

Lesson 5: Temperature And Density

Science Focus Question

How does a change in temperature affect the density of a substance?

Getting Started

1. Examine your thermometer and answer the following questions.
 - a. Where is most of the liquid in your thermometer? _____

 - b. What is the temperature range of your thermometer and what units does it measure in? _____

2. Hold the bulb end of the thermometer (the red end) in your hand. Use your observations to answer the following questions.
 - a. What happens to the red liquid? _____

 - b. What temperature does it reach? _____
 - c. What happens to the reading when you let go of the bulb and hold on to the other end of the thermometer? _____

 - d. Why do you think the liquid in the thermometer moves? _____

Inquiry 5.1

Building a Thermometer

1. Draw your design for a thermometer. Use a ruler, colored pencils and labels in your diagram.

2. Record the temperature of the water baths using the alcohol thermometer.

Cold water bath: _____ Hot water bath: _____

What is the difference between the two temperatures? _____

3. Use the alcohol thermometer to measure the room temperature.

Room temperature: _____

4. Place your laboratory thermometer and the alcohol thermometer into the hot water bath for 1 minute. Now place them both into the cold water bath for 1 minute. Answer the following questions.

a. How quickly does your laboratory thermometer respond to temperature changes? Is it quicker, slower or the same as the alcohol thermometer?

b. When the temperature increases, what happens to the volume of water in your thermometer? _____

c. When the temperature increases, do you think the mass of water in your thermometer changes? Why or why not? _____

d. If you decreased the size of the thermometer bulb, how would the accuracy and the response time of your thermometer be affected?

5. How could you improve the design of your thermometer to make it more accurate and more sensitive? _____

Modeling Activity

You will create a model to represent what your group thinks happens to a liquid when it is heated up. You will act out this model using yourselves as particles of matter.

Inquiry 5.2

Replacing the Liquid With Air

1. Draw your design for an air-filled thermometer. Use a ruler, colored pencils and labels in your diagram.

2. How did the sensitivity of your air-filled thermometer compare with that of your liquid-filled one? _____

Inquiry 5.3

Heating the Metal Strip

1. What do you think will happen to the metal strip when it is heated?

2. What did you observe when the strip was heated? _____

3. What happens to the strip after it cools? _____

4. What did you observe when the strip was heated on the other side? Why do you think the strip behaves this way? _____

Laboratory Questions

- 1) What do these three inquiries tell you about how the volume of matter is affected by temperature? _____

2) How does the change in the volume of the air differ from the change in the volume of the liquid? _____

3) How does this change in volume affect the density of solids, liquids, and gases?

4) When measuring the density of a substance, why do you think it might be important to record the temperature of the substance? _____

Reading: Changing Temperature, Changing Density

1) When a substance is heated, its density decreases. Explain why this happens.

2) When a substance is cooled, its density increases. Explain why this happens.

Reading: Measuring Temperature by Degrees

- 1) Who was the first scientist to invent a device to measure temperature? What was this device called? _____

- 2) In science, we use the Celsius scale to measure temperature. Why is this scale so popular and used in most countries around the world? _____

- 3) Describe the coldest temperature possible. What is this called and what is unique about objects at this temperature? _____

Reading: Just a Load of Hot Air

- 1) Use your knowledge of density to describe its role in allowing a hot air balloon to rise. _____

Reading: Density Creates Currents

- 1) Describe how changes in the temperature of air cause a change in its density and create convection currents. _____

- 2) What does density have to do with wind? _____

- 3) Big birds such as vultures and hawks can often be seen gliding around and around over big parking lots or large open fields on sunny days, without even flapping their wings. Why? _____

Reading: The Trans-Alaska Pipeline: Meeting Nature's Challenges

- 1) How did engineers overcome the challenge of a 95° C temperature range when designing the Trans-Alaska Pipeline? _____

- 2) Explain how density is related to the expansion and contraction of materials or objects. _____
