

Hi, everyone. My name is Brandon Leshchinskiy, and I'm a graduate student here at MIT. Now the presentation that you're watching was created by an organization here at MIT called Earth DNA, but it's going to be shared with high school students all around the country. And so I'm really excited to be sharing it with you guys. Welcome.

This talk is going to have some audience interaction. So to get everybody warmed up, please just yell out your own name on three. Ready? One, two, three.

[ALL YELLING]

Nice to meet you. Like I said, I'm Brandon.

Now in this talk, we're going to cover four things: the truth, the consequences, the myths, and the future. And I want to start with the truth. In particular, let's review the science of what's happening. We'll go through it slowly.

In 1896, a scientist discovered the greenhouse effect. Can somebody here tell me what the greenhouse effect is? Does anyone here know? Yes?

AUDIENCE: It's the part of the atmosphere sun's rays go inside it and then it's difficult for them to get outside of it, so it keeps the earth's atmosphere at a normal temperature.

BRANDON LESCHINSKIY: Cool. It's part of the sun's-- it's part of the earth's atmosphere that keeps our temperature warm and normal. OK. Anybody else? What is the greenhouse effect? Yes? Go ahead.

AUDIENCE: So there are certain gases that trap heat and release that heat after it's trapped-- it's something called the radiative forcing. And so some-- for a lot of gases in the atmosphere, like nitrogen, sun rays just pass right through. But for a select few, like water and carbon dioxide, that absorb infrared light and then for red spectrum, and then that traps heat in the atmosphere

BRANDON LESCHINSKIY: Fantastic. You must know your climate science. But that's exactly right. And the basic idea is that some gases in our atmosphere trap heat.

And you can see here how light from the sun hits the Earth. It gets converted into heat. And it gets trapped underneath this atmospheric blanket.

We emit these greenhouse gases by burning fossil fuels for transportation and electricity. Things like driving, flying, air conditioning. These all emit greenhouse gases into the atmosphere as we burn fossil fuels like oil, gas, and coal, greenhouse gas concentrations rise. You can see here that since 2005, the amount of carbon dioxide, one of the main greenhouse gases, has increased steadily.

Here's that same graph since 1700. You can see the Industrial Revolution happening in 1760, and shortly thereafter we start to see this increase in the amount of carbon dioxide in the atmosphere. Here's the last 800,000 years.

Now notice in the last 800,000 years, the maximum carbon dioxide level has been 300 parts per million. 300,000 years ago is the oldest Homo sapiens fossil. That's us.

The Industrial Revolution happened in 1760, a little under 300 years ago. And here's where we are now. Atmospheric greenhouse gases have spiked.

As humans emit more greenhouse gases, our atmosphere traps more heat and the earth gets warmer. You can see here the global temperature anomaly from NASA over time. It starts with lots of blues and reds, meaning things are pretty normal.

But as time goes on from 1950 to today, it gets redder and redder and redder. That's earth warming to 0.82 degrees Celsius above normal, or 1.5 degrees Fahrenheit. Now, I know what you're thinking.

I know what you're thinking. Who cares about 1.5 degrees Fahrenheit? That's like nothing and I can barely even feel it.

Well, to answer this question, we have to talk about the consequences. Climate change already affects us. Whether it's through wildfires in California, or flooding in the Midwest, or hurricanes on the east coast, the effects of climate change are already here.

Heat waves, floods, and other disasters are becoming more frequent. You can see the recorded natural disasters per year has skyrocketed since the 1960s. In Boston, the city is already planning seawalls because of more intense and frequent

flooding. We are already doing these things. In other words, cities must spend your parents' tax money on climate adaptations instead of schools, transit, and hospitals.

Unusual weather also affects food. By 2030, a drought could double the price of corn. And maybe you don't like corn, but I bet you like chicken or fish, which are both raised on corn feed. Or maybe you like high fructose corn syrup in cereal or bread. The point is corn is in a lot of foods, and by stifling crop growth climate change limits food access.

Of course, it's not just corn either. But at any rate, climate change also affects water. This woman migrated over 150 miles because of a drought. By 2050, the UN projects 200 million environmental migrants.

These are people who leave their homes because of changes in the environment. And my question to you is this. In recent migrant crises, thousands of refugees created turmoil in Europe and America. What happens when millions of people move north in search of food, water, and safety? Can we handle that? I'm not sure.

Even the US military refers to climate change as a threat multiplier, because it makes every bad situation worse. And by the way, the Pentagon has released reports about climate change under both Democratic and Republican administrations. This is not a partisan issue.

These problems are not just in the future either. They're happening right now. The current species extinction rate is 1,000 times higher than normal. If pollinators go, so do we. There's no more crops left. We're on track for one million species extinctions, and here's what just one of those looks like.

We could live more sustainably, so why don't we? And to really understand this, we have to talk about the myths. And I want to set the stage with a game called Commons.

So at this point, I want everybody to form groups of five and count off from one to five. Go ahead and sit in a circle. You guys can stand up, form groups. I'll give you a second to make this happen.

It might be easier for people in the front row to kind of move to-- turn your chairs to face the back. Because we're going to be sitting in a circle. Cool. OK. And everybody

count off from 1 to 5 within your groups.

AUDIENCE: 1.

AUDIENCE: 2.

AUDIENCE: 3.

AUDIENCE: 4.

AUDIENCE: 1.

AUDIENCE: 2.

AUDIENCE: 3.

AUDIENCE: 4.

AUDIENCE: 5.

BRANDON OK. Has everybody counted off? We good to go? OK.

LESCHINSKIY:

So you're going to all start a pond with 20 fish. This is your pond's carrying capacity. Your goal at the end of the game, the winner is the person in the room with the most fish. And remember, you win as an individual, not as a group.

Here's how the game actually works. Each round, every person in your group will take between one and four fish. You have to take at least one, but you can't take more than four. After each round, your pond will be restocked by doubling the number of fish without exceeding 20. So four fish becomes 8, nine fish becomes 18, 10 fish or more brings the pond back to 20. Does that make sense?

For the group of four in the back, your carrying capacity is actually going to be four times the number of people in your group, so you're going to have 16. And so all the same rules apply where if you double the number of fish, at eight or higher you'll go back to 16. You will never have a pond with 20 fish in it. Does that make sense to the group of four? Great.

Don't eat the goldfish yet. And if you have allergies, don't eat the goldfish at all. So

if everybody could send person number one up to the front, I can hand you guys goldfish.

Thank you.

Great. So everybody should have a pond and a restock supply. And can everybody just make sure that you have the right number of fish in your pond? So it's four times the number of people in your group.

Everybody just make sure. Everybody good? OK. You guys have 30 seconds to discuss strategy starting now.

[STUDENTS ALL SPEAKING]

Round one. Take turns going clockwise, starting with player three. You have 60 seconds.

[STUDENTS ALL SPEAKING]

Go ahead and restock your ponds. You have 30 seconds to do this each time. You'll play four rounds.

Everybody good? Gonna go ahead and skip. Round two, starting with player two.

[STUDENTS ALL SPEAKING]

[BUZZER SOUNDING]

Restock. You have 30 seconds.

AUDIENCE: Adding 11 this time.

AUDIENCE: No, you only get to double.

AUDIENCE: Oh, shit. So we're going [INAUDIBLE].

[BUZZER SOUNDING]

BRANDON Round three. Take turns, starting with player four.

LESCHINSKIY:

AUDIENCE: How many did you take?

AUDIENCE: Two.

AUDIENCE: Oh, what a guy.

[STUDENTS ALL SPEAKING]

Does anybody need more time? I'm going to go ahead and skip again.

[BUZZER SOUNDING]

Go ahead and restock.

[STUDENTS ALL SPEAKING]

Everybody good? Cool.

[BUZZER SOUNDING]

Final round. Start with player three.

[STUDENTS ALL SPEAKING]

AUDIENCE: What are you doing?

AUDIENCE: It's the last turn.

[STUDENTS ALL SPEAKING]

AUDIENCE: Did you take two?

[STUDENTS ALL SPEAKING]

BRANDON Is everybody set? Anybody need more time? Cool.

LESCHINSKIY:

[BUZZER SOUNDING]

Let's do one last round just for fun.

AUDIENCE: No!

[LAUGHING]

**BRANDON
LESCHINSKIY:** So who still has fish in their pond? Cool. OK. So we're actually doing this.

Sometimes we don't. Go ahead and restock your ponds. You guys have 30 seconds.

[STUDENTS ALL SPEAKING]

Are you guys all set? You guys are restocked?

AUDIENCE: We already started. Yeah.

**BRANDON
LESCHINSKIY:** Cool. All right, I'm going to go out and skip ahead.

AUDIENCE: Yep.

[BUZZER SOUNDING]

**BRANDON
LESCHINSKIY:** Final round for real this time. Take turns going clockwise, starting with player number one.

[STUDENTS ALL SPEAKING]

All right. Is everybody good? Cool.

AUDIENCE: Is it for real this time?

**BRANDON
LESCHINSKIY:** All right.

[BUZZER SOUNDING]

So who won? Raise your hand if you have more than 10 fish. Sorry, go ahead and count your fish first, and then raise your hand if you have more than 10. Cool.

Yeah. OK. Only two people have more than 10, three people, OK. More than 11 fish? OK. So you guys each have 12 or more.

Do you have 13 or more fish? 14 or more fish? 15 or more fish?

AUDIENCE: [INAUDIBLE]

BRANDON How many do you have?

LESCHINSKIY:

AUDIENCE: 15.

BRANDON 15.

LESCHINSKIY:

[APPLAUSE]

Congratulations to the winner. Great. OK. Awesome. OK.

So talk to me. Why was Commons hard? What was hard about this game? You guys can go ahead and yell it out or raise your hands as you wish.

AUDIENCE: You have to have a strategy that everyone agrees upon.

BRANDON You have to have a strategy that everyone agrees upon. OK. Anybody else? What

LESCHINSKIY: was hard about this game? Go ahead.

AUDIENCE: The thing that was the best for the commons was the most damaging personally.

BRANDON The thing that was best for the commons was the most damaging personally.

LESCHINSKIY: Anybody else? Yes.

AUDIENCE: [INAUDIBLE] it was unstable.

BRANDON Cool. So you weren't quite sure how long we were going to keep going. Great. These

LESCHINSKIY: are all good answers.

And really the core of this is if everyone acts in their own interest, the pond, the

commons, dies. This is called the tragedy of the commons. When anyone can access a limited resource, it runs out. Roads are another really good example.

Anybody with a car can access a road. And soon enough everybody is thinking, if these idiots would just take the bus, I could be home by now. Can somebody or can anybody else name some other real life examples of commons? Think about limited resources that anyone can access. Yes, go ahead.

AUDIENCE: Air.

**BRANDON
LESCHINSKIY:** Air. Say more. Can you say more about--

AUDIENCE: Air pollution, how we're-- just like you were talking about earlier, how we're abusing it and overusing it with all these resources that we think we need or want.

**BRANDON
LESCHINSKIY:** Yes. So anybody can access the air, and therefore, anybody can pollute it. Great. Anybody else?

AUDIENCE: Wireless internet.

**BRANDON
LESCHINSKIY:** OK, wireless internet. Say more.

AUDIENCE: So if everybody watches Netflix in high HD at the same time, nobody can watch Netflix in HD.

**BRANDON
LESCHINSKIY:** So if everybody watches Netflix in HD, then nobody gets to watch Netflix in HD. Because you don't have enough bandwidth. Great.

Any others? Let's do one last one. Any takers? Yes, go ahead.

AUDIENCE: Office mugs.

**BRANDON
LESCHINSKIY:** Office mugs.

AUDIENCE: Yes.

BRANDON Tell me more about office mugs.

LESCHINSKIY:

AUDIENCE: If you have reusable mugs in your office, you have to rely on people cleaning them and putting them back for everyone else to be able to use them.

BRANDON Great. So office mugs are something that anybody in the office can access, but
LESCHINSKIY: nobody's incentivized to actually take care of them. Great.

What about this one? Earth is a commons. We can all access earth. We're all on it.

And certainly, it's limited. So how do we solve commons problems, either in the game or in real life? Does anybody have any ideas?

How did you guys solve it in the game? Let's start there.

AUDIENCE: Strategize together.

BRANDON Strategize together. Cool. Can you be more specific?

LESCHINSKIY:

AUDIENCE: We talked about how we would be able to keep the most fish on our plate or in our pond by each just taking two.

BRANDON So you guys you guys all ended up each taking two.

LESCHINSKIY:

AUDIENCE: Not the entire time.

BRANDON Not the entire time. OK. Anybody else? Why-- how do we solve common problems,
LESCHINSKIY: either in the game or in real life? What do you guys think? Yes, go ahead.

AUDIENCE: If some people took more, others would take less.

BRANDON So if some people-- if some people took more, others would take less. Great. How
LESCHINSKIY: did that work?

AUDIENCE: Not well.

BRANDON Not well. OK. So it didn't work very well.

LESCHINSKIY:

Well, the answer is, and when we kind of came upon it already, collective action. We have to set rules in order to solve common problems. One example was, let's all take two. But we saw in your case that sometimes those rules get broken.

That's why climate change is really hard. But at any rate, setting rules for everyone is called politics. Setting rules for everyone is called politics, and, therefore, protecting the most important commons, an inhabitable earth, is political. We need rules.

There is an issue. Rules cost money. For example, if I can't sell my products, because I emit carbon to make them, I lose money, and that's not acceptable to me. So now we can answer the question, why haven't we done anything?

And the answer is, no one wants rules limiting carbon. But especially not fossil fuel groups who emit more than anyone. You can see here, carbon dioxide emissions by sector. Residential and commercial industry, transportation, agriculture and land use. Anybody want to guess what that big blue one is?

AUDIENCE: Fossil fuels.

BRANDON Fossil fuels. Energy, oil, gas, and coal. Yeah.

LESCHINSKIY:

The fossil fuel industry has actually known about climate change for decades. In 1978, more than 40 years ago, Exxon's senior scientists had this to say:

"Present thinking holds that man has a time window of 5 to 10 years before the need for hard decisions regarding changes in energy strategies might become critical." In other words, we have five or 10 years to figure out how to get energy a different way. He said that 40 years ago.

But fossil fuel companies spread climate myths to the public, including schools. From 2003 to 2010, Koch Family Foundations and other fossil fuel groups gave 558 million climate denial organizations. And I wish that I could share more financial data with you, but these groups are secretive and hard to study.

In any case, the point is this. Fossil fuel companies know that rules will hurt their profits, so they spread myths to the public about climate change. But now you know

the truth. You know that climate change is real.

It's happening because of us. It already affects you. It will only get worse.

And we haven't done anything, because fossil fuel companies have lied to us for decades. That leaves us with one final question. How do we shape our future?

We need to talk. And I know that words may seem inconsequential, given some of the other information I've shared. But words give life to ideas and ideas lead to change. In other words, your words matter.

I know it may feel awkward, but studies show that teens are actually great at making parents care about climate change. Be open. Be gentle. Be honest.

You can try starting with, "How do you feel about climate change?" In fact, on the count of three, I want everybody to practice. So on the count of three, let's all say, "How do you feel about climate change?" Ready? One, two, three,

AUDIENCE: How do you feel about climate change?

BRANDON It's easy and it works. I want to share one last perspective on why we need to talk.

LESCHINSKIY: It's not too late to keep our paradise, but we can't do it without you.

I'm going to leave you guys with a five day challenge. So go ahead and write down the names of five people you can talk to about climate change. You can do it on your phones. You can do it on a piece of paper. But go ahead and write down five names of people you can talk to about climate change.

Each day, each day for the next five days, talk about climate change with someone on your list. And remember, time is of the essence. Thank you.

[APPLAUSE]

Questions?

AUDIENCE: I noticed the video presentation included afforestation and reforestation for the large solutions to this problem. Are there others that we can consider?

BRANDON A lot of the solutions are collective based. And by the way, I'll be sending out a

LESCHINSKIY: handout to all of you guys for things you can do and informational resources that you can use for after this talk. But to answer your question, the main thing that you can do in your life is actually stop eating beef.

Cattle have a huge impact on greenhouse gases because of the methane they produce. And so if you stop eating beef, that's actually the single biggest contribution you can make within your personal life. Obviously, if you are able to drive less, fly less, that's another huge one. These are all ways that you can contribute.

But as we saw, part of the reason that climate change is such a tricky problem because we need everybody to come together. We need wind farms. We need afforestation, as you mentioned. We need other kinds of renewable energy resources. But in your personal life, don't eat beef, talk about climate change, and fly less are the top three.

Yes, go ahead.

AUDIENCE: We talk a lot about fossil fuels and transportation and flying and things like that, and same with beef. We hear a lot about that. And now people are starting to hear more about plastics, which is a use of fossil fuels.

But there's a lot of fossil fuel uses that are huge, like in manufacturing processes and things where we could buy from companies who use less fossil fuels. But it's really hard for us to find information about that. Is there some sort of resource for that?

BRANDON I haven't seen any, but I can follow up with you. So I can send you something after--
LESCHINSKIY: along with the handouts, I'll have an answer for that. I'll do the best that I can.
Thanks. Yeah?

AUDIENCE: [INAUDIBLE] parents would you recommend a strategy where you use the spiritual [INAUDIBLE] argument that God's given us this world to protect, and it's a paradise and we must protect nature. Or the self-interest argument. How do you think we should lead that conversation?

BRANDON That's a great question. So the question is, how should we talk to our parents about

LESCHINSKIY: climate change. You know your parents better than I do, and that's part of why it turns out that teenagers and kids are actually so good at this. Messenger matters much more than message when it comes to climate change.

And so if you come to your parent and say this is important to you, I think that's enough to start a conversation. Don't attack people, including your parents. That tends not to be super helpful.

To quote one of the professors here at MIT, research shows that showing research to people doesn't work. And so if you can talk to your parents from a personal perspective and what it means to you, that, I think, is the best way to start these conversations. Stories and personal impacts work a lot better than graphs and data.

Yeah. Does that answer your question?

AUDIENCE: Yeah.

BRANDON Cool. Thanks. Anybody else? Awesome.

LESCHINSKIY:

Oh, yes. One more.

AUDIENCE: So what if you come up against someone who insists that it's not real? How should I talk to somebody who says, well, I've been brainwashed.

BRANDON That's a really hard question. The question is how do we talk to people who are truly
LESCHINSKIY: convinced that climate change is not real. If it's a stranger, honestly, you're probably not going to have much of a shot at convincing them. As I said, messenger matters more than message, and there's not-- you don't really have the credibility with that person to sway their opinion on something that they hold so dearly.

But, again, if it's a relative, start the conversation with what climate change means for you. And as I said, I'll send out resources from NASA and from NOAA and from a bunch of other very credible institutions that you can look at to see more information and why our models work. And how we know all of the things that we know about climate change. And, of course, you're more than welcome, in fact, encouraged to share that with your relatives and friends and so on. Does that answer your question?

AUDIENCE: Sure.

BRANDON Thank you. Do we have-- no. Yes, in the back.

LESCHINSKIY:

AUDIENCE: So it was a really well done presentation and I appreciated it. My question is really more form than anything. Whenever you ask the question about greenhouse gas effect, is there like a number in your head that you have before-- you'll ask a certain number of people before you just move on for the sake of time?

BRANDON Cool. I want to hold logistical questions for afterwards, but does anybody have any
LESCHINSKIY: questions within the scope of the presentation? Anybody else? OK.

AUDIENCE: Honestly my, like, two cents on Frank's question, which is coming from a very conservative area of the country. And a very conservative family that not being confrontational and just saying, this is how I feel about climate change and what's going on has actually proven to have an effect. Over years, yes. It's been a slow process.

But saying the data you're getting-- where you're getting this information from is biased. If you look elsewhere, you'll see different data. And then I just leave it.

And over time, they started to see that and have started to change their minds about it. So that would be my two cents from personal experience.

BRANDON Yeah. That's a really good point. So don't expect for a single conversation to
LESCHINSKIY: completely change somebody's mind. That's really hard and unlikely.

But over the course of these conversations, I think you'll be surprised and pleased at how successful you'll be at changing the minds of people that are close to you.
Cool.

Thank you guys so much for coming. I really appreciate it. And we can answer some logistical questions, but we don't need to record that.

AUDIENCE: Thank you.

[APPLAUSE]

