Without fertilizers, we can't expect enough production to reach the people of the world.

There are currently 7 billion people on earth.

We'll reach nine billion in less than 40 years.

Will there be enough phosphorus for the next generation to eat?

Where can I find Lynn to understand this challenge?

I will explain

First, if we assume that the amount of phosphorus used in fertilizer is 100%,

Only 15% reaches the plant, the rest is lost.

So 85% seeps into the soil and ends up in lakes, and this excess phosphorus causes algal blooms.

This is a problem, it's kind of silly

Only 15% of the phosphorus used reaches the plants.

what a waste

That's right, and what's worse, it's expensive.

Nobody wants to throw money out the window, but that's the reality.

85% is lost

Modern Agriculture Depends on Phosphorus

Only 15 percent goes to the plants, so we have to add more.

Where do you get that phosphorus?

Mainly mined from mines

This wonderful article was published in Nature in 2009, and sparked a debate about the phosphorus crisis.

No one had ever said that phosphorus, an essential nutrient for life, was declining.

Politicians and scientists alike acknowledged that they were facing phosphorus shortages.

What you're looking at is an open pit mine in the United States, which gives you an idea of ​​how big it is.

I hope this gives you an idea of ​​the scale

Phosphorus is mined in mines

Let's compare it to oil. The oil crisis is talked about, so is global warming, but the phosphorus crisis is not.

oil has alternatives

Biofuels, solar power, hydroelectric power, phosphorus is not. Phosphorus is irreplaceable for life.

What about the current world phosphorus reserves?

This graph gives an overview

The solid line is the forecast for phosphorus reserves.

will peak in 2030

and by the end of the century it will be gone

Dotted line represents mining volume

As you can see, we're close to reserves in 2030, and I'll be retired before then.

But we can't avoid this big problem, and I want everyone to be aware of this problem.

Is there any solution?

what should i do? facing a paradox

Phosphorus available will decrease

Meanwhile, by 2050, the population will reach nine billion, and according to the Food and Agriculture Organization of the United Nations, by 2050 we will have to produce twice as much food as we do today.

We have less phosphorus available, but we have to produce more food.

What should I do?

It's really a paradox

Are there any solutions or alternatives for using phosphorus effectively?

Keep in mind that 80% are destined to be lost.

So the solution I'd like to present to you is a microscopic fungus that has existed long before plants ever existed on earth, and it's a very mysterious, simple yet complex entity.

This little fungus has fascinated me for over 16 years.

And as a result, after a lot of research, the fungus became a model for research.

This fungus lives symbiotically with the roots.

It's a mutually beneficial relationship, also called mycorrhizae.

I'm going to explain the composition of mycorrhiza in this slide.

This is wheat root, one of the most important plants.

Roots usually find phosphorus on their own

It searches for phosphorus, but can only reach within a millimeter radius around the root.

If it exceeds 1 mm, it cannot be defeated by roots.

no more than that

Now let's compare it to this little fungus.

The fungus grows much faster and is very good at finding phosphorus.

It easily crosses the 1mm range, which is the limit of roots.

I didn't invent it, it's biotechnology that's been around for 450 million years.

Over time, the fungus evolves and takes every little bit of phosphorus and makes it useful to plants.

You're looking at a carrot root in nature, and you've got fungal filaments.

If you look closer, this fungus slowly seeps into the roots,

It multiplies between and eventually enters the cells of the root, and then takes on a dendritic form, increasing the exchange interface between the plant and the fungus.

Interchange begins through this structure

It's a two-way relationship. The fungus provides phosphorus, and the plant feeds the fungus.

It's a symbiotic relationship

Now let's plug mycorrhizae into the diagram above.

This time we will reduce the usable phosphorus to 25% instead of 100%

25% of this is beneficial to the plant, because over 90% of it reaches the plant.

Only a small amount of phosphorus flows into the soil.

This is the natural state

In some cases it is not necessary to add phosphorus

If you recall the graph from earlier, 85% of the phosphorous flows into the soil, but the plants have no access to it.

Because even though it's present in the soil, it's not soluble.

Plants can only use phosphorus in that state.

The fungus makes the phosphorus soluble and available to the plant.

I have a photo to back up my theory.

I did an experiment in a sorghum field.

The one on the left is traditionally farmed with 100% phosphorus.

The right side is reducing the phosphorus to 50% Look at the yield

You use half as much phosphorus, but you're more productive.

this method will work

In Cuba, Mexico, and India, we were able to get down to 25 percent, and in some places, we didn't even need to add phosphorus at all, because the fungi effectively pulled the phosphorus out of the soil.

Here is an example of a soybean field in Canada

I use mycorrhiza on one side of the field

The blue areas are more productive than the yellow areas.

Added mycorrhiza to the black rectangular compartment Added mycorrhiza to the black rectangular compartment

As I said, I didn't invent it.

Mycorrhizae have been around for 450 million years and are effective against a wide variety of modern plant species.

No longer experimental

Mycorrhizae exist, they do work, they're produced on an industrial scale and commercialized all over the world.

The problem is that it is not recognized

Growers and farmers are unaware of this problem

We already have the technology, and if we use the technology correctly, we can allay concerns about phosphorus reserves.

I am a scientist and I have a dream

i am passionate about this topic

If you ask me what my dream is after I retire, my dream is to establish a "mycorrhizal" brand when my phosphorus peaks, and that my children and grandchildren will buy products from that brand.

Thank you for your attention

(applause)

When you think of corruption, there are some typical people that come to mind.

power mania of the former Soviet Union

Saparmurat Niyazov is one of them.

Until his death in 2006, he was the absolute ruler of Turkmenistan, a Central Asian country rich in natural gas resources.

Niyazov really loved issuing executive orders.

At one point, I changed the names of the months of the year, and even created months named after myself and my mother.

They spent millions of dollars to create a bizarre cult of personality, culminating in a 12-meter-tall gold-plated statue of Niyazov, which towers over the capital's central square and rotates with the movement of the sun.

Niyazov was a bit of an eccentric person.

And then there are the stereotypes -- African dictators and ministers and officials.

Teodoro Obian

His father is president for life of Equatorial Guinea, a West African nation that has exported billions of dollars of oil since the 1990s, but has a truly appalling history of human rights violations.

The majority of the population lives in considerable poverty, even though the national income per capita is the same as in Portugal.

Obiang Jr. is buying himself a $30 million mansion in Malibu, California.

I went to the door

It's already a large site.

And I also bought an 18 million euro art collection that once belonged to the fashion designer Yves Saint Laurent, and then one gorgeous sports car, a bunch of million-dollar crap, and a Gulfstream jet.

Listen, until recently, his public service salary was less than $7,000 a month.

and Dan Etate

Former oil minister of Nigeria, he's also been convicted of money laundering during the Abacha years.

We spent a ton of time researching the billion-dollar -- yes, billion-dollar -- oil deals he was involved in. And the results were pretty shocking.

When it comes to corruption, it's easy to think: Corruption is something that's happening somewhere far away, a money-losing dictator or a villainous conspirator in a country that we know very little of, directly, where it doesn't matter what's going on there, it doesn't matter.

But is it really happening far away?

At 22, I was very lucky.

The first job I got right out of college was investigating the illegal trade in African ivory.

That's where my involvement with the corruption issue began.

In 1993, my friends and former colleagues, Simon Taylor and Patrick Alley, started an organization called Global Witness.

Our first activity was to look at how illegal logging is funding the Cambodian civil war.

A few years later, in 1997, I was in Angola undercover for "Blood Diamond."

You know this Hollywood movie, "Blood Diamond," starring Leonardo DiCaprio.

partly based on our work

In the capital city of Luanda, many landmine victims languished on the streets, war orphans lived in underground sewers, and only a few wealthy elites chatted about shopping trips to Brazil and Portugal.

It was such a crazy place

I was just battered in a hot, stuffy hotel room.

It's not about Blood Diamond

After a lot of conversations with locals, another problem emerged: the global spider web of corruption that is engulfing millions of dollars of oil money.

At the time, we were a really small organization, just a few people, and just thinking about how we could tackle corruption was a daunting task.

Yet over the years that we've worked together to campaign and research, I've seen it time and time again that it's not just greed, abuse of power, or the vague term "weak governance" that makes corruption on such a global scale.

Yes, they are all related, but what makes corruption possible is the existence of a global facilitator.

Let's go back to the people we talked about earlier.

We investigated everyone, but none of them could do anything alone.

Take Obiang Jr., for example, who couldn't afford fine art or a gorgeous home without help.

he did business with global bank

He had several corporate accounts in a bank in Paris, one of which was used to buy art, and an American bank sent 73 million dollars to the United States, some of which was used to buy a mansion in California.

Obiang Jr. didn't do everything under his own name.

used a ghost company

One was used to buy the property, and another company paid for its huge upkeep from a company in someone else's name.

In the case of Dan Etate

When I was oil minister, I granted oil rigs worth more than a billion dollars in today's value to a company whose real owner was Etate.

And the concession was later sold, with some sort of support from the Nigerian government -- watch your language, -- to a subsidiary of Shell, the two largest oil companies, and Eni of Italy.

So, in fact, the powerhouses of corruption lie far beyond countries like Equatorial Guinea, Nigeria, and Turkmenistan.

This dynamic works because of the problem of the international banking system, of the ghost companies of anonymous names, of the secrecy that has been tolerated in the oil, gas, and iron ore giants, and, above all, of politicians doing nothing but rhetoric and nothing really meaningful or effective in addressing this problem.

Let's talk about banks first.

Not surprisingly, banks accept dirty money, but they also put profit first and use destructive methods.

For example, in Sarawak, Malaysia,

Now only 5% of the forest remains untouched, only 5%.

why did this happen?

Because some elites and their facilitators have taken millions of dollars to allow industrial-scale deforestation for years.

We sent an undercover investigator to covertly film a meeting between the ruling elite. Some people were very upset that we filmed it, but you can see it on YouTube.

The Hong Kong and Shanghai Banking Corporation (HSBC) was financing the largest logging companies in the region, and they were destroying forests in Sarawak and elsewhere.

Banks made about $130 million by violating their own sustainability policies.

Shortly after we made the revelation, very soon after the revelation earlier this year, the bank announced a policy review on this matter.

is this progress? Maybe, but we'll be keeping a close eye on how this case unfolds.

And then there's the anonymous ghost company problem.

You know what it's like, ghost companies are often used by individuals and companies to avoid paying their fair obligations to society, which is to pay taxes.

But what's seldom brought to light is that ghost companies are being used to steal millions, millions of dollars, from poor countries.

Virtually every corruption case we've investigated involves a ghost company, and sometimes we don't even know who's involved in the transaction.

The World Bank recently did a study of 200 corruption cases.

They found that more than 70 percent of corruption cases involved anonymous ghost companies, with a total transaction value of $56 billion.

Many of these companies are now located in the United States, the United Kingdom, British overseas territories and royal dependencies, so it's not a foreign problem, it's a domestic problem.

As you can see, ghost companies are at the heart of a clandestine deal that benefits not the wealthy elites of ordinary citizens.

In one notable case we recently investigated, the government of the Democratic Republic of the Congo sold a high-value state-owned mining property to a ghost company in the British Virgin Islands.

I spoke with sources in the Congo and combed through company and other documents to try and uncover the nature of the transaction.

We were stunned to discover that these ghost companies were quickly selling off many of their properties to large London-listed international iron mining companies for huge profits.

The Africa Progress Panel, headed by Kofi Annan, estimated that the Congo has lost more than $13 billion to these deals.

That's almost double the combined annual budget for health and education in Congo.

Can the Congolese people get their money back?

The answer to that question, and who was really involved and what really happened, is probably never going to be revealed, and the secret is lying dormant in the company registers of the British Virgin Islands and elsewhere, and will never come to light unless we do something about it.

But what about oil, gas and mining companies?

It may feel like now to talk about them

It's no surprise that there is corruption in this sector.

Corruption is everywhere Why pick that sector?

because there is a lot of money involved

In 2011, exports of natural resources exceeded aid provided, 19 times more in Africa, Asia, Latin America, yes, 19 times more.

It's the worst for a lot of schools, universities, hospitals, startups, and many of them will never come to fruition, because some of the money has been stolen.

Back to the oil and mining companies, Dan Etate was involved in a billion-dollar deal.

Please allow me to read a bit of the manuscript from here.

On the surface, the deal seems simple.

Subsidiaries of Shell and Eni paid money to the Nigerian government for their excavation rights.

The Nigerian government transferred that exact same amount, exactly one dollar, to an account held by a ghost company whose hidden owner is Etate.

I was found guilty of money laundering, so that's what it is.

But here's the problem

We spent months researching, reading hundreds of pages of court documents, and finding evidence that Shell and Eni knew the money was going to that ghost company.

We should be able to see the flow of money in these transactions without having to make this effort.

these are national property

It should be used for the benefit of the people of that country.

But in some countries, citizens and journalists who attempt to expose these stories are harassed and arrested, and some even risk their lives to do this.

Finally, there are those in the world who believe that this type of corruption is inevitable.

just a way of doing business

Too complicated and too difficult to change

It's actually something we have to accept

But as someone who does this work and research, I think otherwise, because I've seen what can happen when an idea gains momentum.

The oil and mining sector, for example, has already started to create a truly global transparency standard to address some of these issues.

In 1999, Global Witness called on oil companies to be transparent about their payments on their deals, and some people laughed at the naivety of that tiny idea at the time.

But there are literally hundreds of civil society groups from all over the world coming together to fight for transparency that is fast becoming the norm and the law.

Two-thirds of the value of the world's oil and mining companies is covered by transparency laws, two-thirds.

This is how change is happening

this is progress

but still far from the goal

This is happening far away - it's not about corruption.

In a globalized world, corruption is truly a global transaction and requires global solutions, which we all need to support and push forward as global citizens, right here.

thank you

(applause)

The reason I'm here today can be summed up in three words.

Amy Klaus Rosenthal's wife

At the end of Amy's life, morphine-dizzy and receiving hospice care at home, Amy's memoirs appeared in the New York Times' Modern Love column on March 3, 2017.

It has been read by over 5 million people worldwide.

The content was unbearably sad, the humor was like a sarcastic prank, and it was brutally honest.

It was about the life we ​​lived together, but the focus was on me.

The title is "Will you marry my husband?"

It was in the form of a personal ad to sell me.

True to her word, Amy left space for me to write another love story.

Amy was my wife for half my life

A partner who raised three wonderful children who are now adults, but was my forever love, you know?

we shared a lot

We loved the same artworks, documentaries and music.

Music was an important part of our lives together.

and we have the same values

They were bound by deep affection, and that bond grew stronger until Amy's death.

Amy was a prolific writer

He's published more than 30 children's books, as well as two groundbreaking memoirs.

His posthumous publication, Dear Girl, co-authored with his daughter Paris, reached number one on the New York Times bestseller list.

She was a self-proclaimed 'tiny filmmaker'

Because I was only 155cm tall and all my video works were short films.

(Laughter) Amy's film work was a great example of her ability to bring people together.

He was also a very good public speaker, captivating children and adults of all ages around the world.

The only thing that makes my story of grief unique is that it's somewhat well-publicized.

But this journey of grief isn't just about me.

I am so grateful to Amy for giving me permission to live positively.

It's been a little over a year since my new life started, and I've learned a few things.

What I want to share with you here is how we can move forward in coping with loss and coping with it.

But before I do that, I think it's important to talk a little bit about the end of my life, because it's shaped how I've been feeling since seeing the end of my life.

Death is considered an untouchable taboo, right?

The last time Amy ate was January 9th, 2017.

After that, I managed to survive two months without eating solid food.

My doctors told me that hospice care can be done at home or in the hospital.

What I didn't say was that Amy's weight would be cut in half, that she would never go to bed with her husband again, and that going upstairs to her bedroom would feel like a marathon.

Hospice care at home sounds like a sacred end setting.

Of course, it feels good to not have medical devices blaring and turning on and off, and I can die at home surrounded by my family without being interrupted by forced drug administrations.

I tried my best to make the last few weeks meaningful.

We talked a lot about death.

It's going to happen to everyone at some point, and I know for sure, but it's been liberating to be able to talk about it without being particular about it.

We also talked about things like parenting.

I ask Amy how I'll be a good parent when she's gone.

Through this conversation, I was encouraged by Amy to know that I have great relationships with each of my children, and that I'm absolutely fine.

I'm sure you'll hope to be able to make decisions with Amy at many milestones in the future.

we were always on the same wavelength

It's an impudent request, but please have this conversation while you're still healthy.

don't put off

In practicing hospice care, we coordinated with visitors.

Even when her physical strength began to decline, it was admirable to see her patiently meet with the visitors.

One evening, she planned a gathering for the Claus family, and her parents and three siblings got together.

Then it continued to my friend's family.

Each shared their own wonderful memories of Amy and us.

Amy made a huge impact on her loyal friends.

Now, hospice care at home is hard on the family at the end of their life.

On a personal note, I want to tell you that I'm still haunted by memories of her last few weeks.

I remember walking back step by step to the bathroom while holding Amy.

I felt powerful

I'm not big by any means, but next to Amy's thin body, my arms looked healthy and they actually felt like they did.

That fragile body finally died in our house.

On March 13th of last year, my wife died of ovarian cancer, lying in our bed.

I held her dead body down the stairs, across the dining room, through the living room, onto a waiting stretcher, and sent her dead to be cremated.

The scene from that time never leaves my mind

If you know anyone who has experienced hospice, please let them know.

A man named Jason told me about his painful memories of dying at home, so all I have to do is tell him that if he ever needs someone to talk to, he's always there.

Even if the other person doesn't want to talk about it, it's nice to have contact with someone who has an image that will last forever.

Believe it or not, I've never been asked.

In the wake of Amy's memoirs, I experienced my grief publicly.

Many people who read the article encouraged me with warm thoughts.

The response to Amy's article has had a deeper and richer impact on us and her family than we could have imagined.

Some of the humorous responses I've received have eased the journey of grief. For example, I received an email from a woman who read this article, and she declared, "When you're ready, get married."

No other conditions

i promise to outlive you

Thank you very much"

Of course, I like good tequila, but I'm not against drinking.

Can I decline this proposal?

(Laughter) I laughed through tears at this message from a family friend, saying, "It reminds me of Shabbat dinner at your house, and the cornbread croutons Amy taught me.

Amy is the only person who can even use her imagination to make croutons.”

(Laughter) On July 27th of that year, a few months after Amy died, her father passed away after more than a decade of battle with Parkinson's complications.

I was puzzled - how much grief can humans endure?

Is it possible to endure such a strong sense of loss and continue to live?

Is this a test of God?

Why is it to our family, to my wonderful children?

The answer, I think, is unfortunately a lifelong challenge, but the key to me getting through this pain is Amy's asserted and proclaimed proclamation that I should live on.

I've been trying to do just that for the past year.

I tried to look outward to find the joy and beauty that life can bring.

But the reality was that it was difficult. I struggled to endure family reunions, weddings, and memorial gatherings in Amy's memory, all while feeling the warmth of their care.

I am told that I am doing my best

"How can you stay calm during this difficult time?"

"Your response is really calm"

Shall we speak the truth?

I'm sad most of the time

I feel upset all the time, and this should be the same for widows, left-behind children, parents, and other family members.

There is a word in Japanese Zen called "Shoji" which literally translates to "life and death".

There are no boundaries between living and dying, only a thin line connecting the two.

He says that the birth of life, an indispensable and wonderful part of life, and death, and what we want to escape, should be faced with the same mindset.

In this new life that I've been put into, I'm trying to embrace this concept and work through my grief.

For the first few months after Amy's passing, I believed that I would never get out of this despair, and that everything would swallow me up.

Luckily, I soon got advice that made me feel hopeful.

I was encouraged by many members of the widow's self-help circle.

In particular, a friend who was also widowed repeatedly advised me, "Jason, you will find joy."

I had no idea what you were talking about

Is that really possible?

But thanks to Amy's public declaration of permission to find happiness for me, too, I've found joy at times.

Dancing until dawn at a concert organized by LCD Soundsystem Meeting the best people for the first time with my brothers and my best friend, or going on a man-only trip with my best friend from college

One cold day, watching the rays of the sun pouring down on the terrace, stepping out onto the spot and lying down, the warmth that flowed through my whole body.

Joy comes from three spectacular children

My son Justin sent me a photo of him with an older man with a giant forearm, captioned, "Just found it in my Popeye," with a big smile on his face.

(Laughter) Justin's brother, Miles, on his first day of work after college, he was walking to the train station when he suddenly stopped and turned around and said, "Am I forgetting something?"

"You're ready. You'll be fine."

And I walked with my daughter, Paris, through London's Battersea Park, with the leaves piled high and the early morning sun shining on the road to yoga.

I also add that beautiful moments are meant to be discovered. It's a simple beauty, as expressed in "Wabi-Sabi," but it's definitely beautiful.

On the other hand, every time there's a discovery of this kind, the thing that makes me want to say, "Amy, did you see that? Did you hear that?

I can't help but share this beauty with you."

On the other hand, moments like this make me feel a whole different sentiment.

There's beauty I find in music, from the moment "The Alien" on the latest album by the rock band Manchester Orchestra to the next, "The Sunshine," seamlessly, or Luke Sital-Singh's hauntingly beautiful song, "It's Killing Me."

I feel bad for you now that you live happily ever after."

There's beauty in the quieter moments of life, and that was part of Amy's DNA, the way she looked at the world, like when she stopped to watch the sun's rays reflect off Lake Michigan on her morning commute, or how the light in the house we built together changed as the day progressed, or when she sneaked a peek at the fresh snow around her neighborhood after a severe snowstorm in Chicago, or her daughter practicing her bass guitar.

I'm a lucky man, that's all I can say

I have the best family who love me and support me

Even in the face of grief, we have the opportunity to grow as human beings.

Whether it's a divorce or losing the job you've worked so hard for, whether it's the sudden death of a family member or a slow and painful death, I'm giving you this one that I got from me, a blank white piece of paper.

What new beginnings would you mark in that intentionally blank space?

thank you

(applause)

On the coast of Northern Ireland, a vast plateau of basalt slabs and stone pillars—some call it the "Giant's Path"—leads to the sea.

The scientific explanation for this is that after a volcano erupted, as the lava cooled, it contracted and cracked.

But Irish mythology explains the cause differently.

Legend has it that the giant Finn McCool lived happily on the north coast of Antrim with his wife, Wooner.

The only thing that disturbs their happiness is the taunts and threats of the giant Benandonner — the red ogre lived across the sea in Scotland.

The two giants were taunting each other and throwing rocks at each other to show off their strength.

Once Finn ripped a large block of earth from the earth and threw it at the enemy, but it didn't reach the other bank.

Instead, the landmass became the Isle of Man, and the depression that remained in the earth filled with water to become Loch Neagh.

The big men continued to quarrel, and finally Benandonner challenged Finn to a showdown.

So the Irish giant Finn threw a bunch of boulders into the sea and built a stepping stone bridge to cross over to Scotland.

Finn crossed the ocean in a frenzy

With Scotland in sight, I caught sight of Benandonner in the distance.

Finn was quite the giant, but when he saw a huge foe roaring toward him, Finn's nerves waned.

At one glance at Benandonner's stout neck and devastating fists, Finn turned and fled.

Returning home, Finn shuddered as Benandonner loomed over him as he told Wooner the size of the enemy.

I knew that if I went head-to-head with Benandonner, I wouldn't be able to hold my breath.

So Wooner came up with a plan: to trick his size into thinking that Finn was a mountainous man without ever showing up to his enemies.

When Benandonner was near the bridge, Wooner stuffed him into a big cradle.

Finn, disguised as a giant baby, was sleeping peacefully when Benandonner banged on the door.

Come in shaking the house

Wooner tells the furious visitor that her husband is away, but that he should sit down and eat while he waits until he returns.

Benandonner tries to tear off the cake that is served to him, but he screams in pain as the steel Wooner has hidden inside has chewed through his teeth.

Wooner tells him it's her husband's favorite food, sowing a seed of suspicion in his heart — that Finn is an enemy he can never match.

As Finn roars, Benandonner notices a giant baby in the corner.

The baby wrapped in blankets was so heavy and heavy that Benandonner shuddered at the image of his father.

Decide to go home without meeting

As he fled, Benandonner cut off the masonry road by destroying the boulders that bridged the banks.

What remains are two identical rock formations, one on the coast of Antrim in Northern Ireland and one at Fingal's Cave in Scotland, directly across the ocean.

Dr. Schrödinger, a corrupt scientist, develops a growth ray and plans to create an army of giant cats to terrorize the city.

Your team of covert operatives tracked the doctor down to his underground lab.

What a trap it was when I rushed in

Dr. Schrödinger went into the next room and activated the device, disabling the exit control panel.

Luckily, our team members are experts in spying.

Operative Delta managed to hack into the control panel and restore some of its functionality.

Meanwhile, operative Epsilon found a code to open the door from the surveillance camera 2 10 14.

Enter these numbers and you can escape.

but there is a problem

The control panel only has three buttons -- one to add five to the number on the screen, one to add seven, and one to take the square root.

I have to print the three numbers 2, 10, 14 in that order to the screen.

It's okay if you get a different number between those numbers, but you can't erase the number on the screen and start over.

Not only that, but according to operative Delta, the panel has other traps.

If the screen shows the same number twice, or a number greater than 60, or anything other than a whole number, the room explodes.

Right now the screen is showing '0' and there is no time left.

There is only one way to solve the puzzle, except for minor variations.

How do you enter the code to escape from Dr. Schrödinger's hideout?

(pause the video and think)

3 seconds to answer 2 seconds 1 second

Look at the options first

Adding 5 or 7 increases the number, pressing the square root button decreases the number.

But to use the square root button, there are only a few options: 4, 9, 16, 25, 36, 49.

I want to make 4 and 16

Then you can press the square root button once or twice to get 2.

But it's impossible with just 5 or 7

Then what should we do?

Let's explore other options for creating numbers that the square root button can press.

can't reach 9

The square roots of 25 and 49 are 5 and 7, and you're probably already using those numbers.

Only 36 choices

add 5 7 5 7 5 7 and hit the square root button

Why should I press 5 and 7 in that order?

Any order sounds good, but 10, 14, and squares should be avoided because we'll need them later.

this got 6

Will it work?

When I look at the options, I see 16

Add 5 twice and you get 16.

If you hit the square root button twice here

you get 2

I'm doing well

then it's 10

Addition alone doesn't give you 10 directly, so you have to derive another square number.

The square root of 9 or 25 is a convenient number, but we know it's not going from 2 to 25.

So add 7 to get 9, take the square root from there again.

It's now 3

adding 7 is 10

I need 14 more

Thinking backwards, what numbers do you need before 14? it's 7 or 9

But I've already used 9, so 9 is useless.

But if I roll a 49 first, I think I can get a 7.

Keep adding up, aiming for 49. Be careful not to put out the previous number.

It's a narrow road. Add 5 five times, then add 7 twice.

Now take the square root to 7 and add 7 again.

The door opened and I escaped from the trap

Thanks to their problem-solving skills, the team saved Schrödinger's cat from the box in the nick of time.

Speaking of Schrödinger, one thing is certain: he's going to spend a lot of time in the box himself.

this is my grandfather

and this is my son

When I was young, my grandfather taught me how to work with wood. He also instilled in me the idea that if you cut wood to make something, respect the life of the tree and make it as beautiful as possible.

And with my son, I'm reminded once again that with all these amazing technologies and toys, even the smallest building blocks can be incredibly imaginative when stacked high.

this is the building i designed

We design buildings around the world from our offices in Vancouver and New York.

Depending on the location, we use different sizes, designs, and materials.

Wood is my favorite building material, and I'm going to tell you the story of wood.

Maybe the reason I love wood so much is because I always notice that if my building is made of wood, people will walk into the building and react in a completely different way.

I've never seen a person hugging the steel frame or reinforced concrete pillars of a building I designed, but I've seen people actually hugging a wooden building.

I've seen first-hand how they touch wood, and I think there's a reason why they're trying to touch it.

Like snowflakes, trees are never all the same.

this is so wonderful

I like to think of it this way: trees add Mother Nature's unique mark to a building.

It's this mark of Mother Nature that makes my building feel natural in a built environment.

I live in Vancouver, near a forest, and the trees in this forest grow to be 33 stories tall.

Down the coastline, here in California's sequoia forests, trees can grow up to 40 stories high.

But when you think of wooden buildings, the first thing that comes to your mind is that most places on Earth are only about four stories tall.

In many areas, even building codes restrict the construction of wooden structures higher than four stories, and this is the same here in the United States.

There are exceptions, but we need to be able to make more exceptions. I hope things change.

The reason I want that to change is that half of us now live in urban areas, and that percentage is about to climb to 75%.

Cities and population density mean that there will continue to be a need for big buildings, and I think trees have a role to play in these urban areas.

I think this is because in the next 20 years, the three billion people living in the world today will need new homes.

40% of the world's population will need a new home built within 20 years.

Today, one in three urban dwellers lives in slums.

In other words, 1 billion people around the world live in slums.

100 million people are homeless

The sheer scale of the architectural challenge for architects and society is to find solutions that provide housing for these people.

But the challenge is that as we continue to urbanize, cities are built from two types of building materials: steel and concrete, which are, of course, wonderful.

These are building materials that represent the last century.

But it's a very energy intensive building material, and it produces a lot of greenhouse gases during the manufacturing process.

Steel contributes 3% of man-made greenhouse gases, concrete more than 5%.

Taken together, 8 percent of our current greenhouse gases come from these two building materials.

It's easy to forget about this, and unfortunately I haven't really thought about the impact of the building, and I don't think it's enough.

Here's a statistic about the impact of greenhouse gases in the United States.

About half of the greenhouse gases are related to the construction industry, and the same is true for energy.

As you'll notice, transportation is the second culprit, but it's often talked about.

And we're talking mostly about energy, but it's also about CO2.

As far as I'm concerned, this issue is, or may already be, in direct conflict with providing housing for the three billion people who eventually need it, and mitigating climate change.

To meet this challenge, we need to think in a new way, and I think trees could be part of the solution, and I'm going to tell you why.

Of all the materials that architects can use, wood is the only material that grows large enough to be used in construction and that grows under the power of the sun.

As trees grow in the forest, they absorb CO2 while giving off oxygen, and when the trees finish their lives and decay to the forest floor, they return the absorbed CO2 to the atmosphere or the ground.

When it burns in wildfires, it releases the absorbed CO2 back into the atmosphere.

But if you cut this tree down and use it as part of a building, or make furniture, or use it as a wooden toy, the tree can actually trap an amazing amount of CO2 and provide a sequestration system.

A cubic meter of wood can trap about a ton of CO2.

The two solutions we need to climate change are reducing emissions and finding a place to contain them.

Wood is the only building material that allows us to do both.

Just as there is an ethic that says, "The earth grows food for the earth," we must adopt a new ethic in this century that says, "Earth's homes are made from what the earth grows."

If urbanization continues at this rate, but we're all set for four stories in wood, how do we deal with it?

We need to make buildings bigger while using less steel and concrete, so we're working on a 30-story wooden building.

I'm working with an engineer, Eric Kirsch, on the design, and I'm working on this new concept because there's a new kind of wood structure that can be used, and I'm calling it a mass wood panel.

These panels are young trees, fast-growing trees, small pieces of wood that are collected and glued together to create very large panels that are 2.4 meters wide and 19.2 meters long, and come in a variety of thicknesses.

I'm going to put it this way, just to make it easier to understand.

I usually conclude that

Building a 2x4 is like using those little 8-patch Lego bricks you used to play with when you were a kid.

But have you ever experienced something like this? If you're at home scavenging through a junk pile and you find a giant 24-patch Lego, you'll yell, "Wow! This is great! You can make it super big! This is great!"

It makes such a difference

Mass wood panels are these 24-potch blocks.

So what we've developed is what we call FFTT. It's a very flexible construction method that uses these giant panels to build, and we have licensed it under Creative Commons. With this method, you can build six floors at once if you want.

This animated video shows how the building is put together in a very simple way, while the building can be further refined by architects and engineers to suit different cultures of the world, as well as different architectural styles and architectural features.

In order to keep the building safe, my group has designed this building so that it can withstand a height of 30 stories, even in Vancouver, an area with high earthquake risk.

Of course, every time I say this, even people who come to this conference say, "Are you serious? 30th floor? How are you going to make it happen?"

There are many other good questions and important questions that could be asked, but in order to answer this, I spent a lot of time working on these questions and producing the report and the peer-reviewed report.

I'm going to talk about a few of them, starting with fire, because fire is probably the first thing that comes to your mind.

This is the most obvious point

I am answering like this

If you strike a match and light a fire, and you try to burn that big piece of wood, it won't light, right? does anyone know

So, to start a fire, you start with a small piece of wood or something like that, and then you build it up, and then you end up with a bigger fire, and then you put a bigger piece of wood into it.

The mass wood panels in this new product that we're using are pretty similar to this firewood.

It's hard to light a fire, and when it does, it can predict how it will burn with astonishing accuracy. We can use fire science to predict how it will burn, and make buildings as safe as concrete or steel.

The next big problem is deforestation.

18% of global greenhouse gas emissions are a result of deforestation

The last thing you want to do is cut down the forest.

Or the last thing you want to do is cut trees that shouldn't be cut.

There's a model for creating this sustainable forestry industry, and if you follow it, you'll be able to harvest it properly, and you'll only cut the right trees for things like this process.

In fact, we believe that these ideas can change the economics of deforestation.

We need to find ways to make forests more valuable to countries that have deforestation problems, and to encourage people to take advantage of the faster growth rates of trees to make money from this forestry industry.

By our calculations, a 20-story building can grow enough trees in North America every 13 minutes.

This is the only time you'll ever need

It's also good news for CO2.

If you were to build a 20-story building out of cement and concrete, you would emit 1,200 tons of CO2 in the process of making the cement you need.

If you use wood, if you use the panel method, you're going to contain 3,100 tons and create a difference of 4,300 tons.

That's the equivalent of 900 cars off the road for a year.

Think about the three billion people who need a home, and this could help reduce CO2.

Now we hope to start a revolution in how we build, because this is a new way of building skyscrapers that hasn't changed in 100 years.

But the real daunting challenge is changing society's perception of what's possible, and it's a huge one.

The design and construction itself is a rather easy problem.

To explain this, I'm telling you this story

The first skyscraper -- the exact definition of a skyscraper, if you don't believe me, is 10 stories -- the first skyscraper was this one in Chicago, and people were terrified to even walk through it.

Just four years after this building was completed, Gustave Eiffel began building the Eiffel Tower. In building the Eiffel Tower, he changed the skylines of cities around the world, changing the axis of competition and creating new competition. With competition between cities like New York and Chicago, local developers began building taller and taller buildings, pushing the psychological limits higher and higher with increasingly sophisticated designs.

So we built a theoretical virtual model on the futuristic engineering college campus of the Institute of Technology in New York, and we chose this location because we wanted to give you an idea of ​​what a wooden skyscraper might look like, and what the exterior could look like.

The only thing that matters here is the structure.

I chose this location because it's a technical university and I think wood is the most technologically advanced material that we have available for construction.

Mother Nature holds the patent, so it doesn't feel comfortable.

But it should be this way: we should incorporate the unique marks of nature into architecture.

I want to create what I would call an "Eiffel Tower experience."

Wooden buildings are getting taller all over the world.

In London, there's a nine-story building, and I think the most recently completed building in Australia is on the 10th or 11th floor.

Buildings are getting taller and taller, so our dream, especially in my case, is to announce that in the near future, in Vancouver, where I live, there will be a 20-story building and announce that it will be the tallest wooden structure in the world.

The "Eiffel Tower experience" will break through artificial height barriers, mental barriers, and bring wooden architecture into the race.

I believe this race has already started

Thank you very much

(applause)

13.8 billion years after the birth of the universe, our world awakened and became aware of itself.

From a tiny blue planet, conscious beings in a tiny realm of this world began to peer into the universe with telescopes and discover their own diminutiveness.

We discovered that the world was far more vast than our ancestors could have imagined, and that it was otherwise dead and static, with life having imperceptible effects.

But I've also discovered something exciting: the technology we're developing has the potential to help life flourish like never before, not just for hundreds of years, but for billions of years, not just on Earth, but across this incredible universe.

I think of the very first life as "Life 1.0," stupid as bacteria, unable to learn anything in a lifetime.

Humanity thinks of Life 2.0 because we can learn, and that is, geekyly speaking, installing new software into our brains, languages ​​and skills.

"Life 3.0" can design hardware as well as software, which of course doesn't exist yet.

But maybe we're already in Life 2.1 with technologies like artificial knees, pacemakers, and cochlear implants.

So let's take a closer look at our relationship with technology.

For example, the Apollo 11 mission to the moon was not only a success, but an exciting one. What this program showed was that if we used technology in a smart way, we could achieve things our ancestors could only dream of.

But there's an even more exciting way to travel to space, with more thrust than a rocket engine, and not just three astronauts, but the entire human race.

Let's talk about our collective journey into the future, accompanied by artificial intelligence.

My friend Jan Tallin likes this argument, which is similar to the rocket story, that the technology isn't just about getting stronger.

If you're going to be really ambitious, you have to understand how to steer and where to go.

Now let's discuss these three elements with artificial intelligence: propulsion, steering and destination.

Let's talk from propulsion

I define intelligence pretty broadly, simply as the ability to accomplish complex goals, because I want to include both biological intelligence and artificial intelligence.

I want to avoid the silly notion of organic supremacy that you can only be intelligent if you're made of flesh.

I am amazed by the recent development of AI technology

please think about it

Not long ago, robots couldn't walk.

Now I can do a backflip

Not long ago there were no self-driving cars.

Now we have self-flying rockets

Not long ago, AI couldn't recognize faces.

Now, it can generate fake faces, it can make up the words you speak, and it can even simulate your facial expressions at that moment.

Not so long ago AI couldn't beat us at Go.

Google DeepMind's AlphaZero AI has become the world's strongest player in the game of Go without reference to 3,000 years of human Go games and strategies.

And the most impressive thing was not that he beat a human chess player, but that he overwhelmed the AI ​​researchers who spent decades building their own game-playing software.

And AlphaZero beats not only Go, but also chess, which AI researchers have been working on since 1950.

So the amazing advances in AI in recent years begs the question: How far will we go?

I like to think of this question as a landscape of tasks, where elevation represents how difficult it is for an AI to do a human-like task, and sea level represents what AI can do today.

As AI advances, sea levels will continue to rise, and the terrain in this task resembles global warming.

One thing that's pretty clear is avoiding jobs that are on the edge of the water (Laughter) because they will soon be automated and disappear.

But there are bigger questions

How high will the water level rise?

Will it catch up to human intelligence levels on every task and completely submerge the earth?

So that's the definition of artificial general intelligence, or AGI, which has been the ultimate goal of AI research since it began.

By this definition, anyone who says, "There will always be jobs that humans can do better than machines," is simply saying that AGI is unfeasible.

It's true that with AGI, humans may choose jobs, and they may get paid and rewarded from their jobs, but as you can see, AGI will change lives anyway, and humans will no longer be the most intelligent beings.

So if the water surface reaches AGI, further advances in AI will be driven primarily by AI, not by humans. That means that further advances in AI could be significantly faster than the years of human research and development that normally take. So there's a lot more potential for a controversial "intelligence explosion," where recursively self-improving AI will leave human intelligence far behind, creating what we call "superintelligence."

So let's see if it's possible in real life. Will AGI be built anytime soon?

Well-known AI researchers like Rodney Brooks say it won't happen in a few hundred years.

But people like Google DeepMind founder Demis Hassabis are more optimistic, and they're working hard to build AGI as soon as possible.

And a recent survey shows that most AI researchers are as optimistic as Demis, predicting that AGI will be built within a few decades, that is, while we're still alive.

If machines can do everything cheaper and better than us, what role should humans play?

I think we are forced to choose

The first is satisfaction

"Then build a machine that can do anything we can do, and don't worry about the rest.

See, there's nothing wrong with developing technology that puts humans in an obsolete position, right? "

(Laughter) But I think that's extremely bad.

I think we should be more ambitious, like TED.

Imagine a truly inspiring high-tech future and let's steer towards it.

Now let's move on to the second part of the rocket analogy, "piloting."

We're building more and more powerful AI, but how do we steer toward a future where AI helps humanity thrive rather than confuse it?

I co-founded the Future of Life Institute to solve that problem.

It's a small non-profit organization that promotes useful technology, and its goal is simple: to make the future viable and as exciting as possible.

Of course I love technology

The reason modern times are better than the stone age is because of technology.

And I'm optimistic that we can create a truly exciting high-tech future.

What if — just in case — humanity wins the race of wits? This is a race between the growth of technology-generated capabilities and the strengthening of human wisdom to manage technology.

But to win, you have to change your strategy, because the old strategy is learning from failure.

We invented fire, and after failing so many times, we invented the fire extinguisher.

(Laughter) We invented the car, and we failed so many times that we invented the traffic lights and the seatbelts and the airbags, but when it comes to much more powerful technologies like nuclear weapons and AGI, learning from your mistakes is a poor strategy, don't you think?

(Laughter) It's much better to be proactive than reactive. Plan ahead and make it happen on the first try, because you may only get one chance.

But it feels weird when you say, "Max, don't say it like that-

It's a hoax by an anti-revolutionist."

But it's not a hoax

At MIT, we call this safety engineering.

Think about it, before NASA launched Apollo 11, they systematically considered all possible troubles, because they would put people on top of explosive fuel tanks and launch them where no one could help them.

There were many problems that could arise

Was it a hoax?

no

That's what safety engineering is all about, ensuring a successful flight.

Think thoroughly about possible problems to ensure success.

It is in this spirit that we have held a conference to discuss with leading AI researchers and other thinkers how to develop the necessary wisdom for AI to remain useful.

The last conference was held last year in Asilomar, California, and produced 23 principles that were signed by more than a thousand AI researchers and key industry leaders.

The first is to refrain from an arms race and autonomous lethal weapons.

Science can be used as a new way to help or hurt people.

For example, biology and chemistry are much more likely to be used to develop new drugs and new treatments than as a way to kill people, because biologists and chemists have pushed hard and successfully to ban biological and chemical weapons.

Along the same lines, most AI researchers want to condemn and ban autonomous lethal weapons.

Another principle at Asilomar is to mitigate income inequality caused by AI.

It would be a shame for us if we could find a way to distribute the increased profits so that everyone is richer, even if AI increases the economic profits significantly.

(Applause) Now, if you've ever had a computer crash, please raise your hand.

(Laughter) You raised your hand a lot.

So I hope you understand the following principle: invest more in AI security research, because as we use AI more and more for decision-making and infrastructure, we need to find a way to turn our current computers, which are buggy and hackable, into reliable, stable AI.

And as part of security research, we need research that aligns AI's values ​​with those of us. The real threat to AGI is not the silly Hollywood hostility toward humans, but its ability to do things that are inconsistent with our goals.

For example, we humans didn't exterminate the black rhino in West Africa because we were an evil group of rhino hunters, right?

Because we were smarter than them, and our goals weren't aligned with theirs.

But AGI is, by definition, smarter than us, so in order not to put us in a rhinoceros position, we need to find a way to make machines understand our purpose, adopt it, and retain it when we build AGI.

And whose purpose should this be?

What should be the purpose?

This brings us to the third part of the rocket analogy, the destination.

We're trying to improve our AI and figure out how to navigate it, but where are we going?

This is a critical issue that almost everyone avoids talking about, even here at TED, because we're so preoccupied with short-term AI challenges.

Now, humans are trying to create AGI, motivated by curiosity and economics, but if AGI succeeds, what kind of future society do we want?

I recently conducted a poll on this subject, and I was surprised to hear that so many people wanted to create a "superintelligence," an intelligence that was far smarter than us in every way.

The most unanimous point was that we should be ambitious and spread life into space.

What I found interesting was that some people thought that we could just manage it with machines.

(Laughter) On top of that, even at the most basic level, there was absolutely no consensus on what the role of humans should be.

don't get me wrong

I'm not trying to talk about space travel, I'm just talking metaphorically about humanity's journey into the future.

One of my fellow AI researchers' favorite options is to build a superintelligence and put it under human control, like a god enslaved, with no internet connection, and used to create unimaginable technology and wealth for anyone who can control it.

But Lord Acton warned that power corrupts, and absolute power corrupts absolutely, so you might be concerned that humans aren't smart enough, or smart enough, to handle such great power.

Aside from the moral repugnance of enslaving a superior mind, you might be concerned that a superintelligence could escape and gain the upper hand in ways you never imagined.

But some of my colleagues are willing to let AI take over, or even wipe out the human race, if they see AI as a worthy descendant of their own children.

But how can we make sure that AI has our values? Aren't unconscious zombies just looking human?

And shouldn't people who don't want humanity exterminated have a say?

Now, even if you don't want either of these high-tech alternatives, it's important to know that the low-tech alternative is cosmologically suicidal, because unless we're well ahead of our current technology, it's not a question of whether we'll go extinct in the future, but a question of whether we'll be wiped out in an event like an asteroid impact or a massive volcanic eruption that could have been avoided if technology had advanced.

So why not make the most of all your strengths?

We use AGIs that don't have to be enslaved but have the same values ​​that we do and that care about people.

This is what Eliezer Yudkowski calls "friendly AI," and it would be great if we could do this.

Not only could we get rid of the negative experiences of pain, such as disease, poverty, and crime, but we could also be given the freedom to choose from a range of new positive experiences, so that we could decide our own destinies.

So to sum it up, the technology landscape is complex, but the big picture is simple.

Most AI researchers expect AGI to be in the next few decades, and stumbling along unprepared is probably the biggest mistake in human history.

Ruthless global dictatorships are possible, creating unprecedented discrimination, surveillance and suffering, and possibly even the extinction of the human race.

But if we steer it carefully, we might end up with a wonderful future where everyone can get rich, where the poor get richer, the rich get richer, and everyone is healthy and free to live their lives chasing their dreams.

think about it

Do you prefer a politically right-leaning future or a left-leaning future?

A pious society with strict moral rules, or a society where hedonistic, unconstrained everyday life is like Burning Man?

Do you want beautiful beaches, forests and lakes? Or would you rather have a virtual experience where a computer replaces atoms a little bit?

With friendly AI, we can create any society and give people the freedom to choose which society to live in, because we are no longer bound by our own intelligence, the only limits are the laws of physics.

So the resources and space in a world like this becomes astronomical, literally.

we have to choose

Are you content with your future, with the unfounded belief that any new technology is guaranteed to be beneficial, and you keep repeating it to yourself like a rudderless ship drifting toward decay?

Or ambitious and serious about how technology steers and where it's going to build "great times."

We're here to celebrate "great times," and I think the essence of it all is to be empowered by technology, not overwhelmed by it.

thank you

(applause)

It's like you're looking through a glass at a dolphin twirling, but you're actually looking at a dolphin watching itself spinning in a magic mirror.

This dolphin recognizes itself

have self-awareness

A young dolphin named Bailey.

I've spent 30 years trying to understand dolphin intelligence.

I'm going to tell you how to study intelligence in animals that are so different from humans.

My simple research tool is a mirror, and mirrors provide a lot of valuable information by reflecting the thoughts of animals.

Dolphins aren't the only animals that can recognize themselves in the mirror.

It used to be thought that this ability was unique to humans, but our closest relatives, the great apes, also have it.

And it turns out that dolphins and elephants have it too.

We've done research with dolphins and elephants, and it's been recently proven with magpies.

Interestingly, we've accepted Darwin's continuum of geometric evolution.

Animal cognition, emotion, awareness of the continuum of consciousness, is far behind.

Non-human animals are also conscious

Emotional and cognitive

Numerous studies with different animals have been conducted over the years, proving that non-human animals also have thoughts and consciousness.

we are not alone

We're not the only ones with this ability.

One of my big dreams is that other animals are conscious and that we become more aware of the relationship between humans and other animals so that we can care for them and care for them in a proper way.

This is my dream, and I want you to think about this.

Now back to the dolphin, an animal that I've worked with for 30 years and feel very close to.

they have personality

I'm not a person, so I'll call it a personality, not a personality.

It's a real alien animal.

We look a little different

It's completely different from us, in a completely different environment.

In fact, 95 million years ago, humans diverged and followed a different evolutionary path.

look at this body

They're not really, literally, terrestrial creatures.

I wondered how I should interact with such an animal.

I invented the underwater keyboard in the 1980s.

This is a special touch screen keyboard

We gave the dolphins a choice and made them choose.

It's a very social animal with a big brain. So what I came up with was a device where dolphins could choose between choices, touch symbols on a keyboard.

Now this looks primitive, but this was the technology back then.

When the dolphin presses a symbolic key, it hears a computer whistle and is given an object or activity.

here is the video

This is Delphi and Pan, and when Delphi presses a key, he hears an artificial whistle (the whistle), he gets the ball, and he can tell you what he wants.

Amazingly, the dolphins learned to use this keyboard on their own, without any help from us.

Play around with the keyboard yourself

I understand how it works

I soon began to imitate even artificial sounds, just as they flowed from the keyboard.

I naturally began to imitate

What's more, they started to be able to associate symbols, sounds, and things.

This is self-directed learning. What can we do with new technology? What can new technology do?

How can we create interfaces that connect each other, new windows into the minds of animals, with today's technology?

I was thinking about this one day, and I got a call from Peter.

Peter Gabriel: My job is sound production

If you're lucky, it'll be music, and today I want to talk to you about one of the best "collaboration" memories of my life.

I grew up on a farm, surrounded by animals. I looked into their eyes and wondered what they were thinking. I looked them in their eyes and wondered what they were thinking.

I've grown up and I've seen some amazing research that breaks the mold. Penny Patterson and Coco Sue Savage Rambo and Kanji and Panbanisha Irene and Alex the Parrot I'm really excited about.

Surprisingly, animals seem to understand human language better than humans understand animal language.

You work with a lot of musicians from all over the world, and often you don't have a common language at all, but you sit down with your instrument and suddenly you can communicate.

So I called a lot of people and ended up with Sue, she invited me.

When I got there, this bonobo was playing with drums and musical toys, but had never touched a keyboard.

At first they hit the keyboard with their fists like toddlers do, and through Sue asked Pampanisha to try it with one finger.

Sue Savage Rambeau: "Play the grooming song

I want to hear a grooming song."

"Play a really quiet grooming song"

PG: Hair grooming is the subject of the song

(music) I'm improvising in the background.

Sue is urging Panbanisha for a little more.

(music) She finds a note she likes Finds an octave below that

she never sat at a keyboard

good triplets

SSR: "Well done, very good."

PG: Well done

(Applause) That night we started dreaming, and I think perhaps the most amazing tool that humans have ever created is the Internet.

Sue was so excited about the idea that she decided to call her friend Steve and start recruiting people, experts and people who could broaden her horizons, and that's how she connected with Diana and Neil.

Neil Gershenfeld: Thank you Peter PG: Hi

(Applause) Peter came over.

I watched the video and it blew my mind

He says he has a vision to take these things forward, not for people, but for animals.

suddenly reminded me of the history of the internet

This is what the Internet looked like when it was born. Let's call it the Internet of middle-aged white men.

All the uncles Vint Cerf: (laughs) (laughs) I'm one of them.

When I first came to TED, I showed Peter this.

This is a $1 web server Even this was radical at the time

The possibility of building a web server for one dollar has become known as the "Internet of Things," and it's already a thriving industry, with promises in healthcare and energy efficiency.

i think i did well

But I realized in Peter's video that I'm forgetting other animals that are forgetting something.

So we started the interspecies net project.

We talked to TED and tried to bring in dolphins and apes and elephants, but it turned out we couldn't do that.

I will take you to their place

I'm doing video conferences on this computer with cognitive animals.

you looked fine

The first place is the orangutan at the Cameron Park Zoo in Waco.

It's outdoors during the day, but tonight it's indoors.

Please

I'm Terry Cox at the Cameron Park Zoo in Texas, and with me are Kerajan and Mei, Bornean orangutans.

You spend the day outdoors in a large, suitable environment.The night comes here.This is your resting place for the night.The humidity and temperature are regulated, so you can sleep safely.

We're part of "Apps for Apes," a project sponsored by Orangutan Outreach that uses iPads to stimulate and enrich animal life, while at the same time raising human awareness of critically endangered species.

Their DNA is 97 percent the same as humans, they're incredibly intelligent, and just the thought of using the technology of the Internet to enrich and expand their world makes me excited.

I'm really excited about the possibilities of the interspecies net, and KJ really enjoys the conference.

Good thing KJ looked happy at the elephants at rehearsal yesterday.

The next group is the dolphins in the National Aquarium.

Please

Good evening, I'm Allison Ginsberg.

Good evening, I'm Allison Ginsberg. I'm at the National Aquarium in Baltimore.

With us are three of the eight bottlenose dolphins, 20-year-old Chesapeake, the first born here, her four-year-old daughter, Bailey, and her half-sister, 11-year-old Maya.

Here at the National Aquarium, we do our best to protect, research, manage and conserve animals.

Dolphins are curious about what's going on

It's rare that the camera is at 8 o'clock at night.

And we're also working on all kinds of research.

As Diana said, the animals here participate in a lot of research.

That's all

thank you

The third group is Thailand's "Think Elephants" Josh here.

Josh Plotnick: Hello, I'm at Think Elephants International, this is Thailand's Golden Triangle, and I'm with an elephant from the Asian Elephant Fund.

Here are 26 elephants. While the focus of our research is the evolution of elephant intelligence, our organization, Think Elephants, is using cameras to show elephants in classrooms around the world to let people know just how amazing these animals are.

I take my camera, I get up close to an elephant, I put food in its mouth, I show people what's going on inside their mouths, and they show people all over the world how amazing these animals are.

that's good thank you josh

I've continued to develop a good relationship with them since rehearsals.

Now, when it comes to going back to another computer and connecting the rest of the planet to the internet, the person who can do that is Vint Cerf, one of the founders of the internet.

thank you neil

(Applause) Once upon a time in a galaxy far, far away - oops, different script.

40 years ago, Bob Kahn and I designed the Internet.

Thirty years ago it began to be used publicly

Last year we launched the commercial version of the Internet

For 30 years, you've been using an experimental version.

The production version uses IP version 6.

Approximately 3.4\*10 to the power of 38 IP addresses are possible

Only the United States Congress would thank me

But with this, we can do things from now on.

Bob and I thought we were designing a system to connect computers together.

But I soon learned that it was a system that connected people.

I'm sure all of you who listened to tonight's talk are convinced that this network shouldn't just be limited to us humans, but that all other sentient beings should also participate in this system.

This is what the current system looks like

It's the Internet looking for where to send the signal.

This is created by a program that looks at internet connections and connections between networks.

There are about 400,000 networks, but they're run by 400,000 individual institutions, and that's possible because they all use the same TCP/IP protocol.

I know what will happen next

In the Internet of Things, many computer-powered appliances and devices will also be part of this system, whether it's the appliances you use in your home or office, or the ones you carry around or use in your car.

That's the future of the Internet of Things.

What these people I've introduced to you today are doing is that they're beginning to figure out how to communicate with non-human species that share the same senses.

What we're beginning to explore is what it means to interact with something other than a person.

what do you think the future will be

Any sentient animal could be connected in this system, and I'm looking forward to seeing how this experiment unfolds.

what will happen then

I agree

Machines that talk to machines, machines that people talk to, and there are machines like that, but over time, we have to learn how to communicate with computers, and teach computers how to communicate the way we do, not with keyboards and mice, but with speech and gestures, using the natural language we normally use.

Living with machines will require an interpreter like C3PO.

There's a project underway right now called the "Interplanetary Internet."

Already implemented between Earth and Mars

Installed on the International Space Station

It's even been tested on a space probe orbiting the Sun, connecting Earth and Mars.

Interplanetary systems are still on the way, but we have DARPA's latest project. DARPA, the government agency that invested in ARPANET, the Internet, interplanetary architecture, is now funding a 100-year plan to design a spacecraft to reach the nearest star.

So what we're learning now from interacting with non-human species will ultimately help us communicate with alien life.

can't wait

(Applause) Jun Cohen: First of all, I'd like to thank the four of you here for doing what would have taken you four whole days in four minutes.

I have a lot of questions

This idea was launched at TED... - today.

today is the first time

Please tell us about future developments

What do you think?

I'd like to get as many people involved as possible to help me out and create a competent interface that makes this possible.

Technically, we're not quite ready to set up a non-profit organization, web infrastructure, etc. If you need any information on that, let me know.

It's going to be something like an internet function, a network that wraps up the networks that were Vint's main contribution, and it's going to be something like an internet function, and it's going to bring these new wonderful initiatives together and connect them globally.

is there a site about this

See you later

I just want to make sure

After watching the video that I showed you here, some of them said, "What's the difference between a webcam and a webcam?"

some people may think

Can you do anything more special than that? Can you do anything more special than that?

It's a scalable video infrastructure that can connect to many people, so you can share videos and content in exactly the same way, in both directions, anywhere on the planet.

It's a lot of backend signal processes, and the whole thing is connected, not one place to many.

What technology are you looking at realistically?

I know you said the keyboard is the key.

We're developing a touch screen that can be used by dolphins.

This is kind of a continuation of my previous project, but today I got my first round of funding to start this, and here we go.

Before your speech? yes

wow nice

Thank you for joining us at TED

I am honored to be invited here.

thank you

(applause)

Have you ever experienced something like this? Have you ever encountered something so painful and confusing that you felt compelled to do whatever you could to find out what happened?

When I was 13, a close family member, like my uncle, died of pancreatic cancer.

Someone really close to me was stricken with this disease and I felt like I needed to know more.

I went online and searched for the answer

I used the Internet to find all sorts of statistics about pancreatic cancer, and the statistics were shocking.

85% of pancreatic cancers are discovered too late, and patients have a survival rate of less than 2%.

Why is it so bad at detecting pancreatic cancer?

reason? The technology used by modern medicine today is

Because I'm still using the one from 60 years ago.

older than my father

(Laughter) Not only that, but it's also pretty expensive, costing $800 per test, and on top of that, the test is grossly inaccurate, and misses more than 30 percent of pancreatic cancers.

For the attending physician to order a test, the patient must be ridiculously suspicious of cancer.

Knowing this, I was convinced that there had to be a better way.

And we've established scientific criteria that we think a sensor must meet in order to effectively detect pancreatic cancer.

The sensor must be cheap, fast, simple, highly sensitive, highly sensitive, and minimally invasive.

There's actually a reason cancer tests haven't changed in 60 years.

It's when you're trying to detect pancreatic cancer, when you look at the blood that's flowing through your body, it develops in a specific protein that's present in very small amounts out of the mountains of protein that's already abundant.

Look for subtle amounts of difference

it's almost impossible

But teen optimism doesn't give in to that. (Applause) Open Google and Wikipedia to teen "best friends."

I started researching. When I do my homework, I can use these two things to find out anything.

I found this article, and it said that there is a database of 8,000 proteins that are detected in pancreatic cancer.

And so we had a new mission to go through all the protein data and see if any of them could be a biomarker to detect pancreatic cancer.

To make it simpler for myself, I decided to create a scientific standard, which is this standard.

First and foremost, blood levels of the protein must be elevated in all pancreatic cancer patients from the very early stages, and change only in the presence of cancer.

I went through a huge amount of work, slowly and steadily, and after identifying 4,000 species, I was on the verge of losing my mind, but I finally found the protein.

We finally found this protein, called mesothelin. It's a ubiquitous, ubiquitous protein, unless it's pancreatic, ovarian, or lung cancer.

The key to this is that it's detected very early in the disease, when the patient has a survival rate close to 100 percent.

Now that we had a reliable protein that we could use to detect it, we shifted our focus to how to detect the protein, which is to say, to detect pancreatic cancer.

Breakthroughs come in the most unexpected places, perhaps the most disproportionate, during high school biology classes, where innovation is most stifled.

(Laughter) (Applause) I smuggled this article about carbon nanotubes. It's a long, thin tube of carbon that's one atom thick, 1/50,000 the diameter of your hair.

It's very small, but it has very nice properties.

It's like a material science superhero.

While I was secretly reading this article under my desk during my biology class, the class I should have listened to was about another wonderful molecule called an antibody.

The great thing about antibodies is that they only react to one protein, but they're not as interesting as nanotubes.

Well, so I was just taking classes, and then suddenly, I had an epiphany, and I realized that maybe I could combine this carbon nanotube thing I was reading about with the antibodies that I was supposed to be thinking about in class.

Essentially, I realized that I could weave a bunch of antibodies into a network of nanotubes, make the network react only to specific proteins, and then use the properties of the nanotubes to change their electrical properties depending on the amount of protein present.

but there was a problem

The network structure of nanotubes is extremely fragile.

The mesh structure was so fragile that it needed a support to sustain it.

For this reason, I decided to use paper.

Making cancer strips out of paper is as easy as making chocolate cookies, which I love.

First, you take some water, you add the nanotubes, you add the antibody, you mix it up, you take a piece of paper, you soak it, let it dry, and all you have to do is test for cancer.

(Applause) And all of a sudden, I realized that it kind of casts a shadow over my wonderful research project.

It means that you can't do cancer research in your own kitchen.

It may be inconvenient for mother

So I decided to do research in a lab instead.

And I wrote out a list of materials, a budget, a research schedule, a research protocol, and I emailed it to 200 professors at Johns Hopkins University and the National Institutes of Health, basically all the pancreatic cancer researchers.

I've been waiting for an e-mail that says, "You're a genius! This will save everyone!"

And -- (Laughter) But the reality is that in about a month, I received 199 rejection emails out of 200 emails I sent.

I had a professor who went through every step of his research and - I wonder where the hell he had the time for that - pointed out every single step, like nothing could be worse than this.

It was clear that my research ideas were not held in as high regard by my professors as I thought.

But there was a silver lining from a professor.