Purpose
To accurately use and read a thermometer to measure water temperature.

Process Skills
Predict, measure, observe, collect data, communicate, identify and control variables, draw conclusions

Background
Thermometers are tools that are used to measure temperature. An object’s temperature shows how much heat it has. If you are measuring something that is warm or hot, the liquid in the thermometer will expand and rise inside the thermometer’s glass tube. If you are measuring something cool or cold, the liquid will contract and move down the tube. Markings on the side of a thermometer help you measure the temperature. Thermometers use two scales—Celsius and Fahrenheit. Scientists usually use the Celsius scale to measure temperature. Water boils at 100° Celsius (212°F) and freezes at 0° Celsius (32°F). Room temperature is about 25° Celsius (77°F).

Time – Part 1: 20 minutes; Part 2: 30 minutes
Grouping – Small groups

Materials
Part 1:
- data sheet
- large classroom thermometer (°C and °F)
Part 2:
- container of room-temperature water, labeled room temperature
- container of warm water, labeled warm
- container of ice water, labeled cold
- 400 mL beaker
- student thermometer (°C)
- paper towels
**Safety:** Handle the beaker and thermometer carefully. If your thermometer or beaker breaks, do not try to clean up yourself. Tell your teacher immediately!

**Procedure**

*Part 1: Practice and Predict*

**Practice**

1. Use the classroom thermometer as a model. On your data sheet, label the Celsius degrees on the thermometer. Only number the long lines, counting by tens. Some of the lines have been labeled for you. Notice that some of the markings are below zero.

2. Discuss with your group what the shorter lines on the thermometer stand for. Then practice reading your thermometer. Take turns pointing a pencil tip to the

   lines on the thermometer that match these temperatures: 20°C, 40°C, 12°C, 36°C, 8°C, and –10°C. As a group, discuss where 52°C would be.

3. Now take turns pointing to lines on the thermometer and asking a partner to read the temperatures. Also try pointing to temperatures between the lines, such as 17°C or 33°C.

**Predict**

1. As a group, make a prediction about the temperature you think the thermometer will read when you put it in room-temperature water.

2. On the “Temperature Predictions” side of your data sheet, draw an arrow to the thermometer reading that matches your prediction. Label it “Room-Temperature Prediction.”
3. Make a prediction about the temperature of the warm water. On the “Temperature Predictions” side of your paper, draw an arrow pointing to the thermometer reading that matches your prediction. Label it “Warm Prediction.”

4. Make a prediction about the temperature of the cold water. On the “Temperature Predictions” side of your paper, draw an arrow pointing to the thermometer reading that matches your prediction. Label it “Cold Prediction.”

5. Compare your group’s temperature predictions with the rest of the class. Be prepared to share how you came up with each prediction, based on what you already know about temperature.

Part 2: Measuring Temperature in Water

1. Carefully pour room-temperature water into your beaker until the water level reaches exactly 200 mL.

2. Carefully place your thermometer in the beaker, bulb side down. (The bulb is the bottom tip.) You do not need to hold the thermometer or stir the water.
3. Observe your thermometer as it measures the water temperature. Make sure that the liquid inside the tube has completely stopped moving before going on to step 4.

4. Draw an arrow on the “Actual Temperatures” side of your data sheet pointing to the actual water temperature. Make sure to place your arrow at exactly the same spot on your data sheet as the line you read on the thermometer. Label the arrow “Room-Temperature Actual.”

5. Carefully remove the thermometer from the beaker and place it in a safe spot. Pour the water out of the beaker.

6. Repeat steps 1–5 with the warm water. Label the arrow on your data sheet “Warm Actual.”

7. Repeat steps 1–5 with the cold water. Label the arrow on your data sheet “Cold Actual.”
EXPLORATION

Science Tools—Measuring Water Temperature Data Sheet

Name________________________________________  Date_____________

Collect Data

Temperature Predictions  Celsius Thermometer  Actual Temperatures
Analyze Data

1. How did your prediction about the room-temperature water compare with the actual temperature? (Find differences by using subtraction.)
   
   Prediction: ______°C  
   Actual: ______°C  
   Difference: ______°C

2. How did your prediction about the warm water compare with the actual temperature?
   
   Prediction: ______°C  
   Actual: ______°C  
   Difference: ______°C

3. How did your prediction about the cold water compare with the actual temperature?
   
   Prediction: ______°C  
   Actual: ______°C  
   Difference: ______°C

4. Which of your predictions was closest to the actual temperature? Why do you think this prediction had the smallest difference?

5. What temperature reading do you think you would get if you combined 100 mL of warm water with 100 mL of cold water? Why?
6. Write the actual Celsius temperatures from your data sheet on the top three lines below. Then find these Celsius temperatures on your classroom thermometer. Write the matching Fahrenheit temperature for each kind of water on the bottom three lines.

Room: _______ºC  Warm: _______ºC  Cold: _______ºC
Room: _______ºF  Warm: _______ºF  Cold: _______ºF

Draw Conclusions
1. Why is it useful to know how to read a thermometer? Think about how you might use a thermometer in school and how you might use it outside of school.

2. What would happen to the temperature reading if a thermometer were left in the beaker with warm water for three hours? Why?
TEACHING TIPS

This process activity will help students understand how to use a thermometer. Students will reproduce a temperature scale and predict, measure, record, and compare water temperatures. As students relate temperature to common objects, they may come to appreciate how the temperature scale helps people in a variety of settings. Practicing temperature measurement will also help students estimate the temperatures of solids, liquids, and gases in many applications.

SET-UP AND PROCEDURES

- Before students measure the water temperature, you may want to conduct your own measurements so you will be able to assess whether the results students record are reasonable.
- Provide adequate time for students to practice reading thermometers before asking them to begin Part 2.
- Prepare the container with room-temperature water on the day before beginning the activity with students so that the water is as close to room temperature as possible.
- All results will be more profound when there is a greater disparity in the water temperatures being used. The warm water used for this exploration should be warm, but below 50ºC. Ice may be put in the container of cold water, but direct students to fill their beaker with only the water.
- It may be helpful to have students rinse their container with tap water after using the warm or cold water to bring the container back to room temperature before starting the next measurement.
- Model how to read the student thermometer and how to place the thermometer in the beaker. Remind students to keep the thermometer in the beaker until the temperature reading has completely stopped moving.
- Circulate among groups once students have completed Part 1. Ensure that students have correctly labeled the thermometer on their data sheet and that their predictions are realistic. Refer students who are having difficulty making predictions to the Background portion of the Process Activity.
- You may want to assign a job to each student within a cooperative group. Examples include recorder, temperature reader, cleaner, water pourer, and reporter.

SAFETY

- Be sure student thermometers are not mercury-based (most school districts in the United States have banned the use of mercury thermometers in the classroom).
- Direct students to alert you immediately if a thermometer or beaker breaks. Students should not clean up broken glass on their own.
- If water spills, students should dry the area immediately.
EXPLORATION

Science Tools—Measuring Water Temperature

MATERIALS

- Many districts have a science resource center to contact if student thermometers are not readily available at the school. Otherwise, they can be purchased at local or online science or teacher supply stores.
- If beakers are not available, most baby bottles also have mL markings.
- Containers with pour spouts and handles will help limit spills.
- Containers with lids will help keep water temperatures constant for a longer period of time.
- If water is not readily available in the classroom, use thermoses to store water at the three temperatures.
- If a large classroom thermometer is not available for the Practice portion of the Process Activity, students can either use a printout of a thermometer or use the student thermometer as a model for labeling their data sheet.
- Have plenty of paper towels on hand in case of spills.

EXTENSIONS AND VARIATIONS

- **Inquiry Science:** Before and after the activity, you may want students to practice temperature measurement by keeping track of daily outdoor temperatures (in Celsius and Fahrenheit) using a classroom thermometer.
- **Variation/Inquiry Science:** Once students have answered Analyze Data question 5, regarding combining warm water with cold water, encourage them to try it and then to compare the result with their prediction.
- **Inquiry Science:** On a sunny day, take students outside to measure the temperatures of different solid materials, such as concrete, metal, wood, and plastic. Also encourage students to explore air temperatures by holding their thermometer above the three different temperatures of water.
- **Technology:** Once students have used the classroom thermometer to match their Celsius reading with the Fahrenheit equivalent, they can use an online conversion calculator to check their visual estimates.
- **Art:** Have students compare natural cloth dyed in warm and cold water.
- **Guest:** Invite a local meteorologist to the classroom to discuss how changes in temperature impact the weather.
- **On-Site Field Trip:** Take a trip to the cafeteria and invite students to learn from the cafeteria manager about temperature regulations involving the storage and preparation of food.
- **Home Connection/Writing:** Have students interview their parents about all of the ways that they measure temperature at home. For extensive writing instruction, including transactional writing, visit [Writinga-z.com](http://Writinga-z.com).
- **Writing:** Have students write about a time when they had a fever. You will also find narrative writing instruction on [Writinga-z.com](http://Writinga-z.com).
While predictions will vary, students should predict the temperature of the cold water to be below that of the room-temperature water, which in turn should be below that of the warm water. Because students were told at the beginning of the Process Activity that room temperature is about 25°C Celsius, their prediction for room-temperature water should be about 25°C. Students’ predictions for the cold water should not be below freezing (0°C), and their predictions for the warm water should not be above boiling (100°C).

While results will vary, the range of likely water-temperature readings will be:

- **Warm Actual:** 45–50°C
- **Room-Temperature Actual:** 20–30°C
- **Cold Actual:** 0–5°C
EXPLORATION

Science Tools—Measuring Water Temperature Questions

ANSWER KEY AND EXPLANATIONS

Analyze Data

1. How did your prediction about the *room-temperature water* compare with the actual temperature? (Find differences by using subtraction.)
   
   *Answers will vary.*

2. How did your prediction about the *warm water* compare with the actual temperature?
   
   *Answers will vary.*

3. How did your prediction about the *cold water* compare with the actual temperature?
   
   *Answers will vary.*

4. Which of your predictions was closest to the actual temperature? Why do you think this prediction had the smallest difference?
   
   *Answers will vary and should include an explanation.*

5. What temperature reading do you think you would get if you combined 100 mL of warm water with 100 mL of cold water? Why?
   
   *Answers will vary but might be an average of the warm-water temperature and the cold-water temperature. An estimate may suffice. Students should include an explanation of how they reached their answer.*

6. Write the actual Celsius temperatures from your data sheet on the top three lines below. Then find these Celsius temperatures on your classroom thermometer. Write the matching Fahrenheit temperature for each kind of water on the bottom three lines.
   
   *Answers will vary, but a likely range of temperatures is included below.*

   Room: 20–30°C   Warm: 45–50°C   Cold: 0–5°C
   Room: 68–86°F   Warm: 113–122°F   Cold: 32–41°F

Draw Conclusions

1. Why is it useful to know how to read a thermometer? Think about how you might use a thermometer in school and how you might use it outside of school.
   
   *Answers will vary. It is useful to know how to read a thermometer for many reasons. In school, students can use a thermometer to do science experiments and to set the classroom’s air conditioning and heating to desired levels. At home, it is useful so that students can know how to dress for the weather, decide when food is cooked, and determine whether they have a fever.*

2. What would happen to the temperature reading if a thermometer were left in the beaker with warm water for three hours? Why?
   
   *Answers will vary but should indicate that the water will lose heat over time until it reaches room temperature.*