

## Section 3

### Understanding Matter and Energy

#### EXPLORATION 1

## A Coin Jump

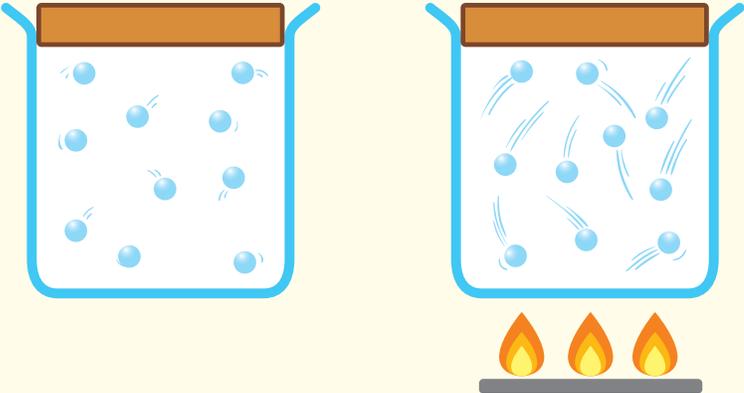
Discover that heated air expands and can cause movement.

The particle theory of matter states that all water consists of many small particles that are constantly moving. Temperature affects the speed at which these particles move. This concept is also known as thermal expansion. “Thermal” refers to heat and “expansion” refers to the increase in volume.

Thermal expansion occurs when an object changes its shape, volume, and/or density due to an increase in temperature. As temperature increases, particles move faster and take up more space. This means the volume increases.

But what happens to the pressure of the object? Try this experiment to find out how pressure changes due to an increase in temperature.

**Pressure-temperature  
Relationship of Gases**



- same number of gas particles
- same volume
- an increase in temperature
- How does the pressure change?

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Try this experiment to examine how thermal expansion can cause movement.

*Ask an adult for help when handling hot water.*

### Materials:

- 2 bowls
- ice cubes
- 1 coin (slightly bigger than the bottle's mouth)
- a glass bottle
- hot water



### Steps:

1. Fill one of the bowls with the ice cubes.
2. Place the glass bottle in the bowl of ice cubes upside down so that its neck is submerged in the ice.
3. Place the coin inside the bowl of ice.
4. Leave the bottle and coin in the ice for about ten seconds.
5. Fill the other bowl with hot water with the help of an adult.
6. Remove the bottle and coin from the ice. Place the coin on top of the bottle so it covers the bottle's mouth.
7. Place the bottle and coin upright in the bowl of hot water.
8. Observe what happens to the coin.



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As you observed, the coin began to jump up and down after the bottle was placed in the hot water, and it continued to jump for a while.



At the beginning, the bottle and the air inside it was cold because of the ice. As soon as the bottle was placed in the hot water, the air particles inside the bottle rapidly heated up, causing thermal expansion to occur. However, the heated air particles were contained in the bottle with a fixed volume and did not have space to expand, so the pressure inside the bottle increased. The

warm air inside the bottle pushed harder than the cool air outside, so it pushed its way out of the bottle, causing the coin to jump up and down. The coin stopped jumping when the air pressure inside the bottle reduced and became the same as that outside the bottle.

