that no women could handle financial matters.

There will be sanctions.

However, this is commonly practiced today in nearly every religion in the world.

We accept in religious life what we do not accept in secular life. I know that because I've been doing this job for 30 years.

I was the type of girl who grew up fighting all forms of sexism.

I played a game of pick-up basketball with the boys and inserted myself as well.

I said I was going to be the first female president of the United States.

I have fought for the Equal Rights Amendment, which has been void for 40 years.

I am the first woman on either side of my family to work outside the home and have a higher education.

I never accepted being excluded for being a woman, except for religion.

All that time, I was part of a very patriarchal Orthodox Mormon.

I grew up in a very traditional family.

I have eight siblings and a stay-at-home mom.

Actually, my father is a religious leader in the area.

And I grew up in a world where I believed my worth and place was to live by these rules I've known all my life.

Married as a virgin, he doesn't drink or smoke, he's always volunteering, and he's a good boy.

Some of our rules were strict, but you followed them because you loved people and you loved and believed in religion.

Everything about Mormons determined what you wore, who you dated and who you married.

It determined the underwear we wore.

I was a religious person who donated 10 percent of the money everyone I knew, myself included, to the church.

I donated 10 percent from document delivery and babysitters.

I was the kind of religious person who heard parents say to their children who were leaving for two years of missionary work that they would rather die than go home committing sins without honor.

I was a religious person whose children committed suicide every year for fear of coming out as gay to the community.

But I was also the kind of religious person who had friendships and instant mutual aid, no matter where in the world I lived.

This was my safe place. This is certainty and clarity about life.

I helped raise my young daughter.

That is why I have accepted without question that only men can be leaders, and that women cannot have divine spiritual authority on earth, which is called the priesthood.

And I tolerated discrepancies between men and women in operating budgets, disciplinary councils, and decision-making capacity, and gave them a free pass because I liked my religion.

Until I stopped and realized I had allowed myself to be treated as a man's real work support staff.

And I faced this contradiction within myself and worked with other activists within the community.

We have worked very, very hard over the last ten years.

The first thing we did was raise awareness.

You can't change what you can't see.

We started writing podcasts, blogs and articles.

I made a list of hundreds of ways men and women are unequal within their communities.

The next thing we did was build an advocacy organization.

We tried to do things we couldn't ignore, like wearing pants to church and trying to attend all-male gatherings.

These seem like simple things, but they cost us a lot as organizers.

we lost a relationship. we lost our jobs.

I received harassing emails on a daily basis.

We were attacked on social media and in national newspapers.

We received death threats.

We have lost our place within the community. Some of us have been excommunicated.

Most of us have been put on disciplinary boards and excluded from the communities we love. Because we wanted to make our community better, and we believed we could do it.

And I began to expect this reaction from my own people as well.

I know how it feels when you feel someone is trying to change you or criticize you.

But what completely shocked me was that throughout all of this work, I was bombarded with as much vitriol from the secular left as it was from the religious right.

And what my worldly friends didn't realize was this religious animosity, the phrase, "Oh, all religious people are crazy or stupid."

"Don't pay attention to religion."

"They will be homophobic and sexist."

What they didn't realize was that such hostility breeds religious extremism, not combats it.

Arguments like that don't work, and I know that because I remember someone telling me I was stupid for being a Mormon.

And what it caused me to do was protect myself and my people and all that we believe in, because we are not stupid.

Therefore, criticism and hostility did not work, and I did not listen to these arguments.

I still get angry when I hear these discussions because I have family and friends.

They are my people and I am the first to protect them, but the struggle is real.

How can you respect someone's religious beliefs while still holding them accountable for the harm or damage those beliefs may cause to others?

That's a tough question. There is no perfect answer yet.

My parents and I have been walking this tightrope for the last ten years.

they are intelligent people. They are lovely people.

And let me help you understand their point of view.

Mormons believe that after death, if we follow all the rules and follow all the rituals, we can be together again as a family.

And to my parents, the fact that I am now doing the simple thing of wearing a sleeveless top and showing my shoulders is that I am not worthy.

I can't be with my family forever.

But more than that, to me my brother died in a tragic accident at the age of 15 and something as simple as this means we can no longer be together as a family.

And my parents don't understand why something as simple as fashion or women's rights is the reason I can't see my brother.

That's the mindset we work with, and criticism doesn't change that.

So my parents and I have been walking this tightrope, explaining each other's positions and respecting each other while actually overruling each other's very basic beliefs by the way we live our lives, and it's been hard.

The way we have been able to do that is by getting past those defensive shells and really looking inside the soft insides of unbelief and faith, trying to respect each other while keeping boundaries clear.

Another thing they all didn't understand, secular left or atheist, orthodox or religious right, was why they care about religious activity.

I can't speak for the hundreds of people who say, "If you don't like religion, get out."

Why would you want to change that?

Because what is taught on the Sabbath leaks into our politics, health care policies, and violence around the world.

It seeps into educational, military, and financial decision-making.

These laws are legally and culturally codified.

In fact, my own religion has had a huge impact on this country.

For example, during Proposition 8, my church raised over $22 million to fight same-sex marriage in California.

Forty years ago, political historians would say that had it not been for Mormon opposition to the Equal Rights Amendment, the Equal Rights Amendment would have been included in the Constitution today.

How many lives did it affect?

And we can spend our time fighting each and every one of these tiny little laws and regulations, and ask ourselves why gender inequality is the default around the world.

Why such an assumption?

For religion not only produces the roots of morality, but the seeds of normalcy.

Religion can liberate or conquer, it can empower or exploit, it can comfort or destroy, but those who flip the balance on ethics and morality are often not the ones in charge.

Religion cannot be ignored or neglected.

we need to take them seriously.

But, as I said earlier, it's not easy to influence religion.

But I will tell you what my people did.

My group is small, hundreds of people, but I've made a big impact.

Now, for the first time, a photo of a woman is displayed next to a man in the hall.

Women are now allowed to pray in church-wide meetings, but previously they were not allowed to pray in general conference.

As of last week, in a historic move, three women were invited to serve on three governing boards that oversee the entire Church.

We have seen a shift in perception within the Mormon community that allows discussion of gender inequality.

We have opened up the space for more conservative women, despised or not, to step in and make real change, allowing the words “women” and “priesthood” to be uttered in the same sentence.

It never happened.

My daughters and nieces have inherited a religion that I never had and it is more equal and we have influence.

Standing in line to attend an all-male gathering was not easy.

There were hundreds of us and one by one we got to the door and were told 'sorry, this meeting is for men only' and we had to step back and watch as young men as young as 12 joined the meeting and were escorted past us all in line.

But none of the women in that line will forget that day, nor will any of the boys who passed us forget that day.

We are multinational corporations and governments and we would be outraged if that happened, but we are just a religion.

We are all part of a religion.

We cannot continue to look at religion that way. Because it doesn't just affect me, it affects my daughter, all your daughters, and what opportunities they have, what they can wear, who they can love and marry if they have access to reproductive medicine.

We need to restore morality in a secular context that creates ethical oversight and accountability for religion around the world, but in a respectful way that creates cooperation, not extremism.

And we can do that through the courageous actions we cannot ignore, standing up for gender equality.

Now is the time for half the world's population to have a voice and equality in religions, churches, synagogues, mosques and shrines around the world.

I work on my subordinates. what are you doing for you

(applause)

How many times can you fold a piece of paper?

Suppose you have very fine paper, such as you normally use to print your Bible.

It actually looks like silk.

To evaluate these ideas, let's say you have a piece of paper that is 1/1,000th of a centimeter thick.

This is 10 to the power of minus 3 centimeters, or .001 centimeters.

Also, let's assume you have a large piece of paper, like a single page of a newspaper.

Now start folding it in half.

And one more question. If you could fold a piece of paper any number of times, say 30 times, imagine how thick it would be?

Before moving on, I encourage you to really think about the possible answers to this question.

OK。

Once the paper is folded, it is two thousandths of a centimeter thick.

Fold this in half again and the paper will be 4/1000 centimeters.

Each fold doubles the thickness of the paper.

And if you keep folding in half all the time, after 10 folds, you'll be faced with the following situation.

2 to the 10th power, or 2 multiplied 10 times, is 24 thousandths of a centimeter, which is just over a centimeter.

Suppose you keep folding the paper in half.

What happens then?

Folding it 17 times gives it a thickness of 2 to the 17th power, or 131 centimeters, or just over 4 feet.

If it could be folded 25 times, it would be 2 to the 25th power, or 33,554 centimeters, or just over 1,100 feet.

It's worth stopping here and thinking for a moment.

If you fold a piece of paper in half, even if it's as thin as a Bible, when you fold it 25 times, it's almost 400 meters.

what do we learn?

This type of growth is called exponential growth. As you can see, you can reach very quickly and farther just by folding the paper.

In summary, if the paper is folded 25 times, it will be almost 400m thick.

After 30 iterations, the thickness reaches 6.5 miles, which corresponds to the average height at which an airplane flies.

A thickness of 40 times is almost 7,000 miles, or the orbit of an average GPS satellite.

48 times, its thickness is well over a million miles.

Now, assuming the distance between the Earth and the Moon is less than 250,000 miles, it takes 45 folds of the Bible paper to get to the Moon.

Then double it again and it will return to Earth.

My wife is pregnant with her first child now, and when I see her big baby, almost always the first question I ask is "Is it a boy or a girl?"

Now, behind that question are some assumptions that we take for granted due to our familiarity with human biology.

We take for granted that there is a 50/50 chance that a human baby will be either a boy or a girl.

But why?

Well, the answer depends on the sex determination system that evolved for our species.

As you know, in most mammals, the baby's sex is genetically determined by the XY chromosome system.

Mammals have a pair of sex chromosomes, one inherited from the mother and one from the father.

Combining two Xs produces a girl, and combining X and Y produces a boy.

Gender is determined by the father, with a 50/50 chance of being born male or female, as females only have X, which is inherited in the egg cell, and males can give either X or Y in the sperm cell.

This system works well in mammals, but through the tree of life we ​​can see other systems that work equally well in other animals.

There are other groups of animals that make genetic sex determinations as well, but their systems can be quite different from ours.

Birds and some reptiles are genetically sexed, but not by the father, but by the mother.

In those groups, males are born from a pair of Z sex chromosomes, so these males carry Z only.

However, in these animals, one Z and one W chromosome pair to give rise to females.

In this system, the odds of male or female are still 50/50, depending on whether the mother puts a Z or a W in the egg.

Certain groups are taking genetic sex determination in a completely different direction.

For example, ants have one of the most interesting systems for determining gender. That's why male ants don't have fathers.

In ant colonies, there is a dramatic division of roles.

There are soldiers guarding the colony, there are workers gathering food, cleaning nests and tending young, and there are queen bees and a small group of male genitalia.

Now, the queen bee mates and stores the male's sperm.

And this is where this system is really interesting.

When the queen bee uses stored sperm to fertilize an egg, the egg grows into a female.

However, if an egg is laid without fertilization, that egg will grow into an ant, but will always be male.

In other words, it is impossible for a male ant to have a father.

And male ants live their lives like this, with only one copy of every gene, like walking sex cells.

This system is called the haploid system and is found not only in ants but also in other highly social insects such as honey bees and wasps.

Since our own sex is genetically determined, and we know other animals whose sex is genetically determined, it is easy to assume that for all animals the sex of the baby should also be genetically determined.

However, depending on the animal, whether it becomes a boy or a girl has nothing to do with genes, and may be affected by things such as the weather.

These are animals like crocodiles and most turtles.

In these animals, temperature determines the gender of the embryo in the developing egg.

In these species, the baby's sex is not yet determined at the time the eggs are laid, and remains so until the critical period, midway through the entire developmental period, is reached.

And during this period, the sex is completely determined by the temperature inside the nest.

For example, in painted turtles, warmer temperatures above the critical temperature will produce females in the eggs, and lower temperatures will produce males.

I don't know who came up with this mnemonic, but when it comes to painted turtles, remember they're all charming chicks and cool dudes.

For some tropical fish, the question of whether it will be a boy or a girl is not resolved until later in life.

Clownfish are born male, but grow to be female.

They also spend their lives in small groups with strict dominance hierarchies, where only the most dominant males and females reproduce.

And surprisingly, when the dominant female in the group dies, the larger and most dominant male quickly becomes a female to take her place, while all other males move up one rank in the hierarchy.

In the case of another very different marine animal, the green spoonbill, the gender of the baby is determined by a completely different aspect of the environment.

For this species, it only matters where the larvae randomly drop on the ocean floor.

When the larvae land on the open sea floor, they become females.

However, if you ride on a female, it will become a male.

Therefore, for some species, the question of boy or girl is answered by genetics.

For others it is answered by the environment.

And even then, some people aren't interested in the question at all.

Consider the whiptail lizard, for example.

For desert lizards, the answer is simple.

it's a girl It's always been a girl

They are almost all female species and still lay eggs, but these eggs hatch female clones of themselves.

Now, will it be a girl or a boy?

Throughout the animal kingdom, practically everything depends on the sex determination system.

For humans, that system is the genetic XY system.

And for me and my wife, the baby turned out to be a boy.

Why do we cringe when we hear "Shakespeare"?

If you ask me, it's mostly because of his words.

All these thou and thou, and therefore, and therefore thou, can be no small nuisance.

But one has to wonder why he is so popular.

Why have his plays been written and remade more often than any other playwright?

It's because of his words.

In the late 1500s and early 1600s, it was the best tool man had and there was a lot to talk about.

But most of them were pretty depressing.

Same with the Black Death.

Shakespeare uses a lot of words.

One of his most impressive achievements is his use of insults.

They will unite the entire audience. And no matter where I sat, I could laugh at what was happening on stage.

Words, especially dialogue in drama settings, are used for a variety of purposes, such as to set the mood of a scene, to give atmosphere to a setting, and to develop relationships between characters.

Insults do this in a very short and sharp way.

Let's start with "Hamlet".

Just before this dialogue, Polonius is the father of Ophelia, who is in love with Prince Hamlet.

King Claudius is trying to figure out why Prince Hamlet has been acting so mad since the king married Prince Hamlet's mother.

Polonius offers to use his daughter to get information from Prince Hamlet.

Then we enter act two, scene two.

Polonius: "Lord, do you know me?"

Hamlet: "I'm glad you're a fishmonger."

Polonius: "Not me, sir."

Hamlet: "Then I wish you were so honest."

Now, even if you don't know what "fishmonger" means, you can still use the contextual clues.

1: Polonius reacted negatively, so it must be bad.

2: Fish must be bad because it stinks.

And third, I don't think the word "monger" is a very good word.

I mean, we're starting to build characterizations about the relationship between Hamlet and Polonius out of things that don't even make sense, and it wasn't good.

But if you dig a little deeper, "fishmonger" means a broker of sorts, and in this setting it means something like a pimp. It's like Polonius brokering his daughter for money, and he's doing it for the king's favor.

This proves that Hamlet isn't as crazy as he claims, and the animosity between the two characters intensifies.

Need another example?

"Romeo and Juliet" contains some of the best insults of Shakespeare's play.

This is a play about two gangs and lovers who are destined to take their own lives.

Well, in any fist fight, you know there's some serious fist talk going on.

and you won't be disappointed.

Act I Scene 1 shows from the outset the level of mistrust and hatred faced by members of two families: the Capulet and Montague families.

Gregory: "Frown your brows when you pass by and let them take what they list."

Sampson: "No, if they dare, I'll bite them the thumb, but if they put up with it, it's a shame on them."

Abraham and Balthazar appear.

Abraham: "Are you going to bite us thumbs, sir?"

Sampson: "I bit my thumb, doctor."

Abraham: "Are you going to bite us thumbs, sir?"

So how does this development help us understand moods and personalities?

Well, let's break it down into insults.

Biting your thumb might not seem like a big deal today, but Sampson says it's an insult to them.

If they think so, it must have been one.

This is beginning to show a level of animosity even among the men who work for both houses.

And normally you wouldn't do anything to someone unless you want them to get into a fight, but that's exactly what's about to happen.

Looking deeper, biting your thumb in the era when this play was written is like giving someone a finger today.

I'm starting to feel the tension on set right now, as it involves quite strong emotions.

Later in this scene, Capulet Tybalt says nice things to Montague Benvolio.

Tybalt: What, have you been drawn into these heartless bastards?

Benvolio, turn around and watch your death. ”

Benvolio: "I only keep the peace. Raise your sword or you can pull these men away from me."

Tybalt: What are you drawing to talk about peace!

I hate that word the same way I hate hell, the whole Montague family, and you.

Please, you coward! ”

Now, heartless doe.

Again, I know it's not a good thing.

Both families hate each other, but this only adds fuel to the fire.

But how bad is this needle?

A ruthless doe is a coward, and to call someone that way in front of one's men or hostile families means a fight is about to break out.

Tybalt basically summons Benvolio and Benvolio has to fight to protect his honor.

This conversation gives us a good sense of the characterization between these two characters.

Tybalt sees the Montagues as just cowardly dogs and has no respect for them.

Once again, it adds dramatic tension to the scene.

Well, spoiler alert here.

Tybalt's short temper and deep hatred of the Montagues are what we literary people call his Hamartia, or the cause of his downfall.

Oh yes.

He falls at the hands of Romeo.

So when you're watching Shakespeare, stop and look at the words. Because Shakespeare is really trying to tell us something.

Which is correct: "There are 12 eggs"? Or "A dozen eggs?"

When I was in elementary school, I remember my teacher talking extensively about this unit.

One day I went to the grocery store and wanted to buy apples, but I couldn't buy any apples.

I had to buy a whole bag of apples.

So I did. I bought a bag of apples, brought it home, took an apple out of the bag and cut it.

and ate a piece.

Which of these is the real "one"?

Of course they all are, and that's what my elementary school teachers were trying to tell me.

Because that's the key idea behind integer digit values, decimal digit values, and fractions.

Our integer system relies on being able to change units.

There are two ways to change the units.

It can be composed, it can be divided.

When you build a unit, you take lots of things and combine them to make something as big as 12 eggs.

Collect 12 eggs to form a group and call the group a dozen.

12 eggs are the building blocks.

Other examples of constituent units include playing cards, a pair of shoes, a jazz quartet, and of course the Barbie and Ken couple.

But think about a loaf of bread.

This is not a cohesive unit. Because you don't get a bunch of slices from different bakeries and combine them to make bread.

No, you start with a loaf of bread and cut it into small pieces called slices. So each slice of bread becomes a divided unit.

Other examples of segmented units include square chocolate bars, orange slices, and pizza slices.

The important thing about units is that once you create a new unit, you can treat it like an old unit.

You can compose composite units or split split units.

Think about the pastries you make in your toaster.

Supplied in packs of 2, these packs are assembled into sets of 4 to form a box.

So when I buy a box of toaster pastries, do I buy one, four, or eight?

Varies by unit.

1 box, 4 packs, 8 pastries.

And when you share a slice of pizza with a friend, you have to cut "it" into two smaller pieces.

So a toaster pastry box is made up of made up units, and when you split a slice of pizza, you're going to split the made up units.

But what does that have to do with mathematics?

In mathematics, everything is certain.

2 + 2 is equal to 4 and 1 is just 1.

One is not always one.

Here's why. Start counting from 1 and count to 1, 2, 3, 4, 5, 6, 7, 8, 9 and 9. and reach 10. To write 10, write 1 and 0.

The 1 means there is 1 group, and the zero is a good reminder that it means 1 group, not 1 thing.

But 10 is a unit, just like 1, just like 12 eggs, just like 1 egg.

And 10 of 10 becomes 100.

Is 100 one thing, 10 things, or 100 things?

It depends on what "1" is and what the units are.

A person exists no matter where he is or how many things he represents.

Have you ever wondered what animals think and feel?

Let's start with the question: does my dog ​​really love me or does he just want a treat?

Well, it's easy to see that our dog really loves us. It's easy to understand what's going on in that hazy little head.

what's going on?

something is happening

But why do they always love us?

Why are we always talked about?

Why are we so narcissistic?

I found another question to ask animals.

who are you?

The human mind has a capacity that we tend to think of as a capacity that only the human mind has.

But is it true?

What are other beings doing with their brains?

What are they thinking and feeling?

Any way to know?

I believe there is a way in.

I think there are several ways to enter.

We can observe evolution, we can observe their brains, we can observe what they are doing.

The first thing to remember is that our brains are genetic.

The first neurons were born from jellyfish.

Jellyfish gave rise to the first chordates.

The first vertebrates gave rise to the first vertebrates.

Vertebrates came out of the ocean and here we are.

But it is still true that neurons, nerve cells, look the same in crayfish, birds and humans.

What does it say about the crayfish heart?

can you tell me something about that?

It turns out that giving a crayfish a series of small electric shocks every time it tries to get out of its burrow induces anxiety in the crayfish.

Giving crayfish the same drugs used to treat anxiety disorders in humans will make them relax and get out and explore.

How can you show how much you care about crayfish anxiety?

Most of the time it is boiled.

(Laughter) Octopuses use tools like most apes and recognize human faces.

How can we celebrate the ape-like intelligence of this invertebrate?

Mostly boiled.

When a grouper chases a fish into a coral crevice, it may go where the moray eel knows it is sleeping, signaling the moray eel to "follow me," which the moray eel understands.

A moray eel may crawl into the crevice and catch a fish, but a fish may bounce and a grouper may catch it.

This is an old partnership and we only recently learned about it.

How should we celebrate that ancient partnership?

mostly fried.

A pattern is emerging that says more about us than they do.

Sea otters use tools to teach their babies what to do outside of what they are doing, which is called "teaching."

Chimpanzees don't teach.

Killer whales teach, killer whales share food.

When Evolution builds something new, it uses off-the-shelf stock parts before adding a new twist.

And our brains have reached us through a vast stream of time.

Comparing the human brain to the chimpanzee brain shows that our brain basically has a very large chimpanzee brain.

Our size is a good thing. Because we are also really worried.

(Laughter) But, oh, there are dolphins. A bigger brain with more convolutions.

OK, so you probably want to say, okay, we're looking at the brain, but what does that mean about the mind?

Well, from the logic of action we can see how the mind works.

These elephants are clearly resting.

They find shade under a palm tree and put the baby to sleep under it, while he dozes off and stays alert.

We fully understand the image, just as we fully understand what they are doing. For under the same arc of the sun on the same plain, hearing the same howl of danger, they became them and we became us.

We have been neighbors for a very long time.

No one would mistake this elephant for being relaxed.

They are obviously very worried about something.

what are they worried about?

It turns out that if you record the voice of a tourist and play the recording through a speaker hidden in a bush, the elephant ignores it because the tourist doesn't bother them.

But recording the voices of nomadic herders carrying spears and frequently injuring elephants in collisions in the water would cause them to band together and escape the hidden speakers.

Elephants not only know that there are humans, they know that there are different kinds of humans, and that some are okay and some are dangerous.

They have been watching over us for far longer than we have been watching over them.

They know us better than we do.

We have the same obligation. Take care of your baby, find food and try to survive.

Whether we are geared up for hiking in the African hills or geared up for underwater diving, we are basically the same.

We are relatives under the skin.

Elephants have the same skeleton, and killer whales have the same skeleton as us.

We ask for help where we need it.

Young people are curious.

You can see family ties.

we recognize affection

Courtship is courtship.

Then ask, "Are they conscious?"

General anesthesia will make you unconscious and you won't feel anything.

Consciousness is simply something that feels like something.

If you see, if you hear, if you feel, if you are aware of something, you are conscious and they are conscious.

People often say that there are several things that make humans human, and one of them is empathy.

Empathy is the mind's ability to match the moods of its peers.

It's very convenient.

When my friends start moving quickly, I feel like I have to hurry too.

We are all in a hurry now.

The oldest form of empathy is contagious fear.

It's not very effective to say, "Hmm, why did they all leave?" if they suddenly startled and flew away.

(Laughter) Empathy is old, but like everything else in life, empathy manifests and details on a sliding scale.

So there is basic empathy. When you feel sad, I feel sad too.

Seeing you happy makes me happy too.

Then there's what I call sympathy, a little further away. "I am sorry to hear that your grandmother passed away.

I don't feel the same sadness, but I get it. I know how you feel and it worries me too. ”

And when we are motivated to act on empathy, I call it compassion.

Human empathy is far from perfect, let alone what makes us human.

We catch empathic creatures, kill them, and eat them.

Now, you might say, "OK, well, those are different species."

It's just predation and humans are predators.

But we don't treat our own race very well.

Even those who seem to know only one thing about animal behavior know that we cannot blame other species for our thoughts and feelings.

Well, I think that's stupid. Because blaming other species for human thoughts and feelings is the best way to infer what they are doing and how they are feeling. Because their brains are basically the same as ours.

they have the same structure.

The same hormones that produce our mood and motivation are also present in those brains.

It's unscientific to say they're hungry when they're hunting, or tired when they're sticking out their tongues, but when they're playing with children and looking happy and having fun, I don't know if it's possible they're experiencing anything.

It's not scientific.

So a reporter said to me, "Perhaps, but how do you actually know what other animals can think and feel?"

And when I started going through all the hundreds of scientific references in the book, I realized the answer was in my room.

When my dog ​​got off the rug, came over to me instead of the couch, and lay on his back, baring his belly, she thought,

If I go to Carl, he'll understand what I'm looking for.

We are family and I know I can trust him.

He will get the job done and it will feel good. ”

(Laughter) She's been thinking and feeling, but it doesn't get more complicated than that.

But we look at other animals and say, "Oh, killer whales, wolves, elephants, they don't see it that way."

That tall finned male is L41.

he is 38 years old.

The woman to the right of his left is L22.

she is 44 years old.

They've known each other for decades.

they know exactly who they are.

They know who their friends are.

They know who their rivals are.

Their lives follow a career arc.

they always know where they are.

This is an elephant named Philo.

he was a young man

This is him 4 days later.

Humans not only feel sorrow, they also create so much sorrow.

We want to carve their teeth.

Why can't we wait for them to die?

Elephants once lived from the shores of the Mediterranean to the Cape of Good Hope.

In 1980, Central and East Africa had vast bases of elephant range.

And now their range is shattered into small pieces.

This is the geography of the animals we are driving to extinction, the most amazing creatures on land.

Of course, in the United States, wildlife care is much more important.

In Yellowstone National Park, we killed every single wolf.

In fact, we killed every wolf south of the Canadian border.

But at this park, park rangers did just that in the 1920s, and 60 years later the moose had to be brought back because the numbers were out of control.

And then people came.

Thousands of people flocked to see the world's most approachable wolf.

And I went there and saw this incredible family of wolves.

Pack is family.

There are breeding adults and several generations of juveniles.

And I have observed the most famous and most stable populations in Yellowstone National Park.

And when they wandered just outside the border, two of the adults were killed, including their mother, sometimes called Alpha Mess.

The rest of the family soon descended into sibling rivalry.

A sister kicked out another sister.

The woman on the left tried for days to get back to her family.

They were jealous of her and did not forgive her.

She was getting too much attention from the two new men, but she was a precocious man.

It was too much for them.

She ended up wandering outside the park and was shot.

This alpha male was eventually banished from the family.

As winter approached, he lost his territory, hunting support, family and spouse.

We are causing them a lot of pain.

The mystery is why they don't hurt us more than they do.

This whale had just eaten part of a gray whale along with the mate who killed it.

The people on the boat had nothing to fear.

This whale is T20.

He and two of his companions had just finished tearing the seal into three pieces.

The seals weighed about the same as the people on the boat.

They had nothing to fear.

they eat seals.

why don't they eat us?

Why can we trust them around young children?

Why did a killer whale return to a researcher lost in heavy fog and lead them for miles until the fog lifted and they found the researcher's home just down the coastline?

And it happened more than once.

There is a woman in the Bahamas named Denise Herzing. She studies spotted dolphins and they know her.

She knows them well. she knows who they all are.

they know her They recognize the research vessel.

When she shows up, it's a very happy reunion.

Only once did they show up and they wouldn't go near the boat. It was really weird.

And I didn't understand what was going on until someone came out on deck and announced that one of the crew had died while napping in the bunk.

How could the dolphins know that one of the human hearts had stopped?

why would they care?

And why would it scare them?

These mysteries only hint at all that goes on in our minds on earth that we have almost never thought about.

There was a tiny baby bottlenose dolphin named Dolly in an aquarium in South Africa.

She was breastfeeding, but one day the keepers were taking a cigarette break and she was smoking while looking out the window at the pool.

Dolly came over and saw him, ran back to his mother, nursed him for a minute or two, and returned to the window releasing a cloud of milk, wrapping his head like smoke.

Somehow, this bottle-nosed dolphin came up with the idea of ​​using milk to represent smoke.

When humans use one thing to represent another, we call it art.

(Laughter) What makes us human is not what we think we are.

What makes us human is that of all these things in our minds and their minds, we are the most extreme.

We are the most benevolent, the most violent, the most creative, the most destructive animals that have ever lived on earth, all mixed together.

But love is not what makes us human.

It's nothing special for us.

We're not the only ones who care about our peers.

We are not the only ones who care about our children.

Albatrosses often fly 6 kilometers, sometimes 10,000 miles, over several weeks to deliver a single meal to waiting chicks.

They nest on the most remote islands in the oceans of the world, and here they are.

Passing life from one generation to the next is a chain of existence.

When it stops, everything disappears.

If something is sacred, then in that sacred relationship comes our plastic waste.

All these birds have plastic in them.

This was a six-month-old albatross, ready to leave the nest, stuffed with a red lighter and dead.

This is not the relationship we should have with the rest of the world.

But we, named after our brains, never think about the consequences.

When we welcome new human life into the world, we welcome our babies into the company of other creatures.

We paint pictures of animals on the walls.

We do not paint mobile phones.

We do not paint workshops.

We draw animals to show that we are not alone.

we have friends

And all the animals deemed worthy of salvation, depicted in all the paintings of Noah's Ark, are now in mortal danger, and their flood is us.

So we started with the question: Do they love us?

I will ask another question.

Can we use something that requires our full attention to just let it continue?

thank you very much.

(applause)

Meet our chemist, Harriet.

She has chemistry that needs to happen faster.

A chemist has several processes at her disposal to speed up reactions, and she knows five ways.

And to remember them, she reminisces about her time in high school and the day she made a dance date appointment.

She lost track of time and was about to be late for class.

Before she knew it, Harold, who was right around the corner, was almost late.

They both sprinted to class, coincidentally sprinting to each other.

Now, this was no small conflict.

They ran headlong into each other and he knocked the book out of her hands.

He kindly helped her reassemble her belongings and politely offered to walk her to class.

And you'll never guess who went to the dance with them later that year.

As you can see from this example, the key to scheduling the dance is to bump into someone and knock the book out of your hand.

Now, thankfully, you probably already know that not all conflicts lead to dance dates.

Collisions must have two important characteristics. One is the correct orientation that allows the book to fall out of your hand. And two, enough energy to knock out a book.

Shortly after this incident, Harriet decided to tell me, her chemistry teacher, the whole story.

I noticed some interesting parallels between her story and chemical kinetics. It happened to be what she was studying in the hallway on the day of the crash.

Harriet wanted to help all chemistry students and chemists learn how to speed up chemical reactions. And being a nice person, I decided to make it my mission to help create an educational environment in which more book-dropping clashes would occur in order to increase the chances of future chemists joining dance dates.

To facilitate this improved dance date acquisition process, we propose five similar changes to five ways to increase Harriet's chemical reaction rate for all schools.

First, I would suggest reducing the size of the corridor.

This makes it more difficult to navigate safely through corridors and can cause more collisions than wider corridors.

And increasing the number of collisions increases the likelihood that some of those collisions will have the correct alignment and enough energy to create a dance date.

Now, chemically speaking, this is equivalent to reducing the volume of the reaction vessel or reaction mixture.

Doing so brings the individual particles closer together, resulting in more collisions.

The more collisions there are, the more likely collisions will occur with the right energy and configuration.

Then I propose to increase the population of the entire school.

More students means more conflict.

Creates an environment where more collisions can occur by increasing the number of particles available for collision.

Third, we must reduce the time allowed between classes. Well, let's cut it in half.

In doing so, students have to move more quickly to move from one class to the next.

This speed increase helps give the collision just the right amount of energy needed to reliably drop the book.

This is analogous to raising the temperature of the reaction mixture.

The higher the temperature, the faster the particles move.

Particles moving faster means more energy, which means more chance of collisions to trigger a reaction.

Fourth, students should refrain from traveling in groups.

By traveling in groups, students on the outside of the group protect students in the center from collisions.

By splitting, each student has more exposed areas for collisions with passing students.

When particles move in packs, the surface area is very small and only the outer particles collide.

However, breaking the agglomerate into individual particles increases the total surface area and exposes the surface of each particle for reaction.

Is this clash and book fall too violent?

Then matchmakers help with this.

Matchmakers coordinate matchmaking to make it easier for couples to form.

Our matchmakers are like catalysts.

Chemical catalysts work by lowering the activation energy, i.e. the energy required to initiate a reaction.

This is achieved by gathering two particles together and orienting them correctly in space so that they meet in the correct arrangement and the reaction takes place.

In summary, if a future chemist wants to schedule a dance, he has to knock the book out of his hand by colliding with others.

And if a chemist wants a chemical reaction to occur, the particles must collide in the right direction with the right amount of energy.

And both of these processes can be sped up using the five methods we've discussed so far.

Suppose you are on the beach and you have sand in your eye.

How do you know there is sand there?

Although apparently invisible, normal, healthy humans can experience extreme discomfort, also known as pain.

Now, pain makes me do something, but in this case, rinse your eyes until the sand is gone.

And how will we know when the sand is gone?

that's right. Because there is no more pain.

Some people feel no pain.

It may sound cool, but it's not.

If you can't feel pain, you may hurt or hurt yourself without even realizing it.

Pain is the body's early warning system.

It protects you from the world around you and from yourself.

As we grow, we attach pain-sensing devices to most parts of our bodies.

These detectors are specialized nerve cells called nociceptors that extend from the spinal cord to the skin, muscles, joints, teeth, and some internal organs.

Like all nerve cells, they carry electrical signals and send information back to the brain wherever they are located.

But unlike other nerve cells, nociceptors only fire when something happens that can or is causing damage.

So, gently touch the tip of the needle.

You will feel the metal and those are your normal nerve cells.

But I feel no pain.

Now, the harder you push the needle, the closer you get to the nociceptor threshold.

If you press hard enough, nociceptors will fire when that threshold is crossed, telling your body to stop whatever you're doing.

However, the pain threshold is not fixed.

Certain chemicals can modulate nociceptors and lower the pain threshold.

When a cell is damaged, that cell and other nearby cells start producing these regulatory chemicals like crazy, lowering the nociceptor threshold to a level that causes pain at the touch.

And this is where over-the-counter pain relievers come into play.

Aspirin and ibuprofen block the production of one class of these regulatory chemicals called prostaglandins.

Let's see how they do it.

When cells are damaged, they release a chemical called arachidonic acid.

Two enzymes, called COX-1 and COX-2, convert this arachidonic acid to prostaglandin H2 and then other chemicals that increase body temperature, cause inflammation, lower the pain threshold, and more.

Now, all enzymes have an active site.

It is where the reaction within the enzyme takes place.

The active sites of COX-1 and COX-2 are very compatible with arachidonic acid.

As you can see, the space is tight.

Now, it is this active site where aspirin and ibuprofen act.

So they behave differently.

Aspirin acts like a porcupine's spine.

It enters the active site and is then cleaved, leaving half of itself there, completely blocking the channel and making it impossible for arachidonic acid to fit.

This permanently deactivates COX-1 and COX-2.

Ibuprofen, on the other hand, enters the active site but does not break down or alter the enzyme.

COX-1 and COX-2 are free to exhale it again, but while that ibuprofen is there, the enzyme cannot bind to arachidonic acid and carry out its normal chemical reaction.

But how do aspirin and ibuprofen know where the pain is?

Well, it's not.

Once the drug enters the bloodstream, it is carried throughout the body and reaches the painful area as it normally would.

This is how aspirin and ibuprofen work.

But pain also has another dimension.

For example, neuropathic pain is pain caused by damage to the nervous system itself. No external stimulation is required.

And scientists are discovering that it controls how the brain responds to pain signals.

For example, how much pain you feel depends on whether you pay attention to it and even how you feel.

Pain is an area of ​​active research.

If we can understand it better, we may be able to help people manage it better.

(music) The basic question is, does life exist outside of Earth?

Scientists called astrobiologists are now trying to figure it out.

Most astrobiologists are trying to figure out if there are microbes on Mars, in oceans beneath the frozen surface of Jupiter's moon Europa, or in liquid hydrocarbon lakes discovered on Saturn's moon Titan.

But one group of astrobiologists is working on SETI.

SETI is the Search for Extraterrestrial Intelligence, and SETI researchers are looking for evidence that intelligent life elsewhere has used technology to build transmitters of some kind.

But what are the chances of finding the signal?

There are certainly no guarantees when it comes to SETI, but something called the Drake equation, named after Frank Drake, can help organize your thoughts on what is needed for successful detection.

If you have worked with equations before, you would expect to have a solution to the equation, the correct answer.

But Drake's equation is different because there are so many unknowns.

There is no correct answer.

As we learn more about our universe and our place in it, the unknowns become better known, allowing us to extrapolate answers a little more accurately.

But until SETI succeeds, or Earthlings prove to be the only intelligent species in our part of the universe, there will be no clear answer to the Drake equation.

In the meantime, considering the unknown can be very helpful.

The Drake equation seeks to estimate the number of technological civilizations (we call this N) in the Milky Way galaxy. This is usually written as: N is equal to R-star multiplied by f-sub-p, n-sub-e, f-sub-l, f-sub-i, f-sub-c, and finally capital L.

Multiplying all these factors gives us an estimate of the number of technological civilizations we could potentially detect today.

R stars are the rate at which stars were born in the Milky Way galaxy over the past billion years, which is the number of stars per year.

Our galaxy is 10 billion years old, but early in its history stars formed at different rates.

All f factors are fractions.

Each must be less than or equal to 1.

F-sub-p is the fraction of stars with planets.

N-sub-e is the average number of habitable planets in any planetary system.

F-sub-l is the fraction of planets where life actually begins and f-sub-i is the fraction of all life forms that develop intelligence.

The F-sub-c is part of intelligent life that has developed a civilization that has decided to use some kind of transmission technology.

And finally, L -- the longevity factor.

How many years do those transmitters keep working on average?

Astronomers can now pretty much know what the product of the first three terms is.

We are now discovering exoplanets almost everywhere.

The part concerning life, intelligence, and technological civilization has been pondered by so many experts, but no one knows exactly.

So far, we know of only one place in the universe where life exists, and that's right here on Earth.

In the coming decades, as we explore Mars, Europa, and Titan, we will discover life of all kinds there, which means that the Milky Way galaxy is teeming with life.

Because if life originated twice in this one solar system, it would easily mean that life could arise elsewhere, given similar conditions.

So the number 2 is a very important number here.

Scientists, including those at SETI, tend to make very rough estimates in order to make progress, and recognize that these estimates are subject to very large uncertainties.

Both R-star and n-sub-e are numbers closer to say 10 than 1, and you know that all f factors are less than 1.

Some of them can be much less than 1.

But the largest unknown of all these unknowns is L, so perhaps the most useful version of the Drake equation is to simply say that N is approximately equal to L.

The information in this formula is very clear.

If L is not large, N will be small.

But you know, you can change that too.

In the near future, if SETI succeeds in detecting a signal after examining only a small subset of stars in the Milky Way, we know that L should be large on average.

Otherwise we wouldn't have been able to succeed so easily.

A physicist named Philip Morrison summarizes SETI as the archeology of the future.

This means that the speed of light is finite, so any detected signal from a distant technology tells us about its past by the time it reaches us.

But because L must be large for successful detection, we also learn about our future, and that we may have a particularly long future.

We have developed technology that can send signals into space and send humans to the moon, but we have also developed technology that can destroy the environment and wage war with weapons and bioterrorism.

In the future, will our technology stabilize the planet and its population, leading to a much longer lifespan?

Or will it destroy our world and its inhabitants with just a brief appearance on the cosmic arena?

It is recommended to consider the unknowns in this equation.

Why not make your own assumptions about these unknowns and see what you get for N?

Compare this with estimates made by Frank Drake, Carl Sagan, other scientists, or your neighbors.

Remember there is no right answer.

not yet.

Sea turtles are a miracle.

First, they have been around since the late Jurassic period, about 150 million years ago.

The sea turtle, a relative of the dinosaurs, has survived many years of hardship and continues to live even after many other animals have completed the evolutionary process.

Second, for centuries to this day, all living adult sea turtles have survived overcoming difficulties as a result of chance, skill and ability.

The challenges each sea turtle faces over its lifetime are: First, leathery, ping-pong-ball-sized eggs are laid in burrows dug by their mothers high on the beach, but of the 50 to 200 eggs laid, about 20 percent never hatch.

About a month and a half after being laid, when the surviving eggs hatch, palm-sized hatchlings squirm to the surface, emerging en masse from the sand and making a frantic dash out to sea.

Along the way, debris, pitfalls, crabs, seagulls, raccoons, and other threats will kill roughly 50 percent of those who crawl out of the sand.

Those who actually reach the wave trade one set of threats for another. First, they face the repulsive force of the waves, and then, as young turtles rise to the surface for air, they find a whole new set of predators waiting for them, including a variety of fish, dolphins, sharks, and seabirds.

During the first few days of life, weaker turtles swim forward frantically if they consider themselves part of the living turtles.

Eventually they will often try to settle on a piece of flotsam, preferably a piece of floating seaweed.

Over the next few months, they will try to avoid what they might eat, find what they can eat, and hold out against the pressures of harsh weather and unlucky currents.

Approximately 50% of those who reach the wave die at this stage.

Ultimately, as time progresses, surviving individuals grow from table size in the first year to table size after a decade or so in the case of at least one species of leatherback turtle.

Depending on the size, it comes with some means of protection.

Currently, the only predators of real concern are some large sharks, including bulls, tigers, white sharks, and the occasional killer whale.

Survivors reach breeding age at about age 20, continuing the cycle that their very existence tells them.

At least less than 10 percent of the individuals that were laid as eggs on distant shores are now surviving, but these are the odds before significant human intervention.

Over the past century, especially in recent decades, human efforts from coastal development to plastic litter, poaching, longlines, nets, and even toxic chemicals, including petroleum, have increased sea turtle survival rates, dropping them to less than about 1 percent per nesting cycle.

Adding to this human pressure, eight species of sea turtles are each endangered.

Because while they have evolved to overcome many obstacles, recent ones have come so quickly and on such a large scale that the species feels overwhelmed.

Let's briefly summarize this cycle of odds.

Using a hypothetical nesting season, females may nest 1,000 eggs multiple times per year.

1000 eggs were laid.

800 hatch.

400 reach the water.

200 Progression to adulthood.

Twenty survive to breeding season without human intervention.

Two survive to mating season despite human intervention.

In short, breeding adult sea turtles are the epitome of opportunity.

It's the exception, not the rule.

jackpot.

It's a miracle in the true sense of the word.

It was April 8th, 2003.

I was in Baghdad covering the Iraq War.

That day, American tanks began arriving in Baghdad.

We were a few journalists in a Palestinian hotel, and as is so often the case in war, fighting began to loom outside our window.

Baghdad was blanketed in black smoke and oil.

It smelled awful.

Of course, I was supposed to write an article, but that's what it always is -- when I'm supposed to be writing, something big happens.

So I was in my room on the 16th floor, writing and sometimes looking out the window to see what was going on.

Suddenly there was a big explosion.

In the past three weeks there have been Halfton missile bombardments, but this time the impact was felt inside me and I thought "very close."

So I went down to see what was going on.

I went up to the 15th floor and saw it.

And I saw journalists and people screaming in the corridors.

Upon entering the room, I realized that a missile had been shot.

someone was injured.

Near the window, a man named Taras Protzyk, a photographer, was lying face down.

I used to work at a hospital, so I wanted to help in some way.

So I turned him over.

And when I turned him over, I found that it was open from his sternum to his pubic bone, but I couldn't see anything, I couldn't see anything at all.

All I saw was blinding white, pearly specks, and I had no idea what was going on.

Once the spots had cleared and we could see that his wounds were very serious, my friend and I put a sheet under him and carried him up the elevator that stopped at each of the 15th floor.

We put him in the car and took him to the hospital.

He died on his way to the hospital.

Spanish photographer Jose Cuso, who was on the 14th floor, also died on the operating table when a shell exploded between the two floors.

We returned as soon as the car left.

There was an article I was supposed to write, I had to write.

So when I returned to the hotel lobby with blood on my arm, one of the hotel patrons stopped me and asked me to pay the taxes I hadn't paid in 10 days.

I told him to get lost.

And I said to myself, 'Clear your head and put everything aside.

If you want to write, you have to put everything aside. ”

And that's what I did.

I went upstairs, wrote an article and sent it.

After that, apart from the feeling of losing my colleague, something else bothered me.

I kept looking at those shiny pearly specks, but I couldn't understand what they meant.

And the war is over.

Afterwards I thought: "It can't be. We have to know what happened."

It wasn't the first time it happened, and it wasn't the only thing that happened to me.

I have seen similar things happen to others in my 20-35 years of coverage.

I've seen things that have affected me too.

For example, there was a man I knew in Lebanon. He was a 25-year-old veteran who had fought for five years. A true veteran. We followed everywhere.

He would crawl through the darkness with confidence—he was a great soldier, a true soldier—and we followed him, confident that we would be safe with him.

And then one day, as I was told, I saw him again after that, but when he was back in camp playing cards, someone came next to him and fired a weapon.

The guns rang out, the explosion, the single shot, and he ducked under the table as quickly as a child.

He was shaking and panicking.

He couldn't sleep, so he ended up working as a dealer in a casino in Beirut that I later found, and it was a very fitting job.

So I thought, "What can kill a person without leaving visible scars?"

How does that happen?

What is this unknown? ”

So I started researching. It's the only method I know of.

I started researching by reading books, contacting psychiatrists, going to museums, libraries, etc.

Finally, I discovered that some people knew about this, often military psychiatrists, and that what we were dealing with was called trauma.

Americans call it PTSD or traumatic neurosis.

It existed, but we never talked about it.

So what is this trauma?

Well, it's an encounter with death.

I don't know if you have ever died. I'm not talking about a dead body, or a grandfather lying in a hospital bed, or someone being run over by a car.

I'm talking about facing the void of death.

And that's something no one should see.

"You can't look directly at the sun or death," people used to say.

Humans should not face the void of death.

But when that happens, it can go unseen for a while, days, weeks, months, or even years.

And at some point it explodes. Because it is a kind of window between what comes into your brain, the image, and the mind. It penetrates your brain and stays there, taking up all the space inside.

And there are people, both men and women, who suddenly cannot sleep.

And they experience terrifying anxiety attacks, or panic attacks, rather than just mild fright.

They suddenly don't want to sleep. Because I have the same nightmare every night even if I want to sleep.

They watch the same footage every night.

For example, a soldier entering a building encounters another soldier who is targeting him.

He stares straight into the muzzle.

And this barrel suddenly becomes huge and transforms.

It becomes fluffy and swallows everything.

And he says - later he will say, "I have seen death.

And since then he knew he was dead.

It's not realization, he's convinced he's dead.

In reality, someone walked in and the guy walked away or didn't shoot or whatever, he wasn't actually shot, but for him, he died in that moment.

Or maybe it smells like a mass grave. I've seen a lot of that smell in Rwanda.

It may be the voice of a friend on the phone, but they are slaughtered and there is nothing they can do.

That voice would wake me up every night for weeks or months, sending me into a trance-like state of childlike anxiety and fear.

I have seen men cry like children when watching the same footage.

Therefore, there will be images of fear in your brain, and the analogue of seeing the death void, the fear hiding something, will be completely dominated.

You can't do anything, you can't do anything at all.

I can't work anymore, and I can't love.

When I get home, no one recognizes me.

He hides and stays at home, stays home and gets sick.

I know someone who left a small tin of coins outside their house in case someone tried to break in.

Suddenly I feel like I want to die, I want to kill, I want to hide, I want to run away.

I want to be loved, but I hate everyone.

That feeling completely hits you every day and you are in great pain.

and no one understands.

They say, "You are fine. You have no injuries and you seem fine."

You went to war and came back. fine. "

After all, suicide is like updating your daily planner. I'm already dead, so I'd rather kill myself.

Some people commit suicide, others drink alcohol and fall under bridges.

We all remember having grandfathers, uncles, and neighbors who drank and didn't say a word, were always in a bad mood, beat their wives, and ended up either becoming alcoholics or dying.

And why don't we talk about this?

I won't talk about it because it's taboo.

There are no words to describe the emptiness of death.

But others don't want to hear it.

The first time I returned from a mission, they said, "Oh, he's back."

There was a fancy dinner with white tablecloths, candles and guests.

"Tell me everything!"

After 20 minutes people started giving me dirty eyes and the hostess stuck her nose in the ashtray.

It was terrible and I realized I had ruined the whole night.

So no more talking about it.

People clearly say "please stop".

Is that unusual?

One-third of the soldiers who died in Iraq didn't "died," but let me paraphrase it. One-third of US soldiers in Iraq suffer from PTSD.

In 1939, 200,000 soldiers who had fought in World War I were still being treated in British psychiatric hospitals.

54,000 Americans died in Vietnam.

In 1987, the US government doubled the number of veterans who died by suicide to 102,000.

In Vietnam, suicide kills twice as many as combat deaths.

So this is all about modern warfare, but also ancient warfare. You can read about it and the evidence is there.

So why not talk about it?

Why didn't we discuss it?

The problem is, if you don't talk about it, you're in dire straits.

The only way to cure it - and the good news here is that this is curable - think Munch's The Scream or Goya - this is certainly curable.

The only way to heal from this trauma, this encounter with death that overwhelms, petrifies and kills you, is to find a way to express it.

People used to say that language is the only thing that unites us all.

Without language, we are nothing.

It is what makes us human.

When faced with such a terrifying image, the image of speechless oblivion that haunts us, the only way to deal with it is to imbue it with human language.

Because these people feel alienated from humanity.

No one wants to see them anymore and they don't want to see anyone.

They feel dirty, defiled and embarrassed.

One person said, "Doctor, I won't take the subway anymore because I'm afraid to see fear in my eyes."

Another man spent six months going from one dermatologist to another thinking he had a terrible skin disease.

And then one day they sent him to a psychiatrist.

During the second session, he told the psychiatrist that he had a terrible skin disease from head to toe.

The psychiatrist asked, "Why are you in this state?"

Then the man said, "Well, I must be rotting because I am dead."

You can see that this is something that has a big impact on people.

To heal, we need to talk about it.

You need to put that fear into words, human language, so you can sort it out and speak again.

We must face death.

And if we can do that, if we can talk about these things, verbally work them out, step by step, we can regain our place among humanity.

And it matters.

So what does this mean?

That means that after trauma, we undoubtedly lose the “unbearable lightness of being,” the sense of immortality that keeps us here. I mean, being here, we almost feel like we're immortal, which we really aren't, but if we don't believe it, we're going to say, "What the hell is that all about?"

But trauma survivors have lost that sense of immortality.

They have lost their lightness.

This means, if only we could face death in the face and face it, instead of hiding in silence, like the men and women I know, such as Michael from Rwanda, Carol from Iraq, Philip from Congo. Also, like others I know, like Sorge Sharandon, now a great writer, who gave up on-site duties after trauma.

Five friends of mine committed suicide and they didn't survive the trauma.

So if we can face death, if we, mortal humans, if we can understand that we, mortals, mortals, we are human and mortal, if we can face death and once again recognize that death is the most mysterious of all mystical places, because no one has seen it, if we can reclaim its meaning, yes, we may die and survive and come back to life, but we come back stronger than before. will come

thank you.

(applause)

When I was in fourth grade, one day my teacher said, "There are as many even numbers as there are numbers."

"Really?" I thought.

But since even numbers are only part of integers and all odd numbers are left over, there should be more integers than even numbers, right?

To see what your teacher meant, let's first consider what it means for the two sets to be the same size.

What do I mean when I say that my right hand and my left hand have the same number of fingers?

Of course, each has five fingers, but it's actually simpler.

No need to count. You just need to check for a one-to-one match.

In fact, some of the ancients, whose languages ​​did not have words for numbers greater than three, may have used this kind of magic.

For example, if you graze sheep out of a pen, you can have a stone for each sheep and put them back one by one as they come back so you can keep track of how many have left so you know if you're missing something without actually counting them.

As another example of how matching is more basic than counting, if you are in a full auditorium, with all the seats taken and no one standing, you will know that there are as many chairs as there are audience, although you cannot tell which and how many.

So when we say that two sets are the same size, what we really mean is that the elements in those sets may match one by one in some way.

The 4th grade teacher displayed the whole numbers side by side and doubled the number under each one.

As you can see, the bottom row contains all even numbers and matches 1 to 1.

In other words, there are as many even numbers as there are numbers.

But what still haunts us is our anguish over the fact that the even numbers seem to be only part of the whole number.

But can you see that the number of fingers on my right hand is not the same as the number of fingers on my left hand?

of course not.

If we try to match the elements in some way and it doesn't work, it doesn't convince us of anything.

If we can find one way to match the elements of two sets, we say that the two sets have the same number of elements.

Can you make a list of all fractions?

And it's also not clear what to put first or how to make sure everything is on the list.

Nevertheless, there is a very clever way to create a list of all fractions.

This was first done by Georg Cantor in the late 1800s.

First, put all the fractions into the grid.

For example, you can find 117/243 at line 117, column 243.

Now start at the top left and sweep diagonally back and forth, skipping fractions such as 2/2 that represent the same number as the number you already selected, and build your list from this.

Got a list of all fractions. This means that we created a one-to-one match between integers and fractions, even though we thought there should be more fractions.

Now here's where it gets really interesting.

You may know that not all real numbers are fractions, that is, not all numbers on the number line are fractions.

For example, the square root of 2 and pi.

Such numbers are called irrational numbers.

It's not because you're crazy, but because fractions are ratios of integers and are called rational numbers. So the rest is irrational, or irrational.

Irrational numbers are represented by infinite non-repeating decimals.

So is it possible to have a one-to-one match between the integers and the set of all decimal numbers (both rational and irrational)?

Cantor has shown that it is not possible.

Suppose you claim to have created a list of all decimals.

Computes a decimal not in the list to indicate unsuccessful.

Build the decimal one digit at a time.

As for the 1 decimal place for my number, let's look at the 1 decimal place for your first number.

If it's a 1, make mine a 2. If not, make it mine.

For my number two, let's see your second number two.

Again, if yours is a 1, make mine a 2. If not, make mine 1.

Can you see what's going on?

why? Is it your 143rd number, for example?

No, because my 143rd decimal place and your 143rd digit have a different 143rd place.

I made it that way.

And given any list, I can do the same and generate decimals that are not in that list.

We are then faced with the surprising conclusion that decimal numbers cannot be put into lists.

Therefore, although we are familiar with a few irrational numbers, such as the square root of 2 and pi, the irrational infinity is actually greater than the fractional infinity.

Someone once said that rational numbers, or fractions, are like stars in the night sky.

The irrational is like darkness.

Cantor also showed that for any infinite set, forming a new set from all subsets of the original set represents an infinity greater than the original set.

This means that once you have created one infinity, you can always create a larger infinity by creating a set of all subsets of that initial set.

And creating a set of all its subsets makes it even bigger.

So there are an infinite number of infinities of various sizes.

If these thoughts make you uncomfortable, you're not alone.

Some of the great mathematicians of Cantor's time were very offended by this.

They made these various infinities irrelevant and somehow tried to make the math work without them.

Cantor was also personally vilified, which became so severe that he suffered from severe depression and was in and out of mental hospitals for the rest of his life.

But in the end his idea won.

All research mathematicians are open to these ideas, and all college mathematics majors learn these ideas. We covered these in a few minutes.

Someday, perhaps they will become common knowledge.

We have others, too.

I pointed out that the set of decimal numbers, i.e. the real numbers, is infinitely larger than the set of integers.

Cantor wondered if there could be an infinity of different size between these two infinities.

He didn't believe there was such a thing, but he couldn't prove it.

In 1900, the great mathematician David Hilbert identified the continuum hypothesis as the most important unsolved problem in mathematics.

The 20th century solved this problem, but in a totally unexpected and paradigm-shattering way.

In the 1920s, Kurt Gödel showed that the continuum hypothesis can never be proven false.

And in the 1960s, Paul J. Cohen showed that the continuum hypothesis can never be proven correct.

Taken together, these results mean that there are questions that mathematics cannot answer.

A very surprising conclusion.

Mathematics is rightfully considered the pinnacle of human reasoning, but we now know that even mathematics has its limits.

Still, there are some really amazing things in mathematics for us to think about.

For most of the past century, architecture has been under the spell of a well-known doctrine.

"Form follows function" became an ambitious manifesto and a pernicious constraint of modernization, as it liberated architecture from ornamentation while decrying practical rigor and restrained purpose.

Of course architecture emphasizes function, but I would like to recall Bernard Tschumi's rewriting of this word and propose a completely different quality.

If form follows fiction, we can think of architecture and buildings as narrative spaces, the stories of the people who live in them, the stories of the people who work in them.

And you can start imagining the experiences our buildings create.

In this sense, I am interested in fiction not as improbable but as reality, as the reality of what architecture means to the people who live in it and live with it.

Our buildings are prototypes, ideas for how living and working spaces will change, and what cultural and media spaces will look like today.

Our building is real. they are built.

They are explicit engagements with physical realities and conceptual possibilities.

I think of architecture as an organizational structure.

At its core, it is certainly system-like structural thinking. It's about how things can be arranged in a functional and empirical way.

How can you create a structure that creates a series of relationships and narratives?

And can the fictional stories of our building's inhabitants and users script architecture, and architecture script those stories at the same time?

And here comes the second term. This is what I call a "narrative hybrid". This is the structure of multiple simultaneous stories unfolding throughout the building we create.

We can therefore think of architecture as a complex system of relationships, both in a programmatic and functional way and in an experiential, emotional or social way.

This is the headquarters of China National Broadcasting, which was designed with Rem Koolhaas of OMA.

When I first came to Beijing in 2002, the city planner showed me this image. It was supposed to be a forest of hundreds of skyscrapers in the central business district, but at the time there were only a handful of them.

So we had to design in a context where we knew almost nothing, but the only thing was that it was all about verticality.

Of course skyscrapers are vertical. It seems to be a very hierarchical structure, with the top always being the best, the bottom being the worst, and the taller the better.

And we wanted to ask ourselves, could the building be of a completely different quality?

Is it possible to undo this hierarchy and have a system that emphasizes collaboration rather than isolation?

So we bent this needle back into a loop of interconnected activities.

Our idea was to bring together all aspects of television production – news, programming, broadcasting, research and training, operations – into one structure and incorporate them into the interconnected circuits of activity that people encounter in the process of interaction and cooperation.

I still love this image.

Recalling the human body and all its organs and circulatory system reminds me of biology classes in school.

And suddenly we no longer think of architecture as a constructed material, but as an organism, a living organism.

And when we begin to analyze this organization, we can identify a series of major technology clusters such as programming, broadcast centers and news.

These are closely intertwined with social clusters such as conference rooms, dining rooms, chat areas and other informal spaces for people to meet and interact.

So the organizational structure of the building was a hybrid of technical and social, human and performance.

And, of course, we used the building loop as a circulation system to tie everything together and allow both visitors and staff to experience all these different functions in great unity.

Covering an area of ​​473,000 square meters, it is one of the largest buildings ever built in the world.

With a population of over 10,000, this is of course beyond the comprehension of many things and beyond the scale of typical architecture.

So we stopped for a while and sat down to cut out 10,000 little sticks and glue them to the model. It was just to point out to myself what that amount really meant.

But, of course, it's not the numbers, it's the people, the community that lives in the building. To understand this as well as script this architecture, we identified five characters, hypothetical characters, followed their day in life in this building, where they meet and what they experience.

So this was a way of scripting and designing a building, but of course it was also a way of communicating that experience.

It was part of an exhibition with the Museum of Modern Art in New York and Beijing.

This is the main broadcast control room, a very large technical facility capable of broadcasting over 200 channels simultaneously.

And this is what the buildings in Beijing look like today.

The first live broadcast was at the 2012 London Olympics after being externally completed for the Beijing Olympics.

And you can see those three little circles at the tip of this 75 meter cantilever.

And they are indeed part of a public loop through the building.

This allows you to stand on glass and watch the city pass below in slow motion.

The building has become part of everyday life in Beijing.

it's there.

It is also a popular backdrop for wedding photography.

(Laughter) But the most important moment is probably this moment.

“That’s Beijing” is akin to Time Out, a magazine that broadcasts what’s going on in town during the week, and suddenly we see buildings no longer being portrayed as physical objects, but actually as actors of the city, as part of a set of personas that define city life.

So architecture suddenly takes on the player nature of something that writes and executes the story.

And I think that could be one of its primary implications we believe.

But, of course, this building has another story.

This is the story of the people who built this building. The 400 engineers and architects I coached spent almost a decade working together to script this building, imagine its reality, and finally build it in China.

This is a large residential development in Singapore.

Of course, if you look at Singapore, like most of Asia and many parts of the world, it's dominated by towers, a typology that certainly creates a sense of isolation rather than connection. And I wanted to ask: How can we think about living not only in terms of privacy and individuality in ourselves and our apartments, but also in terms of the concept of collective?

How can we think about creating a communal environment where sharing things is as good as owning them?

A typical answer to this question -- we had to design 1,040 apartments -- would be: A height limit of 24 stories given by the planning authorities, 12 towers with nothing left in between -- a very tight system, towers isolate you, but are so close to their neighbors that they don't even give you privacy. I very much doubt what the nature of this would be.

So I suggested knocking down the towers and throwing the vertical towers into the horizontal towers and stacking them. It looks a little random from the side, but from the helicopter's perspective, you can see that its organizational structure is actually a grid of hexagons. Within it, these horizontal components are stacked to form a huge outdoor courtyard, the central space of the community programmed with various amenities and functions.

And you can see that these courtyards are not closed spaces.

They are open and permeable. they are interconnected.

We named this project "The Interlace" and thought about interweaving and interconnecting humans and spaces alike.

And the quality of every detail we designed was to liven up the space and provide space for its inhabitants.

And really, it was primarily a system of layering shared spaces and stacking even more personal and private spaces.

So we end up opening up the spectrum between collectives and individuals.

Just a little math. If we subtract the building footprint from all the greenery left on the ground and add back all the terraced greenery, we get 112 percent green space, which is more natural than no building.

And, of course, this small calculation shows that we're doubling the space available to the people who live there.

In fact, here we are on the 13th floor of one of these terraces.

In other words, we can see a new standard, a new standard for social activities.

We paid close attention to sustainability.

In the tropics the sun is the most important thing, and in fact we seek protection from it.

We first proved that all the apartments have enough sunshine all year round.

Then we optimized the façade glass to minimize the energy consumption of the building.

But most importantly, through the geometry of the building's design, the building itself was able to provide sufficient shade to the courtyard, proving that the courtyard can be used all year round.

In addition, water bodies were placed along the prevailing wind paths to create a microclimate through evaporative cooling, enhancing the quality of space available to residents.

And it was the idea of ​​creating freedom, different options to think about where you want to be and where you want to escape, in the complex complexity you live in.

But from Asia to Europe. The building of a German media company based in Berlin that is making the transition from traditional print media to digital media.

And that CEO asked some very pertinent questions. Why would anyone want to go to the office today when they can actually work from anywhere?

And how can a company's digital identity be embodied in a building?

We didn't just create an object, we created a huge space in the center of this object. The space was about collective experience, collaborative experience and togetherness.

Communication and interaction are framed in a standard modular office as the center of a floating space in the center of the building, itself called the Collaboration Cloud.

So, just a few steps away from your quiet work desk, you're part of the massive collective experience of the central space.

Finally, we come to London, a project commissioned by the Mayor of London Legacy Development Corporation.

We were asked to investigate a potential site within Stratford's Olympic Park.

In the 19th century, Prince Albert founded Albertopolis.

And Boris Johnson thought of creating an Olympic police.

The idea was to bring together some of Britain's greatest institutions and international institutions to create a new system of synergy.

Prince Albert still envisioned creating Albertopolis in the 19th century to showcase all human achievements and bring art and science closer together.

He then built an exhibition road that connects these facilities in a straight line.

But of course, today's society has evolved from there.

We no longer live in a world where everything is so distinct and separate from each other.

We live in a world where the boundaries between different spheres start to blur, making collaboration and interaction far more important than maintaining separation.

So we wanted to think about a giant incubation machine, or building, where different domains could interact and work together while coordinating and animating them.

At its base is a very simple module called the Ring module.

It functions as a double corridor, allowing lighting and ventilation.

It can be glazed and transformed into a huge exhibition performance space.

These modules were stacked on the idea that over time, almost any feature could occupy one of these modules.

Therefore, the future of culture is in some ways the most uncertain, so the organization may shrink or shrink.

The building is located opposite the Olympic Stadium and adjacent to the Aquatics Center.

And you can see how its cantilevered volumes protrude and engage with public spaces, and how its courtyards enliven those inside.

The idea was to create a complex system in which organizational entities could maintain their own identity and not be contained within a single volume.

This is a scale comparison with the Pompidou Center in Paris.

This shows the enormous scale and potential of the project, but it also shows the difference. Here we demonstrate a heterogeneous structural diversity in which different entities can interact without losing their own identity.

And that was the next thought. It's about building an organizational structure that can script multiple stories for people in the education sector who create and think culture. For those who express visual arts and dance. And the public is allowed to participate in all this with a series of possible trajectories, reading these stories for themselves and being able to script their own experiences.

And I want to end up with a very small, in a way very different project. It's a floating movie theater in Thailand.

A friend of mine founded a film festival, and I thought that if you think about the stories and stories of movies, you should also think about the stories of the people who watch them.

So I designed a small, modular floating platform based on the techniques of local fishermen, how they build lobster and fish farms.

Working with the local community and using our own recycled materials, we have built this fantastical floating platform that gently navigates you through the sea while you watch British Film Archive films (such as [1903] Alice in Wonderland).

The audience's most primitive experience fused with the film's narrative.

Therefore, I believe that architecture goes beyond the realm of physical matter and built environments and is really about how we want to live our lives and how we script our own and others' stories.

thank you.

(applause)

Well, today we will talk about moles.

Well, I know what you're thinking. "I know what a mole is. It's a tiny furry creature that burrows into the ground and destroys gardens."

And some of you might think it's just a hairy bump on your aunt's face.

Well, in this case a mole is a concept used in chemistry to count very small things such as molecules and atoms.

Have you ever wondered how many atoms there are in the universe?

Or in your body? Or even in grains of sand?

Scientists have wanted to answer that question, but how do we count something as small as an atom?

In 1811, someone had the idea that given the same volume of gas at the same temperature and pressure, they would contain the same number of particles.

His name is Lorenzo Romano Amedeo Carlo Avogadro.

I wonder how long it took him to sign.

Unfortunately for Avogadro, most scientists didn't accept the atomic idea, and there was no way to prove Avogadro was right.

There was no clear distinction between atoms and molecules.

Most scientists regarded Avogadro's work as a mere hypothesis and gave it little thought.

But it turns out he was right! By the late 1860s, Avogadro had been proven right, and his work helped lay the foundations of atomic theory. Unfortunately, Avogadro died in 1856.

Now the problem is that even in a small sample the amount of particles is enormous. For example, if you have a balloon of gas at 0 degrees Celsius and 1 atmosphere of pressure, there are exactly 602 sextillion gas particles.

So there are 6 gas particles with 23 trailing zeros in the container.

Or, in scientific notation, 6.02 times the 10th to 23rd particles.

This example is a little misleading. Because the kinetic energy of gas particles is high, they occupy a lot of space and make atoms appear larger than they actually are.

Instead, think of water molecules.

If you pour 18.01 grams of water into a glass (18.01 milliliters, equivalent to 3.5 teaspoons of water), there are 602 sextillion water molecules.

Lorenzo Romano - well, never mind - Avogadro was the first to come up with this idea, so scientists named the 23rd number of 6.02 times 10 after him.

It is known simply as Avogadros number.

Now, back to the mole. Not that mole.

This mole. Yes, this number has a second name.

Mole. Chemists use the term mole to refer to quantities as large as 602 sextilions.

This is known as the molar amount.

Atoms and molecules are so small that chemists group them together into groups called moles.

Moles are hard to understand because students have trouble imagining how big they are, i.e. how big a 602 sextillion is.

It's too big to wrap our brains around.

Remember 18.01 milliliters of water?

Well, it's a mole of water.

But how much is it?

What exactly is a 602 Sextillion?

Maybe this will help.

Exchange water particles for donuts.

One mole of donut would cover the entire Earth to a depth of 8 kilometers (about 5 miles).

I really need a lot of coffee for that.

One mole of basketball can create a new planet the size of the Earth.

Even if you received a mole of pennies the day you were born and spent $1 million every second until you died at age 100, you would still have over 99.99% of your money in the bank.

OK. Now you have some idea of ​​the size of the mole.

So how do we use it?

You might be surprised to learn that chemists use pounds in the same way that pounds are used to buy grapes, deli meat, and eggs.

When I go to the supermarket, I buy salami by the pound instead of going to the deli counter and ordering 43 salami.

When you buy eggs, you are buying 12 eggs.

When you hear the word dozen, you probably think of the number 12.

Also, a pair is 2, a baker's dozen is 13, Gross is 144, paper reams - who?

The number of runs is 500.

Well, moles are actually the same.

To a chemist, a mole is a reminder of the number 6.02 times 10 to the 23rd power, not a fuzzy little animal. The only difference is that other quantities are more familiar to us.

It tells the story of moles, Avogadro, basketball, and how to buy salami at the grocery store.

When we speak, we sometimes say things directly.

"I'm going to the store, I'll be back in five minutes."

However, they may also speak in a way that evokes a small scene.

"It's raining both dogs and cats," or "I was waiting for the other shoe to fall," we say.

A metaphor is a way of talking about one thing by explaining another.

It may seem roundabout, but it's not.

Seeing, hearing and tasting is the first thing we know.

The philosopher William James described the world of newborn infants as "a bustling, blossoming mess."

Abstract ideas pale in comparison to the first bees and flowers.

Metaphors use imagination and senses to think.

The spiciness of the chili peppers inside will explode in your mouth and heart.

Accuracy is also high.

We don't often stop and think about raindrops the size of an actual cat or dog, but when we actually stop and think, we're pretty sure that dog must be a small cocker spaniel or dachshund, not a golden love or a newfoundland.

A metaphor is neither true nor false in the usual sense.

Metaphor is an art, not a science, and yet sometimes it feels right and sometimes it feels wrong.

Inappropriate metaphors are confusing.

I know what it means to feel like a square wheel, but I don't know what it means to feel tired like a whale.

There is a contradiction in the metaphor.

They almost always say things that aren't true.

When you say "there's an elephant in the room," that doesn't mean the elephant is actually looking for the peanut plate on the table.

Metaphor penetrates the skin, beyond logical thinking.

Moreover, we are used to thinking in images.

We dream the impossible every night.

And when we wake up, that mindset is still within us.

We take off the shoes of our dreams and press the buttons on our lives.

Some metaphors include the words "like" or "as".

"Sweet as honey" and "strong as wood".

They are called similes.

A simile is a metaphor that acknowledges a comparison.

Similes tend to make you think.

A metaphor makes things feel directly.

Consider Shakespeare's famous trope, "All the world is a stage."

Metaphors also exist in verbs.

Emily Dickinson begins the poem, "No way the heavens were sewn together—" but we soon see what it would be like if the sky were sewn together.

They can also live in adjectives.

A person who is quiet and thoughtful, we say, "quiet waters run deep."

And depth is as important as calmness and water.

One of the most obvious places to find good metaphors is poetry.

Consider this haiku by the eighteenth-century Japanese poet Issa.

"Crickets are chirping on the branches floating downriver."

The first way to encounter metaphor is to see the world through its eyes. Insects chirp from the branches that pass through the middle of the river.

But even if there are parts in the image that you recognize a little portrait of what it's like to live in this world of change and time, our human destiny is as certain to perish as that little cricket, and yet we're doing it.

Poetry may take a metaphor and extend it, building on an idea in many different ways.

It is the beginning of Langston Hughes' famous poem "From Mother to Son".

"Well, son, I'll tell you.

There were tacks, debris, torn boards, and in some places no carpet on the floor. ”

Langston Hughes likens a difficult life to a broken house that still has to be lived in.

Those shards and tacks feel real and hurt my feet and my heart, but my mother explains her life here. Not a real home.

And hunger, cold and tiring work, and poverty are among the fragments.

Metaphors are not necessarily about human life or emotions.

Chicago poet Carl Sandberg wrote, "The fog comes on little cat's feet.

The comparison here is straightforward.

Mist is depicted as a cat.

But a good metaphor is not a puzzle or a way to convey a hidden meaning, but a way to feel and know something differently.

No one who heard this poem will forget it.

I see fog and a little gray cat nearby.

A metaphor gives words a means beyond their own meaning.

They are the door handles to what we can know and imagine.

Each door leads to a new home and a new world that only one handle can open.

What's amazing is that you can create a world by making a steering wheel.

What if you could give the gift of a story that can be remembered with your whole body, not just your head?

Throughout my life as a journalist, I have been compelled to create stories that make a difference and perhaps even make people interested.

I have worked in the printing industry. I have been working on documentaries.

I have worked in broadcasting.

But it wasn't until I got involved in virtual reality that I started seeing really intense and genuine reactions from people that really shocked me.

In other words, if you use VR, virtual reality, you can appear in the middle of the story.

With these goggles that track wherever you look, you'll feel like you're really there all over your body.

Five years ago, I started pushing the envelope with a combination of virtual reality and journalism.

And I wanted to make a piece about hunger.

American families are starving, food banks are overwhelmed, and food is often in short supply.

Now, I knew I couldn't make people feel hungry, but maybe I could find a way to make them feel something physical.

So, again, this was five years ago. So doing journalism and virtual reality together was considered a worse idea than halfway through, and I didn't have the funds.

Believe me, a lot of my colleagues laughed at me.

But I had a really great intern, a woman named Michaela Kobusa Mark.

And we started going to food banks together and recording audio and photos.

She was just crying until one day she came back to my office.

She was at the scene of a long line, and the woman running the line was extremely overwhelmed and shouted, "Too many people!"

Too many people! ”

And this diabetic man doesn't eat in time and his blood sugar drops so low that he falls into a coma.

As soon as I heard the audio, I knew it would be an exciting film that really portrayed what was going on at the food bank.

Here is the real line. You know how long it's been, right?

And then, again, like I said earlier, we didn't have a lot of money, so we had to recreate it using donated virtual humans. People begged or borrowed money to help me build models and make them as accurate as possible.

And I tried to tell as accurately as possible what happened that day.

(Video) Voice: Too many people! Too many people!

Voice: OK, he's having a seizure.

Voice: We need an ambulance.

Nony de la Peña: Now the man on the right is walking around the body for him.

For him, he is in the room with the body.

Oh, it looks like that person is at my feet.

And even though you can see through your peripheral vision that you're in this lab space, you should know that he's not really on the street, but he feels like he's there with those people.

He's very careful not to step on this guy who isn't actually there, right?

So that piece ended up at Sundance in 2012. This is kind of amazing, basically making it the first virtual reality movie ever made.

And when I went, I was really scared.

I had no idea how people would react or what would happen.

And we showed up with duct taped goggles.

(Video) Oh, you're crying. you are crying Gina, you're crying.

Can you hear the surprise in my voice?

And this kind of reaction became the kind of reaction we've seen over and over again. Those who fell to the ground would try to comfort the seizure victims, whisper something in their ears, or help in some way, even if they were unable to do so.

And a lot of people took it out of this piece and said, 'Oh my God, I was really frustrated.

So, after this film was made, the dean of the film school at the University of Southern California, USC, brought the chairman of the World Economic Forum to try out The Hunger, and he took off his goggles and asked me to make a film about Syria on the spot.

And I really wanted to do something about the children of Syrian refugees, because they are the ones who are most affected by the Syrian civil war.

I sent a team to the Iraqi border to record material in refugee camps, but basically, it's an area where ISIS is really active, so basically an area where I don't want to send a team right now.

I also recreated a street scene with a young girl singing and a bomb exploding.

Now, when you're in the middle of the scene, hearing the sounds and seeing the injured around you, it feels incredibly frightening and real.

I've heard from people involved in actual bombings that they evoke similar horrors.

[The Syrian Civil War may seem far away] [until you experience it yourself] (Girl's Song) (Explosion) [Project Syria] [Virtual Reality Experience] NP: Then we were invited to take this work to the Victoria and Albert Museum in London.

And it wasn't advertised.

And we were put into this tapestry room.

There was no press coverage about it either, so anyone who happened to enter the museum that day to visit it would see us with these crazy lights.

Perhaps they would like to see old stories on tapestries.

They were facing our virtual reality cameras.

But a lot of people gave it a try and ended up with a 54-page guestbook comment after a five-day run. And the curator there told me that he had never seen so many comments.

"It's so real," "I can absolutely believe it," and of course, what excites me is, "It feels like you're actually there, like you often see on TV news."

So it works, right? This works.

And it doesn't matter where you are from or how old you are. It's really exciting.

Don't get me wrong. I'm not saying that once you're in the work, you forget you're here.

But it turns out that we can feel like we are in two places at once.

We can have what I call duality of being, and I think that's what allows me to tap into this feeling of empathy.

right?

So, of course, you have to be very careful when creating these pieces.

I have to follow journalism best practices and make sure these powerful stories are built with integrity.

If you don't shoot the material yourself, you have to be very strict about its provenance and knowing where it came from and whether it's authentic.

Let's take an example.

In this Trayvon Martin case, this is a 17-year-old man, a child, who bought soda and candy at a store and was chased on his way home by a neighborhood warden named George Zimmerman who ended up shooting him dead.

To make this work, we obtained architectural drawings of the entire complex and reconstructed the entire scene from the inside out based on those drawings.

All actions are informed by an actual recorded 911 call to the police.

And interestingly, some news was announced in this story.

Primor Productions, the forensic agency that performed the audio restoration, says George Zimmerman pulled out his gun when he got out of the car before going after Martin.

So you can see that the basic principles of journalism haven't changed much here, right?

We continue to follow the same principles as ever.

The difference is the feeling of being there, whether it's watching a man dying of hunger or feeling like you're in the middle of a bombing.

And this is what got me moving forward with these pieces and thinking about how to create them.

We're obviously looking to make this more accessible beyond headsets.

We make mobile works like Trayvon Martin works.

And these things are having an impact.

I have heard from Americans that they have donated money that is directly deducted from their bank accounts to donate to Syrian refugee children.

And I think 'Hunger in LA' will help launch a new form of journalism that will join all the other regular platforms in the future.

thank you.

(applause)

Why are gas stations always built next to other gas stations?

How can you drive a mile without finding a coffee shop and then stumble upon 3 coffee shops on the same corner?

Why do grocery stores, auto repair shops, and restaurants always seem to exist as a group instead of evenly distributed throughout the community?

While there are several factors that can determine where a business is located, clusters of similar companies can be explained by a very simple story called Hotelling's Spatial Competition Model.

Imagine you are selling ice cream on the beach.

Your beach is 1 mile long and has no competitors.

Where would you place your cart to sell the most items?

In the middle.

A half-mile walk might be too far for those on either end of the beach, but carts help as many people as possible.

One day, you show up at work to find your cousin Teddy arriving at the beach with his ice cream cart.

In fact, he sells the exact same kind of ice cream as you.

We set up the carts in the middle of your territory, 400 meters south of the beach center so that your customers don't have to walk far.

Teddy is located in the middle of Teddy's territory, 400 meters north of the center.

With this pact, everyone in your south buys ice cream from you.

Everyone north of Teddy shop from him, while 50% of beachgoers walk to the nearest cart.

No one walks more than 400 meters, and both shops sell to half the beachgoers.

Game theorists believe this is the socially optimal solution.

This minimizes the maximum number of steps a visitor must take to reach the ice cream cart.

The next day, when you arrive at work, Teddy has set up his cart in the middle of the beach.

Return to a location 400 meters south of the center and attract 25% of your customers south.

Teddy continues to take all customers north within Teddy's territory, but now splits 25% of the people between the two carts.

On the third day of the Ice Cream Wars, you arrived at the beach early and set up in the heart of Teddy's territory, leaving your cousin to serve 75% of the beachgoers to the south and sell to 25% of the customers to the north.

When Teddy arrives, he'll take up a position just south of you, stealing all your south customers and leaving a few people north.

You can't be outdone and move 10 steps south from Teddy to get the customer back.

When you take your noon break, Teddy will hobble all the guests back to the end of the beach again while limping 10 paces south of you.

Throughout the day, both continue to move south toward the majority of regular ice cream buyers, eventually both arriving back to back in the center of the beach, each serving 50% of the ice cream eating bathers.

At this point, you and your competitive cousin have reached what game theorists call a Nash equilibrium, the point at which neither of you can improve your position by deviating from your current strategy.

The initial strategy of staying 400 meters from the center of the beach did not last long as it was not a Nash equilibrium.

Either one can move the cart in the other direction and sell more ice cream.

Since we are both in the center of the beach, we can't relocate the cart closer to the furthest customer without exacerbating the current customer's situation.

But it's no longer a socially optimal solution, as customers at both ends of the beach have to walk more than necessary to get their sweet treats.

Think fast food chains, clothing boutiques, and cell phone kiosks in malls.

Distributing services across communities may serve customers better, but this leaves businesses vulnerable to intense competition.

In the real world, customers come from multiple directions, and companies are free to compete with their marketing strategies, whether it's differentiating product lines or cutting prices, but at the core of strategy, companies want their competitors to be as close as possible.

There is something about caves that draws you in. A shadowy opening in a limestone cliff.

Passing through a portal between light and darkness, you enter the underworld. It is a place of eternal darkness, the smell of earth, and quiet silence.

Long ago, even in Europe, the ancients entered this underworld.

They left mystical sculptures and paintings as witnesses to that passage, such as the human, triangular, and zigzag panels of Ojo Guareña in Spain.

You are now on the same path as the early artists.

And in this surreal, otherworldly place, you can imagine hearing the muffled footsteps of skin boots on the soft ground and seeing the flickering of torches at the next turn.

When I'm in a cave, I often wonder why these people ventured so deep into the dangerous narrow passages to leave footprints.

Filmed half a kilometer underground, or about a third of a mile, in Spain's Cudong Cave, this video clip reveals a series of red paintings on the ceiling of an unexplored part of the cave.

The ceiling was getting lower and lower, crawling forward like a soldier, until we reached a point where the ceiling was so low that my husband, project photographer Dylan, couldn't focus his DSLR camera on the ceiling.

So while he filmed me, I kept following the trail of red paint with a single light and an autofocus camera that I kept for such occasions.

half a kilometer underground.

seriously.

What was someone doing there with torches and stone lamps?

(Laughter) I mean -- me, that's for sure, right?

But you know, this is the kind of question I try to answer through research.

I am researching some of the oldest art in the world.

It was created by early European artists between 10,000 and 40,000 years ago.

And the point is, yes, some of it is beautiful, but just because it's beautiful doesn't mean I'm studying it.

But I am interested in the development of the modern human mind, the evolution of creativity, imagination, abstract thinking, and what it means to be human.

All species communicate in some way, but only we humans have taken it to another level.

Our desire and ability to share and collaborate is a big part of our success story.

Our modern world is largely based on a global information exchange network made possible by our communication skills, especially graphic and written ones.

But the point is, we've built on the spiritual achievements of our predecessors for so long that it's easy to forget that certain abilities don't exist yet.

That's one of the things I find most fascinating about studying our deep history.

They couldn't stand on the shoulders of giants.

It was the original shoulder.

It's amazing how many important inventions have come out of that time, but the one I want to talk about today is the invention of graphic communication.

There are three main types of communication. voice communication, gestures (such as sign language), and graphic communication.

Spoken words and gestures are ephemeral in nature.

Sending and receiving messages requires close contact.

And after a moment of transmission it is gone forever.

Graphic communication, on the other hand, disconnects that relationship.

And with that invention, it became possible for the first time to send and store messages beyond the moment, place and time.

Europe is one of the first places to start seeing graphic marks appearing regularly in caves, rock shelters and even some existing outdoor sites.

But this is not Europe as we know it today.

It was a world of towering ice sheets three to four kilometers high, vast grasslands and frozen tundra.

This was the Ice Age.

Over the past century, more than 350 Ice Age rock art sites have been discovered across the continent, some decorated with animals, abstract shapes and even figures like those carved at Grotta del Addaura in Sicily.

These provide us with a rare glimpse into the creative world and imagination of early artists.

They've dominated research since their discovery, including a black horse from Cullalbera in Spain and a rare purple bison from La Pasiega.

But for me, it was the abstract shapes, the so-called geometric symbols, that inspired me to study art.

What is interesting is that in most places there are far more geometric symbols than images of animals and humans.

But when I started working on this in 2007, there wasn't even a clear list of how many shapes there were, nor a strong sense of whether the same thing would appear across time and space.

Before I start asking questions, my first step was to compile a database of all known geometric symbols from all rock art sites.

The problem was that while some sites, usually those with very nice animals, were well documented, there were many sites that were very obscure. There wasn't much explanation or details.

Some of them had not been visited for more than half a century.

These were the subjects of my fieldwork.

Over the course of two years, my faithful husband Dylan and I each spent over 300 hours underground, hiking, crawling and wriggling at 52 locations in France, Spain, Portugal and Sicily.

And it was totally worth it.

We found new undocumented geometric signs in 75% of the places we visited.

This is the level of precision we knew we would need if we wanted to answer the bigger question.

Let's look at those answers.

Excluding a few outliers, there are only 32 geometric symbols.

There are only 32 signs across a time span of 30,000 years and continental Europe.

That's a very small number.

Now, if these were random graffiti and decorations, we would expect to see even more variation, but instead what we found were the same signs repeated across both space and time.

Some signs were strong in the beginning and then fell out of favor and faded away, while others were invented later.

However, 65 percent of these markers are 10,000-year-old sites high in the Pyrenees and continued to be used throughout that period: lines, rectangles, triangles, ovals, and circles, much like those seen at the end of the Ice Age.

And while certain markers span thousands of kilometers, others have a much more restricted distribution pattern, and some researchers speculate that some markers may be confined to a single region, some sort of family or clan marker, as seen here in the divided rectangles found only in northern Spain.

As an aside, the earliest rock art found from France and Spain to Indonesia and Australia bears striking similarities.

With many of the same symptoms appearing at such remote locations, especially in the 30,000 to 40,000 year range, it's starting to seem more and more likely that this invention actually traced back to a common origin in Africa.

But unfortunately that is a subject for future stories.

Now, back to the main topic.

Like the 25,000-year-old bas-relief sculpture in La Roque-de-Venasque, France, there is no doubt that these signs were meaningful to their creators.

We may not know what that means, but people certainly understood it back then.

The repetition of the same signs on so many sites for so long shows that the artists were making a deliberate choice.

If you're talking about geometric shapes that have specific meanings that are culturally recognized and agreed upon, you're talking about one of the oldest graphic communication systems in the world.

We haven't talked about writing yet.

There are currently not enough letters to represent every word in the spoken language. This is a requirement for a complete writing system.

Nor do I see any symbols repeated regularly enough to suggest they are some alphabet.

But what we do have are some interesting one-of-a-kind pieces, like this panel from La Pasiega, Spain, known as "Inscriptions". The left side has a symmetrical mark, the center has a stylized hand representation, and the right side looks like a bracket.

The world's oldest systems of graphic communication—the Sumerian cuneiform, the Egyptian hieroglyphs, and the oldest Chinese script—all arose between 4,000 and 5,000 years ago, and each arose from an early archetypal system of counting marks and pictographic representations that shared the same meaning and imagery.

Therefore, a picture of a bird actually represents that animal.

It is only later that we begin to see these pictograms become more stylized and almost unrecognizable, and we also begin to see more symbols being invented to represent pronouns, adverbs, adjectives, and all other words lacking in language.

So, knowing all this, it seems extremely unlikely that the geometric signs of Ice Age Europe were truly abstract characters.

Rather, it is more likely that these early artists were also making countable marks, perhaps like this series of lines in the Ripalo di the Minich in Sicily, and creating stylized representations of things in the world around them.

Could some of the signs be weapons or housing?

Or what about celestial bodies like constellations?

Or maybe it's landscape features like this black pentagram, surrounded by rivers, mountains, trees and the odd bell-shaped sign on the site of El Castillo in Spain.

The term peniform is Latin for "feather-shaped," but is this actually a depiction of a plant or tree?

Some researchers are starting to ask these questions about specific signs in specific locations, but I think it's time to revisit this category as a whole.

The irony of all this, of course, is that we've just carefully grouped all signs into a single category, so we feel that the next step will be to break it down again when identifying and isolating different types of images.

Don't get me wrong. The subsequent production of fully developed writing was an impressive feat in itself.

But it's important to remember that these early writing systems didn't come out of a vacuum.

And even 5,000 years ago, people were already building on something much older, with their origins dating back tens of thousands of years, to the geometric symbols of Ice Age Europe, and far beyond, to that point deep in our collective history, when someone first came up with the idea of ​​creating graphic marks, forever changing the nature of how we communicate.

thank you.

(applause)

Imagine that the part of our brain that we label our subconscious mind contains a microscopic ladder.

The inference ladder, first proposed by Harvard professor Chris Argyris, is the basis of this model.

Every time we interact with someone, the experience goes down the bottom ladder.

The same experience runs up the ladder in the blink of an eye and out of the top.

This process happens thousands of times a day without us even noticing it.

Notice what happens on each rung of the ladder.

The first stage has raw data and empirical observations.

This is very similar to what someone watching a video recording of our experience would see.

Moving on to the second row filters out specific information and details from the experience.

Subconsciously, we filter based on our preferences, tendencies, and many other aspects we consider important.

Go to the 3rd step.

We assign meaning to filtered information.

From here, we begin to interpret what the information is telling us.

In the fourth row, something very important happens.

As you develop assumptions based on the meaning you created in the previous stage, the line between what is fact and what is story begins to blur.

The fifth step draws conclusions based on assumptions.

This is also where our emotional reactions are born.

The sixth step adjusts our beliefs about the world around us, including the people involved in our experience in the moment.

The seventh and final step is to act on your aligned beliefs.

still with me? wonderful!

Let's take a real-world example and see how this works.

Have you ever turned on a traffic light in a parking lot and steered toward your dream location, but at the last moment you stepped on the brakes and someone pulled in front of you and took your spot?

Imagine that experience and notice all the data and observations that make it to the first rung of the ladder.

Now let's see what to focus on in the second row.

Who cares if it's sunny outside and the birds are singing?

A 50% off sign outside your favorite store is meaningless.

Filter the feeling of tighter grip on the steering wheel, feel your blood pressure rise, hear your brakes squeal. And you notice the look on the faces of other drivers who park in front of you and quickly look away.

It's time for the third step.

From an early age, your parents taught you the importance of standing in line and waiting your turn.

Live and die is a first come, first served rule.

And now this man has stolen your seat.

Go to the 4th step.

Watch carefully how our assumptions take over and automatically create stories.

"That idiot, didn't your parents teach you anything?"

How could he not see my traffic lights?

Why does he think he is more important than anyone else? ”

You quickly jump to the 5th row and conclude that this man is ruthless and unsympathetic and should be taught a lesson and replaced.

We feel angry, frustrated, vengeful and justified.

In the sixth step, we adjust our beliefs based on our experience.

"This is the last time you give in!

The next time someone tried to cut me in, there would be tires smoking on the pavement as I squealed past and arrived at my spot. ”

And finally, the last step, we take action.

We backed up, parked behind his car, honked, rolled down the windows, and shouted a few words of choice.

Now imagine him rushing over apologizing.

My wife, who was about to give birth to her first child, called me from inside the mall, telling me that she was going into labor and needed to go to the hospital immediately.

We were momentarily shocked, profusely apologised, and wished him luck as he rushed to our front door.

What happened here?

In the parking lot example, our beliefs were short-circuited by other people's ladders.

"My wife is in labor and I have to get there urgently. Parking is available. Wow!"

Oh crap, I cut someone off.

But what if you could short the ladder yourself?

Willingly and proactively?

guess what? we can!

Let us return to the unique human function of free will.

The next time you find yourself reacting to your experience, focus your attention on the ladder.

Ask yourself what beliefs influence you and where they come from.

What data or observations did you filter as a result of your beliefs, and why?

Are your assumptions valid and supported by facts?

Would a different set of assumptions evoke different emotions, resulting in new and better conclusions and actions?

We all have our own unique ladder.

Take care of yourself and help others understand themselves.

The most important wall in Western history isn't even in the West.

They surround the modern city of Istanbul, which the Romans called Constantinople.

And for a thousand years the fate of Europe depended on them.

Constantinople was designed to be the center of the world.

As the frontiers of the Roman Empire began to crumble in the 4th century, the capital was moved to the cultured, wealthy and still stable east.

At the crossroads of Europe and Asia and at the center of the ancient world's major trade routes, Emperor Constantine founded the city.

This city of libraries and universities was 20 times larger than London or Paris at the time.

It contained valuable knowledge about the classical world that is being lost in the West.

To protect this masterpiece from many enemies, Constantine's successors built the greatest defensive fortress ever built.

The first line of defense was a moat 60 feet wide and 22 feet deep, extending all four miles from coast to coast.

Pipes from the inside of the city could fill the city at a glance of the enemy, and short walls protected archers, allowing them to fire at soaked soldiers trying to swim across.

Those lucky enough to cross the moat had to contend with a constant barrage of fire from the 27-foot-high outer wall above it.

Arrows, spears, or worse, Greek fire, an ancient napalm bomb that ignites on contact and cannot be extinguished by water, will rain down on them.

The Roman defenders carried portable flamethrowers and fired them at anyone who attempted to climb out of the moat.

Terrified victims jumped back only to find themselves still burning in the water.

At times, the Romans mounted siphons on ramparts and fired clay pots filled with Greek fire from catapults at invading forces.

The frontline turns into hell, and it looks as if the earth itself is on fire.

If by some miracle the outer wall is compromised, the attackers are faced with the last line of defense: the great inner wall.

These walls were wide enough for four people to ride side by side, allowing troops to rush where needed.

Attila the Huns, the destroyer of civilization who called himself the Divine Scourge, took one look at them and turned around.

The Avars fought the wall in vain until the catapult rock was gone.

The Turks tried to dig a tunnel under it, but found the foundation too strong.

The Arabs tried to starve the city into submission, but they themselves ran out of food and had to resort to cannibalism.

It took a modern world gun to finally bring them down.

In 1453, the Turks brought a superweapon, a monster cannon capable of firing a 1,500-pound ball of stone over a mile.

Coordinated with more than 100 small artillery, it continued to fire steadily day and night.

Some of the old walls have collapsed, but even in their death throes they proved to be terrifying.

Rubble absorbed the impact of artillery shells better than a solid wall.

It took a month and a half to finally break through.

The last Roman emperor, Constantine XI, vanished into legend when he drew his sword and leaped into the crevice to stop an oncoming horde.

The city was occupied and the Roman Empire finally disappeared.

But there was one last gift in that broken wall.

Survivors carried precious books and ancient traditions with them as they fled the doomed city.

They traveled west to Italy, reintroducing the Greek language and learning to Western Europe and igniting the Renaissance.

We still have a classical past thanks to the walls of Constantinople, the mountains of brick and marble that have protected it for so long.

(zombie voice) Doctor 1: So how did this happen?

Doctor 2: Well, it's my professional opinion that the wide open bite mark on your shoulder might have something to do with it.

D1: Thank you. So what is the cause of the behavioral anomaly?

D2: Well, I know that all behavior is rooted in the brain, so I'm guessing there's probably something terribly wrong going on in the brain.

D1: Thanks again, Dr. Obbias.

Let's be more specific.

What changes must occur in the brain to trigger this kind of behavior?

D2: Hmm. Well, let's see.

The first thing you notice is how it moves.

The legs are stiff, with long, clumsy gait, very slow and clumsy.

Similar to what is seen in Parkinson's disease.

Maybe there's something wrong with the basal ganglia?

These are collections of deep brain regions that regulate movement through a neurochemical called dopamine.

Most people think of dopamine as the brain's "happy" chemical, but in Parkinson's disease, dopamine-containing neurons in the basal ganglia die, and that's why.

It becomes increasingly difficult to take action.

D1: What?

Let's see how it works again. Stiff legs, long postures, this is not Parkinson's disease movement. People with Parkinson's take short steps with a limp, all of which are incorrect.

This is similar to what happens when the cerebellum is damaged.

The cerebellum is a small cauliflower-shaped area at the back of the head, but don't let its size fool you.

That little guy contains almost half of the neurons in your entire brain.

Patients suffering from degeneration of this area, the so-called spinocerebellar ataxia, show a lack of coordination, resulting in stiff legs, a wide stance and a wobbly gait.

My money is on the cerebellum.

D2: Tushe. OK. So I fixed the motor problem.

Now, what about that moaning and lack of dialogue?

D1: Hmm. You know, this sounds like expressive aphasia, or Broca's aphasia, which makes it difficult to say words.

It is caused by damage to the inferior frontal gyrus, or possibly the anterior insula, behind the temple on the left side of the head.

D2: I think you're only half right. Zombies definitely can't communicate, that's for sure.

But they don't seem to get things very well either.

look at this. Hey Walker! Your father smells like elderberry!

(laughs) Do you understand? No reaction.

Either you're not a Monty Python fan or you don't understand what I'm saying.

I think this is exactly like fluent Wernicke's aphasia. It is caused by damage to the junction of the two brain lobes, the temporal and parietal lobes, usually on the left side of the brain.

This area is physically connected to the Broca's area you mentioned by a huge bundle of nerve fibers called the arcuate fasciculus.

I hypothesize that this vast bunch of connections will be completely wiped out by zombies.

It's like pulling a highway between two cities.

One city manufactures the product and another city ships it around the world.

Without that highway, product distribution would simply come to a halt.

D1: So basically it's arguable to reason with Zombies. Because they don't understand you.

D2: (Laughter) I mean, you can try, but I'm going to stay on this side of the glass.

March 17, 73 AD.

We are visiting ancient Rome to see Liberia, an annual festival celebrating Roman civil liberties.

The one we are looking into is a 17-year-old named Lucius Popidius Secundus.

He doesn't come from a poor family, but he lives in a poor neighborhood in Rome, near the city center, called Sebra.

(Gong) The tenants in this apartment are packed and (grunts) This poses a considerable danger.

Fires are frequent and it is not uncommon to smell ash and smoke in the morning.

Awakening at dawn, Lucius must perform his family duties today.

(cheers) His fifteen-year-old brother is coming of age.

This is a particularly important milestone, as half of all children in ancient Rome died before reaching adulthood.

Lucius watches as his brother puts on his new toga, stands in front of a household altar enshrined with a guardian deity, and places his protective amulet bra on the household altar with a prayer of thanksgiving.

Bra was working. That's what saved him.

Unlike many others, he survived to adulthood.

Seventeen-year-old Lucius is nearly finished with his education.

He spoke well, gave public speeches, and learned to read and write Latin and Greek.

His father taught him things he couldn't learn in a classroom, like how to run, how to swim, how to fight.

Lucius became a military tribunal at the age of 17 and could choose to command soldiers at the edge of the empire.

But in another sense, Lucius is still a child.

He has no credit to arrange business deals.

His father will take care of him until he turns 25.

And the father plans to arrange the marriage of Lucius to a girl ten years his junior.

His father has his sights set on a family with a seven-year-old daughter.

Return to Liberia.

The store is open as people go about their business as Lucius leaves with his family.

The streets are filled with peddlers selling trinkets and people bustling to and fro.

Large vans are banned from entering the city until after 9pm, but the streets are still busy.

Fathers and uncles take their children to the Forum Augustus to see statues of famous Roman warriors like Aeneas, the ancestor of Rome, who led the Trojan army into Italy.

and Romulus, the founder of Rome.

And all the great Generals of the Republic over 100 years ago.

We can imagine lovingly fathers and guardians with their adult children recalling the stories of Rome's glory and retelling the good deeds and quotes of past greats, lessons on how to live well and overcome the stupidity of youth.

This place has a sense of history that is relevant to their present.

The Romans built an endless empire in time and space.

(Thump) Rome was destined for eternity by war.

Even in 73 AD, war was real.

Operations are being conducted from northern England to Scotland, north of the Danube to Romania, and east on the border between Syria and Iraq.

It's already eight hours, it's time to go to the bath.

Lucius and his family make their way to Campus Martius and the enormous Agrippa Baths through the wide avenue Via Rata.

Families leave their clients and freedmen outside and enter the bathhouse with their companions.

The bath transforms from a dark and stuffy room into a bright room.

The Romans perfected the glazing.

Everyone moves from a cold room to a warm room to a very hot room.

(man) Oops!

After more than an hour, the bathers were massaged, oiled (whistling) and left to be scrubbed with strigil to remove any remaining dirt.

At nine o'clock, seven hours after leaving the house, the men return for a celebratory dinner.

Dinner takes place in an intimate atmosphere with nine people lying around a low table.

If the diners request more food and wine with gestures, the slaves will attend to any needs.

As the sun goes down, you can hear the roar of wagons outside.

Clients and freedmen, shoved with poor—even if bad—good food, hobbled into lukewarm water and returned to their apartments.

Back at Lucius' house, the booze continues into the night.

Lucius and his brother-in-law are not doing well.

Slaves stand by in case either of them needs to vomit.

Now that I think about it, we know Lucius' future.

Twenty years later, Domitian, the youngest son of Emperor Vespasian, will enforce the reign of terror as emperor.

Will Lucius survive?

(drum)

(Video) Announcer: Ten seconds.

5、4、3、2、1。

official top.

Plus 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Guillaume Néry, France.

No change in weight, 123 meters 3 minutes 25 seconds.

Domestic record challenge.

70 meters.

[123 meters] (Applause) (Video) Judge: White card. Guillaume Nery! National record!

Guillaume Néry: Thank you.

(Applause) Thank you very much for your warm welcome.

The dive you just saw is a journey, a journey between two breaths.

A journey that takes place between two breaths. It's the last breath before diving into the water and the first breath back to the surface.

That dive is a journey to the limits of human potential, a journey into the unknown.

But it's also, and most of all, an inner journey in which many things happen, both physiologically and spiritually.

That's why I'm here today to share and take you on my journey.

So let's start with the last breath.

(Breathe in) (Breathe out) As you can see, the last breath is slow, deep, and intense.

Finally, we use a special technique called Carp. This allows you to compress the air and store an additional 1-2 liters in your lungs.

When you leave the surface, your lungs hold about 10 liters of air.

As soon as you leave the surface, the first mechanism begins - the diving reflex.

The first thing the diving reflex does is slow your heart rate.

My heart rate drops from about 60-70 beats per minute to about 30-40 beats per minute within seconds. almost immediately.

The dive reflex then triggers peripheral vasoconstriction. This means that blood flow leaves the extremities of the body to supply the most vital organs such as the lungs, heart and brain.

This mechanism is innate.

I have no control over it.

Going underwater will experience the exact same effect, even if you've never done it before.

All humans share this trait.

And the amazing thing is that we share this instinct with all marine mammals: dolphins, whales, sea lions.

As they dive deeper, these mechanisms are activated, but to a greater extent.

And of course it works much better for them.

It's really charming.

As soon as I emerge from the surface, nature pushes me in the right direction and I can confidently descend.

So as you dive deeper into the blue, the pressure will slowly start to squeeze your lungs.

And I float by the amount of air in my lungs, so the further down I go, the more pressure I put on my lungs, the less air they contain, and the easier it is for me to fall.

At some point, you don't even need to swim below 35 or 40 meters.

My body is dense and heavy enough to naturally fall into the depths, entering the so-called free-fall phase.

The free fall phase is the most fun part of diving.

That's why I still dive.

Because you feel like you're being pulled down and you don't have to do anything.

You can move from 35 meters to 123 meters without taking any action.

Lose yourself in the depth and feel like you are flying underwater.

It's a really great feeling, an extraordinary sense of freedom.

and continue to slide slowly to the bottom.

At 40m down, 50m down and between 50-60m a second physiological response kicks in.

My lungs have reached a residual volume that, in theory, should not be compressed.

And this second reaction is called a blood change, or "pulmonary erection" in French.

I prefer "Bloodshift".

(Laughter.) So how do blood changes work?

Suction fills the capillaries in the lungs with blood, stiffens the lungs, and prevents the entire chest cavity from collapsing.

It prevents the two walls of the lungs from collapsing, sticking together and collapsing.

This phenomenon, common to marine mammals, keeps me diving.

When you fall to 60 or 70 meters, the pressure will crush your body more and more, so you will fall more and more.

Below 80 meters the pressure is so strong that you start to feel it physically.

I start feeling really short of breath.

I know what it's like, but it's not pretty at all.

Your diaphragm is completely collapsed, your ribcage is compressed, and something is happening mentally.

You might think, "This doesn't look like fun."

How do you do it ”

If I rely on my reflexes on the ground, what should I do on the water when things go wrong?

We resist and oppose it.

Underwater, it doesn't work.

If you attempt it underwater, your lungs may burst, you may vomit blood, edema may develop, and you will have to stop diving for a considerable amount of time.

So what you have to do mentally is tell yourself that nature and the elements are stronger than you.

So I was crushed by the water.

I accept the pressure and work on it.

At this point my body receives this information and my lungs begin to relax.

I let go of all control and relax completely.

I'm feeling overwhelmed by the pressure, but I don't feel bad at all.

It even feels like being in a cocoon and being protected.

And then the diving continues.

80 meters, 85 meters down, 90 meters, 100 meters.

100 meters -- a magic number.

In any sport, it's a magic number.

For swimmers, athletes, and us freedivers, that's a number we all dream of.

Everyone wants to be able to reach 100 meters one day.

This is a symbolic number for us. In the 1970s, doctors and physiologists did the math and predicted that the human body would never dive below 100 meters.

Below that, they said, the human body would collapse.

Then the Frenchman Jacques Mayol – you know him as the main character in The Big Blue – came along and dove to 100 meters.

reached 105 meters.

I was doing "No Limit" at the time.

Just like in the movie, he used weights to descend faster and returned with a balloon.

Today I will dive 200 meters in no limit freediving.

I can reach 123 meters with just muscle strength.

And, in a way, it's all because of him. Because he has challenged the known facts and removed all theoretical beliefs and mental limitations we want to impose upon ourselves.

He showed that the human body has infinite adaptability.

So I keep diving.

105、110、115。

The bottom is near.

120, 123 meters.

I'm the last

And now I would like you to join me and stand in my shoes.

close your eyes.

Imagine reaching 123 meters.

The surface is far away.

you are alone

There is very little light.

It's cold -- it's freezing cold.

The pressure completely crushes you - 13 times stronger than the surface.

And I know what you are thinking. "This is terrible.

what the hell am i doing here?

he's not insane ”

But it's not.

It's not what I think when I'm there.

I feel good when I'm at rock bottom.

I feel this wonderful feeling of happiness.

Maybe it's because I completely let go of all tensions and let myself go.

I don't even need to breathe and I feel great.

You would agree, but I should be concerned.

I feel like a tiny dot, a tiny drop of water, in the middle of the ocean.

And the same image comes to mind every time.

[Pale Blue Dot] It's the little dot that the arrow is pointing to.

do you know what that is?

it is the earth.

Earth photographed by the Voyager spacecraft from 4 billion kilometers away.

And it shows that our homes are those little dots in the middle of nowhere.

That's how I feel when I'm at the lowest point, 123 meters above sea level.

I feel like a small speck, dust, stardust, floating in the middle of the universe, in the void, in the vastness of the universe.

It's a very interesting feeling. Because if you look up, down, left, right, forward or backward, you see the same thing: infinite deep blue.

Nowhere else on earth can you experience this. Look around and see the same thing.

that's abnormal.

And at that moment, even now, I still feel a sense of humility building up inside me.

Looking at this photo makes me feel very humble. It's the same as when you were at rock bottom. Because I am nothing, a little spot of nothingness lost in all of time and space.

And it's still really attractive.

This is not my place, so I decided to return to the ground.

I belong to the earth

So I start going back.

The moment you decide to climb, you get a shock.

First, it takes a lot of effort to get out of the bottom.

It pulled you down on the way up and will do the same on the way up.

You have to swim twice as fast.

Then they are hit with another phenomenon known as narcosis.

I don't know if you've heard of it.

It's called nitrogen narcosis.

This happens to scuba divers, but it can also happen to freedivers.

It is caused by dissolved nitrogen in the blood, causing confusion between the conscious and the unconscious.

Various thoughts run through your head.

You cannot control them and you should not try to control them. You have to let it happen.

The more you try to control, the harder it will be to manage.

Then a third thing happens. It is the desire to breathe.

I am a human, not a fish, and my desire to breathe is a reminder of that fact.

At about 60-70 meters, it starts to become difficult to breathe.

And when other things are happening, you can easily lose your ground and start panicking.

When that happens, we think, "Where's the surface?"

I want to climb I want to breathe now ”

You shouldn't do that.

Never look up at the surface with your eyes or mind.

Never imagine yourself there.

you have to stay in the present.

I saw the rope in front of me and pulled me back to the surface.

And that's what I'm going to focus on right now.

Because when you think about superficial things, you panic.

And when you panic, it's over.

This will speed up the flow of time.

And rescued at 30 meters.

My guardian angel, the Safety Diver, joins me.

They left the surface and we met at 30 meters and escorted me to the last few meters where potential problems could arise.

Every time I see it, I think, "Thanks to you."

I am here because of them and my team.

It restores humility.

Without my team and everyone around me, a deep sea adventure would be impossible.

A trip to the deep sea is above all a group effort.

So I am happy to finish my journey with them. Because without them I wouldn't be here.

Twenty meters, ten meters, the lungs slowly return to normal volume.

Buoyancy pushes me to the surface.

Five meters below the surface, I begin to exhale. As soon as I reach the surface, I just take a breath.

And I arrive on earth.

(Inhale) Air flows into the lungs.

It's like being reborn, and I'm relieved.

It feels good.

The journey has been extraordinary, but you have to feel the tiny oxygen molecules energizing your body.

It's an extraordinary feeling, but it's also traumatic.

As you can imagine, this is a shock to the system.

I went from total darkness to daylight, from the near-silent depths to the hustle and bustle of the summit.

In terms of feel, it ranges from the soft, velvety feel of water to the feel of air rubbing across your face.

As for the smell, it feels like air rushing into your lungs.

And the lungs open up instead.

It was completely collapsed just 90 seconds ago, and now it's open again.

So all this affects quite a few things.

It takes a few seconds to come back and feel 'everything is there' again.

But the judges will be there to check my performance, so it needs to be done quickly. I have to show them that I am in perfect shape.

As you can see in the video, I was doing a so-called exit protocol.

Once on the surface, you have 15 seconds to remove the nose clip, signal and say "I'm fine" (in English).

Additionally, you must be bilingual.

(Laughter) Besides, it's not very good.

Once the protocol is complete, the judge shows me a white card. That's where the fun begins.

We can finally celebrate what happened now.

So the trip I just described is a more extreme version of freediving.

Fortunately, that's not all.

Over the last few years I have tried to show a different side of freediving, as the media is mostly concerned with competitions and records.

But freediving is much more than that.

It's about feeling safe in the water.

So beautiful, so poetic and so artistic.

So my wife and I decided to make a film that would make people want to get in the water and show them the other side.

Let me show you some images to finish my story.

A collection of beautiful underwater photos.

(music) I want you to know that one day, if you try to hold your breath, you will find that when you stop breathing, your thoughts also stop.

It calms me down.

In the 21st century, we are under tremendous pressure.

Our minds are overworked and stressed all the time, thinking we are going a million miles an hour.

Freediving can help you relax your mind, even if it's just for a moment.

Holding your breath underwater means giving yourself the chance to experience weightlessness.

It means being in the water and floating, allowing the body to completely relax and release all tension.

This is our plight in the 21st century. We have stress and tension all the time that makes our backs hurt, our necks hurt, and everything hurts.

But when you're in the water, you can float yourself, as if you were in space.

you completely free yourself.

I feel special.

You will finally be able to face your body, mind and soul.

Everything gets better at once.

Learning how to freedive is also learning how to breathe properly.

We breathe from the first breath when we are born to the last breath.

Breathing gives rhythm to our lives.

Learning to breathe better is learning to live better.

It doesn't necessarily have to be 100 meters deep, but maybe 2-3 meters deep, you can hold your breath, put on goggles and flippers and go to see another world, another universe, something completely magical.

You can see small fish, seaweed, flora and fauna. You can watch it glide through the water, look around, and watch it all come back to the surface without a trace.

It feels great to be one with nature in this way.

And, if I may say one more thing, to hold your breath, to be in the water, to find this underwater world, it's all about connecting with yourself.

You've heard me talk a lot about body memory going back millions of years and going back to marine origins.

The day you return to the water, hold your breath for a few seconds and you will reconnect with their origins.

And I assure you it is absolute magic.

I highly recommend you give it a try.

thank you.

(applause)

Most people have heard of the Electoral College during the presidential election season.

But what exactly is an Electoral College?

Simply put, the group of people appointed by each state to formally elect the President and Vice President of the United States.

To understand how this process began and how it continues today, see the United States Constitution, Articles 2, 1, and 2 of the Constitution.

Specifies the number of entitled electors each state has.

Since 1964, each presidential election has had 538 electors.

How did they decide on the number 538?

The number of electors equals the total number of voters in the United States Congress.

435 members of the House of Representatives, 100 senators, and 3 electors from the District of Columbia.

Essentially, the Democratic and Republican candidates each seek to win the presidency by over half of the 270 electoral votes in each state combined, or 538 votes.

So how do states get electoral votes?

Each state receives a certain number of electors based on population size.

Because the census is taken every 10 years, each state may gain or lose a few electoral votes each time the census is taken.

Let's say you are a California voter with 55 electoral votes.

If a candidate wins in California, that candidate gets all 55 electoral votes in the state.

If the candidate loses, you get nothing.

That's why many presidential candidates want to win states like Texas, Florida and New York.

Now, if you add up the electoral votes in those three states, you get 96 electoral votes.

Even if the candidate wins in North Dakota, South Dakota, Montana, Wyoming, Vermont and New Hampshire. Connecticut and West Virginia only get a total of 31 electoral votes from those eight states.

This is where things get a little tricky.

In rare cases like the year 2000, someone might win the popular vote but not get the 270 electoral votes.

This means that the winner could have won by a small margin and collected the electoral vote and won enough states with just enough electoral votes, but the losing candidate could have won a large margin of votes in the rest of the states.

In this case, the huge margin secured by the losing candidate in other states amounts to more than 50% of the votes cast nationwide.

Therefore, the losing candidate may have won more than 50% of the votes cast by the electorate, but may not have received 270 of the electoral votes.

Some critics of the electoral college system argue that it unfairly favors states with large electoral votes.

Think of it this way.

Even if a candidate does not receive any votes in 39 states or the District of Columbia, he or she can be elected president by winning the popular vote in just 11 of 12 states: California, New York, Texas, Florida, Pennsylvania, Illinois, Ohio, Michigan, New Jersey, North Carolina, Georgia and Virginia.

This is why both sides pay attention to these conditions.

However, some argue that the electoral college protects not only smaller states such as Rhode Island, Vermont, and New Hampshire, but even large, geographically sparsely populated states such as Alaska, Wyoming, and Dakota.

Because every electoral vote counts in a closely contested election, no candidate can completely ignore Koshu.

Certain states have a long history of voting for certain political parties.

These are known as "safe states".

In the last four election cycles (1996, 2000, 2004, 2008), Democrats could count on states like Oregon, Maryland, Michigan and Massachusetts, while Republicans could count on states like Mississippi, Alabama, Kansas and Idaho.

A state that swings between political parties is called a "swing state."

Over the past four election cycles, Ohio and Florida have been battleground states, providing electoral votes to Democratic candidates twice and electoral votes to Republican candidates twice.

please think about it. do you live in a safe state?

If so, is it a safe state for Democrats or Republicans?

do you live in a swing state?

Is Your Neighboring State Unstable or Safe?

Is your state's population increasing or decreasing?

And don't forget. When you're looking at the electoral votes on election night every four years and the big map of the United States pops up on your screen, you know the magic number is 270 and start adding up.

There are approximately 100 billion galaxies in the universe.

Each of these galaxies contains about 100 billion stars.

Many of these stars have planets orbiting them.

So how do we search for life in that vast space?

It's like looking for a needle in trillions of haystacks.

We may want to focus and explore planets that we know can sustain life as we know it, the habitable worlds.

What would such a planet look like?

To answer that question, we don't look there.

Instead, we look at ourselves. on earth.

Because this is the only planet in the universe that is known with certainty to be habitable.

If you look at the earth from space, you will see a world of blue water.

It's no coincidence that three-fourths of the earth's surface is covered by ocean.

Due to its unique chemical and physical properties, water is absolutely essential for all life as we know it.

That's why we're especially excited about other worlds where water is plentiful.

Fortunately, water is very common in space.

But life requires water in liquid form rather than ice or steam, which is a little less common.

For liquid water to exist on the planet's surface, three things are important.

First, the planet must be large enough to prevent water molecules from being splattered into space by gravity.

For example, Mars is smaller than Earth and therefore has less gravity, which is one important reason why Mars has a very thin atmosphere and no oceans on its surface.

Second, a planet needs an atmosphere. why?

Because without an atmosphere, the Earth would be in a vacuum, and liquid water would not be stable in a vacuum.

For example, our Moon has no atmosphere, so if you spill water on it, it will either boil as steam or freeze as a solid into ice.

Liquid water cannot exist without atmospheric pressure.

Third, the planet must be at the proper distance from its star.

If you get too close, the surface temperature will exceed the boiling point of water, and the ocean will turn to steam.

Too far and the surface temperature drops below the freezing point of water and the ocean turns into ice.

fire or ice In life as we know it, neither is enough.

We can imagine that the perfect zone, where water remains liquid, looks like a belt around the star.

We call that belt the habitable zone.

Therefore, when we look for habitable worlds, we always want to look for planets in habitable zones around stars.

These regions are the best places to find Earth-like planets.

But while the habitable zone is a great place to start exploring life on planets, it also presents some complications.

First, just because a planet is in the habitable zone doesn't mean it's habitable.

Consider Venus in our solar system.

If you're an alien astronomer, you'd think Venus is a pretty good bet in life.

It's a good size, atmospheric and in a sun habitable area.

Alien astronomers may view it as Earth's twin.

But Venus is not habitable, at least not on its surface.

Not by life as we know it. Too hot.

That's because Venus' atmosphere is filled with carbon dioxide, an important greenhouse gas.

In fact, its atmosphere is composed almost entirely of carbon dioxide and is almost 100 times thicker than ours.

As a result, the temperature of Venus becomes hot enough to melt lead, leaving Venus dry as bone.

So finding a planet with the right size and distance from its star is just the beginning.

I would also like to know about their atmosphere composition.

A second complication becomes apparent when we look a little deeper into the Earth.

Over the past 30 years, we have discovered microbes that live in all kinds of extreme environments.

We find them in cracks in rock miles below our feet, in boiling water on the ocean floor, in the acidic waters of hot springs, and in droplets of clouds miles above us.

Such so-called extremophiles are not uncommon.

Some scientists estimate that the mass of microbes living deep underground is equal to the mass of all life on the surface.

These underground microbes don't need the sea or the sun.

These findings suggest that Earth-like planets may be just the tip of the astrobiological iceberg.

Life may persist in aquifers beneath the surface of Mars.

Microorganisms could thrive on Jupiter's moon Europa, which probably has a liquid water ocean beneath its icy crust.

Another ocean beneath the surface of Saturn's moon Enceladus is the source of geysers that erupt into space.

Are these geysers raining microbes?

Why not jump over them and find out?

And what about life unknown to us that uses liquids other than water?

Maybe we are crazy creatures living in abnormal and extreme environments.

Perhaps the true habitable zone is very large, with billions of needles in trillions of haystacks.

Perhaps, in the big picture, Earth is just one of many different kinds of habitable worlds.

The only way to know it is to go out and explore.

The literary critic Northrop Fry once remarked that in our primeval times, literary heroes--well, they were close to gods--but as civilization progressed, they kind of descended down the mountain of gods, becoming more human, more flawed, less heroic.

From divine heroes like Hercules, under the mountain there are miraculous but mortal heroes like Beowulf, great leaders like King Arthur, and great but flawed heroes like Macbeth and Othello.

Harry Potter, Luke Skywalker, Hiccup, and other unlikely but eventual heroes, until you reach the deep end and meet the anti-heroes.

Contrary to what it sounds like, antiheroes are neither villains nor adversaries.

In some works of contemporary literature, antiheroes are actually the protagonists.

Fahrenheit 451's Guy Montag and 1984's Winston Smith unwittingly challenge those in power -- those who abuse their power to brainwash the masses into believing that society's ills are gone.

Ideally, those who challenge the regime should be wise, confident, brave, physically strong, and have the charisma to inspire their followers.

However, this anti-hero exhibits some underdeveloped traits at best and utter incompetence at worst.

Most antihero stories unfold like this.

Antiheroes initially unwittingly accept preconceived notions and conform as typical, unsuspecting, brainwashed members of society.

Antiheroes struggle to conform, but all the while begin to disagree, perhaps finding other outsiders who can voice their doubts, naively and wisely sharing those doubts with authority figures.

Antiheroes openly challenge society and attempt to combat the lies and tactics used to suppress the masses.

For antiheroes, this step is rarely a matter of brave, wise and heroic opposition.

Perhaps the anti-hero will succeed in fighting and overthrowing an oppressive government with improbably good luck.

Perhaps he or she runs away and runs off to fight another day.

But more often than not, antiheroes are killed or brainwashed to follow the populace.

There are no heroic victories here, no brave individuals confronting the inhuman institutions of the modern world, no inspiring others to fight, no tactful outsmarting the hordes of an evil empire.

Our storytelling ancestors gave us Hercules and other heroes strong enough to fight the demons and monsters that supposedly haunt the night beyond the campfire, alleviating our fear of powerlessness.

But eventually we realized that the monster wasn't there, it lived inside us.

Beowulf's greatest enemy was mortality.

Jealousy of Othello.

Hiccups, self-doubt.

And in the tales of the helpless antiheroes of Guy Montag and Winston Smith, hidden is the warning of a modern narrator who plays with a very primitive horror: we are not strong enough to slay monsters.

Only this time, it wasn't the monster that was chased away by the campfire, but the monster that created the campfire in the first place.

She's just a few feet away.

As he gets closer, he becomes more and more nervous, and the pimple that has sprouted on his nose grows bigger and bigger, eventually obscuring his face.

She looked at him hovering nearby and laughed at the giant pimples.

He felt sick and fell down.

Stress can certainly cause confusion, and it happens to teens and adults alike.

But how does that happen?

Let's rewind to before acne, before Justin met someone he liked.

Already late for school, Justin arrived at class just in time to hear the teacher say "pop quiz."

He hadn't done his homework the night before, which made him feel less prepared than The Ambushed Soldiers of World War II, which he was supposed to write.

A sudden panic gripped his body, his palms sweaty, his head cloudy, and his heart pounding.

He staggers out of class in a dazed state and rushes over to the person he's always had a crush on, adding to his stress.

Stress is a common biological response to potential danger.

In primitive caveman terms, stress can cause you to fight for your life or flee for your life if you encounter, say, a hungry saber-toothed tiger.

The term “fight or flight” comes from the fact that special chemicals called stress hormones flow through our bodies, giving us more oxygen and the strength to escape from danger or to face danger and fight for our lives.

But if you don't fight or run away, you will face a predicament.

We internalize stress when we're taking final exams, sitting in traffic, or thinking about environmental pollution.

Everything starts with the brain.

The master controller of hormones, the hypothalamus, releases something called adrenocorticotropin-releasing hormone.

This triggers the release of adrenocorticotropic hormone from the pituitary gland, a pea-sized gland at the base of the brain, which stimulates the adrenal glands above the kidneys to release cortisol, the main stress hormone.

These natural chemicals are very helpful when you need to run away in a hurry or perform feats of superhuman courage, but just sitting around allows these stress hormones to build up in your body and affect your overall health.

Stress hormones increase inflammation in the body and suppress the immune system, making you more susceptible to infection from acne-causing bacteria, and may even increase oil production in your skin.

And this is the perfect storm to form acne.

Cortisol is the main stress hormone responsible for skin cells producing large amounts of oily lipids from special glands called sebaceous glands.

But too much of these oily lipids, called sebum, clogs swollen and inflamed pores, trapping pesky acne-causing bacteria inside where they can take up residence and thrive.

Add a dash of pro-inflammatory neuropeptides released by the nervous system when you're tense, and rage-filled acne ensues.

To make matters worse, Justin is a boy, so he has more testosterone than a girl.

Testosterone is another hormone that increases oil production in the skin.

So his naturally oily skin, combined with increased oiliness and stress-induced inflammation, is the perfect environment for bacteria to swell, swell, and swell into big pimples.

So what could Justin do to avoid big pimples?

Stressful situations are inevitable.

But you can change your response to make it less stressful in the end.

And if he had approached her with confidence, she might not have noticed the pimples, and he might not have had them either.

Dialogue adds color to the story, excites it, and moves it forward.

Romeo: Oh, you leave me so unhappy?

Juliet: What kind of satisfaction do you get tonight?

Romeo: The exchange of fidelity vows of your love and my vows.

No dialogue: (Crickets sound) So how do you write effective dialogue?

Well, you have social skills. Making friends, resolving conflicts, being nice and polite.

I will not use any of them today.

Instead, we'll call them "anti-social skills."

If you are a writer, you may already have some of these.

The first is eavesdropping.

If you hear an interesting conversation while riding the bus, you can write it all down.

Of course, when you write fiction, you are creating a character, not portraying a real person.

But sometimes the words we hear give rise to ideas.

"I didn't," says one.

“I see,” replies the other.

Who says those words?

Perhaps there are two children in the class and the boy thinks that the girl imposes himself.

Perhaps it's a couple, but one of them is a vampire, and a female vampire witnessed a man flirting with a zombie.

or maybe not.

The characters are supposedly a teenager and his mother, who are supposed to be vegetarians, but her mother sees him eating a hamburger.

So let's say you've decided on some characters.

This is the second antisocial skill. Start pretending to be real.

What are they like? where are they from what kind of music do they listen to?

Spend time with them.

If you are on the bus, consider what they would do if they were there too.

Do you talk on the phone, listen to music, draw, sleep?

What we say depends on who we are.

Older people may speak differently than younger people.

People from the south may speak differently than people from the north.

Understanding the characters allows you to understand how they speak.

At this stage, it's helpful to use anti-social skill #3, mumbling to yourself.

As you speak your character's words, listen to them to see if they sound natural, and correct them if necessary.

Most people usually speak in a very informal manner.

They use simple language and abbreviations.

So "Don't lie to me" sounds more natural than "Don't lie to me."

Also, keep it short.

People tend to speak in short bursts rather than long speeches.

And let the dialogue do the work.

Ask yourself, "Is that adverb really necessary?"

For example, "'Money or life,' she said threateningly."

Here, "threateningly" is redundant and can be safely removed.

However, adverbs can be helpful when words and actions don't match.

"'Money or life,' she said lovingly."

To summarize, the first is eavesdropping. Now assume that the fictional character is real.

Finally, mutter to yourself and write it all down.

You already have everything you need.

This is an imaginary dialogue, or "a way to hear voices in your head."

The periodic table is immediately recognizable.

It's used in t-shirts, coffee mugs, and shower curtains, as well as in every chemistry lab around the world.

But the periodic table is more than just a trendy icon.

This is a colossal piece of human genius alongside the Taj Mahal, Mona Lisa and Ice Cream Sandwich. And the creator of this table, Dmitri Mendeleev, is a bona fide Hall of Famer.

but why? What's so great about him and his table?

Is it because he made a comprehensive list of known elements?

No, just making a list doesn't get you a spot in Science Valhalla.

Besides, Mendeleev wasn't the first to do it.

Is it because Mendeleev arranged elements with similar properties?

No, it was already done.

So what was Mendeleev's genius?

Let's take a look at one of the first versions of the periodic table, circa 1870.

Here, elements designated by two-letter symbols are placed in a table.

Check the entry in column 3, row 5.

There you will find the dash.

From that understated placeholder comes Mendeleev's unvarnished brilliance.

That dash is science.

By putting a dash in there, Dmitri is making a bold statement.

He said -- and I'm paraphrasing here -- you haven't discovered this factor yet. I'll give it a name for now.

We call it Eka aluminum because it is a step away from aluminum. "Eka" is a Sanskrit word.

No one has discovered Eka Aluminum yet, so we have no idea about it, right?

error! Based on where it is, I can tell you all about it.

First, an atom of ekaaluminum has an atomic weight of 68, about 68 times that of a hydrogen atom.

Isolation of ekaaluminum reveals it to be a solid metal at room temperature.

It is lustrous, has excellent thermal conductivity, and can be flattened into sheets or stretched into wires, but has a low melting point. Like, unusually low.

Oh, 1 cubic centimeter weighs 6 grams.

Mendeleev was able to predict all of this simply from his understanding of where the void was and how the elements around it behaved.

A few years after this prediction, a Frenchman named Paul Emile Lecoq de Boisbaudelin discovered a new element in an ore sample and named it gallium after the historical French name Gallia.

Gallium is one step ahead of aluminum on the periodic table.

Eka aluminum. So were Mendeleev's predictions correct?

Gallium has an atomic weight of 69.72.

One cubic centimeter weighs 5.9 grams.

It is a solid metal at room temperature, but melts at 30 degrees Celsius and 85 degrees Fahrenheit.

It melts in your mouth and in your hands.

Mendeleev not only fully succeeded with gallium, but also predicted other elements unknown at the time: scandium, germanium and rhenium.

The element he called ekamanganese is now called technetium.

Technetium is so rare that it could not be isolated until it was synthesized in a cyclotron in 1937, some 70 years after Dmitri predicted its existence and 30 years after his death.

Dmitri died in 1907 without a Nobel Prize, but ultimately received a much more exclusive honor.

In 1955, scientists at the University of California, Berkeley, created 17 atoms of a previously undiscovered element.

The element filled the empty spot at number 101 in the periodic table and was officially named mendelevium in 1963.

Although there are well over 800 Nobel Prize winners, only 15 scientists have been named after them.

So the next time you stare at the periodic table, whether it's on the wall of a college classroom or on your $5 coffee mug, its designer, Dmitri Mendeleev, will be staring back.

Chris Anderson: We might start by talking about your country.

There are three dots on the planet. Those dots are pretty big.

I think each area is about the size of California.

Please tell me about Kiribati.

Anote Tong: Well, first of all let me say how deeply grateful I am for this opportunity to share my story with those who care.

I think I've shared my story with a lot of people who don't really care.

However, Kiribati is made up of three groups of islands. The Gilbert Islands in the west, the Phoenix Islands in the center, and the Line Islands in the east.

And, frankly, Kiribati is probably the only country that actually has four corners of the world. Kiribati is located in the northern hemisphere, the southern hemisphere, and east and west of the International Date Line.

These islands are all made up of coral atolls and are about 2 meters above sea level on average.

And this is what we have.

The width usually does not exceed 2 kilometers.

So people have asked me, "You're in pain, why should you back down?"

they don't understand

They have no idea what's involved.

The sea is rising and they say, "Well, you can go down."

So I say to them:

If you step back, you will fall to the other side of the sea. OK?

But these are the kinds of problems people don't understand.

CA: Sure, it's just a drawing of a vulnerability.

When did you yourself realize that your country might be in imminent danger?

AT: Well, the climate change story has been going on for decades.

And when I took office in 2003, I started speaking to the United Nations General Assembly about climate change, but not with much passion. Because at that time there was still a debate among scientists whether it was man-made, real or not.

However, I think the debate was largely settled in the 2007 IPCC Fourth Assessment Report. The report asserted that this was real, man-made, and predicted a very serious scenario for countries like ours.

So I got very serious.

I talked about it before.

we were worried.

But when the scenarios and forecasts came out in 2007, it became a real issue for us.

CA: Well, I think these projections are projecting sea levels to rise maybe 3 feet by 2100.

Of course, there are scenarios where it goes higher than that, but what do you say to the skeptics who say, "What is 3 feet?"

Average 6 feet above sea level.

what happened? "

AT: Well, much of the land is low, so I think we need to understand that a small rise in sea level means that a lot of land is lost.

And quite apart from that, right now we are feeling the swell.

It's not about getting two legs.

I think what a lot of people don't understand is that they think climate change is something that will happen in the future.

Well, we are at the bottom of the spectrum.

It's already with us.

Some communities have already dislocated themselves.

They have had to relocate, and with each Congress there are complaints from various communities asking for help building a seawall and wanting to know what can be done since the freshwater lens has been destroyed. So in my travels to various islands, I see evidence of communities having to contend with loss of food crops and contamination of water lenses. Perhaps these communities will likely be forced to relocate within five to ten years, and we will see them leave.

CA: So, I think this country had its first cyclone, and that has something to do with it. what happened here?

AT: Well, we're on the equator, and I think a lot of people understand that there should be no wind on the equator. No cyclone is coming.

We create them and send them north or south.

(Laughter) But they're not coming back.

But earlier this year, for the first time, Cyclone Pam devastated Vanuatu, and in the process, its ends actually reached two of our southernmost islands, submerging all of Tuvalu when Hurricane Pam hit.

But on our two southernmost islands, this has never happened before, as the waves have crossed over half the islands.

It's a new experience.

And I have just returned from my constituency to see the beautiful trees that have been there for decades completely destroyed.

This is what is happening now, but when we talk about sea level rise, we think of it as something that happens gradually.

With winds and swells, the impact could be even greater, but what we are beginning to see is a change in weather patterns, perhaps an urgent challenge that we will face sooner than sea level rise.

CA: So you're already seeing results in this country?

Looking ahead, what options do we have as a country, as a nation?

AT: Well, I tell this story every year.

I have traveled all over the world trying to make people understand.

We have a plan and we think we have a plan.

One time, I think I spoke in Geneva, there was a gentleman who was interviewing me about this sort of thing, and I said, 'We're looking at floating islands,' and he thought it was funny, but somebody said, 'No, it's not funny, they're looking for a solution.'

So I've been observing floating islands.

The Japanese are interested in building floating islands.

But we, as a nation, have committed ourselves to exist and continue to exist as a nation as long as we can, no matter what happens.

What it takes, it will be very important, very substantial.

We live on floating islands or have to build islands to keep us out of the water when sea levels rise and storms intensify.

But even then it will be very difficult to get the kind of resources we need.

CA: And the only way out is some form of forced relocation.

AT: Well, we're looking into that too. Because we are prepared in case there is no offer from the international community and we do not want to be caught like what is happening in Europe.

OK? We don't want mass migration at some point.

We want to give the people of today, the people who choose and want to migrate, the option to migrate.

I don't want to be forced to emigrate when I'm not ready.

Of course, our cultures are very different, our societies are very different, and moving to a different environment, a different culture requires a lot of adjustments.

CA: Well, your country has had forced migration in the past. I think you visited these people just this week, yesterday or the day before yesterday.

what happened here? what is the story here?

AT: Yes, I'm sorry, but I think someone was asking why we were secretly visiting the place.

There is a Kiribati community living in that part of the Solomon Islands, and this was for good reason. But they were in fact immigrants from the Phoenix Islands in the 1960s.

A severe drought occurred, and people could no longer live on the islands, so they migrated here to the Solomon Islands.

So it was very interesting to meet these people yesterday.

They didn't know who I was. they hadn't heard of me.

Some of them recognized me later, and I think they were very pleased.

After that, they really wanted the chance to welcome me formally.

But I think what I saw yesterday was very interesting. Because here are our people.

I spoke in our language and of course they spoke back, they answered, but their accent, they are starting to be unable to speak Kiribati properly.

I looked at them and saw a woman with red teeth.

She used to chew on betel nuts, which we don't do in Kiribati.

We do not chew betel nuts.

I have also met families here who have married locals and this is what is happening now.

When you enter another community, change always happens.

Some degree of identity loss is inevitable and this is what we will be looking for if we migrate in the future.

CA: It must have just been a very emotional day because of these questions about identity, the joy of meeting you, and perhaps the heightened sense of what they've lost.

And it is very encouraging to hear you say that you are going to fight to the end to defend your country somewhere.

AT: This is our wish.

This was a very difficult decision for me as I don't think anyone wants to leave the house.

As a leader, you don't make plans to leave your island, your home, so many times I've been asked, "So how are you feeling?"

And it doesn't feel good at all.

It's an emotional thing and I've tried to endure it, but I know that sometimes I'm accused of not trying to solve a problem just because I can't solve it.

It's something you have to do as a group.

Climate change is a global phenomenon, and as I have often argued, when you come to the United Nations, unfortunately, countries — I was at a meeting with the Pacific Islands Forum countries, which Australia and New Zealand are also members of — had discussions.

It was a bit of news because they argued that it could not be done to reduce emissions because it would affect the industry.

So I said here, okay, I hear you, I understand what you're saying, but try to understand what I'm saying too, because if you don't cut your emissions, our survival is at stake.

So it's your own business to weigh these moral issues.

It's about industry, not people's survival.

CA: Yesterday, when I asked him what made him angry, he said, "I'm not angry." But then you stopped.

I think this made you angry.

AT: I would like to refer to my previous remarks at the United Nations.

I was so angry, so frustrated, and depressed.

There was a sense of emptiness that I was fighting a battle that I had no chance of winning.

I had to change my approach.

I had to be more rational because I thought people would listen to a rational person, but whatever it is, I remain thoroughly rational.

(laughter) CA: Well, the core of your national identity is fishing.

I think almost everyone said that they were involved in fishing in some way.

AT: Well, we eat fish every day, and I'm pretty sure we have probably the highest rate of fish consumption in the world.

Since there are few livestock, fish are the most reliable.

CA: You say that both at the regional level and the income that countries receive from the global tuna fishery depend on fish, and yet you took a very drastic step a few years ago.

can you tell me about that?

I think something happened here in the Phoenix Islands.

AT: Let me give you some background on what fish means to us.

We remain the world's largest tuna fishery.

In the Pacific, I think we own about 60 percent of the remaining tuna fisheries. And while it remains relatively healthy for some species, not all.

And Kiribati is one of the three major resource countries and tuna resource owners.

And at the moment, 80-90% of our revenue comes from access and license fees.

CA: National income.

AT: Governments, hospitals, schools, everything we do is driven by national income.

However, we decided to close this one, which was a very difficult decision.

I can assure you that it has not been easy, both politically and regionally, but I am convinced that it must be done to keep the fisheries sustainable.

There have been some indications that some species, especially bigeyes, are seriously threatened.

Yellowfin was also caught well.

Bonito is still fine.

So we had to do something like that and that was why I did.

Another reason I did that was because I was appealing to the international community that in order to deal with climate change, there must be sacrifices and commitments to fight climate change.

Therefore, I thought that if we were to ask the international community to make sacrifices, we would have to make the same sacrifices ourselves.

So we made a sacrifice.

And the suspension of commercial fishing in the Phoenix Islands Protected Area means lost income.

We are still assessing what that loss will be like as we actually closed earlier this year. So we will know by the end of the year what that means in terms of lost revenue.

CA: So there are so many things involved in this.

On the other hand, it also has the potential to promote fisheries health.

In other words, how much can you increase the price for the rest of the area?

AT: Negotiations were very difficult, but we managed to raise the shipping cost for one day.

We have increased our rates from $6,000 and $8,000 to now $10,000 and $12,000 per boat for a day of fishing.

And we've seen a significant increase in that.

At the same time, however, it is important to note that whereas previously these vessels may have fished and caught 10 tons in a day, they are now so efficient that they are probably catching 100 tons.

Therefore, we must do the same.

Technology is so advanced that we have to be very careful.

There was a time when the Brazilian fleet moved from the Atlantic to the Pacific.

I couldn't do that.

They themselves began experimenting with what they could.

But now there is a way to do it, and it's very efficient.

CA: Can you tell us what those negotiations are like?

Because, essentially, you're playing against a company with hundreds of millions of dollars at stake.

How do you hold the line?

Do you have any advice for other leaders doing business with the same companies on how to get the most profit for their country, how to get the most profit for their fish?

What advice would you give?

AT: Well, I think we're focusing too much on licensing to get the rate of return. That's because what we get from license fees is about 10 percent of what we land on the wharf side of the catch, not the retail outlets.

And you only get 10% or so.

What we have tried to do over the years is really increase our participation in the industry, harvesting, processing and ultimately marketing.

It's not easy to infiltrate, but we are working towards it and the answer is to strengthen.

We need to be more involved in order to increase the rate of return.

So we started it and we have to rebuild the industry.

We have to tell these people that the world has changed.

Now we want to produce our own fish.

CA: On the other hand, the local fishermen are still fishing, what is the business like for them?

Is it getting harder? Are you running out of water?

Or is it operating on a sustainable basis?

AT: For artisanal fisheries, we do not participate in commercial fishing activities, except only to supply the domestic market.

The tuna fishery is actually completely for foreign markets, mainly here in the US, Europe and Japan.

I used to be a fisherman and I used to be able to catch yellowfin tuna.

Currently, catches of yellowfin are extremely rare as they are pulled out of the water in hundreds of tonnes by purse seine vessels.

CA: Now, let me introduce you to some beautiful girls from your country.

I mean, what message do you want to give to them and to the world when you think about their future?

AT: Well, I've been telling the world that we really have to do something about climate change. For us, it is about the future of our children.

I have at least 12 grandchildren.

My wife knows, I think I have 12 of them.

(Laughs) And I have eight kids, I think.

It's about their future.

Every day I see grandchildren about the same age as these young girls, and it makes me wonder and sometimes angry.

what will happen to them?

Climate change is, unfortunately, viewed by many countries as a national issue, so it is about them that we should tell everyone that this is not about their own national interests. it's not.

This is a recent discussion we had with our Australian and New Zealand partners. Because they said, "We can't cut it any further."

This is what one of the leaders, the Australian leader, said, we have done our part, we are making cuts.

I said, "What about the rest?" Why not keep it?

If we can keep the rest of our emissions within our borders, within our borders, we will have no questions.

Proceed as far as you like.

But unfortunately you guys are sending it to us and it is affecting the future of our children.

And I believe that is at the heart of today's climate change problem.

We will meet in Paris at the end of this year, but until we can think of this as a global phenomenon, we are creating it as individuals, as a nation, affecting everyone else, and we refuse to do anything about it, treating it as a national problem, but it is not. This is a global problem and must be addressed collectively.

CA: People are very bad at reacting to graphs and numbers, and we close our minds to it.

Somehow, with people, we sometimes respond well to it.

And despite the serious problems you face, it seems very likely that your country is the most visible and most powerful warning light to the world.

I would like to thank you on behalf of all of us for your extraordinary leadership and for being here.

President, thank you very much.

AT: Thank you.

(applause)

Let's start with a challenge.

Imagine each of these two scenes in as much detail as possible.

Scene 1: "They welcomed us wholeheartedly."

Now, who are the people who welcome you wholeheartedly?

what are they wearing

what are they drinking

OK, scene 2: "They welcomed us wholeheartedly."

How are these people standing?

What kind of expressions do they have on their faces?

what are they wearing and what are they drinking?

Visualize these pictures in your mind and write down a sentence or two to describe them.

We'll talk about them later.

Now let's move on to our story.

in 400 AD

The Celts of Britain were ruled by the Romans.

This had one advantage for the Celts. The Romans protected the Celts from the barbaric Saxon tribes of northern Europe.

But then the Roman Empire began to crumble and the Romans withdrew from Britain.

With the Romans gone, the Germanic tribes, Angles, Saxons, Jutes, and Frisians quickly crossed the seas to eliminate the Celts and form kingdoms in Britain.

For several centuries these tribes lived in England and their Germanic language, Anglo-Saxon, became the common language, the so-called Old English.

Old English may sound like a different language to modern English speakers, but if you look and listen closely, you will find that there are many words that you can recognize.

For example, the Lord's Prayer in Old English goes like this:

It may look unfamiliar at first glance, but with a little spelling update, you'll see a lot of common English words.

The English thus happily spoke Old English for centuries, until a series of Viking invasions began in the 700s, until a treaty split the island in half.

On one side were the Saxons.

On the other side were the Danes who spoke a language called Old Norse.

As Saxons fell in love with their pretty Danish neighbors and marriage blurred the boundaries, Old Norse mixed with Old English, and many Old Norse words such as freckles, legs, roots, skin, and scarcity are still part of our language.

300 years later, in 1066, the Norman conquest brought war to Britain again.

The Normans were Vikings who settled in France.

They ditched their Viking language and culture in favor of a French lifestyle, but still fought like Vikings.

They installed Norman kings on the English throne, and for three centuries French was the language of the English royal family.

British society now has two levels: the French-speaking aristocrats and the Old English-speaking peasants.

The French also took many Roman Catholic clergymen who mixed Latin.

Old English adapted and grew as thousands of words flowed in, many of which concerned government, law, and nobility.

Words such as Council, Marriage, Sovereignty, Governance, Damage, Parliament.

As the language expanded, English speakers quickly realized what to do if they wanted to sound sophisticated. This means using words that come from French or Latin.

The Anglo-Saxon language seemed so plain, like an Anglo-Saxon peasant speaking it.

Let's go back to the two sentences we just considered.

When you think of a warm welcome, have you ever seen the simple sight of relatives hugging and talking loudly?

were they drinking beer?

Were they wearing lumberjack shirts and jeans?

And what about a cordial welcome?

I'm sure you were imagining more elegant and sophisticated people.

Blazers and skirts, wine and caviar.

why is this?

How can phrases that are considered almost synonymous in dictionaries evoke so different images and emotions?

Both "sincerely" and "welcome" are Saxon.

"Cordial" and "reception" come from French.

Words of French origin have strong connotations of nobility and authority.

And the connotations of peasant, real people, and salt of the earth persist around the Saxon language.

Even if you've never heard this history before, its memory remains as emotion evoked by the words you speak.

On some level, it's a story you already knew. Because our history lives in the words we speak and hear, whether we are consciously aware of it or only unconsciously.

We all start life as one single cell.

Then that cell divides into 2 cells, then into 4 cells, then into 8 cells.

Cells form tissues, tissues form organs, and organs form us.

These cell divisions in which we grow from a single cell to 100 trillion cells are called growth.

And when we think of growth, we usually think of someone getting taller or wider later in life, so growing seems like an easy thing to do, but it's not simple for cells.

Cell division is a complex chemical dance, partly individual, partly community driven.

And in the neighborhood of 100 trillion cells, problems can arise.

Presumably, typos, so-called mutations, can occur in the set of instructions, or DNA, of an individual cell.

In most cases, either the cell senses the mistake and shuts down, or the system detects and eliminates the troublemaker.

However, a sufficient number of mutations can circumvent the failsafe and cause the cell to divide recklessly.

That one bad cell becomes two, then four, then eight.

At every stage, false instructions are passed on to the cell's progeny.

Weeks, months, or years after a single rogue cell changes, you may see a doctor for a lump in your breast.

If you have trouble going to the toilet, it may turn out to be a problem with your bowel, prostate or bladder.

Alternatively, routine blood tests may show too many white blood cells or elevated liver enzymes.

Doctors give you bad news, it's cancer.

Strategies from here depend on where the cancer is and how advanced it is.

Even if the tumor is slow-growing and concentrated in one area, surgery may be the only option.

If the tumor is growing rapidly or has invaded nearby tissue, the doctor may recommend radiation or radiation after surgery.

If the cancer has metastasized, or is ubiquitous in nature, like leukemia, doctors are more likely to recommend chemotherapy or radiation plus chemotherapy.

Radiation and most chemotherapy work by physically chopping up a cell's DNA and disrupting the copying machinery.

However, neither radiation nor chemotherapy drugs target cancer cells alone.

The radiation hits what you aim at, and your bloodstream carries the chemotherapy drugs throughout your body.

But what if different cells are attacked?

Let's look at healthy liver cells, healthy hair cells, and cancer cells.

Healthy liver cells divide only when stressed. Healthy hair cells divide frequently. And cancer cells divide more often and recklessly.

When you take chemotherapy drugs, all these cells are attacked.

And remember, drugs usually work by interfering with cell division.

Therefore, every time a cell divides, it exposes itself to attack. In other words, the more frequently a cell divides, the more likely the drug will kill it.

So, do you remember hair cells?

Not a threat as it splits frequently.

There are also other cells in the body that divide frequently, such as skin cells, intestinal cells, and blood cells.

The list of unpleasant side effects of cancer treatment is therefore similar to tissue types, such as hair loss, skin rashes, nausea, vomiting, fatigue, weight loss, and pain.

This is not surprising, as these cells are the most damaged.

So, in the end, it's all about growth.

Cancer hijacks the cell's natural division machinery, causing it to pedal and proliferate rapidly and recklessly.

But chemotherapeutic drugs take advantage of their aggressiveness and turn cancer's main strength into a weakness.

Imagine this. You and your friends are watching a sitcom when your cheeky sidekick walks into the room with a four-tiered wedding cake.

He stumbles, falls, and plunges his face into the cake.

Your friend doubles down on laughter and says, "That's so ridiculous! It's so ironic!"

Now, quickly, what are you going to do?

Will you laugh along with the laugh track and ignore this grave misunderstanding of sarcasm?

Or do you defy caution and explain the true meaning of sarcasm?

If you were me, I would choose the latter.

Unfortunately, the sarcasm is completely misunderstood.

When we see something funny or accidental, we tend to spit out the words.

And while many examples of true sarcasm are funny, that's not what drives sarcasm.

The situation becomes ironic when the opposite happens.

It's ironic if you expected an A and got a B .

Take the slapstick cake situation as an example.

It's funny, but not ironic, when someone walks in and trips, falls, or messes up something that you shouldn't be carrying alone.

In fact, you might imagine someone tripping while carrying a large cake alone.

Then reality matches expectations, so it's not ironic.

But what if this cheeky sidekick showed up wearing the gold medal he won in cake walking at the 1996 Atlanta Olympics?

What if that buddy is a professional cake hauler?

Then there might have been a reasonable expectation that he would be more skilled when carrying ridiculously large cakes.

And when that reasonable expectation was not met by a stumbling buddy, it would epitomize irony.

Another example.

Seniors writing text messages and blogs.

A common and reasonable expectation of more mature men and women is that they don't like technology, aren't tech savvy, have difficulty turning on computers, or have an old 1980s cell phone.

You shouldn't expect them to be connected, high-tech, or knowledgeable enough to write emails and blogs. It must seem like some kind of new thing that they never had "in my time".

So when grandmas pull out their smartphones to post pictures of their dentures and grandchildren, something ironic happens.

Reasonable expectations of the situation have not been met.

That's ironic.

I mean, cake droppers may not be ironic, but there are all sorts of situations in life that deserve irony.

Go out and find a true example of sarcasm.

Your company will start searching for open positions.

Applications are opened and qualified candidates are identified.

Now the selection begins.

Person A: Ivy League, 4.0, perfect resume, great recommendation.

everything is correct.

Person B: Attends state school, has done a fair amount of job hunting, and has odd jobs such as cashier and singing waitress.

But remember that both are eligible.

So I ask you: Who are you going to choose?

My colleagues and I have created a very formal term for two different categories of candidates.

We call A the "silver spoon". Someone who had obvious advantages and was destined for success.

And we call B the "Scrapper". A man who had to fight tremendous hardships to get to the same point.

I just heard the HR director call people silver spoons and scrappers -- (Laughter) This sounds a little critical, not politically accurate.

But before my personnel certification is revoked -- (Laughter) let me explain.

A resume tells a story.

And over the years, I've learned something about people having experiences like patchwork quilts. This made me stop and give my resume a good look before throwing it away.

A series of odd tasks can indicate inconsistency, lack of focus, and unpredictability.

Alternatively, it may indicate a dedicated struggle against disability.

At least Scrapper deserves an interview.

To be clear, I have nothing against the silver spoon. It takes a lot of effort and sacrifice to get into and graduate from an elite university.

But if your whole life has been designed for success, how do you handle tough times?

One person I hired was attending an elite university and felt he had certain duties below him, such as doing temporary manual labor to better understand the business.

Eventually he quit.

But what if your life is destined for failure, but you actually succeed?

I would suggest interviewing the scrapper.

I'm a scrapper, so I know a lot about this stuff.

Before I was born my father was diagnosed with paranoid schizophrenia and despite his talent he was unable to get a job.

Our life has been part 'Cuckoo's Nest', part 'Awakening' and part 'Beautiful Mind'.

(Laughter) I am the fourth of five children raised by a single mother in a rough neighborhood in Brooklyn, New York.

We never owned a house, car, washing machine, and for most of our childhood didn't even have a phone.

So I was very motivated to understand the relationship between business success and scrappers, as my life could have easily turned out so differently.

As I met successful business people and read profiles of strong leaders, I noticed some commonalities.

Many of them experienced hardships in childhood, from poverty, neglect and the death of a parent at an early age, to learning disabilities, alcoholism and violence.

The traditional view is that trauma causes suffering, and much of the focus has been on the resulting dysfunction.

However, during the study of dysfunction, the data revealed an unexpected insight that even the worst of conditions can lead to growth and transformation.

A surprising and counterintuitive phenomenon that scientists call "post-traumatic growth" has been discovered.

In one study designed to measure the impact of adversity on children at risk, a full third of the subset of 698 children who experienced the most severe and extreme situations grew up to lead healthy, successful and productive lives.

In spite of everything, and in spite of the tremendous difficulties, they succeeded.

one third.

Please bring this resume.

This man's parents gave him up for adoption.

He will never graduate from college.

He changed jobs many times, spent a year in India, and is dyslexic.

Would you please hire this person?

His name is Steve Jobs.

A study of the world's most successful entrepreneurs found that a disproportionate number of them were dyslexic.

In the United States, 35 percent of surveyed entrepreneurs had dyslexia.

Notably, among entrepreneurs who have experienced post-traumatic growth, they now see their learning disability as a desirable challenge and see it as an advantage to them.

They don't think they are in spite of adversity, they know they are because of adversity.

They accept their traumas and hardships as an important part of who they have become, knowing that without those experiences they might not have developed the muscles and grit necessary to succeed.

One of my colleagues had his life changed as a result of China's Cultural Revolution in 1966.

At the age of 13, his parents were transferred to the countryside, the school was closed, and he was left to support himself in Beijing until he started working in a garment factory at the age of 16.

However, instead of accepting his fate, he decided to pursue his formal education.

Eleven years later, when the political climate changed, he heard about the highly selective college entrance exams.

He was given three months to study the entire middle and high school curriculum.

So he came home from the factory every day, took a nap, studied until 4 a.m., went back to work, and repeated the cycle every day for three months.

he did it, he succeeded.

His commitment to education was unwavering and he never lost hope.

He is currently pursuing a master's degree and his daughters have degrees from Cornell and Harvard respectively.

Scrapper is driven by the belief that he is the only one in complete control.

When things go wrong, scrappers ask, "What can we do to produce better results?"

Scrappers have a sense of purpose that keeps them from giving themselves up. It's like someone who's survived poverty, a crazy father, and a few robberies thinking, "Business challenges? -- (Laughter) Really?"

piece of cake. i got this "

(Laughter) Come to think of it, it's humor.

Scrappers know that humor can get you through tough times, and that laughter can help you change perspectives.

And finally, there are relationships.

Those who overcome adversity do not do it alone.

Somewhere along the way, they meet people who bring out the best in them and invest in their success.

In order to overcome adversity, it is essential to have someone you can trust no matter what.

I was lucky.

In my first job after graduating from university, I didn't have a car, so I shared two bridges with a woman who was an assistant to the president.

She looked at my work and encouraged me to focus on the future and not dwell on the past.

Along the way, I have met many people who have provided me with brutally honest feedback, advice, and guidance.

These guys don't care that I used to work as a singing waitress to pay for college tuition.

(Laughter) Finally, I would like to leave you with one valuable insight.

Companies committed to diversity and inclusive practices tend to support scrappers and outperform their peers.

DiversityInc outperformed the S&P 500 by 25% in the Top 50 Diversity Survey.

So back to my first question.

Would you bet on a silver spoon or a scrapper?

I would say pick an underrated candidate whose secret weapon is passion and purpose.

Hire a scrapper.

(applause)

People often think the word "doubt" is a bit oddly spelled because of the letter "b".

It doesn't spell sounds, so most people can't understand what they're doing there.

But the sound never &lt;/i&gt;never &lt;/i&gt; despite what most of us learn in school. The most important aspects of spelling English words.

Word meaning and history must come first.

To doubt means to doubt, to hesitate, to hesitate.

As a noun, it means uncertainty or confusion.

The word "doubt" in modern English originated from the Latin word "dubitare".

First it moved from Latin to French, where both the ``buh'' sound and the letter ``b'' disappeared.

It was introduced into English in the 13th century.

About 100 years later, scribes who also knew Latin while writing English began reinserting the 'b' into the spelling of words, even though no one had pronounced it that way.

But why would they do this?

Why would a sane person reinsert the letter of silence into the spelling?

Well, the scribes knew Latin, so they understood that the etymology of "doubt" had a "b" in it.

As time went on, even as fewer and fewer literate people knew Latin, the 'b' persisted. This was because it showed important and meaningful connections with other related words such as "dubious" and "indubitally". These words were later borrowed into English from the same Latin root, dubitare.

Understanding these historical connections not only helps spell out "questions", but also helps us understand the meaning of these more sophisticated words.

But the story doesn't end there.

Looking deeper, we can see how obvious that "b" is beyond a shadow of doubt.

There are only two base words in the entire English language that have the letters ``d-o-u-b''. One is suspect and the other is double.

On the basis of each of these many other words can be constructed, such as doubtful and unquestionable, or doublet, redouble, doubloon.

An examination of their history reveals that they both derive from the same Latin form.

The meaning of double, two is reflected in a deep understanding of doubt.

You see, when we doubt and hesitate, we second guess ourselves.

When we have doubts about something, when we have doubts or confusion, we have two thoughts.

Historically, before English began borrowing words from French, the English language already had interrogative words.

Its Old English word is ``tweogan'', and its relation to ``2'' is also evident from its spelling.

So next time you wonder why English spelling works this way, think again.

What you find may make you think twice.

One of the most striking properties of life is that it has color.

To understand the phenomenon of color, it helps to think of light as a wave.

But before that, let's talk a little bit about waves in general.

Imagine you are sitting in a boat on the ocean watching a cork bob and bob in the water.

The first thing you notice about this move is that it repeats.

Cork follows the same path over and over again... up and down, up and down.

This repeating or cyclical motion is characteristic of waves.

Then you realize something else...

Use a stopwatch to measure how long it takes for the piece of cork to move past its highest point, to its lowest point, and back again.

Let's say this takes 2 seconds.

In physics terminology, you've measured the period of the waves that rock the cork.

That is, the time it takes for a wave to pass through its entire range of motion once.

The same information can be expressed in another way by calculating the frequency of the wave.

Frequency, as the name suggests, indicates the frequency of the waves.

That is, how many people pass through in one second.

If you know how many seconds it takes for one complete wave, it's easy to calculate how many waves pass in one second.

In this case, each wave takes 2 seconds, so the frequency is 0.5 waves per second.

Enough about bobbing cork... what about light and color?

If light is a wave, it must have a frequency. right?

Well... yes, that's right.

And it turns out that the frequencies of light that our eyes perceive already have names.

It is called color.

That is correct. Color is just a measure of how fast a wave of light ripples.

If our eyes were fast enough, we might be able to directly observe this cyclical motion, much like cork or the ocean.

But the frequency of the light we see is so high that it waves up and down about 400 million times per second, so we can't see it as a wave. But you can tell what that frequency is by looking at its color.

The lowest frequency light we can see is red and the highest frequency is violet.

Between all other frequencies forms a continuous band of colors called the visible spectrum.

But what if you have a yellow pencil on your desk?

Well, the sun gives off all colors of light, so all colors of light hit the pencil.

A pencil looks yellow because it reflects more yellow light than other colors.

What about blue, purple, and red light?

They are absorbed and the energy they carry turns into heat.

The same is true for objects of other colors.

Blue objects reflect blue light and red objects reflect red light.

A white object reflects all colors of light, while a black object does the opposite, absorbing all frequencies.

By the way, this is why it's uncomfortable to wear your favorite Metallica t-shirt on a sunny day.

As humans, each of us sees ourselves as unique and independent individuals, but we are never alone.

Our bodies are inhabited by millions of subtle beings and no two bodies are the same.

From the dry deserts of our skin to the villages on our lips to the cities in our mouths, each is a different habitat for microbial communities.

Even each tooth has its own characteristics, and our gut forms a metropolis of interacting microbes.

And in these busy streets in our intestines, there is a constant influx of food, all the microbes doing their job.

For example, cellulolytic bacteria.

One of their jobs is to break down cellulose, a common compound in vegetables, into sugar.

These monosaccharides then travel to another microbial community, the ventilator, which captures the monosaccharides and burns them as fuel.

As food passes through our digestive tract, it reaches a fermentor where energy is extracted by converting sugars into chemicals such as alcohol and hydrogen gas, and these sugars are exhaled as waste products.

Deeper in our gut cities, symbionts make their living by collecting fermenter waste.

Each step in this process releases energy, which is absorbed by cells in the digestive tract.

This city we saw is different for each person.

Every person has a unique and diverse gut microbial community that can process food in different ways.

One person's gut microbes may only be able to release a fraction of the calories that another person's gut microbes can extract.

So what determines the membership of our gut microbial community?

Things like our genetic makeup and the microbes we encounter throughout our lives can affect our microbial ecosystem.

The foods we eat also affect the microbes that live in our gut.

For example, a variety of microorganisms are required to decompose food such as apples, which are made up of complex molecules.

But when food is made of simple molecules like lollipops, some of these workers are put out of business.

Workers leave the city and never return.

What is not working well is the gut microbial community, which has only a few types of workers.

For example, humans who suffer from diseases such as diabetes and chronic enteritis typically have fewer types of microbes in their gut.

Although we do not fully understand how to best manage individual microbial communities, it is possible that lifestyle changes, such as a varied intake of complex plant-based foods, can help rejuvenate microbial ecosystems in the gut and throughout the body.

Therefore, we are not really alone in our bodies.

Our bodies are inhabited by millions of different microbes, and we need them as much as they need us.

As we learn more about how our microbes interact and interact with our bodies, it becomes clear how we can nurture this complex and invisible world that shapes our personal identity, our health and well-being.

You may have heard that light is a wave and that the color of an object is related to the frequency of the light waves it reflects.

High frequency light waves appear violet, low frequency light waves appear red, and frequencies in between appear yellow, green, orange, etc.

This idea can also be called physical color, as it states that color is a physical property of light itself.

It does not rely on human perception.

And this is not wrong, but that's not all.

For example, you may have seen this photo before.

As you can see, the area where the red and green lights overlap is yellow.

This is pretty weird when you think about it.

Since light is a wave, the two different frequencies should not interact at all, but should coexist like a singer harmonizing.

Therefore, there are two different kinds of light waves in this yellow-looking region. One for red frequencies and one for green frequencies.

There are no yellow lights at all.

So why does this region of mixed red and green light appear yellow to us?

To understand this, we need to understand a little bit about biology, especially how humans see color.

Light perception occurs in a paper-thin layer of cells called the retina that lines the back of the eyeball.

There are two different types of light-sensing cells in the retina: rod cells and cone cells.

Rods are used for low-light vision and are of only one type.

Cones, however, are a different story.

There are three types of cone cells, roughly corresponding to the colors red, green, and blue.

Each cone sends its own distinct signal to the brain when it sees a color.

For example, let's say yellow light, or real yellow light with a yellow frequency, is hitting your eye.

There are no specific cones to detect yellow, but yellow is close to green and close to red, so both red and green cones are activated, each sending a signal to the brain saying so.

Of course, if both red and green light are present at the same time, there is another way to activate red and green cones at the same time.

Importantly, the brain receives the same signals whether it sees light in yellow frequencies or light mixed with green and red frequencies.

So for light, red plus green equals yellow.

So why can't we see colors in the dark?

Well, the rod cells in the retina take over the job in low light.

Since there is only one type of rod cell, only one type of signal can be sent to the brain. Light or no light.

If you have only one type of photodetector, there is no room for color perception.

Although there are an infinite number of physical colors, there are only three types of cones, so by carefully adding together the appropriate combinations of red, green, and blue colors, you can trick your brain into thinking it sees any color.

This property of human vision is very useful in the real world.

For example, television production.

Rather than having an infinite number of colors on TVs to simulate the real world, TV manufacturers only need to include red, green, and blue. This is really lucky.

now...

Let's go back in time.

It's 1974.

Somewhere in the world there is a gallery, and a 23-year-old girl stands in the middle of that space.

There is a table in front of her.

On the table are 76 objects representing pleasure and pain.

Among the objects are a glass of water, a coat, a shoe, a rose, etc.

A knife, a razor blade, a hammer, and a pistol with a single bullet.

There is an instruction, "I am an object."

Use me whatever is on the table.

I take all responsibility, even if it kills me.

Time is 6 hours. ”

The beginning of this performance was easy.

People gave me a glass of water or gave me a rose.

But shortly after, a man appeared with scissors and cut my clothes, then stuck a rose thorn into my stomach.

Someone cut my neck with a razor blade and drank my blood, and I still have the scars.

Women tell men what to do.

And men didn't rape me. Because it was just a normal opening, it was all public and they were with their wives.

They picked me up and put me on the table and stuck a knife between my legs.

Then someone took a pistol and bullets and put it in my temple.

Then another took the pistol and started a fight.

And after 6 hours, I...

I started walking towards the masses.

I was a mess

I was half-naked, covered in blood, and had tears running down my face.

And everyone fled, just fled.

They couldn't face me as a normal human being.

And what happened is I went to the hotel, it was 2am.

And when I looked at myself in the mirror, I had white hair.

Yes, please remove the blindfold.

Welcome to the world of performance.

First of all, I will explain what kind of performance it is.

There are so many artists and so many different explanations, but my explanation of performance is very simple.

A performance is the mental and physical construction that a performer makes in a space in front of an audience within a certain time, after which an energetic dialogue takes place.

Audiences and performers create works together.

And the difference between performance and theater is huge.

In theater, a knife isn't a knife and blood is just ketchup.

In performance, blood is the material and razor blades and knives are the tools.

It's all about being there in real time, you can't rehearse your performance. Because a lot of this sort of thing can't be done twice.

This is very important and performance. As you know, humans are always afraid of very simple things.

We fear suffering, we fear pain, we fear death.

So what am I doing – I'm staging this kind of horror in front of an audience.

I'm using your energy With this energy, I can push my body as far as it can go.

And I free myself from these fears.

And I'm your mirror

If I can do this myself, so can you.

After Belgrade where I was born, I went to Amsterdam.

And as you know, I've been performing for the last 40 years.

And here I met Ooley, and he was the one I actually fell in love with.

And we made performances together for 12 years.

I turn knives, pistols, and bullets into love and trust.

So to do this kind work, you have to trust the person completely. Because this arrow points to my heart.

I mean, heart pounding, adrenaline rush, etc. This is about trust, complete trust in another human being.

Our relationship has been 12 years and we have addressed so many themes of both male and female energy.

And when all relationships come to an end, so will ours.

We didn't just call like normal people and say 'I'm done'.

We walked the Great Wall to say goodbye.

I started in the Yellow Sea and he in the Gobi Desert.

We each walked 25,000 kilometers in 3 months.

It was difficult because it was a mountain.

It was a climb and a ruin.

As you know, it passes through 12 provinces of China, and this was before China opened up in 1987.

And we met on the way and succeeded in saying goodbye.

And then our relationship stopped.

And now it has completely changed my view of the masses.

And one of the very important works I made at that time was "Balkan Baroque".

And this was the time of the Balkan Wars. I wanted to create a very strong and charismatic image that would be useful in any war at any time, because the Balkan war is already over, but there is always a war going on somewhere.

So here I am washing 25,000 dead big bloody cow bones.

Blood cannot be washed away, and shame cannot be washed away from war.

So I've been washing this for 6 hours, 6 days, and the war is peeling off these bones and becoming possible-unbearable smell.

But then something is remembered.

I want to show you something that really changed my life, and this was my most recent performance at MoMa.

This performance is when I said to the curator, ``You can just sit in a chair, and there are empty chairs in the front, so anyone from the public can come and sit as long as you like.''

The curator told me, "That's ridiculous, this is New York, this chair is going to be empty, no one has time to sit in front of you."

(laughs) But I've been sitting for three months.

And I sit for 8 hours every day when the museum is open, and 10 hours on Fridays when the museum is open for 10 hours, and never move.

And I removed the table and I'm still sitting and this changed everything.

This performance, maybe 10 or 15 years ago, wouldn't have happened.

But people really needed to experience something different, and the masses were no longer groups, the relationships were one-to-one.

I was observing these people and they would come and sit in front of me, but I would have to wait hours and hours before they reached this position and they would eventually sit down.

and what happened?

They are observed by others, photographed, photographed on camera, observed by me, and they have no escape but within themselves.

And that makes a difference.

There was so much pain and loneliness. When you look into someone else's eyes, incredible things happen. Because in that total stranger's gaze you didn't even utter a word - everything happened.

And when I got up from my chair three months later, I understood that I wasn't the same anymore.

And I realized that I have a very strong mission to share this experience with everyone.

Thus was born the idea for me to establish a non-physical performing arts institute.

Because when we think about immateriality, performance is a time-based art.

It's nothing like a painting.

When you have that picture on your wall, it will be there the next day.

The performance, if you miss it, you only have a memory or a story someone told you, but really you miss the whole thing.

So you have to be there.

And my point is that if we talk about immaterial art, music is the most immaterial and therefore the best of all arts, absolutely the best art.

And after this is performance, and everything else.

That's my subjective way of doing it.

The lab will be in Hudson, upstate New York, and we're building it with ideas from Rem Koolhaas.

And it's so easy.

If you want to gain experience, take your time.

Before you enter the building, you have to sign a contract to spend the full six hours there, and you have to do me a favor.

It's so outdated, but if you don't honor your own words of honor and leave before that, it's not my problem.

But it's a 6 hour experience.

You'll get a certificate of achievement when you're done, so go home and frame it if you want.

(laughs) This is the orientation hall.

When ordinary people enter, they must first put on a white coat.

That's the importance of stepping up from being a mere spectator to being an experimenter.

Then go to your locker and put down your watch, iPhone, iPod, computer, or any other digital or electronic device.

And you have free time for yourself for the first time.

Our approach to technology is wrong because there is nothing wrong with technology.

We are losing time for ourselves.

This time it's a research institute that actually gives back.

What you do here is start walking slowly and slowing down.

It's coming back to simplicity.

After a slow walk, learn how to drink water. It's very easy, probably just drinking water for half an hour.

After this, go to the magnet room and create a flow of magnets on your body.

After this, go to the crystal chamber.

After the Crystal Room go to the Gaze Room, and after the Gaze Room go to the Lying Room.

This means that there are three basic postures of the human body: sitting, standing and lying.

and walk slowly.

And then there's the sound chamber.

And once you've seen all of this and prepared yourself mentally and physically, you're ready to see something long-lasting, like immaterial art.

It could be music, opera, theater, film, or video dance.

Now that I am comfortable, I sit in the chair for a long time.

After sitting in a chair for a long time, you are taken to a large place where you can see the work.

And when you fall asleep (which is quite possible as it's been a long day) you'll be taken to the parking lot.

(Laughter) And you know, sleep is very important.

You continue to receive art while you sleep.

That is, stay in the parking lot for a certain amount of time, then go back and see more of what you want to see or go home with your certificate.

So this lab is virtual for now.

Right now, I'm building a lab in Brazil, and then Australia, and then here, in Canada, and everywhere else.

And this is experiencing a kind of simple way, a way of returning to simplicity in your own life.

Counting rice is another story.

(laughter) As you know, if you count rice, you can also create life.

How to count 6 hours of rice?

It's very important.

Bored, angry, utterly irritated, or unable to finish the counted portion of food, we experience many different situations.

And when a satisfying job is done, or counting sand in the desert, you get this incredible peace.

Or it's a sound-blocked situation, where you're wearing headphones and you can't hear anything, there's no sound, you're just with them, and people are experiencing silence, just silence.

We are always doing what we love in life.

And this is why you do not change.

In life, you do things. If you always do things the same way, nothing happens.

But my way is to do what I'm afraid of, what I'm afraid of, what I don't know, and go where no one else has been before.

Including failure.

I think failure is important. Because the experiment can fail.

Even if you don't step into that territory and fail, you're really doing the same thing over and over again.

And I think humanity needs change now, and the only change to be made is at the individual level.

You have to make the change yourself.

Because the only way to change our consciousness and change the world around us is to start with ourselves.

It's so easy to criticize how the world is different, that things are not right in the world, governments are corrupt, there's hunger in the world, there's war, that is murder.

But what are we doing on an individual level, what is our contribution to this whole?

Now can you look at your neighbor, your stranger, and look into their eyes for two full minutes?

(chattering) We'll have two minutes, but it's very short.

Breathe slowly, don't blink, and don't get too self-conscious.

Relax.

And look in your eyes, in his eyes, a total stranger.

(pauses) Thank you for believing in me.

(Applause) Chris Anderson: Thank you.

Thank you very much.

Once upon a time, in the land of magical round pies, lived six brave musketeers.

There were names for brackets, exponents, multiplication, division, addition and subtraction.

But each was best known by its respective sign. Two hands ready to catch a fly in brackets, a small raised number for exponents, a mighty X for multiplication, a slash for division, a plus for addition, and a small subtraction are the most familiar symbols you can guess.

Pie country was not always the most peaceful place. That is why a number of kingdoms needed musketeers.

The Nation of Pi was ruled by numbers as an anarcho-syndicalist commune, and each number had a vote, but a powerful figure in the so-called Imperial Senate orchestrated a war between the robots and the Knights of the Kingdom, making themselves Supreme Emperor, and Puff the Magic Digit Dragon ate him, and one or two of the princesses, and indeed all the other numbers of the Nation of Pi.

It was an important day.

Anyway, the musketeers were called to action to save the Pai Nation from the ravenous dragons.

They came charging against him on brave horses.

I used multiplication first, then parentheses, but that didn't work.

The dragon continued to eat people.

An addition was attempted there, but was ignored.

Followers leaped at the beast, but were quickly crushed.

nothing was working.

The musketeers gathered and made a plan.

We will attack in order, but who will attack first?

They quarreled for a while, but the dragon ate a few more princesses, and finally they agreed.

They dived into the first tiny bracket inside the great Puff the Digit Dragon.

Parentheses indicated where to work first and protected exponents, multiplication, division, addition and subtraction while dicing and slicing.

First here, then there, and then there.

look out! I have another set!

Parentheses point and Exponents lead.

Then multiplication, division, addition and subtraction were done in order, always in the same order.

P-E-M-D-A-S When they finished that set, they moved on to the next set and then to another set, always working in parentheses in PEMDAS order.

pop! pop! pop! pop! pop!

PEMDAS, we have one more spot!

Remember you can put parentheses inside parentheses.

There is one!

And that tricky exponent.

alright, let's go!

Finally, the PEMDAS musketeers shaved Puff down to its last terrifying roar.

But having defeated Puff the Magic Digit Dragon, all the numbers in the empire sprang up again from this tiny little number one, and they all lived happily ever after.

Except for the emperor number, which they threw into the mouths of ancient creatures that nested in the desert.

end.

Looking down, there is a yellow pencil on the desk.

Your eyes, and then your brain, collect all sorts of information about your pencil: its size, color, shape, distance, and more.

But how exactly does this happen?

The ancient Greeks were the first to think more or less scientifically about what light is and how vision works.

Some Greek philosophers, including Plato and Pythagoras, believed that light originated in our eyes, and vision was caused by tiny invisible probes being sent to gather information about distant objects.

It took the Arab scientist Alhazen over 1,000 years to realize that the old Greek theory of light was incorrect.

In Alhazen's picture, the human eye isn't sending out an invisible intelligence-gathering probe, it's just collecting the light that comes in.

Alhazen's theory explains a fact the Greeks couldn't easily explain: why they sometimes get dark.

The idea is that very few objects actually emit light on their own.

Special luminous objects like the sun or light bulbs are known as light sources.

Most of the things we see, such as the pencils on our desks, simply reflect light from light sources rather than producing light from them.

So when you look at a pencil, the light that hits your eye actually originates from the sun, travels millions of miles through empty space, and then reflects off the pencil to your eye. Come to think of it, this is pretty cool.

But what exactly is the material being emitted from the sun and how can we see it?

Is it a particle like an atom, or is it a wave like the ripples on the surface of a pond?

Modern scientists would spend hundreds of years finding the answer to this question.

Isaac Newton was one of those early ones.

Newton believed that light was made up of tiny, atom-like particles called microparticles.

Using this assumption, he was able to explain some properties of light.

For example, refraction, how a ray of light looks bent as it enters water from air.

But in the world of science, even geniuses can make mistakes.

In the 19th century, long after Newton's death, scientists conducted a series of experiments that clearly showed that light could not consist of tiny, atomic-like particles.

First, two rays crossing paths do not affect each other at all.

If the light were made up of small solid balls, we would expect some of the particles from beam A to collide with some of the particles from beam B.

The two particles involved in the collision then bounce off in random directions.

But that doesn't happen.

The beams pass through each other as you can see for yourself using two laser pointers and chalk dust.

Another reason is that light creates interference patterns.

Interference patterns are complex undulations that occur when two wave patterns occupy the same space.

They can also be seen when two objects disturb the surface of a stationary pond, or when two point-like light sources are placed close to each other.

Only waves, not particles, create interference patterns.

Furthermore, understanding that light acts like waves naturally provides an explanation for what color is and why a pencil looks yellow.

So it's a rule, light is a wave, right?

Not so soon!

In the 20th century, scientists conducted experiments showing that light behaves like particles.

For example, when you shine light on a metal, the light transfers its energy to the atoms within the metal in discrete packets called quanta.

But we can't forget about properties such as interference.

Therefore, these light quanta look nothing like the small, hard sphere Newton imagined.

The result that light sometimes behaves like a particle and sometimes like a wave has led to a revolutionary new physical theory called quantum mechanics.

Now, with all that said, let's get back to the question, "What is light?"

Well, light is very different from what we are used to in our daily life.

Sometimes it behaves like a particle, sometimes like a wave, but it's not exactly the same.

What do horror movies and comedies have in common?

The two genres may seem quite different, but the reason both are popular is probably due to their commonality: their use of dramatic irony.

First, let's be clear.

There are three types of irony there.

The irony of the situation is that you expected something and the opposite happened.

Verbal sarcasm refers to someone saying something that actually means the opposite.

The dramatic irony, however, is what we are now focusing on.

Dramatic irony is when the audience seems to know more about an event, situation, or conversation than the characters in a movie, show, or book.

Audiences get to know the secrets that the characters miss.

This is a great storytelling device that creates a great deal of emotion within the text.

Think about it for a moment.

How does it feel to know that a horror movie hides a hideous villain behind a door in a dark room?

The music is eerie and the lighting creates perfect shadows. This must be bad for the hero.

But, of course, the hero has to enter the room to find the villain.

I feel a lot of tension and fear that someone will jump out and scare me, but I don't know when that will happen.

The tension is dramatic irony. You know something more than movie characters.

Now, let's take a typical comedy as an example.

Some "misunderstandings" can occur.

Again, we know what's going on better than the characters.

Imagine two characters planning a birthday surprise for their roommate, who is listening to the entire conversation from the hallway.

From there, confusion and misunderstanding arise, and tension builds.

This is not the same tension as a horror movie. Because it's probably pretty funny to see the characters trying to figure out who the killer is. But it serves as a great example of the tension and suspense of dramatic irony.

In both genres this tension or suspense drives the story and keeps the plot moving.

Audiences want—need—to see the tension of dramatic sarcasm collapse, either by a terrifying figure popping out of the shadows, or by someone finally revealing someone's identity and clearing up the confusion.

So when you feel like you're grasping for a secret, it's dramatic irony, a hallmark of all great writers from Shakespeare to Hitchcock.

It's often said that you can tell a lot about a person by looking at what's on the bookshelf.

What does my bookshelf say about me?

Well, when I asked myself this question a few years ago, I made an amazing discovery.

I always thought of myself as a fairly cultured and international person.

But my bookshelf told a much different story.

Almost all titles were by British or North American authors, and very few were translated.

It was quite a shock to discover this huge cultural blind spot in my reading.

And thinking about it, it seemed like a real shame.

I thought there must be many wonderful stories by authors working in languages ​​other than English.

And it made me really sad to think that I probably wouldn't come across them because of my reading habits.

So I decided to prescribe myself an intensive course in Global Reading.

2012 was set to be a very international year for the UK. It was the year of the London Olympics.

So I decided to use that as my time frame to read novels, short stories, and memoirs from around the world.

And so did I.

It was so inspiring, I learned some great things and made some great connections. I would like to share that with you today.

But it started with some real problems.

After considering which of the various lists of countries around the world to use for my project, I finally decided to use the list of UN-approved countries. Adding Taiwan to this brings the total to 196 countries.

And after figuring out how to fit reading and blogging four books a week on the basis of working five days a week, I had to face the fact that I might not even be able to get English books from every country.

Only about 4.5 per cent of the literary works published each year in the UK are in translation, a figure that is similar across most of the English-speaking world.

However, the percentage of translations published in many other countries is much higher.

The figure of 4.5% is small enough to start with, but what this figure doesn't tell you is that many of these books come from countries with strong publishing networks and plenty of industry professionals ready to pitch their books to English-language publishers.

For example, well over 100 books are translated from French and published in the UK each year, most of which come from countries such as France and Switzerland.

French-speaking Africans, on the other hand, are rarely surveyed.

The bottom line is that there are actually quite a few countries where there is little or no commercially available literature in English.

Their books remain invisible to readers in the world's most published languages.

But when it came to reading the world, the biggest challenge for me was the fact that I didn't know where to start.

Having spent my life reading almost exclusively British and North American books, I had no idea how to source, find and select stories from the rest of the world.

Couldn't tell you how to source the story from Swaziland.

I don't know of any good Namibian novels.

I couldn't hide it. I was an ignorant literary xenophobic.

So how on earth were you going to read the world?

I had to ask for help.

So in October 2011, I registered my blog ayearofreadingtheworld.com and posted a short appeal online.

I asked someone who cared to leave me a message explaining who I was, how narrow my reading was, and suggesting what I was reading from other parts of the globe.

Now, I wasn't sure if anyone would be interested, but within hours of posting the complaint online, people started contacting me.

At first it was friends and colleagues.

Then it was a friend of a friend.

And soon it became a stranger.

Four days after posting the complaint online, I received a message from a woman named Lafida in Kuala Lumpur.

She said she liked the sound of my project. Could you please go to your local English bookstore and pick out my Malaysian book and mail it to me?

I enthusiastically agreed. A few weeks later, I received a package containing two books instead of one. A book from Malaysia that Rafida chose and a book from Singapore that she chose for me.

Well, at the time I was amazed that a stranger over 6,000 miles away would go to such lengths to help someone he probably would never meet.

But Rafida's kindness set the pattern for the year.

Many times people have gone out of their way to help me.

There are people who undertake research for me, and there are people who take a detour to the bookstore on holidays or on business trips.

It turns out that if you want to read the world, if you want to meet the world with an open mind, the world will help you.

As for countries with little or no commercially available English literature, people went even further.

Books are often published from unexpected sources.

For example, my Panamanian reading came from a conversation I had on Twitter about the Panama Canal.

Yes, the Panama Canal has a Twitter account.

And when I tweeted about my project, he suggested I try to get my hands on the work of Panamanian author Juan David Morgan.

I found Morgan's website and messaged him asking if his Spanish novel was translated into English.

And he said that nothing has been published, but that he has an unpublished translation of his novel "The Golden Horse."

He emailed this to me so I could be one of the first to read the book in English.

Morgan wasn't the only worder to share his work with me in this way.

From Sweden to Palau, authors and translators have sent me self-published books, unpublished manuscripts of books that have not been picked up by English-speaking publishers or are no longer available, and have provided me with glimpses into wonderful imaginary worlds.

For example, I read about the South African king Ngungunhane, who led the resistance movement against Portugal in the 19th century. And about marriage ceremonies in a remote village on the Caspian coast of Turkmenistan.

I came across Kuwait's answer to Bridget Jones.

(Laughter) And then I read about an orgy in an angora tree.

But perhaps the most astonishing example of all the effort people made to help me read the world came when, toward the end of my quest, I tried to get a book from São Tomé and Príncipe, a small Portuguese-speaking African island nation.

After months of trying everything I could think of to find a book translated into English in my country, it seemed that my only option was to see if I could get something translated from scratch.

Now, I was really wondering if anyone would be willing to spend time on something like this and help with this.

However, within a week of my Twitter and Facebook campaign for Portuguese speakers, there were more people than I could possibly want to join the project. Among them was Margaret Jules Costa, a leader in the field who translated the work of Nobel laureate José Saramago.

With the help of nine volunteers, I managed to find a São Tomé author's book available online in sufficient quantity.

Here is one of them.

And I sent a copy to all the volunteers.

They all took a few short stories from this collection, kept their promises, sent the translations back to me, and within six weeks I was able to read the whole book.

In that case, as I often realized during my year of reading the world, being open and not knowing my own limits was a big opportunity.

As for Sao Tome and Principe, it was not only an opportunity to learn something new and discover a new collection of stories, but also an opportunity to bring groups of people together to foster joint creative endeavors.

My weaknesses became the project's strengths.

The books I read that year opened my eyes to many things.

If you love reading, you know that books have the uncanny ability to take you out of yourself, into someone else's way of thinking, and to see the world differently, at least for a while.

It can be an uncomfortable experience, especially if you're reading a book from a culture that may have values ​​very different from yours.

But it's also really enlightening.

Struggling with unfamiliar ideas helps clarify your thoughts.

And it also reveals blind spots you might have been watching the world.

For example, looking back at much of the English literature I grew up with, I began to see how narrow much of it was in comparison to the richness the world had to offer.

And as the pages turned, something else began to happen.

Little by little, the long list of countries I covered at the beginning of the year morphed from dry, academic place-name registers to vibrant entities.

Now, I don't mean to say that it's quite possible to get a complete picture of a country just by reading one book.

But cumulatively, the stories I read that year made me realize more than ever the richness, diversity and complexity of this amazing planet.

It was as if the story of the world and the people who went to great lengths to help me read it made it real to me.

Looking at a bookshelf or thinking about a piece on an e-reader these days tells a very different story.

This is a story of the power of books to unite us across political, geographical, cultural, social and religious divides.

This is a story about the possibility that humanity must work together.

And it's also a testament to the extraordinary times we live in. Thanks to the internet, it's easier than ever for strangers to share stories, worlds, and books with someone they might never meet, halfway around the world.

I hope it's a story you can keep reading for years to come.

And I hope more people will join me.

If we all read more widely, there would be more incentive for publishers to translate more books, which would enrich us all.

thank you.

(applause)

So how many people have robots in their homes?

Okay, I can see about 20, 30 hands.

That's really good.

How many of you would like to have your very own robot in your home?

You will!

So why doesn't this exist?

Why can't you go to a convenience store or department store, go to the cash register and say, "Yes, I want a personal robot"?

Now let's talk about how to make it happen.

All we have to do is make robots smarter.

Now, no one would argue that we don't have robots.

We have rovers heading to Mars to acquire scientific data and broaden our understanding of the world.

We have manufacturing robots that help build the cars we drive today.

There are also robots that assist the military and defuse bombs so that soldiers can get home safely.

With all this, why not have a personal robot?

Why are there no robot chefs? Because I can't cook.

(Laughter) So this is one of my robots. It's a simple walking robot, but it's by no means smart.

So what we have to do is change the definition of what a robot is.

How do we do that? Well, as a first step, before you start designing and get your hands dirty, you need to come up with rules, things like laws, codes of conduct.

And why is this? Because if these robots are smart, they might be able to do more than we want.

So you have to come up with rules.

Thou robot, do not harm humans.

You should obey me and only me.

you will always protect me

So before you actually start designing, you need to set boundaries, or rules of engagement.

And then you have to come up with a tool.

So I believe the way to make robots smarter is to imitate humans.

Now, our brains are complex, and there's a lot going on in them, so it would be difficult to open them up and really try to figure out how to mimic humans.

The best way is to observe, to actually see people doing something, to understand what they are doing, what they are thinking, what they are doing, what they are feeling.

So part of making robots smarter is actually mimicking humans and mimicking the way we do things so they can do a little better.

Some tools are therefore diverse.

So I have a classical training as an electrician.

I never thought I would have to understand things like child psychology and early childhood development.

Therefore, understanding how infants develop into children, how they develop into adults, and how infants learn and interact is of real importance to robotics.

Monkeys have social mechanisms to learn from each other, which is very good for making robots smarter.

And of course neuroscience, I've always been fascinated by neuroscience, but I didn't understand that we need to understand why neurons fire, how the environment helps us learn, and all of that really contributes to making robots a little bit smarter.

So some of the things I do, and this is just a little snapshot, one of them is mirroring.

So the ability to look in a mirror and wave your hand and actually recognize the person on the other side, that self-awareness is a manifestation of intelligence so that we can see someone throwing a ball and understand, "Okay, I know how to throw a ball. Let's mimic their progress."

So, I actually have a robot that I'm trying to design a robot health coach for.

So we asked an exercise physiologist to teach the robot how to exercise.

You know, we want to be strong.

And the other is learning.

So learning is important. We do this as children, we do this as adults, we do this as seniors.

Yet one form of learning is muscle memory.

So how many people play musical instruments?

For example, when you start thinking about the violin, the instructor might actually come and move your hand a little, or raise your bow a little.

So they actually touch you to give you muscle memory.

And it helps us figure out how to make things a little better.

And we actually have a learning methodology, but of course we don't use motors to move the legs, so we need to nunchuck to give the robot's muscles a memory as to how to perform the dance moves.

And the last is creativity.

So you might ask, "Robots? Creativity? I don't get it."

Why should robots be creative? Why does creativity make them smarter?”

Well, creativity and imagination are what allow us to create problems when we don't know how to deal with them.

They allow us to create something out of nothing.

So if you look at the apps, tablets, iPads, iPhones, and Androids out there, they didn't exist 20 years ago.

So how was it possible to get something out of nothing and expand?

It was our imagination. It was our creativity.

And these are what allow us to understand new things.

So I'm creative, I play piano, I'm a composer, and I have a robot that plays "Twinkle Twinkle Little Star" when I hear it.

(music) Putting it all together, the last is interaction.

So you have a robot and you want it to interact with you as a playmate, teacher, and mentor.

And isn't it so cute?

(Laughter) So the interaction part is very important because interaction is the key and key to understanding how we work together in our world.

It deals with communication, it deals with understanding, it deals with gaze, it deals with attention.

Combining all of these enables interactions and smarter robots.

These are just some of the tools used to make robots smarter.

So I would like to leave you with one thought.

So I am all for robots and smart robots.

I mean, that's what I do, and if I didn't believe it, I would be out of a job.

But where does it end?

How far can you push yourself?

How far and how smart should smart robots be?

thank you.

Hello, my name is Christian Rudder. I am one of the founders of OkCupid.

It is now one of the largest dating sites in the US.

Like most of you in the field, I was a math major. As you can imagine, we are known to love analytical approaches.

We call this the matching algorithm.

Basically, OkCupid's matching algorithm helps two people decide whether or not they should go on a date.

We built our entire business around it.

Now, the word algorithm is a fancy word and people like to ignore it like it's such a big deal.

But in reality, algorithms are just systematic, step-by-step ways to solve problems.

It doesn't have to be flashy at all.

In this lesson, I'll explain how I arrived at a particular algorithm, so you understand how it's done.

So why are algorithms important?

Why does this lesson exist?

Now notice the very important phrase I used above. They are a step-by-step method of solving problems, and as you probably know, computers are great at step-by-step processes.

A computer without an algorithm is basically an expensive paperweight.

Algorithms are everywhere because computers are so pervasive in our daily lives.

The math behind OkCupid's matching algorithm is surprisingly simple.

It's just addition, multiplication, and a little square root.

The hard part of the design was figuring out how to take that mystical, human charm and break it down into components that computers can manipulate.

The first thing we need to match people is the data that the algorithm uses.

The best way to get data quickly from people is to request it.

So we decided that OkCupid would ask users questions like, "Do you want to have kids someday?"

"How often do you brush your teeth?"

"Do you like scary movies?"

And then there are big questions like, "Do you believe in God?"

Now, many questions are good for like-like matching, where both people answer in the same way.

For example, two people who are interested in scary movies might be a better match than one who is interested in scary movies and one who is not.

But what about questions like "Do you like being the center of attention?"

If both people in a relationship say yes to this, they will be in big trouble.

We realized this early on and decided we needed a little more data from each question.

We had to ask people to specify the answers they wanted from others, not just their own.

It worked really well.

But I needed one more dimension.

Some questions tell you more about the person than others.

For example, a political question, "Which is worse, burning books or flags?"

You may find out more about the person than just their movie tastes.

And it makes no sense to rate them all equally. So I added one data point at the end.

For everything OkCupid asks you, you have the chance to talk about what role OkCupid plays in your life.

And this ranges from irrelevant to essential.

Now, for all questions, the algorithm needs three things. The first is your answer. Second, how do you want others (your potential opponents) to respond? And third, how important the question is to you.

With all this information OkCupid can determine how well you two get along.

Algorithms compute numbers and return results.

As a practical example, let's see how we match you with others.

Let's call him "B".

Match percentage with B is based on questions answered by both.

Let's call this set of general questions 's'.

As a very simple example, take a small set 's' with only two common questions and compute matches from that.

Below are two example questions.

The first question is "How dirty are you?"

And the possible answers are: very messy, average, very organized.

And suppose you say "very organized" and you want others to say "very organized". That question is very important to you.

Basically, you are a neat freak.

You're neat and you want others to be neat, that's all.

And let's say B is a little different.

He himself answered that he was "very organized", but the answer from others was "average", and the question is only slightly important to him.

Let's look at the second question in the previous example. "Do you like being the center of attention?"

The answer is yes and no.

You said "no", but I'd like others to say "no", but the question is a little bit more important to you.

Well, Mr. B answered "yes".

He wants others to answer "no" because he wants the spotlight on himself, and the question is somewhat important to him.

Now let's calculate all this.

The first step uses a computer to do this, so you need to assign numbers to thoughts like "somewhat important" and "very important." Because computers have to represent everything numerically.

We at OkCupid have decided on a scale where the value of "irrelevant" is 0.

"It's a little important" is worth 1.

"Somewhat important" is worth 10.

"Very Important" is 50.

And "must have" is 250.

The algorithm then performs two simple calculations.

First, how satisfied were you with B's answer?

So how many points did B score on your scale?

Well, it turns out that B's answer to the first question about clutter is very important to you.

It's worth 50 points and B got it right.

The second question deserves only a 1 because you said it was only slightly important.

B got it wrong, so B's answer was 50 out of 51.

It is 98% satisfied. pretty good.

The second question the algorithm looks at is "How satisfied are you with B?"

Well, B gave 1 point to your answer to the randomness question and 10 points to your answer to the second question.

Of these 11, 1 plus 10, you got 10. The second question satisfied each other.

So, your answer is 10 out of 11, and Mr. B is 91% satisfied.

not bad.

The final step is to get these two match percentages to get a single number for both.

To do this, the algorithm multiplies the scores and computes the nth root. where 'n' is the number of questions.

The number of questions in this sample, s, is only 2, so the match rate is equal to the square root of 98 percent and 91 percent.

This corresponds to 94%.

94% of them match B.

This is a mathematical representation of how happy you would be with each other based on what we know.

Now, why does this algorithm do multiplication instead of, say, averaging two match scores and doing the square root operation?

This formula is commonly called the geometric mean.

This is a great way to combine a wide range of values ​​to represent very different properties.

In other words, perfect for romantic matching.

Like I said, we have a huge range and a lot of different data points about movies, politics, religion, whatever.

Intuitively, this also makes sense.

Affection needs to be mutual, so two people who satisfy 50 percent should be a better match than the other two who satisfy 0 and 100.

If the number of questions is small, as in this example, there is no problem if you make small corrections within the margin of error.

Every time OkCupid matches two people, it goes through the steps outlined above.

It first collects data about your responses, then uses simple mathematical methods to compare your choices and preferences to those of others.

I think this ability to make real-world phenomena understandable to microchips is the most important skill anyone can have today.

Just like we use text to tell stories to humans, we use algorithms to tell stories to computers.

Learning a language allows you to go out and tell your own story.

I hope this helps.

You may think that there are many things you cannot do because you are blind.

That's mostly true.

I actually needed a little help getting on stage.

But there are also many things I can do.

It's my first time rock climbing.

Actually I love sports and I can do many different sports like swimming, skiing, skating, scuba diving and running.

But there is one limitation. That's what I need someone to help me with.

I want to be independent

I lost my sight in a pool accident when I was 14.

I was an active, independent teen when I suddenly became blind.

The hardest thing for me was losing my independence.

What once seemed easy has become almost impossible for one person.

For example, one of my assignments was a textbook.

At that time there were no computers, no internet, no smartphones.

So I had to get one of my two brothers to read the textbook, and I had to write my own book in Braille.

Can you imagine?

Of course, the brothers didn't like it. Later I realized that my brothers weren't there when I needed them.

(Laughter) I think they tried to stay away from me.

i don't blame them.

I really wanted to be free from being dependent on someone else.

That became my strong desire to innovate.

Fly to the mid-1980s.

I became acquainted with cutting-edge technology and wondered why there was no computer technology to produce books in Braille.

These wonderful technologies should also help people with disabilities like me.

That is the moment my innovation journey began.

I started developing digital book technologies such as digital Braille editors, digital Braille dictionaries, and digital Braille library networks.

Today, all visually impaired students can read textbooks in braille or audio using a computer or mobile device.

In 2015, everyone has e-books on their tablets, so this may not come as a surprise.

But Braille was digitized many years before e-books, and already in the late 1980s, almost 30 years earlier.

The strong and specific needs of visually impaired people created the opportunity to create digital books at that time.

And history shows that accessibility drives innovation, so this isn't the first time something like this has actually happened.

The telephone was invented during the development of communication tools for the deaf.

Some keyboards were invented to help people with disabilities.

Here is another example from my own life.

In the 90's, people around me started talking about the internet and web browsing.

I remember the first time I hit the web.

I was amazed.

I had access to newspapers at any time of the day.

I was able to search for all the information myself.

I had a strong desire to make the internet accessible to blind people and found a way to render the web into synthesized speech. This greatly simplifies the user interface.

This inspired me to develop Home Page Reader in 1997, first in Japanese and then translated into 11 languages.

When I developed the homepage reader, I got a lot of comments from users.

Some people strongly remember the saying, "For me, the Internet is my little window into the world."

It was a revolutionary moment for the blind.

The cyber world has become more accessible and the technology we created for the blind has far more uses than I could have imagined.

Helps drivers listen to emails and hear recipes while cooking.

I'm more independent now, but it's still not enough.

For example, when I approached the stage just now, I needed help.

My goal is to come here independently.

Not only here.

My goal is to be able to travel and do simple things.

Well, let me show you the latest technology.

This is a smartphone application that we are developing.

(Video) Electronic voice: 51 feet to the door, go straight ahead.

EV: Open the two doors and go outside. The door is on your right.

EV: Nick is approaching. They look very happy.

Chieko Asakawa: Hi, Nick!

(laughs) CA: Where are you going? You look very happy.

Nick: Oh -- well, my paper just got accepted.

CA: That's amazing! congratulation.

Nick: Thank you. Wait, how did you know it was me and that I looked happy?

(Chieko and Nick laugh) Man: Hello.

(Laughter) CA: Oh... hello.

EV: He's not talking to you, he's on the phone.

EV: Potato Chips.

EV: Dark chocolate with almonds.

EV: You've put on five pounds since yesterday. Take an apple instead of chocolate.

(laughs) EV: It's getting closer.

EV: You've arrived.

CA: Well...

(Applause.) Thank you.

So the app navigated me by analyzing beacon signals and my smartphone's sensors, allowing me to navigate indoor and outdoor environments alone.

But the computer vision part that shows who is approaching and what mood is still in the works.

And recognizing facial expressions is very important for me to be social.

The convergence of technology has made it possible to see the real world.

We call this cognitive assistance.

It understands the world around us, whispering in its voice or sending vibrations to my fingers.

Cognitive support reinforces abilities that are lacking or weakened: our five senses.

The technology is still in its early stages, but eventually you'll be able to find a classroom on campus, go window shopping, or find a nice restaurant while walking down the street.

It would be great if I could find you on the street before you noticed me.

It will be my best buddy and yours.

So this is a really big challenge.

This is a challenge that requires collaboration, so we are creating an open community to accelerate research efforts.

Just this morning, we announced the underlying open source technology you just saw in the video.

The frontier is the real world.

The blind community is exploring this technological frontier and pathway.

I would like to open up a new era together with all of you, and next time I stand on this stage, I would like to walk this path alone through technology and innovation.

Thank you very much.

(applause)

By now you know that you need numbers for everything you do in life.

However, some fields in particular require a large number of numbers, not just a few.

How do you keep track of all these numbers?

Well, mathematicians dating back to ancient China have figured out how to represent an array of many numbers at once.

Today we call such an array a "matrix" and many of them hanging together a "matrix".

Matrix is ​​everywhere.

They're all around us and they're still in this room.

Sorry, let's get back on topic.

However, matrices are actually everywhere.

They are used in the fields of business, economics, cryptography, physics, electronics and computer graphics.

One of the things that makes matrices so great is that they can pack so much information into them that they can transform a huge set of different problems into one problem.

So to use matrices you need to learn how matrices work.

It turns out that matrices can be treated just like regular numbers.

You can also add, subtract, and multiply.

You can't split them, but it's a rabbit hole in itself.

Adding a matrix is ​​very easy.

Just add the corresponding entries in order.

So the first entry is added, the second entry, the third entry, and so on down.

Of course the matrices have to be the same size, but that's pretty intuitive anyway.

You can also multiply the entire matrix by a number called a scalar.

Just multiply all entries by that number.

But wait, there's more!

You can actually multiply one matrix by another.

However, it is different from adding each entry.

Once you get the hang of it, it becomes more unique and pretty cool.

Here's how it works:

Suppose we have two matrices.

Let's make them both 2-by-2, or 2-by-2.

Write the first matrix to the left, put the second matrix next to it, and move it up a little bit like creating a table.

The product you get when you multiply matrices fits between the matrices.

It also draws grid lines for your convenience.

Now look at the first row of the first matrix and the first column of the second matrix.

Can you see that there are two numbers in each?

Multiply the first number in the row by the first number in the column. 1 times 2 is 2.

Do the following: 3 times 3 is 9.

Let's add them up: 2 plus 9 is 11.

Let's put that number in the top left position to match the row and column we used to get that number.

Do you know how it works?

You can do the same to get other entries.

-4 plus 0 is -4.

4 plus - 3 is 1.

-8 plus 0 is -8.

So here is your answer.

Not so bad, right?

However, there is one catch.

As with addition, the matrix size must be appropriate.

Look at these two matrices.

8 multiplied by 2 is 16.

3 x 4 is 12.

Please wait three times. The second matrix has no more rows.

I'm out of room.

So you can't multiply these matrices.

The number of columns in the first matrix must be the same as the number of rows in the second matrix.

However, it's pretty easy if you're careful to get the dimensions right.

By the way, understanding matrix multiplication is just the beginning.

There are many things you can do with them.

For example, say you want to encrypt a secret message.

Let's say it's a "law of mathematics".

But I don't understand why anyone would want to keep this a secret.

If you replace the numbers with letters, you can put the numbers in a matrix and then put the encryption key in another matrix.

Multiplying them gives you a new encoded matrix.

The only way to decode the new matrix and read the message is to get the second matrix, which is the key.

There is also a branch of mathematics that uses matrices all the time, called linear algebra.

If you have the chance to study linear algebra, do it. That's great.

But remember, once you know how to use matrices, you can do almost anything.

What is it like to be a working mother?

This is what I get when I ask questions on the internet.

Never mind that trying to work on a computer with your baby on your lap actually produces these results.

(Laughter) But no, this is not a working mother.

You can see that these pictures have a theme. We will look at them a lot.

The theme, as we all know, is the wonderful natural light that characterizes all American workplaces.

There are thousands of such images.

Just type the term "working mother" into the Google image search engine or stock photo site.

They're all over the internet, topping blog posts and news articles. And I'm kind of obsessed with them and the lies they tell us, and the comfort they give us, that all is well when it comes to being a new working mother in America.

But it's not okay.

As a country, we force millions of women each year to return to work shortly after giving birth, incredibly and terrifyingly.

It's a moral issue, but today I'll also talk about why it's an economic issue.

I was so frustrated and obsessed with the unreality of these images, which bear no resemblance to my life, that I recently decided to shoot and star in a parody stock photo series that I hope will begin to be used around the world to show the truly awkward reality of going back to work when you have baby food on your body.

I will only mention two of them.

(Laughter) Nothing says, 'Let's get that girl promoted' like leaking milk from a dress during a presentation.

You will notice that there is no baby in this photo. Because this is not the case for most working mothers.

Did you know that every time you flush the toilet, the contents aerosolize and stay suspended in the air for hours? This will ruin your day.

Still, for many new working mothers, this is the only place they can make food for their newborn babies during the day.

I have sent more than a dozen of these to the world.

I just wanted to get to the point.

I didn't even know I was opening the door. Because now strangers from all walks of life write me all the time to let me know what it's like to go back to work within days or weeks of having a baby.

Today we would like to share with you 10 of their stories.

They are completely real, some very graphic, but none of them look like this.

First of all, here.

"I was an active duty soldier in a federal prison.

I am back at work after up to 8 weeks of C-section.

A male colleague got mad that I was out on "vacation" and intentionally opened the door while I was pumping and stood in the hallway with the inmates. ”

Most of the stories that women I don't know send me now are actually not even about breastfeeding.

One woman wrote me, "I gave birth to twins and returned to work after seven weeks without pay.

Emotionally, I was in tatters.

Physically, I suffered heavy bleeding and large lacerations during childbirth that left me barely able to stand, sit or walk.

My employer told me that since it's budget season now, I'm not allowed to use my paid leave. ”

I've come to believe that we shouldn't face this situation because it will scare us, and that when we feel scare, we must do something about it.

Therefore, we saw this image and decided to believe it.

This photo is weird and a little creepy, so I'm not really sure what's going on.

(Laughter) What is she doing?

But I know what it tells us.

It tells us all is well.

This working mom, all working moms, and their babies are all fine.

There is nothing to see here.

Anyway, women made a choice, so we have no problem.

I would like to divide this selection into two parts.

The first option indicates that the woman chose to work.

So it's not.

Women currently make up 47 percent of the US workforce and are the sole or primary breadwinners in 40 percent of American households.

Our paid work is part, if not most, of the engine of this economy and is essential to the engine of our families.

At the national level, our paid work is not voluntary.

Option 2 states that women are choosing to have children, and that only women should bear the consequences of that choice.

You know, that's one of those things that might sound right if you happen to hear it.

I didn't let you have a baby.

I certainly wasn't there when it happened.

But that stance ignores the fundamental truth that our procreation on a national scale is not voluntary.

The babies that women, many of them working women, have today will one day fill our workforce, protect our coasts, and make up our tax base.

Our birth on a national scale is not voluntary.

These are not options.

We need women to work. It takes a working woman to have a baby.

So you should at least be comfortable doing these things at the same time, right?

Now, it's quiz time. What percentage of working women in America do you think are unable to take paid maternity leave?

88 percent.

88% of working mothers do not get even one minute of paid leave after giving birth.

That's why I'm thinking about unpaid leave.

exists in America. It is called FMLA. it doesn't work.

Because of the way it works, there are all sorts of exceptions, and half of new mothers are ineligible.

It is:

"We adopted a son.

The day he was born, I had to take the day off from work when I got the call.

I wasn't enrolled long enough to qualify for FMLA, so I wasn't eligible for unpaid leave.

I lost my job when I took time off to see my newborn son. ”

These corporate stock photos hide another reality, another layer.

Of the women who can only take unpaid leave, most of them can barely afford it.

The nurse told me, ``My pregnancy was considered a pre-existing condition, so it wasn't eligible for short-term disability.

We used up all our tax returns and half of our savings in six weeks of no pay.

I couldn't do anything.

It was hard physically, but it was even harder mentally.

I suffered from being away from my son for months. ”

So the decision to go back to work this early is a rational financial decision considering the family budget, but it's often physically terrifying because it's a hassle to send a human being out into society.

A waitress told me, "When I gave birth to my first child, I went back to work five weeks after giving birth.

When I had my second child, I had to wait 6 weeks before returning because I needed major surgery after giving birth.

I had third-class tears. ”

23% of new working mothers in the US return to work within two weeks of giving birth.

"During my pregnancy, I worked an average of 75 hours a week as a bartender and cook.

I had to go back to work before my child was a month old and work 60 hours a week.

One of my colleagues was only able to take 10 days off with her baby. ”

Of course, this is not the only scenario with economic and physical implications.

Birth is, and always will be, a huge psychological event.

My teacher told me, "I went back to work eight weeks after my son was born.

I already suffer from anxiety, but the panic attack I had before going back to work was excruciating. ”

Statistically speaking, the shorter a woman's postnatal leave, the more likely she is to suffer from postpartum mood disorders such as depression and anxiety. Among the many possible consequences of these disorders, suicide is the second leading cause of death in the first year of life in women.

Note the following story -- I've never met this woman, but I find it difficult to understand.

"I am deeply saddened and angry at the loss of precious, irreplaceable and formative time with my son.

Labor and delivery completely broke my heart.

For months, all I can remember is the cry of "colic."

In my heart I was drowning.

Every morning I asked myself how much more I could do.

I was allowed to bring my baby to work.

I shivered and quietly closed the office door and begged him to stop yelling so I wouldn't get in trouble.

I used to hide behind my office door every day and cry while he screamed.

I cried in the bathroom while washing the pump equipment.

Every day, I cried all the way to work and all the way home.

I promised my boss that I would make up for the work I didn't finish during the day at home at night.

I thought there was something wrong with me that I couldn't swing this. ”

So they are mothers.

how are the babies?

As a country, do we care about the millions of babies born to working mothers each year?

I say not until they are old enough to work and pay taxes and serve in the military.

We told them we'd meet in 18 years and it's kind of their responsibility to get there.

One of the reasons I know this is that babies whose mothers are home with them for 12 weeks or longer are more likely to receive vaccinations and checkups in their first year of life, and are therefore better protected from fatal and disabling illnesses.

But they are hidden behind images like this.

America has a message for working new moms and babies.

We should be grateful whenever we get together, and it's a nuisance for the economy and employers.

Many stories I've heard run through that story of gratitude.

One woman said, 'My husband was away from work, so I came back eight weeks after my C-section.

Without me, my daughter would not have grown up.

She didn't drink the bottle.

She started losing weight.

Thankfully my manager was very understanding.

He had mom take four turns bringing the baby on oxygen and monitor so I could breastfeed. ”

There are small clubs in the world in countries that do not give new mothers state paid leave.

Guess who they are?

The first eight make up the total population of 8 million.

These are Papua New Guinea, Suriname, and the smaller island nations of Micronesia, the Marshall Islands, Nauru, Niue, Palau, and Tonga.

In ninth place is the United States, with a population of 320 million.

Oh, that's all.

That's the end of the list.

Every other economy on earth has found a way to put some amount of national paid leave to good use for the people who will shape their futures, but we say it can't be done.

We say the market will solve this problem and rejoice when companies offer more paid time off to already the most educated and highest earning women.

Remember when it was 88%?

Low- and middle-income women are not going to participate in it.

We know that this approach has enormous economic, financial, physical and emotional costs.

We have decided, not by chance, to pass these costs directly to working mothers and their babies.

We know that low-income women are priced higher and therefore disproportionately paid to women of color.

Tell them anyway.

All of these things are a disgrace to America.

But it is also a risk for America.

Because what happens when all the so-called choices of individuals to have babies start to turn into individual choices not to have babies.

One woman told me, "Being a new mother is hard. It shouldn't be traumatic.

Now, when we talk about growing our family, we focus on how much time we need to spend taking care of ourselves and our new baby.

If we had to do it again like we did the first time, we might stick with one child. ”

The fertility rate required to stabilize the population in the United States is 2.1 per woman.

1.86 in the United States today.

We need women to have children, and we actively discourage working women from having children.

What will happen to the workforce, innovation and GDP if every single working mother in this country decides that repeating this over and over again is unbearable?

I'm here today with just one idea worth spreading. Now you know what it is.

For the first time in a long time, the most powerful country on earth has given state paid leave to the people who will shape its future and the baby who will represent that future.

Procreation is a public good.

This vacation should be subsidized by the state.

There are no exceptions for SMEs, employment terms and entrepreneurs.

Must be shareable between partners.

We talked a lot about mothers today, but co-parents are important on so many levels.

No more women returning to work limping and bleeding.

No more families should be pulling out of their savings accounts to get a few days of rest, recuperation and bonding.

No more frail infants will need to go straight from the incubator to daycare because their parents have used up all the little time they have in the NICU.

We should no longer tell working families that the conflict between their jobs, the jobs they need and the children they need is their own.

The problem is that when this happens to new families, it's consuming and new mothers can't afford to speak up for themselves because families with newborns are more financially vulnerable than ever.

But we all have voices.

I'm done giving birth, I'm done giving birth, and you may be pre-baby, post-baby, not yet a baby.

that shouldn't be a problem.

We have to stop seeing this as a mother's problem, or even a woman's problem.

This is America's problem.

We have to stop buying the lies these images tell us.

We must stop being comforted by them.

We have to wonder why we are told this doesn't work when it works everywhere in the world.

We must recognize that this American reality is our disgrace and our danger.

Because this is not, this is not, and this is not what a working mother looks like.

(applause)

When we think of learning, we often think of students in classrooms or lecture halls, with books open on their desks, listening intently to teachers and professors in front of the room.

But in psychology, learning has a different meaning.

For psychologists, learning is experience-based long-term behavioral change.

Two of the main types of learning are called classical conditioning and operant (instrumental) conditioning.

Let's talk about classical conditioning first.

In the 1890s, a Russian physiologist named Ivan Pavlov conducted a very famous experiment with dogs.

He showed the dog food and rang the bell at the same time.

After a while, the dog began to associate the bell with food.

They learned that if they heard the bell, they would be fed.

Eventually, just ringing the bell made the dogs salivate.

They have learned to hear the bells and expect food.

Under normal circumstances, the sight and smell of food causes dogs to salivate.

We call food an unconditioned stimulus and salivation an unconditioned response.

Nobody trains dogs to eat steak and drool.

But when you combine an unconditioned stimulus, such as food, with something that was previously neutral (such as the ringing of a bell), that neutral stimulus becomes a conditioned stimulus.

Then classical conditioning was discovered.

We know how this works for animals, but how does it work for humans?

in exactly the same way.

Suppose you go to the doctor one day to get an injection.

She says, "Don't worry, this won't hurt a bit," and hits the most painful injection she's ever had.

In a few weeks, I will go to the dentist for a check-up.

He puts a mirror in your mouth and starts examining your teeth and says, "Don't worry, this doesn't hurt a bit."

Even though I know the mirror won't get scratched, I jump out of my chair and run screaming out of the room.

When you go to take a shot, the words "it doesn't hurt a little bit" combine with the pain of the shot, the unconditioned stimulus to become the conditioned stimulus, followed by the conditioned response of getting out of it.

Classical conditioning is practiced.

Operant conditioning describes how outcomes lead to spontaneous behavioral changes.

So how does operant conditioning work?

Operant conditioning has two main components: reinforcement and punishment.

Reinforcers make you more likely to do something again, whereas punishers make it less likely.

Reinforcement and punishment can be positive or negative, but this does not mean they are good or bad.

Positive means adding a stimulus, such as eating dessert after eating vegetables, and negative means removing a stimulus, such as spending the night without doing homework because you did well on an exam.

Let's look at an example of operant conditioning.

After having dinner with my family, I clear the table and wash the dishes.

When you're done, mom hugs you tight and says, "Thank you for helping me."

In this situation, the mother's response is positive reinforcement if she is more likely to repeat the operant response of clearing the table and washing the dishes.

Operant conditioning is ubiquitous in our daily lives.

There aren't many things we do that aren't affected by operant conditioning at some point.

Operant conditioning is also seen in special situations.

A group of scientists demonstrated the power of operant conditioning by teaching pigeons to be art connoisseurs.

Scientists used food as a positive reinforcer to teach pigeons to choose Monet paintings over Picasso paintings.

When shown the work of other artists, scientists observed a generalization of stimuli in Pigeon's choice of Impressionism over Cubism.

Perhaps the next step is to condition pigeons to paint their own masterpieces.

Scientists these days know how people inherit traits from their parents.

They can calculate the odds of having a particular trait or having a genetic disease based on information from their parents and family history.

But how is that possible?

To understand how traits are passed from one organism to its offspring, we have to go back to the 19th century, Gregor Mendel.

Mendel was an Austrian monk and a biologist who loved working with plants.

By breeding the peas he grew in his monastery garden, he discovered the principles that govern heredity.

In one of the most classic examples, Mendel combined a purebred yellow-seeded plant with a purebred green-seeded plant, resulting in only yellow seeds.

He called the yellow trait dominant because it is expressed in all new seeds.

He then self-pollinated a new yellow-seeded hybrid plant.

And in this second generation he got both yellow and green seeds. This means that the green properties are masked by the dominant yellow color.

He called this hidden trait a recessive trait.

From these results, Mendel speculated that each trait was dependent on a set of factors, one maternal and one paternal.

These factors are called alleles and are known to represent different variations of the gene.

Depending on the type of allele that Mendel found in each seed, there are so-called homozygous peas when both alleles are identical, and so-called heterozygous peas when the two alleles are different.

This allelic combination is known as the genotype, and the resulting yellow or green color is called the phenotype.

To clearly visualize how alleles are distributed among offspring, use a diagram called a Punnett square.

Place different alleles on both axes and find possible combinations.

Take Mendel's peas, for example.

Write the dominant yellow allele with a capital "Y" and the recessive green allele with a lower case "y".

A capital Y always overwhelms its lowercase friends, so you only get a green baby if you have a lowercase Y.

In the Mendelian first generation, the yellow homozygous pea mothers give each pea child the yellow dominant allele, and the green homozygous pea fathers give the green recessive allele.

Therefore, all pea children will be yellow heterozygotes.

Then, in the second generation, where two heterozygous children marry, the children will have one of the three possible genotypes and exhibit the two possible phenotypes in a 3:1 ratio.

But peas also have many characteristics.

For example, peas can be yellow, green, round, or wrinkled.

So round yellow peas, round green peas, wrinkled yellow peas, wrinkled green peas, and all possible combinations.

Punnett squares can also be used to calculate the ratios for each genotype and phenotype.

Of course, this makes things a little more complicated.

And there are many things more complicated than peas, for example humans.

These days, scientists know a lot more about genetics and heredity.

And there are many other ways some traits can be inherited.

But it all started with Mendel and his peas.

Great weather!

great job!

You are a great athlete!

Flattering, right?

Well, maybe.

Depending on the attitude and tone of voice behind these lines, it could be a compliment.

However, it can also be a sharp, aggressive line.

This slight shift in demeanor behind the line reveals what we call verbal irony.

So when someone says, "It's nice weather, isn't it?" it's quite possible that what they really mean is that the sun is shining, the birds are chirping, and the wind is calm.

But when the weather is bad, the clouds are looming, and the wind is raging, and someone says, "What a beautiful day," it probably doesn't really mean that.

Perhaps he's saying the weather is terrible, but he's saying the opposite.

This is verbal sarcasm when the speaker says the opposite of what they intended.

I know what you are thinking.

Isn't this ironic, isn't the speaker ironic?

yes.

It is verbal irony when the speaker says the opposite of what he or she wants to say.

It's ironic when the speaker goes a step further and tries to express the opposite meaning of what they're saying and be a little harsh and mean, as if they're making fun of something.

Consider the second example. "Great job!"

Someone who achieved a lifelong dream: Amazing!

A person who won a sports championship: Wow!

Someone hits another car, it's not great.

So when the passenger said, "Great job!"

Perhaps it is used in a teasing sense and the other way around.

It's verbal irony and irony.

“You are a talented athlete,” he said to the Olympian, was genuine, not verbal sarcasm.

I said that to a clumsy kid who stumbled in English class and spilled books and pencil cases all over the room, but now it's just harsh and verbal sarcasm. Because what you said wasn't what you meant to say.

It's verbal irony.

You are saying the exact opposite of what you think.

Moreover, you are not only verbally sarcastic, but also sarcastic, because you intend to ridicule this poor fellow.

But be careful.

All sarcasm fits the definition of verbal sarcasm, but not all verbal sarcasm is sarcasm.

Verbal sarcasm adds a little punch to attitude when what you mean is the opposite of what is being said.

However, sometimes there can be another layer of meaning even without the sarcastic tone.

Now, go out and find examples of verbal sarcasm and sarcasm.

Good luck!

Seriously, do your best.

No, no, I really wish you the best of luck in this difficult mission.

Ok, ok, really good luck.

I can do it!

There is no verbal irony here.

Deep in the Vietnamese jungle, soldiers from both sides have battled heatstroke with each other for nearly two decades.

But the key to Communist victory was not weapons or physical strength, but dirt roads.

Winding its way through Vietnam, Laos and Cambodia, the Ho Chi Minh Trail began as a simple dirt road network and blossomed as the center of the victorious North Vietnamese strategy during the Vietnam War, supplying the South with weapons, troops and psychological support.

The road was a network of railroad tracks, dirt roads and river crossings that ran west from North Vietnam and south along the Truong Son Mountains between Vietnam and Laos.

The journey south initially took six months.

However, the Vietnamese have extended and improved this path through engineering and ingenuity.

At the end of the war, the highway bypassed Laos, so it took only a week.

Here's how it happened.

In 1959, as North-South relations deteriorated, a trail system was constructed to infiltrate soldiers, weapons, and supplies into South Vietnam.

The first troops traveled in single file along routes used by local ethnic groups, often all a broken tree branch at a dusty crossing was to indicate direction.

Initially, most communist cadres who followed this path were native Southerners trained in North Vietnam.

They were dressed like civilian peasants, wearing black silk pajamas and checkered scarves.

They wore Ho Chi Minh sandals cut from truck tires, carried steamed rice in elephant guts, and hung flax tubes around their bodies.

Conditions were harsh, with many dying from radiation exposure, malaria, and amoebic dermatitis.

The possibility of getting lost, starving to death, or being attacked by wild tigers or bears has always been a threat.

My diet was always just rice and salt, and it ran out quickly.

Fear, boredom and homesickness were the dominant emotions.

Soldiers spent their leisure time writing letters, drawing sketches, drinking and smoking with the local villagers.

The first troops on the road did not see much fighting.

And after six months of exhausting travel, our arrival in the South became a real highlight, often celebrated with song.

By 1965, the road was traversable by truck.

Thousands of trucks supplied by China and Russia were put into service amidst the blistering bombardment of B-52s, and truck drivers became known as pilots on the ground.

As traffic on the trail increased, so did American bombing.

They drove at night or early in the morning to avoid airstrikes, and observers were ready to warn drivers of enemy aircraft.

Villages along the trail organized teams to ensure traffic flow and to help drivers repair air raid damage.

Their cry was, "All for our Southern brothers!"

And, "Even if the car can't pass yet, don't worry about the house."

Some families donated doors and wooden beds for road repair.

The Vietnamese military even used deception to have US planes bomb hillsides to produce gravel for use in building and maintaining roads.

The red dust that spread all over the area was soaked into every corner.

The Ho Chi Minh Trail had a major impact on the Vietnam War and was key to Hanoi's success.

North Vietnam's victory was determined not by the battlefield, but by the road, the political, strategic, and economic cornerstone.

The Americans recognized the achievement, calling the path "one of the great achievements in military engineering of the 20th century."

The trail is a testament to the strength of the Vietnamese people's will, and the men and women who used it have become national heroes.

Why do we see illusions?

I will tell you about some of my research. I have provided evidence for a different kind of hypothesis than the one you find in the books on the coffee stand.

Now let's look at one of the illusions.

And this is a stand-in for so many kinds of illusions explained by this hypothesis.

I will only discuss this particular one.

As usual with these things, these two lines are actually parallel, but they appear to bend outward at the center.

The central part with these radial lines has a wider field of view than the top and bottom.

This is a surprisingly simple stimulus, so it's worth noting.

It's just a collection of straight lines.

Why can't one of the most complex objects in the universe render this incredibly simple image?

When you want to answer questions like these, you need to ask yourself, "What does this mean for your brain?"

And it's not just a few lines on the page that your brain recognizes this.

Your brain has evolved to handle the kinds of natural stimuli you encounter in real life.

So when does the brain encounter such stimuli?

Well, it sounds a little strange, but you actually encounter this stimulus all day long.

Whenever you move, especially when you move forward.

Moving forward creates an optical flow that flows out of sight, much like the Enterprise warps.

All these objects flow outward and leave traces, or blurry lines, on the retina.

They are continuously activating mini-neurons.

So this is a version of what happens in real life, and this is another version of what happens in real life all the time.

Actually, cartoonists know this.

They put these blurry lines in their cartoons, but that means "movement" to your brain.

Now, it's not like you see blurry lines in real life.

Importantly, these visual blurring and other back-of-the-eye stimuli tell your brain that you're moving.

When you move forward, your eyes are like a camera, like a snapshot camera, it stares, it stares, it's a shot of a little (snapshot sound) camera, and every time it stares as you move forward, you see all this flowing out.

So when you gaze, you get this weird visual blur that tells you the direction of movement.

Well, that's half the story.

That is the meaning of this stimulus.

This means that when you look at the first image, your brain thinks it's actually going towards the center.

It still doesn't explain why these straight lines should be recognized as bending outward.

To understand the rest of the story, you have to understand that our brains are slow.

What you want is a "ping!" sound when the light hits your eye. -- You instantly recognize what the world is like.

But it doesn't work.

It takes about a tenth of a second for your perception to form.

A tenth of a second doesn't seem like a long time, but it's a lot in normal behavior.

If you're moving at 1 meter per second, which is pretty slow, you've moved 10 centimeters in 1/10th of a second.

So, if you didn't fix this lag, anything you perceive to be within 10 centimeters of you would either hit you or pass you by the moment you perceive it.

And, of course, it's going to get worse -- (Laughter) It's going to get worse in situations like this.

Your perception is delayed.

What you want is for your perception to look like this:

You always want your perception at time T to be of the world at time T.

But the only way the brain does it is that instead of perceiving what the world looks like when light hits the retina, it has to do something more flashy.

You cannot passively respond and create your best guess. You have to make your best guess about the next moment.

What will the world look like in a tenth of a second?

Build that awareness. Because by the time near-future awareness occurs in your brain, the near-future will arrive and you will have the present awareness that you want.

My research has provided a lot of evidence that the brain is packed with mechanisms that try to compensate for its slowness. And evidence is provided in other areas of research.

And I have shown that a vast swath of illusion is accounted for by this, but this is but one example.

But one last thing, how exactly does this explain this particular example?

So really the question we have to ask is how do these two vertical lines of the first stimulus change, how do they change the next moment when I move towards the center, are all these lines of light suggesting that I am moving?

what will happen to them?

Now imagine.

There is an entrance and exit.

To be more specific, imagine that it's the entrance to a cathedral. It will help you in no time.

At very far distances the sides are perfectly parallel.

But imagine what happens when you get close to here.

It all flows outward and outward in your field of vision.

But when you get really close, imagine the sides of the doorway here and here. But if you look up at the doorway of this cathedral and move your finger like this, the sides of the doorway rise like railroad tracks in the sky.

What started out as two parallel lines actually bend outward at eye level and less outward at the top.

In the next moment, it will look like the following picture.

Projective geometry, the way things are projected, actually changes like this the next moment.

There is nothing wrong with the brain when it receives such stimulation. Just two vertical lines and no clue that the next moment will change, just render as is.

But adding clues, this is just one of many kinds of clues that can cause this kind of illusion. It's such a strong visual blur cue that instead you end up recognizing exactly how it will look the next moment.

Our perceptions always try to be about the present, but to actually perceive the present, we must perceive the future.

And these illusions are a failed perception of the future. Because they are just static images on the page, they don't change like they do in real life.

Finally, let me end by presenting an illusion here.

I'll show you two soon, if possible.

This is fun.

If you just stare at the center of it and make a piercing movement with your head, it will approach you like this.

Everyone please do that.

Make short, stabbing movements.

Because we're adding blur to these visual streamlines, the brain thinks, "Maybe it's already moving, and it's blurry."

When you do this, they should pop into view faster than you want them to.

They shouldn't be moving that much.

Finally, I'll leave this in the background.

Here we introduce motion cues, the kind of cues we get on the retina when an object is in motion.

No action is required. just look.

Raise your hand if things are moving when they shouldn't be.

Weird, right?

But what you have now, from the brain's point of view, is a signal that there is irritation in the eye, like, "Oh, this is moving."

Render awareness of what they will do in the next moment. They should be moving, they should be shifting.

What was the toughest job you've ever done?

Was it working in the sun?

Were you working to provide food for your family or community?

Were they working day and night to protect life and property?

Was it working alone, or was it working on a project whose success was not guaranteed, but which could improve human health or save lives?

Did you work to build something, create something, make a work of art?

Was it a job where you weren't sure if you were well understood or valued?

Those engaged in these tasks in our community deserve our attention, affection and our deepest support.

But people aren't the only ones in our community doing this difficult job.

These tasks are also performed by plants, animals and ecosystems around the globe, including the tropical coral reef ecosystems that I study.

Reefs are farmers.

They provide food, income and food security to hundreds of millions of people around the world.

Coral reefs are guards.

The structures they built protect our coastlines from storm surges and waves, and the biological systems they inhabit filter the water, making it safer for us to work and play.

Coral reefs are chemists.

Molecules we are discovering in coral reefs are becoming increasingly important in the search for new antibiotics and new anticancer agents.

And reefs are artists.

The structures they build are some of the most beautiful on earth.

And this beauty is the basis of the tourism industry in many countries with few other natural resources.

For all these reasons, with all these ecosystem services economists estimate the value of the world's coral reefs at hundreds of billions of dollars annually.

But despite all the hard work that went into it for us, and the wealth that we gained, we have done pretty much everything we could to destroy it.

We have taken fish out of the sea and added fertilizer, sewage, disease, oil, pollution and sediment.

We have been physically trampling coral reefs with boats, fins and bulldozers, altering the chemistry of the entire ocean, warming the water and making storms worse.

All of these are bad on their own, but these threats magnify, compound, and exacerbate each other.

Let's take an example.

Curaçao, where I live and work, was hit by a tropical storm a few years ago.

And on the eastern tip of the island, with coral reefs thriving in their pristine condition, little did we know the tropical storm had passed.

But in towns where corals were dying from overfishing and pollution, tropical storms picked up dead corals and used them as clubs to kill the remaining corals.

This is a coral that I studied during my PhD, and I am familiar with it.

And after this storm robbed half of the coral tissue, the algae infested, the algae overgrown the tissue, and the coral died.

This escalating threat, the compounding of factors, is what Jeremy Jackson describes as "the slippery slope to slime."

This is not even a metaphor, as many of our reefs are now literally covered in bacteria and algae and mucus.

Now, this is part of the talk, and you might think I'm going to start appealing to all of us to protect our coral reefs.

But I have to make a confession. That word drives me crazy.

Whether it's in a tweet, a news headline, or the glossy page of a protective pamphlet, that phrase bothers me every time I see it. Because we conservationists have been sounding the alarm about the death of coral reefs for decades.

But most people I meet, no matter how educated they are, don't know what corals are or where they come from.

If the world's coral reefs are abstract and almost incomprehensible, how do you get them interested?

If they don't understand what corals are, where they come from, how interesting, interesting and beautiful they are, why would they care to save them?

So let's change that.

What is coral and where did it come from?

Corals are born in a variety of ways, most often by mass spawning. That is, one night a year, all individuals of a single species release all the eggs they have laid that year into the water column, where they are grouped into bundles of sperm cells.

And those bundles reach the surface and break apart.

And hopefully -- hopefully -- you'll meet other coral eggs and sperm at the surface.

And that's why reefs need lots of coral. That way all the eggs can meet their counterparts on the surface.

Once fertilized, it splits in half again and again, just like the eggs of other animals.

Taking these pictures under the microscope every year is one of my favorite and most magical moments of the year.

At the end of all this cell division, they turn into swimming larvae. It's a tiny lump of fat about the size of a poppy seed, but with all the sensory systems we have.

They can sense color, light, texture, chemicals, and pH.

They can even feel pressure waves. they can hear sounds.

And they use their talents to find a place to live the rest of their lives, sticking at the bottom of the reef.

So imagine you found a place to spend the rest of your life on your second day of life.

They attach themselves where they see fit, build a skeleton under themselves, build mouths and tentacles, and begin the difficult task of building the world's coral reefs.

A single coral polyp splits again and again, leaving a limestone skeleton underneath to grow toward the sun.

Considering hundreds of years and many species, we get huge limestone structures, often visible from space, covered with the thin skin of these hardworking animals.

There are currently only a few hundred, perhaps 1,000, coral species on Earth.

But these systems are home to millions of other species, and their diversity is what makes them stable and where we find new drugs.

That's how we find new food sources.

I was lucky enough to work in Curacao, where there are still reefs like this.

But in reality, much of the Caribbean and much of our world is a lot like this.

Scientists are studying the loss of the world's coral reefs in more and more detail and documenting their causes more and more reliably.

However, in my research, I am not interested in looking back.

My colleagues from Curacao and I are looking forward to seeing what happens.

And we have the tiniest reason to be optimistic.

Because even at some of these reefs that we probably could have ignored long ago, we sometimes see baby corals arriving and surviving.

And we're beginning to suspect that baby corals have the ability to adapt to some conditions that adults can't.

They may become a little easier to adapt to this human planet.

So the research I'm doing with my colleagues in Curacao is trying to figure out what baby corals need and want in their critical early stages, and how we can help them through the process.

Here are three examples of the work we've done to answer these questions.

A few years ago, we used a 3D printer to conduct a selection survey of corals of different colors and textures, simply asking where they would like to live.

And even without biology involved, corals still prefer the colors of healthy reefs: white and pink.

And they prefer crevices, ditches, and holes that are safe from being trampled or eaten by predators.

So we can say that we need to use this knowledge to go back in time and restore those elements in a conservation project: that pink, that white, that crevice, that hard surface.

You can also use that knowledge when building something underwater, such as a seawall or a pier.

You can choose to use materials, colors and textures that can bias the system towards those corals.

In addition to surfaces, we are now studying chemical and microbial signals that attract corals to reefs.

About six years ago, he began culturing bacteria on the surface of coral colonies.

Then they tried them one by one, looking for bacteria that persuaded the corals to settle and attach.

And our freezers now have many strains of bacteria that ensure the colonization and attachment process on corals.

So as we speak, my colleagues in Curacao are testing these bacteria in the lab to see if they help grow more coral settlers and if they survive better when those coral settlers are put back into the water.

In addition to these tools, we are now trying to unlock the mysteries of understudied species.

This is and always will be one of my favorite corals. Dendrogilla Cylinder Coral is a pillar coral.

I love it because it has this funny shape, because the tentacles look thick and fuzzy, and because it's unusual.

Finding these on the reef is a lot of fun.

In fact, it is so rare that it was added to the endangered species list last year.

And part of the reason is that in more than 30 years of research, scientists have failed to find baby columnar corals.

I wasn't sure if they could still breed, or even if they would still breed.

So four years ago we started tracking them at night to see if we could figure out when they spawned on Curacao.

We got some good tips from a colleague in Florida who saw one in 2007 and 2008, and were finally able to figure out when they spawned in Curacao and catch them.

This is the female on the left with some eggs in her tissue about to be released into the seawater.

And this is the male on the right, releasing sperm.

We collected them, put them back in the lab, fertilized them, and made the baby column corals swim in the lab.

Thanks to the work of our scientist uncles and aunts, and thanks to our 10-year practice of breeding other coral species in Curacao, some of those larvae were able to go through the rest of the process, settle and attach and transform into metamorphic corals.

So this is the first pillar coral baby that anyone has seen.

(Applause.) And I have to say - if you think baby pandas are cute, this one is even cuter.

(Laughter) So we're starting to figure out the secrets of this process, the secrets of coral reproduction, and how we can help them.

And this is true all over the world. Scientists are devising new ways to handle and establish embryos, and perhaps even cryopreserve them so that their genetic diversity can be preserved and studied more often.

But this is still very low tech.

We are limited by bench space, the number of people in the lab, and the number of coffees we can have in an hour.

Now, compare this to other crises and other areas of concern as a society.

We have advanced medical technology, defense technology, science and technology, and even cutting-edge art.

However, our conservation technology lags behind.

Think of the hardest job you've ever done.

Many would say it's for parenthood.

My mother said that being a parent is what makes your life so much better and so much more difficult than you ever imagined.

I have been trying to help corals become parents for over ten years.

And witnessing the wonders of life certainly filled me with amazement from the bottom of my heart.

But I have also seen how difficult it is for them to be parents.

The columnar coral spawned again two weeks ago and we collected the eggs and brought them back to the lab.

And here we see one embryo dividing, alongside 14 eggs that explode because they weren't fertilized.

They become infected with bacteria, explode, and the bacteria end up threatening the life of this one unborn child with a chance.

I don't know if the way we were handled was wrong. I also don't know if it's just the corals on this reef that are constantly suffering from low fertility.

Whatever the cause, there is still much work to be done before baby corals can be used to grow, repair or conserve reefs.

So never mind that they are worth hundreds of billions of dollars.

Coral reefs are hardworking flora, fauna, microbes and fungi.

They provide us with art, food and medicine.

And we've nearly wiped out an entire generation of corals.

However, despite our best efforts, a few still managed to succeed. Now is the time for us to thank them for their work and give them every chance to raise the baby corals that are the reefs of the future.

Thank you very much.

(applause)

As anyone studying geometry now or in the past knows, the father of geometry is Euclid, a Greek mathematician who lived in Alexandria, Egypt around 300 B.C.E.

Euclid is known as the author of a highly influential work known as 'Elements'.

Do you think your math book is long?

Euclid's "Elements" is a total of 13 volumes filled with only geometry.

In The Elements, Euclid structured and supplemented the work of many of his previous mathematicians, including Pythagoras, Eudoxus, and Hippocrates.

Euclid described everything as a logical proof system built from a set of definitions, general concepts, and his five famous postulates.

Four of these postulates are very simple and straightforward, for example two points determine a line.

But the fifth element is the seed that grows our story.

This fifth mystery postulate is known simply as the parallel postulate.

Unlike the first four, the fifth postulate is very complicated.

Euclid's version states, "If a line overlaps two other lines so that the sum of the two interior angles on the same side of the transverse line is less than two right angles, the lines eventually intersect on that side and are not parallel."

Wow, it's a mouthful!

This is the simpler, more familiar version. "In the plane, you can draw only one new line parallel to the original line through any point not on a particular line."

Over the centuries many mathematicians have tried to prove the parallel postulate from the other four assumptions, but have been unable to do so.

Along the way, they began to consider what would logically happen if the fifth postulate were not actually true.

Some of the greatest minds in the history of mathematics have asked this question: Ibn al-Haytham, Omar Khayyam, Nasir al-Din al-Tusi, Giovanni Sackeri, Janos Bolyay, Karl Gauss, Nikolai Lobachevsky.

They all experimented against the parallel postulate, but found that this yielded perfect alternative geometries.

These geometries came to be collectively known as non-Euclidean geometries.

We will leave the details of these different geometries for another lesson.

The main difference depends on the curvature of the surface on which the lines are constructed.

It turns out that Euclid didn't tell the whole story in The Elements, but merely described one possible way of looking at the universe.

It all depends on the context of what you're looking at.

A plane moves in one direction, but positive and negative curved surfaces exhibit very different properties.

At first these alternative geometries seemed strange, but I soon found them equally adept at describing the world around us.

Navigating our planet requires elliptical geometry, and much of M.C.'s art requires elliptical geometry. Escher displays hyperbolic geometry.

Albert Einstein, as part of his general theory of relativity, also used non-Euclidean geometry to explain how space-time distorts in the presence of matter.

The big mystery is whether Euclid was even remotely aware of the existence of these different geometries when he wrote his postulates.

We may never know, but it is hard to believe that a man of such great intelligence, and with such a thorough understanding of the field, that he was ignorant of their nature.

Perhaps he knew and wrote the postulates in such a way as to leave curiosity to wash away the details.

If so, he will surely be satisfied.

These discoveries would never have been made without gifted progressive thinkers who were able to put their preconceptions aside and think outside the box.

We, too, must sometimes put aside our preconceived notions and physical experiences and look at the bigger picture. Otherwise, you risk losing sight of the rest of the story.

The universe is kind of beautiful.

From very large to very small, literally everything.

Sure, there are some elements there that aren't very palatable, but on the whole, scholars agree that its presence is probably a good thing.

It's a good thing that the whole scientific field is focused on that research.

This is known as cosmology.

Cosmologists look at things in space and piece together how the universe evolved—what it does now, what it will do, and how it all began in the first place.

Edwin Hubble was the first to notice that our universe was expanding, noting that galaxies seemed to fly further and further apart.

This means that everything should have started with a monumental explosion of infinitely hot, infinitely small dots.

The idea was jokingly called the "Big Bang" at the time, but as the evidence piled up, the concept and name actually took hold.

We know that after the Big Bang, the universe cooled and formed the stars and galaxies we see today.

Cosmologists have many ideas about how this happened.

However, by recreating the high temperature and high density that existed in ancient times in the laboratory, we can also explore the origin of the universe.

This is done by particle physicists.

Over the past century, particle physicists have studied matter and forces at higher energies.

First with cosmic rays, then with particle accelerators. This is a machine that crushes elementary particles with great energy.

The more energy the accelerator has, the more effectively it can go back in time.

Matter is now composed primarily of atoms, but hundreds of seconds after the Big Bang it was too hot for electrons to combine with the nuclei to form atoms.

Instead, the universe consisted of a swirling ocean of subatomic matter.

Seconds after the Big Bang, it was even hotter, usually hot enough to overwhelm the forces that bind protons and neutrons together in the nucleus.

Further back, just a few microseconds after the Big Bang, protons and neutrons were just beginning to form from quarks, one of the fundamental building blocks of the Standard Model of particle physics.

Going back even further, the energy was so great that the quarks didn't even stick together.

Physicists hope that reaching even greater energies will take them back to a time when all forces were the same, making it much easier to understand the origin of the universe.

To do that, we need to work hard not only to build bigger colliders, but also to combine our knowledge of the very big and the very small, and share these interesting insights with each other, and with you.

It should be!

After all, when it comes to our universe, we are all in this universe together.

The human eye is one of the most powerful machines on earth.

It's like a 500-megapixel camera that works in bright light, near-darkness, and, although it doesn't really work, underwater.

It tells our brain a lot about the world.

Our eyes are on how we find partners, how we understand the people around us, how we read, and how we watch TV game shows where padded wrecking balls plunge people into cold water.

Yes, humans have very beautiful eyes, and we are lucky to have two.

However, no matter how hard you look, there are still some things you can't see well.

For example, you can see a horse galloping, but your eyes can't keep up with its fast-moving hooves enough to determine if all four feet are off the ground at the same time.

This kind of question requires a camera.

About 150 years ago, photographer Edouard Muybridge used this camera to solve the mystery of galloping horses.

Muybridge took careful photographs to prove that at one point the horse was indeed flying.

"Hey mom! My hooves aren't croaking!"

Since then, photography has been incorporated into all aspects of mathematics and science.

It gives us a better understanding of the world we thought we already saw, but it's a world we really need help with to see a little better.

It doesn't necessarily matter that the world goes by faster than our eyes can handle it.

Cameras can help you see objects and movements that are too small for the naked eye.

Botanists use photographs to show the plant's life cycle and how a flower takes hours to follow the sun and turn and grow toward the light in a phenomenon called phototropism.

Mathematicians have used photographs to find out where in the whip's twist and rotation the crackling sounds occur as it breaks through the sound barrier.

Meteorologists and environmental scientists are revealing the growth of major hurricanes and the long-standing depression of many of the world's glaciers.

Slow-motion films and high-speed photography have shown us the beating of a hummingbird's wings and the path of a bullet through its target.

In one project, a corpse, or corpse, was frozen and sliced ​​into thousands of thin discs.

The disc was shot to create an animated film, allowing viewers to move up and down skeletons, enter flesh, and move through bones and blood vessels. Maybe I should have recommended not watching this during dinner, bad.

In today's classrooms, thanks to cameras in nearly every cell phone and computer, young scientists can observe the world around them, document them, and share their findings online.

Whether it's the changing seasons or the growth of sprouted seeds, cameras allow us to see the beautiful world with new eyes.

Have you ever wondered who has the power to make laws and punish those who break them?

When we think of US power, we usually think of the president, but the president doesn't act alone.

In fact, he's just one piece in the power puzzle, and for good reason.

When the American Revolutionary War ended in 1783, the American government was in a state of transformation.

The Founding Fathers knew they didn't want to establish a new country ruled by a king, so the debate centered around creating a strong and just national government that protected individual liberties and didn't abuse power.

When the new Constitution was adopted in 1787, the structure of the United States' early government called for three independent departments, each with its own powers, and a system of checks and balances.

This ensures that no branch gets too powerful, as other branches can always check the power of the other two branches.

These chapters work together to run the country and set guidelines for all of us to follow.

The legislative branch is defined in Article 1 of the United States Constitution.

Many feel that the Founding Fathers documented this branch first because they considered it the most important.

The legislative branch consists of 100 US Senators and 435 US Representatives.

This is better known as the United States Congress.

While the legislature's primary role is to make laws, it is also responsible for approving federal judges and magistrates, passing the national budget, and declaring war.

Each state is assigned two senators and a certain number of representatives, depending on the number of people living in that state.

The executive branch is stipulated in Article 2 of the Constitution.

The leaders of this branch of government are the President and Vice President, who are responsible for enforcing the laws enacted by Congress.

The President works closely with an advisory body known as the Cabinet.

These appointed aides assist the President in making important decisions within specialized areas such as defense, finance, and homeland security.

The executive branch also appoints government officials, commands armed forces, and meets with leaders of other countries.

All of this combined is a lot of work for many people.

In fact, the executive branch employs over 4 million people to do it all.

The third brand of the U.S. government is the Judiciary, detailed in Article 3.

This branch is made up of all courts across the United States, from the United States District Court to the U.S. Supreme Court.

These courts interpret our country's laws and punish those who violate them.

The Supreme Court, the Supreme Court, resolves interstate disputes, hears appeals from state and federal courts, and determines whether federal law is constitutional.

The Supreme Court has nine justices, but unlike other offices in our government, justices are appointed for life or for as long as they wish.

Our democracy depends on an informed public, so it is our duty to know how it works and what powers each branch of government has over its citizens.

Aside from voting, at some point in your life you may be asked to participate in government, such as serving on a jury, testifying in court, or petitioning members of Congress to pass or reject a bill.

Knowing your branches, who runs them, and how they work together helps you get involved, informed, and intelligent.

This is Zenon of Elea. He is an ancient Greek philosopher famous for inventing numerous paradoxes, arguments that appear logical but whose conclusions are absurd or contradictory.

For over 2,000 years, Zeno's haunting riddles have inspired mathematicians and philosophers to better understand the nature of infinity.

One of Zeno's most well-known problems is called the dichotomy paradox, which in ancient Greek means "paradox of halving".

It's like this: After a long day of sitting and thinking, Zeno decides to walk from home to the park.

Fresh air cleanses his mind and helps him think better.

In order to go to the park, you have to go halfway through the park first.

This part of his journey takes some time.

After reaching the halfway point, you must walk half the remaining distance.

Again, this takes a finite amount of time.

Even if you get there, you still have to walk half the distance, which takes a finite amount of time.

This happens over and over and over again.

In this way we find that we can divide the remaining distance into smaller and smaller parts and keep going forever so that it takes a finite amount of time to move each one.

So how long does it take Zeno to go to the park?

To find out, we need to add up the time for each part of the journey.

The problem is that there are an infinite number of these finite-sized pieces.

So shouldn't the total time be infinite?

By the way, this discussion is completely general.

It states that it should take infinite time to move from any place to any other.

This means that any movement is impossible.

This conclusion is clearly absurd, but where is the logic flawed?

A good way to resolve this paradox is to turn it into a math problem.

Let's assume Zeno's house is one mile from the park and Zeno walks at one mile per hour.

Using common sense, the travel time should be 1 hour.

But let's look at things from Zeno's point of view and split the journey into several parts.

The first half of the journey takes 30 minutes, the second part 15 minutes and the third part 8 hours.

Summing up the time so far, we end up with a series that looks like this:

"Well," Zeno might say, "Since there are an infinite number of terms on the right side of the equation, and each term is finite, the sum should equal infinity, right?"

This is the problem with Zeno's argument.

As mathematicians later discovered, it is possible to add infinitely many terms of finite size to get a finite answer.

"How?" you ask.

Now let's think about it.

Let's start with a square with an area of ​​1 meter.

Then cut the square in half and cut the other half in half.

While doing this, let's track the area of ​​the piece.

The first slice creates two parts, each with half the area. On the next slice, one of them is split in half, and so on.

But no matter how many times you slice the box, the total area will be the sum of the areas of all the parts.

Now I know why I chose this particular method of cutting squares.

I got the same infinite series as in Zeno's Journey.

In mathematics jargon, n tends to infinity, so if you build up more and more of the blue part considering the limit, the whole square will be covered in blue.

However, the infinite sum must equal 1 because the area of ​​a square is only 1 unit.

Returning to Zeno's journey, we see how the paradox is resolved.

Not only is the sum of an infinite series a finite answer, but the finite answer is the same answer that common sense holds true.

Zeno's journey takes an hour.

Great things happen at intersections.

In fact, I would argue that some of the most interesting things in human experience occur at the intersection of bounded spaces. Boundary means the space in between.

There is freedom in between, the freedom to create a new self-definition out of the ambiguity of not here, not there at all.

The great crossroads of the world come to mind, such as the Arc de Triomphe in Paris or Times Square in New York City, both of which are buzzing with constant excitement.

Intersections like the Edmund Pettus Bridge in Selma, Alabama, and Canfield Drive and Copper Creek Court in Ferguson, Missouri also come to mind. This is because of the tremendous energy at the intersection of humans, ideologies, and the ongoing struggle for justice.

Beyond the physical landscape of our planet, some of the most famous astronomical images are of the intersection.

Stars are born at the random intersections of gas and dust due to the irreversible gravitational pull of gravity.

The star dies at this same intersection, and is now flung outward by violent collisions of tiny atoms, crossing and merging efficiently into something entirely new and massive.

We can all think of a crossroads that has special meaning for us.

Therefore, to be intersectional is to occupy the position of intersection.

I have lived my life in a marginal space between dream and reality, race and gender, poverty and abundance, science and society.

I am black and I am also a woman.

Like the birth of stars in the sky, this robust combination of knowledge provides a shining example of the explosive fusion of identities.

I am also an astrophysicist.

I study blazers, supermassive superactive black holes that are located in the centers of massive galaxies and shoot jets at near-light speeds near their black holes, a process we are still trying to fully understand.

I dreamed of becoming an astrophysicist since I was 12 years old.

Little did I know at the time that, according to Dr. Jamie Alexander's Archive of African American Women in Physics, only 18 black women in the United States had ever earned a doctorate in a physics-related field, and the first black woman to graduate with a doctorate in astronomy-related fields was exactly one year before I was born.

As I traveled my way, I met the best and worst of my life at the crossroads. It's an amazing opportunity to define yourself, a clash of expectations and experiences, the exhilaration of triumphant breakthroughs, and sometimes the explosive pain of rebirth.

I started college life right after my family fell apart.

Our financial situation collapsed shortly after my father left our lives.

This forced my mother, sister, and I out of the relative comforts of middle-class life and left us struggling almost constantly to make ends meet.

So, I was one of about 60% of women of color who felt that their financial goals were a major barrier to their educational goals.

Thankfully, Norfolk State University fully funded me so I could complete my bachelor's degree in physics.

After graduating, I was frustrated, even though I wanted a PhD in astrophysics.

It was a poster that saved my dreams and it was a really great people and program.

The American Physical Society had this beautiful poster encouraging students of color to become physicists.

What struck me was the depiction of a young black girl, probably about 12 years old, intently looking at a physics equation.

I remember feeling like I was staring straight at the girl who dreamed of this dream for the first time.

I immediately wrote to the association requesting a private copy of the poster. It's still hanging in my office.

In my email, I explained my educational background and my desire to find myself again by pursuing a PhD.

They directed me to the Fisk Vanderbilt University Bridge Program. The program itself combines a master's and doctoral degree from two universities.

After two years of school, they accepted me into their program and put me on the path to a PhD again.

After completing my master's degree at Fisk, I went on to Yale University for a Ph.D.

I expected that physically occupying the space that would eventually bring my childhood aspirations to fruition would smoothly advance me to my Ph.D.

(Laughter) It quickly became clear that not everyone was thrilled to have that degree of limitation in their space.

I was ostracized by many of my classmates, one of whom even invited me to do what I really wanted to do when I came here, pushing all the dirty dishes from our meal in front of me.

I wish it was a special occasion, but for many women of color in science, technology, engineering, math—STEM—this has endured for a long time.

In a recent study by Joan C. Williams of the University of California, Hastings, 100 percent of 60 women of color interviewed reported facing racist gender bias, such as being mistaken for a janitor.

This false identity was not reported among the Caucasian women interviewed for this study (557 women in total).

There's nothing inherently wrong with janitorial jobs, and indeed my parents were able to attend college because many of them had these jobs, but it was clearly an attempt to put me in their place.

The encounter was certainly painful, but the real problem is that my appearance tells everyone about my abilities.

But beyond that, it is emphasized that women of color in STEM fields do not experience the same set of barriers that only women and people of color face.

That's why today I want to focus on women of color who live relentlessly and unapologetically as a collective of inseparable identities in STEM.

STEM itself is a cross-cutting term and its true richness cannot be understood without considering the marginal space between disciplines.

Science, which seeks to understand the physical world through chemistry, physics and biology, cannot be achieved without mathematics.

Engineering requires the application of basic science and mathematics to practical experience.

Technology is firmly rooted in the foundations of mathematics, engineering and science.

Mathematics itself plays a key role in the Rosetta Stone, deciphering and encoding the physical principles of the world.

STEM is completely incomplete without its individual elements.

This is to say nothing of the richness that can be achieved by combining STEM with other disciplines.

This talk has two purposes. One is to say directly to every Black, Latino, Indigenous, and other woman and girl resting at the blessed intersection of race and gender that you can be whoever you want to be.

My personal hope is that you become an astrophysicist, but anything beyond that is fine.

Don't think for a moment that you can't be who you imagine yourself to be because you are who you are.

Hold onto that dream and let it take you to a world you can't even imagine.

Second, most of the most pressing issues of our time are now finding contact with STEM.

As a global society, we have solved most of the monolithic problems of our time.

What remains requires a thorough exploration of the marginal space between disciplines to create tomorrow's multifaceted solutions.

No one is better at solving these marginal problems than those who have faced them at the crossroads their whole lives.

As thought leaders and decision makers, we must move beyond the first steps of diversity into the richer and more robust realm of full inclusion and equal opportunity.

One of my favorite examples of good limits comes from the late Dr. Claudia Alexander, a black female plasma physicist. He died in July after a ten-year battle with breast cancer.

She was the NASA project scientist spearheading NASA's side of the Rosetta and $1.5 billion Galileo missions to Jupiter, two high-profile scientific triumphs for NASA, the United States, and the world, made famous this year by landing a probe on a comet.

Dr. Alexander said, "I'm used to going back and forth between the two cultures.

For me, one of the purposes of life is to lead us from a state of ignorance to a state of understanding through daring quests that we cannot do every day. ”

This really shows the power of the marginal.

She had the technical prowess to spearhead the most ambitious space mission of our time and knew exactly where she was, wherever she was.

Jessica Matthews, inventor of the SOCCET series of sports products that generate renewable energy when played with, such as soccer balls, said, "A major part of invention is not just making things, it's understanding people and understanding the systems that make up our world."

The reason I tell my story and the story of Dr. Alexander and Jessica Matthews is because they are fundamentally intersecting stories, stories of lives lived through the nexus of race, gender and innovation.

Despite the unspoken doubts about my right to be in elite territory, I am proud to say that upon graduation, I was the first black woman to earn a doctorate in astrophysics in Yale's then 312-year history.

(Applause.) I am now part of a growing small group of women of color executives in STEM who are bringing new perspectives and new ideas to the most pressing issues of our time: educational inequality, police brutality, HIV/AIDS, climate change, gene editing, artificial intelligence, and Mars exploration.

This is to say nothing of what we haven't even thought about yet.

Women of color in STEM fields are some of the toughest and most exciting socio-tech issues of our time.

We are therefore uniquely positioned to contribute and drive these conversations with a more diverse set of lived experiences in a more inclusive way.

This perspective can be extended to many intersecting people whose experiences, positive or negative, enrich conversations in ways that outperform even the best resourced like-minded groups.

This is not a request born out of a desire to fit in.

It is a reminder that without this very cooperation, bringing together people who have reached their limits, who have lived differently, who have clearly experienced and who have been affected differently, we cannot achieve the best possible outcome for humanity as a whole.

Simply put, we cannot best express our collective talents unless we are at our best as human beings.

thank you.

(applause)

Feathers are some of the most remarkable things animals have ever made.

They are amazing in their complexity, delicate in their construction yet strong enough to hold a bird thousands of feet in the air.

Like everything in nature, feathers have evolved over millions of years into their present form.

It may be difficult to imagine how this could have happened.

After all, what was the intermediate form like?

What is the use of half wings adorned with half feathers?

Thanks to science, we know that birds are living dinosaurs.

Their skeletal affiliation reveals their kinship.

Certain dinosaurs share some anatomical details with birds that are not found in other animals, such as wishbones.

And in the late 1990s, paleontologists began digging up compelling evidence for that idea. It's a dinosaur that still has feather fragments on its body.

Since then, scientists have discovered dozens of species of dinosaurs with feathery remains.

Some were as small as pigeons, others as big as a school bus.

Looking at how they are related in the family tree, the evolution of feathers doesn't seem so impossible.

The most distant relatives of birds had wiry straight wings.

These wires are then split to produce a simple branch.

In many dinosaur lineages, these simple feathers evolved into more complex feathers, including those found in birds today.

At the same time, feathers spread across the dinosaur's body, changing from sparse fluff to dense plumage, extending to the feet.

Some fossils have preserved some of the molecules that give feathers their color.

They display a beautiful range of colors, such as shiny dark plumage reminiscent of crows, alternating black and white stripes, or splashes of bright red.

Some had high crests on their heads, while others had long, striking tail feathers.

Well, none of these dinosaurs used wings to fly. The arms were too short and the rest of the body too heavy.

But birds don't just use their wings to fly.

The woodcock uses its plumage to blend perfectly into the forest background.

An ostrich spreads its wings on its nest to provide shade for its chicks.

The peacock spreads its splendid tail feathers to attract the peacock.

Feathers may have served these functions for dinosaurs as well.

How feathered dinosaurs managed to fly is still a mystery.

But if a small feathered dinosaur flapped its arms as it ran up a slope, its feathers would have provided extra lift to run faster.

This physical coincidence may have evolved dinosaurs to have longer arms, allowing them to run faster or leap short distances through the air.

Eventually, their arms stretched into wings.

Perhaps 50 million years after the first wiry feathers evolved, feathers lifted dinosaurs into the sky for the first time.

Big data is an elusive concept.

This represents an uncomfortable amount of digital information to store, transfer, or analyze.

Big data is so vast that it overwhelms the technology of the time and challenges us to create the next generation of data storage tools and technologies.

Big data is nothing new.

In fact, CERN physicists have been grappling with the ever-expanding big data challenges for decades.

Fifty years ago, CERN data could be stored on a single computer.

OK, so this wasn't a normal computer, it was a mainframe computer that filled an entire building.

Physicists from all over the world have visited CERN and connected to this giant machine to analyze the data.

In the 1970s, an ever-increasing amount of big data distributed across different sets of computers proliferated at CERN.

Each set was joined by a dedicated homegrown network.

But physicists needed access to all this data because they collaborated without caring about boundaries between sets.

So we bridged the independent networks with our own CERNET.

In the 1980s, islands of similar networks, speaking different dialects, sprang up across Europe and America, allowing remote access, but with pain.

To enable physicists around the world to easily access the ever-expanding big data stored at CERN without traveling, the network needed to communicate in the same language.

We adopted the nascent Internet working standards from the United States, and then other European countries, and in 1989 established a major link at CERN between Europe and the United States, giving birth to a truly global Internet.

This will enable physicists from around the world to easily access terabytes of big data remotely, generate results, and write papers in their home labs.

And they wanted to share the results with all their colleagues.

To make this information sharing easier, we created the web in the early 1990s.

Physicists no longer need to know where information is stored to find and access it on the web. This idea has spread all over the world and transformed the way we communicate in our daily lives.

In the early 2000s, the continued growth of big data has outstripped the ability to analyze big data at CERN, even though the building was packed with computers.

We needed to start distributing petabytes of data to our collaborating partners to adopt local computing and storage in hundreds of different research institutions.

To coordinate these interconnected resources with their diverse technologies, we developed a computing grid to enable seamless sharing of computing resources around the world.

This relies on trust and interaction.

However, this grid model could not be transferred outside the community so easily. Not everyone in the community has resources to share, nor can companies expect the same level of trust.

Instead, another, more business-like approach to accessing on-demand resources, called cloud computing, has recently become popular and used by other communities to analyze big data.

It may seem paradoxical that a place like CERN, a lab focused on studying the building blocks of matter that is unimaginably small, is the source of something as big as big data.

However, methods to study elementary particles and the forces with which they interact involve generating the particles for a fraction of a second, bombarding them with protons in an accelerator, and capturing the particle's trail as it zooms out at near the speed of light.

To see these tracks, our detector with 150 million sensors acts like a very large 3D camera, taking pictures of each impact event. That's up to 14 million times per second.

It creates a lot of data.

But if big data has been around for so long, why are we suddenly hearing about it now?

As the old metaphor explains, the whole is greater than the sum of its parts, and science is no longer the only one taking advantage of this.

The fact that more knowledge can be derived by combining related information and identifying correlations can inform and enrich many aspects of everyday life, such as real-time like traffic and financial conditions, short-term changes like health care and weather, or predictive situations like business, crime and disease trends.

Virtually every sector is looking to collect big data, including mobile sensor networks that span the globe, cameras on the ground and in the air, archives that store information published on the web, and loggers that record the activities of internet citizens around the world.

The challenge is to invent new tools and technologies to mine these vast reserves, inform decision-making, improve medical diagnosis, and otherwise meet the needs and desires of tomorrow's society in ways unimaginable today.

Is it possible to create something out of nothing?

Or, more precisely, can energy be transformed into matter?

Yes, but only if it combines with its twin antimatter.

And there's something pretty mysterious about antimatter. That is, the amount of antimatter is much less than it should be.

Let's start with the most famous physics formula of all time: E equals m c squared.

It basically states that mass is concentrated energy and that mass and energy are interchangeable like two currencies with a huge exchange rate.

90 trillion joules of energy equals 1 gram of mass.

But how do we actually convert energy into matter?

The magic word is &lt;i&gt;energy density&lt;/i&gt;.

Concentrating a huge amount of energy in a small space creates new particles.

If you look closely, you can see that these particles always exist in pairs, like twins.

That's because a particle always has a counterpart antiparticle, and these are always produced in exactly the same amount, ie 50/50.

It may sound sci-fi, but this is everyday life in particle accelerators.

Collisions between two protons at CERN's Large Hadron Collider produce billions of particles and antiparticles every second.

For example, consider electrons.

It has very little mass and a negative charge.

It is the antiparticle, the positron, which has exactly the same mass but a positive charge.

However, apart from their opposite charges, both particles are identical and perfectly stable.

And the same is true for their heavier cousins, protons and antiprotons.

Scientists are therefore convinced that a world made of antimatter would look, feel and smell exactly like ours.

In this anti-world you may find anti-water, anti-gold and, for example, anti-marble.

Now imagine marble and anti-marble together.

These two seemingly solid objects vanish completely in a flash of energy as great as an atomic bomb.

Combining matter and antimatter produces so much energy that science fiction is full of ideas for harnessing the energy stored in antimatter, for example, as fuel for spacecraft like Star Trek.

After all, the energy content of antimatter is a billion times higher than conventional fuels.

The energy of one gram of antimatter is enough to drive a car 1,000 times around the Earth or put a space shuttle into orbit.

So why shouldn't antimatter be used for energy production?

Antimatter is not just there for us to harvest.

Antimatter must be created before it can be burned, and creating antimatter requires a billion times more energy than it returns.

But what if there is antimatter in the universe, and one day we can mine it from some antiplanet?

Decades ago, many scientists believed this was indeed possible.

Today, observations show that there is not much antimatter anywhere in the visible universe. This is strange. Because, as I said before, there should be as much antimatter in the universe as there is matter.

Antiparticles and particles should exist in equal numbers, so this missing antimatter?

It's really a mystery.

To understand what's going on, we have to go back to the big bang.

At the moment the universe was born, a huge amount of energy turned into mass, and our first universe contained equal amounts of matter and antimatter.

But after just a second, most matter and antimatter all destroyed each other, producing the enormous amount of radiation that can still be observed today.

Only about 100 millionth of the original amount of matter is attached to the surroundings, and there is no antimatter at all.

"Now wait!" You might say, "Why did all the antimatter disappear and only matter remained?"

It seems that we were somehow lucky that there is a small asymmetry between matter and antimatter.

Otherwise, there would be no particles anywhere in the universe, and there would be no humans.

But what causes this asymmetry?

Experiments at CERN are trying to figure out why something exists and why we don't live in a universe filled with nothing but radiation.

But for now, I don't know the answer.

For the last few months, I've been traveling for weeks at a time with just one suitcase.

One day I was invited to an important event and wanted to wear something special and new.

So I looked in my suitcase, but I couldn't find anything to wear.

I was lucky enough to be at a technology conference that day and had access to a 3D printer.

So I quickly designed the skirt on my computer and loaded the file into the printer.

I just spent one night printing the work.

The next morning, I took out all the pieces and put them together in my hotel room to create the skirt I'm wearing today.

(Applause.) So this wasn't the first time I printed clothes.

For an advanced collection for fashion design school, I decided to 3D print an entire fashion collection from home.

The problem is that I know next to nothing about 3D printing and only had 9 months to figure out how to print 5 fashionable looks.

I have always felt most creative when working from home.

I love experimenting with new materials and was always trying to develop new techniques to create the most unique textiles for my fashion projects.

I loved going to old factories and weird shops looking for weird powders and weird ingredient leftovers and then taking them home and experimenting.

As you can probably guess, my roommate didn't like it at all.

(Laughter) So I decided to work on a machine that was too big to fit in my living room.

I love being able to do precise and custom work with all kinds of fashion technology like knitting machines, laser cutting, silk printing and more.

One summer vacation, I came to New York to do an internship at a fashion house in Chinatown.

We worked on two amazing 3D printed dresses.

As you can see here, they were great.

However, there were some issues with them.

They were made of hard plastic, which made them very fragile.

The models were unable to sit and were even scratched by the plastic under their armpits.

3D printing gave designers a great deal of freedom to make the dress exactly how they wanted, but it still relied heavily on large, expensive industrial printers in labs far from the studio.

Later that year, a friend gave me a 3D printed necklace printed on a home printer.

I knew these printers were much cheaper and much more available than the ones I was using for my internship.

So when I saw that necklace, I thought, "If I can print my necklace at home, why not print my clothes at home too?"

I loved the idea of ​​being able to design and print directly at home instead of having to go to the market and pick fabrics that other people chose to sell.

I found a small makerspace where I learned everything I know about 3D printing.

Soon they literally gave me the keys to their lab so I could experiment every night until midnight.

The main challenge was finding the right filament for printing on clothing.

So what is filament?

Filament is the material that feeds the printer.

And I spent about a month trying PLA, a hard, scratchy, brittle material.

The breakthrough came when I came across a new kind of filament, Filaflex.

Powerful yet extremely flexible.

And with it I was able to print my first garment, a red jacket with the word 'Liberté' (French for 'freedom') embedded in it.

I chose this word because I feel so empowered and free when I can design and print my own clothes at home.

And in fact, this jacket is easy to download and you can easily change the words to another word.

For example, your name or your lover's name.

(Laughter) The printer plates are small, so I had to piece the clothes together like a puzzle.

And I wanted to solve another problem.

I wanted to print a textile that could be used like regular fabric.

Then I found an open source file from an architect who designed one of my favorite patterns.

This allowed us to print beautiful textiles that could be used just like regular fabrics.

And it actually looks a little like lace.

So I took his file, modified it, changed it, tried different versions.

And I had to print another 1,500 hours to finish printing the collection.

So I brought 6 printers into my house and printed 24/7.

This is actually a very slow process, but remember, 20 years ago the internet was significantly slower. So 3D printing will also accelerate, and soon you will be able to print t-shirts at home in just hours, or even minutes.

So guys, would you like to see what it's like?

Audience: Yes!

(Applause) Danit Peleg: Rebecca is wearing one of my five outfits.

Almost everything she wears here is printed by me from home.

Her shoes are also printed.

Audience: Wow!

Audience: Cool!

(Applause) Danito Peleg: Thank you, Rebecca.

(to the audience) Thank you, everyone.

So I think in the future the materials will evolve and look and feel like the cotton and silk fabrics we know today.

Imagine personalized clothing that fits your exact measurements.

Music used to be very physical.

Whereas in the past you had to go to a record store and buy a CD, now you can simply download music (digital music) directly to your mobile phone.

Fashion is also very physical.

And I wonder what our world would be like if our clothes were digitized, like this skirt.

Thank you very much.

(Applause) [Thank you] (Applause)

The ancient Greeks had a brilliant idea: the universe is simple.

In their minds, they only needed four elements to make it: earth, air, fire, and water.

In theory, it's a beautiful thing.

It combines simplicity and elegance.

Combining the four basic elements in different ways can create an amazing variety of universes.

For example, earth and fire give dry.

air, water or wet objects.

But as the theory went, it had its problems.

It is not a prediction of what can be measured, measurement is the foundation of experimental science.

Worse, the theory was wrong.

But the Greeks were great scientists of the mind, and in the 5th century BC Leucippus of Miletus came up with one of the most enduring scientific ideas ever.

Everything we see is made up of tiny, indivisible pieces called atoms.

This theory is simple, elegant, and more correct than the Earth, Air, Fire, and Water theories.

Centuries of scientific thought and experimentation have established that real elements such as hydrogen, carbon, and iron can be broken down into atoms.

In Leucippus' theory, an atom is the smallest indivisible substance that can still be recognized as hydrogen, carbon, or iron.

The only mistake in Leucippus' idea is that atoms are actually divisible.

Moreover, it turns out that his atomic idea explains only a fraction of what the universe is made of.

What seems like a normal thing in space is actually very rare.

Leucippus atoms and what they are made of actually make up only about 5% of what is known to be there.

Physicists know that the rest of the universe, or 95% of it, is a dark universe made up of dark matter and dark energy.

How do we know this?

Well, we see things and we understand them, so we know.

It may look pretty simple, but it's actually very deep.

Everything made of atoms is visible.

Light reflects and you see it.

When we look into space, we see stars and galaxies.

Some of them, like the ones we live in, have beautiful spiral shapes, spinning gracefully through space.

When scientists first measured the motion of galaxy groups in the 1930s and quantified the amount of matter they contained, they were amazed.

They found that these groups did not have enough visible things to hold them together.

Subsequent measurements of individual galaxies confirmed this puzzling result.

Galaxies don't have enough visible things to provide enough gravity to hold them together.

As far as we can see, they should fly away, but they don't.

Therefore, there must be something there that we cannot see.

We call it dark matter.

The best evidence for dark matter today comes from measurements of what is called the cosmic microwave background, the afterglow of the Big Bang, but that's another story.

All the evidence we have indicates that dark matter exists there, and it accounts for much of the matter in the beautiful spiral galaxies that fill the heavens.

So what do we do?

We have long known that the heavens do not revolve around us, but that we are residents of ordinary planets orbiting ordinary stars in the spiral arms of ordinary galaxies.

The discovery of dark matter has taken us one step further from the heart of the matter.

It taught me that the matter that makes us up is just a small part of the matter that makes up the universe.

However, there was still more to come.

Earlier this century, scientists studying the outer edges of the universe confirmed that not only is everything moving away from everything else, as would be expected in a universe that began with a hot, dense Big Bang, but the universe's expansion also appears to be accelerating.

what is that?

Either there is some energy driving this acceleration, just like we give energy to accelerate a car, or gravity doesn't work the way we think it does.

Most scientists believe it's the former, and that some kind of energy is causing the acceleration, which they call &lt;i&gt;dark energy&lt;/i&gt;.

The best measurements to date can reveal how much of the universe is dark.

Dark energy makes up about 68% of the universe, dark matter about 27%, and only 5% seems to remain for us and all that is actually visible.

So what is that black substance made of?

I don't know, but there is one theory that could explain some of it, called &lt;i&gt;supersymmetry&lt;/i&gt;.

Supersymmetry, or SUSY for short, predicts a whole range of new particles, including those that could make up dark matter.

Finding evidence for SUSY could advance our understanding of 5% of the universe (what we actually see) by a third.

Not bad for a day's work.

Dark energy is probably difficult to understand, but there are some speculative theories that could point the way.

Some of them go back to the ancient Greeks first great idea, an idea we started minutes ago, that the universe should be simple.

These theories predict that there is only one element from which all the great diversity of the universe originates: the vibrating string.

The idea is that all the particles we know today are just different overtones on a string.

Unfortunately, string theory today cannot be tested yet.

But with so many parts of the universe waiting to be explored, the stakes are high.

Doesn't all of this make you feel small?

It can't be.

Instead, we are amazed by the fact that, as far as we know, you are part of the only species in the universe that can begin to comprehend its wonders, and you live at the perfect time to see our understanding explode.

Today we take a look at the Roman world through the eyes of a young girl.

Here she is painting herself in the atrium of her father's huge house.

Her name is Domitia and she is 5 years old.

She has a 14-year-old brother named Lucius Domitius Ahenobarbus, named after his father.

Girls don't get long names like boys.

To make matters worse, the father is adamant about calling all his daughters Domitia.

"Domitia!"

His call to Domitia is depicted on the pillar "Domitia III".

She has an older sister, Domitia II, who is seven years old.

And then there is Domitia I, 10 years old.

Domitia IV was to be born, but her mother died trying to give birth to her three years ago.

Messed up?

So did the Romans.

They were able to unravel their ancestry through the male line with lovely tripartite names like Lucius Domitius Ahenobarbus.

However, when trying to write it down, they got very confused as to who Domitia married, great-aunt or great-stepmother, etc.

Domitia III not only paints the pillars, but also monitors their movements.

You know, it's the time when all her father's clients and friends come to see her at her house to pay her respects.

Seventeen-year-old Lucius Popidius Secundus also hopes to marry Domitia II within the next five to seven years.

He seems to be wooing her father, not his future wife.

Poor Lucius, he doesn't know that Domitia's father thinks he and his family are wealthy, but he's still a scumbag of Subra.

After all, it is the most barber and prostitute-filled area in Rome.

Suddenly all the men walk out with their dad.

In his second hour in court, a large number of clients have gathered, applauding his arguments and hissing and cursing at his opponents.

The house is quieter now.

The men do not return for seven hours until dinnertime.

But what is going on inside the house during those seven hours?

Domitia, Domitia, what does Domitia do all day?

Not an easy question!

Everything we have today written by the Romans was written by humans.

This makes it difficult to build a woman's life.

But we can't have a history of just Roman men, so here we go.

Let's start with the atrium.

There's a huge loom, and Dad's latest wife is making a new toga.

Domitia, Domitia, Domitia are tasked with spinning the wool used to weave this mighty garment over 30 feet long and oval.

The Romans loved the idea of ​​wives working with wool.

We know it because it is written on the tombstones of so many Roman women.

Unlike Greek women, Roman women get out of their homes and move around the city.

They go to the bath in the morning, avoiding men, or take a separate bath for women.

Some have the latest fad of the 70s AD: bathing naked with men.

Where they have no place is the forums, the courts, the Senate, where men are.

Their public place is a portico with gardens, sculptures and paths for walking.

When Domitia, Domitia, Domitia want to leave the house and go somewhere like the Portico of Rivia, you have to be prepared.

Domitia II and Domitia III are ready, but Domitia I, who is to marry her beloved Filatus in two years, is not yet.

It's not that she's late, it's just that she still has work to do.

Being engaged means that she is wearing an engagement ring, and all the gifts given to her by Pilatus: jewels, earrings, necklaces and pendants.

She may even wear a crown of myrtle.

These glittery people are yelling, "I'm going to marry that 19-year-old who gave me everything I'm wearing!"

While waiting, Domitia II and Domitia III play with dolls that reflect their sisters dressed up for their wedding.

One day, these dolls will be dedicated to the house gods on their wedding day.

Well, you're all set.

The girls step onto stretchers carried by strong slaves.

They have an escort, and they plan to meet their aunt at Porticus in Livia.

Raised high on the shoulders of these slaves, the girls look out through the curtains onto the crowded street below.

They traverse the city, past the Colosseum, but then change paths and climb a hill to Porticas of Livia.

It was built by Livia, wife of the first emperor Augustus, on the site of the house of Vedius Pollio.

He wasn't that great of a guy.

He once tried to feed slaves to eels in a fish pond by simply dropping a plate.

Fortunately, the emperor was present at the banquet, which calmed his anger.

Once the trash is on the ground, the girls go outside and, arm in arm, climb the steps to an enclosed garden with many pillars.

Domitia III is on fire and is drawn to the pillar.

Domitia II joins her, but tries to read the graffiti on the pillar.

She finds paintings of gladiators and tries to imagine them fighting, but this is never allowed except from the tail end of the Coliseum.

From there, she has a good view of the 50,000 spectators, but hardly any blood or gore.

If she really wanted a decent view, she could be a vestal virgin and sit in the front seat.

But the profession of managing Vesta's Sacred Flame isn't to everyone's liking.

Domitia the First met a ten-year-old child, also dressed in a betrothal insignia.

home time.

When we arrive after 8 hours, something is happening.

A broken plate is lying on the floor.

All the slaves are gathered in the atrium and await their master's arrival.

Dad will go mad.

Although he does not beat his own children, he believes, like many other Romans, that slaves should be punished.

The whip awaits his arrival.

No one knows who broke the plate, but my father is going to call the undertaker and torture him to get it out if necessary.

The gatekeeper opens the front door of the house.

Silence comes to the anxious slaves.

It's not my husband who's taking a walk, but a pregnant teenager.

The eldest daughter of a master who is already a veteran of marriage and childbirth, is 15 years old.

guess her name

There's a 5-10 percent chance she won't survive after having a child, but for now she's coming to dinner with her family.

As a teenage mother, she proved herself a successful wife by producing children and offspring for her future husband.

The family heads into the dining room and is served dinner.

It seems that your father has been invited to dinner somewhere.

After dinner, the girls walked across the atrium to say goodbye to their sister, who was being carried home on a stretcher, escorted by some of her father's bodyguards.

Back at the house, the girls cross the atrium.

Slaves, young and old, await their master's return.

When he returns, he may take revenge through the violence and terror that any slave can suffer, ensuring he maintains power over his slaves.

But for the girls, they go upstairs for the night and get ready for bed.

Imagine a place so dark that you can't see the nose on your face.

Whether you open your eyes or close them, the sun never hits them, so it's all the same.

You can see the light ahead.

When you sneak in for investigation, blue light will fly around.

“I could watch this forever,” you think.

But you can't because the anglerfish's mouth will open and you will be eaten alive.

You're just one of many creatures at the bottom of the ocean who didn't realize the power of bioluminescence too late.

Bioluminescence refers to the ability of certain organisms to produce light.

The human body can make things like earwax and toenails, but these creatures can turn parts of their bodies into psyllium.

It's as if nature prepared them to rave.

why?

In some way, bioluminescence increases the survival chances of organisms.

Take the firefly with you.

The ability to glow green helps attract allies on warm summer nights, but that's just one of many glowing creatures.

The railway bug, Phrixothrix hirtus, can glow red and green.

Do you eat things like airport runways?

Neither do wise predators.

Flashing lights keep worms safe.

Next is the deep-sea shrimp, Acantherphyra purpurea.

When threatened, it spews a cloud of glowing mucus from its mouth.

Who doesn't run backwards after just throwing up?

In addition, its vomit attracts larger predators who seek to eat the shrimp's enemies.

But what if bioluminescence is not possible?

no problem!

Even if organisms weren't born with a device that emits light, there are other ways organisms make bioluminescence work.

Think back to the moment before the monkfish tried to eat you.

That glowing bait on your head?

It comes from a skin pocket called an esca.

Esca contains bioluminescent bacteria.

The anglerfish cannot glow on its own there, so instead it carries a bag of glowing bacteria.

Remember fireflies?

It can actually light itself up.

Inside the lantern are two chemicals: luciferin and luciferase.

When firefly luciferase and luciferin mix in the presence of oxygen and a cell fuel called ATP, a chemical reaction releases energy in the form of light.

Once scientists figured out how fireflies produce luciferase and luciferin, they decided to use genetic engineering to make this light-producing reaction happen in other organisms that can't emit light.

For example, they inserted genes, or instructions, into tobacco plants for the cells to produce firefly luciferase and luciferin.

Once there, the tobacco tree followed instructions embedded in its DNA and lit up like a Christmas tree.

The advantage of bioluminescence is that it is not hot, unlike the light from the sun or incandescent bulbs.

It is done at a temperature that does not cause burns to living organisms.

Also, unlike psyllium, which disappears when the chemicals inside are exhausted, bioluminescence reactions use replenishable resources.

That's one reason engineers are working to develop bioluminescent trees.

please think about it. Planted on the side of a highway, it can light the way, using only oxygen and other free, clean resources to drive.

Talk about a survival advantage!

It may help extend the life of our planet.

Did you find yourself thinking of other ways to put bioluminescence to good use?

That glowing stick you swing at a rave might help you find a mate, but what else could bioluminescence do to improve survival?

When you start thinking this way, you see the light.

What is Algorithm?

In computer science, an algorithm is a set of instructions for solving a problem step by step.

Algorithms are usually run by computers, but we humans have algorithms too.

For example, how can you count the number of people in a room?

If you're like me, you probably point at one person at a time and count from 0 to 1, 2, 3, 4.

Well, it's an algorithm.

In fact, let's express it a little more formally, using pseudocode with an English-like syntax similar to programming languages.

Let n be 0.

Set n = n + 1 for each person in the room.

How should I interpret this pseudocode?

In the first line, we kind of declare a variable called n and initialize its value to zero.

This means that at the start of the algorithm the value of what we use to count is zero.

After all, we haven't counted anything yet before we start counting.

Calling this variable n is just a convention.

You can call it almost anything.

Here, line 2 marks the beginning of the loop, which is a series of steps repeated a fixed number of times.

So, in this example, the step is to count the number of people in the room.

Below the second line is the third line. This describes exactly how it counts.

Indentation means that it is the third line that is repeated.

So what the pseudocode is saying is, after starting from zero, increment n by 1 for each person in the room.

Now, is this algorithm correct?

Well, let's do our best.

Will it work if there are two people in the room?

let's see.

The first line initializes n to zero.

Increase n by 1 for each of these two people.

So the first pass through the loop updates n from 0 to 1, and the second pass through the same loop updates n from 1 to 2.

So by the time the algorithm finishes, n will be 2, matching the actual number of people in the room.

So far, so good.

But what about special cases?

Assume there are no other people in the room besides me counting.

The first line initializes n to zero again.

But this time, line 3 doesn't run at all because there are no people in the room, and n remains 0, matching the actual number of people in the room.

So simple, right?

But counting people one at a time is also pretty inefficient, isn't it?

I'm sure you can do better!

Why not count two people at a time?

Instead of counting 1, 2, 3, 4, 5, 6, 7, 8, etc., why not count 2, 4, 6, 8, etc.?

It sounds even faster, and it certainly is.

Let's express this optimization in pseudocode.

Let n be zero.

Set n = n + 2 for each pair of people in the room.

Pretty simple change, right?

Instead of counting people one at a time, count two people at a time.

Therefore, this algorithm is twice as fast as the previous algorithm.

But is it correct?

let's see.

Will it work if there are two people in the room?

The first line initializes n to zero.

Increase n by 2 for that set of people.

So by the time the algorithm finishes, n will be 2, matching the actual number of people in the room.

Now assume there are no people in the room.

The first line initializes n to zero.

As before, there are no pairs of people in the room, so line 3 is not executed at all and n remains zero, matching the actual number of people in the room.

But what if there are three people in the room?

How fair is this algorithm?

let's see.

The first line initializes n to zero.

For those pairs of people, we increment n by 2, but what happens after that?

Row 2 no longer applies because there are no other perfect pairs in the room.

So n is still 2 when the algorithm finishes, which is incorrect.

In fact, this algorithm is said to be buggy because it has mistakes.

Let's fix it with new pseudo code.

Let n be zero.

Set n = n + 2 for each pair of people in the room.

If one person is unpaired, set n = n + 1.

To solve this particular problem, on line 4, we introduced a conditional, also known as branching, that only executes if there is one person that cannot be paired with another.

Now, whether there are 1 person, 3 people, or an odd number of people in the room, the algorithm will count them.

Could we do better?

Well, you can count by 3 or 4 or 5 or 10, but beyond that it becomes a little harder to point.

At the end of the day, an algorithm is just a set of instructions to solve a problem, whether run by a computer or a human.

These were only 3.

What problem do you want your algorithm to solve?

So when I was a kid...

This was my team.

(laughs) I was not good at sports.

I didn't like playing it or watching it.

Here is what i did. I went fishing.

And I used to fish off the coast of Connecticut all my childhood, and these are the creatures I used to see regularly.

But after I grew up and went to college and returned home in the early 90's, this is what I found.

My team was shrinking.

It was like the roster was literally destroyed.

As I looked into it from a very personal perspective as a fisherman, I started to get a vague idea of ​​what the rest of the world thought about it.

The first place I started looking was the fish market.

And when I went to the fish market, wherever I was—North Carolina, Paris, London, wherever—on the menu, on the ice, I kept seeing this strangely repeated metaphor of the four creatures—shrimp, tuna, salmon, and cod—over and over again.

I thought this was pretty weird, and while watching it I wondered, has anyone else noticed this kind of market shrinkage?

Well, I did some research and found that people don't see it as their team.

The common people's view of seafood was like this.

It is human nature and not uncommon to reduce the natural world to very few elements.

We did it before, 10,000 years ago, when we came out of the cave.

Take a look at the 10,000-year-old fire pit and you'll see raccoons, wolves, and all sorts of creatures.

But if we go back 2,000 years, we see four mammals: pigs, cows, sheep, and goats.

So do birds.

If you look at the menus of restaurants in New York City 150, 200 years ago, you'll see sandpipers, woodcocks, grouse, dozens of ducks and dozens of geese.

But if you look to the modern era of animal husbandry, you'll find four species: turkeys, ducks, chickens and geese.

Therefore, it is natural that we went in this direction.

But how did we go in this direction?

good ...

First, this is a very new problem.

This is how we have fished the ocean for the last 50 years.

World War II was a major motivation for arming ourselves to fight fish.

All the technology we perfected during World War II, sonar, lightweight polymers, etc., was aimed at fish.

And we can see that over the course of time between the end of World War II and the present day, fishing capacity has increased tremendously, quadrupling.

And now that means we're taking 80 to 90 million tons out of the ocean each year.

That's the equivalent of the human weight China takes out of the sea each year.

It is no coincidence that I used China as an example, as China is now the world's largest fishing nation.

Well, this is only half the story.

The other half of the story is the incredible boom in fish farming and aquaculture that is now beginning to outpace the amount of wild fish we produce in just the last year or two.

Combined with wild and farmed fish, the oceans produce an amount equivalent to two pieces of China each year.

Again, my mention of China is no coincidence. Because in addition to being the largest fish catcher, China is also the largest aquaculture country.

So let's take a look at the four choices we're making right now.

First, shrimp is by far the most consumed seafood in the United States and much of the West.

Wild shrimp, as a wild product, is a terrible product.

5, 10 and 15 pounds of wild fish are routinely killed to bring 1 pound of shrimp to market.

It's also very fuel efficient to put on the market.

A recent study at Dalhousie University found that dragging shrimp is one of the most carbon-intensive fishing methods.

So you can farm and people are actually farming and they're farming a lot right here in this area.

The problem is...

Where you farm your shrimp is in these wild habitats: mangrove forests.

Now watch this lovely root come down.

They bind the soil, protect the coast, and create habitats for all kinds of juvenile fish and shrimp, which are important to the environment.

Well, this is what is happening in many coastal mangrove forests.

Over the last 30-40 years, millions of acres of coastal mangroves have been lost.

Although the rate of destruction has slowed, there is still a significant shortage of mangrove forests.

Another phenomenon at work here is what filmmaker Mark Benjamin called "Grinding Nemo."

This phenomenon is very much related to everything you have ever seen on tropical reefs.

Because what's happening now is that the shrimp draggers drag the shrimp to capture a large amount of bycatch, which is then pulverized into food for the shrimp.

And sometimes, many of these boats manned by slaves catch the fish we want to see on our reefs, the so-called “garbage fish,” and crush them into food for the shrimp. It literally eats itself and spits out shrimp.

Tuna is the next most consumed seafood, not only in the United States but throughout the West.

In short, tuna is the ultimate global fish.

Proper management of tuna requires adherence to these vast management areas.

Our own management area, called Regional Fisheries Management Organizations, is called ICCAT (International Commission for the Conservation of Atlantic Tuna).

The great naturalist Carl Safina once called this "an international conspiracy to catch all the tuna".

Of course, ICCAT has made amazing progress in the last few years and there is absolutely room for improvement, but it goes without saying that tuna is the world's fish. To manage tuna, you have to manage the whole planet.

You could try farming tuna, but tuna is a surprisingly bad animal for farming.

It may not be well known, but tuna are warm-blooded animals.

They can heat their bodies up to 20 degrees above ambient temperature and swim at over 60 miles per hour.

So the benefits of farming fish are all but gone, right?

Farmed fish, in other words, fish are poikilotherms, so they don't move much.

That's great for increasing protein.

But if you have this crazy wild creature that swims at 40 miles per hour and warms your blood, it's not good for aquaculture.

Salmon is the second most consumed seafood in the United States and throughout the West.

Well, salmon were also plundered, but that didn't necessarily happen with fishing.

This is my home state of Connecticut.

Connecticut was once teeming with wild salmon.

But if you look at this map of Connecticut, every dot on that map is a dam.

Connecticut has over 3,000 dams.

I often say that this is why people in Connecticut are so strict -- (laughter) I think if someone could unblock Connecticut's chi, we could have an infinitely better world.

But when I once made this particular comment at a convention of national park officials, a man from North Carolina leaned over me and said, "You know, we have 35,000 dams here in North Carolina, so Connecticut doesn't need to be so strict."

So this is a national trend, an international trend.

And dams are everywhere, and that's exactly what prevents wild salmon from reaching their spawning grounds.

As a result, we turned to aquaculture. Salmon is one of the most successful, at least in terms of numbers.

When they first started salmon farming, it took six pounds of wild-caught fish to make one pound of salmon.

To my credit, the industry has improved a lot.

If you look at how aquaculture feed is made, they measure pellets so it's less than 2 to 1, which is a bit of a cheat.

Those pellets, in turn, reduce the fish.

So it's kind of hard to say what the actual -- what's called FIFO, fish-in and fish-out -- is.

But either way, to the industry's credit, there's less fish per pound of salmon.

The problem is that the amount of salmon we are producing is also increasing at an alarming rate.

Aquaculture is the fastest growing food system on earth.

It's growing at about 7% per year.

So even though we are processing less per fish to bring them to market, we are still killing many small fish.

And it's not just fish that we feed fish, we also feed chickens and pigs.

We have chickens and they eat fish, but oddly enough there are fish that eat chicken.

This is because the chicken's by-products, feathers, blood and bones, are ground into food for the fish.

So I often wonder, is there a fish that ate a chicken that ate a fish?

It's like a chicken-and-egg rehash. Anyway -- (laughter) But when it all comes together, it's a terrible mess.

You're talking about 20 to 30 million tons of wildlife harvested from the ocean, used and crushed.

That's one-third of China's or the entire United States' human population taken out of the ocean each year.

The last of the four is kind of amorphous.

It's what the industry calls "whitefish".

There are many fish that cycle through this whitefish, but I think the way to tell that story is through a classic piece of American culinary innovation: the Filet-O-Fish sandwich.

So the Filet-O-Fish sandwich actually started with halibut.

And it all started when a local franchise owner noticed nobody was coming when McDonald's opened on Fridays.

Being a Catholic community, we needed fish.

So he went to Ray Kroc and said, "I'll bring you a fish sandwich made with halibut."

"I don't think it's going to work," Ray Kroc said.

I'd like to make a hula burger, but the bun will have a slice of pineapple on it.

But let's do this, let's bet.

Whoever sells more sandwiches will be the winning sandwich. ”

Well, it's kind of sad for Umi that Flaberger didn't win.

So he made a halibut sandwich.

Unfortunately the sandwich was 30 cents.

Ray wanted a sandwich for 25 cents and turned to Atlantic cod.

We all know what happened to Atlantic cod in New England.

Today, filet-o-fish sandwiches are made with pollock and are the largest fillet fishery in the United States, with two to three billion pounds of fish pulled from the ocean each year.

Once you've passed walleye, tilapia is probably your next option.

Tilapia is one of those fish that no one had heard of 20 years ago.

In fact, it was a highly efficient converter of plant protein to animal protein, a godsend to the Third World.

This is actually a very sustainable solution, growing from egg to adult in 9 months.

The problem is, when you look at the West, they aren't doing what they want.

No so called oily fish profile at all.

It does not contain the omega-3s of EPA and DHA that we think will last forever.

What should I do?

So, first of all, what will become of this poor fish, the Crypeid?

Fish make up the majority of that 20 to 30 million tonnes.

Now, one of the possibilities many conservationists have raised is whether we can eat them.

Can I eat the salmon directly without feeding it?

There is debate about it.

These are very fuel efficient to bring to market, costing a fraction of the fuel cost of shrimp for example, and are among the highest on the carbon efficiency scale.

It is also rich in omega-3s and is a good source of EPA and DHA.

I mean, it's a possibility.

If we go down that road, what I'm saying is, instead of paying a few bucks a pound, really a few bucks a ton and making it a fish feed, can we cut the catch in half, double the price for the fisherman and make it the way this particular fish is treated?

But another, more interesting possibility is to look at bivalves, especially mussels.

Now, mussels are very high in EPA and DHA, similar to canned tuna.

It's also very fuel efficient.

The amount of carbon required to market a pound of mussels is about 1/30th of the carbon required to market beef.

They don't need forage fish and actually get their omega-3s by filtering microalgal water.

In fact, omega-3s don't come from fish, they come from there.

Microalgae produce omega-3s, but they are only bioconcentrated in fish.

Mussels and other bivalves filter vast amounts of water.

One mussel can filter dozens of gallons each day.

And this is very important when looking at the world.

Currently, nitrification and overuse of phosphate in waterways are generating enormous amounts of algae.

More than 400 new dead zones have been created in the last 20 years, contributing to the vast deaths of marine life.

Sometimes I couldn't see any fish at all.

I could see the vegetables.

Let's take a look at some very good foods that are rich in different types of omega-3 and protein, such as seaweed and kelp.

Filter the water the same way you would with mussels.

And strangely enough, it turns out that this can actually be fed to cows.

Now, I'm not a big fan of beef.

However, if you want to continue raising cattle in times and places where water resources are limited, you will be growing seaweed in the water, and you won't need to water it. This is an important consideration.

And the last fish is a question mark.

We have the ability to create farmed fish for a net profit of marine protein.

This creature needs to be vegetarian, grow fast, be able to adapt to changing climates, and have a fatty fish profile, EPA, DHA and omega 3 fatty acid profiles that are what we are looking for.

This exists on paper.

I have been covering these subjects for 15 years.

Every time I make a new story someone says to me

You can produce fish with a net boost of marine protein and omega-3s. ”

wonderful.

It doesn't seem to scale up.

It's time to scale this up.

That would leave 30 million tonnes of seafood in the sea, equivalent to one-third of the world's catch.

So, I think what I'm trying to say is, this is what we've been doing.

We tend to act according to our appetites rather than our hearts.

But you might get a little more functionality with this or that configuration.

thank you.

(applause)

Olive oil is 100% fat. nothing else.

Pancake mix, on the other hand, contains only about 11% fat.

Still, while olive oil is good for you, pancake mix isn't.

why is that?

After all, the amount of fat we eat doesn't affect our weight, cholesterol or heart disease risk as much as the type of fat we eat.

But let's get back to it. What is Fat?

If you look beyond the organs and tissues of the fatty fish, salmon, and into the cells, you'll see that what we call fat is actually made up of molecules called triglycerides, and they're not all the same.

Here is an example.

The three carbons on the left, that's glycerol.

It can be thought of as a skeleton that holds the rest of the molecule together.

The three long chains on the right are called fatty acids. Subtle differences in the structure of these chains determine whether a fat is solid or liquid. Will it spoil quickly? And most importantly how good or bad it is for you.

Let's look at some of these differences.

One is length.

Fatty acids can be short or long.

Another more important difference is the type of bond between carbon atoms.

Some fatty acids have only single bonds.

Some have both single and double bonds.

Fatty acids with only single bonds are called saturated fatty acids, and fatty acids with one or more double bonds are called unsaturated fatty acids.

Now, most unsaturated fats are good for you, but too much saturated fat is bad for you.

That's pretty much the end of the story for saturated fats, but not for unsaturated fats.

The double bonds in these molecules have some strange properties. they are stiff

This means that there are two ways to place all double bonds.

The first is like this, with both hydrogens on the same side and both carbons on the same side.

The second method looks like this.

Here hydrogen and carbon are on opposite sides of the double bond.

Now, even though both of these molecules are made up of exactly the same building blocks, they are two completely different substances that behave quite differently in our bodies.

The configuration on the left is called CIS, but you've probably never heard of it.

The one on the right is called TRANS, and you've probably heard of trans fats.

They do not spoil, are more stable when frying, and can alter the texture of food in ways other fats cannot.

It's also technically a type of unsaturated fat, but it's much worse than saturated fat, and it's bad for your health.

It may seem silly, but the human body doesn't care what molecules look like on paper.

All that matters is the 3D shape of where the molecule fits, where it doesn't fit, and which pathways interfere.

So how can you know if a food contains trans fat?

Well, the only way to know for sure is if the ingredient list has the words "partially hydrogenated".

Don't be fooled by nutrition labels and advertising.

The FDA allows manufacturers to claim that their products contain "0" grams of trans fat when in fact they contain up to 0.5 grams of trans fat per serving.

However, there are no hard and fast rules about how small a serving size can be, which means you should refer to the keyword partially hydrogenated as this is how trans fats are made by partially hydrogenating unsaturated fats.

Now, let's go back to the topic of olive oil and pancake mix.

Olive oil is 100% fat.

Pancake mix contains only 11% fat.

However, olive oil is mostly unsaturated fats and does not contain any trans fats.

On the other hand, more than half of the fat in pancake mix is ​​saturated or trans fat.

That means olive oil has 10 times more fat than pancake mix, which is good for your health, whereas pancake mix doesn't.

Well, I'm not going to pick pancake mix.

There are many foods with this kind of fat profile.

What matters is not how much fat you eat, but what kind of fat you eat.

And it's the shape that determines whether a particular fat is healthy or unhealthy.

There are still many unanswered questions about space, such as whether time travel is possible.

Or do aliens live somewhere in the Milky Way?

But there is one thing I believe about the universe. It means the universe is trying to kill me.

Not that you have space to catch me personally.

It also wants to kill you and everyone else.

please think about it.

Space doesn't naturally have what it takes to survive when we travel there. No air, too hot or too cold, no ozone to protect us from the nasty UV rays.

All this sounds bad, but what would the universe actually do for me if I stayed on Earth?

What we need to understand is that objects in space can make people think their lives are not long, even if there are events on Earth that could hurt or kill us before something from space happens.

So what are the chances that one of these celestial bodies will actually affect the Earth and you and me in our lifetimes?

Well, we can use what we know about the universe to try to understand it.

You may have heard stories about asteroids hitting Earth.

That would be pretty bad.

Scientists believe that an asteroid may have wiped out most of the dinosaurs.

Sounds like something I should be worried about, right?

Well, astronomers can now observe asteroids in space and watch them come by using complex computer models to predict the path of deadly rocks.

For a while, the odds of asteroid Apophis hitting Earth in 2036 were once reported to be 1 in 625.

But after updating the data, astronomers now say that is highly unlikely.

Well, what about the sun?

Hollywood movies like to feature the sun, depicting it being destroyed by solar flares or disappearing and freezing the earth.

Astronomers predict that our Sun will contain enough gas to produce energy for another 3 to 5 billion years.

So in 3-5 billion years, if humans were still on Earth, they would have to deal with it.

But today, well, it's safe.

Sometimes the Sun fires flares at Earth, but the magnetic field that surrounds Earth blocks most of that radiation.

Penetrating radiation creates something like the Aurora Borealis.

A giant solar flare can wreak havoc on satellites and electrical equipment, but the chances of dying from it are fairly low.

Now, what about the supermassive black hole in the middle of our galaxy?

What will happen to the earth and us when the earth pulls us in?

After all, it's super huge.

No, it won't happen.

It's a big object that can't bother us.

How can you be so sure?

Our solar system lies on the edge of the Milky Way, but the closest supermassive black hole is about 26,000 light-years away from Earth.

I mean, we're not on that black hole's menu.

So after what I've said so far, do you still think space objects are trying to kill you?

I think I even convinced myself that it was very likely that the space and the objects in it wouldn't kill me after all.

But I would probably keep looking up just to make sure nothing was going in my direction.

The next time you see news about hurricanes or tropical storms hitting trees and homes with strong winds, ask yourself, "Why are the winds so fast?"

Amazingly, this is a movement that began over 5 billion years ago.

But to understand why, you need to understand spin.

In physics, we talk about two kinds of motion.

The first is linear motion.

Press anything to move forward.

In the second type of spin, the object rotates in place, or around an axis.

An object in linear motion will continue indefinitely unless it is slowed down by the friction of the ground beneath it.

The same thing happens when something rotates.

It keeps spinning until something stops it.

But the spin can accelerate.

If an ice skater pulls her arms inward while skating on the ice in a straight line motion, she continues skating at the same speed.

But once she spins on the ice and pulls her arms together, you know what happens next.

she spins faster.

This is called the law of conservation of angular momentum.

Mathematically, angular momentum is the product of two numbers, one describing the spin rate and the other describing the distance of the mass from the axis.

If something is spinning freely, as one number increases, the other number decreases.

Move your arms closer together to rotate faster.

Keep your arms far and your rotation slow.

Spin also triggers other effects.

Throw a ball at your friends on a spinning merry-go-round and the ball will appear to curve.

It doesn't actually bend.

It really goes in a straight line.

It was you who followed the winding trajectory, but from your point of view the ball appears to be curved.

This is called the Coriolis effect.

Oh, and you're on a fast-paced merry-go-round right now.

we call it the earth.

The earth rotates on its axis once every day.

But why does the earth rotate?

Well, it's a story that begins billions of years ago.

The sun, the earth, the planets, and the clouds of dust and gas that make up you and me began to collapse as gravity pulled them all together.

This cloud was spinning very gently before it started to collapse.

And as it crumbled, the rotation got faster and faster, like an ice skater pulling his arm.

And everything formed from the clouds, the sun, the planets around the sun, the moon around the planets all inherited this rotation.

And it is this inherited spin that gives us day and night.

And this day-night cycle determines our weather.

The Earth is warmer on the day side and cooler on the night side, and warmer at the equator than at the poles.

Differences in temperature cause differences in atmospheric pressure, and differences in atmospheric pressure cause air to move.

they make the wind blow

However, due to the Earth's rotation, the Coriolis effect bends the air to the right in the northern hemisphere.

If there is an area of ​​low pressure in the atmosphere, air is forced towards it, much like water flows down a drain.

However, the air bends to the right as it travels, which causes it to spin.

Dramatic low pressure in a storm pulls air in tighter and faster, and this is how hurricane winds work.

So when you see a spinning storm in the weather forecast, think about it. That rotation ultimately comes from the Earth's rotation, which is a fossil remnant of the gentle rotation of clouds of dust and gas that collapsed to make the Earth about 5 billion years ago.

You are looking at something older than dirt, older than rock, older than the earth itself, spinning.

How big was the fish you caught?

this big?

this big?

this big?

Without photographic evidence, there's nothing to prove you've caught a big fish. That's been true since the dawn of fishing.

In fact, hundreds of years ago, long before photographs could capture the moment, Japanese fishermen invented a unique method of documenting trophy catches.

They called it gyotaku.

Gyotaku is an ancient art of printing fish that originated in Japan as a way of recording trophy catch, before the spread of modern cameras.

"Gyo" means fish, and "taku" means emotion.

There are many theories about the origin of gyotaku, but it basically started when fishermen needed a way to record the type and size of the fish they caught over 100 years ago.

The fishermen took paper, ink, and brushes and headed out to sea.

They told tales of wonderful adventures at sea.

The Japanese worshiped certain fish, so fishermen would scrape and release these fish.

To scrub, paint the fish with non-toxic sumi-e ink and print on rice paper.

In this way they could be released or washed and sold on the market.

The first such prints were for archival purposes only and provided no additional detail.

It was not until the mid-1800s that they began to include eye details and other decorations in their prints.

Lord Sakai, a famous aristocrat, was an avid fisherman, and when he caught a big catch, he wanted to leave a memory of that big red sea bream.

To that end, he asked a fisherman to print his catch.

After that, many fishermen brought gyotaku to Lord Sakai, and if they liked the work, they began to ask him to print it.

During the Edo period, many prints were displayed in the palace.

After this period, gyotaku became less popular and began to decline.

Today, gyotaku has become a popular art form enjoyed by many.

This crest is said to bring good luck to fishermen.

But the art form is completely different than before.

Today, most artists are self-taught through trial and error.

Before the artist can start printing, the fish must be prepared for printing.

First, the artist places the fish on a hollowed out surface.

The artist then unrolls the fins and pins them onto the board to dry.

Then wash the fish with water.

There are two different methods when printing.

The indirect method begins with sticking a damp cloth or paper to the fish using rice paste.

The artist then uses a tompo, a silk-covered cotton ball, to apply ink to fabric or paper to create a print.

This method requires more skill and great care must be taken to avoid tearing the paper when removing it from the fish.

In the direct method, the artist paints directly onto the fish and gently presses a damp cloth or paper onto the fish.

Either way, no two prints are exactly alike, but both reveal dramatic images of fish.

As a finishing touch, the artist can use a chop or stamp to sign the work, hold it up and say, "The fish was exactly this size!"

Fifty years ago in the former Soviet Union, a team of engineers secretly moved large objects through the desolate countryside.

With this, they hoped to become the first beings to conquer the universe and win the hearts and minds of people all over the world.

Rockets were huge.

And its nose was stuffed with a silver ball, inside which were two radios.

On October 4, 1957, they launched a rocket.

One Russian scientist said at the time: "We are creating a new planet called Sputnik.

Long ago, explorers like Vasco da Gama and Columbus had the good fortune to open the globe.

Now we are lucky enough to open up a space.

And that's because future generations will envy us for our joy. ”

You are watching an excerpt from my nearly completed fifth documentary feature film, Sputnik.

It tells the story of Sputnik and what happened to America as a result.

In the days after the launch, Sputnik aroused great curiosity.

An artificial moon for the public to see evoked awe and pride that mankind had finally launched an object into space.

But just three days later, on a day called Red Monday, the media and politicians told us that Sputnik was proof that the enemy had defeated us in science and technology, and that they could use Sputnik rockets as IBM missiles and hit us with hydrogen bombs.

All hell broke loose.

Sputnik quickly became one of the three biggest shocks to hit America - historians say it was on par with Pearl Harbor and 9/11.

It induced a gap for the missile.

It exploded an arms race.

The space race has begun.

Within a year, Congress funded a massive arsenal build-up, from 1,200 to 20,000 nuclear weapons.

And the response to Sputnik went far beyond increased armaments.

For example, some of you may remember the National Civil Defense Exercise that took tens of millions of people in 78 cities underground on this day in June 1958.

Alternatively, a Gallup poll found that 7 in 10 Americans believe a nuclear war will occur and kill at least 50 percent of the population.

But Sputnik also caused some great changes.

For example, some of the people in this room went to school on scholarships because of Sputnik.

Support for engineering, mathematics, science, and education in general surged.

And Vint Cerf points out that Sputnik led directly to ARPA, the Internet and, of course, NASA.

My feature length documentary shows how people who know how to use media trample free societies.

But it also shows how a seemingly bad situation can be turned into an overall very good situation for America.

"Sputnik" is coming soon.

Finally, I want to say a little thank you to one of my investors, longtime TEDster Jay Walker.

And I would like to thank all of you.

(applause).

Thank you Chris.

Well, I'm a marine chemist.

Today I tried to find out about the chemistry of the sea.

I investigated the chemistry of the oceans of the past.

A way to look back in time is with the fossilized remains of deep-sea corals.

Behind me you can see an image of one of these corals.

The coral, which was collected from thousands of meters under the sea near Antarctica, is very different from the kind of coral that tropical vacationers might have been lucky enough to see.

I hope this talk will give you a 4th dimensional perspective on the ocean.

Two-dimensional, such as a beautiful two-dimensional image of sea surface temperature.

It was captured using satellites, so it has an amazing spatial resolution.

The overall features are very straightforward.

Equatorial regions are warmer due to more sunlight.

The polar regions are cold due to the lack of sunlight.

As a result, large ice caps can accumulate in Antarctica and the northern hemisphere.

Dive deep into the ocean, or put your toes in the water, and you'll find it gets colder the lower you go. This is mainly because the deep waters that fill the ocean abysses come from the cold polar regions where the water is denser.

When we traveled back in time 20,000 years ago, the Earth looked very different.

And I just showed you one of the big differences you'll see if you go all the way back in the comics.

The ice cap was much larger.

They covered much of the continent and spread across the oceans.

Sea level has dropped 120 meters.

Carbon dioxide [levels] were much lower than they are today.

So the Earth as a whole was probably 3 to 5 degrees colder, and the poles were much colder.

What I am trying to understand, and what my other colleagues are trying to understand, is how we transitioned from that cold climate condition to the warm climate conditions we enjoy today.

Studies of ice cores show that these cold-to-warm transitions were not smooth, as expected from the slow increase in solar radiation.

And we know this from ice cores. Because every year when you drill the ice, you find bands of ice that you see inside the iceberg.

You can see the pale layer.

Ice cores trap gas, so CO2 can be measured. So we know that CO2 was low in the past. We can also learn about polar temperatures from the chemical properties of ice.

And if you move the time from 20,000 years ago to the present day, you can see that the temperature is rising.

did not grow steadily.

It increased very rapidly at times, then had a plateau, then increased rapidly.

Unlike the two polar regions, CO2 also increased sharply.

So I'm pretty sure the ocean has a lot to do with this.

The oceans store large amounts of carbon, about 60 times more than the carbon in the atmosphere.

It also plays a role in transporting heat across the equator, the ocean is rich in nutrients and controls primary productivity.

So if you want to know what's going on in the deep sea, you have to actually go down there, see what's there, and start exploring.

This is a stunning image taken from a seamount about a kilometer deep in the high seas of the equatorial Atlantic, far from land.

You, along with my research team, were among the first to see this part of the ocean floor.

You will probably see new species.

A sample must be collected and a very rigorous classification performed.

See beautiful bubblegum corals.

A brittle star grows in this coral.

They are like tentacles growing out of coral.

There are various forms of calcium carbonate corals that grow from the basalt of this huge submarine mountain, they are fossilized corals and are of dark color. We'll go back in time and talk a little bit more about them.

To do that, we need to charter a research vessel.

This is James Cook, a marine-class research vessel moored in Tenerife.

It looks beautiful, right?

It's okay if you're not a good sailor.

Sometimes it looks a little more like this.

We try not to lose precious samples.

Everyone is so busy and I get seasick too, so it's not always fun, but overall it's fun.

So you have to be a really good mapper to do this.

Nowhere else is there such an abundance of spectacular corals.

It's global and deep, but we really need to find the right place.

We looked at the global map and the last year's cruise routes were overlaid.

This was a 7 week cruise. this is us. In seven weeks, we independently mapped nearly 75,000 square kilometers of the ocean floor, but that's just a fraction of the ocean floor.

We travel from west to east, over parts of the ocean that appear featureless on a large-scale map, but there are actually mountains as big as Mount Everest.

So the map you create on board will have a resolution of about 100 meters, which is enough to identify the area where the equipment will be deployed, but not enough to see too much.

That would require flying a remotely controlled vehicle about five meters above the ocean floor.

Then you can get a 1 meter resolution map even if you are thousands of meters below.

This is a remotely operated vehicle, a research grade vehicle.

You can see the big lights on the top.

I have a high-definition camera, a manipulator arm, and lots of small boxes and stuff to put my samples in.

Here we will join the first dive of this cruise and dive into the sea.

We move at great speeds to keep our remote-controlled vehicles from being affected by other ships.

And then we're going down and these are kind of what you'll see.

These are deep-sea sponges, metric scale.

This is a swimming Holoturian. It's basically a small sea slug.

It can also be slowed down.

All of this takes time, so most of the footage shown here has been sped up.

This is also a beautiful holoturian.

And this animal that will appear from now on was a big surprise.

We were all a little surprised because we had never seen anything like this before.

This was after about 15 hours of work, and when we were all kind of trigger happy, suddenly this giant sea monster started passing by.

This wasn't what we were looking for.

We were looking for corals, deep sea corals.

The photo will appear immediately.

It's small, about 5cm tall.

Because it is made of calcium carbonate, you can see the tentacles moving with the ocean current.

Such creatures probably live for about 100 years.

And as they grow, they take in chemicals from the ocean.

And the chemical, or amount of chemical, depends on the temperature. It depends on pH and nutrients.

And if we can understand how these chemicals enter our skeletons, we can go back in time and collect fossil specimens to reconstruct what the ocean once looked like.

Here you can see corals being collected using a vacuum system and placed into sampling containers.

This can be done very carefully. I will add.

Some of these organisms live even longer.

This is a black coral called Leopates, taken by my colleague Brendan Rourke about 500 meters underground in Hawaii.

Four thousand years is a long time.

If you take a branch from one of these corals and polish it, it's about 100 microns in diameter.

And Brendan did an analysis of this whole coral -- you can see the traces -- and was able to show that these are real annual bands, so even at 500 meters of depth the coral can record seasonal changes, which is quite spectacular.

But 4,000 years is not enough for us to go back to the last ice age maximum.

What should I do?

We go looking for these fossil specimens.

This is why I'm really unpopular with research teams.

Everywhere there are giant sharks, pyrosomes, swimming holoturians, giant sponges. But I let people spend years going to these dead fossil sites and feeling like shoveling on the ocean floor.

And then we pick up all these corals, bring them home, and sort them.

But each of these is a different age, and being able to tell how old they are and measure their chemical signals will help us understand what was happening in the ocean in the past.

In the image on the left here, the coral was sliced ​​and polished very carefully and optical images were taken.

On the right, a piece of the same coral was taken and placed in a nuclear reactor to cause nuclear fission. Every time a decay occurs, you can see it marked in the coral, giving you an idea of ​​the distribution of uranium.

Why do we do this?

Uranium is a less popular element, but I love it.

Breakdowns help us know the speed and date of what is happening in the ocean.

If you remember the first, that's what we want to arrive at when we think about climate.

So, using lasers to analyze the uranium and one of its daughter products, thorium, in these corals, we can tell exactly how old the fossils are.

The beautiful Antarctic animation we're going to use shows how we're using corals to get feedback from the ancient oceans.

This animation by Ryan Abernathey shows the density of surface water.

With just one year of data, you can see how dynamic the Antarctic Ocean is.

The intense mixing, especially the Drake Passage shown in the box, is actually one of the strongest currents in the world flowing west to east through here.

As it moves over large submarine mountains, it is highly turbulent and mixed, exchanging CO2 and heat in and out of the atmosphere.

And essentially, the ocean breathes through the Southern Ocean.

We've traveled back and forth across this Antarctic Strait to collect corals, and the uranium dating has turned out to be quite astonishing. That is, corals migrated from south to north during the glacial-to-interglacial transition.

The reason is not well understood, but it is thought to be related to the food source and possibly the oxygen in the water.

So here we are.

I'll explain what we think we've learned about climate from Antarctic corals.

Here is my illustration.

Our analyzes of coral suggest that, in retrospect to the Ice Age, the deep Antarctic Ocean was very rich in carbon, with a low-density layer above it.

Then carbon dioxide will stop coming out of the ocean.

Later, corals of the Middle Ages were discovered, indicating that the oceans mixed in the middle of climate change.

This allows carbon to come out of the deep ocean.

And if you analyze the corals near modern times, or actually go there today anyway and measure the chemistry of the corals, you'll find that the carbon has moved into positions where it can move in and out.

This is how fossil corals can be used to learn about the environment.

Now, I would like you to look at this last slide.

It's a still from the first footage I showed you.

A beautiful coral garden.

We never expected to find something so beautiful.

Thousands of meters deep.

There are also new species.

Just a beautiful place.

There are fossils inside, and I trained them to appreciate the fossil corals there.

Think about it the next time you are lucky enough to fly or sail over the ocean. There are huge seamounts that no one has ever seen and beautiful corals.

thank you.

(applause)

Imagine a world where numbers and letters appear colored even though they are printed in black. In that world, music and voices set in motion swirls of colored shapes, and words and names fill the mouth with unusual flavors.

Jail tastes like cold, hard bacon, while Derek tastes like earwax.

Welcome to synaesthesia, a neurological phenomenon where 4% of the population connects two or more senses.

Synesthetes not only hear my voice, but they may also see it, taste it, and feel it as physical contact.

It shares the same root as anesthesia, meaning no sensation, while synaesthesia means sensation combined.

If you have one type, such as colored hearing, you have a 50% chance of having a second, third, or fourth type.

1 in 90 of us experience graphemes—the written elements of language such as letters, numbers, and punctuation marks—saturated with color.

Some people have genders and personalities.

For Gail, 3 is athletic and sporty and 9 is vain elitist girl.

In contrast, the phonetic units of language, or phonemes, provoke a synesthetic taste.

For James, college is like a sausage, as are messages and similar words ending in -age.

Synaesthesia is a trait, such as having blue eyes, rather than a disability, because nothing is wrong with it.

In fact, all additional hooks give synesthetes excellent memory.

For example, a girl happens to meet someone she met a long time ago.

"You see, she had a green name.

D is green: Debra, Darby, Dorothy, Denise.

yes! Her name is Denise! ”

Pairings established once in childhood are fixed for life.

Synesthetes inherit a biological tendency to overconnect brain neurons, which requires exposure to cultural artifacts such as calendars, food names, and alphabets.

The surprising thing is that a single nucleotide change in the DNA sequence alters recognition.

Synesthesia thus provides an avenue for understanding subjective differences, how two people can see the same thing differently.

Sean prefers blue-flavoured foods such as milk, oranges, and spinach.

This gene strengthens the connections that normally occur between the gustatory regions of the frontal lobe and the color regions further back.

But suppose someone else's gene worked in the non-sensory domain.

Then you will be able to connect seemingly unrelated things. This is the definition of metaphor, we can see the similar in the dissimilar.

Not surprisingly, synaesthesia is common in artists who excel at making metaphors, such as novelist Vladimir Nabokov, painter David Hockney, and composers Billy Joel and Lady Gaga.

But why are the rest of the non-synesthetic people able to understand metaphors like "sharp cheese" and "sweetie"?

As it happens, sight, hearing, and movement already correspond so closely to each other that even a poor ventriloquist can be tricked into believing that a dummy is speaking.

Similarly, in a movie, you can be sure that the sound is coming from the actor's mouth rather than the surrounding speakers.

In other words, we are all synesthetes on the inside, but on the outside we are unaware that perceptual coupling is always happening.

Crosstalk in the brain is the norm, not the exception.

It seems like a good deal to me.

May I raise my hand -- how many of you in this room have flown in the last year?

That sounds pretty good.

Well, it turns out you share that experience with over 3 billion people each year.

When you put so many people in metal tubes and fly them around the world, sometimes this happens and disease can spread.

I first became interested in this topic when I heard about the Ebola outbreak last year.

And while Ebola spreads through these more limited, large droplet pathways, it turns out there are all kinds of other diseases that can spread in airplane cabins, too.

The worst part is, looking at some numbers, it's pretty scary.

In the case of H1N1, there was a man who decided to fly and actually spread the disease to 17 other people in just one flight.

And there was another man with SARS who managed to infect 22 other people in a three-hour flight.

It's nothing like my idea of ​​a great superpower.

This also shows that pre-screening for these diseases is very difficult.

So when someone actually gets on a plane, that person could be sick, and they could actually be infected with the disease but in an incubation period where they don't show symptoms, thus spreading the disease to many other people on board.

How this actually works is that at the moment air is coming in from the top of the cabin and the side of the cabin as shown in blue.

The air is also expelled through a highly efficient filter that eliminates 99.97 percent of pathogens near the exit.

But what's happening now is that we have this mixture flow pattern.

So if someone actually sneezes, the air will swirl many times before it can pass through the filter.

So I thought: Clearly, this is a pretty serious problem.

I didn't have the money to buy an airplane, so I decided to build a computer instead.

In fact, we have found that computational fluid dynamics can be used to create simulations with higher resolution than actually walking inside an airplane and taking measurements.

So basically how this works is that you start with these 2D drawings. These drawings are circulating in technical documents on the Internet.

Put it into this 3D modeling software to actually build a 3D model.

We then split the model we just built into these smaller pieces, essentially meshing them so the computer can understand the model better.

And then you tell the computer where the air is going in and out of the cabin, throw in a ton of physics, and basically just sit there and wait for the computer to work out the simulation.

In fact, here's what you get in a conventional cabin: The person in the middle will notice that he is sneezing and say "Splat!" ――It is transmitted directly to people's faces.

That's pretty disgusting.

From the front, you can see that the two passengers sitting next to the middle passenger aren't having much fun.

And if you look at it from the side, you'll notice that pathogens are spread across the length of the cabin.

My first thought was, "This is no good."

So I actually ran over 32 different simulations and finally came up with this solution.

This is what I call -- patent pending -- the Global Inlet Director.

This can reduce pathogen transmission by approximately 55 times and increase inhalation of fresh air by approximately 190 percent.

How this works in practice is attaching this composite to an existing spot that is already in a plane.

Therefore, the installation is very cost-effective and can be done directly overnight.

Just insert a few screws and you're good to go.

And the results we got are really nice.

Instead of problematic swirling airflow patterns, air walls can be created between passengers to create personalized breathing zones.

Now you'll notice that the middle passenger is sneezing again, but this time it can be effectively pushed into the filter and eliminated.

When viewed from the side, you can see that pathogens can be directly pushed down as well.

So if you look again at the same scenario where this innovation was introduced, you'll notice that the middle passenger is sneezing. This time, it's pushing it straight to the exit before it can infect others.

Thus, it turns out that the two passengers sitting next to the middle person had virtually no pathogens.

Even from the side, you can see that it is a very efficient system.

So with this system, we can win.

If you look at what this means, you'll see that this works not only if the middle passenger sneezes, but also if the window seat passenger sneezes or the aisle seat passenger sneezes.

What does this solution mean for the world?

Looking at this from a computer simulation to the real world, you can see that the same airflow pattern hits the passenger directly in this 3D model that I built here, essentially using 3D printing.

In the past, the SARS epidemic actually cost the world about $40 billion.

And in the future, a major disease outbreak could actually cost the world over $3 trillion.

In the past, this meant taking planes out of service for a month or two, spending tens of thousands of man-hours and millions of dollars to change anything.

But now I can basically install anything overnight and see the results immediately.

So in practice it is important to move this to certification, flight testing and all these regulatory approval processes.

But this shows that sometimes the best solution is the simplest one.

And even two years ago, this project wouldn't have happened simply because the technology at the time didn't support it.

But now, with advanced computing and the development of the Internet, we are truly in a golden age of innovation.

So what I want to ask you today is why should you wait?

Together, we can build the future today.

thank you.

(applause)

Imagine yourself standing on the beach looking out at the ocean as blue waves crash against the shore as far as the eye can see.

Let's really appreciate its vast scope and scale.

Now ask yourself, "How big is it?

how big is the ocean? ”

First of all, you need to understand that there is really only one ocean, made up of five basins called the Pacific Ocean, Atlantic Ocean, Indian Ocean, Arctic and Antarctic.

Although each of these five is commonly called an ocean in its own right, they are actually part of a single, vast body of water, or ocean, that defines that very facet of the Earth.

The ocean covers about 71% of the Earth's surface, or about 360 million square kilometers, an area larger than 36 United States.

Seen from space, it is so vast that the oceans are by far the dominant feature of our planet.

Speaking of space, the ocean currently contains over 1.3 billion spaces, which includes 'b' in 1 billion, or cubic kilometers of water.

In other words, this is enough to immerse the entire United States in salty water over 132 kilometers high, well beyond the reach of the tallest clouds and extending deep into the upper atmosphere.

With this volume, the oceans account for 97% of the total water content of the Earth.

In addition, the ocean contains more than 99% of the world's biosphere, the space and places where life exists.

Let's think for a minute here.

The familiar world as we know it, in fact, the totality of all living spaces enclosed by the continents themselves, is only 1% of the biosphere.

1%！

The sea is everything else.

So the ocean is physically huge.

Its importance to life is virtually unparalleled.

It also holds the greatest geological feature of our planet.

Without further ado, here are the four most notable.

The ocean contains the Mid-Ocean Ridge, the largest mountain range in the world.

This underwater mountain range is about 65,000 kilometers long, about 10 times longer than the longest purely terrestrial mountain range, the Andes.

Beneath the Denmark Strait is the world's largest waterfall.

This giant cataract pumps about 116 times more water per second than the largest waterfall on land, the Inga Falls on the Congo River.

The tallest mountain in the world is actually hidden in the sea.

Hawaii's Mauna Kea sits at an elevation of 4,200 meters, but at 5,800 meters its sides drop below the waves.

This Hawaiian mountain is nearly 10,000 meters high from its snowy top to its silty bottom, making it appear more than a kilometer smaller than the tiny peak of Everest.

Next, since we're talking about impoverished Everest, let's consider Challenger Deep, the deepest canyon in the world, located 11 kilometers below sea level and about six times deeper than the Grand Canyon.

This is deep enough to submerge Everest, with more than 2.1 kilometers of water still remaining at its newly submerged summit.

In other words, the depth of Challenger Deep is about the height at which commercial aircraft fly.

So no matter how you cut it, the ocean will be a capital B, a capital I, a capital G, and a big one.

It defines our planet as having the greatest geological features, constituting the greatest habitable space, and thus being home to the greatest number and form of life on Earth.

Scope-wise, it's virtually incomprehensible.

But it's untouchably big, vast, and nothing special.

In fact, with about 50% of the world's population living within 100 kilometers of coastlines, and most of the rest living near lakes, rivers and wetlands that eventually lead to the ocean, virtually everyone on earth has the opportunity to influence the overall health and nature of the world's oceans.

Evidence of human influence is found everywhere in the ocean, no matter how deep or how far away.

The ocean defines our planet, but in a very real sense, it is us who define the ocean.

What is at the center of the universe?

It is an essential question that mankind has been asking for centuries.

But the path to the answer was a strange one.

If you want to know the answer to this question in the 3rd century B.C.E., Greeks, why not look up at the night sky and believe what you see there?

That is what Aristotle, the interrogator at the time, did.

He thought that since we are looking up on Earth, that must be the center, right?

For him, the world sphere consisted of four elements: earth, water, air and fire.

These elements moved around a nested set of solid crystal spheres.

Wandering stars, planets each had their own crystal ball.

The rest of the universe and all its stars were on the final crystal ball.

If you watch the sky change over time, you'll find that this idea works well to explain the motion you see.

For centuries this has been central to the cosmology of Europe and the Islamic world.

But in 1543, a man named Copernicus proposed a different model.

He believed that the sun was at the center of the universe.

This radically new idea was hard for many to accept.

After all, Aristotle's ideas made sense with what they were visible and were pretty flattering to humans.

However, a series of subsequent discoveries made the heliocentric model no longer negligible.

First, Johannes Kepler pointed out that orbits are not perfect circles or spheres.

Galileo's telescope then picked up Jupiter's moons orbiting Jupiter, completely ignoring the Earth.

Newton proposed the theory of universal gravitation, proving that all objects are attracted to each other.

Ultimately, we had to let go of the idea that we were at the center of the universe.

Shortly after Copernicus, in the 1580s, the Italian monk Giordano Bruno suggested that the star is the Sun, probably has planets of its own, and that the universe is infinite.

This idea didn't work.

Bruno was burned at the stake for his radical suggestion.

Centuries later, the philosopher Rene Descartes proposed that the universe is a series of spirals, which he called spirals, with each star at the center of the spiral.

In time, we realized that there were far more stars than Aristotle dreamed of.

As astronomers like William Herschel acquired increasingly sophisticated telescopes, it became clear that our Sun is actually one of many stars in the Milky Way.

And what about that dirt you see in the night sky?

They are other galaxies, as vast as our home, the Milky Way.

Maybe we are farther from the center than we ever thought.

In the 1920s, astronomers studying nebulae wanted to understand how they moved.

Based on the Doppler effect, they expected that objects moving toward us would see a blue shift, and objects moving away from us would see a red shift.

But all they saw was a redshift.

Everything was rapidly moving away from us.

This observation is one of the evidences for what is now called the Big Bang Theory.

According to this theory, all matter in the universe was once a single, infinitely dense particle.

In a way, part of our universe was once centered.

But this theory eliminates the whole notion of a center, since there can be no center in an infinite universe.

The Big Bang was not just a cosmic explosion. It was a cosmic explosion.

Each new discovery proves that while our observations are limited, our ability to infer or dream what's out there is limitless.

What we think we know today may change tomorrow.

Like many thinkers we've just met, sometimes our wildest guesses lead to wonderfully humble answers and drive us to more complex questions.

Ever wondered where to put your forks when helping set the table?

Or have you sat down to eat at a restaurant and wondered what utensils to use?

Now, here are some simple, traditional etiquette tips on how to set the table.

What would happen if we set up a table like this?

It doesn't look good either and you need to clean up the clutter before you start.

Let's try another method.

First, use a placemat or tablecloth to prevent the plate from being placed directly on the table. don't use both.

It's more of a cosmetic issue than an etiquette, but unless you're eating at a picnic table, you'll rarely have anything under your plate.

Decorate with your favorite flowers, candlesticks and other decorations.

Candles are usually lit only at night.

Start with the main course dishes. Place your dinner fork on your left and your dinner knife on your right. Because these are the hands we use.

Helpful Tip: Since you always eat outside-in, place the salad fork on the outside of the dinner fork and the salad knife on the outside of the dinner knife to set the salad.

Eat the salad first, then the main course.

Also notice that the knife blades both point towards the plate.

This is an old tradition from the days when dinner knives were very sharp, and it was a sign of politeness and non-aggression to keep the knife away from other dinner knives.

You may drink the soup, but usually the soup comes first, so the soup spoon is held in your right hand, so it is outside the knife.

Another tip is to put only what you need on the table.

If you don't eat soup, don't set the soup spoon.

Well, dessert is ice cream, but I don't need it for a while, so I put dessert on top.

Notice that the bowl of the spool faces left.

That way, when you eat, just slide it down and it will be in the correct position.

To eat the cake, place a fork and flip it 180 degrees so the right side is on the left.

Then use the plate to fix the setting.

It can also be served in the kitchen and then brought to the table.

The bread plate moves to the top left of the setting, and the butter knife moves diagonally over the plate again with the blade facing inward.

Only one seat left is for drinks.

Place the wine glass on the top right and the water glass diagonally to the left.

If you're like me and can't quite remember which went where, think water, wine, wow, wow, wow. Oh, me Alphabetically from left to right.

One more tip: Think of B-M-W like a car to remember the left and right sides of bread and drinks.

B, the bread plate is on the left. M (food) is in the middle and W (water) is on the right.

Finally, the napkin is traditionally placed on the left side of the fork, but it is okay to place it under the fork.

For a fancy meal that takes up a lot of space like this, place it in the center.

Now you are ready to eat.

We hope these tips will help you next time you're asked to help set the table or sit down for a fancy meal.

fun!

Some superheroes can grow to the size of buildings at will.

That is so scary!

But scientists have to ask where the extra matter came from.

The law of conservation of mass implies that mass can neither be created nor destroyed. In other words, the mass of the hero does not change just because the size of the hero has changed.

For example, when baking a fluffy sponge cake, the resulting delicious treat will be much larger in size than the cake dough in the oven, but the weight of the cake dough should be equal to the weight of the cake plus the evaporated water.

In chemical equations, molecules are rearranged to create new compounds, but all components must still be considered.

As our hero grows from 6ft to 18ft, he triples in height.

According to Galileo's law of square cubes, Galileo must expand into all three dimensions, so his weight is 27 - 3 times 3 times 3 is 27 times his normal weight.

So when a superhero transforms into a giant, we are dealing with two possibilities.

At 18 feet tall, our hero still weighs only 200 pounds, the original weight of this human form.

Now, for option 2, when the hero is 18 feet tall, he weighs 5,400 pounds (200 pounds x 27 equals 5,400 pounds). So if you're 6 feet tall, you'll also weigh 5,400 pounds.

No one can get in the same elevator with him unless the alarm goes off.

Now, Option 2 seems a little more scientifically plausible, but that begs the question. Since the pressure he exerts on the soil is calculated as his mass divided by the area of ​​the soles of his feet, how can he walk through the park without sinking into the ground?

And what supersocks and supershoes does he wear on his feet to withstand all the friction caused by dragging his 5,400-pound body across the road as he runs?

And can he even run?

And I'm not going to ask how they found the pants to be flexible enough to withstand swelling.

Now let's examine the densities of the above two options.

Density is defined as mass divided by volume.

The human body is made up of bone and flesh, and their density is relatively fixed.

In option 1, if the hero always weighs 200 pounds, he will have normal sized bones and flesh.

Expanding to a larger size while still weighing 200 pounds, he essentially turns into a giant fluffy teddy bear.

In option 2, if the hero always weighs 5,400 lbs, he'll be flesh and bones at 18 feet and supporting 5,400 lbs on his two legs.

As he moves, his weight rests on his leg bones at different angles.

Bones are hard, but they are not malleable, meaning they do not bend, so they break easily.

Tendons are also at risk of tearing.

The tall building is made of steel, so it doesn't run or fly around in the jungle and stands still.

Our hero, on the other hand, landed at a bad angle and went down.

Assuming his bodily functions are the same as those of other mammals, his heart must pump a large amount of blood throughout his body to provide enough oxygen to move his 5,400 pounds.

This requires an enormous amount of energy, requiring you to consume 27 times as much food as 3,000 calories each day to provide energy.

This is equivalent to about 150 Big Macs.

27 x 3,000 calculated is equivalent to 81,000 calculated and 550 calories is equivalent to 147.

He doesn't have time to fight crime because he has to eat 24/7 and work 9-5 to cover everything he eats.

But what about superheroes who can turn their bodies into rocks and sand?

Now, everything on earth is made up of elements.

And it is the number of protons in the nucleus that defines each element.

That's how our periodic table is made up.

Hydrogen has one proton, helium has two protons, lithium has three protons, and so on.

The main component of the most common sand is silicon dioxide.

On the other hand, the human body is composed of 65% oxygen, 18% carbon, 10% hydrogen and 7% other (including 0.002% silicon).

In chemical reactions, elements recombine to form new compounds.

So where does the silicon needed to make sand come from?

Certainly, it is possible to change elements by nuclear fusion and fission.

But nuclear fusion requires a lot of heat, and stars are the only places where this process occurs naturally.

In order to use nuclear fusion in a short time, the temperature of the region must be hotter than the sun.

All innocent bystanders will be burned.

Rapid nuclear fission is often not very good as it produces many radioactive particles.

Our hero becomes a walking, talking nuclear power plant that ends up harming everyone he tries to save.

And do you really want the heat of the sun or radioactive nuclear power plants in your body?

So, which super-powerful physics lesson will you explore next?

Changes in body size and content, super speed, flight, super strength, immortality, transparency.

Some superheroes can move faster than the wind.

The Apollo 10 crew reached a record-breaking speed of about 25,000 miles per hour when the shuttle reentered Earth's atmosphere in 1969.

Wouldn't being able to act this fast save a lot of time?

But what's wrong?

Air is not empty.

Elements such as oxygen and nitrogen, as well as countless dust particles, make up the air around us.

When we pass these things in the air, they rub against each other and create a lot of friction, which in turn creates heat.

Much like rubbing your hands together to heat them up, or rubbing two sticks together to start a fire, the faster objects rub together, the more heat they generate.

So, if you're going 25,000 miles an hour, the friction heat will burn your face.

Even if we manage to withstand the heat, the sand and dirt in the air will scrape us away, creating millions of tiny cuts all at once.

Have you ever seen a truck's front bumper or grille?

What do you think birds and bugs would do to your open eyes and exposed skin?

Well, I wear a mask so as not to hurt my face.

But what about the people in the buildings between you and your destination?

It takes about one-fifth of a second to react to what we see.

By the time we see and react to what lies ahead, time x velocity = distance = 1/5th of a second x 25,000 miles per hour = 1.4 miles - we will have passed or gone by over a mile.

We either kill ourselves by crashing into a nearby wall at super speed, or worse, if we can't destroy it, it essentially turns our bodies into missiles that destroy everything in their path.

So traveling 25,000 miles an hour over long distances leaves us burnt out and covered in bugs with no time to react.

What about short bursts in plain sight with no obstacles in between?

Now suppose a bullet is about to hit a beautiful damsel in distress.

So the hero swooped down at super speed, grabbed her and carried her to safety.

It sounds very romantic, but in reality, the girl would take more damage than a bullet if the protagonist made her move super fast.

Newton's first law of motion deals with inertia, which is the resistance to changes in the state of motion.

So unless something changes, the object will either keep moving or stay in the same place.

Acceleration is the rate of change of velocity over time.

The girl at rest has a speed of 0 miles per hour, and within a few seconds she begins to accelerate until she reaches that speed, her speed rapidly increases to 25,000 miles per hour, and her brain collides with the side of her skull.

And when she comes to a sudden stop, her speed rapidly drops back to zero miles per hour, causing her brain to collide with the other side of her skull, turning her brain into mush.

The brain is too fragile to cope with sudden movements.

And for that matter, every part of her body.

Just as astronauts survived Apollo 10, remember that it's not speed that causes damage, acceleration or sudden stops can cause internal organs to crash into the front of the body, much like a bus driver's brakes push forward.

What the protagonist does to the girl is mathematically equivalent to running over her at top speed with a space shuttle.

He probably died instantly on impact.

He will owe the poor girl's family an apology and a large restitution check.

Oh, and you might get jail time.

Physicians must take out liability insurance in case they make a mistake and injure a patient.

How much does superhero insurance cost?

So, which super-powerful physics lesson will you explore next?

Changes in body size and content, super speed, flight, super strength, immortality, transparency.

If you wake up one morning with 1,000 times more energy than you did the night before, how can you handle the delicate daily tasks?

Everything will seem so fragile to you, as your power has multiplied a thousand times in scale.

When you shake someone's hand, you have to be very careful not to break their bones or crush everyone you hug.

And using a fork to remove broccoli without sticking it in a styrofoam dish would be as difficult as brain surgery.

Suppose the day comes to save a maiden who has fallen from a helicopter and is in distress.

So you hold out your arm to catch her.

After a few seconds, you will find yourself holding her lifeless body.

what happened?

Now, pressure is force divided by area.

The smaller the area, the greater the pressure.

This is why we can lift heavy objects without damaging our skin, but even a small prick with a small needle can cause bleeding.

The pressure on her body can be calculated by dividing the force by the area of ​​the upper arm in contact with her.

It doesn't matter if your arms are strong enough to catch her body without breaking any bones.

Her spine isn't strong enough to damage you if you catch her.

Even breaking down the nearest door to provide a larger area to catch her won't save her anyway.

Remember, it wasn't the fall that killed her, it was the sudden stop at the bottom.

Let's say she falls off a 32-story building about 300 feet tall and you're 6 feet tall, maybe 10 feet on tiptoes, and you're holding on to the door with your arm over your head trying to spread the pressure over a larger surface area. But what you're doing is essentially just moving the ground ten feet up.

So she's now falling from a height of 290 feet instead of 300 feet and, not accounting for air resistance, reaches a velocity of 173 feet per second just before impact.

This is the equivalent of hitting a wall with a door at 94 mph.

The only thing that can save her is flying.

But that power comes with many scientific problems.

If you can fly, all you have to do is fly up to her, start jumping down at the speed she's falling, cling to her, and slowly slow down until you come to a complete stop.

This process requires a lot of cushion space between the point where you started falling and the ground.

Her head is getting closer and closer to the pavement while she changes into her superhero costume and flies up to her height.

If she's falling from a great height and you can't get close to her just a few feet above the ground, there's nothing you can do except magically turn the pavement into marshmallows to give her enough time to slowly come to a halt.

Next, crack chocolate crackers and graham crackers and your s'mores are ready.

Mmmm delicious!

So, which super-powerful physics lesson will you explore next?

Changes in body size and content, super speed, flight, super strength, immortality, transparency.

Immortal.

In the movies, the kings are always searching for the secret of immortality.

But is immortality really a good thing?

For a 10 year old boy, 1 year is 10% of his life.

For a 40-year-old mother, one year is only 2.5% of her life.

Even in the same year, 365 days, people feel differently.

If we live to be 82, that's about 30,000 days.

If this boy lives 30,000 years, a year might feel like a day to him.

And if this boy's feelings persist in the latent boredom of living for millions of years, he may become extremely lonely and sad to find out that he has outlived and will outlive those he has ever loved.

But what if everyone was immortal?

First of all, the earth is very big.

So where will we live?

(grunts) "Excuse me!" "That's my face!"

"Stop!" "I'm sorry."

"Stay here!"

Do you remember what you did last year or when you were 5?

How long have you forgotten the past?

If you can't remember what you did when you were 5 years old, how would you remember if you lived 1,000 years ago?

1 million years ago?

We don't remember everything from the past because our brains have limited capacity and replace useless memories like middle school locker combinations with relevant information.

If this immortal boy finds someone to fall in love with once every 100 years, he will have 10,000 girlfriends in a million years.

And how many of those 10,000 girl names can he remember?

This changes the meaning of meaningful relationships, doesn't it?

Another tricky thing about immortality is that humans don't always look the same.

This can be explained by Darwin's theory of evolution.

For example, if women find taller men more attractive, more tall men will mate and have offspring, putting more tall genes into their gene pool.

In other words, the next generation will have more children with genes that make them taller.

Repeating this process for a million years, the average height would be much taller than the average height today, assuming no natural disasters wiped out all tall people.

Our ancestors were short, hairy apes.

We still have body hair, but we don't look like monkeys anymore.

If only you were immortal while others continued to evolve over generations, you would end up looking quite different from the people around you.

"Maido! How are you?"

If one of our ancestors, the ape, was still alive today, how many people would befriend a monkey without calling the Museum of Natural History?

And there is one more physical consideration of immortality. It's a scar.

After all, immortality doesn't automatically translate to invulnerability, it just means you can't die.

But that doesn't guarantee how you will live.

Look at your body and count how many scars you have.

Imagine how much damage it would take if you were 1,000 years old after creating this many permanent scars in your life.

There are currently approximately 185,000 amputation-related hospital discharges each year in the United States.

These injuries are due to accidents or illness.

Indeed, if you live only 100 years, that percentage is low compared to the total population.

But even if you live for over a million years, it's highly unlikely that you'll still have all your limbs.

What about small accessories like eyes, noses, ears, fingers and toes?

how are your teeth?

What are the odds of keeping your teeth healthy for 100 years?

millennium?

A million years?

You may end up looking like a badly worn Mr. Potato Head with missing parts and false teeth.

So do you really want to live forever?

So, which super-powerful physics lesson will you explore next?

Variable body size and content, super speed, flight, super strength, immortality, and—invisibility.

Nicole Paris: TEDYouth, make some noise!

(beatbox) TEDYouth, make something -- (beatbox) (end of beatbox) Are you ready?

(Cheers and applause) Are you ready?

Ed Cage: Yes, yes, yes!

(Beatboxing) (laughs) EC: Do you like it? Let me show you how we used to do -- NP: Pop it, go ahead.

EC: ...when I was a kid, in the 90's.

(beatboxing) (end of beatboxing) (laughter) (beatboxing) NP: pop, pop, pop, pop, pop, pop, hold up, hold up, hold up, hold up!

oh my god.

OK, he's trying to fight me.

Hold on, hold on now.

Remember when you beatboxed me to sleep?

EC: Yes, yes, I remember.

That was when she was just a little baby.

we would do something like this

(beatboxing) NP: I remember that.

(Beatboxing) NP: Okay pop pop pop chill out chill out.

wait, wait, wait.

EC: Guys, do you remember the video?

This is kind of a little revenge for the 50 million people who call me a loser or something.

NP: Wait, wait.

But many people out there don't really know what beatboxing is or where it all started.

EC: Yes, yes.

NP: Where did it come from?

So why not give it a little history, a little history of where it came from.

EC: Beatbox started here in New York.

(cheers) Yes, yes. New York, NY!

Everyone said, "Yes!"

Well, we're from St. Louis.

(laughs) NP: You can put your hands down now.

(laughs) EC: But beatboxing started here in New York.

When we go to a party, there's a DJ and there's a rapper.

But I had no electricity coming out of me, so I had to emulate what the beat was doing.

So if you look at beatboxers, you'll see us on the side.

Then there was the rapper, and once the rapper started rapping, we made a simple beat. Because beats were simple back then -- (beatbox) or -- (beatbox) They were simple beats.

But now there are people who want to do all sorts of things with their beats and they want to embarrass their fathers. If you want to shame the people who look after you and pay your tuition in full, it's not right (Nicole laughs). Especially when you have 50 million people who just call you a "loser."

Well, it's taken to heart.

But now I'm doing something different at home, so I'm jamming. A jam session consists of jamming in church.

You know, in church, we look at each other like this [beatboxing] (laughs) and text each other beats.

Or it could be cooking in the kitchen, traveling, or going to the airport.

NP: Standing right there in the corner and saying, "Oh, Dad, listen."

(Beatboxing) No, just kidding. But do you know?

We're talking about this jam session and everything else.

EC: Right.

NP: Would you like to take a peek at our jam session?

NP: Would you like to hear a jam session? EC: Are you ready for a jam session?

(Cheers) NP: Excuse me? i can't hear you.

(Cheers) Yes! Kick, pop!

(Beatbox) (Applause) (Beatbox) (End of beatbox) (Applause) NP: Preparing to leave!

EC: Are you ready? Everyone stand up! Come on, everyone, stand up!

Get up! Go ahead and stretch!

(beatbox) (end of beatbox) NP: That's it.

(Cheers and applause) Thank you! Please make noise!

EG: Thank you everyone!

NP: Please make noise! ​​Please make noise!

thank you!

If humans could fly without tools or machines, how fast do you think they would be?

As of 2012, the world record for fastest sprint speed is about 44 mph.

Running speed is determined by the amount of force exerted by the runner's legs. According to Newton's second law of motion, force is the product of mass and acceleration.

And Newton's third law states that for every action there will be an equal and opposite reaction.

This means that running requires the ground to push, and the ground pushes back on the runner's foot.

So flying is actually more like swimming.

Michael Phelps is currently the fastest man in the water and the most decorated Olympian of all time.

How fast do you think he can swim?

The answer may surprise you.

His top recorded speed is less than 8 miles per hour.

A kid on the ground can easily outrun Michael Phelps in the water, but why?

Now let's go back to Newton's third law of motion.

When we run, we push forward with our feet and the ground pushes us back.

The ground is firm.

By definition, this means that the particles are essentially stuck in place and must be pushed back out of the way, but water is a liquid and flows easily.

When we move our limbs to push water back, some of the water molecules can slip too far onto each other instead of being pushed back.

Now think about flight.

Even more energy would be wasted because air has much more free space for particles to pass through each other.

In order to move forward, a large amount of air must be pushed backward.

Astronauts move in zero gravity by pulling handles installed on the shuttle's ceiling wall and floor.

Now imagine you were given the ability to float.

How do you move in the middle of the road?

Well, you can't go far by swimming in the air, right?

No, I don't think so!

Now let's talk about flight height, assuming you have the ability to float and the speed to move efficiently.

According to the ideal gas law (P-V N-R-T), pressure and temperature are positively related and they increase and decrease simultaneously.

This is because air expands in volume at lower pressures, giving the molecules more room to move around without colliding with each other and generating heat.

At high altitudes, the atmospheric pressure is quite low, so flying over clouds can be freezing cold.

You need to wrap yourself up to keep your core body temperature above 95 degrees Fahrenheit. If you don't, you will start shivering violently, gradually become mentally confused, and eventually fall from the sky due to loss of muscle control due to hypothermia.

Now, the ideal gas law means that as the pressure decreases, the volume of the gas increases.

So if you fly straight off too quickly, the inert gases in your body will expand rapidly, like soda bubbling up when you shake it.

This phenomenon is called "bend," decompression sickness, or "diver's sickness," because deep-sea scuba divers experience it when they surface too quickly.

This can lead to pain, paralysis, or death, depending on the degree of blood foaming.

Now, let's say you want to fly a few meters above the ground where you can still see the road signs and easily breathe oxygen.

Goggles and helmets are required to protect against birds, insects, road signs, power lines and other flying humans. It also includes flight police who can get you tickets if you don't follow flight rules.

Now remember that if you collide in the air and lose consciousness, you will experience free fall until you hit the ground.

Without society and the laws of physics, flying would have been an absolutely wonderful ability.

But even if we could only float a few feet above the ground and move at a snail's pace, that's a cool ability I'd want, right?

Yes, I thought so.

So, which super-powerful physics lesson will you explore next?

Changes in body size and content, super speed, flight, super strength, immortality, transparency.

Wouldn't it be great if we could be transparent?

huh?

This means you can spy on people without being noticed and do whatever you want without being held accountable.

Now magicians have discovered how to use life-size mirrors to bend light and create vanishing illusions.

Scientists have created metamaterials to guide light rays around small two-dimensional objects.

The camera can also capture what's behind you and project an image so you can't see it from the front.

However, none of these options can make a human-sized object invisible at all angles and distances while moving.

But if you're really invisible like from the inside out, here are some issues you might never have considered before.

To move around unnoticed, you have to be completely naked.

Even if it's freezing outside!

You cannot carry anything with you, including your wallet and keys. Otherwise, you'll just see your wallet or keys floating.

Drivers and people on the street can't see you either, so they can and will run into you one day.

Oh, it's better not to wear perfume and make breathing noises. Otherwise they will know you are there.

And just because it started out inconspicuous doesn't mean it will stay that way.

What would you do if someone accidentally spilled hot coffee on you?

And what if it rains?

But if you think that only liquids can make you visible, you are wrong.

Dust consists of dead human skin cells, soil particles, and fibers from clothing made from cotton and other materials.

When you sweat, the moisture on your skin sticks to it, and when it's dry, dust sticks to the tiny hairs on your skin.

So even if you can't see it, dust will still stick to every part of your body.

We usually don't notice dust on our skin because we can't see the thin layer of dust on top of our skin color.

But if you're Invisible, people will see human-shaped clumps of dust walking around with terribly dirty soles.

gross!

What do you think the world would look like if you were transparent?

Well, the answer is nothing.

You cannot see in the dark because there is no light.

To see an apple, light must hit the apple and return to the eye.

The retina of the eye then captures the light reflection and the brain interprets the image of the apple.

If you are transparent, of course light travels through you or around you instead of being reflected back to you and seen by people.

But that means that the retina of the eye is also not capturing light.

So your brain has nothing to interpret the images.

Can you see your own reflection without a blocking mirror?

no.

In other words, when you can't see others, you can't see yourself either.

ah!

Now, have you ever wondered if invisibility is persistent?

If so, how can I get medical attention if I get injured?

Doctors don't have access to injuries, so they don't know where to apply ointments and bandages.

What's more, you can't see it either.

I mean, what happens if you get sick or infected?

If you can't see the color change or inflammation, how can a doctor diagnose it?

And what if everyone becomes invisible forever?

Well, think how boring the world would be if we didn't meet people on the street, on TV, or on our home computers like we do now.

It's sad to lose sight of it.

So, which super-powerful physics lesson will you explore next?

Changes in body size and content, super speed, flight, super strength, immortality, transparency.

Remember when you first realized your computer was more than just a monitor and keyboard?

Between the mouse click and the video playing, was there something that captured your intent, understood it, and made it a reality?

what is that?

Are you a gremlin?

Let's imagine that we can shrink to the size of an electron and inject ourselves into mouse clicks.

Taking apart the mouse reveals it to be a very simple machine.

It has some buttons and a system that detects movement and distance.

There may be optical mice that use lights and sensors to make these measurements, but older ones used a hard rubber ball and some plastic wheels to make the measurements.

Same concept.

When you click a mouse button, a message is sent to your computer containing information about its position.

Mouse clicks are received and processed by the basic input/output subsystem.

This subsystem works like a computer's eyes, ears, mouth, and hands.

It basically provides a way for a computer to interact with its environment.

However, it also acts as a buffer to keep the CPU from being overwhelmed by distractions.

In this case, the I/O subsystem determines that the mouse click is critical and generates an interrupt to the CPU.

"Hey, CPU! I clicked here."

The CPU, or Central Processing Unit, is the brain of the entire computer.

The CPU doesn't occupy the entire computer in the same way that the brain doesn't occupy the entire body, but it still runs the show.

And the CPU's job, its whole job, is to fetch instructions from memory and execute them.

So while you're typing, your CPU is fetching and executing billions of instructions per second, at a very fast rate of perhaps 60 words per minute.

Yes, billions of instructions are displayed every second. You'll see commands to move your mouse around the screen, run a clock widget on your desktop, play internet radio, manage files you're editing on your hard drive, and much more.

Your computer's CPU is truly capable of multitasking.

"But oh my God, a very important mouse click is happening now!

Throw it all away now and let's deal with it! ”

Everything the CPU does has a program.

A special program for processing characters sent by mice, clock widgets, Internet radios, and keyboards.

Each program was originally written by a human in a human-readable programming language such as Java, C++, or Python.

However, human programs take up a lot of space and contain a lot of unnecessary information for computers, so programs are compiled into smaller pieces and stored in memory as 1's and 0's.

The CPU realizes it needs instructions to handle this mouse click, looks up the address of the mouse program, and sends a request to the memory subsystem for the instructions stored there.

Each instruction in the mouse device driver is properly fetched and executed.

And the story doesn't end there.

The CPU learns that the mouse was clicked when the cursor is over the picture of a button on the monitor screen, so the CPU requests memory for the monitor program to figure out what that button is.

Then the CPU has to request the button's program from memory. This means the CPU needs the monitor program again to display the video associated with the button.

And let's just say that by the time you click and the on-screen button lights up, many programs are involved.

So the simple act of clicking a mouse means accessing all the important components of a computer's architecture - peripherals, basic input/output system, CPU, programs, memory - not just one Gremlin.

Have you ever floated in a comfortable, warm pool and thought, "Wouldn't it be cool if I could be an astronaut?"

You can float in outer space and look down on the earth and everything.

It would be so beautiful! ”

But not at all.

When you are in space, you are orbiting the Earth. This is called free fall.

you are actually falling towards the earth.

Let's think about this for a moment. It's that "Wow!" feeling you get when you're over the top of a roller coaster.

Only you are doing this all the time, two hours, three hours, four hours, or days, while orbiting the Earth.

Anything is fine, right?

So how do orbits work?

Check out Isaac Newton's page.

He came up with this idea. It's a little experiment in my head. Pick up the cannon and place it on the hill.

If you shoot a cannonball, it will move away a little.

But if you shoot harder, it will fly far enough to land just beyond the curvature of the earth.

Well, if you shoot really, really hard, it will circle the globe and come back, Dawn! --And hit me in the back or something.

Let's zoom in far forward and put you on a small satellite above the Earth's North Pole, and think north is up.

It will fall and hit the earth.

But it's actually moving sideways very quickly.

So if you fall, you will fail.

You will eventually fall to the side of the earth and fall, and now the earth is pulling you back to the side.

So you are pulled back and you fall. And you miss the earth again and now you are under it.

The earth is trying to pull you up, but you are still moving sideways.

Then you will miss the earth again.

Now you are on the other side of the earth, moving upwards, and the earth is pulling you sideways.

That is, it will fall on its side, but it will move up, so it will fail.

Now you are back on top of the earth again, above the North Pole. It will fall sideways. Yes, you guessed it.

It moves so fast that you will miss it many times.

In this way the astronaut orbits the earth.

They are always falling towards the earth, but they are always falling because they are always missing.

I feel like I'm falling and I need to get over it.

So, strictly speaking, if you run fast enough and stumble, you can miss the Earth.

But there is a big problem.

First, you have to go 8 kilometers per second.

That's 18,000 miles per hour, just over Mach 23.

Second problem: If you're going that fast, you're circling the Earth and back, but there's a lot of air on the way, much less people and things.

In other words, it burns up due to atmospheric friction.

So this is not recommended.

Myths and misconceptions about evolution.

Let's talk about evolution.

You've probably heard that some people consider it controversial, even though most scientists consider it controversial.

But even if you're not that kind of person and think you have a pretty good understanding of evolution, chances are you still believe things like "evolution is the adaptation of organisms to their environment" that aren't quite right.

This was an early, now discredited theory of evolution.

Almost 60 years before Darwin published his book, Jean-Baptiste Lamarck proposed that living things evolve by developing specific traits throughout their lives and passing them on to their offspring.

For example, he reasoned, giraffes spend their lives stretching to reach leaves on high branches, so their offspring would be born with longer necks.

But we now know that genetic inheritance doesn't work that way.

In fact, individual organisms do not evolve at all.

Instead, random genetic mutations cause some giraffes to be born with longer necks, which in turn gives them a better chance of surviving than giraffes who were less fortunate, resulting in "survival of the fittest."

Because of this, while it sounds like evolution always favors the biggest, strongest, and fastest creatures, it really isn't.

First, evolutionary fitness is simply how well we adapt to our current environment.

If all the tall trees suddenly died and only the short grass remained, all the long-necked giraffes would be at a disadvantage.

Second, evolution occurs in reproduction, not survival.

And the world is full of creatures like male anglerfish. Anglerfish are very small when born and unfit to survive, so they must quickly find a mate before they die.

But at least we can say that if an organism dies without reproducing, it's evolutionarily useless, right?

error!

Remember that natural selection occurs at the genetic level, not the organismal level, and the same genes that are present in one organism are also present in its close relatives.

Thus, genes that altruistically sacrifice themselves to animals to aid in the survival and future reproduction of siblings and cousins ​​may be more widespread than genes that are only intended for self-preservation.

Anything that causes more copies of a gene to be passed on to the next generation, except for the purpose of evolution, serves that purpose.

One of the most difficult things to keep in mind about evolution is that when we say things like "genes want to make more copies of themselves" or even "natural selection", we are actually using metaphors.

Genes don't want anything, and there is no external mechanism to choose which genes are best preserved.

All that happens is that a random genetic mutation causes the organism that carries it to behave differently and develop differently.

Some of these methods result in more copies of the mutated gene being passed on, and so on.

Also, the pre-determined plan is not progressing towards the ideal form.

It's not ideal for the human eye to have a blind spot where the optic nerve exits the retina, but it developed that way starting with simple photoreceptor cells.

In retrospect, it would have been much better for humans to want nutrients and vitamins than just calories.

But over the thousands of years our ancestors evolved, calories were in short supply, and nothing could have predicted that this would change so quickly later on.

Evolution therefore proceeds blindly, step by step, creating all the diversity found in nature.

Commas can be tricky, especially when they involve subordinates and conjunctions.

If you remember some basic rules, some simple laws of physics, and some common scenarios, you'll be able to use commas correctly.

I like to think of different parts of a sentence as characters.

Small conjunctions, powerful subordinates, and clever commas are just a few.

Conjunctions are small and light.

A word that connects clauses, words, and phrases.

Remembering the FANBOYS acronym will help you remember the conjunctions easily.

Conjunctions are ``and'', ``but'', ``however'', ``so''.

It's so small that it often needs the help of a comma, but not always.

On the other hand, Subordinate is the WWE Heavyweight Sentence Champion.

These are words that connect two things that are not equal: a dependent clause and an independent clause.

Subordinates make it clear what they prioritize in their writing.

Commonly used subordinates are though, because, before, but, unless, and even while.

As for subordinates, power is the key, so I can handle physical work by myself.

But of course, sometimes even the strongest among us need the help of a wise friend.

Our clever Comma is so sweet that she often walks around the neighborhood doing some community service.

Today, as soon as she left home, she saw her men lifting two sentences worth of weight, one on each arm.

Barthélemy loves to participate in political debates, even though he usually loses.

Comma asks his men if they need help.

Well, we know the men are the WWE Heavyweight Champions of the Moon.

With the weight of these two full sentences evenly distributed on both arms, you can easily support the weight of these sentences.

So when Comma asks, "Can I help?"

No, maybe next time!

So it's followed by a comma.

Immediately, she looks like a few men trying to lift the weight of the sentence before their very eyes.

Barthelemy loves to sing, but never in public.

Comma asks his men if they need help.

You may hate to admit it, but this time your subordinate needs your help.

A complete sentence carries a lot of weight.

Simple physics tells us that it is easier to balance a heavy object if the weight is evenly distributed.

So when subordinates have weights on both sides, they have a good ability to balance two complete sentences, but have difficulty picking just one.

Comma rushes to help his struggling subordinates, but how will he help them?

When a subordinate begins a sentence, a comma is placed immediately after the first thought or complete sentence.

After rescuing her men, the comma heroine continues and finds a conjunction that weighs two complete sentences.

Barthelemy has been accepted to the University of Chicago and is on the waiting list for Stanford University.

The comma asks the conjunction if it needs help.

Of course it is! busy!

A comma is placed before the conjunction in haste.

Fanboys are less belligerent than subordinates.

Because of this, commas don't have to line up behind fanboys.

Fanboys are polite creatures.

A comma can precede it.

Helping others is hard work!

On the way home, our commas saw conjunctions bearing the weight of complete and fragmented sentences.

Barthélemy plans to major in molecular biology or interpretive dance.

An exhausted Comma asks Conjunctive if she needs help lifting things.

This is one of the rare cases where conjunctions don't need the help of commas.

Conjunctions ensure that commas don't need help. This is good for commas. Because for now all Comma wants to do is go home and take another day off to brace himself and build sentences.

So we offer you an overlooked but potentially lucrative investment opportunity.

In the UK, the return on burial grounds has outperformed the UK property market by about 3 to 1 over the past decade.

Private cemeteries have been set up with plots for sale to investors, with prices starting at around £3,900.

And it is projected to achieve growth of around 40%.

The biggest advantage is that it is a market with continuous demand.

Now, this is a realistic proposition, and there are actually companies proposing this investment, but my interest in it is quite different.

I am an architect and urban designer and have spent the past year and a half looking at death and its approaches to death and how they have shaped our cities and the buildings within them.

So in the summer I held my first exhibition on death and architecture in Venice. Its title was "Death in Venice".

And since death is a very difficult subject to talk about for many of us, this exhibition was designed to be very playful so that people can literally tackle it.

One of our exhibits there was an interactive map of London showing how much of the city's real estate is dying.

Wave your hand over the map to see the names of properties such as buildings and cemeteries.

And those white shapes you can see are all hospitals, hospices, mortuaries and cemeteries in the city.

In fact, most are cemeteries.

We wanted to show that even though death and burial are things we don't really think about, they are all around us and an important part of our cities.

That means about 500,000 people die each year in the UK, and about a quarter of them want to be buried.

But, like many Western European countries, the UK is running out of burial space, especially in major cities.

Greater London authorities have long recognized this, largely due to population growth and the fact that existing cemeteries are nearly full.

In Britain, there is a custom that graves are considered to remain buried forever, and there is also development pressure. People want to use the same land to build houses, offices and shops.

So they came up with some solutions.

They said, "Maybe we can reuse that grave in 50 years."

Alternatively, you can bury 4 people deep so that 4 people can be buried in the same premises. That way the land can be used more efficiently. I hope that in the near future there will still be burial space in London.

Traditionally, however, cemeteries have not been managed by local governments.

In fact, what is surprising is that in the UK there is no legal obligation to provide a burial place for anyone.

Traditionally, this has been done by private religious groups such as churches, mosques and synagogues.

However, from time to time, there are also commercial entities that seek to participate in this practice.

And, you know, they seem to make good money considering the small size of the burial grounds and their high cost.

So really, if you want to build your own cemetery, you can do it.

There was this couple in South Wales. They had a farm and a lot of fields next to it and wanted to develop the land.

They had many ideas.

They first considered building a caravan park, but the council said no.

And they wanted to build a fish farm, but Congress said no again.

So they came up with the idea of ​​creating a cemetery and calculated that doing this could increase the value of the land from about £95,000 to over £1 million.

But back to the idea of ​​making a profit from the graveyard, it's kind of silly, right?

The problem is that the high cost of these burial sites is actually very misleading.

It looks expensive, but the cost reflects the fact that the burial ground needs to be maintained. For example, someone has to mow the grass for the next 50 years.

This means that it is very difficult to make money in a cemetery.

And that's why it's usually run by a council or a non-profit organization.

But anyway, the city council gave these people permission and they are now trying to build a cemetery.

To explain how this works, if you want to build something like a cemetery in England, you first need to apply for a planning permit.

So if you want to build a new office building for a client, or add to your home, or if you have a shop and want to convert it into an office, you have to make a lot of drawings and submit them to Congress for approval.

And then consider how it fits into the surroundings and so on.

So let them see what it looks like.

But they will also think about how it will affect the local environment and so on.

And they'll think, is this going to cause pollution, or is there a lot of traffic that wants to go to this thing I made?

But there are also good things.

Will you add local services to your neighborhood, such as shops that locals want to use?

They then weigh the pros and cons before making a decision.

If you want to build a large cemetery, it will look like this.

But what if you have land and only want to bury a few people, say 5 or 6?

Well, you don't actually need anyone's permission!

In fact, there are very few regulations on burials in the UK and only a few regulations on not polluting waterways, such as not polluting rivers and groundwater.

So if you really want to create your own mini-cemetery, you can.

But I mean, really, who would do this? right?

Well, if you are from a noble family and have a large piece of land, chances are you have a mausoleum there and bury your family members there.

But what's really strange is that you don't have to own a certain amount of land before you can start burying people.

So, strictly speaking, this applies to things like suburban backyards.

(Laughter) So what if you want to try this at home?

Several councils have helpful guidance on their websites.

So the first thing they said was they needed a burial certificate before the burial could begin. Just killing people and burying them under the courtyard is not allowed.

(Laughter) They also say that we need to keep track of where the graves are.

However, this is sufficient as a formal requirement.

Well, they warn you that your neighbors might not like this, but legally speaking there's little they can do about it.

And just in case anyone still has the profit idea on their minds about how much a burial site costs and how much money they can make, they also warn that it can drop the value of your home by 20 percent.

But in reality, it's more likely that no one will want to buy your house after that.

What I find interesting about this book is the fact that it sums up so much of our attitudes towards death.

In the UK, and probably across Europe as well, only about 30% of people have told anyone about their death wishes, and only 45% of people over 75 have told them about it.

And the reason people give is because they think their death is too far away, or they think that talking about it will make people uncomfortable.

And to some extent, there are others who take care of things for us.

For example, governments have all sorts of regulations and bureaucracies regarding the burial of death, etc., and there are people like morticians who devote their entire lives to this issue.

But when we think about our cities, and how death fits into them, there is far less regulation, design, and thought than we imagine.

I mean, we don't think about this, but all the people we imagine are thinking about it - they don't even care about it.

thank you.

(applause)

Measure a circle.

Diameter and radius are straight lines that can be measured with a ruler, so it's easy.

But to measure circumference, you'll need a tape measure or string unless there's a better way.

Now, it is clear that the circumference of a circle decreases and increases with its diameter, but the relationship does not stop there.

In fact, the ratio of the two, the circumference divided by the diameter, will always be the same number, no matter how big or small the circle is.

Historians aren't sure when or how this figure was first discovered, but it's been known in some form for about 4,000 years.

Its estimates appear in the writings of ancient Greek, Babylonian, Chinese, and Indian mathematicians.

It is also believed to have been used in the construction of the Egyptian pyramids.

Mathematicians deduced it by inscribing a polygon in a circle.

And by 1400, it was calculating to 10 decimal places.

So when did you finally know the exact value instead of just a guess?

Actually, never!

As you know, the ratio of the circumference to the diameter of a circle is known as an irrational number and cannot be expressed as the ratio of two integers.

You can get close, but you'll always be slightly off, no matter how accurate your fractions are.

So if you write this out in decimal format, you'll get a continuous series of numbers that start at 3.14159 and go on forever.

So instead of trying to write out an infinite number of digits each time, just refer to it using the Greek letter pi.

We are currently testing its speed by having a computer calculate pi, but quantum computers can now calculate pi to 2,000 trillion digits.

People even compete to see how many digits they can memorize, and have set records for memorizing over 67,000 digits.

However, for most scientific uses only the first 40 or so are needed.

And what are these scientific uses?

Well, you can do all sorts of calculations about circles, from the volume of a soda can to the orbit of a satellite.

It's not just circles.

Pi is also useful for studying curves, and thus helps us understand periodic or oscillatory systems such as clocks, electromagnetic waves, and even music.

In statistics, pi is used in equations to calculate the area under the normal distribution curve. It helps you understand the distribution of error bars in standardized test scores, financial models, or scientific results.

As if that wasn't enough, pi is used more subtly in particle physics experiments like those using the Large Hadron Collider, not only because of its round shape, but also because of the trajectories along which small particles travel.

Scientists have even used pi to prove the fantastic concept that light acts as both a particle and an electromagnetic wave, and perhaps most impressively, even to calculate the density of our entire universe. Incidentally, the universe contains infinitely less matter than the total number of digits of pi.

This Vitruvian man, taken from a Leonardo sketch, has become one of the most famous symbols of the Renaissance.

but why?

It's a simple pen and ink drawing, right?

error!

Let's answer this question with a math problem.

I know how to calculate the area of ​​a circle.

Take the value of pi and multiply it by the radius squared.

I know how to find the area of ​​a square.

Multiply the base by itself.

But how do I get the area of ​​the circle and create a square of equal area?

This is a problem often called "squaring the circle", first proposed in the ancient world.

And like many ideas of the ancient world, it was given new life during the Renaissance.

After all, the nature of pi makes it impossible to solve this problem, but that's another story.

Influenced by the writings of the Roman architect Vitruvius, Leonardo's sketches place humans firmly in the center of circles and squares.

Vitruvius argued that the navel is the center of the human body, and that if you hold a compass and place a fixed point on the navel, you can draw a perfect circle around the body.

Moreover, Vitruvius realized that arm width and height correspond almost perfectly in the human body, and therefore the body also fits perfectly within a square.

Leonardo used Vitruvius' ideas to solve the circle-to-square problem, figuratively using humanity as the realm of both shapes.

But Leonardo wasn't just thinking about Vitruvius.

At that time there was an intellectual movement in Italy called Neoplatonism.

The movement employs a four-century-old concept called the Great Chain of Being, developed by Plato and Aristotle.

This belief holds that there is a chain-like hierarchy in the universe that begins with God at the top and travels down through angels, planets, stars, and all life forms, ending with demons and demons.

In the early days of this philosophical movement, mankind's place in this chain was thought to be very central.

Since humans have mortal bodies with immortal souls, they can divide the universe cleanly in half.

But around the time Leonardo sketched the Vitruvian Man, a Neoplatonist named Pico della Mirandola had a different idea.

He pulled humanity out of its chains, claiming that humans have the unique ability to take any position they choose.

Pico argued that God wanted beings who could comprehend the beautiful and complex universe that He created.

This led to the creation of mankind, and he placed mankind at the center of the universe with the ability to take whatever form he desired.

According to Pico, humans can crawl on chains and act like animals, or climb chains and act like gods, it's our choice.

Looking back at the sketch, we can see that by changing the position of the man, we are able to fill in the irreconcilable realm of circles and squares.

If geometry is the language to describe the universe, this sketch seems to say that we can exist in all its elements.

Humans can fill any shape they like, both geometrically and philosophically.

In this single sketch, Leonardo was able to combine the mathematical, religious, philosophical, architectural and artistic skills of his time.

No wonder it became such an icon throughout the era.

Read below.

how was it?

Are you annoyed?

slow?

What were those sentences about?

These are actually simulations of the dyslexic experience, designed to help you decipher each word.

A person with dyslexia experiences that strenuous pace every time they read a book.

When most people think of dyslexia, they think of seeing letters and words backwards, such as seeing 'b' for 'd' and vice versa, and you might think that people with dyslexia see 'saw' for 'was'.

The truth is that people with dyslexia perceive things like everyone else.

Dyslexia is caused by problems with phonological processing. In other words, people with dyslexia have trouble manipulating language, not seeing it.

For example, after hearing the word cat, if someone asks you, "Please remove the 'c'", which word would you leave?

and.

This can be difficult for people with dyslexia.

Given a single word such as "fantasy", a dyslexic student must read the word by breaking it down into parts such as "fan", "tas", and "tic".

The longer it takes to decode, the harder it is for others to catch up and get a good understanding.

It is also common to spell words phonetically, such as s-t-i-k for sticks and f-r-e-n-s for friends.

These difficulties are more extensive and diverse than one might imagine.

Dyslexia affects up to 1 in 5 people.

It happens continuously.

One person may be mildly dyslexic, the next may be severely dyslexic.

Dyslexia can also be passed on in families.

Situations where one family member has difficulty spelling and another has great difficulty deciphering syllable words such as catch are common.

The continuity and distribution of dyslexia suggests broader principles to keep in mind when examining how the brains of people with dyslexia process language.

Neurodiversity is the idea that all our brains have differences in structure and function, so that any deviation from the “norm” should not be immediately labeled as a pathological disease, nor should people living with these alterations be dismissed as “defective.”

People with neurobiological mutations like dyslexia, including creative and original figures like Picasso, Muhammad Ali, Whoopi Goldberg, Steven Spielberg, and Cher, clearly have every ability to shine and succeed in life.

So, let's take a look at how the brains of people with dyslexia work in a special way.

The brain is divided into two hemispheres.

The left hemisphere is generally responsible for language and eventually reading, while the right hemisphere is usually responsible for spatial activities.

fMRI studies have found that the brains of people with dyslexia are more dependent on the right hemisphere and frontal lobe than those without.

This means that when you read a word, it takes longer to travel through your brain, which can delay transmission in your frontal lobe.

This neurobiological defect makes them more difficult to read.

However, dyslexics can physically alter their brains and improve their reading comprehension through focused, multi-sensory interventions that teach readers to break down language and decipher it based on syllable types and spelling rules.

A dyslexic's brain begins to use the left hemisphere more efficiently while reading, resulting in improved reading comprehension.

This intervention works because it properly identifies dyslexia as a functional change in the brain, and naturally all kinds of changes are seen in different people.

Neurodiversity highlights this spectrum of brain functioning in all humans and suggests that in order to better understand the perspectives of those around us, we should not only see the world through their eyes, but also try to understand the world through their brains.

When you watch a movie or play, you know that the actors probably learned their lines from the script. A script basically tells you what to say and when.

Written music works on exactly the same principle.

In a very basic sense, it tells the performer what to play and when.

Aesthetically speaking, there is a world of difference between Beethoven and Justin Bieber, for example, but both artists use the same building blocks to create their music: the musical note.

The end result may sound very complicated, but the logic behind the notes is actually quite simple.

Let's take a look at the basic elements of sheet music and how they interact to create works of art.

Music is written in five parallel lines across the page.

These five lines are called a staff, and the staff moves on two axes: up and down and left to right.

The up-down axis tells the player the pitch of the note and which note to play, while the left-to-right axis tells the player the rhythm of the note and when to play the note.

Let's start with the pitch.

I'll use a piano here, but the system works with almost any instrument imaginable.

In Western music tradition, pitches are named based on the first seven letters of the alphabet: A, B, C, D, E, F, G.

Then the cycle repeats A, B, C, D, E, F, G, A, B, C, D, E, F, G, etc.

But how did these pitches get their names?

For example, if you play an F on the piano and then another F higher or lower, you'll notice that it sounds pretty similar compared to, say, a B.

Back on the staff, every line and every space between two lines represents a discrete pitch.

Placing a note on one of these lines or on one of the spaces tells the performer to play that pitch.

The higher the note is placed on the staff, the higher the pitch.

However, it is clear that there are many more pitches than the nine given by these lines and spaces.

For example, a grand piano can play 88 notes.

So how do you condense 88 notes onto a single staff?

We use something called a clef. These are odd-looking shapes placed at the beginning of a staff that act like reference points to indicate that a particular line or space corresponds to a particular note on an instrument.

If you want to play a note that is not on the staff, you kind of cheat by drawing an extra little line called a ledger line and placing the note on it.

If you need to draw too many ledger lines and get confused, you should change to a different clef.

When it comes to telling a performer when to play a note, there are two main things that control this: beat and rhythm.

The beat of music itself is kind of boring.

Something like this.

(ticking) Notice that it hasn't changed, it's just going very happily.

Go slow or fast, whatever you really like.

The point is that just like the second hand of a clock divides a minute into 60 seconds, each of which is the same length as the others, beats divide music into small time shards, or beats, all of equal length.

With a steady beat as the foundation, you can add rhythm to the pitch and that's where the music really begins.

This is a quarter note.

This is the most basic unit of rhythm and corresponds to one beat.

This is a half note, equal to 2 beats.

This whole note equals 4 beats, but these smaller notes are eighth notes, each equal to 0.5 beats.

"Great, what does that mean?" you say.

You may have noticed that there are small lines running the entire length of the staff, dividing it into smaller sections.

These are barlines and each section is called a bar.

At the beginning of a piece of music, just after the clef, there is something called the time signature, which tells the performer how many beats there are in each measure.

This indicates that there are 2 beats in each bar, this one has 3 beats and this one has 4 beats.

The numbers below indicate the type of note used as the basic unit of the beat.

1 corresponds to a whole note, 2 corresponds to a half note, 4 corresponds to a quarter note, 8 corresponds to an eighth note, and so on.

So we know that this time signature has four quarter notes (1, 2, 3, 4) in each bar. 1, 2, 3, 4, etc.

However, as I said earlier, I would get bored with just the beat, so I will replace some of the quarter notes with other rhythms.

Note that while the number of notes in each bar has changed, the total number of beats in each bar has not changed.

So what do our musical compositions sound like?

(music) Well, it looks okay, but maybe it's a little thin?

Let's add another instrument with its own pitch and rhythm.

Now it sounds like music.

Admittedly, it takes some practice to read this book quickly and get used to playing what you see on the instrument, but with a little time and patience, you too could be your next Beethoven or Justin Bieber.

There are many things that don't make sense in this wonderful language of ours, English.

For example, when we talk about multiple things, we almost always put an S at the end.

1 cat, 2 cats.

However, there are some words that behave differently.

There is a man alone If he has a mate, you have a man, or he has a woman.

If there's only one person, it's a woman.

Or if there are multiple geese, they are geese, but why are there so many elk?

Or if you have two legs, why not read two beaks instead of books.

In fact, if you spoke English about 1,000 years ago, the very word beak would have been used in multiple books.

If Modern English is strange, then Old English needed therapy.

Believe it or not, English was once an even more difficult language to learn than it is today.

2500 years ago, English and German were the same language.

They slowly drifted apart and became a little different.

This meant that inanimate objects had genders in early English as well as in German.

Folk, Gafor was a woman. Spoon, Rafel was a man. And the table at which they sat was called a board, neither, or neutral.

Go figure!

Being able to use words means knowing not only what they mean, but what gender they are.

And while there are only a dozen or so nonsensical plurals in Old English today, such as men and geese, it was quite normal for countless plurals to be like that.

Do you find it strange that multiple geese are geese?

Well, what if the goats were bunches of gut, or the oaks were fields of ack?

To talk about these, you have to know the exact word for the plural, not just the convenient S at the end.

And it wasn't always S at the end.

Cheerful Old English also allows other sounds to be added at the end.

Multiple lambs were rumble, eggs were fried, and people spoke of bread, not bread, as multiple children are children.

Sometimes, like sheep today, the plural would do nothing.

One sheep, two sheep.

In Old English, one house, two houses.

And just like today, instead of cows, there are cows.

The old English had toungen instead of tongue and namen instead of name. And if the situation were as it were, today we would have eyens instead of eyes.

So why didn't things stay as they were?

Vikings in a nutshell.

In the 8th century, Scandinavian marauders began to occupy much of England.

They spoke no English, they spoke Norse.

Moreover, they are adults, and adults are not as good at learning languages ​​as children.

As we all know what language classes are like, after about 15 years old it's nearly impossible to learn a new language without an accent and stumbling here and there.

The Vikings were no exception and had ways of softening the English language's difficult parts.

Part of it was that crazy plural.

Imagine encountering a language with eggru and gat on the one hand, and then other words, all you have to do is add an 's' to get the sun and stone.

Wouldn't it be easier to just use 's' for everything?

So did the Vikings.

And there were so many of them, and they married so many English women, that anyone who grew up in England would soon hear English as fluent as the actual English.

After a while no one remembered the true kind.

No one remembers that you once said Doala instead of door and Handa instead of hand.

Plural forms are much more meaningful now, except for a few retained elements such as children and teeth that have been so overused that it's hard to break the habit.

The lesson is that English means a lot more than you think.

Thanks to the ancestors of the people of Copenhagen and Oslo for the fact that today we do not ask for a handful of peanuts instead of peanuts.

But wouldn't it be fun if you could do it for just a week or two?

Pat Mitchell: So I've been thinking a lot about female friendships. By the way, these two women are also my friends, with great honor.

Jane Fonda: Yes, I have.

PM: One of the things I read about female friendship is Cervantes.

"You can tell a lot about someone, in this case a woman, by the company they're associated with," he said.

So let's start -- (laughter) JF: We're in big trouble.

Lily Tomlin: Give me a glass of water, I'm so dry.

(laughter) JF: You're taking our time.

We are very limited in what we can do -- LT: Just being with her drains my life.

(laughs) JF: You haven't seen anything yet.

Anyway -- I'm sorry.

PM: So tell me, what do you look for in a friend?

LT: I'm looking for someone who is playful, bold, aggressive, political, has a little bit of passion for the planet, is polite, has a sense of justice, and feels he is worthy.

(Laughter) (Applause) JF: You know, I was thinking this morning, I don't even know what I would do without my female friends.

That is, "I have friends, so I am."

LT: (laughter) JF: No, really.

I exist because I have female friends. They -- you are one of them.

I don't know about you But anyway -- (laughter) You know, they make me stronger, smarter, braver.

They tap me on the shoulder when I need a course correction.

And most of them are considerably younger than me.

Look? I mean, that's great -- LT: Thank you.

(laughter) JF: No, I will. That includes you. Because listen, when you're nearing the end, it's nice to still have someone by your side to play and learn with.

I'm getting closer -- I'll be there sooner than you.

LT: No, I'm glad you're growing old with me.

(laughter) JF: I'm the one showing the way.

(laughter) LT: Well, you are and you are.

PM: Well, as we age and go through different life journeys, what are you doing to keep your friendships alive and vibrant?

LT: Well, you have to use a lot -- JF: She doesn't ask me out often. I'll tell you that.

LT: I have to use social media a lot -- shut up now. So -- (laughter) LT: And then I go through emails and texts and find friends. That way I know they need my advice so I can get back to them as soon as possible.

(laughter) They need my support. Because most of my friends are writers, activists, or actors, and all three of you are the same...

And so on followed by long descriptive phrases. I want to get back to you as soon as possible, so you know I'm there for you.

JF: Do you use emojis?

LT: Oh... JF: No?

LT: That's embarrassing. JF: I'm very interested in emoji.

LT: No, I spell out my joy and my blessings and my grief.

JF: I spell it correctly -- LT: I spell every letter.

(laughs) JF: You're very purist.

As you know, I understand the importance of friendship more as I get older, so I really try to keep in touch and go on playdates so as not to waste my time.

I read a lot, and as Lily knows very well, I send my favorite books to my friends.

LT: When you found out we were coming here today, you sent me a lot of books about women and female friendship. And I was very surprised to see how many books there are and how much research is being done these days. -- JF: So thank you? LT: Thank you.

(laughter) PM: And -- LT: Wait, no, this is really important. Because this is another example of how women are neglected, sidelined and marginalized.

We have volunteered many times, but very little research has been done on us.

JF: It certainly is.

(laughs) LT: This is really exciting, I think you'll be interested.

A Harvard Medical School study shows that women who have close female friendships are less likely to develop disability, or physical disability, as they age and are more likely to appear to have more vibrant and exciting lives.

JF: We live five years longer than men.

LT: I would trade the years for joy.

(laughter) LT: But the most important part is what the researchers found. The results were very exciting and very conclusive. Researchers found that not having close female friends is just as harmful to health as smoking or being overweight.

JF: And there are others -- LT: I mentioned my role...

(laughter) JF: OK, listen to my part. Because there is something extra.

Because for years, decades, they only studied men when trying to understand stress. Only recently have we studied what happens to women when they are stressed. And it turns out that when we're stressed, that is, women, our bodies are flooded with oxytocin.

It is a hormone that makes you feel good, calms the mind, and reduces stress.

It's even more likely when you're with your girlfriends.

I think that's one of the reasons why we live so long.

It's a pity that men don't have it.

Male testosterone reduces the effects of oxytocin.

LT: Well, when you and I and Dolly made '9 to 5'...

JF: Oh -- LT: We laughed, we laughed, we laughed a lot, and we realized that while we had a lot in common, we were so different.

Here she is, like Hollywood royalty, I'm a tough kid from Detroit, [Dolly]'s like a Southern kid from a poor town in Tennessee, and we found ourselves very in sync as women, and we definitely -- we laughed -- our lives must have been extended by at least a decade.

JF: I think we used to cross our legs a lot.

(laughs) If you know what I mean.

LT: I think I know what you mean.

(laughter) PM: You are adding decades to our lives now.

So, among the books that Jane sent us both to read about female friendship was a book written by a woman whom we greatly admire, Sister Joan Chittister. She said that female friendship is not just a social act, but a spiritual one.

Do you consider your friends to be spiritual beings?

Do they add something spiritual to your life?

LT: Spiritual -- I definitely agree.

Because, especially with people I've known for a long time, people I've spent time with, I see the spiritual essence, the tenderness, the vulnerability that's in them.

In fact, there is some kind of love, love factor in that relationship.

I'm just looking deep into your soul.

PM: Do you think so, Jane -- LT: But I do have special powers.

JF: Well, I have many friends.

I have business friends, I have party friends, there are a lot of them.

(Laughter) But the friendships that produce oxytocin...

They feel it's spiritual because it opens their hearts, right?

You know, we dig deeper. And I found that I often shed tears with my closest friends.

Not because I'm sad, but because I'm so touched and inspired by them.

LT: And I know one of them will be leaving soon.

(laughter) PM: Now there are two of us sitting here, Lily, which one are you talking about?

(Laughter.) And I always think that men always look a little quizzical when women talk about friendship.

What do you think is the difference between male friendships and female friendships?

JF: There are many differences. And I think we have to have a lot of empathy for men -- (laughter) that they don't have what we have.

I think that might be why they die early.

(laughter) I have a lot of sympathy for men. Because women, no joke, relationships and friendships between women are completely public and deeply involved.

they are revelatory.

We risk our weakness. This is what men do not do.

I mean, how many times have you asked, "Am I okay?"

"Did you really fail there?"

Prime Minister: You are doing very well.

(laughter) JF: But we ask the same questions as our female friends, but we don't.

You know, people describe women's relationships as face-to-face, but men's friendships are more next door.

LT: Most of the time, men don't want to reveal their feelings, they want to hide their deeper feelings.

So that's the general, conventional thinking.

They would rather go to a man cave and watch a game, hit a golf ball, talk about sports, hunting, cars, or sex.

So it's a kind of more masculine behavior.

JF: I mean -- LT: They talk about sex.

What I meant was that if you can lure someone into a man's cave, they might have sex -- (Laughter) JF: But you know what I find very interesting -- and again, psychologists didn't know this until relatively recently -- that men, like women, are born with relationships in every way.

If you watch a movie about newborn boys and girls, you will see that the baby boys need to look into their mother's eyes and have a relational exchange of energy just like girls do.

When the mother looked away, she could see that the child was upset, and even the boy was crying.

they need a relationship.

So the question is, why does it change as they grow?

And the answer is the patriarchal culture, which tells boys and young men that it's girlish to need relationships and to be emotional with someone.

A real man doesn't ask for directions, doesn't express a need, doesn't go to the doctor when he doesn't feel well.

they don't ask for help.

There is a saying that I really like. "A man fears that becoming 'we' will erase his 'I'."

You know, his self-consciousness.

A woman's self-consciousness, on the other hand, is always porous.

But our "we" is our salvation and what makes us strong.

It's not that we're better than men, it's just that we can't prove our masculinity.

LT: So yeah -- JF: That's what Gloria Steinem said.

So we can express our humanity -- LT: I know who Gloria Steinem is.

JF: I think you know who she is, but this is -- (laughter) No, but I think it's a great quote.

We are not superior to men, we just cannot prove masculinity.

And it really matters.

LT: But men are very much indoctrinated into a culture of comfort within the patriarchy.

And something different has to happen.

JF: Female friendship is like a renewable source of power.

LT: Well, that's the interesting thing about this subject.

Because our friendship, the friendship between women, is just a hop into our sisterhood, and sisterhood can be a very powerful force in giving the world what it needs and what it should be.

Prime Minister: Jane, because, as you said, female friendships are a source of renewable power.

So how do we harness that power?

JF: Well, women, especially older women, are the fastest growing demographic in the world.

And with our power, we can change the world.

And what do you think? There is a need.

(Applause.) And we need to do that now.

One of the things we have to do is set consumer standards as one of the things we can do as women.

we need to consume less.

Living in the Western world, we need to consume less and when we buy things we need to buy locally made and when we buy food we need to buy locally grown food.

We are the ones who need to get off the grid.

We need to become independent from fossil fuels.

And the fossil fuel companies, Exxons and Shell Oils, and the bad guys will tell us we can't do that without going back to the Stone Age.

As you know, not enough alternatives exist yet, but that's not true.

Today, there are countries in the world that live and thrive primarily on renewable energy.

And they tell us that if we move away from fossil fuels, we'll be back in the Stone Age, and indeed if we start using renewable energy and don't drill in the Arctic and start drilling -- LT: Oh boy.

JF: And please don't drill in Alberta's tar sands -- well.

What we will have is more democracy, more jobs, more happiness, and it will be women who lead the way.

LT: Maybe we have the momentum to start a third-wave feminist movement with sisterhoods around the world and women who may or may not have met, but that's how we come together. Because, as Aristotle said, most people die without male friendship.

And the word in force here was "man."

Because they thought friendship should be equal and women weren't equal -- JF: They didn't think we even had a soul, the Greeks.

LT: No, that's right. This shows how limited Aristotle was.

(Laughter) And wait, no, here's the best part.

You know, men seem to need women now.

The earth needs women.

The US Constitution requires women.

We don't even exist in the Constitution.

JF: You're talking about the Equal Rights Amendment.

LT: Yes.

Justice Ginsburg said that all constitutions enacted after World War II contained provisions making women equal citizens, but ours did not.

So that's a good place to start.

Very, very calm -- JF: Yes.

(Applause.) And gender equality is like the ebb and flow of the tide that will lift all boats, not just women.

PM: We need a new role model on how to do that.

How we can be friends, how we can think differently about our power as consumers, as citizens of the world. This is why Jane and Lily are role models for how women can be friends. For a very long time, we even disagreed.

thank you.

Thank you both.

(Applause) JF: Thank you.

LT: Thank you.

JF: Thank you.

(applause)

Please try to imagine. You are fast asleep and suddenly wake up.

It's not an alarm clock.

Open your eyes and the devil is sitting on your chest and holding you down.

I open my mouth and try to scream, but no sound comes out.

You get up and try to escape, only to find yourself completely immobilized.

The devil wants to choke you, but you can't fight back.

You woke up in a dream and it's a nightmare.

It looks like something out of a Stephen King movie, but it's actually a medical condition called sleep paralysis, and about half of the population experiences this strange phenomenon at least once in their lives.

This panic-inducing episode of confrontation with a nightmare creature can last from seconds to minutes and may be accompanied by demonic visions, auditory hallucinations, or an out-of-body sensation of floating.

Some even mistake sleep paralysis for ghost encounters or alien abductions.

In 1867, Dr. Cyrus Weir Mitchell was the first medical expert to study sleep paralysis.

"Subject becomes aware of its surroundings, but is unable to move its muscles.

Looks lie and is still asleep.

He takes the fight for exercise seriously with intense emotional distress.

If he manages to shake his body, the spell will vanish instantly. ”

Although Dr. Mitchell was the first to observe a patient in a state of sleep paralysis, it is so common that almost every culture has had some sort of paranormal explanation for it throughout the ages.

You might think that in medieval Europe, incubus, sex-hungry demons in male form, would visit at night.

In Scandinavia, a mare, a damn woman, is responsible for visiting a sleeping person and making him sit on his ribcage.

In Turkey the jinn will hold you down and try to strangle you.

In Thailand, Fayam gets bruised while sleeping.

In the American South, an old hag will pick you up.

In Mexico, the deceased person, Subirse El Muerto, can be blamed.

In Greece, Mora sits on your chest and tries to choke you.

In Nepal, the ghost Kyaak lives under the stairs.

It may be easier to blame sleep paralysis on demons because it's much harder to explain what's actually going on in your brain.

Modern scientists believe that sleep paralysis is caused by an abnormal overlap of REM sleep, rapid eye movements, and wakefulness stages of sleep.

During a normal REM sleep cycle, you are experiencing many sensory stimuli in the form of dreams, and your brain is completely unconscious and asleep.

While dreaming, a special neurotransmitter is released that paralyzes almost every muscle.

It is called Remuatonia.

It's what keeps you from running away in bed when you're being chased in your dreams.

Normal components of REM occur during episodes of sleep paralysis.

You are dreaming, your muscles are paralyzed, only your brain is conscious and fully awake.

This is what makes you think you are encountering a terrifying entity.

Now that's an explanation for hallucinations, but what about what many people describe as panic, the feeling of choking, choking, and chest tightness?

During REM sleep, voluntary control of breathing is also disabled by REM asthenia, a function that prevents dream fulfillment.

Breathing becomes shallower and faster.

You take in more carbon dioxide and experience a small blockage of your airway.

In an episode of sleep paralysis, the body's fear response upon perceiving an attack by an evil creature combines with the brain's full wakefulness while the body is in REM sleep to trigger a response to take in more oxygen.

So you're going to gasp for air, but you can't breathe because you've lost control of your breathing due to remuatonia.

During sleep, the body's struggle for air causes a feeling of pressure in the chest and choking.

A small number of people experience sleep paralysis on a regular basis, which may be related to sleep disorders such as narcolepsy, but many people who experience episodes of sleep paralysis experience sleep paralysis infrequently, perhaps only once in their lifetime.

So rest assured that no evil entity is trying to haunt you, possess you, strangle you, or suffocate you.

Save it for a horror movie!

Ten years ago, I had my first solo exhibition here.

I wasn't sure if it would work, if it was possible at all, but after some small steps and a very steep learning curve, I made my first sculpture called "The Lost Correspondent".

I worked with a marine biologist and a local dive center to submerge the piece off the coast of Grenada in an area devastated by Hurricane Ivan.

And then this incredible thing happened.

it transformed.

One sculpture has become two.

The two soon turned 26.

And when I noticed, the world's first underwater sculpture park was made.

I moved to Mexico in 2009 and started by casting local fishermen.

This has grown into a small community and almost a whole people's movement to protect our oceans.

Finally, visit the Underwater Museum, home to over 500 living sculptures.

Gardening isn't just about greenhouses, it seems.

Since then we have scaled up the design. The Bahamas' Ocean Atlas, 16 feet above the water and weighing over 40 tons, now on Lanzarote, creates the first underwater botanical garden in the Atlantic Ocean.

In each project we use materials and designs that help facilitate life. Long-lasting pH-neutral cements provide a stable and durable platform.

Textured to allow coral polyps to adhere.

We place them under streams from natural reefs to allow them a place to settle after spawning.

The formations are all configured to gather fish on a very large scale.

This VW Beetle also has an internal habitat for crustaceans such as lobsters and sea urchins.

So why exhibit my work in the sea?

Because honestly, it's really not that easy.

When you're in the middle of the ocean trying to lower an 8-ton ship to the bottom under a 100-foot crane, you start to wonder if you shouldn't be painting watercolors.

(Laughs) But in the end I am always amazed by the results.

(music) The sea is the most wonderful exhibition space an artist could wish for.

Amazing lighting effects that change by the hour, explosions of sand covering the sculptures in clouds of mystery, a timeless and unique quality, and queues of curious visitors, each giving this place its own special touch.

(music) But as the years went by, I realized that the greatest thing we do, the really humble thing about this work, is that as soon as we submerge the sculptures in water, they no longer belong to us. Because as soon as we submerge the sculpture, the sculpture is of the sea.

As new coral reefs form, literally new worlds begin to evolve, and they constantly surprise us.

It's a bit cliche, but nothing man-made can match nature's imagination.

Sponges all over the face look like blood vessels.

Staghorn coral changes its shape.

Fireworms draw white lines when feeding.

A tunic explodes from the face.

Sea urchins feed by crawling on their bodies at night.

Coral algae paints a kind of purple paint.

The deepest red color I have ever seen in my life lives underwater.

Gorgonian fans vibrate with the waves.

A purple sponge breathes water like air.

And gray angelfish glide silently overhead.

And our amazing response to these works tells us that we were able to successfully connect to something truly primal. Because these images seem to be translated all over the world, it made me focus on my responsibilities as an artist and what I was trying to achieve.

I am standing here today on a boat in the middle of the ocean. There is no better place to talk about the really, really important impact of my work.

Because, as we all know, our coral reefs are dying and our oceans are in trouble.

Here's the problem: This is the most used, searched and shared image of my work to date.

And I think there's a reason for this, or at least I hope so.

What I really hope is that people are starting to understand that when we think about the environment and the destruction of nature, we need to start thinking about the ocean as well.

Since building these sites, we have seen some amazing and unexpected results.

In addition to creating over 800 square meters of new habitat and living coral reefs, visitors to Cancun's marine park now spend half their time at the museum and natural reefs, giving the overstressed natural area a meaningful respite.

Visitors to the Bahamas' Ocean Atlas highlighted a leak from a nearby refinery.

International media then coerced the local government into committing $10 million to clean up the beach.

Grenada's Sculpture Park helped the government designate it a Marine Protected Area.

Park admission fees now fund park rangers to manage sightseeing and fishing quotas.

In fact, this place has been listed as a "Wonder of the World" by National Geographic.

So why are we gathered in this room today?

What do we all have in common?

I think we all share the fear that we are not protecting our oceans enough.

And one way of thinking about this is that we don't consider the ocean sacred, and we shouldn't.

When we see incredible places and objects, such as the Himalayas, the Sagrada Familia, and the Mona Lisa, we understand their importance.

We call them sacred and do our best to cherish them, protect them, and keep them safe.

But in order to do that, we have to assign it a value. Otherwise, it will be desecrated by someone who doesn't understand its value.

So I would like to end tonight by talking about sacred things.

When naming this place in Cancun, we named it a museum for a very important and simple reason. The point is that museums are places of preservation, preservation and education.

They are places where we store things that are of great value to us, and where we keep them as they are.

If someone threw an egg into the Sistine Chapel, we would all go insane.

If anyone wanted to build a 7-star hotel at the bottom of the Grand Canyon, we would laugh them off from Arizona.

But we dredge, pollute and overfish our oceans every day.

I find it easier to do so because when we look at the ocean, we can't see the catastrophe we are causing.

Because this is what the ocean is to most people.

And it's really hard to think that something this simple and huge is fragile.

It's too big, it's too vast, it's too limitless.

And what do you see here?

In fact, I think most people are looking beyond the horizon.

So I think there's a great danger that we don't really see the ocean. If we don't actually see the ocean, and if it doesn't have its own iconography, we miss its majesty, I think there's a great danger of taking it for granted.

Cancun is famous for spring break, tequila and foam parties.

And that waters are where the fractal boys can run around on jet skis and banana boats.

But thanks to our work there, a small corner of Cancun is now a treasure in its own right.

And we don't want to stop in Grenada, Cancun, Bahamas.

Just last month, I set up the Four Horsemen of the Apocalypse right in front of the Houses of Parliament on the River Thames in central London to deliver a harsh message about climate change to those who have the power to change things.

Because for me, this is just the beginning of the mission.

We want to collaborate with other inventors, creators, philanthropists, educators and biologists to envision a better future for our oceans.

And we want to look beyond sculpture, beyond art.

You are a 14-year-old kid who lives in the city and has never seen the ocean.

And instead of being taken to a natural history museum or an aquarium, you are taken to the ocean, an underwater Noah's Ark accessed through a dry glass observation tunnel, where you can see all the wildlife of the land colonizing the wildlife of the sea.

Obviously, it will surprise your mind.

So think big, think deep.

Who knows where our imagination and willpower can lead us?

By bringing our art into the ocean, we hope that not only do we harness the amazing creativity and visual impact of the setting, but we also encourage new environments to thrive, and also give something back by opening up new environments in some way. Or maybe it's the very old view of seeing the ocean as a delicate and precious place, something that we all deserve to protect.

Our ocean is sacred.

thank you.

(applause)

On October 4, 1957, the world watched in awe as the Soviet Union launched Sputnik, the world's first artificial satellite, into space.

Less than two feet in diameter, this tiny metal sphere sparked a space race between the United States and the Soviet Union.

It will last 18 years and change the world as we know it.

In fact, Sputnik was not the first human technology to go into space.

Its superlative is given to the V-2 rocket used by Germany in last resort missile attacks on Allied cities in the final days of World War II.

It was not very effective, but at the end of the war both the US and the USSR seized the technology and the scientists who developed it and began using it for their own projects.

By August 1957, the Soviet Union successfully tested its first intercontinental ballistic missile, the R-7. This was the same rocket that would be used to launch Sputnik two months later.

So the scary thing about Sputnik wasn't the orbiting ball itself, but the fact that the same technology could be used to launch nuclear warheads in any city.

Not wanting to lag too far, President Eisenhower ordered the Navy to accelerate its own projects and launch satellites as soon as possible.

So, on December 6, 1957, excited people across the country watched live as the Vanguard TV3 satellite took off and hit the ground two seconds later.

Vanguard's failure was a great embarrassment for the United States.

Newspapers carried headlines such as "flopnik" and "kaputnik".

And the Soviet representative to the United Nations derisively suggested that the United States should receive foreign aid to developing countries.

Luckily, the Army was working on its own parallel project, the Explorer, which was successfully launched in January 1958, but the United States barely caught up, only to be overtaken again in April 1961 when Yuri Gargarin became the first man to fly into space.

Almost a year passed, and several more Soviet cosmonauts completed their missions before Project Mercury succeeded in February 1962, when John Glenn became the first American to enter orbit.

By this time, President Kennedy knew that simply catching up with Soviet progress in the months ahead would not work.

The United States had to do something first, and in May 1961, a month after the Gargarin flight, Gargarin announced its goal of landing a man on the moon by the end of the 1960s.

They succeeded in this through the Apollo program, and on July 20, 1969, Neil Armstrong took a famous step.

With both countries eyeing an orbiting space station next, it's unclear how long the space race will last.

But thanks to improved relations negotiated by Soviet Prime Minister Leonid Breshnev and US President Nixon, the Soviet Union and the United States turned toward cooperation rather than competition.

A successful joint mission, known as Apollo-Soyuz, saw an American Apollo spacecraft dock with a Soviet Soyuz spacecraft where the two crews met, shook hands and exchanged gifts, ending the 1975 space race.

What was the point of this whole space race, after all?

Was it just a huge waste of time?

Are the two superpowers trying to outwit each other by pursuing risky, costly and iconic projects with resources that could have been better spent elsewhere?

Indeed, in some ways the greatest advantage of the space program had nothing to do with one country winning over another.

During the Space Race, funding for research and education in general increased dramatically, resulting in many advances that otherwise would not have been possible.

Many NASA technologies developed for space are now widely used in civilian life, from memory foam in mattresses to freeze-dried food to LEDs for treating cancer.

And, of course, the satellites we rely on for GPS and cell phone signals wouldn't exist without the space program.

All this shows that the benefits of scientific research and progress are often far more enormous than even those who pursue them can imagine.

Imagine you are watching a football game and this obnoxious guy is sitting next to you.

He's loud, spills drinks on you, and makes fun of your team.

A few days later, while you were walking in the park, it suddenly started to rain.

Who should show up beside you and hold out an umbrella?

The same guy from the football game.

Do you change your mind about him based on this second encounter, or do you stick to your first impression and ignore him?

Social psychology research shows that we quickly form lasting impressions of other people based on their actions.

We can do this with little effort, inferring stable personality traits from single actions such as harsh words or clumsy steps.

Using impressions as a guide, you can accurately predict how people will behave in the future.

If you have the knowledge that the guy who showed up at the football game was a bastard when you first met him, you might expect the same thing in the future.

If so, you might choose to avoid him the next time you see him.

That said, you can change your impression based on new information.

Behavioral researchers have identified consistent patterns that may guide this impression-renewal process.

On the other hand, knowing highly negative and highly immoral information about someone generally has a stronger impact than knowing very positive and highly moral information.

So, unfortunately for your new friend at the football game, a bad attitude at the game can outweigh a good one at the park.

Research suggests that this prejudice occurs because immoral behavior is more diagnostic or revealing of a person's true character.

Now, according to this logic, bad is always stronger than good when it comes to updates.

Well, not necessarily.

Certain types of learning do not appear to induce this kind of negative bias.

For example, this prejudice is reversed when we learn about other people's abilities and abilities.

In fact, it is the positive information that is given more weight.

Let's go back to that football game.

When a player scores a goal, it ultimately has a greater impact on the impression of a player's skill than when he misses the goal.

The two sides of the update story are ultimately very consistent.

Overall, behaviors that are perceived as infrequent are behaviors that people tend to attach more importance to in forming and renewing impressions, highly immoral behaviors, and also highly competent behaviors.

So what happens at the brain level when we update our thoughts?

Using fMRI (functional magnetic resonance imaging), researchers identified an extended network of brain regions that respond to new information that doesn't match the initial impression.

These typically include areas associated with social cognition, attention, and cognitive control.

Furthermore, when updating impressions based on people's behavior, activity in the ventrolateral prefrontal cortex and superior temporal sulcus correlates with perceptions of how often those behaviors occur in everyday life.

In other words, the brain seems to track low-level statistical properties of behavior to make complex decisions about other people's personalities.

You need to determine if this person's behavior is typical or unusual.

In the situation of the obnoxious football fan turned good Samaritan, your brain says: "In my experience, most people lend someone their umbrella, but this guy's behavior at a football game was insane."

And you decide to go with first impressions.

This data contains good morals. Your brain, and therefore you, may care more about highly negative and immoral behaviors committed by others than about highly positive and moral behaviors, a direct result of the relative rarity of those bad behaviors.

We are used to people being basically good, like taking time out to help a stranger in need.

Evil may be stronger than good in this context, but only because good is more abundant.

Think about the last time you made a decision based on someone's behavior, especially when you really felt like you changed your mind about someone.

Is the behavior that caused you to update your impression, something that everyone would expect to do, or is it completely out of the ordinary?

Our planet has two polar regions. The name derives from the North Pole, from the Greek Arcticos for north, and the South Pole, from Antarctikos for the other side of the north.

But remembering what surrounds them can help you remember them more easily.

The North Pole is located in the northern hemisphere of the earth and is a completely landlocked ocean.

On the other side of the earth, Antarctica is a continent completely surrounded by ocean.

So the Arctic has polar bears but no penguins, and the Antarctic has penguins but no polar bears.

Let's talk about the North Pole first.

The Arctic region consists of vast ice-covered oceans surrounded by treeless permafrost.

This region can be defined as the area between the Arctic Circle and the North Pole.

If you were standing at the North Pole, everywhere you looked would be south.

However, the North Pole is in the middle of the ocean and is covered with frozen sea ice that is constantly moving, making it difficult to stand at the North Pole for long.

If you fell into the water at the North Pole, you would fall into 13,980 feet of water.

On the water, winter temperatures can average as low as -40 degrees Celsius, with the lowest recorded temperature of about -68 degrees Celsius.

Despite these incredibly harsh conditions, humans have lived in the Arctic region for thousands of years.

Arctic life includes ice-dwelling organisms, zooplankton and phytoplankton, fish and marine mammals, birds, land animals, plants, and human communities.

Well, what about Antarctica?

Antarctica is the southernmost continent of the Earth and geographically includes the South Pole.

It is the fifth largest continent on earth and almost twice the size of Australia.

Almost 98% of Antarctica is covered in ice more than 1 mile thick.

The situation in Antarctica is one of the harshest in the entire world.

On average, it is the coldest, windiest and driest continent with the highest average elevation of all continents.

You might think it's always snowing in Poland, but Antarctica is very dry, with only 200mm of rainfall along the coast and much less inland and considered a desert.

The temperature in Antarctica reached minus 89 degrees Celsius.

So harsh and difficult to reach, Antarctica is not permanently inhabited, but research stations scattered across the continent are home to between 1,000 and 5,000 people year-round.

Even the most extreme animals fight for survival, where only cold-adapted organisms such as various types of algae, animals, bacteria, fungi, plants and protists survive.

But why is Antarctica colder than the North Pole?

First, most of the continent is more than 3 kilometers above sea level, and temperatures drop as altitude increases.

As a result, the mountain tops are covered with snow.

Second, remember that the Arctic is actually a frozen ocean.

The ocean water beneath it is warmer than the frozen ground of Antarctica, and that warmth is transmitted through the ice masses.

This prevents temperatures in Arctic regions from reaching the temperature extremes typical of the Antarctic surface.

Third, the seasons are conspiring against Antarctica.

During the aphelion in July, when the Earth is furthest from the Sun, Antarctica can also be wintered, giving the South Pole a double whammy of cold.

But despite the inhospitable environment, the North and South Poles are a big part of why our planet is the way it is.

Our polar regions are very important climate controllers.

They moderate temperate temperatures and provide stable weather.

Weather around the world is becoming increasingly volatile as climate change and global warming reduce Arctic sea ice.

War is a tragic part of our history and will almost certainly be a tragic part of our future.

Since the establishment of the United Nations, wars of aggression have been outlawed, and multilateral treaties refer to armed conflict, not war.

But future wars will be different from past wars.

In addition to conventional warfare, our future will include cyberwarfare, where we will fight enemies remotely using new classes of weaponry, such as computer viruses and programs that alter the behavioral capabilities of our enemies.

And not only is cyberwarfare not covered by the existing legal framework, but the question of what exactly constitutes cyberwarfare is still hotly debated.

So how do we deal with cyber warfare if we can't even agree on what it means?

One way forward is to envisage situations where new international law may be required.

Imagine a new breed of assassin who can commit crimes without firing a single shot or staying in the same country.

For example, an individual who works for the government uses a wireless device to transmit a signal to another foreign leader's pacemaker.

This device instructs the pacemaker to malfunction, ultimately leading to the death of the foreign leader.

Is this cyber assassination an act of war?

As a second example, imagine a group of allies working together to infiltrate the computer systems of an enemy nuclear warship.

The attack nearly caused the nuclear-powered carrier to melt down, but was stopped just before it killed thousands of soldiers and civilians.

Adversaries launch defensive cyberattacks as a means of defense, shutting down allied power grids.

Hospitals can no longer treat patients, and without heating and clean water, entire regions are ultimately causing tens of thousands of civilian deaths.

Counterattacks were the cause of the blackouts, but weak infrastructure, weak cybersecurity, and the outdated state of the power grid all contributed to the civilian deaths.

Can the country fight back?

who will they fight?

And would their retaliation be considered an act of war?

Are they war crimes against humanity?

Who is responsible?

Was the code written by a computer programmer?

The military project manager who oversaw the creation of the crypto?

Commander who pressed the button to start the event?

A hardware engineer who built a computer to enable attacks?

War has been with us for so long that we have laws to determine who should be held accountable for actions in combat.

These legal frameworks aim to contain atrocities and prevent further atrocities from escalating.

The command and use of civilian aircraft as weapons, the dropping of atomic bombs, the use of gas chambers and toxic gases in conflict, all these acts, if committed, constitute acts of war and war crimes under customary international law and the Hague Convention.

Again, the current legal framework remains silent on what-if questions and a myriad of other questions for lack of easy answers. Also, there are only two ways to move forward on these issues. Peace or new law.

So what hypothetical but plausible scenarios can we imagine that fit the burgeoning definition of cyberwarfare, and how can we design an international legal framework to deter such activity?

100 years ago this month, 36-year-old Albert Einstein stood before the Prussian Academy of Sciences in Berlin to unveil a radical new theory of space, time and gravity: general relativity.

General relativity is undoubtedly Einstein's masterpiece, a theory that reveals how the universe works on the grandest scale, capturing everything from why apples fall from trees to the beginning of time and space in a beautiful line of algebra.

1915 must have been an exciting year for physicists.

Two new ideas have turned the topic upside down.

One was Einstein's theory of relativity and the other was arguably even more revolutionary. Quantum mechanics is a mind-meltingly strange yet surprisingly successful new way of understanding the microscopic world, the world of atoms and particles.

Over the past century, these two ideas have completely changed our understanding of the universe.

Thanks to the theory of relativity and quantum mechanics, we now know what the universe is made of, how it started and how it continues to evolve.

100 years later, we are at a new tipping point in physics, but the problem today is quite different.

In the years to come we may find out whether we can continue to improve our understanding of nature, or perhaps for the first time in the history of science we may be faced with questions we cannot answer, not because we have no brains or technology, but because the laws of physics themselves forbid it.

This is the real problem. Space is too interesting.

The theory of relativity and quantum mechanics seem to suggest that the universe should be a boring place.

It has to be dark, deadly and lifeless.

But if we look around us, we find that we live in a universe full of interesting things: stars, planets, trees, squirrels.

Ultimately, the question is, why does such an interesting thing exist?

Why is there something instead of nothing?

This contradiction is the most pressing problem in fundamental physics, and the next few years may tell us whether it can be resolved.

At the heart of this issue are two numbers -- two very dangerous numbers.

These are the properties of the universe that we can measure, and if they were even slightly different, the universe as we know it wouldn't exist, which is very dangerous.

The first of these numbers relates to discoveries made at the European Organization for Nuclear Research (CERN), a few kilometers from this hall. This machine is home to the largest scientific device mankind has ever built, the Large Hadron Collider.

The LHC flies subatomic particles around a 27-kilometer ring, bringing them closer and closer to the speed of light before colliding them in a giant particle detector.

On July 4, 2012, physicists at CERN announced to the world that they had discovered a new fundamental particle, the Higgs boson, produced in violent collisions at the LHC.

Now, if you followed the news at the time, you would have seen many physicists actually get very excited, and you'd be forgiven for thinking that it happens every time a new particle is discovered.

Well, that's kind of true, but the Higgs boson is especially special.

The discovery of the Higgs boson proved the existence of a cosmic energy field and we were all very excited.

Now, as hard as it may be to imagine an energy field, we all experience it.

If you've ever held a magnet close to a piece of metal and felt a force pulling it across the gap, you've felt the effects of a magnetic field.

And the Higgs field is a bit like a magnetic field, except that it has a constant value everywhere.

It's all around us now.

We cannot see or touch it, but without it we would not exist.

The Higgs field gives mass to the elementary particles that make us up.

If it didn't exist, those particles would have no mass, atoms wouldn't form, and we wouldn't exist.

But there is something very mysterious about the Higgs field.

Relativity and quantum mechanics tell us that this product has two natural settings, similar to a light switch.

It should be turned off to have zero value anywhere in space, or turned on to have an absolutely huge value.

Atoms cannot exist in either of these scenarios. Therefore, all other interesting things that we see around us in space are absent.

In reality, the Higgs field is slightly on, not zero, but 10,000 trillion times weaker than the fully on value, like a light switch stuck just before the off position.

And this value is very important.

If it were any different, there would be no physical structure in the universe.

This is the first dangerous number, the strength of the Higgs field.

Theorists have spent decades trying to understand why this highly fine-tuned number exists, and have come up with several possible explanations.

They have sexy-sounding names like 'supersymmetry' and 'large extra dimensions'.

I won't go into the details of these ideas right now, but the key points are: If any of these ideas explained this strangely tweaked Higgs field value, we should see new particles being created at the LHC along with the Higgs boson.

But so far, we've seen no signs of that.

But there's actually an even worse example of this kind of dangerous numerical tweaking, this time coming from the other side of the scale: the study of the distant universe.

One of the most important achievements of Einstein's theory of general relativity was the discovery that the universe began as a rapid expansion of space-time, the Big Bang, 13.8 billion years ago.

Well, according to early versions of the Big Bang theory, the universe has been expanding ever since, and gravity is gradually putting the brakes on that expansion.

But in 1998, astronomers made the startling discovery that the expansion of the universe is actually accelerating.

The universe is growing faster and faster due to a mysterious repulsive force called dark energy.

Now, whenever you hear the word "dark" in physics, you should be very suspicious. Because that probably means we don't know what we're talking about.

(Laughter) I don't know what dark energy is, but the best idea is that it's the energy of empty space itself, the energy of the vacuum.

Now, if we use good old quantum mechanics to calculate how strong dark energy should be, we get some absolutely amazing results.

It turns out that dark energy should be 10 to 120 times stronger than the values ​​observed in astronomy.

It's the one with 120 trailing zeros.

This is a mind-boggling number, impossible to get your head around.

We often use the word "astronomical" when talking about big numbers.

Well, even that doesn't help here.

This number is higher than any number in astronomy.

That's 1000 trillion times the number of atoms in the entire universe.

So it's a pretty bad prediction.

In fact, it's been called the worst prediction in physics, and it's not just a theoretical curiosity.

If dark energy were near this intensity, the universe would tear apart, stars and galaxies wouldn't form, and we wouldn't be here.

So it's the second in a dangerous number, the strength of dark energy, and explaining it requires an even greater level of fine-tuning than we've seen with the Higgs field.

However, unlike the Higgs field, this number has no known explanation.

There was hope that a perfect combination of Einstein's theory of general relativity (the theory of the universe on a large scale) and quantum mechanics (the theory of the universe on a small scale) might provide a solution.

Einstein himself spent most of his later years in a fruitless search for a unified theory of physics, which physicists have pursued ever since.

One of the most promising candidates for a unified theory is string theory, the essential idea of ​​which is that if we could zoom in on the fundamental particles that make up our world, we would find that they weren't really particles at all, but tiny strings of vibrating energy, each vibration frequency corresponding to a different particle, a bit like the notes on a guitar string.

So it's a pretty elegant, almost poetic way of looking at the world, but with one fatal flaw.

It turns out that string theory is not a theory at all, but a collection of theories.

In fact, it is estimated that there are between 10 and 500 different versions of string theory.

Each would describe a different universe with different laws of physics.

Now, critics say this makes string theory unscientific.

The theory cannot be disproved.

But some have actually flipped this around and said that this apparent failure may be string theory's greatest triumph.

What if these 10 to 500 different universes all actually exist somewhere in the grand multiverse?

Suddenly, the strangely tweaked values ​​of these two dangerous numbers become understandable.

In most of the multiverse, the dark energy is too strong to tear apart the universe, or the Higgs field is too weak to form atoms.

We live in one of the places in the multiverse where two numbers fit together.

We live in a Goldilocks world.

Now, this idea is highly controversial, and it's easy to see why.

Following this line of thinking leaves us unable to answer the question, "Why is there something instead of nothing?"

Most of the multiverse is empty, and we live in one of the few places where the laws of physics allow anything to exist.

Worse, we can't test the idea of ​​a multiverse.

We have no access to these other universes, so we have no way of knowing if they are there.

So we are in a very frustrating position.

That doesn't mean the multiverse doesn't exist.

If there are other planets, other stars, other galaxies, why aren't there other universes?

The problem is that it is impossible to know for sure.

Well, the idea of ​​a multiverse has been around for a while, but in the last few years we're starting to get the first solid hints that this line of reasoning might come about.

Despite the high hopes for the first run of the LHC, what we were looking for there was a new theory of physics: supersymmetry or a large extra dimension that could explain this strangely fine-tuned value of the Higgs field.

But despite great expectations, the LHC has revealed a barren subatomic wasteland inhabited only by an isolated Higgs boson.

Paper after paper was published in my experiments, and I was forced to sullenly conclude that there were no signs of new physics.

Now the stakes couldn't be higher.

This summer, the LHC began its second phase of operation with nearly double the energy achieved in the first run.

All particle physicists desperately want signs of something completely unexpected emerging from new particles, micro black holes, or violent collisions in the Large Hadron Collider.

If so, we can continue the long journey that began 100 years ago with Albert Einstein towards a deeper understanding of the laws of nature.

But if, two or three years later, when the LHC switches off again for a second long outage, and nothing but the Higgs boson is discovered, we may be entering a new era in physics. It is a time when there are strange features of the universe that we cannot explain. An age that suggests we live in a multiverse that is frustratingly forever out of reach. An era in which the question "Why is there something instead of nothing?" will never be answered.

thank you.

(Applause) Bruno Giussani: Harry, you said earlier that science may not have the answers, but I have a few questions. The first question is that building something like the LHC is a generational project.

As I introduced earlier, I said that we live in a short-term world.

Projecting your own generation, how do you think long term when building something like this?

Harry Cliff: I was very lucky to be part of the experiment I was working on at the LHC in 2008. It was just around the time we started to switch on. I have people in my research group who have been working on this experiment for 30 years and have been on one machine their entire careers.

So I think the first time people talked about the LHC was in 1976. That's when we started planning the machine without the technology we knew we needed to build it.

In other words, computing power didn't exist when design work began in earnest in the early '90s.

One of the big detectors recording these collisions, we didn't think there was a technology that could withstand the radiation produced at the LHC, so we basically had a lump of lead in the middle of this object with some detectors outside of it, and then we developed the technology.

So we have to rely on people's ingenuity to solve the problem, which can take 10 years or more.

BG: China just announced a few weeks ago that it intends to build a supercollider that is twice the size of the LHC.

I'm curious how you and your colleagues are welcoming this news.

HC: Size isn't everything, Bruno. BG: Certainly. I'm sure.

(Laughter) It sounds crazy for a particle physicist to say that.

But seriously, this is great news.

Therefore, countries around the world need to share resources to build machines like the LHC.

No country, except perhaps China, can afford to build such a large machine. Because enormous resources, manpower and money can be mobilized to build such machines.

So it's only good.

I think this is great news for physics because what they really plan to do is build a machine to study the Higgs boson in detail, and it could give us some clues as to whether new ideas like supersymmetry really exist.

BG: Thank you, Harry. HC: Thank you.

(applause)

Have you ever experienced déjà vu?

It's that dark feeling you get when a situation seems familiar.

The scene at the restaurant unfolds exactly as you remember it.

The world moves like a ballet you choreographed, but having never eaten here, the sequence cannot be based on past experience.

It's my first time to eat clams, how is it going?

Unfortunately, there is no single explanation for deja vu.

This experience is brief and unannounced, making it nearly impossible for scientists to record and study.

Scientists can't just sit back and wait for it to happen to them. This can take years.

It has no physical manifestations and is described by subjects in research as sensations or sensations.

This lack of solid evidence has led to speculation over the years.

Since Émile Boirac introduced déjà vu as a French word meaning "already seen", more than 40 theories have attempted to explain the phenomenon.

Still, recent advances in neuroimaging and cognitive psychology have narrowed the field of vision.

Let's take a look at three popular theories today, each using the same restaurant setting.

The first is dual processing.

Action is required.

Let's go where the waiter drops the tray with the plates.

As the scene unfolds, hemispheres of the brain process one hemisphere after another: the waving of the waiter's arm, the cries for help, the smell of pasta.

This information traverses the path within milliseconds and is processed in the blink of an eye.

For the most part everything is recorded synchronously.

However, this theory argues that déjà vu occurs when there is a slight delay in information from either of these pathways.

Due to the difference in arrival times, the brain interprets the delayed information as separate events.

Playing back an already recorded moment feels as if it happened before.

Our next theory deals with past turmoil, not current mistakes.

This is the hologram theory. Let's use that tablecloth to verify.

As I scan that square, distant memories emerge from deep within my brain.

According to this theory, this is because memories are stored in the form of holograms, which require only one fragment to see the whole picture.

Your brain recognized the tablecloth as something from the past, perhaps from your grandmother's house.

But instead of remembering what you saw at grandma's house, your brain called up an old memory without specifying it.

This is familiar, but not memorable.

You haven't been to this restaurant, but you've seen that tablecloth, you just haven't recognized what it is.

Now look at this fork.

Are you careful?

Our final theory is split attention, which states that déjà vu occurs when the brain subconsciously takes in the environment while being preoccupied with a particular object.

When your attention returns, it feels as if you have been here before.

For example, right now you were looking at the fork, not the tablecloth or the downed waiter.

Your brain records everything in your peripheral vision, but it does so subconsciously.

When you finally leave the fork in the road, you'll think you've been here before.

All three of these theories share a common feature of déjà vu, but none of them are conclusively responsible for the phenomenon.

Yet while we wait for researchers and inventors to come up with new ways to capture this fleeting moment, we can study it ourselves.

After all, most research on déjà vu is based on first-hand accounts, so why isn't it yours?

The next time you feel déjà vu, think about it for a moment.

Distracted?

Do you see any familiar objects?

Is it just that your brain is slow?

Or is it something else?

Have you ever noticed that the full moon looks bigger when it's closer to the horizon than when it's overhead?

If so, you are not alone.

People have wondered about this bizarre effect since ancient times, and surprisingly there is still no clear explanation, but it was not for lack of effort.

Aristotle, Ptolemy, Da Vinci, Descartes, and the greatest minds in history have all wrestled with this problem, but have been unable to come up with an adequate explanation.

One of the first ideas proposed was that the image of the moon in the sky would actually get bigger near the horizon.

Perhaps Earth's atmosphere acts like a giant lens, magnifying the moon as it rises and sets.

But this explanation doesn't make sense.

Rather, the moon will appear slightly smaller due to atmospheric refraction.

Furthermore, measuring the actual size of the moon as seen from different positions does not change anything.

But then why does it look bigger even when it's rising?

This must be some kind of optical illusion.

Which is the problem?

One explanation is the Ebbinghaus illusion. This means that two identical objects look different depending on the relative size of the objects they surround.

Here the two central circles are actually the same size.

Perhaps the moon appears larger near the horizon because it's next to smaller trees, houses, and towers in the distance.

However, when the moon is high up, it is surrounded by vast darkness in the night sky and appears small in comparison.

Another possibility is the famous Ponzo illusion.

If you've ever tried to draw in perspective, you know that things closer to the horizon should be drawn smaller.

Our brain automatically compensates for this by perceiving objects near the horizon to be larger than they actually appear.

The two yellow lines in this figure are the same size, but the top line appears larger because we interpret it as going farther into the horizon.

So, between Ponzo and Ebbinghaus, it seems like the lunar apparition mystery has been solved, but unfortunately there are some details that complicate things.

First, if this were just the Ebbinghaus effect, we would expect the illusion of the moon to disappear for pilots flying above the clouds, since there are no other small objects near the horizon.

In fact, however, pilots and sailors at sea still claim to have seen moon apparitions.

On the other hand, if our brains were just auto-compensating for the size of objects near the horizon, we would expect to see the moon illusion in a planetarium where the entire sky, including the horizon, is displayed in a spherical dome overhead.

But research shows that's not the case.

Worse, just bending down and gazing at the moon between your legs seems to completely erase the lunar illusion.

Now this is going to be crazy!

One of the most promising explanations today is known as vergence micropsia.

Our brain uses the focal point of our eyes to determine the distance to an object and its apparent size.

When you look at the horizon, your brain perceives you're looking far because your eye's focus is far away.

The moon appears to be a certain size.

Your brain thinks it's far away, but it's so, so you naturally conclude that the moon must be big.

But when looking up at the night sky, there is nothing for the eye to focus on, so humans by default focus on a point just a few meters away.

Now your brain thinks the moon is much closer than it actually is, so it naturally concludes that the moon isn't as big as you thought.

Convergence microspears do not explain why the Moon near the horizon appears so large, but why the Moon overhead appears so small.

Still not satisfied?

Well, frankly, there aren't many scientists either. So the debate over the moon illusion is still hot, and may continue for as long as we see the moon in the night sky.

Bruno Giussani: Secretary, thank you for coming to TED.

Antonio Guterres: I'm happy.

BG: Let's start with the numbers.

In 2015, nearly one million refugees and migrants arrived in Europe from Syria, Iraq, Afghanistan, Bangladesh, Eritrea and many other countries.

And there were two different kinds of reactions: welcome parties and border fences.

But I would like to look at it a bit from a short-term and long-term perspective.

The first question is very simple. Why has there been such a rapid surge in refugee movements over the past six months?

AG: Well, basically I think it was the Syrian refugee groups that triggered this massive increase.

Migration from Africa and Asia to Europe is increasing, but the increase is slow, and the first few months of the year suddenly saw this significant increase.

why? I think there are three reasons, long term and two triggers.

The long-term one is that when it comes to Syrians, hopes are becoming less and less clear to the people.

So when they look to their own country, they see little hope of returning home because there is no political solution and no light at the end of the tunnel.

Second, living conditions for Syrians in neighboring countries are deteriorating.

A study with the World Bank found that 87 percent of Syrians in Jordan and 93 percent of Syrians in Lebanon live below the national poverty line.

With only half the children attending school, it means that people's lives are very difficult.

Not only are they refugees, they are away from home, suffering from what they have received, but they are living in very, very dramatic conditions.

And the trigger was when international aid suddenly dropped.

The World Food Program has been forced to cut food aid to Syrian refugees by 30 percent due to lack of resources.

Not allowed to work, they were completely dependent on international assistance and felt that "the world was abandoning us."

In my opinion, that was what started it.

Suddenly there was a rush and people started moving in droves. To be honest, if I had been in the same situation and had had the courage to act, I would have done the same.

BG: But I think what surprised a lot of people was that it wasn't just sudden, it wasn't supposed to happen.

The Syrian civil war has been going on for five years.

Millions of refugees are in camps, villages and towns across Syria.

For example, you yourself warned about this situation and the consequences of the collapse of Libya, and yet Europe seemed completely unprepared.

AG: Well, because we are split, we are not ready, and when we are split, we don't want to be aware of reality.

You are incapable of making decisions and prefer to postpone them.

The evidence is that even when the surge occurred, Europe remained divided and failed to put in place mechanisms to manage the situation.

You are talking about a million people.

It looks huge, but the European Union has a population of 550 million. This means 1 in 550 Europeans.

Currently, there is one refugee for every three Lebanese in Lebanon.

And Lebanon? Of course I'm struggling, but I'm doing it somehow.

So the question is, if we didn't mention the most important thing about addressing the root causes, forgetting them for now, and seeing the phenomenon as it is, if Europe could unite and build a sufficient capacity for entry points, how could this have been done?

But this will require massive support for the countries at the points of entry, the selection of citizens through security checks and all other mechanisms, and the distribution of people entering across Europe according to the possibilities of each country.

So it's always too late when you look at a transfer program approved by the Commission, or too late when you look at a transfer program approved by the Council -- BG: It's already broken.

AG: My country is supposed to receive 4,000.

4000 means nothing in Portugal.

So it's perfectly manageable if this is controlled, but in the current situation there is pressure at the point of entry and then people move in this chaotic fashion across the Balkans, reaching Germany, Sweden, basically Austria.

These three countries are the final hosts of refugees.

The rest of Europe sits and waits.

BG: Let's be a little advocate for the devil and pose three questions.

I will ask them frankly.

But I think this question is very much present in the minds of many people in Europe today. The first question is, of course, about numbers.

They say 1 million vs. 550 million is not a big deal, but realistically how many can Europe accommodate?

AG: Well, it's a question without an answer. Refugees have the right to protection.

And since there is something called international law, we can't say, "Once we get 10,000 people, we're done."

One thing to remember is that when the crisis started in Turkey, I remember a minister saying, "Turkey will be able to accommodate up to 100,000 people."

Turkey now has 2.3 million or so, including all refugees.

So I don't think it's fair to say how many we can accept.

What we can say is, how can we organize ourselves to take on international responsibilities?

And Europe could not. Because Europe is basically divided because there is no unity in European projects.

And it's not just about refugees. There are many other areas as well.

To be honest, now is the time when we need more Europe, not less.

But as the public trusts less and less in the European system, it becomes harder and harder to convince them that more Europe is needed to solve these problems.

BG: It seems we're at a point where the numbers turn into political change, especially domestically.

We saw it again this weekend in France, but we've seen it many times in Poland, Denmark, Switzerland and many other countries. It's not that important as an absolute number, but the numbers make a big difference.

-- AG Chancellor: But let me ask you about these things: I mean, what do Europeans see as home in a village without immigration?

What the Europeans see is that a few months ago, when the news began on television every day, crowds came and moved uncontrolled from border to border, and television footage showed hundreds and thousands of people moving.

And then there's the idea that no one is taking care of it. This is happening without any control.

So their thought was, "They will come to my village."

So there was a completely false notion that Europe was being invaded, that our way of life would change, and that everything would change. The thing is, if this had been properly managed, people had been properly received and welcomed, protected on entry, screened on entry, and had flown to different European countries, it wouldn't have frightened people.

But unfortunately, many people are terrified simply because Europe has failed to do its job properly.

BG: But there is a village in Germany with 300 inhabitants and 1,000 refugees.

So what is your position?

How do you think these people will react?

AG: If the situation were managed well and people were well distributed across Europe, you would always get the percentage I mentioned, 1 in 2,000.

Ultimately we find ourselves in a situation that is completely intolerable because things are not properly managed. And of course, if there are villages, there are many villages in Lebanon with more Syrians than Lebanese. Lebanon has lived with it.

I am not asking for the same thing to happen in Europe, for every village in Europe to have more refugees than residents.

What I want is for Europe to do its job well and be ready to accommodate its people as the rest of the world has had to do in the past.

BG: And if you look at the situation not just in Europe, but in the world -- (applause) BG: Yes!

(Applause.) BG: I know I could make a long list of countries that aren't really making progress if you look at the world situation, not just Europe, but I'm more interested in other parts. Are there people doing the right thing?

AG: Well, 86 percent of the world's refugees are in developing countries.

And if you look at countries like Ethiopia, Ethiopia hosts more than 600,000 refugees.

All Ethiopian borders are open.

And as a policy they have a "person to person" policy that all refugees should be accepted.

And they have South Sudanese, Sudanese, Somalis.

They all have neighbors.

They have Eritreans.

In general, African countries are very welcoming to the arrival of refugees, and it can be said that the Middle East and Asia tend to open their borders.

We can see that there are some problems with the situation in Syria now as it has also developed into a major security crisis, but the truth is that for a long time all borders in the Middle East have been open.

The truth is, for Afghans, the border between Pakistan and Iran was open at the time for the 6 million Afghans who came.

Therefore, it can be said that even today, borders tend to be open in developing countries.

As is the case with developed countries, these issues tend to become increasingly complex, especially when public opinion is mingling debates between refugee protection on the one hand and security issues on the other - misunderstood in my opinion.

BG: Again, you mentioned funding cuts and vouchers from the World Food Programme.

This reflects the overall underfunding of organizations working on these issues.

Are you getting more funding and support now that the world seems to be waking up, or is it still the same?

AG: We're getting more support.

I would say we are approaching last year's levels.

It was worse during the summer.

But that alone is clearly not enough to meet the needs of people and the needs of the countries that support them.

It is here that a fundamental review of the standards, objectives and priorities of required development cooperation takes place.

For example, Lebanon and Jordan are middle-income countries.

As these countries are middle-income countries, they cannot receive soft loans or subsidies from the World Bank.

Well, today this makes no sense. Because they provide a global public good.

There are millions of refugees there. To be honest, they are the pillars of regional stability and the front line of collective security in the face of all the difficulties.

Therefore, it makes no sense that these countries are not the top priority of development cooperation policy.

And it's not.

And not only are refugees living in very dramatic conditions in those countries, but the local communities themselves are suffering as wages fall, unemployment rises, prices and rents rise.

And of course, if we look at the situation of today's indicators in these countries, it is clear that the lives of the poor, in particular, are getting worse and worse due to the crisis they are facing.

BG: Who should provide this support?

By country, international organization, European Union?

Who Should Consider This Support?

AG: We need to participate in every effort.

It is clear that bilateral cooperation is essential.

It is clear that multilateral cooperation is essential.

It is clear that international financial institutions must be flexible enough to make large investments in support of these countries.

We must combine all means to understand that today, at a point in time when the situation is protracted, it no longer makes sense to distinguish between humanitarian aid and development assistance or the development process.

Because you're talking about school kids, health, and overcrowded infrastructure.

You are talking about the need for a long-term perspective, a development perspective, not just an emergency humanitarian perspective.

BG: Please comment on what was in the paper this morning.

That's what Donald Trump, the current frontrunner for the Republican nomination for president of the United States, said.

Yesterday he said:

(Laughter) No, listen. That's interesting.

"I am calling for a total ban on Muslims entering the United States until our country's representatives can figure out what is going on."

how would you react to that?

AG: Well, it's not just Donald Trump.

We have seen several politically charged people around the world say that Muslim refugees, for example, should not be accepted.

And the reason they say this is because they think that by doing or saying this they are protecting the security of their country.

Now I am in power.

I strongly feel the need for governments to protect the security of their countries and their people.

But if you say in America or in a European country like that, ``We are going to close the door to Muslim refugees,'' then what you are saying is most helpful for the propaganda of terrorist organizations.

Because what you're saying -- (applause) what you're saying will be heard by every Muslim in your country, and it paves the way for the recruitment and mechanisms that Daesh, al-Nusra, al-Qaeda, and all the other groups are permeating our society today through technology.

And it just says, "You are right, we are against you."

Clearly, therefore, this is creating a multi-ethnic, multi-religious and multi-cultural society, creating a situation in which it is actually much easier for the propaganda of terrorist organizations to effectively mobilize people to terrorist acts in countries where judgments of this kind are being expressed.

BG: Has the recent attack in Paris and the reaction to it made your job more difficult?

AG: Definitely.

BG: What do you mean?

AG: So for many people, the first reaction to this kind of terrorist attack is to close all borders, not understanding that Europe's terror problem is largely homegrown.

There are thousands of European fighters in Syria and Iraq. This problem cannot be solved by simply not allowing Syrians to enter the country.

And I have to say that I'm pretty sure the passport that came out was placed by the person who, yes, blew himself up.

AG: [I believe] that was intentional because part of Daesh's strategy is against refugees, and Daesh sees refugees as people who should be on the side of the Caliphate, people fleeing to the Crusaders.

And I think this is part of Daesh's strategy to get Europe to react, to keep it closed to Muslim refugees, to make it hostile to Muslims in Europe, just to promote Daesh's work.

And my deepest conviction is that it was not the refugee movement that caused terrorism.

As I said earlier, terrorism in Europe is basically a domestic movement related to the world situation we face today, and what we need is to prove precisely these groups wrong by welcoming and effectively integrating people from that part of the world.

And I also believe that a large part of the price we pay today in Europe is the failure of the integration model that did not work in the 60s, 70s and 80s, and associated with the massive migration flows that took place at that time, created a situation in which many people, for example the second generation of the community, live in today's marginalized, unemployed, inadequately educated and socially underserved areas. public infrastructure.

And this kind of anxiety, and sometimes even anger, that exists in this second generation is largely due to the failure of integration policies, the failure of what was supposed to be a stronger investment in creating the conditions for people to live together and respect each other.

For me it is clear.

(Applause.) It is clear to me that in the future all societies will be multi-ethnic, multi-cultural and multi-religious.

Trying to avoid it is impossible in my opinion.

And, to me, it's good for them to be that way, but I also realize that for it to work properly, it takes a lot of investment in social cohesion in our societies.

And Europe has largely failed in its investments over the last few decades.

BG: Question: At the end of the year, you will be leaving your job of ten years.

When you look back in 2005 when you first entered that office, what do you see?

AG: Well, look. In 2005, we were helping one million people return home in safety and dignity as the conflict ended.

Last year we helped 124,000 people.

In 2005, approximately 38 million people were displaced by conflict worldwide.

Today, that number exceeds 60 million.

We had some conflicts at the time, but they were resolved recently.

New conflicts are proliferating now, including Afghanistan, Somalia and the Democratic Republic of the Congo, but old conflicts will never go away.

It is clear that today's world is much more dangerous than it used to be.

Unfortunately, it is clear that the ability of the international community to prevent and timely resolve conflicts is much less than it was ten years ago.

There are no clear power dynamics in the world and no functioning global governance mechanisms. This means that we tend to be rife with impunity and unpredictability, which means that more and more people are suffering – those displaced by conflict.

BG: Traditionally in American politics, when a president leaves the Oval Office for the last time, he leaves a handwritten note on his desk addressed to his successor who will arrive in a few hours.

If you had to write such a note to your successor, Filippo Grandi, what would you write?

AG: Well, I don't think I will write a message.

As you know, one of the scariest things about leaving the office is trying to be the backseat driver and constantly telling new drivers what to do.

That's why I don't do that.

If I had to say anything to him, it would be, "Be yourself and do your best."

BG: Thank you for your work, Secretary.

Thank you for coming to TED.

(applause)

what is love?

Seriously, but what is it?

what is love?

verb?

noun?

universal truth?

ideal?

What do all religions have in common?

cult?

Is it a neurological phenomenon?

The answers are endless.

Some are generic.

it conquers all.

That's all you need.

That's all.

But these are all comparisons, a way of defining it in contrast by saying that it is more important than everything else, but are they really?

Sure, love is more important than a standard turkey sandwich, but is it more important than shelter?

Or are you sane?

Or an exceptional turkey sandwich?

Whatever the answer is, it's only ranking, not defining.

Another challenge in defining love is that we often fall in and out of love while trying to define it.

Do you believe that someone who has just won the lottery can accurately define the concept of currency?

Or, I don't know, ask a man what a bear is while chasing it away?

Or is love just like winning the lottery?

Isn't a breakup like being attacked by a bear?

Bad comparison?

That's what I mean.

I'm not thinking right because I'm in love, so haha!

Whether it's taking a step back, taking a cold shower, or whatever, love can be the most intensely conceived thing in human history.

And despite centuries of obsession, it still overwhelms us.

Some say it's a magical feeling, a feeling for someone they've never felt before.

But emotions are fluid and have no concrete basis for definition.

You may hate the person you love.

Plus, hey, you've probably felt similar feelings before, in some kind of miniature.

Your relationship with your family shapes your relationship with your partner.

And your love for your partner may be in its own dynamic relationship, healthy or completely bizarre, with the love of your parents and siblings.

Love is also a set of actions that we associate with that feeling, such as holding hands, kissing, hugging, showing affection, dating, getting married, having children, or just having sex.

However, these loving actions can be subjective or culturally relative.

You may love someone who can't have children, who doesn't want to have children, who believes in marriage but also in divorce, who comes from a culture that doesn't date as much as we think of it, or who doesn't want to flirt on the bus.

But if love is something we can define, how can it mean the opposite for so many people?

So maybe love is only in your head. Personal mysteries may wind their way through neural pathways, bringing pleasing natural rewards to the nervous system.

Perhaps these rewards are addictive.

Perhaps love becomes a temporary or permanent addiction, much like a person becomes addicted to drugs.

I don't want to make something edgy like a pop song.

There is evidence that chemicals in the brain stimulated by another person can shape that person's habits.

People come to satisfy their physiological needs, and you want more.

But sometimes, slowly or suddenly, it doesn't.

You fell in love and broke free from your addiction.

what happened?

Have you built up your tolerance or have you reached your limit?

Why do lovers remain dependent on each other for life?

Perhaps to create new life and multiply seeds?

Perhaps love is the best way for human DNA to trigger replication of itself.

There are evolutionary theories about every aspect of human mating behavior, from how we present ourselves to potential mates, how we treat each other in relationships, and even how we raise children.

So some would argue that the emotions you think you feel in your soul are just biology's way for you to keep our species alive.

Just as monkeys go crazy with sexy monkeys, nature chooses you to go crazy with sexy monkeys, and biology progresses.

But is that all there is to love?

Or, perhaps worse, is it just a construct, a false notion that we are all persuading each other to achieve a false sense of purpose?

Perhaps it is a construct, but let us explain more precisely what a construct is, because love is constructed from reality: our experiences, our emotions, our brain chemistry, our cultural expectations, our lives.

And this structure can be viewed through a myriad of dimensions: scientific, emotional, historical, spiritual, legal, or simply personal.

If no two people are the same, no two love is the same.

Therefore, a loving relationship always has a lot to talk about and partners should be open to it or the relationship probably won't last long.

Love is always up for debate and, of course, under construction.

So if you can't define it, that's a good sign.

It means we are all still successful.

Wait, I didn't mean that, you know what I meant.

Imagine two people listening to music.

What are the odds that they're listening to the exact same playlist?

probably quite low.

After all, everyone has different tastes in music.

Now, what are the odds that your body will need exactly the same medical care and treatments as someone else's?

Even lower.

As we move through life, each of us will have very different needs for our own medical care.

Scientists and doctors are constantly researching ways to make medicine more personalized.

One way they do this is by studying stem cells.

Stem cells are undifferentiated cells, meaning they have no specific job or function.

Skin cells protect the body, muscle cells contract, nerve cells send signals, but stem cells have no specific structure or function.

Stem cells have the potential to become other types of cells in the body.

Your body uses stem cells to replace worn out cells as they die.

For example, the intestinal lining is completely replaced every four days.

Stem cells under the intestinal lining replace these cells as they wear out.

Scientists hope that stem cells can be used to create a very special kind of personalized medicine that allows people to replace parts of their own body with parts of their own.

Stem cell researchers are working hard to find ways to use stem cells to create new tissue to replace parts of organs damaged by injury or disease.

Using stem cells to replace damaged body tissue is called regenerative medicine.

For example, scientists are now using stem cells to treat patients with blood disorders such as leukemia.

Leukemia is a type of cancer that affects the bone marrow.

Bone marrow is the spongy tissue inside bones where blood cells are produced.

In leukemia, some cells in the bone marrow grow out of control, putting pressure on healthy stem cells that form blood cells.

Some leukemia patients can undergo stem cell transplantation.

These new stem cells produce blood cells that the patient's body needs.

In fact, there are multiple types of stem cells that scientists can use for therapy and research.

Adult stem cells or tissue-specific stem cells are present in small numbers in most tissues of the body.

Tissue-specific stem cells replace existing cells in the organ as they wear out and die.

Embryonic stem cells are made from leftover embryos voluntarily donated by patients from fertility clinics.

Unlike tissue-specific stem cells, embryonic stem cells are pluripotent.

This means that it can grow into any kind of tissue in the body.

A third type of stem cell is called an induced pluripotent stem cell.

These are normal skin, fat, liver, or other cells that scientists have modified to behave like embryonic stem cells.

Like ES cells, these too can become any type of cell in the body.

Scientists and doctors want to use all these types of stem cells to create new tissues to heal the body, but they can also be used to understand how the body works.

Scientists can observe how stem cells develop into tissue to understand the mechanisms the body uses to create new tissue in a controlled and coordinated manner.

Scientists hope that further research will not only lead to the development of specialized medicine specific to the body, but also to a better understanding of how the body functions both when it is healthy and when it is not.

Today, more than half of the world's population lives in urban areas.

By mid-century, this will increase to 70%.

But as recently as 100 years ago, only 2 in 10 people lived in cities, and even less before then.

How did we reach such a high degree of urbanization, and what does it mean for our future?

Early in human history, humans were hunter-gatherers, often moving from place to place in search of food.

But about 10,000 years ago, our ancestors began learning the secrets of breeding and early agricultural techniques.

For the first time, people were able to grow food instead of looking for it, and this led to the development of semi-permanent villages for the first time in history.

"Why semi-permanent?" you might ask.

Well, at first the village still had to be relocated every few years because the soil was depleted.

Only with the advent of technologies such as irrigation and soil tillage some 5,000 years ago did people become dependent on a stable and long-term supply of food, making settlement possible.

And the food surplus created by these technologies made it unnecessary for everyone to farm.

This enabled the development of other specialized industries and, in turn, cities.

Cities began to produce surplus food, tools, crafts, and other commodities, creating the potential for long-distance commerce and exchange.

And as trade prospered, so did the technology that facilitated it: wagons, ships, roads, ports.

Of course, more labor was needed to build and maintain these things, so more jobs and opportunities became available, drawing more people from the countryside to the cities.

If you think modern cities are overcrowded, you might be surprised to learn that some cities in the second millennium BC were overcrowded. The population density was almost double that of Shanghai and Calcutta.

One reason for this was that transportation was not very available, so everything had to be within walking distance, including the few sources of clean water that existed at the time.

And the need for walls to prevent attacks further limited the city's land area.

The Roman Empire was able to develop the infrastructure to overcome these limitations, but otherwise modern cities as we know them didn't really take off until the Industrial Revolution. In the Industrial Revolution, the massive introduction of new technologies further expanded and consolidated cities, establishing police, fire and sanitation departments, road networks, and later electricity distribution.

So what will the future of cities look like?

The world population is now over 7 billion and is projected to reach about 10 billion.

Most of this growth will occur in the urban areas of the world's poorest countries.

So how will cities need to change to accommodate this growth?

First, the world needs to find ways to provide adequate food, sanitation and education for all.

Second, growth must occur in a way that does not harm the land that provides us with the goods and services that sustain humanity.

Food production may move to vertical farms, skyscrapers, rooftop gardens, or open spaces in urban centers, while electricity will increasingly come from multiple renewable sources.

Instead of single-family homes, more homes will be built vertically.

There may be buildings with everything people need for daily life, and small, self-sufficient cities with an emphasis on local, sustainable production.

The future of cities is diverse, adaptable and creative, no longer built around a single industry but increasingly connected and reflective of a global world.

What if you could only see one color?

For example, imagine that you can only see red things and nothing else.

After all, the human eye can only see a tiny fraction of the full spectrum of light, so we know that's how we live our lives all the time.

From the radio waves that play your favorite tunes, to the x-rays that doctors use to look inside your body, to the microwaves that heat food, all kinds of light surrounds you every day, but is invisible to the human eye.

To understand how these things become light, we need to know a thing or two about what light is.

Light is electromagnetic radiation that acts like both waves and particles.

Light waves are like ocean waves.

Some waves are big, some are small, some waves crash one after another, and some waves come only occasionally.

Wavelength is the size of a wave, and frequency is the frequency of the waves.

Imagine a ship bobbing up and down with the waves in that ocean.

If the waves on that day are long wavelengths, you will bob less often or less often.

Conversely, if the waves have short wavelengths, they will move closer together and bounce more often at higher frequencies.

All different kinds of light are waves, they just differ in wavelength and frequency.

If you know the wavelength and frequency of a light wave, you can also know its energy.

Longer wavelengths have lower energy and shorter wavelengths have higher energy.

It's easy to remember when you think about being on that ship.

If you've been out sailing on a short, choppy wave day, you probably have a lot of energy yourself and you're running around trying not to fall.

But in the long-wave ocean, it will roll around in a relaxed, low-energy state.

Light energy tells us how light interacts with matter, such as the cells of our eyes.

When we see, it's because light energy stimulates eye receptors called the retina.

Our retinas only sense light in a very narrow range of energies, so we call that range visible light.

Inside our retina are special receptors called rods and cones.

The bar measures brightness so you can tell how much light you have.

Different cones are sensitive to different light energies, so the cones are responsible for the color of the light we see.

Some cones are more excited by long-wavelength, low-energy light, while others are more excited by short-wavelength, high-energy light.

When light hits our eyes, the relative amount of energy each cone measures signals our brain to perceive color.

The rainbow we perceive is actually visible light in order of its energy.

One side of the rainbow sees low-energy light as red, and the other side sees high-energy light as blue.

Even if light with an energy that our retinas can't measure hits us, we can't see it.

Light with too short a wavelength or light with high energy is absorbed by the surface of the eye before reaching the retina, and light with too long a wavelength does not have enough energy to stimulate the retina.

The only thing that distinguishes one kind of light from another is its wavelength.

Radio waves have long wavelengths, while X-rays have short wavelengths.

Visible light, which we can actually see, lies somewhere in between.

Our eyes cannot detect light outside the visible range, but we can build special detectors that are stimulated by other wavelengths of light, like the digital eye.

These devices allow you to measure the light that's there, even if you can't see it yourself.

So take a step back and think about all this for a moment.

Although they may look different, the warmth you feel from a crackling fire is the same as the sun on a sunny day, the UV rays that apply sunscreen, and the TV, radio, and microwave.

Now, all of these examples are here on Earth and you experience them in your daily life, but here is something even more amazing.

Our universe also emits light in all spectrums.

When you think of the night sky, you might think of being able to see the shining stars with your own eyes, but we know that it's only visible light, a tiny fraction of the total spectrum.

If I had to draw the universe, and I could only use visible light, it would be like using only one crayon, which would be very sad.

To see the universe in its full spectrum, you must have the right eyes. That means we need to use special telescopes that help us see beyond visible light.

You've probably heard of the Hubble Space Telescope and seen beautiful pictures taken in visible and ultraviolet light.

But what you may not know is that there are 20 space telescopes in orbit, and each mission can see a portion of the full spectrum of light.

With telescopes acting as our virtual eyes, we can see amazing things, both in space and on Earth.

And best of all, regardless of wavelength or energy, the light we see in the distant universe is the same light we can experience and study here on Earth.

So now that we know the physics of how X-rays, ultraviolet light, or microwaves work here, we can also study the light of distant stars and galaxies and learn what's going on there.

So think beyond the visible and invisible as you go about your daily life.

Knowing just a little bit about the natural world will always help you to perceive the bigger picture of your surroundings.

In 1977, physicist Edward Purcell calculated that if you push and release a bacterium, it will stop in about one millionth of a second.

During that time, the atom will travel a distance less than the width of one atom.

The same applies to sperm and many other microorganisms.

It's all about really small things.

Microscopic creatures inhabit a world alien to us, and getting through an inch of water is an incredible endeavor.

But why is size so important to swimmers?

What is the fundamental difference between the world of sperm whales and the world of sperm whales?

To know that, we need to dig deep into the physics of fluids.

Here are some thoughts on this:

Imagine you are swimming in a pool.

It's you and a lot of water molecules.

The number of water molecules exceeds one in a thousand trillion.

So it's easy to push them away with your huge body, but if you're really small, like a molecule of water, suddenly you feel like you're swimming in a pool of people.

Instead of just passing tiny, tiny molecules, every water molecule becomes something of a different person and has to be pushed around to get anywhere.

In 1883, physicist Osborne Reynolds discovered that there is one simple number that can predict the behavior of fluids.

This is called the Reynolds number and depends on simple properties such as swimmer size, speed, fluid density and fluid viscosity or viscosity.

What this means is that creatures of very different sizes live in very different worlds.

Sperm whales, for example, live in worlds with high Reynolds numbers because of their enormous size.

Once you flap your tail, you can coast for incredible distances.

Sperm, on the other hand, live in a low Reynolds number world.

If the sperm stopped flapping its tail, it wouldn't be able to pass a single atom.

To imagine what it would be like to be sperm, you have to consider its Reynolds number.

Imagine moving your arm as slowly as the minute hand of a clock in a bath of molasses, and you'll get a good idea of ​​what the sperm is up against.

So how can microbes get anywhere?

Well, many people are not interested in swimming at all.

They just let the food drift.

This is like a lazy cow waiting for the grass under its mouth to grow.

But many microbes swim, so a surprising adaptation is born here.

One of the tricks they can use is deforming the shape of the paddle.

Single-celled organisms like Paramecium manage to navigate through crowds of water molecules by deftly bending their paddles to create more drag on their power strokes than on their recovery strokes.

But there is an even more ingenious solution that bacteria and sperm have arrived at.

Wind the paddle like a corkscrew instead of swinging it back and forth.

Much like the cork on a wine bottle turns winding motion into forward motion, this little creature spins its spiral tail to propel itself forward in a world where water feels thick like a cork.

Other strategies are even stranger.

Some bacteria take a Batman-like approach.

They use their grappling hooks to pull themselves.

They can also use this grappling hook like a slingshot to propel themselves forward.

Some use chemical engineering.

Helicobacter pylori lives only in the slimy, acidic mucus in our stomach.

Releases chemicals that thin the surrounding mucus, allowing you to glide through your slime.

Perhaps it should come as no surprise that these guys are the culprits of stomach ulcers.

So if you look closely at our bodies and the world around us, we see that all sorts of tiny creatures find clever ways to get around sticky situations.

Without these adaptations, the bacterium could never find a host, nor could the sperm reach the egg. In other words, you won't get a stomach ulcer, but you won't even be born a human being in the first place.

(pop)

For many, one of the coolest things about Game of Thrones is that the inhabitants of the Dothraki Sea have their own real language.

And Dothraki came to prominence following the actual language spoken by the Na'vi in ​​"Avatar." When the Klingons of "Star Trek" have had their own complete language since 1979, the Na'vi certainly needed one.

And don't forget JR's Elvish. Tolkien's "Lord of the Rings" trilogy, especially since it was the official grandfather of Fantasy Conran.

"Conran" is an abbreviation for "artificial language".

These are more than ciphers like Pig Latin, nor are they just a bunch of made-up slang like the Nassat terms spoken by the teenage thugs in A Clockwork Orange. "Droog" in Russian just happens to mean "friend."

What makes Conran a real language isn't the number of words it has.

Of course, having a lot of words helps.

Dothraki has thousands of words.

Na'vi started with 1,500 words.

Fans on the website are steadily creating more works.

But if you look at how Tolkien constructed the magnificent Old Elvish language, Conran of thousands of words, you can see the difference between vocabulary alone and what actually constitutes language.

After all, after memorizing 5,000 Russian words, you can barely put together a sentence.

A 4-year-old will talk about the circles around you.

Because you have to know how to construct words.

In other words, a real language has a grammar.

Elves do.

In English, we add "-ed" to make the verb past.

wash, wash

In Elvish, "washed" is "allu" and "washed" is "allune".

The language of reality also changes over time.

There is no such thing as the same language today as it was a thousand years ago.

As we speak, we flow into new habits, discard old habits, make mistakes, and be creative.

Today someone says, "Give us our daily bread today."

Old English used to say "Urne gedaeghwamlican hlaf syle us todaeg".

Things change with Conran.

Tolkien charted the old and new versions of Elvish.

When the first Elves awoke in Kuivienen, the word for "people" in their new language was "Qwendi," but in the language of one of the estranged groups, the Teleri, "Qwendi" became "Pendi" and "k" changed to "p" over time.

And just like real languages, Conran, like Elvish, also split into many languages.

When the Romans transplanted Latin across Europe, French, Spanish, and Italian were born.

As the group moves from place to place, over time, like everything else, the way they speak will fall apart.

Thus, the Latin word for hand was "manus", but in French it became "main" and in Spain "mano".

Tolkien made the elves do the same.

The original word "Qwendi" became "Pendi" among the Teleri, but dropped the "w" and became "Kindi" among the Avaris spread throughout Middle-earth.

The elvish variants that Tolkien fleshed out the most are Quenya and Sindarin, whose words differ as well as French and Spanish.

Quenya is 'suc' which means 'drink' and Sindarin is 'sog'.

And as you know, real language is tricky.

Because change works against order, just like a living room or bookshelf.

Real-life language is never entirely logical.

That is why Tolkien made sure that elves had many exceptions.

Many verbs are conjugated in ways that you should know.

Even the word "know".

It used to mean "I knew", but I couldn't explain it with English rules.

oh well.

In Elvish, "to know" is "ista", but "to know" is "sinte".

oh well.

But the truth is that Elvish is more of a sketch of an actual language than a complete language.

For Tolkien, Elvish was a hobby, not an attempt to create something people could actually speak.

Much of the Elvish language spoken by characters in The Lord of the Rings movies has been invented by die-hard Elven fans since Tolkien, based on speculation about what Tolkien might have built.

There are no actual elves around to tell it for us, so that's the best we can do for the elves.

But modern Conran goes further.

Dothraki, Na'vi, and Klingon are developed enough to actually speak.

This is the Klingon translation of "Hamlet". To play this, though, you'll need to get used to pronouncing the "k" with your uvula, that weird cartoon-like thing hanging down the back of your throat.

Believe it or not, many languages ​​around the world actually do this, including Eskimo languages.

However, Elvish pronunciation is much easier.

So let's step away from this introduction to Elvish Conlang for a moment and discuss the other three in a hearty Four Conlangal Roundup. "A Na Marie!"

"Hairy!"

Na'vi's "Kiebame!"

"Kappa!"

and "Goodbye!"

In 2008, 17-year-old Burhan Hassan boarded a plane from Minneapolis to the Horn of Africa.

Mr. Burhan was the youngest recruit, but he was not alone.

Al-Shabaab has a large presence on social media platforms such as Facebook and has successfully recruited more than 20 young people in their late teens and early 20s.

The internet and other technologies have changed our daily lives, but they have also changed the front lines of recruitment, radicalization and conflict today.

What about the link that connects Twitter, Google, and protesters fighting for democracy?

These numbers represent Google's public DNS servers. This server is virtually the only digital server that cross-border protesters have had and could use to communicate with each other, contact the outside world, and spread viral awareness of what is happening in their countries.

Today, conflicts are essentially borderless.

If there is any potential for conflict today, it is digital, not physical geography.

And at its core is a power vacuum in which non-state actors, individuals and private organizations have an edge over slow and outdated military and intelligence agencies.

And this is because in the digital age of conflict there is a feedback loop in which new technologies, platforms like the ones I mentioned, and more disruptive technologies are adapted, learned, and introduced by individuals and organizations faster than governments can react.

To understand the pace our government thinks about this, I turn to something that really lives up to its name: the Global Threat Assessment. There, the U.S. Director of National Intelligence surveys the global threat landscape each year, stating, "These are the threats, these are the details, and this is how we rank them."

In 2007, cyber security was not mentioned at all.

It took until 2011 and eventually other things took precedence, such as drug trafficking in West Africa.

In 2012, terrorism, proliferation, etc. weren't there yet, but they were creeping in.

It was the number one threat in 2013 and is expected to continue in 2014.

What this situation shows us is that governments today lack a fundamental capacity to adapt and learn from digital conflicts. In digital disputes, disputes are immaterial, borderless and often completely untraceable.

And as we see with terrorist radicalization, conflicts go not just from online to offline, but vice versa.

We all know of the terrible events that took place in Paris this year, the Charlie Hebdo terrorist attacks.

What an individual hacker, or small group of anonymous individuals, did was participate in a social media conversation many of us participated in.

#I'm Charlie.

On Facebook, Twitter, Google, everywhere, millions of people, myself included, have talked about the event and seen images like this, emotional and heartbreaking images of babies with "Je suis Charlie" written on their wrists.

And it became a weapon.

What the hackers did was weaponize this image, and like all of us in the conversation, an unsuspecting victim saw it and downloaded it, but it contained malware.

Therefore, downloading this image will hack your system.

It took six days to roll out the global malware campaign.

Today, the chasm between the physical and digital realms no longer exists, and offline attacks, such as the Paris attacks, have been devoted to online hacking.

And vice versa when it comes to hiring.

We are seeing the radicalization of teens online, and it could be deployed worldwide for offline terrorist attacks.

Take all this into consideration and you can see that a new battle for the 21st century is brewing, and governments aren't necessarily on board.

Well, another case is Anonymous vs. Los Zetas.

In early September 2011, Los Zetas, one of Mexico's most powerful drug cartels, hanged two bloggers with placards that read, "This is what happens to all Internet meddlesomes."

A week later they decapitated the young girl.

They cut off her head and placed it on a computer with similar notes.

And because governments could not understand what was happening or even act, they launched a digital counterattack, and a group we might not consider the most active force in the world, Anonymous, acted not in cyberattacks but in the form of threatening public disclosure.

They said on social media that they would "publish information that links prosecutors and governors to corrupt drug deals with cartels."

And escalating the conflict, Los Zetas said, "For every bit of information you reveal, we kill 10 people."

And it ended there because it would be too gruesome to continue any further.

But what was powerful about this was that anonymous individuals, not federal police, military personnel, or politicians, could instill fear at the heart of one of the world's most powerful and violent organizations.

So we live in a time of past lack of clarity about conflicts, who they are fighting, the motives behind attacks, the tools and techniques used, and how quickly they evolve.

And the question remains: What can individuals, organizations and governments do?

I believe the answer to these questions starts with the individual and peer-to-peer security is the answer.

When people in teenage and older relationships make purchases online, we can do so with peer-to-peer security.

Individuals have more power than ever to influence national and international security.

And you can build these positive peer-to-peer relationships, both online and offline, to support and educate the next generation of hackers like me instead of saying, 'Either you're a criminal or you're in the NSA.

That's what matters today.

And it's not just individuals, it's the same with organizations and companies.

They have the advantage of being able to act more effectively and quickly across more borders than governments, and they have a set of substantive incentives.

Being seen as trustworthy in the digital age is beneficial and valuable, and will be even more so in future generations.

But we still cannot ignore the government. Because it is governments that call for collective action to keep us safe and secure.

But we see how it got us this far, our inability to adapt and learn from digital conflict, our leaders at the highest levels, the CIA director and the secretary of defense, saying, “Cyber ​​Pearl Harbor is going to happen.” “Cyber ​​9/11 is imminent.”

But this only makes us more scared, it doesn't make us safer.

Sure, GCHQ and NSA can spy on you if you ban encryption in favor of mass surveillance and mass hacking.

But they're not the only ones who can do it.

Features are cheap and even free.

All over the world, technological prowess is improving, giving advantages to individuals and small groups.

So today it might just be the NSA and GCHQ, but who can say the Chinese can't find that backdoor?

Or maybe another generation had a child in the basement of their home in Estonia?

So I'm saying it's not something the government can do, it can't.

Governments today must relinquish power and control to make us even more secure.

Abandoning mass surveillance and hacking and instead fixing those backdoors means that while they certainly can't spy on us, neither can the Estonian Chinese or those hackers a generation from now.

And while government support for technologies like Tor and Bitcoin means relinquishing control, it means developers, translators, and anyone with an internet connection in countries like Cuba, Iran, and China can sell their skills and products on the global market, but more importantly, sell their ideas and show us what's happening in their country.

So for the governments that fought for civil rights, free speech and democracy in the great wars of the last century, it should be both fearless and encouraging that today, for the first time in human history, we have a technological opportunity to make billions of people around the world safe.

It should be inspiring.

(applause)

Many elements of traditional Japanese culture, such as cooking and martial arts, are well known around the world.

A form of classical theatrical performance, Kabuki may not be well understood in the West, but it evolved over 400 years and remains influential and popular to this day.

The word "Kabuki" comes from the Japanese verb "Kabuku" which means unusual or strange.

Its history begins in early 17th-century Kyoto, when a shrine maiden named Okuni of Izumo performed an unusual dance to passers-by on the city's dry Kamogawa riverbed, finding her daring parody of a Buddhist prayer amusing and enchanting.

Other units soon began performing in the same style, and kabuki went down in history as Japan's first form of theatrical performance for the common people.

By relying on make-up, make-up and facial expressions instead of masks, and focusing on historical events and everyday life rather than folklore, Kabuki set itself apart from the upper-class dance-theatre form known as Noh and offered a unique commentary on Edo society.

Initially, only women danced, and it was generally called 'Onna Kabuki'.

It soon evolved into an ensemble performance that became a staple attraction in teahouses, attracting audiences of all social classes.

At this point, onna kabuki was often risqué as geisha performed not only to show off their singing and dancing abilities, but also to advertise their bodies to potential customers.

A ban by the conservative Tokugawa shogunate in 1629 gave birth to wakashu kabuki, which featured young boys as actors.

However, when this was also banned for the same reason, it shifted to Yaro Kabuki performed by men, and elaborate costumes and makeup were required for the female roles.

Attempts by the government to control kabuki did not stop at banning the gender and age of performers.

The Tokugawa military group, or shogunate, was fueled by Confucian ideals and often enacted sanctions on costume fabrics, stage weapons, and plot themes.

At the same time, Kabuki became closely associated with and influenced by Bunraku, the elaborate puppet theater.

These influences led to the evolution of the once spontaneous one-act dance into a structured five-act play, often based on the tenets of Confucian philosophy.

Until the fall of the Tokugawa Shogunate in 1868 and Emperor Meiji's return to power, Japan was in isolation from other countries.

Thus, the development of Kabuki has been largely shaped by domestic influences.

However, even before this period, European artists such as Claude Monet were interested in and inspired by Japanese art such as woodblock prints and live performances.

After 1868, artists such as Vincent van Gogh and composer Claude Debussy began incorporating kabuki influences into their works, while kabuki itself underwent many changes and experiments to adapt to the new contemporary era.

Like other traditional arts, Kabuki declined in popularity after World War II.

However, innovations by artists such as director Tetsuji Takechi soon made a comeback.

In fact, Kabuki was even considered a popular form of entertainment among the US military stationed in Japan, despite initial US censorship of Japanese traditions.

Today, Kabuki remains an integral part of Japan's rich cultural heritage, and its influence extends beyond the stage to television, film and animation.

The art form Okuni pioneered continues to delight audiences with the elaborate make-up of the actors, the rich and intricately embroidered costumes, and the unmistakable melodrama of the stories told on stage.

Nicholas Stheno is rarely heard outside of introductory geology, but those who wish to understand life on Earth need to know how he expanded and connected the very concepts of earth, life, and understanding.

Born Niels Stensen in Denmark in 1638, the son of a goldsmith, he was a sickly child and his schoolmates died of the plague.

As an anatomist, he cut corpses and studied organs shared across species to survive.

He found a tube in the animal's skull that pumped saliva into its mouth.

He refuted Descartes' idea that only humans have a pineal gland, proving that the pineal gland is not the seat of the soul, perhaps the debut of neuroscience.

Most notable at the time was his technique.

Stheno never allowed ancient texts, Aristotle's metaphysics, or Descartes' deductions to overrule empirical and experimental evidence.

His vision was profound, not cluttered with speculation and rationalization.

Steno had observed how gallstones form as they adhere to wet organs.

They followed molding principles he knew from his work as a goldsmith, rules that serve across disciplines to understand solids through their structural relationships.

Then the Duke of Tuscany commissioned him to dissect a shark.

Its teeth resembled lingual stones, strange rocks found in Malta and other rocks in the mountains near Florence.

Pliny the Elder, the ancient Roman naturalist, said that these things fell from the sky.

During the Dark Ages, people called them serpent tongues petrified by St. Paul.

Steno noticed that the lingual calculus was a shark tooth and vice versa with signs of structural growth.

Thinking that similar things were made in a similar way, he argued that the ancient teeth came from ancient sharks in the water, which formed rocks around the teeth and turned into mountains.

The rock strata were once layers of watery sediment, stacked horizontally one after another from older to newer.

When a stratum is deformed, tilted, or cut by a fault or canyon, the change occurs after the strata are formed.

It sounds easy today. It was revolutionary at the time.

He invented stratigraphy and laid the foundations of geology.

By stating that the natural laws that govern the present also govern the past, and finding the origin of one of the shark's teeth in two epochs, Stheno planted the seeds of uniformism, the idea that the past was shaped by processes observable today.

In the 18th and 19th centuries, British uniformist geologists James Hutton and Charles Lyell studied the very slow rate of erosion and deposition that is present and realized that the Earth must be much older than the biblical estimate of 6,000 years.

Their work gave rise to rock cycles, combined with plate tectonics in the mid-twentieth century, to produce the great theories of Earth melting, tectonic movements, quakes, and surrounding the entire planet, from gallstones to 4.5-billion-year-old planets.

Think bigger and turn to biology.

Suppose you have a shark tooth in one layer, and a fossil of a creature you've never seen before.

Deep fossils are old, right?

We now have evidence of the origin and extinction of species over time.

become uniformist.

Perhaps a process still active caused a change in not only the rock but also life.

It may also explain the similarities and differences between species discovered by anatomists like Steno.

There's a lot to think about, but Charles Darwin had time on his long trip to the Galapagos to read Principles of Geology by his friend Charles Lyell, a kind of founder of Steno.

Sometimes giants ride on the shoulders of curious little people.

Nicholas Steno helped advance evolution, laid the groundwork for geology, and showed how unbiased empirical observation can push our intellectual boundaries and deepen our perspective.

But his greatest accomplishment may be his maxim, the search for truth beyond our senses and our current understanding, the pursuit of beauty in the as-yet-unknown.

The beautiful is what we see, the more beautiful is what we know, the most beautiful is what we don't know.

You probably know that everything is made up of atoms, and atoms are really, really, really tiny particles.

All atoms have a nucleus, which consists of at least one positively charged particle called a proton and most often some neutral particles called neutrons.

Its nucleus is surrounded by negatively charged particles called electrons.

The identity of an atom is determined only by the number of protons in the nucleus.

Hydrogen has only one proton, so it's hydrogen, carbon has six, so it's carbon, gold has 79, so it's gold.

Immerse yourself in the tension of the moment.

How can we know about the structure of an atom?

We cannot see protons, neutrons and electrons.

So we did a lot of experiments and developed a model that we think is there.

Then do a few more experiments to see if it matches your model.

If so, great.

If not, it may be time for a new model.

Since Democritus in 400 BC, there have been many very different models of the atom, and there will almost certainly be more in the future.

Well, the tangent is over.

Chemists love electrons because the nuclei of atoms tend to stick together, but electrons are free to move.

If we could marry them, we probably would.

But electrons are strange things.

Depending on the experiments we perform, they appear to behave either as particles like baseballs or as waves like water waves.

One of the strangest things about electrons is that we can't say exactly where they are.

It's not that we don't have the equipment, it's that this uncertainty is part of our electronic model.

Therefore, they cannot be identified.

However, we can say that the probability of finding an electron in a particular space around the nucleus is constant.

That means you can ask: What would it look like if you could draw a shape around the nucleus such that you could be 95% sure of finding a particular electron within that shape?

Here are some of these shapes.

Chemists call them orbitals, but what each one looks like depends, among other things, on how much energy that orbital has.

The greater the energy of an orbital, the farther away most of its density is from the nucleus.

By the way, why did you choose 95% instead of 100%?

Well, this is also a feature of our electronic model.

Beyond a certain distance from the nucleus, the probability of finding an electron begins to decrease more or less exponentially. That is, the electron approaches zero, but never actually reaches zero.

Therefore, every atom has a small but non-zero probability that one of its electrons is on the other side of the known universe for a very short period of time.

However, most electrons stay close to the nucleus as a cloud of negative charge density that changes and moves over time.

Almost everything depends on how electrons from one atom interact with electrons from other atoms.

Atoms can give up electrons and give them to other atoms, or they can share electrons.

And it's this social network dynamic that makes chemistry interesting.

From rustic old stones to the beautiful and complex of life, the nature of everything we see, hear, smell, taste, touch and even feel is determined at the atomic level.

What keeps us healthy and happy as we go through life?

If you were to invest in your future best self today, where would you put your time and energy?

A recent survey of millennials asked them what their most important life goal was, and more than 80% said that becoming rich was their primary life goal.

And another 50% of those same young people said their other big life goal was to be famous.

(Laughter) And we are constantly told to lean in and try harder and achieve more.

We are under the impression that these are the things we need to pursue in order to live a good life.

It's almost impossible to get a picture that depicts life as a whole, the choices people make, and how those choices play out.

Most of what we know about human life can be learned by asking people to remember the past, but as you know, hindsight is not 20/20.

We forget a huge amount of things that happened in our lives, but sometimes memories can be downright creative.

But what if we could observe the whole life unfolding over time?

What if we could study people from their teenage years to old age and find out what really keeps them happy and healthy?

we did it.

The Harvard Adult Development Study may be the longest study of adult life ever done.

For 75 years, we tracked the lives of 724 men annually, asking about their jobs, home lives and health. Of course, I asked them all along the way, not knowing what their life story would be.

Such studies are extremely rare.

Most projects of this sort fall apart within a decade because too many people drop out of the research, research funding dries up, researchers get distracted, they die, or nobody gets the ball further.

But a combination of luck and the tenacity of several generations of researchers allowed this work to survive.

About 60 of the original 724 men are still alive and participating in the study, most of them in their 90s.

And we are now beginning a study of over 2,000 children of these men.

And I am the fourth research director.

Since 1938, we have followed the lives of two groups of men.

The first group started their research when they were sophomores at Harvard University.

They all graduated from college during World War II, and most have served in the war since.

And the second group we tracked was a group of boys from the poorest neighborhoods of Boston, specifically those selected for study because they came from the most troubled and disadvantaged families in 1930s Boston.

Most people lived in tenements, many of which lacked hot and cold running water.

All of these teens were interviewed when they entered the study.

They had a medical examination.

We visited their homes and interviewed their parents.

And these teens have grown up into adults who venture into all kinds of fields.

They became factory workers, lawyers, bricklayers, doctors, and a president of the United States.

Some developed alcoholism. A few people developed schizophrenia.

Some climbed the social ladder from the bottom to the top, while others went the other way.

The founders of this research would never have dreamed that 75 years later I would be standing here telling you that research is still going on.

Every two years, a patient and dedicated research staff calls subordinates and asks if they can send another set of questions about their lives.

Many men in inner-city Boston ask, "Why do you want to study me? My life isn't that interesting."

Harvard students never ask that question.

(Laughter) To get the clearest picture of these lives, we don't just send surveys.

We interviewed them in their living room.

We receive medical records from our doctors.

We take their blood, scan their brains, talk to their children.

We videotaped them talking to their wives about their deepest concerns.

And when we finally asked our wives about ten years ago if they would be willing to join us as members of the study, many said, "Okay."

(Laughter.) So what have we learned?

What are the lessons to be learned from the tens of thousands of pages of information we have generated about these lives?

Well, the lesson isn't about wealth or fame or working harder.

The clearest message from these 75 years of research is: Good relationships keep us happier and healthier. period.

We learned three big lessons about relationships.

The first is that social connections are really beneficial to us, and loneliness kills.

People with strong social ties to family, friends, and communities have been found to be happier, physically healthier, and live longer than those with fewer ties.

And the experience of loneliness turns out to be harmful.

People who are more isolated than they would like from others are less happy than those who are not lonely, have worse health conditions early in middle age, have earlier brain function declines, and have shorter lifespans.

And the sad fact is that at any given time, more than 1 in 5 Americans report being lonely.

And we know that one can be lonely in a crowd, and one can be lonely in a marriage. The second big lesson we learned there is that it's not just the number of friends you have or whether you're in a committed relationship, it's the quality of your rapport that counts.

It turns out that living in the midst of conflict is very bad for our health.

For example, a less loving and conflicted marriage is very bad for your health, probably worse than a divorce.

And living in good, warm relationships protects you.

After tracking the men into their 80s, we wanted to look back at them in midlife and see if we could predict who would grow up to be happy and healthy in their 80s and who wouldn't.

And when you put together everything you know about them at age 50, it wasn't their middle-aged cholesterol levels that predicted how they would age.

It was about how happy they were with their relationship.

People who were most satisfied with their relationships at age 50 were the healthiest at age 80.

And good, close relationships seem to protect us from the shackles and arrows of old age.

Men and women in their 80s in the happiest relationships reported feeling just as happy on days when physical pain increased.

However, those in unhappy relationships experienced more emotional distress on days of increased physical distress.

And the third big lesson we've learned about relationships and our health is that good relationships don't just protect our bodies, they protect our brains.

Even in their 80s, it turns out that having strong relationships is protective, and that those who truly feel they can count on them in times of need find their memories lasting longer and more vividly.

And those in relationships where the other person feels truly unreliable experience early memory decline.

And that good relationship doesn't always have to be smooth.

Some couples in their 80s quarreled day in and day out, but those quarrels didn't hurt their memories as long as they felt they could really count on each other when things got tough.

So this message that good, close relationships are good for our health and well-being is wisdom as old as mountains.

Why is this so hard to get and so easy to ignore?

Well, we are humans.

What we really want are quick fixes, things we can get to improve our lives and keep them going.

Relationships are messy and complicated, caring for family and friends is hard work, not sexy or attractive.

It's also lifelong. it never ends.

In our 75-year study, the happiest people after retirement were those who actively worked to replace their workmates with new playmates.

Like the millennials in our recent survey, many of the men starting out as young adults genuinely believed that they needed to pursue fame, fortune, and high achievement in order to have a good life.

But over the last 75 years, our research has repeatedly shown that the people who do best are those who are committed to their relationships with family, friends and community.

So what about you?

Let's say you are 25, 40, or 60 years old.

What would it be like to lean towards a relationship?

Well, the possibilities are virtually endless.

It could be something as simple as replacing screen time with time with people, doing something new together, taking a long walk or date night, or reinvigorating an old relationship by reaching out to family members you haven't spoken to in years. Because these all-too-common family feuds wreak havoc on those who hold grudges.

Finally, I would like to end by quoting Mark Twain.

More than a century ago, he looked back on his life and wrote, "Life is too short, no time for arguing, no apologies, no heartburn, no time for blame.

The time to love is, so to speak, only a moment. ”

A good life is built from good relationships.

thank you.

(applause)

A riddle of words: a machine, a robot, capable of performing a programmable sequence of actions.

The origin of the word robot dates back over 1,000 years, to the serfs of Central Europe. At that time, slavery was the currency of the rent.

At that time, the Old Church Slavonic word "labota" meant forced labor of the people.

With a slight adjustment in spelling, rabota became the Czech robota and was used not only to define serf labor, but also to metaphorically describe any kind of hard or unskilled labor.

In 1920, Czech writer Karel Čapek published a science fiction play called "R.U.R." (short for "Rossum's Universal Robot").

The story featured automatons with distinctly human features, catering to the whims of the Earthlings before revolting.

Čapek initially considered calling these industrious machines "leivoli," the Latin word for "labor," but feared that would be a bit too academic.

Instead, he chose to emphasize their servitude by naming them Roboti, or robots in English.

"R.U.R." was such a success that when it was translated into English in 1923, the word robot was enthusiastically received.

Most of today's robots look a lot different than what Mr. Čapek imagined, but they are as popular as Mr. Čapek predicted.

However, unlike "R.U.R.", our robots have not risen up against us and we hope it stays this way.

Oh sorry!

Have you ever yawned because someone yawned?

Even though I'm not particularly tired, I suddenly open my mouth wide and let out a big yawn.

This phenomenon is known as contagious yawning.

And while scientists still don't fully understand why it happens, many hypotheses are currently being researched.

Before moving on to psychological hypotheses, let's start with two physiological hypotheses and look at some of the most common hypotheses.

Our first physiological hypothesis is that contagious yawning is triggered by a specific stimulus: the first yawn.

This is called a fixed behavior pattern.

Think of fixed behavior patterns like reflexes.

Your yawning makes me yawn.

Similar to the domino effect, yawning in one person causes yawning in nearby observers of the act.

Once this reflex is triggered, it must subside on its own.

Have you ever tried to stop yawning once it started?

Basically impossible!

Another physiological hypothesis is known as the unconscious mimicry, or chameleon effect.

This happens when you unknowingly mimic someone else's behavior. This is a clever and unintentional copycat act.

People tend to copy each other's postures.

If you sit across from someone who has your legs crossed, you may cross your legs too.

This hypothesis suggests that when we see another person yawning, we unconsciously yawn because we unconsciously imitate that person's behavior.

Scientists believe this chameleon effect is made possible by a special set of neurons known as mirror neurons.

Mirror neurons are a type of brain cell that responds the same way when we perform an action as when we see another person doing the same action.

These neurons are important for learning and self-awareness.

For example, seeing someone doing something physical, such as knitting or applying lipstick, can help you perform the same action more accurately.

Neuroimaging studies using fMRI (functional magnetic resonance imaging) have found that when someone appears or hears someone yawning, certain areas of the brain where these mirror neurons are located tend to light up, thus triggering the same behavior in humans, the response of yawning.

Our psychological hypothesis also involves the work of these mirror neurons.

This is called sympathetic yawning.

Empathy, the ability to understand what another person is feeling and participate in those emotions, is an important ability for social animals like us.

Recently, neuroscientists discovered that a subset of mirror neurons allows us to empathize with the emotions of others on a deeper level.

(yawning) Scientists discovered this empathic response to yawning while testing the first hypothesis I mentioned earlier, the fixed behavior pattern.

This study was set up to show that the sound of a human yawning alone can trigger the yawning reflex in dogs.

Their research showed this to be true, but they also found another interesting point.

Dogs yawn more often when someone they know well, such as their owner, than when someone they don't know.

Following this study, other studies on humans and primates also show that contagious yawning occurs more frequently among friends than among strangers.

In fact, contagious yawning begins around the age of four or five, when children develop the ability to properly perceive the emotions of others.

Still, newer scientific research aims to prove that contagious yawning is based on this ability to empathize, but more research is needed to figure out exactly what's going on.

The answer may lie in a completely different hypothesis.

The next time you yawn, take a moment to think about what happened.

Have you been thinking about yawning?

Did someone close to you yawn?

Is the person a stranger or a close friend?

And are you yawning now?

I once said, "If you want to liberate society, all you need is the internet."

I was wrong.

I said those words in 2011, when my anonymous Facebook page started the Egyptian Revolution.

The Arab Spring revealed social media's greatest potential, but also its greatest shortcomings.

The same tools that united us to overthrow a dictator ultimately split us apart.

I would like to share my own experience of using social media for activism and talk about some of the challenges I personally faced and what can be done about them.

In the early 2000s, Arabs were flooding the web.

Thirsting for knowledge, opportunities and connections with people around the world, we escaped frustrating political realities and lived virtual and alternative lives.

Like many of them, I was totally apolitical until 2009.

At the time, when I logged into social media, I began to see more and more Egyptians eager for political change in the country.

I felt like I wasn't alone.

In June 2010, the internet changed my life forever.

While browsing Facebook, I saw a picture of the tortured corpse of a young Egyptian man, a horrifying picture.

His name was Khalid Said.

Khalid, a 29-year-old Alexandrian, was killed by police.

I saw myself in his photo.

I thought, "Maybe I can be Khalid too."

I couldn't sleep that night, so I decided to do something.

I created an anonymous Facebook page and named it "We are all Khaled Said".

In just three days, the page has gathered over 100,000 same Egyptians who share the same concerns.

I had to stop whatever was happening.

I hired co-administrator Abdel Rahman Mansour.

We worked together for hours.

We were crowdsourcing ideas from people.

we were involved with them.

We were collectively calling for action and sharing news that the regime did not want the Egyptians to know.

The page has become the most followed page in the Arab world.

They had more fans than existing media organizations and top celebrities.

On 14 January 2011, Ben Ali fled Tunisia after intensifying protests against the regime.

I saw a ray of hope.

"If Tunisia did it, why can't we?" the Egyptian asked on social media.

I posted an event on Facebook entitled "Revolution Against Corruption, Injustice and Dictatorship".

I asked the 300,000 users who were visiting this page at the time: "Today is January 14th.

January 25th is Police Day.

It's a national holiday.

If 100,000 of us hit the streets of Cairo, nothing would stop us.

I wonder if I can ”

In just a few days, more than 1 million people were invited, and more than 100,000 confirmed their attendance.

Social media was integral to this campaign.

It helped generate decentralized movement.

It made people realize they were not alone.

And that made it impossible for the administration to stop it.

They didn't understand it at the time.

And on January 25, Egyptians flooded the streets of Cairo and other cities, demanding change, breaking down the walls of fear, and ushering in a new era.

Then came the results.

Hours before the regime shut down the internet and telecommunications, I was walking the dark streets of Cairo around midnight.

I had just tweeted, "Pray for Egypt.

The government must be planning a massacre tomorrow. ”

I was hit hard on the head.

Four armed men surrounded me as I lost my balance and fell.

One covered my mouth and the other paralyzed me.

I knew I would be kidnapped by the National Guard.

I found myself in a cell, handcuffed and blindfolded.

I was scared.

So did my family, who started looking for me in hospitals, police stations, and even morgues.

After my disappearance, several colleagues who knew that I was the administrator of the page told the media about my relationship with the page and that I could be arrested by the State Security Agency.

My colleagues at Google launched a search campaign to find me, and my fellow protesters in the square demanded my release.

After 11 days of total darkness, I was released.

Three days later, Mr Mubarak was forced to resign.

It was the most inspiring and empowering moment of my life.

It was a time of great hope.

The Egyptians lived in Utopia for 18 days during the revolution.

They all shared the belief that despite our differences, we could actually live together, that post-Mubarak Egypt would be better for everyone.

Unfortunately, the post-revolutionary events were a punch in the gut.

Happiness has waned, we have failed to reach consensus, and political strife has caused extreme polarization.

Social media has only fueled and amplified the spread of misinformation, rumors, echo chambers and hate speech.

The environment was just toxic.

My online world has become a battlefield filled with trolls, lies, and hate speech.

I started to worry about my family's safety.

But of course, this was not just my problem.

The polarization between the two main forces, pro-military and Islamist, has reached a climax.

Like me, those in the center began to feel helpless.

Both groups wanted you to side with them. You were either with them or against them.

And on July 3, 2013, the military ousted Egypt's first democratically elected president after three days of popular protests demanding his resignation.

That day, I made a very difficult decision.

I decided to be completely silent.

It was a moment of defeat.

I remained silent for over two years and used that time to reflect on everything that happened and try to understand why it happened.

While it is true that polarization is primarily driven by our human behavior, it has become clear that social media shapes this behavior and magnifies its impact.

They say things that aren't based on facts, pick fights, and ignore people they don't like.

These are all natural human urges, but thanks to technology, we can act on these urges with just one click.

In my view, there are five major challenges facing social media today.

First, we don't know how to deal with rumors.

Rumors confirming people's prejudices are now believed and circulated among millions.

Next, create your own echo chamber.

We tend to only communicate with people we agree with, and social media allows us to mute, unfollow, or block others.

Third, online discussions quickly descend into angry mobs.

Everyone probably knows that.

It's as if we forget that the people behind the screen are actually real people, not just avatars.

And fourth, it became very difficult to change our opinion.

The speed and brevity of social media force us to jump to conclusions about complex world affairs and write sharp opinions in 140 characters.

And once we do, the information stays on the Internet forever, so we lose the incentive to change these views, even if new evidence is discovered.

Fifth, and perhaps most importantly, today our social media experience is designed to prioritize broadcasting over engagement, posting over discussion, and shallow commenting over deep conversation.

It's as if we agreed to be here to talk to each other, not to each other.

I have witnessed how these grave challenges affect an already polarized Egyptian society, but not only in Egypt.

Polarization is on the rise around the world.

We need to work hard to understand how technology can be part of the solution, not part of the problem.

There is a lot of discussion today about how to fight online harassment and fight trolls.

This is very important.

No one could argue against that.

But we also need to think about how to design social media experiences that promote politeness and reward thoughtfulness.

In fact, I know that the more sensational, the more one-sided, sometimes angry and offensive my posts are, the more people will see them.

Get more attention.

But what if we put more emphasis on quality?

Which is more important, the total number of readers of the posts you write, or who are the influential people who read what you write?

Couldn't we give people more motivation to participate in the conversation instead of constantly broadcasting their opinions?

Or will it reward people who read and respond to opinions they disagree with?

And can we make it socially acceptable, or perhaps even reward it, for us to change our minds?

What if you had a matrix of how many people changed their minds and it became part of the social media experience?

If I could track how many people are changing their minds, I'd probably write more thoughtfully in an attempt to do so, rather than appealing to people who have already agreed and liked me just by confirming their biases.

We also need to think about effective crowdsourcing mechanisms that fact-check widely disseminated online information and reward people for participating.

In essence, we need to rethink today's social media ecosystem and redesign its experiences to reward thoughtfulness, politeness and mutual understanding.

As an Internet devotee, I teamed up with a few friends to launch new projects to find answers and explore possibilities.

Our first product is a new media platform for conversation.

We host conversations that promote mutual understanding and hopefully change minds.

We don't claim to have answers, but we've started trying out a variety of debates on highly controversial issues such as race, gun control, the refugee debate, and the relationship between Islam and terrorism.

These are important conversations.

Today, at least 1 in 3 people on the planet have access to the Internet.

But part of this internet is trapped in the less noble aspects of our human behavior.

Five years ago, I said, "If you want to liberate society, all you need is the internet."

I believe that if we want to liberate society today, we must first liberate the Internet.

thank you very much.

(applause)

Monsters come to life in the time-lapse video.

For some time it sits harmlessly there.

And ripples spread on its surface.

It bulges outward and bursts in strange boils.

It triples in volume.

Its color darkens eerily and its surface hardens into an alien terrain of peaks and craters.

Then the kitchen timer rings.

Cookies are ready.

What happened inside that oven?

Don't let the apron fool you!

The baker is a mad scientist.

Sliding the bread into the oven triggers a series of chemical reactions that transform one substance (the dough) into another (the cookie).

When the dough reaches 92 degrees Fahrenheit, the butter inside will melt and the dough will begin to spread.

Butter is an emulsion, a mixture of two substances that do not stay together. In this case, it's water, fat, and milk solids that help hold them together.

As the butter melts, it releases trapped moisture.

And when the cookies heat up, the water expands into steam.

It pushes the dough from the inside and tries to escape through the cookie wall like Ridley Scott's chest-bursting alien.

Your eggs may be harboring salmonella.

An estimated 142,000 Americans are infected this way each year.

Salmonella can survive for weeks outside the body and can withstand freezing, but 136 degrees is too hot for Salmonella.

Once the dough reaches that temperature, it will disappear.

You'll be living and testing your destiny by sneaking a bite of raw dough from the next batch.

At 144 degrees, the proteins in the dough, mainly derived from eggs, begin to change.

Eggs are made up of dozens of different proteins, each sensitive to different temperatures.

In a freshly harvested chicken egg, these proteins look like coiled balls of string.

When exposed to thermal energy, the protein thread unfolds and entangles with neighboring proteins.

This chain structure makes the simmering egg almost solid, creating a fluffy dough with filling.

Water boils at 212 degrees. As a result, the cookies dry out and become hard, similar to baking mud in the sun.

Cracks spread across the surface.

The steam that was bubbling inside evaporates, leaving an airy pocket that makes the cookie light and crispy.

A leavening agent, sodium bicarbonate, or baking soda can help with this.

The sodium bicarbonate reacts with the acid in the dough to produce carbon dioxide gas, creating an airy pocket inside the cookie.

Now you're almost ready for a refreshing dip in a glass of cold milk.

One of science's most delicious reactions occurs at 310 degrees.

This is the temperature at which the Maillard reaction occurs.

The Maillard reaction occurs when proteins and sugars break down and rearrange, forming ring-like structures that reflect light in a way that gives foods such as Thanksgiving turkey and hamburgers their distinctive rich brown color.

When this reaction occurs, different taste and aroma compounds are produced, which react with each other to form even more complex tastes and aromas.

Caramelization is the final reaction that takes place within the cookie.

Caramelization, which occurs when sugar molecules break down at high heat and form sweet, nutty, and slightly bitter flavor compounds, is exactly the hallmark of caramel.

In fact, even if the recipe calls for a 350 degree oven, that never happens because caramelization starts at 356 degrees.

You can also set the oven to 310 degrees if your ideal cookie is barely browned, like a Northeastern beach vacationer.

If you want your cookies to be nicely tanned, increase the heat.

Caramelization continues up to 390 degrees.

There is one more trick. No kitchen timer needed. Your nose is a sensitive scientific instrument.

The cookie is ready when it smells nutty from the Maillard reaction and caramelization.

Grab a glass of milk, put your feet up, and think that science is such a wonderful thing.

What is the Worst Bug on Earth?

You may vote for horseflies and wasps, but for many people, mosquitoes are by far the worst offenders.

The buzzing, biting and itchy mosquito is one of the most commonly hated pests in the world.

In Alaska, mosquito swarms can get so dense that they can actually choke caribou.

And mosquito-borne diseases kill millions of people each year.

The scourge of mosquitoes is nothing new.

Mosquitoes have been around for over 100 million years, during which time they have co-evolved with all kinds of species, including ours.

In fact, there are thousands of species of mosquitoes in the world, all of which share a certain latency of sucking blood. And they are very good at sucking blood.

Here's how:

After landing, the mosquito smears its saliva onto the victim's skin. This acts like an antiseptic, paralyzing the area and making attacks unnoticeable.

By the way, this is what causes itching and red rashes.

The worm then uses its serrated mandibles to puncture small holes in the skin and probes with its proboscis to find blood vessels.

A lucky parasite can absorb 2-3 times its body weight in blood if it hits one.

Actually, we found that we didn't like it very much.

In fact, humans hate mosquitoes so much that billions of dollars are spent worldwide to keep them away, from citronella candles to bug sprays to powerful agricultural pesticides.

But mosquitoes are not only annoying, they are also deadly.

Mosquitoes can transmit everything from malaria to yellow fever to West Nile virus to dengue fever.

Mosquito-borne diseases kill more than a million people worldwide each year, but only humans.

Horses, dogs, cats, they can all get sick from mosquitoes.

So if these bugs are so nasty, why should we get rid of them?

After all, we are humans and we are good at eliminating species.

Well, it's not that simple.

Getting rid of mosquitoes eliminates a food source for many creatures such as frogs, fish and birds.

Without them, the plant would lose pollinators.

But some scientists say mosquitoes aren't really all that important.

If we get rid of them, they argue, other species will just take their place and there will probably be far fewer malaria deaths.

The problem is that no one knows what will happen if all the mosquitoes are killed.

A better one might take the place, and maybe something worse.

The question is whether we are willing to take that risk.

In late January 1975, a 17-year-old German girl named Vera Brandes appeared on the stage of the Cologne Opera House.

The auditorium was empty.

It was lit only by the dim green light of an emergency exit sign.

This was the most exciting day of Bella's life.

She was Germany's youngest concert promoter and convinced the Cologne Opera to host a late-night jazz concert by American musician Keith Jarrett.

1,400 people were coming.

And just hours later, Jarrett is on the same stage, sitting at the piano and playing without rehearsal or sheet music.

But now, when Vera was introducing Keith to the piano in question, it didn't work.

Jarrett looked a little cautiously at the instrument, played some notes, walked around it, played some more notes, and muttered something to the producer.

Then the producer came up to Bella and said...

"Keith can't play unless he buys a new piano."

There was a mistake.

The Opera House provided the wrong instruments.

This sound had a harsh, raspy high end because the felt was all worn out.

Black notes stuck together, white notes were out of tune, pedals didn't work, and the piano itself was too small.

It doesn't produce enough volume to fill a large space like the Cologne Opera House.

So Keith Jarrett left.

He sat outside the car and had Vera Brandes answer the phone to find a replacement piano.

Now she got a piano tuner but couldn't get a new piano.

So she went outside and stood in the rain to talk to Keith Jarrett and beg him not to cancel the concert.

And he looked out of the car at this limp German teenager in the rain and took pity on her and said, "Never forget...just about you."

And a few hours later, Jarrett was indeed on stage at the Opera House, sat down at the unplayable piano, and started singing.

(music) It soon became clear that something magical was happening.

Jarrett eschewed those high notes and stuck to the midrange on the keyboard, which gave the song a pleasant ambient feel.

But also because the piano was so quiet, he had to set up a rumbling riff on the bass.

Then he wriggles to his feet, banging on the keyboard, desperately trying to get loud enough to reach the people in the back row.

It's a moving performance.

It has a calm atmosphere, but it is also full of energy and dynamic.

And the audience loved it.

The Cologne concert recording remains a favorite with audiences as it is the best-selling piano album of all time and the best-selling solo jazz album of all time.

Keith Jarrett was treated like a mess.

He accepted the confusion and it soared.

But let's take a moment to think about Jarrett's first intuition.

he didn't want to play

Of course, I think all of us feel the same way and have the same instincts in similar situations.

We don't want to be asked to do good work with bad tools.

No need to jump over unnecessary hurdles.

But Jarrett's intuition was wrong and thankfully he changed his mind.

And I think our instincts are wrong too.

I think we need to understand a little more about the unexpected benefits of having to deal with some confusion.

So let's take a few examples from cognitive psychology, complexity science, social psychology, and of course rock and roll.

The first is cognitive psychology.

In fact, we've known for some time that certain kinds of difficulties and certain kinds of obstacles can actually improve performance.

For example, psychologist Daniel Oppenheimer teamed up with a high school teacher several years ago.

He asked that handouts that had been distributed to some classes be reformatted.

As such, handouts are typically produced in friendly formats such as Helvetica or Times New Roman.

However, half of these classes received handouts formatted with something fiery like Hettensweiler, or something zesty and bouncy like Italic Comic Sans.

Well, these are really ugly fonts, hard to read fonts.

But when students were tested at the end of the semester and asked to read more difficult fonts, they actually did better on tests in a variety of subjects.

The reason was that the difficult font slowed them down and required them to work a little harder, think and interpret what they were reading a little more...

So they learned more.

Another example.

Psychologist Sherry Carson tests the quality of attentional filters in Harvard undergraduates.

What does that mean?

I mean, imagine you're in a restaurant and having a conversation. There are all sorts of other conversations going on at the restaurant, and I want to filter them out and focus on what's important to me.

can it?

If possible, you would have a good and powerful attention filter.

But some people really struggle with it.

Some of Carson's undergraduates struggled with this.

They had weak filters, they had porous filters, and a lot of outside information came in.

That is, they were constantly disturbed by the sights and sounds of the world around them.

Even if the TV was on when they were doing their essays, it couldn't be shown.

Well, you would think that would be a drawback...

But no.

Carson observed the accomplishments of these students and found that those with weaker filters were far more likely to hit true creative milestones in life, publish their first novel, and release their first album.

These distractions were actually the driving force behind their creativity.

Their box was full of holes so they could think outside the box.

Let's talk about the science of complexity.

So how do we solve really complex problems? The world is full of complex problems, but how do we solve truly complex problems?

For example, let's say you want to build a jet engine.

There are many different variables such as operating temperature, materials, dimensions, and shape.

Such problems cannot be solved at once, it is too difficult.

So what do you do?

Well, one thing you can do is try to solve it step by step.

So you have a prototype of sorts, tweak it, test it, improve it.

Tweak it, test it, improve it.

Now, this marginal profit thinking ends up with a good jet engine.

And it is quite widely deployed around the world.

For example, in high performance cycling, you'll hear web designers talking about optimizing web pages and looking for incremental gains.

It's a good way to solve complex problems.

But do you know what makes it a better way?

A dash of chaos.

Adding randomness early in the process, making crazy moves or trying stupid things that shouldn't work, tends to work for problem solving.

The reason is that the step-by-step process is problematic and can lead to small gains and a gradual dead end.

And starting with randomness makes it less likely and more certain to solve the problem.

Let's talk about social psychology.

So psychologist Katherine Phillips, along with some colleagues, recently gave some students a murder mystery problem, and these students were gathered in groups of four and given documents about the crime: alibi and evidence, witness statements, and information about three suspects.

A group of four students was then asked to figure out who did it and who committed the crime.

There were two treatments in this experiment.

In some cases, these were four friends, all of whom knew each other well.

In other cases there are 3 friends and 1 stranger.

And you see where I'm going with this.

Obviously, I'd like to say that the group with the stranger was able to solve the problem more effectively, but it's true, they did.

In fact they solved the problem much more effectively.

In other words, the probability that a group of four friends got it right was only 50/50.

Which of the three options is actually not that great?

(Laughter) Three friends and a stranger, even if the stranger had no additional information, it was just a case of how they changed the conversation to accommodate the awkwardness, three friends and the stranger had a 75 percent chance of finding the correct answer.

This is a pretty big leap forward in performance.

But I think what's really interesting is not just that the three friends and the stranger did a better job, but how they felt about it.

So when Katherine Phillips interviewed a group of four friends, they thought they had a good time and did a good job.

they were complacent.

When she talked to her three friends and a stranger, they weren't having a good time. It's actually pretty hard and pretty awkward...

And they were full of suspicions.

They didn't think they did a good job, even though they did a good job.

And I think this really embodies the challenges we're working on here.

Because, yes, ugly fonts, awkward strangers, and random movements...

Such confusion helps you solve problems and it also helps you to be more creative.

But we don't feel they are helping us.

I feel like they are getting in the way...

So we resist.

That's why the last example is so important.

So I'd like to talk about someone with a background in the rock and roll world.

As you may know, he's actually a TED star.

His name is Brian Eno.

He's an ambient composer, and he's pretty good.

He's also kind of the catalyst behind some of the great rock and roll albums of the last 40 years.

He's worked with David Bowie on 'Heroes', he's worked with U2 on 'Actung Baby' and 'Joshua Tree', he's worked with DEVO, he's worked with Coldplay, he's worked with everyone.

And what is he doing to make these great rock bands better?

Well, he does crazy things.

He interferes with their creative process.

His role is to be an awkward stranger.

His role is to teach you that you have to play the piano that you can't play.

And one of the ways he creates this mess is by using this amazing deck of cards -- here's my signed copy -- thanks Brian.

They are called "The Oblique Strategies" and he developed them with his friends.

And when they're locked up in the studio, Brian Eno will reach for one of the cards.

He draws one at random and tells the band to follow the instructions on that card.

So this is...

"Changing the role of musical instruments"

Yes, everyone swapping instruments -- drummer for piano -- great, great idea.

"Look carefully at the most embarrassing details. Zoom in on it."

"Suddenly, destructive, unpredictable behavior. Incorporate."

These cards are destructive.

Now they've proven their worth with every album.

Musicians hate them.

(laughs) Phil Collins played drums on Brian Eno's early albums.

He became so annoyed that he started throwing beer cans at the studio.

Carlos Alomar, the great rock guitarist who worked with Eno on David Bowie's Roger album, at one point turned to Brian and said, "Brian, this experiment is stupid."

But the problem is not only that it was a pretty good album, 35 years later Carlos Alomar is now using Oblique Strategies.

And he noticed something, so he told his students to use the "diagonal strategy."

Just because you don't like it doesn't mean it's useless.

In fact, the strategy wasn't originally playing cards, it was just a list - a list on the wall of a recording studio.

A checklist of things to try if you get stuck.

list didn't work.

do you know why?

Not messy enough.

Your eyes work their way down the list and settle on the least confusing and least annoying, but of course that misses the point completely.

And what Brian Eno realized was, yeah, you gotta do stupid experiments, you gotta deal with awkward strangers, you gotta read ugly fonts.

These help us.

They help us solve problems and help us be more creative.

but also ...

It really takes persuasion to accept this.

So no matter how...

Whether it's sheer willpower, card flipping, or a trip through German teenager guilt, we all need to sit down and try playing the piano we can't play from time to time.

thank you.

(applause)

When you look up at the night sky, you will be amazed by its beauty that seems to last forever.

But what will the sky look like billions of years from now?

A particular kind of scientist called a cosmologist spends time thinking about that very question.

The end of the universe is closely related to what it contains.

Over 100 years ago, Einstein developed general relativity, a set of equations that helped us understand the relationship between the components of the universe and their shape.

It turns out that the universe can be curved like a ball or sphere.

This is called right curved or closed.

Alternatively, it can be shaped like a saddle.

This is called a negative curve or open.

Or it can be flat.

And that shape determines how the universe lives and dies.

We now know that the universe is very close to being flat.

However, the components of the universe can still influence the ultimate fate of the universe.

By measuring the abundances and energy densities of various components in the current universe, we can predict how the universe will change over time.

So what is the universe made of?

The universe has everything we can see: stars, gas, planets.

We call these things ordinary matter or baryonic matter.

Even though we see them all around us, the total energy density of these constituents is actually very small, about 5% of the total energy of the universe.

Now let's talk about what the remaining 95% is.

The remaining 27% of the universe's energy density is made up of so-called dark matter.

Dark matter only interacts very weakly with light. That is, they don't shine or reflect light like stars or planets, but they otherwise behave like ordinary matter, attracting things with their gravity.

In fact, the only way this dark matter can be detected is through this gravitational interaction, how objects orbit around them, and how dark matter bends light as it curves the space around it.

We have yet to discover a particle of dark matter, but scientists around the world are searching for this elusive particle and its effects on the universe.

However, this is still not 100%.

The remaining 68% of the universe's energy density is made up of dark energy, which is even more mysterious than dark matter.

This dark energy acts like anti-gravity unlike any other matter we know.

It is said that there is a gravitational pressure that does not exist in normal matter or dark matter.

Instead of pulling the universe together as we would expect from gravity, the universe appears to be expanding at an ever-accelerating rate.

The main idea of ​​dark energy is that it is the cosmological constant.

In other words, it has the strange property of expanding as the volume of space increases in order to keep the energy density constant.

Therefore, as the universe expands as it does now, there will be more and more dark energy.

Dark matter and baryonic matter, on the other hand, do not expand with the universe and are further diluted.

Due to this property of the cosmological constant, the future universe will become increasingly dominated by dark energy, become colder and expand faster.

Eventually, the universe will run out of gas to form stars, and the stars themselves will run out of fuel and burn up, leaving only black holes in space.

Given enough time, even these black holes will evaporate, leaving behind a completely cold and empty universe.

That is what is called cosmic heat death.

Living in a cold, lifeless universe might sound depressing, but the doomsday fate of our universe actually has a beautiful symmetry to its fiery beginning.

We call the accelerating terminal state of the universe the “De Sitter stage” after the Dutch mathematician Willem de Sitter.

However, it is also believed that the universe had another stage of de Sitter expansion early in its birth.

We call this early inflation. Immediately after the Big Bang, the universe expanded very quickly in a short period of time.

Therefore, the universe, while accelerating, ends in much the same state as it began.

We live at a special time in cosmic life when we begin to understand space travel and see history unfolding in the skies that we all can see.

It feels like using it for the first time in my life.

1 in 50 of your genes are assigned to it.

That's important, right?

Now, take a deep breath through your nose.

It's your sense of smell, it's breathtakingly powerful.

Adults can distinguish about 10,000 different odors.

Here's how the nose works:

Smell begins when you sniff airborne molecules into your nostrils.

95% of the nasal cavity is only used to filter air before it hits the lungs.

But at the very back of the nose is an area called the olfactory epithelium, a small patch of skin that is key to all odors.

The olfactory epithelium has a layer of olfactory receptor cells, specialized neurons that sense smells like the taste buds in your nose.

When odor molecules hit the back of the nose, they are trapped in a layer of mucus that covers the olfactory epithelium.

When they dissolve, they bind to olfactory receptor cells, which fire and send signals down the olfactory pathway to the brain.

As an aside, the size of the olfactory epithelium tells us a lot about how good an animal's sense of smell is.

A dog's olfactory epithelium is 20 times larger than the tiny human olfactory epithelium.

However, there are still many unknowns about this tiny patch of cells.

For example, our olfactory epithelium is pigmented, and scientists don't really understand why.

But how do you actually tell the difference between smells?

We know that there are 40 million different olfactory receptor neurons in the human brain, so odor A could trigger neurons 3, 427, and 988, while odor B could trigger neurons 8, 76, and 2,496,678.

These different combinations make it possible to detect a surprisingly wide range of odors.

Olfactory neurons are always fresh and ready for action.

These are the only neurons in the body that are regularly replaced every 4-8 weeks.

When a signal is triggered, it travels through bundles called olfactory tracts to destinations throughout the brain, stopping in the amygdala, thalamus, and neocortex.

This is different from how we process vision and hearing.

Each of these signals first travels to a relay center in the middle of the cerebral hemisphere and then exits to other areas of the brain.

But because smell evolved before most other senses, it can reach different areas of the brain directly, where it can trigger a fight-or-flight response, recall memories, or whet your appetite.

But even if we all have the same physiological settings, two nostrils, and millions of olfactory neurons, we don't all smell the same.

One of the most famous examples of this is the ability to smell so-called "asparagus pee".

For about a quarter of the population, urinating after eating asparagus means smelling it.

The remaining 75% are unaware.

This isn't the only way different noses smell different.

To some people, the chemical Androstenone smells like vanilla. Androstenone is commonly found in goodies such as pork, so it's unfortunate that it smells like sweaty urine to others.

So, keeping in mind those who smell the sweat, pork producers will castrate boars to block the production of androstenone.

The inability to smell scents is called anosmia, and there are about 100 known cases of it.

People with allicin anosmia cannot smell garlic.

People with eugenol anosmia cannot smell cloves.

Also, some people don't smell it at all.

There are several possible causes for this type of complete anosmia.

Some people are born with no sense of smell.

Some lose it after an accident or illness.

A swollen or infected olfactory epithelium can interfere with your sense of smell, something you may have experienced when you were ill.

Not being able to smell anything can confuse your other senses as well.

Many people who can't smell at all also can't taste like other people.

It turns out that the taste of something is closely related to the smell.

When you chew food, air is forced up into your nasal passages, carrying food odors with you.

Their scent stimulates the olfactory epithelium and tells the brain a lot about what you're eating.

Without the sense of smell, we cannot perceive tastes more complex than the five tastes that our taste buds can perceive (sweet, salty, bitter, sour, and umami).

So the next time you smell exhaust fumes, salty sea air, or roast chicken, you'll know exactly how you did it, and probably be a little more grateful that you did it.

[Why don't you eat bugs?] For centuries, people have eaten everything from beetles to caterpillars, locusts, grasshoppers, termites and dragonflies.

This practice also has a name: entomophagy.

Perhaps early hunter-gatherers learned from animals that foraged for protein-rich insects and followed suit.

As we evolved and insects became part of our dietary traditions, insects served as both a staple food and a delicacy.

In ancient Greece, cicadas were considered a luxury treat.

And even the Romans found beetle larvae delicious.

Why have we lost our sense of taste for insects?

The reason for our refusal is historical, and the story probably begins around 10,000 BC in the Fertile Crescent of the Middle East, a major birthplace of agriculture.

At that time, our once nomadic ancestors began to settle in the Crescent.

And as they learned to grow crops and domesticate animals there, their attitudes changed, sending ripples outward to Europe and the rest of the Western world.

As agriculture came into full swing, people might have dismissed insects as mere pests that ravaged crops.

Population growth and the urbanization of the West weakened our ties to our foraging past.

People forgot their buggy history.

Today, for people who are not accustomed to eating insects, bugs are just an irritant.

They infest our food by biting or chewing it.

We feel the "bad factor" associated with insects and are disgusted by the idea of ​​cooking them.

About 2,000 species of insects feed and form a large part of the daily diet of 2 billion people worldwide.

Tropical countries are the most enthusiastic consumers because they are culturally acceptable.

Species in these areas are large and diverse, and tend to form groups or flocks for easier harvesting.

Take Cambodia in Southeast Asia as an example. Giant tarantulas are collected, fried and sold at the market.

In southern Africa, juicy mopane worms are a staple food, boiled in spicy sauces or dried and salted.

In Mexico, chopped jumir is toasted with garlic, lemon and salt.

Insects can be eaten whole to make up a diet, or added to food in flours, powders, and pastes.

But taste isn't everything.

they are also healthy.

In fact, scientists say entomophagy could be a cost-effective solution for food-insecure developing countries.

Insects contain up to 80% protein, an important building block for the body, and are also rich in energy-rich fats, fiber, and micronutrients such as vitamins and minerals.

Did you know that most edible insects contain as much or more mineral iron as beef and that they are a huge untapped resource given that iron deficiency is currently the most common nutritional problem in the world?

Mealworms are another nutritious example.

Yellow beetle larvae are native to America and are easy to keep.

It's high in vitamins, packed with healthy minerals, and contains up to 50% protein, which is about the same as an equivalent amount of beef.

To cook, simply sauté in butter and salt or roast and sprinkle with chocolate for a crunchy snack.

It is to gain nutrition and taste that the "disease factor" must be overcome.

Sure, bugs can be delicious.

Mealworms taste like roasted nuts.

Locusts are similar to shrimp.

Some say that crickets have the flavor of popcorn.

Farming edible insects also has less environmental impact than animal husbandry because insects emit far fewer greenhouse gases and use less space, water and food.

Socio-economically, insect production has the potential to invigorate people in developing countries, as insect farms are small, productive and relatively cheap to maintain.

Insects can also be turned into more sustainable food for livestock, and can be raised on organic waste such as vegetable skins that can rot in landfills.

Still hungry?

Even today, most people would cringe at a plate of fried crickets and imagine legs and tentacles wedged between their teeth.

But think of the lobster.

It's just a giant insect with lots of legs and antennae that was once considered inferior and disgusting food.

Well, lobster is a delicacy.

Could the same paradigm shift happen to bugs?

So give it a try!

Throw the insect into your mouth and enjoy its crunchy texture.

In the world of J.R.R., Gandalf is one of five wizards sent by the Valar to lead the inhabitants of Middle-earth in their fight against the dark forces of Sauron.

Although Gandalf's body was mortal according to the physical laws of Middle-earth, his spirit was immortal, as evidenced by his death as Gandalf the Gray and resurrection as Gandalf the White.

According to Wachowski's script, an awakened human can learn to fly a helicopter in seconds by simply plugging in and hacking the Matrix's neon binary code.

Or if you're a One, or one of the Ones, you don't even need a helicopter. All you need is a pair of cool shades.

The Cheshire Cat can juggle its own head.

The iPad is rudimentary.

A Quidditch match isn't over until the Golden Snitch is caught.

And the answer to the ultimate question about life, the universe, and everything is definitely 42.

Like the real world, the fictional world behaves consistently within different physical and social rules.

That's what makes these complex worlds believable, understandable, and worth exploring.

In real life, the laws of gravity keep the seven-book set of "Harry Potter" on millions of bookshelves around the world.

We know this to be true, but we also know it to be true since the JK incident. Wizards, wands, and typing the word "Wingardium leviosa" caused the laws of gravity to cease to exist in the trillions of pages between those bookends.

Sci-fi and fantasy writers literally build worlds.

They create rules, maps, lineages, languages, cultures, universes, universes within universes, and from those worlds sprout stories, stories after stories, stories after.

Done well, the reader can understand the fictional world and its rules as much as the characters who live in it, and in some cases as much or more than the world outside the book.

But how?

How does a human-made squiggle on the page reflect light in our eyes, send a signal to our brain, and logically and emotionally decipher it as a complex story that moves us to fight, cry, sing, and think, and is strong enough to not only hold a world entirely invented by its author, but also change the reader's perspective on the real world, which only resumes when the final squiggle is reached?

No one knows the answer to that question, but fanciful, fictional worlds are created every day in our heads, on our computers, and even on our napkins in street restaurants.

In fact, all it takes to start writing a novel is your imagination and, figuratively speaking, a willingness to live in your own world.

I never dreamed of Hogwarts or Star Wars cantinas, but I've written some science thrillers for kids and young adults.

Here are some of the questions and methods I used to build the worlds in which these books are set.

Start with the basic location and time.

Whether it's a fantasy world or a real-world futuristic setting, it's important to know where you are and whether you're working in the past, present, or future.

I like to create timelines of how the world came to be.

What events in the past shaped the current situation?

Then brainstorm answers to questions that elicit details about the fictional world.

What are the rules here?

This covers everything from the presence or absence of the law of gravity to social rules and penalties for individuals who violate them.

What kind of government do we have in this world?

Who has power and who does not?

What do people here believe?

And what does this society value most?

And it's time to think about everyday life.

How's the weather in this world?

Where do residents live, work, and go to school?

What do they eat and how do they play?

How do they treat children and old people?

How do they relate to the flora and fauna of the world?

And what do those animals and plants look like?

What kind of technology exists?

Transportation facilities?

communication?

Access to Information?

So much to think about!

So spend some time on those tasks and answering those questions. Then you are well on your way to building your own fictional world.

Once you understand your world and want your readers to know it, let your characters be free in it and see what happens.

And ask yourself, "How does this world you've created shape the people who live in it?

And what kind of conflict can arise? ”

Answer these questions and your story is complete.

Good luck, future world builders!

I'm looking for another planet in the universe that has life.

This planet cannot be seen with the naked eye, let alone with the most powerful telescopes we currently possess.

But I know it's there.

And understanding the contradictions that occur in nature helps us find them.

On our planet, where there is water, there is life.

So we look for planets orbiting the right distance from the star.

At this distance, shown in blue in this diagram showing stars of varying temperatures, the planet could be hot enough for water to flow to its surface as lakes and oceans where life could exist.

Some astronomers focus their time and energy on finding planets at such distances from their stars.

What I do is carried over at the end of their work.

I model possible climates on exoplanets.

And here's why it matters. There are many factors other than distance from a star that control whether a planet can sustain life.

Consider Venus.

Named after the Roman goddess of love and beauty for its serene and dreamlike appearance floating in the sky.

But spacecraft measurements revealed something else.

The surface temperature is close to 900 degrees Fahrenheit and 500 degrees Celsius.

It's hot enough to melt lead.

The reason is not its distance from the Sun, but its thick atmosphere.

It causes a greenhouse effect on steroids, trapping heat from the sun and scorching the planet's surface.

Reality completely contradicted our initial perceptions of this planet.

These lessons from our own solar system show that a planet's atmosphere is crucial to its climate and habitability.

We don't know what the atmospheres of these planets are like because they are so small and dark compared to stars and so far away from us.

For example, one of the closest planets capable of supporting surface water, its name is Gliese 667 Cc. It's a very attractive name, isn't it, a nice name for a phone number, but it's 23 light years away.

That's over 100 trillion miles.

It is difficult to measure the atmospheric composition of an exoplanet that passes in front of its host star.

It's like trying to watch a fruit fly pass in front of your car's headlights.

Now imagine your car is 100 trillion miles away and you want to know the exact color of that fly.

So I use computer models to calculate what kind of atmosphere a planet needs to have a climate suitable for water and life.

This is the artist's concept of the planet Kepler-62f. I also added the Earth as a reference.

It is 1,200 light-years away and only 40% the size of Earth.

In our NSF-funded research, we found that the different types of atmospheres and their orbital orientations could lead to significant temperatures in the open ocean.

Therefore, I would like future telescopes to track this planet and look for signs of life.

Planetary surface ice is also important for climate.

Ice absorbs the longer red wavelengths of light and reflects the shorter blue wavelengths.

That's why the iceberg in this photo looks so blue.

Red light from the sun is absorbed on its way through the ice.

Only blue light reaches the bottom.

And it is reflected back to our eyes and we see blue ice.

My model shows that planets orbiting cooler stars can actually be warmer than planets orbiting hotter stars.

There is another contradiction. Ice absorbs longer wavelength light from cooler stars, and that light, that energy, heats the ice.

Investigating how these discrepancies affect the planet's climate using climate models is essential for searching for life elsewhere.

And no wonder this is my area of ​​expertise.

I am an African-American female astronomer and classically trained actor who loves wearing makeup and reading fashion magazines. So we're in a unique position to understand the contradictions of nature -- (laughter) (applause) ...and how they can help us in our quest for the next planet inhabited by life.

My organization, Rising Stargirls, uses theater, writing, and the visual arts to teach astronomy to middle school girls of color.

This is also a contradiction. Science and art don't often go together, but by interweaving science and art, they can fully commit to what they've learned, and one day they might join the ranks of contradictory astronomers and use their background to discover once and for all that we're really not alone in the universe.

thank you.

(applause)

Can you read a book in your car?

If so, consider yourself pretty lucky.

A third of the population quickly get stomachaches when reading a book while traveling in a car, boat, train or plane.

But why get motion sickness in the first place?

Believe it or not, scientists aren't exactly sure.

The most popular theory has to do with discrepancies in sensory signals.

When you're in a car, your body receives two different messages.

Your eyes are looking inside the car, which seems to be motionless.

Meanwhile, your ears tell your brain that you are accelerating.

Wait a minute, what about your ears?

The ear has other important functions besides hearing.

At its innermost is a series of structures known as the vestibular system that give us our sense of balance and kinesthetics.

Inside are three semi-circular tubules that can sense rotation, one for each dimension of space.

And there are also two furry sacs filled with liquid.

When you move, the fluid moves and tickles your hair, telling your brain whether you're moving horizontally or vertically.

All of this tells your body what direction you're moving, how much you've accelerated, and even what angle you're moving.

In a car, your vestibular system correctly senses your movements, but your eyes don't, especially if you're glued to a book.

The opposite can also happen.

When you are watching a movie, the camera moves a lot.

In this case, the eye perceives you as moving, while the ear perceives you as stationary.

But why does this contradictory information make us feel so frightened?

Scientists aren't sure, but they think there's an evolutionary explanation.

Fast-moving vehicles and video recordings have come into existence only in the last few centuries, a blink of an eye in evolutionary time.

For most of our history, there weren't many things that could cause this sensory disruption, except poisons.

And because toxins aren't the best thing for survival, our bodies have evolved direct but uncomfortable ways to get rid of the mess-causing food we eat.

It's a fairly reasonable theory, but it leaves no explanation for why women are more prone to motion sickness than men, or why passengers are more nauseous than drivers.

Another theory suggests that the cause is that the unfamiliar situation makes it difficult to maintain a natural body posture.

Studies have shown that simply immersing yourself in water or changing your posture can significantly reduce the effects of motion sickness.

But I don't know what is actually going on.

Common remedies for car nausea, such as horizon-gazing, over-the-counter medications, and chewing gum, are not entirely reliable and cannot deal with severe motion sickness. And in some cases, the risks are much higher than not getting bored during a long car ride.

Motion sickness is a serious problem at NASA, where astronauts are launched into space at 17,000 miles per hour.

In addition to researching the latest space age technologies, NASA spends a lot of time finding ways to keep astronauts from vomiting space food.

Much like understanding the mysteries of sleep or curing the common cold, motion sickness is one of those seemingly simple problems that, despite amazing scientific advances, is still largely unknown.

Perhaps one day the exact cause of motion sickness will be discovered, and a completely effective way to prevent it, but that day is still a long way off.

In the 1920s, German mathematician David Hilbert devised a famous thought experiment that showed how difficult it was to mentally grasp the concept of infinity.

Imagine a hotel with an infinite number of rooms and a very hard working night manager.

One night, Mugen Hotel was fully booked with Mugen guests.

A man walks into a hotel and asks for a room.

The night manager decides to make room for him rather than turn him down.

how?

it's simple. Ask the guest in room number 1 to move to room 2, and ask the guest in room number 2 to move to room 3.

All guests move from room number 'n' to room number 'n+1'.

There are an infinite number of rooms, so a new room exists for each existing guest.

This leaves Room 1 open for new customers.

This process can be repeated for any finite number of new guests.

For example, if a tour bus drops off 40 new guests looking for a room, all existing guests can simply be moved from room number 'n' to room number 'n+40' to free up the first 40 rooms.

But now an infinitely large bus with countless passengers arrives to rent a room.

Countable infinity is the key.

Well, the endless buses with endless passengers puzzled the night manager at first, but he realized there was a way to place each new passenger.

He asks the guest in Room 1 to move to Room 2.

Then ask the guest in room 2 to move to room 4 and the guest in room 3 to room 6.

Each current guest moves from room number 'n' to room number '2n', filling only infinite even rooms.

This caused him to empty all the infinitely many odd-numbered rooms, and those rooms were occupied by people getting off the infinite bus.

Everyone is happy and hotel business is booming more than ever.

Well, it's actually the exact same amount that's been booming, depositing infinite dollars in the bank overnight.

Rumors spread about this wonderful hotel.

People come from far away.

One night, something unexpected happens.

When the night manager looks out, he sees endless lines of endless motorcoaches with countless passengers.

what can he do

If he can't find rooms for them, the hotel will lose an infinite amount of money and he will surely lose his job.

Luckily, he remembers Euclid proving that there are infinitely many primes around 300 B.C.E.

Thus, to accomplish this seemingly impossible task of finding infinite beds for infinite buses carrying infinitely weary travelers, the night manager assigns all current guests the first prime number 2 raised to the power of their current room number.

Therefore, the current occupant of room number 7 moves to room number 2^7, or room 128.

The night manager then puts people on the first bus of the infinite bus and assigns them room numbers of 3, the next prime number raised to the power of the seat number on the bus.

So the person in seat number 7 on the first bus goes to room number 3^7 or room number 2,187.

This continues for all first buses.

Passengers on the second bus are assigned the next prime power of 5.

Next bus, power of 7.

Each bus follows a power of 11, a power of 13, a power of 17, and so on.

Since each of these numbers has only factors of 1 and its base natural powers, there are no duplicate room numbers.

All bus passengers are fanned into rooms using a unique room assignment scheme based on unique prime numbers.

In this way the night manager can serve all passengers on all buses.

However, since 6 is not a prime power, there are many unfillable rooms, such as room 6.

Luckily, his boss wasn't very good at math, so his job is safe.

The night manager strategy is possible because while the infinite hotel is indeed a logistical nightmare, it only deals with the lowest level of infinity, mainly the countable infinity of natural numbers such as 1, 2, 3, 4, etc.

Georg Cantor called this infinite level Aleph Zero.

Natural numbers are also used for room numbers and bus seat numbers.

When dealing with infinite higher orders such as the real numbers, these structured strategies are no longer possible as there is no way to include all numbers systematically.

The Real Infinite Hotel has negative number rooms, fraction rooms in the basement, so I always suspect that the guy in room 1/2 has less room than the guy in room 1.

In square root rooms such as Room Radical 2 and Room pi, guests expect free dessert.

Would any self-respecting night manager want to work there, even if he got an infinite salary?

But at Hilbert's Infinite Hotel, there's never a vacancy, and there's always room for an extra. The ever-hard-working and perhaps too kind-hearted Lord of the Night faces the scenario that serves as a reminder of how difficult it is for our relatively finite minds to comprehend concepts as big as infinity.

After getting enough sleep, you may be able to deal with these problems.

But to be honest, you may need to change rooms at 2am.

how fast are you moving now?

It seems like a simple question.

The first attractive answer is "I don't move".

If you think about it more deeply, you'll probably find that the motion of the Earth is important.

So the second attractive answer is "19 miles per second around the sun".

But then I recall learning that the Sun moves around the center of the Milky Way Galaxy, the Milky Way moves within the Local Group, the Local Group moves within the Virgo Cluster, and the Virgo Cluster moves within it...

"How fast are you moving?"

It's not an easy question.

When controllers tell astronauts how fast they are going, there is always an assumed rest criterion.

At the start of the voyage, you are given a speed relative to the launch pad.

But then, when the launch pad is another arbitrary location on the Earth's spinning surface, the velocity is given relative to the pinpoint center of an ideal, non-rotating Earth.

On their way to the moon, the Apollo astronauts struggled to answer the question, "How fast are you traveling?"

The speed away from the earth and the speed towards the moon are two different things.

This is because the earth and moon are moving relative to each other.

Oh yes of course!

Speed ​​is a relative quantity.

When Captain Kirk asks Captain Sulu if the Enterprise has reached warp 7 speed, Sulu should answer, "For what, Captain?"

A cheeky reply like this might annoy a subordinate Starfleet officer, but it's the only good answer to the question, "How fast are you moving?"

This is basic relative talk.

Not fancy Einstein relativity, but good old (and still correct) Galileo relativity.

Galileo seems to have been the first to realize that there is no such thing as absolute speed.

Speed ​​is relative.

This means that velocity only has meaning when referring to a reference frame.

Perhaps the reference frame itself is stationary.

But then we have to ask again, "What are we resting against?"

This is because even the concept of rest has lost its absolute meaning.

Speed ​​is relative, and so is rest.

The speed of the earth is 19 miles per second relative to the sun.

The Enterprise's velocity is Warp 7 relative to the center of the Milky Way galaxy.

Velocity is zero for the easy chair.

But depending on where you're sitting, the distance from the center of the earth can be hundreds of miles an hour.

When we furrow our brows and ask, "But how fast is the Earth really moving?"

We imagine Spaceship Earth wading through the oceans of space as it orbits the Sun.

But space is not an ocean.

There is no substance like water.

Space is not a thing. there is no space.

The universe is nothing.

You can travel between two points in space, say between Earth and Mars, but you can't travel through space.

Nothing passes.

It's like trying to guess the weight of a hole.

There is nothing in the hole, so the hole has no weight at all.

It is emptiness, and so is space.

Movement relative to nothing is meaningless.

The concepts of speed and rest are only relative.

They are utterly pointless.

They mean something only in terms of an arbitrarily chosen artificial frame of reference.

One day, even if you were buckled into a spacecraft and watched, say, a space station pass by at a constant speed through a side window, there would be no way of knowing which one was actually moving.

Neither is really moving, as there is no deep reality of constant velocity.

Constant velocity in a straight line has only relative meaning, something like relative reality.

Does this mean that all motion is relative?

no! Some movements have only relative meaning, while others have absolute meaning and are completely real.

For example, constant speed is relative, but changing speed is absolute.

To call something absolute in science means that no arbitrary criteria are used to measure it.

It is clearly measurable.

There is no doubt that when a spacecraft starts its engines, its velocity changes.

It can be felt in the stomach and the ship's sensors can measure it.

Outside the window, a passing space station may appear to change speed, but those inside the station do not feel it.

And there are no sensors that can measure it.

You're actually changing the speed, they're not really.

There is something absolutely real about speed changes.

The same is true for rotation.

If the spacecraft is spinning, it can be felt and the ship's sensors can measure it.

It may seem like the space station outside revolves around you, but it's you who's feeling nauseous, not the people inside the space station.

You're really spinning, but they're not really spinning.

There is something absolutely real about rotation.

Therefore, some movements are relative and some are not.

There is no deep reality about constant velocity, but changes in velocity are very real, and so is rotation.

Identifying what is deeply real requires careful analysis of everyday experience.

All perceptions may need to be carefully scrutinized, as we can be fooled by basic perceptions such as speed.

This is what inspired Einstein's amazing insight into the speed of light and forward time travel.

Knowing how to discern what is very real is a difficult and important task.

If a police officer stops you for speeding and asks, "Do you know how fast you were going?"

And as you sit in the backseat of your police car and feel it speeding toward the prison, you can add, "But there are absolutes too!"

A persistent myth is that we only use 10% of our brains and the other 90% sit idle for spare power.

Hacksters promised to unlock that hidden potential in a “neuroscience-based” way, but all they really unlock is your wallet.

Two-thirds of the population and nearly half of science teachers erroneously believe the 10% myth.

In the 1890s, William James, the father of American psychology, said, "Most of us are not living up to our spiritual potential."

James intended this as a challenge, not an accusation of poor use of his head.

But the misconception has persisted.

Also, scientists have long failed to understand the purpose of large areas of our giant frontal and parietal lobes.

Authorities concluded that nothing had been done because the injury did not cause motor or sensory impairment.

For decades, these parts were called silent areas, and their function was elusive.

Since then, we have learned that they emphasize the ability to execute and integrate, without which we cannot be human.

They are essential for abstract reasoning, planning, weighing decisions, and flexible adaptation to situations.

When you calculate how your brain consumes energy, the idea that nine-tenths of your brain sleeps inside your skull seems absurd.

The brains of rodents and dogs consume 5% of the total body energy.

Monkey brains use 10%.

The adult brain accounts for only 2% of body mass, but consumes 20% of the glucose consumed daily.

The rate is 50% in children and 60% in infants.

This is far more than would be expected given their relative brain size, which expands in proportion to body size.

Human brains weigh 1.5 kg, elephant brains 5 kg, and whale brains 9 kg, but on a weight basis, humans pack more neurons than any other species.

This high density packing is what makes us so smart.

There is a trade-off between body size and the number of neurons that primates, including us, can sustain.

A 25 kg ape must eat eight hours a day to maintain a brain with 53 billion neurons.

The invention of cooking 1.5 million years ago gave us great advantages.

Cooked foods are softened and pre-digested outside the body.

Our gut absorbs that energy more easily.

Cooking saves you time and gives you more energy than eating raw food, keeping your brain at a high density of 86 billion neurons.

40% more than apes.

Here's how it works:

Half of the calories consumed by the brain are used to keep structures intact by pumping sodium and potassium ions across membranes to maintain electrical charge.

To do this, the brain needs to expend a lot of energy.

It consumes a staggering 3.4 x 10^21 ATP molecules per minute. ATP is the coal in the body's furnace.

The high cost of maintaining the resting potential of all 86 billion neurons means there is little energy left to propel signals down the axons and across synapses, the neural discharges that actually get things done.

The energy load that generates spikes across the brain is unsustainable, even if only a few neurons fire in a given area at once.

Energy efficiency is important here.

Having only a few cells transmit the signal at a time, known as sparse coding, conveys a lot of information while using the least amount of energy.

A small number of signals have thousands of possible paths to distribute themselves.

A drawback of sparse coding within a huge number of neurons is that it is costly.

Worse, if most cells don't fire, they're unnecessary and evolution would have discarded them long ago.

The solution is to find the optimal proportion of cells that the brain can work on at once.

For maximum efficiency, 1% to 16% of cells should be active at all times.

This is the energy limit we must endure in order to remain conscious.

Due to the need to conserve resources, most of the brain's operations must occur outside of consciousness.

This is why multitasking is a stupid business.

We just don't have the energy to do two things at once, let alone three or five.

If you put in the effort, you will perform each task no better than if you paid your full attention.

Numbers are against us.

Your brain is already smart and powerful.

It is so powerful that it needs a lot of power to stay strong.

It's so smart that it has energy efficient planning built in.

So don't let false myths guilt your lazy brain.

Guilt is a waste of energy.

With all this in mind, don't you realize that wasting your mental energy is foolish?

There are billions of power-hungry neurons that must be maintained.

So hop on it!

Roy Price, April 19, 2013, is someone most of you have probably never heard of, even though he may have been responsible for the rather mundane 22 minutes of your life.

He may have had 22 minutes of great fun, but you guys aren't much.

And it all goes back to a decision Roy had to make about three years ago.

As you know, Roy Price is a senior executive at Amazon Studios.

That's Amazon's TV production company.

He's 47, slim, with spiky hair, and describes himself on Twitter as "movies, tv, tech, tacos."

And Roy Price has a very responsible job because it's his responsibility to choose shows that are original content created by Amazon.

And, of course, it's a highly competitive field.

There are so many TV shows out there already that Roy can't choose which one.

He has to find a really great show.

So he has to find a show right on the very right end of this curve here.

This curve is the distribution of ratings for about 2,500 TV shows on the website IMDB, with ratings ranging from 1 to 10, with the height here indicating the number of shows that earned that rating.

So if your show gets a rating of 9 or more points, it's a winner.

That way you have a top 2% show.

It's shows like "Breaking Bad," "Game of Thrones," and "The Wire." I mean, all of these shows are addictive, and after watching a season, your brain is basically thinking, "Where can I get more of these episodes?"

That kind of program.

On the left, for clarity, there's a show called "Toddlers and Tiaras" right here at the end -- (laughter) -- that should give you a good idea of ​​what's going on at the end of the curve.

Well, Roy Price isn't worried about riding the left edge of the curve. Because I think it takes a good deal of brainpower to go below "toddlers and tiaras."

So what he's worried about is this middle bulge, the average TV bulge, you know, shows that aren't really good, aren't really bad, aren't really exciting.

So he has to make sure he's really on the right track.

So the pressure is on, and of course it's the first time Amazon has done something like this, so Roy Price doesn't want to take the risk.

he wants to be successful.

He needs guaranteed success, where he holds a contest.

So he receives a flood of TV show ideas, selects eight TV show candidates from those ideas through evaluation, creates the first episodes of each show, and puts them online for free for everyone to watch.

So when Amazon gives you a free product, you're going to take it, right?

That's why millions of viewers watch those episodes.

What they don't realize is that while they're watching their shows, they're actually being watched.

They are being watched by Roy Price and his team, and they record everything.

Record when someone hits play, when they hit pause, what parts they skipped, and what parts they watched again.

As such, they collect millions of data points. Because I want to have those data points to decide which shows to create.

And sure enough, they collect all the data, do all the data processing, and the answer emerges. The answer is, "Amazon should make a sitcom about four Republican senators."

they did the show.

Anyone know the name of the show?

(Audience: "Alpha House") Yes, "Alpha House," but I don't think many of you here remember that show, because it really wasn't that great.

As a matter of fact, this is just an average show. Literally, in fact, this curve averages 7.4 and "Alpha House" hits 7.5, so it's a slightly above average show, but it's certainly not what Roy Price and his team were aiming for.

Meanwhile, however, at about the same time, at another company, another executive successfully used data analytics to win top shows. His name is Ted, Ted Sarandos. Chief Content Officer at Netflix. Like Roy, he's on a constant mission to find great TV shows, and he also uses data to do so, but in a slightly different way.

So instead of holding a contest, what he and his team did, of course, was to look at all the existing data about Netflix's audience: ratings given to shows, viewing history, shows people liked, and so on.

And then we use that data to discover every little bit of information about our audience: what kinds of shows they like, what producers they like, what actors they like, and so on.

And with all that stuff in place, they took the plunge and licensed a drama series about one senator instead of a sitcom about four senators.

Do you know that program?

(Laughter) Yes, House of Cards, and of course Netflix, had success with that show for at least the first two seasons.

(Laughter) (Applause) House of Cards has a 9.1 rating on this curve, which is exactly where they wanted it.

Now, naturally, the question arises as to what happened here.

So you have two very competitive, data-savvy companies.

Connecting all these millions of data points works great for one of them but not for the other.

why?

Because the logic is like saying this should always work.

So, if you've collected millions of data points about the decisions you're about to make, you should be able to make pretty good decisions.

200 years of statistics are reliable.

We use very powerful computers to amplify it.

At least you can expect good TV, right?

And when data analysis doesn't work that way, it actually gets a little scary. Because we live in an era where we rely more and more on data to make very important decisions that go far beyond television.

Anyone know of a company called Multi-Health Systems?

no one. Yes, it's actually a good thing.

MultiHealth Systems is a software company. I hope no one in this room touches that software. Because if you touch it, it means you can go to jail.

(Laughter) If someone is in prison here in the United States and they apply for parole, it's very likely that the company's data analytics software will be used to decide whether to grant parole.

It's the same principle as Amazon and Netflix, but now it's not the TV shows that are good or bad, but the people that are good or bad.

And mediocre TV, 22 minutes, that might be pretty bad, but I think it's probably worse with more years in prison.

And unfortunately, there is real evidence that this data analysis does not always give optimal results, despite the large amount of data.

It's not because companies like Multi-Health Systems don't know what to do with their data.

Even the most data-savvy companies get it wrong.

Yes, even Google gets it wrong sometimes.

In 2009, Google announced it was able to predict nasty flu epidemics by analyzing Google search data.

And it worked brilliantly, making headlines in the news, including publication in the pinnacle of scientific success, Nature.

It worked brilliantly for years and years until one year it failed.

And no one could explain exactly why.

The year did not go well, but of course there was big news again, including the withdrawal of publications from the magazine Nature.

So even the most data-savvy companies, Amazon and Google, sometimes get it wrong.

And despite all these failures, data is rapidly moving into real-world decision-making: workplaces, law enforcement, and healthcare.

So you need to make sure your data is useful.

Now, I personally have seen many struggles with data like this. Because I work in the field of computational genetics. Many very smart people in this field are using unimaginable amounts of data to make some pretty big decisions, like determining cancer treatments or developing drugs.

And over the years, I've noticed a certain pattern, or a certain law, about the difference between making successful and unsuccessful decisions based on data. I think this is a pattern worth sharing. It's like this:

So basically when you're solving a complex problem you're doing two things.

The first is to break the problem down into pieces so that those pieces can be analyzed in depth. Then of course it runs the second part.

Reassemble all these pieces and draw a conclusion.

Sometimes I have to start over again, but it's always those two things. It means taking it apart and putting it back together.

The important thing here is that data and data analysis are valid only in the first part.

Data and data analysis, no matter how powerful, can only help you break down a problem and understand its parts.

It's not a good idea to put those pieces back together and come to a conclusion.

There is another tool that can do that, we all have it, and that tool is the brain.

If there's one thing the brain is good at, it's recombining pieces of even incomplete information to draw appropriate conclusions. Especially if it's the brain of an expert.

That's why I believe Netflix has been so successful because they've put data and brains to good use in the process.

They use the data first to understand a lot about the audience otherwise they wouldn't have gotten that deep, but then the decision to take all these pieces and put them back together to create a show like "House of Cards" was nowhere in the data.

Ted Sarandos and his team made the decision to license the show, which meant they took a pretty big personal risk with that decision.

Amazon, on the other hand, did it the wrong way.

They used data throughout to drive decision-making, first when they held a television idea competition, and then when they chose "Alpha House" to produce as a show.

Of course, this was a very safe decision for them. Because they can always point to the data and say, "This is what the data tells us."

However, it did not lead to the great results they had hoped for.

Data is, of course, a very useful tool for making better decisions, but I believe things can go wrong when data starts to drive decisions.

Data, no matter how powerful, is just a tool, and to keep that in mind, I find this device very helpful.

Many of you will...

(Laughter) Before data existed, this was the vehicle for decision making.

(laughs) I think many of you know.

This toy is called the Magic 8 Ball. This is really great. Because when you have to make a decision, it's a yes or no question and all you have to do is shake the ball. That way you'll get the "most likely" answer in real time in this window.

It will be released later for tech demos.

(Laughter) Now, the problem, of course, is that I've made some decisions in my life that, in hindsight, I should have listened to Ball.

But of course, if you have data available, you'll want to replace it with something more sophisticated, such as data analysis, to make better decisions.

However, the basic settings remain the same.

So while Ball may get smarter and smarter, I believe it's still up to us to decide if we want to achieve something special on the right end of the curve.

And indeed, I think it's a very encouraging message that it's beneficial to make decisions, be an expert in what you do, and take risks in the face of massive amounts of data.

Because at the end of the day, it's risk, not data, that gets you to the right end of the curve.

thank you.

(applause)

In the early 1960s, Dick Fosbury tried almost every sport before turning to the high jump at age 16, but never excelled in any of them.

But when he couldn't keep up with the strong college athletes using the standard high jump technique of the time, Fosbury tried something else: jumping backwards.

Instead of the traditional straddle technique of jumping with both feet forward and facing the bar, he jumped with his back to the bar.

Fosbury improved his record by more than half a foot and surprised his coaches with this strange new style of high jump.

Over the next few years, Fosbury perfected his high jump style, winning the US national trials and securing a spot at the 1968 Mexico Olympics.

At the Olympics, Fosbury stunned the world with his new technique, winning gold in the Olympic record jump of 2.24 meters.

By the next Olympics, nearly all high jumpers had adopted a discipline known as the Fosbury Flop.

What is the secret of that technique?

It's in a concept in physics called the center of mass.

For any object, we can determine the average position across its mass by considering how the mass is spread around the object.

For example, the center of mass of a flat rectangular object with uniform density is at the intersection of both diagonals and equidistant from each corner.

The center of mass of other objects can be found by similar calculations or by finding the balance point of the object directly below the center of mass.

Try to balance the broom by holding the broom and slowly bringing it closer until your hands meet.

This balance point is directly below the broom's center of gravity.

We humans care too.

When most people stand up, their center of gravity is around their stomach, but what happens to your center of gravity when your hands are in the air?

Center of gravity moves up.

It constantly moves based on your body position as you move throughout the day.

It can also move outside the body.

When you slouch, your center of gravity is under your bent stomach, where you have no mass at all.

Strange to think, but this is the average position of all populations.

The center of mass of most objects is outside the body.

Think donuts and boomerangs.

Then look at the Fosbury Flop to track the position of the jumper's center of gravity.

Jumpers run so fast that they jump by changing horizontal speed to vertical speed.

wait...there.

Look at the center of gravity as the jumper's body bends backwards.

It's under the bar.

That's the secret of jumping.

The old technique, pre-Fosbury, required the jumper to apply enough force to lift the center of gravity several inches above the bar to clear it.

Not so with the Fosbury Flopper.

The genius of the Fosbury Flop is that it allows the jumper to lift the body much higher than before while applying the same amount of force.

That means he can lift the bar very high, and an arched body can do it even if he can't lift his center of gravity any further.

Fosbury's technique took the high jump to new heights by decoupling the jumper's body from the center of gravity, giving him more room to clear higher bars.

So while the Fosbury flop may be the only big step forward in sports history, it's also a big setback.

All objects around you are made up of submicroscopic units called molecules.

And molecules are made up of individual atoms.

Molecules frequently break down to form new molecules.

On the other hand, virtually every atom you come into contact with throughout your life, the atoms in the ground beneath you, the air you breathe, the food you eat, and the atoms that make up all living things, including you, have existed for billions of years and were created in places quite different from our planet.

I would like to share with you how these atoms came to be.

It all started 14 billion years ago with an event called the Big Bang, which resulted in the creation of a universe made entirely of gas.

There were no stars or planets.

Gases consisted only of atoms belonging to the simplest elements.

About 75 percent was hydrogen, and almost all the rest was helium.

Elements such as carbon, oxygen and nitrogen do not exist.

No iron, no silver, no gold.

At some locations the density of this gas was slightly higher than at others.

Gravity causes these places to attract more gas, further enhancing the gravitational pull, pulling in more gas.

Eventually, a large dense gas sphere formed and contracted under its own gravity, resulting in internal heating.

At some point, the center of such a ball becomes hot enough for nuclear fusion to occur.

When hydrogen atoms collide to form helium, they release a large amount of energy powerful enough to counteract the contraction force of gravity.

Equilibrium occurs when the energy pushed out of the fusion reaction matches the gravitational force pulling all the gas inwards.

A star is born from it.

Nuclear fusion reactions in the core of massive stars, over their lifetimes, produce not only helium, but also carbon, oxygen, nitrogen, and all the other elements in the periodic table, all the way down to iron.

Eventually, however, the core will run out of fuel and collapse completely.

It causes an incredibly powerful explosion called a supernova.

There are two things to note about how supernovae produce elements.

First, this explosion releases so much energy that nuclear fusion rages, forming elements with atoms even heavier than iron, such as silver, gold, and uranium.

Second, all the elements that had accumulated in the core of the star, such as carbon, oxygen, nitrogen, and iron, as well as all the elements formed in the supernova explosion, are ejected into interstellar space, where they mix with the gas already there.

And history repeats itself.

Gas clouds contain many elements besides the original hydrogen and helium, and there are dense regions that attract more matter.

As before, new stars are born.

Our sun was born in this way about 5 billion years ago.

That means the gas from which it originated has itself been enriched with many elements from supernova explosions since the universe began.

In this way the sun absorbed all the elements.

It's still mostly 71 percent hydrogen and most of the rest is 27 percent helium.

However, keep in mind that while the first star was composed only of hydrogen and helium, the rest of the elements in the periodic table make up 2 percent of the Sun.

And what about Earth?

Planets form from the same gas clouds as the stars themselves, as an incidental process to star formation.

Small planets like ours do not have enough gravity to hold large amounts of hydrogen and helium gas because they are so light.

Thus, carbon, nitrogen, oxygen, etc. make up only 2% of the gas clouds that form the Earth, yet these heavier elements form the majority of the Earth and everything on it.

Think about this. Except for hydrogen and some helium, the ground you walk on, the air you breathe, you, are all made up of atoms made inside stars.

When scientists first figured this out in the early 20th century, famous astronomer Harlow Shapley commented, "We are the brothers of rocks and cousins ​​of clouds."

Our story is about a girl named Iris.

Iris is very sensitive.

(Birds chirping) So much she cries all the time.

She cries when she's sad, when she's happy (Godzilla roars), and even the smallest things.

She has special lacrimal glands to make new tears and special tubes called puncta to drain old tears.

And she cries so much that she cries 10 ounces a day, 30 gallons a year.

In fact, if you look closely, you can see that she cries a little all the time.

The basal tears, which Iris constantly secretes, form three thin layers to cover her and keep dirt and debris at bay.

Immediately next to the iris is a layer of mucus, the whole is fixed to her.

Above it is a layer of water that keeps the iris hydrated, repels invading bacteria, and protects the skin and cornea from damage.

And finally, there is the lipid layer, the oily outer membrane that keeps the surface smooth for the iris to show through and prevents the other layers from evaporating.

Usually, Iris goes about her day not really realizing that rudimentary tears are doing their part.

That's kind of their gist.

One day, she meets a girl named Onion.

Iris quickly becomes infatuated.

Onion looks gorgeous in her bright purple jacket and smells amazing.

So Iris invites Onion to dinner at her house.

But when she comes in and takes off her jacket, something horrible happens.

When you take off an onion's jacket, a chemical reaction takes place that transforms the sulfoxide that makes onions smell good into sulfenic acid, and then the nasty substance with the long name of syn-propaneethial S-oxide.

Gus stabbed Iris and suddenly she started crying helplessly and uncontrollably.

These reflex tears are different from the basal tears that Iris is used to.

Designed to wash away harmful substances and particles, much more is released and the water layer contains more antibodies to deter any trying microbes.

Both Iris and Onion are destroyed.

They know they can't keep the relationship going if Iris hurts and cries every time Onion takes off his jacket.

So they decide to separate.

Iris stopped crying as Onion walked out the door.

And soon it will start again.

Only now she is shedding emotional tears instead of reflex tears.

If someone is too sad or too happy, it can feel like they've lost control and can be dangerous.

So, emotional tears are pumped in along with other physical reactions such as increased heart rate and slowed breathing to stabilize the mood as quickly as possible.

But scientists still don't know exactly why or how the tears themselves help.

They can be social mechanisms to elicit sympathy or show submission.

However, some studies have also found that emotional tears contain high levels of stress hormones such as ACTH and enkephalins, which are endorphins and natural pain relievers.

In this case, emotional tears not only calm Iris directly, but also let others know about her emotional state.

I'm sorry that it didn't go well with Onion and Iris, but don't worry.

As long as all three types of tears are working to keep you in balance and healthy, your symptoms will improve.

You know.

Our grandparents' generation created an amazing system of canals and reservoirs to allow people to live in places where water is scarce.

For example, during the Great Depression they built the Hoover Dam, which gave birth to Lake Mead, allowing the cities of Las Vegas, Phoenix, and Los Angeles to provide water to people who lived in very dry places.

In the 20th century, we literally spent trillions of dollars building the infrastructure that supplied our cities with water.

From an economic development perspective, it was a great investment.

But over the past decade, we have seen these critical lifelines and water resources threatened by the combined effects of climate change, population growth and competition for water resources.

This figure shows changes in Lake Mead's surface over the past 15 years.

From around 2000, you can see that the water level of the lake began to fall.

And the rate of decline was so rapid that Las Vegas' drinking water withdrawals would remain high and depleted.

The city is so concerned about this that it recently built a new drinking water intake structure called the "third straw" to pump water from the lake's deeper depths.

The challenges associated with supplying water to modern cities are not limited to the American Southwest.

In 2007, Australia's third largest city, Brisbane, ran out of water within six months.

A similar drama is happening today in São Paulo, Brazil. The city's main reservoir, which was completely full in 2010, is nearly empty today as the 2016 Summer Olympics approach.

For those of us who are fortunate enough to live in some of the world's largest cities, we have never experienced the devastating effects of drought.

We like to complain about having to shower in the Navy.

We want our neighbors to see our dirty cars and brown grass.

However, I have never actually faced a situation where I turned on the faucet and nothing came out.

That's because in the past, when things got worse, it was always possible to expand the reservoir or dig a few more groundwater wells.

Now, in times when water resources are all contested, it would be impossible to rely on this tried and true method of supplying water.

Some believe that fetching water from nearby rural areas can solve urban water problems.

But this is a politically, legally and socially dangerous approach.

And even if we succeed in getting water from our rural neighbors, we are only shifting the problem to someone else, and there is a good chance it will come back to hit us in the form of higher food prices and damage to the aquatic ecosystems that already depend on that water.

I believe there are better ways to solve the urban water crisis. I think it's about developing four new local water sources that can be compared to taps.

If we can invest wisely in these new water sources in the coming years, we can solve our cities' water problems and reduce the likelihood of encountering devastating drought impacts.

Now, if you had told me twenty years ago that a modern city could exist without an imported water supply, I probably would have dismissed you as an unrealistic, ignorant dreamer.

But my own experience, working in some of the most water-scarce cities in the world over the last few decades, has shown us that we have the technology and management skills to make a real transition from imported water. That's what I want to talk to you about tonight.

The first local source of water that needs to be developed to solve urban water problems is the one that flows with the city's rainwater.

One of the great tragedies in urban development is that as cities grew, all surfaces began to be covered with concrete or asphalt.

And doing so would require the construction of storm drains to drain the water that falls on the city before it floods, which is a waste of vital water resources.

Let's take an example.

This figure shows how much water the city of San Jose could harvest if it were possible to harvest rainwater that falls within the city limits of San Jose.

The intersection of the blue line and the dotted black line shows that if San Jose could capture half of the water that falls on the city, it would have enough water to survive for a year.

Now, I know what some of you are probably thinking.

“The answer to our problem is to build a very large tank, attach it to the roof gutter downspout and start collecting rainwater.”

Here's an idea that might work in some places.

However, if you live in a place where it rains mostly in the winter and most of your water demand occurs in the summer, it is not a cost-effective way to solve your water problem.

And once California experiences the effects of several years of drought, as California is currently experiencing, it won't be able to build rainwater tanks big enough to solve the problem.

I think there are more practical ways to collect rainwater and stormwater that falls on our cities. It's about capturing it and letting it seep into the ground.

After all, many of our cities sit on natural water storage systems that can hold large amounts of water.

For example, historically, Los Angeles has gotten about one-third of its water supply from a huge underground aquifer in the San Fernando Valley.

Now, as you watch the water fall off the roof, run down the lawn, and run down the gutters, you might wonder, "Do I really want to drink that?"

Well, the answer is that you don't want to drink until you've been treated a little.

Therefore, the challenges we face in urban water harvesting are to capture water, purify it, and bring it underground.

And that's exactly what the City of Los Angeles is doing with a new project under construction in Burbank, California.

This illustration shows a stormwater park under construction by connecting a series of rainwater collection systems or stormwater sewers and directing the water to an abandoned gravel pit.

The water captured in the quarry slowly passes through man-made wetlands, enters baseball fields there, seeps into the ground and recharges the city's drinking water aquifers.

In the process of penetrating the ground through wetlands, water encounters microorganisms that live on the surface of plants and soil, purifying the water.

And if the water is still not clean enough to drink after going through this natural treatment process, the city can treat it again as it is pumped from the groundwater aquifer before it reaches people.

The second faucet that needs to be opened to solve the city's water problem flows with the wastewater coming out of the sewage treatment plant.

Well, many of you are probably familiar with the concept of recycled water.

You've probably seen signs like this to show that shrubbery, highway medians, and local golf courses are being fed with water from a sewage treatment plant.

We have been doing this for decades.

But what we have learned from experience is that this approach is much more expensive than we expected.

Because once you've built your first few water recycling systems near your sewage treatment plants, you'll need to build longer and longer networks of pipes to get the water where it's needed.

And that would be prohibitive in terms of cost.

What we have discovered is that a much more cost-effective and practical way to recycle wastewater is to turn treated wastewater into potable water through a two-step process.

The first step in this process is to pressurize the water and force it through a reverse osmosis membrane. This membrane is a thin permeable plastic membrane that allows the passage of water molecules but traps and retains salts, viruses and organic chemicals that may be present in the wastewater.

The second step in the process is to add a small amount of hydrogen peroxide and expose the water to UV light.

UV light breaks hydrogen peroxide into two parts called hydroxyl radicals. These hydroxyl radicals are a very powerful form of oxygen that decomposes most organic chemicals.

Water that has undergone this two-step process is safe to drink.

For the last 15 years I have been researching recycled water using every measurement technique known to modern science.

Some chemicals were found to be able to get through the first step of the process, but very few are present by the time the second step, the advanced oxidation process, is reached.

And that's in stark contrast to the water we take for granted, which we drink regularly all the time.

There is another way water can be recycled.

This is a recently constructed man-made treated wetland on the Santa Ana River in Southern California.

This treated wetland is fed by a portion of the Santa Ana River and during the summer months consists almost entirely of wastewater from cities such as Riverside and San Bernardino.

Water enters our treated wetlands and is exposed to sunlight and algae, which break down organic chemicals, remove nutrients and inactivate waterborne pathogens.

The water is returned to the Santa Ana River, flows to Anaheim, where it is extracted, seeps into the ground, becomes drinking water for the City of Anaheim, and completes the journey from the Riverside County sewers to the Orange County drinking water supply.

Now, you might think that this idea of ​​drinking wastewater is some kind of futuristic fantasy, or generally not done.

California already recycles about 40 billion gallons of wastewater annually through the two-stage advanced treatment process I just talked about.

This is enough water to supply about 1 million people if it were the only source of water.

The third faucet that we need to open is not a faucet at all, but a kind of virtual faucet, which is the water saving we manage to do.

And with about half of water use occurring outdoors in California and other modern American cities, it's outdoors where you need to think about saving water.

It turns out that in the current drought, it's possible for the grass to survive and the plants to survive with about half the water.

So you don't have to paint concrete green, install astroturf, or buy cacti.

California-friendly landscapes can be achieved with soil moisture detectors and smart irrigation controllers to bring beautiful green landscapes to cities.

The fourth and final tap that needs to be opened to solve the city's water problem is desalinated seawater.

Now, you've heard what people say about seawater desalination.

"If you don't have a lot of water and you have a lot of oil and you don't care about climate change, that's great."

Desalination of sea water is energy intensive no matter how you cut it.

But the characterization of seawater desalination as a non-startup is hopelessly outdated.

We have made great strides in seawater desalination over the past 20 years.

This photo shows the Western Hemisphere's largest desalination plant, currently under construction north of San Diego.

Compared to the desalination plant built in Santa Barbara 25 years ago, this treatment plant uses about half the energy to produce a gallon of water.

But just because seawater desalination consumes less energy doesn't mean you should start building desalination plants everywhere.

Of all the options we have, perhaps the most energy intensive and potentially environmentally damaging option is building a local water supply.

that's right.

With these four water sources, we can get rid of our dependence on imported water.

Reinventing the way land surfaces and sites are landscaped can reduce outdoor water use by about 50%, thereby increasing water availability by 25%.

By recycling the water that flows into our sewers, we can increase our water supply by 40%.

And combining rainwater harvesting with seawater desalination can make up for the difference.

So let's build a water supply that can withstand whatever challenges climate change throws at us in the years to come.

Use local water sources and create watering facilities that leave more water in the environment for fish and food.

Create a water system that is in harmony with environmental values.

And let's do it for our children and grandchildren and tell them that this is the system they will have to take care of in the future because this is the last chance to build a new kind of water system.

Thank you for your attention.

(applause)

Why does eating hot chilies make my mouth burn?

And how do you soothe burns?

Why does eating wasabi make your eyes moist?

And how hot is the hottest spice?

Let's do some backup.

First, what is spicy?

We often say it tastes spicy, but it doesn't actually taste sweet, salty, or sour.

Rather, what really happens is that certain compounds in spicy foods activate a type of sensory neuron called a multimodal nociceptor.

These are the same receptors found throughout the body, including the mouth and nose, that are activated by extreme heat.

In other words, the reason your mouth feels like it's burning when you eat a chili pepper is because your brain actually recognizes that the chili pepper is burning.

The opposite happens when you eat anything that contains menthol.

Cool, minty-like compounds activate cold receptors.

When these heat-sensitive receptors are activated, the body thinks it's coming into contact with a dangerous heat source and reacts accordingly.

This is why you start sweating and your heart beats faster.

Bell peppers evoke the same fight-or-flight response that your body responds to most threats.

However, you may have noticed that not all spicy foods are equally spicy.

And the difference lies in the types of compounds involved.

Capsaicin and piperine, found in black pepper and chili peppers, are made up of large, heavy molecules called alkylamides, most of which remain in your mouth.

Mustard, horseradish, and wasabi are made up of small molecules called isothiocyanates, which easily float in your sinuses.

This is why chili peppers burn your mouth and wasabi burns your nose.

A standard measure of the spiciness of food is its rating on the Scoville scale. The Scoville Scale measures how much the capsaicin content dilutes before the spiciness is no longer perceived by humans.

Sweet peppers have a Scoville Heat Unit of 0, while Tabasco sauce has a Scoville Heat Unit of 1,200 to 2,400 units.

The race to be the hottest chili is ever-on-going, but two chili peppers generally come out on top. Trinidad Morga Scorpion and Carolina Reaper.

These peppers measure between 1.5 and 2 million Scoville thermal units, which is about half the units contained in pepper spray.

So why would you want to eat something that causes you so much pain?

No one really knows when or why humans started eating chili peppers.

Archaeologists have found spices such as mustard and human remains dating back 23,000 years.

However, it is not known whether the spice was used as food or medicine, or simply as a decoration.

More recently, 6,000-year-old clay pots containing charred fish and meat also contained mustard.

One theory is that humans began adding spices to their food to kill bacteria.

Also, some studies indicate that spices developed primarily in temperate climates where microbes are more prevalent.

But why we continue to be exposed to spicy foods today is still a bit of a mystery.

For some people, eating spicy food is like riding a roller coaster. They enjoy the thrill that follows, even if the feeling in the moment is unpleasant.

Some studies even show that people who like to eat spicy food are more likely to enjoy other adrenaline-rich activities such as gambling.

A preference for spicy food can also be genetic.

And if you're looking to do a little training to increase your tolerance to spice, know this. Some studies say the pain doesn't get any better.

It's only going to get tougher.

In fact, researchers found that even people who liked to eat spicy food did not rate their burns as less painful than those who did not.

They seem to prefer pain.

Pain the heat receptors as much as you like. But remember that spicy food will burn you.

An environmental mystery is underway, which begins with seemingly trivial details and uncovers a global disaster.

One day you realize that honey on your morning toast is more expensive.

Investigate the reasons for the price hike instead of switching to jam.

What you find is shocking.

The number of domesticated bees in the United States is declining at an alarming rate.

This decline appears to be too great to be explained by common bee death causes such as disease, parasites and starvation alone.

At a typical crime scene, few adult bees remain in the hive, except perhaps a lone queen bee and a few other survivors.

It is filled with pristine food stores and swarms of immature larvae, suggesting that the adults left before hatching.

But what's particularly creepy is the lack of any apparent mass of dead or dying bees nearby.

Either they have forgotten their way back to their nests, or they have simply disappeared.

These mysterious disappearances are nothing new.

Humans have been collecting honey for centuries.

But it wasn't until European settlers introduced the subspecies Apis mellifera in the 1600s that we were able to domesticate bees.

Since the 19th century, beekeepers have reported occasional mass disappearances, with cryptic names such as vanishing disease, spring weakness, and autumn collapse.

However, in 2006 such losses were found to affect more than half of all hives in the United States, giving the phenomenon a new name: colony collapse disorder.

The scariest thing about this mystery isn't that you have to go back to using regular sugar in your tea.

We farm bees for our honey, but they also pollinate crops on an industrial scale, producing more than a third of America's food production this way.

So how can we find the culprit behind this disaster?

Here are three possible culprits.

Evidence A: Pests and diseases.

The most notorious is the varroa mite. This is a small red pest that not only invades colonies and feeds on bees, but can also carry pathogens that stunt the bees and shorten their lifespan.

Evidence B: Genetics.

The queen bee is the center of a healthy hive.

But the millions of queen bees currently in circulation in commercial hives have been bred from just a few original queens, raising concerns that a lack of genetic diversity could weaken bees' defenses against pathogens and pests.

Evidence C: Chemicals.

Pesticides used in both commercial bee hives and crops to ward off parasites can find their way into the food and water bees consume.

Researchers have even found that some pesticides damage the homing ability of honeybees.

So there are lots of clues in the file, but no clear ones.

In fact, the scientists who are the actual detectives in this case face disagreement over the cause of colony collapse disorder.

At this time, several factors are believed to be responsible.

Bees aren't necessarily endangered, but it's important for scientists to solve the bee extinction case because fewer bees overall means less pollination and higher food costs.

Because while honey shortages may be troublesome, crop shortages are a real pain.

You'd probably be offended if someone called you scum, but scientifically, that might not be too far off.

Have you ever wondered where your food comes from?

You might say it comes from plants, animals, or even fungi, but you don't want to think about the rotting organisms and faeces that those plants, animals, and fungi feed on.

So, in reality, you and most of the substances in your body are only a few degrees away from something like pond dregs.

From coral reef creatures to lake fish to savannah lions, all species within an ecosystem derive their nourishment directly or indirectly from carcasses.

Most of the organic matter in our bodies is derived from CO2 and water through photosynthesis, if we go back far enough.

Plants use the energy of sunlight to convert carbon dioxide and water from the environment into glucose and oxygen.

That glucose is then converted into more complex organic molecules to form leaves, stems, roots, fruits, etc.

The energy stored in these organic molecules supports the food chain we are all familiar with.

You've probably seen illustrations like this and others like this.

These eco-friendly food chains start with living plants at their roots.

However, in real terrestrial ecosystems, less than 10% of plants are eaten during their lifetime.

What will happen to the remaining 90 people?

Now look at the ground on an autumn day.

Living plants shed dead leaves, broken branches, and even underground roots.

Many plants are lucky enough to survive their entire life without being eaten, eventually dying and leaving behind debris.

Do all inedible, undigested, dead plant parts make up 90% of terrestrial plants?

It becomes the detritus, the basis of the so-called brown food chain, similar to this one.

What happens to plants also happens to all other organisms up the food chain. Some can be eaten alive, but most are eaten only after they have died and rotted.

And through this food chain, organisms excrete organic matter, excrete digestive wastes, and then die and decompose their bodies.

Death sounds horrible, doesn't it?

But it's not.

All detritus is eventually consumed by microbes and other scavengers, so it actually forms the basis of the brown food chain that sustains many other organisms, including us.

Scientists are learning that this detritus is an unexpectedly large source of energy, powering most natural ecosystems.

But the interactions within the ecosystem are even more complex than that.

What the food chain really represents is a single path of energy flow.

And within any ecosystem, many of these currents are linked together to form a rich network of interactions, a food web, supported by carcasses at every step.

The resulting food web is so tightly connected that almost all species are within 2 degrees of detritus, and so are we humans.

They probably won't eat rotten things, poop, pond dregs, etc. directly, but they will probably eat food sources.

Many of the animals we eat either eat the detritus itself directly or eat animal by-products, including bottom feeders such as pork, poultry, mushrooms, shellfish and catfish.

So if you think nature has a lot of waste, you are right.

But one organism's trash is another organism's gold, and all that rotting carcass ultimately provides the energy that feeds us and most life on Earth as it makes its way through the food web.

This is the material for my thoughts.

Choose a card. Any card will do.

Actually, take everything in your hands and see.

This standard 52 card deck has been used for centuries.

Every day, thousands of like-minded people are shuffled across casinos around the world, and each time the order is rearranged.

Still, every time you pick up a well-shuffled deck like this, you're almost certainly holding a card arrangement that has never existed before in history.

What should I do?

The answer lies in how many different arrangements you can place the 52 cards or any object.

52 may not seem like a big number, but let's start with a smaller number.

Suppose there are four people trying to sit on four numbered chairs.

How many ways are there to sit?

First, any of the four can sit in the first chair.

Once this selection is made, there are only three people standing.

When the second person sits down, only two candidates remain for the third chair.

And when the third person sits down, the last person standing has no choice but to sit in the fourth chair.

If you manually write out all the possible arrangements, or permutations, you'll find that there are 24 ways 4 people can sit on 4 chairs. However, when working with larger numbers, this can take a significant amount of time.

So let's see if there is a quicker way.

If you start over again, you'll see that each of the four initial choices for the first chair leads to three more possible choices for the second chair, and each of those choices leads to two more choices for the third chair.

So instead of counting each final scenario individually, we can multiply the number of choices for each chair. So 4 x 3 x 2 x 1 gives the same result of 24.

An interesting pattern emerges.

Start with the number of objects you want to place (4 in this case) and multiply by successively smaller integers until you reach 1.

This is an exciting discovery.

So interesting that mathematicians chose to represent this kind of calculation, known as factorial, with an exclamation mark.

As a general rule, the factorial of a positive integer is computed as the product of the same integer and all smaller integers up to 1.

In this simple example, the number of ways to place 4 people on a chair is written as 4 factorials, which equates to 24.

Now let's go back to the deck.

There are 52 factorial ways to place 52 cards, just as there are 4 factorial ways to place 4 people.

Luckily, you don't have to calculate this by hand.

Just put the function into the calculator and you'll find that the number of possible arrangements is 8.07 x 10^67, or roughly 8 followed by 67 zeros.

How big is this number?

Well, if a new permutation of 52 cards were written out every second from 13.8 billion years ago, when the Big Bang is believed to have happened, that writing would continue now and for millions of years to come.

In fact, there are more ways to arrange this simple deck of cards than there are atoms on Earth.

So the next time it's your turn to shuffle, remember that you have something that never existed and may never exist.

Sugar is playing hide and seek with you.

Considering all the sugar in the soda, ice cream, candy, and big white bag that says Sugar, you'd think it would be pretty easy to win.

People get about half of their added sugar from these drinks and treats, so it may seem like the sugar is hidden out of sight, but like someone in the witness protection program, the other half is hidden in the most suspicious places.

Check ingredients for ketchup, bologna, spaghetti sauce, soy milk, sports drinks, fish sticks, and peanut butter.

Sugar is hidden in most of their products.

In fact, three-quarters of the more than 600,000 items available in grocery stores have added sugar.

But how is the sugar hidden?

Can't we just look at the food label?

It's not that easy.

There are many other names for added sugar, like my friend Robert being called Bob, Robbie, Rob, Bobby, Roberto, etc.

Often, you don't mean 5 or 6, try 56.

There's brown rice syrup, malted barley, Demerara, Florida Crystal, Muscovado and, of course, high fructose corn syrup, sometimes called HFCS or corn sugar.

Sugar's tricky nickname also has a nickname.

Grape and apple concentrates have the same effect on your body as their 55 sweet twins.

Organic evaporated sugar cane juice is supposed to be healthy, but evaporation gives you sugar.

Chemically speaking, they are all the same.

To make matters worse, when one type of product contains multiple types of added sugar, they get buried in a long list of ingredients, so the sugar content may seem fine, but when you add them all together, sugar can be the largest ingredient.

Currently, the FDA has not suggested a recommended daily limit for sugar, so it's hard to tell whether that 65 grams in a bottle of soda is too much or too much.

However, the World Health Organization recommends limiting sugar to just 5% of total calories, or about 25 grams per day.

So 65 grams is well over double that.

But what exactly is sugar?

What is the difference between glucose and fructose?

Both are carbohydrates with the same chemical composition of carbon, hydrogen and oxygen.

However, they have very different structures and behave quite differently in our bodies.

Glucose is the best source of energy for almost all life on earth.

Metabolized in all organs in the body.

On the other hand, fructose is mainly metabolized in the liver, and when the liver is overloaded with sweet, sweet fructose, the excess is metabolized into fat.

In fact, fresh fruit contains fructose, which is naturally occurring and does not cause an excessive load as the fiber in the fruit slows down its absorption.

This gives your liver the time it needs to do its job.

Sugar is what makes cookies chewy and candy crunchy.

The bread crust will also turn a beautiful golden color.

It is also an excellent preservative. Because it does not spoil or evaporate, added foods tend to be easier to store and transport over long distances, and cheaper.

That's why sugar is hiding everywhere.

In fact, it might be easier to list sugar-free foods like vegetables, eggs, meat, fish, fruit, raw nuts, and even your kitchen sink.

You can avoid hidden added sugars by simply choosing water instead of sodas, juices, and sports drinks.

At the very least, pay attention to food labels to keep your sugar intake at a healthy level.

Because in this hide-and-seek game, you win every time you don't find any extra sugar.

A few years ago I received such a spam email.

And it managed to get through the spam filter.

For some reason I don't know, I got it in my inbox. It was from a man named Solomon Odonko.

(Laughter) I know.

(Laughter) It went like this. “Hi James Veitch, Solomon, I have an interesting business proposal to share with you.”

Well, my hand felt like it was on the delete button.

I was looking at my cell phone. I was wondering if this could be removed.

Or maybe we should all do something we've always wanted to do.

(Laughter) So I said, "Solomon, your email is intriguing."

(Laughter) (Applause) And then the game started.

He said, "Dear James Veitch, I will send you the gold."

(Laughter) “You get 10% of the gold you distribute.”

(Laughter.) So I found out I was dealing with an expert.

(laughs) "How much is that?" I said.

He said 'start small' - I thought oh - then he said 'start with 25kg.

(Laughter) That should be worth about $2.5 million. ”

I said, "Solomon, if you're going to do it, let's do it big.

(Applause) All right. how much gold do you have? ”

(Laughter) He said, 'It doesn't matter how much money I have, it's your processing power that matters.

Trial shipping is possible from 50 kg. ”

Me "50 kg?

There is absolutely no point in doing this unless you are shipping at least a ton. ”

(Laughter) (Applause) He said, "What do you do for a living?"

(Laughter) I said, 'I'm an executive bank manager for a hedge fund.'

(Laughter) Friends, this isn't the first time we've shipped bullion.

Then I started panicking.

"Where are you based?"

I don't know about you, but I think you have to sign it if you use the postal service.

"It won't be easy to convince my company to ship in bulk," he said.

I said, "Solomon, I fully agree with you on this matter.

I'm creating visuals to submit to the board of directors.

Stay strong. ”

(Laughter) This is what I sent to Solomon.

(Laughter) (Applause) I don't know if there's a statistician at home, but there's definitely something going on.

(Laughter) I said, 'Solomon, I have attached a helpful chart to this email.

I had one of my assistants calculate the numbers.

(Laughter) We are ready to ship as much gold as possible. ”

They always have their moments of trying to strike a chord, and that was the case with Solomon.

"If the deal goes well, I'm very happy because I get a lot of commission," he said.

And he said, "What about real estate?"

I thought for a long time.

And I said, "One word, hummus."