

---

## LAB 33

# The Greenhouse Effect and Surface Temperature

---

### Purpose

The purpose of this lab is to illustrate the concept known as the greenhouse effect and how it helps to regulate surface temperature on the Earth.

### Materials

one 300-milliliter glass beaker  
two 6-inch thermometers  
~ 50 milliliters of dry, instant coffee crystals  
8.5" × 11" white piece of paper  
light source  
stopwatch  
colored pencils  
graph paper

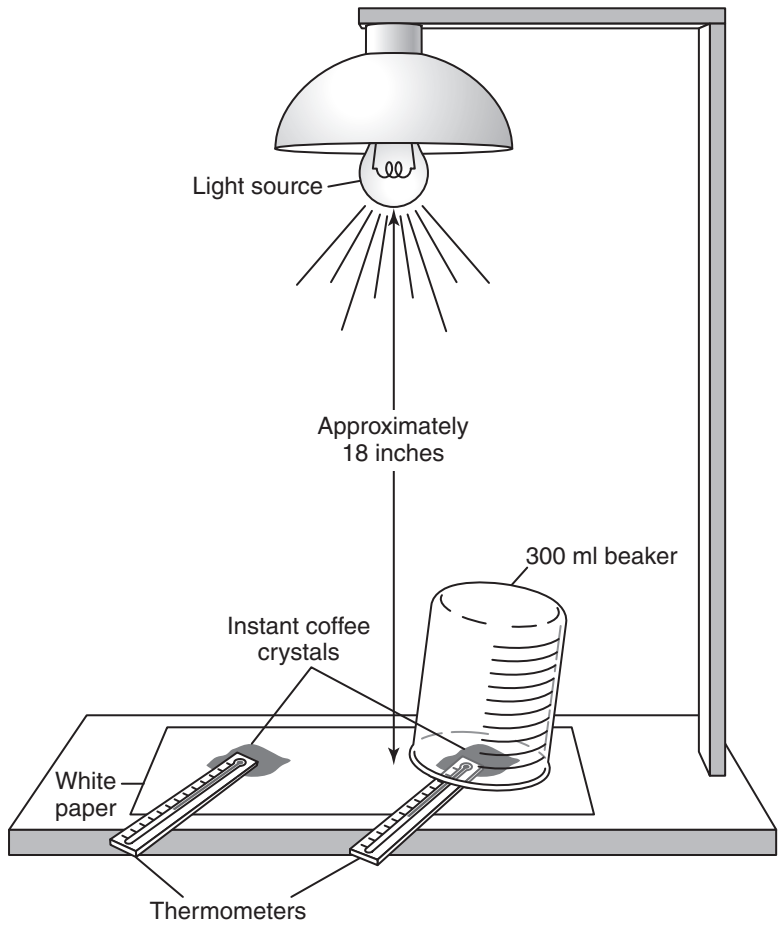


#### SAFETY CONCERN

THE LIGHT AND THE THERMOMETERS USED IN THIS EXPERIMENT CAN GET VERY HOT! DO NOT TOUCH THEM UNTIL THEY HAVE HAD TIME TO COOL DOWN!

### Procedure A

1. Make two small piles of instant coffee (approximately 25 milliliters each) on the white piece of paper. Carefully lay the bulb of each thermometer on top of each pile (see Figure 33–1). Cover one thermometer with the 300-milliliter beaker.
2. Position your light source over the two piles of coffee, making sure that it is approximately 18 inches above the thermometers (see Figure 33–1). **DO NOT TURN YOUR LIGHT ON.** Wait until the thermometers have leveled off, and then record the temperature for each pile at time 0 in Table 33–1.
3. After your instructor has checked your experiment, turn on your light and start your stopwatch. Record the temperature for both piles once every minute for 10 minutes in Table 33–1. **DO NOT TOUCH THE BEAKER DURING THIS EXPERIMENT BECAUSE IT MAY GET VERY HOT!**



**FIGURE 33-1**

<b>TABLE 33-1</b>											
Time	0	1	2	3	4	5	6	7	8	9	10
Open Coffee											
Covered Coffee											
Time	11	12	13	14	15	16	17	18	19	20	
Open Coffee											
Covered Coffee											

- After the first 10 minutes, turn off your light and carefully point it away from the piles. Continue to record the temperature of each pile of coffee once every minute for another 10 minutes in Table 33-1.

5. Make sure you allow the experiment to completely cool down before you clean up. Follow your instructor's directions for proper cleanup procedure.

## Procedure B

1. Use the data from Table 33–1 to construct a dual line graph that shows the relationship between the heating and cooling of the open coffee and the one covered with the beaker. The  $x$ -axis should be labeled "Time," and the  $y$ -axis should be labeled "Temperature." Use a different colored pencil for each beaker, and make a key for your graph.

## Conclusions

1. Calculate the rate of heating for both piles of coffee during the first 10 minutes of the experiment (show your work!).
2. Calculate the rate of cooling for both piles of coffee during the last 10 minutes of the experiment (show your work!).
3. Which thermometer heated up more quickly? Why?
4. Which thermometer cooled off more quickly? Why?
5. Which retained the most heat, the open thermometer or the covered thermometer? Why?
6. What role did the 300-milliliter beaker play in this experiment?
7. Explain the process known as the greenhouse affect.
8. Which gases in the Earth's atmosphere act like the 300-milliliter beaker in the experiment?
9. What would happen to the Earth's surface temperature if it had no atmosphere?

10. What would happen to the Earth's surface temperature if it contained a higher concentration of greenhouse gases?
  
11. Describe how the planets Mercury, Venus, Earth, and Mars are affected by the greenhouse effect.