HOW DOES HEAT AFFECT WATER?

BIG IDEA 9: CHANGES IN MATTER

BENCHMARKS AND TASK ANALYSES

SC.3.P.9.1 Describe the changes water undergoes when it changes state through heating and cooling by using familiar scientific terms such as melting, freezing, boiling, evaporation, and condensation.
The student:

- observes and describes ice melting.
- observes and describes water freezing.
- observes and describes water boiling.
- observes and describes water evaporating.
- observes and describes water vapor condensing.
- records these changes in a science notebook, using the words melting, freezing, boiling, evaporation, and condensation.

SC.3.N.1.2 Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
The student:

- works in a group using the same tools as other groups to gather common data.
- compares groups' data and explains differences.

SC.3.N.1.3 Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.4 Recognize the importance of communication among scientists.
The student:

- understands the importance of communicating results.

SC.3.N.1.5 Recognize that scientists question, discuss, and check each other's evidence and explanations.
The student:

- understands that scientists question, discuss, and check each other's evidence and explanations.

SC.3.N.1.6 Infer based on observation.

KEY QUESTION

How does heat affect water?

BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or reducing heat causes matter to change from one state to another.

A solid is something that maintains its shape. Its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid.

A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate).

A gas has no fixed volume. The atoms of a gas are spaced apart. The matter changes from gas to liquid to solid states when heat is lost.

MATERIALS

Teacher
electric skillet with lid
cooler for storing ice
chalk

Student
plastic zipper-type bag with ice
1 ice cube in a cup
science notebook

SAFETY

Caution students not to touch the electric skillet.

TEACHING TIP

A good analogy to help students understand molecular motion is to compare the movement of particles in a solid to the movement of soldiers in a tight military formation; the particles of liquid to the movement of dancers on a crowded floor; and the particles of gas to the movement of popping popcorn.

ENGAGE

1. Give each student a cup with one ice cube. Tell the students to put the pieces of ice on their tongues but not to chew them.
2. Ask:
   - *What is happening?*
   - *What is causing the ice to melt? (heat)*
   - *What are some other ways we could melt the ice? (sunlight, air that is warmer than ice cube, body heat, microwave, stove, etc)*

EXPLORE (Part 1)

1. Give each student an ice cube in a plastic zipper-type bag.
2. Tell students to see if they can melt the ice cube without taking it out of the bag.
3. Create a data table recording the methods attempted and the amount of time it took to completely melt the ice cube.

EXPLAIN

1. Record the best method (melted ice cube the fastest) from each group on a class data table that has labels for time, method, and group name.
2. Ask:
   - *What can we say about melting ice from the data displayed?* (group 4 melted ice the fastest by using their hands because it only took them 20 seconds to completely melt the ice cube.)
   - *Did anyone use the same method but get different results? Why do you think this is? Group __, why were you able to melt your ice faster than group __ when you both chose to use your hands?*
   - *Why do you think scientists share their results with each other?*

EXPLORE (Part 2)

1. Explain that they are now going to observe ice being melted at a higher temperature than they could produce themselves.

2. Place an ice cube in an electric skillet. Caution students not to touch the electric skillet. Ask students to observe the melting ice. Continue heating until most of the water has changed to a gas.
   Ask:
   - *What is the difference between melting the ice cube in a bag and melting it in a skillet?*
   - *Do you observe anything forming above the skillet?*
   - *What about the skillet made the ice melt* (heat)
   - *What would you call this smoke-like substance forming above the skillet?*
   - *What about the skillet made the ice melt* (heat)
   - *What do you think is going to happen to the liquid?*
3. Emphasize to students that the increased heat not only caused the ice to melt quickly but that it also changed the liquid to a gas.
4. Ask students if they think we could reverse the process (change the gas back to liquid).
5. Ask: *If we added heat to change the ice to water and the water to steam, what could we do now to make the steam turn into liquid and the liquid into a solid again?* Have the students feel the lid of the skillet.
6. Ask: *How does the lid feel?* (since the lid has not been used on the skillet, it should feel cool to the touch.)
7. Put the lid on the skillet to collect the condensation. After a few moments, remove the lid to show the students the water droplets.
   Ask: *How did these water droplets form*? (When the steam came in contact with the cool skillet lid, the gas particles condensed into liquid particles.) *Did we turn the gas (steam) back into a liquid (water)? How?* (cooling down the steam instead of heating it up)

EXPLAIN

1. On an outside paved area, have the students stand as close to each other as they can while you draw a chalk circle around them. Tell them to move without getting out of the circle. Tell them that they are behaving as the parts of a solid. They stay in one spot and cannot move freely.
2. Now have the students step away from each other so there is at least an arm's length between them and they can no longer touch one another. Draw another chalk circle around the outside of the group. Tell them to move around within the circle again. Point out that they are now behaving as the parts of a liquid. They can move a little more freely but still tend to stay together.
3. Finally, have the students spread out in the entire area of a large given space (an area still has to be designated for the students). Tell them to move around the space.
   Ask: *Do you feel more space?*
   Do you feel restricted or confined?
   Tell them that they are behaving as the parts of a gas. They can move very freely and do not have to stay in one place.
4. An excellent reference is Pg. 253 of *ScienceSaurus*, from Great Source Education Group.

EXTEND/APPLY

1. Allow students to observe an ice cube tray of water and make observations in their notebook. Pull the ice cube tray out in about half hour and have students make observations. Finally, share the tray once the cubes are fully frozen.
2. Have students draw diagrams in their science notebooks of melting, freezing, boiling, evaporation, and condensation.
3. Ask students to estimate how long it would take the ice cube to melt at room temperature, in the sunlight, in a cooler, or in a refrigerator. Invite other suggestions and explore as time allows.

ASSESSMENT

Have students illustrate how the parts are arranged in a solid, a liquid, and a gas in their science notebook. Have students create a list of some solids, liquids, and gases under their illustrations.