

S2. What's Up With Climate?

The Ongoing Adventures with Rena and Jeremy

Rena and Jeremy are watching TV on Saturday afternoon when a news update comes on for the evening news....

TV: "...and so it appears that the climate and energy bill will not be debated by congress this year as lawmakers remain divided over how to best deal with climate change..."

Rena: Hey Jeremy, change the channel...

Jeremy: (sleepy) Wha...?....

Rena: Change the channel! Seems like all that's on is commercials these days.

Jeremy: I kinda like the commercials, there are some great ones, and sometimes I even learn something...

Rena: Oh yeah, right, like this global warming thing, I can't believe how people just freak out about it. My Dad was saying how last winter was colder than any winter in recent memory... what a joke...global warming...

Jeremy: Yeah, but I don't know, sometimes I really wonder about it, you know, global warming and how it relates to all the stuff we have been talking about. When I was at the aquarium the other day some oceanographer guy was talking about it...

Rena: What? What does the ocean have to do with it? And besides, my Dad assured me that it was all probably just a natural cycle, if it is happening at all. The earth has gone through cycles like this all through history. Do you really think that some cars and planes can actually make a difference on something as huge as the climate of the earth?

Jeremy: Wait, now hold on, there is really more to it than that. First of all, this guy at the aquarium, I think his name was Dr. Greenfield, explained how our atmosphere has more carbon dioxide in it now than ever before, than over the past 600,000 years!

Rena: WHAT? That's just what I'm talking about, who was around 600,000 years ago? Do you actually believe that?

Jeremy: No, THIS is a fact—it's not something scientists are predicting or guessing at. They all agree on *this*. You see, scientists took ice core samples in the Arctic and measured trapped bubbles of atmosphere for their carbon dioxide content and graphed the numbers. The largest amount ever found over 600,000 years was about 280 ppm (parts per million). That's the way they express the proportion of gasses in the air, in ppm. You know Rena, there are all kinds of gasses in the air—oxygen, nitrogen, argon, ozone, we learned about this in Ms. Plotsky's science class, remember?

Rena: Yea, sure, I think I remember that, so what's the point?

Jeremy: Today we have about 390ppm of carbon dioxide in the atmosphere, and its increasing all the time. The increase actually started around the time of the industrial revolution--remember that, the industrial revolution, from social studies?

Rena: Oh yeah, but I don't remember learning about carbon dioxide, that's what we do in science class!

Jeremy: Yeah sure, but Dr. G pointed out that there are two main reasons for the increase in carbon, and both of them have to do with the industrial revolution and how more people started using up more of the earth and burning fossil fuels—oil, gas and coal. And in addition to that, we have been cutting down trees to make room for farmland, make paper, build hoses, and so on. You remember what trees do for the atmosphere don't you?

Rena: Of course, I'm not that dumb!! Trees absorb carbon dioxide during photosynthesis. So, I see where you're going with this. While we're putting more carbon dioxide in the

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atmosphere, we're also removing the things that take it out—trees. It does make sense that the carbon would increase.

Jeremy: Yes, that's exactly what he was saying! You really are smart in science...

Rena: Yes, I like it too, but just the sound of Ms. Plotsky's voice would put anyone to sleep...but wait, my question is, so what? Carbon dioxide is good for plants, what does it matter if there is a whole lot more of it? Things seem fine.

Jeremy: Boy, you really did sleep through science class... First, the oceans also absorb carbon dioxide, and when the ocean concentration of carbon dioxide goes up it lowers the Ph, remember that? Ph? Ph is how acid or alkaline a system is. Well, oceans have become more acidic as a result. It turns out, according to Dr. G, that sea creatures have difficulty in growing their shells in a more acidic environment. Shells are made from calcium carbonate, and calcium carbonate does not form well in the acidic ocean.

Rena: Woah, that's a trip. Are you trying to tell me that carbon in the atmosphere could endanger all shellfish in the ocean?

Jeremy: Well, that's what the oceanographer was saying, and it actually makes sense. And remember, this is happening now, today; scientists see it and measure it.

Rena: So I guess the global warming thing was way off base after all, its not heating the earth we have to worry about, its killing shellfish we need to worry about! They should get their story straight. I can see the bumper stickers now: "Save a clam: CARPOOL." I don't even like clams....

Jeremy: You know, you're right *and* wrong. Actually, there is more to this. Dr. G pointed out that its really important to know the difference between what we know for sure, 100% fact, and what we know is *probably* true, based on evidence. Scientists come up with probabilities for things. Scientists are like detectives or lawyers in a court of law—they gather data and facts, and assemble the facts together and make conjectures, about what the facts suggest. It's a logic game, and they come out with a certain likelihood that a defendant is guilty. So with climate science, the carbon dioxide levels are facts, and how those levels will affect life on earth has a *probability* of truth. In this case scientists from the Intergovernmental Panel On Climate Change have determined that there is a 90% certainty that modern civilization is the cause of global warming with catastrophic consequences if we do nothing about it. That panel was made of 1,500 scientists from 70 nations, looking at hundreds of studies.

Rena: Well that's sort of impressive, but its kind of like how they predict the weather.

Jeremy: Yea, that's an example, but not really a good one...

Rena: Why not? I'll tell you, if their prediction of global warming is as accurate as the prediction of weather, well, you know what I mean, the weather report is always wrong...!!

Jeremy: Hold on, you're way off base. First of all, weather is completely different from climate. Weather is an event that happens on a day, in the moment. Climate is the average of many weather events; climate is the pattern of weather events for a region over many years. Actually what Mr. G was saying was that the term "global warming" is actually really not so accurate for what we're talking about. The average temperature on the globe has increased almost 1 degree centigrade over the past 100 years. This is a *global average*, it is hotter and cooler in specific places. That doesn't seem like much, but in the global atmospheric system it changes things a lot. (In the ice age global temperature was only 5 degrees cooler!) It changes weather patterns, or causes "climate change." Some scientists even think that the term "climate change" is misleading—its really "climate disruption" because some places change and some don't—its really chaotic.

Rena: Ok, so, "climate change", whatever . . . My Dad says that if we get all freaked out about climate change and make changes to stop it that it will ruin our economy—that many

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people will lose jobs and all that. Do you really think that we should take a chance on that when the scientists are making guesses?

Jeremy: Rena, stop for a minute. They aren't guessing. Let's walk through it like Dr. G did, *starting with information that we know has nothing to do with guessing!*

Rena: Ok, that's fair, go for it....

Jeremy: First, let's start with what we learned in science class. Actually, you start...

Rena: What?

Jeremy: Yeah, what do you remember about the atmosphere? What is it for, how does it support life on earth?

Rena: Oh man, ok. I think I memorized this in Plotsky's class, lets see...our atmosphere serves many functions, but one key function is to moderate our temperature—to keep temperatures even and in a range that living things enjoy. If you were in space, half of you would freeze while the other half burned to death—not good for living things. The atmosphere creates a livable earth using the greenhouse effect, where some solar radiation stays in while other escapes back to space. The atmosphere is a blanket in a sense, delicately balanced to keep our temperature just right.

Jeremy: Ok, and what gasses in the atmosphere actually act to hold in heat

Rena: I'm not really sure, I don't remember her talking about it so much, but I know where you're going—is it carbon dioxide?

Jeremy: Bingo! And there are others of course—methane is actually 20 times more heat trapping than carbon dioxide. But let's just talk now about carbon dioxide. So can you put 2 and 2 together? We have much more carbon in the atmosphere and ever before, carbon is a heat trapping gas, and the global temperature increase began at the same time we started cutting the trees and burning fossil fuels, putting more carbon in the atmosphere.

Rena: Hmm, that is an interesting coincidence...

Jeremy: I suppose you could call it a coincidence, but scientists saw it as more than that and started studying it over 30 years ago.

Rena: Really? So guess this isn't some wild theory a few scientists are trying to make a name for themselves with...

Jeremy: Far from it. Like I said, over 95% of the world's scientists are on board with this—I'll get to that but first let's check a few more facts. Over the past century a whole lot of changes have been measured on the earth: global average temperatures have increased, major wildfires in western U.S. have quadrupled in frequency, floods have increased 5 times over worldwide, the level of oceans has increased significantly, permafrost in the Arctic is melting, glaciers are disappearing at an extreme rate (in Glacier National Park, nearly 100 glaciers have completely disappeared), the force of cyclones has increased, and for the first time in recorded history, the north pole is expected to be 100% ice free in summers!

Rena: Wow, that is a lot of stuff but how can you be sure that....

Jeremy: RENA, these are historical facts. That's all we're talking about now, things we know 100% for sure.

Rena: Ok, Ok. So when you lay it out like this, I can see how scientists would make connections and want to look into it.

Jeremy: Yes, and its also important to know that this is just the obvious stuff. Science studies these things in a much more complicated way that you and I or even our parents can understand.

Rena: When you put it like that, it kinda freaks me out, maybe we should do something. But try convincing my Dad...

Jeremy: Well that's another thing all together. People have trouble acting on things they don't actually see day to day, and actually, they don't trust a lot of the news and science

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information. They just think it's twisted and corrupt, or even politically motivated. It can be confusing and difficult to know what to believe. That's why learning to think for your self, learning to think and find out yourself, is so important.

Rena: Yeah, I know what you mean. But another thing, if this is all so true and important, why don't we learn about it in school?

Jeremy: Rena, you know schools can't teach us everything, they have their hands full, but actually I heard my Mom talking about this climate scientist from NASA who has studied this for 30 years. His name is James Hansen. He said that schools have trouble teaching it because it is so "political."

Rena: Political? What? What's political about science?

Jeremy: Well it seems that lots of the solutions to reduce carbon are seen by some politicians as threatening to the economy, or just against how government should run. Some actually don't really believe the scientists, or at least they say that. I don't get it sometimes...

Rena: Wow, adults are more like my little brother sometimes...

Jeremy: I hear you...

Rena: Jeremy, I always love these conversations with you—you have given me a lot to think about. I remember in social studies that Mr. Jackson was talking about how governments make laws—that they should use the "precautionary principle" that says some like this: "In the face of potential serious harm, act to prevent the harm based on some probability of the likelihood of harm." It's like insurance. My parents pay for insurance on everything. Maybe we need insurance against climate change!

Jeremy: Wow, that's so right, it's the same thing. You know, there are so many ways of thinking about this that can open people's minds. Actually, there are many reasons to act that have nothing to do with oceans or climate change!

Rena: What?

Jeremy: Consider this. Reducing climate change means reducing carbon emissions which means reducing the use of fossil fuels, which means a lot of conservation and technologies to help conserve, and also changing our fuels to renewable fuels. Why do you think they call non-carbon producing fuels "renewable?" Its because they will not run out—fossil fuels are going to run out at some point, even in our lifetime. This may not be true for coal but its definitely true for oil. And guess what, we get most of our oil from countries involved with terrorism—we're making them rich!

Rena: This is sick—

Jeremy: It doesn't stop there. My Dad told me China is investing in the non carbon based fuel technologies I was talking about, and if we don't, we'll be buying those from China also. This is about keeping our country strong economically into the future. So actually the solutions for climate change are good for the economy, at least in the long term!!

Rena: That does it. I'm not just getting mad, I'm going to get even!

Jeremy: What are you talking about? Hold it Rena, I know how you feel, but remember what we talked about before—the adults need out help. They are making decisions about what they think will be best for our overall long-term well being.

Rena: I guess you're right...

Jeremy: Yes, I'm right. And its our job to help them get over their closed minded thinking. It's our job to lead the way, for our future, and for our kids.

Rena: Ok, so how do we do that?

Jeremy: Talk, learn, act, be positive and lead by example.

Rena: Will do. Let's start a discussion group after school—let's invite some teachers!

Jeremy: Now there's a plan...