How much water do you eat? *A water conservation activity*

APPROPRIATE FOR: 3rd – 12th Grades
STANDARDS FOR: California Content Standards for 3rd to 6th grade
SUBJECTS: Life Science, Ecology, Using Models, Mathematical and Computational Thinking
DURATION: Prep: 30 minutes; Activity: 90 minutes

Objectives

At the end of this lesson students will be able to

1. Recognize that some foods have lower water footprints than others and that meat production is particularly water intensive
2. Plan and create a healthy, balanced meal that has a low water footprint
3. Understand how each person's food choices affect the water availability in the environment

Materials

- Food cards cut to size (one set per group) print pages double sided so that the water use is on the back, or tape food on top of water use so students can flip it up and look underneath
- Student data sheet (one per student)
- Student handout (one per student)
- Paper plates (one per group, recommended group size 3 - 4 students)
- Scratch paper (1-2 per group)
- An empty one gallon milk container (1)
- Teacher Chart 1: Pie chart showing water distribution in the world
- Teacher Chart 2: Average American water consumption per day.
- Teacher Chart 3: Water footprint of some typical American meals

Scientific Terms for Students

- **Fresh Water:** water that is not salty and can be used for drinking, showering etc. Fresh water is usually found in rivers, lakes, aquifers. Oceans contain salty water.
- **Water Footprint of a Person:** the water footprint of a person is the total amount of fresh water used by that person every day. This includes direct and indirect water footprint.
    - **Direct Water Footprint**: water consumption that you directly see – this includes showering, drinking, washing, flushing toilets, and outdoor water use such as watering plants, gardens, lawns, and pools
    - **Indirect Water Footprint:** The hidden water that is used to produce the food we eat and items we consume. This is water that we use, that is not directly visible to us. For example, the water used by agriculture and farming to produce our food; water used by industries to produce electricity, gasoline, clothes, electronics, household products etc.

- **Water Footprint of Food:** Water footprint of any food item is the total volume of fresh water that goes into producing that food. It includes all the fresh water that goes into raising livestock, growing food crops, processing and transporting food.

Teacher Prep

- ☐ Print and cut out one set of food cards per group.

  Teacher tip: *The activity works well in groups of 3 to 4 students. Print pages double sided so that the water use is on the back (or tape food on top of water use so students can flip it up and look underneath). Each card has a picture of a portion of food on the front and the water footprint value at the back. The numbers represent the amount of water (in gallons) that went into producing the specified portion size of the food.*

- ☐ Download the *Teacher Charts* power point and prepare to project them onto a large screen (alternatively, you may print out all three charts in large size and display them)
- ☐ Draw Table 1 (from student datasheet) on the board.
- ☐ Print datasheets (one per student)
- ☐ Print student handout cards (one per student)

Optional: pre-activity reading

This is optional, but you can use these articles to have students explore how animals and plants are impacted by the drought:

- http://america.aljazeera.com/articles/2014/2/18/drought-threatenscaliforniawildlife.html
- http://calwil.wordpress.com/2014/02/08/drought-and-the-impact-on-californias-wildlife/
- http://www.calacademy.org/sciencetoday/drought-hurting-animals-plants/5514104/

Activity

Introduction

1. Ask students: what are some things that are absolutely required for us to live? *(air, oxygen, drinking water, food)*
2. One of the things that we need for survival is water. Where do you find water on earth? Brainstorm with students different types of water bodies that might be found on Earth. Examples include ocean, rivers, lakes, seas, ponds, deltas, wells etc. You may write these on the board. Highlight that some of these contain freshwater *(rivers, freshwater lakes),* others contain salty water *(ocean, sea, some lakes).*
3. Ask students: It turns out that of all the water in the world 97% is salty ocean water; then how much do you think is freshwater (drinking water)? Point to the pie chart to show how much freshwater is really there on this planet. Only 3% is fresh water. Out of this, 2.5% is in the form of glaciers and ice that we cannot really access. Only 0.5% is freshwater that is available for use by all plants, animals and humans on this planet.

4. Brainstorm with students what freshwater is used for, and why it is important. (Uses of freshwater include drinking, washing, showering, cleaning, watering lawns, growing crop plants and producing food)
5. Highlight that freshwater is not only required by us, humans, but also various other animals and plants that live in this world. Many animals live in freshwater and others that live on land need to drink water. Ask for examples of California's animals and birds that live in or on freshwater and depend on it for survival (examples are all animals and birds that require fresh water; salmon, white pelicans). See the "extensions" section for articles that may be used for pre-reading on this topic.

Water Use

6. Hold up a gallon jug to show how much one gallon is. Ask students: how many gallons of fresh water do you think a person uses in a day? Call out on a few students to guess the amount.
7. State that the average American consumes around 2000 Gallons a day. That means 2000 of these gallon jugs. Are the students surprised by this? Point to the chart on the board (Table 1 on the student datasheet). Tell students to predict where the water goes and enter it in their data sheets. Then, display Teacher Chart 2 and fill in the "actual use" column on the board. Spend a few minutes discussing student observations, and thoughts about the use of water.

How many gallons of water does the average American use each day?			
	Prediction	Actual Use	Direct/Indirect
Home and personal use *(drinking, showering, flushing toilets, gardens, etc.)*		100 Gallons	
Products *(clothes, electronics, furniture, etc.)*		250 Gallons	
Energy *(production of gasoline, electricity)*		650 Gallons	
Food production *(farming and food industry)*		1000 Gallons	
Total		**2000 Gallons**	

Table 1: Average American Water Consumption

8. Each of us can see directly when we use water- such as when we pour water to drink, take a shower, or use a toilet. If you can see water it is called "direct use." Each of us also uses water even 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.
9. Instruct students to work with a partner and discuss their thoughts on Q1a and Q1b on their datasheets. Call out for answers once the students are done. Fill in "direct" or "indirect" in the last column on the table. (Home and personal use = Direct;; Products, Energy and Food = Indirect)

10. We can see that a large amount of water this goes towards producing our food. We are going to further explore food and water use in today's activity. Brainstorm with a partner: why do you think it takes a lot of water to produce food? (Q2 on datasheets)

Let's Explore! Create a Meal Activity

1. Divide students into groups of 3 or 4 and give each group one set of food cards, a plate and some scratch paper.
2. They have to pick 4 cards to create one balanced meal (either lunch or dinner). Tell students that a balanced meal should contain one entrée or main dish; one side; one beverage; and one dessert.
3. 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.

   Teacher tip: *For elementary age students it helps to remind them what a gallon is by pointing to the 1 gallon container. Give a few examples to highlight the relationship between gallons of water and a portion of food: It takes 20 gallons of water to produce 1 orange or 70 gallons of water to produce 1 egg.*
4. Instruct students to fill out the Q3 table on their datasheets.
5. Call out for volunteers from each group to call out their food cards and their total water footprint values. Draw a table on the board for different groups' water footprints.

Group	Entrée	Side Dish	Drink	Dessert	Total
A	Steak 700	Fries 20	Milk 65	Ice Cream 200	1,085 gallons
B					
C					
D					
E					

6. Display the chart with a two examples of a "typical" American meal (lunch / dinner). Tell students to play around with the cards and create "water conscious" meals - meals that are balanced, nutritious and use less water than the typical meals. Allow them to explore making different meals with the food cards (Q4).

   Teacher tip: *While they are exploring with the cards, remind students that their meal has to be healthy and balanced. They cannot have a meal that only has sides or only vegetables.*

Whole group discussion questions

a. Can you make a balanced nutritious meal that uses minimal amounts of water? (Q4a)

b. What patterns do you notice? Are there certain types of foods that take more or less water? (Q4b)

   Teacher tip: *You can ask students to make comparisons between animal-based foods such as beef, lamb, pork and plant-based foods such as beans, grains or vegetables. Refer to your food cards for specific examples and numbers. Meat generally tends to use more water than plant-*

based foods. Also different types of meats use different amounts of water – for example – beef use a lot more water than chicken).

c. 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; See Educator Background for detailed numbers on beef production)*

d. Droughts are becoming common in many places which can make it tough not only for humans but also for animals and wildlife. How do you think human food choices affect wildlife and their ability to survive? (Q5).

Wrap- Up

- Do a *Think-Pair-Share* with the students. Propose the questions below (or write them on the board). Students can *think* about it and turn to a partner *(pair)* to *share* their ideas.
  - What is one thing you would like to change about your food habits that will help you conserve water?
  - What are some ways we can continue to eat meat (or beef) and still conserve water *(meatless Mondays, meatless three days a week, substituting chicken for beef, consuming half the amount of beef every week, etc.)*
- Give students the "Take Action!" handout card. Encourage them to write down their pledge and conserve water by making one or more small changes to their diet. The card also has a list of foods with low, medium and high water footprint that students can share with their families, take with while they go grocery shopping or to a restaurant.
- Call out for volunteers from each group to share what they talked about with the entire class

Background for Educators

Fresh water is a vital but scarce resource on this planet. Although three-fourths of the Earth's surface is covered in water, more than 97% of this water is salty. Another 2.5 % is locked in glaciers, snow and ice. And that means only 0.5% is available as fresh water that we can use for drinking, cooking, growing food, and manufacturing products (Fry, 2005). With the world population increasing every year, water demand is just going to keep increasing unless we change how we use it. Scarcity of fresh, clean water affects nearly 2.7 billion people worldwide (Drinking Water and Sanitation, n.d.)

Average American Water Footprint

People use lots of fresh water for drinking, washing, cooking and watering lawns, but even more for producing food, clothes and electricity. The water footprint of a person is the total amount of fresh water used by that person every day. This includes direct and indirect water use. The average person in the United States has a water footprint of around 2000 gallons a day! Only 5% of this (~ 100 gallons) is our direct water footprint, i.e., water that we use for showering, cleaning, cooking and watering lawns. The remaining 95% (~ 1900 gallons) is our "hidden" or indirect water footprint – water that is used to produce the food that we eat, energy that we consume, and products that we buy (Water Footprint Calculator, n.d.).

Average American Water Consumption (per person per day)	
Home and personal use *(drinking, showering, flushing toilets, gardens, etc.)*	100 Gallons
Products *(clothes, electronics, furniture, etc.)*	250 Gallons
Energy *(production of gasoline, electricity)*	650 Gallons
Food production *(farming and food industry)*	1000 Gallons
Total	2000 Gallons

(Water Footprint Calculator, n.d.)

Water Footprint of Food

As we can see above, a large proportion of fresh water is used for producing the food that we eat. On a national and global level, food production accounts for 50 to 70% of freshwater use (United Nations International Year of Water Cooperation: Facts and Figures, 2013). Much of this water goes towards animal agriculture i.e., raising farm animals for producing meat, dairy and eggs. If we intend to reduce our water footprint in a way that is impactful, then we should look critically at our diets in addition to our water use in the kitchen, bathroom, and garden.

Water footprint of any food item is the total volume of fresh water that goes into producing that food. It includes all the fresh water that goes into raising livestock, growing food crops, processing and transporting food (Hoekstra, 2008).

Raising farm animals for meat is generally more water-intensive than growing fruits, vegetables and grains (Mekonnen and Hoekstra, 2012; Hoekstra, 2012). Foods like steak, hamburgers, and ground meat come from cattle, and raising cattle takes a huge amount of water. Beef production is especially water intensive and here's why: A cow lives for around 3 to 5 years before it is slaughtered to produce approximately 450 pounds of boneless beef (on an average). It takes around 810,000 Gallons of fresh water to grow a single cow's lifetime's supply of food (alfalfa, grains, hay, pasture) and 6000 Gallons of water for the cow to drink during its lifetime. Add another 2000 gallons of water (per cow) for producing and transporting beef. That's a total of 818,000 gallons of water per cow to produce 450

pounds of beef, or 1800 gallons per pound of beef. And that's an average of 700 gallons of water per steak!! (Morelli, n.d.). By comparison, it takes around 100-200 gallons to produce high-quality plant-based proteins such as tofu, beans and legumes. So, one way to conserve water is to eat less beef! In general, the more plant-based foods we eat, the less water, fossil fuels and other precious natural resources we consume.

Cutting down on beef is not only better for the environment but also better for our health. Reducing meat and increasing plant-based foods (whole grains, legumes, leafy greens, fresh fruits, vegetables, and nuts) in our diets has many health benefits. Plant-based foods have been shown to prevent lifestyle diseases like obesity, diabetes, heart attacks, and cancer that are often associated with a high intake of meat, especially beef.

California's Water Infrastructure

California is a not only home to two of the most densely populated urban centers in the world (San Francisco Bay Area and Los Angeles), but is also a large agricultural state. Several large water projects provide fresh water to various regions of the state. The largely agricultural areas of Central Valley are supplied by the Central Valley Project, and Kern County is supplied by the State Water Project. The Imperial Valley gets its water from the Colorado River through the Imperial Irrigation District system. Majority of water for the San Francisco Bay Area comes from the *Hetch Hetchy Aqueduct*, the *Mokelumne Aqueduct*, the *State Water Project* and the *Contra Costa Canal* (part of the Central Valley Project). Southern California gets its water through the *Los Angeles Aqueduct*, the *Colorado River Aqueduct*, and the *State Water Project*. (Aquafornia, 2008)

If you are from California, you can find out where your water comes from by clicking here: (http://www.water-ed.org/watersources/).

California Drought and Water Crisis

In 2014, after three straight years of drought, California is facing one of the most severe droughts on record. Because of extremely low precipitation in the last three years (Drought Information, 2014), water levels in the state's reservoirs are at an all time low, with most reservoirs at less than 50% of capacity. Mountains are devoid of snow and fire-hazard has been extreme. In January 2014, Governor Brown declared a drought State of Emergency urging everyone to take all possible steps to conserve water. The U.S. Drought Monitor of May 2014 reports that most of California is suffering from conditions of "extreme drought" to "exceptional drought" (United State Drought Monitor: California, 2014).

The drought has serious implications on urban water use, agriculture, as well as water available for plants and wildlife. The following excerpt from the San Diego Free Press (2014) highlights the severity of the drought on farm and food, and its impact on consumers and the economy:

> *"The drought is hitting the farm industry and its workers particularly hard. The Central Valley, one of the world's richest food-producing regions, is up against what geologists are calling the 500-year drought. Fresno County, the heart of the Central Valley's San Joaquin Valley farm belt—and the number one farming county in the nation—may lose up to a quarter of its orchards and fields this year for lack of water. Growers in Shasta Valley were expected to have only enough water to irrigate what equals a single irrigation on about half of their acreage. The state's farmers will leave about 800,000 acres idle this year, according to estimates by the California Farm Water Coalition, which will negatively impact the state's entire economy. As a result, consumers can be expected to pay*

> *more at the grocery store for a wide range of staple foods. The Department of Agriculture warns that "major impacts from the drought in California have the potential to result in food price inflation above the historical average." (Weathers, 2014)*

California is home to rich and diverse wildlife that depend on fresh water for their very survival. These include a multitude of animals, birds, fish, reptiles, amphibians, and so on. Much of this wildlife is threatened and dying out in large numbers because of the severity of drought. For example, many species of the Pacific salmon migrate hundreds of miles upstream from the ocean to fresh water rivers and creeks during winter to lay their eggs. Salmon require fresh water in order to lay their eggs. However, this year most of the rivers and creeks of California are dry and the salmon are stranded in the ocean unable to reproduce (Fimrite, 2014; Marois, 2014)

> "*Water is a limited resource; there is only so much of it to go around. Managing California's finite water supply in the future so that it is sustainable and reliable will require striking a balance between the three stakeholders: urban users, agricultural users, and the environment. As the state continues to grow, it's going to require rethinking how we view and use water throughout the state, and we're all going to have to be more efficient in how we use it.*" (Aquafornia, 2008)

Correlated California Content Standards

Grade Three

Life sciences:

- Students know that living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms and others are beneficial. (3c)

Mathematics

- Count, read and write whole numbers to a 10,000 (1.1)
- Find the sum or difference of two whole numbers (2.1)

Grade Four

Life Sciences

- Living organisms depend on one another and on their environment for survival (3)

History Social-Science

- Trace the evolution of California's water system into a network of dams, aqueducts and reservoirs (4.4.7)

Grade Five

Earth Sciences

- Students know most of Earth's water is present as salt water in the oceans, which cover most of the Earth's surface (3a)
- The amount of fresh water located in rivers, lakes, underground resources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water (3d)
- Students know the origin of water used by their local communities (3e)

Mathematics

- Interpret percents as a part of a hundred; find decimal and percent equivalents for common fractions and explain why they represent the same value; compute a given percent of a whole number (1.2)

Grade Six

Ecology (Life sciences)

- Students know that the number and types of organisms and ecosystem can support depends on resources available and on abiotic factors, such as quantities of light and water, a range of temperatures and soil composition

Correlated NGSS Standards

Scientific & Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concept
•Developing and using models •Analyzing and interpreting data •Using mathematics and computational thinking	(5-LS2-1) A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment. (MS-LS2A) Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. (MS-LS2C) Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (HS-LS2A) Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem. (HS-LS2.C) If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.	» Cause and effect » Systems and system models » Stability and change

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Activity Inspiration

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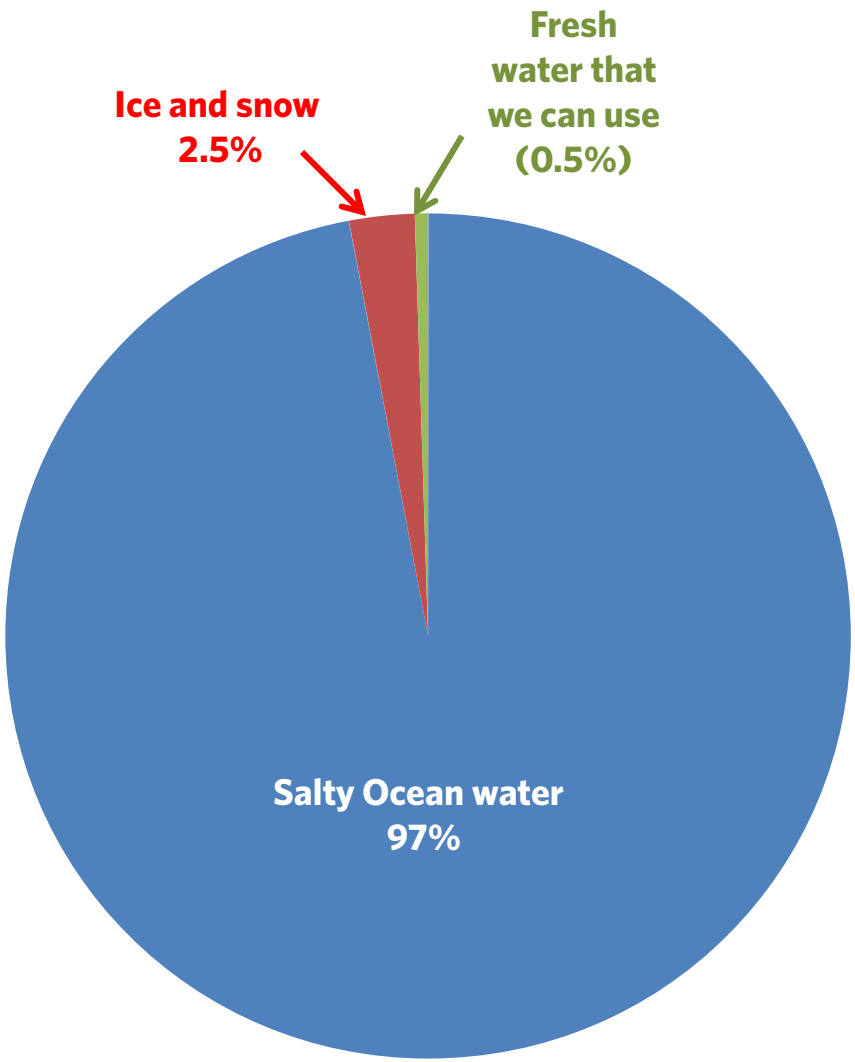
Distribution of Water on Earth



California Drought

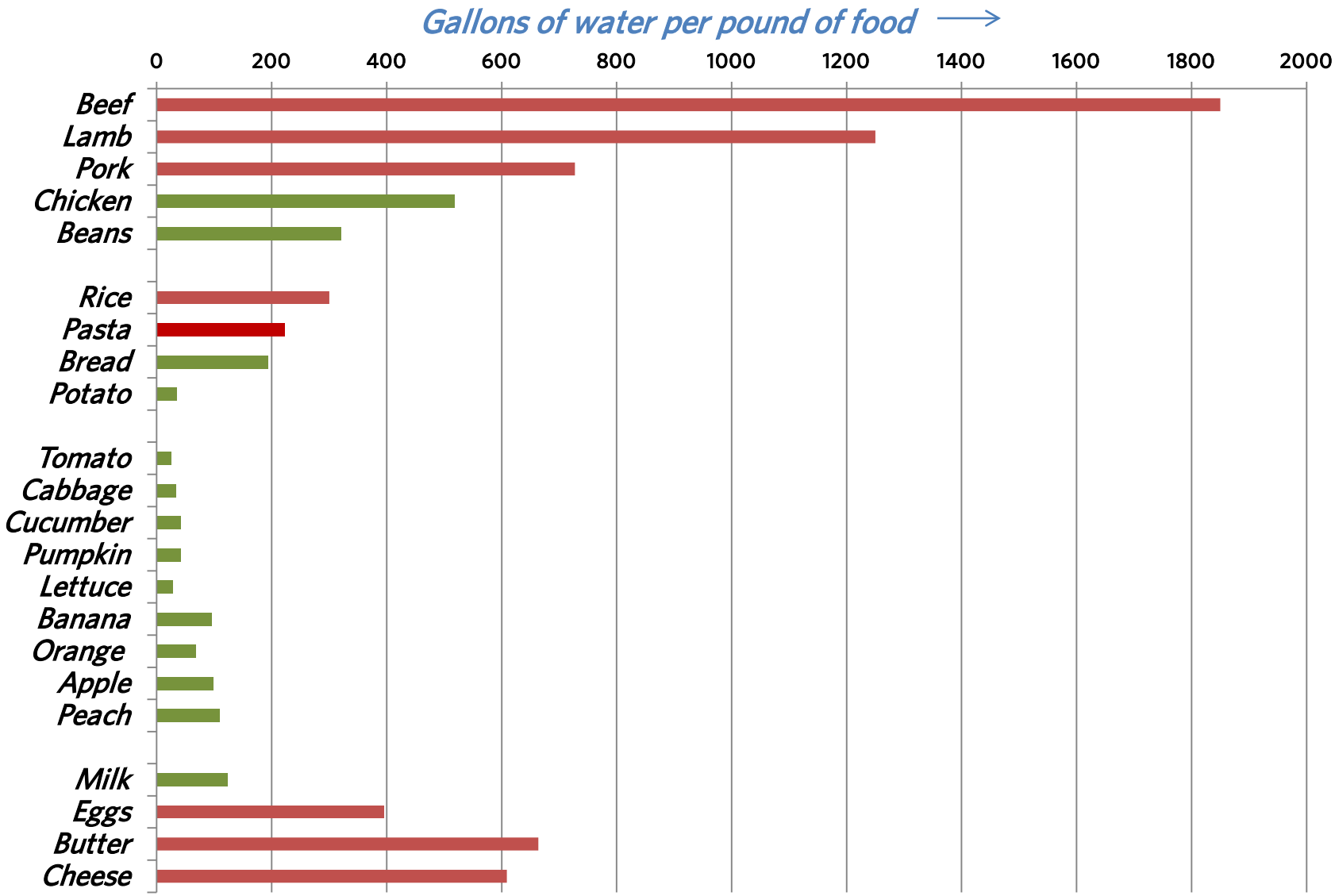
Salmon are dying due to insufficient water levels in rivers

California Drought

2011 2014

Images of Folsom Lake, a reservoir in Northern California, show the severity of the state's drought. The photo at left, taken on July 20, 2011, show the lake at 97 percent of total capacity and 130 percent of its historical average for that date. The photo at right shows the lake on Jan. 16, 2014, when it was at 17 percent of capacity and 35 percent of its historical average.

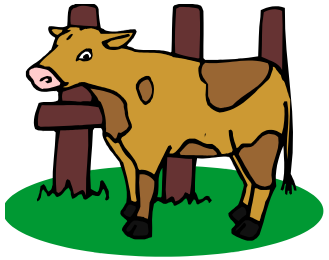
Meat takes more water to produce than most fruits, vegetables and grains



Learn more at: www.waterfootprint.org

How much water to produce beef?

A cow lives for 3 to 5 years before it is slaughtered to produce an average of 450 pounds of boneless beef



It takes **810,000 Gallons** of water to grow the cow's lifetime supply of food (grains, hay, pasture)...

Another **6,000 Gallons** of water for the cow to drink..

And **2,000 Gallons** of water for servicing the farmhouse and slaughtering facilities...

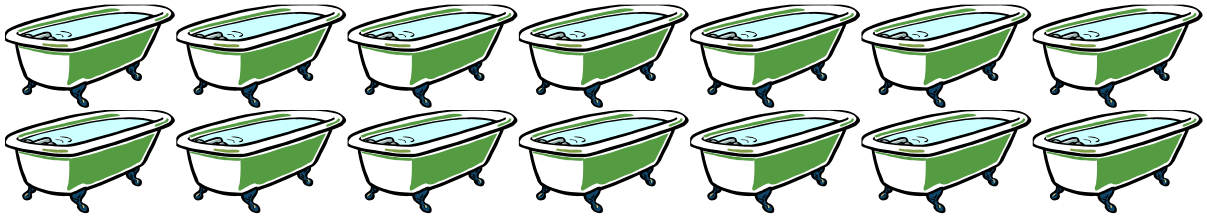
That's a total of **818,000 Gallons** of water for every cow or 1800 Gallons for every pound of beef.

Or 700 Gallons for every steak!!

For more information see: http://www.angelamorelli.com/water/ and www.waterfootprint.org

Which one would you choose?

It takes 700 gallons of water to produce 1 six-ounce beef steak. That is equal to 14 bathtubs full of water !



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The same amount of chicken takes 250 gallons.

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And the same amount of beans takes 150 gallons.

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Average bathtub volume is considered as 50 gallons

Learn more at: www.waterfootprint.org

How much water does the average American use per day?

Home and personal use
(drinking, showering, flushing toilets, watering lawns, etc.)



100 Gallons

Products
(clothes, electronics, furniture, etc.)



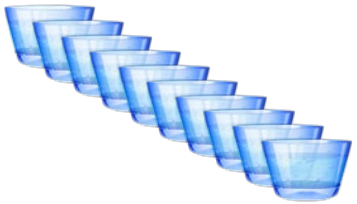
250 Gallons

Energy
(gasoline, electricity, etc.)


650 Gallons

Food production
(farming, food industry, etc.)


1,000 Gallons



Take Action and become a WATER WARRIOR!!!

It takes a ton of water to produce the food we eat every day. You could be saving a LOT of fresh water by choosing foods that take less water to produce. By pledging to make one of these small changes, you can help save water for wildlife and humans.

What is something new that you will do to save water?

- ❑ Choose beans or chicken as your protein instead of beef.
- ❑ Eat vegetarian lunch or dinner 3 times a week
- ❑ Choose fruits instead of chocolate for dessert whenever possible
- ❑ Tell your family members about how much water it takes to produce food
- ❑ Do a meatless Monday
- ❑ Any other action of your choice _____

Here are some helpful websites for more information:

- http://www.waterfootprint.org/
- http://kidsblogs.nationalgeographic.com/2010/08/12/water-footprint-calculator/
- http://environment.nationalgeographic.com/environment/freshwater/about-freshwater-initiative/

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- ❑ Eat vegetarian lunch or dinner 3 times a week
- ❑ Choose fruits instead of chocolate for dessert whenever possible
- ❑ Tell your family members about how much water it takes to produce food
- ❑ Do a meatless Monday
- ❑ Any other action of your choice _____

Here are some helpful websites for more information:

- http://www.waterfootprint.org/
- http://kidsblogs.nationalgeographic.com/2010/08/12/water-footprint-calculator/
- http://environment.nationalgeographic.com/environment/freshwater/about-freshwater-initiative/

Small Water Footprint	Medium Water Footprint	Large Water Footprint
Choose Often	Choose Sometimes	Choose Sparingly
Beans Lentils Soy/ Tofu Wheat Bread Potato Vegetables Fresh fruit Water	Chicken Pork Rice Pasta Tea Milk	Beef Lamb Cheese Butter Chocolate Coffee Apple Juice Orange Juice

Small Water Footprint	Medium Water Footprint	Large Water Footprint
Choose Often	Choose Sometimes	Choose Sparingly
Beans Lentils Soy/ Tofu Wheat Bread Potato Vegetables Fresh fruit Water	Chicken Pork Rice Pasta Tea Milk	Beef Lamb Cheese Butter Chocolate Coffee Apple Juice Orange Juice