Lesson 1: Earth, The Water Planet

Big Ideas of the Lesson

- More of the Earth's surface is covered with water than it is with land.
- Most of the water on the Earth is salt water, but there is also fresh water on Earth.
- Salt water is in the oceans.
- Fresh water is in the lakes and the polar ice caps.
- We use fresh water for drinking and many other things.

Abstract

In this lesson children taste and compare both salt and fresh water and discuss the uses of both. They learn where these two types of water are located on a globe and estimate how much of the Earth's water is saltwater and how much is freshwater. The teacher demonstrates how little freshwater there is on Earth.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- describe the properties of water as a liquid (visible, flowing, shape of container) and recognize rain, dew, and fog as water in its liquid state (E.FE.02.13).
- describe the properties of water as a solid (hard, visible, frozen, cold) and recognize ice, snow, and hail as water in its solid state (E.FE.02.14).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM0.2.14).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

lake

ocean

river/stream

surface water

water source

Instructional Resources

Equipment/Manipulative
Aluminum pie pan

Blindfold

Clean, clear cups that can hold at least 1 cup of liquid (2 per child and 2 for the teacher)

Counting objects (e.g., beans, paper clips, counting bears; 100 for each group of 3 children)
Crayons — blue, green, and red (several of each color)

Globe

Measuring cup (several)

Measuring spoons (teaspoon, several)

Overhead projector transparencies (1 for each group)

Overhead transparency pens (1 for each group)

Paper clips (4 for each group)

Paper towels

Salt

Spoons (clean; 1 per child)

Stirring sticks (like those used for coffee; clean; 1 per child)

Student Resource
Hooper, Meredith. *The Drop in My Drink: The Story of Water on Our Planet*. New York: Viking, 1998.

Lauw, Darlene. *Water.* New York: Crabtree Publishing, 2003.

Locker, Thomas. *Water Dance*. Orlando, FL: Harcourt School Publishers, 1997.

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McKinney, Barbara Shaw. *A Drop Around the World.* Nevada City, CA: Dawn Publications, 1998.

Muir, John, as retold to Donnel Ribay. *Stickeen: John Muir and the Brave Little Dog.* Nevada City, CA: Dawn Publications, 1998.

National Geographic Society. *Beginner's World Atlas.* Washington, D.C.: National Geographic Society, 1999.

Pallotta, Jerry. *The Freshwater Alphabet Book.* Watertown, MA: Charlesbridge Publishers, 1996.

Rauzon, Mark J., and Cynthia Overbeck Bix. *Water, Water Everywhere*. New York: Little, Brown and Co. (Time-Warner), 1994.

Simon, Seymour. *Icebergs and Glaciers.* New York: Harper-Collins, 1999.

Taylor, Barbara. *Arctic and Antarctic.* New York: Alfred A. Knopf, 2000.

Wick, Walter. *A Drop of Water*. New York: Scholastic Press, 1997.

Teacher Resource

Badders, William, et al. *Discovery Works: Earth's Water*. New York: Silver Burdettt & Ginn, 1996.

Brummet, David, et al. *Destinations In Science, Grade 2*. New York: Addison-Wesley, 1995.

Delta Education. *Water.* FOSS Module. 22 January 2009 <http://www.delta-education.com>.

Hoover, Evalyn, et al*. Primarily Earth*. City: Fresno, CA: AIMS Education Foundation, 1996.

Lund, Karen. *Water, Stones, and Fossil Bones*. Arlington, VA: National Science Teachers Association, 1991.

Nelson, Dennis, et al*. Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

Sequence of Activities

Advance Preparation: Copy the grid paper from Teacher Background onto overhead projector transparencies, making one transparency for every three children. A sample world map in Teacher Background can also become a transparency for you to help children practice the procedure. After making this transparency, color the water areas blue with a permanent marker. (You can also have children color their own copies of this map with blue markers or crayons before beginning the exercise or use complete world maps that you purchase.

Safety Precautions: Use a clean blindfold for each child to avoid spreading conjunctivitis.

1. Tell the children that today is an important day. Today, the class will begin to study something that every person on Earth needs in order to live — water. Although people spend most of their time on land, they could not survive without water. Ask children to brainstorm ideas about how we use water and why we need it. Next, show children a globe and explain that it is a model of the Earth. (You will focus on the purpose of a model in a later lesson in this unit.) Point to some familiar locations on the globe. Ask for two volunteers, one to be the Recorder and one to be the Pointer. (Explain in advance that the Pointer will be blindfolded, and be sure the child you select is comfortable with that).

2. Put the Recorder at the chalkboard and have that child write the headings, “Land” and “Water.” Explain that the Recorder’s job is to tally the number of times the Pointer’s finger lands on land and the number of times it lands on water.

3. Blindfold the Pointer. Slowly spin the globe and ask the Pointer to stop the globe by pointing to a spot on it and placing a finger on that spot. Ask the Recorder to use tally marks to record in the two-column chart on the board whether that spot was located on land or on water.

4. Repeat this procedure at least 10 times. If the Pointer seems to land on the same latitude, move the globe up or down as it spins. (Note: There are more land masses in the Northern Hemisphere than in the Southern, so it is important that the Pointer “samples” from both hemispheres.)

5. Examine the final number of tally marks with the class. Ask: “What does this information tell us about the amounts of land and water on Earth?” [It shows that more of the Earth’s surface is covered with water than it is with land.] “Why is this important to us?” Allow children to share their ideas. Use affirmation to encourage children to listen to others. Praise children who refer to other children’s comments and ideas as they explain their own.

6. Say: “We have an idea that there is more water than land on Earth. Most of the water on Earth is salt water but there is also fresh water on Earth.” Explain that children will now do an experiment to learn more about the types of water that are found on Earth. Remind children that they should never taste anything during an experiment unless their teacher tells them to do so.

7. Have children wash their hands.

8. Divide the class into groups of three children.

9. Distribute two clean cups, one clean stirring stick, and one clean spoon to each child. Explain that children will share a water source, measuring cups, teaspoon measures, and containers of salt. Show children where these shared resources are located.

10. Demonstrate how to use a measuring cup and how to measure 1/2 cup. Demonstrate how to use a teaspoon measure, and how to measure 1 teaspoon. Have children write their names on their cups.

11. Let each child measure and pour 1/2 cup of water into each of the two cups.

12. Have each child measure and add one teaspoon of salt to one of the cups and stir it with a stirring stick (not the teaspoon measure). Tell children to leave the stirring stick in that cup to identify it as the cup that contains salt.
13. Hand out the Student Page, “Salty or Not?”

14. Explain to children that they will taste one spoonful from each of their two cups. Their job is to try to determine which water is drinkable and which water is not. Have children do their taste tests and then write their responses on their Student Pages.

15. Lead a discussion to help children understand the importance of fresh water. Prompting questions could include:
    - “How does the water in the two cups differ in taste?” [Answers will vary.]
    - “Did you like the taste of the salty water?” [Answers will vary.]
    - “What would happen if you drank salty water instead of fresh water all the time?” [You would become very sick and very thirsty. While a little salt is not bad for you, having only salt water to drink would be very unhealthy. All land mammals need fresh water to drink.]
    - “Where can we find lots and lots of salt water?” [The oceans. There is also salt water underground in some places.]
    - “Is it bad that there is so much salt water?” [While we cannot drink salty ocean water, many other forms of life depend upon it. To illustrate this, have the class list some creatures that live in the oceans. Point out to children that oceans are also important because they affect our weather. Through evaporation, they provide most of the water for rain and snow. Precipitation is important to all land-dwelling animals and plants.]

16. Refer again to the globe and help the class identify the oceans (where salt water exists), the land masses, the fresh water that is visible in the few large lakes, and the polar ice caps. Point out the Great Lakes and Michigan on the globe. Help children appreciate that there is more salt water than fresh water on Earth, and that they live close to one of the largest sources of fresh water on Earth.

17. Explain to children that the class is going to pretend that the two cups of water represent all the water in the world. The cup with salt and the stirrer in it represents the salty oceans, and the cup with no stirrer represents all the fresh water in the world.

18. Say: “Right now, your two cups hold about the same amount of water. But wait! We just discovered by looking at this globe that there is a lot more salt water than fresh water on Earth. Your job is to change the amount of water in your two cups so that these amounts reflect the amounts of fresh water and salt water in the world.” Have children pour some of the water from their fresh water cup into the salt water cup until they think that their cups accurately reflect the

relative amounts of fresh and salt water in the world. (The amounts need not be exact. Children should simply demonstrate their estimates by showing “a lot” or “a little.”) If necessary, you can guide children by referring again to the globe and reminding them that there is more salt water than fresh water on the globe. When every child has finished, have children set their pairs of cups aside or in a central location. Be sure the cups are kept in pairs. The cups will be used again later in the lesson.

19. Put children in groups of three. Hand out a copy of a world map to each child and have a globe nearby. Explain that the page shows a map of the world. A map is a flat picture of what is found on the globe, as if the colored paper covering the globe were torn off and flattened. Point out some of the same features (e.g., the continents, polar ice caps, oceans, Michigan, and the Great Lakes) on both the globe and the map.

20. Ask children to color the oceans blue, the land green, and the fresh water (large freshwater lakes — including the Great Lakes — and polar ice caps) red. Point out that in some places —such as the Antarctic— frozen fresh water covers the land. Have the class agree on a way to show that these are areas of both land **and** water.

21. Give each group a set of counting objects, tape or paper clips, an overhead projector pen, and a copy of the Student Page, “How Many Squares?” Also give each group a transparency onto which a grid has been copied.

22. Ask one child in each group to use paper clips to attach the transparency to the map. (Children may need help with this.) With the transparency on top of the map and using an overhead projector pen, the children should number on the grid all the squares that are mostly filled with blue oceans. (**Note**: If necessary, you can model this for children by making another transparency of the map itself, and using both at the same time on the overhead.) Have children record this number on the Student Page, “How Many Squares?” Then ask them to clean the transparency with a paper towel.

23. A second member of the group should repeat the procedure, this time numbering the squares filled mostly with green land. This number should be recorded on the Student Page, “How Many Squares?” and the grid wiped clean.

24. Finally, the third member of the group should count the squares filled mostly with red fresh water, and record this number on the Student Page, “How Many Squares?”

25. Each group should make piles of counting objects on the Student Page, “How Many Squares?” These should be placed next to the numbers of grid squares mostly covered with saltwater, land, and fresh water.

26. Have each group of children work together to answer the questions on the Student Page, “How Many Squares?”

27. Lead a class discussion about the results and children's responses to the questions. Whenever possible, ask children to defend their statements or ideas by referring to the results of their investigations.
    - "What is most of the Earth's surface covered by?" [There should be many more squares nearly filled with water than nearly filled with land.]
    - "What type of water is there most of on Earth?" [There should be many more squares nearly filled with salt water than nearly filled with fresh water.]
    - "How much more salt water is there than fresh water?" [There should be an obvious difference in the numbers of squares counted, and the piles of counting objects that the children have assembled. You can help children construct an equation that will answer this question: saltwater grids – fresh water grids = difference.]

28. Creating and interpreting graphs are two skills that are troublesome for many children. To give children a chance to exercise these skills, pool the data from the whole class and walk children through the process of creating a bar graph.

29. Say: "Now think about those two cups you had awhile ago. Do you remember that you estimated the amounts of fresh and salt water on Earth by changing the amounts of water in your two cups? Now that you have finished this work and learned more, it is time to think again about that estimate. Sometimes we change our minds or have a new idea after we have learned about something. Changing your mind because of new or better information can be a good thing to do. That is how science works." Have children carefully place their cups on their desks or on a convenient flat area. Say: "It is time now to think about what we have learned and make a choice. You will walk slowly through the room looking at (but not touching) other children's cups. Remember, the cup with the stirrer contains the saltwater. Your job is to choose the one pair of cups that you think best shows the relative amount of fresh and salt water on Earth. You might choose your cups if you think they are the best estimates. But you would be right to choose someone else's cups if you think they are the best estimates. Remember the name of the person whose cups are the best estimate." Let children tour through the classroom and make their choices.

30. In front of the class, measure1/2 cup of water into each of two cups, just as the children did. Then add a teaspoon of salt to one of the cups, stir it with a stirrer and leave the stirrer in the cup.

31. Next, pour all but 1 1/2 teaspoons (7.5 ml) of water from the fresh water cup into the salt water cup. Pointing to the salt water cup, say: "The amount of water in this cup represents the amount of salt water on Earth. Most of it is found in the oceans." Pointing to the cup that contains only a tiny amount of water, explain, "The amount of water in this cup represents *all* the fresh water in the world, including all the large fresh water lakes and polar ice caps that you saw on your maps, and

also the fresh water that is found under the ground." Ask children to observe both cups. Conclude: "By comparing the amounts in these two cups — salt water and fresh water — we can see that there is much more salt water than fresh water on Earth. Take time at this point to compare the amounts in children's cups with this model and determine which child's pair is the best representation.

32. Hold an aluminum pie pan about two feet below the fresh water cup. Ask children to be very quiet, and then pour all of the water into the pan. It should make a very soft sound, helping to emphasize the small amount of fresh water in the world compared to the nearly full cup of salt water.
33. Have a discussion using constructive questioning. Sample questions may include:
    - "How do the amounts of salt water and fresh water on Earth compare?"
    - "Why is fresh water so important to us?" [We need fresh water to drink—drinking salt water would make us sick. We use fresh water for many things: drinking, cleaning, food preparation, generating electricity, recreation, irrigating crops, manufacturing, and transportation.]
    - "What would happen if the small amount of fresh water we have became polluted?" [Some of it could not be used for certain purposes. It might make us sick.]
    - "How should we treat the fresh water that we have?" [We should keep it clean and not waste it.]

34. Conclude the lesson by telling children that the water shown on a map or a globe does not seem to move. Remind them that a map and a globe are just models. Ask them whether or not they think water on Earth moves. If they answer, "Yes," ask them to give some examples. This helps children learn to defend their statements with observations or reasoning. Conclude by saying that the water on Earth is almost constantly moving. Tell children that during the next lesson, they will have a chance to learn more about how water moves.

Assessment

Ask children to identify on a globe or map where salt water and fresh water are located.

Make a checklist of children's names and three skills: comparing and measuring using a measuring cup and teaspoon; measuring using a grid; and drawing/interpreting a graph. If a child shows proficiency in any of these skills, put a check in the appropriate column by that child's name.

Application Beyond School

Children now know how precious and important fresh water is. This sets the stage for future activities related to pollution prevention and water conservation at home and school.

Children can identify their location near the Great Lakes on a map or globe, and therefore have a better sense of their place on the planet.

Connections

Health and Physical Education

While studying about water, children learn about the importance of fresh water to good health.

Mathematics

While conducting experiments about fresh and salt water, children make estimates, measure volumes, use measuring tools (cups and teaspoons), and measure surface area using a grid system.

Lesson 2: Water's Ways

Big Ideas of the Lesson

- Ground water is water below the surface of the ground.
- Wetlands are areas of land that have wet soil.
- Water moves from high places to low places.
- Scientists make predictions about what will happen and then observe experiments to find out what happens.

Abstract

In this lesson children work in small groups to make water move using dishpans or cake pans containing various types of containers. They list what they know and what they wonder about how water moves. Children then come up with a plan to learn about one way that water moves, using the materials given to them. They go to the schoolyard and create small "water features" using a cup of water and existing features such as small rocks, hills, gullies, and depressions.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- describe how rain collects on the surface of the earth and flows downhill into bodies of water (e.g., streams, rivers, lakes, oceans) or into the ground (E.FE.02.21).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

Water

lake

river/stream

surface water

water source

Instructional Resources

Equipment/Manipulative
Blue food coloring

Camera — disposable or otherwise

Cards with water features on them (1 per group—see Advance Preparation)

Containers and other objects for water to flow through, such as sieves, funnels, cups, cups with holes in the bottom, tubes, straws, and flowerpots (4 or 5 objects for each group)

Cups (1 per group)

Dish pans or cake pans (1 per group)

Empty, clear 2-liter bottle (capped)

Jugs or pitchers of colored water

Sand or gravel (1 cup for each group)

Shovel (in winter only)

Towels or paper towels (for cleaning up spills)

Student Resource

Cherry, Lynne. *A River Ran Wild*. New York: Harcourt, 1991.

Gibbons, Gail. *Marshes and Swamps*. New York: Holiday House, 1998.

Hooper, Meredith. *Drop In My Drink: The Story of Water On Our Planet*. New York: Viking Penguin, 1998.

Krulik, Nancy E. *The Magic Schoolbus Goes Upstream: A Book About Salmon Migration.* New York: Scholastic, Inc., 1997.

Locker, Thomas. *Water Dance.* New York: Harcourt, 1997.

---. *Where the River Begins*. New York: Puffin (Penguin), 1993.

Mayer, Marianna. *A Boy, A Dog, A Frog and A Friend.* New York: Penguin Putnam Young Readers, 1993.

McKinney, Barbara Shaw. *A Drop Around the World.* Nevada City, CA: Dawn Publications, 1998.

Pallotta, Jerry. *The Freshwater Alphabet Book.* Watertown, MA: Charlesbridge Publishers, 1996.

Rauzon, Mark J., and Cynthia Overbeck Bix. *Water, Water Everywhere*. Little, Brown and Company, 1994.

Tafuri, Nancy. *Have You Seen My Duckling?* New York: Morrow/Avon, 1991.

National Geographic Society. *Beginner's World Atlas.* Washington, D.C.: National Geographic Society, 1999.

Walker, Sally M. *Water Up, Water Down: The Hydrologic Cycle.* Minneapolis, MN: Lerner Publishers, 1992.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

National Geographic Society. *A Drop of Water*. Washington, DC: National Geographic Society, 1991.

Sequence of Activities

Advance Preparation: Create cards with the name of one water feature written on each. Water features include "pond," "lake," "waterfall," "river," and "stream." Each small group of children will receive just one of these cards, not a complete set of them. The outdoor portion of this lesson is best undertaken in spring or fall. If there is snow on the ground, use a shovel to scrape away snow from a few grass-covered surfaces and from a few areas covered by a harder surface.

1. Begin the lesson by reminding children about the work they did last time. Prompting questions might include: "What kind of water is the Earth mostly covered with?" [Salt water.] "What kind of water do we need to drink?" [Fresh water.] "Where is fresh water found on Earth?" [Children will probably mention rivers, streams, and lakes.] "What about water that travels

underground in the spaces between pieces of soil, sand, and rock?" [This is groundwater. About half of the people in the United States and about half of Michigan's residents get their drinking water from groundwater. Your children may or may not be aware of the existence of groundwater. They will learn more about it during this unit.] "What do we have when water sits on top of the ground, and plants poke up through it?" [Wetlands.] "How does water act? How does it move?" [Children may mention that rain and snow fall out of the sky, that rivers flow, that lakes have waves, and that oceans have waves and tides.]

2. Explain that although there is much more salt water than fresh water on earth, today's lesson focuses on that small amount of fresh water, which is found in rivers, lakes, streams, ponds, and in groundwater. Remind children again that fresh water is essential to human survival. Hold up an empty pop bottle and a cup filled with colored fresh water. (Water is colored in this lesson only to make it more visible.) Ask children to predict what will happen when you pour the colored water into the bottle. "Where will the water go?" [To the bottom of the bottle!] "What if we turn the bottle on its side?" [The water will move to fill the lowest part of the bottle.] "Does it matter which way the bottle lies?" [No. The water will always move to the lowest part of the bottle.] Pour some water into the bottle and demonstrate the movement of water to the class.

3. Break children into groups. Provide each group with a cup of sand or gravel, a dishpan or cake pan, and various containers through which water can run. These might include a cup, a cup with a hole in the bottom, a funnel, a sieve, a straw, a flat pan, or a tray. Explain to children that they are going to work in their groups to design a system through which water can move. Remind them that water moves from high places to low places. After they design their systems but before being given colored water, groups should draw their system and predict what will happen when water is added to it —where the water will go and the direction in which it will move. Tell children that when you see a written prediction for their group, you will give them some colored water, which they will use to check their predictions. Remind children that good thinking takes time. This is not a race to see who can be the first group to get colored water. Rather, you want to see signs of good thinking.

4. Allow children time to develop their systems and predictions. As the first group finishes and is given water, take an extra moment to emphasize to the whole class two fundamental processes in science: prediction and observation. Remind children that scientists regularly make a prediction about what will happen and then test or check that prediction by doing an experiment. During the experiment, they pay very careful attention to what happens and they carefully record what they observe. Encourage children to do the same during this activity.

5. As children add water, they should carefully observe where and how it moves — and catch it with the dish or cake pan. Their observations should be recorded or verbally reported to an adult. Review the results with children and ask them if they see any patterns or similarities among the groups' observations. (At this point, you can remind them that scientists often work in teams and make use of information collected by other people.) Children may notice a pattern in the direction of water's movement. If not, suggest this as a pattern and ask: "Why does water move from a high spot to a lower spot?" [For the same reason that our feet stay on the ground and we do not float off into space: gravity!]

6. Have children form a single group in the front of the classroom. Using the chalkboard or large pieces of paper, make a four-column chart with the headings: “Know,” “Wonder,” “How to Find Out,” and “Learned.” Help children fill in the “Know” column in this chart. In the “Know” column, they should list what they know about how fresh water moves and exists on Earth.

7. Next, help children fill in the “Wonder” column, listing what they wonder about how fresh water exists and moves on earth. This might include questions about how waves are made, how water can move up, what water can move through, how waterfalls work, or how fast water can move.

8. Referring to particular entries in the “Wonder” column, help children generate ideas about how they could use the materials they have been given (e.g., funnels, sieves, straws) to explore and perhaps answer some of these questions about how water exists and moves. Remind them that they must keep the water in or near the pan. Using children’s ideas, help each group devise a step-by-step procedure that involves arranging materials in a way (or ways) that will help answer one or more of the questions in the “Wonder” column. Children might propose to pour water into the sand or gravel, pour the sand or gravel into the water, time water going through an arrangement of materials, tilt or splash in the pan to make waves, or devise a way to squirt water out of the pan — or something completely different!

9. Explain to children that scientists often use equipment to help them answer questions, and that scientists design experiments or procedures, just as the children have done. Remind children again about the importance of first predicting and then observing what happens. (Young children are novice scientists and need to be reminded regularly about the processes involved in science.) Then help children write their predictions — what they think will happen when they add water to their systems—on the Student Page. When they are done, have them complete their observations in the column “I saw.”

10. Let children do the procedures that they developed and be sure that they observe what happens. Have them record their results by drawing or describing what happened on their prediction/observation sheets.

11. Lead a discussion about children’s results, including questions such as:
    - “Where did the water go?” [Answers will vary.]
    - “Did it move as you predicted it would?” [Answers will vary.]
    - “What stops water from moving?” [It stops when it hits something it cannot move through (such as the bottom of the pan). Waves stop moving when their energy is used up. Geysers stop squirting when there is nothing pushing the water up anymore.]
    - “When does water outdoors behave like the water in your experiment?” [Perhaps when it is in a waterfall, geyser, river, lake, pond, or falling as rain.]

12. Explain to children that the class will now go outdoors. Give them some ground rules for outdoor learning, e.g., stay within sight of the group; stay with your small group; stay within certain boundaries; come when called. Next, describe to children what they will do. Each group will get a card with one word on it. Each card's word describes one way that fresh water is found in nature. Each group will be asked to find a place in the schoolyard where they can create a small fresh water feature like the one on the card. When their small group has found such a place and created this feature, they are to put their card there as a marker and wait until the teacher calls the children back together.

13. Go outside. Take one cup of water for each small group. (Do not give this water to children yet.) Give each small group one card. Let groups wander to find a spot where they can create their fresh water features. They may want to look for things like depressions in the ground, gullies, rocks, or hard surfaces.
14. When every group is finished, gather the whole class at one group's area. Have one student in that group read that group's card, and let another student describe why they chose the site that they did — and what he or she thinks will happen if water is added to this feature. Then give the third student from that group a full cup of water to pour in the chosen spot. Be sure the whole class observes. If desired, while the water is visible, a fourth student from the group can take a picture with a camera. Have a class discussion at each group's spot, asking questions such as:
    - "How is the group's fresh water feature like the real thing?"
    - "How is it different?"
    - "What was it about the spot the group chose that made the fresh water feature like (or unlike) a real one?" [A chosen spot might be a high place from which water can run downhill, a depression in which water can pool, a hard surface through which water cannot move, a surface through which water seeps into the ground.]
    - "Is this fresh water feature one that has standing water or flowing water?" [Answers will vary.] **Note:** This distinction is not a major focus of this unit, but it is not difficult for children to understand and it will help them appreciate the variety of situations in which water occurs on Earth.
    - Repeat this procedure until all groups have had a chance to explain and add water to their fresh water features.

15. Return to the classroom. With the whole class, fill in the "Learned" column on the chart. List there what children learned about how fresh water exists and moves. Compare this with the entries in the "Wonder" column. Point out unanswered questions. Challenge children to think about how these persistent questions could be studied or answered.

16. If children took photos, create a poster of fresh water features. Children could label these with the name of the actual fresh water feature that they represent.

Assessment

Ask children to list several different water features in which fresh water can be found in the outdoors.

Ask children to describe the likely path of water when it is poured in a certain place, such as the top of a hill, a low spot in the ground, through a tube, or onto sand or gravel.

Application Beyond School
Children can discuss with parents the names of different bodies of water they have visited. These may include lakes, waterfalls, rivers, streams — even geysers! This information may then be shared with the class. Help the class list the names of local water features.

Connections
English Language Arts
While exploring various fresh water surface features, children can locate books with pictures or information about the forms of fresh water.

Lesson 3: That's the Ticket!

Big Ideas of the Lesson

- We use water for many different things. It is very important in our lives.
- We can compare our estimates to actual counts.

Abstract

In this lesson children are given several tickets for "water use." During one school day, they deposit one ticket in the central collection bucket for each time they use water (e.g., getting a drink, using the bathroom). Children then examine the ways they used water based upon the tickets collected.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- identify household uses of water (e.g., drinking, cleaning, food preparation) (E.FE.02.12).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM.02.14).
- construct simple charts and graphs from data and observations about water use (S.IP.02.16).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

water source

Instructional Resources

Equipment/Manipulative

Bucket
Envelopes (1 per child)

Scissors or paper cutter

Water tickets (found in Student Pages)

Student Resource

Hewitt, Sally. *Using Water.* New York: Crabtree Publishing, 2009.

Hooper, Meredith. *Drop In My Drink: The Story of Water on Our Planet*. New York: Viking Penguin, 1998.

Kerley, Barbara. *Drink of Cool Water*. Washington, DC: National Geographic Society, 2002.

Morgan, Sally. *Water for All (Earth Watch).* London: Franklin Watts, Inc., 2000.

Weninger, Brigitte. *Precious Water*. New York: North South Books, 2002.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

Nelson, Dennis, et al. *Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

Water Environment Federation. 22 January 2009 <http://www.wef.org/Home>.

Water System and Water Use. Denver, CO: American Water Works Association, 2003. (Poster of a water system and water use is available for $5.95 plus shipping. Call to request a catalog 1-800-926-7337.)

Water Use Posters. Denver, CO: U.S. Geologic Survey, Branch Distribution, 2003. (Free set of water use posters, 1-888-ASK-USGS)

Sequence of Activities

Advance Preparation: In order to complete this lesson it would be helpful to order posters from the sources above. Make copies of the water tickets found in the Student Pages and in the Teacher Background for this unit.

1. Ask a child to read to the whole class the imaginary news bulletin: "Water Supply To Be Stopped?" found in the Student Pages.

2. Ask children if they agree with the student and teacher quoted in the article: "Do the staff and children at your school need water?" "What kinds of things might people at this school need water for?" List these uses in a list entitled, "Uses of Water," either on the chalkboard or on a large piece of poster board or butcher paper. Be sure the list is visible throughout this lesson. Then ask: "How could we find out how we *really* use water during the school day?" [Allow children to brainstorm answers.]

3. When the idea of keeping track of uses is offered, focus on it. Explain that today is a special day. Today, children must deposit a water ticket in a bucket every time they use water. Before they put the ticket in the bucket, they must write on the ticket next to the word "use" what that water is being used for. Some examples are drink, flush, wash, cook, science (experiments), and cleaning. Put the key words on the board to help them. Remind children that just one use can be written on each ticket, and that they need to put a ticket in the bucket every time they use water during the day.

4. Model this by explaining: "We can pretend that I want to have a drink of water. Because I will use water, I will write the word "drink" on the ticket, put it in the bucket, and then get a drink." Demonstrate this to children, showing them the bucket they will use. (Children can decorate the bucket, if desired.)

5. Give each child an envelope containing 12 tickets. Remind them that each time any child does something that uses water; she or he must place a ticket in the bucket.

6. Throughout the day, make sure that children deposit tickets. If necessary, remind them of this task as the day progresses. You may want to give some special assignments today (e.g., washing desks or watering plants) to increase the variety of ways in which water is used.

7. The next morning, ask a child to again read the news bulletin "Water Supply to Be Stopped?" to the class. Explain to children that it is time for the class to tell the school's officials what *they* think should be done about supplying water to the school. (You might invite the principal to your classroom to take part in today's session and listen to children's recommendations.)

8. Refer to the list, “Uses of Water.” Ask children whether or not they want to add any other uses to this list, based on ways they used water yesterday or ways they observed their classmates using water. Add any new uses to the list.

9. Add a new column, entitled “Estimate,” to the right of the list of uses. Ask children to estimate the number of times that the class used water in each of the ways that appear on the list. Some children might be confused about the idea of estimating. Help them by suggesting that one way to make this estimate would be for a student to recall the number of times she or he got a drink, for example, and then multiply that number by the number of children in the class. Work your way down the list of uses and lead children through the process of estimating. Write the estimate for each use in the column you just created.

10. Say: “An estimate is an educated guess. Is there any way that we could know exactly how people in our class used water yesterday?” Let children think about this question and discuss their ideas. If necessary, provide more guidance by saying: “Think about what we did yesterday with our tickets. Is there a way that we could count exactly how many times we used water in the ways we listed on our chart?” When the idea of counting the tickets is offered, focus on it.

11. Make a third column, entitled, “Actual.” To find out the correct numbers to put in this column, the class will count and sort all the tickets in the bucket.

12. Have a few children sort the tickets by type of water use. They may find that there are uses written on the tickets that are not listed on the chart. If so, the children should add these new uses to the chart. (**Note:** Allow children, themselves, to write directly on the chart. Research shows that children are much more engaged with an experiment or investigation if they physically record data or observations. This holds true for activities done by individuals, small groups, or a whole class.)

13. Have other children count the number of tickets spent on each type of water use. Ask those children to write these numbers in the “Actual” column on the chart. Emphasize the difference between the two columns, “Estimate” and “Actual.”

14. Construct a class bar graph with these results. Be sure to save these results for future lessons.

15. Have a class discussion about the results.

- “Where does fresh water come from?” [Remind children of the models of fresh water features they created outdoors in Lesson 2: ponds, lakes, rivers, streams, groundwater, and wetlands.]
- “How many different activities did we use water for?” [Refer to chart.]
- “Were there any activities that we used water for, but did not predict?” [Refer to chart.]

- "For what activity did we most often use water? For which activity did we least often use water? [Refer to chart.] "How would you explain this?" [Answers will vary. If it was a cold day, children may not have been very thirsty. If a particular experiment was conducted that day and it required lots of water that would be reflected in the data.]
- "Did we correctly predict which activity we would do the smallest number of times? The largest number of times?" [Refer children to the appropriate parts of the chart and help them answer this question.]

Before proceeding, congratulate children on the good work they have done up to this point. Explain that science involves asking questions and then collecting information in order to answer those questions. Confirm with the class that they have asked questions, collected information, and then come up with answers to their questions.

16. Divide the class into four or five groups. Assign each group one of the four or five most frequent uses of water. Give each group a copy of the Student Page "Do We Need Water?" Have each group answer the questions on this page. Doing so will help the group decide whether or not its particular type of water use is important to the daily functioning of the school and its children.
17. Let each group share with the class its answers to the questions on the Student Page, "Do We Need Water?" Begin by discussing one specific water use with the children using the questions on the Student Pages. Question #1: "Could we do this with no water?" [Cannot cook or water plants, but could clean, experiment. Some toilets do not use water.] Question #2: "What would happen if we did not do this at all?" [Answers will vary.] Question #3: "What are the three most important uses of water?" [Water is an essential element for life. Other uses might be discussed.] Some additional questions to help students analyze the issues are:

- "Could we survive without doing some of these activities? Which ones?"
- "What would be the consequences of not using water in certain ways?"
- "Does the number of times we used water in a particular way tell us about how important that kind of water use is? Why or why not?"
- "Did you have enough tickets for the school day? Do you use water more or less than 10 times in one school day?"
- "What do you think are the three most important water uses? Did your answer change after hearing about the other groups' water uses?"
- "How important is water to our school?"
- "What would we do differently if the water source (a river, lake or groundwater) that supplies our school got used up or polluted? What does this tell us about how we should treat fresh water?" [Conserve it and do not pollute it.]
- "What would our class recommend to the officials at our school?" [Refer to the choices on the Student Page, "Water Supply to Be Stopped?" and ask children to come to a consensus about a recommendation.]

Lesson 4: Water Town

Big Ideas of the Lesson

- Pioneer families who lived long ago used less water than modern families.

Abstract

In this lesson children use manipulatives to measure water and establish a scale. They then discuss the use of models and examine several models in the classroom. Using one model, children perform a narrated skit to demonstrate the relative amounts of water used 100 years ago in a developing town. The skit is then repeated to reflect modern times. To conclude the lesson, they compare the amounts of water used in these two periods of time.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- identify household uses of water (e.g., drinking, cleaning, food preparation) (E.FE.02.12).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM.02.14).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

water source

Instructional Resources

Equipment/Manipulative

Buckets (5-7, depending upon their size)

Cups (150 identical paper or plastic bathroom sized cups)

Dishpans (1 for each group: for alternatives, see Step 1)
Milk jugs (1-gallon jugs only; 1 for each group)

Props or signs and tape

Towels or paper towels
Student Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

The Exploratorium. 22 January 2009 <http://exploratorium.org>.

Hewitt, Sally. *Using Water.* New York: Crabtree Publishing, 2009.

Hooper, Meredith. *Drop In My Drink: The Story of Water on Our Planet*. New York: Viking Penguin, 1998.

Kerley, Barbara. *Drink of Cool Water*. Washington, DC: National Geographic Society, 2002.

Morgan, Sally. *Water for All (Earth Watch).* London: Franklin Watts, Inc., 2000.

Weninger, Brigitte. *Precious Water*. New York: North South Books, 2002.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

ITT Industries Waterbook. 22 January 2009 <http://www.itt.com/waterbook>.

Nelson, Dennis, et al. *Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

United States Geological Survey. 22 January 2009 <http://wwwga.usgs.gov/edu/wuir.html>.

Water Environment Federation. 22 January 2009 <http://www.weg.org>.

Water System and Water Use. Denver, CO: American Water Works Association, 2003. (Poster of a water system and water use is available for $5.95 plus shipping. Call to request a catalog 1-800-926-7337.)

Water Use Posters. Denver, CO: U.S. Geologic Survey, Branch Distribution, 2003. (Free set of water use posters, 1-888-ASK-USGS)

Sequence of Activities

Advance Preparation: Fill 135 paper or plastic cups with water. Set them together at the front of the room. Gather props and costumes or prepare signs with tape for the following roles: Animal, Pioneer Family, and Modern Family. Props might include paper ears and tails for animals, an old-fashioned object or bonnet for the pioneer family, and something "hip" (e.g., radio or CD) for the modern family. Make a sign for each of the three roles. These signs will be taped onto the chests of three children. Write "2 Units of Water" on a piece of paper, "11 Units of Water" on another piece of paper, and "123 Units of Water" on another piece of paper. Have these papers and three buckets handy but not visible to children.

Safety Precautions: Mop up spilled water quickly to avoid slipping.

1. Explain to children that today the class is going to continue to study ways that water is used. Remind them of the last lesson, in which they kept track of the ways they used water at school (and at home, if the class did the suggested extension activity). They also discovered how much water was needed for different uses. Tell children that today they are going to learn about how humans' use of water has changed over time.

2. Organize children into small groups and give them either names (e.g., Water Wizards, Drop Detectives) or numbers (e.g., Group 1, Group 2). Give each group a dishpan of water, a few cups, and an empty one-gallon milk jug. If dishpans are not available, children can be given filled cups of water, or can fill cups themselves if the classroom has a water fountain or faucet/sink.

3. Explain that each group's assignment is to find out how many cupfuls of water it takes to fill the milk jug. Explain that children must carefully pour full cups of water into the milk jug until the jug is completely filled with water. One child in each group should keep track of how many cups of water are poured into the jug. Remind children that it is important to collect data when we do an experiment. That might involve measuring or counting. To model the process of collecting data and to emphasize its importance, draw a chart on the board. List the groups' names or numbers down the left side of the chart. Next to that column, make a second column headed: "Cups of Water Poured into Jug." Explain to children that someone from each group will record the group's data in the correct place on this chart. (You may need to help recorders place their numbers in the correct cells.)

4. Remind children about the characteristics of good teams: members listen to each other, respect each other, work together to accomplish a goal, and take good care of the equipment and supplies. Have each group designate a “counter” and then ask children to begin their work. Be sure that every group records its results on the chart. [Results will vary, depending upon the size of the cups used.] Remember, children are more engaged in activities when they, themselves, record data on a chart rather than simply telling the teacher what to record on the chart.

5. Compliment children on their work in small groups by citing some real examples of good work that you observed. Then show the class a globe. Ask: ““How is this globe different from the real earth?” [The globe is a *model* of the earth—a smaller version of the real thing, and one that can be handled and moved in the way the real earth cannot be.] “Can anyone explain what a model is?” [Models are often smaller than the real thing, so they are easier to look at and handle. Sometimes you can make a model do things that you could never make the real object do. For example, marine engineers use water tanks and model boats to see how the real boats they want to build would hold up in bad weather. Anthropologists and archeologists might make small models of very large ancient artifacts to demonstrate what they looked like and how they worked. Architects use small models of buildings to help them design safe structures and to show people how those buildings will look once they are constructed.]

6. Explain to children that today, the class will travel through time using their imaginations in order to study the amounts of water used by two families which lived at different times. “We do not have any containers large enough to hold all of the water used by these two families. Because they used so much water, we need to use a model to show those amounts of water. Let us think about what we could use.” Refer to the chart and ask: “How many cupfuls of water did it take to fill one milk jug?” [Refer to the chart and review the group’s results.] Say, “Our chart tells us that it takes about one gallon of water to fill this milk jug. What could we use as a model for one gallon of water?” [In this lesson, the model for *one gallon* of water will be *one cup* of water.] Set one cup filled with water next to a filled milk jug. Refer again to the globe. “Just as the globe is a model for the Earth — it is smaller and easily handled — one cup of water will be our model for one gallon of water. A cup is smaller than a gallon, and it is easier to handle and move around.”

7. If needed, continue to discuss and explain the usefulness of models by asking: “How will using a model make it easier to see and talk about how much water our two families use? Why couldn’t we just use gallons of water instead of cups?” [It would be a lot of work and time to carry that much water into the room. We would waste a lot of water. It would be hard to find enough jugs in which to measure the water. We would need lots of buckets to hold the gallons and gallons of water. The buckets would be very big and very heavy.]

8. Look at the Student Page “Models.” Show children how to read the chart. The name of the real object is written in the left-hand column. The object that acts as a model for it is written in the right-hand column. Some examples are filled in. Children should draw or write models and the things they represent in the remaining spaces. They may use objects in the classroom or objects at home. You may give them this page as homework if children cannot find or think of enough objects. [Possible pairs of objects/models include: cup filled with water/milk jug filled with water;

earth/globe; car/hot-wheels car; person/doll; house (and the things in it)/dollhouse (and the things in it); animal/stuffed animal; airplane/toy airplane. Children may come up with additional objects and models.] If your class has computer time, you may wish to explore the idea of a model further at the *Exploratorium* site.

9. Say: "We know about models, and so we understand that in this lesson one cup of water represents one gallon of water. Now we can begin our trip through time. We will discover how water has been used in one place over many years by different living things." Explain to children that some of them will be actors, some will be directors, and you will be the narrator in this story. Distribute the Student Page, "How Much Water?" Show children how to read and interpret the chart: find the activity in the left-hand column, and look in the right-hand column to find out how many units of water that activity requires.

10. *Pre-settlement:* Read the following story aloud: "About 100 years ago, there was a clearing in the woods with a creek running through it. Lots of plants grew by the creek and got their water from it. Deer came there to drink. Birds came there to take their baths. Fish swam in the water. It was a very peaceful and beautiful place."

11. Ask a child to come up front to represent the animals that drank from the creek. The child should bring her or his child page in order to follow along. Put the "Animal" costume or sign on this child. Refer the class to the chart and ask them: "How many units of water did the animals that lived by the creek drink in a day?" [Two gallons.] Have the child hold the bucket while you pour two cups of water into it, saying: "In this lesson, a cup represents a gallon of water, so I am pouring two cups of water into the bucket." Tape the sign: "Two Units of Water" to the bucket. Have the "Animal" child remain standing but move off to the side.

12. *Pioneer Family:* Continue the story. "One day a family of four settlers came to the creek. 'This looks like a great place to live!' they said. They set up camp and later built a house there. The people in the family hauled their water in buckets from the creek. Hauling water was hard work. They used water for many things every day."

13. Ask four children to come to the front of the class and stand close together to represent the family. They should bring their Student Pages in order to follow along. Put a "Pioneer Family" costume or sign on one of these four children. Give another member of the family a bucket to hold. You will pour the cups of water used in each activity into this bucket. Refer children to the chart and ask, "When they used the outhouse, they used how many gallons of water?" [Zero.] "When they washed their faces, how do you think they did it?" [There was no plumbing, as we know it — no pipes or drains. The pioneers poured water into a wash basin or bowl.]"How many gallons of water did they use to wash their faces?" [One.]

14. Pour one cup of water into the bucket, saying: "In this lesson, one cup of water represents one gallon of water." To emphasize the notion of relative amounts, point again to the filled cup and the

filled jug as you make this statement. Then ask: “When they washed dishes, how do you think they did it?” [There were no sinks, and certainly no dishwashing machines. Pioneers washed dishes by hand in a pail or basin.] “How many units of water did they use each time they washed dishes?” [Two.] Pour two cups of water into the bucket, saying, “Two cups of water represents two gallons of water.” Ask: “How much water did they use for drinking and cooking in a day?” [Three gallons.]

15. Pour three more cups of water into the bucket, saying: “Three cups represents three gallons.” Ask: “How do you think they washed their clothes?” [There were no washing machines. Pioneers washed clothes in a tub. They heated water, added soap and then stirred the clothes with a paddle.] “How many gallons of water did this use?” [Five gallons.] Pour five more cups of water into the bucket, saying, “Five cups represents five gallons of water. That is a lot.”

16. Point to the filled jug and exclaim: “Imagine five of these containers filled with water!” “Now we will add up the amounts of water that this family of settlers used for in a typical day.” Walk children through the process of addition: 0 + 1 + 2 + 3 + 5 = 11 gallons of water used. This amount is represented by the 11 cupfuls of water in the bucket held by a member of the “Pioneer Family.”

17. Tape the sign: “11 Units of Water” to the bucket. Have the Pioneer Family remain standing but move aside.
18. *Modern Family:* Proceed by saying: “The story continues! Time marches on! Over the next 100 years, a town grew up in this place by the creek. Time went by, and the houses in town added indoor plumbing and electricity. Clever people built machines that made life easier by saving people’s time and energy. Other people bought these machines. There was another family of four, the Modern Family. In many ways, this family lives just as your family does.”

19. Ask four more children to come to the front of the room and stand close together. Give one of these children the “Modern Family” prop(s) or sign. Give another of these children a bucket to hold. Refer children to the chart once again and ask: “The Modern Family has flush toilets. Look on the Modern Family’s chart to find out how many gallons of water they use for each flush.” [Seven gallons.] Pour seven cups of water into the bucket, saying, “Seven cups represents seven gallons. When they wash their faces, how do they do it?” [At a sink, sometimes leaving the water running while they wash!] “How many units of water does this use?” [20 gallons.] Pour 20 cups of water into the bucket. Ask the class to help you count.

20. At this point, the bucket may be heavy. When it becomes too heavy to hold, the child can set it on the floor. Make sure the class realizes that the bucket is too heavy to hold because there is so much water in it. This will help emphasize the volume of water in the bucket. Continue with your questions. Ask: “When they wash dishes, how do you think they do it?” [With a dishwasher.] “How many gallons of water does a dishwasher use each time?” [30 gallons.] If needed, give another bucket to another member of the Modern Family. Pour 30 cups of water into this bucket. Let the class help you count. Alternatively, you can have two children each add 15 cups of water. “How much water do they use for drinking and cooking?” [Six gallons.] Pour six more cups of water into a bucket. “How does the Modern Family wash clothes?” [With a washing machine.] “How much water does this use?” [60 gallons.] Again, get another bucket if needed. Pour 60 cups of water into

the bucket. Let the class help you count. Alternatively, have four children each pour in 15 cups of water. Exclaim: “Wow! A washing machine uses 60 gallons of water for just one load of laundry.” Motioning to the filled jug, say: “Imagine 60 of these jugs filled with water. We have represented that amount of water by pouring 60 cups of water into the bucket. Now you can see why using a model is helpful. We would have had lots of trouble pouring 60 gallons of water — that is 60 big jugs. And we would have had trouble finding a container large enough to hold that much water.” “How much water does the Modern Family use to do the same tasks the Pioneer Family did?” [Help the children set up the addition problem: 7 + 20 + 30 + 6 + 60 = 123 gallons. The Modern Family used 123 gallons of water in a typical day.]

21. Give one member of the Modern Family the sign, “123 Units of Water.” Have the “Animal,” the “Pioneer Family,” and the “Modern Family” face the class, with the signs on their respective buckets visible to the children. Then ask: “Who used the least amount of water?” [The Animal.] “Why do you think this is so?” [Children might suggest that animals do not have to wash clothes or dishes.] “Let us look closely at the two families. The Modern Family and the Pioneer Family are doing the same tasks and chores every day. We can see that by comparing the tasks listed on the chart. Both families are washing faces, washing clothes, washing dishes, and drinking. They are doing the same things, but are they using the same amount of water? [No.] Which family uses the most water?” [The Modern Family.]

22. Motioning to the two families of children, say: “Let us compare the amounts of water used by the Modern Family and the Pioneer Family. You just said that the Modern Family used more water than the Pioneer Family. How much more water did the Modern Family use?” Referring to the signs on the buckets, help children set up the math problem: 123 – 11 = 112 gallons. In a typical day, the Modern Family uses 112 gallons more water than does a Pioneer Family.

23. Discuss the difference in amounts of water used. Prompting questions include:
    - “Is there a big difference or a small difference in the amount of water the two families used?” [A big difference.]
    - “Why is there such a big difference between the amount of water a family used 100 years ago and the amount of water a family uses today?” [Children will probably have many answers.]
    - “How did the amount of work it took to get water to the house affect the amount of water the Pioneer Family used? How did it affect the amount the Modern Family used?” [The easier it was to get water, the more of it people used. The Pioneer Family conserved their water because they had to carry it themselves from the creek to their house. The Modern Family did not have to carry any water. It came to them in a pipe that ran into their house. To get water, all they had to do was turn on a faucet. The Modern Family was not always careful to turn off the faucet while washing faces or washing vegetables.]
    - “Did anything else cause the Modern Family to use more water than the Pioneer Family?” [Certain things we do today were not done in pioneer days. For example, we change our clothes nearly every day. Pioneers might have owned only two or three outfits, so they washed fewer clothes. We also bathe more than once a week, while pioneer families did not.]

- "Think about your own family and your own house. Do you think your family is more like the Pioneer Family or the Modern Family?" [Most children will probably identify with the Modern Family.]
- "Do you and the Modern Family do things differently than the Pioneer Family did?" [We have indoor plumbing and electricity. We want to keep things much cleaner than did the Pioneer Family. We are more interested in saving time and effort. We have machines, such as dishwashers and washing machines. We tend to do things in the same way as other people in our communities in order to "fit in."]
- "Is there any reason to do things today the way the Pioneer Family did them 100 years ago?" [They used much less water — and other resources — than we do today. There are some ways in which we could save water without giving up health, safety, and convenience. For example, we could turn off the faucet while we brush our teeth or wash our hands. We could buy toilets that use less water. We could water our lawns during early morning or late afternoon to reduce evaporation caused by sun and wind.]

24. To review the concept of a model, tip the Pioneer Family's bucket so that the class can see the amount of water in it. Ask: "Now look carefully at the amount of water in this bucket. Do you believe that even our careful Pioneer Family could wash their faces, their dishes, their clothes, and do all their drinking and cooking with exactly this much water?" [No. They used only a small amount of water compared to the Modern Family, but no family could do all of those things with the amount of water in the bucket.]

25. Ask children to explain why there is only a small amount of water in the bucket. [Because we used a model — one cup of water equaled one gallon of water. A milk jug holds one gallon of water. Using gallons of water rather than cupfuls in this lesson would have been very difficult. According to our model, the Pioneer Family would have used 11 gallons of water. Ask children to imagine 11 jugs of water.]

26. Discuss other uses of water: "We have finished our story. Now we can talk about our own community. What kinds of things in our community use lots of water?" [Examples include irrigation of farm fields, industries, swimming, and boating.] "Could we bring into our classroom the amount of water that any one of these things uses? Why or why not?" [No! It would be way too much water. A swimming pool might have enough water to fill up a whole classroom. You will find figures in the Teacher Background, "Classroom Volume," to tell children approximately how many classrooms-full of water a farmer might use to irrigate a field in one day, or the number of classrooms full of water a paper plant uses in one day.]

27. Ask: "Now that we have talked about conserving water by being careful about how we use it, what do you think we should do with the water in our buckets?" [Do not simply pour it down the drain. Although the buckets are probably not clean enough to drink from, you can save the water for use in Lesson 5, or you may water outdoor plants. You can dip water out of the buckets to water classroom plants and animals. You can ask the custodian if she or he needs a large amount of water for any chore. Children may think of these options or something completely different. Affirm creativity and thoughtfulness!]

Assessment
Have children name five uses of water. Have them explain how one of those uses was different 100 years ago.

Application Beyond School
Children gain practice reading and interpreting charts. This is useful in everyday life. Have children find one example of a chart they can read at home. Places they may find charts include the newspaper, a cookbook, a magazine, or a how-to book.

Connections
Health and Physical Education
Children can talk about how hygiene practices today are different than they were 100 years ago. Some of these improved practices require more water. Hand-washing, using a dishwasher to sterilize dishes, washing clothes more frequently, and bathing more frequently increase water usage.

Social Studies
Children can learn about Michigan's history when they consider how the Pioneer Family lived. They learn about their community and state when they discuss how farmers, industries, and residents use water today.

Lesson 5: Special Delivery

Big Ideas of the Lesson

- Pioneer families had to haul water to where they needed it.
- Modern families get water from water delivery systems.

Abstract

This lesson focuses on how water is transported for humans' use. Children play an outdoor game that involves hauling water. They then discuss better ways to deliver water. Children list what they know and what they wonder about where their school's water comes from and how it gets to the school. They design and build simple models of a well and a water tower.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- identify household uses of water (e.g., drinking, cleaning, food preparation) (E.FE.02.12).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM.02.14).
- describe how rain collects on the surface of the earth and flows downhill into bodies of water (e.g., streams, rivers, lakes, oceans) or into the ground (E.FE.02.21).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

surface water

water source

Instructional Resources

Equipment/Manipulative

Aspirator bulb, syringe, or eyedropper (1 for each group)

Box (cardboard, 1 per group)

Cake pan or dishpan (1 for each group)

Cup full of gravel and half full of water (1 for each group)

Masking tape

Paper cup (1 for each group)

Pencil

Plastic bins or indoor trashcans (2)

Scissors

Straws (bendable, 4 or 5 for each group)

Student Resource

Cole, Joanna. *The Magic Schoolbus: At the Waterworks*. New York: Scholastic, Inc., 1986.

Collard, Sneed. *Our Wet World*. Watertown, MA: Charlesbridge, 1998.

Hooper, Meredith. *The Drop in My Drink: The Story of Water on Our Planet*. New York: Viking, 1998.

Kerley, Barbara. *Drink of Cool Water*. Washington, DC: National Geographic Society, 2002.

Weninger, Brigitte. *Precious Water*. New York: North South Books, 2002.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

Nelson, Dennis, et al. *Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

Water Cycle Posters. Madison, WI: Wisconsin Geological and Natural History Survey, 2003. (Call Donna with request (608) 263-7389.)

Water Environment Federation. 22 January 2009 <http://www.weg.org>.

Water System and Water Use. Denver, CO: American Water Works Association, 2003. (Poster of a water system and water use is available for $5.95 plus shipping. Call to request a catalog 1-800-926-7337.)

Water Use Posters. Denver, CO: U.S. Geologic Survey, Branch Distribution, 2003. (Free set of water use posters, 1-888-ASK-USGS.)

Sequence of Activities

Advance Preparation: In the schoolyard, place two large, empty plastic bins or relatively clean, indoor plastic trash cans about 100 meters (about 150 paces) from a tree (or two trees, if possible) that may need water. Fill both bins with equal amounts of water. You can use the water you saved from Lesson 4.

For each small group, set the following items on a cake pan, dishpan, or cookie sheet: a cup filled with gravel and then half-filled with water; a syringe or eyedropper or bulb; several bendable straws; an empty paper cup; some masking tape; a pencil; scissors; a small cardboard box.

Warn your custodian that your children will be requesting a tour or a copy of the school plans.

Safety Precautions: Children must not taste any water or put their mouths on equipment during this experiment.

1. Begin by reminding children of the last lesson about how people's use of water has changed over time. Then say: "We know how the Pioneer Family — a family that lived 100 years ago — got water. The members of that family hauled it in buckets from a nearby creek. But is that really so hard? Let us find out."

2. Take the class outside. Show them the bins of water. Say: “We are going to use another model in this lesson. You remember that in the last lesson, one cup of water was a model for one gallon of water. These bins are a model, too. What do you think these bins represent?” Accept children’s ideas and then explain that the bins of water are a model of the creek from which the Pioneer Family hauled its water. The bins contain some water, but the creek contained much more. Show children the cups, and state that they, too, are models. Ask: “What do you think these cups might represent?” If necessary, remind children that the Pioneer Family used buckets to haul their water. Then explain that children will use cups as models of the Pioneer Family’s buckets. Show children the tree or trees that will be used during this activity and explain that these are models of the Pioneer Family’s garden. Say: “So we have a creek (the bins of water), the buckets (the cups), and the garden (the trees). We are ready to go!”

3. Divide the class into two groups: Pioneer Family 1 and Pioneer Family 2. One child from each Pioneer Family will be the timer for her or his group. The two Pioneer Families will have a relay race to see who can be the first to haul all the water needed for the Pioneer Family’s garden.

4. Give each Pioneer Family one cup. Explain that when you say, “Go!” the first person in line in each Pioneer Family is to scoop up a “bucket” full of water from the bin and carry it to the “garden” (the tree), where they will pour the water on the ground at the base of the tree. Children may not run but should walk quickly. After dumping the water on the “garden,” they must walk as quickly as possible back to their Family, hand the “bucket” to the next person in line, and go to the end of the line. The next person repeats the task. The first Family to get all of the water to the “garden” wins. The Timers should record the time it takes for their Family to do this task.

5. Play the game. After the game is over, have children make a list of the advantages and disadvantages of hauling water in this way. Tell children that often, hauling water was the job of children in a family. Remind children that the small cups were models of the big buckets that the Pioneer Family used to haul water.

6. Discuss with children the advantages and disadvantages of transporting water this way. The advantages are several: it is good exercise; people tend not to waste water when they have worked hard to get it. Disadvantages might include that is tiring (especially if big buckets are being hauled); it takes a lot of time—children might not have time to go to school or do other things if the family needs a lot of water hauled. As an added disadvantage, point out that it would take even more time for children to haul the amount of water needed by a Modern Family, such as the one they studied in Lesson 4.

7. Back in the classroom, say: “We have acted out how the Pioneer Family hauled water from the creek. Do we haul our school’s water from a creek?” [No.] Does our water at school come from a creek?” [No.] Ask children to brainstorm the first two questions on the Student Page: “Where does water at our school come from?” and “How does water get to our school?” Create a four-column

chart on the board. Label the first column, “Know.” Have children make a list of what they *know* about these two questions.

8. Label the second column “Wonder.” Help children make a separate list of what they *wonder* about these two questions.

9. Label the third column: “*How To Find Out*.” Help children figure out *how* to find the answers to some of the questions they wonder about. Some ways to learn about the source and delivery of water for the school include calling the city’s or township’s utilities department; visiting the drinking water treatment plant; touring the water delivery system of the school; checking a blueprint of the school; asking the school custodian or principal; following the pipes leading from a sink, ripping up the walls and floors and burrowing into the ground to follow the paths of the pipes. An imaginative child might suggest attaching a tiny video camera to a drop of water and following it as it moves down a sink’s drain.

10. Help children seek answers in as many ways as they can. Emphasize the importance of being prepared before contacting someone for information. Help children write down an introduction and a list of questions before they make telephone calls or write letters. Do the same before children speak to the custodian or the principal.

11. If children request a tour from the custodian, ask her or him to show children a blueprint of the school that shows where the water main enters the building, the location of the water heater, some of the school’s water pipes, and some spigots.

12. If possible, arrange a field trip to the local drinking water treatment plant. Have children write down a list of good questions before the trip. If a field trip cannot be arranged, ask someone from the plant to visit the class. Help the speaker prepare by communicating any key points you would like him or her to cover. If your school gets water from its own well or a municipal well, a well driller could visit your class. It would be especially exciting if the well driller could bring a rig to the school. Again, be sure to prepare children by having them prepare some questions ahead of time.

13. After children have learned about some water delivery systems, say: “You have learned something about how water is moved to different places where water is used. Now you will have a chance to make a model of a water delivery system.” Show them the materials they will use: a cup filled with gravel and half-filled with water, a syringe, eyedropper, or bulb, several bendable straws, an empty paper cup, some masking tape, a pencil, scissors, and a small cardboard box.

14. Draw children’s attention to a cup containing gravel and water. Explain that this object is a model of groundwater, water that occurs underground. To be used by humans, groundwater must be moved to the surface. Tell children that they have a challenge: design a model of a system that will move the water in the cup out of that cup — without moving the cup off the desk —into a water tower over the desk and then down through a pipe to a building below.

15. *Give each group one Task Card (in the Student Pages). Let small groups discuss how they will accomplish the task and follow the rules. There is no right or wrong way to set up the models, as long as the steps and rules on the Task Cards are followed. When a group has an idea to try, give that group a set of materials. Place the group's cup of groundwater on a cake pan or dishpan to catch water.*

16. *Children may need to experiment a bit before they find an idea that works. They may need refills of water, assistance with tape, or other help. Provide encouragement to groups and affirm groups that are working well as a team. Remind each group to call you over when they create a model that works.*

17. Once a group has built a successful model, its members should draw a diagram of it. Children should label the well, groundwater, water tower, building, and pipes. To help children label the parts write the words on the board.

18. Have each group set up its model and place the diagram next to it on a desk. Then have groups take a tour around the classroom, observing but not touching other groups' models. Then discuss the models as a whole class. Prompting questions include:
    - "Were all models the same?" [Probably not. There are often many solutions to a single problem or challenge.]
    - "What were some of the difficulties you had while designing your model?" [The opening to the straw placed inside the water tower must be underwater in order for water to come out of the "water tower." The whole structure probably leaked a bit. The tip of the syringe, eyedropper, straw, or bulb had to be underwater for the "well" to work. Children may have had other difficulties, too.]
    - "How are your models like real wells?" [Like a real well, groundwater is sucked up from the spaces between pieces of rock and soil.]
    - "How are your models different from real wells?" [In real wells, the energy for sucking is provided by a motor. In children's wells, energy came from muscle power. Real wells have filters on them, which screen out sand and dirt. The children's wells do not. Children's wells are smaller than real wells.]
    - "How are your water towers like real water towers?" [Like real water towers, the ones built by children use water pressure to make water come out of them and go down through pipes to a building. Like real water towers, children's towers are above the ground and the building.]
    - "How are your water towers different from real water towers?" [Children's towers are smaller. The water was put into the towers by children's hands rather than by a pump. The water in real water towers is cleaned or otherwise treated before being put into the water tower.]
    - "What could we do with models that we could not do with a real well and water tower?" [The models let us experiment with different parts of the system, e.g., placing the water tower at different heights, shutting, and opening pipes.]

19. Children now know where the water at their school comes from and how it is delivered. Have a class discussion. Ask questions such as:

- "What are the advantages and disadvantages of our water delivery system versus the Pioneer Family's system of hauling water in buckets from the creek?" [If there is an electrical power failure, we cannot get water. Delivery pipes can develop leaks.]
- Which system would you rather use? Why?" [Responses will vary. Encourage children to debate this question in a thoughtful and respectful way. Affirm children who refer to the comments of others during the debate. Then take a vote! But point out to children that some people in our culture live in ways that most of us consider to be "primitive," or very similar to the way the Pioneer Family lived.]
- "What could be done to teach other children about where our water comes from?" [Possible projects include: a bulletin board display of student drawings of water's route to the school and within the school; drawings of their models; a student-written skit about the travels of a water drop to and within the school; a student-led tour for other children of the school's water system; a display of the models children built; a detailed model of the school and its water system, using small boxes for buildings and plastic straws for pipes. Children may have other good ideas.]

20. Refer again to the chart created at the beginning of the lesson. Add a fourth column, "*Learned"* and have children add to this column. If necessary, prompt them by referring to the entries in the "*Wonder"* column.

Assessment
Before the lesson, have children draw a picture of where they think drinking water comes from and how they think drinking water is brought to their school. After the lesson, have children again draw a picture of where they think drinking water comes from and how it gets to the school. Post the "after" diagrams on a bulletin board with other information about water, such as the posters listed in the Teacher Resource section of this lesson.

Application Beyond School
Have children find out where the water for their homes comes from. Children can share this information with each other during a subsequent class. If appropriate help the class make a bar graph that shows the number of children who get water from a municipal water source and the number of children who get water from private wells. In some schools, all children will tap a single source of water — either a municipal well or a private well.

Connections
Social Studies

When studying water children can learn about the sources of water in their local community.

Assessment
Have children write a short recommendation to local officials. Tell them in advance what the recommendation should address: whether or not the pipe that brings water to the school should be

fixed, and why or why not. If bottled water is recommended, rather than fixing the pipe, the letter should recommend the three activities for which bottled water should be used. Create a three-column assessment rubric. On the left-most column, list children's names. Have two additional columns. Use one to note whether or not the student made a recommendation about fixing the pipe. Use the other to note whether or not the child justified her or his decision.

Application Beyond School
Send an envelope of 10 tickets home with each child. Ask children to repeat the activity they did in school, writing on the ticket every time they use water at home. Have children bring all their tickets (used and unused) to school the next morning. After children deposit their tickets in the bucket, analyze the data the same way you did for water use at school. Compare water use at home to water use at school. Is water used more often at home or at school? How do the uses at each place differ? How are they the same? Save the data for future lessons.

Connections
Mathematics
While conducting experiments on the uses of water children use bar graphs, comparisons, estimates, and numerical predictions.

Lesson 6: Clever Clean-Up

Big Ideas of the Lesson

- Allowing particles to settle to the bottom is one way to clean dirty water.
- Adding a chemical to dirty water is another way to clean dirty water.
- Filtering water is another way to clean dirty water.
- Some substances are toxic and should not be put down the drain.

Abstract

In this lesson children try three different methods of removing impurities from a mixture, and make observations about each method's effectiveness. They learn how these methods are used to treat drinking water and sewage. Using results and observations from their experiments, children design a water treatment system and evaluate its effectiveness. They discuss how these systems compare to real treatment systems for drinking water and sewage.

Grade Level Context Expectation(s)

Children will:

- identify water sources (e.g., wells, springs, lakes, rivers, oceans) (E.FE.02.11).
- identify household uses of water (e.g., drinking, cleaning, food preparation) (E.FE.02.12).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM.02.14).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

surface water

water source

Instructional Resources

Equipment/Manipulative

Alum (1 jar of powdered alum, available in the spice section of grocery stores and drugstores)
Clear plastic cups (6 for each group)
Coffee filters (1 for each small group)
Ground black pepper (1/2 cup)
Markers, crayons, or pencils
Milk jugs or other large pitchers (1 or 2)
Paper cups with pencil hole in the bottom (1 for each group)
Permanent marker
Powdered milk (1 box)
Safety goggles (1 for each student)
Scissors
Sieve
Tape

Student Resource

Cole, Joanna. *The Magic School Bus: At the Waterworks*. New York: Scholastic, Inc., 1986.

Collard, Sneed. *Our Wet World*. Watertown, MA: Charlesbridge, 1998.

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

Hooper, Meredith. *The Drop in My Drink: The Story of Water on Our Planet*. New York: Viking, 1998.

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Weninger, Brigitte. *Precious Water*. New York: North South Books, 2002.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

Nelson, Dennis et al. *Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

SEE-North. *Classroom GEMS: Groundwater Education in Michigan Schools: Activities and Resources for Grades K-6*. Petoskey, MI: SEE-North, 1991.

United States Geological Survey. 22 January 2009 <http://ga.water.usgs.gov/edu/wuir.html>.

Water Cycle Posters. Madison, WI: Wisconsin Geological and Natural History Survey, 2003. (Call Donna with request (608) 263-7389.)

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Water Use Posters. Denver, CO: U.S. Geologic Survey, Branch Distribution, 2003. (Free set of water use posters, 1-888-ASK-USGS.)

Sequence of Activities

Advance Preparation: Cut up the Task Cards (in the Student Pages) so there is one card for each small group of children. Also copy the entire page so there is one page per child. Use a pencil to poke a hole in the bottom of one paper cup for each small group.

Safety Precautions: Children should wear goggles and wash their hands after using any chemical. (Since they do not know that your chemicals are milk and pepper, they must wear the goggles at all times.) Remind children that they should never taste substances used in experiments. Wash safety goggles with antibacterial soap after using.

1. Introduce this lesson by reminding children about the last lesson about water. “Last time, we learned that there were several important sources of drinking water. We learned how water can be moved around so that humans can use it. Much of the water that humans use must be very clean. For example, everyone knows that drinking water must be clean, whether it comes from under the ground, from a lake, or from a river. Today, we are going to study how water can be cleaned both before we drink it and after we use it.”

2. Put on safety goggles. Let children observe while you mix powdered milk and water in one or two milk jugs. Use one fourth of the amount of powdered milk called for in the package directions. Pour some of the milk and water mixture into a clear cup and add one teaspoon of pepper. Stir it thoroughly. **Note:** Do not let children see the containers for the milk and pepper. You want to keep the identities of these substances a mystery.

3. Ask children: “What do you call the liquid in the jugs?” [A mixture — a combination of two or more things.] Ask: “What things are in the mixture?” [Water, a black substance, and a white substance. Children do not need to name or know the substances, but should be told that the liquid is water.]

4. Pick up a cup of the mixture and say: “Mmmmm. I am so thirsty! I think I will take a drink of this nice, clean water. It looks so pure and refreshing!” Let children object. Ask: “Why should I not drink this?” Then say, “Maybe I will just use it for washing dishes instead.” When children object, ask them what the problem is. Tell them: “Well, maybe I will just pour it in our local river. I am sure the fish will not mind dirty water.” Children will likely object and tell you that you would be polluting the water. Say: “Well, if it is not clean enough to drink or to use around the house, and if it will pollute our local river if I toss it in there, what should I do with this stuff?” Hopefully, children will insist that you clean it up. Say: “I have an idea. Let us work together to clean it up.”

5. Discuss the following questions briefly, but do not discuss the water treatment process in detail. Subsequent steps in the lesson will lead into that.

- “Where does your drinking water come from?” [In Michigan, about half of the people get their drinking water from groundwater. The other half get their drinking water from a lake, river, or reservoir. Some municipal water sources are a mixture of the two.]
- “Is the water we take from underground or from lakes and rivers clean enough to drink as it is?” [Sometimes groundwater is clean enough to drink untreated. But water from lakes and rivers and reservoirs should never be drunk without first being cleaned up, or treated. All cities and towns that supply water to people treat the water to some extent before sending it to homes and businesses.]
- “What do people do to water to make it clean enough to drink?” [Help children write a list of cleanup ideas on the board. Ideas may include filtering, adding chemicals, skimming waste off the top, picking out big things, or other ideas.]
- “Could these same ideas work to clean up water that has already been used by people?” [Yes.]
- “Is the water in my cup clean? Would you like to drink it? Would you like to bathe in it?” [No. The water is obviously dirty.]

- "How many different substances are in my cup?" [At least three. The water, a white substance, and a black one. Do not tell children what these are. Just refer to them as the white part of the mixture and the black part of the mixture.]

6. Say: "We are going to try three different ways of cleaning this dirty water. You thought of some good ideas for cleaning water, so we will try some of those."

7. Divide the class into small groups of three or four children. Give one Task Card to each group. **Note:** There are three types of Task Cards. Make sure that you distribute at least one of each of the three types. Then model the instructions on each of the Task Cards. Explain to children that later in the lesson, they will have to follow the instructions on ***all*** of the Task Cards — not just the one they have now — so they need pay attention now as you model the instructions.

8. To model instructions on the Task Cards, use clear cups marked, "1," '2," and "3." Each of the three cups should be half-filled with the milk mixture. Then add one teaspoon of pepper to each cup and stir thoroughly.

- **Task 1, "Settling:"** Say: "What does 'settling' mean?" [Settling means to stop moving, to be still. Ask children if anyone has ever asked them to 'settle down."] Ask: "How can we settle our mixture?" [Just let it sit.] Using your cup of mixture marked "1," show children how to let the mixture sit. Show them how to measure five minutes on the clock. Explain: "The part that does not settle can be carefully poured into another clear cup. The part that has settled to the bottom should **not** be poured into the clear cup." Be sure that you do not let your mixture settle for very long, or children will observe what happens and might lose interest in their own experiment. (**Note:** If children's mixtures have not settled after five minutes, they should stir it (without letting the stirrer touch the bottom of the cup) and let it settle for five more minutes.)
- **Task 2, "Add A Chemical:"** Explain: "I have a special chemical, alum, and safety goggles at my desk. If your group has Task 2, one person may come up to my desk, put on safety goggles, and get one-half teaspoon of alum. Then you will add the alum to your group's cup and stir the mixture." Show them how to measure a half teaspoonful of alum to put into Cup 2. But **do not** put the alum into your cup, or children will see what happens and may lose interest in their own experiment. Stir Cup 2 with the stirrer. Say, "You stir the mixture and then wait five minutes." Show them how to measure five minutes on the clock. Continue, "Then draw your 'after' picture."
- **Task 3, "Filtering:"** Show children a sieve. Say: "Can you see the holes in the sieve? What would happen if we poured a lumpy mixture into this sieve?" [The water would come through and the lumps would be left in the sieve.] Explain: "This filter is a lot like a sieve. The difference is that the filter's holes are so tiny that we cannot see them." Next show children a paper cup with a hole in the bottom. Place a coffee filter in the cup, hold the cup over an empty clear cup, and pour the mixture from Cup 3 into the filter. (**Do not** pour your mixture into the cup. Just show the children how the mixture must go on top of the filter, not to its side.) Tell children: "You must pour slowly, so that the mixture does not overflow the filter. If the filter plugs up, pull very gently on the edge of the filter. The liquid should begin to flow again."

9. Explain: "Each group will do the task on its Task Card. In any group, not every member can do the task at the same time. Any child who is not doing the task is an Observer, watching carefully to see what happens to the mixture. Observers are just as important to the group as are the people who are doing the task."

10. Hand out a piece of paper to each child. As you show them how, tell children: “Fold your paper into thirds. At the very top of the page, write your name and the task number from your group’s Task Card. On the top part of the paper, write ‘Before’. On the middle part, write, ‘What we did.’ On the last part, write ‘After.’ Your ‘Before’ and ‘After’ drawings should include pictures of your group’s mixture, including anything that is floating, anything that has settled to the bottom, and anything in the water, itself. ‘What we did’ should have a picture or words describing what you did to the mixture. “How can we show in our drawings that the mixture is white?” [The class should agree to use a certain color or some other symbol to represent white.]

11. Remind children that they should not taste anything while they are doing an experiment unless their teacher gives permission. Then say: “OK! It is time for groups to get to work.” Remind children about the importance of being a good group member — respect other people, respect the equipment, ask good questions, be a careful observer, and pay attention. Remind children that each of them needs to fill out the paper that is folded into thirds.

12. Add one teaspoon of pepper to each of the cups and stir thoroughly. Then give each group one clear cup that is half-filled with the mixture, and other materials needed for that group’s task. These additional materials are listed below.

Task 1: A second clear cup;
Task 2: A stirrer;
Task 3: A paper cup with a hole in the bottom, a coffee filter, and a second clear cup.

13. For each of the three tasks, ask one child who was in a group that did that task to show the class her or his paper and explain “Before,” “What we did,” and “After.” The child may display the group’s cup.

14. Discuss the children's results and observations:

- “Which task seemed to work best to clean the water?” [Opinions will vary.]
- “What did each task remove from the water?” [The settling took most of the black part of the mixture out of the water. The chemical, alum, made the white substance form lumps in the water. The filter removed the black substance, but did not remove the white substance from the water.]
- “How does the mixture look now, compared to the way it looked before the tasks?” [Have a clear cup containing the milk and pepper mixture, recently stirred, to which children can compare their results.]
- “What is still in the water?” [Depending upon the task, the water still contains either the black substance or the white substance — or both substances.]

15. Compare procedures used to treat drinking water and sewage (water that leaves our homes after we have made it dirty) to those used by the children. Say: “When water is being cleaned at a sewage treatment plant or at a drinking water treatment plant, dirty water is passed through a screen. Anything that cannot fit through the tiny holes in the screen is left behind — taken out of the water.” Ask:

- “What did we use that worked like a screen?” [Our filters.]
- “What kinds of things do you think screens can take out of the water?” [Large pieces of waste, such as litter, plants, and sewage.]

- "Settling is also used to clean up dirty water. Anything that sinks, like the black part of our mixture, is taken out this way. Alum is also added to big tanks of dirty water. What does alum do?" [Alum makes one or more substances in the water clump together.]
- "How does alum help us clean water?" [Clumps are easier than the tiny particles to remove.]
- "Would you want to drink any of the mixture that you tried to clean?" [Responses will vary.]
- "Did any of the tasks completely clean the water?" [No.]
- "How could we do a better job cleaning the water?" [We could do more than one of the tasks with the same cup of mixture.]

16. Say: "I have a job for you. I would like us to figure out a way to get most of the black and white substances out of the mixture, using the three tasks we just did, or by trying something new. The order in which we do each task is important to the clean up. What order do you think would be best?" [Accept and discuss children's ideas. The best order would be 2, then 1, and then 3. Filtering should be done after adding alum. Because it helps to let both the pepper and the clumps caused by alum settle out, settling could be done after alum is added. Filtering would be the final step.] "Do you have any other ideas for clean-up?" [Children may think of skimming material off the surface of the liquid in the cups, or poking a hole in the bottom of the cups to let clear liquid out. They may think of something entirely different!]"So what did we decide is the best way to get the black and white substances out of our mixture?" [Unless children have a different idea, Task 2, then Task 1, then Task 3 is the best approach. Write on the board whatever procedure the class has decided to follow and review it so everyone understands it.]

17. Explain that each group will do the procedures in the order that is written on the board. Give each group scissors, tape, and a copy of the Student Page containing all the Task Cards. Tell them to cut apart the three Task Cards and then tape the cards together in the order in which the class has agreed to do them.

18. Give each group one clear cup half-filled with the mixture, two clear, empty cups, one paper cup with a hole in the bottom, one coffee filter, and a stirrer. Remind them that alum and safety goggles are at your desk.

19. Tell children: " Set up the 'Before,' 'What we did,' and 'After' parts on the back of your papers. In the 'Before' section, draw the cup of mixture before any of the tasks are done to it. In the 'What we did' section, write the task numbers in the order that we agreed upon. In the 'After' section, draw the cup of mixture after the last task has been done."

20. Give children a chance to draw the "Before" picture and write down the Task numbers, in the order agreed upon.

21. Have groups run their mixture through their treatment system. When they are done, remind them to draw the cup of liquid in the "After" spot on their paper.

22. Have a class discussion using open-ended questioning techniques. Some sample questions follow:

- "How did the mixture end up? Was the water in the mixture completely clean?" [Probably not.]

- “How did the water after the tasks compare to the water before the tasks?” [It was probably cleaner. Have a clear cup containing the milk and pepper mixture available for children to use as a comparison.]
- “Which tasks took which parts of the mixture out?” [Settling and filtering removed the black part of the mixture. The chemical, alum, made the white part of the mixture clump. After it was clumped, the filtering worked for the white part of the mixture.]
- “Was there anything left in the water after our treatment plan? Was it cleaner than it started out to be?” [The water will still be cloudy, but less white than it was originally. All the pepper should be gone. Again, allow children to observe a clear cup of the milk and pepper mixture, recently stirred, for purposes of comparison.]
- “How could we take out the rest of the ‘dirt’ in this water and make the water very, very clean?” [Real water treatment plants use other chemicals to clean the water even more. They sometimes use gravel and sand as filters. They sometimes do some tasks more than once.]
- “How is the water at our school cleaned before it comes here?” [It depends upon where we live, and whether we tap a municipal water supply or have our own well. Filters on wells keep dirt out of the water. Other than this screening, well water may not be treated at all. Sometimes a water softener is used to treat the water before we drink it. Water softeners add chemicals to the water. If we have city water at school, it is treated by chemicals, and may also be treated by settling, filtering, the addition of alum, a combination of these strategies, or other strategies in addition to these.]
- “How can we find out more about this?” [Call the municipality that provides water to the school, or call a well driller. Arrange a speaker or a field trip.]
- “What kinds of dirt gets into our water at school?” [Some of the things that are added to water as it is used at school include sewage, soap, paint, and germs.]
- “How is water cleaned up when it leaves our school?” [It depends upon whether water goes to the school’s septic system or goes to the wastewater treatment plant. In a septic system, water goes to a big underground tank, where solids settle to the bottom. The liquid waste is sent out under the ground, where dirt serves as a filter. The city’s or township’s wastewater treatment plant uses settling ponds the size of swimming pools, adds alum and other chemicals, and uses screens as filters. In addition, both methods of cleaning water also rely upon tiny living organisms called bacteria to clean waste.]
- “How are our model treatment systems like and unlike the real ones?” [Our models are smaller than the real systems. Our water still is not clean enough to drink when it leaves our treatment model, whereas it is clean enough when it leaves a real system. Our mixture was made of water and just two other things. Real wastewater is made of a mixture of water and many different things.]
- “How could we make sure that less water needs to be cleaned up?” [By using less water and by being careful about what we add to our water before it leaves our school and homes.]

23. Tell children that the white part of the mixture was powdered milk and the black part of the mixture was ground black pepper. Ask: “Are these pollutants?” [Yes, in quantity anything can be a pollutant.] “What should we do with our clean mixture and the leftover mixture?” [It can be safely disposed down the drain of a sink once the larger particles have been removed. This is only true because the mixtures do not contain any harmful or toxic substances.] Ask children, “What kinds of things should not be put down the drain?”[Examples of substances include strong chemicals used to clean houses and do projects, such as paint, paint thinners, pesticides, and strong cleaners.] “What should be done with these things instead?” [Many communities have a

household hazardous waste drop-off site, where these chemicals are treated as hazardous materials and disposed of more safely. Disposing of toxins and poisons costs a lot of money and is often very difficult work. For those reasons, we should minimize our use of toxins and poisons.]

Assessment
Each child should draw or tell where their water comes from and where it goes after it leaves their school. Each child should describe two things that can be done to clean up dirty water.

Application Beyond School
Have children find out whether their homes are on municipal water or have private wells. Have them find out whether their home's wastewater goes to a septic system or to the city's or township's wastewater treatment plant.

Connections
Health and Physical Education

While studying about water children can discover what is needed for a healthy water supply.

Lesson 7: Watching Water

Big Ideas of the Lesson

- It takes a lot of water to do everyday jobs.
- There are many ways that we can use less water.

Abstract

This lesson focuses on the conservation of water. Children do tasks that require water, using a sink or dishpan to collect the water required for each type of task. They first leave the water running while performing each task, and then devise a different way to complete the task while trying to conserve water. Children measure the amounts of water in the dishpan after each trial and make bar graphs to compare the amounts of water they use. This lesson consists of two parts and spans two to three days.

Grade Level Context Expectation(s)

Children will:

- identify household uses of water (e.g., drinking, cleaning, food preparation) (E.FE.02.12).
- measure the volume of liquids using common measuring tools (graduated measuring cups, measuring spoons, graduated cylinders, and beakers) (P.PM.02.14).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).
- construct simple charts and graphs from data and observations about water use (S.IPI.02.16).

Key Concept(s)

water source

Instructional Resources

<u>Equipment/Manipulative</u>

Dishpans (1 per group)

Drawing paper or poster board (1 per group)

Graph paper (1 sheet per child)

Markers or crayons

Materials for tasks (e.g., soap, a clean toothbrush, washcloths, a clean cup)

Old towels or paper towels (for wiping up spills)

Paper cups (100; those used in previous lessons can be reused)

Potatoes or other vegetables still covered with some dirt from the garden (5-pound bag)

Scrubber

Water-filled milk jugs, 2-liter bottles, or pitchers (at least 1 per group)

Student Resource

Albert, Richard E. *Alejandro's Gift*. San Francisco, CA: Chronicle Books, 1994.

Bash, Barbara. *Desert Giant: The World of the Saguaro Cactus*. Boston, MA: Little, Brown & Company, 1990.

Chambers, Catherine. *Deserts.* Crystal Lake, IL: Heinemann Library, 2000.

Hewitt, Sally. *Using Water.* New York: Crabtree Publishing, 2009.

Hooper, Meredith. *Drop In My Drink: The Story of Water on Our Planet*. New York: Viking Penguin, 1998.

Kerley, Barbara. *Drink of Cool Water*. Washington, DC: National Geographic Society, 2002.

London, John. *Ali, Child of the Desert*. Louisville, KT: Lee Lothrop Publishers, 1997.

Morgan, Sally. *Water for All (Earth Watch).* London: Franklin Watts, Inc., 2000.

Steele, Christy. *Biomes: Deserts.* Austin, TX: Steck-Vaughn, 2001.

Weninger, Brigitte. *Precious Water*. New York: North South Books, 2002.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Teacher Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

Nelson, Dennis, et al. *Project WET.* The Watercourse and Western Regional Environmental Education Council, 1995.

SEE-North. *Classroom GEMS (Groundwater Education in Michigan Schools).* Petoskey, MI: SEE-North, 1991.

United States Geological Survey. 22 January 2009 <http://ga.water.usgs.gov/edu/wuir.html>.

Water Environment Federation. 22 January 2009 <http://www.weg.org>.

Water System and Water Use. Denver, CO: American Water Works Association, 2003. (Poster of a water system and water use is available for $5.95 plus shipping. Call to request a catalog 1-800-926-7337.)

Water Use Posters. Denver, CO: U.S. Geologic Survey, Branch Distribution, 2003. (Free set of water use posters, 1-888-ASK-USGS.)

Sequence of Activities

1. Set the stage for this lesson by reminding children about what they learned previously in this unit: fresh water is a precious and limited resource; humans need fresh water to survive; humans use water every day; some uses make water "dirty;" humans can sometimes clean the water after they use it. Tell children that not everyone is as lucky as we in Michigan are — we have lots of fresh water around us. Say: "Today, we will learn how water is used and how much water we use to do different tasks." Read children a story about life in the desert. There are several such stories listed in the Student Resource section. Discuss how people's use of water in the story differs from our use of water today.

2. Make space on your board for a list called, "Water Use." Explain to children that today, each time they use water, they should write down on the list how they used water. (Some children may remember writing uses of water on tickets and putting tickets in a container during Lesson 3. Explain that today's procedure is slightly different.) Tell children that if the use is already on the list, children need not write it there again. Model this for them by getting a drink and writing, "Drink," on the list. Ask: "Now, when you get a drink, will you write "Drink" on the list?" [No. The child who gets a drink will not write anything because that use of water is already on the list.] Add some variety to the uses of water by assigning several water-related tasks today (e.g., cleaning paintbrushes, watering classroom plants). Before children leave for the day, ask them to keep track of uses of water at home.

3. The following day, review the list, "Water Use." Add tasks that children did or observed someone else doing at home. If children have not listed "washing vegetables," mention that you performed that task last night and add it to the list.

4. Then say: "One common use of water in the kitchen is washing vegetables. Root vegetables, such as potatoes or carrots, often carry a lot of soil, which clings to them throughout the packaging process. Nobody likes to eat dirt. Its texture is gritty and it may contain harmful bacteria that can make us sick. Washing vegetables is an important step in preparing food. How much water does it take to wash vegetables?"

5. If your classroom has a sink, have two children participate in the following activity. (If you do not have a sink in your classroom, use a water-filled milk jug, two-liter bottle, or pitcher and a dishpan.) Ask one child to be the Faucet. Ask another child to be the Water User. Explain the rules to the class: When the Water User says, “On,” the Faucet pours a steady stream of water into the dishpan as the other child does her or his task. When the Water User says, “Off,” the Faucet stops pouring. Let the Faucet and Water User practice a bit, and empty the dishpan or sink after the practice session. (If possible, reuse the water by pouring it back into the container.)

6. Next say: “We are almost ready to use water to wash a vegetable. Where does the water go in a sink?” [Down the drain.] “Where does it go from there?” [To the wastewater treatment plant or a drain field.] Ask the Water User to wash the vegetable. When he or she says, “On,” the Faucet should pour a steady stream of water. The Water User should wash the vegetable and then say, “Off,” at which point the Faucet should stop pouring water.

7. When the two children have completed the task, ask: “How much water do you think it took to wash the vegetable?” [Children’s estimates will vary.] Point out the variation in estimates and emphasize that we can often learn a lot if we measure. “How could we find out how much water is going down the drain? Could we measure it?” [Yes. Place a dishpan in the sink or plug the drain.]

8. Repeat the process using the same two children. Once they have completed the task, have the other children take turns using paper cups to dip the water out of the dishpan or sink. Have them set the full paper cups in a row on a counter or table. (When only a small amount of water remains in the sink or dishpan, use one cup as a dipper and another as a holder — dip with one cup and pour water into the other cup to fill it.) Draw pictures of the full cups on the board, showing how many were needed to empty the sink or dishpan. Then draw a bar graph and graph the data. Label the x-axis, “cups of water,” and the y-axis, “use of water.” Directly beneath this first bar, write, “Washing vegetable, water running.”

9. Remind children that fresh water is a precious resource. Ask: “How could we use less water to wash the vegetable and still get the food clean?” Listen to children’s ideas and encourage them to listen to their peers. (**Note:** Someone will probably suggest turning off the water for a portion of the task. If not, ask: “Does the water need to be poured during the whole time or could we turn off the water while we scrubbed the food?”) Record children’s ideas on the board. (**Note:** Some ideas will involve several steps. Be sure to write down the entire procedures suggested by children.) Let the class pick two of these ideas to try. (Most likely, the best method is to turn on the water, wet the vegetable, turn off the water, scrub the vegetable thoroughly, turn on the water, rinse the vegetable thoroughly, and turn off the water. A scouring brush or pad may remove the dirt more quickly or more completely.) After each of the two trials, collect the water in cups and have children help you record the results on the bar graph on the board. Be sure to label each bar. Once you have three bars on the graph, you can help children compare the amount of water used by the three methods. Challenge children to say how the method that used the least amount of water differed from the other methods. Review

why it is important to conserve fresh water. [Its supply is limited. People and other living things need clean fresh water to survive.]

10. Refer again to the list, “Water Uses.” and add any new ones that children have observed. Write on slips of paper (“Task Cards”) a few of the uses that occur at a sink (e.g., brushing teeth, washing hands, washing face, washing dishes, getting a cold drink of water). You will need one Task Card for each small group.

11. Break children into small groups of three to six children. Give each group a Task Card. Say: “Your job, as a group, is to do the task that is named on your Task Card and then measure the amount of water (in cups) that you used while doing this task. Remember how we measured how much water we used to wash the vegetable?” If necessary, review the procedure and stress the importance of collecting the water and measuring it. Note that some tasks have safety issues. For example, children brushing their teeth should not spit into the dishpan.

12. Give each child a copy of the Student Page, “Watching Water.” Have them write their names and their group’s task on the page.

13. Remind children about their responsibilities as group members: Respect other group members and their ideas, respect the equipment, follow directions, and pay attention. List the three jobs for group members on the board: “Faucet (1),” “Water User (1),” and “Counters.” Then have groups assign jobs to their members. One child in each group will be the Faucet. One will be the Water User. The remaining children will be the Counters. Counters can take turns being Water Users during the different trials, but for consistency the same person should be the Faucet in all trials.

14. Give each group the materials needed for its particular task (e.g., dishes, soap, a scrubber). Also give each group a dishpan and a milk jug, two-liter bottle or pitcher filled with water. Explain that when the Water User (the child doing the task) says, “On,” the Faucet should pour a constant stream of water into the dishpan as the other child does the task. When the Water User says, “Off,” the Faucet should stop pouring. Let the Water Users and Faucets practice before doing the task. Be sure that the water in the dishpan at the end of the practice session is removed (and if possible poured back into the pitcher to be reused).

15. Say: “Now that the Faucets and Water Users have practiced, it is time for groups to do their tasks. Water Users should now do the task written on the Task Card, *leaving the water “on” during the whole task***.** When the task is done, the Counters should do their job.

16. Watch the groups. When a group’s task has been completed, direct children who are Counters to dip paper cups full of water from the dishpan, set the full cups in a row, and count them.

17. When all groups have finished their tasks, direct children to the Student Page, “Watching Water.” Say: “Everyone should write a phrase or draw a picture in the left-hand column headed, “Water on all the time.” In the right-hand column, everyone should record the number of cupfuls of water it took to perform the task your group did.”

18. Tell the groups: “The next step is for each group to think of two other ways to do its task. Your challenge is to think of ways that use *less* water — remember, fresh water is a very precious resource. This time, you can turn the Faucet “on” and “off” during the task as many times as you would like. Also, your ideas might include more things than just a faucet. If so, tell me what equipment or supplies you need and I will see if we have what you want. Write or draw the two ideas that your group agrees upon on your paper in the two boxes that say, ‘Different way.’”

19. Give children the extra equipment they ask for, such as a washcloth, a cup, or a piece of ice. Refer children to the Student Page and show them where they will write the number of cups of water used while doing the task using each of the two methods. Then let each group do its task in the two ways it developed.

20. Give one piece of graph paper to each group. Help each group make a bar graph showing the amounts of water used by the three methods. Children should label their bar graphs and identify the method that uses the least water.

21. Discuss why using less water is important:

- “How much fresh water do we have on earth?” [It seems as though there is a lot of fresh water on earth, especially to those of us who live in Michigan. But compared to the amount of saltwater, fresh water is scarce. (See Lesson 1)]
- “Where does our fresh water come from?” [Both from underground and from surface water sources, such as rivers and lakes.]
- “Where does the water in our school come from?” [It probably comes from the municipal water supply (a lake or river or well), where it is treated before getting to the school. It may come from a well near the school, where it is pumped up from underground and sent through the school’s pipes into the faucet. (See Lesson 5)]
- “Where does water in our school go after it goes down the drain?” [Most likely, it goes to the municipal wastewater treatment plant, where it is cleaned up in many different ways. (See Lesson 6) It is possible that it goes into a septic system, where it goes underground.]
- “What kinds of work or energy does it take to get our water to the faucet?” [It takes a lot of work by people at the drinking water treatment plant to get water to the school. People at the wastewater treatment plant work hard to clean up water that goes down the drain. Both places have machines that use energy when they run. It costs a lot of money to run the machines at both places. Wells and septic systems need maintenance. Well pumps take energy to run. The people in the community have to pay for these costs.]
- “Why is it good to use less water?” [If we use less water, the wastewater treatment plant and the drinking water treatment plant use less energy and cost less to operate. It may mean that new plants will not have to be built. Using the septic system and well less uses less energy, too. Saving water and keeping water clean help protect our environment.]

22. Conclude the lesson by saying: “We have learned a lot over the past few days about how to be wise users of water. I bet we know more about how to conserve water than just about any other class in the school. Part of being a scientist is sharing what you learn. I think we should share what we have learned with other children.” Have each group make a small poster that describes and encourages the method that uses the least water to do its task. Encourage them to make the posters colorful and attractive. These can be posted in the classroom or in the school cafeteria or restroom. Children can also take the posters home and hang them over a kitchen or bathroom sink. Have each group present its poster to the class.

23. Help the class consider the methods that required the least amount of water. Discuss any similarities between methods that use the least water.

Assessment

Children can list three ways to use less water.

Application Beyond School

Children can do a “Watching Water Week,” during which they try to use as little water as possible at home and at school. They can keep a journal detailing how they reduced their use of water each day.

Connections

Social Studies

Children discuss how a community needs water and why water conservation is important.

Lesson 8: Water – Solid or Liquid?

Big Ideas of the Lesson

- Solids keep their shape, but liquids take the shape of the container they are in.
- Water can be a liquid or a solid.

Abstract

This lesson focuses on the properties of water, specifically the solid and liquid forms. Children examine water and ice and make lists of words describing each of the them. They then play a matching game to reinforce what they have learned.

Grade Level Context Expectation(s)

Children will:

- describe the properties (of water as a liquid (visible, flowing, shape of container) and recognize rain, dew, and fog as water in its liquid state. (E.FE.02.13).
- describe the properties of water as a solid (hard, visible, frozen, cold) and recognize ice, snow, and hail as water in its solid state (E.FE.02.14).
- share ideas about water and its properties through purposeful conversation (S.IA.02.12).

Key Concept(s)

water source

Instructional Resources

Equipment/Manipulative

Bowls (1 per group)

Clear cups (2 per group)

Crayons or markers

Ice (2 cube per child)

Towels or paper towels to wipe up spills

Water (in a clear, closed container)

Student Resource

Hooper, Meredith. *The Drop in My Drink: The Story of Water on Our Planet*. New York: Viking, 1998.

Keats, Ezra Jack. *The Snowy Day*. New York: Viking Press, 1962.

Locker, Thomas. *Water Dance*. New York: Harcourt, Brace, 1997.

Ontario Science Center. *Starting with Science Series: Solids, Liquids and Gases.* Buffalo, NY: Kids Can Press, 2000.

Simon, Seymour. *Icebergs and Glaciers.* New York: William Morrow, 1999.

Taylor, Barbara. *Arctic and Antarctic.* New York: Alfred A. Knopf, 2000.

Walker, Sally M. *Water Up, Water Down: The Hydrologic Cycle.* Minneapolis, MN: Lerner Publishers, 1992.

Wick, Walter. *A Drop of Water.* New York: Scholastic Press, 1997.

Zoehfeld, Kathleen Weidner, and Paul Meisel. *What Is the World Made Of? All About Solids, Liquids, and Gases*. New York: Scott Foresman, 1998.

Teacher Resource

EPA Office of Water, Groundwater and Drinking Water. 22 January 2009 <http://www.epa.gov/safewater/kids/index.html>.

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United States Geological Survey. 22 January 2009 <http://ga.water.usgs.gov/edu/wuir.html>.

Water Environment Federation. 22 January 2009 <http://www.weg.org>.

Sequence of Activities

Advance Preparation: Prepare grab bags with items listed, for each group or prepare one grab bag. Pictures of forms of water are found in the Teacher Background.

1. Give each group a bowl containing one ice cube for each child in the group. Let children hold and feel the ice cubes. Draw a picture of an ice cube on the board and ask for words that describe how the ice cube feels. Write children's words beneath the picture. Ask: "Can I pour an ice cube? Can I stick my hand through it? Is ice a solid or a liquid?" [Ice is a solid.]

2. Have children put the ice cubes back in the containers. Collect the bowls of ice and set them aside while the class does something else. Depending upon conditions, it could take hours for the ice to melt. When all ice cubes have melted, put children back in their groups and return the same containers to them. Those containers now contain water rather than ice.

3. Ask children: "Look in your containers. Do you notice a change?" Then ask: "Where did this water come from?" [The ice melted and became water.]

4. Let children touch the water. Draw on the board a picture of a container of water and ask for words that describe how the water feels. Write children's words underneath the picture. Ask: "Is water a solid or liquid?" [Liquid.] Encourage children to defend their answers.

5. Discuss these two states of water. Some prompting questions are below.

- "What is ice made of?" [Frozen water. Ice is a solid.]
- "What is this water made of?" [Melted ice. Water is a liquid.]
- "Have you ever seen frozen water that is not in a cube?" [Ice appears in different forms in nature. These forms include hail, snow flakes, ice on lakes, and glaciers. People sometimes make ice sculptures.]
- "What is frozen water used for?" [To keep drinks and food cold, to help you feel better when you are hurt, to skate on, to make snowballs with, to ski on.]
- "Have you ever seen liquid water that is not in a cup?" [Water is seen in nature as rain, lakes, rivers, ponds, oceans, geysers, tap water, groundwater, and puddles.]
- "What is liquid water used for?" [Drinking, cooking, cleaning, swimming, water skiing, boating, watering plants and crops, making things in a factory, cooling things, washing things, and making electricity (with hydroelectric dams).]

6. Say: "Now we will play the game we played before "Solid or Liquid?" This time, the grab bags are filled with pictures of water. We will use the same rules we used before. Each group will get a grab bag. Take turns. The person taking a turn should close his or her eyes, reach into the grab bag, and pull out one picture. The person may use the "Clue Sheet" to decide where to put the picture — on the paper marked 'Solid' or on the paper marked 'Liquid.' If the person is not sure where to put the picture, he or she may ask for help from the group. Otherwise, the members of the group should be quiet. Pass the bag around and take turns. Keep going until everyone has had a turn and the bag is empty."

7. After the game, have each group describe the item that was hardest to figure out, and where they placed it. It was probably snow. Draw a two-column chart on the board, with columns headed, “Solid” and “Liquid.”
8. Discuss children’s results for snow, using the prompting questions listed below:

- “How is snow is like a solid.” [It does not settle to the bottom of the container. It does not take the shape of the container it is in unless we push it. We can see it. We cannot pour it.] Chart children’s ideas in the column headed “Solid.”
- “How snow is like a liquid.” [We could put our hands through it. We can see it. It can be made to take the shape of the container it is in.] Chart children’s ideas in the column headed “Liquid.”
- “What is snow made of?” [Snowflakes.]
- “What are snowflakes made of?” [Frozen water.]
- “Is frozen water a solid or a liquid?” [Frozen water — ice — is a solid.]
- “Is snow a solid or a liquid?” [Solid]

9. After the game, have children cut apart pictures from Student Pages and put them in the correct columns under “Solid” or “Liquid.” Post these pages around the room.

10. Surprise your class with special refreshments—cups of water with an ice cube in each! While they are sipping their refreshing drinks, discuss what they have learned about water and ice.

Assessment

Ask each child to fold a piece of paper in half. On one side, they are to draw a picture of one of water’s liquid forms. On the other, they are to draw a picture of one of water’s solid forms.

Application Beyond School

Give each child a checklist of the different forms of ice and water (e.g., snow, tap water, ice cube, lake, stream). Children can mark off each form of water they see. The next day, children can compare checklists, discuss what they observed, and list the forms of water they did not see.

Connections

<u>English Language Arts</u>

When studying the solid and liquid forms of water children can use the organizational patterns in information texts to aid comprehension.

Lesson 9: Water – Clean it Up? (Engineering Activity)

Clean It Up!

OBJECT

Students explore how filtration systems work.

GRADE LEVEL

Elementary through middle school

MATERIALS *(for each team):*

- 2 cups of gravel
- 2 cups of sand
- ½ cup of activated charcoal, rinsed
- Sponge
- Coffee filter
- Paper clip
- Drinking straw
- Cotton balls
- 2-liter plastic soft drink bottle, cut in half
- Rubber band
- Tape (electrical or duct)
- Pantyhose
- Modeling clay or plumber's putty
- Scissors
- Yarn, 12" long

For the group: One large bucket filled with water and small amounts of these **Contamination Materials:** food coloring, soy sauce, raisins or dry beans, potting soil, baking soda, paper plate torn into small pieces

DISCUSSION

Each team will need one 2-liter soft drink bottle, cut in half. Remove the screw-on cap and discard it. Take the top portion of the bottle and turn it upside down and place it in the bottom portion. The filter will be built inside the inverted, top portion of the bottle. The base portion will act as a reservoir and collect the water that runs out of the filter.

Ask one or two students to help you mix the contamination liquid that will be poured through the students' filters. Add the "contamination materials" to the water in the bucket. The food coloring represents chemicals, the raisins represent animal and human waste, the potting soil represents earth, the baking soda represents road salt, the soy sauce represents motor oil, and the torn paper plate represents litter.

ACTIVITY

Divide the class into small teams of 2-3 students per group. Provide each team with the filter materials and explain to them that they have been charged with the mission to design the most efficient water filtration system possible with the materials supplied. The teams may only use eight items, not counting the soft drink bottle, to construct their filtration device. Grant them fifteen minutes to discuss, design and construct their filter.

At the end of the fifteen minutes, have each team share with the group which materials they chose to use and why they decided to use each item. Then pour the "contaminated" water on to the top of each of the filtration systems. This part can be messy, so it's best to move outside. The team that has the clearest, most debris-free water in its collection base is declared the winner.

Compare and contrast the outcomes of each team's filtration system. Ask each team what they would change if they could re-build their filtration system.

CONNECT TO ENGINEERING

It takes a lot of work to make that clean, clear drinking water that comes out of the tap. Imagine what it takes to bring clean water to a remote village. Every day, people in developing or remote areas struggle to gain access to clean water. Engineers for a Sustainable World, Engineers without Borders, and similar organizations engage engineers and engineering students in projects around the world to make a difference in people's lives.

Water purification activity, courtesy Craig Just, University of Iowa, is from the DVD Discover Engineering. *See www.discoverengineering.org,* a project of the National Engineers Week Foundation.