**Describe How Farmers Conserve Water**

Pillar 1 E (Grades 4th – 8th)

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| **Introduction**: Explain the importance of water conservation and explain that water, although abundant in oceans, is a scarce resource **Website**: <https://tn.pbslearningmedia.org/resource/ess05.sci.ess.watcyc.lp_waterconservation/water-conservation/#.WS8nPjM-K9Y> **Hands On:*** <http://intotheoutdoors.org/wp-content/uploads/2016/11/healthy_natural_environments_english.pdf>
* <http://droughtmonitor.unl.edu>
* <http://wateruseitwisely.com/kids/>

 <http://www.tennessee.gov/assets/entities/environment/attachments/watershed-guide.pdf> |

How Farmers Conserve Water

Approximately 70% of the world's freshwater is used by the agricultural industry.

It is estimated that 40% of the fresh-water used for agriculture is lost, either by evaporation, spills, or absorption deep down in the soil. The [uncertainty of climatic conditions](http://www.mathaware.org/mam/09/essays/UncertainClimate.pdf) calls for optimal utilization of water. Efficient water management and utilization are needed.

Sustainability-minded farmers are looking ahead and using an array of methods to conserve water.

Here are the Top Ten Ways Farmers Conserve Water:

1. Drip Irrigation - Drip irrigation systems deliver water directly to a plant’s roots during the cooler times of the day, minimizing water loss. Properly installed drip irrigation save up to 80 % more water than conventional spray water systems, and result in higher crop yields.
2. Capturing and Storing Water - Properly managed ponds create a natural habitat for wildlife while helping farmers minimize their need and impact on the surrounding watersheds.
3. Irrigation Scheduling - Intelligent water management is the sustainable management of water resources which involves application of water at the right time, right amount, right place and right manner to increase productivity and water use efficiency along with reduction in energy cost on irrigation.
4. Drought-Tolerant Crops - Growing crops that are appropriate to the region’s climate is another way that farmers are getting more crop per drop. Crop species that are native to arid regions are naturally drought-tolerant, while other crop varieties (olives, Armenian cucumbers, tepary beans) have been selected over time for their low water needs get more crop per water drop.
5. Dry Farming - [Dry farmers](https://en.wikipedia.org/wiki/Dryland_farming) don’t irrigate. Dry farming relies on soil moisture to produce their crops and special tilling practices and careful attention to micro-climates. Dry farming tends to enhance flavors, but produces lower yields (wine grapes, olives, potatoes, and apple trees) than irrigated crops.
6. Rotational Grazing - [Rotational grazing](https://en.wikipedia.org/wiki/Managed_intensive_rotational_grazing) is a process in which livestock are moved between fields to help promote pasture regrowth. Grazing management increases water absorption and decreases water runoff. Increased soil organic matter and better forage cover are also water-saving benefits of rotational grazing.
7. Compost and Mulch - Compost, or decomposed organic matter (mulch) used as fertilizer improves soil structure while conserving moisture, increases its water-holding capacity.
8. Cover Crops - Planted to protect soil that would otherwise go bare, cover crops reduce weeds, increase soil fertility and organic matter, and help prevent erosion and compaction.
9. Conservation Tillage - [Conservation tillage](https://www.extension.purdue.edu/extmedia/ct/ct-1.html) uses specialized plows that partially till the soil but leave vegetative crop residue on the surface to help increase water absorption and reduce evaporation, erosion, and compaction.
10. Going Organic - Organic methods help retain soil moisture while keeping toxic pesticides out of our waterways and improve our groundwater supplies.

The need to conserve water in agriculture and prevent the misuse of water cannot be overstated.  Protect and preserve water.

## Water Conservation Activity

In this lesson, students study the availability of fresh water on Earth and the methods that can be used to purify and conserve it. They also assess how much water they and their families typically use and think about ways to reduce water usage.

### Lesson Summary

### Overview

Although over 70% of Earth's surface is covered with water, less than 1% of this water is available for human consumption. In this lesson, students study the availability of water on Earth and discuss methods that can be used to purify and conserve this critical resource. They also assess how much water they and their families typically use, and think about ways to reduce their water usage. Finally, students explore different techniques being employed for water management around the world, including the use of dams to create reservoirs.

### Objectives

* Identify sources of fresh water available for consumption
* Understand the need for water conservation due to the limited fresh water supply
* Explore strategies for conserving water at home
* Compare the benefits and drawbacks of using different water management techniques, particularly dams

### Materials

* Two 2-liter bottles full of water
* Food coloring (dark color preferable)
* Measuring cups (for measuring amounts ranging from 50 ml to 14.5 ml)
* Five clear containers (to hold water ranging in volume from 1,950 ml to 0.5 ml)
* Markers and tape for making labels
* Map of your local watershed (Here is Tennessee <https://cfpub.epa.gov/surf/state.cfm?statepostal=TN>)
* Notebooks for student work

### Before the Lesson

* Fill two 2-liter bottles with water. Add enough food coloring so that the water is visible from all seats in the classroom.
* Prepare to lead the class in a discussion about your local watershed by researching the following:
	+ How does water get to Nashville? (Where does it originate? What path does it travel?)
	+ How is the water managed along the way?
	+ How is the water treated once it leaves Nashville as wastewater?
	+ Where are the water treatment plants?
	+ Are there any dams? If so, where are they located?

### The Lesson: How Much Water Do We Really Have?

Tell students that you would like them to think about the answer to this question: What percentage of Earth's water is available for human consumption? Ask students to write down their answers. You may want to remind students to consider what they know about oceans and about the type of water that is considered usable by people.

Ask a volunteer to demonstrate his or her answer to the question. Give the student a 2-liter bottle filled with colored water and a clear, empty container. Tell the class that the bottle represents all of the water on Earth. Ask the volunteer to pour into the empty container the amount of water that he or she thinks represents the percentage of Earth's water available for human use. (Provide the student with a measuring cup if needed.) Then ask the class to make suggestions about whether more or less water needs to be in the container. Have the volunteer adjust the amount until there is a general consensus among the students. Put the class estimate (the clear container with water) aside.

Tell students that you will now demonstrate the amount of water on Earth that is available for human consumption.

1. Show students the second 2-liter bottle filled with colored water.

Tell students that this bottle again represents all of the water on Earth.

Measure out 1,950 ml of the water and pour it into a clear, empty container. Label the container SALT WATER.

Tell students that this represents how much of our planet's water is found in oceans — 97%.

1. Pour the remaining 50 ml from the bottle into another container

 Tell students that this represents the amount of fresh water on Earth — 3%. Label this container FRESH WATER. Ask students to guess what percentage of fresh water is available for human use.

Place a fresh water sign on the table at this time. As you pour off additional amounts of water in steps c and d, you can place the new containers near the fresh water sign to remind students that each one is part of the "fresh water" category.

1. Measure 35 ml of the fresh water into another container. Label the container ICE CAPS.

Tell students that this water is frozen in ice caps, so it is not available for our use!

1. Now measure 14.5 ml of the fresh water into another container. Label the container AIR, SOIL, AND UNDERGROUND.

Tell students sorry, but this water is found in the air, in the soil, and deep underground, so it's also not available for human use!

1. There should be about 0.5 ml of water left in the fresh water container. (Note that this is just under two drops of water!) Hold this up.

Explain that this represents all of the fresh water available for human use. Less than 1% of all water on Earth is available for consumption!

Divide the class into small groups

Ask students to discuss what they just witnessed in your demonstration and in the interactive activity. Have students answer the following questions during their small-group discussions:

1. Where is usable water located?
2. Is this water a renewable resource?

Bring the class back together

Ask student groups to share some of their ideas. Conclude by reminding students that water is necessary for life and thus important to conserve and maintain so that it stays available for human consumption, as well as for consumption by plants and animals, which people use for food.

**WATER WATER ANYWHERE ACTIVITY**

Student Learning Objectives

Water scarcity is often a concept that students have difficulty truly visualizing. In this activity, students will go through three different stations for approximately 5 minutes each in order to experience the effects of water scarcity. The stations include:

* Water Abundance
* Physical Scarcity
* Economic Scarcity

Tools, Equipment, and Supplies

* Water, Water Anywhere Notes handouts (3 pages)
* 2 1-gallon jugs of water
* 3 large (27 oz.) Water bottles
* 1 3-cup measuring cup
* 30 5 oz. disposable paper cups
* 3 large flat bottomed bowls for water bottles to sit in
* Small opaque pitcher (approx. 4-5 cups)
* Coffee Grinds or dirt
* 5 pound weight (This can really be any size. The intention of the weight is to remind students of the physical burden of carrying water. A real jerry can weighs more than 40 pounds when full. An alternative to a hand weight might be a backpack filled with heavy books.)
* Clock
* Marker (for labeling)
* Paper towels (just in case)

Procedure

1. Label everything:

* Disposable paper cups per group: 7 "Agricultural Needs", 2 "Industrial needs" and 1 "Human needs"
* 1-gallon water jugs: 1 "Potential", 1 "Resources"
* Opaque pitcher and 3-cup measuring cup: "Resources"
* 27 oz. water bottles: "Population"
* Large bowls: "Water Abundant", "Physical Scarcity" and "Economic Scarcity"

2. Use the "Resources" gallon of water to fill opaque pitcher and 3-cup measuring cup.

3. Stir coffee grinds/dirt into the opaque pitcher to make it "dirty"

4. Set up each stations with the supplies (resources, needs and population) needed.

Set Up

**STATION 1: Water Abundance**

* 1-gallon water jug labeled "Resources" (now partially empty)
* 10 paper cups, labeled "Agricultural/Industrial/Human Needs" as stated above
* 1 water bottle labeled "Population"; place inside "Water Abundant" bowl

**STATION 2: Physical Water Scarcity**

* 3-cup measuring cup labeled "Resources"
* 10 paper cups, labeled "Agricultural/Industrial/Human Needs" as stated above
* 1 water bottle labeled "Population"; place inside "Physical Scarcity" bowl

**STATION 3: Economic Water Scarcity**

* 1-gallon jug of water labeled "Potential" (still full and sealed, if possible)
* 10 paper cups, labeled "Agricultural/Industrial/Human Needs" as stated above
* 5 pound weight or alternative such as backpack with books
* 1 water bottle labeled "Population"; place inside "Economic Scarcity" bowl
* Opaque pitcher labeled "Resources"
* Clear path across the room to where the opaque pitcher is located (if you can't have students walk, just have students wait 30 seconds between pours)

Overview

In the first station, Water Abundance, students will see their water bottle (symbolic of their population) overflowing into a bowl with little effort and quite early on.

The second station, Physical Scarcity, will require students to prioritize which segment of their population (agriculture, industry, human) are most important to receive a portion of the limited resource, water. The exercise is set up so this station will never truly be satisfied as they will simply not have enough water to fill their whole bottle. The challenge will be to process what happens when part of their resources are not fulfilled (hunger, poverty, health, etc.)

The last station is Economic Scarcity. In this station, though students technically have enough water, they cannot easily access it. Their "potential" clean water is sealed and prohibited while the resource that they are permitted to use is "far away" (on the other side of the room) and dirty. This symbolizes the resources, such as underground water, that the population does not have access to for economic reasons. Further, they must carry an extra weight with them as they walk, individually, across the room. The weight here is symbolic of the physical burden of collecting water, while the individual walk is meant to remind students of the vulnerability and dangers of the process. During the third station the students will likely run out of time before their water bottles are filled. This is symbolic of the fact that people in this situation often don't have enough time to both collect water and earn an income.

At the end of the 5-minute period, students will spend a few minutes in reflection, discussing their observations with their group members. At the end of the activity, a discussion of the concepts and challenges relating to water scarcity will provide students to reflect on the activity with the larger group.

 Interest Approach

* Today you’re going to do an activity about water scarcity and you’ll visit 3 stations. Each station represents a part of the world with a different condition of water.
* You are going to "travel around the world" stopping in each station for 5 minutes to read about the specific situation and then provide your citizens with water by filling your 27 oz. water bottle according to the instructions at each station.
* I’m going to time you for 5 minutes at each station. When I say Stop! you will stop pouring and take a few minutes to discuss your observations with your group.
* After you finish each station, please carefully return the water from your "Population" bottles and station bowls to its "Resource."
* Does anyone have questions?

Objective 1. Understanding what is meant by water abundance

STATION 1: WATER ABUNDANCE

You are in an area of water abundance. Water conservation is something you know about, but never really seems relevant with your excessive access to freshwater and advanced technologies. Use what is left of your five minutes to provide water for this population. Fill the "Need" cups from your "Resources" and pour it into your "Population." Because of your abundance, all cups should be completely full as they are added to the bottle - make sure your "Population" bottle is inside the bowl to prevent a mess.

Observations:

Did your population have enough water to fill the water bottle? Explain.

Reflections:

What went through your mind as you kept pouring more and more water into the abundant population? Did you ever think it was too much? Reflect on the experience.

Objective 2. Understanding what is meant by physical water scarcity

STATION 2: PHYSICAL WATER SCARCITY

You are in an area that has physical water scarcity. You may be located near a desert, or simply have had a population boom that has caused your old resources not to be enough. Use what is left of your five minutes to provide water for this population. Fill the "Need" cups from your "Resources" and pour it into your "Population." Because of your scarcity, water use is carefully allotted and conserved. Some cups will be half full while others are totally full. Choose carefully how you fill distribute your water.

Observations:

Did your population have enough water to fill the water bottle? Explain.

Reflections:

How did you decide to fill your paper cups? What would it mean if you were only able to provide half the agriculture resources needed? (hunger, etc) industrial resources? (poverty, etc), domestic resources? (health, etc) Reflect on the experience.

Objective 3. Understanding what is meant by economic water scarcity

STATION 3: ECONOMIC WATER SCARCITY

You are in an area that has economic water scarcity. You have a good source of water but for some reason cannot access it. This might be due to political unrest, conflict, or simply lack of money. Instead, you use an unimproved water source that is dirty and far away to provide for your population. To fill the "Need" cups from your "Resources" (the pitcher across the room), you must individually *walk* across the room carrying the weight and a single cup, then *walk* back and pour the "Need" into your "Population." You may NOT use the "Potential" water at all. You may not have enough time to fill all of your population's needs so choose which cups are most important to fill first.

Observations:

Did your population have enough water to fill the water bottle? Explain.

Reflections:

How did you feel about having to do so much work in the economic scarcity station, (carrying extra weight, walking back and forth, getting dirty water, etc.) when you had a gallon of clean water in front of you? Reflect on the experience.

Review/Summary

* What went through your mind as you kept pouring more and more water into the abundant population at station one? Did you ever think it was too much? Reflect on the experience.
* How did you decide to fill your paper cups? What would it mean if you were only able to provide half the agriculture resources needed? (hunger, etc) industrial resources? (poverty, etc), domestic resources? (health, etc) Reflect on the experience.
* How did you feel about having to do so much work in the economic scarcity station, (carrying extra weight, walking back and forth, getting dirty water, etc.) when you had a gallon of clean water in front of you? Reflect on the experience.