Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Modeling the Greenhouse Effect

**Purpose**

The purpose of this lab is to model the greenhouse effect and compare your results to the greenhouse effect caused by Earth’s atmosphere.[[1]](#endnote-2)[[2]](#endnote-3)

**Background**

A greenhouse is a structure whose glass or plastic panes allow light from the sun to enter the structure but also prevent heat from escaping. In a similar way, Earth’s atmosphere allows solar radiation to pass through it. Some of this radiation is absorbed by Earth’s surface. Gases in the atmosphere, including carbon dioxide and water vapor, also absorb some of this energy and reflect it back to Earth’s surface as heat. This greenhouse effect makes our planet’s surface and atmosphere warmer than they would be otherwise.

**Procedure**

**Materials**

1. Clean, dry, transparent 2-L plastic soda bottles with caps (2)
2. Lab burner
3. Heat-resistant gloves
4. Safety matches
5. Large, metal knitting needle
6. Celsius thermometers (2)
7. Modeling clay
8. Direct sunlight or a lamp with 100W bulb
9. Clock or watch
10. Colored pencils
11. Safety Goggles

*\*If lab burners are not available, other instruments may be provided by the teacher to make holes in the plastic bottles.*

**Sequence of Steps**

1. Put on safety goggles.
2. Connect the lab burner to the gas valve.
3. Put on heat resistant gloves and open the valve. Carefully light the burner and properly dispose of the match.
4. CAUTION: Carefully warm the knitting needle in the flame and use it to make 30 holes in one of the 2-L bottles. Distribute the holes evenly around the bottle, but do not make holes around the bottom 6cm of the bottle. Turn off the burner and put it away.
5. Lower one thermometer into the mouth of each bottle so that the bulbs of the thermometers are at the bottoms of the bottles. Screw the caps tightly onto the bottles.
6. Use the modeling clay to secure the bottles – upside down – in an area that gets direct sunlight or under the lamp. The bottles should be about 15cm apart. If you are using a lamp, adjust the lamp so that each bottle is the same distance – about 10cm – from the bulb.
7. C:\Users\Angela\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\DRP2N1IJ\MCj04242300000[1].wmfAdjust the bottles so that the thermometers are set up the same way with respect to the light source.
8. C:\Users\Angela\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\DRP2N1IJ\MCj04242300000[1].wmfIf you are using a lamp as your light source, turn it on. CAUTION: Lamps can get very hot. Do not move too close to the lamps when they are in use. Measure the initial temperature shown on each thermometer and record these values in the data table.
9. Measure and record the temperature in each bottle every 5 minutes for 30 minutes.

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**Observations**

**Data Table**

|  |  |  |
| --- | --- | --- |
| Time (minutes) | Temperature (˚C) | |
| Bottle Without Holes | Perforated Bottle |
| 0 |  |  |
| 5 |  |  |
| 10 |  |  |
| 15 |  |  |
| 20 |  |  |
| 25 |  |  |
| 30 |  |  |

**Graph**

Construct a line graph of your data on the grid. Plot time, in minutes, on the horizontal axis, and temperature, in degrees Celsius, on the vertical axis. Use a different colored pencil to connect each set of data points. Include a key that indicates which set of data is which. Give your graph an appropriate title.

KEY:

1. In which of the two bottles did the temperature of the air rise at a faster rate? Explain why this happened.
2. In which of the bottles did the air reach the higher temperature? Why?
3. Which processes of heat transfer – conduction, radiation, convection – are involved in this activity?
4. Which bottle simulates the greenhouse effect caused by Earth’s atmosphere? Why?
5. What are some of the limitations of this model of Earth’s greenhouse effect?
6. How is the greenhouse effect related to global warming?
7. How is agriculture production potentially impacted by the greenhouse effect?

1. Pearson Prentice Hall, Modeling the Greenhouse Effect. *Pearson Education, Inc.* [↑](#endnote-ref-2)
2. Goehring, Jessalee (2008). Greenhouse Effect Lab. *Lodi High School Ag Dept.* [↑](#endnote-ref-3)