

Teacher Guide
Case Study:
Carbon Dioxide and Global Warming: What is the Evidence?

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Activity Focus: In this case study, students read and interpret data about the link between atmospheric carbon dioxide levels and global warming. In addition to answering focus questions, students conduct an issues analysis.

Major Concepts: Although the Earth's temperature has naturally varied over time, data indicates that the Earth's temperature has increased since the Industrial Revolution. This increase is linked to an increase in greenhouse gases (carbon dioxide, methane, and nitrous oxide), especially carbon dioxide. The increase in atmospheric carbon dioxide is mainly associated with the burning of fossil fuels. In addition, other human activities have caused an increase in atmospheric methane and nitrous oxide. This global warming has resulted in changing the Earth's climate. Although El Niño and La Niña and the Milankovitch cycles naturally affect the Earth's temperature and climate, these processes do not account for the observed increase in the Earth's temperature or the observed changes in the Earth's climate. The impact of climate change will vary by geographic region.

Objectives: After completing this activity, students will be able to:

- state how human activities have resulted in an increase in the atmospheric concentration of greenhouse gases (e.g., carbon dioxide, methane, and nitrous oxide)
- explain how an increase in greenhouse gases is effecting the Earth's temperature and climate
- describe the impact of global warming and climate change on different geographic regions
- identify how natural processes, such as El Niño and La Niña and the Milankovitch cycles, affects the Earth's temperature and climate
- recognize that the Earth's temperature varies over time

Materials and Preparation: You will need to prepare the following materials before conducting this activity.

- Copy the *Case Study: Carbon Dioxide and Global Warming: What is the Evidence?* (make 1 copy per student).
- Provide each student/group with copy of the *Issue Analysis Tool*.
- Make a transparency or PowerPoint slide for each data set (appendix) for use in the class discussion. You may want to make a color copy of the data set for each group of students.

Procedures: Students may work individually or as a group to complete the activity. You may want students to work in pairs, using the think-share-pair strategy (recommended).

1. Indicate to students that in this activity they will be reading and analyzing a case study that investigates the cause(s) of global warming and climate change. Have students answer the “what I currently know and think” questions before starting the activity. Discuss students’ response before completing the case study. These guiding questions represent the big ideas students will be answering based on the case study. Also introduce the *Issue Analysis Tool* that students will complete based on the case study. You may also want students to answer the focus questions that are embedded in the case study and that are designed to help students think about the information and data presented in the case study.
2. If students are working in small groups, have them read and discuss as a group the focus questions and/or guiding questions before recording a consensus response. In essence, students are re-answering the engage questions writing their responses to the “what I now know and think” questions based on the information and data presented in the case study.
3. After students have worked through the case study, have them, as a group, complete the *Issue Analysis Tool*.
4. Discuss the activity as a class, asking students to share their responses to the questions and their issue analysis. Ask other students to share additional information/responses. Show the data sets (Master in Appendix) as students share their responses as needed. Use the data set to focus the discussion.
5. Have students reflect on their own thinking by completing the “how my ideas and thinking have changed” question.
6. Collect student/group responses. Administer assessment item.

Assessments: The following assessments may be used as a pre/post activity assessment or as part of a module assessment.

- What causes the Earth’s temperature to vary over time?
- What evidence suggests that the Earth’s temperature is warming?
- How does an increase in atmospheric carbon dioxide impact the Earth’s temperature?
- What are some human activities that might cause the Earth’s temperature to increase?
- What are some natural processes that might cause the Earth’s temperature to increase?
- How might climate change impact our environment?

Quiz: The following quiz may be used as a post activity assessment.

True or False The Earth's temperature has varied over time, with cool periods and warm periods.

True or False The Earth is entering a warm period.

True or False The Earth's temperature is warmer today than at any other time in the past 1,000 years.

True or False Land use change has an impact on the Earth's temperature.

Which of the following greenhouse gases has increased mainly from the burning of fossil fuels?

- A. Nitrous oxide
- B. Methane
- C. Carbon dioxide
- D. Carbon monoxide

Explain how economics and population growth might affect future atmospheric carbon dioxide levels.

Describe how human activities impact the naturally occurring greenhouse effect.

Sulfate aerosols are often called?

- A. Anti-greenhouse gas
- B. Greenhouse gas
- C. Radiative gas
- D. Anti-radiative gas

Which of the following is believed to not happen as a result of global warming?

- A. Land area will warm more than oceans
- B. Northernmost regions of North America will warm more
- C. Melting ice will lower the temperature in the Arctic
- D. Winters will warm more than summers

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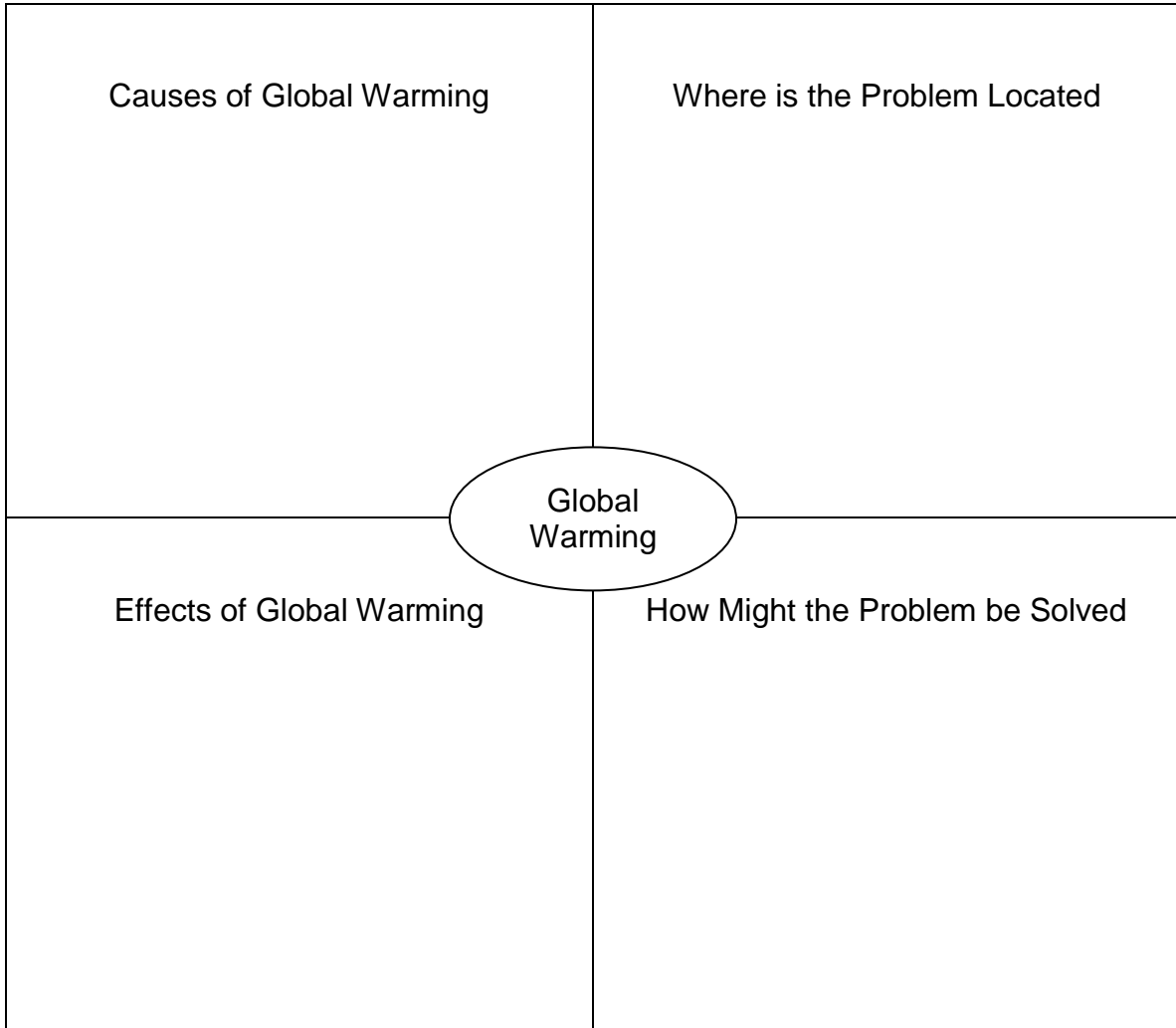
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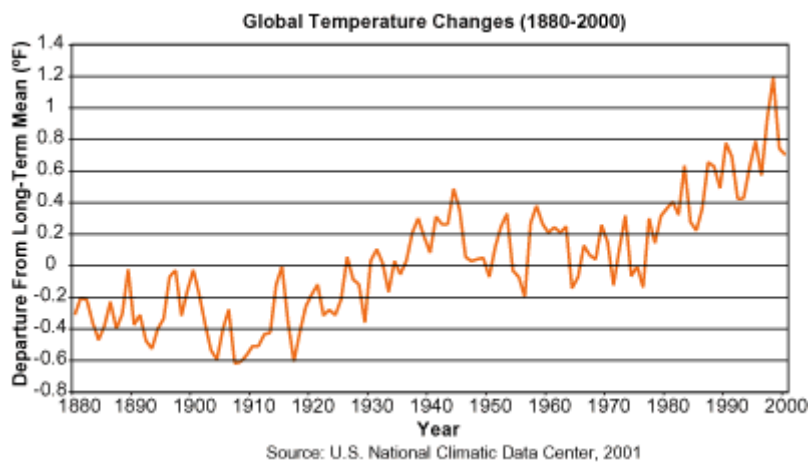
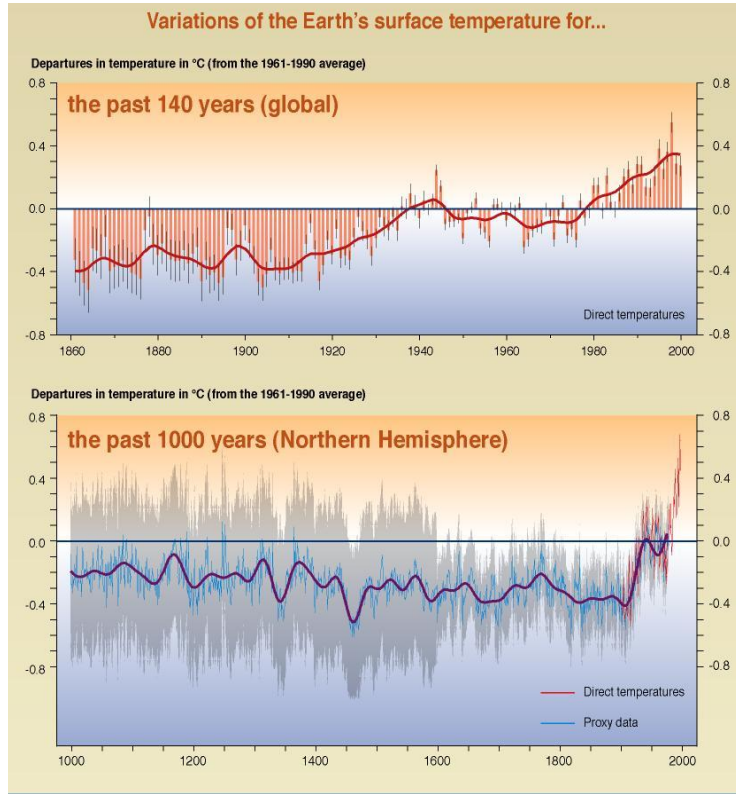
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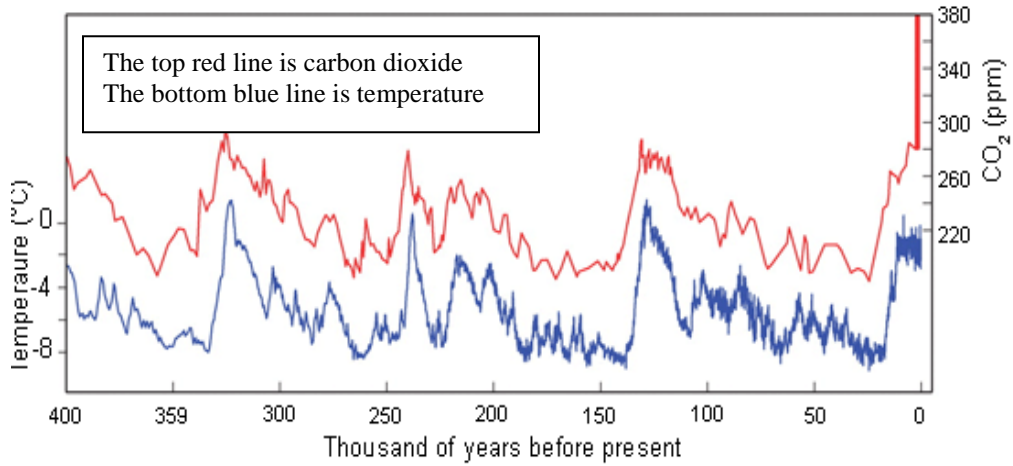
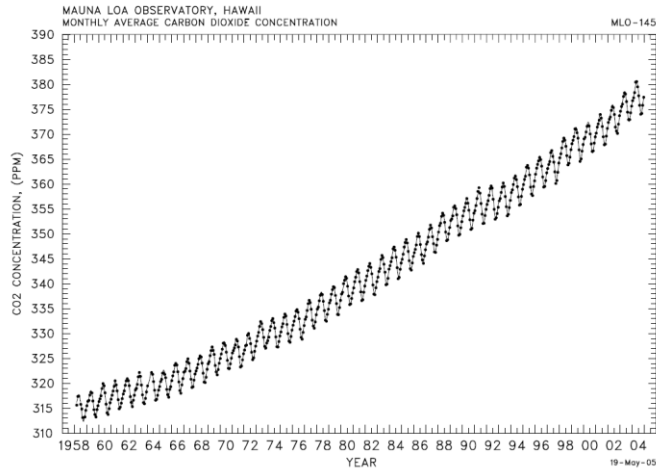
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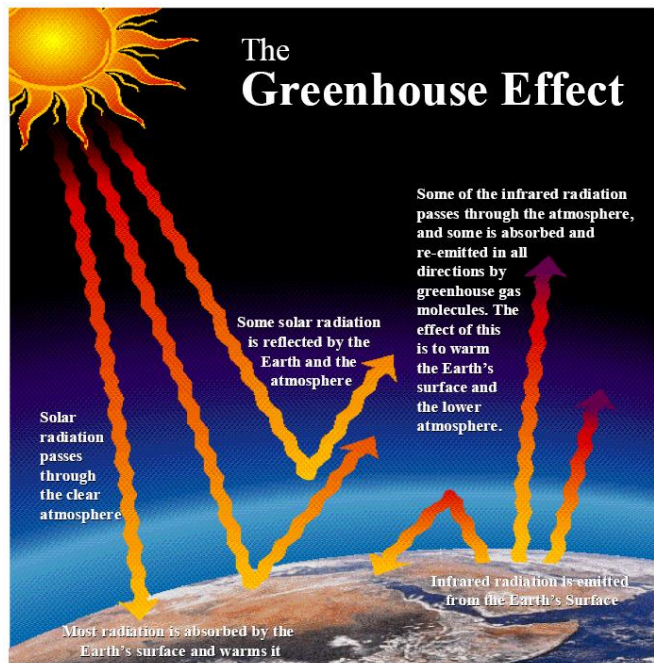
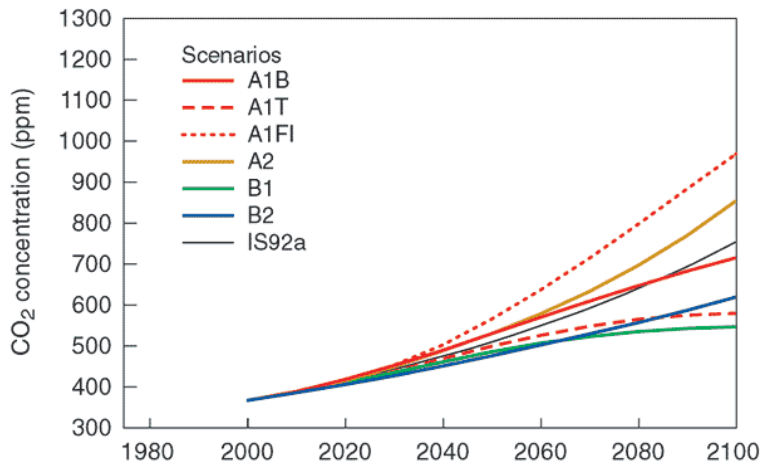
Appendix: Data Masters

Issue Analysis Tool









Changes in Greenhouse Gases from ice-Core and Modern Data

