Science-Forward--Climate Change

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http://cuny.is/scienceforward

[0:01] [music]

Cynthia Rosenzweig: [0:10] Climate change is the planetary issue of our time, and the future. It's also the issue in which human beings finally realized that they were affecting everything.

Flora Lichtman: [0:28] It's unusual for a scientist to speak so unequivocally. It should give us some indication of the seriousness of the challenge that we face with climate change. Despite scientific consensus, there's been a lot of political divisiveness about climate change.

[0:43] In this video, we're just going to focus on the science. We're going to walk through how we know that climate is warming. We're going to talk to a researcher who's studying past climate by looking at trees that are alive today. We're going to talk about climate modeling and how researchers verify that their models are reliable.

[1:01] We'll start with a look at carbon and its natural cycle. The carbon cycle is the exchange of carbon between living organisms and the inorganic parts of the Earth.

[1:11] What scientists have discovered is that humans are interfering with the carbon cycle in a major way.

Cynthia Rosenzweig: [1:16] Mostly we look back to the beginning of the industrial revolution, because that's when basically our civilization changed. We began to power our entire society with fossil fuel, which is burning stored carbon, which releases CO2.

Flora Lichtman: [1:32] We've all heard that more greenhouse gases in the atmosphere, like carbon dioxide, warms the climate. How does that work, exactly?

Tom Koutavas: [1:39] It turns out that these particular substances or molecules that we call greenhouse gases, have the ability to allow sunlight coming towards the Earth from the Sun to come in unimpeded.

[1:51] They're basically transparent to sunlight, but they are relatively opaque to Earth light or Earth radiation going back out, and so they capture that. In the process of capturing and absorbing that, they warm up and they warm up the air around them.

[2:04] What we're doing right now with human activities, unfortunately, is we're adding to this natural greenhouse. You can think of it as starting from something that is good, the natural greenhouse, and adding to it. Adding and getting too much of a good thing, if you like.

Flora Lichtman: [2:18] The hockey stick graph, so called because of its shape, plots CO2 levels in our atmosphere and shows that, for about the past 150 years, levels have been rising exceptionally fast and continue to escalate.

[2:30] When researchers talk about climate change, you often hear them refer to climate models that predict Earth's future climate. What is a climate model?

Cynthia Rosenzweig: [2:39] First of all, I have to tell you what it's not. Sometimes very young students, like high school students, come, and they've heard that they're going to work on the model. So they come in and they start looking around for a terrarium. [laughs] You know, one of those things that has like a closed...with plants inside.

[2:58] Unfortunately, that is not what a climate model is.

[3:01] A climate model is a set of mathematical equations that solve the forces of our climate system that represent and solve for the dynamic movement, heat relations and precipitation falling down, what the oceans and the cryosphere are doing.

[3:27] It's all represented by equations and the computer programs, when they hit the button to run a simulation, are solving those equations across grid boxes covering the entire globe.

Flora Lichtman: [3:44] How do we know we can trust the models? "Replication of findings?" says Rosenzweig.

Cynthia Rosenzweig: [3:49] There are now about 30 global climate models with groups of scientists all over the world doing the same thing, and guess what? They differ somewhat in their ranges, because they're representing the processes. Those equations are slightly different from the scientists around the world.

[4:10] Basically, all of the modelers, when they do this experiment, they get the same result. That's really the fundamental heart of the climate change issue.

Flora Lichtman: [4:23] How do our observations of weather fit with the climate change story?

[4:27] Take the winter of 2013, 2014. If it doesn't ring a bell, the words "polar vortex" may jog your memory. It was one of the record books.

[4:37] Here in New York City, we suffered through more than a month of sub-freezing temperatures and over 50 inches of snow. How do we put this in context?

Laura Broughton: [4:46] You've probably heard a friend say it was a really hard winter, there was a lot of snow, so obviously there's no climate change. The thing to remember about changes in the overall climate is we're not looking at individual events. We're looking at the long-term trends. We're looking at the averages over time. It's really all about probabilities.

[5:08] When you start looking at the models, for predictive models for what's happening with climate change, you have a higher incidence or higher probability of big events. Really big storms or more extreme weather days.

Flora Lichtman: [5:22] Part of understanding how climate is changing is comparing current climate to past climate. Systematic weather records only go back 150 years, and the planet is 4.5 billion years old. How do scientists get a sense for prehistoric climate?

Tom Koutavas: [5:40] They call it "Proxies" because they are stand-ins, or surrogates, for something that we would like to know more about.

[5:49] A temperature proxy is some kind of physical, biological or chemical variable in a natural system that is related to temperature itself. We measure the proxy. Each proxy has a specific relationship with the target variable. It might be temperature or it might be precipitation.

Flora Lichtman: [6:06] Plant fossils can give us a measure of CO2 from as long as 15,000 years ago. Ice cores can be used for determining CO2 levels 800,000 years ago. The trunks of trees can also help us look back in time.

[6:19] As you've probably noticed, trees don't just grow up, they grow out. Every year a tree adds more wood to its trunk, and for many trees this shows up as a tree ring.

[6:28] Climatologists can learn a lot about trees from their rings because climate and weather can influence tree growth.

[6:34] Scientists can use tree cores, especially from trees that are hundreds or even a thousand years old as a proxy for studying the Earth's climate in times that predate our weather records.

[6:45] To do this, scientists like Dr. Koutavas collect tree cores.

[6:49] So you can core at will here?

Tom Koutavas: [6:52] We admire and respect these organisms just like we admire and respect any part of a natural system.

[6:58] You're not going to learn anything about a natural system unless you're able to study it. It's like taking a blood sample from a human being to help restore his or her health. We learn from them in the hope that we'll develop a better understanding of how their ecosystem works in the broader climate system.

Flora Lichtman: [7:19] Scientists like Dr. Koutavas take these tree core data samples and combine them with other climate records to get a clearer picture of our past climate.

Tom Koutavas: [7:31] This sequence of clicks eventually will generate an 800-year-long or so record of tree ring measurements that we can then import into our data analysis software.

[7:42] Compare with other samples from the same region, normalize them, standardize them, average them, and explore their properties in terms of their correlation with modern climate, where they tend to overlap with instrumental records, that allow us to interpret the nearly thousand-year-long history of this particular sample in terms of climate variability.

Flora Lichtman: [8:05] In this video, we've talked a lot about how climate scientists do their research. But what many people want to know is, what does climate change mean for us?

Laura Broughton: [8:12] We already are seeing rises in sea level. We're already seeing more extreme heat days, hotter average years than ever recorded before.

Cynthia Rosenzweig: [8:21] It's not only the sea level rise. It's what happens when storms come along. This coastal flooding due to that storm extends farther onto the coast, and that is the real danger.

[8:38] Our flood zones, which up until now we've all been organized here was our 1-in-100-year storm, and we all knew what it was. Guess what? Our 1-in-100-year storm is not going to be the same in the future.

Flora Lichtman: [8:52] In New York City, we're going to have a front row seat for the effects of climate change. Sea level is already rising. We're already seeing more extreme heat and higher average temperatures. Models suggest that we should expect fiercer storms, like Sandy, and more of them.

[9:10] City officials in New York are considering the risks of climate change in their rebuilding plans.

Cynthia Rosenzweig: [9:16] This is groundbreaking for the New York region, but not just for the New York region, but for the United States and for the world. It's a signal that increasing risks due to climate change with higher sea level rise, no matter what happens to the storms, all coastal areas are more vulnerable.

Flora Lichtman: [9:39] Do you get the sense that cities are taking this seriously?

Cynthia Rosenzweig: [9:42] Absolutely. This is one of our main areas of work. We work with cities all over the world. The cities are the first responders to climate change. They are stepping up.

[9:55] [music]