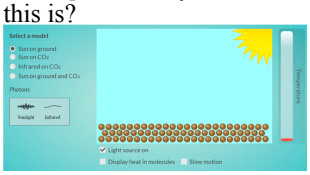
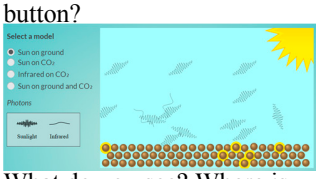
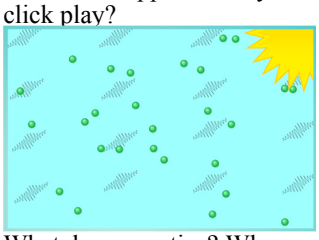
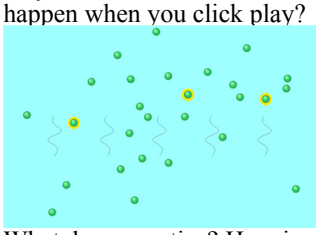
Supplementary Materials

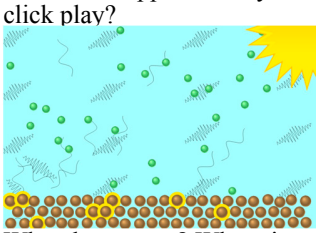
Figure S1. Interview Protocol

Introduction: Hello my name is [AUTHOR NAME, TITLE, & INSTITUTION]. During this interview, I would like you to interact with a computer simulation that will show you things in the world that you can't normally see with the naked eye, and then I am going to play a short film to follow up or conversation. As you interact with the simulation, I would like to hear about what it is that you see and what you are thinking about. This interview is expected to last about 20-30 minutes. Any information you share with me will be kept confidential. Please let me know if you feel uncomfortable answering a question or would like me to stop the interview at any time.

(Note: Items in **BOLD** were added after pilot interviews)

What We Say/Do	Why We/Do This	Possible Responses	Follow Ups
Simulation Protocol			
[Show page 1, simulation is in idle] What do you think this is? 	Gage initial reactions to simulated environment. Establish common vocabulary for the sun, the ground, and the buttons that can be clicked. Give them a chance to read the labels.	I have no idea. A sunny day, a computer game, chocolate malt balls, molecules, atoms, a thermometer, this is the ground, if they read the labels: (sun on ground, photons, infrared, visible light, temperature)… Is this a multiple choice? Why does the ground look like that?	What if you were walking down here? What would it look like/feel like? What else do you notice? Did you notice the sun? Another student said that this is the ground.
What do you think will happen if you click the play button?  What do you see? Where is the visible light coming from? Why are the atoms on the ground lighting up? Where is the infrared light coming from? Where does it go? **What happens to visible light when it hits the ground?**	Prompt a prediction. Establish vocabulary for sunlight, infrared. Guide students to attend to sunlight absorption and Infrared emission.	I have no clue. I see squiggles coming down from above, the balls are lighting up, there are two kinds of squiggles, the temperature is going up. The ground lights up, and that is all.	Go ahead and click the play button! Ok, what else do you notice? What should we call the squiggles? Did you see the labels on the side? Did you notice the infrared light? Where is it coming from?

Now click the button that says "sun on CO_2". What do you see? What will happen when you click play?  What do you notice? Where is the sunlight coming from? Where is it going? **How does the sunlight interact with the CO_2?**	Elicit perceptual judgments of simulation before animation. Establish common vocabulary for CO_2. Guide students to attend to the transparency of CO_2.	Green balls. I think the light will crash into the CO_2. The temperature is not changing. The sunlight is making the CO_2 move	What should we call the green balls? Let's call them CO_2. It's a molecule in the air. Well go ahead and find out! Did you notice the light waves? Did you notice the sunlight? Do you think the sunlight is bumping into the CO_2, or passing through?
Now click the button that says "Infrared on CO_2". What do you see? What will happen when you click play?  What do you notice? How is this different than visible light on the "CO_2"? Where is the infrared coming from? Why does the "CO_2" light up? What happens to the CO_2 after it lights up? **How does infrared interact with the "CO_2"?**	Elicit perceptual judgments and predictions. Guide students to attend to absorption and emission of infrared light. Guide students to attend to absorption and re-emission (this is very difficult to see in the simulation. Students may need explicit instruction.)	The sun disappeared. I can't tell, it's hard to see. The infrared passes through the CO_2. Nothing. When it bumps into another CO_2 the light goes away.	Try clicking the slow motion button It does. Does *all* infrared pass through the CO_2? Choose a CO_2 molecule for me, and let's watch it light up, and see what happens after. Did you see that? No? Ok, keep watching. Another student noticed that the CO_2 releases an infrared wave when it loses its glow. See?

Now click the button that says "Sun on ground and CO2". What do you see? What will happen when you click play?  What do you see? Where is the visible light coming from? Where is it going? Does the visible light crash into the CO2, or pass through? What happens when visible light hits the ground? Where is the infrared light coming from? What happens to the infrared light when it hits the CO2? Tell me the story of what happens to sunlight after it leaves the sun.	Elicit perceptual judgments and predictions. Prompt students to synthesize the mechanisms of the greenhouse effect in this cumulative, complex scenario.		Tell me more? **How do you know? What are you thinking about in order to make that prediction? Did you picture what would happen?** Did you notice the sun is back? What do you predict will happen when the sunlight leaves the sun? Where will it go? Ok, let's hit play and find out!
What is the temperature? How would you compare this temperature to the temperature of the sun and ground with *no* CO_2? **What effect does CO_2 have on temperature?**	Prompt a an opportunity for students to establish causal inferences between rising temperatures and the presence of CO_2.	The temperature is changing. CO_2 has no effect.	Right. Can you bound the temperature for me? Do you think it will ever exceed the second mark? Why not? Let's find out the difference! Go ahead and click "sun on ground" again and let's watch the temperature. Why? Why not? Explain. How do you know?
Video Protocol			
TRANSITION: What you just described to me is called the greenhouse effect. What do you know about the greenhosue effect?	**Transition into discussion of global warming.**		
Ok, now we are going to watch a brief, 3 minute film about climate change. But before we watch this, tell me what you know about climate change. **Do you feel connected to the problem?**	Orient students toward notion of climate change/global warming	What's climate change?	Have you heard of global warming?

Do you think it's real? Do you think that your actions reflect global consciousness? What are your feelings/emotions about global warming? Do you view science as a relevant aspect of this issue? Are you ready?  What are your impressions of the video? What are your thoughts on climate change/global warming? Do you buy it? Do you think that humans cause temperatures to rise globally? **Did any of this change your mind? Do you think climate science is a debatable issue?**	Elicit students personal views about global warming/climate change, and their scientific justification of them.		How do you know? Why? Tell me more.

Figure S2. Transcribed Interview Data

PARTICIPANT 1

Interviewer:	Hello, I am [NAME, TITLE, INSTITUTION] and my contact info is on the information sheet that I gave you. During this interview I'm going to ask you to interact with a computer simulation that I'll pull up on the screen in a minute and I'm going to ask you to ... I'm also going to play you a three minute film that summarizes the stuff that we go over. As you interact with the simulation, I'm going to ask you questions to walk you through the simulation, learn about what you see and what you're thinking about. You're going to get full credit for this regardless of whether or not you answer the questions in any particular way, so don't worry about that. It's supposed to last about 20 to 30 minutes and any information you share with me will be audio recorded, but it'll be kept confidential. I'll transcribe everything and your name won't be attached to anything and the audio will be deleted. Let me know if you feel uncomfortable answering any questions or want me to stop the interview at any time and we can stop. Before we start, what do you know about climate change?
Participant:	I do know about the carbon radiation that creates this methane effect that adds to a heated sort of greenhouse effect that adds to ... Yeah, it makes it hotter. It increases the temperature and it's not going to go down unless the ozone layer ... Ozonolysis, I think, it breaks down from O3 into O2 because of the oxygen radicals and all that stuff. I took some chemistry so we had to learn about all of those things.
Interviewer:	Oh okay. You have methane and ozone that you're talking about there. You think that has something to do with it?
Participant:	Yeah.
Interviewer:	Okay. Anything more?
Participant:	Basically the burning of fossil fuels and volcanoes have sulfur and those things they contribute to an escalation in the percentage of carbon in the air that leads to this sort of global warming.
Interviewer:	All right, great. What are you attitudes about global warming in general?
Participant:	I think given the melting of the polar ice caps and how it's effecting organisms in general, we should probably take a stand towards minimizing the effects.
Interviewer:	Okay.

Participant: Through ET regulation and stuff.

Interviewer: ET regulation?

Participant: Yeah, like Donald Trump.

Interviewer: Okay.

Participant: Yeah, yeah.

Interviewer: All right. You think that we should take a stand?

Participant: Yeah to limit fossil fuel and coal production and stuff like that.

Interviewer: Okay. By taking a stand, who do you think is going to be effected by any changes that are made in those kinds of behaviors that you're talking about, like reducing fossil fuel consumption?

Participant: I think everybody benefits from that.

Interviewer: All right, cool. Now I'm going to show you a simulation that kind of goes through the chemical, physical mechanisms behind global warming. Here's the first screen. What do you see?

Participant: I think those are molecules. I don't know. That's the sun and that's the sky. So far, yeah.

Interviewer: Yeah. What do you think the molecules might make up seeing that it's like-

Participant: The sky? I'm not sure or the layers of the sky. I don't know.

Interviewer: It actually turns out to be the ground.

Participant: Oh, I'm so bad.

Interviewer: That's supposed to be ... No, it's okay.

Participant: Oh yeah, sun on the ground. Oh yeah, I just saw that.

Interviewer: No problem. Anything else you notice?

Participant: No.

Interviewer: Okay. Did you notice the play button down at the bottom?

Participant: Yeah, I did.

Interviewer: What do you think is going to happen when we click the play button? Wild guess.

Participant: I don't know.

Interviewer: Okay, well let's find out. The clicking is a little bit weird here. Maybe tap. There we go.

Participant: Okay, that's sunlight.

Interviewer: Yeah, so describe what you see.

Participant: The sunlight is interacting with the ground and the ground is giving infrared signals back to the sky. That's what I see so far.

Interviewer: Yeah, and where is the sunlight coming from?

Participant: The sun.

Interviewer: Where is the infrared going?

Participant: Towards the sky. It's in no particular direction.

Interviewer: All right. Very good. If you were to summarize for me the interaction between ... Whoa, this is the wrong page. If you summarize for me, what's the interaction between sunlight and the ground?

Participant: Basically what I can judge specifically looking at this animation is that the sunlight sort of catalyzes something, some element in the ground that leads to this infrared radiation. I don't think that's been specified as to what that element is but that's what we can gauge from just looking at the animation.

Interviewer: Okay. Yeah.

Participant: Maybe this is the status quo of how it's supposed to be. I'm not sure.

Interviewer: My status quo of how that's supposed to be, do you mean like ...

Participant: Current.

Interviewer: Yeah, like current understanding or simplification of how the effect works. Okay, sure. You were talking about the infrared is ...

Participant: Bouncing back sort of.

Interviewer: Bouncing back. Do you see where the source of the infrared radiation is coming from?

Participant: Yeah, the ground.

Interviewer: The ground?

Participant: The molecules on the ground.

Interviewer: Okay, let's go to the next screen. Sun on CO2. What do you see here?

Participant: Gas molecules.

Interviewer: Yes. Anything else?

Participant: The sun.

Interviewer: The sun. All right. Turns out those green gas molecules are greenhouse gases. They are supposed to represent CO2 specifically. What do you think is going to happen when we click the play button this time?

Participant: I think they are going to go in a haywire fashion. They are going to contaminate the screen a little.

Interviewer: What do you mean by they?

Participant: The greenhouse gases.

Interviewer: Oh, okay. Let's click play and find out.

Participant: Oh.

Interviewer: What do you see?

Participant: So there's sunlight and it's interacting with the greenhouse gases but so far they seem to be in equilibrium. I don't see an increase in the number of greenhouse gases nor do I see them moving too fast. I guess this is in equilibrium.

Interviewer: What do you mean by equilibrium?

Participant: The rate of forward reaction is equal to the rate of backward reaction.

Interviewer: Okay, you mean like ...

Participant: There's no net change.

Interviewer: No net change. All right, so what would net change look like in this situation?

Participant: Basically if you are increasing sunlight and there's a sudden increase proportionately to the amount of greenhouse gases in the system. Or decrease. That's what a net change would be. Negatives or positives.

Interviewer: Okay so you mean additional ...

Participant: Additional or less ...

Interviewer: Greenhouse gases would appear.

Participant: Yeah.

Interviewer: Okay, all right. Then if you were to summarize for me the interaction between sunlight and CO2, how would you describe that interaction? Is there an interaction?

Participant: No.

Interviewer: How do you know?

Participant: Because it's in equilibrium. Nothing's changing. They're just gas molecules that are moving around.

Interviewer: In the previous screen you were describing how sunlight is absorbed by the ground. Is there any absorption going on in this ...

Participant: No.

Interviewer: Okay, all right.

Participant: Not that I think. I'm not sure but yeah.

Interviewer: It doesn't look like it.

Participant: It doesn't look like it. Yeah.

Interviewer: Okay. Also did you notice the temperature gauge on the right?

Participant: Yeah I did.

Interviewer: Any difference in temperature here?

Participant: It's lower here.

Interviewer: All right, let's go to the next screen. What do you see?

Participant: Gas molecules. I'm pretty sure their interaction with infrared now.

Interviewer: How did you guess that?

Participant: It's written right there.

Interviewer: Good guess. All right, from what direction do you think that the infrared is going to come from. Wild guess.

Participant: The ground. I'm not sure.

Interviewer: Good guess. Let's click play and find out.

Participant: Oh yeah.

Interviewer: What do you see?

Participant: I see that the infrared radiation is interacting with these gas molecules and the temperature's increasing as a result. The more they interact, the more the temperature is increasing and it's getting a little haywire-ish.

Interviewer: Can you talk about the interaction?

Participant: The interaction is that I see these yellow halos or outlines on these green balls every time the infrared radiation hits it, a greenhouse gas. That leads to an increase in temperature.

Interviewer: All right. That's great. Let's go on to the next screen. I know the clicking is not the best.

What do you see now?

Participant: There's the ground, the greenhouse gases and then sun and basically their interaction between all of them. I don't know if there are any specific conditions placed here but I don't think there are so far.

Interviewer: What do you mean by specific conditions?

Participant: What the attraction will look like.

Interviewer: Oh, okay. Can you make a prediction for what will happen when you click play?

Participant: The sun on ground and CO2. Infrared. Sun on ground and CO2. I think it should be in equilibrium because there's no added factor in this particular screen. I'm not sure.

Interviewer: Okay, well. Let's put the play button here. Let's put it in slow motion first actually. All right.

Okay, what do you see?

Participant: Oh, definitely. It's like the layers have been added on top of the screen. Basically when the sunlight interacts with the ground, the ground releases infrared radiation which interacts with the greenhouse gases which leads to an increase in temperature. That's the correlation I can make.

Interviewer: All right. That's great. You think then that ... You said that it leads to an increase in temperature? Can you talk more about that?

Participant: Judging by what I can see, the infrared radiation ... I don't know exactly what ... It doesn't showcase what it does but the greenhouse gases definitely interact with it which is leading to an increase in temperature according to the screen.

Interviewer: You said the greenhouse gases interact with it. What do you mean by it?

Participant: The greenhouse, sorry, the radiation.

Interviewer: The radiation.

Participant: Yeah.

Interviewer: Which form of radiation? The sunlight?

Participant: Infrared.

Interviewer: The infrared. Okay, all right. You think that that interaction between the infrared and the greenhouse gases will lead to an increase in ...

Participant: The more the infrared radiation from the ground, the more the increase in temperature.

Interviewer: And that is because of the CO2, you're saying?

Participant: That is because of the increase in infrared radiation.

Interviewer: Okay.

Participant: So I think that's the culprit here.

Interviewer: Is the infrared radiation.

Participant: Because we naturally do have carbon dioxide in the air system. It's only when it's triggered or catalyzed that it would affect the global warming scale. Because we do need carbon dioxide.

Interviewer: That's true. If there were additional ... if we were to add double the number of greenhouse gases on the screen here, double the number of little CO2 molecules that you see, what do you think the difference would be?

Participant: Increase rise in temperature because the more carbon dioxide in the air, the more the imbalance is created and the more proportion increase. Or maybe not in proportion, maybe exponential increase in temperature.

Interviewer: How would having more greenhouse gases ... can you tie that back to what your ...

Participant: Because they're more interactions, collisions between the infrared radiation and the greenhouse gases. The frequency of collisions increases which leads to an increase in the temperature.

Interviewer: All right, nice.

Participant: Yeah.

Interviewer: Thank you. There is still a couple more things. Let me see here.

What you just described here is called the greenhouse effect which is the main mechanism scientists credit for global warming. So we're going to watch a quick three minute film that kind of summarize what you just described and then I have some follow up questions for you.

Speaker 3: You may have heard of global climate change which is often called global warming. But how much do regular people understand the science of climate change. Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism?

In one study we asked almost three hundred adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works. First here is how earth's temperature works without considering how humans influence it.

The earth absorbs light from the sun which is mostly visible light. To release that light energy, earth also emits lights. But because the earth is cooler than the sun it emits lower energy infrared light. So earths surface essentially transforms most of the visible light it gets from the sun into infrared light.

Greenhouse gases in the atmosphere such as methane and carbon dioxide let visible light pass through but absorb infrared light causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space.

The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees fahrenheit cooler which is well below the freezing point for ice. So how have humans changed things?

Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has almost tripled. These increases cause extra infrared light absorption meaning an extra greenhouse effect which has caused earth to heat above it's typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase ...

Interviewer: It's making us [inaudible 00:17:07]

Speaker 3: Thus producing global climate change. Please share this video with others so you can help them understand how global ...

Interviewer: What are your impressions of the video?

Participant: It was very clear to see it in video format. It was a reinforcement of whatever I just said and now it's solidified.

Interviewer: All right. That's good. What are your thoughts and feelings on climate change or global warming? Do you think they have changed at all over the course of this ...

Participant: No. It's still climate change. So yeah.

Interviewer: I'll be right with. Actually, you know what, I'll be right back.

Just a few more questions. Thank you for your patience. All right, do you think that the science is a relevant aspect the more political issue?

Participant: Of course it is because it's the thing not even about politics. It's about the world and we are living in it. This is not a political ... This can't be a political stance. This is not political. This is reality. If someone's going to be political and be like, "Oh, I don't believe in climate change" then they just need to take a sixth-grader global warming course. I don't know. That need to be ...

Interviewer: Oh, student ID. IT. So you're saying it's not a matter of debate.

Participant: It's not a matter of debate. No.

Interviewer: Why?

Participant: Because so if we ... The thing is that it's the science. For most of us if can study about the heart and the organs and relative build an understanding of the world

regarding our perception in science the average adult knows about then this is also ... It's similar, it's the same thing. There is no room for debate against it.

Interviewer: All right. Thank you. You obviously think is climate change is real.

Participant: Of course.

Interviewer: That it's not ...

Participant: A hoax. No.

Interviewer: Okay, do you think that ... You've already described to me that you think humans are responsible for ...

Participant: Of course. Yeah.

Interviewer: Okay, because you were explaining that humans should take action.

Participant: Of course.

Interviewer: Do you feel connected to the issue of climate change?

Participant: I think yes. This refresher, because I was a little dusty but this was a good refresher so now I'm even more ... Now I know it's like three times more methane since 19-something, since 1750. I can remember these facts so that's cool.

Interviewer: Nice. Do you feel a sense of ... You have these facts and you feel connected because you understand the science ...

Participant: Yeah, more cohesively.

Interviewer: You were talking about taking action earlier in order to mitigate greenhouse gases. Do you feel like your actions reflect global consciousness? Can you talk about that?

Participant: Could you rephrase the question?

Interviewer: So you were saying that people should take action right?

Participant: Yeah.

Interviewer: Do you feel that you personally take those kind of actions?

Participant: I think by ... I don't think CFOs are in use anymore or the ones that contribute. But I think that being aware of how you are contributing to the increase of

methane or carbon dioxide in the environment, just being individually aware of it, could be beneficial in the long run.

Interviewer: Okay, do you feel like you are aware of it?

Participant: Oh yeah, also I personally do take a stand but it's like, I'm a college student so how much do I really interact with. It's like when I can, I'm aware of it.

Interviewer: Okay, all right. In what context I guess is what I'm looking for here? So if you're saying ...

Participant: Like the products I use or ... Whatever I'm using for day to day routine activities. Being aware of the ingredients. Stuff like that.

Interviewer: Ingredients. Can you give me an example?

Participant: It's not coming to my mind right now. But that's as specific as I can get for now.

Interviewer: Okay, that's fine. I guess I have two final questions. Do you think that global warming is a problem that concerns normal people?

Participant: What do you mean when you normal?

Interviewer: Like everyday people or do you think that ...

Participant: So I do know one thing about global warming is that it creates holes in the ozone layer. Or I think it's linked to that. That allows for UV light to come in and can lead to skin cancer and other sort of diseases so of course it's a concern for everybody. Everybody's affected. Animals are affected.

Interviewer: Okay, so you think ozone layer ... So everyone's affected by ...

Participant: The increase in temperature.

Interviewer: The increase in temperature. Okay, to be clear, it was mostly greenhouse gases that were causing that increase in temperature right?

Participant: Mm-hmm (affirmative)

Interviewer: And you think that it affects everyone basically?

Participant: Mm-hmm (affirmative)

Interviewer: You already talked about how it concerns you. Do you think that anything that we looked at today changed your mind about anything?

Participant: It didn't change my mind about my initial stance. Maybe just made it a little more cohesive.

Interviewer: Of the science you mean?

Participant: Yeah, I think that's important too if you're talking about global warming and you're a little rusty, you might not be as persuasive as you want to be if you don't have your facts or your knowledge is demented. I think it's a nice refresher.

Interviewer: All right, thank you so much. If you want to ... How do I stop this thing? If you want ...

PARTICIPANT 2

Interviewer: Yeah, but it'll be kept confidential. So, it'll be transcribed, and then the audio will be destroyed and your name won't be attached to anything. So let me know if you feel uncomfortable asking any of the questions or want me to stop the interview at any time and we can stop.

Participant: Okay. Uh-huh. Uh-huh.

Interviewer: Alright, so before we start about the simulation, tell me what you know about climate change.

Participant: I know that it's happening. It's actually true. I'm not one of those people who do not believe in climate change. It is, I guess, there are for ... there are like legislation in place, but I know that as of right now there is no active stuff that it's like progressing a lot in the Earth's O-Zone layer. I know that has slowed down in the last couple of years, I think. Right? That's what I've read, I think. That's basically all I know. Yeah, scientific-wise. Or recent study-wise, I would say.

Interviewer: Okay, so the slowing of the O-Zone relates to climate change?

Participant: Well, I guess, oh climate change. Okay, climate change, it's happening. It's due to the depletion of the O-Zone layer, right? And then the melting of the glaciers. That's kind of the gist of what I know.

Interviewer: Okay. Alright. Alright. So yeah, that was gonna be the next question I asked is, how does it work basically. So you're saying it has to do with the O-Zone layer.

Participant: Right, right, right. And then the pollution that humans contribute to the Earth and the atmosphere, and then, yeah.

Interviewer: Alright great. So, who does climate change affect?

Participant: I think it affects people, the Earth, the organisms that live on Earth. I would say, just the environment, the plants, the fungus, the dirt, water. I would say, yeah, like everything.

Interviewer: Okay. And when you said people, do you mean like all people on Earth? Or certain groups of people?

Participant: Yeah, yeah. I think all people. I think regardless of societal standing, regardless of status, any ... yeah.

Interviewer: Okay. And then, last question before we start is, how would you characterize your attitudes towards climate change? Do you have a positive attitude or do you have like ...

Participant: Is that just climate change or conservation efforts, environmental ...

Interviewer: Oh, good question.

Participant: You know what I mean? Like would I actually take initiative to let's say, turn off lights or save water, or would that be my, you know, stance on climate change? Like do I ... some people don't even believe it's true. And then, some people, they think it's too far off or you know ... what are you ...?

Interviewer: How bout with respect to action that you would take?

Participant: Towards climate change specifically?

Interviewer: Mmm-hmmm.

Participant: Me personally, I don't really do anything towards conservation.

Interviewer: That's honest.

Participant: Yeah.

Interviewer: I appreciate that.

Participant: I definitely think it is a real issue and I do try to keep as updated as possible. I would say if there's an article trending on Facebook or something that I would definitely click on it and educate myself. But I wouldn't take initiative. I'm not one of those hug-a-tree day kind of person. Or take shorter showers, for example. I always keep my showers exactly to the time I want, you know? So, yeah.

Interviewer: Okay. Great. Thank you.

Alright, so now I'm gonna show you a simulation, and this simulation, let me see. Okay. Here it is. So let me turn up the brightness so you can actually see it.

Okay. So what do you see here?

Participant: Like, right here?

Interviewer: Yeah. Or everywhere?

Participant: I see sun. Okay. Photons, sunlight, infrared. Oh, so it's like different affects on how, where the sun is and then the sunlight particles, infrared on CO2 levels. Okay. That's like chemistry, biology stuff.

Interviewer: Okay. Yeah. So, okay. So you see the sun up in the top?

Participant: Mmm-hmmm.

Interviewer: What about down here?

Participant: Those molecules?

Interviewer: Yeah. Those are molecules. Yeah. And to give you an idea of what the molecules are supposed to represent. They're supposed to be the ground, so the molecules that make up the ground.

Participant: Okay.

Interviewer: Alright. Do you see the temperature gauge on the right?

Participant: Yes.

Interviewer: Did you also notice the play button down at the bottom?

Participant: Yes.

Interviewer: So what do you think's gonna happen when we click play? Wild guess.

Participant: Well I think it's gonna show the particles moving or not moving, affected/not affected, et cetera, based on temperature rise up, down.

Interviewer: Okay. Let's find out.

Participant: Should I press play?

Interviewer: Yeah, and you know, the clicking is weird. So just tap it.

Participant: Tap it?

Interviewer: Yeah.

Participant: Okay.

Interviewer: There we go.

Participant: Yeah, there we go.

Interviewer: So what do you see?

Participant: Okay, so there are particles released. Sunlight and infrared. And then, yeah, as the temperature rises, your increased activity both from the sunlight and then from the particles. There's more infrared being released as the temperature rises. There is more activity between the molecules on the ground. Yes.

Interviewer: Yeah. Good. And where is the sunlight coming from?

Participant: The top. The sky?

Interviewer: Yeah. The sky. Like the top right corner right?

Participant: Right. Right. Right. The top right corner, yes.

Interviewer: Which is where the sun is.

Participant: Right. Right. Right.

Interviewer: Alright, good. And so you were mentioning the infrared light, right?

Participant: Mmm-hmmm.

Interviewer: Where is the infrared coming from?

Participant: The ground.

Interviewer: Ah-hah!

Participant: The molecules are like ... yes, the ground.

Interviewer: From the ground. So why do you think the atoms on the ground are lighting up? Or the molecules on the ground are lighting up?

Participant: Because it's exposed to the sunlight? And then there's activity between the molecules on the ground and then therefore, it releases infrared.

Interviewer: Good.

Participant: Okay.

Interviewer: Yeah. So if you could summarize to me, the process of what happens when visible light hits a ground, how would you summarize that process?

Participant: I would say ... visible light like sunlight?

Interviewer: Yeah.

Participant: Okay. Sunlight hits the ground. So there's interaction between the ... well, there is a visible light source on the ground and the molecules on the ground, and there's, or I don't know, activity between the molecules of the ground. Just like the ground, the dirt, and then infrared is released into the air, the atmosphere.

Interviewer: Yes. Great. Alright. Let's move to the next screen. So click on sun on CO2 forming.

Okay. What do you see?

Participant: I see the sun on the right hand corner. I see [inaudible 00:08:07] CO2 molecules I'm guessing.

Interviewer: Oh. Good guess.

Participant: And then they're scattered. There's no ground. So I'm just guessing, those just like ... in the air. Okay. That's what I see.

Interviewer: Great.

Participant: Okay.

Interviewer: What do you think's gonna happen when we click play this time?

Participant: I think someone's gonna be released and there's gonna be some kind of action with difference in temperature on the CO2 molecules.

Interviewer: Okay. So you think ... okay. So, let's click play and find out.

Participant: Okay. It's gonna disappear or multiply this.

Interviewer: What do you see?

Participant: Movement in CO2 molecules. No infrared or no anything. Yeah. Just movement of CO2 molecules.

Interviewer: So what do you mean by no anything?

Participant: Oh, like no release in infrared or radiation or whatever, yeah.

Interviewer: Okay.

Participant: Just CO2 molecules moving on the screen.

Interviewer: So they have some motion and do you think that the sunlight is contributing to the motion or not really doing much?

Participant: Yeah. I'm not seeing it's doing much. I think CO2's just in the air. Molecules move in the air. That's what they do. Yes.

Interviewer: And do-

Participant: And temperature gauge is steady.

Interviewer: And what you say that the sunlight, or the that the CO2 absorbs the sunlight, like the ground particles did or not so much?

Participant: Oh, not so much.

Interviewer: Okay. Good. Alright. Great. Let's move on to the next one.

Participant: Okay. Should I click the infrared [crosstalk 00:09:41]

Interviewer: Yes. Now, what do you see this time?

Participant: The sun is gone. Molecules are the same. Temperature gauge is stagnant. Yeah.

Interviewer: Alright. What do you think's gonna happen when we click play this time?

Participant: I think there is gonna be an affect on the movement of CO2.

Interviewer: Mmm-hmmm.

Participant: See, that's different from the sun.

Interviewer: Right. So yeah, it's different from the sun, cuz the sun's not here anymore. This time we're gonna see infrared light, and it's gonna up from where the ground would be.

Participant: Yes.

Interviewer: So, and yeah. Can you tell me your prediction again?

Participant: I would say that the molecules move faster or perhaps multiply or yeah, I don't how [crosstalk 00:10:32] would become.

Interviewer: Okay. Let's find out. Kay, what do you see?

Participant: Things ... what's the yellow thing? Why'd it do that?

Interviewer: So you see a yellow thing?

Participant: I don't know what's the simulation, but yeah, they move. Seems to be the same number. Something's are telling me a little.

Interviewer: Same number of?

Participant: The CO2 molecules. Yeah, infrared's coning. Oh! Temperature's rising. Same. Same number of molecules. Yes.

Interviewer: And so, here you're like why-

Participant: I just completely realized what I just said, told you right now. Because I actually, yeah, yeah, yeah. Because, yeah. Okay, yeah. I am sticking to my original, what I said.

Interviewer: Which is?

Participant: Which is like ... what I said before. The molecules are the same. There's yellow stuff. I don't know what that means.

Interviewer: Okay.

Participant: Yeah.

Interviewer: Alright. There's movement?

Participant: Mmm-hmmm. There's movement.

Interviewer: And maybe we can see what's going on better if we click the slow motion button. Alright. So, okay. How is this different than when visible light was shining on the CO2? And by visible light I mean sunlight.

Participant: The sunlight. There's no yellow stuff. I don't know what the yellow thing means. [inaudible 00:12:21] so it'd move slower.

Interviewer: Right.

Participant: But when it was [inaudible 00:12:25], there was no infrared on this, when there was visible light. There was just movement of the particles.

Interviewer: Right. And before it was like, the sun might just passed right through. And this time, maybe not. Okay. It's a little bit hard to see in this screen, but what's making them light up is ... so maybe just follow-

Participant: Oh, that's what you were trying to make me see. Like help me see.

Interviewer: So if you can ... basically they light up when an infrared particle, or infrared wave hits it just right. It will actually absorb-

Participant: The infrared.

Interviewer: Yeah. And then it glows yellow.

Participant: Oh! Okay. Oh! I see. So it almost passes through and then it'll light up.

Interviewer: Mmm-hmmm.

Participant: Okay. I see that.

Interviewer: And then at some point it will stop glowing.

Participant: Yes.

Interviewer: And when it stops glowing, you see what ... watch when it's glowing and see what happens.

Participant: And it doesn't absorb the ...

Interviewer: Cuz it'll go from glowing to no longer glowing.

Participant: Right.

Interviewer: And there's a number of things that happen when it stops glowing.

Participant: Oh, does it release the infrared?

Interviewer: It does.

Participant: Oh. Interesting. Okay.

Interviewer: There you.

Participant: Yeah, I literally had to watch one, like this. Okay. Yeah.

Interviewer: Yeah. And that's good. You saw what I wanted you to see.

Participant: Okay.

Interviewer: And it might not release it in the same direction that it was originally going, but it releases it.

Participant: It releases it. Yes.

Interviewer: Okay. Great. So how would you summarize the interaction between infrared and CO2?

Participant: So CO2 absorbs infrared from the ground, but it also release the infrared from the ground, and it does not get rid of the infrared from the ground. It releases it back into the atmosphere.

Interviewer: Alright. Great. Let's go on to the next screen.

Participant: Okay. Pause. Oh this one.

Interviewer: Yes. Okay. What do you see now?

Participant: So I see the ground. CO2 molecules. The sunlight in the right hand corner, and they're dispersed. Yes.

Interviewer: And what do you think's gonna happen when we click play?

Participant: I think the sun is gonna release light, the sunlight. And the the ground is gonna release infrared, and that's gonna affect ... the temperature, I guess, will rise, and then, the CO2 molecules will be affected. You want me to say how?

Interviewer: Yeah.

Participant: Okay. So, I think when the CO2, when the sun hits the CO2 molecule, it didn't absorb anything. I just kinda floated. And then when it was exposed to infrared, it absorbed and then it released. So I think it'll just be kinda there, like infrared and sunlight.

Interviewer: Alright. Let's click play and find out. Okay. What do you ...

Participant: Oh slow motion [crosstalk 00:15:42].

Interviewer: That's okay. Tell me what you see.

Participant: So, sunlight's being released. The ground's doing the same thing again. As the sunlight hits the ground, it's releasing infrared. Something happening. Nothing's happening to the molecules or CO2 molecules.

Yeah. There we go. It's happening.

Interviewer: And what's happening?

Participant: The CO2 molecules releasing the infrared, lighting up, re-releasing the infrared into the atmosphere. Sunlight's continuously being poured out. Ground's continuously being exposed to the sunlight. Yeah. And they're releasing infrared continuously.

Interviewer: Alright. Great. And what effect do you think this has on temperature?

Participant: Like in general? Temperature rises as sunlight is continuously exposed or released onto the ground. The ground increases where there's more infrared. So increases the temperature.

Interviewer: Okay. And what do you think the effect of having CO2 is compared to the first screen that we looked at when there was no CO2? On the temperature?

Participant: I think it is higher, because ... hmmm. Yeah, I just think it's higher. Do I have to say why?

Interviewer: If you can. You can make a guess too.

Participant: I think because there's more free particle in the air, which absorbs the infrared, and then releases it again, but absorbs the infrared. Yeah. [inaudible 00:17:56] Sorry.

Interviewer: No, you're doing great. You're doing great. No, that was great.

Alright. So let's just check and see if you're right about that whole temperature business right? So you see where the temperature kind of like goes up and down a little bit, varies a little bit, but it's about, it's above the second line here. Whereas if we go the situation where there is no CO2, oh we have to give it a minute. You'll see that ...

It's moving a little bit slow, but you would see that after a while, it would stabilize it a little bit less than the ...

Participant: Than two?

Interviewer: Yeah. Okay. So what you just described to me on the final page is something called the greenhouse effect. And that is what scientists credit as the physical mechanisms behind global warming. So, just to kind of reiterate, I'm going to play for you a three-minute movie that summarizes what we have been talking about. And it kind of talks about ... and ties it to like the human contribution to ... exactly.

And if this thing loads. And then I'm gonna follow it up with a few extra questions.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the Earth is warming. What is the physical or chemical mechanism?

In one study, we asked almost 300 adults in the U.S., and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works. First, here is how Earth's temperature works without considering how humans influence it.

The Earth absorb light from the sun, which is mostly visible light. To release that light energy, Earth also emits light, but because the Earth is cooler than the sun, it emits lower energy infrared light. So Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light.

Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the Industrial Age, around the year 1750, atmospheric carbon dioxide has increased by 40 percent and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range.

In other words, energy that gets to Earth has an even harder time leaving it, cause Earth's average temperature to increase, thus producing global climate change. Please share this video with others so you can help them understand how-

Interviewer: So, there you go. What are your impressions of the video?

Participant: It's well summarized, I would say. Much simpler than how I've learned it. So it's basically what you described to me earlier from what you were saying in the simulation.

Interviewer: So do you buy all this stuff? Do you think that this is actually going on in the atmosphere?

Participant: Yeah. I do. Yes. I think it's true.

Interviewer: And why is that?

Participant: I think, I mean me personally I'm a biology major. So, I'm just being, learning this so many times in so many different capacities. Whether or not, that's from the carbon cycle, all these, oxygen cycle, water cycle, like all these kind of things that are affected by the greenhouse gases. I mean, there's scientific proof for all of this, I would say. Yes.

Interviewer: And you trust the scientists?

Participant: I do.

Interviewer: So you then think that science is a relevant aspect of the issue of global warming?

Participant: Yes. Yes.

Interviewer: Okay. Good. And you think it's real obviously. That was the first thing you told me when you sat down. So do you think that humans are responsible for these?

Participant: I do. I think there is a factor that cannot be explained by only nature, that global warming to this extent and this capacity and at this speed, that we can't say that it just happened naturally, with no intervention. And it is true that scientifically that the gases and methane and stuff like that we release into the atmosphere.

In a molecular level has it ... impact in the whole system of things. That's how the carbon cycle really has been affected and that's why this happened. So. Yes.

Interviewer: Okay, so do you feel like normal people have a responsibility to do something about this?

Participant: Yeah. I mean, yes. I think "normal people" do. Yeah. Just to answer your question. Should I elaborate?

Interviewer: If you want, yeah.

Participant: I think, like for me personally, which obviously I don't do anything about it, I think it has a lot to do with legislature as well on the big spectrum of things. And stuff like people cannot water their lawns anymore in the middle of the day in certain cities. And I think stuff like that forces people tom make a change.

That's very different from, let's say, I am taking 30 minute showers and I want to cut that to 15. That's gonna be very different and the impacts that that has, on a global scale or as a country, or as a state, it's gonna be very different. And very, in both capacity, and what people are think, stuff like that so.

Interviewer: So you're saying then that ... so let me make sure I understand what you're saying. So you're saying your individual action of cutting your shower time in half, will have an impact. If everyone did it, is that what you're saying.

Participant: Yeah, but that's hard. You know what I mean. It's virtually impossible to say, cut your shower time in half or don't use the dishwasher, something like that you know. And I think that's why legislature, and a big scale, kind of forcing people to do certain things that they feel will impact the environment in a large way. Very quickly I guess. Cuz everyone's doing it at the same time.

Interviewer: Oh I see. So you're kind of saying it's the responsibility of the lawmakers to come up with some systematic way to make sure everyone is cutting their water in half or something like that.

Participant: And that's my personal belief. Like I really agreed with the not watering in the middle of the day thing. And that has done tremendous for California, so yeah.

Interviewer: Alright. Okay. So do you think that the science that we learned today, you know, the CO2, and the infrared being absorbed leading to increased temperature, do you think that that's changed your mind about anything?

Participant: I may be a little biased here, because I learned this. It's kind of, a big part of biology in general, but personally knowing about it for so long and in so much detail, probably more than what usual people know, has not changed my practices in everyday life. I still take baths quite often. I do certain things. I could turn off the light when I leave, but I don't. Stuff like that. So this kind of very over-simplified version of what I learned, but you know. Yeah, so, me honestly I would say no.

Interviewer: Okay. That's okay. That's alright. And yeah, okay. Yeah. That's alright. Yeah. Thank you so much for your time and that's it.

Participant: Perfect.

Interviewer: Yeah.

PARTICIPANT 3

Participant : Discrete math now.

Interviewer : Oh yeah? Discrete math, like probability?

Participant : Probability, implication, P and Q stuff.

Interviewer : Oh, okay.

Participant : Yeah. Induction, weak, strong and stuff.

Interviewer : Oh, that's a good one. That was my forte. I'm taking more statistics now, just because that's part of my ...

Participant : Research.

Interviewer : Part of my research. Yeah. So, anyway, during this interview I'm gonna ask you to interact with a computer simulation that illustrates the science of climate change and it shows you things that you can't normally see with the naked eye. And then, I'm gonna play you a short film to summarize what we learned. Then, as you interact with the simulation, I'm gonna ask you what you're thinking about and what you see in the simulation. And, you'll receive full credit for participation regardless of how you respond to any of my questions. The interview's expected to last about 20 to 30 minutes. Probably like 30 minutes. And then, any information you share with me is going to be audio recorded, but it's all confidential. So, as soon as we're done, probably within a couple of weeks, it'll be transcribed and then the audio will be deleted and so.

Participant : Yeah. I know the ...

Interviewer : You know the drill?

Participant : I'm the psychology major.

Interviewer : Oh, you are?

Participant : Yeah.

Interviewer : Oh, okay. Oh, I didn't know that.

Participant : So, I say, like, "Psychology major. CS minor."

Interviewer : Oh, I didn't hear the psychology major part. All I heard was the CS minor part. Okay. Yeah, so let me know if you feel uncomfortable answering any questions at any time and we can end the interview. Before we start, tell me everything you know about climate change.

Participant : From what I learn, climate change is real. The iceberg in the North Pole is melting and probably by 2030, many cities will be drowned because the sea level is much higher. Countries are trying to negotiate. They want the economy to develop, so they kind of negotiate. They agree to increase one celsius degree every year. That's good for economy, but also for the climate. I know China is doing ... trying to control the pollution now. I know President Obama cares a lot about the energy saving and the pipeline projects. But, President Trump has different opinions and most of the Republicans, they care about now, like, lower price for oil, probably more employment. But, I think climate change is long term, so we should be concerned about it.

Interviewer : All right. When you're talking right now, you were explaining pollution and curbing consumption of-

Participant : The energy or the natural resources.

Interviewer : And so, how does that fit in with how climate change works?

Participant : Okay, so, the major greenhouse gas, like water vapor, carbon dioxide, when the carbon dioxide move to the tops of, like, to cover the earth, it's like the coat of bedding for the earth. So, the heat enters from, like, gather heat from the sun, but it never leaves. So, it will be ... keeps warming up, warming up, warming up. And, because the major biosphere carries this water, then it becomes water vapor. I think water vapor is most dangerous or most ... it cause more damage even then the carbon dioxide.

I know the carbon dioxide level is correlated with temperature, 'cause people took the core of the iceberg down to the very deep of the South Pole or North Pole. They extract the ice from thousands of years ago, so they simulate the correlation between carbon dioxide level and the temperature to predict, like ... it's a good predictor for the rise of temperature. For now, we are the highest carbon dioxide level. And also, we are at probably a very high temperature now.

Interviewer : All right. That was a very good description. Thank you.

Participant : I took a environmental study class, so.

Interviewer : Okay, so you may have seen some of the stuff I'm gonna show you then. It maybe, but I can still show you what I'm gonna show you. All right. So, you said that you think climate change is real.

Participant : Yeah.

Interviewer : What are your feelings in general about climate change?

Participant : I feel from a 20 year experience, right, I feel ... I maybe don't have some memory before five, but I feel the winter is become warmer and warmer. Because, when I was young I can see the snows and the outside of the houses, you have the ice corn, like, dropping from the ceiling or from the roof, but now it's gone and it varies. And, I think the climate's more disruptive 'cause from the news reports, it's the worst winter storm in the couple decades.

And, I also did a research about California jobs. I do believe this was caused by the global warming. There's kind of like some bridge stuff around Alaska. So, when the wind from the North Pole is coming down, but that bridge prevent water or the wind reaching the California or the West Coast. So, it pushes the precipitation to the east coast. So, I get friends in Boston, they always have the worst storm in the decade or historical bad storm. So, it pushes to the east coast and middle east, then the west, very dry. So, it's more disruptive and the place should be warm become cold. If it should be cold, it can be even colder. It's also causing the flooding in the south.

Interviewer : Okay. Thank you. Now, what I'm gonna do is show you a computer simulation. What do you see?

Participant : Atoms and sun.

Interviewer : Atoms and the sun. And, what do you think the atoms comprise?

Participant : Probably water.

Interviewer : Okay. And, in this case, it's actually the ground.

Participant : Okay.

Interviewer : All right. What else do you see here on the screen?

Participant : Some options, like "sun on ground," "sun on CO2," "infrared on CO2," "sun on ground and CO2."

Interviewer : And, these are like different pages that we'll visit. Do you notice the temperature gauge?

Participant : There's a scale on the right. Now, it's lowest point, I guess.

Interviewer : Right. And, the play button. What do you think's gonna happen when we click the play button at the bottom? Wild guess.

Participant : The temperature rise. Then, you change the option on the right when the vector receiver too is involved in the ... becomes the parameter. Yeah.

Interviewer : Okay. Nice guess. Click the play button and let's see what happens.

Participant : This one?

Interviewer : Yep. Oh yeah, you have to ... sorry, the clicker is weird. You have to just tap it. Yeah. It's not working quite right. There we go. Yeah.

Participant : Start reading. Sunlight.

Interviewer : Okay, what do you see?

Participant : Fraction. The heat is leaving, coming maybe from different angles. A reflection of the heat.

Interviewer : You see heat. So, what does the heat look like?

Participant : We saw wavelengths.

Interviewer : Yeah, different wavelengths. Did you notice the two keys over here?

Participant : Yeah. One is sunlight, one is infrared. I don't know what does this mean, but it seems to be reflecting?

Interviewer : What seems to be reflecting?

Participant : Both of them are are reflective.

Interviewer : Okay. Yeah. And, where is most of the sunlight coming from? Would you ...

Participant : From the sun.

Interviewer : From the sun? And then where is the infrared coming from?

Participant : From the ground.

Interviewer : From the ground?

Participant : Yeah.

Interviewer : What happens when the sunlight hits the ground?

Participant : It's absorbed, mainly absorbed and partially reflected. And, probably transformed to infrared, I guess.

Interviewer : Yeah. Good. So, if you could summarize for me the interaction between sunlight and the ground.

Participant : Okay, so, the sun, it means the sunlight, when sunlight reaches the ground then the sunlight absorbs the ... partially absorbed by the ground. Then, it's transformed into infrared and reflect back to the space. And also, part of the sunlight was also reflected.

Interviewer : Right. Okay. Let's click on "Sun on CO2." Okay, before you click play, what do you see?

Participant : Green particles in the air and the sun, and temperature is higher.

Interviewer : What do you think the green particles represent?

Participant : CO2.

Interviewer : CO2, yeah. And they're green because they're supposed to be like greenhouse gases. Okay. What do you think's gonna happen when you click play?

Participant : The particles are vibrating, probably moving, maybe more randomly or maybe move to the top.

Interviewer : Okay. Let's find out. What do you see?

Participant : The sunlight from the sun. The CO2 moving around, moving around randomly.

Interviewer : How do you characterize the interaction, if there is any, between the sunlight and the CO2?

Participant : I think that the sunlight provides the energy for the CO2, so it's some chemical changes or some physical changes provides more energy for the movement.

Interviewer : Okay.

Participant : More active.

Interviewer : Okay. So, you think that the sunlight is causing the CO2 particles to move around?

Participant : Yeah, because before the energy was static, right? The sun wasn't emitting the sunlight. Now, you have the sunlight.

Interviewer : All right. Would you say, though, that the CO2 is changing the path of the sunlight as it falls or is the sunlight passing mostly right through the CO2?

Participant : Mostly right through. 'Cause the direction of the sunlight is very consistent, even though the CO2 is moving around.

Interviewer : In the previous screen, you described the ground as absorbing the sunlight and then emitting infrared. Is there any absorbing happening here?

Participant : Seems no.

Interviewer : Okay.

Participant : Yeah.

Interviewer : All right. So, how would you summarize for me the interaction between sunlight and CO2?

Participant : The sunlight provides energy for CO2 particles and the sunlight goes through the CO2 and the CO2 doesn't interfere with sunlight's direction.

Interviewer : All right, great. Let's go to the next screen. Okay, what do you see here?

Participant : Green particles. So, it should be CO2.

Interviewer : Right.

Participant : I don't see the infrared yet. I probably will.

Interviewer : When you click the play button. So, go ahead.

Participant : Okay.

Interviewer : Okay, what do you see now?

Participant : Infrared is changing ... no, infrared and CO2 are interacting, so the infrared changed the direction of the CO2 and vice versa. And, because the random movement of the CO2, the direction of the infrared becomes random as well. They will hit each other. And, the temperature rise pretty fast. Scale to the three out of five now.

Interviewer : And-

Participant : Four out of five now.

Interviewer : How do you know that the infrared is interacting with the CO2?

Participant : 'Cause, I can see the green circle when the ... the yellow circle was highlighted when the infrared hits the CO2 particle.

Interviewer : All right. Just summarize for me again the interaction between infrared and CO2.

Participant : So, the infrared and CO2 interact with each other by hitting each other. Then they will change each other's direction. And, because the movement of the particles, kind of arbitrary, so the new directions for the CO2 and infrared are also uncontrollable.

Interviewer : Great. Let's go to the final screen. "Sun on ground and CO2." Okay, what do you see here?

Participant : I can see the brown particle is representing the ground and the green particles, CO2 and the sun.

Interviewer : What do you think is gonna happen when we click play?

Participant : I think the temperature will reach the maximum. Then, I think it will be the combination of the previous four ... previous three, so the carbon dioxide particles will randomly sun ... the ground absorbs the sunlight partially and generate infrared, and infrared's direction change by the CO2. CO2's direction change by the infrared. And, temperature rise. Yeah.

Interviewer : Okay. And so, if we were to compare, just as a prediction, this screen with the initial screen of just the sun on ground with no CO2, what do you think the difference would be?

Participant : You just don't see the CO2, but you can still ... by this obstruction, right, the arbitrary direction of the infrared in the first scene should be the same in the last one, only it makes the CO2 invisible.

Interviewer : You're right. Only the CO2 is invisible. And, now that the CO2 is here, do you think it will have no effect on the process of the sunlight and the infrared emission?

Participant : I mean ... 'cause from the first scene, the infrared is already arbitrary ... have arbitrary directions, right? Okay. So, maybe more arbitrary and temperature rise more, like, even faster.

Interviewer : Okay. And so, the particles will be moving even faster? And, what does that mean for the temperature?

Participant : Increase. Accelerate faster.

Interviewer : Okay. Let's find out. Okay, what do you see? Go ahead. You can just say whatever's on your mind.

Participant : Fewer infrared reflecting. Or, maybe fewer sunlight was reflecting, because CO2 is kind of a bridge preventing [inaudible 00:19:57]. It's a little bit slower than I expect.

Interviewer : I think also it's because the computer slows down. It has memory. Limited memory.

Participant : I think that's pretty much I predict from the first scene. Oh, I can see more infrared now.

Interviewer : So, pretty much what you predicted which was, just reiterate for me, what was that again?

Participant : The arbitrary direction of the infrared and also arbitrary direction of the sunlight reflected from the ground.

Interviewer : And the CO2? How does that come into play?

Participant : The CO2 blocked some of the reflection and so. It also changed the direction, so maybe-

Interviewer : It changes the direction of?

Participant : The infrared.

Interviewer : Okay.

Participant : So, by chance, the infrared will come back to the ground, I guess. So, more heat will remain on the sea floor or the ground.

Interviewer : Very good.

Participant : And, temperature is now rising fast compared to the other one.

Interviewer : Yeah. How would you compare the temperature on this screen to the first screen?

Participant : It's higher. The first one, from what I remember was one out of five. No, six, sorry. It was six out of five. Now, it's almost three out of six.

Interviewer : All right. Let's say that we were to double to the amount of CO2 onscreen. What do you think would happen?

Participant : Double the CO2? So, more infrared coming back to the ground, I guess. Because, by probability, I guess, so there's a certain chance you'll be, right? Assume there are eight directions, right? The upside ... up, down, left, right and the other four. But, there are more ... like, have a probability for the infrared going back to the ground if there are more particles blocking and, yeah. I mean there's same probability, but different amount, so the expected value will be different.

Interviewer : That's a really interesting way of looking at it. Like, higher probability of it coming back to the earth, right?

Participant : Then more amount. Yeah. Maybe the same probability. It seems independent. Or, maybe dependent.

Interviewer : The more events.

Participant : Then more of the particles over there. So, yeah.

Interviewer : And, do you think it would have an impact on the temperature?

Participant : Sure. Because, I mean, CO2 is correlated with the temperature. And, if the heat is not leaving, so the temperature definitely will rise.

Interviewer : All right. Great. So, what I'm gonna do now is show you a short video to kind of summarize what we saw here. And then, I'm gonna follow up with some questions and that will be about it. This connects what we just saw with the human influence.

Speaker 3: You may have heard of global climate change, which is often called "global warming." But, how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the U.S. and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you short explanation of how global warming works. First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light. But, because the earth is cooler than the sun, it emits lower energy infrared light. So, earth surface essentially transforms most of the visible light it gets from the sun into infrared light.

Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40 percent and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused earth to heat above its typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase, thus producing global climate change. Please share this video with others, so you can help-

Interviewer : So, what are your impressions of the video?

Participant : Decent. It talks about the carbon dioxide and methane, but it doesn't talk about the source of the two gases. But, it's very informative in three minutes. I took one class about climate change so I know more about methane produced by the animals. Especially the meat industry and knows it should not talk about it. The media doesn't want to talk about it because the food industry buys big money, so they can cajole the reporter or they can use the PR to make silence. It makes money, but they don't care about the methane or the global warming.

Interviewer : You're talking about one side of an argument that the meat industry is taking and creating, or doing science, I guess, in order to have a debate. Do you think that this

should be debated? Do you think that a debate is something that should be happening publicly on TV, in the news, things like that?

Participant : I'm not sure. To not offend people, but maybe people here don't care about it or they barely understand it. 'Cause the higher education portion of the United States is low, and people like the V8 big engines and if you want them to change it's very difficult. And maybe, it's kind of too late to educate their child. So, when their children grow up, it can be too ... I'm ambivalent. But, I feel it's very important.

Interviewer : So, you think that maybe when some people are arguing, one side like that-

Participant : I think, ideally, we should talk about it publicly. But, realistically, it probably won't because the media are privately owned by people, right? And, you know how strong the PR, public relation, is. And, yeah.

Interviewer : And-

Participant : I think that the U.S. is controlled by the rich people. In certain levels, I think.

Interviewer : How do you think the science fits into that?

Participant : I think all the managers know the science, they know what they are doing, but the profit is the profit. So, I think the government should negotiate with industry to do more active work. And, as globalization is a big issue today, right? I know the U.S. refused to sign the climate change con ... like, stuff. But, China is trying to cooperate. Then, President Trump said it's a trap or it's a big lie. It's kind of disappointing since the U.S. is number one or the leading voice. Yeah. Climate change is visible in certain levels, but as long as people don't want to deal with it. But, I'm optimal about the result, but I'm not sure when it will come.

Interviewer : The result, meaning?

Participant : Like, people can control the climate change, since we can control ... since there are so many smart people out there.

Interviewer : Do you think that-

Participant : I think the policymaker should be more active or has more [inaudible 00:31:36].

Interviewer : Do you think that the science will come into play in changing people's minds about this kind of thing?

Participant : Yeah, you have to insert this idea into the elementary students. They are the future people, right? I know how stubborn the adult will be. Talk about 40 or 50 year old, middle aged people now talk about global warming, they probably don't care about it, 'cause when it comes they already dead. And also, they never think about it or they not be educated or they may not care. They like their V8 big engine pickup.

Interviewer : So, you think it's the normal people who are gonna be ... like, they're responsible for-

Participant : Yeah, they are responsible. So, the extreme right is brainwashed. The last warning cycle, education, right? So, we should educated the young children, 'cause they are more susceptible to the idea or they are more willing to learn. If the curriculum is consistent, making children believe, they can change their parents, maybe. We can change the parents easily. I think the parents will learn from the children. They will ask, "What did you learn today in the class?" So, if the children can be a positive voice.

Interviewer : Do you feel connected to the issue? Obviously, you said you've taken a class on global warming, so you know a lot. I mean, just from me talking to you, I can tell that you have a pretty extensive knowledge on how it works and what's going on and what's involved. Do you take any actions in particular in order to reflect that?

Participant : I mean, as an individual, I don't have much power to do that. But, I want to save the energy as much as I can. Turn off the light or I use the carpool, maybe. I guess, as an individual or a man having graduated from college, you can't do much about it. I mean, people talk about global warming, but they don't give specific advice what to do. So, maybe more education about what to do or very specific points.

Interviewer : I'm sorry. I didn't follow the last thing.

Participant : I mean, we all know global warming is out there.

Interviewer : Maybe not everyone, but.

Participant : Not maybe everyone, but we don't learn the specific actions we can do. 'Cause we all learn we should take actions, but take what actions? I mean, it should be very simple, doable for individuals. It can be some positive reinforcement for the psychology, or some punishment or stuff. But, yeah. It can be very specific and small, doable. It will be effective.

Interviewer : You were telling me that you take part in little actions, not necessarily little, but you save energy and you try and take public transportation. Is that what you said?

Participant : Yeah.

Interviewer : Yeah.

Participant : Because there's no public transportation here.

Interviewer : Oh, right.

Participant : Because, I'm from Shanghai, so there are many public transportation. You can take buses. There are 15 lines in the subway. So, I usually take subway. And, it's cheap and comfortable and you can go anywhere. For L.A. it's not very doable. But, in general, I

don't like driving 'cause you are stuck on the road, you can't do anything. In the subway, you can do many things.

Interviewer : Has anything that you saw today changed your mind about anything at all?

Participant : No. I mean, I already know almost everything about global warming. But, I learned more about infrared and the CO2.

Interviewer : Okay, great. Well, thank you so much. That's it. Sorry, my hand is a little bit sweaty, but thank you so much.

Participant : Thank you. So, I can just leave?

Interviewer : Yeah, you can go. And, I will give you credit.

PARTICIPANT 4

Interviewer: Yeah. My information's on the sheet if you want to contact me for any reason. And so, during the interview I'm going to show you a computer simulation that illustrates the science of climate change, and shows you things you can't normally see with the naked eye.

Participant: Okay.

Interviewer: Then I'm going to play a three minute film to summarize the content that you see in the simulation, and throughout I'm gonna be asking you questions to find out what you're thinking about, what you see, and you know, other questions as well.

Participant: Okay.

Interviewer: Yeah, and the interview is expected to last about 30 minutes. And any information you share with me is going to be strictly confidential. It'll be audio recorded but then it'll be transcribed and then the audio will be destroyed, and your name won't be attached to anything.

Participant: Okay, got it.

Interviewer: And let me know if you feel uncomfortable answering questions at any time, and we can stop the interview whenever you want.

Participant: All right, perfect.

Interviewer: So what's your major?

Participant: Health and Human Sciences. It's in [inaudible 00:01:10].

Interviewer: Okay.

Participant: It's relatively new. I think they brought it on two years ago.

Interviewer: Okay, how do you like it so far?

Participant: I love it.

Interviewer: Yeah?

Participant: It's similar to health and humanities, which has been here forever but it's just a little bit different. The requirements are different between the two majors. But I really like it. So yeah. Some science and humanities classes.

Interviewer: That's great.

Participant: Yep.

Interviewer: So why don't you tell me everything you know about climate change?

Participant: Okay. Well, I know I get a lot of one side because my dad is very conservative. So growing up I heard the more conservative approach to climate change and his opinions definitely are skewed in that direction. And my mom doesn't have as much research. My dad does a lot of research online. But in terms of the opinions I have formed, I feel that I stand in the middle of things and I have have not done enough research myself to really have that great a concept of climate change. I do think that it is problem, and the most things I've researched about are to do with agriculture in the United States and how farming and the cows integrate into the bigger picture and the problem. Aside from that I don't know very much about oil, and how that contributes. In terms of my education I took a few environmental classes throughout college which are definitely educational. That's where I stand. I don't know if that's a good answer.

Interviewer: Well I mean there's no good or bad answer. I just want to know what-

Participant: I would say I'm not very opinionated either way, just because I don't have enough information yet.

Interviewer: Okay, and you mentioned something about cattle.

Participant: Yeah.

Interviewer: Do you want to talk a little bit about that?

Participant: The CO2 production from their waste, I believe I've read that that contributes in some way to environmental pollution in the air. I'm really interested in food, that's why I liked the survey. The whole process of making on hamburger and the environmental impacts of just making one hamburger, feeding the cows, and all what goes into that process, I think has a negative impact for sure on the environment as opposed to just eating plant-based food.

Interviewer: Interesting. So you you like thinking about the systems and how everything-

Participant: Yes, exactly.

Interviewer: -interacts? That's so cool. So you said that you came from a more conservative background, but your more in the middle. Right?

Participant: Yes. I definitely listen to what my parents would talk about growing up, but I didn't let that really impact my decisions now.

Interviewer: Okay, all right. I have to get these. I'm so sorry.

Participant: Yeah, go for it. Don't worry.

Interviewer: So sorry about that.

Participant: It's okay.

Interviewer: I appreciate all of this. Okay, great. So let's get started with the simulation.

Participant: Cool.

Interviewer: What do you see here?

Participant: Sun and-

Interviewer: Here I'll move it closer.

Participant: -temperature scale that's very low. And that the light source is on, which is the sun. I'm assuming that the ground is the brown dots.

Interviewer: Yeah.

Participant: Okay. The sun is on the ground, great.

Interviewer: Why do you think they're dots?

Participant: Because things can seep down through the ground, so instead of being one thick line it has space for things to seep into it.

Interviewer: Okay interesting. Yeah. And just to let you know I think they're supposed to be particle-like molecules.

Participant: Okay.

Interviewer: So that might help you understand what happens as we go forward.

Participant: Okay.

Interviewer: All right. Do you see the play button at the bottom?

Participant: Yes.

Interviewer: Okay. What do you think is gonna happen when we click it?

Participant: It's gonna go through these models, maybe.

Interviewer: Okay. At this point you're making a wild guess and that's fine.

Participant: Yeah.

Interviewer: Okay, so you do see the models though on the left.

Participant: Yes.

Interviewer: Okay that's a good thing. Well, let's click it and find out. And I have to let you know the clicking, you just have to tap.

Participant: Okay, cool.

Interviewer: It's an old computer. Okay, what do you see?

Participant: I see the dirt particle, or whatever they're called, moving, and the light hitting the particles and being reflected in different directions from where they came, mostly upwards towards the atmosphere, and some are turning into smaller squiggly lines which indicates that they're different from what originally hit the dirt. And I don't know why the dirt's turning yellow but [inaudible 00:06:50].

Interviewer: Okay. And sorry for interrupting, the two squiggly lines-

Participant: So they're infrared. Yeah, okay.

Interviewer: There you go, maybe that'll help.

Participant: Yeah. So sunlight is being turned into infrared light when it bounces back into the environment.

Interviewer: Great. And you were talking about the yellow when I interrupted, sorry about that.

Participant: I'm assuming the yellow is the point of contact, and then it shoots back off.

Interviewer: All right, great. If you could summarize and-

Participant: Oh, and the temperature is rising.

Interviewer: Very good. If you could summarize for me the interaction now between sunlight and the ground, how would you summarize that for me?

Participant: When sunlight hits the ground some sort of chemical or physical process occurs and that sunlight leaves the ground as infrared light or whatever infrared is.

Interviewer: Great, yeah. That's perfect.

Participant: Okay.

Interviewer: Okay, let's go to the next model.

Participant: Okay.

Interviewer: If you could just click on sun on CO2 for me. Okay, what do you see here?

Participant: Sunlight and the CO2 molecules.

Interviewer: All right. And do you want to make a guess why they're green?

Participant: ...

Interviewer: It's okay. They're greenhouse gases.

Participant: Okay.

Interviewer: Okay. All right. Now what do you think is gonna happen when we click the play button?

Participant: Well there's no dirt anymore. So that's interesting. But I'm assuming again that sunlight will hit the CO2 molecules and in some way change them to produce something.

Interviewer: How did you know when a sunlight particle hit a ground molecule in the last one?

Participant: Because it turned yellow.

Interviewer: Right, okay. Let's find out. Okay what do you see?

Participant: The sunlight molecules are just going straight past the CO2 molecules as they float in the atmosphere without interaction.

Interviewer: Okay, great. So can you-

Participant: And the temperature isn't high.

Interviewer: -summarize the interaction then between sunlight and the CO2 particles one more time for me?

Participant: Sunlight leaves the sun and does not interact with CO2 molecules.

Interviewer: All right, great.

Participant: It's right?

Interviewer: Yeah.

Participant: Okay.

Interviewer: Let's go on to the next one. All right, now what do you see?

Participant: Just CO2 molecules.

Interviewer: Right.

Participant: Greenhouse gas molecules.

Interviewer: Yeah, same.

Participant: Okay.

Interviewer: What do you think will happen when we click the play button this time?

Participant: Well there's no sun. Is that supposed to be important? I'm assuming the infrared molecules will have an effect this time, because they're different from just regular sunlight molecules.

Interviewer: All right, let's find out. Now do you see?

Participant: They are hitting the green CO2 molecules and making them bounce. Actually I don't know if they're changing the trajectory of the molecule itself, but the infrared molecules are being hit off to the sides, and so it's changing their trajectory when it hits the CO2 molecule. Okay. And it's turning yellow when it gets hit. And sometimes the CO2 molecules are hitting each other. But I think that's normal. And the temperature's very high.

Interviewer: Right. Why do you think the temperature is higher than when it was sunlight on CO2?

Participant: Because this interaction of infrared and CO2 must be raising the temperature. Maybe. Or we're now in a different country where it's hotter outside.

Interviewer: I like your personal [inaudible 00:11:06].

Participant: The only explanation I can see is that.

Interviewer: Right.

Participant: Yeah.

Interviewer: Great, so if you could just summarize for me one last time what the interaction is between infrared and CO2.

Participant: Okay. So when infrared hits a CO2 molecule its direction is changed and this reaction causes an increase in temperature.

Interviewer: Okay, great. Let's go on to the next screen.

Participant: Sun on ground and CO2. Okay so we have the sun, we have green CO2, greenhouse gas molecules, and we have ground.

Interviewer: So what do you think will happen when we hit play this time?

Participant: So now we have all three integrated. The sun will hit the ground first. We'll just see all three in play. So the sun will hit the ground, then it will bounce back as infrared molecules, which will hit the CO2 molecules and deflect and raise the temperature.

Interviewer: All right.

Participant: Okay.

Interviewer: What do you see?

Participant: So far the sun. I have to follow them. Sunlight hits the dirt. It bounces back up into the atmosphere as infrared light, and when it it hits a greenhouse gas molecule sometimes it hits back to the Earth, or it goes sideways and hits another greenhouse gas molecule and it doesn't do a normal trajectory upwards and the temperature is rising.

Interviewer: And how do you think the temperature in this screen compares to the temperature on the screen where there is no CO2?

Participant: Wait, sorry. Say that again.

Interviewer: Sorry. By having CO2 particles do you think it makes a difference compared to when we just had the sun and the ground with no CO2?

Participant: Yes, I think the dirt makes the temperature higher, if I can remember correctly, the temperature didn't seem as high on the first model that we ran.

Interviewer: How would you compare the temperatures between the two screens, between the first screen and this screen?

Participant: The temperature seems to be higher on the second screen.

Interviewer: Explain to me one more time. I know that you already explained why the temperature [crosstalk 00:13:53]-

Participant: The temperature on this screen is higher because the ground and the CO2 have been integrated as well as the sun. So all three components.

Interviewer: All right, great. Let me see if I have any other questions before we move on to the video. Okay. So what effect does CO2 have on temperature, you already told me.

Participant: It raises the temperature.

Interviewer: Raises the temperature. All right, great. One last questions. What do you think would happen if we added more CO2?

Participant: There would be more CO2 particles for the CO2 particles to interact with, and thus the temperature would rise even higher. Maybe.

Interviewer: Yeah, okay. So that's the greenhouse effect. And adding more CO2 particle indeed is theorized temperatures to rise even more. So the video I'm going to show you just kind of summarizes everything you learned here. Not going to restart the computer. And it ties it to the idea of human involvement in the process.

Video: You may have heard of global climate change which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the Earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how Earth's temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But because the Earth is cooler than the sun, it emits lower energy, infrared light. So Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light.

Greenhouse gases in the atmosphere such as methane and carbon dioxide let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space.

The added time this energy hand around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice. So, how have humans changed things?

Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40%, and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change. Please share this video with other-

Participant: Okay. Very self explanatory.

Interviewer: Yeah.

Participant: There's the methane I was talking about from the cows.

Interviewer: Exactly.

Participant: Okay.

Interviewer: Exactly. So do you think this agrees with your-

Participant: Yeah. I would say I had a basic understanding and this laid it out in a more clear sense, and this is what I would have thought would explain global warming.

Interviewer: And when you say this, are you talking about the video or the-

Participant: How. Like; Step one, sunlight.

Interviewer: I see.

Participant: I couldn't have put that into words earlier, but now I can see that that is what I was thinking originally.

Interviewer: All right, okay. So that's like the process of it.

Participant: Yes exactly.

Interviewer: Okay, great. So do you buy that this is how it works? We weren't actually looking at real CO2 particles on the screen-

Participant: Yeah.

Interviewer: -and it's not like we could touch them and see them and know that they were real. It was a model.

Participant: Yeah.

Interviewer: I'm kind of making this question up as I go along. But are you skeptical of any of this?

Participant: Yes. Only because I know that it's still a debate, and there are two sides, and it's not like there's a lot of factual evidence on both sides in my opinion. So thus there must be some discontinuity still of the research done. And obviously this is just an animation that someone could have made who has these beliefs, and then someone could completely dispute this through another random animation. I know I wrote that on my thing, maybe more hard data would be better to form an opinion.

Interviewer: I see. Okay. And what you mean by you wrote it on the thing you're talking about the study from previously, right?

Participant: Yes. Yeah, obviously.

Interviewer: Okay. All right. It's important to weigh both sides of the story, you're saying.

Participant: Yeah.

Interviewer: What's on the other side of the story for you?

Participant: Well from what my dad's told me, for example, the Earth has been going through cycles of cooling and heating and cooling and heating since the dinosaur ages, so these are expected changes and humans have gone through these changes for centuries. Let me see what else he says. I mean, again, this is what my dad has told me so I haven't done my research, but I do know that there are strong opposing sides out there but I'm not sure exactly what they say past that.

Interviewer: Okay. All right.

Participant: Yep.

Interviewer: All right, that helps. And what are your general feeling towards global warming? Either the science you saw here, in the news, or whatever. What's your emotional feelings towards all if that?

Participant: Yeah, if I'm to be completely candid, I understand that this is such a longe term problem, if it is a problem, that will effect my children and whatnot, but I think I find it difficult to be really passionate about this because I don't see myself going out in the world and being an activist on this subject. So I wouldn't say on a day to day level it effects me that much. I know my roommates recycle more than I do, and do little small things that they consider to be helping the environment, and I'm not doing as much. I probably should be, but I just know that's how I am as a person. I just am not too passionate about these subjects.

Interviewer: So you don't feel as connected, maybe, as your roommates to the issue or to the problem.

Participant: Yeah, yeah.

Interviewer: Okay. All right.

Participant: I should probably change that, but just-

Interviewer: Tell me more about that. Why do you say that? Why do you say that you should change?

Participant: Well if anything I should just become more educated on the subject, and then from there decide if I should be making personal changes or not, as opposed to just doing it because my roommates or whoever are doing it. So definitely do some more research.

Interviewer: So then, like they were saying, 98% of the scientists agree that the process that we went over now is the way that things are, and then there's the 2% who are on the other side

of things. So let's say you went out and you read 100 articles. How do you think you would go about integrating the two sides of things?

Participant: If the vast majority of what I'm reading is pointing in one direction, and they're both imperical evidence, then I would definitely head to the group majority of what scientists believe, I would say.

Interviewer: Okay. All right. Thank you so much. Is there kind of a general thinking of the 30 minutes that we've sat here together?

Participant: Yeah yeah.

Interviewer: Do you think anything's changed your mind about anything over the course of us sitting here?

Participant: Yeah, I think that the first animation that we used was really helpful, and hearing myself explain what was going on really helped me understand as opposed to just reading it. And I think that it got me thinking about the bigger process of greenhouse gases and that I don't know as much as I probably should on this issue. And that it's an important modern topic that people should be educated on.

Interviewer: Yeah, and let's say someone asks you, "Hey, how do scientists explain global warming?" Do you think you could explain it to them now?

Participant: Yeah I could go through the little animation that I saw, definitely, and explain it in somewhat kindergarten terms, but it would be-

Interviewer: It's kindergarten, I mean-

Participant: Not kindergarten, but fifth grade maybe. Yeah.

Interviewer: All right, well thank you so much. I appreciate your time.

Participant: Thank you for it.

Interviewer: And I think yeah, that's it.

Participant: All right. And you have my email for just so that-

PARTICIPANT 5

Participant : Yeah.

Interviewer : Yeah, so I'm interested in how people learn in science and math-

Participant : Yep.

Interviewer : In particular, but I'm also like, taking statistics classes now-

Participant : Oh, cool.

Interviewer : So it's like, fun.

Participant : For which department?

Interviewer : Through the math department.

Participant : Oh, wow.

Interviewer : Yeah. It's good I mean, it's intense-

Participant : Yeah, I bet-

Interviewer : It's intense, yeah.

Participant : I bet.

Interviewer : Okay, so I have this interview protocol. So I told you my name is Interviewer -

Participant : Yep.

Interviewer : …So what we're gonna do is, I'm gonna ask you to interact with a computer simulation-

Participant : Okay.

Interviewer : That illustrates the science of climate change-

Participant : Okay.

Interviewer : And it's gonna show you things that you can't normally see with the naked eye.

Participant : Okay.

Interviewer : And then I'm gonna play a short film to kind of summarize everything that we talk about while interacting with the simulation, and then I will be asking you questions throughout-

Participant : Cool.

Interviewer : Just to find out what you're thinking about, what you see, like how you're making sense of things.

Participant : Okay.

Interviewer : Yeah, so you will receive full credit for participation, regardless of how you respond-

Participant : Okay.

Interviewer : To any of the questions. Expect it to last about 30 minutes, any information you share is gonna be recorded, but it will be confidential.

Participant : Okay.

Interviewer : So after we're done, it'll be transcribed and then the audio will be destroyed and your name won't be associated with anything.

Participant : Okay.

Interviewer : If you feel uncomfortable at any time, just let me know and we can stop.

Participant : Okay.

Interviewer : All right.

Participant : Sounds good.

Interviewer : So before we start with the simulation, which isn't up yet, you're looking at like, my blackboard page right now, but don't worry about that. Tell me what you know about climate change.

Participant : I know it's happening, I know the average temperature's going up with time and the ice caps are melting, that's about it.

Interviewer : Okay. What do you know about how the process of what makes this happen?

Participant : Carbon emissions, fossil fuels, cars, emissions.

Interviewer : Mm-hmm (affirmative), yeah, and can you tell me more about that?

Participant : Yeah, so like a build up of ... For example, the cars release their CO2 is it, from the pipes? Which goes up in the atmosphere and then does something up there and causes it to get warmer.

Interviewer : Okay, great. What are your feelings ... so you said it's real-

Participant : Yeah.

Interviewer : So that's like, you personally believe that it's a thing-

Participant : I think so, yeah.

Interviewer : That's happening?

Participant : Yes.

Interviewer : Okay. So, what are your feelings around climate change, like emotionally I guess? If that's a ...

Participant : I don't like it, however I understand it's something that is likely not gonna be a huge deal for my generation, but two, three generations from now might feel some of the results.

Interviewer : Okay.

Participant : I think it's just kinda starting now.

Interviewer : All right. Okay, so then the people that it affects will like, a few generations-

Participant : A few generations away.

Interviewer : Okay. All right, great. So let's look at this computer simulation. So here it is, what do you see?

Participant : A sun and some particles.

Interviewer : Yes, good, cool. What do you think the particles represent, like what part of the earth?

Participant : The ground.

Interviewer : Yeah. Anything else you see?

Participant : The sky is blue-

Interviewer : Yeah.

Participant : Between.

Interviewer : Did you notice the temperature gauge?

Participant : Looks like it's 70 degrees and sunny.

Interviewer : (laugh) Right.

Participant : (laugh).

Interviewer : Okay.

Participant : Oh, there's actually a temperature gauge right on the side-

Interviewer : There is, right.

Participant : Okay, I did not see that. Seems low.

Interviewer : It does-

Participant : Yeah.

Interviewer : That's because we have not clicked the play button yet-

Participant : Okay.

Interviewer : But we will soon. We will soon. What do you think will happen when we click the play button? Wild guess.

Participant : The temperature's going to rise?

Interviewer : Okay. Well let's find out. So to click, okay I just have to tell you about how the mouse works because it's kind of broken.

Participant : Okay.

Interviewer : You have to actually just tap.

Participant : Okay. Right here?

Interviewer : Yup. There you go. What do you see?

Participant : Stuff bouncing off the ground into the sky.

Interviewer : And where's the stuff coming from?

Participant : It's coming from the sun. Oh, so it's ultraviolet radiation?

Interviewer : Uh-huh. Actually, close. It's sunlight.

Participant : Sunlight, okay.

Interviewer : It's coming from the sun and then what?

Participant : It's bouncing back. It's refracting in the opposite direction. Or no, random directions. Kind of.

Interviewer : Say more?

Participant : It's either bouncing in then out at a 90 degree angle, or back again.

Interviewer : Uh-huh. Are you just looking at sunlight here?

Participant : I'm just looking at sunlight, yup. And it's coming back as infrared.

Interviewer : There we go. Okay. Did you notice the little ground particles lighting up?

Participant : I did.

Interviewer : What do you think makes them light up like that?

Participant : The contact? From the sun? Sun exposure?

Interviewer : Good. If you could summarize for me the interaction between sunlight and the ground.

Participant : The sun warms up the ground and the ground sends the rays back out.

Interviewer : Okay. Sends the rays back out as sunlight or as infrared?

Participant : As infrared.

Interviewer : Okay. All right, great. Let's go to the next screen. Sun on CO2. What do you see?

Participant : The sun, and then it looks like a bunch of floating CO2 molecules?

Interviewer : Yup, good guess. The reason why they're green, I'll just tell you, is because they're supposed to represent greenhouse gases.

Participant : Okay.

Interviewer : Okay. What do you think will happen when we click the play button this time?

Participant : They're going to move around at a certain speed?

Interviewer : Okay. Let's find out. What do you see?

Participant : The greenhouse gases' moving with the sunlight going through them and not altering the path at all.

Interviewer : All right, great. Any changes in the temperature?

Participant : No.

Interviewer : No, okay. Let's go to the next screen. Position you can't see on the previous screen. Maybe, let's go back one just so you can see what happens to the temperature. We'll go to sun on ground.

Participant : Here the temperature is staying constant for now.

Interviewer : For now.

Participant : Oh, it's rising.

Interviewer : It is rising.

Participant : Got it.

Interviewer : Just to kind of give you an idea of what would happen, as you let it go for longer and longer is stabilizes around here.

Participant : Okay.

Interviewer : Okay. Let's go to infrared on CO2. What do you see here?

Participant : I see greenhouse gases again and that's it.

Interviewer : What do you think will happen when we click play?

Participant : Maybe that the temperature is going to change? Maybe alter their motion.

Interviewer : Okay.

Participant : There's no sun in the picture so I assume the sun's not a factor.

Interviewer : Right, right. And this time infrared will be in the picture.

Participant : Okay.

Interviewer : What direction do you think the infrared will come from?

Participant : From below?

Interviewer : Yeah, why's that?

Participant : From the ground?

Interviewer : All right, let's find out. What do you see?

Participant : That they seem to go away when they make contact with a greenhouse gas.

Interviewer : When you say they-

Participant : And the temperature rises. So the infrared hits a greenhouse gas, seems to get absorbed or some sort of, go somewhere, not continue in an upward motion. As a result the temperature is rising.

Interviewer : All right. Notice how sometimes you see an infrared wave being admitted in a direction-

Participant : Sometimes it goes a different direction. Being reflected.

Interviewer : Yes. And why does it get reflected? From what?

Participant : From the greenhouse gas.

Interviewer : Okay.

Participant : It makes contact but then it stops and sends it in a different direction.

Interviewer : All right, great. Yeah, so if you could summarize for me the interaction between infrared and CO2.

Participant : Infrared hits CO2, which causes it to go in a different direction, which cases the temperature to rise.

Interviewer : All right. Okay, let's go to the next screen. What do you see here?

Participant : CO2, the sun, and the ground.

Interviewer : All right. What do you think will happen when you click play this time?

Participant : The whole system.

Interviewer : Ah, and tell me the story of what this will entail.

Participant : Sunlight is going to come from the sun, hit the ground, refract off into the air. Some of it's going to hit greenhouse gases and some of it's not.

Interviewer : Okay. So when it comes off the ground, right?

Participant : It comes off as infrared.

Interviewer : Okay. When it's coming down is it going to bump into the greenhouse gases?

Participant : No.

Interviewer : Okay. When it's coming up?

Participant : It can because it's infrared.

Interviewer : All right. Let's find out. What do you think will happen to the temperature as a result?

Participant : It's going to rise.

Interviewer : Okay. What do you see?

Participant : It's coming, some of it's coming back as infrared, some of it's coming back as sunlight? Or just going away? Yeah, some of the sunlight is actually coming back up this time. And then the infrared, some of it's coming in contact with the greenhouse gases some of it's not. The temperature is rising.

Interviewer : Would you say the temperature is stabilizing in a region that's higher or lower that it was supposed to stabilize in?

Participant : Higher.

Interviewer : Higher. Okay. Can you summarize for me this whole process again?

Participant : Sunlight's coming from the sun, going down to the ground. Of that, some of it's being converted into infrared, which is going up into the sky, which is making contact with greenhouse gases. Some of that ends up causing the temperature to rise.

Interviewer : Great. If you ... let's say we're to double the number of greenhouses gases that are on the screen.

Participant : Yup.

Interviewer : What do you think the net effect would be?

Participant : Temperature would rise more because there'd be more collisions with infrared and the greenhouse gases.

Interviewer : All right, great. Let's just see where I'm supposed to be ... what you just described to me here is called the greenhouse effect.

Participant : Okay.

Interviewer : Scientists credit this as the physical mechanism behind global warming. We're going to watch a three minute video to summarize what we talked about here. It's called, "How Global Warming Works." And here it goes.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the Earth is warming. What is the physical or chemical mechanism?

In one study we asked almost 300 adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how Earth's temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But because the Earth is cooler than the sun, it emits lower energy infrared light. So, Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time the energy hangs around has kept Earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40%. Methane has almost tripled. These increases cause extra infrared light absorption, meeting an extra greenhouse effect, which has caused Earth to heat above it's typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase. Thus producing global climate change.

Interviewer : All right. What are your impressions of the video?

Participant: It's explain that because of humans there's more CO2 in the atmosphere which is preventing the infrared from leaving. It's getting absorbed into the particles which is in turn creating more heat in the sky. On Earth.

Interviewer : Okay, yeah. Great. You were telling me earlier that you think climate change is a real thing that's happening, right?

Participant: Yes.

Interviewer : Do you see the science as a relevant issue that should be considered when making those kinds of decisions about whether or not it's real or not real?

Participant: I think so. I think it should definitely be taken as a real issue.

Interviewer : Why is that?

Participant: Because I feel like it's something that no matter what you do in the future, you should consider what it's going to do to future generations. And the impact that it might have. I think there's enough science for now to prove it. Or to give a pretty good idea that it's happening.

Interviewer : Yeah. The science, like what we were just talking about here with the sunlight and the infrared and the CO2, do you think that ... do you buy all of that stuff?

Participant: I do. I have no reason not to.

Interviewer : Okay. Why would you say ... what is the ... yeah. Is it like ... I guess what I'm wondering is, do you trust the scientists?

Participant: It seems logical. That there's things in the sky that would absorb infrared.

Interviewer : All right. Okay. Let's see, we've already answered a lot of these questions so I'm not going to ask them again. Do you think that climate change should be debated in the way that it is today?

Participant: No. I think that if there's a bit more of a connection between politicInterviewer s and scientists then there wouldn't be as much of a problem. Cause it said that, earlier in the study said almost all scientists, Earth scientists believe in it.

If it was 50-50 then I'd be a bit more skeptical. But if people who specialize in this are all believing in it, it should be true.

Interviewer : Great. Yeah. Okay. I'm with you there. So you're saying because of the overwhelming number of scientists that support it?

Participant : Correct.

Interviewer : That you're more like to be like, "Okay, I agree with the scientists."

Participant : I agree with it, correct.

Interviewer : All right. Do you feel personally connected to the issue of climate change?

Participant : I personally don't because I grew up in the Northeast where it's not really as big of a deal as in California. So I haven't really grown up in a very green area. Which is not something that I'm ingrained to.

Interviewer : Do you do actions in order to curb the amount of CO2 you emit?

Participant : I try to reuse things and not ... recycle when I can. But that's about it.

Interviewer : Okay. Do you think that global warming is a problem that concerns normal, every day people?

Participant : Yes. Yes. Because when the climate changes it can lead to more extraneous weather circumstances, which in turn affects every one. Be it hurricanes, tsunamis. Polar vortexes.

Interviewer : So everyone is kind of at risk?

Participant : Everyone is at risk.

Interviewer : Okay. Do you think then that everyone has a responsibility to?

Participant : Yes.

Interviewer : Yeah? Okay. All right. Last question is, we looked at some science, I asked you some opinions and things like that. Has any of your ideas or concepts changed over the course of this interview?

Participant : I think my ideas stayed the same but I have a better understanding of the science behind it.

Interviewer : So if someone were to ask you, "How does climate change work?" What would you say?

Participant : I would say that the sun emits sunlight which then hits the ground and turns into infrared. Then went bouncing into the sky and makes contact with greenhouse gases, which absorb the infrared, which cause the climate to rise.

Interviewer : Nice, good one. All right, I think that's all I have to say.

Participant : Cool.

Interviewer : Thank you for your time, I really appreciate it.

Participant : Thank you.

PARTICIPANT 6

Interviewer : But, no of course. So, my name is Interviewer . I'm at [SCHOOL NAME] , and my contact info is on there. If you want to keep it, you can. So, during this interview I'm going to ask you to interact with a computer simulation that illustrates the science of climate change, and it shows you things you can't normally see with the naked eye. Then I'm gonna play a three-minute film tat summarizes the stuff that we learned, and I'm gonna walk you through the simulation and ask you questions about what you see, and what you're thinking about. You're gonna receive full credit for participation, regardless of how you respond to any of the questions, and those are gonna be totally confidential. So, this is recording but it'll eventually be transcribed and the audio will be deleted so your voice won't be attached, all of that stuff.

Let me know if you feel uncomfortable answering any questions at any time, and I will be happy to stop the interview at any time. You can still get credit.

So, before we start, tell me everything you know about climate change.

Participant: We're going in a pretty bad direction. We really need to make some changes. The carbon emissions level is way too high, with coal and other fossil fuels. We need to reduce that and get more into some natural energy.

Interviewer : All right. So you're mentioning here, like carbon emissions, and fossil fuel burning, and stuff like that. So how does that contribute to the way that climate change works?

Participant: Well, from what I learned form high school, the carbon emissions get wrapped in the greenhouse, which is creating a thicker ozone layer. So when the sun rays come in, and they bounce off the earth, the ozone layer is getting too thick, so they can't fully leave so the earth is getting warmer, which is melting the ice caps, raising the ocean levels as well as just keeping more carbon dioxide in the atmosphere, which is bad for everything.

Interviewer : Okay. All right, and you obviously think it's a real thing.

Participant: Yeah.

Interviewer : So, you believe the science and stuff like that.

Participant: Very much so.

Interviewer : All right. And who does it affect?

Participant: Everybody. Absolutely everybody. I mean, it's our planet, it's our world. Obviusly I think we, as humans, can adapt to it more, but animals have taken a big hit. I mean, when we're chopping down rainforests, their ecosystems are dying.

Overall, it's our planet and the whole world is being affected so every living and nonliving organism on the planet is being affected.

Interviewer : Okay. All right, then let's take a look at this simulation now. Thank you for that.

Let me open it.

What's your major?

Participant: Narrative studies.

Interviewer : Oh yeah? Oh, cool. Wow, I've never even heard of that before. What is narrative studies?

Participant: It's sort of a new one, it's been rapidly expanding. I sorta view it as storytelling, in a way, and how to tell stories [crosstalk 00:03:32] through different forms of narrative.

Interviewer : I like it. Okay, here we go. Let me just real quickly check [crosstalk 00:03:40] on this other room. I'm gonna see if anyone showed up.

Okay. Sorry about that.

Okay. So let's take a look here at ... actually, put this over here ... I don't care what I say. Let me move this as well.

Okay, what do you see here?

Participant: The sun, and I guess carbon dioxide molecules?

Interviewer : Oh, down below?

Participant: Yeah.

Interviewer : Okay, so they are molecules, but they represent the molecules that make up the ground.

Participant: Okay.

Interviewer : Anything else you see?

Participant: Temperature gauge on the right, which is very low. Then the photons and the keys on the left side.

Interviewer : Right. So, what kind of photons do you think we'll be seeing in this?

Participant: Carbon dioxide, oxygen molecules. Possibly nitrogen, but I don't know.

Interviewer : Where'd you think of the word photon from?

Participant: Chemistry, seven years ago. I don't know. Oh, [inaudible 00:05:07] that's where I thought of it.

Interviewer : Oh, yeah! Hey, look at that. It's funny because you're the first person to actually use the word photon, even though it's been on the screen this whole time.

Participant: I knew it came from somewhere, I definitely wouldn't just think of that off the top of my head.

Interviewer : Interesting. So, did you see the play button at the bottom?

Participant: I did not.

Interviewer : We are going to click the play button, but hold on. Before we do, make a wild guess - what do you think is gonna happen?

Participant: We're gonna see the sprays into sunlight through this key, and how it bounces off the ground, and some form of ozone layer, maybe, will appear to simulate the infrared being trapped in. Something like that.

Interviewer : Interesting. Okay. Let's click play and find out.

Oh yeah, feel free to like, have this be your mouse. Oh, there we go. Okay, what do you see?

Participant: Sun rays coming in, bouncing off the ground, the ground absorbing some of the heat, but also bouncing infrared and sunlight back up into the atmosphere.

Interviewer : All right.

Participant: And the temperature rising on the right side.

Interviewer : Okay. Do you think it's gonna continue to rise?

Participant: Yeah.

Interviewer : All right. Let's see what happens to it.

Participant: There's more infrared rays bouncing up. Sunlight's sorta going in a different direction. May stop at some point. No, it's going back down.

Interviewer : So why do you think it's doing that?

Participant: Probably because it's a healthy ecosystem, and the planet is balanced so there's not a thick ozone layer so the heat is able to escape, rather than get trapped in the atmosphere.

Interviewer : Oh, all right. Okay. So if you could just summarize for me one more time, what's the interaction between them? Sunlight and the ground.

Participant: Sunlight hits the ground of the earth, and heat gets absorbed into the ground, while also bouncing sunlight off and releasing infrared photons, or waves, off the ground and back into the atmosphere.

Interviewer : All right, great. Lets go to the next screen. Sun on CO2.

Okay, what do you see here?

Participant: The sun and a ton of CO2 molecules.

Interviewer : All right, and I'll just tell you now. The reason why they are green is they're supposed to represent greenhouse gases.

Participant: Got it.

Interviewer : So, what do you think will happen when we click play this time?

Participant: Sun is gonna keep coming off the sun, obviously. It will interact with the CO2 molecules. Some will keep going through and CO2 molecules will also trap the sunlight and the infrared that will probably bounce off the bottom of the screen and get trapped within the greenhouse gases.

Interviewer : All right, let's find out.

Okay, what do you see?

Participant: Sunlight just sorta going in.

Interviewer : Any interaction?

Participant: No, just CO2 molecules moving around.

Interviewer : And how would you summarize the interaction between sunlight and CO2?

Participant: Not really much without the added layers that need to be added later on.

Interviewer : Okay. So, then would you say that ... what do you mean by the added layers?

Participant: I mean like, once you put the ground in which affects, you know, the sunlight bouncing off the ground and then ... because the infrared rays come from the

ground, rather than the sun, so when those all sort of interact together, then the sun a carbon dioxide will have some correlation with each other.

Interviewer : Okay, so then you're saying that once the ground and the infrared are in the picture, then maybe something will happen with the CO2. But right now, you're not seeing any interaction.

Participant: No.

Interviewer : Okay.

Participant: Just moving around.

Interviewer : All right. How would you know if they were hitting, and interacting?

Participant: I think you'd see some of the sun rays bouncing off of something, or like the sun being absorbed by the CO2 molecules. Something of that nature. But the sun rays are just going without changing any course of direction. The CO2 molecules are just moving around freely. There's no organized pattern within them, and the sun waves are just going.

Interviewer : Okay.

Participant: Don't have anything stopping them.

Interviewer : All right. Thanks, let's go to the next screen.

Infrared on CO2. Okay, what do you see here?

Participant: Bunch of carbon dioxide molecules, just on the screen. No sun, no ground, just that.

Interviewer : And what do you think will happen when we click play this time?

Participant: Honestly I have no idea where the infrared's gonna come from. So, yeah, don't really know.

Interviewer : All right, well, let's find out. But you do think that infrared is going to come into the picture?

Participant: Yeah, and the CO2 molecules will probably move around in some way. And they'll interact somehow.

Interviewer : Okay. What do you see?

Participant: Infrared, I'm assuming, rising from the ground, trying to go back into the atmosphere. A lot of it's passing through, but the carbon dioxide molecules

definitely capture some and bounce them back into the atmosphere. Some are escaping, but some are also staying because of the carbon dioxide molecules.

Interviewer : All right. So, one more time, just summarize for me the interaction between infrared and CO2.

Participant: As infrared rises into the atmosphere, the CO2 molecules allow some to escape, but also because of the density of the CO2 molecules, some of the infrared gets trapped and brought back into the atmosphere, while the temperature is significantly rising on the right side of the screen.

Interviewer : What do you mean by the density?

Participant: Just by the amount of CO2 molecules. I feel like if there weren't as many CO2 molecules, or if there were no CO2 molecules, the infrared would be able to just escape the atmosphere rather than get brought back in.

Interviewer : So you think that if you were to double the density, or ...

Participant: A lot more infrared would stay in if you doubled the density of CO2 molecules.

Interviewer : All right, great. Let's go on to the next screen.

Okay, what do you see here?

Participant: The sun, the ground, and the CO2 molecules.

Interviewer : All right, what do you think will happen when we click play this time?

Participant: Sun waves will come in, hit off the ground, bounce back up, infrared waves will bounce off the ground and up into the atmosphere because of the CO2 molecules, a lot of that is gonna get trapped in while obviously, some will still escape, but a lot of that will get trapped, resulting in the temperature to rise.

Interviewer : Okay. Let's find out.

Okay, what do you see?

Participant: The sun waves coming in, bouncing off the ground, infrared being released, and the CO2 molecules interacting with the infrared. And some of those infrared waves being bounced back to the ground, resulting in a temperature rising? Even though it just went back down. Yeah, but the sun waves keep going straight up. The sunlight doesn't really get stopped, it gets released, but the infrared waves. Some are thrown back into the ground.

Interviewer : And why do you think that the sunlight is able to move upwards without stopping?

Participant: I guess it just doesn't have ... like the CO2 molecules don't have an affect on it. I'm trying to remember what it's called, but yeah. Something about the sun waves are allowed to just go past them - it doesn't affect them, but the infrared's what traps the heat.

Interviewer : All right. The infrared is what traps the heat? [crosstalk 00:13:12] So, you're saying like ... tell me more about that.

Participant: The infrared, when it bounces back into the planet, is where the temperature increase is coming from. In the first one it was just the sun and the ground, the temperature was at a pretty stable level, it didn't go up and down. Now for the infrared, as in when it was infrared and CO2, the temperature got really high. Now the temperature is slowly increasing as, it seems like, more infrared is interacting with the ground on the bottom. Because it has yellow circles around it.

Interviewer : More infrared interacting with the ground ... and how does the CO2 come into play into all this?

Participant: The CO2 is what's sort of blocking the infrared waves from scaping the atmosphere and pushing them back down to the earth.

Interviewer : Mm-hmm (affirmative). And you're saying that the temperature is higher as a result of the CO2? I heard you say that a couple times, so higher than what?

Participant: The temperature?

Interviewer : Yes.

Participant: Higher than it should be. Higher than it was when it was just the sun on the ground. Not as high when it was just infrared on CO2, but it is still slowly increasing, dropping a little bit, but as this continues to play the temperature continues to slowly rise. Which seems to be what's happening in our world, where it's been happening in our world.

Interviewer : Okay. All right, great. So what you just described to me here was the Greenhouse Effect, which is the main mechanism that most climate scientists agree is the cause of global warming. So, this doesn't show human's contribution, but can you make a guess as to what that contribution would be?

Participant: Does not help it. Yeah, I mean it definitely hurts it because we're releasing even more greenhouse gases into the atmosphere, which aren't able to escape, which just results in more infrared waves being trapped, resulting in higher temperatures and everything.

Interviewer : All right. Great. So I'm gonna play you a short film here, kinda summarizing everything we talked about, and then I'm gonna ask you some follow up

questions, and while it's playing I'm just going to check this other room because I think somebody's not here that should be.

Here we go. Now it's gonna be too loud, watch.

Speaker 3: You may have heard of climate change, which is often called global warming. But how much do regular people understand the science of climate change?

Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the U.S., and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light. But because the earth is cooler than the sun, it emits lower energy, infrared light. So, earth's service essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. [crosstalk 00:17:23] The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the Industrial Age, around the year 1750, atmospheric carbon dioxide has increased by 40%, and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused earth to heat above its typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase. Thus, producing global climate change.

Interviewer : All right, so what'd you think?

Participant: Very clear to understand, yeah. Straightforward, to the point, easy to understand and comprehend.

Interviewer : Does this fit with your thinking so far?

Participant: Yeah.

Interviewer : All right, okay great. So what are your ... so you mentioned that a kind of a sense of urgency earlier. What are your thoughts and feelings about climate change in general?

Participant: There needs to be some more political action done than, obviously ... Well, right now we're in a really bad situation because the political action that was being done is all getting reversed, but there needs to be consistent action to sort of push this green movement forward in order to reduce carbon emissions, and reduce more greenhouse gases being released to the atmosphere. I think we're at the pint right now where it's sort of tough to go back to where we used to be, but it's just increasing way too fast, and we need to slow that down. Otherwise, planet's going to go away a lot sooner than it should.

Interviewer : All right, so obviously you feel like normal people have some sort of responsibility to do something. It's not just a certain group, like scientists ...

Participant: No, everybody has to take part.

Interviewer : All right. Do you think that this model that we were looking at here is relevant to the issue of global climate change, and should be considered by, say politicInterviewers, or the people that you were mentioning earlier?

Participant: I think it is. The only thing is, it doesn't really show much of the human's impact, interaction, aside from showing the statistics since the Industrial Age. It's like, there's no real showing of "Because of this, this and this that carbon emissions have increased, and we can do this, this and this to decrease them". There's no sort of just showing the other side, how to help the situation. It's more of "This is the problem", so it's still good to explain the problem because I think it's a good way of conveying the problem. But there's no real show of like, what could we do to fix the problem, which is also needed to teach this sort of issue.

Interviewer : Okay, good. Let's see ... So, do you think that this is an issue that should be debated?

Participant: I mean, should it be? No. Will it be? Yes. It's tough, I personally believe the scientists pretty clear, but there's also people that just don't believe that, so obviously there's going to be debates. But I think it's pretty clear. I mean, we've seen in ten years the amount of hurricanes have increased because of warmer waters, shorelines decreasing, the Great Barrier Reef which has shrunk significantly in 10-15 years. Yes, debates are still gonna happen, but there just needs to be action.

Interviewer : All right. Do you feel like ... So it sounds like you feel personaly connected to the issue. Do you ... yeah, talk about that. You, personally, how do you feel connected to the issue?

Participant: I don't know. I've always loved ... I'm like a scuba diver, I love marine biology. Just to see the ocean ecosystems dying out because of [inaudible 00:22:07]. I'm from Manhatten, so I've seen the projections of like if we continue, Lower Manhatten is done. It's just gonna get overwashed, and obviously I don't want that to happen. It's just not ... I've always loved animals. Watch all that stuff. So it's sad to see this happening, and it shouldn't happen. We could do something about it, and we don't.

Interviewer : Do you do things?

Participant: I try to. I try, especially when it comes to marine biology. In the past eight years I've done a bunch of trips to check on reefs, and how to work to stabilize reefs. I've done a lot in that sense. Then there's the carbon footprint, which I mean, we do what we can in reducing what we use, and energy wise. But at the same time, in this country, it's sort of impossible to, in a way. When all of the energy comes from ... Like, yes you can take a shower in less than two minutes, which is great. You can shut off all your lights, but still, there's so much going on, it needs to be more than just me. It needs to be a city, it needs to be a state, it needs to be something significant.

Interviewer : So you feel like there's some sort of social component to this?

Participant: Absolutely.

Interviewer : But at the same time, you are still taking action in your own realm of what you can do.

Participant: Yeah. At least, I'm trying to.

Interviewer : Okay. Do you think you can do more?

Participant: Absolutely, I think everybody can do more. I don't think there's a single person that's doing enough. Everybody can be pushing more and doing more to get the word out, and really ... even that's just telling other people, like, "hey, take a minute less in the shower, turn the water off", you know? All those little things. Get a better car, or don't get a car. Ride a bike, take public transportation, there's always more that someone can be doing.

Interviewer : Yeah. So, do you think that ... Okay, that's good. Thank you. Do you think that anything you've seen in the last half hour about sitting here has changed your mind about anything?

Participant: If anything, it has more implanted it back in my mind. Because, you know, it tends to slip out and you don't think about it as much as you should be. So if anything, it brings me back into the mindset of, "There needs to be action.". it definitely refreshed my memory on the science behind it, because I have not

thought about the science behind it since, probably, six, seven years ago in chemistry or biology in high school. So, that definitely was a refresher.

Interviewer : Okay, all right. So if you could summarize for me again, how does global warming work?

Participant: So the sun ... you get sun rays coming into the earth, hits the ground, and the ground bounces some of the sun rays off, absorbing it, but also releases infrared waves, which gets trapped within these greenhouse gases. Carbon dioxide and methane, and they end up escaping, but sometimes it takes time. Some bounce back towards the earth, and with the increase in humans since the Industrial Age, releasing more of these gases, the greenhouse gases have increased, which is trapping more infrared waves, which is warming up the planet to an unsafe level.

Interviewer : Beautiful, thanks. And notice that you didn't mention ozone.

Participant: Yeah, forgot ozone.

Interviewer : Yeah, good. Thank you so much. That's it.

PARTICIPANT 7

Interviewer : Still getting used to this.

So, my name is Interviewer , I am [TITLE] here in the [School Name]. My contact information is on this sheet, if you want to keep it, feel free to take it with you, and if you have any questions for me afterwards you can feel free to contact me.

During this interview I'm going to ask you to interact with an online visualization that's going to show you things that you can't normally see with the naked eye, and it's going to illustrate the science of climate change.

Then I'm going to play a three minute video to summarize what we see in the simulation, what we talk about. I'm going to be asking you questions throughout, mostly I just want to know about what you're thinking and what you see in the simulation.

Participant: Okay.

Interviewer : You are going to receive full credit for participation in this interview, whether or not you answer the questions in any particular way, so don't worry about that. It should last about 30 minutes and any information you share with me will be audio recorded but it will be confidential, so your name won't be attached to anything, this will be transcribed and deleted, the audio will be deleted and your name won't be attached to any of that. So, let me know if you feel uncomfortable answering questions, at any time, and we can stop the interview.

All right, so, before we start, tell me everything you know about climate change.

Participant: Okay, I guess the general stuff, like the ice caps melting, just the temperature rising, and a lot of flooding happening, yeah.

Interviewer : Okay, and how does it work?

Participant: I guess human caused, like a lot of plants, corporation plants giving off a lot of gases and things like that.

Interviewer : All right, and so the gases are ... ?

Participant: Just changing the climate, in a way.

Interviewer : Yeah, okay.

First of all, do you believe it?

Participant: Yeah.

Interviewer : You think it's a real thing that's happening?

Participant: Yeah.

Interviewer : Okay, and why is that?

Participant: I guess just because it's obvious that things are changing, yeah, just kind of obvious.

Interviewer : Oh yeah, how so?

Participant: With the ice caps melting, and the temperature is rising and things like that. And the weather is getting more severe, like with the tornadoes outbreak and things like that.

Interviewer : Okay.

Let me get it straight one more time. The way that you are envisioning that this process is happening is through plants releasing gases, is that what you said?

Participant: Yeah, I guess, yeah.

Interviewer : Okay, and that effecting the climate.

Participant: Yeah.

Interviewer : Any more to that?

Participant: Yeah, I just [inaudible 00:03:32] like gases being released that aren't normal for the climate.

Interviewer : All right, great, well we're going to learn more about this right now. Let me pull up the simulation, okay, so what do you see here?

Participant: What do you mean?

Interviewer : Like, what do you see on the screen?

Participant: The Sun, and dots.

Interviewer : Right. Any guess as to what those dots might represent?

Participant: I'm guessing soil.

Interviewer : Yeah, soil, or the ground, good. Do you know why they're dots, and not just the way soil normally looks?

Participant: Maybe because things can be absorbed, and there's little gaps, I guess, I don't know.

Interviewer : Yeah, good. I'll tell you they're supposed to represent molecules, or atoms, of the ground. Did you notice any of the labels and things like that?

Participant: Oh, yeah. Like the temperature, and different options of the model.

Interviewer : Good, and we will be changing the model as we go along. The play button at the bottom, so before we click the play button, which I'm going to have you do in a second, make a wild guess what you think is going to happen.

Participant: The Sun's going to hit the ground and maybe it's going to get hot, yeah.

Interviewer : All right, good guess, let's find out.

Participant: Okay.

Interviewer : Okay, what do you see?

Participant: Things hitting the ground and going back up and releasing something.

Interviewer : Something? Okay, tell me more.

Participant: I guess infrared.

Interviewer : Ah, infrared. Because you saw the ... ?

Participant: Yeah.

Interviewer : I saw you point at the legend on the side.

Okay, so you said there are things coming down.

Participant: Sunlight, I guess, yeah.

Interviewer : Explain the process again for me.

Participant: So, sunlight's leaving the Sun and hitting the molecules, and then the molecules are bouncing off infrared and sunlight.

Interviewer : All right, and how has the temperature changed?

Participant: It's slowly increasing as, I guess, process keeps going.

Interviewer : Do you think it's going to increase forever?

Participant: As long as the Sun's hitting it.

Interviewer : Okay, so can you summarize for me one more time this whole process. The interaction between sunlight and the ground.

Participant: Okay, so, from the Sun, the sunlight's leaving it and hitting the molecules, ground molecules, and then some of them are lighting up, and then sunlight's coming off of the molecules, and infrared. Some of the infrared's going back to the Sun, it looks like.

Interviewer : Great, and has the temperature continued to go up?

Participant: It's going up, but it looks like it's going back down.

Interviewer : So, what do you think is going on there?

Participant: Maybe an exchange between them. Like, as the sunlight's hitting it it warms up and then it gives off heat, I guess, to where it goes back down.

Interviewer : So, do you still think it's going to continue to go up and up and up and up forever?

Participant: Not really, because it keeps going down and back up. It looks like it's in the same area, a little bit.

Interviewer : Great, let's go to the next screen, 'Sun on CO2'. Hm, something is wrong, let me try. I see what's going on here, there we go, okay, what do you see now?

Participant: Just a bunch of green molecules all over the screen, sporadically.

Interviewer : Any idea what those molecules might be?

Participant: I'm guessing CO2.

Interviewer : Yes, good guess. I'll tell you they're green because they're supposed to represent what's called greenhouse gases.

Participant: Okay.

Interviewer : All right. What do you think will happen when we click play this time?

Participant: I'm guessing sunlight's going to hit some of the molecules, and go through it, or pass some of the molecules.

Interviewer : So you think it's going to pass some of the molecules ...

Participant: And hit some of them.

Interviewer : Okay, let's find out.

What do you see?

Participant: The CO2 molecules are just moving around, and then the sunlight just going through them.

Interviewer : So, if you could summarize the interaction between sunlight and CO2, how would you do that?

Participant: I'm not sure if there's any interaction, 'cause the sunlight's just going past it, it doesn't look like it's hitting any of them, and the molecules just keep moving around.

Interviewer : What would it look like if the sunlight were hitting the CO2?

Participant: I'm guessing they would light up, from how it looked on the previous model.

Interviewer : Good. All right, let's go to the next one. Okay, what do you see?

Participant: Just the green molecules.

Interviewer : And what do you think will happen when we click play this time?

Participant: They're just going to move around.

Interviewer : All right, let's find out.

What do you see?

Participant: I'm guessing that's infrared that's hitting- infrared's coming up and is hitting some of the molecules, and then it just keeps moving around, molecules keep moving around.

Interviewer : Any effect on the temperature?

Participant: It's increasing, like, a lot.

Interviewer : And why do you think that is?

Participant: Maybe because of the infrared that just keeps going instead of hitting the molecules.

Interviewer : Okay.

Participant: It looks like a lot.

Interviewer : It looks like a lot? What do you mean by that?

Participant: A lot of the infrared just keeps going through it instead of hitting the molecules.

Interviewer : But you did say that some of it is hitting?

Participant: Yeah.

Interviewer : How do you know?

Participant: The molecules are lighting up.

Interviewer : And what happens after one of the molecules light up, after infrared hits it?

Participant: The infrared changes direction. Instead of going straight up it goes in a completely different direction.

Interviewer : All right. So, if you could summarize for me the interaction between infrared on CO2.

Participant: Okay, so the infrared's coming up and then some of them go straight through, and then some of them hit the molecule and light up, and then the infrared just goes in a different direction, and the temperature just keeps increasing.

Interviewer : Great. Let's move on to the next screen.

Okay, what do you see?

Participant: Sunlight, or the Sun, molecules, and the ground molecules.

Interviewer : What do you think will happen when we click play this time?

Participant: The sunlight's going to go past the molecules and hit the ground, and then infrared's going to come back up and hit some of the green molecules, and then some will just keep going.

Interviewer : All right, let's find out.

What do you see?

Participant: The Sun's giving off sunlight, and it's hitting the ground, and then some of the sunlight comes back up, and when some of the sunlight hits the ground, infrared comes up and hits the CO2 molecules and they light up and then go in a different direction. Then some of the infrared just goes past the molecules, and the temperature is just increasing.

Interviewer : How would you compare the temperature on this screen to that of the first screen, when there was no CO2?

Participant: The temperature is a lot higher.

Interviewer : Why do you think that is?

Participant: I'm guessing because now it's hitting the CO2 molecules, infrared's hitting the CO2 molecules. Before, the first model didn't have CO2 molecules in it, so there wasn't any infrared bouncing off.

Interviewer : There wasn't any infrared?

Participant: Oh, yeah, there was some, but they weren't hitting the CO2 molecules.

Interviewer : All right. So, if you could summarize for me, one more time, what is the process that we're looking at here?

Participant: The Sun's giving off sunlight, it's hitting the ground, and then from the ground some molecules light up when the sunlight hits it, and then from there infrared is coming off and hitting the green molecules, and then from there the infrared goes into a different direction than it was actually going.

Interviewer : All right.

Participant: And the temperature just increasing.

Interviewer : Let's talk about the green molecules again, what are they again?

Participant: Greenhouse gas, or CO2.

Interviewer : Yeah, same. Turns out CO2 is a type of greenhouse gas. So, where does CO2, or greenhouse gases, come from?

Participant: I guess us, we give off CO2.

Interviewer : So, what do you think would happen if somebody came in there and doubled the number of CO2 particles?

Participant: The infrared would hit a lot more CO2 molecules.

Interviewer : Do you think it would have an impact on the temperature?

Participant: I think it would increase it.

Interviewer : Why is that?

Participant: Because now the infrared will be hitting more CO2 molecules, and the infrared won't be going straight anymore, it'll just be going in a different direction.

Interviewer : Thank you. What you just described to me here is called the greenhouse effect, it's what most climate scientists agree is the main mechanism behind global warming. What I'm going to do now is show you a short film that summarizes everything that we've been talking about, and includes the impact that humans have on this whole process.

So let me cue that up for you. Hm, something is not right here. Oh well, here we go.

I'll be right back.

Participant: Okay.

Video: You may have heard of global climate change, which is often called global warming, but how much do regular people understand the science of climate change?

Take a moment to try to explain to yourself how virtually all climate scientists think the Earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the US, and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how Earth's temperature works without considering how humans influence it. The Earth absorbs light from the Sun, which is mostly visible light. To release that light energy, Earth also emits light, but because the Earth is cooler than the Sun, it emits lower energy infrared light. So, Earth's surface, essentially, transforms most of the visible light it gets from the Sun into infrared light.

Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50°F cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40%, and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth

has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change.

Interviewer : All right.

Video: Please share this video with other so you can help them understand how glo-

Interviewer : What are your impressions of the video?

Participant: I think it was good, it was easily explained.

Interviewer : Does it fit your understanding?

Participant: I think it made it more clear than what I thought it was.

Interviewer : Oh, how so?

Participant: I guess it was just more simplified. It explained it really well, step by step, than what I- yeah, mine wasn't clear before, it was kind of jumbled.

Interviewer : Any particular aspects of something that you didn't know?

Participant: The part about the infrared, yeah. That it absorbs visible light, I got that part, but I didn't know we give off infrared.

Interviewer : Okay.

So, let's tie this back to what we were talking about in the beginning, you know, more of the political, global issue of global warming. What are your thoughts and feelings about climate change, or global warming, same thing?

Participant: I think a lot more needs to be done about it, 'cause I think it's a real issue, and I think with everything political right now, I guess they're not taking it seriously, and undoing a lot of things that were set in place to protect it, to prevent global warming.

Interviewer : And you're not happy about this?

Participant: No. When I saw all the things that were happening it bothered me, yeah.

Interviewer : Do you think that the science that we learned today has any relevance for any of that stuff?

Participant: I feel like it should influence global prevention because it's more studied, people are studying it more and I feel like it should be taking serious, what science is putting out.

Interviewer : So, you don't think it's very serious right now?

Participant: I feel like it's not taken as serious, right now, but I feel like it's a serious issue that we need to try and prevent.

Interviewer : Then you think, by when you say we need to try and prevent, do you think that normal people are effected by climate change, or are involved, or responsible for it?

Participant: I feel like it's all of it. We are responsible for it but we do need to try and prevent it [inaudible 00:22:16].

Interviewer : What do you think climate change will effect in the future?

Participant: I feel like it will effect everybody. Yeah, I think it just effects everybody, I don't think no one's really excluded from being effected by it.

Interviewer : Okay. I'll just wait a second to ask you the next one.

Hi Ann, how're you doing?

Ann: Good.

Interviewer : This is Ann.

Ann: I'm not trying to get in the way.

Interviewer : I know, you can't help that your office is right there.

So, I was going to ask you next, do you feel connected to the issue?

Participant: Yeah, I guess I do. I find it interesting, especially with everything political that's happening, yeah, I guess I do.

Interviewer : So, you feel interested, does that mean you're reading, or you watch it on the news?

Participant: Yeah, I guess the news, and news articles, things like that.

Interviewer : Okay. Do you think that your actions reflect a global consciousness?

Participant: I think sometimes, but sometimes not. Sometimes I'm conscious about it, but sometimes not, I guess.

Interviewer : In what ways are you conscious about it, and what ways do you think you could be more?

Participant: I recycle a lot, and try and conserve water, but sometimes I- it's kind of a hard question ... This is hard ...

Interviewer : Well, you said you feel like you could do more.

Participant: Yeah, I feel like I could do more, yeah. Maybe get more involved with the issue, I'm not sure.

Interviewer : Okay. But it is a problem that concerns you?

Participant: Yeah.

Interviewer : All right.

So, do you think that any of the science that we learned today, the visualization, or the video, do you think it's changed your mind about anything in particular?

Participant: I think it's just changed my mind about how the process of global warming, through this video, how the Earth absorbs visible light and gives off infrared, and how CO2 keeps increasing and it's effecting the temperature and things like that.

Interviewer : Okay. Then that whole process, which you just spontaneously summarized, which is great, that's something that you didn't know before, or you were a little fuzzy on?

Participant: Yeah, I think I was a little fuzzy about it and wasn't really clear.

Interviewer : Do you think any of the science might have changed how you feel about the issue, or do you think you're about the same, or even more negative?

Participant: I feel about the same. I think you've just helped clear up some things, but I think I feel about the same.

Interviewer : All right, great. Well, thank you so much for your time, I appreciate it, and that is all.

PARTICIPANT 8

Interviewer: Okay, so to start ... oh, and by the way, this is going to last about thirty minutes, and any information you share with me is going to be audio recorded, but it's going to be totally confidential.

Participant: Okay.

Interviewer: So, your name won't be connected with anything. It will be transcribed, and the audio will be destroyed so your voice won't be heard. So, let me know, also, if you feel uncomfortable at any time and we can stop the interview. All right. So, let me start by asking you ... tell me everything you know about climate change.

Participant: Well, I think I did climate change as a topic in high school, maybe freshmen year or sophomore year. But, what I do know now is just what I hear in the news, and like a lot of politicInterviewers claiming that it exist and that it doesn't exist. But I, even though I am not sure about the science behind it, I am pretty sure it exist. Because of just what I witness in everyday to day life, even like the temperature increasing, or like sudden change of temperature all across the world. And I hear about the polar ice caps melting, so I guess that I would say, yeah, it exist. That's it a real concern.

Interviewer: And, you said that you're not so sure about the science. What do you mean by that?

Participant: By that I mean that if you asked me right now to support it in the sense that I would be able to convince a scientist I wouldn't be able to support it. But, if I was having a conversation with like another [inaudible 00:01:35] like myself I would be able to talk to them about it.

Interviewer: Okay. And so, to your best understanding, how does that process of global warming work?

Participant: I think global warming right now is happening largely due to the green house effect. Which means that because of the carbon dioxide in the air is increasing, which traps heat coming from the sun's wreath in the earth, which leads to rise in temperature, which means that like the polar ice caps are melting, which leads to increase in like water and change in temperature of the water, which leads to like the fragile Eco system, the marine Eco system being disrupted. So, I guess, yeah. Even though we can't really see the change it's happening, I guess. Yeah.

Interviewer: All right.

Participant: Yeah.

Interviewer: Great. Well, now lets look at this visualization. Before we do let me just make sure nobody, wait. Here. Whoa. This is not good. Here let me let this load and I just need to make sure nobody's waiting here. Some people, it's not on time.

Participant: I thought I was going to be late too, but thankfully.

Interviewer: You're okay. Okay, here we go. What do you see? You can use the mouse.

Participant: Oh. I can see the sun on just this. And, I suppose this is the Earth, or like air molecules maybe. I don't know, or the ozone layer. That could be-

Interviewer: Okay. Okay.

Participant: Yeah.

Interviewer: Anything else you notice on the screen?

Participant: Well, yeah. There's like a temperature the same, which I guess once the simulation starts would change. And then, yeah. Just like the information for the model I guess. Yeah.

Interviewer: Right. And, you said it could be the ozone, it could be the earth, or it could be something else.

Participant: Just the air. Like the atmosphere.

Interviewer: Right. And, I'll just tell you. It's supposed to be the ground.

Participant: Okay.

Interviewer: So, the earth. Right?

Participant: Yeah.

Interviewer: All right. So, we're going to click the play button in a second, and you said that once you do click the play button you expect to see the temperature rise.

Participant: Right.

Interviewer: Anything else that you might guess? Wild guess.

Participant: I guess the sun should have the, this right here. You should be able to see like the sunlight hitting the ground. And, yeah that's it.

Interviewer: All right. Let's find out. Okay what do you see. Oh.

Participant: Oh. My bad. Sorry.

Interviewer: No problem.

Participant: So the sun beams are hitting the ground, and then there is infra red rays, but something is like ... the ground is radiating it back. I suppose, yeah.

Interviewer: Yeah. Anything else?

Participant: Or reflecting it. I would actually, yeah. Reflecting the sunlight back. And also it is sort of disrupting the ground in a sense. And, there are these yellow things which I'm not so sure what they are. Maybe it's being absorbed. I guess, yeah.

Interviewer: Anything-

Participant: Oh and the temperature's increasing. Is this the temperature for the ground, or for the atmosphere?

Interviewer: Good question. I think it's the temperature of the ground. Of all of the molecules that you see on the screen. Okay. All right. So the temperature is risen, do you think it's going to continue rising? Do you think it's going to go down? Do you think it will stay about the same?

Participant: I think it should stabilize at a certain point. But, no, yeah. I think it should stabilize at a certain point. Because then like scientifically the ground should change state if it likes keep being heated up. But, yeah. I think it should stabilize at one point. So, yeah.

Interviewer: Because you don't want to see the earth turn into a gas, or something like that. Okay. All right. Lets go to the next screen.

Participant: Which is just this?

Interviewer: Sun on CO2. Yep. Okay. What do you see here?

Participant: These are CO2 molecules, and the sun, and the temperature. And I'm guessing this is the earth's atmosphere, or a part of it because it has CO2 and I'm sure space doesn't. So, yeah.

Interviewer: Okay. Sure. Well, yeah. That's fine. What do you see?

Participant: So it's the sun passing right through the CO2 molecules. They're moving. I'm not sure if that's their normal speed, but like the sunlight is disrupting them in a sense.

Interviewer: Oh, okay.

Participant: Yeah.

Interviewer: How do you know?

Participant: Well, I don't know actually. They could be moving without the sunlight too. But, it just yeah. That's actually a good question. I just ... they could be also moving without the sunlight because molecules do tend to like move. But, if the sunlight is effecting them, the temperature isn't moving up. So, I guess I couldn't say for sure that the sunlight was disrupting them because they would also move without the sunlight. So, yeah. I retract the previous statement. Maybe the sun light isn't effecting them.

Interviewer: Okay. Okay. How do you know that?

Participant: Because I don't have like a base line to compare. Like were they moving without the sun light or not? That why. I guess because the temperature isn't rising either.

Interviewer: And you said earlier, like the first thing you said is the sun light is passing through the CO2. What would it look like if they weren't passing through?

Participant: It would look like how it was for the ground. It would reflect something back. So, there would be either infra red or sun light being reflected back.

Interviewer: All right. Great. Let's go to the next screen. Okay. What do you see here?

Participant: There's no sun, it's just the CO2 molecules.

Interviewer: And what do you think will happen when we click play this time?

Participant: I guess it's the base line that I was talking about. Like we would see the CO2 molecules just interacting with themselves and not anything else.

Interviewer: Oh, okay. Okay. And I'll tell you that infra red is actually going to appear into the screen. So what do you think will happen there?

Participant: I think it shouldn't pass through if this is the ground and it's coming from here as opposed to coming from the sun. It should just not pass through, it should bounce back.

Interviewer: Okay. Lets find out. What do you see?

Participant: Oh. It's passing through. So it is effecting some of the CO2 molecules.

Interviewer: How do you know?

Participant: Because of these yellow, and the temperature's rising so I'm guess it's effecting in a way that would increase temperature of the CO2 molecules.

Interviewer: And so you said you know that its-

Participant: Effecting the CO2 molecules, yeah.

Interviewer: Because it's lighting up. Right?

Participant: Yes. Also like you can see some of them are being directed. So I'm guess they're hitting one of the molecules and then instead of going and [inaudible 00:10:27] what's the word for it? They're diffusing. Yeah.

Interviewer: Good. All right. So if you could summarize for me what we're looking at, the interaction, if you will, between the infra red and the CO2, how would you do that?

Participant: So I would say that if the infra red is able to pass through the CO2 molecules I said before that it wouldn't be able to pass through, but it is clearly being able to pass through. But, it's actually increasing the temperature of this environment, and some of the infra red rays are being moved from their original like part.

Interviewer: All right. Great. Lets move on to the-

Participant: Last one.

Interviewer: The last one. Okay. What do you see?

Participant: The ground, the carbon dioxide molecules, and then the sun.

Interviewer: And what do you think will happen when we start the simulation?

Participant: The sun light is going to hit the ground basically, which is going to heat up the temperature for the ground. And the ground is going to reflect the infra red rays back up, which are probably going to pass through the CO2 molecules. But, it's going to lead to a temperature change in the ground, as well as the CO2 molecules. Yeah.

Interviewer: So you think the infra red will pass through the CO2?

Participant: Yes. I think it will. I mean I know it shouldn't, but in the last simulation that we saw it was going through if it wasn't hitting some of the CO2 molecules.

Interviewer: Okay. If it wasn't hitting?

Participant: Yeah.

Interviewer: Some of them hit.

Participant: Can I just go back?

Interviewer: Yeah. That's fine.

Participant: Yeah. Like some of them are passing through. But, some of them are hitting and like, I'm sure this one, is being reflected back. Or it's technically not following like a lineal trajectory.

Interviewer: You can also put it in slow motion if you want to see it in slow motion.

Participant: Yeah. But some of them are still being able to pass through, but a lot of them are getting deflected. And then there is the temperature rising way faster than it was for either two of these.

Interviewer: Okay.

Participant: I'll just move to the next one.

Interviewer: Yeah. Okay. So, tell me again your prediction.

Participant: I think the sun light is going to pass through the CO2 molecules and hit the ground. The infra red rays are going to be able to go back, but if they hit the carbon dioxide molecules they are going to deflect, either reflect back to the old or just deflect within the environment. So not pass thought the layer of carbon dioxide molecules. And the temperature is going to keep on increasing.

Interviewer: Okay. What do you see?

Participant: It's the sun light hitting the ground. It's effecting the ground so I'm guessing the temperature of the ground is increasing. So the sun beams are being reflected back. Also the ground is, there's also infra red beam. I think infra red is coming from the ground. And, some of them are passing through the carbon dioxide molecules. But some of them are hitting them and like hitting the ground back again. And, the temperature is increasing I think. Yes, it's increasing.

Interviewer: And how do you think the temperature in this model compares to that of the first model when there was no CO2?

Participant: I think it's increasing faster. But it's definitely increasing slower in the third one. Because the third one was, it reached the top pretty quickly. I think the first one was a little bit slower than this one.

Interviewer: And do you think that it has reached a higher maximum than the previous one?

Participant: Than the first one?

Interviewer: Yeah. Than the first one.

Participant: I don't remember actually.

Interviewer: Okay.

Participant: I think it's still increasing, but in the first one, if I remember correctly, it did stop at a certain point. Yeah I think it did stop at a certain point. But this is still increasing. So, I'm sure at one point it will cross the maximum that I saw in the first one. As far as I remember.

Interviewer: Yeah. Because you told me that it was stabilized.

Participant: Yeah.

Interviewer: And do you remember where it was stabilizing at about when you were showing that to me?

Participant: Not really.

Interviewer: I mean we could go back. I could just tell you. It stabilizes at about here.

Participant: That's what I would have guessed, but I actually didn't remember.

Interviewer: That's okay. That's okay. I figured save you time having to watch it. Okay.

Participant: This is, I just noticed, it is going down. Like it's slowly increasing and it goes down a little bit. Like it dips, and then increases again. I don't know if that's significant or not, but.

Interviewer: Okay. Yeah. It's going up and down, why do you think that is the case?

Participant: I'm not sure actually. Maybe it's the movement of the CO2 is ... but I don't know why it would like increase, and then dip down, and then increase higher than the level it should have stabilized at as in the first one. I'm not sure.

Interviewer: Okay. So, like the ups and downs, do you think there's a rhythm to it? Or do you think it's kind of random?

Participant: I think there is a rhythm to it. Like it's increasing now, and then it's decreasing. And then it will increase higher than before. It should. Now it's decreasing. Yeah. I don't know.

Interviewer: Does this match your experience with the real temperature?

Participant: As in like the weather?

Interviewer: Yeah.

Participant: Yeah. I think so. Yeah. LA has been having a pretty weird like pattern of just really hot days, and then really cool days, and then really hot days. So, I would say so. Yeah.

Interviewer: All right. So if you could summarize for me one last time the process that we're looking at here.

Participant: Okay. So, the sun beams are hitting the ground, which is effecting the molecules in the ground and causing them to radiate or slash reflect back these infra red waves. Infra red the waves are hitting the carbon dioxide molecules, and technically they should be going straight back up to the atmosphere. But, because of these molecules they're being diffused or deflected within the [inaudible 00:18:14].

Interviewer: Okay. And so, CO2, do you know where CO2 comes from?

Participant: Yeah. We exhale CO2, and then I guess exhaust from cars and everything, and like, but yeah CO2 is exhaust from cars and burning fossil fuels, and just stuff like that.

Interviewer: So, if lets say we built a little factory here that double the amount of CO2 molecules on the screen, what would you expect to see?

Participant: I would expect the infra red waves to be ... Some more infra red waves would hit CO2 molecules as the number of CO2 molecules is increased. And then instead of going back out above the sun, to the sun or whatever, they would stay in .. like they would be deflected back. So they would keep hitting the ground again and again.

Interviewer: And do you think this would have an impact on the temperature?

Participant: I think yes it should. It should increase the temperature. Not really sure why scientifically, but I guess it should increase temperature.

Interviewer: Okay. Okay. Well I think what might helps you is this three minute video. So what you just described to me is called the green house effect.

Participant: Yeah.

Interviewer: And, as you mentioned earlier, the main mechanism behind global warming. And this is going to talk about all of that and tie it back to the impact that humans contribute. Okay. I'll be right back. I'm going to go check in here.

Video Speaker: You may have heard of global climate change, which is often called global warming. But, how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in the U.S., and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light. But, because the earth is cooler than the sun it emits lower energy infra red light. So, earth's surface essentially transforms most of the visible light it gets from the sun into infra red light. Green house gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through but absorb infra red light. Causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this green house effect caused by these green house gases in the atmosphere, the earth's average surface temperature would be about fifty degrees Fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age around the year 1750, atmospheric carbon dioxide has increased by 40%. And methane has almost tripled. These increases cause extra infra red light absorption. Meaning an extra green house effect, which has caused earth to heat above it's typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase. Thus producing global climate change. We share this video with others-

Interviewer: Okay. What do you think?

Participant: I actually forgot that the green house effect is good up to a certain like level in increasing the methane and carbon dioxide gases. I mean, up to a certain point they're good, but they increase has been caused and like almost triple the amount of methane, and 40% more CO2 is sort of increasing the temperature way faster than is needed to sustain life on earth. So, that was one thing. I actually forgotten that the green house effect is not bad. That we need it, otherwise the oceans would be all ice. Also, I learned that they absorb, like the CO2 molecules absorb instead of reflecting it back. So I was saying that the infra red rays are reflected back, but I guess that yellow thing was them absorbing the heat and retaining for the earths atmosphere.

Interviewer: Oh. Okay. Great. So, lets tie this back to kind of the more global conversation we were having earlier when you were like, you know, thinking of it as kind of a geo political issue almost.

Participant: Yeah.

Interviewer: So, like what are your thoughts and feelings about climate change?

Participant: Honestly I know that it's probably not going to effect me in my lifetime. But, for generations to come, if we notice a certain change I think it's our responsibility to make earth more habitable for like the future generations. So, politicInterviewers or like people in power not believing that like climate change is a real thing could be a problem, because that just means that we're not making earth safer, or like livable for the future generations. So, I think that even if it's not been proven in a sense that you can't really have a study, you can just have numbers and statistics, and I feel that maybe that's not enough to convince certain people. But, it is still our responsibility to like decrease the methane levels or the carbon dioxide exhaust just from factories and stuff just in general. So, there should be regulations against that I think. That would help it in the long run.

Interviewer: So, then the people that you think are responsible for making a difference, who's responsible for making a difference?

Participant: I think the regulations can only be implemented by the people in the government. So it is really important for me for the people that I work for, or the people I elect do believe in the climate change. Or at least advocate for the change in regulations for like exhaust and the tacks, the carbon foot print, tacks or whatever. I think it's, yeah. I mean, I'm not

from the U.S., but I feel like it is a country that a lot of people look up to. And if it starts making a change then I'm sure other countries are going to follow. So yeah.

Interviewer: So, in addition to like politicInterviewers that pass regulations, right? Do you think it's also up to normal people to make a difference?

Participant: Oh definitely. I mean, so here a lot of people have their own cars, and travel tends to be one person per car, and then each family, I think, the number of cars in each family is higher in the U.S. than in like India, where I'm from. So, I think it is important that people end up carpooling, even if it takes a little bit more time. That's something that we can do. Not using the CFC's or HCFC coolants, which I think are present in aerosol spray, or if ... I'm not sure. But like refrigeration, so like fridges, and like big coolants they're present in. So, if people can get CFC less fridges and a/c's, it would be small, but I guess if enough number of people do it it could make an impact. Yes. That's it. Also, I guess using public transport. But that's not always viable so I guess carpooling within a family would be ... Instead of like each kid like getting a car and going to their school, maybe all the kids could carpool. Or just that way. Yeah.

Interviewer: Great. Do you think that you perform any of these actions?

Participant: I mean, I definitely carpool. Here I walk because I live really close to campus, so I walk everywhere. And if I'm going further distances I usually end up calling an UBER pool and certain UBER acts. I would admit that it is also because of the money. But, I think in the long run it makes a difference. Because if two or three people are sharing a car to go longer distances, if a lot of people end up doing it then it would reduce the exhaust. And, I guess also in the future, I'm living in an apartment building now, but when I move into my own apartment or my own house, if I'm not in debt ... I would look for more environmental friendly solutions instead of buying cheaper stuff. I guess I would want to invest in something that helps the environment in the long run. Or at least I would like to think, I mean, of course money is always what would limit people. I guess a lot of people who buy end up buying non environmental friendly solutions just because they don't have the money to do so. But if people could invest that would be cheaper environmental friendly solutions that would be better.

Interviewer: All right. Great. All right. In general, over the thirty minutes we've been sitting here, do you think your mind has been changed about anything in particular?

Participant: I mean, I already knew that global warming exists. I guess some of the basic concepts of global warming were refreshed. But, I wouldn't say changed but definitely more enlightened in a way. Now I have more information. And if someone would ask me how to explain it, I'm sure I would be able to explain it in much more detail than I would have been before.

Interviewer: How would you explain it?

Participant: Now? Okay. So the sun light that we basically see, it's the visible light. And it passes through our atmosphere, which contains carbon dioxide molecules. It includes a lot of

things like hydrogen and nitrogen, but carbon dioxide molecules mainly. And they pass through and they're technically absorbed by the ground, and the ground converts that visible light spectrum to the infra red, which are not visible to the naked eye. And, the carbon dioxide molecules end up retaining it, absorbing it and retaining it before passing it out to the atmosphere. Which is what makes the earth more habitable. But because the number of carbon dioxide molecules are increasing due to increase in like factory and the industrial revolution since like the the eighteenth century, the carbon dioxide molecules and methane molecules have been increasing. Which means that more heat is retained in our environment, which leads to even like subtle temperature change, but it leads to temperature change which can potentially be disruptive to a lot of fragile Eco systems. So that's why I guess in essence it's our responsibility to stop that increase in any way we can.

Interviewer: Great. Thank you so much. I appreciate your participation in this.

PARTICIPANT 9

Interviewer: There we go. Everything you say is totally confidential. It is audio recorded but it will be transcribed and then the audio will be deleted so your voice won't be attached to anything and your name won't be associated with any of the data we collect.

Participant: Okay.

Interviewer: It should last about 30 minutes, and you'll receive full credit for participation regardless of how you respond to any of the questions.

Participant: Okay.

Interviewer: Let me know if you feel uncomfortable at any time and we can stop.

Participant: Okay.

Interviewer: All right. So before I start, let me ask you, tell me everything you know about climate change.

Participant: It's happening, it's real. I think it's caused by greenhouse gases in the atmosphere and then I think they get trapped in a layer and then if there's a lot of carbon dioxide, or carbon monoxide in the atmosphere, the greenhouse gases trap that layer and it keeps the Earth much warmer than it should be. And it can cause a variety of different issues stemming from the polar ice caps melting to other environmental issues.

Interviewer: Okay. So tell me more about this layer.

Participant: If I remember correctly, I think, the Earth has layers in order to protect itself from the sun. But if these layers, I guess if there's too much CO2 in the air, then it can be damaging because there's too much heat that gets trapped inside from the sun. I'm not entirely sure.

Interviewer: That's okay. That's okay. All right. Great. And you said you think it's real, it's a real think.

Participant: Yeah.

Interviewer: Why do you think that?

Participant: Because I mean, some people don't believe in it. I do think it's definitely happening. The statistics show that it is getting warmer.

Interviewer: Mm-hmm (affirmative). And you believe the statistics?

Participant: Yeah. For the most part.

Interviewer: Okay. All right. Who does it affect?

Participant: Everyone. Yeah, just everyone. We all live on this earth, so yeah.

Interviewer: All right. Okay. Great. Let's take a look at the simulation. Okay, what do you see here?

Participant: A sun and the ground.

Interviewer: All right. Anything else?

Participant: A temperature scale. Then some measures of check boxes and things like that, that show what is happening, like buttons.

Interviewer: What do you think will happen when we click the play button at the bottom? Wild guess.

Participant: The animation will start?

Interviewer: Yeah. Yup. Okay, let's find out. Okay, what do you see?

Participant: It looks like sunlight is coming into the ground, bouncing back and some of it is bouncing back as sunlight and some of it is bouncing back as infrared.

Interviewer: Anything else?

Participant: The temperature is like slowly increasing.

Interviewer: All right. Why do you think that the ground is, did you notice that they are lighting up yellow?

Participant: Yeah. I assume that's where the sunlight's hitting it, and then it's having some sort of effect where it goes back up.

Interviewer: All right. If you could summarize for me the process or the effect that the sun on the ground, how would you summarize that for me?

Participant: It just seems like it's affecting the ground and kinda bouncing back up into the atmosphere.

Interviewer: Mm-hmm (affirmative). Does infrared come in there anywhere?

Participant: Yeah. It's coming in as sunlight and coming out as infrared.

Interviewer: Okay. Regarding the temperature, do you think that the temperature is going to increase, go down, stay the same?

Participant: Right now looks like it's stabilizing a bit, yeah.

Interviewer: Good. All right. Let's move onto the next screen, oh, so, or the next model.

Participant: Okay.

Interviewer: Click on, sun on CO2. Okay, before we click play, tell me what you see.

Participant: The sun again and it looks like there's probably CO2 molecules in the air.

Interviewer: Mm-hmm (affirmative). I'll tell you that the reason why they are green is because they represent greenhouse gases.

Participant: Okay.

Interviewer: Or CO2, greenhouse gas, you know, same thing. What do you think will happen when we click play this time?

Participant: The molecules will probably bounce around. Similar to how stuff was bouncing around in the first model.

Interviewer: Mm-hmm (affirmative). Okay, let's find out. What do you see?

Participant: Sunlight is just passing through and the molecules, they just seem to be moving, they're not really increasing or decreasing.

Interviewer: Increasing or decreasing or size or shape or speed, or what do you mean by increasing and decreasing.

Participant: They're not really increasing or decreasing, I don't think. Unless they are.

Interviewer: Well like, oh, you mean like the number of them?

Participant: Yeah.

Interviewer: Oh, I see. It's not like there are more, okay.

Participant: Yeah.

Interviewer: Okay. So you said that the sunlight is passing right through, right?

Participant: Yeah, seems like it's not really changing the sunlight or, yeah.

Interviewer: What would it look like if it were?

Participant: Well, the sunlight would have more of an effect when it touches the CO2 molecules, but it right now just keeps moving straight across.

Interviewer: Okay. Well that's good. Oh, and can you summarize for me the interaction or [inaudible 00:07:17] between sun on CO2.

Participant: It doesn't seem like there's that much of an interaction, it just means that the CO2 molecules are moving, when they're being touched by sun. The sun rays.

Interviewer: Okay. Let's move onto the next one. Okay, what do you see here?

Participant: Just CO2 molecules, no more sun.

Interviewer: What do you think will happen when we click play this time?

Participant: We'll see the effect of the infrared on the CO2 molecules.

Interviewer: Yeah, what do you think that effect will be, wild guess?

Participant: Probably different from the sunlight.

Interviewer: What was the interaction between sunlight and CO2 again?

Participant: Not much of a change, really. But maybe this one will actually affect other aspects.

Interviewer: Let's find out. Okay, what do you see?

Participant: So it seems like the CO2 molecules are lighting up in yellow. The temperature is increasing. I'm assuming the yellow is some sort of heat or light. Not entirely sure, but yeah, they're kinda bouncing all over the place, and the temperature is getting really high.

Interviewer: What do you think is causing the CO2 to light up?

Participant: Some sort of reaction with the infrared, or ...

Interviewer: Did you see, maybe if we click the slow motion button it will be more clear.

Participant: Oh, I guess it gets, it stops getting lit up when it touches another CO2 molecule.

Interviewer: Oh yeah, sometimes.

Participant: It lights up when an infrared thing passes through it.

Interviewer: In the cases where it lights up when a infrared passes through it, does the infrared keep passing through it or does it stop, when it hits the?

Participant: It stops. It's like getting absorbed by the CO2 molecule.

Interviewer: When it goes from glowing to not glowing, do you notice anything?

Participant: They keep passing through, the infrared.

Interviewer: Yeah, the infrared keeps passing through. Let's look, like you see that one or maybe that one. If you follow one that's glowing and see what happens when it stops.

Participant: Mm-hmm (affirmative).

Interviewer: Do you notice anything?

Participant: It turns back to glowing?

Interviewer: Oh yeah, sometimes. I like it. Let's watch this one. That one changed when one hit it. What about this one? It's still glowing, do you see that?

Participant: Oh, so if an infrared passes through it, it stops glowing. Is that it?

Interviewer: Well, I mean, but, so what do you mean by passes through?

Participant: Like if it touches the CO2 molecule.

Interviewer: Well, how about this? Let's say, do you notice that not all of the infrared are moving up?

Participant: Oh, it changes direction?

Interviewer: Right. Or you were saying that it lights up when it absorbs an infrared. It absorbs the infrared, and then when it goes from having absorbed one to not, it releases the infrared.

Participant: Oh, I see.

Interviewer: You can see that it's released in a random direction.

Participant: Okay, yeah. Because the one that's being sent up is going straight up, and the ones that are being released are going like different directions.

Interviewer: Right, exactly.

Participant: Okay.

Interviewer: If you could summarize for me, the whole, everything we're looking at here.

Participant: Infrared is going up into the atmosphere, it's touching the CO2 molecules, and then when they release, when they become lit up and then they eventually release this infrared, it's kinda being sprout randomly, yeah.

Interviewer: All right.

Participant: The temperature is very high.

Interviewer: Yeah. Yes it is. Okay, great, let's go to the next one. Okay, what do you see here?

Participant: The sun, the ground and the CO2 molecules.

Interviewer: Right. What do you think will happen when we click play this time?

Participant: A combination of the previous animations. The sunlight will probably go down, hit the ground, come back up as infrared and then infrared will touch the CO2 molecules, probably.

Interviewer: Mm-hmm (affirmative). What happens after it touches the CO2?

Participant: They'll light up and then they'll release more infrared.

Interviewer: Great. What's your guess as to how that will impact the temperature?

Participant: It will increase.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: Sunlight's coming down into the ground and some of it is being released as infrared. Then when that touches certain CO2 molecules, they will release it into the atmosphere. Yeah. The temperature is slightly going up.

Interviewer: How about, let's un-click the slow motion button. Okay, how would you compare the temperature on the screen to that of the first screen when there was no CO2?

Participant: It's rising much faster and not really stabilizing.

Interviewer: Okay. All right, one last time, can you summarize for me this whole process of the sun and the ground and the CO2?

Participant: Yeah, so sunlight comes down into the ground, when it bounces back up, it's as infrared light. When this infrared interacts with the CO2 molecules, it releases more infrared, increasing the temperature, yeah.

Interviewer: All right, great. What you just described to me here is the greenhouse effect. Which scientists credit as being the main mechanism of global warming. As you were mentioning, humans are a part of this. Do you know what emits CO2?

Participant: Yeah. If you are like manufacturing, [inaudible 00:14:57] factory and you're burning a lot of coal or something like that. That kind of can emit CO2. I know that cars emit CO2 with fuel. In general, just like air pollution of sorts emits CO2 and other not so good things to the environment. Yeah.

Interviewer: Right. Let's imagine a car drives through here and it doubles the number of CO2 molecules that you see on the screen. What do you think then the effect would be?

Participant: There would be more infrared released, because there would be more CO2 molecules to interact with the infrared coming from the ground, and then the temperature would probably go up significantly.

Interviewer: Okay. Great. What I'm gonna do is play you a short three minute film, that kinda summarizes what we were talking about, and it talks about the influence of humans. I'm gonna play it and I'll be right back.

Participant: Okay. Is there volume, oh, yeah.

Interviewer: Here you go.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think that Earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in The US and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how Earth temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But because the Earth is colder than the sun, it emits lower energy infrared light. Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed any minute by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degree Fahrenheit cooler, which is well below the freezing point for ice. How have humans changed things?

Since the dawn of the industrial age, around the year 1750, atmosphere carbon dioxide has increased by 40%. Methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase. Thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay, what did you think of the film?

Participant: It's very informational in a clear way. Not like overly scientific, it was just very straight to the point.

Interviewer: Does it fit with your understanding?

Participant: Not entirely. I think I knew about greenhouse gases, but I didn't realize that the light was passing among the greenhouse gases, and that was how it was trapping that layer of warmth in. Yeah, so there were some technical things I didn't really remember.

Interviewer: Okay. The very first thing when we started this, that you said was, that global warming is real, right?

Participant: Yeah.

Interviewer: Do you think that, so then you believe the science that we're talking about here?

Participant: Mm-hmm (affirmative).

Interviewer: Why is that?

Participant: I mean in the video they also said like all the climate change scientists do believe that the Earth is getting warmer. I think it's always better to assume the worst, rather than assume that everything is okay. If you assume that, or if you can do [inaudible 00:20:04] measures with the assumption that it is warming, then it's better than ignoring everything and just letting the worst case happen. Yeah.

Interviewer: Yeah. Interesting. That's a good point. What are your thoughts and feelings about climate change in general?

Participant: It makes me very nervous, in the sense that we've done so much damage in such a short period of time. The Earth has been around for so much longer than we have been on it, but we've done so much damage in what, the past like 200 years. That makes me nervous. I guess just curious to see what solutions that we can come up with. I'm not like an environment studies major, but I'm wondering in my field, is there anything that I can do to help, yeah.

Interviewer: So you then feel like you want to do something to help?

Participant: Yeah, if I can.

Interviewer: Do you think you do anything right now?

Participant: Probably yeah, if it's something feasible, like within my control, yeah.

Interviewer: What kind of things do you perceive as in your control, that you could do?

Participant: In general just being more energy friendly and take public transportation. I'm already a vegetarInterviewer, I know that not eating that much meat can help with the amount of water and resources that are used. Just small changes in my lifestyle and probably sharing this video or getting more people to know about.

Interviewer: Mm-hmm (affirmative). Do you think that getting people to understand the science would help, I'm trying to think about how I want to ask this question. Do you think that the science is a part of this issue, basically?

Participant: Yeah, I definitely think so. I think at least for me, when I see evidence, hard facts like that, it makes me more convinced. Not that I wasn't convinced before. But I think that just even more solidifies my belief in it. I think many of the people may share that same perspective of seeing evidence and the facts and the science.

Interviewer: All right. Do you think that, so people debate this. This is debated science, I guess, you would say.

Participant: Yeah.

Interviewer: Do you think that it should be debated?

Participant: Not really. Just because I think there is a lot of evidence that supports climate change. Also like I mentioned earlier, it's always better to take more care of the planet that you live on, than just do everything to maximize your own profit or your own gain, and not think about what you're doing to the world that you're gonna leave behind for generations to come. I mean, obviously I'm on one side of the debate, so I can't say that it can't be debated. But yeah, I don't think that it's something that we should really argue over. It's just something we should work together to try and solve.

Interviewer: Okay. Let me think, see if I'm missing anything. Okay. Over the course of the 30 minutes or whatever that we've been sitting here. Do you think that your mind has changed about anything?

Participant: I don't think my opinion has changed, I think my knowledge has changed about how much I know about global warming. I feel like in the beginning I knew some terms here and there but I didn't really know the specifics. But after going through and seeing the animation and the video, I kinda knew more detailed information about what those terms meant. What the actual actions of the sun and infrared were doing.

Interviewer: Mm-hmm (affirmative). What is that again? The interaction between the sun and ...

Participant: Oh. The sunlight passes through as visible light and then when it hits the earth it gets passed up as infrared light, and it's kind of like the Earth is like a filter. That infrared light gets trapped in those greenhouse gases and that's why our Earth stays warm, but it's also why we have climate change now.

Interviewer: All right, great. That's it, thank you very much.

Participant: Cool.

Interviewer: Yeah, thank you for your time.

Participant: Mm-hmm (affirmative).

PARTICIPANT 10

Participant: Do you need my ID or anything?

Interviewer: No, I have it on here already on the Sona system so I'll just you know.

Participant: Alright, perfect.

Interviewer: Click "go" at the end. So before we start with the simulation, tell me everything you know about climate change.

Participant: I know that we are polluting the earth and therefore we're releasing all these toxic gases that are creating holes in the ozone layer or trapping greenhouse gases even and then ... So the temperature of the world is slowly, well not slowly anymore, increasing and ice caps are melting. The sea levels are rising cause of the ice caps melting. Yeah.

Interviewer: Alright. Go ahead, sorry.

Participant: I think that's pretty much it.

Interviewer: Okay. And so like the process that you're describing, you mentioned something about ozone and something about greenhouse gases. You wanna talk more about that? About your current understanding of how that works?

Participant: Okay. So cars and just waste and everything causes releases of these gases that then get trapped in our atmosphere. Or something along those lines.

Interviewer: Okay. Okay. Yeah. Alright. And somehow that's leading to-

Participant: The temperature of the world going up.

Interviewer: Okay. Gotcha. Great. And so, what are your thoughts and feelings about that issue? Do you think it's a real thing? Do you think it's-

Participant: Yes, definitely a real thing. Definitely should put more effort into kind of just conserving the environment in general and recycling and just trying to get rid of our carbon footprint. Cause it is a very real thing and I honestly think it's going to hurt the environment very drastically very soon if we don't start doing something. And it's a shame that some people don't believe it's real. Yeah.

Interviewer: Alright. Thank you. So let's start the simulation. This isn't it. Okay. Here we go.

So tell me what you see here and this mouse you can use to kinda like, I don't know.

Participant: Am I supposed to just click around or just-

Interviewer: Yeah, in a minute I'll have you click on different things. But for now, just tell me what you see on the screen.

Participant: Something that's supposed to resemble the ground, I suppose. And then the sun. And temperature. And the labels of what's going to happen, I assume.

Interviewer: So since you're already thinking about what's going to happen, what do you think will happen when we click the play button? Wild guess.

Participant: Something to do with how the sun's rays is going to affect the ground and something to do with the carbon dioxide.

Interviewer: Okay.

Participant: And photons.

Interviewer: Okay. Let's find out.

Participant: Alright.

Interviewer: What do you see?

Participant: The sun's rays are hitting whatever that's supposed to be, the ground, I suppose. And the infrared photons are bouncing back up towards the atmosphere.

Interviewer: Great.

Participant: And the temperature's increasing as this is happening.

Interviewer: Alright. So good. If you could summarize for me, like the process that you see here, how would you summarize it? One more time for me.

Participant: The sun's rays are traveling down to the ground, bouncing off and infrared photons are bouncing back. And then the temperature is greater than what it was before we started.

Interviewer: Alright. And do you think the temperature is going to continue to rise? Do you think it's gonna like go down, or do you think it'll be about the same.

Participant: Well it's going up and down currently so I think it's balanced out unless something else is going to happen.

Interviewer: Okay. Great. Let's go to the next model, so on the left if you click "sun on CO2".

Participant: Oh, okay.

Interviewer: There you go. What do you see now?

Participant: So these are carbon dioxide molecules in the air. And the sun.

Interviewer: And what do you think will happen this time when we-

Participant: So now we're gonna see how the sun's rays are going to affect carbon dioxide.

Interviewer: Okay. Alright, what do you see?

Participant: It's traveling through the molecules, not really affecting them. The temperature is still the same.

Interviewer: Okay. So if you could summarize for me the interaction between sunlight and CO2, how would you do that?

Participant: It looks like there isn't any interaction between the sunlight and CO2.

Interviewer: Alright, great. Let's move to the next model. Okay, what do you see here?

Participant: CO2.

Interviewer: Okay. And what do you think will happen when we click the play button this time?

Participant: Something to do with the infrared photons with the CO2.

Interviewer: Okay. What do you see?

Participant: So the infrared photons are bouncing off the ground onto the CO2 molecules and they're retaining the heat, I suppose, which is causing the temperature to go up drastically.

Interviewer: Okay. How do you know that the ... So you said the infrared was being retained by the-

Participant: I assumed cause they would hit one of the molecules and they'll glow yellow for a little while and then stop.

Interviewer: And do you see what happens to it when it stops glowing? It might help to click the slow-motion button. It's moving pretty fast.

Participant: It looks like it's bouncing off other molecules and then stopping. SO maybe it's like transferred.

Interviewer: And do you see that like maybe not every infrared photon is traveling up?

Participant: Yeah. They're bouncing off of, I assume, the CO2 molecules then.

Interviewer: I see what you're saying. Say more about that.

Participant: It looks like they're traveling from the ground, hitting one of the molecules, and then bouncing in a different direction maybe.

Interviewer: Okay. Gotcha.

Participant: You can't really tell. Yeah.

Interviewer: Yeah. That is what it's supposed to be showing. I know it's kinda hard to see in this, but yeah, that's what's going on. All right, so if you could once again just summarize for me, the interaction between infrared and CO2.

Participant: So infrared is being retained by CO2, which is causing the temperature to go up way higher than it was before.

Interviewer: Alright. Let's go to the next one. Okay, what do you see here?

Participant: The ground, the sun, and CO2.

Interviewer: And what do you think will happen this time?

Participant: See how it all comes together to react with all of one another?

Interviewer: And make your best guess. Like what will that process look like?

Participant: The sun's rays are gonna come down, bounce off the ground. The sun's rays itself are not going to affect CO2 but the infrared coming off the ground will be retained and held within the atmosphere, causing the temperature to go up.

Interviewer: Alright.

Participant: Can I not play it in slow-mo?

Interviewer: Yes, you can. Okay, what do you see?

Participant: So, the sun's rays are coming down, hitting the ground. Some of the rays are bouncing back up and then some of them become infrared and are hitting the CO2 molecules in the air. And then the temperature's slowly rising.

Interviewer: Great. And if you were to compare the temperature on this model to the first one that we looked at when there was no CO2, how would you compare them?

Participant: When there wasn't any CO2, the temperature was at kind of a constant range, where it would like kind of fluctuate up and go back down but it remained within that same range. Versus, in this simulation, where there is CO2 in the air, the temperature is just slowly increasing and not going down at all.

Interviewer: So you think it's gonna continue going up and up and up?

Participant: Well it's fluctuating right now so maybe not. It was going up. Yeah.

Interviewer: Okay. So you think then it's not fluctuating? Or I'm sorry, it's not going to continue up and up, it's going to fluctuate and go up and down.

Participant: Yeah. It looks like that's what it's doing.

Interviewer: Okay. So you think it's kind of stable?

Participant: Yeah. For now, yeah.

Interviewer: Alright. And do you think that it's stabilized at a place that's higher, lower, or the same as the first screen?

Participant: I feel like it was a little bit higher than the first screen. Yeah.

Interviewer: Okay. And you'd be right if we went back and looked, we would see that it's a little bit higher. Great. All right. So, let me think. What you just described to me here is called the greenhouse effect. And this is what most scientists attribute to ... or they claim that this is the mechanisms behind global warming. So do you know what creates CO2?

Participant: Pollution. So CO2's part of our waste. It's also, we produce it as we breathe. So by cutting down trees and stuff that absorb CO2, there's so much more there in the air.

Interviewer: And so, if we were to have some sort of polluting thing there, like a car or something, double the amount of CO2 that you see on the screen, how do you think that would change things?

Participant: The temperature would go up cause there's more CO2 to bounce off of, I guess.

Interviewer: For what to bounce off of?

Participant: The infrared.

Interviewer: Okay. Alright, so now we're gonna watch a little film that kind summarizes everything and ties it to this idea of the role that humans play in all of this. Okay. So I'm going to play it.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change?

Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism?

In one study, we asked almost 300 adults in the U.S., and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light. But because the earth is cooler than the sun, it emits lower energy infrared light. So, earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees fahrenheit cooler, which is well below the freezing point for ice.

So how have humans changed things? Since the dawn of the industrial age around the year 1750, atmospheric carbon dioxide has increased by 40 percent and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused earth to heat above it's typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase. Thus producing global climate change.

Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay. So, what do you think?

Participant: That sounds right, yeah.

Interviewer: Okay. So it fits your understanding?

Participant: Yeah.

Interviewer: Alright. So, let's go back to the more general view of climate change that we were talking about to start this interview, right. So, what are your general feelings and thoughts about climate change?

Participant: It's caused by humans being on earth too long and we should clean up or try to clean up after ourselves, to try to work towards bringing down the level of greenhouse gases to kinda stop climate change. Even though stopping it isn't an immediate goal, like it's not gonna happen right away but it's something that we should work towards.

Interviewer: You feel like we should do something.

Participant: Yeah.

Interviewer: Okay. And by we, who do you mean?

Participant: Everybody. Cause everybody contributes.

Interviewer: Okay. And do you think that the science is a relevant aspect of the issue as it relates to ... First of all, do you buy the science? Do you believe that this is the process that-

Participant: I do, yeah.

Interviewer: Okay, why is that?

Participant: Well, it's science. I'm a scientist. It makes sense. We know that we breathe out carbon dioxide, we know that there are different things that produce different gases, different waste products. We know that nothing is created or destroyed so therefore it has to go somewhere. We know that the sun emits light and different spectrums of light. And we know that that has to go somewhere. So yeah. I think that's accurate. I believe it.

Interviewer: Alright. So, let me think. You're answering a lot of these questions, I wanna make sure I'm getting to all of them.

So, this is an issue that's debated like on TV. You know, like certain people argue against the science or some people support it. What do you think about that?

Participant: That's hard. I think that's more of like "do you believe in science" question. Cause if you believe in science, it's very clear that yeah, this makes sense. Like we think we know how the world works and that's the issue of like "what is science?" Do people really believe in science? Cause people who believe in science like to say that science is fact cause you can prove it and there are aspects that yes, you can prove it. You can demonstrate gravity, you can do experiments and you can physically show something happening.

But then there are other parts of science that is all theories. And that's where the gray line kinda comes in where people are like, "well I don't know if I believe in that because I can't physically see this happen." Or like, you could or some people don't. So, I think that's the issue with whether or not people believe in climate change. It's more of like "do you believe in science" kind of thing.

Interviewer: So, when you were talking about like science is made of theories, right. By that, do you mean that there's some uncertainty to them?

Participant: Yeah. Cause there's some things that we just can't prove. So if you take into theories about space and how earth was created, you know, the big bang theory, it's a theory. We didn't exist in the time so we don't know for sure but there are lots of evidence that suggests that this is what happened. But again, it's a suggestion. It's not hardcore and there's no way to really prove it. And so there's a lot of people that make that argument of "yeah, you can't prove it so I don't believe it." You know?

Interviewer: And you think that people should believe in science?

Participant: I think you should examine the evidence and if, depending on how much or little of it, kinda just make your own opinion of it. Yeah.

Interviewer: Cool. Yeah. So do you feel like connected to the issue of global warming?

Participant: I think we should all feel connected. We all live on this planet and we can physically see that the polar ice caps are melting and sea levels are rising. There is physically proof that at least something is going on with the world. So yeah. And it's going to affect all of us. So yeah.

Interviewer: And would you say that your actions reflect like a global consciousness?

Participant: I try to. So recycling of course and just kind of minimizing energy waste and not using as much paper so we don't have to cut down as much trees. Or just kind of being conscious and just kind of telling people that this is what's going on. Yeah. So yeah I think so.

Interviewer: Alright. Great. And so, okay. So like in the duration of these 30 minutes that we've been sitting here, right, has anything that we've talked about or that you've interacted with in the simulation changed your mind about anything in particular?

Participant: Not really. Cause I think I pretty much agreed with it coming in so.

Interviewer: How about how the science works?

Participant: Same. I agreed with it coming in so seeing that was kind of like a confirmation of like "yep, that's what I believe in."

Interviewer: Okay. And if you were to, let's say, some skeptic came up to you and they were like, "I don't get it, I don't understand how it works, I can't see it with my eyes, how could it possibly work?" How would you explain to them that process?

Participant: Just kind of like how the video did. Yeah, we produce different waste products and I hope that they believe in oxygen and CO2. Cause you can't see those either. But to break it down, like yeah we produce this and this and we're cutting down trees and therefore they can't reabsorb the CO2 and therefore it's getting trapped in our atmosphere.

Interviewer: And how does that trapping work?

Participant: Good question. We have, I believe, the ozone layer is what keeps the air in cause without it, we'd just be space. So I think that's how that works.

Interviewer: Okay. Alright. Thank you very much.

Participant: Thank you.

Interviewer: And that's that.

PARTICIPANT 11

Interviewer: There we go. What I'm going to do is I'm going to show you a simulation, like a visualization that illustrates the main mechanisms of global warming. Okay? As I show you this, I'm going to ask you questions to just figure out what you're thinking about, what you see in the simulation and then we're going to watch a three minute video and some followup questions after that.

It doesn't matter how you respond to any of the questions. You'll get full credit for this. Also, it's being audio recorded but it's fully confidential, so your name won't be attached to anything, like any of my records and the audio will be transcribed and deleted. So after it's in text form, your voice won't be connected to any of this stuff. What else do I need to let you know? Oh yeah, if you feel uncomfortable answering any questions at any time, just let me know, and we can stop.

Participant: All right. No problem.

Interviewer: All right. Before we start the simulation, tell me everything you know about climate change.

Participant: Well, essentially it's the fact that through our production of greenhouse gases, both with the burning of fossil fuels and also the production of cows that burp and fart methane, you thicken, I don't know necessarily if it's the stratosphere, but ultimately you thicken just the ozone layer of Earth's atmosphere, and with that, the photons of light that come in through the sun hit the surface of the Earth, and essentially, what they do is they hit and then they get reflected back and back into space, essentially, and because the outer layer's thicker, what happens is that they reflect back, but the photons can't leave the atmosphere, so they get reflected back into Earth, and then essentially increase the temperature that way.

I absolutely believe it's a thing, and have completely been, like for many years, kind of an advocate for it and just like, we need to do something about it, but I also think that the media now more than ever has completely manipulated, essentially, what it is, and the means to which we can make a difference, like how we can make a difference and what are the actual substitutes for climate change, essentially. Like in terms of green energy, and solar and wind, for example. I cannot say, like although I'd love to think that it would substitute fossil fuels, and it's the future and stuff like that, first off, I cannot for sure guarantee that at the end of the day, if everybody, for example, switched to an electric car as opposed to a gas-powered car, I cannot guarantee to what extent that you're going to actually be reducing the consumption of CO2 because even though, yeah, once the car is ready, you're just using electrical energy. Fine. That's all great. But to make that care, you're still extracting lithium, which is a precious metal from the ground. You're still making these batteries and all those things that use fossil fuels to be made.

And there is some data to back up the fact that when you just do the math, the amount of CO2 that you burn just using gasoline, and the amount that you use going through all

the process to make that clean energy vehicle ends up being the same, so it's not clean. You're just feeding people the information that, "Oh, this is eco-friendly," so that people buy and consume more of these things. So it's just that cycle, and I think more than ever, mainstream media is just using that to their benefit because I do think that we can reduce ... I do think that climate change has been increased by us, but I think that the significant changes that we can do as citizens is like, if I had to say, probably number one is reducing our consumption of meat because that's what destroys a lot of the forests, and not only consumes carbon dioxide, but methane is four times more dense than CO2, so the methane that the cows are releasing has a greater impact on climate than just CO2.

And we use a lot of water. Like the amount of water to make a cheeseburger is the amount of what all your showers for, I think a month or six months, I don't know exactly how much the measure is, but you realize how just turning off the faucet, although you like to think that, "Oh, I'm reducing water," the minute that you go to McDonald's and buy a cheeseburger, all your eco-friendly things just went out the window because you're destroying just as much of the planet by doing that.

And I also think that realistically, wind right now, like the amount of energy that you put into making a turbine and placing it almost doesn't pay off the amount that it will generate for you during its lifespan. Solar's a little bit better, yes, but realistically, I think these two types of energies are only going to be able to produce our energy for the stuff that doesn't take much energy, which is heating up your shower, turning on your TV, these lights, all these things, but the stuff that actually needs energy on demand and 24/7 like all the factories, all the huge ships bringing shipments from China to here and back, and all the things that actually power the world, if that's oil, and the only thing that can substitute oil that I see that can potentially be feasible is nuclear.

And although that is far in the future, that's what our intention should be towards especially because if you're able to finally develop nuclear and keep it in, essentially be able to manipulate it, like have small generators that you can have in your car that won't explode. If you're able to essentially control it, which obviously is much harder than it sounds, but if you're able to do that, all the investment that you've put in the past 15, 20 years in solar and wind just flies out the window because now with a stick of this size of uranium, you can power your car for 20 years, and all the energy from the solar panels that you literally spend 20 years switching all of your industry from oil to that renewable energy, which essentially, I don't even know how renewable it is. I don't know.

Sorry I went in like 1,000 tangents, but yeah. I don't know. I think it is a thing, and it's absolutely something that we should be worried about because it has immense implications to what our planet is going to look like, but just like anything nowadays, there's so much BS there that we don't know exactly. Like we don't know what we should be paying attention to, what are the actual, significant steps that we can take to reduce this amount, and then it becomes everybody saying, "Oh, yeah, the ozone layer is thickening, the Earth is getting warmer," but then nobody does anything, and they think that just because they buy a Tesla now, they're eco-friendly. So I don't know. Yeah.

Interviewer: No, that's great. I have a couple of followup questions, so first of all, you seem skeptical of the stuff that you see and read in the news, or things that people tell you to do as far as how to conserve energy and things like that. What's your way of sifting through the BS? Like how do you determine what's good news and what's bad news?

Participant: The one big thing that has shown me ... Because I've always been skeptical, but I used to have a reduced, like I kind of always identified myself a little bit more liberal leaning towards, and not in terms of economics, but I feel like in terms of how to run a country economically, I think the Republicans just have a better grasp of that, factually, although I think obviously they have issues, like they have a better grasp on that. In terms of just how to live and treat each other and how to essentially better the best situation, I think that the liberals, for me personally, they've always had a better vision of it, at least that I identify myself with it. But recently, my movement towards more scientific and more just science classes, and just that form of thinking because I used to hate science when I was in high school, to be honest, but then I took a neuroscience class here, loved it, and now I'm just really, really enjoying it.

And so that shift from going to more scientific fields, it gave me a better outlook on what are actual scientific sources and what aren't. Like to the level that a year or two years ago, I'd read something published by The New York Times or The Washington Post or anything talking about science, and now I approach it, and I realize how that journalist, it's impossible for him to be able to actually, factually get a scientific study, and if he doesn't have a solid scientific background, it's impossible for him to do justice to that study and to the limitations and what that study actually is showing. It's not just condensing the guy's abstract. If you're scientist, and you read an abstract, then you read a study, like if you're familiar with how the scientific method works, you can immediately, even if the study doesn't say that, you can immediately deduce like, "Ah, maybe this study has severe limitations because maybe they only considered this pool of people." Maybe they did this, this, and that, and then you can only really grasp if you are a scientist, if you do that.

If you're the person that's just translating an abstract, you're just going to feed the people what the abstract of the study fed you, in a much less detailed sense of it. I don't know. I feel like I'm reading, especially because that's what you get bombarded in your Facebook news feed. Like, "Oh, neuroscientists found this," and now that I know a little bit more, I go read the study, and it's really, like it doesn't tell you anything because it doesn't go into any of the science. It goes very briefly, and it kind of bothers me because it's the sense that, of course, it's written in a way that it's perfect because it reaches everybody that doesn't know anything about science, but at the same time, I do think that we should all do ourselves some effort to understand the minimal amount of it, which isn't that much. For us to be able to at least demand of the person to give us something that gives us a little bit more information so that we have more to deduce like, "Oh, how skeptical should I be about this or not?" I don't know.

It reached the point, even this past week, my skepticism increased because even the more liberal-leaning places that I kind of used to lean more towards, I realized how they are also completely full of fake news and BS. This past election, honestly, for me, I lost any ties because I'm not an American, so I don't necessary have as powerful a tie to any

political stance, but I'm a citizen so obviously I think critically of everything, and the kind of more bias that I have had to the liberal side of things, after this election I completely lost it because I think that, essentially, it wasn't Donald Trump who won, it was the liberals who lost, and they lost because they obviously are just as lost as the republicans are because I think, I don't know, I've seen things ...

Again, I'm going off in a bunch of tangents, but seeing things like what happened in Berkeley when the Milo, the republican went to talk, regardless of what you believe, the minute that you're burning cars and destroying the public school's property, like 100k of damages, you're on the wrong side of the argument. You just lost the argument right there. I don't care what you have to say. I don't care what your opinion is. The minute that for you to vocalize your opinion is to shut out another person's opinion, and then start burning things and destroying things, when you're the party that claims to have freedom of speech? You've just lost what you stand for, so how can I back people up if what they told me that they believe in, they're not walking the walk? They're just talking, "Oh, this is what I believe in," but when they actually go to practice it, they manipulate their audience just like Donald Trump does. They feed people false information for their own benefit. It's just the same. It's just the one is the red team and one is the blue team, and for some reason I thought that the blue team was a little bit better than the red team because they properly manipulated me once upon a time.

And recently one thing that bothered me was that a lot of people nowadays make money off of YouTube videos, like the YouTubers and essentially how they make their money is through the ad companies that put ads on their videos and stuff like that, and what happened recently is the Wall Street Journal published not a study, but just an article, basically, discussing how YouTube was monetizing videos that had racial underpinnings, or anything kind of controversial, and the reality of what actually happened was that YouTube wasn't doing that. YouTube had already stopped monetizing the videos that were controversial long before. What the Wall Street Journal did, is they got these controversial videos, they posted on their page, they Photoshopped in ads from YouTube onto these videos that weren't in these videos in the first place, and because of that, a bunch of ad companies removed their sponsorship from YouTube, and because of that, YouTube now doesn't have the money to pay the YouTubers.

So the actual YouTubers that were making legit videos, now they're being completely censored, and the guys that were getting paid, that made their living off of this, getting paid like $2,000, $2,500 a video, are now making $150 a video. So it's not longer become a viable thing for them to make their living from, and essentially they're destroying it just like they destroyed TV. There's people coming here like, "Oh, yeah, we'll make these ... " Because now the only videos that can be monetized properly are the ones that contain family friendly material, and that's just basically what you do to TV.

You censor to the level. You tell the ad companies, "Here. We're going to make a bunch of stuff that you're going to love that people are watching because it's all nice. There's no controversy. It's all censored and beautiful." And then that's what you feed information, but that's why people shifted to YouTube in the first place, because it was

this free place of sharing of ideas and freedom of speech, essentially, and now just like anything, and what bothers me is essentially because this only happened because of fake information. The videos that the Wall Street Journal used to scare the ad companies and to make them not support YouTube and stuff like that, those videos didn't have the ads in the first place. YouTube had already done the right thing of not have monetized those videos that had racial comments or anything like that in the first place, but because they created, just like the United Airlines thing, nowadays that's all that matters. One piece of controversial, even if it's true or not, the fact that it's out there and people are giving attention to it, it's enough to destroy your company. So people are just scared of that. So I don't know.

I feel like it's just disgusting that you have an actual source that should be news like the Wall Street Journal taking their fucking time to make a Photoshop edition of a YouTube video with ads that aren't there just to screw people over. It's crazy because if these are the people ... It's just like politicInterviewers, or doctors, or journalists. These people should be taking these jobs not because they want to make money, or because they have other interests. No, but because they want to service society and they understand the responsibility of their job. If you're a journalist, you have the responsibility to tell the truth. If you're a politicInterviewer, you have the responsibility to not be an asshole and steal from people, just like if you're a doctor, you have the responsibility of treating your patients. But nowadays, it's all too individualistic, and it's, "I'm going to go in here. I'm going to make as much money as I can, and them I'm out." And so yeah, we live in the messed up society we now live in.

Interviewer: But you trust science?

Participant: No.

Interviewer: You don't trust science?

Participant: Well, I do. I do, but I also do think that those studies are also prone to manipulation. Just because it's published in a scientific journal, although I think it's more legit than the Wall Street Journal, obviously, I do think that it can be prone to manipulation, and I've seen that. Like why is marijuana illegal? Why is LSD illegal? That's not factual information. That's manipulated information that people want to sell you to keep things illegal so that you remain in your state of, essentially, oppression. And that's the thing that kind of ties to climate change is that I do believe that climate change is real, but I cannot tell you that maybe the scientists, the 98% of scientists that are in consensus of this didn't just do everything that I've ... Because I've seen this.

Like politicInterviewers do this, and back in Brazil with data and datasets. You basically get the outliers that say that icecaps are melting, or the temperature is increasing. You have the outliers of plus and minus five, and there's the average. They'll just get the top, top outlier, and they'll make that the average, and that's what they're spoonfeeding everyone. They're not actually spoonfeeding everyone the correct information. They're using powerful biases to manipulate you even more. That's not me saying that, "Oh, climate change is not a real thing." Obviously, I do believe it is, but I also do believe that

we're just being manipulated by what exactly the problem is, how serious it is, and how we should be tackling it, essentially.

I mean, I just think that I'm scared that we're going to spend the next ... If we want it to be super ... The mindset nowadays is that, and that's why people are kind of pissed with Trump with certain things, but the mindset is like, "Oh, we should be going to solar and wind," but I just can't help but think that if we put all our eggs in that basket, in 20 years, we're all just going to implode because it's not going to be a reality. We're not going to be completely sufficient off solar and wind because that's not honestly ... You're still mining for lithium. You're still destroying the planet to make those batteries, even if they one day become as productive as oil, which realistically they probably won't. These are still precious metal that you're still destroying the planet to get them, and if everybody has a solar car, has solar panels in their house, you're destroying the planet just as much, and you're potentially losing productivity, and you lost years and years of investment on something that didn't prove to be as sufficient as you thought it was.

But that's the thing, and I don't think nobody thinks it is. People are just being fed information to make them think it is when they're not actually going through the data themselves and calculating the numbers and doing the math, because the data itself can be manipulated by the people that ... You know what I mean? There's too much power involved.

Interviewer: Now you had mentioned earlier that you think it's important for people to know how to be critical of science. Right? And that it seemed like you were thinking that that is one possible way to alleviate the situation, right? Is to make sure that the reporters and the news people, they know how to read science, they know how to use science correctly and be critical of what they're given. What do you think about that?

Participant: Yeah. I think that's a big part of it, but it's tough when you have a news company that's comprised solely by journalists because they might not have, I'm not saying they don't, but they might not have that scientific understanding, and especially with science, it's very delicate because it's changing. And also, that's the thing that completely changed my grasp of it. Two years ago, when I'd go to a doctor, I listened. The white coat had all the effect that it needed to have. This man knows his stuff. But now coming here and going to a bio lecture when every lecture that I'm going, the stuff that they're showing us is stuff that has been found, like people have discovered last year, or two weeks ago. I'm like, "Dude, this guy went to school in the 1980's, let's say, when we had a lot less technology to know what we know." What is his body of knowledge?

It's just like me trying to talk about the new advances of technology. I was huge into technology. I was a big gamer when I was a kid. I knew a shit ton of technology. Nowadays, I'm way behind because you can't keep up. It's exponential. Our brains aren't exponential. So the things that the kids are learning how to do now, even if I try, I'm not going to be able to comprehend it. Just like in 10 years, they're not going to be able to comprehend the stuff that the past generation is doing. It's changing so fast, and especially the past generation, the past generations were ones that did not accept change so easily. They did not understand that things could change so quickly. For them,

for you to say, "Oh, actually, marijuana doesn't make people crazy. Actually it's less damaging as a drug than alcohol and tobacco," they're not so willing to hear that.

Our generation is a little bit more, like our generation doesn't care, although some people do. We don't care a lot about the stigmas, or the creations that we already put. People back in, they're not so willing to say, "Maybe weed is not that bad," because alcohol and tobacco are just ingrained in the society, and that's just what you do. Those are the rights and wrongs, and vice versa. We're, thankfully, a generation that's more like, "Listen. Let's just get the facts and proceed from there." I mean, I don't know. I don't know. It's tough. It's also very tough for you to talk about science and for you to have a critical and logical taking and just understanding of everything when you still have church and state mixed. It just drives me nuts.

It's crazy that I want to go back to my country and have a logical discussion, but there, we're having people, like we have abortion being illegal because God said so. Okay, my friend. Come on. It's crazy. I don't know. People need to start grasping that things like religion, they're very valuable, but not as explanations of the nature of life. They're very valuable as explanations of the human consciousness. Like why do humans have the need to explain why we're here? Why do we have the need to create these sorts? Like do you think if it really was going to tell, like from all the science that we know, if it was actually going to explain anything about the meaning of life, it would come down to two options, Heaven or Hell, and if you're a good guy, you're going to Heaven, if you're bad, you're ... Come on.

That's simple narrative stories that you create simple premises because you're telling these stories orally around a fire, so everybody wants to get a good story, so you just make a simple premise so you can quickly tell, it can quickly get spread. That's how these things get started. It's literally Harry Potter, but written 100,000 years ago, and just because a lot of people believed in that because you didn't have science. Of course you're going to grasp onto those things when you don't even understand, like you don't even know of an atom. People are dying and you don't know that what they're dying of are these microscopic things that you can't see through the human eye. When these things aren't feasible to your brain because you just haven't been able to abstractly grasp that concept, of course the nature of life is going to be Heaven and Hell. That's totally obvious.

But thankfully we're in a turning point where we know that information. We know that we're in a ball rotating at 450 miles an hour, or kilometers an hour, around a sun that is just one in another ... You know what I mean? It's ludicrous for us to give so much meaning and stress of the smallest and irrelevant things that we do in our day to day life when essentially they're nothing in the grand scheme of things. They're nothing. We should be a lot more concerned in everyone's well-being, and the safety of this planet. That's essentially all that matters. The bickering that we have, and the day to day of who's going to ... That's other stuff that doesn't really matter.

Interviewer: It seems like you've thought a lot about this stuff. I want to know, in what situations have you been in where you've thought so much about these kinds of things? Like classes or friends?

Participant: I mean, it's a combination of things. I think I just always, from a very young age, I always reflected. My brain was always fine on my own. Thinking about shit, like things, and considering both sides of things, especially because I wasn't like ... I spent the beginning of my life, let's say the beginning of school, more on like kind of introspective, and I was always like an extrovert, but in my mind, being introspective in the sense of thinking about things and reflecting about things, and stuff like that. I wasn't a good student or anything like that, and I had that shift later in high school, and then now coming to [SCHOOL NAME] and stuff like that. So I guess I was like a philosopher that finally got more information and understood that there's a huge body of knowledge that I can use to develop even further these ideas and stuff like that.

And also, I don't know, a big thing is just that I think we shouldn't be in the shit storm that we're in now. We could totally be living better and happier lives for everyone's well-being that doesn't involve ... Think about the amount of people that suffer from anxiety and depression. Those conditions aren't tangible. Like if I punch you in the face right now, it's going to hurt because it hurts. There's a kinetic energy there that creates hurt, and I'm not saying that you're never going to feel sadness. Of course you will.

Like let's say you lose somebody and stuff like that, that stuff will happen, but the problem is that nowadays we stopped living in the present, so when that sadness hits, instead of just letting that come into us, and feel the emotion when it is tangible, when it is there, and just letting it affect us, and then moving on, humans have this brain that you can create memories like that whenever you want, so what happens is we keep playing these negative things in our brains so the sadness, or the depression, or the anxiety that happened at one moment, we take it throughout our entire lives because we haven't learned to control this, and we haven't ...

We think that we're so smart, that we're not animals anymore, that we don't abide by the laws of nature, that we're not just machines that are affected by constant stimuli that come into us day in and day out, and because of that, we don't think that we need to take some time to give this some breather, give our brains ... Meditate a little bit. Like think, reflect, essentially, about our day to day lives. Essentially, we think we're free to choose. No, we're not. Like for the practical senses of it, and for our day to day experience, it feels like we're free to choose. I feel that if I want to get this water bottle and take a drink, I'm free to do that, but I'm not. It's just stimuli. It's literally sodium ions going into neurons and potassium ions going out that make me do things and generate a bunch of thoughts and different processes in my brain, and I think that, although you can't necessarily-

Interviewer: Oh. Oh, yes. Oh, okay. I'll be right back. Sorry.

Participant: Yeah, no problem about that.

Interviewer: [inaudible 00:31:11] just had to ... I'm recruiting your help for this one. So he might come out [inaudible 00:31:19]. Yeah. Mm-hmm (affirmative). Okay. Thank you.

All right. Sorry about that.

Participant: No, no problem.

Interviewer: Okay. Maybe we should get to this simulation, right? Okay. So this might be old stuff to you, but at least I can find out what you think about it. There we go. Okay. So what do you see here?

Participant: Sun. Are those supposed to be molecules or atoms?

Interviewer: Yep. And what do you think they comprise?

Participant: Either the ocean or land, I'm assuming.

Interviewer: Yeah. I'll just tell you. It's supposed to be the land. It's supposed to be the Earth. Okay. Anything else you see on the screen?

Participant: Like in this screen or the entire screen?

Interviewer: The entire screen.

Participant: All right. Temperature levels. Yeah, I mean, I'm imagining that you're going to press some button and I'm going to see the beams of light coming in. But yeah.

Interviewer: Yeah. I was just going to ask you what you would predict would happen when we start it, and you just did, so let's start it. You can click down there. Okay, what do you see?

Participant: Some atoms absorbing the photons and some reflecting them back in all directions.

Interviewer: Mm-hmm (affirmative). Are all of the photons the same?

Participant: No. Some are infrared, and some are sunlight.

Interviewer: All right. So if you could summarize for me the process, or like the interaction between sunlight and the ground, how would you do that?

Participant: It comes in from an angle and then it reflects back at any different angle, and then sometimes, depending on where it hits, the photons can be absorbed so that only infrared gets reflected back.

Interviewer: And does this have an effect on the temperature?

Participant: I forget, like on the spectrum, I forget where infrared lays. I can't say for certain if it does more damage than just natural visible sunlight. I'm assuming it ... I don't know. I think the most harmful ones might be like x-rays and those rays more than infrared. I don't remember if infrared is close to them, or if it's on the opposite after the visible light spectrum. I forget that.

Interviewer: Yeah. It's like lower energy than x-rays.

Participant: Yeah. I'm assuming it's lower energy because it only has one photon in the video.

Interviewer: Yeah. How is the temperature? Is it continuing to increase, decrease, or is it stabilized?

Participant: It increased from the beginning of the video, but now it's kind of fluctuating. Decreasing and increasing.

Interviewer: All right. Let's go to the next screen. So the next model is sun on CO2. Okay, what do you see here?

Participant: Molecules of CO2 in the atmosphere, and then the sun.

Interviewer: What do you think will happen when we click play this time?

Participant: I think that the rays might come in, and when they're reflected back, they might have a harder time coming through these molecules, but maybe just ... I don't know. Maybe the infrared, no. The infrared won't have ... Maybe the infrared will have an easier time getting through than the normal sunlight, perhaps. I'm not sure.

Interviewer: Let's find out.

Participant: Or it won't penetrate in the first place. Not sure.

Interviewer: Okay, what do you see?

Participant: I don't actually know. Yeah, it's going directly through the CO2.

Interviewer: Anything else? If not, that's okay.

Participant: Yeah.

Interviewer: Yeah. So if you could summarize for me the interaction between sunlight and CO2, how would you summarize that?

Participant: It has no effect, essentially. Yeah, I think that the molecules of CO2 are completely permeable to something from what I'm seeing here in the video.

Interviewer: All right. Let's move on. Infrared on CO2. What do you see here?

Participant: The same molecules of CO2, but now the sun is not present. Yeah, I guess I'm thinking that maybe the infrared will have a harder time going out, or if it doesn't, then you agree with, maybe then you're proving to me that climate change is a hoax. I'm not sure. I'm not sure.

Interviewer: Let's see. Okay, what do you see?

Participant: I'm seeing that, yes, some are being reflected back, but many are being reflected out, just at different angles, and the CO2 molecules are gaining energy, I think. That's why they're moving a little bit faster. Not sure if that has an implication in terms of increasing the amount over time that will get reflected back. But essentially, you're increasing the temperature. The temperature, is that reflecting the molecules of CO2? Because I thought that the temperature got increased because of the photons of light, but is it just the heat from molecules getting accelerated that increases the temperature?

Interviewer: Yeah.

Participant: That's where mainstream media then messes you up, because my understanding, at least, is not at all molecules of CO2. Like the effect that molecules of CO2 have is just thickening the layer that the photons can get through, but what's actually increasing the temperature are the photons, like the photons coming back into the Earth, and they have energy, and they increase the energy, and not like CO2 molecules being increased, and they therefore, because they're being hit with infrared, they increase their thermal energy and increase the temperature.

Interviewer: Yeah, so I think you're, if I understand correctly, you're saying that you never really thought about the temperature of the actual CO2 molecules as being a contributing factor to the temperature of the Earth?

Participant: Exactly.

Interviewer: You were more thinking of the Earth, the temperature of the Earth, and actually, I think you're-

Participant: The photons of light, essentially, were the ones. Like the energy that they have, not the energy that they give off to molecules.

Interviewer: Oh, I see.

Participant: I thought that CO2 was just like a permeable, not a permeable barrier, but a non-permeable barrier for those photons, so the photons couldn't leave so it just got reflected back, and then reflected back until it released all of its energy onto the surface of the Earth.

Interviewer: Okay. So you thought that it was the photons being sticking around longer that contributed to the heat, and not the actual movement of the particles.

Participant: Yeah, exactly.

Interviewer: Okay, cool.

Participant: But is it both, or is it primarily the movement of molecules?

Interviewer: Well, I think we'll see on the next screen, but before we go, can you just summarize for me one more time what you see here, like with the process that's going on here?

Participant: Infrared photons are moving towards the atmosphere to leave Earth, and they hit CO2 molecules, and some of them get reflected sideways. Some of them get reflected backwards into Earth, and in the process, all the CO2 molecules are excited and the temperature increases like, what? A hundredfold? Tenfold, I don't know, from the bar. The bar is completely full, so yeah.

Interviewer: Yeah. All right, great. Let's go to the next screen. Okay, what do you see here?

Participant: The same as the first one, but now together with the CO2 molecules on the screen as well, so the atoms on the surface of the Earth in addition to the CO2 molecules in the atmosphere and the sun.

Interviewer: And what is your prediction of what will happen when we click the play button?

Participant: The atoms on the surface are already going to reflect less than were being reflected before, and those few that are reflected out are going to be reflected back in by the CO2 molecules as they increase in energy and increase in temperature.

Interviewer: When you say "they", are you talking about-

Participant: The CO2 molecules.

Interviewer: Okay. But you're saying that they're going to be reflected back, so you're talking about the CO2 molecules reflecting back?

Participant: No, no. The infrared, or the sunlight or infrared photons back into the Earth.

Interviewer: Okay. Let's find out. Okay, what do you see?

Participant: Yeah, it's kind of like all the processes and combinations where the sunlight comes in, but only infrared is being absorbed by CO2 molecules from what I'm seeing, and those infrareds are the ones that get reflected back into the Earth, and potentially those infrareds are the ones that increase temperatures dramatically. Yeah, and I think that slowly the molecules are gaining speed as they gain energy from the infrared molecules.

Interviewer: All right. And do you think that the temperature is going to continue to rise forever? Do you think it's pretty stable where it is?

Participant: No, I think it's dependent on the concentration of CO2 molecules, essentially. I think if you increase the amount of molecules, the temperature is going to increase. If you decrease the molecules, the temperature's going to decrease because then you're just going to have less photons being reflected back if there are less molecules and you have more photons reflected back if there are more molecules.

Interviewer: All right, great. So what did you think of the simulation?

Participant: I thought it was interesting, yeah.

Interviewer: Yeah, okay.

Participant: Like I said, I hadn't seen practically the effect of the molecules in the atmosphere and how they got excited. I had seen more just about the photons.

Interviewer: Oh, okay. Well, that's good. You know, you haven't seen everything that I showed you before today. So yeah, what you just described to me basically happening there is called the greenhouse effect, and this video is going to summarize basically everything you just told me, and you know, it ties it back to human impact. Okay. Hopefully the sound is on.

Video: You may have heard of global climate change, which is often called global warming.

Interviewer: I'm going to step out just for a second. I'll be right back.

Video: But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the Earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the US, and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works. First, here is how Earth's temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light, but because the Earth is cooler than the sun, it emits lower energy infrared light.

So Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

So how have humans changed things? Since the dawn of the industrial age around the year 1750, atmospheric carbon dioxide has increased by 40%, and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change.

Interviewer: All right.

Video: Please-

Interviewer: Okay. What are your impressions?

Participant: The first one completely goes in line with what we've been talking. It's ridiculous that even myself that ... Well, thankfully, none of the stuff that I've done in science here has been around climate change because I'd be embarrassed if I didn't know it, but the fact that I've been fed, since eighth grade, and I did not ... Even though it's not like, obviously I had gotten the logic of what climate change was, but essentially, no, because when it comes down to the molecular and the chemical effect of what is actually going on, so you have a better grasp on what you can actually do to avoid the problem, I didn't know it.

And I'm a person that is actually trying to be a neuroscientist. Like I'm going to graduate here with a bachelor's degree in a form of science, and to think that I was affected by that mainstream media things just shocks me to think, like I'm a very fortunate individual to be studying at USC. The majority of the people in the world don't have access to this amount of education, and if I'm fooled by that, what is this ... You know what I mean? What about the people that are still taught the rudimentary beliefs of life, you know what I mean? It's completely understandable why half of, many, I don't know if it's half of this country, but so many people think climate change is a hoax. If you just have people that aren't necessarily, like don't have access to so much knowledge, and you have a bunch of systems that are made to manipulate people, you're going to succeed in manipulating them. You're going to win.

It's especially because people are just numb. Like people go to their phones nowadays because it's an addiction. It releases dopamine when you look at your phone. When you maybe have a message, when you maybe have this, it releases dopamine. So it's not about what you're seeing, it's about the effect that you're getting. So you're just literally, you wake up, and you go to get the addiction just like an addict would have a cigarette, and now you're just getting your daily dopamine release through filtering through Facebook and whatever is coming in, you're just eating that and accepting that. "Oh, fuck, it's heating. Oh, Donald Trump released a bomb. Oh, shit." You know what I mean? It's overwhelming. It's overwhelming. And you buffer through what actually matters.

And from at least what I've seen in this video, the biggest thing that an individual can do to actually create change is reduce the amount of meat they consume because methane is obviously creating a harsher impact than CO2, although CO2 is creating a major impact, but at the end of the day, to have all of this, we need CO2. Methane is coming from a little bit of the gases that you're burning, yeah, but mostly from the production of meat and the production of cows and stuff like that, and those are literally the worst waste of user resources. You use a ridiculous amount of land, a ridiculous amount of water, and release a ridiculous amount of gases into the atmosphere.

Literally, if we, for example, still had the cars that we had, and burned the factories that we had, but we ate meat once a day and went ... I'm not saying even becoming a vegetarInterviewer, but switching to fish or chicken for eating meet once a week, you've

drastically made an impact, more than you have lying to yourself that turning off your shower is going to make a difference, or driving an electric car. If you actually want to make a significant impact, and improve your health as well by doing that. Especially because now most of the cows that we're getting our meat anyways are fed corn. They're not even eating grass anymore because there isn't more grass in the Amazon. Yeah, I don't know.

Yeah, I just think that is stupid, especially because trees absorb CO2, like if you have a lot of trees ... Of course CO2 is an issue, but CO2 is obviously not the forefront of the issue. I genuinely believe it's methane because the methane, what happens is the more you release methane, the more you reduce those trees that were going to consume CO2 in the first place because you're cutting them out to make way for these cows to use all the land to just live day by day. So I just think that, yeah, I don't know, essentially, obviously, CO2 has a huge impact, but it's alarming that we're putting all of our eggs in one basket. We're just feeding everybody this idea of clean energy, and wind, and solar, and this and that, and we're not talking about what actually matters, which is, "Dude. Stop stuffing your face with meat every day." You know what I mean?

Interviewer: So you think, obviously, that normal people have a responsibility in trying to make a difference as far as greenhouse gases go. Do you personally do things in order to-

Participant: So I absolutely do think people have a responsibility, and myself included. Unfortunately, right now in college, I don't practically do it because I basically live in a fraternity, and I pay dues, and the dues include meals, and I don't want to pay extra to ... You know what I mean? So I'm literally just eating foods to keep me alive. It's not even a diet that I would want to eat because a proper diet for myself in terms of science would be very different than what I'm eating now, and it's definitely something that as soon as I graduate, and that I'm buying my own food, cooking my own food, and living my own life, I'll essentially do. But now it's just tough because I want to do it, but I don't want to spend double the money to be paying for six meals a day instead of three, which I'm already paying for because that's the only way. I kind of just pay for housing and meals all in one together.

But yeah, I do think ... I just find it funny. Alongside that, think about the amount of people, the amount of eco-friendly people that'll give hunters, like people that hunt, so much shit about it. Like, "Oh, you're cruel. You're this, this, and that," when in reality, the people the pay these habitats for these animals to live amazing lives because they don't even have prey anymore. It's not like they're living in the wild. It's even better than the wild. You're being able to have deer multiply by the thousands because there's nobody to eat them, only hunters to kill them, and these people are literally paying ridiculous amount of taxes and taxes on weaponry to hunt, and the tickets to go there and hunt, to maintain all this habitat.

They're going there for a week, they're killing one animal, which provides them food for literally six months worth of meat, and there is a respect, like if you know a little bit about hunting, you'll know that these people aren't just going there and shooting randomly. Especially like bow hunting. Like you only kill an animal with a bow if you have a clean shot that you know you're going to get them in the first, and you're not

going to make the animal suffer. There is an etiquette to that sense and all those things. And you have people saying, "Oh, that's cruel. That's animal cruelty." And then they'll just go and get a fucking cheeseburger at McDonald's, when they're having a much greater impact, a much greater impact, because they're fueling an economy that is a bunch of disgusting politicInterviewers that are force feeding cows corn and making a bunch of money.

Like that's so much worse than the dude that just goes into the wild, respecting nature, with a bow and arrow, and kills another animal. Sorry, that's a fact. Life eats life. That's just the laws of things. We're at the top of the food chain. Yes, we have more skills to kill life than other life, but to think that ... I don't know. People think that just because you're not killing it, you're not the one that's pushing the heroin, killing the cow, that the cow that you're eating from the meat that you get in your grocery store is better. It's more humanitarInterviewer when it's not. It's actually legitimately worse. I don't know.

Interviewer: So do you think in the future ... So you said that you're eating the meals that are provided for you at the fraternity that you're at, right? But that you might change your diet in the future. Do you think you would go vegetarInterviewer?

Participant: Oh, no. Not vegetarInterviewer because again, vegetarInterviewer is to lie to yourself and say that life doesn't eat life. Are you kidding me? Of course it does. That's just the laws of nature. And that doesn't mean, again, I respect animals. It doesn't mean I'm going to torture animals. I love animals, but we need to be aware that life eats life, but no, I'm going to eat animals at a much lesser extent. Like I'm going to have a diet that's a lot more established on healthy fats, and vegetables, and moderate amounts of protein, and protein especially from vegetables and from other good sources, and then some meat, chicken, fish, but at a lesser amount. Especially because if you think about it, like how our biology evolved, like this idea that we're having three meals a day, our body wasn't made to have three meals a day, and that's why ... I don't know. This goes onto topics like healthcare for everyone and stuff like that.

I totally believe everyone should have free healthcare, but I also don't think ... Like I don't mind paying taxes if you get in an accident or anything like that, so that my taxes go to help you if you don't have the money to pay for that. Absolutely. But if you choose to fucking stuff your face with donuts and Skittles every day, which is 60% to 70% of how Americans are dying. It's like high sodium diets. If you made those choices, because it's your choice not to exercise. And again, nowadays, unfortunately, we completely screwed the people that have less money in the world because we make them, like not only are they working shittier jobs that they have less time to potentially go home, and cook, and have nice meals, but you're making the avenues much easier for them to just go to McDonald's and get a cheeseburger than to actually make a proper meal, and I agree that that's a problem.

Basically you need to make a world in which, for the rich guy to get his proper meal is the same level of difficult and strain than for the person to get their meal, and once that's established, again, if we have those equal opportunities, essentially. Once that's established, if you opt to just eat shit, I don't think my taxes should be going to pay for your healthcare because it shouldn't. It should go to the person that needs it more, that

it was an honest problem, like that's the thing that ... People want cures for everything. They don't realize that you can do so much more by preventing things. Like yeah, if we create a bunch of medicine and stuff like that to cure or at least treat a lot of these diseases, yeah maybe you'll improve 10 years of your lifespan, but had you prevented those, you would have lived another 30. It's that level.

Especially because if you're consuming fats, for example, fats don't go through your digestive track. They don't release insulin. What happens nowadays is that we have this idea that we should rely on proteins and carbohydrates, and that we should have three meals a day. But what happens? You wake up in the morning, 8:00 a.m., have some form of carbohydrate. Boom, spike your insulin level. Of course you're going to be hungry by 12:00, 12:30 because your insulin levels are going to crash, and then you're going to be jittery and you need food, you need food. Going to have another piece of carbohydrate during lunch. Spike your insulin all over again, and the same process to dinner. What happened? Throughout your entire day, you've left your insulin completely spiked. This increases inflammation. Inflammation leads to Alzheimer's and other neurological diseases. It increases your blood pressure and your cholesterol levels, all these things.

The one thing that science has found that improves longevity is actually the restriction of caloric intake, which makes total sense. Think about how we evolved as human beings. You wake up in the morning, you might have some nuts around, some good fats, some stuff that the gatherers got, but you're a hunter. You're going to spend your entire day looking for food, and then you're going to have to have energy at the end of the afternoon to run and to hunt that food, and then you're going to have that one big meal once in your day. And who evolves? The smarter people that can find food.

So it has been shown also that when you're in the states of, not glycogen-fueled states, but deprived and that your body is working or using fats for fuel, you improve cognitive processes. Your brain works faster. Essentially, you're sharper. So it's like essentially how your body is made to work. It's just like a car. If you put this amount of fuel, it'll last you 50 years. If you put this, it'll last 20 because it's not made to run off of that, and essentially, I don't know, that's the big issue. I don't know.

And then people start having psychological disorders. You have crazy people. All this is, is people eating ... People don't understand that when you eat, it's energy, right? And if you don't release that energy, it's going to start fucking with your brain. There's no way around it. There needs to be the in and the out, and you need to establish that homeostasis in your life. Not only in your body, but in your life, in everything. Think about the people that are just stuffing their faces with horrible foods, like very high in calories, and sodium especially, and then they're having sedentary lifestyles. Not only is that horrible for your body, but your brain is no longer functioning how it should be. And that increases your chances of anxiety, depression, other issues. That increases even your chances of being a mass murderer and buying a gun and going ...

And that's the problem. What do we do as a society? Instead of focusing on the real problems, we say, "Oh, we should ban guns. That's the move." That's not the move. That's not the move. That's just putting it under the rug. That's just putting actual

problems under the rug. How do you improve things? It's on education and on ... I don't know. There's a billion things that I can go on and on about this, like even sexual assault on college campuses. Sexual assault on college campuses happens because of the 21 drinking age. Of course, that's not the sole reason, but binge drinking culture here is to a degree of no other place in the world, and the sole reason for that is because of the 21 years of age, because you put so much focus on that.

It's like a child. If you take the child's toy out, the only thing that the child wants to do is get the toy back. What is the only thing that an American wants to do when they turn 21 in the country? The sole thing because that's the sole thing that matters, and it becomes more important than getting your driver's license. When I was 18, I remember I loved a bunch of things, and yes, drinking was a part of it. When I turned in my country, that's the legal age, but it was one part of a bunch of other things. Now I could drive. Now I could vote. It's a series of things. And not only that, it was always a more chill society in terms of alcohol.

So if I'm in a restaurant with my parents, if they say it's fine, I can have a glass of wine. It's not like here. The restaurant's going to say, "No, we're not going to serve you if you're with your parents." And what happens? It creates maturity. It gives you the ability to understand these things, and what happens in the US? You have this 21 drinking age, so nobody's realistically properly drinking, let's say, before they come to college. That's when they actually start drinking, even if they're not 21. That's when they actually start drinking a lot, and what happens is you go from a place, which was your beautiful high school with all your high school friends, which have known you for your entire life with your family, everybody who cares about you. You're around a pool of people that genuinely, if something happens, are going to take care of you when you should be, perhaps having an experience where you drank a little bit too much, because that's part of life. That will happen.

But instead, no. You're told that you're not supposed to do that, so people ship you off to college where you're just another number, and that's when you start experimenting with that, and guess what? You're going to have that bad experience one night that you drank too much because everybody does. It's just if you're drinking, that's prone to happen at some point, especially if you have a culture of binge drinking. Then what happens? You have two people in the scenario, which maybe don't have that much experience with alcohol, and are having their first understanding of how to, I guess, be drunk, and now, they're having sexual relations with each other and the consent has gone out the window. Know what I mean?

It's a combination of things also, but essentially, that's one of the bigger motives, and it frustrates me that this discussion isn't being had. It also puts more lives at risk because, for example, if anything happens in somebody's house, or a fraternity or anything like that, and it involves minors, you're a lot less likely to call anybody, call police, call DPS, call anybody to help because you're going to get screwed because you're a minor in possession of alcohol. How is that protecting the well-being of everyone? Listen, there was actually, I think it might have been in Texas, or some university, but this actually happened. I don't know if it was one of the fraternity guys, or a girl that was there, but basically, the person there had too much to drink, was intoxicated, but the person was

in their fraternity, and they couldn't call the DPS because they knew that the university would completely screw them over, like basically remove their fraternity from the school if they reported it because they're minors in possession of alcohol.

How the hell is that our systems of laws? Our laws should protect our citizens and not create things that punish them if they're honest. You know what I mean? Like everybody's going to make a mistake. Come on. Are you kidding me? How are you going to create a law that punishes people for reporting and saving somebody's life if they're a minor drinking an alcohol if there are minors drinking alcohol every day? Come on. Aren't people aware that everybody in the school has a fake? You know what I mean? Do you have to be in the [inaudible 01:05:37] to be aware of that? No. Everybody knows. Everybody knows that you're going to drink anyways, and even if you don't have a fake, you'll get a friend to buy you alcohol. It doesn't change you're doing or you're not doing the drug. What changes is, in the eyes of the law, and in the eyes of the things that should be protecting our citizens is just creating a maze that you don't want to enter because you're going to get screwed in the end, and you're going to let that person die, which is what happened in Texas. The kid died of [inaudible 01:06:08] intoxication. You know what I mean?

Interviewer: Wow.

Participant: Anyways, I don't know what I'm talking about anymore.

Interviewer: No, no. This is great. I'm learning probably more than you are. But what I want to know is, so over the course of the time that we've been sitting here, has your mind changed about anything in regards to climate change, or do you feel like you're about the same? And if so, if something changed, what was it?

Participant: No, I mean, not really because I definitely believe climate change exists, and is a thing, and is a problem. I enjoyed learning, getting a better grasp of the actual implications are the molecules in the atmosphere and not just the photons of light. But I don't know. I'm still kind of worried because, again, obviously this wasn't the purpose of this video, but this video, for example, which is a lot of what you would potentially find on the internet, doesn't give you a, "Hey, this is the steps that you can take to help solve this problem." It doesn't. It just tell you that there's a problem, period. And you're going to hear that there's a problem.

Of course there's a problem, but what does it matter for me to know that there's a problem? The problem's still going to be there. It's not going to disappear, and I feel that more and more, again, we don't have the actual, we don't have one good place to know how you're actually supposed to tackle it. Even the videos that tell you how to solve this problem, "We're going to tell you a bunch of different things." Yeah, I don't know. I think that we're in very interesting times. I think that society is entering ... I don't know, man. I don't know.

I think in the next 50 to 100 years, we're either going to improve the world dramatically and completely shift our understanding of what it is to live a human life, what it is,

because at the end of the day, you don't want to live a human life in terms of what we created to be a human life. You want to live it as factually how you can maximize everybody's well-being. That's all you want to do. You want to be the happiest you can be, and right now we have these illusions of how to achieve those happinesses, but they're not truthful. Like wealth and money, so many people associate that with happiness, but factually, it doesn't. There's so many other things that are the actual genuine process of happiness, which essentially are what all other animals do. Valuable connections with other human beings.

Like people that are addicts, for example, I love the [inaudible 01:08:59] like, "Oh, drugs are addictive. Drugs should be illegal because they're addictive." No, people. The drug isn't the problem. The problem is the person, how the person is. If that person has issues, she's going to go to the drugs as an escape to solve those issues, but it's not the drug that is causing those issues. It's just the option, like the person may be depressed and doesn't have meaningful relations, has troubles with their parents. There's a variety of reasons, but we need to understand it and understand how the human brain works, whether you can better treat all these situations.

But yeah, I think either we're going to create an amazing world in which we take all these things into account, or the machines are just going to destroy us. Or we're going to destroy ourselves, to be honest. All it takes is a couple nuclear bombs. We might do it this weekend. I don't know how things are going with North Korea. It's crazy. That's all it takes nowadays. You don't even need AI anymore. Three nuclear bombs on each side, you create an ice age, and we're done.

Interviewer: Well, I feel you. Like the tension is in the air right now more than ever. One last thing, so could you re-describe to me how the process of global warming works?

Participant: So basically, sunlight comes in through the atmosphere, and they go through the CO2 and the methane molecules, which don't absorb sunlight. They get reflected from the surface of the earth, and what usually gets reflected is infrared, which is what the molecules or the atoms on the surface of the Earth don't absorb. Those get reflected back to the surface, or not to the surface, to the sky, and the CO2 molecules and the methane molecules that are in the atmosphere absorb all those infrared photons, and that increases their thermal energy, so they start to move a lot more, and that overall just increases the temperature of the Earth's atmosphere.

Interviewer: All right, great. That's it. Thank you so much.

Participant: Thank you very much.

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Interviewer: But it'll be confidential so your name won't be attached to anything that's recorded and we're gonna transcribe it and then delete the audio later, so your voice won't even be associated with the interview.

Participant: Okay.

Interviewer: Yeah. Let me know if you feel uncomfortable at any time and we can stop the interview.

Participant: Okay. Sounds good.

Interviewer: All right. Let's just, before we start, tell me everything you know about climate change, or global warming.

Participant: Yeah, I was wondering. I know a little bit. Like pollution is, like everything we let out into the atmosphere goes up there, kinda traps in the heat that comes from the sun and the more pollution there is, the less the heat can bounce back out. The more pollution we have the more heat and then overall the temperature in the world raises. Pretty much all I know.

Interviewer: Okay. Do you believe that it's true, do you believe that it's happening?

Participant: Oh yeah.

Interviewer: Yeah. Who does it affect?

Participant: Everybody. Us, the environment, animals, I think it will have political effects, as our resources start depleting. It's gonna lead to more conflict throughout the world, [inaudible 00:01:25] or more fighting for these depleting resources.

Interviewer: All right. Thank you. Let me think, did I ask all my questions? I did. All right, let's look at the simulation now. That was just to get a background information about what you know. Here's the simulation, what do you see here? On the screen.

Participant: I see a blue sky and then the ground and then just the sun right there.

Interviewer: All right. Anything else? Do you notice the other parts of the simulation. The buttons and thing that you can click?

Participant: Oh, like these options right here? Well yeah, I didn't know that was what we're looking at.

Interviewer: Oh yeah, that's okay.

Participant: But I guess the options. There's a little, like a legend where it shows the sun and infrared.

Interviewer: Do you see the temperature gauge on the side?

Participant: Yeah. [inaudible 00:02:34]

Interviewer: All right, great. What do you think will happen when we click that play button at the bottom, wild guess.

Participant: I assume it's gonna start having sunlight coming out of the sun and infrared radiation hitting the Earth, and as more comes in the temperature gauge is gonna rise up.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: I see sunlight hitting the earth and some of it bouncing back, infrared radiation bouncing backwards also. Just a lot of movement of the heat going into the earth and coming back up. Temperature rising. It looks like it kind of plateaued for a little. It's going back up, more heat is coming in. The heat is just constantly moving back and forth, the temperature seems to have plateaued again.

Interviewer: Great.

Participant: Just a lot of heat moving around.

Interviewer: When you say a lot of heat moving around, what particularly are you talking about on the screen?

Participant: The heat is coming up from the sun, going down to, I assume those little brown circles are supposed to be the earth. As they hit, some of it bounces back, some of it looks like it's gonna move forward, because it's just going into, but then a lot of it is bouncing back, so.

Interviewer: Right, and you mentioned that there's infrared coming from the ground, right?

Participant: Yeah.

Interviewer: Is there any infrared coming from the sun?

Participant: Not that I can see. At least from this model. I'm assuming it comes from the sun as well.

Interviewer: Yeah, it actually turns out that the sunlight has infrared in it as well as all other types of light, but yeah. Good assumption. If you could just one more time for me, summarize the process that we're seeing on the screen right now?

Participant: We're seeing the sun releasing heat in the form of sunlight and infrared light. It's going into the earth. Some of it gets absorbed and a lot of it gets bounced back at first. As

more heat was coming in, we saw the temperature rising, it plateaued for a bit, then we had more heat coming in and then it rolls up again and it seems to be staying now. Now the heat seems to be slowing.

Interviewer: All right, great. Let's go to the next model. On the left you'll see there's a button that says sun on CO2. Yeah, good. Okay, what do you see here?

Participant: I see little green balls, I'm assuming it's gonna be the CO2 molecules. the sunlight and it's all sky, there's no ground in this model.

Interviewer: Okay, what do you think will happen when we click the play button?

Participant: The sun is gonna release heat again and prevent, it's gonna go all over the place. I think the CO2 is gonna have it bounce around just the same as it did on the ground.

Interviewer: Okay.

Participant: It will keep on going everywhere.

Interviewer: Okay, let's find out. What do you see?

Participant: I see sunlight going outwards, and the CO2 molecules just moving freely around. Doesn't seem to be bouncing and anything else. Just sunlight and CO2 freely moving throughout the sky.

Interviewer: Okay, if you could summarize for me the interaction between sunlight and CO2, how would you do that?

Participant: I don't know, it doesn't seem like, it's just, they're kinda just floating around. I don't really see anything in particular.

Interviewer: So no interaction? They're just passing through?

Participant: Yeah. I guess nothing is being reflected back out, like when it hits the ground. I guess that would account for the greenhouse effect, because there's no bouncing back outwards.

Interviewer: Oh, I see. So you're saying that there's no greenhouse effect here, because there's no bouncing back, or there is?

Participant: I think there is the greenhouse effect. An effect that it's, like when the hit the ground, the heat was bouncing back out. But when it hits the carbon dioxide, it doesn't bounce back out. It might be just, as it goes through, it'll keep it inside.

Interviewer: Interesting. All right, let's go to the next screen. Infrared on CO2. What do you see here?

Participant: Just carbon dioxide molecules in the air. I don't see the sunlight.

Interviewer: What do you think will happen when we click play this time?

Participant: Probably much the same as the sunlight, just the infrared light traveling downwards, I guess, which will I mean, just come from the sun. The CO2 molecules are gonna run freely again.

Interviewer: Okay. Let's find out. Okay, what do you see?

Participant: I see the infrared coming downwards, out into, towards the CO2. The temperature is rising. Some of the CO2 molecules turn yellow as infrared is hitting them. Then it sends the infrared light in different directions. Some of them are going back down, some of them, they're getting skewed off to the right or left, heat's rising pretty rapidly and it's decreasing. Now it's increasing again. As it hits the molecules, it looks like the more it hits these molecules, the higher the temperature rises. Meaning it's supposed to trap in heat inside. The heat would be from the infrared and not directly from the sunlight, I guess. The temperature has almost topped off, as activity increases between the infrared and the CO2 molecules. It just kinda goes with how active the infrared and the CO2, the more active it is, the temperature increases, and as it has less impact, it'll decrease and now it's full.

Interviewer: So when you're saying the more active it is ...

Participant: The more the infrared impacts the CO2, it looks like it's causing the heat from the infrared light to come back down to, what I assume is earth and cause the temperature to increase.

Interviewer: Well, all right. Great, if you could just summarize it for me one last time, what we're looking at here.

Participant: Infrared light is being bounced back upwards towards the CO2 molecules. As infrared light travels, if it doesn't hit the CO2 molecules, it looks like the temperature stays constant. But as it starts having more contact with the CO2 molecules it gets bounced back downwards or sideways. Obviously the more it gets bounced down, the heat rises along with it.

Interviewer: All right. Great, let's go to the next screen. Okay, what do you see here?

Participant: I see the sun shining, the CO2 molecules in the air and the ground. Temperature gauge.

Interviewer: What do you think will happen when we click play this time?

Participant: Then we're gonna see sunlight coming out down towards the ground. It will obviously, the sunlight hasn't been bounced out, it doesn't bounce against the CO2. It will hit the ground, but as that happens, the infrared light that comes out of it is gonna come back up and as it starts hitting the CO2 molecules, the temperature is gonna increase.

Interviewer: All right, and you said, as the infrared comes out of it, what did you mean by it?

Participant: Like when the sunlight hits the ground, like we saw on the sun and ground model. Infrared light was coming back out. I thought it was from the earth, but I guess it's from the sun, but it's being bounced back, right?

Interviewer: Yeah. Great, let's, yeah, that's right. Let's click the play button and see what happens. Okay, what do you see?

Participant: sunlight coming in, and the infrared light bouncing out from the earth, temperature is rising, there's a lot more infrared impacting CO2, so the temperature is rising pretty steadily right now. There's a lot of movement. The impact between the infrared hitting the earth and bouncing ... The infrared light is bouncing from earth back to the CO2 molecules and back down, so it's pretty active. The temperature is rising still, and the sunlight is just moving freely throughout. The CO2 molecules are moving around, they're impacting more and more with the infrared light. The temperature continues to rise.

Interviewer: Right, why does the temperature rise?

Participant: Because the infrared light bounces from, between the earth and the CO2 molecule, causes the heat that it has to be trapped inside, instead of bouncing out towards the atmosphere, or outwards, away from the planet.

Interviewer: All right. How does the temperature on this screen compare to that of the first screen, when there was no CO2?

Participant: It's a lot higher. It's in like, one, two, three, four, five, it has six box increments, I don't think in the first one it completely filled the second box. This time it was past the second box. It's steadily going, well, it's not going up anymore. It's about halfway through the third temperature box.

Interviewer: If we were to double the amount of CO2 that's on the screen here, what do you think would happen?

Participant: A lot more infrared light would be trapped inside, causing the drastic increase in temperature, because, there's gonna happen a lot more impact with the infrared light, so it's gonna keep that trapped inside more.

Interviewer: All right, great. Okay. How does this compare to your previous understanding of the greenhouse effect, that you explained to me?

Participant: I guess I can see the heat coming out from infrared light, not directly from the sunlight, but from the infrared light hitting the CO2. I guess some of the heat still gets out, obviously.

Interviewer: Right. So yeah, this whole process that you just described to me here. This is called the greenhouse effect, which is the main physical mechanism for causing global warming. That most scientists attribute to causing the Earth's temperature to rise. Now I'm gonna

play you a short little film, to summarize everything we looked at here. Then I'm gonna follow up with some more questions.

Participant: Okay.

Interviewer: Three minutes.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think that Earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in The US and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how Earth temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But because the Earth is colder than the sun, it emits lower energy infrared light. Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed any minute by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degree Fahrenheit cooler, which is well below the freezing point for ice. How have humans changed things?

Since the dawn of the industrial age, around the year 1750, atmosphere carbon dioxide has increased by 40%. Methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase. Thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay, so what do you think?

Participant: Pretty interesting, really informative. I'm gonna guess from what I saw, earlier I said that the sunlight was [inaudible 00:17:42] infrared. I'm guessing from this, I'm getting that the infrared is coming from the Earth, but I guess that it absorbs the sunlight and then it emits the infrared light out. Well, I guess now it doesn't trap the daylight, the sunlight but it absorbs the infrared light. I also understand from what I saw during the little models.

Interviewer: Great. So do you think that was what ... Oh yeah, you basically said that, everything else basically fit your understanding, if I'm ...

Participant: Yes.

Interviewer: Okay. What are your, I'm gonna talk about, changing gears a little bit. What are your feelings and thoughts about global warming in general?

Participant: It's dangerous and it needs to be looked at by everybody, seriously. We need to find solutions to it, I guess, I mean I'm not really up to date to what's going on with it. I know there's a lot of climate change [inaudible 00:18:57]. PoliticInterviewers, Trump and stuff like that. I think they just, I don't know, but like it frustrates me when I hear people trying to deny it. It's like, how do you deny something with so much evidence? It's not just one person or two people. There's so many scientists that have been studying this for years and they keep bringing the evidence, and then just like, oh, it's just some kind of agenda. Really? I don't know.

Interviewer: You think then the evidence, which is based on the science that we were talking about. The greenhouse effect. Do you think that's a relevant aspect of the political stuff that's going on with global warming?

Participant: I'm not sure I understand.

Interviewer: You're saying that there's so much evidence, right?

Participant: Yes.

Interviewer: That evidence is, is that evidence you think scientific evidence, or do you think it's some other kind of evidence?

Participant: I think there's a lot of scientific evidence. I haven't really looked at everything, I haven't looked at [inaudible 00:20:13]. But I for sure look up the research, like scholarly articles, [inaudible 00:20:19], stuff like that. You'll find plenty of evidence. Some politicInterviewers are discarding it, they're like, oh, nonsense.

Interviewer: Mm-hmm (affirmative). And you believe the evidence?

Participant: Yes.

Interviewer: Right.

Participant: I mean, the experts versus somebody not even bothering to look at it. It's like, yeah, I'm gonna go with the evidence.

Interviewer: Do you think then, you're saying that there are people that are skeptical of the science, and they debate it on TV and things like that. What do you think about that?

Participant: It's frustrating. Seeing, I mean, I guess everybody's entitled to their own opinion, but this isn't really a matter of opinion, it's a scientific fact. Then they're spreading this out to other people. They're like, oh, they're just trying to push an agenda, then others believe it and they just take it all in. There's must more people spreading this misinformation that global warming is a hoax or whatever they're saying. It's just, and then it impedes more progress, because then as more people think it's fake, being like, oh, why are we even bothering to fund this research and stuff like that. Or like why, it's natural, the temperature changes all the time. Yeah, because, but our pollution is speeding it up or making it go way above what it's supposed to. It's like, we gotta do something about it. But the more people start believing that it's fake, the less we're gonna be overall willing to do anything about it.

Interviewer: Mm-hmm (affirmative). I agree. Actually, I shouldn't say that. Do you think, okay. Then it sounds like you think that most people, normal people should be doing something about this. That normal people, not just scientists and not just politicInterviewers, but everyone should be involved in this?

Participant: Yes. I mean, I know maybe most normal people can't really contribute to the scientific aspect, but in terms of putting pressure on politicInterviewers, to like, hey, don't let the government de-fund research for this. Or some kind of support somehow, like the political pressure, putting it on your representatives. Reaching out to them, why are you gonna keep letting, like false statements about this thing with all this evidence just keep spreading and [inaudible 00:22:59]. We should do something. Also, obviously the things we are capable of doing, like cutting back on our consumption of gasoline and whatever other things that cause global warming.

Like walking short distance instead of driving. Like if you want to go to the corner store, you should walk instead of, or bike, I mean it's better for us, individually for our health, obviously, and overall for the environment, because we're not using it when we don't need it. Making more decisions that kinda help reduce the pollution we produce.

Interviewer: Mm-hmm (affirmative). Do you feel connected to this problem of global warming?

Participant: Connected how?

Interviewer: Do you feel like you, I guess your actions kind of reflect a global consciousness or something like that?

Participant: Honestly, I don't think so. Before today, I probably, like I said, it does frustrate me when people try to say, oh, it's fake, it's fake. You didn't like pay attention in science class or something. But like for, thinking about it, I actually don't really, like I said, we probably should put pressure on the politicInterviewers, I don't do any of that. That's just something that came to me right now, that we could do something. I do try to walk and bike short distances, rather than, but I'm a commuter, so I commute here. But other places where I don't need to be driving, yeah. I try to, I do avoid it. If it's like a long distance, but I'm not short on time, I'll bike. Little things like that.

Interviewer: That's okay.

Participant: Nothing too actively involved in anything.

Interviewer: Right now is a good time to bike, I mean, the weather is nice.

Participant: Yeah, it's really nice.

Interviewer: Give it a couple of months, it's gonna be so hot. Okay, over the course of the 30 minutes that we've been sitting here or however long it's been. Has your mind changed about anything in particular?

Participant: Like I said, I'm thinking of ways to attack the problem. Not just from individuals but as a collective effort to reach out to our politicInterviewers, I think it would be a good thing. Rather than just letting them decide, because they're supposed to represent our views. If they have this issue where they're gonna be fund, climate research, climate change and stuff like that. Nobody speaks out against it, they're gonna go through with it. Because they're like, well, they don't care. They'll do it, they're not gonna, I'm not gonna lose their vote, because I don't care. Whereas if we put all this pressure on them, we're like no, they're gonna know. If I'm going against all of them, they're not gonna vote me back in. That's how we have leverage over them, I guess. It's what they're supposed to do. But yeah, I think that's my new idea, that just kinda formed.

Interviewer: All right, that's great.

Participant: [crosstalk 00:26:28] kinda weird.

Interviewer: That's great, that makes me happy. If someone would ask you, why is the global temperature rising, what would you say?

Participant: Our dependence on fossil fuels.

Interviewer: Oh, okay.

Participant: [inaudible 00:26:46], I'm not sure there's actual evidence besides the three minute video, but sorry.

Interviewer: It's okay.

Participant: It's multiplied so much since industrial revolution. What's different between, before the industrial revolution and after. It's like our dependence on fossil fuels. Whether it's coal, or oil and all that. We're just burning it and burning it and burning it and it's releasing all these gases that we know are trapping the heat.

Interviewer: How does that work again?

Participant: Oh, from the sunlight, from the sun ...

Interviewer: Yeah.

Participant: It goes into the earth, it moves through the greenhouse gases. The earth releases infrared gas, when it contacts the greenhouse gas molecules, it gets trapped in. The more it hits those molecules, the longer it stays with us.

Interviewer: Great. Thank you so much. Do you hae any questions for me?

Participant: No.

Interviewer: All right. Okay, thank you so much.

Participant: Thank you. [crosstalk 00:27:53]

Interviewer: I appreciate your time. Oh, that's good, I'm glad you ...

PARTICIPANT 13

Interviewer: To start, let me ask you, before we look at the simulation, tell me everything you know about climate change.

Participant: I know that it involves the pollutions in the air coming from carbon and other greenhouse gases from that and interacting somewhat with the ozone layer, I think. I believe, maybe? And then that allows more UV light in from the sun. And that leads to global warming by more UV light, I'm guessing, makes it hotter.

Interviewer: Okay. Anything else?

Participant: Not really, no.

Interviewer: And how do you feel about ... What are your thoughts and feelings about global warming and climate change, more broadly?

Participant: Broadly ... I honestly haven't noticed too much firsthand, so all of my opinions are based on media representation, so I'd say negative, but not super negative because I haven't actually been impacted myself on a personal level.

Interviewer: And by negative, you mean, you view the ... Can you tell me more about what you mean by negative?

Participant: For the preservation of the earth. I want that. Yeah, that's generally a good thing. But just keeping air quality and the ecosystem and preserving our ecosystem.

Interviewer: So then by negative, you mean you don't like it. You don't like global warming. It's something that you want to stop.

Participant: Yeah.

Interviewer: Okay. And yeah. So, you said that most of what you know is based on the media.

Participant: And high school earth science class and media, yeah.

Interviewer: Okay, okay. All right. Well, let's look at the simulation. First I have to turn on the computer. That usually helps. Okay. So here's the simulation. What do you see here?

Participant: I see sun in the top right corner, a bunch of brown balls on the bottom, temperature meter on the right, and some selections or options to click on, I think?

Interviewer: Yeah. And what do you think the brown spheres on the bottom are supposed to represent?

Participant: Soil?

Interviewer: Yeah, yeah. It's the ground, basically. Okay. What do you think will happen when we click the play button that's at the bottom of the screen?

Participant: Show rays coming from the sun and then a reaction from the earth, maybe, and then temperature going to something?

Interviewer: Okay. Let's find out. All right. What do you see?

Participant: I see sunlight coming down diagonally and some of the earth balls are lighting up yellow and some smaller rays, it appears to be infrared rays, are bouncing off, as well as some of the sunlight rays are bouncing off.

Interviewer: All right. And where are the infrared rays coming from?

Participant: They're coming from the earth.

Interviewer: Mm-hmm (affirmative). All right. So, if you could just summarize for me one more time, what's the process or the interactions that go on between the sun and the ground.

Participant: So, the sunlight is hitting the ground, some is being bounced back, and some is being turned into infrared rays and also being sent back.

Interviewer: And earlier, you mentioned that something would happen with the temperature.

Participant: And the temperature is about a bar and a half.

Interviewer: Okay. All right. Great. Let's go to the next model. So on the left, you see it's a sun on CO2.

Participant: Should we hit pause?

Interviewer: It doesn't matter.

Participant: Okay, because I don't see it.

Interviewer: Yup. Okay. What do you see here?

Participant: Sun in the top right and then all over the screen are a bunch of green balls.

Interviewer: Yup. And what do you think the green balls represent?

Participant: The atmosphere?

Interviewer: Yeah, yeah. Molecules in the atmosphere, particularly CO2. And the reason why they're green is because they're supposed to represent greenhouse gases. So it's one of many

types of greenhouse gases. Okay. What do you think will happen when we click play this time?

Participant: Maybe the sunlight will just go through it and not bounce back?

Interviewer: Oh? Interesting. All right. Let's find out. Okay. What do you see?

Participant: The sunlight is going through, not being affected and the greenhouse gases are moving around.

Interviewer: Mm-hmm (affirmative). So just like you predicted. Did you know that this would happen from prior experiences or class or anything like that?

Participant: No. I just intuited that I didn't think they would be bounced back because then it goes against the intuition of global warming, so more CO2 would probably not affect sunlight's reflectibility.

Interviewer: Okay. Interesting. Cool. Could you just summarize for me, one more time, what we're looking at here.

Participant: Sure. The sunlight is going through the greenhouse gases, being unaffected. Temperature is at a bar, and the greenhouse gases are just moving around slightly through the screen.

Interviewer: All right. Great. Let's go to the next model. Infrared on CO2. Okay, what do you see here?

Participant: No sun, and just the greenhouse gas balls on the screen.

Interviewer: And what do you think will happen when we click play?

Participant: I don't know. Maybe the infrared would just go through again.

Interviewer: All right, let's find out. What do you see?

Participant: There's infrared coming up from the bottom of the screen and when it hits one of the greenhouse gases it gets deflected and just shoots in a random direction. And some of the greenhouse gas balls are lighting up yellow.

Interviewer: Ah! Why do you think they're lighting up yellow?

Participant: They're being activated or ...

Interviewer: Do you see what's activating them?

Participant: Is it the infrared?

Interviewer: Yeah. Yeah. Technically, when an infrared hits it, it absorbs it for a minute, lights up yellow, and then will send it off in a random direction.

Participant: And also the temperature is very high.

Interviewer: Okay. If you could just summarize for me, one more time, interaction between infrared and CO2.

Participant: Sure. The infrared rays are shooting out from the bottom of the screen and when they come in contact with one of the greenhouse gas balls, it lights up yellow, and the ray is shot in a random direction and the temperature is at the top.

Interviewer: All right. Great. Let's go to the fourth and final screen. Okay. What do you see here?

Participant: Sun in the top right. There's the earth brown balls on the bottom. And the CO2 greenhouse gas balls throughout the screen.

Interviewer: All right. And make your best prediction. What do you think will happen when we click play?

Participant: I'm gonna go with that the sunlight's gonna go down through the greenhouse and hit the soil like the first one, but some of the infrared rays that come up from the soil are going to hit the greenhouse gas balls and be deflected in a random direction like they were in the last one.

Interviewer: Okay. Good prediction. What do you see?

Participant: I see the sunlight coming down and hitting the brown balls and some of the sunlight's being deflected back up and some is making the infrared rays. And if one hits one of the greenhouse balls, they come back down towards the earth or slightly to the right or left, it looks like. And the temperature is at two bars.

Interviewer: And how does that compare to the temperature that we saw on the first screen when there was no CO2?

Participant: No CO2 screen was at a bar and a half, and now it's just going above two bars.

Interviewer: Right. And so, if we were to double the CO2 that was on the screen here, what would you anticipate would happen?

Participant: Probably another half to three quarters of a temperature bar.

Interviewer: Increase or decrease?

Participant: Increase.

Interviewer: Increase. All right. If you could just summarize for me, one more time, interactions between the sun, the ground, and CO2.

Participant: Sure. So the sun is shooting down sunlight and going through the greenhouse gas and hitting the earth and some is deflected and some is turned into infrared rays and the infrared rays are shot back up and if an infrared ray comes in contact with one of the greenhouse gas balls, it is shot back down towards the earth.

Interviewer: All right. And how does that relate to temperature again?

Participant: And the temperature is about ... It's at two and a half bars now, it's about a bar higher on the temperature scale than it was with just the sun and the ground.

Interviewer: Okay. All right. Great. So what you just described to me here is called the greenhouse effect, which is what most client scientists agree is the main mechanism that leads to global warming. So what I'm gonna do now is show you a short film that summarizes what you've seen here but also ties it to this idea of human ... The human influence on this whole process.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think that the earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how Earth's temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light, but because the Earth is colder than the sun, it emits lower-energy infrared light. So, Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere such as methane and carbon dioxide let visible light pass through but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year, 1750, atmospheric carbon dioxide has increased by 40% and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect which has caused Earth to heat above its typical energy range. In

other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change.

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Interviewer: Okay. What do you think?

Participant: Seemed like the same explanation that I got through the game or simulation.

Interviewer: Mm-hmm (affirmative). And okay, so it fits your understanding pretty well, then, with how global warming works? Yes. Okay. Good. So let me ask you again, let's think about what are your thoughts about global climate change?

Participant: I didn't realize to the degree that from the video, how many more were in the atmosphere since the industrial age started. So that's interesting to see, then, that it's more of a recent thing on people's mind rather than, because everyone's just focusing on the here and now and not really ... Or at least, I, personally, hadn't, before this, heard much about the past history of it.

Interviewer: Interesting. Yeah, so, you're talking about how at the beginning of the interview, your understanding of the issue is based on what you see in the news and stuff like that. Do you think that ... So, you might be seeing something on the news and they don't really talk about the science all the time. They're not all ... They just mention it like this big umbrella topic. Do you think that the science is a relevant aspect of the issue?

Participant: Yeah, I would say it is, because then, if ... Just educating more people on the actual science, then people would probably have more of a bearing and understanding on it rather than just knowing the term and the effect.

Interviewer: Yeah. And so, you think it's a real thing, right?

Participant: Yeah.

Interviewer: Do you think, then, that ... Okay, sorry. How connected do you feel to the issue of climate change?

Participant: Not so connected. As I said earlier, I haven't really personally witnessed ... Not really witnessed, but been affected, but at the same time, I also acknowledge that it is a slow, steady growing problem. So I try to do my best and in energy savings and just general energy consumption. So even though it's not really affecting me directly, I still, just in the back of my mind, habitually, don't use energy if I don't have to.

Interviewer: So energy savings. Anything else?

Participant: Renewable foods, I guess, and organic foods and stuff. When I'm at home, I usually ... My whole family just usually gets organic things and recycling, too. I don't know if that's connected, but ...

Interviewer: Yeah, sure. Sure. Yeah, how do you think it might be connected? And see if you can tie it back to the science of global warming.

Participant: If you recycle products, then you don't have to ... There's not need to make any more and so you're not burning that energy in the process of making it.

Interviewer: Yeah. And when you burn energy, what do you create?

Participant: Greenhouse gases.

Interviewer: Mm-hmm (affirmative). And then what happens?

Participant: And then there's more infrared rays in the atmosphere.

Interviewer: Good. All right. So, has any of this stuff, in the last thirty minutes or twenty minutes, however long we've been sitting here, has anything I've shown you or that we talked about changed your mind in any way?

Participant: Not really changed my mind, but reinforced that, as I mentioned, the voice in the back of my head that's just energy conscious. That will probably be on my mind a little bit more now. Just kind of on autopilot, thinking about it.

Interviewer: Good. And if you could name three things that are involved in the science, the mechanisms of increasing the temperature on earth, what would those three things be?

Participant: So the sunlight coming in to the earth and earth absorbs sunlight, reflects the infrared rays, and then if infrared rays hit the greenhouse gases and they're activated and they hold the heat for longer than they should and it just can create a chain before going back out.

Interviewer: Great. And notice one thing you didn't mention: ultraviolet light. Right? That's not a part of the issue. Isn't that crazy? Lot of people think that, but that's what you said at the beginning, remember?

Participant: Yeah.

Interviewer: Right. It's just what you explained just now. That was perfect. So yeah, that's it. Do you have any question for me?

Participant: Yeah. Why is the public opinion that it involves UV then, if ...

Interviewer: Because ... So, okay, this is interesting. At the same time that science was discovering these mechanisms of the greenhouse effect, there was also an issue with CDC's, I think, it's called. Stuff that's in the spray-cans that were dissolving the ozone, which is a different ... And you described the ozone issue pretty well. This stuff that's destroying the ozone, which lets in UV light, and that gives us sunburn, and it does other things that

are bad. I think it destroys coral reefs and things like that. But that's a different thing than the greenhouse effect which involves sunlight, and infrared, and greenhouse gases.

Participant: Oh. Okay. So it was just kind of like the two discoveries were simultaneous ... Or not simultaneously, but around the same time, so that people just got it mixed up?

Interviewer: Yeah. And they're both invisible. And they're both created by humans. So it's like, "Okay, we're creating some sort of something that's messing up the atmosphere and changing the light that comes in," but it's not clear to everyone that they're separate issues. Any other questions?

Participant: No. That was it.

Interviewer: All right. Okay. Great. Yeah, that's it. We are done.

PARTICIPANT 14

Interviewer: Like in interactive simulation that demonstrates the science of climate change. Then I'm going to, as you're interacting with it, I'm going to ask you questions about what you see, what you're thinking about. Then afterwards I'm going to followup with some questions and play a short three-minute video to kind of summarize everything we were talking about and looking at.

Participant: Okay.

Interviewer: As we go along, your responses to my questions won't affect whether or not I give you credit. You'll get full credit regardless of how you answer any of my questions. I'm audio recording this but it's totally confidential. Your name won't be associated with any of the data or anything like that. Let me know if you feel uncomfortable at any time, we can stop the interview.

Participant: Okay.

Interviewer: All right. Before we start, tell me everything you know about climate change.

Participant: Well, I know it's real, to start. Every year for the past ten years I've been going to different islands in Hawaii and the majority of the changes I noticed are from those experiences of going there and just from looking at the coral reefs, looking at the wildlife, the temperatures, everything. I've noticed a difference since I've been a teenager to now.

Interviewer: Are you -

Participant: Here ...

Interviewer: So are you from Hawaii?

Participant: No, I'm from here but I go there every year for the summer.

Interviewer: Oh, okay. Cool.

Participant: Here just the temperature changes, I don't know, the fluctuations like for storms. That's pretty much it.

Interviewer: Your experience with the weather is something that you've noticed ...

Participant: Has changed over the past decade. Yeah.

Interviewer: Okay, cool. What's your understanding of how global warming works then since you believe it's real thing? Yeah, what's your current understanding of how it works?

Participant: I don't know. I haven't studied it very much but how I understand it is we're putting a lot of carbon into the atmosphere and it's trapping heat, like sunlight radiation stuff, and changing the natural mechanics of our world which is creating different weather patterns, changes in the oceans, changes in the environment. Stuff like that.

Interviewer: So carbon in the atmosphere trapping heat. Anything else?

Participant: Hmm-Uh.

Interviewer: Okay.

Participant: I don't know much more.

Interviewer: All right, great. That's fine. Let's take a look at this simulation. So you can use the mouse. You don't need this thing. You can take this with you when you leave by the way, if you want.

Okay, what do you see here?

Participant: Sun on ground. Sun on CO2. Infrared on CO2. Sun on ground and C02.

Interviewer: Anything else?

Participant: I don't know. What are these things?

Interviewer: Those are supposed to be molecules that represent the ground.

Participant: Okay. So then ...

Interviewer: Skipping ahead.

Participant: Is there something I'm supposed to be doing here? Oh, I supposed to hit play.

Interviewer: Oh, yeah. Hold on. Hold on. Before you do, the ground right? Anything else on the screen?

Participant: The sun. There's a table with information. Light source, I don't know. I guess these are settings you can use. Slow motion.

Interviewer: Did you notice the temperature gauge on the right?

Participant: Mm-Ugh.

Interviewer: All right. What do you think will happen when we click the play button at the bottom?

Participant: I don't know. Is that going to activate the sun and increase the temperature?

Interviewer: Good guess. Let's find out.

Okay, what do you see?

Participant: So sunlight is going from the sun to the ground and reflecting off as infrared and raising the temperature gradually by interacting with the ground. But what is it .... Is it measuring the temperature of this area or is it measuring the temperature of the ground?

Interviewer: Good question.

Participant: Like this, the air or the ground?

Interviewer: What temperature is is a measurement of the movement of molecules. You just clicked the "Display Heat and Molecules". So now what would you say like where the heat is coming from? The temperature?

Participant: From the ground.

Interviewer: Yeah. Okay, if you could summarize for me the interaction between sunlight and the ground.

Participant: The sunlight is transferring energy to the ground. The ground is transferring it between the molecules of the ground and also emitting photons or sorry, infrared back out into the environment.

Interviewer: All right, great. Let's go to the next model. Maybe unclick the display heat. What do you see here?

Participant: A bunch of CO2 molecules.

Interviewer: All right.

Participant: In the air.

Interviewer: I'll just tell you that the reason that they're green is because they're supposed to represent greenhouse gases. What do you think will happen when we click the play button?

Participant: Sunlight will interact with the carbon dioxide molecules.

Interviewer: Let's find out.

All right, what do you see?

Participant: It's not interacting with them.

Interviewer: Okay, how do you know?

Participant: Because it's just passing right through them.

Interviewer: Okay, so to summarize the interaction between sunlight and CO2, how would you do that?

Participant: They're not interacting so ...

Interviewer: And you just clicked the display heat. What do you see here?

Participant: Well, the molecules are transferring heat to each other but the sunlight isn't transferring heat to them.

Interviewer: All right, great. Let's go to the next model.

What do you see here?

Participant: This is just the CO2 molecules, no sunlight. No sun as of right now.

Interviewer: What do you think will happen when we click play?

Participant: It says infrared on CO2 so I'm assuming it's going to have infrared coming from the ground and then interacting with the CO2.

Interviewer: You think there will be an interaction this time?

Participant: Yeah.

Interviewer: Okay. Let's find out.

Okay, what do you see?

Participant: The infrared is coming from the ground and it is interacting with the CO2 molecules and raising the temperature of them.

Interviewer: How do you know that they are interacting?

Participant: The infrared waves are hitting the molecules making them .... It has a little animation that has a glow.

Interviewer: What do you see with the heat turned on? Heat option.

Participant: The infrared is increasing the temperature of the molecules significantly.

Interviewer: All right. So what happens ... You said that you know there's an interaction because you see them light up right? Do you see what happens to the infrared when it interacts with a ...

Participant: Yeah, it bounces off at a different angle.

Interviewer: Okay, I just wanted to make sure ...

Participant: It's not directly up.

Interviewer: Okay, good. All right, great.

Participant: Next one?

Interviewer: If you could one more time summarize for me the interaction between infrared and CO2.

Participant: Infrared is coming up from the ground and when it comes into contact with the CO2, it's transferred some of it's energy, which is being converted to heat.

Interviewer: All right, great. Let's go to the ...

Participant: Next one?

Interviewer: Yep. Okay, what do you see here?

Participant: So this is a combination of the three previous models. It's probably just going to show the visible light interacting with the ground, the ground emitting infrared up into the CO2.

Interviewer: Into the CO2 and then what?

Participant: Then the previous interaction also. The CO2 how it interacts with the infrared from the ground.

Interviewer: Okay, let's find out. What do you see?

Participant: So it's like I was saying where the visible light from the sun, the sunlight all the different wavelengths are interacting with the ground and the ground is heating up. Then as the ground heats up, it's emitting infrared wavelengths upwards towards the CO2 which is interacting with some of the CO2 and heating it up.

Interviewer: All right. How do you think ... How does this relate to the temperature?

Participant: How does what relate to the temperature?

Interviewer: How does this compare to say the first screen, where there was no CO2?

Participant: The temperature is going to be increasing faster because the infrared is now being trapped by the CO2. Or the infrared is giving off some of it's energy to the CO2. The temperature is going to be increasing faster than if there was no CO2.

Interviewer: You say that the temperature is increasing faster with CO2. Do you think that the overall temperature is any different than the situation where there was no CO2?

Participant: The overall temperature? Do you mean the final temperature that it reaches?

Interviewer: Yeah.

Participant: I think it should be higher, yeah, with more CO2 just based on how this diagram. Because you have the CO2 interacting with the ground too so it's transferring more of it's energy to the ground. I guess temperature is still measuring just the ground. Or maybe it's measuring everything, like all the molecules.

Interviewer: And let's say it's measuring all of the molecules. You say based on basically the process that you see here, you can see why the temperature would be higher with CO2 than without CO2. Can you explain that one more time?

Participant: Yeah. I think the temperature would be higher in this diagram because the visible light is transferring, er the sunlight is transferring energy to the ground. The ground is emitting infrared up to the CO2 and then the CO2 is heating up and then also transferring more of that heat energy to the ground.

Interviewer: All right, great. Well, what you are describing to me here is called the greenhouse effect and this is the main, what most scientists attribute as being the mechanism ...

Participant: To global warming.

Interviewer: To global warming. Right. Let's say that a human were to drive his car across this screen and emit more CO2. What do you anticipate would happen as a result?

Participant: More CO2, more greenhouse effect.

Interviewer: And thus, how would you ...

Participant: Thus rising temperature.

Interviewer: Rising temperature. Okay, great. What I'm going to do is show you a short video to kind of summarize everything we've been talking about here. Then I'm going to follow up with some questions. I'm going to step out and be right back.

Video: Warming. You may have ...

Interviewer: Let's start it. There we go.

Video: Heard of global climate change which is often called global warming but how much do regular people understand the science of climate change. Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism?

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So how have humans changed things? Since the dawn of the industrial age around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has also tripled. These increases cause extra infrared light absorption meaning an extra greenhouse effect which has caused earth to heat above it's typical temperature range. In other words, energy that gets to earth has an even harder time leaving it causing earth's average temperature to increase thus producing global climate change.

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Interviewer: Okay. What do you think?

Participant: Of the video?

Interviewer: Hmm-Ugh.

Participant: It's good. Informative. It's pretty simple but it's good. It described it well.

Interviewer: Does it fit your understanding?

Participant: Yeah I think so.

Interviewer: All right. So kind of like looking at this idea of global warming more broadly, what are your thoughts and feelings about the issue?

Participant: I think it's much more important than most people treat it to be, especially the government.

Interviewer: Say more.

Participant: I just think that it should be ... I think more resources should be put into trying to prevent it or having global meeting like the United Nations or something to talk about ways that we put regulations on the amount of carbon that we put into the atmosphere. That'd be important.

Interviewer: Okay, so then it's a matter of importance for high up people in politics and things like that. Do you think that normal people also have a role to play?

Participant: I think normal people's role in it would be the publicity, making it an important issue because I think if it's only ... I don't think the people that are high up in politics would treat it with as much importance if the general population wasn't talking as much about it.

Interviewer: Okay, so then by publicity you mean just making ...

Participant: More people known to the danger of having this happen.

Interviewer: Okay, so do you think ... We're talking now about politics and publicity and people communicating with the media and things like that, right? Do you think science fits into this anywhere?

Participant: Yeah, I mean I think science will be the main argumentative point that you can use to show why it's dangerous or show how we've changed it so much from it's natural state. So I think science is the main driving force behind making it a public issue and getting it into the media and providing good understandable graphics or data that common people can understand.

Interviewer: When you're saying that science will be important to show people that it has changed, right, what do you mean by it?

Participant: The world. The globe. The temperature. Climate. Weather patterns. Temperature of the ocean. Everything that global warming is doing. I think science would be important to show that.

Interviewer: Gotcha. Thanks. Do you think that ... How connected do you feel to this issue personally?

Participant: I think it is ... Personally, I know about it and I want to see it improved but I feel like I'm not in a position to where I can make those improvements, if that makes sense? I feel

like the improvements are going to have to come from government because with capitalism and companies trying to make the most money a lot of times it's way more profitable to be blasting carbon dioxide up into the atmosphere and burn fossil fuels. I think regulations on that is what is going to be most effective in making change.

Interviewer: You had mentioned publicity earlier right? And how it's the normal person's role to kind of make it a public issue. Do you think that relates to the legislations that you were just talking about?

Participant: Yeah absolutely. Because I think legislation's going to spend more time on, pay more attention to, make more actions on the things that are most important to the public. And I think that global warming should be up there with the military and all these other things that are very serious public issues.

Interviewer: All right. Do you take any specific actions in order to reflect a global consciousness of that, of any kind?

Participant: Learning about it and people that don't understand it or people that don't believe in it try to convince them and show them that it's actually happening. And it's effecting the planet and it could become a much larger problem. I think it will become a much larger problem as time goes on. Once things start getting serious, like we have worse storms and things in the ocean start dying at a significant rate then I think people will start paying more and more attention to it and then things will start changing.

Interviewer: Great. Do you think in the last 30 minutes or however long we've been sitting here that your mind has changed about anything in particular?

Participant: Well, yeah. I mean I got a refresher on how the system worked that changed it. Because I knew but I just forgot it in this moment. I've always had this opinion about climate change that I've explained it to other people besides you also. Not much has changed other than that.

Interviewer: So your attitudes have stayed the same?

Participant: My attitudes are the same, yeah.

Interviewer: Okay, if you could summarize for me the process of global warming, the scientific process, how would you ...

Participant: Like what we just ...

Interviewer: Yeah.

Participant: The energy from the sun goes to the earth and interacts with the ground. The ground emits infrared wavelengths that back out into the atmosphere and those infrared wavelengths interact with greenhouse gases like carbon dioxide and other carbon based gases. They absorb the infrared light as heat and then bounce it off as or then re-emit

the infrared wavelengths at a different angle so that they can interact with more greenhouse gases and transfer more heat and gradually it raises the overall temperature before the infrared can finally get out of the atmosphere and back into space.

Interviewer: Great. Lastly, do you have any questions for me?

Participant: Nope. When's the next thing?

Interviewer: Right now. All right thank you so much. Yeah.

PARTICIPANT 15

Interviewer: Let me ask you. Tell me everything you know about climate change.

Participant: Well, I took a environmental health class. I'm in a public policy class this semester. So, climate change is a huge topic, especially with the new administration, and the way things are going, and the new EP director, Scott Pruitt, not really considering the people's health in total. So, he's allowing a lot of pollutants to be admitted, now, into the air. So, that's gonna affect a lot of people's health, and the way that help is viewed.

It makes it look like the United States isn't putting climate change, what the Obama administration, did as a priority. So, then, it's gonna be like the other countries, since America's like so affluent, and we're like really driven. It's gonna make it look like we don't really care, so other countries are gonna see it as, "Since we don't care, then why do we have to try to combat climate change and stop our emissions?" and do things like that. That's pretty much the gist of it.

Interviewer: You don't like that?

Participant: I don't like it, 'cause I'm a science major. Health is really a priority, like the profession I want to go into. That's gonna affect people, like their health, overall. It's not something that we're gonna see in the next, maybe, two or three years, but like, 40 years down the line. It's gonna be like, "Okay, wow, we should've taken the climate change thing really seriously."

Interviewer: You wouldn't consider yourself as skeptic, then?

Participant: No. I believe in the Science.

Interviewer: Okay. What's your understanding of the science?

Participant: I feel like science is pretty certain. I mean, there's some things that are kinda uncertain. I feel like, since a lot of people proven that research shows like, "Yes, pollutants and greenhouse gases cause certain effects, and you're more prone to develop diseases." I think it's true.

Interviewer: What's your understanding of how climate change works, scientifically? I know, you just said greenhouse gases. Maybe, talk a little bit more about that.

Participant: The greenhouse gases emit a bunch of pollutants, and gases, and they get trapped in the atmosphere. Then, those atmosphere stay. Us doing daily lives, and driving, that all contributes to that. Then, we breathe it in, and it's in our body. Yeah, it's exposure, but it's the dose. Like, what actually gets in our body.

If it's around 24/7, we're more prone to get it into our body. That's gonna lead to adverse effects, later on in life.

Interviewer: Okay, so, it's like, the breathing in, then, of the pollution, and stuff like that?

Participant: Yeah.

Interviewer: Okay, all right. What about temperature increases?

Participant: I'm not really familiar with the temperature. I haven't really looked into that, or know about it, to be honest with you.

Interviewer: All right, great. Then, this simulation will be helpful for you. I hope. Okay, so what do you see here? Here's the simulation.

Participant: The sun. I think, these are atoms, I want to say. I'm not really a hundred percent sure.

Interviewer: Yeah. Basically.

Participant: They're just, like, hanging around in the atmosphere.

Interviewer: Mm-hmm (affirmative). Any guess as to why they're all at the bottom?

Participant: I guess, the way that climate change happens, it all ends up at the surface area. Not so high. I'm assuming.

Interviewer: Actually, it turns out that, these are supposed to represent the atoms of the ground.

Participant: Okay.

Interviewer: That's supposed to be the ground. It's just a weird way of representing it.

Participant: Okay.

Interviewer: Anything else you see?

Participant: No.

Interviewer: What about the options on the screen, and things like that?

Participant: I guess that, you could select different models. It has temperature. Then, it shows the photons, and sunlight, and the ... Such.

Interviewer: All right, yeah. You see the temperature gauge, and all that. This is for you, by the way. You can click around. Before we click on the 'play' button, at the bottom, what do you think is gonna happen when we click that button?

Participant: I think, the atoms will rise, and then temperature will rise as the sunlight reflects on it. I think that's gonna happen. It's gonna display a little bit more heat, as time goes on in the video. I think that's what's gonna happen.

Interviewer: Okay, lets find out. What do you see?

Participant: There's sunlight radiated. I think, from the atoms, they're releasing their gases. It's being all admitted in the air, the atmosphere. As the temperature is rising, slowly, but it's rising as all this is happening.

Interviewer: You said it's releasing gases? Tell me more about that.

Participant: I'm not sure what kinds of gases. I'm sure it's not really good gases. I can't think, off the top of my head, right now. That's what I'm guessing I see in this video.

Interviewer: Did you see the legend, on the left side?

Participant: This legend, or this legend?

Interviewer: That one. The second one.

Participant: Yeah, I did.

Interviewer: You said that sunlight's coming down. You know it's sunlight, probably, because of that, right? Do you see another kind of squiggly wave?

Participant: Yeah, the in-fared, in-fored ... I don't know if I'm pronouncing that right. That's coming out of the atoms, and they're bouncing off each other, as the sunlight comes off.

Interviewer: It's called infrared. Where's the infrared coming from, again?

Participant: I think, it's coming from the atoms. As the sunlight projects on them, they're releasing from the atoms.

Interviewer: Mm-hmm (affirmative). What do the atoms comprise, again?

Participant: On the ground. What's on the ground, on the baseline.

Interviewer: Okay, great. If you could summarize, for me, the process that we're looking at here.

Participant: Sure. Basically, from what I'm seeing is, as sunlight reflects down on these atoms, on the ground, the atoms are releasing these infrared things. Then, they're getting released up into the atmosphere. They're kind of staying in the atmosphere, and that's causing the temperature to rise, overall.

Interviewer: With regards to the temperature, do you think that it's going to increase forever, or do you think it'll stay the same? Do you think it'll go down?

Participant: I think the temperature will keep going up. I mean, like California, especially, has been having hotter and hotter days in the years, because of climate change. I think, because there's more pollutants being admitted, and all of that, that temperature will continue to rise, in effect.

Interviewer: Fantastic. In the screen that we're looking at here, like, in this model, does it look like the temperature is going up, and up, and up, or do you think it's about stable?

Participant: I feel like it's gradually, a little bit. It's not spiking all at once, but it's, in little bits and pieces going up. Now, it seems to be, kind of, stayed. It hasn't really gone up, anymore.

Interviewer: All right, great. Let's click on the next model, which is sun on CO2. You see it on the left?

Participant: Yeah.

Interviewer: What do you see here?

Participant: This looks like, now, the CO2 atoms are, kind of, up in the atmosphere. They're not really on the ground anymore. They're just hanging there, floating around in the atmosphere, or in the sky.

Interviewer: Mm-hmm (affirmative). Do you notice any differences between these CO2 atoms, and the other atoms in the previous screen?

Participant: There's less, but they're more spread out. I also noticed the temperature's starting a little bit higher, as opposed to the other one. It started lower.

Interviewer: That's true. Did you notice any color differences between ...

Participant: Yeah. These atoms are green, and the other ones were a darker brown.

Interviewer: Right. Any idea why they might be different?

Participant: No. Maybe, they represent a greenhouse gas. Maybe, that's why they're green.

Interviewer: Ah. Yeah, actually. That turns out to be exactly right. And, why the other ones were brown?

Participant: 'Cause they were just things that were already in that, on the ground. Just, the atoms on the ground.

Interviewer: Yeah, exactly. They're supposed to represent the ground. The ground's made of atoms, so. All right, great. What do you think will happen when we click the 'play' button, this time?

Participant: I think, the atoms will continue to circulate around the atmosphere. Then, the temperature's gonna increase, as that happens.

Interviewer: Do you think that the sunlight is gonna, you know ... What do you think the ... Make a wild guess. What do you think the sunlight's gonna do?

Participant: The sunlight's just gonna project the more activity of the CO2, in the atmosphere, I think.

Interviewer: Okay, lets find out. What do you see?

Participant: The CO2 just bouncing all over the place, as more sunlight radiates down. They're not really going away. They're just, kind of, floating around.

Interviewer: How would you say that the sunlight is interacting with the CO2?

Participant: What do you mean?

Interviewer: Like, would you say that the sunlight is having an effect on the CO2?

Participant: Yeah. Just because, now they're moving around, as opposed to before, when the sunlight wasn't really radiating. They were, kind of, just stable. Now, they're just moving around. As sunlight projects down, they have more activity.

Interviewer: On the previous screen, you said the sunlight was reflecting off of the ground? Or, maybe you said bouncing? I can't remember.

Participant: I think, it was just omitting, kind of. That, as sunlight omitted down, the atoms, kind of, got the sunlight, and then caused activity to happen.

Interviewer: Yeah. Do you see any of that activity happening with the CO2 and sunlight?

Participant: A little bit, 'cause it's causing them to move around. It's not as much, I think, as before. 'Cause, the temperature, I've noticed, hasn't really gone up.

Interviewer: Right, okay. All right, great. Let's go to the next screen. Infrared on CO2. Okay, what do you see, here?

Participant: There's no sunlight on this one. There's just CO2, I think. It just looks like it's in the atmosphere. Then, it's just stable, right now. I don't think, since there's the sunlight, there'll be any activity, as much as the previous video.

Interviewer: This time, when we click 'play,' I'll just let you know that infrared ... You remember what those look like?

Participant: Yeah. The squiggly ... Yeah.

Interviewer: Yeah, exactly. The squiggles. They're, like, a little bit different. Those are gonna be on the screen. Make a wild guess. What do you think will happen when those pass through the CO2?

Participant: I think, there'll be a lot more activity. They'll be moving around a lot more. Just my guess.

Interviewer: Okay, lets find out. What do you see?

Participant: Well, as they pass through, or they touch one of the CO2 molecules, or atoms, they, kind of, get a ring around them. I'm not sure what that really means, but that's what I notice. Then, the temperature's spiking really crazy. I think, the infrareds are causing the CO2 to have a lot more activity, without having, really, sunlight there.

Interviewer: Mm-hmm (affirmative). Right. Anything else?

Participant: I noticed that the CO2's activity is a lot faster, compared to the last video. That's a difference.

Interviewer: Great. You said that, you noticed a ring, up here?

Participant: Right.

Interviewer: Tell me more about that process.

Participant: I'm not really sure what caused ... I'm sure the infrareds are causing that. But, I'm not sure the mechanism, or why.

Interviewer: Maybe, if we push the slow motion button, it'll be a little bit more obvious? But, maybe not. I mean ...

Participant: I do notice, as the CO2s come together, or they touch each other, the ring goes away. But, I don't know why.

Interviewer: Mm-hmm (affirmative). I mean, well, right. That is one way that the ring disappears. Then, there's another way that the ring disappears.

Participant: As soon as the infrareds are not around anymore, it kind of looks like. Or, they, kind of ... Yeah. I don't notice it.

Interviewer: Okay. Do you notice that not all of the infrared are rising?

Participant: Right. Yeah.

Interviewer: Do you see, maybe, an instance where one is not going straight up?

Participant: Yeah. Some are, kind of, going diagonal. Or, they're coming downwards.

Interviewer: Right. Do you see where those ones are coming from?

Participant: From the top. I'm gonna guess that's the sun, maybe, up there? I don't know.

Interviewer: It's kind of tricky to see, here. What's going on is that, you know, when the infrared hits one of these greenhouse particles, one of the CO2 particles, they absorb the infrared, and they turn yellow. They have that yellow ring. They stay like that, unless they bump into another CO2 particle, like you said. Also, sometimes, it will emit the infrared light out, in a random direction. Maybe, you can see it?

Participant: Oh, okay. Yeah. Now I see it, that you said it.

Interviewer: Now, it just froze. Okay, there we go. If you could summarize, for me, the whole process that we're looking at, here?

Participant: Okay. The CO2 was emitted. Then, once these infrareds started being released, and the video started playing, the CO2 started wildly. The activity started happening a lot faster, and the temperature started rising. Then, the infrareds started causing these atoms to have these rings around them. Then, the CO2 are causing these infrareds, sometimes, to go into different directions.

Interviewer: Okay. All right, great. Let's go to the fourth and final model. What do you see here?

Participant: So, this is the CO2. Then, now, is sunlight. Now, that the atoms are at the bottom. It's basically, like, everything from the last couple of videos, a little bit.

Interviewer: What do you think will happen, this time?

Participant: Well, I think when we press 'play,' the atoms will start having activity. But, also, I think, it'll have activity, also, with the atoms at the bottom. Or, whatever's on the ground. That might cause the temperature to go up, as well.

Interviewer: Let's find out. Oh, it's in slow motion. Well, actually, maybe leave it there. What do you see?

Participant: Sunlight ... Now, it's causing the atoms to have the ring around them. I think, that's 'cause of the infrared is happening, and because the presence of the CO2. That's what's causing ... So, it's causing the squiggly lines to go in different directions, now.

Interviewer: Okay.

Participant: The temperature's increasing, little by little, while that's happening.

Interviewer: Is there sunlight, on the screen, as well?

Participant: Yeah. There's sunlight on the screen.

Interviewer: Tell me what happens after the sunlight leaves the sun. Tell me what happens from there, on.

Participant: As the sunlight is emitting sunlight, it's going downwards, it appears. As it goes downwards, it seems like the rings are releasing ... It seems like the infrareds are coming from the atoms, down here. Then, that's what's causing the atoms to have rings around them. Once the infrareds are released up, they cause the CO2 molecules to have the rings around them, as well.

Interviewer: Mm-hmm (affirmative). All right, great. What impact do you think this has on the temperature?

Participant: Well, it's obviously causing the temperature to rise. It's not, like, dramatically, but it's little by little, as this whole process is occurring.

Interviewer: Yeah. It's also in slow motion. Maybe, unclick 'slow motion,' so we can see what happens to the temperature. You're blowing up.

Participant: I know. It's the last two weeks of school.

Interviewer: Yeah, I totally understand. So, if you could just summarize for me, one more time.

Participant: Okay. Basically, in this video, as the sunlight is emitting sunlight, and it's going down, it's reflecting off to the atoms at the bottom. It's causing the atoms to release these infrareds, which are causing these atoms to create these rings around them. While these infrareds are released up into the atmosphere, the CO2 that's in the atmosphere is also getting these rings, because of this infrared, which is all causing the temperature to rise gradually.

Interviewer: All right. How would you compare the temperature, on this screen, to the temperature on the first screen, when there was no CO2?

Participant: The temperature's a lot lower. It, kind of, stayed at baseline, basically. Like, the first line. It wasn't rising.

Interviewer: What would you say the impact is of CO2?

Participant: CO2 causes our temperatures to rise.

Interviewer: If we were, to say, double the CO2 on the screen, what do you think would happen?

Participant: The temperature would rise a lot quicker. It'd be a little hotter.

Interviewer: Why?

Participant: Because, there'll be more activity, and the more activity of this would cause CO2 to have more activity. They wouldn't go away, 'cause there'd just be more sunlight, and more temperature.

Interviewer: When you're saying more activity, what ...

Participant: What do I mean by that?

Interviewer: Mm-hmm (affirmative).

Participant: I just mean, there'll be more of the CO2 bouncing around, and more of the infrareds causing the CO2 to have rings around them. As well as, at the bottom of the ground.

Interviewer: All right, great. How do you think humans have ... Like, what have impacted temperatures?

Participant: Well, just by all of the manmade ... By driving cars, having industrial plants that release a ton of pollutants up into the air, I feel. You can't really see CO2, a lot of the time. It's, like, out of sight, out of mind. I feel like, as people are educated about this, then they realize it's an issue. While, we don't see it, or it's not made ... Right now, the government's not making it a priority. People aren't gonna think it's important, or anything's really occurring.

Interviewer: Great. What you basically just described to me, is called the greenhouse effect. It's the main mechanism behind global warming. You, basically, explained to me how humans are, kind of, involved by creating more CO2. This video I'm gonna play for you, right now, is going to, kind of, summarize all of that. I might step out, just for a second, while it's playing. Just because, I've seen this video so many times.

Participant: Okay.

Video Speaker: You may have heard of global climate change, which is often called global warming. But, how much do regular people understand the science of climate change? Take a moment to try and explain to yourself how, virtually, all climate scientists think the earth is warming. What is the physical, or chemical, mechanism? In one study, we asked almost 300 adults in the US, and not a single person could accurately explain the mechanism of global warming, at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how Earth's temperature works, without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But, because the earth is cooler than the sun, it emits lower energy, infrared light. So, Earth's surface essentially transforms most of the visible light it gets from the sun, into infrared light.

Greenhouse gasses in the atmosphere, such as methane, and carbon dioxide, let visible light pass through, but, absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed, and emitted, by the atmosphere many times, before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degrees fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40 percent. And, methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature rage. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change.

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Interviewer: Okay, so, what do you think?

Participant: I think it sums it up pretty well.

Interviewer: It fits your understanding of how it works?

Participant: Yeah.

Interviewer: Now, let's go back to talking about, more broadly, what are your thoughts and feelings about climate change?

Participant: Well, I think it's something that has to be dealt with. As people are educated, I think, it's gonna become more a priority. As people don't know about it, it's just, like, an out of sight, out of mind thing. We don't really think about it. I mean, we kind of just think about everything that makes life convenient for us. Driving is one of the main things that contributes to CO2. People aren't gonna be as happy to take away driving. There has to be other ways, I believe.

Interviewer: You say, out of sight, out of mind? You were talking earlier about, how you can't see CO2?

Participant: Right.

Interviewer: Do you think there would be a difference if, maybe, it were more visible?

Participant: Oh, a hundred percent. I feel like, saw atoms, or things floating out in the air, then people would be more, like, "Okay, this is an issue. We gotta get rid of this." But, since we don't ... It's, like, a clear thing we just don't really care.

Interviewer: Do you ... Hm. Then, do you think that science might be a relevant aspect of, like, the more ... You know. You hear about it in the news, and in politics, and stuff like that. Do you think science is an important part of that?

Participant: Yeah, I think science is an important part to the advocating. As we know, major companies that, like, contribute to CO2 kind of hire scientists, sometimes. They neglect, or deny, that contributes to climate change. I think, there's a discrepancy between, sometimes, the politics and science worlds. There has to be, like, an independent way to, like, say, "Okay. The signs shows, like, this is gonna happen, and this will happen later on in life."

Interviewer: You're kinda saying that some science is better than other?

Participant: Yeah.

Interviewer: You obviously think that climate change is real.

Participant: Mm-hmm (affirmative).

Interviewer: Do you think that humans are responsible?

Participant: Yeah. I think, we've contributed a large portion of it.

Interviewer: Do you think that ... Do you feel, like, connected, personally, to the issue of climate change?

Participant: I don't know how much. 'Cause, before, I took a couple classes on this. I didn't really think about it, like, in the way I contributed. Now that, when I drive just aimlessly, I, kind of, just, like, "Oh, I'm just releasing CO2, for no reason." I think,

you have to be educated on the issue. If you're not, you don't know it, what's going on, or what contributes to it. You, kind of, just don't pay attention to the issue, at all. Or, you don't see how you contribute to it, as a whole.

Interviewer: Mm-hmm (affirmative). So, now, you're feeling more connected as you're learning about it in classes, and things like that? Do you think that your actions reflect a global conscience-ness?

Participant: I think so. Can you explain a little bit more of that question?

Interviewer: Like, so, you say that you think it's a problem, and that people should do things to help mitigate the problem. Do you do anything?

Participant: Now, I'm really bad at that. I just feel like, the way that I contribute the most, is driving. In L.A., you just can't get anywhere without really driving. I mean, you can take public transportation, but it's just, like, not a way ... Growing up here, I just like driving everywhere. I think, it just depends.

Interviewer: You feel connected to the issue, but at the same time, you're like, maybe you don't do as much as you ...

Participant: Right. I feel like, it's just hard. There's, literally, so much I can do. I guess, in a way. I don't know. Driving's the way, I feel like, I contribute most of. I can't take driving away, 'cause that's how I get to school, that's how I get places. I don't know. I feel like there has to be a greater picture that I'm not seeing, that I have to be able to do.

Interviewer: Are there other things that you do, other than driving, that, maybe ...

Participant: Well, I would say cooking. I know cooking sometimes does that when, like, it's trapped in your house, and stuff like that. I don't do a lot of the cooking in my house. So, things like that. I think, just being more aware of what we're doing.

Interviewer: Huh.

Participant: Yeah.

Interviewer: Do you think that global warming is a problem that concerns normal people?

Participant: Absolutely, yeah. I think, it's something that ... Like I said, because it's not something we'll see, like, effects. In the next, maybe like, five or ten years, it'll be something later on. Like, our children, our grandchildren, will have to be dealing with that issue. Like, we could've done things to prevent, or combat, it.

Interviewer: All right. In the course of the, like, thirty minutes that we've been sitting here ... However long it's been. Have you changed your mind about anything?

Participant: I just, now, see the more severity of it. I feel like, you can talk about it, but seeing simulations, and things like that, you kind of realize, "Wow, this is an issue. This is gonna progress as time ... It's gonna get worse, I think."

Interviewer: At the beginning of the interview, you said that you didn't really understand. Or, not that you didn't understand. You didn't really know what ...

Participant: What the mechanisms, and stuff like that.

Interviewer: Yeah, exactly. If somebody asked you, like, "How does global warming work? What are the mechanisms?"

Participant: I think, I can kind of explain it. I still, like, not a hundred ... I didn't memorize it, but I feel like I got the gist of what I'm supposed to get out of it.

Interviewer: Could you try and explain it to me?

Participant: Oh, okay. I can try, but I don't think I could, right now. My brain's a little fried. Basically, there's atoms in the ground. When we release CO2, as sunlight hits it, CO2 has greater activity. Then, there's infrareds that start being released, as all this is happening. That causes the rings around to be occurring. Then, that causes temperature to rise. That's just bad, 'cause, as more CO2 gets emitted, CO2 doesn't really go away. The temperatures will continue to rise. That's basically ...

Interviewer: Yeah, that's pretty good.

Participant: Okay.

Interviewer: When the rings appear, what's happening there is, the CO2, or the ground, or whatever ... You know, whenever you saw a ring, it's capturing the energy of the sunlight, or whatever light. Infrared light. 'Cause, you know, the wave, or whatever you see. Yeah, so. Exactly. You did a good job, there, explaining that. You have any questions for me?

Participant: Mm-mm (no).

Interviewer: No?

Participant: No, no questions.

Interviewer: All right.

Participant: Thank you.

Interviewer: Thank you.

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Interviewer: It happens.

Participant: Yeah.

Interviewer: What year are you in?

Participant: I'm in third year.

Interviewer: Third year? Oh okay, okay. One extra [inaudible 00:00:08], you don't want to, don't rush into your future, it's okay to take your time.

Participant: I want to do it abroad though, so that would be cool.

Interviewer: Even better. Where will you go? Do you know where you want to go?

Participant: I wanted to go to London, but if I do it for psychology, I don't think that's an option.

Interviewer: Oh, really?

Participant: Yeah. I can't do my senior seminar in London, so I might end up just doing that.

Interviewer: Oh well, well sounds like it won't be a semester wasted, for sure.

Participant: Yeah.

Interviewer: Okay. To start, why don't you tell me everything you know about climate change?

Participant: I know that the ice caps are melting and every time ice melts, the ocean level rises and it causes flooding in some areas, but also other areas experience extreme droughts, like LA. Because of all the energy, the non-renewable energy that we use. I know that we only have a little less than 50 years left if we continue at the same rate. I used to work at an aquarium, so.

Interviewer: Say that again.

Participant: I used to work at an aquarium.

Interviewer: Oh, yeah? Oh, okay, nice.

Participant: Yeah, so I know a lot about the oceans.

Interviewer: Oh, all right, so you know about the impacts, the future impacts of climate change.

Participant: Yeah, I know that 99% of scientists agree that it's a real thing.

Interviewer: What do you think?

Participant: I believe it, it's a real thing. Science.

Interviewer: So you mentioned the environment right, any other impacts?

Participant: A lot of species are becoming endangered and one of the most critical, one of the most critical losses that we could face is the extinction of bees, which they are on the food chain, in terms of pollinating all our crops and stuff, that's like a huge thing. If they go extinct, I'm sure we'll follow shortly after.

Interviewer: Oh wow. Yeah. Pretty scary, right?

Participant: Yeah.

Interviewer: You know that, you mentioned that the temperature is rising, and you have a pretty good understanding of like impacts that it's gonna have. Why is the temperature rising? Why does global warming happen?

Participant: Because of all the CO2 emissions and methane from farm animals, specifically cows and pigs and their poop. All the waste that they produce, it goes into the air and it deteriorates the ozone layer, which allows for more UV rays and other kinds of rays from the sun to come through and warm up the Earth more than it's ever been warmed up. It's happening at an exponential rate in comparison to the past.

Interviewer: All right, great. What I'm gonna do now is show you the simulation.

Participant: Okay.

Interviewer: It's right here. This is, you can use this to click around in a minute. What do you see on the screen?

Participant: I see the sun and probably dirt, what's supposed to be dirt. There's temperature, I'm not sure what that brown stuff is though.

Interviewer: Yeah, it's supposed to be the ground. The reason why they are represented as circles like that is because ...

Participant: They can be taken away?

Interviewer: Yeah, they can be taken away and it's also to show the atomic nature, they're supposed to be like molecules.

Participant: Oh, like the drainage of them and stuff, right?

Interviewer: Yeah, that as well. So okay, you mentioned the temperature, right. Okay, good. What do you think will happen when we click the play button that's at the bottom?

Participant: I think that as the temperature rises, the molecules will become bigger and the soil won't be able to hold as much water, so it can't like allow for vegetation.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: I see rays affecting the soil.

Interviewer: Tell me more.

Participant: They're bouncing back up into the ozone layer. I'm not if they're staying, it looks like it comes from the sun, the temperature is rising. It looks like the Earth affects the way the rays are like giving back and it looks like the thin ones aren't very many, so that must mean that's the CO2, it's converted into like other gases, so just oxygen and nitrogen, and the other ones are the bad ones?

Interviewer: Oh, which ones are the bad ones?

Participant: The bigger ones.

Interviewer: Oh, like the ...

Participant: The ones coming down.

Interviewer: Oh, I see. Did you see this? The one's coming down are sunlight and ...

Participant: Oh, yeah. Oh, okay. I didn't know the ones are infrared, okay.

Interviewer: Right.

Participant: I see.

Interviewer: Could you summarize for me one more time what you're seeing here?

Participant: I see sunlight rays being directed onto the earth, and then it bounces off the earth and we get infrared rays coming back up into the sky.

Interviewer: All right. You also mentioned that the temperature was going up.

Participant: Yeah. The temperature is going up.

Interviewer: Okay, do you think that the temperature will continue going up forever, or maybe it's going down, or maybe it's about stable?

Participant: I think it, I don't know. I feel like global warming doesn't necessarily mean that the Earth is just warming. I feel like ice age can be equally catastrophic. I that it could fluctuate, and not in a healthy way.

Interviewer: Okay. All right. Let's go to the next model now. Do you see how on the left there's four buttons, let's click on sun on CO2.

Participant: Oh, this one?

Interviewer: Yup.

Participant: Okay.

Interviewer: Okay, what do you see here?

Participant: Sun on CO2. I see a bunch of green dots in the sky and the sun.

Interviewer: All right. Any guesses as to what the green dots represent?

Participant: The CO2?

Interviewer: Yes, right. They're green because they're supposed to be greenhouse gases.

Participant: Okay.

Interviewer: So what do you think will happen when we click play this time?

Participant: I don't know. This is hard, this is almost chemistry.

Interviewer: Oh, well. Let's just find out then. Okay, what do you see?

Participant: I see the sun rays interacting with the CO2 gases. Kind of.

Interviewer: Why do you say kind of?

Participant: Because they're not changing, but they're bouncing off of them, and they're not like multiplying or subtracting.

Interviewer: What would multiplying or subtracting look like?

Participant: I think there would be way more of them. It looks like there's about the same amount.

Interviewer: Of the?

Participant: CO2 molecules.

Interviewer: Oh, I see what you mean. Okay, would you say that, you said in the last screen that the sunlight was bouncing off of the earth?

Participant: Yeah.

Interviewer: Is there any bouncing going on between sunlight and CO2?

Participant: It looks like it's just passing through it. But every time it passes through it they like, I don't know how they change, maybe I'm hallucinating. It doesn't look like it's reacting with it very much.

Interviewer: Okay, how about the temperature?

Participant: Temperature is the same.

Interviewer: All right. If you could just summarize for me what you see here?

Participant: I see greenhouse gases bouncing around in a little screen and then sun rays going from the sun at equal rates.

Interviewer: And the sun, you said it was, as the sun passes through the CO2, I basically am putting words in your mouth here, sorry about that. You said earlier that the sunlight was passing through the CO2.

Participant: Yeah, it passes through, but it doesn't seem as if it's interacting with it.

Interviewer: Right, okay, great. Let's go to the next screen. Infrared on CO2. Okay, what do you see here?

Participant: Greenhouse gases.

Interviewer: Right. What do you think will happen when we click play this time?

Participant: I feel like the temperature will rise. That's the only safe assumption I can make.

Interviewer: Okay, let's find out. What do you see?

Participant: I see the infrared reacting with the greenhouse gases. They're like turning yellow around them. The temperature is rising, knew it. Okay. I don't think they're multiplying, they're staying the same in terms of amount. But the temperature is rising exponentially.

Interviewer: You said they're not multiplying in amount of?

Participant: Greenhouse gases.

Interviewer: Okay. You said that ...

Participant: Every time an infrared hits one, then it like goes a different way.

Interviewer: Oh, tell me more about that.

Participant: It looks like when the infrared reacts with the greenhouse gas, it is directed in a different pathway, so it could be directed back down to the earth, rather than out.

Interviewer: By out, what direction do you mean?

Participant: Up and out to space, out into space, away from us.

Interviewer: Good, if you could summarize for me one last time the interaction between infrared and CO2.

Participant: When infrared reacts with CO2 it is refracted, I don't know if that's the right word, that's a term for light, in a different direction and it causes the temperature to rise.

Interviewer: All right, great. Let's go to the next screen. Sun on ground and CO2. What do you see here?

Participant: I see the CO2 and the sky, the sun, and the ground.

Interviewer: What will happen when you click play this time?

Participant: The rays and the infrared will come out and then the infrared will react with the CO2, and then it'll bounce all over the place from the ground to the CO2 and the temperature will rise.

Interviewer: Okay. How do you think that it'll compare, like the temperature, since you mentioned the temperature. How do you think the temperature will compare to the first screen, when there was no CO2?

Participant: I don't think it'll be as high, but it'll get much higher than the first frame.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: The rays. Just the rays, the sun rays. Then we got some infrared, reacting with the CO2, the ground is absorbing some sun rays. Nothing too crazy yet. Temperature is rising. It's a slower process. It seems as if the infrared is reacting a lot more with the ground when it's bounced back from CO2.

Interviewer: What effect do you think that has?

Participant: I think it probably dries out the earth more. Maybe reduces the nutritional. I don't know, does the earth have nutritional value?

Interviewer: Yeah, I think it does. I think it does.

Participant: It has to give some type of life to the plants with their, yeah, it's probably taking away the fertility of the earth. Making it less habitable for vegetation.

Interviewer: In terms of temperature, do you think that maybe having more infrared hitting the ground might ...

Participant: Absorb more of the temperature, than having no ground, yeah.

Interviewer: What's the temperature looking like right now?

Participant: It's like halfway than what it was with the infrared on the CO2. It's fluctuating up and down.

Interviewer: Do you think this confirms your prediction from earlier? That it would be, that we would see a higher temperature on this screen than on the first screen, when there was no CO2?

Participant: A higher temperature on, yeah, I think it is a higher temperature. Not by very much yet though, I think it takes a lot longer than what the frame is showing me. For global warming to occur like that.

Interviewer: Okay. Why do you think the temperature is higher on this screen?

Participant: Because of the CO2. Because it allows for the manifestation of higher temperature. The chemical composition of the ground, that's what it is. Like nitrogen and the amount of oxygen and stuff that it has to give to plants, because plants need nitrogen and oxygen and all that stuff to create sugar and oxygen, photosynthesis.

Interviewer: Cool. If you could just summarize for me one last time, the process of the sun and the ground and the CO2?

Participant: The sun is delivering rays, which also, and also infrared rays, and then there's the CO2 in the air, so the infrared is reacting with the CO2 and bouncing off of it in different directions rather than just exiting the atmosphere. Sometimes it bounces back onto the earth and reacts with the chemical composition of the soil. The result is the suddenly rising and fluctuating temperature. Global warming.

Interviewer: All right. How do you think humans might come into this picture here?

Participant: I don't really think that our machinery plays a significant role on the heating and cooling of buildings, which gives off the most energy disruption, renewable energy, that kind of thing. I think that more than anything, our eating habits and animals we decide to consume, affect greenhouse gases. If we can have meatless Mondays, it probably would change the course of the environment a little bit.

Interviewer: So if you're saying that, because we consume animals, we're creating more greenhouse gases?

Participant: Yeah, because we produce them in mass quantities, way more than there are supposed to be. Their waste gives off methane and CO2 and whatnot. That's what really reacts with the infrared and causes this environmental impact.

Interviewer: All right, great. What I'm gonna do now is play you a short video, that is going to summarize everything we're talking about here. I'm gonna step out, because I've seen this video like a hundred times. I'll be right back.

Participant: Okay.

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think that Earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in The US and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how Earth temperature works without considering how humans influence it. The Earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light. But because the Earth is colder than the sun, it emits lower energy infrared light. Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed any minute by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the Earth's average surface temperature would be about 50 degree Fahrenheit cooler, which is well below the freezing point for ice. How have humans changed things?

Since the dawn of the industrial age, around the year 1750, atmosphere carbon dioxide has increased by 40%. Methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range. In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase. Thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: All right, what do you think?

Participant: I was like 85% right.

Interviewer: 85, oh.

Participant: I guess like, because I always see the diagram of the sunlight coming off and bouncing back, they never explained that the earth is the one that produces the infrared rays. That was new. I didn't know that greenhouse gases absorb them, I just thought they reacted, I didn't really know which way.

Interviewer: All right, so I think that's more than 85%. That's more like 90.

Participant: Yeah.

Interviewer: A couple of details here and there.

Participant: Yeah.

Interviewer: All right, so tell me what are your thoughts, more broadly, what are your thoughts and feeling about climate change?

Participant: I think it's disturbing to see so many people in power kind of just shrug it off as if the Earth isn't something we need. Especially since like, can't have policy change if you don't have an Earth, so it's just frustrating. Especially since it's gonna take a lot of time to go through these changes, but we don't have that kind of time.

Interviewer: You feel a sense of urgency?

Participant: Yeah.

Interviewer: Okay, so do you think that, so not everyone has that sense of urgency.

Participant: Yeah.

Interviewer: In fact, some people don't believe that it's a thing.

Participant: Yeah.

Interviewer: What do you think, do you think that, what do you think about that?

Participant: I think it's propaganda and a lack of education that has influenced, and like money, I feel like money plays a higher part in not believing in global warming. Mostly because the people that have instilled that propaganda probably know that it's a real thing, they just want the money from the benefits of not regulating the environment. The immediate benefits. Because there are also a ton of long term benefits from actually instituting these environmental regulations. I think it's really sad. Especially when people with higher education don't believe it also.

Interviewer: Yeah. I hear you. Do you think that science is a relevant aspect of understanding climate change?

Participant: Yeah, I think science is relevant to everything we do, from the conversations we have about feelings to walking down the street. I think science is very present in everything.

Interviewer: All right. You believe then, you buy this whole greenhouse effect thing. Because you know, it's like a model. It's not a video game, but it's almost like a video game.

Participant: Yeah, it's not something tangible, but it's scientifically backed by research. I feel that science is consistently checking itself, so I believe it.

Interviewer: All right. Do you think that normal people should be concerned with this?

Participant: Yeah, I think normal people should be concerned on a daily basis, in terms of their actions, from small things and to like meatless Mondays. Driving and stuff like that, I think that should always be in the back of people's minds. Especially normal people because we have the biggest impact with like Grassroots action and whatnot.

Interviewer: All right. Do you feel connected to the issue?

Participant: Yeah, I feel that environmental issues are very intersectional, and a lot of the people that suffer the consequences of environmental impacts are people that are in poverty and people that are minorities. I, as one that identifies with both, feel the impact of environmental disregard in my daily life, consistently work to relieve that in the little ways I can.

Interviewer: So the disregard of people in general, or?

Participant: Yeah, of people in general and just underprivileged people. For instance in Los Angeles, with gerrymandering, and the segregation of neighborhoods. Primarily impoverished and POC neighborhoods are ones with business that don't follow CO2 and emission regulations and are close to schools. I know that those kinds of chemicals in the air so close to families and homes and elementary schools affect the brain development of younger children and babies and women that are pregnant. That affect the learning abilities of those children and just gives them more disadvantage in life. But at the end of the day, that if we don't even make it that far, we don't have an Earth, so.

Interviewer: All right. Do you think that you do things, like you, are there things that you do in order to reflect some global consciousness or?

Participant: Yeah, I believe I do my best, but sometimes it's hard. I don't have a car, partially by choice. I try my best to take public transportation everyone, I try my best to volunteer for these kinds of environmental things or activist causes mostly. With no dapple, it was something that affected me directly racially, but also with the effects of not having water and what we saw happening [inaudible 00:26:27], we did not want that to happen on a reservation, but it frequently does and it probably will happen because [inaudible 00:26:32]. I don't eat meat very frequently, especially red meat. What else do I do? I always turn the lights off, I usually live in a nice and renovated home so they're all up to

date on their applInterviewerces and whatnot. I don't really donate to Greenpeace, mostly because they're not intersectional, but those types of things.

Interviewer: What do you mean by intersectional?

Participant: They don't really focus on environmental racism. They only shout and holler about endangered species, which is important equally so, but it's also very important to take care of the people that are suffering the most damage from the environmental impacts. So if I'm donating my money there, it's like what are you going to do for my community?

Interviewer: I think it's really interesting that you see the issue of climate change as being, and race as relating to each other. Tell me more about that.

Participant: I think I've always had, I grew up in Seattle. A lot of what we do is centered around like, [inaudible 00:27:47]. From a very young age I was taught global warming was a thing. I think at the age of eight I watched, or maybe I was a little older, but we watched like an unconventional truth, my mom made me stay awake for that whole thing. It was just like oh, this is interesting. I don't know, growing up in a neighborhood where it was obviously that we didn't have access to the same kind of food that other neighborhoods did. We didn't have access to the same kinds of advantages that other kids did. It was very obviously that this place was dirtier and this place was cleaner.

There's trash over here, and there's no trash over there. The water is cleaner there, and it's, admittedly, the water in Washington is really clean as a whole. Coming to Los Angeles, I recognize it's a lot heavier here, environmental racism and whatnot, but. Also, I watch a lot of documentaries and I've seen the plastic factories being built next to homes, that have people that can't move immediately, and they've been there forever and that kind of thing. It's awful and people get cancer much faster than intended.

Interviewer: I see, so it's like the impact, you're saying the impact of humans screwing up the environment, it's impacting certain groups more than others.

Participant: Yeah.

Interviewer: Okay. One other question I have for you was, do you practice no meat Mondays? Meatless Mondays.

Participant: I don't do it necessarily on Monday, but I will only eat meat like maybe two times out of the week. Just because I don't have money for meat. I don't want to cook it and sometimes I forget that it's there. If I cook something old, I can get really sick. It's more of just like, I don't have time, it's too expensive and I'd rather eat soy nuggets anyways, so yeah.

Interviewer: All right. Okay, and then last few questions. In the last 30 minutes or however long we've been sitting here. Has anything that we talked about or you've seen, changed your mind about anything in particular?

Participant: Not really, but it's definitely refreshed my mind about all the things that I've learned about it working at the aquarium. Because we just learned a lot about the fish and the effects of runoff and the way the ocean produces 50% of our oxygen and things like that. It's just like, I don't get to see the ocean everyday, but I know it's there and I know it's very important. I just don't really think about the ocean a whole lot anymore, but it's a huge part. Heat plays a huge part in global warming as well.

Interviewer: If you could, like the mechanisms of climate change. If somebody came to you and asked, "Oh, how does climate change work?" What would you say?

Participant: I would say, now I would say, the sun sends its rays down to the earth and the earth creates infrared rays and it's supposed to bounce them back into outer space, but sometimes our CO2 emissions and methane affect and absorb infrared. The infrared being trapped in our atmosphere causes heating of the earth. It's surpassing the average temperature of the Earth and the temperature capacity of the Earth, so it's damaging it.

Interviewer: Great. Notice that you didn't mention ozone this time at all?

Participant: Yeah.

Interviewer: Yeah.

Participant: I think that, is that a myth? That the ozone layer is deteriorating?

Interviewer: Well, that is not a, I think that, I don't know, don't quote me on this but I think the ozone deterioration is slowing down.

Participant: Oh, okay.

Interviewer: But there was deterioration of the ozone, but it's a totally separate issue.

Participant: Yeah.

Interviewer: It's like, without ozone you get ultraviolet rays like you had mentioned, but that causes sunburn and destroys coral reefs and things like that.

Participant: It is completely different from infrared.

Interviewer: Right. And completely different from infrared and heating of the atmosphere. Those are two separate ...

Participant: Two separate environmental issues, okay.

Interviewer: Mm-hmm (affirmative). But they are both environmental issues.

Participant: Okay.

Interviewer: Okay, do you have any questions for me?

Participant: Nope.

Interviewer: All right, great, that's it.

Participant: Awesome.

Interviewer: You're done. Thank you so much.

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Interviewer: Tell me everything you know about climate change.

Participant: I know that it's an issue that should rightly be addressed. I think that our country should be doing a better job of sustaining the environment to stop global warming and to prevent climate change, I mean, to a certain extent. Obviously it's natural like that happens, but also I just think there could be better efforts made to just make the environment more sustainable and not be using so many pollutants. The way that we farm and the way that we produce food and the way that we manufacture our goods because it's adding so much pollution to the atmosphere. That's causing the ozone layer to make climate change happen, something like that. Don't know the specific science around it, but yeah.

Interviewer: When you say climate change, what is changing about the climate?

Participant: It's getting warmer in places where it's usually colder and it's melting ice stuff where polar bears live. I can't think-

Interviewer: [crosstalk 00:01:13]

Participant: Yeah, and in places that it's usually warm it's kind of cooler.

Interviewer: Okay. You mentioned some stuff about pollution. Tell me as much as you know about how climate change works to your understanding.

Participant: I don't know a whole lot about it. I just know that pollutants in the air kind of erupt, I don't think it's the right word, but break down the ozone layer that covers our atmosphere and protects us from the harmful rays of the sun being too much. The more that that breaks down the sun's able to just, the planet is overheating from the energy from the sun that is able to pass through the atmosphere more clearly without having that protective layer that sustains life on the earth. The more that that breaks down and our planet overheats, eventually over time it could be not sustainable to life.

Interviewer: Okay, let me see if I, okay. All right, let's move on to the simulation then.

Participant: Cool.

Interviewer: What do you see here?

Participant: The sun and these look like particles. I don't know what they're supposed to simulate. Is that like the CO2 in the atmosphere, or is it, yeah I'm not sure what those are.

Interviewer: For this one, it's the sun and the ground.

Participant: Okay, that's the ground. Okay. Sun, ground, and then there's CO2, O2, H2 in the air [crosstalk 00:02:57].

Interviewer: Have they shown that on the screen or are you just kind of assuming that it's the-

Participant: No, I'm assuming that that's there.

Interviewer: Okay. Did you see the labels and the meters and things like that that are on the screen?

Participant: Yes. Sunlight is represented by those waves, infrared is like that because ultraviolet is greater frequency. Then infrared are slower. Then temperature, is that like cooler and then hotter as it goes up?

Interviewer: All right, great. What do you think will happen when we click the play button that is at the bottom?

Participant: UV rays from the sun will travel through this, which is the atmosphere I'm assuming, and hit the ground and particles on the ground, or just the ground.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: UV rays from the sun are coming down hitting the ground, exciting the ground and making it warmer. The temperature rose a little bit and is still rising just a little bit the more that the energy from the sun is exciting the ground, the particles on the ground.

They're moving a lot and that just shows that they're getting hotter the more kinetic energy that they have. Then infrared rays are coming off of the ground. The energy from the sun, the UV rays hits the particles, excites them, and they send off infrared into the atmosphere. The more that keeps happening, the more kinetic energy, the more excited the particles are, and then the hotter the ground gets and the temperature rises.

Interviewer: Good. What made you say that it's UV rays?

Participant: Because I know that sunlight has UV rays, I know that there's infrared and ultraviolet, and ultraviolet, the frequency is greater and the wavelength is shorter and infrared are longer. Also, just because infrared is longer and then I know ultraviolet is the opposed, then they have the visual light spectrum.

Interviewer: Yeah, so in the screen, you're right. UV rays have a higher frequency and that's these rays that you see here have a higher frequency than the infrared, but sunlight actually contains all frequencies of light.

Participant: Okay, that makes sense.

Interviewer: At different proportions. It has some infrared in it, it has some UV, it has everything. Even though it's just one big squiggle packet thing, it's actually got all the different-

Participant: Okay, so it's just sunlight I guess.

Interviewer: Yeah, sunlight's the mixture. It's the mixture of frequencies of waves that our sun sends out. Okay, if you could just summarize for me one last time the interaction between the sun and the ground.

Participant: The sunlight is traveling in waves to the ground, exciting the particles on the ground, which is causing them to have an increase in kinetic energy and give off heat as a result, so the temperature of the ground and the earth is rising.

Interviewer: You said some stuff about the infrared rays earlier?

Participant: Yeah, it looks like, I think it looks like when the sunlight hits the ground those particles that are being excited are sending off infrared rays into the atmosphere. That's what it looks like.

Interviewer: Yeah. You said that the motion of the particles has more kinetic energy, more heat, and more temperature, right?

Participant: Mm-hmm (affirmative).

Interviewer: Do you think the temperature's going to continue to grow, or do you think it's going to go down, or stabilize.

Participant: No, I think it will continue to rise the more that that keeps happening.

Interviewer: Okay, let's go onto the next screen then. Sun on CO2, you see the option? Yeah. Okay, what do you see here?

Participant: Sun, and then CO2 particles in the atmosphere. Temperature is, right where it's at now, if it goes up it's increasing. The same things about the sunlight being represented by those and then infrared being represented by that.

Interviewer: Yeah. What do you think will happen when we click the play button?

Participant: I think that sunlight will travel through the atmosphere, maybe excite CO2 molecules? I don't know about infrared. Maybe they'll send off infrared.

Interviewer: Good guess, let's find out. Okay, what do you see?

Participant: Sunlight is traveling through the atmosphere and CO2 molecules gas, so they're just free floating like gas molecules do, and the temperature is stabilized, and there are no infrared rays.

Interviewer: If you could summarize the interaction I guess between the sun and CO2, how would you describe it?

Participant: There's really not much of a reaction between them. I don't know. I would just, yeah, no there's really not. They would just be moving, free floating, because they're a gas anyway.

Interviewer: All right great. Let's go to the next model. Infrared on CO2. Okay, what do you see here?

Participant: Just a bunch of free floating CO2 molecules in the atmosphere.

Interviewer: What do you think will happen when we click the play button?

Participant: Infrared molecules from, I mean infrared, wow. Infrared rays from the ground that were coming off the ground in the first simulation will probably travel or pass up through the atmosphere through the CO2 molecules. I don't know if they'd have any reaction with them, or interaction with them rather.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: It is having some interaction with the molecules. They're turning yellow, I don't know what that means, but the temperature is rising substantially, very quickly, and it's really exciting the CO2 molecules and they're just moving really quickly, bouncing off each other. When they bounce, when they crash with another is when they turn yellow. I don't know what that means, but yeah. That's kind of scary.

Interviewer: Okay, and you said that you noticed that the infrared was interacting with the CO2 this time.

Participant: Actually, no. I changed my mind. I don't think the infrared is interacting with the CO2. Actually, maybe it is. I think when the infrared rays are passing through it's exciting them somehow, so yeah I guess it is interacting with the sort of to a certain extent. I don't know if it's necessarily interacting with them or if it's just the presence of the infrared rays is causing the CO2 molecules to move quickly, but they're interacting with each other, not with the infrared, if that makes sense. It's like of it in the atmosphere is causing them to interact with each other.

Interviewer: Do you notice, you say that you noticed that the glowing, right, some of them are glowing, and sometimes they're not. Maybe if we go into slow motion

mode. Do you see the slow motion button at the bottom? Maybe it'll be a little bit more clear what's going on here.

Participant: Oh.

Interviewer: What do you notice this time?

Participant: When they're glowing, they're sucking up the infrared rays. When they're not glowing they're exerting the infrared rays. Actually, I don't know if they're infrared rays, they don't really look like infrared rays. Oh, they are, because it says there, nevermind.

Interviewer: Yeah, I see what you mean because they don't look exactly the same, but yeah.

Participant: Yeah, they look a little bit different, but-

Interviewer: They are supposed to be infrared rays.

Participant: Okay, then yeah. They glow when they get the infrared rays, and then when they're, then they put it back out into the atmosphere, and that's when they go back to green.

Interviewer: All right, great. If you could summarize for me one more time the interaction between infrared and CO2.

Participant: When infrared molecules are in the atmosphere CO2 molecules are, wait, did I say infrared molecules? I didn't mean that. When infrared rays are in the atmosphere the CO2 molecules are absorbing the energy from them and then releasing them back out into the atmosphere. That energy that they absorb causes them to move more quickly, thus have more kinetic energy and produce more heat in the atmosphere.

Interviewer: Great, and when they're releasing these infrared rays, are they releasing them in the same direction every time?

Participant: No.

Interviewer: How do you know?

Participant: It just doesn't look like they are. It looks like they kind of, because they come up straight up, and then when they're released they're on a diagonal or just going this way and that way.

Interviewer: All right.

Participant: See? They're going up and then they're coming released down like that, or up like that. Yeah.

Interviewer: All right, great. Let's go into the fourth model, sun on ground and CO2. What do you see here?

Participant: There's CO2 molecules in the atmosphere, sun, ground.

Interviewer: What do you think will happen this time?

Participant: I think that sunlight will travel down in rays, hit the ground, excite the ground, the ground will release infrared into the atmosphere. The infrared will be absorbed by the CO2 molecules, exciting the CO2 molecules, causing there to be more kinetic energy in the atmosphere which rises the temperature. As these CO2 molecules absorb the infrared lights and get more energy, they'll then release them back aimlessly in different directions. Yeah.

Interviewer: Okay, nice prediction. Let's see what happens.

Participant: Should I keep it in slow motion?

Interviewer: It's up to you.

Participant: Yeah, [inaudible 00:15:04]. Okay, I will.

Interviewer: Okay, what do you see?

Participant: So sunlight is traveling down, exciting the ground. The temperature of the ground is rising a bit and releasing infrared rays into the atmosphere which then is exciting the CO2 molecules, no they're not. It doesn't look like they are. They're just releasing, oh yeah no it is, that is, okay. The infrared are traveling back up into the atmosphere, interacting with the CO2 molecules, exciting them, rising the temperature, and then those CO2 molecules are then releasing the infrared back down to the ground, and it just keeps doing the same thing. Some go into the atmosphere, but some go back down to the ground.

Interviewer: Does any of this have an effect on the temperature?

Participant: Yeah, no, it's increasing the temperature.

Interviewer: Why is that?

Participant: Because the more kinetic energy the more heat is being released.

Interviewer: Right, and do you think that the temperature on this screen is going to continue to rise forever, or do you think it's kind of stabilized where it's at?

Participant: I think it's continuously rising at a slow rate and I think eventually ... I don't think it would go back down because the sun's going to keep sending sunlight to the ground, which is what's initiating the whole reaction, or chain of reactions, so I

don't know if it would go back down. I would say when eventually they just use up their energy it would go back down, but then they're just going to be re-energized by the sunlight anyway. Unless that were to disappear. No, I don't really think it would go down. I think it's just going to continue to rise, just very, very slowly.

Interviewer: Has it risen much since you've been explaining that to me?

Participant: No. It looks like it keeps going up and down.

Interviewer: Do you think that if the sun kept shining on the earth that the earth temperature would continue to rise forever?

Participant: Probably not, but I don't know what would stop it from doing it. I don't think it would, I just don't know what would prevent it from rising for a very ... I don't know.

Interviewer: The reason is because-

Participant: Energy from the sun excites the particles on the ground and in the atmosphere.

Interviewer: There's no stop to the sunlight, right, so you're thinking because the sun just keeps glowing and keeps glowing, the temperature should keep rising and keep rising, right?

Participant: Yes.

Interviewer: Yeah.

Participant: I hope that doesn't sound stupid.

Interviewer: No, it's reasonable.

Participant: But it isn't going to rise forever, I just don't know what's stopping it.

Interviewer: Well, if you ... This is interesting conversation. If you let something, if you heat something up, is it going to stay at an excited temperature forever?

Participant: No, it'll eventually reach a point where it can't go higher anymore, but it won't go back down unless it's acted on by something else. If the heat is removed, eventually the temperature will go back down.

Interviewer: Right, or but do you have to actually physically remove heat from something, or do you think it emits heat?

Participant: What do you mean?

Interviewer: Think of a pie. You put a pie in the oven. When you take the pie out of the oven, is it going to stay hot forever?

Participant: No.

Interviewer: Why not?

Participant: Because the, what's it called, the law of, not the law of thermodynamics, but it is [inaudible 00:19:16], I don't know. When you, eventually, so heat travels from a hotter object to a cooler object until eventually homeostasis, that's the word I was looking for.

Interviewer: I see what you're saying.

Participant: Until eventually it reaches, each are equal.

Interviewer: Yeah, so the same thing is happening with the earth. As sunlight's coming in, it's also coming out.

Participant: Yes, that's true. It's reflected back out.

Interviewer: When it's reflected out, it's not always the same as it was when it came in. You even said, some of the rays that come out are infrared, right? That's what's allowing it to cool, is that it's releasing infrared back out. When you take a pie out of the oven, you can feel the heat coming off of the pie. That's the pie going back to homeostasis or whatever you want to call it, and cooling down to become equal with the environment that it's in.

Participant: Right.

Interviewer: With that said-

Participant: I don't think that the sun's going to make the earth heat forever, but I do think it is going to keep it at a higher temperature, but yeah.

Interviewer: What do you think the effect of having CO2 has on the temperature? Yeah.

Participant: The effect that CO2 has on the temperature?

Interviewer: Mm-hmm (affirmative).

Participant: Because CO2 is absorbing the infrared rays and getting energy, that energy of the CO2 molecules is causing the temperature to rise.

Interviewer: If we were to go back to the first screen, we don't actually have to, and compare where they're no CO2, how do you think the temperatures will compare?

Participant: I think the temperature is stabilizing higher here because there's CO2, but in the first one it was stabilizing a little lower.

Interviewer: Yeah, right. If we, let's say, double the CO2 on the screen there-

Participant: The temperature would be higher, for sure.

Interviewer: Why is that again?

Participant: Because the more CO2 molecules there, the more there are to absorb the infrared energy, the more excited they're going to get, the more kinetic energy, the more heat, I think.

Interviewer: All right. Do you think humans might have anything to do with this?

Participant: Yeah, we release carbon dioxide into the atmosphere in many ways, just from our breathing in and of itself, but also just through the pollution is carbon dioxide that we're letting out into the air.

Interviewer: All right, great. What I'm going to do now is show you a short video that's going to summarize what we've been talking about here. Yeah, this is it. I'm going to step out just for a second but I'll be right back.

Speaker 3: You may have heard of global climate change, which is often called global warming, but how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming? What is the physical or chemical mechanism? In one study, we asked almost 300 adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light, but because the earth is cooler than the sun, it emits lower energy infrared light.

Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere such as methane and carbon dioxide let visible light pass through, but absorb infrared light, causing the atmosphere to retain heat. This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect cause by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

How have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has almost tripled. These increases cause extra infrared light absorption meaning and extra greenhouse effect, which has caused earth to heat above its typical temperature range. In other words, energy that gets to earth has an even harder time leaving it, causing earth's average temperature to increase, thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay, what do you think?

Participant: That makes sense, but it's like what was shown in the simulation.

Interviewer: It fits your understanding of how climate change works?

Participant: Yeah, for sure.

Interviewer: Okay, great. Now let's talk about the global warming on a more broader scale. What are your thoughts and feelings about global warming?

Participant: I think it's a problem and I really want it to be addressed because it's just not good for the environment if it's overheating because, the thing is, like it said, if we didn't have the greenhouse effect, the earth would be cooler and well below the freezing point of ice, which is too cold to sustain life, but similarly if it's overheating it's going to eventually reach a point, well it already is higher than it normally would be, or should be, and if it keeps increasing eventually it's going to reach a point where the surface of the earth is too hot to support life.

It's a problem because humans with their increasing technology and stuff like that might be able to figure out a way to live despite that, but it's not going to be naturally, I think. They wouldn't, it's not going to be able to support plants or trees or produce, food that we eat. Everything is just going to be manufactured, I don't know, that just bothers me because it's not how it should be. I don't even think, even with that, no matter how many, we're just going to be trying to manufacture homes and not be able to go outside because we're not going to be able to live because it will be too hot. I don't even know if we'd be able to do that, but it just basically wouldn't be able to support life unless people tried to find a way to still inhabit the earth or move to another planet, which is just ridiculous because we're just going to wind up destroying anything.

Interviewer: You say that it's going to effect people. You think it's going to effect all people?

Participant: Yeah.

Interviewer: Okay. You obviously think it's a real thing, you believe it?

Participant: Yeah, I do believe in it.

Interviewer: You know that there are some people who kind of debate, who say that it's not real. What do you think about that?

Participant: I think they're unintelligent. They [inaudible 00:27:43] Donald Trump doesn't inform himself of the issues that are backed with scientific proof and evidence for their existence, and he's just like, "No, it's not a thing", but there's clear evidence it is a thing. I feel like also maybe the word isn't out there enough in a way that it's going to reach people in an effective way. Yeah, we hear about the words climate change and global warming, but just like that study proved, nobody really know what that means.

If they don't really know what that means and we're just having these words tossed around, some people are going to be like, "Oh, no, that's just for people that are all environmental friendly, they just think that's a thing when it's not", but they're not realizing this is what's causing it and thus this is what we need to do to stop it, because if we don't this is what's going to happen. No one really has that spelled out for them. I think no one's also really taking an initiative to learn and to be informed of the severity of it and the science behind it.

Interviewer: You think that the science is related then? It's an important aspect of the-

Participant: Yeah, because there's evidence that it's a thing.

Interviewer: You believe the science?

Participant: Yes, I would say so, I think so, yeah. That's not super detailed scientific experiment. It's just like, greenhouse gases is a thing. I'm sure that there are studies out there that I would like to learn more about before I say, "Oh yeah", but I'm pretty sure there's evidence. I've seen documentaries on how the polar ice caps are melting and endangering polar bears. Just in general how certain states have never gotten snow, have gotten snow recently. I don't know how that really effects it, why it's cooler, but I think that plays a role in it. Just in India how the pavements were melting because it got so hot. There's just evidence that something's going on. Things are changing.

Interviewer: Okay, not to keep going at it, but so then the visualization I showed you shows things that you can't normally see with the visible eye. If you go outside you can't see the CO2, you can't see the infrared, but you do believe that that kind of stuff is happening?

Participant: Yeah, because I believe in physics and I know a little bit about how that stuff works. It would make sense that that's what's going on. Again, I don't know the details of the science behind it that proves it or why people have that idea about it, because we obviously can't see it, but I'm sure that they know that from somewhere. There are scientific evidence that has backed up those ideas or it wouldn't be such a big thing.

Interviewer: Do you feel connected to the issue?

Participant: To a certain extent, yeah, because I feel like, I myself do things that adds to it. Sometimes I just might not be aware of it, but every time I support stuff that does it, or just everything. Every time I drive my car that adds pollutants into the air. Every time, I don't know, I can't think of other stuff right now. Just existing, I'm adding carbon dioxide to the air. Not in excess, it comes from pollutants. I mean like supporting industries that add pollutants into the environment. Obviously they're existing because they have people supporting them financially. Every time I give in, every time I but something that was manufactured in a factory that produces pollutants, I'm playing a role in it, even if it's indirectly.

Interviewer: Do you feel like you do anything to show global consciousness?

Participant: Yeah, I try and take public transportation as opposed to driving. I try to, I'm part of an environmental group that tries to bring awareness to different environmental issues. I buy organic foods, there's no pesticides that are used to produce, I mean like in farming they don't use pesticides that add, because I work at Whole Foods I just watched, at my orientation, a video on conventional versus organic farming and how conventional farming methods add pollutants to the atmosphere and just chemicals it uses as opposed to just using natural fertilizer and soils to organically farm and have produce.

I try and, as much as I can, I try and just do that stuff.

Interviewer: Okay, great. Yeah, so over the course of the 30 minutes, however long we've been sitting here, has anything changed your mind about anything in particular?

Participant: I would say it's definitely something I want to look more into and learn more about the science behind it and get more involved in ... obviously once I've learned more about it, if I become more aware of how pressing of an issue it is without more detailed evidence to back it up. I'd want to get more involved in trying to get that message out to people and just try and actually create something that, just come up with an idea that's like, okay if we lived this way as opposed to this way does it help our problem. Just little things, it's a lot, but something that I'm definitely interested in.

We have organic food stores, and they're trying to move to the healthy environment, and that's becoming a bit more of a prominent thing, but what about all these other ... where we get our textiles from, they're made in factories, and how can we go back to older ways of doing things, which still are efficient and get the job done in a more eco friendly way, I guess.

Interviewer: Has your mind changed about the process of how global warming works?

Participant: Yeah, I feel like I understand it more, because I didn't really understand it. I was just like, "Oh, the ozone layer is breaking down, thus the sun has more of an impact on the earth." I don't know, that's not necessarily the case. It is, but it's more so the methane, carbon dioxide, and greenhouse gases in the atmosphere that are interacting with infrared that are causing the actual increase in temperature, which scientifically and physically makes sense. More sense than just ozone layers breaking down.

Interviewer: The ozone layer is a thing.

Participant: Oh that is, yeah.

Interviewer: It's just a separate issue. It increases sunburn, and I think it's messing up the coral reefs and things like that, but that's not what's responsible for the temperature rise.

Participant: Right.

Interviewer: All right great. That's it. You have any questions for me?

PARTICIPANT 18

Interviewer: Okay, to start tell me everything you know about climate change.

Participant: Having a negative effect on the earth, animals, aquatic life, the people, even land as well. Not land, ice and all that stuff. It's having an effect, negative externalities and stuff.

Interviewer: What causes climate change?

Participant: Pollution. I know pollution is one of them. What it does is there's pollution in the atmosphere, it causes either, I think it's UV rays come into the earth, they stay entrapped because of the particles in the air.

Interviewer: Rays.

Participant: More of less what happens, basically.

Interviewer: Okay. Right, okay. Anything else?

Participant: Climate change. It's mostly anthropogenic causes.

Interviewer: Okay.

Participant: Human causes and stuff like that.

Interviewer: Okay. You believe it's a real thing that's caused by humans?

Participant: Yes, I do I definitely do.

Interviewer: All right. Let's take a look at a simulation then. All right, what do you see here. You can use the mouse whenever you want.

Participant: What do I see? I see just the sun lights up, that's the ground right? I think that's the ground?

Interviewer: Yep.

Participant: What do I see? Am I supposed to go through it?

Interviewer: We'll go through it together. Yeah.

Participant: Pretty much what I see, is just the ground and the sun.

Interviewer: Do you see the different things that you can click on, the meters and things like that on the screen.

Participant: Yeah, all that stuff yeah.

Interviewer: The temperature gauge on the right.

Participant: Yeah.

Interviewer: What do you think will happen when we click the play button at the bottom? Wild guess.

Participant: Probably nothing.

Interviewer: Okay. All right, let's find out. Okay, what do you see?

Participant: I see, rays being reflected off the ground, probably from the sun. UV rays probably. Being absorbed by the ground some of it. It's going in different directions. Yeah. It looks like it's leaving different as it came in, so maybe a different form of it or something. That's all I have to say.

Interviewer: Check out the legend on the left.

Participant: Okay.

Interviewer: You see it here?

Participant: Yeah.

Interviewer: You say it's coming out different to how it came in. Can you be more specific using that language?

Participant: Yeah, the sunlight, it comes in as sunlight. When it gets absorbed by the ground, and by the earth, and then comes out as infra red and then probably stays in the atmosphere, that's probably what causes ...

Interviewer: All right. If you could summarize for me one more time, the process that you're looking at here, at the sun and the ground?

Participant: The sun is emitting sunlight, and it's being absorbed by the ground or most of it at least. Then whatever isn't absorbed is probably being bounced back off into the atmosphere or the air, into this ... As infra red. As a temperature, at least. What I see.

Interviewer: Do you think the temperature there is changing? Is it going up, is it going down?

Participant: It's constant, at least from what it looks like from the meter at the side. It seems to be constant yeah.

Interviewer: All right, let's go onto the next screen. Sun on CO2. Yeah, if you click it, it goes to another screen. What do you see here?

Participant: I'm assuming those are probably CO2 particles in the air. Just all over scattered in the air.

Interviewer: What do you think will happen when we click the play button this time?

Participant: I think, it's probably going to stay around the general area, maybe. There might be more of it, I'm not too sure exactly.

Interviewer: What do you mean by it? More of ...

Participant: More of the CO2 particles.

Interviewer: Okay.

Participant: That's what it is, yeah.

Interviewer: All right, let's find out. Okay, what do you see.

Participant: I see a mixture of sunlight coming in, and I see the CO2 particles moving around as the sunlight comes in. It's scattering. Right. Sun light coming in. Like, it's not really going anywhere either. It's just staying in there. It's not leaving the area.

Interviewer: By it is not leaving the area.

Participant: The CO2 is not leaving anywhere, it's just there.

Interviewer: Okay. What about the sunlight?

Participant: Looks like it's passing right through and looks like it just keeps going through. Which I assume is going to be absorbed by the ground as well. Maybe emitted again by infra red. Yeah.

Interviewer: All right. Great let's go to the next screen. Infrared on CO2. What do you see here?

Participant: I see no sun, I see lots of CO2. Yeah. It's just constant. It's there by itself.

Interviewer: What do you think will happen when we click play this time?

Participant: I'm assuming that because there was sunlight it caused it to move around. Caused the CO2 particles to react in a certain way. It's probably just going to stay there. It's just staying there in that general area.

Interviewer: Okay. Let's find out. Okay, what do you see this time?

Participant: I see the infra red light, which is probably coming from the ground, passing through the CO2, it's going up. It's been absorbed, the CO2, has been absorbing the infra red, that's what it looks like. Some of them at least. Some of them are getting passed, going

straight up into the sky again, into the atmosphere. The other ones have just been absorbed by the CO2 particles. The infrared. Then doing that as the temperature is rising. The temperature is going up, now it's going down again. Maybe it's fluctuation.

Interviewer: Why do you think the temperature is rising?

Participant: I think it's because of all the CO2 particles that are there. Yeah. Maybe because the infrared is being absorbed by CO2 particles. The more that it absorbs, maybe the higher the temperature.

Interviewer: Yeah.

Participant: That's what I assume.

Interviewer: Okay. If you could summarize one more time the interaction between infrared and CO2?

Participant: Perhaps as the infrared is coming up out of the ground, it is being absorbed by CO2. The more that it is actually absorbed by CO2, it is causing the temperature increase.

Interviewer: Great, let's go to the next model, or screen. Oh yeah, the track pad doesn't work very well. You can try. Yeah, sorry. Okay, what do you see here?

Participant: I see a mixture of CO2 particles, the ground, I'm assuming is the surface of the ground, and the sun.

Interviewer: All right. What do you think will happen this time?

Participant: I think that with sunlight mixed with ... The sun lights going to come down into the ground, it's going to reflect it up, and it's come out. Whatever isn't absorbed is going to come up as infrared, and it's going to hit the CO2. The more CO2 there is it's going to cause the temperature to keep rising.

Interviewer: All right. Let's find out. Okay, what do you see?

Participant: I see it absorbed. I see it coming out little by little. It has infrared, some of them are hitting the CO2 particles. You can see on the right as that happens, you see the temperature slowly going up as well. At the same time, sunlight that isn't being directly absorbed is coming back up as well. It looks like. Yeah. It seems like it is starting to, the ground is unstable maybe, perhaps it's more energy being absorbed by the ground as well. I'm not sure exactly how it's affecting the ground.

Interviewer: If you say there's more energy, where would the additional energy come from that is hitting the ground?

Participant: More energy besides what is hitting the ground from the sunlight. I don't know, I'm not too sure.

Interviewer: Okay.

Participant: I wouldn't really know.

Interviewer: That's okay. Nice description of the whole process that you see here. You said the temperature rose as a result of all of that.

Participant: Yeah.

Interviewer: How would you compare the temperature on this screen to the temperature on the first screen, when there was no CO2?

Participant: I believe it was lower. It was actually lower. Now that it's going up slowly at least.

Interviewer: What do you think accounts for the difference in temperature.

Participant: All the CO2. All the CO2, definitely that's what it is. I think it has to do with that.

Interviewer: Why exactly does the CO2 result in more temperature?

Participant: Some reason, I guess it traps light, or traps the infrared rays, I guess it causes more heating. Constant heating of the earth and the atmosphere. Yeah.

Interviewer: All right. How do you think humans contribute to this?

Participant: Everyway possible. The way you breathe, when you breathe, car emissions, factories, farmland, pesticides. Live stock as well, live stock that we raise as well. They emit things like methane and stuff like that, other pollutants as well. I think it's pretty much everything that all of our activities involve some CO2 emission, from what I see.

Interviewer: All right. Additional CO2, say that we double the CO2 on the screen. What do you think would happen?

Participant: It would probably be hotter. Yeah. Would probably get a lot hotter. It's like the way it looks, it's being absorbed. Whatever isn't being absorbed by the ground is either being absorbed by the CO2, at least that's what it seems like. The infrared, or not it's just being reflected back out into the ... Yeah. The atmosphere.

Interviewer: Great, what you basically described to me is called the Greenhouse Effect, which is the main mechanism that most scientists agree causes global warming. What I'm going to do is show you a short film that's going to summarize everything we've been talking about. Except not the credits.

Video Speaker: You may have heard of Global Climate Change, which is often called Global Warming. How much do regular people understand the science of climate change. Take a moment to try to explain to yourself how all climate scientists think that the earth is warming. What is the physical or chemical mechanism? In one study, we asked almost 300 adults

in the US, and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

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How have humans changed things? Since the dawn of the industrial age, around the year 1750. Atmospheric carbon dioxide has increased by 40% and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which is caused earth to heat above the typical temperature range. In other words, energy that gets to earth has a harder time leaving it. Causing earth's average temperature to increase. Thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: All right what do you think?

Participant: It was a good description of the visual example.

Interviewer: Is that your understanding of how this all works?

Participant: Yeah, I think the visual made it a lot easier. I knew how it worked, when you see it, when you see how ... I didn't know it was absorbed exactly. I just knew, that carbon dioxide had something to do with it. I don't know exactly how. When I saw that, it made it more understandable than just hearing it.

Interviewer: Mm-hmm (affirmative).

Participant: Yeah, a bit easier.

Interviewer: Good. Great. Let's talk about global warming more broadly. What are your general thoughts and feelings about global warming?

Participant: I think it's kind of scary. I definitely think it's scary. From what I've seen on TV. We touched a little bit on it in one of my classes. It's scary how over time we see and exponential growth in effects of what the temperature change is causing. It's definitely scary.

Interviewer: Who do you think it's going to effect?

Participant: It affects everyone. Everyone one way or another. We see how it affect wildlife, it gets hotter. When it gets hotter the plants or what ever they feed on it's harder for them to survive. Then they don't survive as well. It affects their production, or whatever. Then you have all the icecaps melting, these things like that as well. Polar bears. Everything is being effected. Humans as well, it's hotter, it makes it harder to grow food, vegetation. It's just scary, because it can affect every aspect of earth, pretty much.

Interviewer: The process in which this is happening. Obviously you think that it's a real thing.

Participant: Yeah. I do think ... I think if I hadn't seen things like this, or in classes things and what not. I definitely had my doubts.

Interviewer: Why is that.

Participant: Because you can't really see anything until you see the side effects or the science behind it. Maybe comparisons, or what not. You can just say that it's there, but if there's no actual explanation for it, then how can you say that it's really happening? Yeah.

Interviewer: The explanation that you agree with then, where does that come from?

Participant: From seeing an explanation I guess. Actually seeing it. For instance, you have a theory, or what ever, a theory of how it works. If you actually have some kind of example of how what you believe, it kind of makes more sense than just saying it's hotter because of this. There's no mediating variables that you get to see.

Interviewer: For instance the simulation that we worked with here, shows you things that you can't normally see with the naked eye. Really it's just an animation. Right. Do you think that these things are really happening?

Participant: I mean not directly through the animation. I think it helps the reasoning behind it. I think the science behind it, at least from what I have seen, is there.

Interviewer: Yeah.

Participant: I've seen videos as well where carbon dioxide like they actually have ... I don't know what they're called? Cameras where you can see it coming out of car tubes and stuff, and buses and factories. You can't see the CO2, but can through the actual lenses and what ever they're using.

Interviewer: Like in some video they show you what it would look like if you could see CO2?

Participant: Yeah.

Interviewer: Ah. Okay. All right. You believe the science?

Participant: Yeah. Kind of believe it.

Interviewer: Okay.

Participant: It does make sense too. The explanation to it. You have a car, the more cars you have, you expect there to be more CO2. CO2, we're also seeing an increase in temperature, that can also be due to the same ... There are also other variables as well. I think ... I mean, yeah, I do believe the science behind it.

Interviewer: Okay. Not everyone believes the science. Right, what do you think about that?

Participant: I think they don't believe it, because they don't really understand exactly how it works, and they can't really see it. Like the saying, seeing is believing. When you see the actual process going on, if you were able to have some kind of mask or something, or lens where you can actually physically see the effects of it, I think people would believe it. I think it has to do with seeing, I think that's what it is.

Interviewer: Cool. Let's see what else I have here. Do you feel like personally connected to the issue?

Participant: Somewhat, yes. Mainly because I live in the Central Valley, that's where I'm from originally. Central Valley. California. It's definitely CO2 levels were pretty high there, because we're entrapped by mountains. From San Francisco and here. Yeah, it definitely get hotter every year. It makes me wonder exactly what is going on, when you have the explanations like this. The cars, or CO2, CO2 levels are rising so it's causing ... You see a temperature increase as well, so you wonder is there's some like, correlation, or there's something going on there. It does personally. I feel it more often back there than I do here. Yeah.

Interviewer: Do you do anything about it?

Participant: Not as much as I can be. It's very hard, all parts of our life are connected to the emission of CO2, in one way or another. I do try to limit my driving once in a while. That's kind of hard to cut everything out, the emissions, and that as well.

Interviewer: You do try and cut down on your driving sometimes.

Participant: Sometimes. Rarely, because I mean you can't get anywhere up here.

Interviewer: Mm-hmm (affirmative). I'm just curious, in the central valley, there's a lot of agriculture, right?

Participant: There's a lot of agriculture.

Interviewer: Yeah.

Participant: It's predominantly agriculture, yeah.

Interviewer: They from what I know, have been hit pretty hard by the drought more than anyone else.

Participant: Yes, mm-hmm (affirmative). More recently, it's gotten better because of the massive floods that we've been having.

Interviewer: Mm-hmm (affirmative).

Participant: It definitely has been hit hardest. Most of the actual crops that we get, everything that we grow in central California, feed the rest of the United States as well. You do see a big effect. Yeah.

Interviewer: Mm-hmm (affirmative).

Participant: It does affect everyone, me personally as well.

Interviewer: Yeah. Okay. Thank you. A couple more questions. Over the last 30 minutes or however long we've been sitting here, has anything changed your mind about anything in particular?

Participant: Maybe from the video a little bit. I mean, when you see that visual picture of it, whether it's completely true or not. It keeps you wondering, what if this is actually going on, even though we're not visually seeing it, and it's constantly getting worse. The temperature is going up and you're seeing more CO2, you see more light being absorbed, and so it's like ... Yeah. I definitely feel like I learned that much at least.

Interviewer: The process of how it works?

Participant: Yeah definitely.

Interviewer: Maybe your attitudes are the same?

Participant: Yeah. I mean, I've always been a believer in global climate change.

Interviewer: All right. If you could just explain for me one last time, how it works?

Participant: What happens is the sun emits light, sun light. It comes in as energy and is absorbed by the earth, what ever isn't absorbed comes out as infrared, I believe what it was. The CO2 in the air, either captures it, or the CO2 that captures it causes the climate to increase. The more that there is the more its, the hotter it's going to get.

Interviewer: All right. Great thank you so much. That's it, do you have any questions for me?

PARTICIPANT 19

Interviewer: Let me ask you, tell me everything you know about climate change.

Participant: I know that it's bad. I know that it's getting worse and that it's human-caused. I also know that it's starting to become a more and more neglected issue, especially in our politics. In terms of chemically how it works, I know that we release carbon dioxide through factories, cars, just like a lot of the things that humans do, it releases CO2 emissions. Then, what happens is it gets built up or caught in our atmosphere. I don't know exactly how that works. It causes heating of the earth. I don't know the details but I know that it's because of our CO2 emissions mainly that climate change is getting worse.

Interviewer: Okay, and what is changing in the climate change?

Participant: Our earth is getting hotter slowly. Glaciers are melting, sea levels are starting to rise, that sort of thing.

Interviewer: You mentioned CO2.

Participant: Yeah.

Interviewer: Right, and you said that that's like one of the main causes.

Participant: Yeah, I think so.

Interviewer: You know that it's temperatures rising.

Participant: Yeah.

Interviewer: What's your best understanding of how the CO2 and the temperature rising are connected?

Participant: I don't know the details of how CO2 is involved specifically, but I know the sunlight, when it gets to Earth, instead of being reflected back up, it's getting caught within our system, I guess. The heat, instead of leaving, it's getting stuck somehow. Maybe because of stuff in the atmosphere like keeping the sunlight from reflecting off. I don't know the details.

Interviewer: Okay. All right great. Who does climate change affect?

Participant: It affects us as humans partly because our trees are starting to die and the sea level is rising. That's probably going to be something that affects us. It's going to

probably start to kill off ecosystems, so animals are going to start dying, so they're going to be affected. I don't know. Just like damage to the environment; it's going to impact humans because we live here. We breathe the air here and any kind of environmental change affects us.

Interviewer: Okay. Thank you. Now, we'll take a look at the simulation. You already know what tab it's in. Yeah, the trackpad is not working. So what do you see here?

Participant: I see the sun. I don't know what those are. I assume those are like atoms or like molecules on the ground and then a temperature bar. Yeah.

Interviewer: Yeah, and the molecules are supposed to actually represent the ground.

Participant: Oh, the ground. Okay.

Interviewer: Yeah. Those are like the molecules that make up the earth.

Participant: Okay.

Interviewer: Okay. What do you think will happen when we click that play button down at the bottom?

Participant: I think sunlight will start to get released and then we'll see how it interacts with the ground and maybe we'll see like CO2 getting released from the ground, if we're looking at human-caused climate change.

Interviewer: Hm. How interesting.

Participant: If there are like factories down there. I don't know. Yeah.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: I see sunlight getting released and then it's going back up. Temperature is rising slowly right now, and it seems like the ground molecules, particles, whatever, they're like moving around a little faster. The light, it's coming down in one direction but it's being reflected off in different directions and sometimes they're reflected back whole, but sometimes it's partially reflected back I guess, like the squiggly lines, it seems like it's being absorbed and then only part of it's released, whereas for other ones, maybe none of it's absorbed. It seems like it's getting faster, the particles, as it keeps going, and then the temperature is still rising.

Interviewer: All right. So you said that like when it's being released, it's being absorbed and then released and it looks different when it's released. Did you see the legend on the left there?

Participant: Oh, I see. Those look more like dots to me, but I guess it's that. The sunlight is the squiggly ones and then infrared is the dotted lines going back up.

Interviewer: Mm-hmm (affirmative).

Participant: Hm.

Interviewer: Great, so could you summarize for me the process one more time?

Participant: Process? Okay. Sunlight is released from the sun. It hits the ground and that excites the molecules on the ground and then sometimes sunlight is reflected back up, but sometimes infrared rays, I don't know how to describe them, are reflected back up instead, and I assume that's because some amount of the sunlight is being absorbed ... because it does go from sunlight to infrared so I assume the sunlight is disappearing somewhere, so I assume it's getting absorbed in the ground. I think that's how the process works. I don't know.

Interviewer: And the temperature?

Participant: The temperature, it's still rising, so I think that's probably the temperature of the ground and that's probably reflecting the sunlight that's being absorbed in the ground. We're seeing that not all of them are being reflected back as sunlight, so some of it's sticking around here, which is causing the temperature to increase.

Interviewer: Yeah. And do you think the temperature is going to increase forever or do you think it's about stable?

Participant: Right now it seems stable. I don't think it'll increase forever. Oh, well maybe. It's still increasing. Yeah, I don't know. I think, at least in this simulation, it'll increase forever I think.

Interviewer: And why is that?

Participant: Because the trend so far is that it's increasing and there's nothing to indicate that the trend would change at this point. I mean, sunlight is still being released at the same rate. It's still being reflected in the same way it seems like, so if it's been increasing up till now, I don't see why it would stop increasing, but I'm not sure. It actually does seem pretty stable. Oh, and it's decreasing too a little bit now. So I guess no. I guess it wouldn't increase forever. I guess it would depend on the amount of sunlight being released and over what period of time.

Interviewer: Hm. Tell me more about that. Why do you say that?

Participant: Because the temperature is sort of decreasing at some points, like right now it's decreasing a little bit, which makes me think there's ... I can't tell whether or not the rate of sunlight being released is changing, but I assume that it is if the

temperature is falling and increasing again. Now, it's increasing. It's increasing a lot now actually. Yeah, I don't know. I can't really tell if the rate of sunlight being released is changing or not, or if that even has anything to do with it.

Interviewer: That would be pretty tricky to see as well.

Participant: Yeah.

Interviewer: Interesting. Interesting that you noticed that. Okay great. Let's go to the next model. So on the left it says, "Sun on CO2." Yeah the trackpad is not really working very well.

Participant: Okay.

Interviewer: Okay, what do you see here?

Participant: CO2 molecules distributed sort of evenly throughout the air and then the sun off to the side.

Interviewer: Mm-hmm (affirmative). What do you think will happen when we click the play button this time?

Participant: We'll see sunlight being released and hitting the CO2 molecules. Well, some of them might not hit the CO2 molecules but I assume if the CO2 molecule is in the way, it'll hit it, and then possibly be reflected off as infrared but maybe reflected off as sunlight. I'm not sure how that interaction would work, but I assume we'll see the sunlight hit the CO2 molecules and the react in some way and be reflected off or absorbed.

Interviewer: Okay, let's find out. Okay, what do you see?

Participant: CO2 molecules are moving around, and it doesn't seem like the sunlight is interacting with it at all.

Interviewer: How do you know?

Participant: Because they're like going in the same direction. They're not changing direction or speed, and they're not reflecting off. They're not changing direction.

Interviewer: And the temperature?

Participant: It's not changing, or if it is, it's very small.

Interviewer: All right. Great. Let's go to the next model.

Participant: Infrared on CO2.

Interviewer: So what do you see here?

Participant: Only CO2 molecules distributed evenly.

Interviewer: What do you think will happen when we click play this time?

Participant: The CO2 molecule will start moving around, and I'm not sure how infrared will be involved. Maybe those CO2 molecules are going to release something. I don't know.

Interviewer: Let's find out. Okay, what do you see?

Participant: So I see infrared molecules being released from the ground I guess and some of them are hitting the CO2 molecules, and when they hit the CO2 molecules, I notice that sometimes they get absorbed and then sometimes they're reflected off. I'm not sure how that works. Yeah, some of them are definitely getting absorbed by the CO2 molecules which then give off a yellow light. The temperature is increasing a lot. I haven't been able to catch how it reflects off, but I can see them changing direction, which makes me think they're getting reflected off of the CO2 molecules.

Interviewer: Maybe it will help if you click the slow motion button.

Participant: Yeah. Yeah, it's still hard to catch. This is actually kind of confusing. I still can't see the point at which it like ... that one seems to just appear out of nowhere ... or maybe it's when it loses it's yellow tint it releases one in a random direction. Let me follow a yellow one. Yeah. Okay. When one that has absorbed an infrared ray I think hits another CO2 molecule.

Wait. Yeah, I think when that one that has absorbed an infrared ray hits another CO2 molecule, that releases an infrared ray. Yeah. The temperature was increasing a lot, but I think it's kind of stabilized, or at least it's oscillating between some point. Some of them aren't reflecting off infrared rays though when they hit each other, so I don't know what it is. It seems like it just releases it randomly at some point sometimes. Yeah. Yeah, I feel like it's kind of random actually.

Interviewer: A random release of the infrared?

Participant: Yeah, I mean, I'm sure there's a trigger for it, but I'm not able to catch it if there is one. The way that they get that yellowed color around them is definitely by absorbing the infrared, but I'm not sure how it's getting released. Oh, and the temperature is like way up again.

Interviewer: All right. So if you could just summarize for me one more time what you see on the screen.

Participant: I'm seeing infrared getting released straight up from the bottom and then some of them go all the way up, but some of them hit CO2 molecules, which I guess absorb it. Then at some point, those CO2 molecules will release infrared and it'll usually be in a sort of random direction. It could be back down or like up or sideways. I think it's sometimes because they hit other CO2 molecules, but sometimes it's released randomly. Yeah.

Interviewer: All right great.

Participant: And it causes temperature to increase.

Interviewer: Great. Let's go to the "Sun on Ground and CO2." Are you left-handed?

Participant: No.

Interviewer: No? Okay. What do you see here?

Participant: CO2 molecules distributed and then the ground and then the sun, and then the temperature bar.

Interviewer: What do you think will happen this time?

Participant: I think sunlight is going to get released and then absorbed by the ground and then the ground will sometimes release the sunlight but it'll also sometimes release infrared. The sunlight, when it reflects back up, it won't interact with the CO2 molecules but the infrared will, so what will happen is when the infrared is reflected back up, if it hits a CO2 molecule, the CO2 molecule will absorb it, and then at some point, that infrared will be released again in some direction. It could be back down to the ground or it could be upwards, and temperature will increase.

Interviewer: Okay. Let's find out. Okay, what do you see?

Participant: Sunlight is getting released in one direction. Yeah, so both infrared and sunlight is being re-released from the ground, and then some of that infrared will hit the CO2 molecules. Both the infrared and the sunlight is being released up in random directions from the ground. Temperature is increasing. Yeah, so the CO2 molecules will at some point release the infrared again. I feel like temperature is increasing more from before when it was just the sun and the ground. I feel like it was down here before.

Interviewer: Yeah. I agree. Great.

Participant: Yeah.

Interviewer: Great. If you could summarize for me one more time what we're looking at here.

Participant: We're seeing sunlight being released from the sun and then it hits the ground and is absorbed in the ground for some time and it's released from the ground either as sunlight or as infrared, so I assume some chemical change there is causing the sunlight to change and then it gets released from the ground in random directions and it'll either get released all the way up back into the atmosphere I guess, or it will hit a CO2 molecule that's present in the air.

If the infrared hits the CO2 molecule, it'll get absorbed and at some point the CO2 molecule will release the infrared again in a random direction. It could be back down to the ground or all the way up. I'm not sure if the infrared that gets released from the CO2 molecule to the ground gets released back up again. It's kind of hard to track on here whether it's constantly recycled. The temperature is still increasing.

Interviewer: Do you think it'll increase forever?

Participant: I don't think it'll increase forever. I think if the conditions are stable, if the number of CO2 molecules stays the same, the amount of ground remains the same, the rate of sunlight released remains the same, I think it'll remain relatively stable, but if the CO2 molecules were to increase or there were to be less ground that's able to absorb the light or something were to change with the sun, then I think something might cause temperature to go down or go up, but for now it seems stable. It is increasing and decreasing at some points, but it seems to be around a mean I guess.

Interviewer: So if we doubled the CO2 on the screen?

Participant: That would increase temperature. I don't know if it would double temperature, but it would definitely significantly increase temperature, and that's because the infrared that's getting ... there's more infrared that would be released from the CO2 molecules to the ground. Because it's being released in a random direction so the amount of infrared that's being released to the ground would increase.

Interviewer: Great. Yeah. We haven't seen a human in this picture yet at all, right?

Participant: Yeah.

Interviewer: But let's just imagine. How do you think humans change things?

Participant: Well, humans would change things one, by increasing the amount of CO2 in the air and that's by gas emissions, cars, factories, that sort of thing, and they would also impact I feel, because they change the landscape. I'm not sure how this kind of thing would work with a building perhaps. I don't know how cars reflect sunlight, but I feel like if there was less soil or less grass, which is something humans tend to do, like reduce trees and grass and soil and that kind of thing, I feel that that would impact this.

Probably if there was less of whatever this is exactly, if that's like soil, if there was like less soil, then ... I mean, I'm not sure how that would exactly change it. My guess is temperature would increase, but I'm not sure. Or maybe stuff like buildings are more likely to absorb sunlight and infrared. I'm not sure how that changes things, but humans would definitely change the landscape and the amount of CO2.

Interviewer: All right. Great. This whole process that you just described to me is called The Greenhouse Effect.

Participant: Yeah.

Interviewer: Most scientists believe that it's the mechanism behind global warming. I'm going to show you a short video that kind of summarizes what we were just looking at, and I'm going to go sit right over here, but I'll be right back.

Participant: Okay.

Video: You may have heard of global climate change, which is often called global warming, but how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming. What is the physical or chemical mechanism? In one study we asked almost 300 adults in the US and not a single person could accurately explain the mechanism of global warming at a pretty basic level.

Allow us to give you a short explanation of how global warming works. First, here is how Earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, Earth also emits light, but because the earth is cooler than the sun, it emits lower-energy infrared light. Earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere such as methane and carbon dioxide let visible light pass through but absorb infrared light, causing the atmosphere to retain heat.

This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep Earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees Fahrenheit cooler, which is well below the freezing point for ice.

How have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has almost tripled. These increases cause extra infrared light absorption,

meaning an extra greenhouse effect, which has caused Earth to heat above its typical temperature range.

In other words, energy that gets to Earth has an even harder time leaving it, causing Earth's average temperature to increase, thus producing global climate change. Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay what do you think?

Participant: What do I think? I mean, I agree with it. I was aware before that I wasn't giving a good explanation, so it's cool to know how it actually works. I know there's like CO2 involved. I've heard of the greenhouse effect, and I've heard of infrared, but I didn't know exactly how it all fit together. Yeah.

Interviewer: All right. So I'm going to ask you some questions now, kind of looking at your thinking about climate change more broadly. What are your thoughts and feelings about climate change?

Participant: I think it's an issue that's pretty easy for people to ignore just because I think it happens pretty slowly. It's not like super noticeable, or at least, we're not in areas where it would be super noticeable, where we could really see the damage. I definitely think it's an issue that deserves a lot of attention, but because it's not as hot as other issues, it doesn't receive the attention that it deserves. Yeah, like especially in our politics right now, the whole thing about the Environmental Protection Agency, like the guy that is in charge of that now not believing in climate change. Things like that.

When you hear about it, it's kind of upsetting because the people who should care about it aren't. For someone like me to not care about it, like, "Okay," I can get away with it because it's not my job. You can just say, "She's ignorant. Fine." But for the head of the EPA to not care about it is a whole other deal I feel like. Yeah, I don't know. Those are my thoughts on it.

Interviewer: Do you think the science is a relevant aspect of the issue?

Participant: I think the science is a relevant aspect of the issue, but I feel like that's not what the focus should be I guess. People need the science to believe that it's real, but when it comes to trying to raise awareness about climate change, I feel like it's not as effective, teaching people the science. Because teaching people that it's real is different than teaching people why they should care I guess.

I feel like peoples' attention span when it comes to science-related things, it's like a little bit less. I feel like someone is much less likely to remember this three-minute video than they are to remember pictures of ... I don't know, something, some kind of disaster that's caused by climate change. You know what I mean? People are more driven by emotion than they are by hard science

or hard logic. I think science is pretty important because especially to climate change deniers who are like, "Oh it's part of the natural cycles of the earth," and it's like, "No it's not. It's not natural. We're causing this." I think it's important in that aspect, but in terms of raising awareness, I don't think it should be the focus.

Interviewer: What's the most convincing thing for you? You obviously think it's a real thing.

Participant: Yeah. I think the most convincing thing for me, as in like convincing me that it's real, I think the science. I trust the science. I don't know. I'm a chemistry major, so I watch this and I trust it. I think for some people maybe, they watch this and they're skeptical, or they watch this and they don't really get it still, like how it would actually impact the earth. I'm not even sure I understand how it would actually impact the earth. I know it would be really bad, but I don't know what the tangible effects of it would be or how it would impact me directly or impact like future generations directly. Yeah, I'm pretty convinced that it's real.

Interviewer: It's the science mostly?

Participant: And it's the science mostly that ... I think maybe some people need more convincing than that, but the science is enough to convince me that it's a thing.

Interviewer: Okay. Yeah. Okay. Let me just see. I feel like I may be forgetting something. Do you feel connected to the issue?

Participant: I don't know. I feel more connected to other issues. I'll put it that way. I'm aware of the severity of the issue, but for whatever reason, it's just kind of hard to connect with, and I think it's because of that whole emotion thing. I don't know. For me personally, I'm Muslim American, so I'm much more likely because of that to be concerned with issues like Islamophobia, stuff like that.

I would say that's much more on the forefront of my mind. I'm much more likely to be stressed out about a bio final that's coming up. I think people have a reserve in their mind for things that they care about and even if climate change is a really big and important issue, I think it's hard to convince people to take out some space in their reserve to care about it because people are emotionally-driven. You kind of have to convince them this is going to be really bad, and here's how it's going to affect us, and here's why people should care.

Interviewer: But it seems like you care.

Participant: I mean, I care, but I'm much more likely to go to a rally against Trump than I am to start a campaign about recycling. You know what I mean? Or like protest against a company. I believe that those are things that are good to do, that should be done, but I'm much less likely to personally do those things, because that's like time out of my life that I need to separate out for, and I have other things going on. I think a lot of people feel that way. It's probably something

that 50 years from now we're going to look back on and regret, like, "Oh we should have separated out more time for this," but it's hard to realize where we are now, that it deserves more of our time, I think.

Interviewer: But it sounds like ... so you do care about, maybe not as much as other issues right now. There are a lot of issues right now.

Participant: Yeah, there are a lot of issues.

Interviewer: Are there any actions? Do you do anything?

Participant: I mean I recycle. My family owns electric cars, although I'm not convinced how beneficial that is for the environment because I have heard even the making of those cars releases a lot of CO2, or like gas in general. So I'm not sure how beneficial those things are. I'm from Washington, so I've always been taught to be very conscious of the environment. Small things like recycling. I don't litter. I feel like if I saw something laying around, I would pick it up and throw it away maybe. But beyond that, I don't know what else I would do that would actually help this issue. Yeah, I don't know.

Interviewer: So you don't feel like there's a lot of options?

Participant: Yeah. At least like in my daily life I don't feel like there's a lot of options. I feel like with things like social injustice, it's a little easier because one big way that you can help with that issue is you see something, you like intervene or you say something about it. You know?

Interviewer: Mm-hmm (affirmative).

Participant: But with something like climate change, which is a little bit more outside of our control almost, because it's not ... I wouldn't say it's average people that are causing it. I would say it's more larger structures like big companies with really bad policies. I guess you could say our capitalist economy, not that social justice issues aren't caused by bigger systems, because they are, but it's more easier to intervene on an individual basis with social issues than it is with climate change issues. Yeah.

Interviewer: I see what you're saying.

Participant: Yeah.

Interviewer: Huh. Over the course of these 30 minutes or however long we've been sitting here, has your mind changed about anything in particular?

Participant: I learned a little bit more about how global warming works. Not really. These have been my thoughts before about it as well.

Interviewer: Mm-hmm (affirmative). So your attitudes are about the same, but maybe you know more of the science?

Participant: Yeah. Pretty much.

Interviewer: If someone asked you to describe how global warming works, what would you say?

Participant: I would say global warming is human caused. It's because of the rise of industrialization. We're releasing more gas into our atmosphere and that's causing more heat to be trapped and causing our earth to warm. I feel like if I knew more of the environmental affects of it or the direct affects of it, I would try to communicate that as well to people who ask how global warming works, but I feel like I'd be able to give a brief overview of the science.

I still wouldn't be able to give the details, but I would say when sunlight is reflected, sometimes infrared light ... it comes down as sunlight, reflected off as infrared, and that infrared is captured in CO2 and methane molecules in our atmosphere. Then global warming is caused by an increase of those CO2 and methane molecules by humans, so the more CO2 we release into the atmosphere, the more infrared gets held within our atmosphere and the more our earth heats up.

Interviewer: All right. Great. Thank you so much. Do you have any questions for me?

PARTICIPANT 20

Interviewer: Okay. So first question. Tell me, I guess it's not a question. Tell me everything you know about climate change.

Participant: I know global warming. I know temperatures are rising. That's much it. I'm not very knowledgeable on it.

Interviewer: Okay. Do you, so temperatures are rising ... What's your best understanding for why they're rising?

Participant: Pollution. That's, I guess car emissions, and yeah. Factories, I guess.

Interviewer: Okay. Factories. Mm-hmm (affirmative). Anything else?

Participant: The burning of coal, but I feel like that's just the basic things they teach you in high school, but yeah. I don't know much.

Interviewer: These are things that you know, so ... Anything else?

Participant: No, not really.

Interviewer: All right. What are your feelings and thoughts towards the whole subject?

Participant: I definitely think it's a real thing, and I think it's happening. Like I said, I don't know much about it, so I wish we were a lot more informed of what's happening. Because I know species are dying, I know we're over fishing in the seas, and yeah. I guess deforestation, something happening too, so I wish we were more aware of what's happening and we could stop it, and prevent further pollution.

Interviewer: Who do you think it affects?

Participant: Well right off the back, deforestation for example, obviously affects the animals living in there, because they're pushed out, and eventually they will have no place to go, and eventually they probably will die off. I think that will essentially effect humans, because those are resources that we need, and the fact that they're gone, they're just going to be even more scarce for us. If that makes any sense.

Interviewer: Yeah. That makes sense to me.

Participant: Okay.

Interviewer: So, do you see trees as being a part of the climate change problem?

Participant: Yes.

Interviewer: Tell me more.

Participant: Well, they produce oxygen for us, so if there's no oxygen being produced ... They take in carbon dioxide, then there's going to be more carbon dioxide in the atmosphere, and that's kind of part of, I guess, global warming, I think.

Interviewer: Okay. Tell me more.

Participant: I think they, oh my gosh, I don't know.

Interviewer: That's okay. That's okay. All right. Cool. Well, lets take a look at this simulation.

Participant: Gonna prove everything wrong?

Interviewer: No, no. There is no wrong, there is no right. I just want to know what you think basically.

Participant: Oh, okay.

Interviewer: Yeah. What do you see?

Participant: Probably the sun? And I'm guessing that's, I don't know, soil? Maybe dirt? The little balls? And I think the sky is blue, and then the temperature says that it's low. Yeah. Oh wait, the sun is on the ground.

Interviewer: I want to see what I can ...

Participant: Am I supposed to look at that?

Interviewer: Yeah, yeah.

Participant: Oh, okay. Oh, am I supposed to select it? Or ...

Interviewer: Yeah, those are things that you can select, or unselect, but before we start selecting things, there's a play button at the bottom. What do you think will happen when you click the play button?

Participant: Probably the temperature will increase, and that's going to show a relationship between the sun and whatever this is. The little balls.

Interviewer: All right. Lets find out.

Participant: Can I press play?

Interviewer: Yep. Okay, what do you see?

Participant: The little balls are moving around. They're reacting to the sunlight, which is the little rays, the big ones, and they're reflecting something back.

Interviewer: Mm-hmm (affirmative). Do you see the key on the left side? Says sunlight ...

Participant: Oh.

Interviewer: Yeah.

Participant: Yeah, okay. So the sunlight rays are energizing the little balls, and they reflect some of them. But then occasionally ones will pass through, I'm going to call it a membrane. And they also reflect the infrared lights, I guess.

Interviewer: Infrared.

Participant: Right.

Interviewer: That's how you say it.

Participant: Infrared.

Interviewer: All right. Great. And the temperature?

Participant: The temperature's increased significantly. Yeah. So.

Interviewer: Could you summarize for me one more time, just what you see on the screen?

Participant: Okay. The sun is sending off sunlight, and that activates or stimulates the membrane or atmosphere. I don't really know exactly what that is yet? The sunlight occasionally passes through them, but it's most of them just get bounced back, and inverted?

Interviewer: Infrared.

Participant: Infrared. Oh, like, infrared rays get sent back as well. Oh, and the temperature has increased.

Interviewer: All right. Is there a reason why you decided change your mind about, because you initially called it the ground at first, but then you changed it to membrane. Any reason?

Participant: I said ground, just because it was solid, like it was a straight line of brown balls, and usually brown is associated to soil and dirt, but then I said membrane because of the way they're moving around and kind of reminded me of phospholipids, like they're heads. Especially because some of the, some lights, and the infrareds are getting through them. So ...

Interviewer: What are phospholipids?

Participant: You know a cell membrane? It's mostly composed of phospholipids, with a phospholipic bi-layer, so essentially they have, yeah. I know a little more about that then the environment.

Interviewer: Oh, okay. So, phospholipids are like cells that make up a thing.

Participant: No, they're lipids that make up the cell membrane of a cell.

Interviewer: Oh, so they're like cell, oh okay. So they're the things that make up the outer ...

Participant: Mm-hmm (affirmative). Layer.

Interviewer: Layer of a cell. Oh, okay. All right. Huh. Interesting. Well, I'll tell you that this is supposed to be the ground, and it's supposed to be like molecules.

Participant: Oh, okay. Well that helps. See, now I'm questioning why they're going through them.

Interviewer: What do you mean by they?

Participant: The sunlight and the infrared rays. Occasionally they won't all bounce back, they'll go down, so, I don't know what that means.

Interviewer: When you say down, like ...

Participant: As in, through the layers of the molecules.

Interviewer: Oh, like, they go ...

Participant: Oh, maybe they're just getting absorbed. Because after they hit them, the molecules turn yellow. That makes sense. Yeah.

Interviewer: So then, the jiggling, the movement of them ...

Participant: Yeah, continues.

Interviewer: What do you think's causing them to move?

Participant: They probably got ... I don't know. They probably have some kind of chemical reaction with the sunlight. That's my best guess. Maybe.

Interviewer: Okay. So, one more time, summarize what you're seeing.

Participant: Okay. So, the sun is in the right corner, and it's sending out sunlight, and when the sunlight hits the molecules of the ground, it excites them and they turn

yellow and they start moving around. But they'll occasionally bounce back sunlight and infrared rays.

Interviewer: Great. Okay, lets go to the next model. So on the left you can click on the thing that's ...

Participant: Oh, sun on the ground. Oh, I get it now.

Interviewer: There you go. Sun on CO2. But no, I see what you mean, you're like "Oh, the sun is on the ground? But it's like ..."

Participant: Yeah. I was so confused.

Interviewer: Wait a second. No, I see how that can be confusing.

Participant: Okay.

Interviewer: Okay, what do you see here?

Participant: Okay. So, I see sun, and I'm assuming the little green balls are molecules of CO2.

Interviewer: Good guess. Or, I mean, yeah, that's what it is. Yeah. What do you think will happen when u click play?

Participant: The sun is probably going to send off sunlight, and the molecules are probably also gonna move around a lot faster, and the temperatures probably going to increase.

Interviewer: All right. Lets find out.

Participant: Okay.

Interviewer: Okay, what do you see?

Participant: I was wrong. I mean, sunlight is ... The sun is throwing off sunlight rays, but they're not really affecting the movement of the carbon dioxide molecules. They're kind of just moving on their own. But the temperature did increase, so ...

Interviewer: Do you think the temperature's going to, is changing? Or is it, you know, increasing? Decreasing?

Participant: It increased, but it looks like it's stable now. Not really moving anymore.

Interviewer: Okay, so if you could just summarize for me one last time what you see here.

Participant: Okay. The sun is emitting sunlight rays, but it's not really affecting, or doesn't seem to be affecting the carbon dioxide molecules that were already present. They're kind of just floating around on their own, even though the temperature increased.

Interviewer: All right. Lets go to the next model. Infrared on CO2. Okay, what do you see here?

Participant: The sun is gone, and there's a bunch of CO2 molecules. But the temperature stayed at the same level as the last slide. It didn't start at the bottom like the previous two slides.

Interviewer: What do you think will happen when you click play?

Participant: I'm assuming that infrared rays are going to pop in the screen, but I'm not really sure how that's going to affect the CO2 molecules.

Interviewer: Okay, lets find out. What do you see?

Participant: When the infrared ... Are they rays? Am I ... yeah. They are rays, right? Okay. When it touches the carbon dioxide molecules, it kind of seems to activate them, as in they turn yellow. Well they don't turn yellow, they have like a outer yellow mem- Circle around them. And the rays bounce in a different direction after touching a carbon dioxide molecule. Oh and the temperature increased a lot. It's still going.

Interviewer: Why do you think that is?

Participant: They're probably ... I don't know if, which causes which, but it's probably related to the more infrared rays. The more movement of the carbon dioxide molecules, and that will also contribute to an increase in the temperature.

Interviewer: Do you think that might have had something to do with the temperature earlier? Like on the first screen?

Participant: As in the rays were bouncing back from the ground?

Interviewer: Well, I guess my question is like, so it seemed like you were saying that the reason that the temperatures raise, is because the infrared, right? Is making more movement.

Participant: Mm-hmm (affirmative).

Interviewer: So, on the first screen ... Actually we didn't talk about the temperature on the first screen, did we?

Participant: No, we kind of just said it increased a little, but we didn't talk about why.

Interviewer: Yeah, but, yeah. Make your best guess as to ... So if you were to use that explanation for why the temperature's rising here, why do you think the temperature was rising on the first screen?

Participant: Probably because the infrared rays would activate the molecules in the soil, and then would start being bounced back. They're also activating molecules in the air, like carbon dioxide. So that already is creating a lot of kinetic energy with the movement of the molecules, which I'm assuming can increase the temperature somehow. So, maybe? I don't know. Best guess.

Interviewer: Yeah. That's great. Can you summarize for me one last time what we're seeing here?

Participant: Yes, so the infrared rays are coming from the bottom of the screen to the top, and as they're going up, some of them will collide with carbon dioxide molecules and energize them, I guess? And turn them yellow, and the infrared rays will bounce off in a different direction.

Interviewer: All right. Great. Lets go to the fourth model. Sun on ground, and CO2. Yeah, the track pad doesn't really work very well .

Participant: Oh.

Interviewer: Yeah. Sorry about that.

Participant: No, it's okay.

Interviewer: What do you see here?

Participant: Okay, so the temperature's back to where it first started in the first slide. The sun's in the corner. We have the ground molecules and the carbon dioxide molecules.

Interviewer: What do you think will happen when we click play this time?

Participant: I think the sun is gonna ... Okay, the sun's gonna release sunlight, which is gonna go past the carbon dioxide without doing anything to them, but it's gonna activate, or excite the ground molecules, and they're gonna bounce back the infrared rays, and they're going to to collide with the carbon dioxide molecules, and that's gonna make the carbon dioxide molecules move faster, or in a different direction.

Oh and the temperature's probably going to increase.

Interviewer: How do you think, well, okay. Yeah. Great. Lets click play and find out. What do you see?

Participant: The sunlight is not really affecting the carbon dioxide, but as soon as it hits the ground molecules, it emits back infrared ray, and those are starting to touch the green carbon dioxide molecules and they get initiated and turn yellow. But sunlight rays are also being bounced back from the ground. It just looks kind of chaotic.

Interviewer: That was a good description. And the temperature?

Participant: It's rising.

Interviewer: Do you think the temperature will continue to rise? Or do you think it's pretty stable?

Participant: I think it would probably continue to, but I feel like it would do it exponentially, as in it would go really ... Well, I don't know if exponential is the right word for this. But it's gonna increase really fast, but then it might level off at some point hopefully.

Interviewer: Oh, I see.

Participant: But I don't think ... I don't ... In the last slide it didn't, so I don't think it's gonna do it on this one either. Oh, just kidding. It stopped. Okay. Oh, no it didn't. I don't think it's gonna stop.

Interviewer: You think it's gonna keep going forever? Like it'll eventually max out?

Participant: I don't know. I don't know how much the ground molecules can handle it. See, at first there was only a few of them yellow at a time. Now it's a lot of them. I don't know if that makes any sense.

Interviewer: So, you mean there are more of the ground molecules lighting up now ...

Participant: Yeah.

Interviewer: Than compared to what?

Participant: To when the temperature was lower.

Interviewer: Oh, I see. Okay. Yeah. What do you think the impact is of having CO2 on the screen? So, how do you think the temperature compares to the first screen, when there was no CO2?

Participant: It kind of helped me to understand the infrared rays a little more, because now I know they'll bounce back with the CO2. I don't know how to describe what I'm thinking. It just makes it all, I mean I might be totally wrong but in the way I'm picturing this as in from sun to sunlight, to ground molecules, to infrared rays to CO2 ... That kind of connects it all together. Whereas before I was confused. I

was thinking "Oh the rays and the sunlight and the infrared rays are just all over the place", but now it kind of makes sense. They bounce back to the air, I guess.

Interviewer: What do you mean by they?

Participant: The infrared rays.

Interviewer: Oh, okay. Cool. All right. So, if you could just summarize for me, one last time, what you see here?

Participant: So the sun is releasing sunlight, which passes through the air down without affecting the carbon dioxide molecules, and once they reach the ground, they kind of light up the ground molecules and they release, or they bounce back infrared rays and sunlight rays. And as the infrared rays move up from the bottom of the screen to the top, some of them collide with carbon dioxide and that lights up carbon dioxide molecules, and bounces off the infrared rays in other directions. Yeah.

Interviewer: And the temperature?

Participant: It's continuing to increase, but I think it's slowed down for a little bit, but now it's going back up.

Interviewer: How does the whole process connect to the temperature?

Participant: I think the kinetic energy of the molecules is what's contributing to the temperature, but that's just a guess.

Interviewer: So, without the ... I'm going to ask the question again. On the first screen, it's the same thing, right? But no CO2. Do you think that there's a difference in temperature between this screen and the first screen?

Participant: Yeah, probably. Because in the first screen you would only have the kinetic energy, or like the movement of the ground molecules. Whereas in this one you have the ground molecules and the carbon dioxide, so those are both like, lighting up because they're coming in contact with either sunlight or infrared rays.

Interviewer: All right. So, lets say you doubled the CO2 on the screen here. How do you think that would affect the temperature?

Participant: I think it would increase, because there would be more collision between the, like if there's more carbon dioxide the collision between the infrared and carbon dioxide is more likely to occur, because there would be a higher possibility, or probability.

Interviewer: So, since you said that temperature and kinetic energy were related, do you think that having a higher probability of interaction between infrared and CO2, do you think that is going to create more kinetic energy somehow?

Participant: Yes.

Interviewer: How?

Participant: Because there will be more CO2, so it will be more likely for the infrareds to collide with it as they're moving up.

Interviewer: All right. Great. Okay. So, so far we haven't talked about how people change things here, right? But, how do you think humans might affect this whole process?

Participant: They can increase the CO2 being released into the air. Yeah.

Interviewer: All right. How would that change the climate?

Participant: It would increase the temperature? Because there would be more CO2.

Interviewer: All right. Well, I'm going to show you a very short film here, that's going to kind of summarize everything we're talking about, and it's going to mention the impact of humans on this whole process.

Participant: Okay.

Interviewer: And, I'm just going to sit over here ...

Video Speaker: You may have heard of global climate change, which is often called global warming. But how much do regular people understand the science of climate change? Take a moment to try to explain to yourself how virtually all climate scientists think the earth is warming? What is the physical, or chemical, mechanism? In one study we asked almost 300 adults in the US, and not a single person could accurately explain the mechanism of global warming at a pretty basic level. Allow us to give you a short explanation of how global warming works.

First, here is how earth's temperature works without considering how humans influence it. The earth absorbs light from the sun, which is mostly visible light. To release that light energy, earth also emits light. But because the earth is cooler than the sun, it emits lower energy infrared light. So, earth's surface essentially transforms most of the visible light it gets from the sun into infrared light. Greenhouse gases in the atmosphere, such as methane and carbon dioxide, let visible light pass through, but absorb infrared light. Causing the atmosphere to retain heat.

This energy can be absorbed and emitted by the atmosphere many times before it eventually returns to outer space. The added time this energy hangs around has helped keep earth warm enough to support life as we know it. Without this greenhouse effect, caused by these greenhouse gases in the atmosphere, the earth's average surface temperature would be about 50 degrees fahrenheit cooler, which is well below the freezing point for ice.

So, how have humans changed things? Since the dawn of the industrial age, around the year 1750, atmospheric carbon dioxide has increased by 40%, and methane has almost tripled. These increases cause extra infrared light absorption, meaning an extra greenhouse effect, which has caused earth to heat above it's typical temperature range. In other words, energy that gets to earth, has an even harder time leaving it, causing earth's average temperature to increase. Thus producing global climate change.

Please share this video with others so you can help them understand how global warming works too.

Interviewer: Okay, what do you think?

Participant: I think I was kind of close, I knew the infrared rays were going to stick, had something to do with the carbon dioxide, but I didn't think they would stay with them. I thought that was kind of interesting. So, yeah.

Interviewer: So, it fits your understanding?

Participant: Mm-hmm (affirmative).

Interviewer: Okay. Great. So now I'm going to ask you about more broadly, what are your thoughts and feelings about climate change?

Participant: I definitely think that we should do something about it. I think we should, I don't really know how to fix it, but definitely be more Eco friendly. Mostly be, like I said, I know a lot of species are going into extinction, so I think that's personally why I care about. But I wish I was way more educated about it so I could do something about it. I don't ... Yeah.

Interviewer: So, do you think that science is an important aspect of climate change?

Participant: Yes. I don't know, I feel like even if you don't have a basic science, if you feel like you don't understand science ... Subject ... Complex idea like global climate change can be explained like this. Like a simple process. It's just like molecules absorb the heat and allow ... The more molecules you have, the more absorption of the heat you have which is harder to release, which will increase the earth's temperature and it will have negative effects on the environment. All of it's living being. I don't know if that makes any sense. I don't know, I'm going on a rant here.

Interviewer: No, that's okay. I like rants. Okay. So, you think it's a real thing.

Participant: Mm-hmm (affirmative).

Interviewer: You're not the kind of person who thinks that it doesn't exist?

Participant: No. I think it's real.

Interviewer: Okay. What do you think about that some people don't believe that it's real?

Participant: I think they're being ignorant to the real issue. Obviously it's getting warmer. There's lots of research on it. And just pretending it's not there is kind of just contributing to the theory that humans are above every other species in this planet, where I think that's not true. I think we're here to share it. So I think that's kind of selfish and ignorant, those people that don't believe that. Sorry, that's how I feel.

Interviewer: So, what makes you believe it?

Participant: This is gonna suck, but I feel like you're just taught as a kid the temperature's rising, we have to do something about it, but I guess if I wasn't presented with that, I guess I would be a little skeptical about it as well.

Interviewer: So is it like your teachers, parents, things like that?

Participant: Yeah.

Interviewer: So basically everyone?

Participant: So, yeah. I guess that's also kind of ignorant on my part, like I haven't done anything to go out and see are forests really disappearing? Is the ice actually melting? I don't have any way of actually doing any research like that. I just have to trust what's taught and passed down to me, how we need to do something to change.

Interviewer: So, what do you think the most convincing thing has been for you?

Participant: For me?

Interviewer: Mm-hmm (affirmative).

Participant: I guess this is a little bit away from global climate change, but I think that's been like, that I know it's a problem, it's like over fishing. That's just because for a long period of time I was like super interested in marine biology, so I watched a lot of documentaries and stuff like that. Obviously documentaries are biased. They're trying to get you to believe something, but that definitely worked to get me to understand how over fishing is a problem.

Interviewer: Okay. Yeah. So, do you feel connected to the problem?

Participant: I guess it's hard to feel, like I said, you don't see ... We're not in the forest. We don't get to see the destruction of it. We live in the city. We get to see the pollution, but we don't get to see how that affects the rest of the world. So I guess I don't really feel connected on it, on a daily basis.

Interviewer: Mm-hmm (affirmative). Right. But you think it's a real think though ...

Participant: Mm-hmm (affirmative).

Interviewer: Okay, yeah. Do you do anything about it?

Participant: I mean, I try to do all the things they tell you, like take shorter showers, don't keep the lights on, take public transportation instead of having your own car. Just like little things like that, but I don't go out of my way seeking, trying to get people to be more Eco friendly. Stuff like that.

Interviewer: Okay. Sorry, I have my questions on here. So, over the course of the 30 minutes that we've been talking here for however long it's been, has your mind changed about anything?

Participant: I kind of want to learn more about it. Because now I get to be one of the 300 people that's like "Oh yeah, I know why global warming is happening." But yeah. That was really interesting.

Interviewer: So, when you say you want to learn more about it, do you mean like ... What are you talking about exactly?

Participant: Well, we as humans obviously increased the amount of carbon dioxide in our atmosphere. So I want to know, I mean, it's not an easy process but I want to know how we can get rid of it, or decrease it, if that makes any sense. So, yeah.

Interviewer: Okay. If you could explain to me how global warming works ...

Participant: Okay.

Interviewer: One more time.

Participant: Okay, so, the sun will send sunlight into the earth. I think it was called visible light from the video? And the earth needs to absorb that light to keep it's environment, and it does so by having carbon dioxide and meth- ...

Interviewer: Methane.

Participant: Methane. In the atmosphere. And what they do is they kid of absorb some of the heat for awhile, and then they release it back into space through, oh my

gosh. I forgot that name. Infrared light? Yeah. That's what the earth bounces out through those molecules. But then if you have too much carbon dioxide or methane in the atmosphere, the heat is maintained in the atmosphere for a longer period, which will increase the temperature. And that's how, I think, global climate is raising.

Interviewer: Nice. Great. All right. That's it.

Participant: Awesome.

Interviewer: So, do you have any questions for me? Before you go?