

## **Please read now: General Instructions**

Intimately related to today's lecture, you are asked to take part in an informative 15-minute study. Thank you for your participation! We believe that you will find this interesting, and we hope that it will also result in some good for society.

The survey looks longer than it is. Some pages have only one item on them.

Associated with this survey is a consent form. If you will, please read it and sign it now. We will collect it soon, and you will be offered a copy of it later.

Once we begin, you may also ask a question at any time. (Pilot-testing suggests that the survey is rather clear, but one never knows!)

This study involves NO deceptions. There is NO "trick" involved, and what we are asking about is what we are actually interested in. Further, any information that we provide you is accurate; for instance, you can share the information with your family tonight, if you wish.

Please *don't* look at your neighbors' surveys. We are using multiple versions, and it will confuse you/us if you have straying eyes. Also, please don't skip ahead and don't go back to an earlier page.

For items that use a 1-9 scale, please respond to them by indicating the degree appropriate—for instance, by circling a number on the 1 to 9 scales below (1 for the least/lowest and 9 for the most/highest).

Please answer honestly regarding your true thoughts and beliefs. We underlined words that might be easy to misread like “not” and “don't,” but please be sure to read each item carefully.

We have a limited time to administer this survey, so please answer the short-answer items with some brevity. Note that some items only ask you if you would “add anything” to what you wrote on a page that is only 1-2 pages back. On these items, there is no need to repeat what you wrote those 1-2 pages back. Add what you will, and if you have nothing to add, simply indicate that and move onto the next item.

Again, your participation is sincerely appreciated—and for a good cause. You will receive feedback regarding what this research is for during the lecture, and you can ask anything you wish at that time.

Do you have any questions?

Thanks again!

*Important! Please read and understand this page.*

**How does climate change (“global warming”) work? The mechanism of the greenhouse effect**

[Or: “Why do some gases concern scientists—like carbon dioxide (CO<sub>2</sub>)—but not others, like oxygen?”]

Scientists tell us that human activities are changing Earth’s atmosphere and increasing Earth’s average temperature. What causes these climate changes?

First, let’s understand Earth’s “normal” temperature: When Earth absorbs sunlight, which is mostly visible light, it heats up. Like the sun, Earth emits energy—but because it is cooler than the sun, Earth emits lower-energy infrared wavelengths. Greenhouse gases in the atmosphere (methane, carbon dioxide, etc.) let visible light pass through, but absorb infrared light—causing the atmosphere to heat up. The warmer atmosphere emits more infrared light, which tends to be re-absorbed—perhaps many times—before the energy eventually returns to space. The extra time this energy hangs around has helped keep Earth warm enough to support life as we know it. (In contrast, the moon has no atmosphere, and it is colder than Earth, on average.)

Since the industrial age began around the year 1750, atmospheric carbon dioxide has increased by 40% and methane has increased by 150%. Such increases cause *extra* infrared light absorption, further heating Earth above its typical temperature range (even as energy from the sun stays basically the same). In other words, energy that gets to Earth has an even *harder* time leaving it, causing Earth’s average temperature to increase—producing global climate change.

[In molecular detail, greenhouse gases absorb infrared light because their molecules can vibrate to produce asymmetric distributions of electric charge, which match the energy levels of various infrared wavelengths. In contrast, non-greenhouse gases (such as oxygen and nitrogen—that is, O<sub>2</sub> and N<sub>2</sub>) don’t absorb infrared light, because they have symmetric charge distributions even when vibrating.]

Summary: (a) Earth absorbs most of the sunlight it receives; (b) Earth then emits the absorbed light’s energy as infrared light; (c) greenhouse gases absorb a lot of the infrared light before it can leave our atmosphere; (d) being absorbed slows the rate at which energy escapes to space; and (e) the slower passage of energy heats up the atmosphere, water, and ground. By increasing the amount of greenhouse gases in the atmosphere, humans are increasing the atmosphere’s absorption of infrared light, thereby warming Earth and disrupting global climate patterns.

*Shorter summary:* Earth transforms sunlight’s visible light energy into infrared light energy, which leaves Earth slowly because it is absorbed by greenhouse gases. When people produce greenhouse gases, energy leaves Earth even more slowly—raising Earth’s temperature.

*Please go on to the next page. At that point, please do not return to this page.*

Did you find anything in this explanation surprising? Please rate according to the following scale:

1	2	3	4	5	6	7	8	9
Not				Somewhat				Extremely
Surprising				Surprising				Surprising
At all								

Briefly, what specifically did you find surprising (if anything)?

*Please go on to the next page. At that point, please do not return to this page.*

*Please respond to the following items, if you will, with a brief textual answer. Questions are on separate pages to prevent backtracking, and it is expected that you will leave a large amount of empty space on these pages.*

Please write 1-3 sentences (about **30** words or less) that you could use to explain how climate change occurs to a senior in high school:

*Please go on to the next page. At that point, please do not return to this page.*

*On the previous page, you responded to the following request:*

“Please write 1-3 sentences (about 30 words or less) that you could use to explain how climate change occurs to a senior in high school.”

*Briefly (25 words or less), what would you add, if anything, in response to the following?*

Please explain any differences regarding how energy (i.e., heat, light) travels to the Earth from the sun compared to how energy travels away from the Earth:

*Please go on to the next page. At that point, please do not return to this page.*

*On the previous pages, you responded to the following requests:*

- 1) “Please write 1-3 sentences (about 30 words or less) that you could use to explain how climate change occurs to a senior in high school.”
- 2) “Please explain any differences regarding how energy (i.e., heat, light) travels to the Earth from the sun compared to how energy travels away from the Earth.”

*Briefly (25 words or less), what would you add, if anything, in response to the following questions?:*

Are all gases “greenhouse gases?” If not, what makes something a greenhouse gas?

*Please go on to the next page. At that point, please do not return to this page.*

The sun mostly emits \_\_\_\_\_ light towards the Earth.

The Earth mostly emits \_\_\_\_\_ light out into space.

*Please go on to the next page. At that point, please do not return to this page.*

*Please indicate the degree to which you are knowledgeable about climate change—by circling a number on the 1 (not knowledgeable at all) to 9 (extremely knowledgeable) scale below.*

1	2	3	4	5	6	7	8	9
Not knowledge -able at all about Climate Change				Moderately knowledge -able about Climate Change				Extremely knowledge -able about Climate Change

*Please go on to the next page. At that point, please do not return to this page.*



Evolution accurately explains how plants, animals, and humans came to be as they are.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

Human activities are largely responsible for the climate change (global warming) that is going on now.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

The United States is one of the very best countries on our planet (e.g., “in the top three”).

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

There exists a supernatural being/deity (e.g., God) or set of beings/deities (gods).

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

After a person dies, that person experiences an afterlife of some sort (for instance, heaven/hell, reincarnation, enlightenment, nirvana, etc.).

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

Biblical creation accurately explains how plants, animals, and humans came to be as they are.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

*Please go on to the next page. At that point, please do not return to this page.*

Global warming or climate changes, when they happen at all, are just parts of a natural cycle.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

I am certain that global warming is actually occurring.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

I am worried about global warming.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

Humans are severely abusing the environment.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

Evolution is unable to explain much of the physical evidence regarding the origins and development of life on Earth.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

Other living things may have evolved, but humans have not.

1	2	3	4	5	6	7	8	9
Extremely Disagree	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree Nor Disagree	Mildly Agree	Agree	Strongly Agree	Extremely Agree

***Please note the change in wording of the following scale***

Overall, how important is it to change your current lifestyle to reduce your carbon footprint (i.e., to decrease the amount of greenhouse gases you emit both directly and indirectly)?

1	2	3	4	5	6	7	8	9
Not Important		Slightly Important		Somewhat Important		Very Important		Extremely Important

*Please go on to the next page. At that point, please do not return to this page.*

Please circle, as appropriate, regarding your background

What is your gender?            M/F

Are you a U.S. citizen or permanent resident?            Y/N

Were you born in the US?            Y/N

If not, how many years have you been living in the U.S? \_\_\_\_\_

Is English your first language?            Y/N

What is your strongest political party affiliation?

1.    None
2.    Democrat
3.    Green
4.    Independent
5.    Libertarian
6.    Republican
7.    Other
8.    Decline to state

On the following scale, indicate the extent to which you consider yourself to be liberal or conservative on most political and social issues:

1	2	3	4	5	6	7	8	9
Extremely Liberal		Somewhat Liberal		Moderate		Somewhat Conserv- ative		Extremely Conserv- ative

What is your main religious faith?

1.    Atheist
2.    Agnostic
3.    Buddhist
4.    Christian
5.    Hindu
6.    Jewish
7.    Muslim
8.    Spiritual but not religious
9.    Other
10. Decline to state

*Please go on to the next page. At that point, please do not return to this page.*