

Molecule Motion in the Three Phases of Matter

Strand	Matter
Topic	Investigating phases of matter
Primary SOL	5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include <ol style="list-style-type: none">distinguishing properties of each phase of matter;the effect of temperature on the phases of matter.
Related SOL	5.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which <ol style="list-style-type: none">estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools;estimates are made and accurate measurements of elapsed time are made using proper tools;hypotheses are formed from testable questions;inferences are made and conclusions are drawn.
	5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include <ol style="list-style-type: none">molecules and compounds.

Background Information

Molecules in all matter are always in motion. They are arranged and move in different patterns. As temperature increases, many kinds of matter change from a solid to a liquid to a gas. As temperature decreases, that matter changes from a gas to a liquid to a solid.

Materials

- Hot plate
- Pan or beaker large enough to heat 200 mL of water
- Goggles for the teacher
- 200 mL water
- Plastic milk container with a screw lid (a pop-on lid may pop off during the experiment)
- Hot pads to handle the hot container
- Measuring beaker (needed to measure 200 mL of water. If it is a smaller beaker, the water can be measured in increments.)
- Classroom clock to time twenty minutes
- Science journals

Vocabulary

molecule, solid, liquid, gas, matter

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Make three columns on a chart or on the board. Label a column “solid,” a column “liquid,” and a column “gas.”
2. Discuss each of the phases with the class. As you discuss the characteristics of each phase, write them on the three column chart.

Procedure

3. Explain to the students that we are going to conduct an experiment that will look at water as it changes from a vapor/gas to a liquid. Tell them that we are going to heat water until it begins to boil. We are then going to pour that water into a plastic milk container, close the top of the container, and then observe what happens.
4. Have the students record the experiment in their science journals as it is conducted.
5. Solicit questions from the students that they would like to have answered about our experiment. (e.g., What is going to happen to the milk container when we pour the hot water in and seal it?, What will happen to the water as it cools?, etc.)
6. From the questions, help the students each write a hypothesis in their journals as to what they think will happen in an “If..., then....” format.
7. Before you begin to heat the water, discuss the safety rules that need to be followed as the experiment is conducted. Be sure to include students staying at a safe distance from the hot plate and the hot water. Make sure that the cap on the plastic milk container is always pointed away from the students. As the experimenter, the teacher should wear safety goggles.
8. Select some students to measure 200 mL of water. Pour the 200 mL of water into an open pan or beaker. Put the open pan or beaker on the hot plate and heat it until the water begins to boil.
9. While the water is heating, ask the students:
 - What is happening to the water?
 - What is heat?
 - As the water heats, what is happening to the water particles?
 - What is happening between the particles?
10. After the water is boiling, carefully pour the water into the plastic milk container and tightly screw the cap on the top.
11. Tell the students that they are going to observe what happens to the milk container. (The milk container will begin to expand because of the increased particle movement of the water vapor.) Have them observe for about 20 minutes.
12. As the students make the observations, ask:
 - What is happening to the milk container?
 - Why is this happening?
 - What is making the container do this?

- How could we test this idea?
13. As the water begins to cool and the milk container goes through another change, ask the students:
- Now what is happening to the milk container?
 - Why is this happening?
 - What is the difference between the water at this time versus the water when we first poured it into the container?
 - What change is happening to the water to make this event occur? (As the water begins to cool and the particle movement decreases, the milk container will begin to collapse.)
14. Put the students into groups of two to three students. In the small groups, have them discuss what they observed, determine if it proved each of their hypotheses true or false, and have them defend and clarify their conclusions. Have the groups answer the following questions:
- Were there differences between your hypothesis and your conclusion? What were they?
 - How has your thinking changed?
 - What do you think would happen if we were to reheat the water that is inside the milk container?
 - Do you think something different would have happened to the milk container if we had cooled the water by putting the milk container in a bowl of ice?
 - Explain why only running the experiment one time might be an issue?

Assessment

- **Questions**
 - Describe what happens to water molecules when thermal energy is applied?
 - Describe the phases of matter – solid, liquid, gas.
- **Journal/Writing Prompts**
 - Write a story titled “A Day in the Life of a Water Molecule.” Be sure to include what happens when you are put on a hot burner on the stove and what happens when you are put into an ice tray and put in the freezer.
- **Other**
 - Create a Memory game with characteristics of the different phases of matter and the names of the three phases of matter.

Extensions and Connections (for all students)

- Give each student a balloon to take home to conduct an experiment. Once home, have the students blow up the balloon and tie it closed tightly with a piece of string. Put the balloon and the string in the freezer for one hour. After one hour, check the balloon and record your observations. Check the balloon each hour for the next three hours and record your observations. Explain what you think is happening and be prepared to support and defend your conclusions.

Strategies for Differentiation

- Pair students to make observations.
- Add drawings that show the molecules of water as a solid, a liquid, and a gas.