

Activity 1.1: Assessing Human Energy Systems Unit Pretest

This pretest is designed to help students to express a wide range of ideas, even if they are incorrect. Ideally, students will come to recognize that they have many different ideas about animal growth, as well as unanswered questions.

*Level 4 responses are in **bold blue italics** below. Remember Level 4 is the eventual learning goal; we do not expect most, possibly any, students to produce these responses at this point in the unit. We also have suggestions based on our research about likely Level 2 and Level 3 responses. This worksheet has “assessing” in the title because we do NOT recommend giving your students a grade based on the scientific accuracy of their responses at this point in the unit. It is designed to be used as a tool for formative assessment.*

1. Fluorescent light bulbs use less energy than incandescent light bulbs.

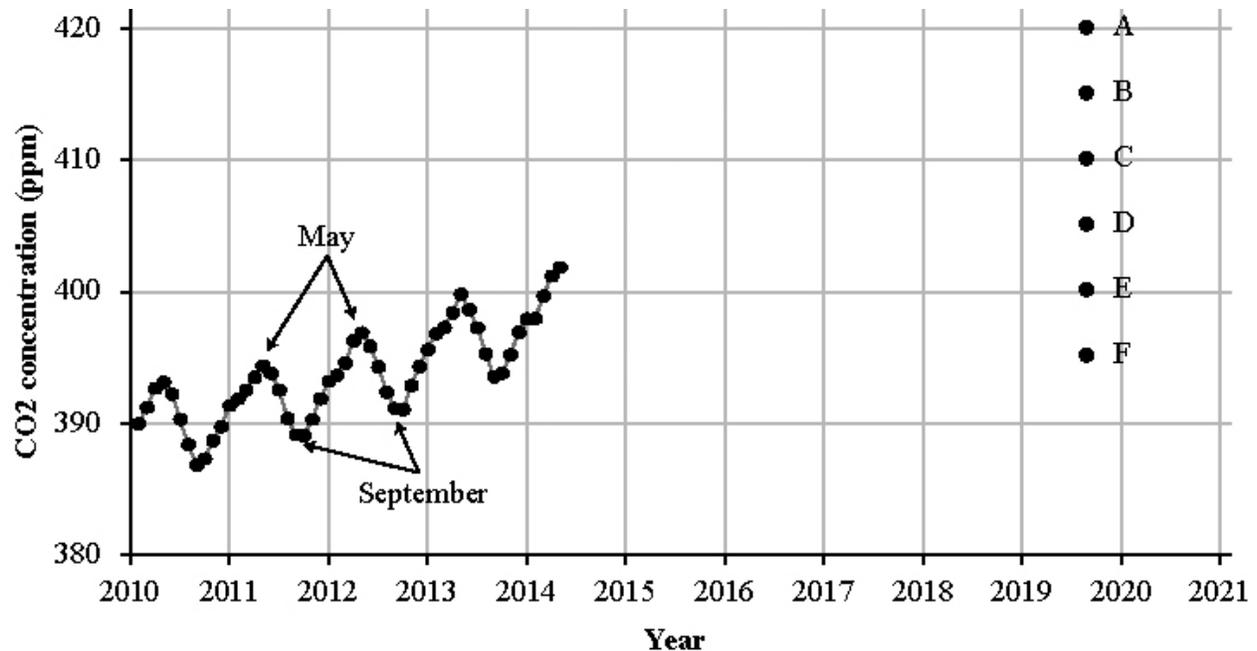
Do you think that using fluorescent light bulbs instead of incandescent light bulbs can reduce the amount of carbon dioxide going into our atmosphere? YES NO



Explain your answer. How can using fluorescent bulbs help reduce the amount of carbon dioxide going into our atmosphere, or why will they not help?

Level 4 responses will most likely connect the energy in the light bulb with the burning of fossil fuels in a power plant (the location of where the fossil fuels are burned is important). These responses may suggest that since fluorescent light bulbs use less energy, they require less burning of fossil fuels, which in turn sends less carbon dioxide into the atmosphere.

Level 3 responses may explain that using less energy/electricity releases less carbon dioxide or that there will be a decreased use of power plants without explaining that this leads to less combustion or fossil fuel use. These responses may indicate that less energy is being “burned” without specifying fossil fuels or that carbon dioxide comes from the burning of these fossil fuels. These responses may include a matter/energy conversion i.e. matter turns into energy. Level 2 responses will not indicate knowledge of carbon dioxide coming from fossil fuels. They might indicate that carbon dioxide is coming from the light bulb itself rather than from a power plant. Level 2 responses will not mention electricity or power or may repeat words from the prompt.



This figure shows the concentration (ppm) of CO₂ in the atmosphere from 2010 to 2014. These data were collected at the Mauna Loa Observatory on top of a tall mountain on the island of Hawaii. Each data point represents the average CO₂ concentration in the atmosphere at the top of the mountain in a particular month.

2. a) The data stop in May, 2014. Please predict how likely the following values are for the CO₂ concentration **five years later, in May, 2019**:

- A) 420 ppm likely / **possible but not likely** / not possible
- B) 415 ppm **likely** / possible but not likely / not possible
- C) 410 ppm **likely** / **possible but not likely** / not possible
- D) 405 ppm likely / **possible but not likely** / not possible
- E) 400 ppm likely / possible but not likely / **not possible**
- F) 395 ppm likely / possible but not likely / **not possible**

b) Explain your reasoning. Why are the values you chose for **May, 2019**, more likely than the others?

Level 4 responses select A or B (i.e., 420 or 415 ppm) as being LIKELY because of the upward trend in the data. Level 3 responses select other points in addition to A or B as also being LIKELY and explain there is an upward trend in the graph. Level 2 responses may describe a pattern in the graph besides the upward trend. They may also make general statements about the graph or an unrelated topic.

3. a) Every year the CO₂ concentration is a little higher than the year before. What causes this trend? Please rate the likelihood that the following activities cause the trend in CO₂ concentration **over five years**:

Measurement error (poor equipment or mistakes that the observers made):	The main cause	A minor cause	Not a cause
Variation in people's use of fossil fuels (e.g., driving cars, heating homes)	The main cause	A minor cause	Not a cause
Variation in plant growth	The main cause	A minor cause	Not a cause
Variation in volcanic activity	The main cause	A minor cause	Not a cause
Variation in nuclear power plant use	The main cause	A minor cause	Not a cause
Global climate change	The main cause	A minor cause	Not a cause

b) Explain your reasoning. Why is the main cause you chose for the upward trend more important than the others?

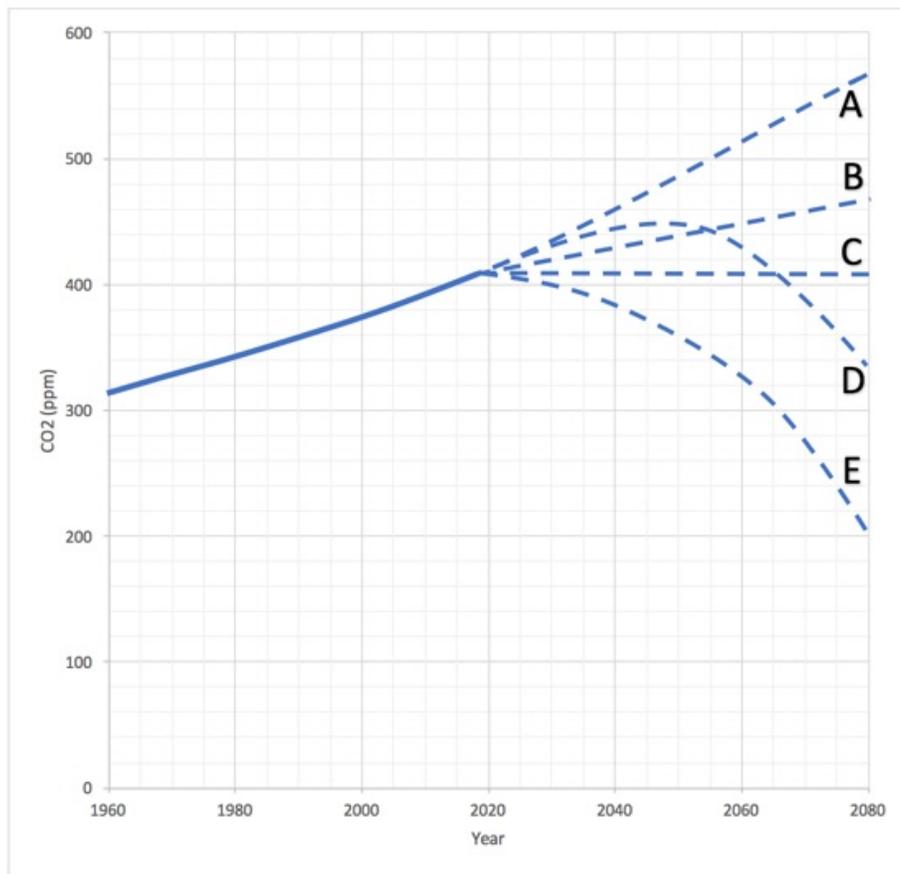
Level 4 responses recognize that fossil fuels are the primary cause of the upward trend over time. Level 3 responses may describe plant processes or deforestation as causing the trend. Level 2 responses may focus on irrelevant causes or make a general statement about CO₂

4. a) Do you think we could use the data in the above figure to tell us anything about how CO₂ concentrations are changing in your state from 2010 to 2015?

Choose one: YES NO

b) Why or why not?

Level 4 responses recognize that CO₂ spreads throughout the atmosphere. Level 3 responses may explain that an increase in CO₂ in an isolated place means it's likely increasing in more populated places, too, or that the student's state has similar characteristics to Hawaii. They may also explain their selection using appropriate connections between CO₂ concentrations and uptake/release mechanisms. Level 2 responses make general statements about the importance of finding out information or about CO₂; they may also explain that there are differences between their state and Hawaii.



In the figure above, the first part of the line in the graph shows how carbon dioxide (CO₂) concentrations in the atmosphere changed between 1960 and 2016.

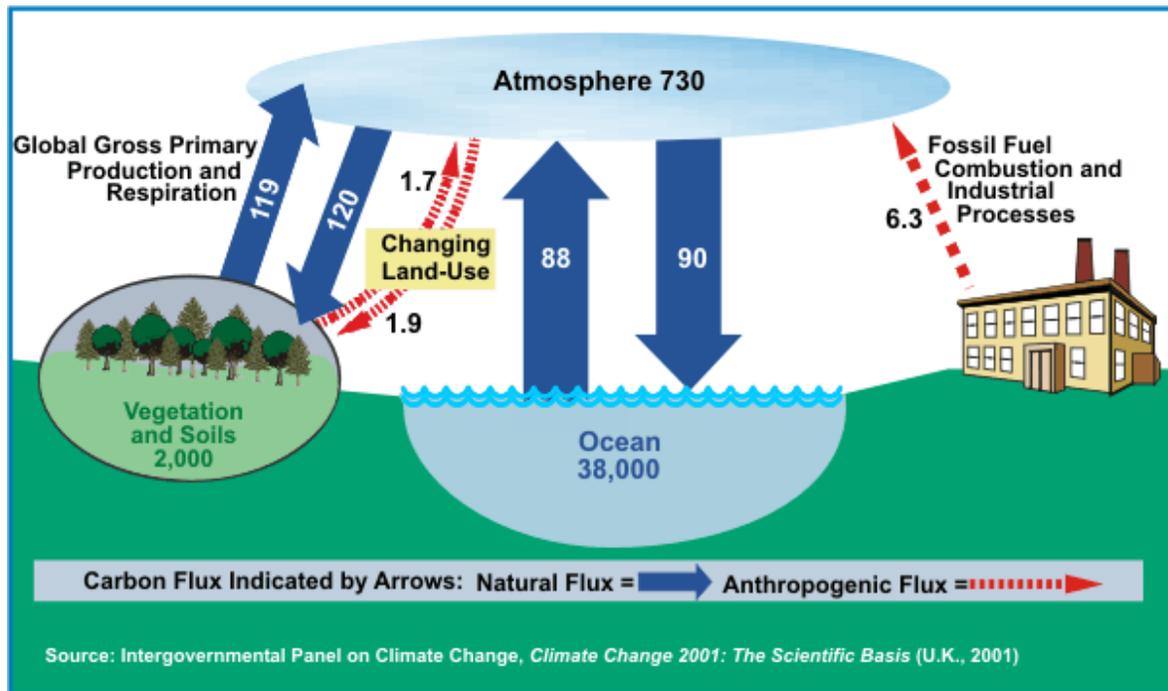
5. a) If the world were suddenly able to **cut its use of fossil fuels in half** tomorrow and maintain that low level of use, what would be the effect on the concentration of atmospheric CO₂?

Choose the line that best predicts what you think would happen to CO₂ levels. CO₂ concentrations would:

- A) continue to rise at about the same rate due to other factors
- B) continue to rise, but more slowly**
- C) level off to a constant amount
- D) continue to rise for a few years, then start to decline
- E) decline to about half of what they are now

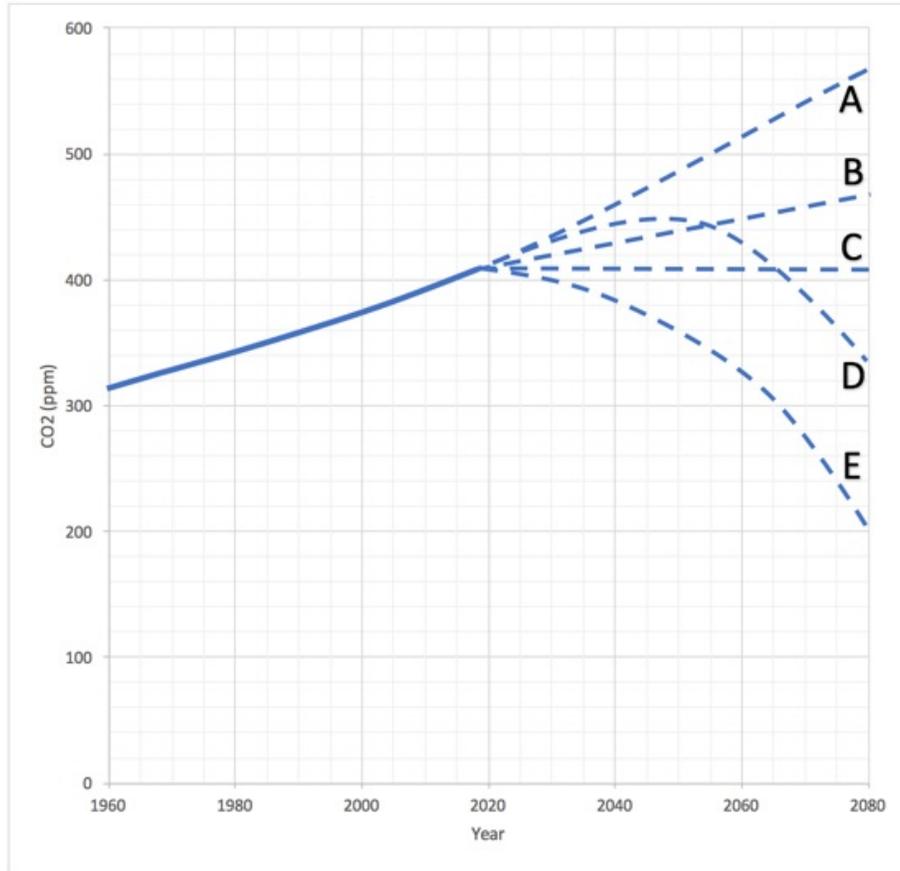
b) Explain your answer. How would reducing our use of fossil fuels affect global CO₂ concentrations?

Level 4 responses recognize that fossil fuels are the primary cause of the upward trend over time and that cutting the use of fossil fuels in half would change the trajectory of CO₂ concentrations but levels would still rise since fossil fuels are still be produced and contributing to CO₂ levels. Level 3 responses recognize fossil fuels as contributing to global CO₂ concentrations i) but may not recognize them as the primary cause of the upward trend so that the cutting of fossil fuels may cause the global CO₂ concentrations to continue to rise or ii) may consider the cut in their use to cause a decrease in global CO₂ concentrations. Level 2 responses may focus on irrelevant causes CO₂ concentrations or do not recognize the contribution of fossil fuels to atmospheric CO₂ concentrations.



The diagram above is a picture of the global carbon cycle. It shows some of the different places, or pools, where carbon is found on the planet and how much carbon each pool contains (in gigatonnes, Gt). The arrows show how much carbon moves in and out of the different carbon pools in one year.

6. a) Using the diagram, reconsider the predictions you made in the previous question regarding what would happen to the concentration of CO₂ in the atmosphere were fossil fuel emissions to be suddenly cut in half.



Choose the line that best predicts what you think would happen to CO₂ levels given the information shown in the carbon cycle diagram above.

CO₂ concentrations would:

- A) continue to rise at about the same rate due to other factors
- B) continue to rise, but more slowly**
- C) level off to a constant amount**
- D) continue to rise for a few years, then start to decline
- E) decline to about half of what they are now

b) Did you change your prediction after seeing the diagram? **Yes** **No**

c) Explain why you either did or did not change your prediction after seeing the diagram.

Level 4 responses recognize that the diagram shows similar input and outputs from natural fluxes and a large anthropogenic flux from fossil fuels contributing to atmospheric CO₂ levels such that students recognize that fossil fuels are the primary cause of the upward trend over time and that cutting the use of fossil fuels in half would

Name _____ Teacher _____ Date _____

change the trajectory of CO₂ concentrations. Level 4 responses also may add up the inputs and outputs and determine that more CO₂ moves out of the atmosphere into different pools and thus CO₂ may level off. Level 3 responses recognize fossil fuels as contributing to global CO₂ concentrations but i) do not recognize that they are the primary cause of the upward trend or ii) may consider the cut in their use to cause a decrease in global CO₂ concentrations. Level 2 responses may focus on irrelevant causes CO₂ concentrations (natural fluxes) or do not recognize the contribution of fossil fuels to atmospheric CO₂ concentrations.