

# Heat Transfer

## Lesson One

### Investigating Heat Conduction

#### Standard 6.2.3

**Plan and carry out an** investigation to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data, and communicating the results of the investigation.

#### Scientific Practice:

- Plan and Carry out an investigation

#### Cross Cutting Concepts:

- Cause and Effect
- Flow of energy and matter

#### A. Literary Reading

Materials:

1. Literacy Reading—Heat conduction
2. Conduction Heat Transfer Examples

Directions

1. Read about *Heat Energy*
2. Read just about *Heat Conduction*
3. Discuss what conduction means by giving some examples. Read the examples of heat conduction
4. You may want to have a single stove unit on with water in it showing the heat transfer from the burner to the pan of water that heats the water in turn.

#### B. Experiments

##### 1. The Melting Effect

a. Materials

- Worksheet, “The Melting Effect”
- Ziploc Bag for each student
- Ice cubes
- Paper towels

b. Directions:

1. Do the experiment

2. Fill out the activity sheet, “The Melting Effect”
- c. Discussion:
  1. Discuss the results of the experiment.
  2. Communicate your ideas in your journal.

## **2. What’s Warm and What’s Cool?**

- a. Materials:
  - Worksheet, “What’s Warm and What’s Cool?”
  - Cardboard
  - Metal
  - Cloth
  - Styrofoam
  - Wood
  - Glass
  - Plastic
- b. Directions:
  1. Follow the directions on the activity sheet.
  2. Answer the questions as you go.
- c. Discussion:
  1. Discuss the results of the experiment.
  2. Communicate your ideas in your journal.

## **3. Cool Water and Warm Water Switch**

- a. Materials:
  - Worksheet “Cool Water and Warm Water Switch
  - Three plastic clear glasses
  - One glass with cold water
  - One glass with hot water
  - One glass with warm water
- b. Directions:
  1. Follow the Directions on the Sheet
  2. Answer the questions as you go.
- c. Discussion:
  1. Discuss the results of the experiment.
  2. Communicate your ideas in your journal.

# Heat Transfer

## **Heat Energy**

Particles that make up substances are always moving and always have energy. This energy can be transferred from one object to another by three means—*conduction*, *convection*, and *radiation*.

There is a difference between heat and temperature. *Heat* is the energy that the object has because the particles are moving. *Temperature* is a way of measuring heat energy. Two scales that are commonly used to measure heat are the *metric system* and the *standard system*. The metric system uses *Celsius* and the standard system uses *Fahrenheit* to measure heat. The measurement of temperature gives the average amount of energy contained in the substance.

Heat always travels from hotter to cooler objects. It may seem that when you are holding an ice cube, the ice cube is causing your hand to feel colder. However, the real physics behind this heat transference is that the feeling of coldness in your hand is caused by the heat flowing away from your hand and into the ice cube. The energy from the faster moving (hotter) particles transfer to the slower moving (colder) particles. The transfer of energy goes on until all the particles in both objects are all moving at about the same speed. When the amount of heat energy of each object is the same, both objects will have the same temperature.

## **Conduction**

When two objects come into contact with each other, the heat energy moves between them because the particles in one object collide with the particles in the other object. Transferred heat resulting from the collision of particles is call *conduction*.

Conduction works best through solids. In a hot solid touching a cold solid, fast-moving particles touch slow-moving particles and the heat is transferred. This causes slower particles to speed up and faster particles to slow down. You can demonstrate this by rubbing your hands together very fast for 30 seconds. Now touch them to your ears. Can you feel the heat transfer from your hands to your ears? As your ears warm, your hands will cool until the particles in each are moving at the same speed.

Examples of everyday conduction heat transfer are frying an egg, making pancakes on a grill, boiling water in a pan on the stove, ironing a shirt, walking on pavement in the summertime, curling your hair with a curling iron, and a person sitting down on a chair making the chair warm.

# Conduction

Transfer of heat  
by direct contact between  
particles

A metal spoon gets hot in a pot  
of boiling water

An egg on a frying pan sizzles  
and cooks

An ice cube held in a hand  
begins to melt

A metal cup gets hot when  
boiling water is poured in it.

A cheek is burned by a hot  
curling iron

## Melting Ice Using Heat Transfer

1. Put an ice cube in your hand. Write down what you feel.

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2. Explain why your hand is feeling this way.

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3. Explain why the ice is melting.

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4. If you were to keep your hand wrapped around the ice cube the whole time, what would actually happen to the temperature of the water?

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5. Why?

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6. What are real world applications connected to this experiment?

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# What's Warm and What's Cool?

## Materials:

1. Metal
2. Cardboard
3. Glass
4. Wood
5. Cloth
6. Styrofoam
7. Plastic

## Directions:

- Have the students put the objects in a row on their desks.
- Follow the directions below and have them put their answers on the lines.

1. Put your hand on the each of the objects. What do you notice about the temperature of each object?

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2. Arrange the objects in order of the temperature that you feel. Write the order of the objects below according to temperature.

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3. Even though the temperature is the same in this room and making the same room temperature, why do they all feel different?

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4. What are real world applications connected to this experiment?

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# Cool Water and Warm Water Switch

## Materials:

1. Three plastic clear glasses
2. One glass with cold water
3. One glass with hot water
4. One glass with warm water

## Directions:

- Put the hot and cold water on either side of the warm water.
- The warm water should be in the center.
- Follow the directions below and have them put their answers on the lines.

1. Put your left index finger in the water of cup on your left and your right index finger in the water of the cup on your right. What type of temperature do you feel in each one?

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2. What is the heat transfer?

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3. Put both index fingers in the cup of water in the middle. What type of temperature do you feel on both fingers?

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4. Explain what the heat transfer is.

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5. What are real world applications connected to this experiment?

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