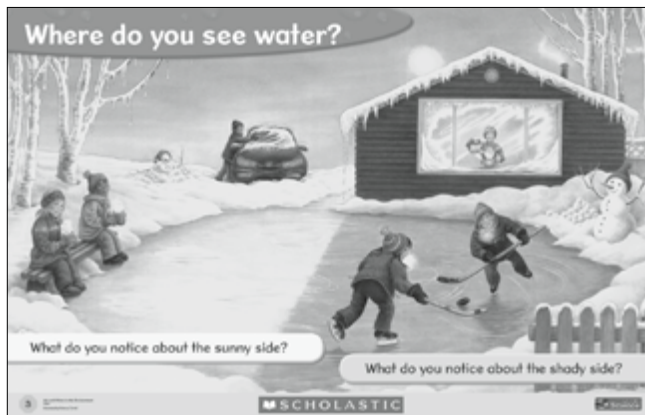


Water and Temperature



Focus: Students will predict how and why water changes from one state to another, make and record observations and measurements while investigating how and why water changes state from liquid to solid or vice versa, and discover the role of temperature in changes of state.

Specific Curriculum Outcomes

Students will be expected to:

- 5.0 investigate changes that occur when the three states of water are heated or cooled [GCO 1/3]
- 6.0 predict based on an observed pattern [GCO 2]
- 7.0 make and record observations and measurements [GCO 2]

Performance Indicators

Students who achieve these outcomes will be able to:

- plan and test a means to slow down the rate of melting of an ice-cube person

NOTES:

Attitude Outcome Statements

Encourage students to:

- willingly observe, question, and explore [GCO 4]
- appreciate the importance of accuracy [GCO 4]

Cross-Curricular Connections

English Language Arts

Students will be expected to:

- communicate information and ideas effectively and clearly, and to respond personally and critically [GCO 2]
- respond personally to a range of texts [GCO 6]

Getting Organized

Components	Materials	Before You Begin	Vocabulary
• Science Card 3 • <i>What Is the Inquiry Process?</i> poster • BLM <i>When Did It Melt?</i> • IWB Activity 4 Literacy Place: • <i>Journey of a Water Drop</i> (Guided Reading, Level N)	• kettle or humidifier • two mugs • thermometers • metal spoons or hand mirrors • frozen shapes or Freezies (optional) • hot and cold water • paper towels • incandescent lightbulb or hair dryer • containers of different shapes and sizes • tray or container for transport • timer (optional) • ice cubes • cups with warm, room temperature, and cool water • trays • index cards • markers • plastic googly eyes • bowls, cardboard, bubble wrap, and other materials to insulate ice-cube people • students' Science Journals • washtubs or other large waterproof containers (optional) • water or snow (optional)	• If using, put metal spoons in the fridge to cool. • Make ice in containers of various sizes and shapes or provide Freezies. • Arrange access to a freezer. • Freeze ice cubes with plastic googly eyes attached to make ice people. • Make ice in various colours (with food colouring) in different shapes and sizes.	• water vapour • steam • evaporation • temperature • thermometer • evidence

Safety

- Ensure that kettle/boiling water are not left unattended and that cords are not placed where someone can trip over them.

Science Background

Change of State	Science Term
solid to liquid	melting
liquid to gas	evaporation
gas to liquid	condensation
liquid to solid	solidification (freezing)

- To change state from solid to liquid or from liquid to gas, a substance must be heated to a specific temperature. To change state from gas to liquid or from liquid to solid, a substance must be cooled to a specific temperature.
- Water is the only natural substance that can exist in all three states (solid, liquid, and gas) in the normal temperature range of Earth. Water changes from a solid (ice) to a liquid at 0 °C, and from a liquid to a gas (steam, or water vapour) at 100 °C.

Possible Misconceptions

- Students may think of water, steam, and ice as being different substances. Melting may be conceived as ice changing into water (or vice versa for freezing), and students may believe that dissolving and melting are the same thing. Evaporation (change of state from liquid to gas) is particularly challenging. Common misconceptions are that steam is hot air and that steam becomes air when it disappears. When asked to explain the bubbles in boiling water, students might call the bubbles air or heat.
- Students may conceive of heat and cold as being substances that can be added or taken away. This view can be reinforced by expressions such as “letting the heat out” or “letting the cold in.” Address this by rephrasing students’ remarks. For example, if a student were to say during the *Stop the Melt* investigation that “the bubble wrap keeps the cold in,” you might say, “So you think that bubble wrap keeps the ice from getting warmer.”

ACTIVATE



Changes

Share Science Card 3 with the class. Ask students to tell you about what is happening in the picture. Allow students to describe any element that captures their interest. Encourage students to notice differences between the “sunny” side and the “shady” side. Then, ask students to find the water in the picture. Ask about the states of water with questions such as:

- **Do you see any ice? Is that water?**
- **What is happening to these icicles? Why might that be happening?**
- **What is that coming out of the mugs?**

CONNECT



Put the Kettle On, Please

Have the students gather around you. Review safety rules and then boil a kettle. (Note: you can also use a small humidifier for this demonstration; leave out the comparison of water temperature if you do.) Before you start, pour some of the water into a mug. As the water heats, ask students to share what they think is happening. Use the term “observe” and add this word to the Word Wall. When steam begins to form, ask:

- **What do you observe is happening?**
- **What is coming out of the kettle?**
- **Where did it come from?**

Explain that the steam that comes from a kettle is actually small droplets of condensed water that form when the water vapour contacts cooler air. Remind students of the term “water vapour” and explain that it is water in the gas state. Tell students that when water goes from the liquid state to the gas state (when it becomes water vapour), this is called “evaporation.” Add this term to the Word Wall.

Pour a small amount of the boiling water into a mug, and set it beside the mug you filled before turning on the kettle. Wrap your hands around each mug or use a thermometer, and describe the difference in temperature aloud. Ask:

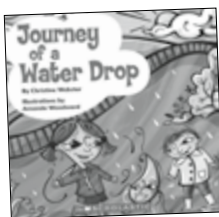
- **I wonder if temperature has something to do with steam. What do you think?**

Add students’ ideas to the unit KWLN chart.

Have ready a number of cold, metal spoons or small hand mirrors at room temperature. If you are using cold spoons, pass them around and ask students to tell you about their temperature; keep one spoon at the front. Challenge the class to predict what will happen if you hold the cold spoon or mirror in steam. Record students’ predictions. Boil water or turn on a humidifier, and carry out the demonstration. When condensation forms, ask:

- **What is this substance? How do you know?**
- **Where did the water on the spoon come from?**
- **What is the evidence for that (how do you know)?**
- **How could we find out (how can we explore/investigate that)?**

Record students’ ideas. Introduce the term “condensation” and add it to the Word Wall.



Literacy Place Connection:

Journey of a Water Drop (Guided Reading, Level N) follows a water drop on its journey from the sky to the earth and back up to the sky. You may wish to focus specifically on pages 10–13 and review with students the concepts of evaporation and condensation.



It's Melting!

Inform the class that they are going to perform an investigation to explore melting. Provide students with the frozen shapes (ice from containers or Freezies), hot and cold water, paper towels, and a thermometer. Also provide tools to apply heat, such as an incandescent lightbulb or a hair dryer—do not allow students to use these items without supervision and be aware of the potential presence of water at all times. Review what a thermometer tells you and how the liquid goes up when temperature goes up and down when temperature goes down. Add “temperature” and “thermometer” to the Word Wall.

Allow students to explore the materials independently. As they are exploring, wonder aloud if these items might be used to find out more about melting. If students need more direction, be more specific; for example, say,

- **I wonder if there is a way to make ice melt faster? Maybe we could use these materials to find out.**

As they share their ideas, guide students to think about what they think will happen (predict) and how they will know what happens (observe, measure, evidence). Remind students that they can use their senses to learn about what is happening. For example, ask:

- **What changes do you see? Feel? Hear? Smell?**

Avoid telling students what to do. Instead, ask questions to prompt deeper thinking, such as:

- **How will you know that you have made it warm?**
- **How would a scientist find that out?**



Before students begin their investigations, display the *What Is the Inquiry Process?* poster and read the steps with the students. Explain that making a plan, exploring, recording results, and drawing conclusions are all part of finding an answer to a question. Provide any materials students need to record their observations. You might also document them working with photographs and/or videos. After the investigation, have the class create a bulletin board or Webpage to share their questions and conclusions. Include a section for students to add new questions based on their results.

It's Freezing!

Ask students if they have ever waited for something to freeze, such as an ice rink or a Popsicle. Allow students to share their stories; when/if an opportunity arises, prompt students to recall specifics about the time, conditions, or any other relevant details. Alternatively, wonder aloud if it always takes the same amount of time to make ice.

Display a selection of containers of different shapes and sizes in which to make ice. Tell students you are going to fill the containers with water and put them in the freezer at the same time. Allow students time to explore the containers. Then, ask students to predict which container would make ice the fastest and explain why they think so. Record students' predictions and reasons in a central place.

Fill the containers with water and place them in a freezer. Use a tray or container to make transport easy, as you will be taking the containers out to make observations once every 15 minutes. Each time you take the containers out, have students record their observations using a method of their own choosing (e.g., digital photos, sketches, or jot notes). Or, a parent volunteer could take small groups of students to the freezer in order to observe and record the changes.

After results have been gathered, meet as a class to discuss them and ask for explanations of what happened. Prompt students to support their explanations with evidence from their observations. Ask:

- **How did what we see show that that is true?**

Add the findings to the unit KWLN chart. Encourage students to record additional questions based on the results. If time allows, assist students in exploring these questions by providing materials and supervision.

Ice and Water

This investigation may be carried out during the *It's Freezing!* investigation above, in the waiting periods. Provide ice cubes; three shatterproof cups filled with warm, room temperature, and cool water respectively; a thermometer; and trays to contain any spills. If necessary, review the use of the thermometer. Ask:

- **In which glass will the ice melt the fastest? Why?**
- **What will happen to the temperature of the water when the ice melts? What evidence could you look for to support that prediction?**

Have students work in groups of two or three; assign each group a letter (A, B, C, etc.), and a particular cup of water. Direct students to write the letter of their group on an index card. Then, have students measure and record the temperature of the water with a thermometer, by placing the index card behind the thermometer and marking a line at the top of the liquid in the column. If your class is ready, have them record the actual number (temperature) on the card.

Have all groups place one ice cube into their cup at the same time. Tell the students to watch their ice cube, and then, as soon as it is completely melted, raise the card with their group's letter on it so you can see. Record the letters in order on BLM *When Did It Melt?*

Have each group share the temperature of the water in their cup with the class and use this to sort the group(s). Record their sorting results on BLM *When Did It Melt?*, and then post the completed BLM in a central place. Have volunteers describe any patterns they see in the results. Ask:

- **What do you notice about the temperature of the water for the groups whose ice cube melted the fastest? How about the groups whose ice cube melted the slowest?**
- **Why do you think this happened? What evidence is there for that idea?**
- **Where did the ice go? How do you know?**



CONSOLIDATE

Stop the Melt

Before class, make ice cubes with added plastic googly eyes. Briefly show the 'ice people' to the class, and then return them to the freezer. If this is not possible, briefly describe the ice people or show a photo of them. Tell students that the ice people have an important message for their leader, and they all have to leave the freezer to wait for her. The leader won't come for 30 minutes! How can they make sure the ice people last long enough to deliver the message?

Provide paper towels, bowls, cardboard, bubble wrap, and other materials of your choosing at a central point in the classroom. You might want to have a cupboard or box accessible for the ice people to 'hide' from sunlight. Divide the class into groups and tell students that their job is to use the materials to keep their ice person from melting for as long as possible. Prompt them to think about what they have learned about melting and then come up with a plan of what materials they will use and how. Consider telling students that groups can work together to keep their ice people frozen longer. Students can record their plans in their Science Journals.



After allowing time for thinking and discussion, provide an ice person to each group on a paper towel or in a small container. Have students carry out their plan, working on trays to avoid spills. Invite students to name their ice person.

Direct the class to watch how quickly their ice people melt. Invite students to record the time using a digital timer or a central clock (this is not required).

While they are waiting, have students record in their Science Journals what they did to protect their ice person. When records are complete, encourage students to visit other groups to see what they did and ask questions and make comments as melting occurs. Circulate and discuss with students what they did and why they think it will work as they are working. Have students indicate when their ice person has melted by raising their hand. Note the order in a central place.

Stop the activity after 30 minutes then review the results as a class. Ask:

- Did any of the ice people last long enough to deliver the message?
- What helped them to slow down the melting? What didn't help?
- Why do you think [choose a method] slows down the melting?
- Was there anything you would do differently if you could do this again?

EXPLORE MORE

Build an Ice House

Use food colouring, water, and containers of different shapes and sizes to create ice for students to build an ice house for ice people to live in. You may provide commercially made trays in different shapes, empty juice and milk boxes, or fill and freeze balloons and then cut the balloon away. Have students work in a washtub or other large waterproof container, or outside, if the temperature is appropriate. Students can use water or snow (when available) as 'mortar.' When the house/houses are built, add ice people, and ask students to predict whether they will last longer inside the house and why.

When Did It Melt?

Starting here, write the letter of each group as soon as they raise their paper.



What was the temperature of the water for each group?

Warm Water

In the Middle

Cool Water