Energy in Motion

Grade 6: Temperature Probe

Aligned with National Standards

ward's science
Single Probes

overview

Just because a bottle looks empty doesn't mean that it is empty. The bottle actually contains air, which is made up of different gases. If the bottle was placed in hot water, the heat energy would make the gas molecules in the air expand and move. We will also see that increasing the temperature of water molecules also increases the movement of these molecules.

This activity uses the WARD's Single Temperature Probe to collect data, allowing students to focus on the science discovery and leaving more time for learning and developing higher level thinking skills. If you prefer, a simple thermometer can be used in this activity.

time requirement:

This activity can be completed in one session of 40 minutes.

materials required for the activity:

Empty plastic water bottle (8 oz) with cap
Container or beaker (big enough to place the water bottle in)
Hot water
Ice water
Temperature probe
Plastic cups
Blue and yellow food coloring
Instructions (this guide) and student data sheet (page 7)

safety precautions

general safety:

- Consider establishing a safety contract that students and their parents must read and sign. This is a good opportunity to identify students with allergies (e.g., latex) so that you (and they) will be reminded of specific lab materials that may pose risks to individuals.
- Remind students to read all instructions before starting the lab activities, and to ask questions about safety and safe laboratory procedures.
- Students should take precautions around hot materials.
- Students should be aware that the food coloring will stain clothing.
- Have students wash their hands after completing this and all lab activities.

standards alignment

framework for K-12 science education © 2012

DIMENSION 1 Science and Engineering Practices

×	Asking questions (for science) and defining problems (for engineering)		Use mathematics and computational thinking
×	Developing and using models	×	Constructing explanations (for science) and designing solutions (for engineering)
×	Planning and carrying out investigations		Engaging in argument from evidence
	Analyzing and interpreting data		Obtaining, evaluating, and communicating information

DIMENSION 2 Cross Cutting Concepts

	Patterns	×	Energy and matter: Flows, cycles, and conservation
×	Cause and effect: Mechanism and explanation		Structure and function
	Scale, proportion, and quantity		Stability and change
	Systems and system models		

DIMENSION 3 Core Concepts

Discipline	Core Idea Focus
Physical Sciences	PS1: Matter and Its Interactions PS3: Energy

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NGSS STANDARDS

Middle School Standards Covered
MS-PS1-4 . Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

national science education standards © 1996

Content Standards (K-12)			
	Systems, order, and organization		Evolution and equilibrium
×	Evidence, models, and explanation		Form and Function
×	Constancy, change, and measurement		

Physical Science Standards Elementary School		Physical Science Standards Middle School
×	Light, Heat, Electricity, and Magnetism	Properties and Changes of Properties in Matter

× Indicates standards covered in activity

prior to class

- Collect water bottles for students.
- Get ice and prepare a bulk quantity of ice water (enough for 1 cup for each student or group).
- You may want to cover the work surfaces with newspaper.
- Review basic information about how to use and read a thermometer and/or the WARD's Single Temperature Probe.

objective

Students will understand the effects thermal energy has on particle motion, and temperature.

background

Thermal energy is the energy a substance or system has related to its temperature, i.e., the energy of moving or vibrating molecules. Atoms and molecules, the smallest particles of any substance, are always in motion.

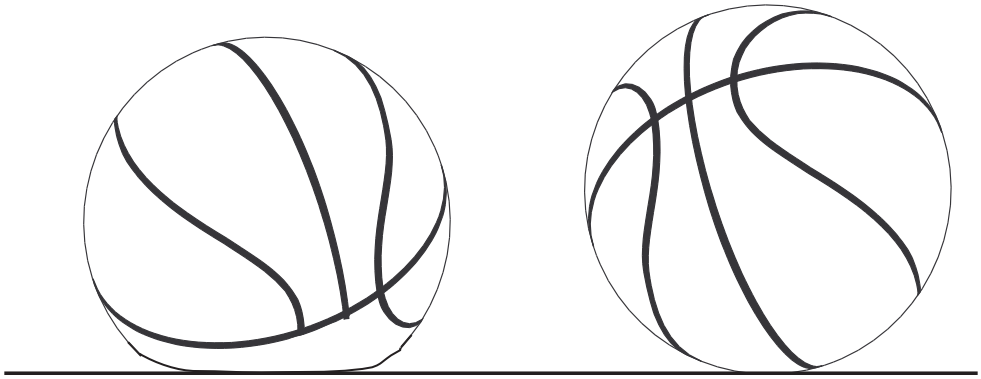
Thermal energy is not the same as heat. Heat is energy transferred between substances or systems due to a temperature difference between them. So it is correct to say that a system contains thermal energy, but not that it "contains" heat, since heat means energy that is transferred from one thing to another.

The amount of heat transferred by a substance depends on the speed and number of atoms or molecules in motion. The faster the atoms or molecules move, the higher the temperature, and the more atoms or molecules that are in motion, the greater the quantity of heat they transfer.

build upon prior knowledge:

- Ask students if they have ever left a ball outside in the winter. Ask if they noticed that it looked deflated. See Figure 1. *(Student responses may include that it looks flatter in the winter than the summer.)*

Figure 1: Basketballs in winter and summer



- Ask the students if they think they know what causes this phenomena. *(Student responses may include cold air takes up less space then warm air.)*

(continued on next page)

lesson

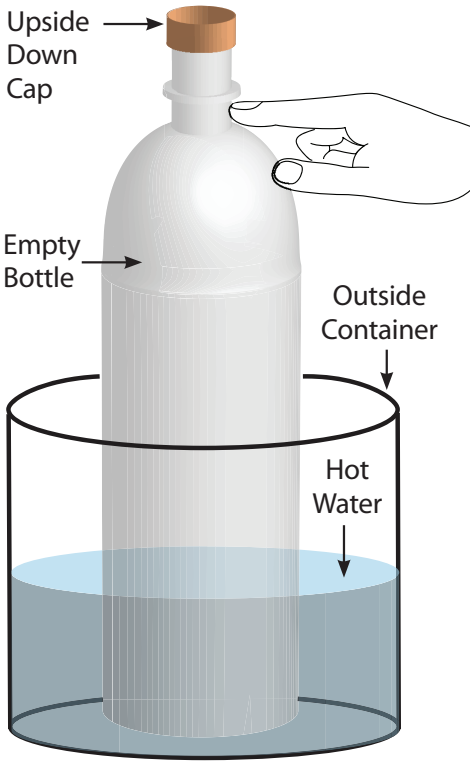
guiding questions

- What do you think will happen? (Hypothesis)
- What do you expect to learn?
- What tools are needed?
- How can we record our findings?

procedure

Part A

1. Dip your finger in room temperature water and wet the rim of the plastic bottle.
2. Turn the bottle cap upside down and place it on the bottle rim.
3. Fill the outside container about 1/3 full of hot tap water.
4. Measure the hot water with the temperature probe and record.
5. Carefully push the empty bottle into the hot water and watch the cap. Hold the bottle in the water lightly with one hand.
6. Record what you observe and explain why this happens.



Part B

1. Fill a cup ¾ full with ice water.
2. Fill another cup ¾ full with hot water.
3. Using the temperature probe, record the water temperature of each cup.
4. Gently place one drop of blue and one drop of yellow food coloring into the water in each cup.
5. Record what happens in each cup.

summarize

Ask the students what they have learned about temperature and the movement of gas and water molecules. (*Student responses may include: heat makes gas molecules expand and hot water has more energy than cold.)*

extension

Students can try charting various water temperatures to find the fastest and slowest thermal energy rates.

data sheet

Part A

What was the temperature of the hot water?

_____

What happened when the empty bottle was placed in hot water?

_____

_____

Why did this happen?

_____

_____

Part B

What was the temperature of the cold water?

_____

What was the temperature of the hot water?

_____

Describe what happened when you added food coloring to each cup of water.

_____

_____

_____

_____

teacher notes

- Review basic information about how to use and read a thermometer.
- This activity uses the Ward's Single Probe to collect data allowing students to focus on the science discovery, leaving more time for learning and developing higher level thinking skills.

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