A Drop in the Bucket

■ **Grade Level:**
Middle School

■ **Subject Areas:**
Earth Science, Mathematics, Geography

■ **Duration:**
Preparation time:
30 minutes

Activity time: 30 minutes

■ **Setting:** Classroom

■ **Skills:**
Gathering information (observing, calculating); Organizing; Interpreting (drawing conclusions)

■ **Charting the Course**
Prior to this lesson, students should review percentages and should know the portion of Earth's surface covered with water. In "Old Water," students explore how long water has been on Earth. This activity supports concepts related to the water cycle ("The Incredible Journey"), watersheds ("Branching Out!"), and water distribution ("Piece It Together," "Wet Vacation," and "Dust Bowls and Failed Levees").

■ **Vocabulary**
salt water, fresh water, consumptive use

What is abundant and rare at the same time?

▼ Summary
By estimating and calculating the percent of available fresh water on Earth, students understand that this resource is limited and must be conserved.

Objectives

Students will:

- calculate the percentage of fresh water available for human use.
- explain why water is a limited resource.

Materials

- *2 colors of construction paper*
- *Sheets of white paper*
- *Markers*
- *Water*
- *Globe or world map*
- *1000-ml beaker*
- *100-ml graduated cylinders*
- *Small dish*
- *Salt*
- *Freezer or an ice bucket*
- *Eyedropper or glass stirring rod*
- *Small metal bucket*
- *Copies of* ***Water Availability Table***

Making Connections

Students may know Earth is covered mainly by water, but they may not realize that only a small amount is available for human consumption. Learning that water is a limited resource helps students appreciate the need to use water resources wisely.

Background

Ironically, on a planet extensively (71 percent) covered with water, this resource is one of the main limiting factors for life on Earth. *The Water Availability Table* summarizes the major factors affecting the amount of available water on Earth. If all the clean, fresh water were distributed equally among people, there would be about 1.6 million gallons (6 million liters) per person. This is only about .003 percent of the total water on Earth.

On a global scale, only a small percentage of water is available, but this percentage represents a large amount per individual. The paradox is that, for some, water may appear plentiful, but for others it is a scarce commodity. Why are some people in need of more water? Geography, climate, and weather affect water distribution. Agriculture, industry, and domestic use also affect availability.

Procedure

▼ *Warm Up*

Tell students they are going to estimate the proportion of potable water on Earth and compare it to the rest of the water on the planet. Have students work in small groups. Instruct them to draw a large circle with a marker on a white sheet of paper. Offer them two sheets of different colored construction paper. One color represents available fresh water; the other represents the rest of the water on the planet.

Tell students that they will be tearing the two sheets of paper into a total of 100 small pieces. Ask them to estimate how many pieces will represent potable water and how many pieces will indicate the rest of the water on the planet. Instruct each group to tear up their paper and arrange the 100 pieces within the circle so that these pieces reflect their estimates. Have groups record the number of pieces representing "potable" and "remaining" water.

ANSWER KEY: Water Availability Table	
Total water (100%) on Earth divided among all people (based on a world population of 6.5 billion people)	= 215.4 billion liters/person
Minus the 97% of each share (215.4 billion liters) that contains salt (oceans, seas, some lakes and rivers) 215.4 billion liters - 208.9 billion liters	= 6.5 billion liters/person
Minus the 80% of this 6.5 billion that is frozen at the poles (5.2 billion) 6.5 billion liters - 5.2 billion liters	= 1.3 billion liters/person
Minus the 99.5% of the 1.3 billion that is unavailable (too far underground, polluted, trapped in soil, etc.) (1.294 billion) 1.3 billion liters - 1.294 billion liters	= 6.0 million liters/person

▼ *The Activity*

NOTE: For simplicity, measurements have been retained in metric. To convert to standard measurements, refer to the *Metric Conversion Table* in the Appendix.

1. **Show the class a liter (1000 ml) of water and tell them it represents all the water on Earth.**

2. **Ask where most of the water on Earth is located. (Refer to a globe or map.) Pour 30 ml of the water into a 100-ml graduated cylinder.** This represents Earth's fresh water, about 3 percent of the total. Put salt into the remaining 970 ml to simulate water found in oceans, unsuitable for human consumption.

3. **Ask students what is at the Earth's poles.** Almost 80 percent of Earth's fresh water is frozen in ice caps and glaciers. Pour 6 ml of fresh water into a small dish or cylinder and place the rest (24 ml) in a nearby freezer or ice bucket. The water in the dish (around 0.6 percent of the total) represents non-frozen fresh water. Only about 1.5 ml of this water is surface water; the rest is underground.

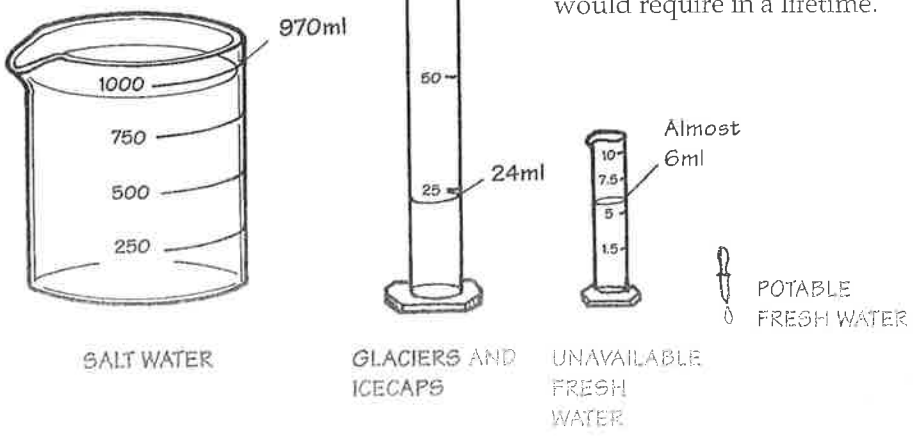
4. **Use an eyedropper or a glass stirring rod to remove a single drop of water (0.003 ml). Release this one drop into a small metal bucket.** Make sure the students are very quiet so they can hear the sound of the drop hitting the bottom of the bucket. This represents clean, fresh water that is not polluted or otherwise unavailable for use, about .003 percent of the total This precious drop must be managed properly.

5. **Discuss the results of the demonstration.** At this point many students will conclude that a very small amount of water is available to humans. However, this single drop is actually a large volume of water on a global scale. Have students use the Water Availability Table to calculate the actual amounts.

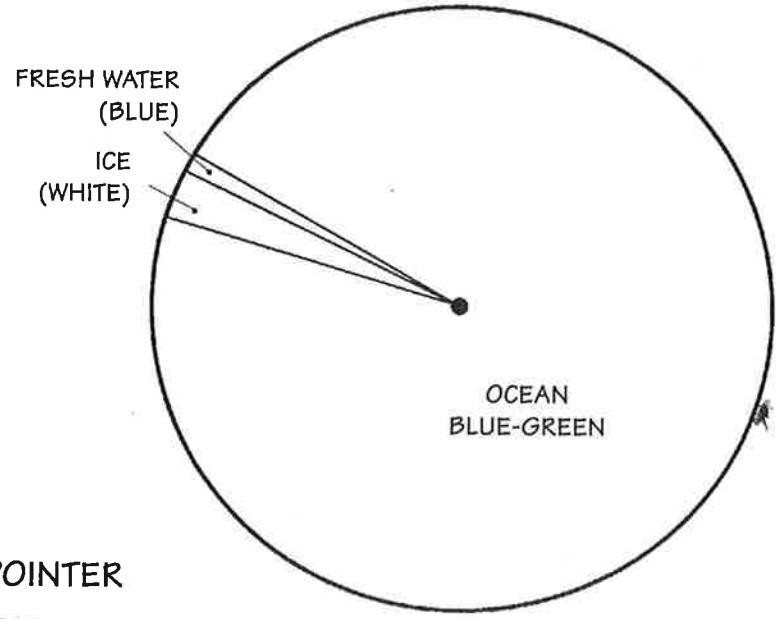
▼ *Wrap Up*

Referring to the Warm Up, remind students of their earlier guesses at how much water on Earth is available to humans and compare the actual percent of Earth's water available. Have students explain their reasoning for their initial estimates. How would they adjust their proportions? (One-half of one of the pieces of paper represents potentially available water [0.5 percent]. Only one small corner of this half [.003 percent] is actually potable water.)

Ask students again if enough water is currently available for people. If the amount of usable water on the planet is divided by the current population of approximately 6.5 billion, 6 million liters of water is available per person. Theoretically, this exceeds the amount of water a person would require in a lifetime.

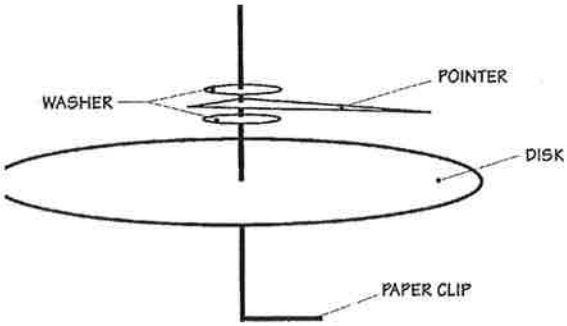


DISK PATTERN



POINTER

DIRECTIONS
for spinner design for K-2 Option.



K–2 Option

Conduct the first four steps of the activity. (If beakers are not available, use approximate volumes with one gallon [4 liters] of water representing all water on Earth. Of this, 1 fluid ounce [30 milliliters] is fresh water, and all but one small drop of the fresh water is frozen at the poles.) To help students appreciate these proportions, have them participate in the following activity. Construct, or have students make, spinners. (Make the disk, pointer, and washers out of sturdy cardboard.) Give each child a copy of the *Water Chart*. Children spin the pointer and color a box of the chart in the appropriate row to indicate where the pointer landed. Which row of the chart do students think will fill up first?

So, why does more than one-third of the world's population not have access to clean water? Discuss with the class the main factors affecting water distribution on Earth (e.g., land forms, vegetation, proximity to large bodies of water). Other environmental influences affect availability of water (drought, contamination, flooding). Students can also consider that other organisms use water, not just humans.

Assessment

Have students:

- determine the proportion of Earth's available fresh water (***Warm Up*** and ***Wrap Up***).
- calculate the volume of water available for human use (step 5).

Upon completing the activity, for further assessment have students:

- develop a television commercial outlining reasons why water is a limited resource.

Extensions

Students can calculate how much water they might use in a lifetime. Provide them with the following instructions: Keep track of how much water they use in one day. (The average person in the United States uses about 100 gallons [379] per day.) Multiply daily use by 365 days and then by 70 years (estimated life span). How does this compare to the 1.6 million gallons (6 million liters) available to them? (This applies to direct water use only.)

Students can identify areas of the globe where water is limited, plentiful, or in excess and discuss the geographical and climatic qualities contributing to these conditions. For example, large variations in precipitation occur within states. (Death Valley receives as little as 2 to 5 inches [5 to 12.5 cm] per year; only 100 miles [160 km] away, mountain ranges receive more than 30 inches [76 cm] per year.) These variations dramatically impact plants, people, and other animals.

Resources

Miller, G. Tyler, Jr. 1990. *Resource Conservation and Management*. Belmont, Calif.: Wadsworth Publishing Company.

Goldin, Augusta. 1983. *Water: Too Much, Too Little, Too Polluted?* Orlando, Fla.: Harcourt, Brace, Jovanovich, Inc.

Hammer, Trudy J. 1985. *Water Resources*. New York, N.Y.: Watts.

Pringle, Laurence. 1982. *Water: The Next Great Resource Battle*. New York, N.Y.: Macmillan.

Water Availability Table

Name:_____ Date:_____

Quantity to be divided among people on Earth	Amount Available liters/person	% of total water
All the water on Earth	215.4 billion	100%
Only the fresh water (calculate 3% of the amount available)		3%
Only the non-frozen fresh water (calculate 20% of the remaining amount available)		0.6%
Available fresh water that is not polluted, trapped in soil, too far below ground, etc. (calculate 0.5% of the remaining amount available)		.003%

Water Chart

K-2 Option