

# Energenius® Out-of-School Time Program

Activity Guide 3

# Water and Energy

Activities on the Water Cycle and Connections  
Between Our Use of Energy and Water



## Introduction

*Water and Energy* is a series of exercises for children and youths who attend out-of-school time (OST) programs. It is designed to encourage participants to think about how water is used, where it comes from, and how to conserve this valuable natural resource.

Children and youths will be introduced or reintroduced to the natural water cycle. They will also learn about what is called the human-made water cycle. They will also explore how water is used in their homes and its connection to energy use. The activities focus on conserving water, identifying wasteful behaviors, and learning valuable water-saving tips.

A key point of these activities is that when water is wasted, energy is wasted as well. And when energy is wasted, water is wasted.

## Guide to Activities

The three activities in *Water and Energy* can be used as standalone units or as part of a larger study of water and energy. Each activity is designed to be completed in three to six sessions. Overviews of activities are provided, along with information pertaining to objectives, preparation, materials needed, and vocabulary.

Written materials that can be taken home to parents, guardians, and other caregivers are also included in the *Water and Energy* program. This includes the Home Energy Information Packet that should be distributed to all participants in the program.

## Training

*Water and Energy* is provided as a resource for OST programs and is offered along with training by the California School-Age Consortium for OST staffs to implement these activities.

The four Energenius Out-of-School Time Program guides and training were developed through a partnership between Pacific Gas and Electric Company and the California School-Age Consortium.



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# Activity 1:

## Water Cycles

### Overview:

In this activity, children and youths are introduced to the water cycle process found in nature and the human-made water cycle. Through interactive activities, they will explore where water comes from and where it goes after it disappears down the drain. They will also participate in a hands-on activity that illustrates how wastewater is purified and treated.

### Objectives:

- Children and youths will be able to explain the natural water cycle.
- Children and youths will be able to demonstrate how water is treated in wastewater treatment plants.
- Children and youths will be able to tell why when water is wasted energy is also wasted.

### Preparation:

- Read through the entire activity, making adjustments as necessary for the age(s) of the children and youths, group size, and session time.
- Make copies of **Around and Around**, **Wastewater Treatment Plant Diagram**, **Wastewater Demonstration**, and **Saving Water at Home** (Handouts 1 through 4) for each child or youth.

### Materials:

- **Around and Around** (Handout 1)
- **Wastewater Treatment Plant Diagram** (Handout 2)
- **Wastewater Demonstration** (Handout 3)
- **Saving Water at Home** (Handout 4)
- Kitchen colanders
- Cheesecloth or sieves
- Straws
- Coffee filters
- Dirt, sticks, small rocks
- Empty pitchers or containers

### Vocabulary:

**condensation** – The process in which water vapor changes its physical state from vapor to a liquid.

**evaporation** – (As a part of the water cycle) Evaporation occurs when the sun heats up water in rivers, lakes, and oceans and turns it into water vapor or steam. Water vapor or steam rises into the atmosphere.

**precipitation** – Water falling from the sky to the ground in the form of rain, snow, sleet, or hail.

**runoff** – Precipitation that does not get absorbed into the ground or that evaporates.

**sewer** – An underground system of pipes.

**transpiration** – Water vapor given off by plants into the atmosphere. Most transpiration happens during the day.

**wastewater** – Water that has been used and contains household or industrial waste products.

**wastewater treatment** – The process of purifying and treating wastewater.

**water cycle** – A continuing process in nature of water circulating through the Earth and its atmosphere.

**water vapor** – A state of water when it is a gas and not a liquid or solid.

# Activity Procedure

1. Ask students if they know what happens to a rain puddle when the sun comes out. Explain that the water in a puddle doesn't disappear, but continues on its journey through the water cycle.
2. Point out that water is a limited natural resource. Although about 71% of the Earth is covered with water, only about 1% is freshwater and usable by humans.
3. Tell the group that there is something unique about the different forms (physical states) in which water can be found. Explain that ice cubes are water in a solid state and the water they drink is in a liquid state. Water vapor or steam is when it is a gas and not a liquid or a solid. Ask students if they have seen water boil away and become steam or watched a rain puddle vanish when the sun came out.
4. Introduce or review the following vocabulary related to the natural water cycle.
  - a. precipitation – Water falling from the sky to the ground in the form of rain, snow, sleet, or hail.
  - b. evaporation – (As a part of the water cycle) Evaporation occurs when the sun heats up water in rivers, lakes, and oceans and turns it into water vapor or steam. Water vapor or steam rises into the atmosphere.
  - c. transpiration – Water vapor given off by plants into the atmosphere. Most transpiration happens during the day. (Water vapor is when water is in the state of a gas, and not a liquid or a solid.)
  - d. condensation – The process in which water vapor changes its physical state from vapor to a liquid.
  - e. runoff – This is precipitation that did not get absorbed into the ground nor did it evaporate.
5. Separate the children and youths into small groups to work together to explain and/or act out a part of the water cycle. Provide copies of **Around and Around** (Handout 1), which has a diagram of the water cycle and a short introduction.
6. Assign or let the groups decide on which part of the water cycle they want to present. There should be a presentation on condensation, precipitation, evaporation, transpiration, and runoff.
7. Commend the groups on their presentations and also on how they have worked together as a team on this activity.

## Debrief Questions:

- a. What was one thing you learned about the water cycle?
- b. Why do you think it's important for us to know about the water cycle?
- c. Do you have any questions about the water cycle you would like to ask?

**Note: If you can't answer their questions right away, tell them that you'll find out and let them know later.**

## Modification Tip:

There could be many in the group who have already studied the water cycle, and for them this activity is a review. They could be asked to identify online resources and print materials to help explain the water cycle for the younger students in the group.





# Human-Made Water Cycle

1. Ask the group if they know where all the water they use in their homes or at school goes after it is used. Tell the group that we're going to talk about where our water comes from, where it goes after it is used, and how our personal choices can conserve both water and energy.
2. Explain that water goes down the drain after it is used and is now called wastewater. Wastewater must be cleaned and treated so it's safe to return to the natural water cycle.
3. Review the typical wastewater treatment steps, using the **Wastewater Treatment Plant Diagram** (Handout 2).
  - a. Wastewater leaves buildings through sewer lines, where it goes to a wastewater treatment plant.
  - b. Pre-treatment includes removing large and small debris such as sticks, plastic containers, small stones, marbles, and gravel.
  - c. Primary treatment tanks remove other small particles and contaminants.
  - d. Aeration tanks add oxygen or air back into the water.
  - e. Secondary treatment tanks provide additional filtration.
  - f. Finally, the wastewater is treated with disinfectants and returned to a river, lake, or ocean. From there it becomes part of the natural water cycle again.

## Debrief Questions:

- a. Have you ever thought, before today, where your wastewater goes?
- b. How would you explain the difference between the natural and the human-made water cycle?

## Aerial view of a wastewater treatment plant.



# Wastewater Demonstration

1. Explain how the group is going to do an activity that helps explain what happens to wastewater once it leaves our homes or schools.
2. Organize the children and youths into groups of five. Provide each group with four empty pitchers and one pitcher containing water, dirt, sticks, and small rocks.
3. Assign four members of each group a part of the wastewater treatment cycle and distribute the following items:
  - a. Pre-treatment – kitchen colander or sieve
  - b. Primary treatment tank – cheese cloth or sieve with a mesh finer than the colander or original sieve
  - c. Aeration tank – straw
  - d. Secondary treatment tank – coffee filter
4. Assign the fifth member of each group to move the water through the cycle.
  - a. The person moving the water will first pour the dirty water through pre-treatment (kitchen colander or sieve) into a clean pitcher.
  - b. Next he or she will then pour the dirty water into the primary treatment tank through the cheese cloth or sieve into a clean pitcher.
  - c. The next step is the aeration tank, where the group member with a straw will “aerate” the water by blowing bubbles into the water.  
**Note: Aeration should be demonstrated by using clean cups of water that the student blows bubbles into to avoid accidental exposure to contaminants in the dirty water.**
  - d. Finally, the individual responsible for moving the water will pour it into the secondary treatment tank through a coffee filter and into a clean pitcher.
5. Group members should carefully observe the differences in the clarity of the water along the steps in the treatment.
6. As the groups go through each step, have them write on their **Wastewater Demonstration** (Handout 3) sheets observations about what happened to the water after each step.

## Debrief Questions:

- a. What did you notice about the water as it went through the different “treatments”?
- b. What is one thing you learned that you would think about the next time you send water down the drain?
- c. Why do you think it’s important to know about wastewater treatment?
- d. Review that the water we use goes through many steps before it can be used again. This moving, treating, and purifying of water uses a great amount of energy. This energy also costs money. Stress that when water is wasted, we are also wasting energy. When energy is wasted, we are also wasting water.

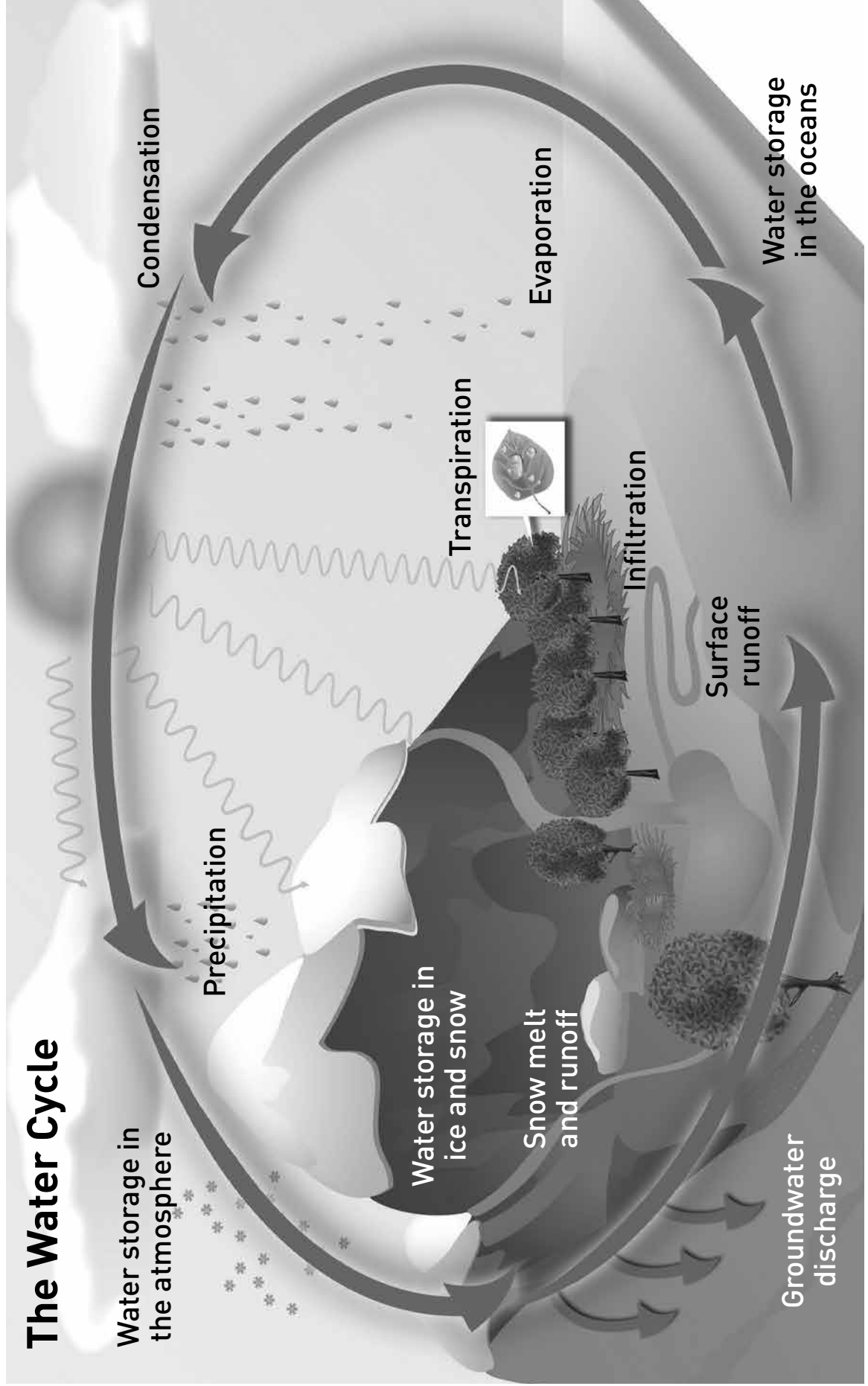
## Take-Home Activity:

1. Remind children and youths that water also needs energy to treat, purify, and transport it to where water is being used. Saving water means saving energy too!
2. Distribute **Saving Water at Home** (Handout 4) and discuss how everyone in the home can take simple actions each day to conserve water.

# Handout 1: Around and Around

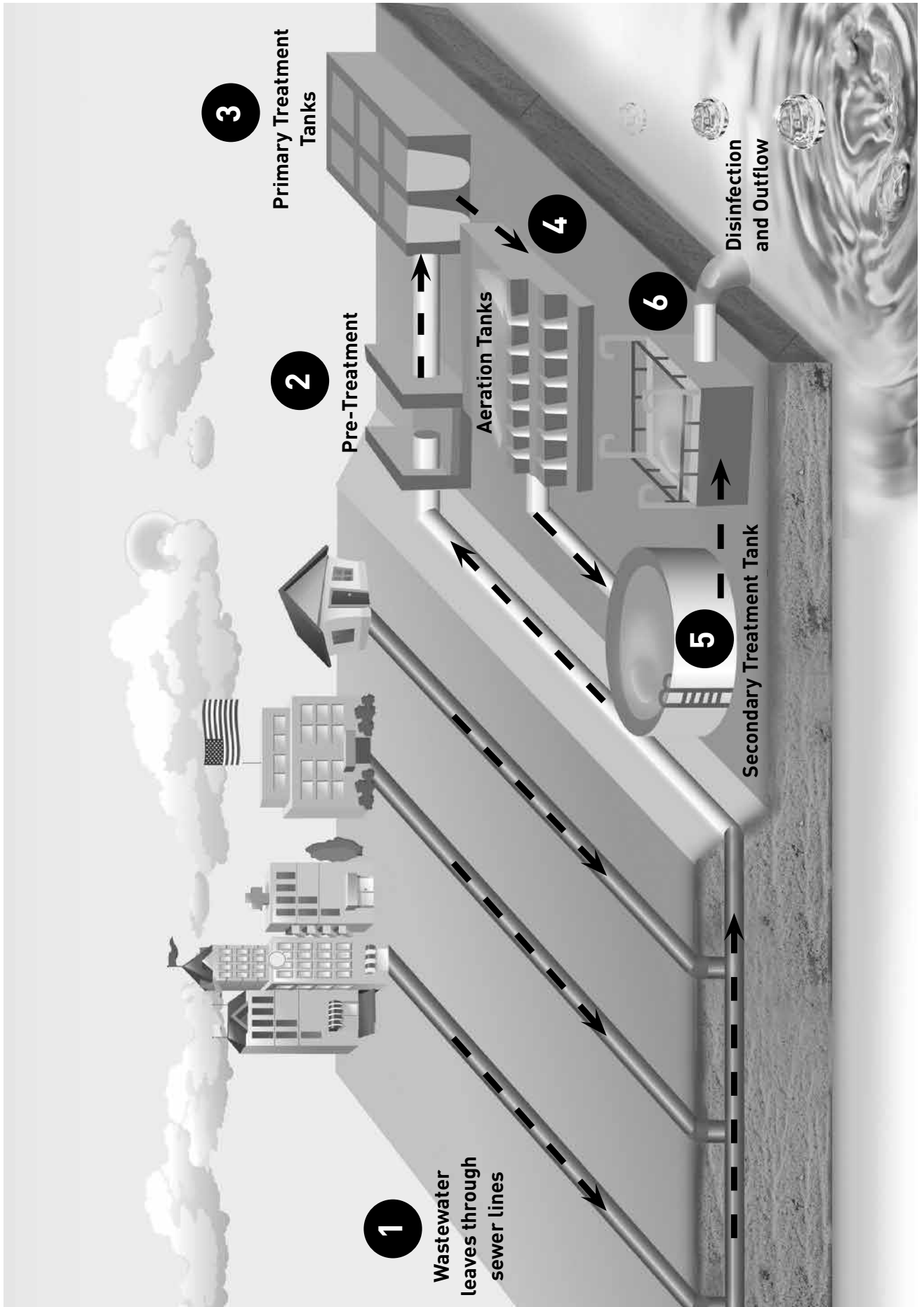
What goes around and around without stopping? It is water! Water is always circulating through the Earth and its atmosphere. This natural process is called the water cycle.

**Directions:** Your group will work together to explain and act out one part of the water cycle. Write your presentation notes on the back of this handout.





# Handout 2: Wastewater Treatment Plant Diagram



# Handout 3: Wastewater Demonstration

While you conduct the wastewater demonstration activity, record your observations on how the water changes during the treatment steps.

Steps:	Observations:	Draw what you see:
Before treatment		
Pre-treatment		
Primary treatment		
Aeration		
Secondary treatment		

# Handout 4: Saving Water at Home

Use this chart to write how you use water in your home and ways you can save water at home.

How I use water at home:	Ways I can save water at home:
Example: Brushing my teeth.	Example: Turn off the faucet while I'm brushing my teeth.

## Activity 2:

# Impacts of Water Use

### Overview:

This activity helps children and youths examine the many ways in which water is used in their homes. They learn how the use of water is connected with energy (electricity and natural gas) and why it's important to save both water and energy. They learn about actions they can take to conserve water and energy.

### Objectives:

- Children and youths will be able to show how their everyday tasks contribute to their home water use.
- Children and youths will be able to identify ways to reduce their impact on the environment by saving water.

### Preparation:

- Read through the entire activity, making adjustments as necessary for the age(s) of the children and youths, group size, and session time.
- Create and post individual signs for the **Water in Our Homes** activity that include the following words written in large print: Dishwasher, Bath, Leaks, Faucets, Shower, Clothes Washer, Toilet.
- Make copies of **H<sub>2</sub>O Global** [Handout 5] for each child and youth.

### Materials:

- Signs for **Water Use in Our Homes** activity
- **H<sub>2</sub>O Global** (Handout 5)

### Vocabulary:

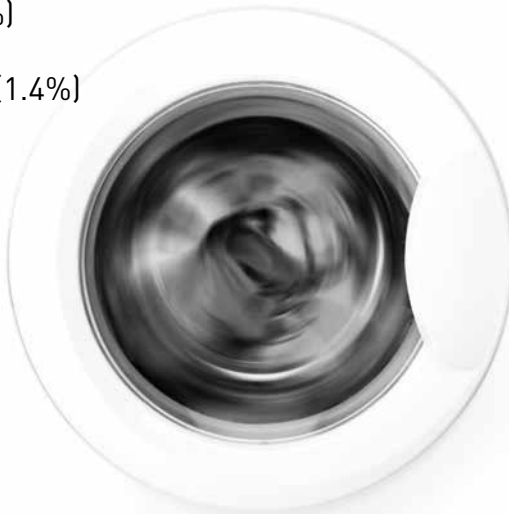
**wastewater treatment** – A process for purifying and treating wastewater.

**xeriscaping** – Landscaping that conserves water and is good for the environment.



# Activity Procedure

1. Ask children and youths to recall the steps in the wastewater treatment cycle. Remind them that energy is needed to move water into homes and, after it is used, to clean and purify it before it returns to the natural water cycle.
2. Tell the group that they are going to explore their own use of water and also learn about ways to save water and energy.
3. Point to the seven signs posted around the room (Dishwasher, Bath, Leaks, Faucets, Shower, Clothes Washer, and Toilet) and explain that these represent important indoor water uses in most homes.
4. Ask everyone to stand by the sign naming what they think uses the most water. Tell them to look around at where the others are standing. Have a few individuals tell why they selected a certain indoor water use as the highest user.
5. Ask one person at each sign to remove it from the wall and bring it to the front. Have the group as a whole arrange the signs that represent highest to lowest water use.
6. Once the group agrees on the order, share the actual order and have them move the signs to reflect the actual order from highest to lowest water use.
  - a. Toilet (26.7%)
  - b. Clothes Washer (21.7%)
  - c. Shower (16.8%)
  - d. Faucets (15.7%) (This includes water used to water plants, hand washing dishes, washing hands, brushing teeth, etc.)
  - e. Leaks (13.7%)
  - f. Bath (1.8%)
  - g. Dishwasher (1.4%)



## Debrief Questions:

- a. What surprised you about this activity on water use?
- b. Why is it important to know what uses the most water at home?
- c. Which uses of water use only hot water?
- d. Which uses of water rely on energy?

(Hot water used for showers, washing dishes, and other purposes is heated by energy in water heaters. Water heaters can use natural gas, electricity, or propane.)

- Remind the group that energy is needed to bring water into our homes. To have clean, safe water, it must be transported and treated before it arrives in our homes. (For water to be clean and safe after it has been used, it needs to go through the wastewater treatment cycle and returned to the natural water cycle.)

## Modification Tip:

For groups that have not yet learned percentages, choose seven volunteers to represent each of the different water uses. Ask the volunteers to form a line ranked from the least amount of water use to the greatest amount of use.



# What Can You Do?

1. Review the tips from **H<sub>2</sub>O Global** (Handout 5) with the entire group. As you review each tip, ask if they think the tip is easy to do (give a thumbs up), medium (give a thumbs sideways), or hard (give a thumbs down). Take a few comments about why they think each tip is easy, medium, or hard to do.
2. After the review, divide everyone into six groups, distribute a tip to each group, and have them create a skit about it. These skits will be presented to the group as a whole. Give the groups 15 to 30 minutes to create their skits.
3. After a skit is presented, have a discussion on what was learned about a tip from either participating in writing it or watching the skit.

## Debrief Questions:

- a. Which of these water-saving tips will you try at home?
- b. What other ways can you try to save water at home or at school?
- c. Why do you think it is important for everyone to save water?
- d. Remind the group about the connection between using water and using energy if it is not mentioned during the debriefing.

## Modification Tip:

Have older group members create a public service announcement based on a tip instead of a skit. Younger children (grades K–2) could also make a poster or drawing of their tip.

## Take-Home Activity:

1. Remind them that they can make a difference for the environment by not wasting water in their homes.
2. Distribute **H<sub>2</sub>O Global** (Handout 5) to each child and youth.
3. Ask several in the group to tell how they plan to share this information with their families.



## Handout 5: H<sub>2</sub>O Global

# Water, Energy, and the Environment



### Make It an H<sub>2</sub>O Habit!

Turn off the tap when brushing teeth or washing hands. This can save up to 100 gallons of water per person each month.



### More Than a Drip!

Fix leaky faucets right away. One drop per second can waste up to 3,000 gallons in a year.



### Bathroom Fix-Its!

Install water-saving showerheads and low-flow faucet aerators. Consider installing a low-flush toilet. They use 60 to 80 percent less water than a less-efficient toilet.



### Keep It Short!

Take shorter showers of less than 5 minutes to save water and the energy to heat the water.



### Make It a Bucket Wash!

Wash bicycles and cars with a bucket of water and not with a running hose. A running hose can waste 10 gallons of water a minute.



### Sweep It!

Use a broom instead of a hose to clean driveways, stairs, and other outdoor areas. Ten minutes of a running hose can waste 100 gallons of water.



### Be Water-Wise!

Think of ways to re-use water for another purpose. The water used to wash vegetables could be used to water your plants.



### Xeriscape for Water Conservation!

Consider native plants when planting a garden. These plants reduce the amount of outdoor watering that is needed.

## Activity 3: Being Water-Wise

### Overview:

This activity is designed to make children and youths aware of the importance of saving water in their own daily lives. It focuses them on how they can encourage others to save water too. They will review a sample water bill to understand how water is measured, paid for, and how these bills can provide a way of measuring over a time period the results of water-saving efforts. The group will also create water-saving slogans to help others remember to save water.

### Objectives:

- Children and youths will be able to read a sample water bill.
- Children and youths will be able to investigate how water is used at home and at school.
- Children and youths will be able to identify ways to save water at home and at school.

### Preparation:

- Read through the entire activity, making adjustments as necessary for the age(s) of the children and youths, group size, and session time.
- Make copies of the **Sample Water Bill** and **Water Investigator at School** (Handouts 6 through 7) for each child and youth.

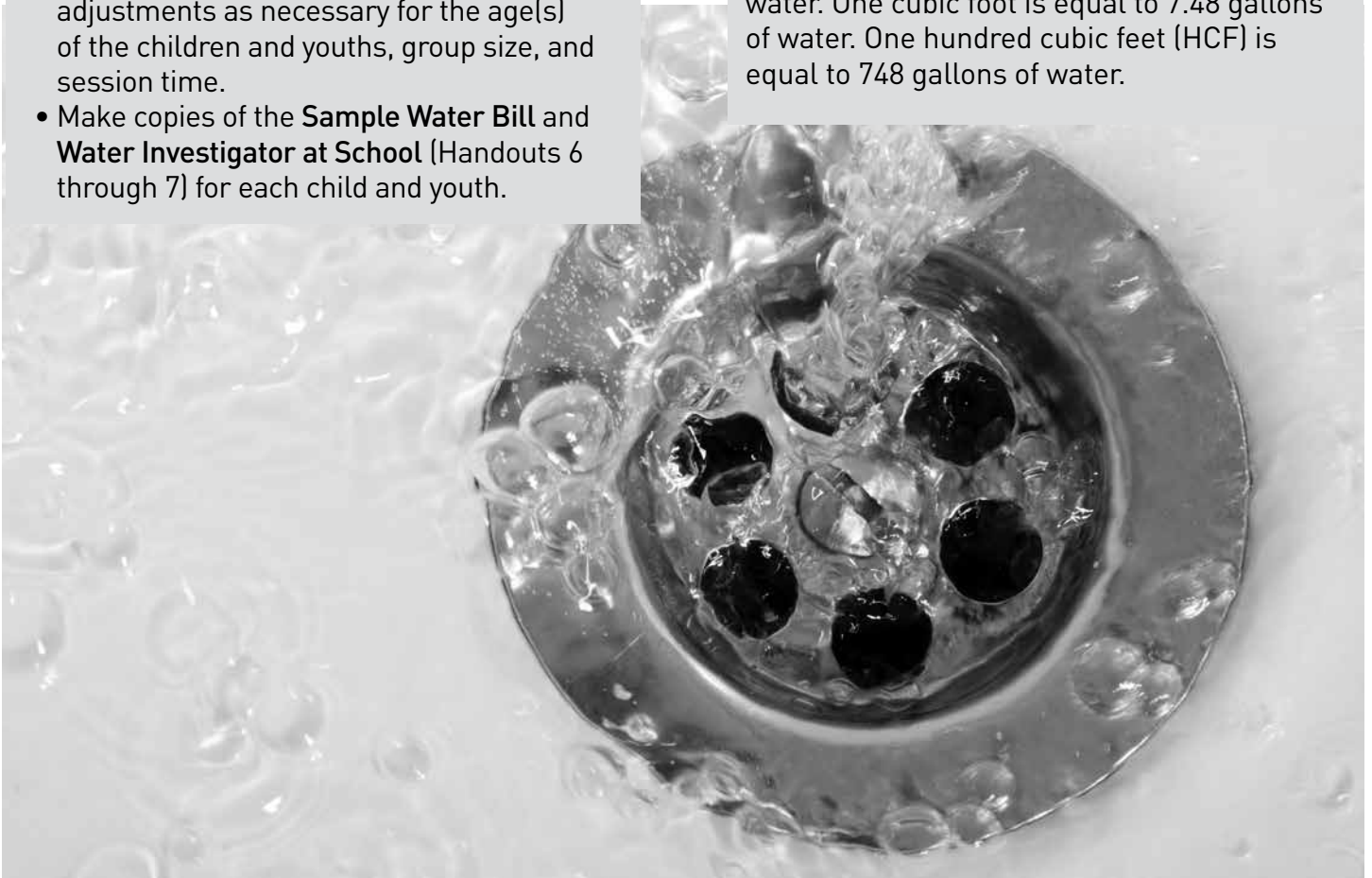
### Materials:

- **Sample Water Bill** (Handout 6)
- **Water Investigator at School** (Handout 7)
- Blank paper
- Markers, crayons, or colored pencils

### Vocabulary:

**conservation** – The management, protection, and wise use of natural resources.

**cubic foot** – A way to measure an amount of water. One cubic foot is equal to 7.48 gallons of water. One hundred cubic feet (HCF) is equal to 748 gallons of water.



# Activity Procedure

1. Ask the group if they've ever wondered why the water from a faucet costs money, while water falling from the sky is free?
2. Explain that the clean water we use is not free because many workers, pieces of equipment, and resources are needed to keep clean water flowing into our homes, schools, and businesses.
3. Tell the group that we're going to learn about how to read a water bill to figure out how much water costs. Explain that in another exercise they will become water investigators that identify where water is being used and wasted.
4. Distribute the **Sample Water Bill** (Handout 6) to each child and youth. Tell them: "A good way to know if your efforts to save water are making a difference is to look at your water bills to see if there is a difference over time."
5. Explain that all households pay for water, but some renters do not receive a bill because water is included as part of their rent payments.
6. Point out on the water bill that it is divided into two charges. There is a water service charge, which is the same no matter how much water is used, and a water usage charge, which changes depending on how much water is used.
7. Explain, using visuals if possible, that water is measured and charged by every HCF, which stands for hundred cubic feet.
  - a. A cubic foot has a volume equal to a cube one foot (12 inches) on each side. One cubic foot of water is about 7.48 gallons of water. If fifteen empty half-gallon cartons were filled with water, this would be about one cubic foot of water.
  - b. One hundred cubic feet of water is about 748 gallons of water.
8. It is estimated that, in the United States, each person uses 50 to 100 gallons per day! For perspective, that is about 50 to 100 big jugs of milk!
9. Point out where the bill lists the rates of water charges. As water use increases, so does the cost per HCF. This is to encourage households to use less water.

## Debrief Questions:

- a. How many months does this sample bill cover? How do you know?
- b. What was the total HCF of water used during the billing period?
- c. Why is it important to know how much water your household uses?
- d. Remind everyone that, in order to know if their efforts to save water are working, they must keep track of their water bills to see if their family's water use is going down.
- e. How many gallons of water were used during the billing period? ( $33 \text{ HCF} \times 748 = 24,684$  gallons) How many gallons per day is that? ( $24,684$  divided by  $61 = 405$  gallons per day)





# Water Investigators

1. Tell the group that since they've learned more about water and its uses, they can now put that knowledge to work by investigating water use at school and making water-saving recommendations.
2. Organize everyone into five groups and distribute a copy of the **Water Investigator at School** (Handout 7) to each group.
3. Explain that each group will become investigators of water use in the OST program. Have groups look around the room to see how water is being used and, if possible, walk around to other program spaces. Groups should also look at water use on the playground area and in lavatories.
4. Discuss their findings after the groups have the results of their investigations.
  - a. Ask for one group to share one of their findings.
  - b. Ask if anyone else found the same thing.
  - c. Ask for another group to share another finding.
  - d. Chart the answers as they share them.
5. Tell children and youths that this information may be taken to the OST director as suggestions to improve our water-saving efforts.
6. Ask the group if they have any tricks or strategies they use to remember something. Answers could include:  
I put my homework in my backpack before I go to bed;  
my parents put notes in my binder to remind me to ask my teacher a question; etc.
7. Explain that sometimes we also need reminders to do the right thing when it comes to saving water or conserving other natural resources. Discuss how the group will make some reminders to post in our program space to remind everyone to save water.
8. Divide the group into teams of three and hand out paper, crayons, colored pencils, or markers to each group. Ask each team to think of slogans to remind people to save water. Give them ten minutes or the time needed to brainstorm and select their top three slogans.
9. Have each team member create a small poster with the slogan on it. Encourage them to think creatively by adding drawings and other decorations.
10. Tell them that their reminders to save water will be posted around the program space.

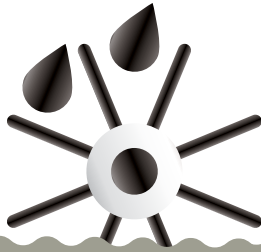
## Take-Home Activity:

1. Remind the group that there are water saving opportunities at home and at school.





# Handout 6: Sample Water Bill



## Cypress County Water District

505 Redwood Avenue, Nearville, CA 90000

### WATER BILL

Account Number:  
109-904

#### For service at:

Brendan Piper Residence  
550 Pepper Avenue  
Nearville, CA 90000

<b>Service period:</b>	05.10.15–07.09.15
<b>Days in period:</b>	61
<b>Water service charge:</b>	\$ 30.00
<b>Water usage charge:</b>	\$102.00
<b>Total amount due:   \$132.00</b>	

First 10 HCF @ \$2.00 = \$20.00  
Second 10 HCF @ \$3.00 = \$30.00  
Additional 13 HCF @ \$4.00 = \$52.00

**Due date:**

08.10.2015

[www.CCWD.com](http://www.CCWD.com)

This is a fictitious bill and utility company—for practice activity use only.

# Handout 7: Water Investigator at School

Work with your group to investigate how water is used during the OST program. Write your findings in the drops.

**Where?**

Example:  
OST Room #33

**What was observed?**

Example: Many paintbrushes were being cleaned under running water.

**Recommendation:**

Example: Paintbrushes should be cleaned in a bucket of water.

**Where?**

**What was observed?**

**Recommendation:**

**Where?**

**What was observed?**

**Recommendation:**

**Where?**

**What was observed?**

**Recommendation:**

**Where?**

**What was observed?**

**Recommendation:**

**Where?**

**What was observed?**

**Recommendation:**

## NOTES:

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The Energenius Out-of-School Time (OST) activity guides were written by California School-Age Consortium (CaSAC) for use with children and youths in OST programs. This offering is funded by California utility customers and administered by Pacific Gas and Electric Company under the auspices of the California Public Utilities Commission. Content and images in these materials have been modified and adapted by CaSAC with permission from the PG&E Energenius Educational Program series. The lessons have been edited and modified to work with various student ages within an after-school setting. Energenius is a registered trademark of Pacific Gas and Electric Company. Energenius materials cannot be used in any form without prior expressed permission from Pacific Gas and Electric Company.

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