Activity C   Teacher Notes

Why is Carbon an Important Element?

Table of Contents

Activity C
Why is Carbon an Important Element?

Overview

Carbon is an element of extreme importance to organisms living on earth. Not only is it an important component of living organism's molecular structure, it also in the form of carbon dioxide and methane enable our atmosphere to trap life sustaining heat. Through this activity students will develop understandings of the carbon cycle and how changes in the amount of carbon going through the different processes in the carbon cycle may affect atmospheric temperature.

Students begin by graphing data on atmospheric carbon dioxide concentrations and temperature from one location, Mauna Loa. Through this analysis of atmospheric conditions at one location, they practice analyzing data and looking for trends. In the process, they will begin to identify the limitations of looking at limited data points. The activity ends with a discussion of global atmospheric wind circulation conditions.

Learning objectives

- ✓ Understand the concept of a cycle
- ✓ Understand the effects of the atmosphere on global temperatures
- ✓ Review the importance of elemental carbon within Earth's carbon cycle

Relevance

Carbon is an essential building block of life. Scientists around the world are hard at work studying whether the unprecedented increase in human activities that produce atmospheric carbon dioxide emissions over the past century may be altering the carbon cycle.

As far back as 1896, Swedish chemist, Svante Arrhenius, hypothesized that growth in the world's population and industrial activities like the burning fossil fuels from coal, oil that produce carbon dioxide would produce a global warming of Earth's temperature. In effect, a global experiment was beginning whereby humans were emitting large amounts of atmospheric CO_2. What will the effects of this increase have on both biotic and abiotic factors around the globe? Additionally, the interrelated nature of the Earth system raises further questions to answer about how changes in atmospheric carbon levels (an abiotic factor) may impact other factors such as global and regional economies and human health.

Materials

The data tables and graphs needed for this activity are found on the module's web site, under Topic 2, *Data and Tools*

- ✓ Data tables of Average Temperature at Mauna Loa, Atmospheric Carbon Dioxide
- ✓ Concentrations at Mauna Loa and Global Temperature over time
- ✓ Graph paper or computer spreadsheet program to create graphs from the data
- ✓ Global Vegetation Map (See module web site: Topic 2, Activity A under *Data and Tools*)
- ✓ Atmospheric Wind Circulation diagram

Data References

a) Mauna Loa Average Monthly Temperature Data Western Regional Climate Center: http://www.wrcc.dri.edu

b) Atmospheric CO_2 Measured at Mauna Loa Carbon Dioxide Information Analysis Center: http://cdiac.ornl.gov/

c) Global Average Temperature NASA GISS Global Temperature Trends Land-Ocean Temperature Index: http://www.giss.nasa.gov/data/update/gistemp/GLB.Ts+dSST.txt

Period 1 – How are Temperature and Carbon Dioxide Concentrations Related?

In this activity students are asked to create a various graphs of real world data from meteorological stations located in different places around the globe. These graphs will then be used as evidence to support the scientific claims they develop through their analysis and interpretation. Students can create the graphs by inputting data to Microsoft Excel spreadsheets or use the pencil and graph paper method.

Preliminary Activity – Engagement – The Carbon Cycle

Present students with a variety of terms related to the carbon cycle.

Terms List: a) Carbon in Plant Tissue   b) Carbon in Fossil Fuels   c) Carbon in Animal Tissue
d) Process of Respiration   e) Atmospheric Carbon   e)Process of Photosynthesis
f) Process of Combustion (Burning)

1. Have students arrange these terms in a diagram (concept or mind map) with arrows showing the connections between the terms. Students can write their mind maps on newsprint. If students

have not already worked with mind maps you may need to review the concepts with them by providing a simple example.

2. Students present their mind maps to the class.

3. Ask students to propose different scenarios that would decrease the amount of carbon dioxide in the atmosphere and others that would increase the amount of the carbon dioxide.

4. Students draw a revised map based on the class ideas using Data Sheet 1: Mind Mapping.

Methods

Data Analysis, Comparison and Consensus

1. Students begin by graphing data from the **carbon dioxide concentrations at Mauna Loa and time data set**. You will need to provide the data to students. Download the data from the module web site under the Topic 2, *Data and Tools* section. Review graphing with the students if they are not familiar with the techniques used in this activity. If you have access to computing resources, students may use Microsoft Excel to graph the data.

2. Students identify and describe the trends they find in the data and then record their ideas and findings in Data Sheet 2: Graphing CO_2 and Temperature.

3. Next, students graph data from the Average Temperature at Mauna Loa and Time data set.

4. Have students identify and describe the trends they find in the data and record them on Data Sheet 2.

5. Within their groups, students discuss any observations that can be made. Remind the students to keep their conclusions specific to the results. Discuss the idea that in analyzing data its important to remember that correlation does not imply causation. However, if correlations are found, this may provide scientists with a reason to investigate the possibility of a causal relationship.

Period 2 – How are local characteristics related to global conditions?

Preliminary Activity – Engagement

Provide students with a picture of Earth (Global Biome Map from Topic 2, Activity A) and the picture of atmospheric wind circulation patterns.

1. Ask students to first locate the Hawaiian Islands.

2. Next, instruct the class to consider how the trends they observed in their graphs from the previous period may affect other places on the globe.

3. Additionally, ask students how the Mauna Loa site may be affected by these global circulation patterns.

4. Students write out their answers and then discuss their responses ideas with a classmate.

5. Call on different groups to share their ideas with the class. Facilitate a brief discussion.

Methods

1. Tell the students that we will now begin to look at the global picture. In this class we will observe trends in global temperature data and compare the global trends with those we have observed at the Mauna Loa site.

2. Have students take out the graphs they made from the "atmospheric carbon dioxide concentrations at Mauna Loa and time data set." Provide the students with a Global Temperature Data set for the same time frame as the other data sets. This is downloadable from the module web site as well. Instruct students to plot the temperature data on to the CO_2 graph.

3. Allow some time for groups of students to discuss the new graphs.

4. Have students record their conclusions and answer the Investigation Questions at the end of the Student Guide.

5. End the day's lesson by presenting a graph of the data and facilitating a discussion of the Investigation Questions.