MAKE MINE COOL!

BENCHMARKS and TASKS

SC.A.1.2.2 The student knows that common materials (e.g., water) can be changed from one state to another.

SC.B.1.2.6 The student knows ways that heat can move from one object to another.

- The student measures the gain or loss of energy by using a variety of tools (e.g., thermometer, electric meter, meter stick).
- The student demonstrates that heating and cooling cause changes in the properties of materials and that many changes occur faster under hotter conditions.
- The student discovers that when warmer things are put with cooler ones, the warm ones lose heat and the cool ones gain it until they are all the same temperature. A warm object can warm a cooler one by contact or at a distance.
- The student experiences that heat energy moves from one place to another in three different ways: radiation, convection, and conduction.

KEY QUESTION

How is energy transferred?

BACKGROUND INFORMATION

Energy in the form of **light, heat** (thermal energy), electricity, and magnetism is abstract and difficult to define simply and accurately. A simple scientific definition is, "Energy is the ability to do work." In other words, you can use energy to bring about certain changes in **systems** or their surroundings.

The concept of adding salt to lower the freezing point of water or the melting point of ice is a difficult concept. Normally, water freezes when the temperature reaches about 32 degrees Fahrenheit (0 degrees Celsius). The addition of a foreign substance, such as salt, interferes with the formation of the ice crystals, and the freezing/melting point is lowered. When you mix salt with water you actually lower this freezing point. Salty water will still freeze, but the temperature has to be colder than it would for normal water. The exact freezing temperature of saltwater depends on the concentration of salt in the water. A 10% salt solution freezes at 20 degrees Fahrenheit and a 20% solution freezes at 2 degrees Fahrenheit. The more salt you add, the colder it must get before the water freezes.

By lowering the temperature at which ice is frozen, we can create an **environment** in which the liquid freezer pop can get colder than 32 degrees Fahrenheit and freeze solid. The ice absorbs energy from the liquid freezer pop since the liquid freezer pop is warmer. (Conduction is the flow of heat through a substance from areas of higher temperature to areas of lower temperature.) This causes the liquid freezer pop to get cooler, because heat energy is being released from it. When the freezer pop has released enough heat energy, the liquid will undergo a **change of state** from a **liquid** to a **solid** or semi-solid state.

MATERIALS

Per student

science journal

Per pair of students
1 freezer pop
1 16 oz. plastic cup filled with ice
2 tablespoons of rock salt in a cup
1 thermometer
paper towels
newspaper

Per class
1 large bag of ice in a cooler
enough frozen pops for every child

TEACHING TIP
Purchase 6-inch long freezer pops, if possible, instead of longer ones.

ENGAGE
Show students the liquid freezer pops. Discuss that freezer pops are in a liquid state and are not usually eaten this way. Ask students what they could do to change the freezer pops to a different state - from a liquid to a solid – other than placing them in a freezer.

EXPLORE
1. Organize students into pairs. Have students cover their desks with newspaper for easier clean-up. Give each pair of students a cup of ice, a liquid freezer pop, and the cup of salt.
2. Tell students to insert their freezer pops into the ice. Have them insert the thermometer into the cup of ice and note the starting temperature in their science journals. Caution students to be careful placing the thermometer down into the ice so the thermometer does not break.
3. Students should sprinkle about half of the salt onto the ice.
4. Students should take turns moving the freezer pop vigorously up and down in the cup of ice. The other student should rotate the cup and put mild pressure on it to keep the ice close to the freezer pop.
5. After a few minutes, students should sprinkle the rest of the salt onto the ice and add more ice, if needed.
6. This procedure should continue until the bottom half of the freezer pop is partially frozen. (It may not be frozen solid). Tell students to reverse the freezer pop and continue the process until the other half is nearly frozen.
7. Remind students to note the temperature of the ice once the pop is frozen and to record the ending temperature in the science journal. Students should calculate the temperature difference and reflect on why there was a change in the temperature of the ice.
8. Give one solidly frozen freezer pop to each pair of students, so that every child has a freezer pop to eat.

EXPLAIN
Discuss:
How did the properties of the freezer pops change? (The freezer pops changed from a liquid to a solid or semi-solid state.)
What caused the freezer pops to change state? (Energy must be taken away from a liquid to make it a solid. As the ice melted, it absorbed heat energy from the warmer liquid pop, which then became cooler and nearly frozen.)
Was there a change in the temperature of the ice? (The temperature of the icy water began to decrease. When salt comes into contact with ice, the freezing point of the ice is lowered.)

Why did the temperature change occur? (The addition of a foreign substance, such as salt, interferes with the formation of the ice crystals and lowers the freezing point of water and the melting point of ice. Water will normally freeze at 32 degrees Fahrenheit [0 degrees Celsius]. Salt lowers the freezing point and causes the ice to start melting.)
Did the heat energy flow from the freezer pop to the ice or from the ice to the freezer pop? (Heat energy flowed from the freezer pop to the ice. The freezer pop was warmer and released heat energy to the cooler ice. When heat flows through a substance from an area of higher temperature to an area of lower temperature, this is called conduction.)

EXTEND/APPLY

Discuss why salt is spread over icy roads in the north during the winter. (Putting salt on ice makes the ice melt, because the salt lowers the melting temperature causing the ice to melt more quickly. If the temperature of the surrounding air is higher than this new melting point, the heat energy flows to the ice/salt solution and it will melt. Salt lowers the freezing point typically to the mid-20s Fahrenheit. If the air temperature is greater than the mid-20s, ice sprinkled with salt will melt.)

EXTENSIONS

1. Ask: *Do you think it would take the same amount of time to freeze a liquid freezer pop as to melt a frozen pop?* Have the class try this activity.
2. Fill one zipper-type plastic bag with warm water and one with cold water. Place a thermometer in each bag and note the temperature. Put both bags together so that they are touching each other. Ask students to predict any temperature changes that may occur in this system in which the hot and cold water interact, but do not mix. Observe and note any temperature changes.

ASSESSMENT

Have students explain in their journals the energy transfer that occurred when the freezer pop was changed from a liquid to a semi-solid state.