Teacher Sheet 1

LAB ACTIVITY:
MATTER ON THE MOVE (#1)

Introduction: In this two-part demonstration and activity, students will be introduced to the idea that heating and cooling have an effect on matter. They will see that food coloring mixes significantly faster in hot water than in cold water and begin to develop the idea that adding heat energy increases the movement of water molecules. Students will extend this idea to realize that adding heat energy increases the movement of gas molecules, too. Students will also do an activity where they heat and cool the air inside a bottle that is covered with a film of bubble solution. These demonstrations and activities will help students develop a foundation for why substances change from one state to another.

OBJECTIVES: Students will:

- Describe changes in the motion of molecules as a substance is heated and cooled.
- Use evidence from an experiment to make an inference about molecular motion.

MATERIALS NEEDED FOR THE DEMONSTRATION:

- Hot tap water
- Cold water
- 2 Tall clear plastic cups
- 1 Wide clear plastic cup
- Plastic bottle with lid, 1/2 pint or 1/2 liter
- Blue food coloring
- Yellow food coloring

MATERIALS NEEDED FOR EACH GROUP:

- Hot water
- Cold Water
- 3 Wide clear plastic cups
- Bubble solution (made with dishwashing liquid, sugar, and water)
- Plastic bottle, 1/2 pint or 1/2 liter

NOTE: You will need two little squeeze bottles each of blue food coloring and yellow food coloring for the demonstration. This is so that you and a student volunteer can place one drop each of yellow and blue food coloring into containers of hot and cold water at the same time. Make a bubble solution for the entire class by adding 4 teaspoons of dishwashing liquid and 4 teaspoons of sugar to 1/2 cup of water. Gently stir until the sugar and detergent are dissolved. Then place about 1 tablespoon of this bubble solution in a wide clear plastic cup for each group.

Demonstration 1: Comparing the movement of food coloring in cold water and hot water

Procedure:

1. Add hot tap water and cold water to two separate clear plastic cups until they are about full.
2. With the help of a student volunteer, add 1 drop of blue and 1 drop of yellow food coloring to each cup at the same time.
3. Do not stir, but watch the colors as they move and mix on their own
4. Discuss with students what makes food coloring move faster in hot water than in cold. Help students begin to think about molecular motion by asking them questions such as the following:
   - Are these observations similar to anything you have experienced before?
   - Do you think the water is moving in each cup?
   - What evidence do you have that suggests something about the water is moving?

Demonstration 2: Showing that heating also affects a gas

Procedure:

1. Add hot tap water to a wide cup until it is about 1/3 full. Make sure students realize you are using hot water.
2. Use your finger and a little water to moisten the rim of the bottle and the top surface of the lid. Then, place the lid upside down on the bottle so that there are no leaks.
3. Carefully push the bottle down into the hot water.
4. Ask studnets the following question:
   - Do you think pushing the bottle into hot water warmed the air in the bottle?
   - How did heating the molecules inside the bottle change their motion?
   - Is it possible that this faster motion could push the lid up?

Activity 1: Similar activity with a film of bubble solution over the opening of the bottle.

Procedure:

Heating a gas:

1. Add hot water to a wide cup until it is about 1/3 full.
2. Lower the open mouth of the bottle into the cup with detergent solution as shown. Carefully tilt and lift the bottle out so that a film of detergent solution covers the opening of the bottle.
3. Slowly push the bottom of the bottle down into the hot water.

Cooling a gas

4. Add cold water to a wide cup until it is about 1/3 full.
5. Re-dip the opening of the bottle in the detergent solution and place it in hot water again to form a bubble.
6. Then slowly push the bottom of the bottle into the cold water. Alternate placing the bottle in hot and cold water. Record your
7. Discuss student observations and explain them in terms of the movement of molecules. Ask students questions such as the following:

- What happened to the bubble film when you placed the bottle in hot water?
- What happened to the bubble film when you placed the bottle in cold water?
- What can you say about the movement of molecules inside the bottle when the bottle was placed in hot water and the air inside the bottle was warmed?

- What effect did this increased motion have on the bubble film?
- What can you say about the movement of molecules inside the bottle when the bottle was placed in cold water and the air inside the bottle was cooled?
- What effect did this decreased motion have on the bubble film?

Note: In the demonstrations and activity, students have seen that heating and cooling affects liquids and gases. Ask students if heating and cooling can affect solids, too. Heating and cooling affects all states of matter—sometimes causing them to change state. For example, cooling water enough can cause it to become ice and heating water enough can cause it to become a gas. Ask students for more examples of heating or cooling that cause matter to change state.

8. Students should complete the activities on their **LAB SHEETS.**