# Pre-Lab Information

Purpose To observe conduction, convection, and radiation and determine how energy flows in each type of transfer

Time Approximately 45 minutes

Question How do the processes of conduction, convection, and radiation help distribute energy on Earth?

Summary In this lab, you will do three short experiments to understand the processes of conduction, convection, and radiation. You will be able to explain how thermal energy moves in each type of energy transfer.

# Safety

* Behavior in the lab needs to be purposeful.
* Your teacher will light your candle for you. Tie back long hair and roll up your sleeves when you are near the flame.
* Do not touch the warm light bulb. Be sure that it is cool before you put the lamp away.
* Do not touch the warm aluminum foil. Be sure to let it cool before handling.
* Wipe up any spills.
* Report all accidents—no matter how big or small—to your teacher.

# Lab Procedure

1. **Gather materials.**

|  |  |  |
| --- | --- | --- |
| * 1 piece of aluminum foil, approximately 28 cm x 28 cm * 2 woodblocks * 1 tealight candle * 6 chocolate chips * 1 toothpick * Timer or stopwatch | * 2 beakers of clear water, room temperature * Green and blue food coloring * Cold water, colored green * Hot water, colored blue | * 2 eyedroppers * 1 sheet black paper * 1 sheet white paper * 2 thermometers * 2 identical lamps |

1. **Observe conduction.**
   1. Fold the foil until you have made a sturdy strip about 28 cm long and 4 cm wide.
   2. Put each end of the foil in between two wood blocks to make a “bridge.”
   3. Put six chocolate chips on your bridge. Space them evenly on the foil, approximately 4 cm apart.
   4. Have the timer ready. Your teacher will place the tealight candle directly under the first chip. Start the timer when the candle is under the foil.
   5. Do not move the candle. Keep a close eye on the chocolate chips. In Table A, record the time at which each chip melts. Use your toothpick to carefully touch the chip to see if it has melted.
   6. When all the chips have melted, gently blow out the candle so that no wax blows from the top of the candle. Wait for the foil and the candle to cool before you touch them.
2. **Observe convection.**
   1. Use your eyedropper to pick up cold water that has been colored with green food coloring.
   2. Place the tip of the eyedropper in the middle of your beaker of clear water.
   3. Adjust your position so that you are looking at the water in the beaker at eye level.
   4. Slowly squeeze the dropper to deposit colored water into the clear water.
   5. Observe what happens and record your findings in Table B every 30 seconds.
   6. Repeat the process with the second beaker full of clear water and the eyedropper with the blue hot water.
   7. Observe what happens and record your findings in Table C every 30 seconds.
3. **Observe radiation.**
   1. Place a sheet of black paper beneath one lamp, and place a sheet of white paper beneath the other lamp. Be sure that the light bulbs are the same distance from each piece of paper so that the sheets of paper receive the same amount of energy.
   2. Put a thermometer on the center of each piece of paper. Be sure the thermometers are placed consistently on the paper.
   3. Turn on your lamps and begin timing with your timer or stopwatch.
   4. Record the temperature every 30 seconds for each thermometer in Table D.
4. **Clean up your area.** 
   1. Return unused materials and dispose of any trash according to your teacher’s directions.
   2. Be sure not to touch warm light bulbs, candles, or aluminum foil. Wipe up any spills. Handle thermometers carefully so bulbs are not broken.

# Data

Record your observations and data either in your lab notebook or in the space below.

**Table A: Conduction**

|  |  |
| --- | --- |
| **Chocolate Chip** | **Time to Start Melting**  **(seconds)** |
| 1 (closest to candle) |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 (farthest from candle) |  |

**Table B: Cold Water**

|  |  |
| --- | --- |
| **Time**  **(minutes: seconds)** | **Food Coloring Movement** |
| **:30** |  |
| **1:00** |  |
| **1:30** |  |
| **2:00** |  |
| **2:30** |  |
| **3:00** |  |

**Table C: Hot Water**

|  |  |
| --- | --- |
| **Time**  **(minutes: seconds)** | **Food Coloring Movement** |
| **:30** |  |
| **1:00** |  |
| **1:30** |  |
| **2:00** |  |
| **2:30** |  |
| **3:00** |  |

**Table D: Radiation**

|  |  |  |
| --- | --- | --- |
| **Time**  **(minutes: seconds)** | **Black Paper**  **Temperature (°C)** | **White Paper**  **Temperature (°C)** |
| **0:30** |  |  |
| **1:00** |  |  |
| **1:30** |  |  |
| **2:00** |  |  |
| **2:30** |  |  |
| **3:00** |  |  |

# Follow-Up Questions

1. What did you observe when you added the cold water to the beaker? How did this compare to what happened when you added the hot water? Why do you think this happens?
2. How did the temperatures of the white paper and the black paper compare over time? Explain why you think they differed.
3. In which direction did thermal energy move when the candle was placed under the foil? How do you know?