

Sensing Heat (from Sensing for Science K-2 Curriculum)

Instructor Overview

In this exploratory activity, students investigate how different sensors can be used to measure heat and temperature. Students will use two types of thermometers:

- **Alcohol thermometer** (traditional liquid thermometer)
- **Infrared thermometer** (non-contact thermometer with a laser pointer)

Through observation and measurement, students will explore how sensors collect information about their environment and communicate that information as a signal that we can interpret.

Grade-Level Adaptations

Grades K-1

Modify this activity by demonstrating the sensors yourself rather than having students use them independently.

With the infrared thermometer:

- Show students the temperature reading on the display.
- Demonstrate how the number changes when measuring warmer and cooler objects.
- Ask questions such as:
 - Which number is bigger?
 - What does a higher number tell us?
 - What does a lower number tell us?

With the alcohol thermometer:

- Invite students to observe the colored liquid inside the thermometer.
- Ask:
 - What do you notice?
 - What happens to the liquid when the thermometer gets warmer?
 - What do you think the change in the liquid level means?

Grades 2 and Up

Students will create drawings throughout the activity to show what they are learning about sensors and heat.

By the end of the lesson, students should create a drawing that includes:

- A heat source or natural phenomenon (sunlight, campfire, warm pavement, cooking, etc.)
- The vocabulary words:
 - **sensor**
 - **signal**
 - **heat**
 - **temperature**
 - **energy**

Teaching Heat vs. Temperature

To help students understand these concepts:

- **Heat** is energy that moves from warmer objects to cooler objects.
- **Temperature** is a measure of how hot or cold something is.

For simplicity, it is appropriate to use the terms "hot" and "cold" with students.

Teacher Note: Scientifically, "hot" and "cold" describe human experience rather than exact measurements. If desired, you may use "higher temperature" and "lower temperature" instead.

Teacher Notes About the Sensors

Infrared Thermometer

- The infrared thermometer can measure temperatures from a distance.
- Although the laser pointer shows where the thermometer is aimed, the sensor actually measures a larger area than the laser dot.
- Temperature readings may vary if the sensor is measuring multiple surfaces within its field of view.

Alcohol Thermometer

- The alcohol thermometer works well for measuring water temperatures and other nearby objects.
- Do not place the thermometer in very hot water.
- The thermometer contains plastic components that can be damaged by excessive heat.
- Handle carefully, as the thermometer can break if dropped.

Materials Needed

- One **Sensing Heat Worksheet** per student (Grades 2+)
- Pencils

- Whiteboard or chart paper
- Guiding questions (printed or displayed)
- Room-temperature water
- Cool water and/or warm water (safe for student use)
- Alcohol thermometer
- Infrared thermometer
- Access to outdoor areas with both sun and shade (optional)

Educator Preparation

Before the lesson:

- Print enough worksheets for all students.
- Decide whether students will conduct investigations indoors, outdoors, or both.
- If working indoors, identify locations with noticeable temperature differences, such as:
 - Near windows
 - Near doors
 - Near heating or cooling vents
- Consider creating a word wall with key vocabulary:
 - Sensor
 - Signal
 - Temperature
 - Heat
 - Energy

Procedure

1. Introduce the Activity (5 minutes)

Distribute worksheets.

Explain that students will use sensors to measure temperatures and investigate how different objects and environments transfer heat.

2. Review Safety Procedures (5 minutes)

Discuss the following safety expectations:

- Warm and cold water can make skin uncomfortable if mishandled.
- Never point the infrared thermometer's laser at anyone's face or eyes.
- Handle thermometers carefully to prevent breakage.
- Follow all classroom safety instructions during investigations.

3. Explore the Thermometers (5 minutes)

Distribute both thermometers.

Allow students time to examine each tool and discuss:

- How they are similar
- How they are different
- How each thermometer measures temperature

Review safety expectations before students begin measuring.

4. Measure Water Temperatures (10 minutes)

Provide samples of room-temperature, cool, and warm water.

Have students:

- Measure each water sample with both thermometers.
- Record their observations and temperature readings on their worksheets.
- Compare results between the two sensors.

Teacher Note: Ensure warm water is comfortable and safe for student handling.

5. Compare the Sensors (Optional, 2 minutes)

Ask:

- Which thermometer was easier to use?
- Which seemed to give the most consistent reading?
- Which would you trust for measuring water?

Guide students toward the idea that different sensors are useful for different purposes.

6. Discuss the Results (3 minutes)

Explain that the alcohol thermometer works especially well for measuring water because it is placed directly in the water.

The infrared thermometer measures a larger area, which can include nearby surfaces in addition to the water itself.

Because of this, the infrared thermometer is often more useful for measuring larger surfaces, such as the ground, a wall, or outdoor objects.

Teacher Note: These instruments measure temperature in different ways, but the scientific details are beyond the scope of this lesson.

7. Find Hot and Cold Spots (10 minutes)

Challenge students to use the infrared thermometer to locate:

- The warmest spot they can find
- The coolest spot they can find

Students should:

- Record the temperatures.
- Draw the locations on their worksheet.
- Describe their findings using the vocabulary words:
 - Sensor
 - Signal
 - Temperature
 - Heat

Possible locations include:

- Sunny pavement
- Grass
- Shaded areas
- Building walls
- Indoor vents
- Windows
- Doorways

Wrap-Up and Reflection

1. Draw How a Sensor Works (5 minutes)

In the final box of the worksheet, ask students to draw how they think a thermometer works.

Encourage them to show:

- The heat source
- The sensor
- How heat moves from one place to another

Students may use arrows, lines, symbols, or labels.

2. Class Discussion

Review the key concepts:

- A **sensor** collects information about its surroundings.
- A **thermometer** is a type of sensor.
- The thermometer measures a **signal** related to heat.
- That signal is displayed as a temperature reading that we can interpret.

Emphasize that different sensors are useful in different situations, and scientists choose the best sensor for the job they are trying to do.