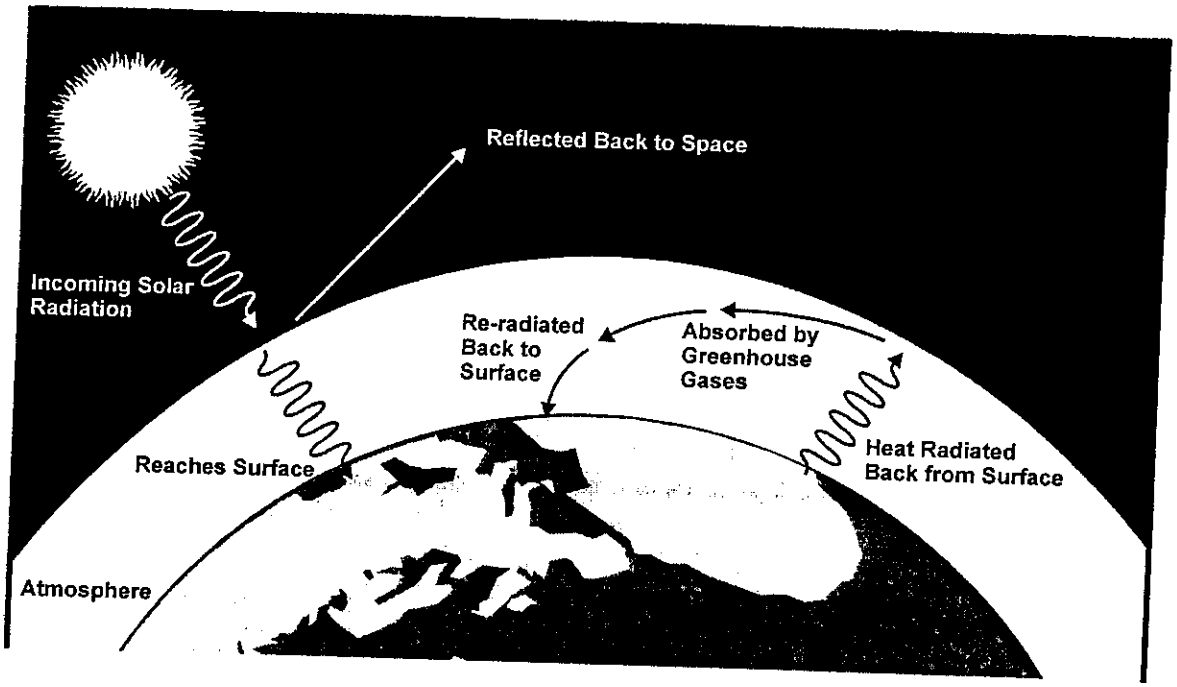
Earth Science Name: Partner(s):

The Greenhouse Effect

Greenhouses allow gardeners to grow plants in cold weather. This is because the air inside the greenhouse stays warmer than the outside air. Short wavelength radiation from the sun passes through the glass, warming the interior of the greenhouse. The longer-wavelength radiation emitted does not pass through glass and is trapped in the greenhouse. This, along with the lack of mixing between the inside and outside air, keeps the greenhouse consistently warm.

On a larger scale, the greenhouse effect helps keep our planet warm. Figure 1 shows how short wavelength radiation from the sun passes through the atmosphere, warming the Earth. The longer wavelength energy is then trapped by certain gases called greenhouse gases. The greenhouse gases most responsible are water vapor, carbon dioxide, methane, and nitrous oxide.



MATERIALS:

3 thermometers
3 plastic bottles
soil
2 lamps with 100 watt bulb
ruler
tape
plastic wrap / biofilm
plastic straw
timer

PROCEDURE

1. Obtain three bottles and place a layer of soil 1 cm deep in each beaker. Label as Bottles 1, 2, and 3.
3. Place the thermometers into the bottles 1 and 2.
4. Cover the top of Bottle 2 tightly with plastic wrap. There should not be too much excess plastic wrap covering the sides of the bottle, seal with tape. Bottle 1 is your control and Bottle 2 is the covered greenhouse.
5. Place a thermometer in bottle 3. Cover bottle 3 tightly with plastic wrap.
6. Lift the edge of the plastic wrap on bottle 3 to make an opening.

7. Take a deep breath and hold it for as long as is comfortable. Without touching your lips to the bottle, exhale into the opening filling Bottle 3 with your breath. This is your exhaled gas bottle.
8. Quickly reseal the plastic over the top of the bottle.
9. Position lamps the same distance from all 3 bottles. The bulbs should not be angled on any one bottle, and the same distance from each.
10. Measure the starting temperature in each bottle.
11. Turn on the lamp.
12. Measure the temperature of each bottle after 2 minutes has passed.
13. Measure the temperature of each bottle after 5 minutes has passed.
14. **Turn off** the lamp.
15. Measure the temperature of each bottle after 7 minutes.
16. At the 10 minute mark, measure the temperature of each bottle and then **turn the lamp back on.**
17. Measure the temperature in each bottle after 12 minutes has passed.
18. At the 15 minute mark, measure the temperature of each bottle and then **turn the lamp back off.**

DATA

	Bottle 1 Control	Bottle 2 Greenhouse	Bottle 3 Exhaled Gas	2-1	3-2	3-1
0 Minute Temperature (°C)						
2 Minute Temperature (°C)						
5 Minute Temperature (°C) **Turn Lamp Off**						
7 Minute Temperature (°C)						
10 Minute Temperature (°C) **Turn Lamp On**						
12 Minute Temperature (°C)						
15 Minute Temperature (°C) **Turn Lamp Off**						

PROCESSING THE DATA

1. Graph the data from bottles 1, 2 and 3. Time on x axis and temperature on y axis. A triple line graph.
2. During periods when the lamp was on, did the covered bottle (2) warm faster or slower than the control?

3. Give a possible explanation for your answer to Question 2.

4. During periods when the lamp was off, did the covered bottle (2) cool faster or slower than the control?

5. Give a possible explanation for your answer to Question 4.

6. Explain why a closed automobile heats up in the sun.

7. What two important greenhouse gases did the exhaled air contain?

8. During periods when the lamp was on, did the bottle 3 with exhaled gases warm faster or slower than the control?

9. Give a possible explanation for your answer to Question 8.

10. During periods when the lamp was off, did the bottle 3 with exhaled gases warm faster or slower than the control?

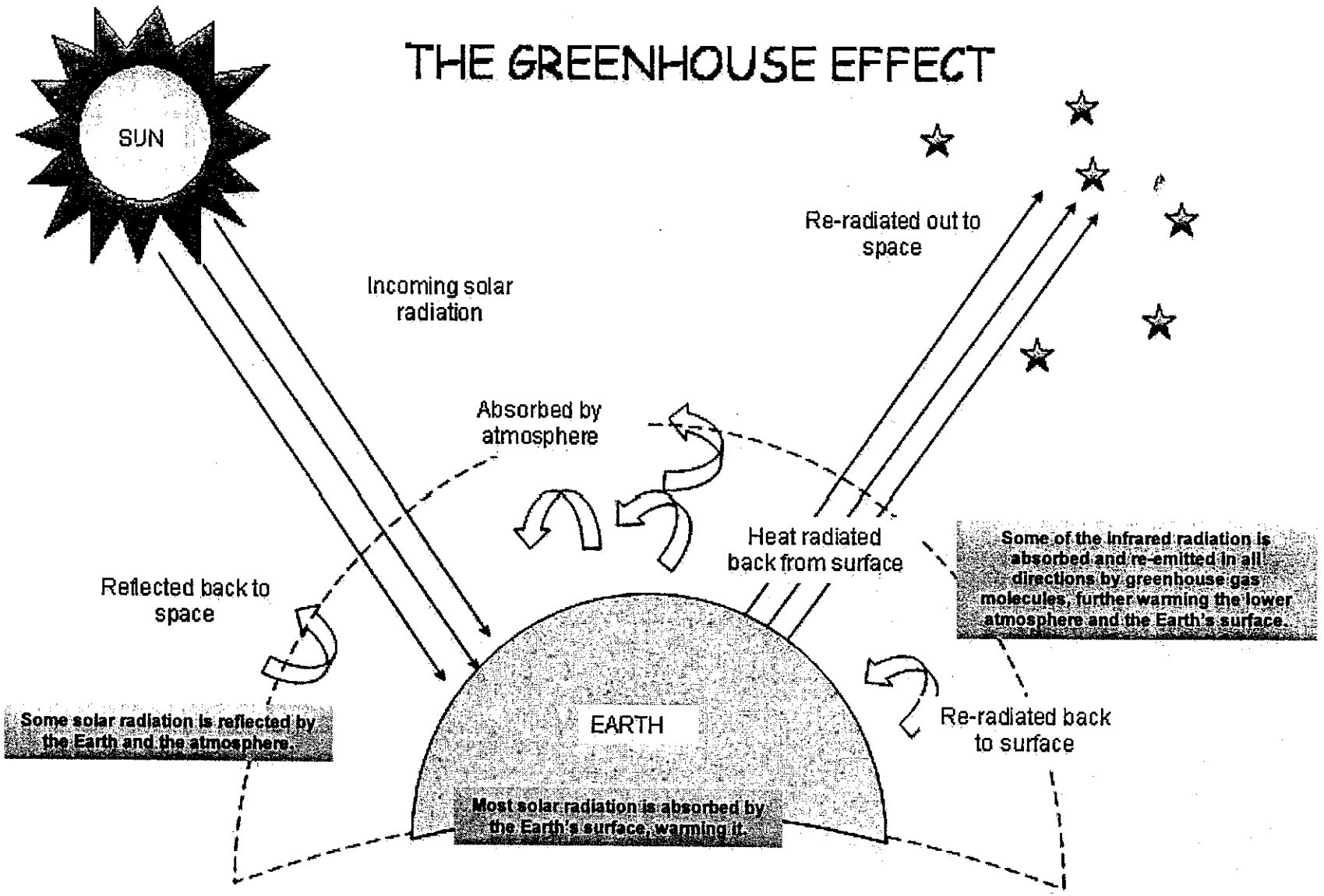
11. Give a possible explanation for your answer to Question 10.

12. During periods when the lamp was on, did the bottle 3 with exhaled gases warm faster or slower than the bottle 2 (covered bottle)?

13. Give a possible explanation for your answer to Question 12.

14. During periods when the lamp was off, did the bottle 3 with exhaled warm faster or slower than the bottle 2?

15. Give a possible explanation for your answer to Question 14.



Source: Natalie Mach, Graduate Fellow, Integrated Teaching and Learning Program, College of Engineering, University of Colorado at Boulder, 2003