

Optional Video Assignment - *Climate Change: Lines of Evidence*

Watch the *Climate Change: Lines of Evidence* videos (<http://nas-sites.org/americasclimatechoices/videos-multimedia/climate-change-lines-of-evidence-videos/>). The videos clearly present the scientific evidence that links human activities to global warming. You can also find all seven videos together in a YouTube playlist here: <https://www.youtube.com/playlist?list=PL38EB9C0BC54A9EE2>

While you're watching the video, answer the questions below. Another resource you can use to help answer the questions is the booklet, *Climate Change: Evidence, Impacts, and Choices, answers to common questions about the science of climate change*, that goes with the video, which you can find at:

http://nas-sites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf

(The booklet is 40 pages, so you might not want to print it. Use it as an online reference.)

Chapter 1. What is climate?

1. What is climate? What statistics measure climate?

2. What human activities are responsible for much of the warming and related changes being observed on Earth?

Chapter 2. How do we know that the Earth has warmed?

1. All of these data show that average earth surface temperatures have increased by _____ °F over the last 100 years, with much of this increase taking place over the last _____ years.
2. Other indicators of global warming? What changes have occurred?
 - a. Heat waves?
 - b. Cold snaps?
 - c. Snow and ice cover in Northern Hemisphere?
 - d. Glaciers and ice caps around the world?
 - e. Many plant and animal species?

3. What do all of these data sets agree upon?

Chapter 3. How do we know that greenhouse gases lead to warming?

1. When did scientists begin to understand the importance of the role of certain gases in regulating the temperature of the earth?
2. Which gases are considered greenhouse gases?
3. If the concentration of greenhouse gases in the atmosphere decreased, what would happen to global temperatures?

Chapter 4. How do we know that humans are causing greenhouse gas concentrations to increase?

1. What human activity has caused CO₂ to be released into the atmosphere much more rapidly than via natural processes?
2. Where did Charles David Keeling begin measuring air samples and CO₂ concentrations in the atmosphere in the late 1950s to test the hypothesis proposed by other scientists?
3. What do data collected around the world reveal about concentrations of atmospheric CO₂ since the late 1950s?

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4. How do scientists study the concentrations of CO₂ in the atmosphere prior to modern measurements?

5. What do these data show about atmospheric CO₂ concentrations before the industrial revolution?

6. Today atmospheric CO₂ concentration exceeds _____ parts per million, which is about _____% higher than pre-industrial levels. And, according to ice-core data, higher than any point in the last _____ years.

7. Which other greenhouse gases have been increased by human activities:

Greenhouse Gas	Chemical Formula	Human Activities Contributing to Increased Concentration

Chapter 5. How much are human activities heating Earth?

1. Greenhouse gases are referred to as _____ agents because of their ability to _____.

2. Forcing agents have the ability to force earth's temperature _____ or _____.

3. Which molecule is more powerful forcing agent, CO₂ or CH₄?

4. Why does CO₂ have a larger warming effect?

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5. What have scientists concluded about the net forcing of all of the human-caused (anthropogenic) and natural forcing agents between 1750 and 2005?
6. What is the rate at which extra energy is reaching the earth's surface per square meter?
7. Each year we add to the climate system more than _____ times the amount of energy produced annually by all of the power plants in the world combined.
8. **Feedbacks** can either amplify or dampen the impact of the warming.
 - a. Polar snow and ice melting – amplifies or dampens warming?
 - b. Amount of water vapor in the atmosphere – amplifies or dampens warming?
9. Why would earth continue to warm even if we stopped emissions right now?

Chapter 6. How do we know the current warming trend isn't caused by the Sun?

1. The most direct measurements of solar output are from _____, which have been available since _____.
2. Has the sun's output shown a net increase in the last 30 years?
3. Is a change in the sun's output responsible for the warming we've seen in the last 30 years?
4. Can the change in sunspots explain the temperature changes in the last century?
5. Both data sets support that a...
 - warming trend has occurred in the _____
 - cooling trend has occurred in the _____
6. Why is this exactly the vertical pattern of temperature change you would expect from greenhouse gases?

Chapter 7. How do we know that the current warming trend is not caused by natural cycles?

Natural variations in temperature, precipitation and other climate variables are caused by many different processes across many different time scales.

1. What are two of the most well-known short-term climate fluctuations? What are they? What are they associated with?
2. Globally, temperatures tend to be _____ during El Niño periods, and _____ during La Niña periods.
3. What impact do major volcanic eruptions have on the atmosphere and the climate? How long do the effects usually last?
4. How do these natural variations in temperature caused by volcanic eruptions, El Niño and La Niña compare with the 20th century warming trend?
5. How does the current concentration of CO₂ in the atmosphere compare with concentrations over the last 800,000 years?
6. What do undisturbed earth simulations predict about what the Earth's temperature would have been like in the last century without human-induced increase in CO₂?
7. Based on a large body of scientific data and evidence, scientists have concluded that there is more than a _____ chance that most of the observed global warming trend over the past _____ years can be attributed to _____