The Greenhouse Effect

Levels V-VI

Grades 9-12

Overview:

In this activity, students learn about the greenhouse effect and its possible effects on global warming and rising water levels on Earth.

Objectives:

The student will:

- learn the nature of the greenhouse effect;
- understand how the greenhouse effect impacts global warming; and
- perform an experiment to demonstrate the greenhouse effect on global warming and Earth's water level.

GLEs Addressed:

Science

- [9] SA2.1 The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by formulating conclusions that are logical and supported by evidence.
- [10-11] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by relating the carbon cycle to global climate change.

Materials:

- 2 large clear boxes (one for each group)
- Saran™ wrap (Group A only)
- 2 lamps with 100 watt bulbs (one per group)
- 2 thermometers (one per group)
- Dyed water
- Tape (preferably masking or other colored tape)
- "Icebergs" (paper cups filled with water and allowed to freeze)
- STUDENT WORKSHEET: "A Greenhouse Model"

Note: The icebergs should be approximately half out of the water. Adjust the water level and/or size of paper cups to assure this result.

Activity Preparation:

Invite an Elder to visit your classroom and speak to you students about how the weather has changed in your community (see Activity Procedure, #4).

Activity Procedure:

Day 1

1. Explain that Earth's atmosphere is composed of nitrogen, oxygen, water vapor, argon, and carbon dioxide. This atmosphere is vital to life on Earth. It does two things: 1) protects organisms from the harmful rays of the sun; and 2) acts as a blanket or greenhouse, absorbing the energy emitted by Earth and radiating it back towards the surface. This second outcome is called the greenhouse effect. A greenhouse is a room usually composed of glass used to grow plants. A greenhouse traps the heat of the sun inside it's glass, therefore keeping it warm for the plants.

2. Explain that while the greenhouse effect is normal, if the levels of the gases that trap warm air increase, the greenhouse effect will increase global warming and can cause drastic climate change.

3. Explain that both natural and unnatural gases are trapped by Earth's greenhouse effect, such as air pollutants from cars and factories, methane from cows, and carbon dioxide produced by animals during breathing and some natural geochemical emissions, such as volcanic eruptions.

4. Explain that Earth naturally helps balance some of those emissions, such as carbon dioxide. Plants take in carbon dioxide as fuel, and release oxygen. Cutting down one or two trees doesn't make a large difference, but scientists believe that deforestation (the cutting down of many trees at once) can have a negative impact.

5. Ask students what they think would happen if Earth warmed up. What would be the impact if there were less snow every year?

6. Ask the Elder visiting your classroom to discuss how weather has changed in your community over the years and the importance of the weather to cultural activities. Thank the Elder for his or her time and invite him or her to stay for the rest of the activity.

7. Explain that changes in the amount of snow cover not only affect social activities but also can have an impact on overall climate. Sunlight is reflected off the snow and into space. An increase in snow cover can have a cooling effect on the climate, causing the winters to be longer. Reduction in snow cover can have the opposite impact; where there is no snow cover, the soil will absorb sunlight. This can cause melting of the permafrost. When the permafrost melts, it causes the ground above it to shift, harming plant life and buildings, and causing erosion. Additionally, permafrost contains methane, a powerful greenhouse gas. If enough permafrost melted, the methane would be released into the atmosphere reflecting heat back onto Earth, reinforcing global warming.

8. Divide the class into two groups (Group A and Group B). Provide each group with a large clear box. Instruct each group to tape a thermometer to the inside of their box so that it can be read from the outside. Instruct group A to tape Saran™ wrap to the top of their box. Leave the other box uncovered. Label the covered model "A" and the uncovered model "B".

9. Pass out the STUDENT WORKSHEET: "A Greenhouse Model." Instruct students to complete the Day 1 section.

10. Explain that, in this experiment, students will determine the effect of greenhouse gases on Earth's temperature and water level. To do this, two boxes are needed. Ask students to identify the difference between the two boxes (Saran™ wrap). Ask students why this difference exists (to compare). Explain that the uncovered box is called a control and the Saran™ wrap, the item that is different between the two, is called a variable. To determine if the greenhouse gases are producing a warmer or cooler temperature, one has to have a control to compare against. The control, model B, is exactly the same as the test subject, model A, except for the Saran™ wrap. That way, if model A produces a different result than model B, one can tell why (the one item that is different).

11. Ask students why it is important to have a control.

12. In preparation for Day 2, freeze 4-6 paper cups filled with water.

Day 2

1. Instruct students to measure the temperature in both models and complete the Day 2 section of their worksheets.

2. Have students add "glaciers" (the water frozen in paper cups, with the paper removed) to the boxes. Make sure the same number of glaciers are added to each tank.

3. Intermittently watch the boxes for 10-20 minutes. Students should notice how the "icebergs" melt on the bottom to form a wine glass shape, then tip over when they get too heavy on top. They continue to repeat this process until they are small enough for the sides to melt relatively evenly or until they

are too flat to roll over. Explain that this observation can be made of real icebergs, and is why it is inadvisable to stand on an iceberg. Glaciers on the other hand, are secured to land, and will not tip.

4. Instruct students to measure the temperature in both models and complete the remainder of their worksheets.

5. Discuss the result as a class.

Extension Idea: Use soil, gravel, rocks, water-resistance toys (people, houses, etc.) to make the tubs look like a community. Then examine how the rising water level might affect houses or the land.

Answers:

Answers will vary, except for:

Day 2 Data: 5. The glaciers melted on the bottom, then tipped over and continued to melt until they were gone.

Data Analysis: 3. b. Model B (with the lid off)

Further Questions:

1. a. It raises Earth's temperature.
2. a. Earth's water level will rise.
4. b. Model B (with the lid off)
5. b. The greenhouse gases (Saran™ wrap)

Name:_____

A Greenhouse Model

Student Worksheet (page 1 of 5)

Levels V-VI

Testable Question

Which model will have the higher temperature?

Hypothesis

Use the background information provided by the instructor to select a hypothesis. Check one of the following:

__ The model with the lid on (with greenhouse gases being held in) will have a higher temperature.

__ The model with the lid off (with gases escaping) will have a higher temperature.

Experiment

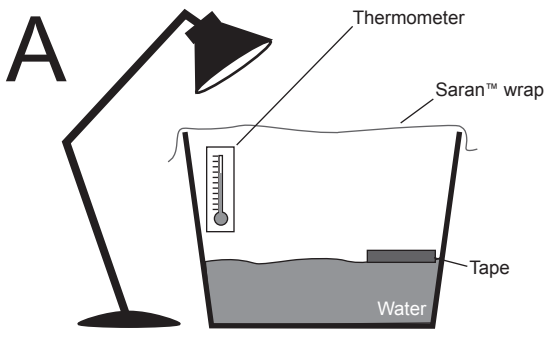
Materials:

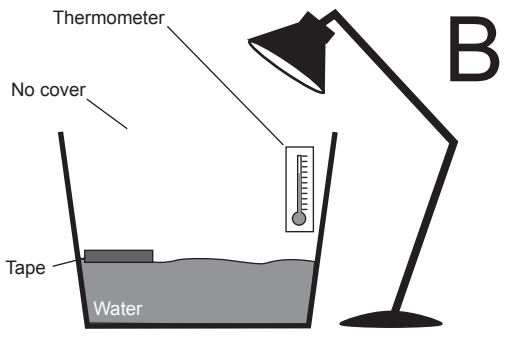
- Large clear container (example: clear storage container) (Day 1)
- Saran™ wrap (Group A only) (Day 1)
- Lamp (Day 1)
- Thermometer (Day 1)
- Dyed water (Day 1)
- Tape (Day 1)
- “Icerbergs” (Day 2)

Procedure:

Day 1

1. As a group, tape a thermometer to the inside of the model so that it can be read from the outside.
2. Fill the container 1/3 full with dyed water. Place a piece of tape on the outside of the model so that the top of the tape is at the same level as the top of the water.
3. Group A: cover the model with Saran™ wrap. Group B: leave your model uncovered.
4. Place a lamp over the model so that it shines directly inside. Make sure the lamp is a few inches above the top edge of the model. Do not let it touch the Saran™ wrap, if using.
5. Complete the Day 1 Data section below.





Name:_____

A Greenhouse Model

Student Worksheet (page 2 of 5)

Day 2

1. Take a temperature measurement of both models.
2. Complete questions 1-4 of the Day 2 Data section below.
3. Add the “icebergs” to your model.
4. Watch the model for 10-20 minutes.
5. Take a temperature measurement of both models.
6. Complete the remainder of the worksheet.

Data

Day 1

1. What is the temperature of model A? _____ ° F

2. What is the temperature of model B? _____ ° F

Day 2

1. What is the temperature of model A? _____ ° F

2. What is the temperature of model B? _____ ° F

3. How did the water level change in model A?
   a. It went up.
   b. It went down.
   c. It stayed the same.

4. How did the water level change in model B?
   a. It went up.
   b. It went down.
   c. It stayed the same.

Name:_____

A Greenhouse Model

Student Worksheet (page 3 of 5)

After the "icebergs" were added to the models:

5. What happened to the icebergs?

   _____

   _____

6. How did the water level change in model A?
   a. It went up.
   b. It went down.
   c. It stayed the same.

7. How did the water level change in model B?
   a. It went up.
   b. It went down.
   c. It stayed the same.

Data Analysis

1. In the chart below, list the temperature for each day.

Day	Model A	Model B
1	˚ F	˚ F
2	˚ F	˚ F

2. What was the temperature change over the 2 days:
   a. for Model A?

   _____°F - _____°F = _____°F
   Day 4 Day 1

   b. for Model B?

   _____°F - _____°F = _____°F
   Day 4 Day 1

Name:_____

A Greenhouse Model

Student Worksheet (page 4 of 5)

3. Which model had the most change in temperature?
   a. Model A
   b. Model B

4. What else changed over the 2 days for model A?

   _____

   _____

5. What else changed over the 2 days for model B?

   _____

   _____

Conclusion

Check one of the following:

___ The model A (with greenhouse gases held in) had a higher temperature.

___ The model B (with greenhouse gases let out) had a higher temperature.

What evidence supports your conclusion? Explain using complete sentences.

_____

_____

Further Questions

1. What does an increase in greenhouse gases do to the temperature of Earth?
   a. It raises Earth's temperature.
   b. It lowers Earth's temperature.
   c. It doesn't affect Earth's temperature.

Name:_____

A Greenhouse Model

Student Worksheet (page 1 of 5)

2. What will happen to Earth's water level if the temperature is raised?
   a. Earth's water level will rise.
   b. Earth's water level will fall.
   c. Earth's water level will stay the same.

3. If Earth's temperature rises, what other changes will occur in the weather?

   _____

   _____

4. What affects will there be to human activities if Earth's temperature rises?

   _____

   _____

5. What was the control group?
   a. Model A (with the lid on)
   b. Model B (with the lid off)
   c. dyed water
   d. "icebergs"

6. What was the variable that was different between the two models?
   a. The water level
   b. The Saran™ wrap (ozone)
   c. The "glaciers"
   d. The lamps