(pre-tour)

WATER YOU NEED

CONCEPTS:

Students will learn:

- how the hydrologic cycle works and why it is important
- how much fresh water is available on Earth
- how much water we use for various activities on a daily basis

Activity Overview:

Students will:

- construct a simple water cycle model
- calculate the amount of fresh water available on Earth
- begin a survey of personal water use

Vocabulary:

- condensation
- evaporation
- hydrologic
- percolation
- precipitation
- surface runoff
- transpiration

Time Requirement:

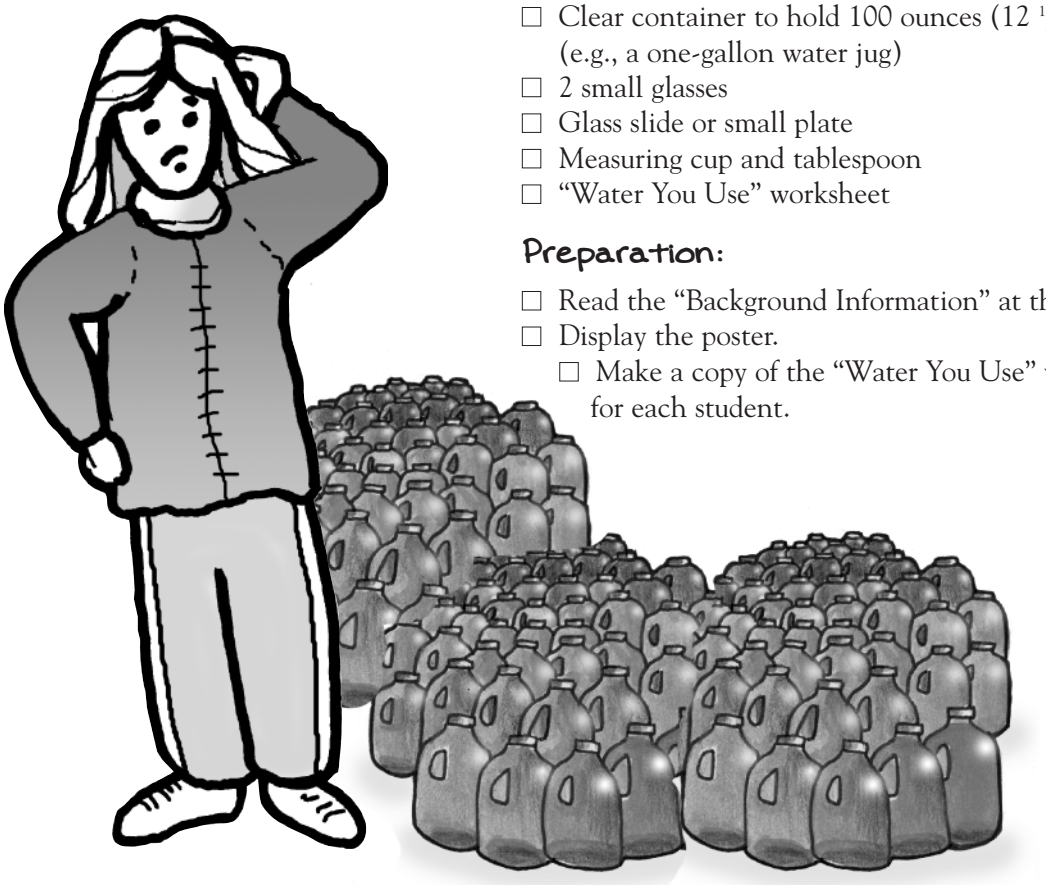
- Approximately 45-60 minutes

Materials:

- ☐ "River In A Concrete Box" poster
- ☐ *(Optional for water cycle demonstration)* small aquarium, gravel, soil, moss, water, sprayer, sheet of tempered glass or plexiglass the length of the aquarium but slightly less than the width of the aquarium
- ☐ Clear container to hold 100 ounces (12 1/2 cups) of water (e.g., a one-gallon water jug)
- ☐ 2 small glasses
- ☐ Glass slide or small plate
- ☐ Measuring cup and tablespoon
- ☐ "Water You Use" worksheet

Preparation:

- ☐ Read the "Background Information" at the end of this lesson.
- ☐ Display the poster.
- ☐ Make a copy of the "Water You Use" worksheet for each student.



PROCEDURES

I. REVIEW THE HYDROLOGIC CYCLE

(approximately 20 minutes)

A. Ask students where their water comes from. Allow all answers, such as *"from the faucet, through pipelines, from the water company, from a lake or reservoir, from rain."*

B. Ask if the water they get and use every day is "new" or "used." Explain that there is no "new" water, that the water they use is the same water used by dinosaurs, early Native Americans, pilgrims, their grandparents. Point out that the water we have now is all the water we're ever going to have; it just keeps going round and round in a cycle.

C. Write the following words on the chalkboard:

- *Evaporation*
- *Transpiration*
- *Condensation*
- *Precipitation*
- *Surface Runoff*
- *Percolation*

D. Display the **"River In A Concrete Box"** poster and use it as a guide to discuss the hydrologic (water) cycle according to the level of your students.

- Have **younger students** point out the places on the poster where each step takes place as you define the term.
- Have **older students** define the terms and explain the importance of each step in the cycle.

Evaporation – Water in lakes, oceans, rivers, as well as other places on the ground gets heated by the sun, turns to vapor, and rises into the sky to form clouds.

Transpiration – Plants give off water vapor through tiny pores, called stomas (or stomata), in their leaves.

Condensation – The water vapor in the clouds cools and changes back into liquid water.

Precipitation – The condensed water vapor gathers together, becomes heavy, and falls to earth as either rain, snow, hail, sleet, or mist.

Surface Runoff – On the ground, water flows into rivers, lakes, and oceans, either naturally or through storm drains.

Percolation – Some of the precipitation soaks into the ground, where it is used by vegetation or stored as groundwater that we can pump up and use.

E. *(optional)* Demonstrate the water cycle by having students construct a model following the directions below:

*(**Note:** This model can also be used in Lesson 3 after the tour of the wastewater treatment plant.)*

1. Put a couple inches of gravel into one end of an aquarium. Build the gravel up against the end of the aquarium to create a slope toward the other end. Cover the gravel with a couple inches of soil.
2. Pour water into the other end of the aquarium to create a lake. Mark the level of the lake on the side of the glass.
3. Plant some moss in the soil and mist the plants and the soil with water to dampen them.
4. Place the edge of a piece of tempered glass or plexiglass into the aquarium so that it rests on the soil; lay the other end of the glass against the top of the opposite end of the aquarium.
5. Place the aquarium near a window that receives indirect light and leave it there for several days.

F. Have students predict what will happen in the model. As the water begins to evaporate and condense, have them relate the process to the water cycle. Also have students note any changes that are taking place in the landscape *(for example, lake level falling, streams or pools forming, water gathering underground)*.

II. DEMONSTRATE FRESH WATER AVAILABILITY

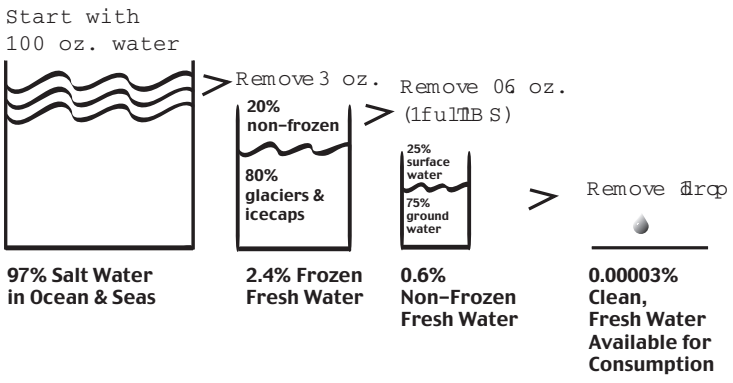
(approximately 15 minutes)

A. Show students a world map or a globe and ask the following questions:

1. **How much of the Earth is covered with water?**
   (Almost three-quarters of the Earth is covered with water.)
2. **How much of this water do you think is clean, fresh water available for us to consume?**
   *(**Note:** Write down students' guesses to compare with the actual number they discover at the end of the demonstration.)*

B. Tell students that they are going to determine how much water on Earth is available for us to use. Fill, or have students fill, a large clear container (e.g., one-gallon water container) with 100 ounces (12 1/2 cups) of water. Tell students that this water represents all the water on Earth.

C. Ask students where most of the water on Earth is located. *(In oceans and seas.)* Tell students that 97% of the water on Earth is salt water; only 3% of our total amount of water is fresh water. Have students calculate 3% of the 100 ounces (3 ounces) and then use the measuring cup or the tablespoon (2 tablespoons per ounce) to remove 3 ounces of water and place it in a glass. Label the large container of water "Salt Water in Oceans and Seas."



D. Tell students that not all of the water in the glass – the 3% – is available for us to use. Ask why some of the water is not available. *(Water is frozen in glaciers and icecaps.)* Explain that 80% of the water in the glass is actually frozen. Have students calculate how much water should remain in the glass to represent glaciers and icecaps and how much should be removed as non-frozen, fresh water.

(80% of 3 ounces = 2.4 ounces
20% of 3 ounces = 0.6 ounce)

Have students remove just over half an ounce (about 1 full tablespoon) of water and put it into another glass. Label the glass with 2.4 ounces of water "Glaciers and Icecaps."

E. Hold up the glass with 0.6 ounce of water in it and tell students that about 1/4 of this water is surface water – that is, water on top of the ground in lakes, rivers, and steams. The remaining 3/4 of the water is underground in basins called aquifers. Ask students if they think all the surface water and groundwater is available for us to use.
(No. Some of the water is polluted and some is too far underground or otherwise too difficult to get out of the ground.)

F. Remove one drop of water (0.5%) and place it on a slide or small plate. Explain that this drop represents the total of clean, fresh water available for human consumption. Point out that this drop is 0.00003% of all the water you started with.

G. Compare the amount with the guesses students made at the beginning of this demonstration. Discuss the findings using the following questions:

1. **Why do we need to manage our water supply?**
   (With no new water available, and with the population growing, it is important that we keep our water clean.)
2. **Is the available water evenly distributed around the world?**
   (No. Climate and geography, as well as other factors, affect the distribution of water.)
3. **Is all the fresh, clean water available all the time?**
   (No. Sometimes we have droughts, when it doesn't rain much. Sometimes water supplies become contaminated.)

III. DETERMINE PERSONAL WATER USE

(approximately 15 minutes)

A. Ask students why water is so important. Be sure to point out that besides all the uses we have for water, our bodies are about 70% water, and we need to constantly replenish that water by drinking. Tell students that they could live only a couple days without water.

B. Divide students into groups. Explain that when you say "start," they will have 60 seconds to list all the uses of water they can think of. Remind students that water is used in places other than in the home, for example to fight fires, water crops, make clothing.

C. At the end of 60 seconds, ask each group to read its list of water uses. Make a list on the chalkboard, perhaps categorized by where the water is used. For example:

- home *(flushing toilets, showering, washing clothes, cooking, watering lawns)*
- community *(fighting fires, watering parks, cleaning streets)*
- business *(making clothes, manufacturing products, cleaning machines)*
- agriculture *(irrigating crops, raising animals)*
- recreation *(water slides, swimming pools, amusement parks)*
- environment *(for rivers, lakes, wetlands; for plants and wildlife)*
- transportation *(in cars, trains, air planes; for boats to sail)*

Once all groups have shared, ask if anyone can think of other uses to add to the list.

D. Hand out to each student a **"Water You Use"** worksheet. Explain that for one entire day – perhaps a weekend day when they are home – they are to keep track of how many times they do each of the activities listed on the sheet. Point out that for the "shower," they are to list the number of *minutes* in the shower, not the number of showers they take. Also point out that at the bottom of the survey, they should list any other ways they use water that day. Tell them they will fill in the numbers of gallons for each of those activities later.

E. Ask students to guess what their total number of gallons will be for the day, and to write their guessstimates in the space provided on the worksheet. Tally students' guesstimates, perhaps within ranges, and keep a record to later compare their guesstimates to their actual figures.

WATER YOU USE

(record for one day)

Name: _____ Date: _____

I guess that I will use _____ gallons of water.

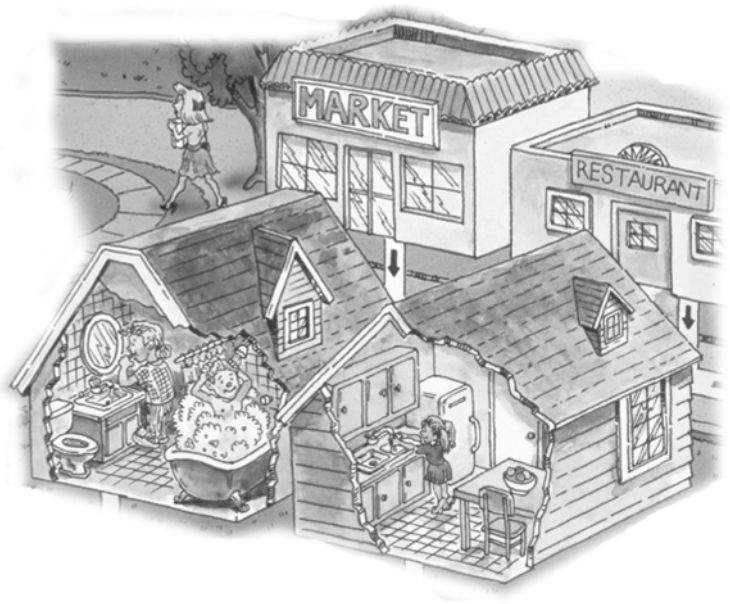
Number of TOILET flushes	___ x	4 gallons	=	____ gallons
Number of minutes in SHOWER	___ x	4 gallons	=	____ gallons
Number of BATHS with tub full	___ x	30 gallons	=	____ gallons
Number of BATHS with tub half-full	___ x	15 gallons	=	____ gallons
Number of TEETH BRUSHINGS with water left on	___ x	4 gallons	=	____ gallons
Number of TEETH BRUSHINGS with water turned off	___ x	1/2 gallons	=	____ gallons
Number of HAND or FACE WASHINGS	___ x	2 gallons	=	____ gallons
		TOTAL		____ GALLONS

Other uses of water:	Approximate number of gallons:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

GRAND TOTAL FOR ONE DAY: ____ GALLONS

Amounts are approximate for Southern California.

F. Tell students on what day they are to bring the worksheets back to class (Lesson 4 after the tour of the wastewater treatment plant).



EXTENSIONS

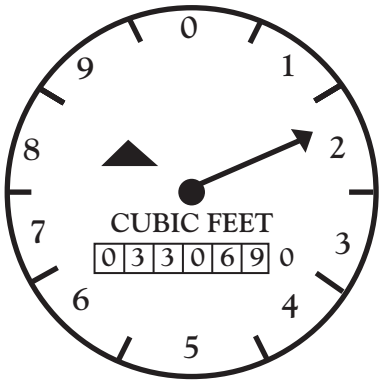
- **Interview grandparents.** Develop a questionnaire about water use and interview grandparents, or people of that age, to compare water use then and now. Do we use more water today? Why or why not? Do we use water more efficiently in some ways? Less efficiently?

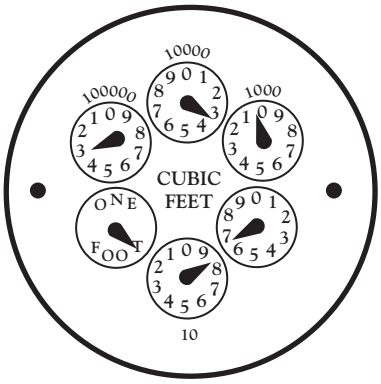
- **Conduct a family use water survey.** Give a copy of the "Water You Use" worksheet to each member of the family and have them keep track of the water they use for one day or one week.

- **Conduct a shower experiment** to see how much water is used. Before taking a shower, close the drain so that the water collects in the bathtub. (Obviously, this can be done only in a tub shower not a stall shower.) Time the length of your shower. Then measure the amount of water in the tub by using a gallon bucket to empty the tub. (Use the water on your lawn or plants!) How many gallons were used per minute of showering? How could you use less water?

- **Research how water is used around the world.** How much water is used in various countries? How does their use of water differ from ours? Why?

- **Read water meters** to determine exactly how much water your family is using. Meters are usually located near the curb under a concrete lid. Use a large screwdriver to carefully lift the lid. (Watch for hiding spiders or insects!) On a straight-reading meter, which usually displays 6 numbers, read the first four numbers shown across in the straight line of boxes. Ignore the last two numbers, sometimes shown in a different color. On a circular-reading meter, which has six little dials in a circle, start with the dial labeled 100,000, then 10,000, then 1,000. Ignore the 100 and 10 dials. Record each number that the hand points to. If the hand is between two numbers, record the lower number. Note the date and time you read the meter. Read the meter again exactly one day later, one week later, and one month later. Calculate how much water was used. (The meters record units of water. Each unit is 100 cubic feet of water, which equals 748 gallons.)





BACKGROUND INFORMATION

Without water, life would not exist on Earth. Our bodies need water to function properly. Plants and animals need water to live and grow. But water does more than just keep us alive. We use it everywhere:

- in homes and businesses – to flush toilets, take showers, cook food
- in industries – to make products and clean machinery
- on farms – to grow crops and water animals
- in communities – to fight fires and clean streets
- at power plants – to generate electricity.

The Hydrologic Cycle

We use a lot of water, but there is only a fixed supply of water on Earth and in its atmosphere. The same water is simply recycled in the hydrologic cycle – the water cycle. Powered by the sun's heat and energy, water evaporates from oceans, lakes, rivers, streams, and any other "pools" of water. Water vapor also rises into the air from plants through a process called transpiration. All this water vapor cools and condenses into tiny droplets that gather and form clouds or fog. Finally, when the clouds meet cool air over land, precipitation in the form of rain, hail, sleet, or snow is triggered, and water returns to the land or sea.

Once on the ground, water flows downhill as runoff, flowing into lakes, streams, rivers, and the ocean. Some water soaks into the ground, where it is used by plants or held in groundwater basins – aquifers. Some of the water may evaporate quickly; some may stay underground for years.

The system has no beginning or end. No water is lost or gained, but the amount of water available for use may fluctuate widely, sometimes producing floods, sometimes droughts. Water that has evaporated from one point on the Earth's surface may fall as precipitation thousands of miles away.

The water cycle has been going on since the first clouds formed and the first rains fell, transferring water over and over from the surface of the land and water into the atmosphere and back again.

Water Availability

Water covers about 70 percent of the Earth's surface, but people can't use most of that water. Sea water constitutes about 97% of the planet's total water supply, and salt water cannot be used for drinking, for bathing, or for irrigating crops. Approximately another 2% is frozen in icecaps and glaciers. Of the 1% of water that is left, some is deep underground and some is contaminated. That leaves only about 0.00003% of all water on Earth as clean, fresh water that we can use.

The water supply on Earth is fixed, but as the world's population grows, the demand for water is increasing. We cannot increase the water supply; however, we can use it more efficiently.

Water Use

U.S. citizens use about 100 to 200 gallons of water per day per person for ordinary household use. Citizens of other nations often use much less.

Water is, of course, used in all sectors of society – residential, business, industry, agriculture. Statewide in California, the highest use of water is for agriculture – 85%. But in the metropolitan Los Angeles region, residential water use constitutes 60% of the total; therefore, most of our water demand comes from everyday personal water uses – from brushing teeth and bathing to watering lawns and washing cars. Typically, here's how much water is used for daily activities:

Getting a drink	1/4 gallon
Washing hands	2 gallons
Brushing teeth with water on	4 gallons
Brushing teeth with water off	1/2 gallon
Flushing toilet	4 gallons
Shaving with water on	10 gallons
Shaving with water off	1/2 gallon
Tub bathing	20 gallons
Showering	30 gallons
Cooking	6 gallons
Cleaning house	7 gallons
Washing dishes by hand	30 gallons
Washing dishes in dishwasher	12 gallons
Washing clothes	30 gallons
Watering lawn	180 gallons

WATER YOU USE

(record for one day)

Name: _____ Date: _____

I guess that I will use _____ gallons of water.

Number of TOILET flushes	**____ x**	**4 gallons**	**=**	**_____ gallons**
Number of minutes in SHOWER	**____ x**	**4 gallons**	**=**	**_____ gallons**
Number of BATHS with tub full	**____ x**	**30 gallons**	**=**	**_____ gallons**
Number of BATHS with tub half-full	**____ x**	**15 gallons**	**=**	**_____ gallons**
Number of TEETH BRUSHINGS with water left on	**____ x**	**4 gallons**	**=**	**_____ gallons**
Number of TEETH BRUSHINGS with water turned off	**____ x**	**1/2 gallons**	**=**	**_____ gallons**
Number of HAND or FACE WASHINGS	**____ x**	**2 gallons**	**=**	**_____ gallons**
		TOTAL		**_____ GALLONS**

Other uses of water:	**Approximate number of gallons:**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

GRAND TOTAL FOR ONE DAY: _____ GALLONS

Amounts are approximate for Southern California.