CONSERVATION STATION

WEEK OF RESOURCEFULNESS | CLASSROOM ACTIVITIES

ENERGY-WATER NEXUS STEM INVESTIGATIONS

Creating a Water Conscious Meal

KEY LEARNING OBJECTIVES

Students will be able to:

- **Discover** that some foods have a lower water footprint compared to others.
- **Create** a healthy, balanced meal that has a lower water footprint.
- **Determine** how each individual food choice affects the water availability.

OVERVIEW

In this activity, students will understand how their food choices affect water availability on Earth and that some foods have a lower water footprint compared to others, particularly meat. Students will predict how many gallons of water they consume in a day. The teacher will lead the students in a discussion about direct use (shower, flushing toilet) vs. indirect use (cotton shirts dyed, food production) of water. Students will be encouraged to create a balanced nutritious menu that uses minimal amounts of water. They will accomplish this by selecting meal cards to create a menu of foods that they normally consume. They will flip the meal cards over to discover how much water was needed to produce that food. They will be asked to modify their menu to decrease the water consumption. The teacher will discuss the need for more water for animal products compared to plant-based foods.

CONNECTION TO THE ENERGY-WATER NEXUS

- Continued increases in demand, growing populations, and a rapid increase in droughts are putting pressure on individuals to use water more responsibly.
- Due to outdated and aging infrastructure, 30% of our treated water in the United States is lost because of leaks.
- Saving energy directly results in saving water. It takes a great deal of water to make electricity and to refine fuel needed for transportation.

NATIONAL STANDARDS

Next Generation Science Standards

- MS-LS2-3 Ecosystems: Interactions, Energy, & Dynamics
  Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

- MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics
  Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

BACKGROUND

Fresh water is an essential but limited resource on our planet. Only 0.5% of our planet's water is fresh and can be used for cooking, drinking, growing food, manufacturing, and making electricity. A water footprint is the total amount of fresh water a person uses in one day, including direct and indirect use of water. An average American uses 2000 gallons of water a day, and only 5% is related to our direct water footprint! The other 95% is used for the food we eat, the products we buy at the store, and the energy we use. This 95% is our indirect or hidden water footprint. Food that is produced around the world uses 50–70% of the fresh water that is found on the planet. In agriculture, fresh water is used to raise livestock, grow crops, and process and transport our food. Raising farm animals generally uses more water compared to growing vegetables, fruits, and grains.

KEY VOCABULARY

- Water footprint
- Direct water footprint
- Indirect water footprint
- Limited resource

MATERIALS

- An empty 1-gallon milk container
- Food cards
- Index cards
- White boards or poster paper

TEACHER PREPARATION

- Print and cut one set of food cards per group. Print pages double-sided so the picture of the food is on one side and the water footprint is on the back.
- White boards or poster paper set up in each corner of the room with the following titles: home and personal use, manufacturing products, energy, food production.

PROCEDURE

1. Open the lesson by holding up the empty gallon of milk. Ask students how many gallons of fresh water they think the average American uses in one day. Randomly call on a few students to share their predictions.
2. State that the average American consumes about 2000 gallons of water per day. Ask students if they are surprised by this. Have them turn to a partner to discuss what activities throughout the day could use 2000 gallons of water. Generate a class list of ideas on the board.

3. While reviewing the class list, state that most of the activities that were mentioned were ones that we could see directly, such as drinking or watering the lawn. If you can see the water use, it is called "direct use." Share with them that this is only a small bit of the water that we use in total. Each of us also uses water if we don't see it. For example, your cotton t-shirt was dyed using water, and water was also used to grow the cotton. This is called "indirect use" because we don't see it, yet water was used in the process of creating it. We also don't see water being used to provide our energy in the form of gasoline or electricity. Water is also indirectly used to produce the food we consume. Food production, manufacturing, and producing energy represent our indirect water footprint. View the Thirst For Power resource for additional examples of the relationship between water and energy.
4. The students will participate in a four-corners activity to discover how many gallons of water the typical American spends daily on home and personal use, manufacturing, energy, and agriculture. Designate one corner of the room to represent each response. You may want to use small white boards or signs to label each corner. State the question and ask students to write their response on an index card or small piece of paper. Then, ask students to take their cards to the designated corner. Direct students to form groups of 2–3 and share why they selected this option. Repeat directions for each question and reveal the correct answer.
    1. How many gallons of water daily is used for home and personal use?
       200 (correct answer)
       600
       1000
    2. How many gallons of water daily is used for manufacturing products?
       200 (correct answer)
       600
       1000
    3. How many gallons of water daily is used for energy?
       200
       600 (correct answer)
       1000
    4. How many gallons of water daily is used for food production?
       200
       600
       1000 (correct answer)
5. Divide students into groups of 3 and give each group one set of food cards.
6. Ask each group to pick 4 cards to create one balanced meal, either lunch or dinner. Explain to students that a balanced meal should contain one entrée or main dish; one side; one beverage; and one dessert.
7. Once they finish creating the meals, instruct them to flip over their food cards and explain that the numbers indicate how much water it took to produce that food. Instruct students to calculate the total amount of water used to create that meal.
8. Invite groups to share their meals and total water footprint values.
9. Challenge students create water conscious meals that are balanced, nutritious, and use less water.

10. To close the lesson, have students think about the following questions below and turn to a partner to share their ideas.
    1. Why do animal products like beef take more water than plant-based foods like grains? (To produce food from animals like cows, pigs, etc. water is needed to grow the animal's food, for the animal to drink, and for cleaning and maintaining the farmhouse facilities, using gasoline to transport the animals to a food processing facility).
    2. What is one thing you would like to change about your food habits that will help you conserve water?
    3. What are some ways we can continue to eat meat (beef) and still conserve water? (meatless Mondays, no meat 3 days a week, substitute with chicken, consume half the amount of beef per week).

EXTENSION

Have students create a public service announcement that explains the difference between direct and indirect water footprints and several tips to reduce water use by making better food choices. Some examples may include infographics, videos, webpages, writing a children's book, morning announcements, or starting a club. Students may use the Energy for Water and Water for Energy guides to support their PSA.

RESOURCES

https://waterfootprint.org/en/

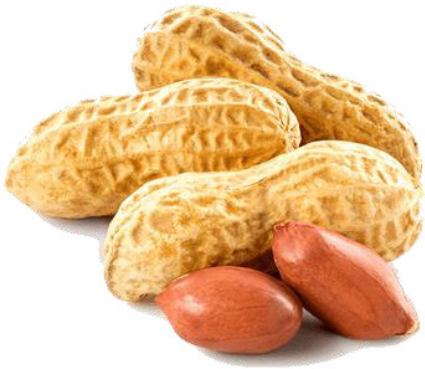
http://stem.guide/water/

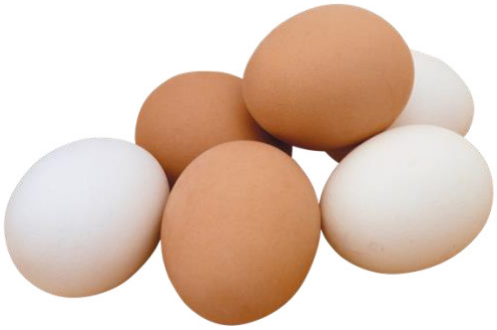
https://www.watercalculator.org/

https://www.pnas.org/content/109/9/3232

https://www.un.org/waterforlifedecade/waterandsustainabledevelopment2015/side_event_water_footprint_14_01_2015.shtml

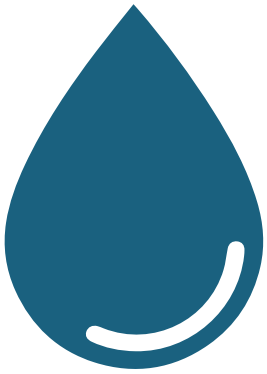
http://stem.guide/water-basics/





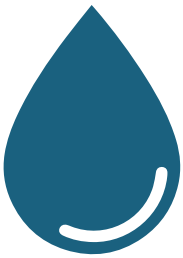
How many gallons of water does it take to produce 4 oz of beef?

346 gallons



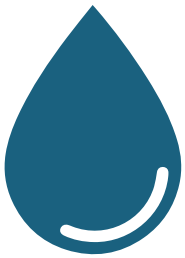
How many gallons of water does it take to produce 4 oz of salmon?

90 gallons



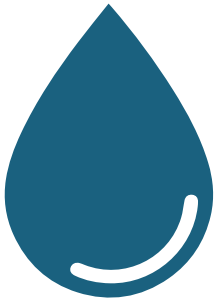
How many gallons of water does it take to produce 4 oz of chicken?

97 gallons



How many gallons of water does it take to produce 4 oz of pork?

134 gallons

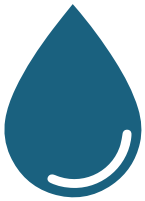


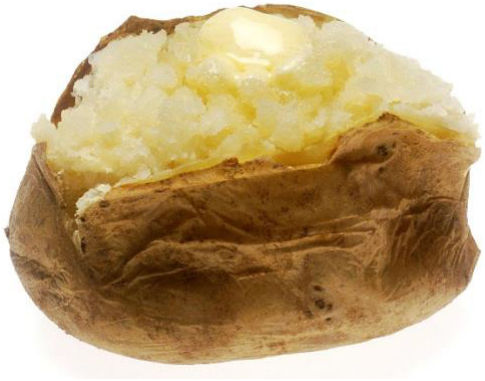
How many gallons of water does it take to produce 28 peanuts?

21 gallons

How many gallons of water does it take to produce 1 large egg?

49 gallons





How many gallons of water does it take to produce 1 cup of rice?

44 gallons

How many gallons of water does it take to produce 1 large potato?

23 gallons

How many gallons of water does it take to produce 1 cup of beans?

77 gallons

How many gallons of water does it take to produce 2 cups of noodles?

49 gallons

How many gallons of water does it take to produce 2 cups of lettuce?

6 gallons

How many gallons of water does it take to produce 2 slices of bread?

20 gallons