Photo courtesy of the US National Park Service.

What is the Water Cycle?

The Science of Water: Activity 4

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BioEd Online

What Is the Water Cycle?

Students will be introduced to the Water Cycle.

Concepts

•Water can be found naturally in the form of a gas, liquid or solid.

•The introduction or removal or heat energy will cause water to change from one state to another.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide.* Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3. Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo courtesy of the US National Park Service. http://www.nps.gov

Key Words

lesson, experiment, water, water drops, liquid, solid, gas, water quality, water molecule, dissolve, solution, oil, solvent, solute,

Materials

Have students work in groups of four. Put each group's materials on a tray and place in a central location for Materials Managers to pick up.

Place a container of sand with a scoop in a central area. Let groups measure out the quantities they need.

Materials per Student Group

- 20 ice cubes (approximately)
- 2 cups of sand
- 8-oz measuring cup, or 250 mL beaker
- Cardboard shoebox
- Clear plastic wrap (enough to completely cover top of the shoebox)
- Foil (to cover shoebox interior)
- Lamp with incandescent bulb, or sunny window
- Rubber band (to secure the plastic wrap)
- Plastic tray to hold materials

Materials per Student

• Copy of “The Water Cycle” page

• Sheet of drawing paper

Option

A plastic shoebox-sized container may be used. If no clear lid is is available, cover the shoebox with plastic wrap and secure it with a rubber band.

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Image Reference

Photo by JP Denk © Baylor College of Medicine.

Key Words

materials, materials list,

Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

•Always school district and school science laboratory safety guidelines.

•Have a clear understanding of the investigation in advance.

•Practice any investigation with which you are not familiar before conducting it with the class.

•Make sure appropriate safety equipment, such as safety goggles, is available.

•Continually monitor the area where the investigation is being conducted.

Safety note: BURN HAZARD. Caution students to be careful to not touch the

lamp to avoid being burned.

References

1.Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.

2.Moreno N., and B. Tharp. (2011). *The Science of Water Teacher's Guide.* Third edition. Baylor College of Medicine. ISBN: 978-1-888997-61-3.

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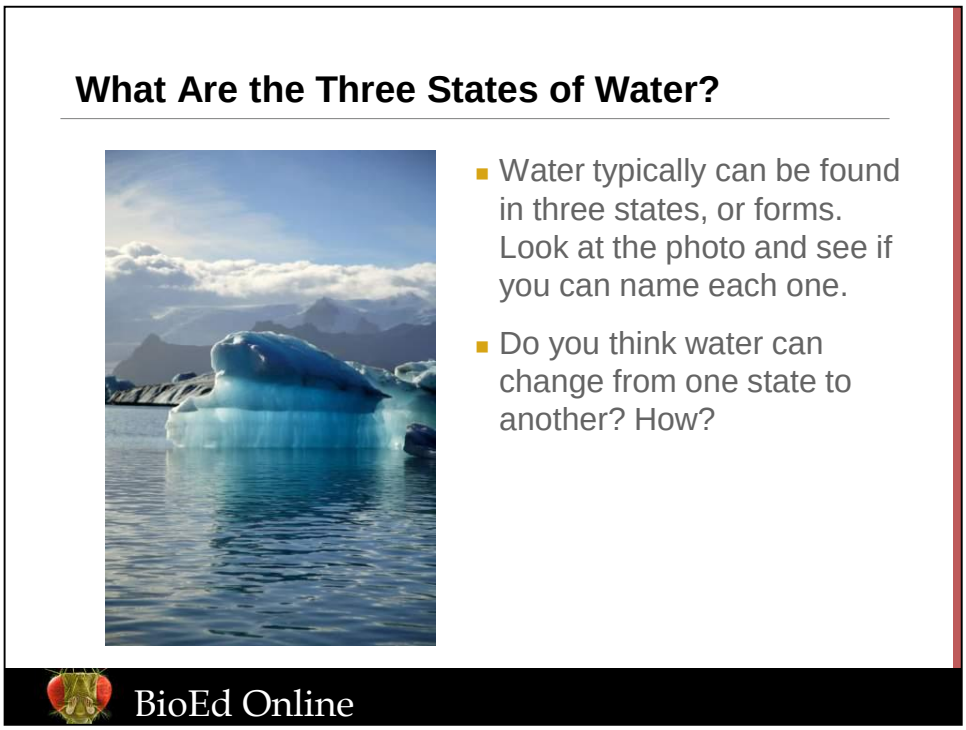
Key Words

science, classroom, safety, lab, laboratory, rules, safety signs,



What Are the Three States of Water?

When starting a new activity, it is always a good idea to focus the attention your students. Begin this activity by engaging students in a discussion about the states of matter. Ask, *Where can you find water on Earth*? Students may give examples such as lakes, rivers, oceans or groundwater. Students should understand that water also exists in solid and vapor form. Solid water occurs in nature as snow or ice. In fact, snow or ice can appear in a lot of places that are not mountains, glaciers and icebergs.) Water vapor, the gas phase of water, can be found in our atmosphere. Although water is abundant, freshwater is a limited resource. Ask students if they think water changes from one state or form to another.

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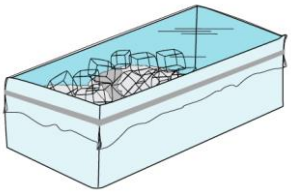
Let's Get Started

1. Cover the inside of a shoebox with foil.
2. Add sand at one end of the box to create a "hill" that gently slopes toward the other end.



3. Place 20 ice cubes on the top of the hill.
4. Cover the box with a clear lid or clear plastic.
5. Predict what will happen in the box if it is placed in a sunny area.
6. Observe the box at intervals throughout the day and record your observations.

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Let's Get Started

Scientist often use models, which can have many different functions. Models frequently are used to explain difficult concepts and to make concepts more tangible. Scientists also use models to make and test predictions.

In this activity, students will create and observe a simple model of the water cycle, predict the behavior of the model, draw and label the model, and draw conclusions from their experience. The model can be built from a clear plastic shoe box or storage box, or from a cardboard shoe box lined with aluminum foil or plastic wrap. To line the shoebox, press a single sheet of aluminum foil or plastic along the bottom and up the sides of the box. Do not cover the top of the box with foil for the original investigation (you may wish to allow students to design different models later, in which they may decide to cover the top of the box with something like aluminum foil.)

Discuss the model with the class. Ask, *Which part of the box and its contents could represent land? Which part could represent snow or ice*

on the top of a mountain? After students have constructed the model, ask them to predict what will happen inside of the shoe box once it is placed in a sunny spot. If a window is not available, you can place the box under a lamp with an incandescent bulb. Make sure the box is close enough to receive the bulb's heat, but not close enough to melt or burn the plastic.

Tell students to fold a piece of paper in half, hamburger style (paper should go from 8 1/2-in. x 11-in. to 8 1/2-in. x 5 1/2-in.), and draw a "side view" of what their prediction would look like on the top half of the folded paper. Have students periodically observe their boxes over several hours. After several hours, ask each student to record what the box looks like on the bottom half of his or her sheet.

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Illustration by M.S. Young © Baylor College of Medicine.

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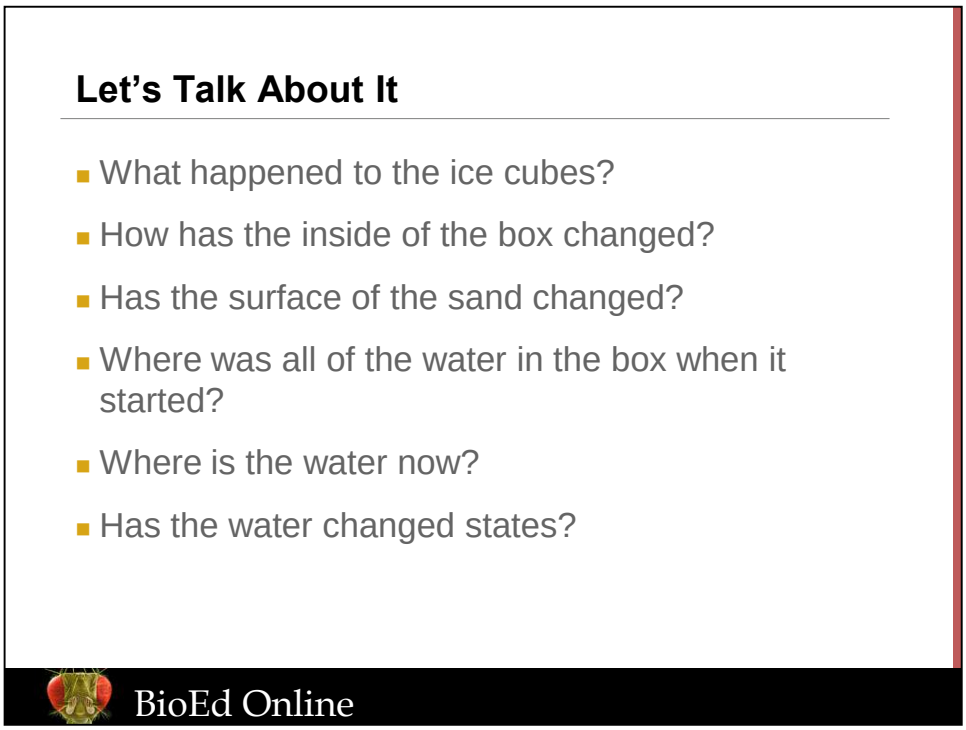

Let's Talk About It

This activity enables students to learn about the water cycle, and to begin to understand the states of matter involved in this cycle. For example, they will learn that without the continuous cycling of water, our freshwater supplies would run out. Also, they will discover that heat from the sun is the major source of energy driving the water cycle. When conducting a class discussion, expect a variety of answers and observations, and pose questions that encourage students to think.

Students will notice that the ice cubes melted, turning from a solid to a liquid. Some of the liquid will pool on the opposite end of the sandy slope, and some water will be absorbed by the sand. Students also should be able to see tiny drops of water forming on the underside of the lid or plastic wrap. Explain that the drops formed when water, in the form of a gas (water vapor), came into contact with the plastic lid.

Since the shoe box with the lid creates a closed system, as the sun shines through the lid, heat is trapped inside, creating a warmer environment. When the vapor touches the cooler surface of the box, it

condenses back into a liquid. And as more and more vapor touches the plastic cover, the water that condenses there collects into larger drops, which eventually will fall back onto the bottom of the shoebox. These drops are like raindrops falling from a cloud.

The sand also will change because it will absorb some of the water from the melted ice. Challenge students to think about what would happen if other substances, such as motor oil or chemicals, were present in the sand.

Give each student a copy of the student page. Encourage students to identify the parts of the experiment that "model" different phases of the water cycle. Have students identify the forms of water shown in the diagram. For example, snow on the mountaintop is a solid form of water. The water evaporating from the ocean is a gas. With very young students, direct each child to place a sticker everywhere on the page where he or she can find some form of water.

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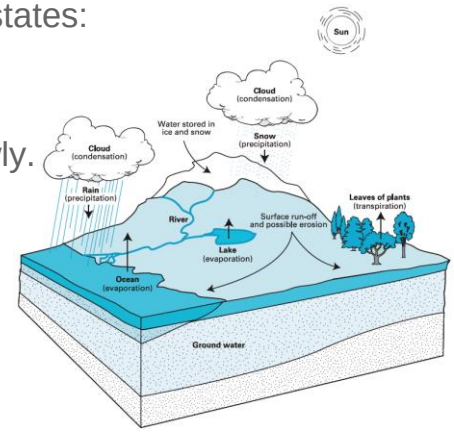
The Science of the Water Cycle

- Water exists in three states: liquid, solid and gas.
- Liquid water changes temperature very slowly.
- Water boils at 100ºC or 212ºF.
- Water freezes at 0ºC or 32ºF.
- Liquid water expands when it becomes a solid (ice).



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The Science of the Water Cycle

Water is unique because it can exist naturally on Earth as all three states of matter. This is possible because water has both a high boiling point (100º C or 212º F) and a low freezing point (0º C or 32º F). Therefore, it can be found naturally as a solid (ice and snow), a liquid (liquid water) and a gas (steam or water vapor) at any time on our planet.

Fortunately, liquid water changes temperature very slowly. This characteristic of water helps animals to maintain the temperatures of their bodies. It also keeps larger areas of water from warming or cooling rapidly, which helps to regulate Earth's climate. Another unique property of water that it expands when frozen. Unlike most substances, water takes up more space as a solid because the molecules in ice crystals are farther apart than those in liquid water. Because it is less dense, ice floats on top of liquid water, allowing many organisms to survive beneath the ice, even in subfreezing temperatures.

References

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2.National Science Foundation. The Chemistry of Water. http://www.nsf.gov/news/special_reports/water/index_low.jsp?id=properties

Image Reference

Wikimedia Commons, "Splash." Licensing: Cc-by-2.0. Author: José Manuel Suárez. Taken: 02–July–2008. Retrieved from http://commons.wikimedia.org/wiki/File:Water_drop_001.jpg

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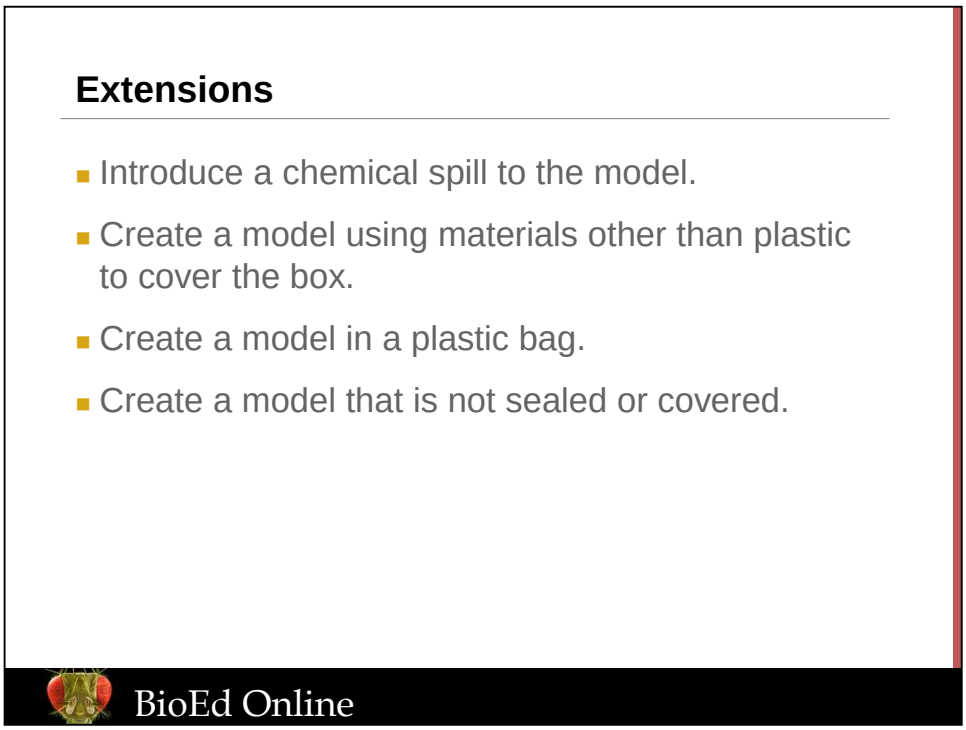

Extensions

Encourage students to suggest variations of the investigation. For example, food coloring can be used to model pollutants. Add a few drops of several colors on or into the sand. Place the ice cubes on top of the sand, cover the box and place it in a sunny location. Have students observe the colors leaching into the "lake" and dissolving into the water, that were in the water are left behind.

Additional variations of the model might include covering the box with different material or changing the contour of the sand.

Students also can investigate how water behaves by observing ice in a sealed plastic bag placed in a sunny window. Specifically, students should be able to observe evaporation and condensation. To demonstrate what would happen if the water cycle was not a closed system within Earth's atmosphere, use a bag that is perforated or has several holes. This will permit some water vapor to escape and minimize the amount of condensation in the bag. Over time, most of the water in this bag will leave by evaporation and the movement of gas

molecules.

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