Water Conservation (At Home)

Middle School / High School

Overview

Water usage and conservation is an important issue. Only 1 percent of the total water supply on Earth is available for humans. Of that, 42 percent is used in agriculture. Not all freshwater resources are evenly distributed. In Kansas, water usage and water rights are very important topics. As a state, how do we balance the need for water in agriculture, manufacturing, and our daily lives? It is important that everybody does their part to conserve the invaluable natural resource.

Objectives

- Students will learn the importance of water conservation.
- Students will learn the proportion of fresh water available for human use.
- Students will learn two different methods for calculating flow rate.

Background

Water covers three-quarters of the Earth's surface. Over 97 percent of the earth's water is found in the oceans as salt water. Only 3 percent of Earth's water is freshwater. Of that, only 3 percent of it is usable freshwater available for human use. About 2 percent of the Earth's freshwater is stored in glaciers, ice caps, and snowy mountain ranges. This leaves only 1 percent of the Earth's water for our water supply needs. Freshwater supplies are found in the atmosphere, beneath the ground, or on the surfaces in lakes, rivers, and streams.

We use freshwater for a variety of purposes. According to the U.S. Environmental Protection Agency, agriculture represents the largest consumer use of fresh water at about 42 percent. Approximately 39 percent of our freshwater is used to produce electricity. About 11 percent of available freshwater is used in homes and businesses. The remaining 8 percent is used in manufacturing and mining.

The total amount of water on the planet does not change. Water moves around on the planet and changes form, but we will never have any more water than we have right now. With our growing population and ever-increasing demand on our freshwater supply, it is more important than ever that we learn to conserve the limited freshwater supply.

Materials

- Water Conservation PowerPoint (available at kansascornstem.com)
- Water in the Heartland Article
- Focused Note Taking Pages
- Quart jar
- 5 pint size plastic cups
- Pipet (medicine dropper) or measuring spoons
- Water
- Food coloring

- 6 empty gallon milk jugs or 2 Liter bottles
- Timer
- 6 large bowls
- 6 small plastic cups
- Measuring cups

Lab #1: Demonstration of the amount of fresh water on Earth

1. Measure 1 quart, or 32 oz, of water. Add a couple drops of food coloring so the water will be easier to see. This represents all the water on planet Earth.
2. Measure out 1 oz or 6 teaspoons of water into a separate plastic cup. Label this cup "fresh water". This water represents the fresh water on Earth available for humans, plants and animals to use. The 31 oz of water remaining in the quart jar is water found in our oceans.
3. Using the 1 oz, or 6 tsp, of fresh water in your plastic cup, remove 5 teaspoons and put them into a new plastic cup labeled "frozen". This water represents the amount of fresh water that is frozen in the ice caps, glaciers, and mountain tops. This water is unavailable for human use.
4. From the 1 tsp of water that is left of your freshwater supply, measure out ¼ tsp and pour it into a separate plastic cup and label it "underground". This represents the amount of fresh water that is found underground. Most of this is unavailable for human use.
5. From the ¾ teaspoon of water left in your cup labeled "fresh water" that is left, use a pipette/ medicine dropper to extract 1 drop and place it in a plastic cup labeled "atmosphere". This represents the amount of fresh water in the atmosphere. This is also unavailable for human use. The remaining 2 drops of water represent the Earth's surface water. This is the amount of water that is found in our lakes, rivers and streams.
6. From the remaining freshwater, use a pipette/medicine dropper to extract 1 drop and squeeze into a separate plastic cup labeled "polluted". This represents the amount of fresh water that is too polluted for human use.
7. Pour the remaining fresh water into the last plastic cup labeled "for human use". This last drop is the surface water that is available for human use. From that last drop, 42 percent is used for agriculture, 39 percent is used to produce electricity, 8 percent is used in manufacturing and mining and 11 percent is used in homes and businesses.

Lab #2: Calculating Flow Rate

Tell students that we are going to try to come up with an estimate for how much water we use during the day. In order to do this, we need to practice calculating flow rate.

Preparation

Gather six empty gallon milk jugs or 2-L bottles. Puncture a small hole in the bottom of each jug/bottle. Vary the size of each hole so the water will flow out at different rates. Label the bottles 1-6 with number one having the smallest hole and number 6 having the largest. Flows should range from slow drips to a steady stream. Cover the holes with tape. Fill the jugs about half full of water. Mark a line on the jug so that it can be refilled to the same point each time.

Directions

Using the jugs/bottles you prepared, a timer, a bowl and measuring cups do the following:

1. Starting with bottle #1, hold the bottle above the bowl (preferably outdoors or in the kitchen sink). Remove the tape and start the timer.
2. After 1 minute, student(s) should place their finger over the hole on the bottom of the jug to stop the water. Hold the jug over the sink. Tilt the jug to the side so the tape can be replaced. Refill the jug to the line marked on the side of the container.
3. Use a measuring cup to measure the water that was collected. The amount of water collected is labeled ml/min. This can be converted to L/min. by dividing by 1,000 (your measuring cup may not have ml; in that case you would have oz/min.).
4. Student(s) can measure the flow rate of their kitchen sink by timing how long it takes for a quart jar to fill. Divide 946 (1 quart = 946 ml) by your time. The answer will be in ml/sec. This can be converted to ml/min. by dividing the answer by 60. And converted to L/min. by further dividing it by 1,000.
5. This method can used to find the flow rate of drinking fountains, or any other water source in their home such as bathroom sink, bathtub, outside water hydrant. Use cups as needed.
6. Next, we will try to find the flow rate for your shower and bath at home. Students can cut the top off one of the bottles/jugs you have numbered 2-6. Fill the bottle/jug with quart of water and mark the line on the outside. Then time how long it takes to fill up 1 quart of water.
   a. One toilet flush uses 5 gal. of water.
   b. A 10-minute shower uses 100 gal. of water.
   c. To fill half a bathtub takes 50 gal. of water.
   d. Brushing teeth takes 2 gal. of water.
   e. The dishwasher uses 10 gal. of water.
   a. The clothes washer uses 50 gal. of water

7. On average, each of us uses about 70 gal. of water every day. Using the above information, students can calculate their daily water use. They can use their own data collected to figure out how much their shower uses. They can look up their dishwasher and/or washing machine to see how much water they use. Students can also use the above estimates if they cannot find the information they need. Fun fact: In pioneer days, it is estimated that people used only 5 gal. of water per day.
8. Look for places in your day where you can reduce water use. Examples might include shorter showers, making sure the dishwasher if full before running it, turning off the water while brushing their teeth, etc.

Assignment

Agriculture uses 42 percent of our available fresh water. Farmers are also trying to do their part to conserve water. Using the "Water in the Heartland" article and the "Focused Note Taking Page" found on kansascornstem.com, read the article and take notes to practice reading comprehension and note taking skills.

Resources

- https://water.usgs.gov/edu/earthwherewater.html
- https://water.usgs.gov/edu/earthhowmuch.html
- https://cuesa.org/article/10-ways-farmers-are-saving-water
- https://www.epa.gov/sites/production/files/2015-08/documents/mgwc-ww-intro.pdf
- http://cmase.pbworks.com/w/file/fetch/65195601/Water%20Distribution%20Demonstration.pdf

Water in the Heartland

Water is important for everyone, which includes farmers. Water is essential for growing the crops we eat every day. With agriculture using 42 percent of our available freshwater resources, farmers are doing their part to conserve water. Farmers are using the latest technologies available to make sure there are enough water resources for everyone and future generations.

1. **Irrigation Scheduling**
   Smart water management is not just about how water is delivered but also when, how often, and how much water is applied. To avoid under or overwatering their crops, farmers carefully monitor the weather forecast. Some farmers use weather monitoring stations in their fields that can send weather information from the field to their smartphones. Soil probes and plant-based sensors can be placed in the fields to help monitor the soil and plant moisture. Farmers can adapt their irrigation schedule to the current conditions. Watering at night can help slow down evaporation, allowing water to seep down into the soil and replenish the water table. Farmers are also using technology that allows them to control their irrigations systems from their smart devices.

2. **Drought-Tolerant Crops**
   Farmers are able to utilize the latest advancements in biotechnology, which allow crops to grow in regions that they were not able to be grown in the past. Scientists genetically engineer the seeds to produce plants that can withstand drier conditions. With the use of genetic modification, we can now grow corn in parts of the country where we have not been able to grow them before because of limited access to water. In some areas of the country, farms don't irrigate. These farmers rely on drought-tolerant crops, soil moisture and special tilling practices to produce their crops during the dry season.

3. **Cover Crops**
   Farmers plant cover crops after their main crop is harvested to protect soil that would otherwise go bare. Cover crops reduce weeds, increase soil fertility, and provide organic matter which in turn helps help prevent soil erosion and compaction. This allows water to penetrate the soil more easily and improves the soil's water-holding capacity. Farmers use perennial grasses and clover in their fields for building healthy soil. Farmers that have fields planted with cover crops can be more productive than conventional fields during years of drought. The ability for a farm to use cover crops is dependent on where the farm is located. Farmers have to decide if cover crops are appropriate for their region because cover crops do use some of the moisture stored in the soil and may not be as effective in drier climates.

4. Soil Management and Conservation Tillage

The Dust Bowl of the 1930s was created by a perfect storm of deep plowing and loss of perennial grasses followed by extreme drought and wind erosion. Modern farmers use soil mapping and no-till practices to help maintain the health of the soil and conserve water. Soil mapping is very important for the correct implementation of sustainable land use management. Soil mapping provides significant information about the characteristics and condition of the land. This mapping describes the condition of the soils and is key in guiding landowners on how to wisely manage their land. Conservation tillage uses specialized plows or other implements that partially till the soil but leave at least 30 percent of vegetative crop residue on the surface. Like the use of cover crops, these practices help increase water absorption and reduce evaporation, erosion, and compaction.

5. Irrigation Segmentation

Not every part of a farmer's field needs the same amount of water. Farmers rely on soil testing to let them know which amounts of water to apply where. Some farmers are able to divide their watering in their fields into fractional parts. As the center pivot irrigation system goes around in a circle in each section, which looks like a slice of pie, fields can have different amounts of water applied to it. All of this is controlled by a computer and changed as needed. For even more control, some irrigation systems can vary the flow of water from each individual spray nozzle. These nozzles are specially designed to apply just the right amount of water to the right spot as the center pivot irrigation system goes around the field.

Not every region has the same amount of water resources available, so farmers are developing ways to make sure not a drop of water is wasted when watering their crops. Continued monitoring of our groundwater reservoirs with index wells is essential for maintaining our aquifers. With good conservation practices and the latest technology, we can make sure that our water natural resources are well preserved into our future.

Focused Note Taking Pages

Key for marking the text:

- ☐ Highlight the information you already know in the text. This is information to build on.
- ☐ Highlight information that is new to you and that you know is important.
- ? Think of a question? Mark the text with a question mark, then write your questions in the section on the right.
- _ Underline your vocabulary and any other keywords that are important.

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Questions and Notes

After you make a question mark in the text, write your question out in this column next to it. Take any notes that helps you remember a concept next to the text.

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