

## Ice Cores: Unlocking Past Climates

### Module 5: Predictions from the Ice

#### Overview

Students will investigate the properties of carbon dioxide and methane, identify natural and man-made sources for both gases, and graph carbon dioxide and methane data for a 160,000-year period. They then engage in an online simulation and examine a climate timeline to gather additional information before predicting the future of global climate. Finally students predict how current climate indicators will appear in ice cores.

#### Content Objectives

Students will

- Investigate the characteristics of methane and carbon dioxide
- Identify natural and man-made sources for carbon dioxide and methane

#### Process Objectives

Students will

- Graph and analyze data
- Use evidence to predict a likely outcome

**Grade Level: 5-8**

**Suggested Time:** 3-4 class periods

#### Multimedia Resources

- [link to video]
- Carbon Dioxide, <http://www.epa.gov/climatechange/emissions/co2.html>
- Reciprocal Net: Carbon Dioxide  
<http://www.reciprocalnet.org/recipnet/showsample.jsp?sampleId=27344121>  
Note: Reciprocal Net has several options for viewing the molecule. The JaMM2 option allows the user to view a line drawing model, ball and stick model, and space filling model. The ball and stick model may be most appropriate for middle school students.
- Methane, <http://www.epa.gov/methane/index.html>
- Reciprocal Net: Methane,  
<http://www.reciprocalnet.org/recipnet/showsample.jsp?sampleId=27344570>  
Note: See Reciprocal Net: Carbon Dioxide note. Additionally, make sure the Hydrogen box is checked under Options. This ensures that the hydrogen atoms are included in the model.
- Cow Power: Waste Not, Watt Not,  
[http://www.riverdeep.net/current/2002/03/032502t\\_cowpower.jhtml](http://www.riverdeep.net/current/2002/03/032502t_cowpower.jhtml)
- Ruminant livestock, <http://www.epa.gov/rlep/index.html>
- Methane Causes Vicious Cycle In Global Warming,  
<http://www.npr.org/templates/story/story.php?storyId=122638800>
- Could termites be the world's terminators?  
<http://www.independent.co.uk/news/science/could-termites-be-the-worlds-terminators-a-humble-forest-insect-may-be-emitting-dangerous-amounts-of-methane-stella-wiseman-reports-1394135.html>

- How Wetlands Worsen Climate Change, <http://www.time.com/time/health/article/0,8599,1953751,00.html>
- Potent methane is an overlooked greenhouse gas, [http://www.usatoday.com/weather/climate/2007-04-30-methane\\_N.htm](http://www.usatoday.com/weather/climate/2007-04-30-methane_N.htm)
- Climate and Greenhouse Gases: A Graphing Exercise, <http://www.easybreathers.org/pdf/teacher/cggGraphing.pdf>
- Climate and Greenhouse Gases: A Graphing Exercise, <http://www.easybreathers.org/pdf/teacher/cggGraphing.pdf>
- Exploring Weather & Climate Change through the Powers of 10, <http://www.ncdc.noaa.gov/paleo/ctl/>
- The Climate Challenge: Our Choices, <http://www.seed.slb.com/subcontent.aspx?id=4120>

## Materials

- transparencies

## Procedures

1. Engage students by showing the *Predictions from the Ice* video
  - a. Before showing the video, ask students if they could predict the future, what would they predict for global climate? Allow adequate time for discussion. After students have shared their thinking, ask them what evidence they have for their predictions. Segue to the video.
  - b. Ask students to jot down topics they would like to learn more about while they watch the video. Students should also watch for evidence that might support predictions about global warming.
  - c. After the video generate a class list of topics the students are interested in learning more about. Group these topics into broad categories. If necessary ask probing questions to guide students toward the desired outcome. Identify the topics the class will investigate now (characteristics of methane and carbon dioxide, their production and presence in the atmosphere, and predictions for the future). Indicate that the remaining topics may be investigated in the future.
2. Identifying the characteristics of carbon dioxide and methane.
  - a. Divide students into pairs for a brief internet exploration into the characteristics of carbon dioxide and methane. Assign each pair either carbon dioxide or methane to investigate. Allow 15-20 minutes for pairs to explore the following websites:
    - Carbon Dioxide, <http://www.epa.gov/climatechange/emissions/co2.html>
    - Reciprocal Net: Carbon Dioxide, <http://www.reciprocalnet.org/recipnet/showsample.jsp?sampleId=27344121>
    - Methane, <http://www.epa.gov/methane/index.html>
    - Reciprocal Net: Methane, <http://www.reciprocalnet.org/recipnet/showsample.jsp?sampleId=27344570>
  - b. After teams have completed their investigation, have the teams who investigated carbon dioxide get together and share what they found. Do the same thing with the teams who investigated methane.
  - c. Ask one representative from each group present the group findings to the class.

3. Students will now continue their internet investigation to learn more about some of the sources of green house gases mentioned in the video.
  - a. Ask the students to rejoin their original research partner. Each team should explore one of the following sites. It is likely that more than one team will explore the same site. After students have had adequate time to explore their assigned sites, have teams who investigated the same sites get together and compare notes. Ask one person from each group to share with the class what they have learned.
    - Cow Power: Waste Not, Watt Not, [http://www.riverdeep.net/current/2002/03/032502t\\_cowpower.jhtml](http://www.riverdeep.net/current/2002/03/032502t_cowpower.jhtml)
    - Ruminant livestock, <http://www.epa.gov/rlep/index.html>
    - Methane Causes Vicious Cycle In Global Warming, <http://www.npr.org/templates/story/story.php?storyId=122638800>
    - Could termites be the world's terminators? <http://www.independent.co.uk/news/science/could-termites-be-the-worlds-terminators-a-humble-forest-insect-may-be-emitting-dangerous-amounts-of-methane-stella-wiseman-reports-1394135.html>
    - How Wetlands Worsen Climate Change, <http://www.time.com/time/health/article/0,8599,1953751,00.html>
    - Potent methane is an overlooked greenhouse gas, [http://www.usatoday.com/weather/climate/2007-04-30-methane\\_N.htm](http://www.usatoday.com/weather/climate/2007-04-30-methane_N.htm)
    - The Carbon Cycle, Climate, and the Long-Term Effects of Fossil Fuel Burning, <http://www.gcrio.org/CONSEQUENCES/vol4no1/carbcycle.html>
4. Now that students know something about carbon dioxide and methane characteristics and sources, they are ready to graph levels of both over a 160,000-year period.
  - a. Conduct the exercise as it is written.
    - Climate and Greenhouse Gases: A Graphing Exercise, <http://www.easybreathers.org/pdf/teacher/cggGraphing.pdf>  
The data table can be found at <http://www.easybreathers.org/teacher/classact.html>.
  - b. Relate the findings from the exercise to the information provided in the video.
  - c. Discuss how human behavior is impacting climate change. Challenge students to use evidence to support their thinking.
5. Having explored historical data, it is now time for students to predict the future of climate change.
  - a. Before thinking about the future, students will work in pairs to refine their understanding of climate change, this time within the context of human history. Each team should access the Exploring Weather & Climate Change through the Powers of 10, <http://www.ncdc.noaa.gov/paleo/ctl/>, site. If adequate time is available, ask each team to explore the entire timeline. If there is not enough time for this approach, assign teams specific portions of the timeline. Either way, teams should share the pieces of information they find the most interesting and the most helpful in predicting the future.
  - b. The students' final task before predicting the future of climate change is to complete The Climate Challenge: Our Choices, <http://www.seed.slb.com/subcontent.aspx?id=4120> . Students should explore what

happens under each of the three conditions: (1) Allow Increased CO<sub>2</sub> Emissions, (2) Level off CO<sub>2</sub> Emissions, (3) Reduce CO<sub>2</sub> Emissions.

- c. Based upon what they have learned, students should predict what they believe the future of climate change will be. Students' should support their predictions with evidence from the past and explain the impact of human behavior on the accuracy of their prediction.
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6. Wrap up by asking students to consider how present conditions will be recorded in the ice. As a whole class, discuss what future ice cores might look for each condition in the simulation (Allow Increased CO<sub>2</sub> Emissions, Level off CO<sub>2</sub> Emissions, Reduce CO<sub>2</sub> Emissions). Finish by asking students to write a paragraph comparing their prediction for global climate before viewing Predictions from the Ice and after viewing it.