Water Connections
adapted from Project WET's *Water Works*

Earth Science, Agriculture

Grade Level: K-6

Time:
Prep time: 30 min
Activity time: 50 min

Standards:
Interdependent Relationships in Ecosystems
K-LS-1-1 LS2.A
K-ESS2-2 LS2.C
K-ESS3-3
Weather and Climate
K-ESS2-1 3.ESS2-1

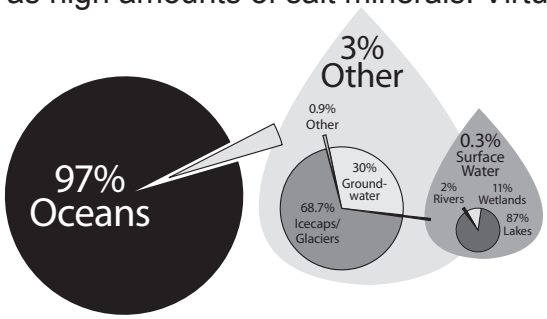
For Kansas standards, visit www.ksde.org

Materials
Ball of string or yarn (cut one 6-foot length of string for each student)
Roll of duct tape (or a ring-shaped object)
2 plastic cups (will need to fit snuggly inside the roll of duct tape)
Copy of ***Descriptions of Water Users***
Index cards
Markers
Large piece of paper or poster board
Water

Overview
Water use and conservation is a critical piece of Kansas agriculture. In this activity, students will create a "water web" to illustrate their dependence on water and the interdependence among water users, producers and people worldwide.

Objectives
1. Students will distinguish between direct and indirect uses of water.
2. Students will illustrate the interconnectedness of water users in a community.
3. Students will demonstrate the complexity of resolving water shortages among interdependent community water users.

Background
Water is essential to all known forms of life. Humans require access to water that does not contain too many impurities, such as high amounts of salt minerals. Virtually all human uses require freshwater.



Right: Earth's Water
Source: USGS

Water Connections

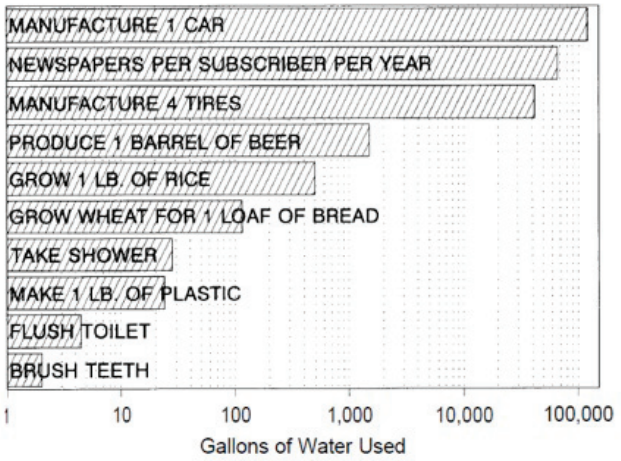
Water resources are sources of water that are useful or potentially useful to humans. Over 90 percent of the United States' freshwater is stored underground. In Kansas, freshwater is obtained from both groundwater (57%) and surface water (43%) resources.

Direct Use of Water: Examples of Household Uses

Household purposes, including drinking water, bathing, cooking, sanitation, and gardening, use an estimated 15 percent of the water used worldwide. According to the U.S. Environmental Protection Agency (EPA), the average American uses 100 gallons of water each day but nearly 75 percent of the water that goes to homes in the United States goes down the drain. Most of the water is treated and returned to surface water systems, except for water used in gardens and other landscaping activities. Kansans value water for recreational purposes, including swimming, fishing, camping, bird watching, hunting, boating, sailing and other water sports.

Water Footprint

Human's water footprint as indicated by EPA (2007) assumes an adult ingestion rate of 68 fluid ounces/day. Of course, the activity level and environmental conditions surrounding an individual cause significant variance: a construction worker employed in the hot summer sun has a higher water intake requirement than an office employee working in an air-conditioned building. Another direct water requirement that contributes to the water footprint is the water used for cooking and cleaning. In Kansas, the average gallons per capita per day (gpcd) is 118 gpcd (KDA 2009), based on water delivered to homes and businesses via public water supplies. Approximately half the water is often used outdoors for lawn watering, while indoor uses include cooking, washing, bathing and toilets use the other half. The largest indoor direct water requirement is generally for toilet flushing. Since food production is water intensive, minimizing food waste may be one method to reduce an individual's water footprint. Recycling programs may also reduce the water footprint for certain products.



Right: Typical water use requirements for various activities. (Rogers and Sothers, 1995)

Table 1. Water footprint for various agricultural products based on global water use averages (National Geographic, 2010).

Animal/Meat Products	Gallons of Water per Pound of Product	Food	Gallons of Water per Serving Size
Beef	1,857	1 hamburger	634
Pork	756	1 glass of milk	53
Chicken	469	1 cup of coffee	37
Sausage	1,382	1 glass of wine	32
Processed Cheese	589	1 glass of beer	20
Eggs	400	1 cup of tea	9
Fresh Cheese	371		
Yogurt	138		
Fruits/Vegetables	**Gallons of Water per Pound of Product**	**Fruits/Vegetables**	**Gallons of Water per Pound of Product**
Figs	379	Oranges	55
Plums	193	Strawberries	33
Cherries	185	Beans	43
Bananas	103	Potatoes	31
Apples	84	Eggplants	25
Grapes	78	Avocados	154
Corn	109		
Manufactured Goods		**Gallons of Water per Product Item**	
1 pair of blue jeans		2,900	
1 cotton bed sheet		2,800	
1 cotton t-shirt		766	

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Indirect Use of Water
In Kansas, irrigation makes it possible to produce the agricultural products that supply the world with food and fiber. As global populations grow and the demand for food increases, Kansas farmers are working to produce more food with less water. In Kansas, irrigation for food crops accounts for the largest amount of water usage.

Instructional Format:
1. Share background information with students.
2. Have students discuss how they are direct and indirect water users.
3. Follow procedures for group activity.
4. Upon completion, students will discuss key takeaways and how they can conserve water.

Procedures:
1. Before activity, create water user necklaces using the index cards connected to yarn. On one side write the name of the water user (i.e. Dairy Farmer, Domestic User, etc.) and on the back write how that person or business uses water. You could incorporate this into the activity by having the students do their own research on water users and creating descriptions for them.
2. Tie the pieces of string or yarn to the roll of duct tape. Have each student hold onto one piece of string (if group is larger than 15, divide into 2 or more groups). They must stay at the end of the strings throughout the activity.
3. Fill the cup with water and place in the middle of the duct tape roll.
4. Each student shares the type of water user they are and how they use water, and whether they are a direct or indirect user.
5. Have several students pull on their strings to demonstrate what happens when one user or several put(s) pressure on the water source and how that affects other water users.
6. Place an empty cup on the floor below the full cup. Have students work together to pour some of the water from the cup into the empty cup on the floor below. Discuss the importance of water users working together and communicating to conserve our water resources.
7. Replace the cup of water with a marker tied to the tape roll. Place a poster board or large piece of paper on the floor below. Have students discuss a word that encompasses water use and conservation and then work together to write that word on the paper or poster board, maintaining their hold of the strings.

Resources
Barnes, P.L., D.H. Rogers, J. Aguilar, I. Kisseka, and K. Ebert. 2015. Water Primer: Part 9 The Kansas Water Budget and Water Footprint. Kansas State Research and Extension. (Currently at press for projected June release).

Kansas Foundation for Agriculture in the Classroom Educator's Guide: *Exploring Kansas Natural Resources.* 2008.

Project WET Curriculum Guide 2.0, Water Works activity pp. 289-296.

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Descriptions of Water Users (from Project WET Curriculum Guide 2.0)

Agriculture:

Water is used to produce food and fiber for processing and consumption.

Corn farmer: Uses water to irrigate crops and transport chemicals (pesticides and fertilizers) to crops.

Cattle Rancher: Uses water to grow food and provide drinking water for cattle and to clean their areas for living and feeding, transporting waste to holding ponds.

Wheat farmer**:** Uses water to irrigate crops.

Dairy farmer: Uses water to grow food and provide drinking water for cows and to sanitize milking equipment and stalls.

Mining:

Water is used in the extraction process of raw materials (coal, iron, gold, copper, sand and gravel).

Miner: Uses water to carry and wash rock material during the mineral removal processes.

Sand and gravel company: Uses water to wash fine soil and rock material out of sand and gravel formations. Sand and gravel are used in cement and road construction.

Logging:

Water is used to grow and harvest trees.

Forest manager: Uses water to support tree growth and control fires.

Logging Company: Uses water to float rafts of logs (on rivers and lakes) to collection points.

Transporting/Shipping:

Water (rivers, seas, oceans) is used to transport raw materials and finished products to points of distribution (ports).

Slurry pipeline owner: Uses water to transport pulverized coal through pipelines to distant coal-fired power plants.

Ship's Crew: Uses water to haul raw materials (e.g. logs, oil, gas, wheat) and finished products (e.g., automobiles, appliances, processed foods) to points of transfer.

Business/Industry:

Water is used in the processing and manufacturing of goods (e.g., cars, food, medical supplies, etc).

Steel producer: Uses large volumes of water to process iron ore into steel.

Textile manufacturer: Uses water to wash and process raw materials (e.g., wool, cotton, mohair). Dye is mixed with water to color fabric.

Paper mill: Uses water to transport pulp fibers for paper making and to carry away waste.

Salsa manufacturer: Uses water to wash tomatoes, uses water in processing; uses water in the ingredients

Wildlife:

Water provides habitat for countless plant and animal species.

Mammals: Beavers, muskrats and otters live in and near waterways.

Fish: Trout, salmon and carp live in water and eat organisms that live in water.

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Insects: Aquatic insects are a food source for many other organisms.
Vegetation: Trees and other plants use water in photosynthesis and to transport nutrients.

Recreation:
People recreate in and around water for exercise and enjoyment.
Cruise ship: People travel to many parts of the world in cruise ships.
Fishing: People catch fish in rivers, lakes and oceans.
Water theme park: Uses water to transport people on exciting and fun rides.
Scuba diver: People enjoy exploring underwater environments.
Winter sports: Snow and ice provide fun for skaters, skiers and sledders.

Power Generation:
Water is used to generate electricity.
Hydropower plant: Water flowing in rivers is stored behind dams in reservoirs. As water is released by the dam, it turns turbines that generate electricity.
Nuclear power plant: Uses water in cooling towers to maintain safe operating temperatures.
Coal-fired power plant: Burning coal produces steam heat that turns turbines, creating electricity.

Community:
Water is used by community members for domestic, maintenance and recreational purposes.
Domestic users: Water is used in a multitude of ways in and around the home, including watering lawns, doing dishes and brushing teeth.
Fire department: Uses water to extinguish fires.
Street cleaner: Uses water to wash oil, litter and other materials from streets.
Restaurant owner: Uses water to cook meals, clean the dishes and restaurant and water lawns/grounds.