

What's Growin' On?

Let's Look at Water



California Foundation for
Agriculture in the Classroom

**Extra!
Extra! Classroom Extensions**

Table of Contents

<i>Introduction</i>	<i>2</i>
<i>Water: A Fact of Life</i>	
1. Earth's Water Sources	3
2. Water and Its Many Uses	7
3. How Do You Use Water?	8
4. Famous Water Quotes.....	10
<i>Earth's Water Cycle</i>	
1. Make a Water Cycle Bracelet	11
2. Water Cycle Demonstration	13
<i>Where Do We Get Our H₂O?</i>	
1. Where is it?.....	15
2. Design a Well	17
3. What Happens to Rainwater?	19
4. Mapping Land Surfaces	22
<i>Water is Energy</i>	
1. Dam Safety.....	23
2. Evacuation Plan Maze Activity.....	25
3. Emergency Plan	26
4. World Hydroelectric Power Usage	27
5. Be a Flood Detective	29
6. Water Safety Activity Sheet.....	30
<i>Preserving Our Liquid Gold</i>	
1. Water Usage at Home	31
2. Design a Drought-tolerant Garden	33
3. Drought Tolerant Plants – Informational Article	34
4. Desalinization– to be or not to be!.....	38
<i>Awesome Ag Math</i>	
1. Word Problems.....	40
2. Food Math is Fun	42
Resources	43
<i>What's Growin' On? Activity Answer Key</i>	<i>44</i>

Introduction

Welcome! Thank you for your interest in California Foundation for Agriculture in the Classroom's (CFAITC) student activity newspaper, *What's Growin' On? Let's Look at Water*. Developed by educators like you, *What's Growin' On?* offers fun and engaging ways to teach and practice core academic skills while demonstrating the importance of our water system.

This EXTRA! EXTRA! Classroom Extensions Guide contains ideas and opportunities for extending the content presented in the student activity newspaper. It includes some inquiry-based lab ideas for incorporating agriculture throughout the curriculum. Activity ideas are varied to help you meet the different learning styles of students in your classroom. Opportunities for group work, hand-on activities, and visual displays support the needs of ELL students.

The agriculture-themed examples and activities found in *What's Growin' On? Let's Look at Water* are designed to motivate and inspire your students by connecting classroom lessons to real-life experiences and circumstances. This is accomplished by weaving agriculture into academics so students can better relate to food they eat, water they drink, clothes they wear, homes they live in, and all the open spaces they enjoy. Additionally, using the newspaper as an instructional tool allows young people to discover the relevance of their classroom studies by reading news stories, acquiring knowledge, forming opinions, and broadening their understanding of the world they live in.

California Foundation for Agriculture in the Classroom is dedicated to increasing the awareness and understanding of agriculture among California's educators and students. CFAITC provides educators with resources and programs that enhance agricultural literacy. To request a free teacher resource packet or a classroom set of the current edition of *What Growin' On? Let's Look at Water*, contact CFAITC via e-mail (info@LearnAboutAg.org) or phone (800-700-2482).

Earth's Water Sources

Source: California and the Environment Initiative

Materials: salt, water, cups, stir straws, pencils, paper, cups to discard stirrers, visuals, maps

Objectives:

1. Identify, orally or in writing, fresh water, brackish water, and salt water;
2. Given a map of California, locate fresh and salt water sources; identify where brackish water might be found;
3. Given a written definition of the terms: fresh water, groundwater, salt water, surface water, and brackish water.

Vocabulary terms:

1. **Fresh water:** inland water that has a low concentration of minerals, salts, and dissolved solids found as surface water or groundwater (rivers, lakes)
2. **Salt water:** water that has a high level of dissolved salts (oceans, seas).
3. **Brackish water:** water that has more salinity than fresh water, but not as much as seawater (estuaries and bays)
4. **Estuary:** body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the seawater.
5. **Bay:** broad inlet of the ocean where the land curves inward
6. **Delta:** a landform that forms at the mouth of a river, where the river flows into an ocean, sea, estuary, lake, or reservoir.
7. **Potable:** safe to drink; drinkable

Review with students that water is a basic need for all life. Without water, there would be no life. Ask them how they use water in a typical day. Tell students that there are three different types of water found on Earth. They will taste each type of water.

Procedure:

1. Organize students into small groups
2. Give each student group enough stirrers and 3 test cups
3. Each group will receive one set of water samples (Cups A, B, and C)
Cup A (fresh water – no salt)
Cup B (add 1/8 tsp salt)
Cup C (salt water – add 1tsp salt)

4. The teacher will demonstrate the procedure for taste testing. Show students how to dip the stirrer into the water and then touch the side of the tongue near the tip. Tell them that they should use a new stirrer for each sample.
5. Students will taste each sample. They must not reveal their findings to any group members at this point. They will take notes on each sample.
6. Small group discussions – “How do the samples differ?” “Which sample is the most potable, and why?”
7. Whole class discussion – small groups report to whole class about their findings
8. Teacher explanation of samples:

Sample A – This sample is fresh water, and it has very little salt. Humans need fresh water to survive. Ask students what kinds of fresh water ecosystems they have heard about (*rivers and lakes*). Plants and animals that live in a fresh water ecosystem need the fresh water in order to survive. What are some plants or animals you know about that live in rivers or lakes?

Sample C – Ask students which water tasted the saltiest. Tell them that this sample is saline or salt water. It is similar to the water found in the ocean. Ask students what kinds of salt water ecosystems they know about (*oceans*). What are some plants and animals that you know about that live in the ocean? Tell them that the plants and animals that live in salt water ecosystems are part of the marine habitat.

Sample B – Sample B is brackish water. It is found where salt water and fresh water mix. Ask students where this might happen. (*Where a river meets the ocean, like in a bay or an estuary.*) These habitats are generally found along the coast and are called coastal habitats. The plants and animals in these ecosystems must have brackish water to survive. Brackish water, like salt water, is too salty for humans. Animals found in brackish water include oysters and crabs, and other plants and animals that have adapted to living in brackish water.

9. Project nature pictures (teacher to find in magazines or Internet) on an overhead projector. Have students identify the source of water and whether it is fresh water or salt water. (Ocean, salt; Snow, fresh; River, fresh; Lake, fresh; Stream, fresh; Estuary; brackish)

Conclusion:

- Students will summarize the similarities and differences between these three types of water and the ecosystems they support. This could be done with a Venn diagram with 3 overlapping circles.

- Students will identify on a map of California the areas where salt water, fresh water, and brackish water are found

Extension:

Break the students into groups. Have them list the names of as many salt and fresh water sources as possible. Give them approximately 5 minutes.

Technology:

The interactive website listed below is a great source of information when teaching this lesson. Students can take a freshwater quiz, learn about water heroes, read interesting water-related articles, and look at freshwater photos. There is also relevant information about salt water issues.

<http://environment.nationalgeographic.com/environment/freshwater/freshwater-101-interactive/>

Fresh or Salty

Cup A



Cup A contains:

_____ water

Cup B



Cup B contains:

_____ water

Cup C



Cup C contains:

_____ water

Water and Its Many Uses source: www.water.org

Materials: magazines, newspapers, glue, scissors, poster board

Objective:

1. After completing a collage, students will analyze and form opinions about the ways water is used in their community and throughout the world

Vocabulary:

A collage is made from images or objects that are glued or attached in some other way. The word “collage” comes from the French word, coller, which means “to stick.”

Background:

Many students have never stopped to think about the value of water and the many ways it is used in daily life. Constructing a collage will be a creative, fun way to see the many ways water is used in everyday life.

Procedure:

1. Students will be asked to donate magazines and newspapers to the classroom.
2. Students will search magazines and newspapers to find pictures that show various ways water is used or things that need water to live. They can also bring in personal pictures showing water usage.
3. Students will work individually or in small groups.
4. Pictures will be glued to a poster board and presented to the class.

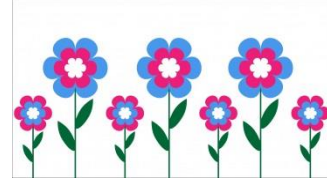
Conclusion:

1. Allow students the opportunity to present their collages.
2. A list of the various ways water is used should be submitted with the poster.
3. Make a class master list of the ways water is used and have each student add new ideas.

GATE:

1. After students have finalized the collage, they will analyze the ways in which water is used. Is water used wisely? Any conservation ideas after analyzing the pictures? What are some of the reasons water is important to our planet? What surprising discoveries did they make?

How Do You Use Water?



Source: California Foundation for Agriculture in the Classroom

Directions: Unscramble these words to complete the phrases showing how you use water.

OWRG

DOFO

DO

AUYRDNL

LIFL

OWESHR

UPC

AWHS

DHNAS

ERWTA

OWEFLSR

TEKA

_____ your _____

_____ your _____

_____ your _____

_____ your _____

_____ your _____

_____ your _____

How Do You Use Water? ANSWER KEY

Source: California Foundation for Agriculture in the Classroom

Directions: Unscramble these words to complete the phrases showing how you use water.

OWRG

DOFO

DO

AUYRDNL

LIFL

OWESHR

UPC

AWHS

DHNAS

ERWTA

OWEFLSR

TEKA

WASH your **HANDS**

DO your **LAUNDRY**

FILL your **CUP**

GROW your **FOOD**

WATER your **FLOWERS**

TAKE your **SHOWER**

Famous Water Quotes

Source: Idaho Foundation for Agriculture in the Classroom

The following quotes are meant to help students explore the world of water, especially the value of water to plants and animals. Responding in writing will allow students to form their own opinions. Sharing can lead to rich classroom discussions.

Have students respond in writing to the following quotes:

“When the well is dry, we will know the worth of water.” Benjamin Franklin (1706-1790)

“Water is the driving force of all nature.” Leonardo da Vinci(1452-1519)

“There is enough water for human need, but not for human greed.”
Mahatma Ghandi (1869-1948)

“A lake is the landscape’s most beautiful and expressive feature. It is Earth’s eye; looking into which the beholder measures the depth of his own nature.” Henry David Thoreau (1817-1862)

“All the water that will ever be is, right now.” National Geographic (10/93)

“Thousands have lived without love, not one without water.” W.H. Auden

“We forget that the water cycle and the life cycle are one.” Jacques Cousteau

This activity can be used as a writing warm-up, a small group discussion topic, or a take home written assignment prior to a lesson. It is meant to push students to analyze and respond to someone else’s ideas.

Water Cycle Bracelet

source: Idaho Foundation for Agriculture in the Classroom

Materials: See list of beads below; yarn, string, leather, rope, or pipe cleaner

Objectives:

1. written or verbal understanding of the sequence of the water cycle
2. use time and order words in writing when explaining their water cycle

Key Vocabulary terms:

1. condensation – when water vapor in the air comes into contact with colder air, it changes state into liquid droplets and can form clouds;
2. precipitation – moisture such as rain, snow, hail, sleet, falling from the atmosphere;
3. transpiration – the evaporation of water from plant leaves;
4. percolation – the process of water seeping down into the ground;
5. groundwater – water that is stored under the surface of the earth in aquifers;
6. evaporation – the process by which water changes from a liquid to a gas or vapor.

Background:

This activity should be used as a culminating activity after students have learned about the water cycle. See *What's Growin' On? Let's Look at Water* for an introduction to the water cycle.

Procedure:

Make a Water Cycle Bracelet: This activity uses 10 beads that represent the water cycle. The beads are used to show the paths water takes through its various states (solid, liquid, and vapor) as it moves throughout Earth's systems (oceans, atmosphere, groundwater, rain, streams, etc.)

1. Give each student a piece of yarn, leather, rope, or a pipe cleaner.
2. Show the students that each colored bead represents a different stage of water in the Earth's systems.
3. Ask each student to string one of each colored bead on their bracelet. They can choose where to begin their water cycle.
4. After the bracelets are complete, ask the students to show you their personal water cycle. For example, if the beads are in the following order: clouds, puddles, plants, etc., the student explains that the water started in the clouds, then it rained and fell into

puddles on the sidewalk, then the water evaporated and collected on the plants overnight.

5. Each student will have a different water story to tell.

The beads and what they represent are as follows:

- Sun (yellow) – the sun is the source of all energy on Earth and powers the water cycle
- Water vapor (clear) – the part of the water cycle where water is suspended in the air or is steam and humidity
- Clouds (gray) – when water vapor condenses but is still in the air
- Rain (sparkling clear) – moisture from clouds falls to the Earth as liquid
- Snow (white) moisture falling as a liquid in the frozen state
- Erosion (brown) – rain causes erosion where soil is unprotected by vegetation. Soil particles are suspended in the water runoff
- Oceans (dark blue) – Earth’s weather factory. Moisture evaporates from the oceans by the sun’s heat and is carried around Earth by winds
- Lakes (sparkling blue) – the way we like to see a lake. Collects water from streams and also evaporates water into the atmosphere
- Puddles (sparkling brown) – rainwater collects in low spots, streets, and sidewalks, and it also collects pollutants (dirt, trash, car fluid, etc.). Puddles evaporate or go into storm sewers.
- Plants (green) – Plants take in water through roots and evaporate water into the atmosphere through leaves – a process called transpiration.

Conclusion:

1. After students have completed their bracelets, have them write about their personal water cycle. They should include ***time and order words*** when describing their cycle.
2. Students will draw a picture of their own water cycle. They should label with key water cycle words.

Extension activities:

Water Cycle song to the tune of “Oh, My Darling”

EvaporationPush both palms up, palms parallel to floor.
CondensationPush with arms straight out to side.
Precipitation on my head.....Pretend to “sprinkle” rain on head
AccumulationSweep arms back and forth in front.
Water Cycle.....Rotate arms in circle in front.
And we start it over again.....Turn around in place in a circle.

Water Cycle Demonstration

source: California Department of Water Resources

Materials needed: hot plate, tea kettle, two cups – clear glass works best so students can see the water dripping, and some water

Objectives:

1. Visual demonstration of the water cycle
2. Demonstrate the ability to use time and order words

Teacher Demonstration:

Step 1: Fill a kettle half full of water.

Step 2: Put the kettle on the hot plate and turn it on.

Step 3: Wait for the water to boil.

Step 4: Hold one cup above the spout so that steam hits it. **Be careful not to let the steam hit your fingers.** When the steam hits the cup, it will “condense” into water.

Step 5: Let the water drip out of the cup you are holding into the second cup.

Step 6: Observe the water collected in the second cup.

Feedback:

Ask students the following questions: Which part of a demonstration is like the rain? Which part is like the lake? Which part is like the sun?

If the “rain water” was left to stand in the cup for a long time, what would happen to it? Why?

Conclusion:

Students will draw a picture of the science experiment. They will label the rain, lake, sun, etc.

They will also write a paragraph describing the water cycle. Time and order words must be used in the writing.

Technology:

These two websites below offer visual and interactive support for students learning about the water cycle. They both offer additional relevant information about water. The Youtube video is targeted for grades four through twelve. It is a short, but provides the viewer with useful information about the water cycle.

<http://www.discoverwater.org/blue-traveler>
<http://water.epa.gov/learn/kids/drinkingwater/gamesandactivities.cfm>

Youtube: Water Cycle: National Science Foundation

GATE:

After the students have learned about the water cycle, they will write a poem or a story about the adventures of a make-believe character in the water cycle. The character must travel through the water cycle, and the water cycle information must be accurate. Other than that, the students must choose a character and write an adventure story. For example, it could start out like this: Muddy, the raindrop, woke up in a dirty, brown pool of water. It was a cold, rainy day

Groundwater – Where is it?

Source: California Department of Water Resources

Materials: One thin plastic cup with several pin holes in the bottom, a 12-liter soda bottle with the top cut off, 1 cup each: soil, sand, gravel, rocks (approx.. 1"size), 8 – 12 oz. of water, modeling clay (tennis ball-sized lump)

Objectives:

1. Students will gain an understanding of how water percolates through the earth and collects as groundwater in an aquifer

Background: A well is a hole in the ground from which water can be withdrawn. Wells are dug in the earth until they reach the aquifer or groundwater. The aquifer is the zone where the soil is saturated with water. Rainwater reaches the aquifer as it percolates through soil layers until it reaches the aquitard, a layer of clay or compacted shale that prevents further movement of water. Sometimes the aquitard is punched through, and the water below is the deep, pure water used. In some areas, the aquitard is near the surface and the water table is not very deep. In other areas groundwater could be 1,000 feet deep. As water percolates through layers of soil and sedimentary rock (sandstone), it becomes purified. The layers used in this lesson are soil, sand, gravel, rock, and clay.

Procedure:

1. Discuss what groundwater is and begin the demonstration.
 - a. Show the class an empty tumbler or 2-liter bottle
 - b. Flatten the modeling clay and place it in the bottom of the bottle. This will be the aquitard.
 - c. Pour in 1 cup of rocks, then the gravel, sand, and soil. The bottle should be nearly filled. Discuss that this model represents the earth's layers.
 - d. Get a plastic cup (with pin holes in the bottom) and hold it above the bottle/pour 8 oz. of water into the cup and let it "rain" onto the top soil layer.
 - e. Observe the water as it flows through each layer. Discuss that the water accumulating in the bottom of the bottle is called groundwater.
2. Distribute the activity sheet "Ground Water." Students will draw the layers of "clay-rock-gravel-sand-soil" and then label the layers with the bottom label being "clay."
3. Color the groundwater accumulated in the rock layers blue. Cut out the cloud rectangle and glue it onto the top of the page above the bottle.

Closure:

- Review the flow of water in the model and collect student work.

Groundwater

Name: _____



Design a Well source: education.com

Materials: cardboard toilet paper tube; large, empty coffee can; gravel, sand, water

Objective:

1. Hands-on opportunity for students to demonstrate how water is obtained from a well
2. Understand that earth should be kept free of chemicals and toxins that can get into our water supply

Background:

Where does our water come from? Most students might say it comes from the faucet or a hose, but how does it get there in the first place? One way that water can be delivered to some people is through water wells. Throughout history, humans have been using wells to draw up the water naturally present in the earth into our homes.

This is an opportunity for kids to see how a well works by having them construct their own. Students will use a cardboard tube, sand, and gravel to make a well. This activity provides an excellent visual demonstration to help kids understand the process behind water wells.

Procedure:

1. Place the cardboard toilet paper tube upright in the bottom of the coffee can. This tube will represent your well.
2. Hold the tube steady and pour a layer of the gravel around the bottom outside edge. Make the gravel layer about 2 inches deep. Remember not to pour any gravel *inside* the tube, only outside!
3. Pour sand on top of the gravel to form a second layer. Some of the sand will fill gaps in the gravel; the rest will build up to make another layer, which should be about 1½ inches deep. Again, make sure that no sand gets inside the tube. After pouring, about half an inch of the cardboard tube should be sticking up above the sand and gravel. Ask the students what they think the sand and gravel layers are supposed to represent. (These layers are the earth's soil.)
4. Now that the well is constructed, it's time to see how wells get our water. Ask students what they think will happen when water is added to the sand and gravel.
5. Have them pour water onto the sand and gravel, continuing until the water level reaches the very top of the sand layer.
6. Observe the tube—what happens? (Water should begin to rise in the tube.)

Classroom Discussion

- Where is the water in the well coming from?

- How does the water get inside the well?
- How is this miniature well related to real-life wells?
- Why is it important to be aware of what we put in our soil?

Teaching Notes

The students have built a well where the cardboard tube represents the well and the sand and gravel around it represent the soil in the earth. When you pour water into the sand and gravel, the water level in the tube should begin to rise. Why does this happen?

After a period of rain, the resulting groundwater is absorbed into the earth and is "stored" in the soil. Eventually, enough water is absorbed into the soil so that water pressure builds up in this underground "storage." When we dig a well, the intense pressure forces water into the well, which allows us to reach the water and use it.

It is important for students to understand why keeping our soil clean is a major concern. Because some of our water is extracted from the earth's soil, it's our responsibility to see that we keep our earth free of as many chemicals and toxins as possible so that our water will also be safe to drink and use in the future.

Extension:

Try this demonstration one more time. After adding the rocks and sand to the well, put a few drops of food coloring on top of the gravel. (The food coloring represents the pollutants that are constantly added to our groundwater.) Then add the sand and the soil. Pour the water over the soil. What happens to the water in the well?

Technology:

Youtube: How a Water Well is Drilled, American Groundwater Trust

This video provides a very good explanation of how wells are drilled, where they are drilled, how much water they will provide, and the steps necessary to add a well to a property. It also teaches kids about the methods used to drill a well.

What Happens to Rainwater?

Source: Save the Bay's San Francisco Bay Watershed Curriculum

Materials: Metal can (or other cylinder) with two open ends, pitcher or empty jug for pouring water, beaker or measuring cup, stop watch, data chart

Objectives:

1. Students will understand how water percolates through Earth's layers

Introduction:

When rain hits the land, water either soaks into the ground to become groundwater, or it runs off the land to become runoff. In this activity, your group will do a percolation test on various land surfaces around your school. A percolation test measures how long it takes for water to soak into the ground. This test will help you determine whether water that falls on your schoolyard becomes groundwater, runoff, or both.

Procedure:

1. Read through this procedure and answer questions 1, 2 and 3 before beginning your experiment.
2. Find various land surfaces around your schoolyard: grass, gravel, packed dirt, loose dirt, sand, pavement etc. Record these in your data chart.
3. Place the cylinder on a land surface. If possible, twist the percolation cylinder into the ground slightly so that water will not flow out the edges.
4. Measure an amount of water and pour it into the cylinder. Record amount of water in your data chart.
5. With a stopwatch, time how long it takes for all the water to soak into the ground. Record this in your data chart.
6. Repeat steps 3-5 for each land surface.

QUESTIONS

1. In this experiment you will be pouring water into a can that is placed on a land surface at your school. You will then be recording the amount of time that it takes for the water to soak into the ground. List the things that you think should be kept constant in this experiment.

2. Before you go outside, your group needs to get organized. Decide who will be responsible for each task. You will need a timer, a recorder, someone to twist the percolation can into the ground, someone to pour the water, and at least one person to observe the water as it seeps into the ground or runs along the surface. Option: After the first test, switch jobs so everyone gets a chance to do everything.

Timer: _____

Recorder: _____

Can twister: _____

Water pourer: _____

Observer: _____

3. Decide the following things before you go outside:
How much water will you pour at each location? _____

At what point will you begin timing? _____

4. Summarize and explain the results of your “perc” test. Which surfaces soaked up water quickly? Which did not absorb water? Based on what you learned about land surfaces during this activity, describe the runoff that you think would occur around your school after a big rainstorm.

Percolation Data Chart

Land Surface- Location	Amount of Water Poured	Time for water to soak in	Observations

Mapping Land Surfaces

Materials: Sheet of large paper or poster board, markers, pens, colored pencils, other art supplies, as needed

Background: This lesson must follow “What happens to rainwater?”

Objective:

1. Students will produce a map of the various land surfaces at school

Procedure:

Tell students they will make a map that shows the land surfaces around school by making a map that shows where the different types of land surfaces are located.

1. Decide within your group how you will show different land surfaces on your map. Draw a key for your map that indicates the different land surfaces that you will be marking. The key will make your map easy to understand.
2. Use a large sheet of paper to draw your schoolyard.
3. Add your key to the schoolyard map when you are finished.
4. Make a table and list the different land surfaces that you found in your schoolyard. Beside each one, decide whether water would more likely “run off” or “soak in” when it hits the surface.

GATE:

In general, analyze how you think your schoolyard rates as far as land uses? For example are there more parking lots than fields? What things might you change to reduce runoff?

Dam Safety

source: PG&E

Materials: Emergency Plan worksheet copies for each student and pencils. Teacher cuts dam failure plan steps into strips for each group.

Objective:

- Generate a preparedness plan in case of a dam failure
- In small groups, students will discuss how to plan for a dam failure

Procedure:

1. As a class, make a list of emergency procedures that students think would be important in the event of dam failure.
2. In small groups, read and discuss the information you have received about how to plan for a dam failure. Talk about how you could teach other students about your safety factor.
3. Choose a student expert from each group to teach other students about one of the ways to be prepared in case of a dam failure. The teacher must make sure each step in the plan is covered.
4. Student experts should be positioned around the classroom. In small groups, the class should move clockwise around the room to each station, spending a few minutes at each station.
5. After moving through each station, students will make an individual safety plan to follow in case of a dam failure.

DAM FAILURE

The chances of dam failure are small but real. Take a few steps to prepare your family and home.

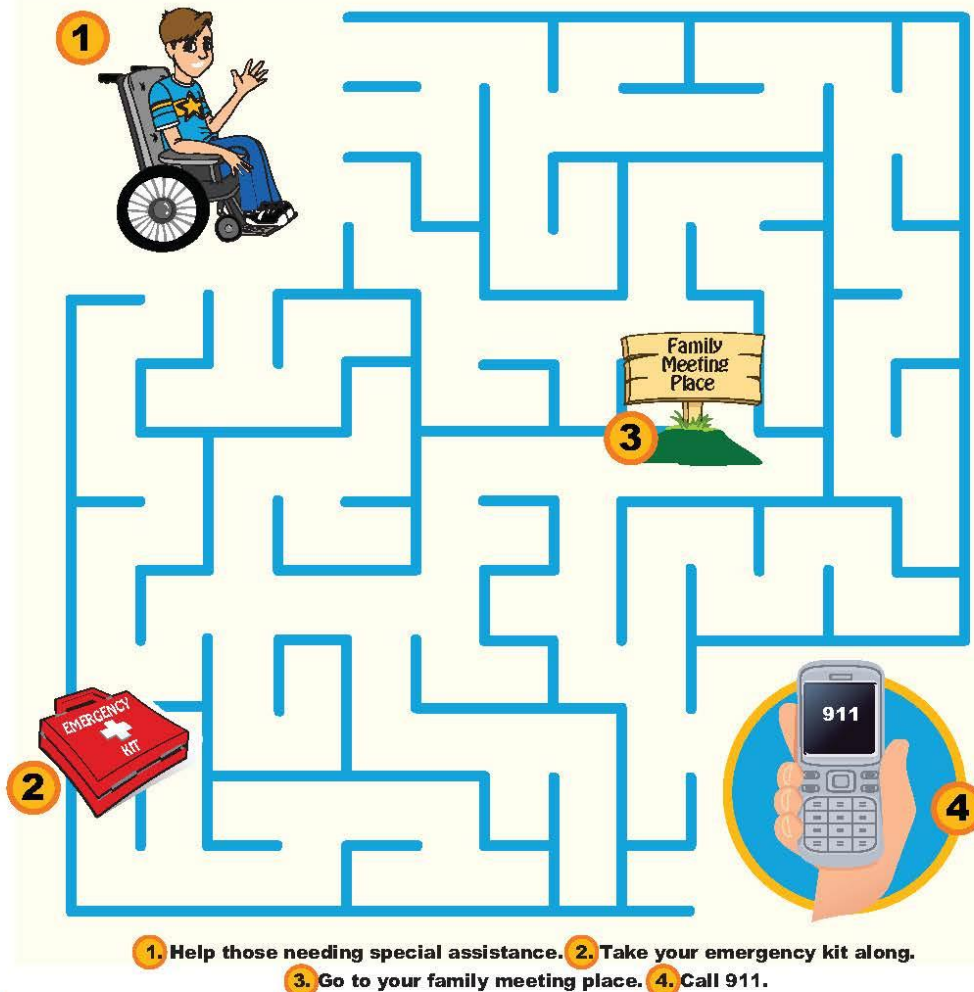
- ✓ Prepare and store an emergency kit with blankets, flashlights, and enough food, water and supplies for 3 days.
- ✓ Think about anyone in your home who is elderly or needs special assistance, and how you will handle their evacuation in the event of an emergency.
- ✓ Contact your city officials to find out if there is an evacuation center in your town.
- ✓ Create a family evacuation plan so that your family knows how to reach your meeting place.
- ✓ Practice your evacuation route with your family and choose your family meeting place.

FIELD TRIP

American River Water Education Center, Folsom, CA (916)989-7100. A section of Folsom Dam explains why it was built, its uses, and its history. The history and head waters of the American River Watershed are explored through interactive exhibits.

Do you have an evacuation plan?

PG&E's dams are very safe. Nevertheless, everyone who lives near a dam should have an evacuation plan in case of flooding. Here's your chance to practice the steps as you work your way through the maze!



1. Help those needing special assistance. 2. Take your emergency kit along. 3. Go to your family meeting place. 4. Call 911.

Show your completed maze to your family. Does your family have an emergency kit?
Do you have a family meeting place and a flood evacuation plan?
Talk about it with a parent or other adult.

Dam Failure

Emergency Plan

Where is our family meeting place?

Two routes to our meeting place:

Main route: _____

Alternate route: _____

Who we need to call in the event of an emergency?

Are there people who need special assistance?

Let's Look at . . .

World Hydroelectric Power Usage

Use the information on the chart below to find out how much hydroelectricity (measurement - trillion BTU) each country used.

Country	Btu Used
China	
Canada	
Brazil	
USA	
Russia	
Norway	
India	
Japan	
Venezuela	
Sweden	
France	
Paraguay	
Turkey	

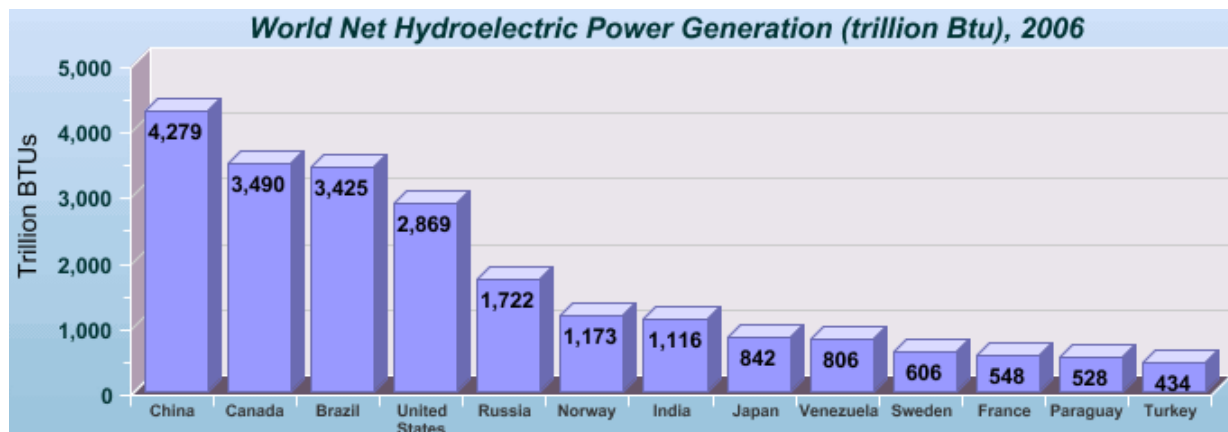
The country that uses the most hydroelectricity is _____.

About how much? _____

Why do you think this is?

The United States used about _____ trillion Btu.

How many more Btu did China produce than the U.S. _____?



Source: United States Geological Services/Water Science School

*Btu – (British Thermal Unit)

Let's Look at . . .

World Hydroelectric Power Usage

ANSWER KEY

Use the information on the chart below to find out how much hydroelectricity (measurement - trillion BTU) each country used.

Country	Btu Used
China	4279
Canada	3490
Brazil	3425
USA	2869
Russia	1722
Norway	1173
India	1116
Japan	842
Venezuela	806
Sweden	606
France	548
Paraguay	528
Turkey	434

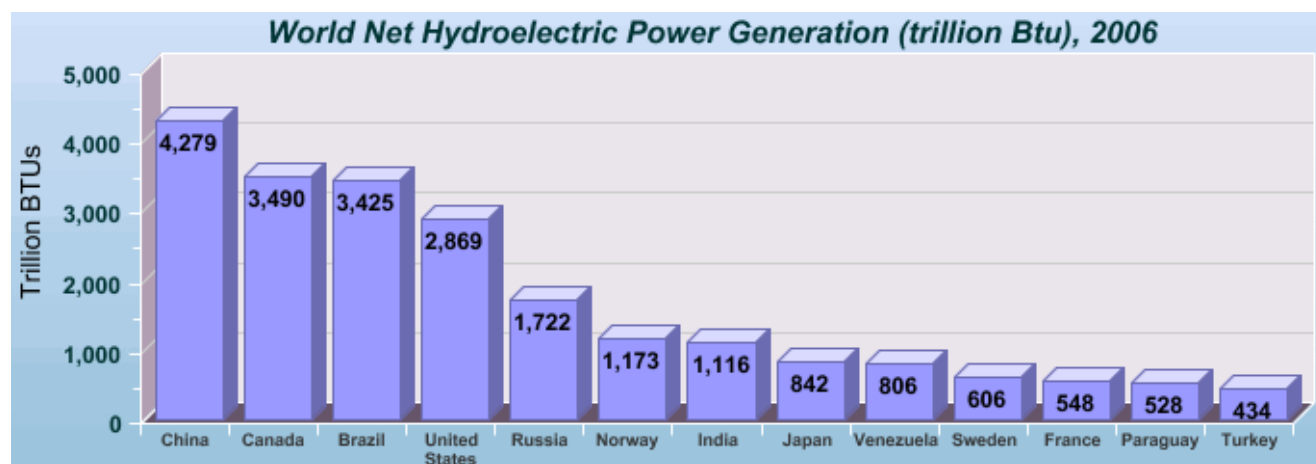
The country that uses the most hydroelectricity is **CHINA**.

About how much? **4300 trillion Btu**

Why do you think this is? **High population, high amount of manufacturing.**

The United States used about **2900 trillion Btu.**

How many more Btu did China produce than the U.S.? **1410**



Source: United States Geological Services/Water Science School

*Btu – (British Thermal Unit)

Be a Flood Detective!



It is important to know the early warning signs of a flood so you will have time to move to higher ground in case one occurs in your area.

Fill in the missing vowels to complete the clues.
(Hint: Only one vowel is missing for each clue.)

Incr__as__d sp____d or d__pth of wat__r.

Unusu__l__mounts of debris in w__ter.

Change __n water from clear to muddy.

Un__s__ally cold water.

If you see these warning signs, use your family evacuation plan to get to your safe meeting place.



**Pacific Gas and
Electric Company®**

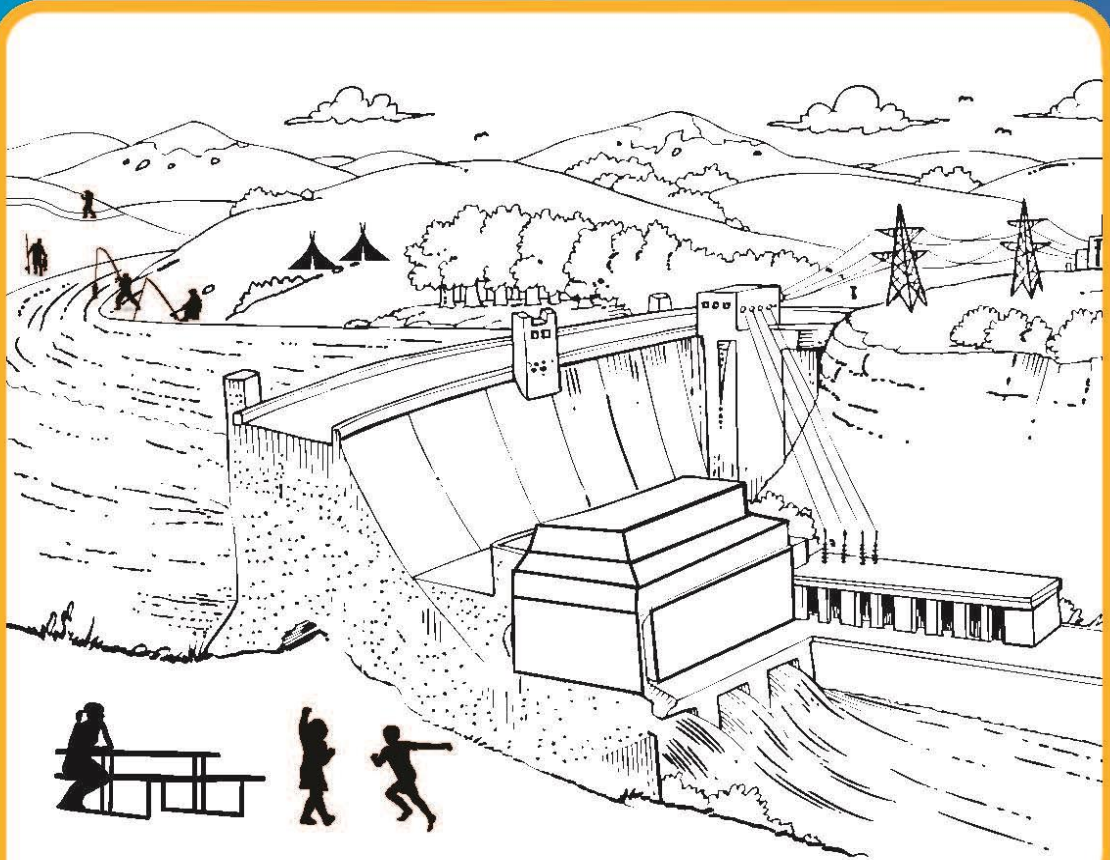


Water Safety



Activity Sheet

Learn About Dams & Hydropower



PG&E's hydropower system produces clean electricity!
It also provides recreational areas for camping, hiking, fishing
and other water sports.

Color this picture. Circle the people who are hiking, camping and fishing.

Water Usage at Home source: Conservation Connection

Materials: clear gallon-sized plastic container, colored markers, measuring cups

Objective:

1. Students will work in groups to demonstrate the break-down of water in California households

Introduction:

The surface water and groundwater on our planet is all that we will ever have. All human beings need to be aware of its importance and take the proper steps to protect it. Discuss with a partner or whole class why this information is important.

This activity will help students visualize the break-down of water use in the average California home. They will have a better understanding of how water is distributed in a household.

Procedure:

1. Students will work in groups to add water in steps to a 1 gallon container.
2. After each addition of water, students will mark the level and label it.
3. Students will observe how the water is distributed in the “household.”

Students will fill and mark containers as follows:

- Add 5oz., mark the level and label: DRINKING & COOKING – 5%
- Add 5oz., mark the level and label: FAUCETS – 5%
- Add 12oz., mark the level and label: LAUNDRY – 12%
- Add 18oz., mark the level, and label: BATHING – 18%
- Add 22oz., mark the level, and label: TOILETS – 22%
- Add 38oz., mark the level, and label: OUTDOOR USES – 38%

Conclusion:

Class will talk about what they notice after adding water to the container. How could changes be made to the way water is used in a household?

GATE:

Utility companies pay employees to help customers conserve water. Now that you have seen the breakdown of water use in California households, write a report to your local utility company and suggest how water could be conserved in households. Make sure to cite evidence from your visual demonstration.

Design a Drought-tolerant Garden

Source: U.S. Bureau of Reclamation

Materials: computers for research, colored pencils, paper

Objective:

- Students will research drought tolerant plants
- Students will design a residential landscape that uses drought tolerant plants

Procedure:

1. After students have learned about the percentage of water Californians use to support the area outside their homes, they will research and design a residential landscape that uses water-saving, drought resistant plants.
2. Tell students that they are landscape designers. They are to redesign landscape for homeowners who are trying to reduce water usage. They must research plants that are drought tolerant and use a minimal amount of water. They will need to think about whether a lawn is necessary, when their chosen plants will bloom, how much water they need, etc.
3. Students will use the attached handouts to begin their research.

Conclusion:

When the research is complete, students will write a report explaining why they selected the plants in their design. They will also draw a picture of their design. They must select a time of year when at least some of the plants are in bloom.

Technology:

http://www.bewaterwise.com/great_native.htmlsign. <http://www.sunset.com/garden/flowers-plants/low-water-plants>

GATE:

Students will research pictures of landscaping that uses a heavy amount of water and landscape that uses a minimal amount of water. They will then present their pictures to the class and compare and contrast the two photographs.

Home Gardening Center Tip Sheet: Drought-Tolerant Plants

By Sonia Uytterhoeven

When thinking about designing a drought-tolerant garden, you will be pleased to find that the list of potential candidates for your borders is quite long and colorful. What makes a drought-tolerant plant? Plants have evolved some clever ways of adapting to dry conditions and even extended periods of drought. They are fairly easy to identify if you know what to look for.

Plants such as stonecrop (*Sedum*) and hens and chicks (*Sempervivum*) have evolved fleshy leaves (the same strategy as cacti) to help them retain water during periods of drought. They are the camels of the plant world. Other plants have evolved a waxy, whitish coating (glaucous) on the leaves. Still others have leaves that are leathery or finely cut to help prevent water loss.

A similar strategy can be seen in bearded irises (*Iris*). They have fleshy rhizomes (modified stems) that store water. In the [Home Gardening Center](#) we have rich garden soil. We have planted the bearded irises high, so that the rhizomes are clearly visible above ground to ensure that they stay dry and do not rot from excessive moisture. The varieties in the Botanical Garden include remontant or reblooming irises that produce a second flush of blooms in early fall.

Other plants have evolved hairy or wooly surfaces to help conserve moisture. One of the favorites for children in the garden is lamb's ears (*Stachys*). It is a common sight to see a child stroking the plant and explaining to their parents that they will be taking it home. Plants with fine hairs are easy to identify in the garden; they have grey or silver foliage that reflects light and heat. Lavender (*Lavandula*) is one of my personal favorites. Wormwood (*Artemisia*), yarrow (*Achillea*) and culinary sage (*Salvia officinalis*) are several other examples. These plants need full sun and good drainage to survive. Many prairie plants have deep tap roots. The advantage of these tap roots are twofold: to help the plant rejuvenate when consumed by grazing animals and to help them weather dry spells. Plants with deep roots systems dry out less quickly than those with shallow roots. A grassland species that is notable for a large tap root is false blue indigo (*Baptisia*).

There are some wonderful cultivars (cultivated varieties) of false blue indigo on the market. ‘Purple Smoke’ has been out for a number of years. It has steel gray stems and robust purple flowers. ‘Carolina Moonlight’ is a more recent introduction that has creamy yellow flowers. The latest addition, ‘Twilite Prairieblues™’, has burgundy flowers highlighted with yellow.

An example of a coastal plant with the same adaptation is sea holly (*Eryngium*). Site and space these plants with care so that you do not have to move them once they have settled in.

In addition to conserving water, there are plenty of other reasons why drought tolerant plants are desirable for the garden. Many, such as tickseed (*Coreopsis*), ornamental sage (*Salvia*), and calamint (*Calamintha*) are long-blooming. Others, such as sea holly and butterfly weed (*Asclepias*) make excellent, long-lasting cut flowers.

A host of drought tolerant plants, including many herbs, are wonderfully fragrant. They attract butterflies and bees yet due to their strong fragrance, they are unattractive to deer. Anise-hyssop (*Agastache*) falls into this category. Two of my favorite cultivars that flower from July until late September are the hot pink ‘Tutti Frutti’ and the smoky purple ‘Black Adder’, which has menthol-scented foliage.

Tips for a Successful Drought-Tolerant Garden:

1. Plan your garden by grouping plants with similar cultural requirements. Place drought-loving plants together to create a low-watering zone in your garden.
2. Site your plants carefully. Drought-tolerant plants will either flop or die in soils that are too rich, have inadequate drainage, or are heavily fertilized. For many Mediterranean plants, it is not the cold but the combination of the wet, water-logged soil with the cold that kills them in the winter. Good drainage is important for drought-tolerant plants.
3. Amend your soil with good organic matter (e.g., compost) before you plant to retain moisture. If you have heavy soil, amend with grit or pea gravel to improve drainage.
4. Substitute ground covers in areas where it is difficult to grow turf; particularly shady areas or narrow sections of your yard.

5. Space plants properly so that they do not compete with each other for root space, water or nutrients.
6. Water wisely. Water early in the morning before the heat of the day to minimize evaporation. Allow nature to do her share; you do not need to water your garden after a heavy rain. Watering by hand at the base of plants, with soaker hoses or with drip irrigation, is highly efficient. Oscillating sprinklers tend to be less efficient, but can be used early in the day.
7. Water deeply and less frequently as opposed to shallow and frequent watering. Deep watering means deeper, more efficient root systems on your plants. Do not water your plants unless they need it. To check, stick your trowel 4 inches into the ground as see if the soil is moist. The rule of thumb is 1 inch per week (approximately 1/2 gallon per square foot).
8. Mulch your garden not only to suppress weeds but also to retain moisture. A 2-3 inch layer of mulch is more than sufficient for most areas of your garden. Shredded pine bark, shredded leaves, and fine gravel are three options that provide very different looks.
9. Weed your garden frequently in the spring. Rather than trying to tackle everything at once, spend 15-30 minutes weeding several times a week. As well as getting the job done, you will be spared of unnecessary back pain and exhaustion. Weeds compete with plants for water and nutrients.
10. Most plants take 1-2 years to establish a good root system. They will need to be watered conscientiously during the first year to establish a healthy root system. Once they are established, you will need to consider your soil conditions as well as the temperature and age of the plant when deciding when to water.
11. Do not fertilize water-stressed plants. The salts in the fertilizer will burn the weakened, water-deprived roots.
12. Use water-retaining polymers (e.g. Terra-Sorb® or Soil Moist™) in your container plantings to absorb and hold water.

13. Look for "reduced maintenance" cultivars and blends of turf grasses including Kentucky bluegrass (*Poa pratensis*), tall fescue (*Festuca arundinaceae*), and fine fescue (*Festuca rubra*) cultivars that have been bred for turf. They tend to have deeper root systems than other turf grasses and will require less water.

14. Have fun designing with drought-tolerant plants. They come in all shapes and sizes and offer a nice selection of textures and colors to experiment with in the garden.

<http://www.nybg.org/gardens/home-gardening/tips/drought-tolerant-plants.php>

Desalinization – to be or not to be!

Source: California Foundation for Agriculture in the Classroom

Material: lined paper or copy of the chart in this lesson, computer to show video clips

Objectives:

- Demonstrate knowledge of the pros and cons of desalinization
- Present an argument and counterargument on the issue of desalinization

Background:

The process of desalinization is fairly complicated and very costly for large scale projects such as pumping ocean water and converting it to fresh drinking water for cities. Students will watch these short YouTube video clips about the process: “Drinking from the Sea”, Explore How and Why Sea Water is Desalinated; and “New Tech Makes Sea Water Safe to Drink”

Procedure:

1. Students will watch the video clips suggested in this lesson
2. They will take notes on the pros and cons of desalinization
3. They will form an opinion based on evidence presented in the video about whether or not desalinization is an effective method of obtaining water

Pros of Desalinization	Cons of Desalinization

GATE:

You are a politician running for office in your county. Your thirsty county has been in a drought for several years. After researching the pros and cons of desalinization, make a one-minute commercial to persuade your voters to take your position on the issue. Make sure to address at least one opposing viewpoint and why you do not agree.

Word Problems

Source: United States Department of Agriculture

Use the information provided to complete the word problems. Show all work.

1. If the average age of a farmer in California is 58 years old and you are _____ years old, how many years older is the average farmer than you?

2. If California raises 11.4 percent of all agricultural products and Texas raises 7.1 percent of all agricultural products, what percentage do they raise together?

3. In 2002, Hispanic farmers operated 72,349 farms; in 2007 they operated 82,462 farms. How many more farms were operated by Hispanic farmers in 2007 than in 2002?

4. If 86.5 percent of farms are individually or family operated, what percentage of farms are partnership or corporately operated?

5. The 2007 census of agriculture reported 2,204,792 farms in the United States. There are 75,810 fewer farms in 2002 than in 2007. How many farms were there in 2002?

6. In 2014, almost 2 billion pounds of Hass avocados were consumed in the U.S. In 2004, Americans consumed just over 682 million pounds of Hass avocados. About how many more pounds were consumed in 2014?

Word Problems - ANSWER KEY

Source: United States Department of Agriculture

Use the information provided to complete the word problems. Show all work.

3. If the average age of a farmer in California is 58 years old and you are _____ years old, how many years older is the average farmer than you?

$$58-7=51$$

$$58-8=50$$

$$58-9=49$$

$$58-10=50$$

$$58-11=47$$

4. If California raises 11.4 percent of all agricultural products and Texas raises 7.1 percent of all agricultural products, what percentage do they raise together?

$$11.4 + 7.1 = 18.5$$

7. In 2002, Hispanic farmers operated 72,349 farms; in 2007 they operated 82,462 farms. How many more farms were operated by Hispanic farmers in 2007 than in 2002?

$$82,462 - 72,349 = 10,113$$

8. If 86.5 percent of farms are individually or family operated, what percentage of farms are partnership or corporately operated?

$$100 - 86.5 = 13.5$$

9. The 2007 census of agriculture reported 2,204,792 farms in the United States. There are 75,810 fewer farms in 2002 than in 2007. How many farms were there in 2002?

$$2,204,792 - 75,810 = 2,128,982$$

10. In 2014, almost 2 billion pounds of Hass avocados were consumed in the U.S. In 2004, Americans consumed just over 682 million pounds of Hass avocados. About how many more pounds were consumed in 2014?

$$2,000,000,000 - 682,000,000 = 1,318,000,000$$

Food Math is Fun

Name _____

KEY

	=	6
	=	4
	=	3
	=	27
	=	1

a.		x		/		=	
b.		/		-		=	
c.		/		x		=	
d.		x		-		=	
e.		x		+		=	

Your turn—Use the product in the key to write your own number sentences. Remember to draw a picture of the products you have selected.

f.

g.

Suggested Non-Fiction books

One Well: The Story of Water on Earth by Rochelle Strauss

A Drop of Water: A Book of Science and Wonder by Water Wicks

Cloud Dance by Thomas Locker

What Makes It Rain? The Story of a Raindrop by Keith Brandt

What Makes It Rain? By Osborne Starting Point Science

The Drop in My Drink, The Story of Water on Our Planet by Meredith Hooper

The Snowflake: A Water Cycle by Neil Waldman

Down Comes the Rain by Franklin Branley

Follow the Water from Brook to Ocean by Arthur Dorrus

A Drop Around the World by Barbara McKinney

Suggested Fiction

A Long Walk to Water by Linda Sue Park

What's Growin' On? Let's Look at Water

Activity Answer Key

Page 3: Water: A Fact of Life

- Unscramble the letters to each word to decode the message.
ssue: uses
rewat: water
vilgni: living
Every living thing uses water.
- True or False Activity
TRUE: Water is the only substance on Earth that exists in three states of matter: solid, liquid, and gas.
FALSE: California usually gets a lot of rain during the summer.
TRUE: All of the food we eat has been grown using water.
TRUE: Water is very important to California's economy.
TRUE: It takes a lot of water to make a slice of pizza.
TRUE: The average person uses 196 gallons of water per day to carry out normal activities.
FALSE: It doesn't take any water to produce a chicken egg.
- Why does water matter to you?
How many total ounces of water is this per day? 8 glasses/day x 8 ounces/glass = 64 ounces/day
Per year? 64 ounces/day x 365 days/year = 23,360 ounces/year
How many gallons of water do you drink in a year? 23,360 ounces/year x 1 gallon/128 ounces = 182.5 gallon/year
How many gallons of water would your whole class drink in a year? For an average class size of 30 take 182.5 gallons/student/year x 30 students = 5,475 gallons/year
- Tech Check (Example):
Two facts about Tomatoes from the text:
 1. There are different varieties for processing and fresh tomatoes.
 2. Processing tomatoes have a thicker skin which helps during transportation.Two facts about Tomatoes from the one-minute radio broadcast:

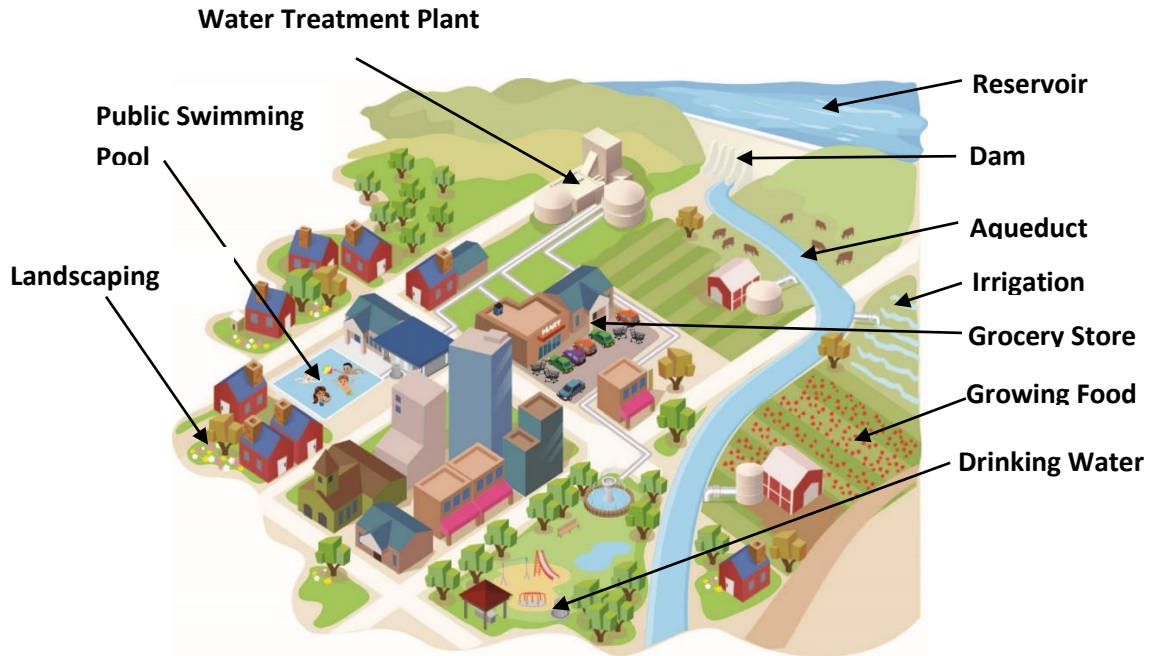
1. California farmers produce about 2 billion pounds of tomatoes each week during the summer.
 2. Tomatoes contain Lycopene, an important cancer fighting antioxidant.
- What do all crops need to grow? *Sun, Water, Soil*

Page 4: What's in your WATERSHED?

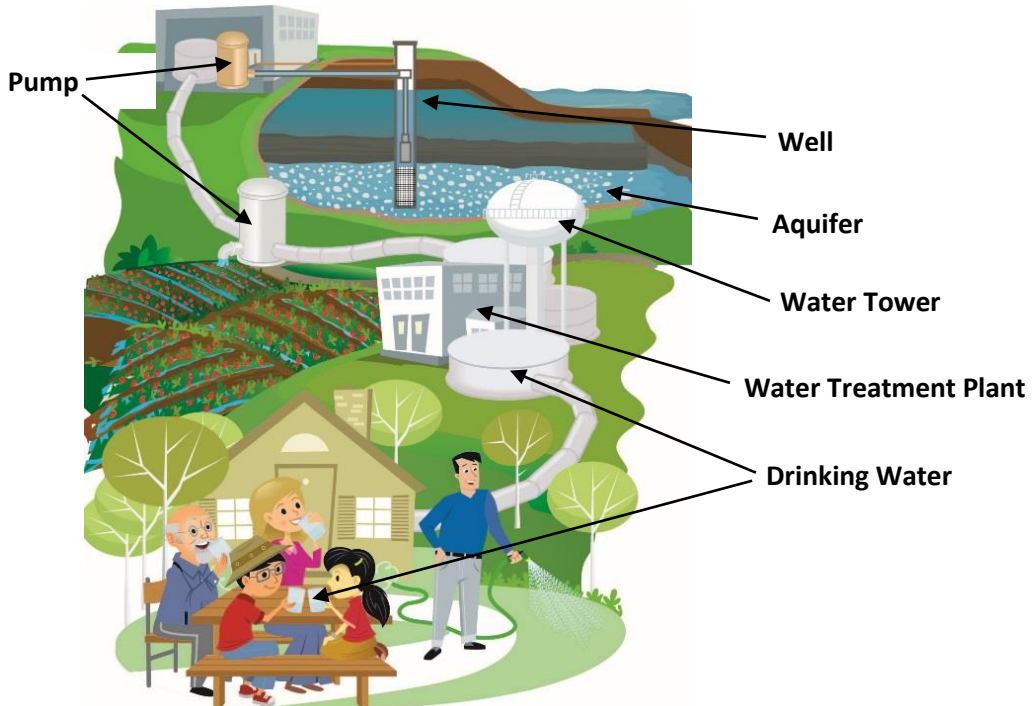
- 8. Why should we be concerned about pollution? *Example answers may include that pollution can get into the water. Plants, animals and people need water to grow and live. Water is necessary for life. What can you do to prevent pollution in your watershed? Example answers may include that trash and recyclables should always be thrown away properly. People could walk or ride bicycles instead of driving to school or work. Businesses should be monitored to make sure they are not polluting the air. People should take care at home, school, work, and in their communities to make sure they keep their cities and towns clean and free of pollution.*
List of things you may find in a watershed: examples may include the following – forest, lake, river, creek, farms, towns, people, pets, pollution
- Tech Check: What watershed do you live in? *Example watershed – Rainfall gathers in ponds and lakes. Runoff flows into streams and creeks which travel downstream and form larger rivers, eventually flowing out to the Pacific Ocean.*
- Water Cycle Activity:
Heat from the sun warms the water in oceans and lakes. Some water turns into water vapor, which is a gas. This process is called evaporation. When water evaporates from the leaves of plants, it is called transpiration. As the water vapor rises into the atmosphere, it cools and forms clouds. This is called condensation. Rain, snow, hail, and sleet are forms of precipitation that fall from clouds when water droplets in the cloud become too heavy to be suspended. In California, about 70% of our surface water falls north of Sacramento. Much of this land is forestland. Some of the rain and melted snow seeps into the ground by percolation and becomes groundwater. The roots of trees and other plants soak up some of the water from precipitation, while other water runs off the surface of the ground into creeks, rivers, and oceans. This is called runoff. Water is used by animals and is also used on farms to water crops grown for people in towns and cities.

Page 5: Where do we get our Water?

- Activity: How Do We Get Our H₂O?
Ways we get surface water



Ways we get groundwater



- Water wise
How many gallons of water could be saved in a week if each person in your house did this? 8 gallons/day x 365 days = 2,920 gallons

Page 6: Drought

- Weather and Climate:
Do you think you would find the same types of plants and animals living in these two different climate zones? Why or why not? *Plants and animals have adaptations to live in their environments. The environment includes the climate. Hot, dry regions would have plants and animals that don't need as much water or can conserve water. Examples would be cactus or lizards. In the coastal mountain areas you would find plants and animals that require a cooler, wetter climate. Examples would be redwood trees and bears.*
- Activity Cause and Effect
-Due to the lack of rain during a drought, grasses and other plants in the environment turn brown and die. This means less food for animals like deer and cattle.
-In 2014, California farmers did not get enough water to grow as much food as they normally do and had to leave more than 410,000 acres unplanted, which meant that 17,000 people lost their jobs.
-There is a lack of snow during the winter and very little melted snow running off the mountains in the spring and summer. Lake levels drop very low and rivers and creeks begin drying up. People and animals have less water to live on.
- Every drop counts. How can you help? *Answers could include the following:*

Task	# per day	Water saved	Total per day
Take a five minute shower instead of a ten minute shower	1	25 gallons	25 gallons
Fill the bath ½ way full instead of full	0	12 gallons	
Turn water off when brushing teeth	2	6 gallons	12 gallons
Don't use toilet as a wastebasket	0	5 gallons per flush	
Total saved			37 gallons

Task	# per week	Water saved	Total per week
Only wash full loads of laundry	2	16 gallons per load	32 gallons
Only run the dishwasher when full	1	8 gallons per load	8 gallons
Water outdoor landscaping only during cool hours of morning and evening	2	25 gallons each time you water	50 gallons
Place mulch around plants to reduce evaporation	2	25 gallons each time you water	50 gallons
Total saved			140 gallons

How much water would be saved if everyone in your house practiced these water saving measures each day? For a family of 5 at 37 gallons per person, $5 \times 37 =$ 185 gallons saved. Each week? $185 \text{ gallons} + 140 \text{ gallons} =$ 325 gallons saved.

- Activity – How does the drought affect you?
Possible answers could include: Prices for food can be higher, certain foods may not be available, quality of food may not be as good
- Tech Check
Answers will vary, go to the website to calculate your usage and compare it to a friend's.

Page 7: Preserving our Liquid Gold

- Solar Still Activity
 - 5a. Yes. *It is fresh.*
 - 5b. *As the water heated up, it evaporated.*
 - 5c. *The plastic wrap collected the condensation.*
 - 5d. *The salt stayed in the bowl.*
 - 5e. *Answers will vary.*
 - 5f. *Place the solar still in a warmer location.*

- Letter to a Farmer
Math challenge: *In our example, tomatoes need 0.24 inches of water/day and the irrigation system applies 0.046 inches of water per hour. To find out how many hours per day you should run the irrigation system start with an equation: 0.24 inches of water per day = 0.046 inches per hour x N number of hours, so $N = 0.24/0.046 = \underline{5.2 \text{ hours/day}}$*

Center Pages 8-9: Our Food Grows Where Water Flows

- Activity:
3. *Northern California has the most lakes and rivers.*
4. *Most precipitation is in northwest California. The least precipitation is in southeast California.*
6. *The California aqueduct carries water from Sacramento to Southern California.*
7. *Most aqueducts are in Southern California because this is the driest region in California.*
10. *Sacramento River, American River, Cosumnes River, San Joaquin River*
12. *Getting water to these areas is important because growing food requires water.*
13. *Example five foods that farmers supply to your grocery store: almonds, grapes, strawberries, walnuts, lettuce.*

Page 10: More Crop per Drop

- Activity – Three Irrigation Types
Answers from left to right: Surface, Sprinkler, Micro

Page 12: Good, Clean Water

- Activity: Farm Wastewater Treatment/City Wastewater Treatment
Possible Venn Diagram-

<u>Farm Wastewater</u>	<u>Similarities</u>	<u>City Wastewater</u>
Tail water recovery system	Filtration system	Sewer system
Drainage water collected	Remove sediment	Wastewater treatment plant
	Remove plant nutrients	Large debris removed
		Addition of chlorine, UV light, microfiltration

Page 13: Water is Energy

- Acre-foot Activity
 1. How many gallons is this? We know that 325,851 gallons = 1 acre-foot so
 $325,851 \text{ gallons} \times 3,500,000 \text{ acre-feet of water} = \underline{1,140,478,500,000}$ or 1 trillion, 140 billion, 478 million, 500 thousand gallons!!
 2. How many acre feet is this? We know one acre-foot fills an area 12 inches deep, but we require 42 inches deep, so divide 42 by 12 which equals 3.5. $3.5 \text{ acre-feet} \times 325,851 \text{ gallons/acre-feet} = \underline{1,140,478.5 \text{ gallons}}$. How many gallons to grow two acres of your favorite fruit? $1,140,478.5 \times 2 = \underline{2,280,957 \text{ gallons}}$
 3. How many acre-feet of water does a family of six use in a year? Since a family of 4 uses one acre-foot per year, find out how many acre-feet per person. Each person would use $\frac{1}{4}$ acre-foot per year. Multiply $\frac{1}{4} \times 6 = \underline{1.5 \text{ acre-feet used per year for a family of 6}}$.
How many gallons is this? Multiply $1.5 \text{ acre-feet/gallon} \times 325,851 \text{ gallons} = \underline{488,776.5}$ or 488,777 gallons
- How does hydroelectric power work?
 - Reservoir-stores water
 - Penstock-carries water from the dam to the turbines
 - Turbine-blades are turned by the force of the water coming down the penstock
 - Generator-generates electricity when rotated by the spinning turbines
 - Powerlines-conduct electricity from the power plant to homes, farms, and businesses.
 - Outflow- water that flows through the dam and power plant is returned to the river.

Page 14: How Would You vote?

- Proposition 1: PASSED