Section 1: Temperature

Preview

- Key Ideas
- Bellringer
- Temperature and Energy
- Temperature Scales
- Math Skills
- Relating Temperature to Energy Transfer
- Temperature and Heat

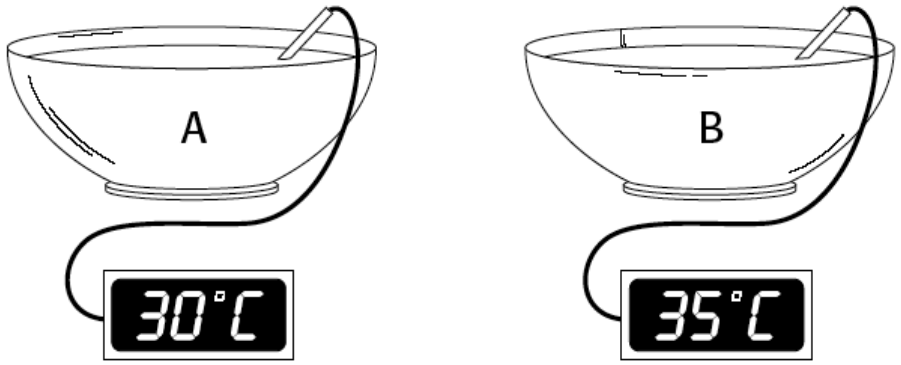
Key Ideas

- What does temperature have to do with energy?
- What three temperature scales are commonly used?
- What makes things feel hot or cold?

Bellringer

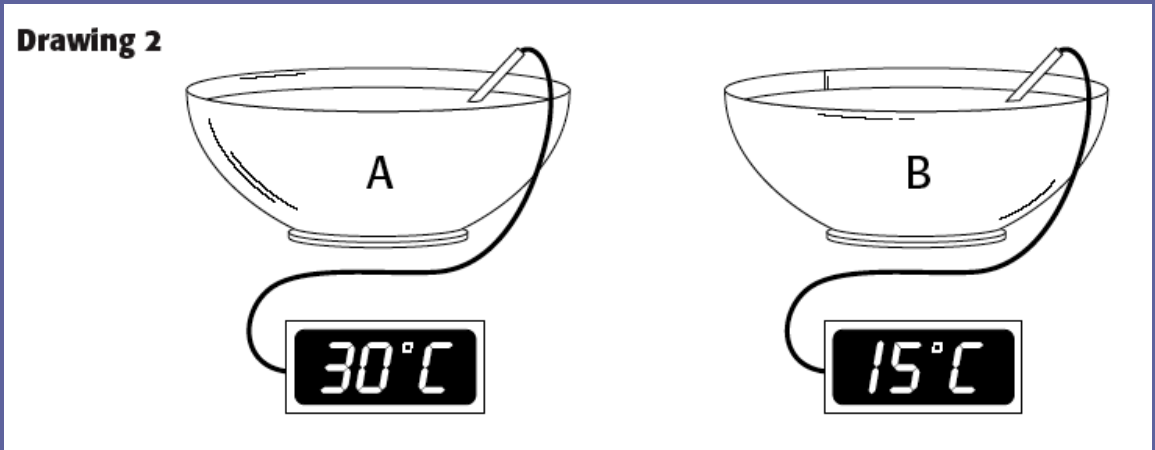
We use words like *hot* and *cold, long* and *short,* and *heavy* and *light* every day to describe the differences between things. In science, however, this is often not accurate enough and leads to confusion.

Drawing 1



- In drawing 1, which bowl would feel warm to your hands? Which bowl would feel cooler?

Bellringer, *continued*



2. In drawing 2, which bowl would feel warm to your hands? Which would feel cooler?

3. A person from Seattle tells his friend from Florida that the weather in Seattle is somewhat warm. When the friend arrives for a visit, he finds that he is uncomfortably cool wearing the shorts he packed. What would be a more effective way for the person from Seattle to explain the weather?

Temperature and Energy

- What does temperature have to do with energy?

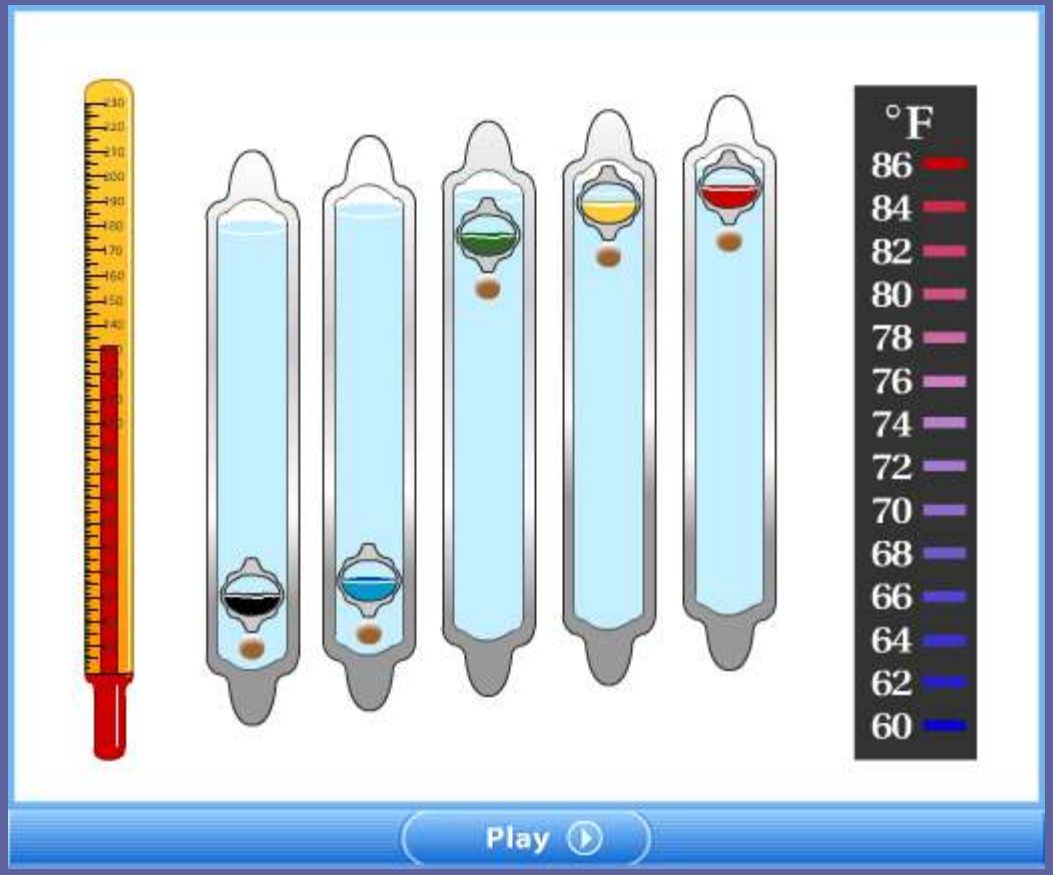
- The temperature of a substance is proportional to the average kinetic energy of the substance's particles.

- **temperature:** a measure of how hot (or cold) something is; specifically, a measure of the average kinetic energy of the particles in an object

Temperature and Energy, *continued*

- All particles have kinetic energy.
  - All particles in a substance are constantly moving.
  - As the average kinetic energy of the particles in an object increases, the object's temperature increases.
- Common thermometers rely on expansion.
  - Most substances expand when their temperatures increase.
  - **thermometer:** an instrument that measures and indicates temperature
- Thermostats rely on the expansion of different metals.

Visual Concept: Measuring Temperature



Temperature Scales

- What three temperature scales are commonly used?

- The Fahrenheit, Celsius, and Kelvin temperature scales are commonly used for different applications in different parts of the world.

Temperature Scales, *continued*

- The units on the Fahrenheit scale are called *degrees Fahrenheit* (°F).
- On the Fahrenheit scale, water freezes at 32 °F and boils at 212 °F.
- The Celsius scale gives a value of 0 °C to the freezing point of water and a value of 100 °C to the boiling point of water at standard atmospheric pressure.

Temperature Scales, *continued*

- One degree Celsius is equal to 1.8 degrees Fahrenheit.
- The temperature at which water freezes differs for the two scales by 32 degrees.

Fahrenheit-Celsius Conversion Equations

$$T_F = 1.8T_C + 32.0$$

$$T_C = \frac{T_F \quad 32.0}{1.8}$$

T_F = Fahrenheit temperature, T_C = Celsius temperature

Temperature Scales, *continued*

- The Kelvin scale is based on absolute zero.

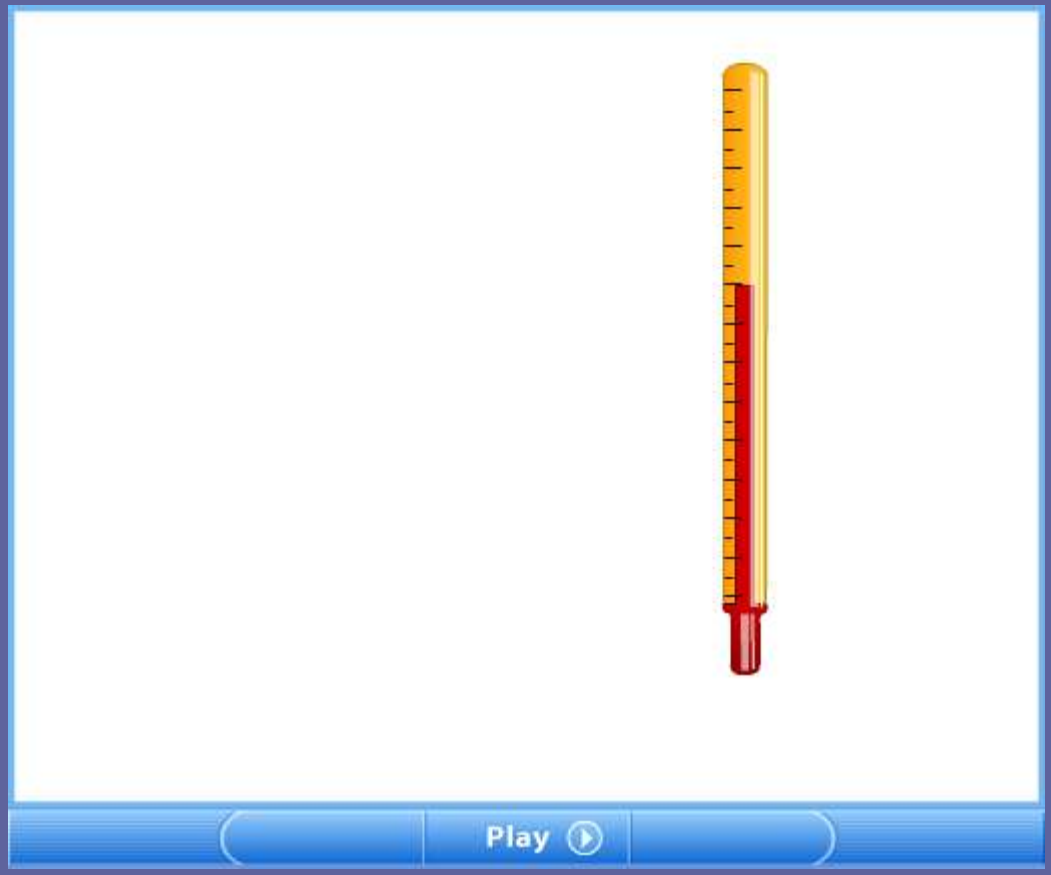
- **absolute zero:** the temperature at which molecular energy is at a minimum
- 0 K on the Kelvin scale or –273.16 ºC on the Celsius scale)

Celsius-Kelvin Conversion Equation

$$T_K = T_C + 237$$

T_k = Kelvin temperature, T_C = Celsius temperature

Temperature Scales



Math Skills

Temperature Scale Conversion

The highest temperature ever recorded in Earth's atmosphere was 57.8 °C at Al-Aziziyah, Libya, in 1922. Express this temperature in degrees Fahrenheit and in kelvins.

- **List the given and the unknown values.**

Given: $T_C = 57.8\ ^oC$

Unknown: $T_F = ?\ ^oF$

$T_K = ?\ K$

Math Skills, *continued*

2. Write down the equations for temperature conversions.

$T_F = 1.8T_C + 32.0$

$T_K = T_C + 273$

3. Insert the known values into the equations, and solve.

$T_F = (1.8 \times 57.8) + 32.0 = 104 + 32.0 = 136\ ^\circ F$

$T_K = 57.8 + 273 = 331\ K$

Relating Temperature to Energy Transfer

〉 What makes things feel hot or cold?

〉 The feeling associated with temperature difference results from energy transfer.

- When two objects that are at different temperatures are touching, energy will be transferred from one to the other.

Relating Temperature to Energy Transfer, *continued*

- Temperature changes indicate an energy transfer.
- **heat:** the energy transferred between objects that are at different temperatures
- The transfer of energy as heat always takes place from something at a higher temperature to something at a lower temperature.
- The greater the difference in the temperatures of the two objects, the faster the energy will be transferred as heat.

Temperature and Heat