A CHILLY SITUATION

Background Information for Activity Leaders

Overview

Children will explore how temperature affects the speed at which water molecules move.

Key Concepts

- Just like any other substance, water is made up of molecules that are smaller than the unaided eye can see.
- Hot substances have faster moving molecules than colder substances. Heating the molecules of any substance makes the molecules move faster, while cooling the substance causes the molecules to move slower. When you describe the temperature of something as hot or cold you are actually describing how fast its molecules are moving.
- In this lesson children will be exploring the way water molecule behave at various temperatures.
- When water is a gas we commonly refer to it as water vapor or steam. Gas molecules move independently from each other. There is a lot of space between the molecules, and the hotter the gas, the faster the molecules will move.
- In liquid water the molecules are able to flow around each other without separating completely. This is what gives liquids the ability to be poured, and to take the shape of the container holding them.
- When water is a solid it is usually referred to as ice. Water molecules can't move around, they vibrate in place.
- Molecules can speed up or slow down without going through a change from solid, liquid or gas. In cold liquids the molecules move more slowly as they slide and bump past each other. In warm liquids the molecules continue to slide and bump, but they do it faster.

What to Expect

- This lesson gives children hands-on experience with solid and liquid water. The activity leader can extend the lesson by introducing children to water vapor, allowing children to explore how liquid water evaporates.
- The food coloring in the cold water will require a few hours to mix well, because the water molecules move around very slowly. Warm water molecules move around faster, so they mix the food coloring quickly. Food coloring in room temperature water will mix faster than the food coloring in the cold water, and slower than the food coloring in the warm water.

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Background Information for Activity Leaders

Common Misconceptions

- *Children may think: "water can only exist as a liquid."*

  Children may identify ice, water and steam as three separate substances, when in fact they are all the same substance. The only difference between the three is how fast the molecules are moving.

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A CHILLY SITUATION

Data Collection Sheet

Name:_____ **Date:**_____

WONDER How does temperature affect how fast water molecules move?

RECORD Measure the amount of time required for the food coloring to mix equally in the water.

Data Table

description	starting temperature (°C)	time (seconds or minutes)
cold		
room temperature		
warm		

CONCLUDE How does the food coloring mix with the water without moving the cups or stirring the water?

_____

How did temperature affect the speed at which the food coloring mixes with the water?

_____

Did the water remain the same temperature during the entire activity? If not, what effect did it have on your experiment?

_____

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A CHILLY SITUATION

Activity Leader's Guide

Group Size: 4-6 children
Time: 45 minutes

Set Up the Expedition

Materials:

For the activity leader:
- (3) plastic bowls
- (1) ice cube

For each group:
- ***A Chilly Situation*** Learning Cards
- (1) clear cup filled with cold water
- (1) clear cup filled with room temperature water
- (1) clear cup filled with warm water
- (1) bottle of food coloring
- (1) stopwatch per group
- (3) thermometers

For each child:
- (1) ***A Chilly Situation*** Data Collection Sheet
- (1) ice cube
- (1) plastic bowl

Prepare the demonstration:
1. Make enough ice cubes to give one to each child.
2. Prepare a small cooler to hold the ice cubes or arrange to use a freezer.
3. Place an ice cube in a plastic bowl for each child.

Prepare the exploration:
1. Give each group one clear cup filled with cold water, one cup filled with room temperature water and another clear cup filled with warm water.
2. Distribute a bottle of food coloring, a stopwatch and three thermometers to each group.

Engage

1 Gather the children together.

Ask:
"What does water look like?" Children tend to think of water in its liquid form. They rarely think of water as a solid (ice) or as a gas (water vapor or steam). Encourage children to mention ice and water vapor or steam.

Say:
"Water can be found in many forms. It can be found as rain, puddles, and even as oceans. These are all examples of liquid water. Sometimes it is easy to forget that ice and snow are also water, solid water." Give each child a small ice cube in a plastic bowl.

2 **Ask:**
"How can you change solid water into liquid water?" The way the children approach this challenge may vary. Some possible solutions that they may come up with are melting the ice with their body heat or by melting the ice using the heat of the sun. Allow time for them to melt the ice.

3 **Say:**
"Good! You have all succeeded in melting water, turning it from a solid to a liquid. You can also change liquid water into a gas by boiling or allowing it to gradually evaporate."

Ask:
"What made the water change from a solid, to a liquid?"
Allow the children to make suggestions. Children should reach a consensus that changes in temperature can cause water to change from a solid to a liquid to a gas. Allow them to reach the conclusion that heat can also change a liquid to a gas.

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Explore

4 If you are working with more than 4-6 children, divide the children into groups. Distribute the Data Collection Sheets and the Learning Cards.

Say:
"Follow the directions on the Learning Card to investigate how temperature affects how fast water molecules move."

5 Allow children enough time to complete the WONDER, EXPLORE, RECORD and CONCLUDE sections of their Learning Card.

Note: It may take several hours for the food coloring in the cold water to mix, so allow children in each group to take turns observing the cup as long as possible.

Conclude

6 Gather the children together and ask the following questions:

"What did you notice about the food coloring in the cold water?" The food coloring in the cold water did not mix immediately. It may take several hours.

"What did you notice about the food coloring in the warm water?" The food coloring in the warm water began to mix as soon as the food coloring was added.

"How long did it take for the food coloring to mix equally thoughout the cup of cold water, room temperature water and hot water?" Encourage the children to share their data. If possible draw a table on poster board and record the results. Compare each group's time for each of the three temperatures of water. Discuss why there may be large discrepancies. For example, if the water is moved around a lot it will mix faster.

"What was different? Why did the food coloring move faster in one cup but not the other?" The molecules of warm water move faster, causing the food coloring to move around more than in the cold water.

Expand

7 Ask the children to follow the EXPAND instructions on their Learning Card at home with the supervision of an adult. Once children have had a couple of days to complete the take home activity, ask the following questions:

"What happened to the food coloring when the water became a solid? What else did you notice as the solid water became a liquid?" Accept all observations and encourage talk about the behavior of solids liquids.

8 **Say:**
"Congratulations! You have earned your 'Ask Me About Water' stamp. You are ready to tell people about properties of water. "

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A CHILLY SITUATION

Expedition Learning Card

How does temperature affect the speed of water molecules?

solid
liquid
temperature

Use cold, room temperature, and warm water to investigate how fast water molecules move at each temperature.

1 WONDER How does temperature affect how fast water molecules move?

Write or draw your ideas on your Data Collection Sheet.

2 EXPLORE The molecules of a liquid bounce off each other and spin around, and slide around from one side of the container to the other. This is why liquids take the shape of their container and why they can be poured.

- Prepare one cup with ice-cold water, one with room temperature water and one with warm water.
- Place a thermometer in each cup. Record the starting temperature of all three cups of water on your Data Table.
- Ask one of your group members to be ready with a stopwatch to record how much time goes by during the experiment.
- Together with two other group members, add one drop of food coloring at the same time to each cup.
- Without moving the cups, carefully observe what happens to the food coloring in each cup of water.

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A CHILLY SITUATION

Expedition Learning Card

3 RECORD Record how long it takes for the food coloring to mix equally through the cup of cold water, room temperature water and warm water. The food coloring is mixed equally when all the water looks the same color.

Write down how much time it takes for the food coloring to mix equally in each cup, and draw what you see.

4 CONCLUDE How does the food coloring mix with the water without moving the cup or stirring the water? What is causing the food coloring to move? How did temperature affect how quickly the food coloring moved?

5 EXPAND At home, with the help of an adult, fill an ice cube tray with cold water. Try not to move the tray as you place one drop of food coloring in half of the sections. Carefully place the tray in the freezer. The next day, remove the tray from the freezer. Notice everything you can about the ice cubes, or solid water. As you allow the solid water to melt, notice everything you can. What happens to the food coloring?

Record on sheet of paper all the interesting things you observe.

Discovery

Why did we do that?

- Liquid molecules move loosely around each other; this allows them to flow and take the shape of the container they are in.
- Water in the solid state is commonly called ice.
- The water we drink is in the liquid state.

Congratulations!

You have earned your "Ask Me About Water" stamp! Now you are ready to tell people about water!

ASK ME ABOUT

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