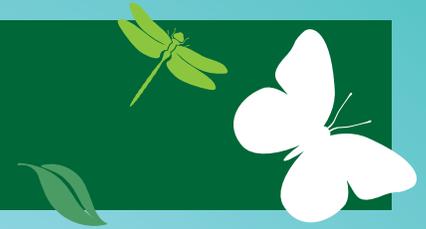


Water, Water, Everywhere?

Students explore the availability of water for humans and wildlife use.



Grade Level:

3-4, K-2, 5-8

Time:

Two 30-45 minute periods

Learning Objectives:

Students will be able to:

- Explain how much water is available for human and terrestrial wildlife use
- Discuss how humans use water
- Formulate strategies for conserving water

Subjects:

Science, social studies

Materials:

- Water
- 2 large, clear plastic containers or an aquarium (4 gallons)
- 2 or 3 smaller buckets or other containers (1 gallon or less)
- 2 or 3 measuring cups or beakers and measuring spoons
- Calculators
- Water droppers
- World map
- Reference materials and/or chart on teacher reference sheet

Background

Water is a **finite** resource, meaning that the water that exists on Earth right now is all that is available. While it is continually cycled, the supply is constant; it is impossible to make more.

Ninety-seven percent of the Earth's water is ocean water, and is largely unusable for drinking, sanitation, cooking, or growing crops. Two percent is frozen in ice caps and glaciers. Another small portion consists of salty inland seas and lakes, soil moisture, and the atmosphere, which leaves less than one percent available for human domestic use and wildlife that need freshwater. This small portion of the water supply consists largely of underground reservoirs of water called **ground water**, but also includes the small amount in freshwater lakes and rivers. Oddly enough, it is from rivers, the smallest (0.0001 %) portion of Earth's water supply that humans obtain most of our water. This supply is unevenly distributed across the Earth. Arid and semi-arid regions, which receive little **precipitation**, build dams to store what little water is available. The populations of large cities of California, for example, would not be able to function without large dams that store and provide river water.

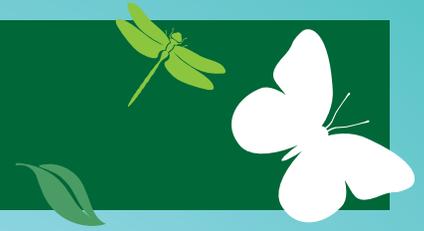
Humans use water in many different ways. In the United States in 1995, power generation and irrigation were tied for the largest percentage (39%) of human water use. Water is used in power generation to cool electricity-generating elements, though a limited number of plants generate power directly from water, known as **hydroelectric power**, when water flows over large turbine blades. Irrigation accounts for such a large percentage because most of the crops grown in the U.S. would not thrive with water they receive from rainfall alone (many areas that grow crops receive little rain and many crops need more water than plants that grow wild). Other water uses include public water supply, which accounts for most drinking water and domestic uses (e.g. washing the dishes, laundry, the car, watering the lawn), industrial and mining use, water for livestock, and commercial use. Wastewater treatment is another important "use" of water for humans, though it is not counted in human water consumption because it deals with water that is being treated after human use.

Procedure

1. You will want to conduct most of this activity outside - it involves a lot of water! Introduce the activity by asking students, *Where in the world is the greatest amount of water found?* (the oceans) *Where are other places water can be found?* (Ice caps, ground water, inland lakes and seas, freshwater lakes, the atmosphere, in soil, rivers and streams.) Write, or have students write, the answers on a board or a large piece of paper. Have them brainstorm the order in which water on Earth exists, from greatest volume (oceans) to the least volume (rivers and streams).



Water, Water, Everywhere? (continued)



Materials for Part Two:

- 1/2 can frozen grape juice (or other drink) for each small group
- Pitcher for each small group
- Drinking cup for each participant
- Enough clean containers to hold 1 gallon for each small group
- 1 container of dish-washing soap for entire group
- Long spoon for each small group

2. Tell students that for the purposes of this activity, they will begin with 12 liters (about 3.2 gallons) of water, which will represent all of the water on Earth. The group should have the measuring beakers (or measuring cups) handy at the start of this activity. Piece by piece, they will remove different bodies of water that are effectively not available for human use or for use by wildlife that need freshwater. Each time they remove a “body of water,” they should place the water in a separate container. Ask students to first remove water that represents the ocean. The approximate amount of water they should remove is on the Teacher Reference Sheet at the end of this activity. Have students sit or stand in a circle around the “world’s water” supply. They should decide with which measuring beaker or cup they will begin, and then should each take turns (and pass the beaker/cup to the next student) to do their part to remove the water. Count for them, or have them count along to make sure the right number of units is removed. Have them dump their full cups into another gallon or large container.

3. Next, they should remove the water stored in ice caps and glaciers, then inland seas, then (if it is possible at this point) a tiny bit for soil moisture and the atmosphere combined. As the water bodies become

progressively smaller, allow students to decide to use different measuring beakers, cups, or water droppers to extract the water.

4. When all these are done, ask, *What is left?* Tell students that humans and wildlife together can use only about what they see left in the large container, less than 1% of the world’s water! Add to that the fact that most water used by humans is from rivers and streams, which comprise only 0.0001% of all the water on Earth, and this tiny amount must be shared with all non-ocean organisms! Challenge students to think about how they would have extracted 0.0001 % of the water they had in the large container. Ask students, *How do humans get enough water?* (Some examples: Dams contain water so that it can be easily extracted, pipelines and aqueducts move water to a particular place to be used, wells are drilled to extract ground water.) *How can wildlife get enough water?*

5. After students have discussed the small amount of water available for humans and non-ocean wildlife to use, ask students, *What do people do with the water we use?* Have them create a list.

Examples:

Domestic uses: cooking, cleaning, teeth brushing, bathing, flushing toilet, watering lawn, etc.

Commercial uses: restaurants, car washes, public restrooms, etc.

Industrial uses: mining, for cooling large engines, etc.

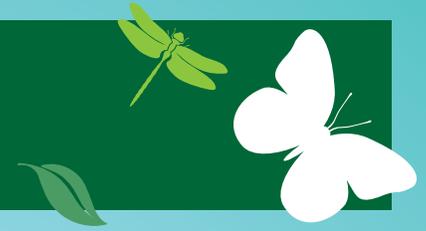
Electricity: cools power generators, runs hydroelectric dams

Irrigation: agriculture, livestock

Where do people get this water? Have students brainstorm on this topic. Some potential answers: public supply (largely from river- or stream-fed reservoirs), well water (from ground water), cisterns or other rain-catching devices (largely individuals; this practice is rare).



Water, Water, Everywhere? (continued)



6. Wrap up the activity by asking students, *How in the world can we do all these activities with so little of the Earth's water? What does this mean to us on a daily basis? If we have so little water, what do we do if it is polluted? What are some positive steps we can take to conserve water and prevent water pollution in our local community or in our schools and homes? Since this same water must be shared with all non-ocean wildlife, what does this mean for the way we use our water and how much of it we use?*

Procedure for Part Two

1. Ask students, *How is fresh water distributed? Do desert habitats receive the same amount of water as those near a large freshwater lake? Ask students to identify areas of the U.S. and the world that receive large amounts of rainfall, and those on the other end of the spectrum that are arid or semi-arid, and areas that fall in between. Use an atlas if necessary. Ask students, What do people in areas with little water resources do to fill all their needs for water? (Use dams to create reservoirs, develop aqueducts or pipelines to move water further, recycle used water, conserve water). How do wildlife species adapt to low-water habitats? (e.g., tough skins to reduce water loss, fat for water storage, active at night when it's less hot, slow moving to reduce energy use).*

2. Tell students to imagine that they are going on a trip to an area with very little water. This could be somewhere widely known for its dryness such as the Mojave Desert, or it could simply be an area experiencing a hot, dry summer, and water is hard to find, perhaps the mountaintops of Pennsylvania after a few weeks without rain, for example. Through amazing advances in technology, they were able to carry with them a can of frozen grape juice concentrate (that is still frozen!). Divide the class into small groups of three to five. If possible, have a volunteer oversee small groups.

3. Tell each group that, with only one gallon of water (in one or several clean containers), 1/2 a can of frozen grape juice concentrate (have two groups share one can), a pitcher, a long spoon, a small amount of soap, a drinking cup for each group member, and a small measuring cup, they must do the following:

- Make enough grape juice for everyone in their group
- Clean up everything so that there is no visible trace of grape juice or soap to be found anywhere (the pitcher, bottles, cans, etc.)
- Brush their teeth (they don't have to actually do it, they just have to estimate enough water)
- Wash their hands

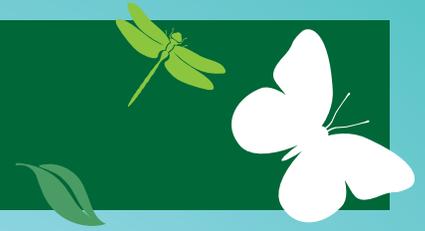
NOTE: Grape juice works well because it can be a challenge to clean up, though any mix that calls for water (dehydrated milk, fruit punch, orange juice, etc., will work). If students are going to drink the juice, make sure that none of them have dietary restrictions.

At the end of this activity, students should decide how to use any remaining water - relatively clean water can be used to water plants, for example.

4. Wrap up by asking students if they were surprised by the amount of water they really needed to do everyday tasks. Was it more or less than they expected? Ask students if they would have had enough water to really stay healthy for a day (The average person living in a moderate climate needs eight 8-oz. glasses per day). Ask, *Why is it important to try to save water, even in areas that seem to have plenty?*



Water, Water, Everywhere? (continued)



What else could they do to conserve water? Discuss other uses of water in the United States, and around the world. What are ways all people can conserve water?

Modifications for Younger Students (Grades K-2)

Talk to students about where people get the water they use. Ask, *Where can we find water? Can we drink ocean water? What is bigger, the ocean or a river?* It is best if they can directly relate the availability of water to something they have experienced. To introduce this activity, ask them what places in the world receive only a little bit of rainfall. What do they think people do about water there? Ask if their parents have ever had to stop watering the lawn or washing the car because of a drought, i.e., when there has not been enough rain. Then ask how else they could conserve water. Lead students through the activity in Part 2 above, but use 3 gallons for the whole class instead of splitting participants into groups. After they have completed Part 2 of the activity above, review some of the concepts of conserving water.

Modifications for Older Students (Grades 5-8)

- Instead of telling students how much water to remove in Part 1, give them the percentages represented by each category and have them calculate how much water to remove from the 12 L starting amount for each step.
- Have students do a project similar to Part 2 of this activity, but have them help create a meal that uses water. NOTE: This will require having very responsible students AND volunteers to oversee small groups. Any boiling of water should be very carefully supervised.
- If students would like to simulate the water requirements of a community, they should also set aside a large amount (on average, about 6 times as much for all domestic tasks combined!) of water for irrigation and electricity. Have students determine the amount of water they need for their project, but make sure they are aware of how much water they are using - groups should use small containers to get water.

Extension

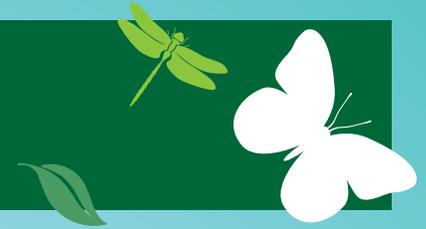
Ask students to look at a world map. *How is the Earth's freshwater distributed? Which areas have more water? Which areas have very little water?* (For example, the Great Lakes in North America have a lot of freshwater, while deserts like the Mojave in the western states, and the Sahara in northern Africa are very dry). Ask, *Where is the nearest freshwater source to you? Do you live in a dry or water-rich area?* Ask students to explain their answers.

Assessment

Have students develop posters depicting the amount of water available for humans and non-ocean wildlife, and suggesting ways their schoolmates and community members can conserve water in their everyday lives.



Water, Water, Everywhere? Teacher Reference Sheet



Water Body	Percentage of All Earth's Water	Generally, Can Humans Use?	For Activity, Volume in Metric (in U.S. cooking measure) (From a 12 liter source)
Oceans	97.24%	No	11.6 L (49 cups)
Ice caps, glaciers	2.14%	No	260 mL (1 cup, 1 TBS)
Ground water	0.61%	Yes*	73.2 mL (1/3 cup or 5 TBS)
Freshwater lakes	0.009%	Yes**	1.1 mL (> ¼ tsp)
Inland seas	0.008%	No	1.0 mL (> ¼ tsp)
Soil moisture	0.005%	No	0.6 mL (1/8 tsp)
Atmosphere	0.001%	No	0.1 mL (tiny drop)
Rivers and streams	0.0001%	Yes**	0.01 mL (unmeasurable)

*In order for humans to extract ground water in a safe, cost-effective manner, the water must be fairly easy to drill to access it, and any contaminant fairly easy to remove.

**Freshwater lakes, as well as rivers and streams, are prone to various natural and human-made contaminant which must be treated and/or removed. Often, rivers are dammed to make extraction easier.

Human Use of Water

Percentage of Earth's water usable by humans: 0.6191%

For Activity: 75 mL (5 TBS, or a little less than 1/3 cup)

Most of the water humans use comes from rivers and streams (0.0001% of Earth's water).

U.S. water sources 1995: 77.6% surface water, 22.4% ground water

1995 U.S. Water Use

Power generation (both thermoelectric and hydroelectric) 39%

Irrigation 39%

Public supply (includes drinking water and domestic use) 12%

Industry/Mining 7%

Livestock 1%

Commercial 1%

Source: USGS Estimated Use of Water in the United States 1995

