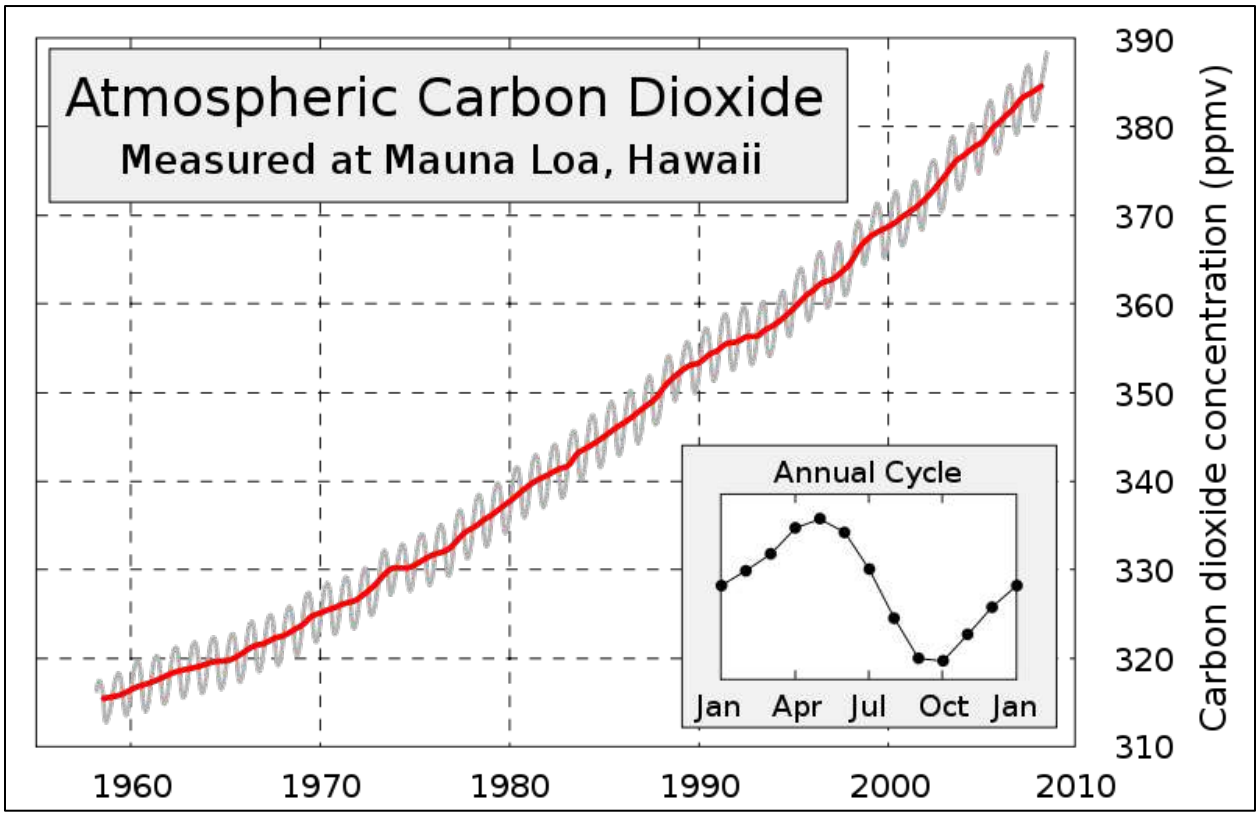
Name _____ Teacher _____ Date _____

Activity 4.5: Assessing The Upward Trend Worksheet

*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.*



The Keeling Curve: Atmospheric CO_2 concentrations measured at Mauna Loa Observatory

1. **What does the upward trend tell you?** What does this part of the graph mean? Describe the trend in your own words.

Level 4: This part of the graph means that since 1960, there has been an increase in carbon dioxide in our atmosphere.

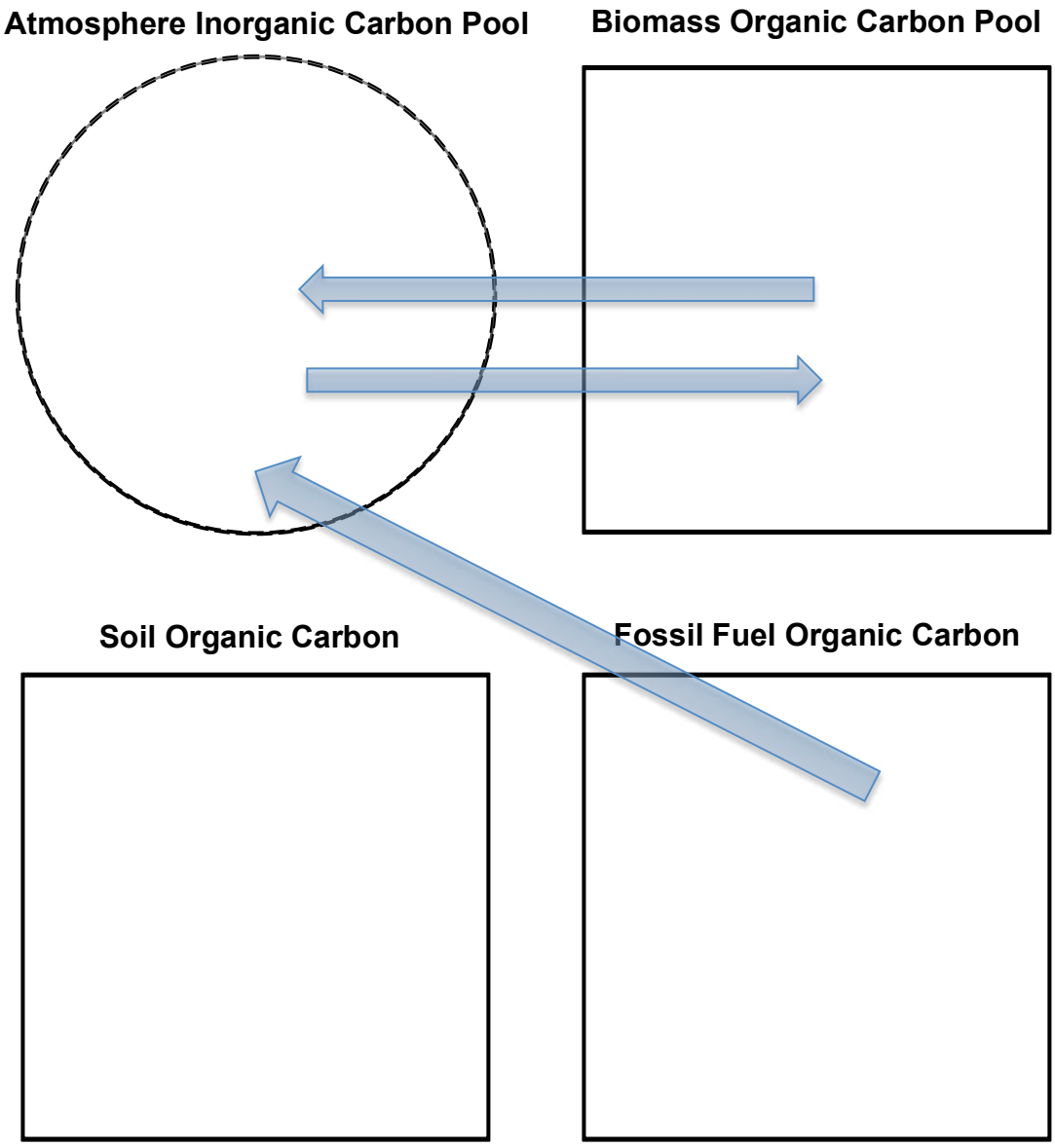
Level 3 and 2 students may confuse the upward trend with the seasonal cycle, not recognizing that although variations in fossil fuels across seasons may have small impacts on variation of the seasonal cycle, the main seasonal cycle is due to the balance between photosynthesis and cellular respiration, and that the upward trend is due to increasing carbon dioxide emissions.

2. Remember the second rule: **Carbon cycles!** This means that if CO_2 concentration is increasing in the atmosphere, then the carbon atoms must be coming from somewhere else. Where do you think this carbon is coming from that causes this increasing trend?

Level 4: Carbon is moving from the fossil fuel pool to the atmosphere pool.

Level 3 and 2 students may suggest that the carbon comes from the air or from pollution in general without making the connection to fossil fuel combustion.

3. The dark line in the Keeling Curve above tells us something about how carbon atoms are moving in the world. Draw arrows to show how carbon atoms are moving from pool to pool to account for both the seasonal cycle and the upward trend.



4. Which carbon transforming process is causing the upward trend in the Keeling Curve? (Circle One)

Photosynthesis Biosynthesis Cellular Respiration Combustion Digestion

Explain your choice. How does this carbon-transforming process cause the upward trend in the Keeling Curve?

Level 4: Combustion of fossil fuels causes the carbon in the organic molecules to oxidize and bond with oxygen. When this happens, energy is released in the form of heat, which humans use for energy. As a result of combustion, CO2 is released into the atmosphere, causing the atmosphere pool to grow.

Level 3 and 2 students may suggest that the upward trend is a result of many carbon-transforming processes, and not identify combustion as the primary process involved.

5. In this unit, we have discussed how energy use causes this upward trend. What are three ways humans use energy that cause carbon to enter the atmosphere?

Answers may vary: any type of energy use that causes carbon emissions is appropriate.