

Heat Transfer: Conduction

Safety Precautions

1. Safety goggles must be worn.
2. All work surfaces should be cleared.
3. Students should be standing when working with heat sources.
4. Oven mitts must be worn when handling hot equipment.

Material List (per group)

1 litre bowl	1 electric tea kettle
1 timing device (stopwatch)	1 metal butter knife
1 plastic knife	1 popsicle stick
3 cubes of butter (1 cm cubes)	3 sugar cubes

Advanced Preparation

Your teacher will already have brought to a boil enough water for your investigation

Procedure

1. Pour 500 ml of hot water into your bowl.
2. Place the metal butter knife, plastic knife and popsicle stick across the top of your bowl.
3. Place a cube of butter (centred) on each of the butter knife, plastic knife and popsicle stick.
4. Place a sugar cube (centred) on each of the butter cubes.
5. Predict which butter cube will melt first, last. Record your predictions in your notebook.
6. Time how long it takes for the each of the cubes to melt and fall off of its respective base.

Analysis Questions

1. Construct a bar graph whose horizontal axis (x-axis) records the type of conductor and whose vertical axis (y-axis) records the duration of heat conduction. Plot and compare.
2. Explain the process of conduction as you observed it. In your observations, which material served as the best conductor? Worst conductor?.

Relating Science and Technology to the World Outside

According to your knowledge of conduction, would it be more advisable to install air-conditioning vents on the ceiling or on the floor? Would the same advice apply to furnace heating? Baseboard electrical heating?

Culminating Task Considerations

Select a material which will generate optimum heat transfer through conduction. Consideration must be given to the placement of heating and cooling elements. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Conduction Craze

Thought Experiments

Name: _____

Date: _____

Activity 4

Discuss the following situations with your group members and try to solve the problems by applying what you know about the transfer of heat by conduction. A reminder that materials that transfer heat well by conduction are called **conductors**, while materials that do not conduct heat efficiently through their atoms are called **insulators**.

A. It is 9:00 p.m. on a warm July night. The sun set at 8:36 p.m. Two houses sit side by side; one with white vinyl exterior siding, the other with red clay brick finishing. You touch each house to find that the red clay brick house feels much warmer to your hand than the white vinyl sided house. Why is this so?

B. It is a mid October morning. A light dusting of snow had fallen overnight. You had helped clean out the garden the previous night and left some tools outside. While picking up a metal hand shovel, you observe that it feels much colder than the plastic hand grips of the pruning shears. Is the metal hand shovel really colder than the pruning shears? How can you explain this?

C. A large layer of ice about 3 cm in thickness has built up in your freezer. Do you think this is good for the energy efficiency of your freezer? Explain why or why not.

D. Your neighbour has complained that the concrete floor in his basement is almost always cold. He just installed new carpeting and under-padding, but the floor still seems cold. Why is this so? What could the neighbour have done to avoid this problem?

Conduction Craze

Marshmallow Madness

Name: _____

Date: _____

Activity 1

As you know, roasting marshmallows is a favourite summer outdoor activity that many people enjoy. A company that produces cookware utensils has asked you and your group to determine what material should be used in making marshmallow roasters. Assume the utensil would not be held directly in the fire, but close enough to roast the tantalizingly tasty treat. Your group must test four different materials before making a decision.

PROBLEM:

What material would serve as the best material for making marshmallow roasting utensils?

MATERIALS:

20 cm pieces of wood (could use pencils or skewers), plastic or plastic straws, glass, metal (could use butter knife), water, kettle, marshmallows, and 250 mL beaker.

PROCEDURE:

1. Place a marshmallow at the end of a 20 cm piece of each substance.
2. Place the other end in a 250 mL beaker of boiling hot water.
3. Carefully observe what happens to the marshmallow at the end of each material.
4. Clean up all materials before rotating to the next centre.

OBSERVATIONS:

CONCLUSION: What type of material would you suggest the company use for their marshmallow roasting utensils? Is there a possible combination of materials that could be used? What material conducted the heat from the water most quickly?
