

# SAVING WATER AT HOME

## Overview

*As a homework assignment, students check the volume of water flowing from their shower heads at home. Back at school, they calculate how much could be saved by installing a water-saving shower head and how much water is lost to leaks. They also identify ways they can reuse water at home.*

**Subjects:** Science, Math, Social Studies

**Group Size:** teams of four students

**Estimated Teaching Time:** homework, one hour in class

**Curriculum Framework:** IIIB1, IIIB2, IIIB3, VA, VB, VC, VIA, VIB, VIC, VID, VIIA

**Environmental Education Framework:** Goals IIIA, IVA, IVB, VA

**Vocabulary:** conservation, reclaimed water, water-saving devices, water reuse

## Objectives

### Students will:

- identify the relationship between the size of a leak and the volume of water a leaky faucet can waste.
- measure the water consumption of their showers at home, and calculate the volume of water that could be saved by using a 2.5-gallon per minute shower head.
- identify places where they could reuse water at home and at school.

## Background

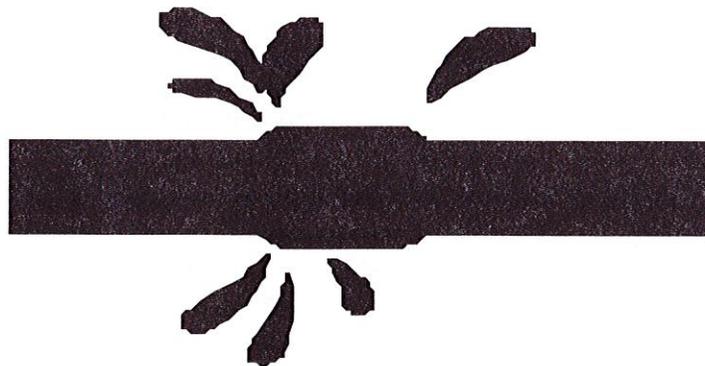
In the WATER IN OUR DESERT COMMUNITY activity, THE WATER YOU USE, students were made aware of the amount of water they use to perform common activities, and look for ways they could use less water. Conservation is the wise use of water through changes in behavior. In this activity, students will learn there are three other ways to save water: fixing leaks, installing water-saving devices, and reusing water.

Every year, millions of gallons of water are lost through leaks. Leakage is estimated to account for 5-10% of all residential water consumption. Even the smallest drip from a worn washer in a sink can waste fifty or more gallons of water each day. Larger leaks can waste hundreds of gallons. Toilet tank leaks can waste more than one hundred gallons of water a day without making a sound, and because the leaking water runs from the tank into the bowl it cannot even be seen. You can, however, detect them with a light sprinkling of talcum powder on the tank water and by adding food coloring to the tank. If

the talcum powder moves toward the overflow pipe in the toilet tank, you probably have an overflow leak. If colored water appears in the toilet bowl 15 minutes after it's added, you probably need to replace the plunger ball or flush valve. Underground leaks are harder to find and may require the assistance of professional leak detectors. Although students with a "fix-it" book can probably fix their own leaking faucets and toilets, encourage them to get assistance or at least prior approval from an adult.

You can purchase or make many devices to save water. Devices include: aerators (which mix air with water), flow regulators (which reduce the flow of water), and displacement devices (to reduce the amount of water stored in high-water use toilets). The once recommended "brick in the toilet" displacement method is now discouraged because bricks eventually disintegrate and damage plumbing. A two-liter bottle, weighted with sand and filled with water, works better to displace toilet tank water.

In 1980, the state legislature passed the Arizona Groundwater Management Code and established the Department of Water Resources (DWR) as the agency in charge of administering the Code, and thus, enforcing water conservation among agricultural users, municipalities, and industry. Another law that became effective in January 1994 requires that all new plumbing fixtures must meet specified water saving performance standards. Shower heads and sink faucets may deliver no more than 3 gallons of water per minute. Toilets may use no more than 1.6 gallons; urinals, no more than 1 gallon. Evaporative coolers must be equipped with water recycling or reuse systems. Another goal of the Groundwater Management Code is to augment Arizona's water supplies through "alternative sources." One of those alternative methods of extending our water supplies is to reuse water. The idea of reusing water seems unusual to some people, but why not? Used water is often suitable for other purposes, even with no treatment or filtration. Rinse water from hand-washed dishes can safely be added to most plants. Bathing water can be used for watering and for heavy cleaning jobs like floors, cars (especially hub caps and wheels), and outside cleaning. Back-washed pool water is fine for some plants. Set an example by watering plants with water left from **THE LEAKING FAUCET** activity.



## Materials

### THE LEAKING FAUCET

For each team:

- 1 quart of water
- 1 plastic bag (re-sealable sandwich or 1-quart storage bags work well)
- a graduated beaker
- a timer or clock
- one of the following leak-makers: straight pin, tacks, and nails of these sizes - 4D (or 4-penny), 6D, 8D. Make sure the more patient students get the smaller leak-makers.
- calculators
- SAVING WATER AT HOME worksheet, one per team
- buckets to store water for reuse

### THE WATER CONSUMPTION OF YOUR SHOWER

- Homework assignment for preceding day: Suggest students work in pairs with one as timer and one as filler. They should use a measured container and a watch with a second hand to learn how long it takes their shower to fill the container. For accuracy, suggest students time several trials and average their results. The technique is to fit the container directly under the shower head and turn the water on full force. (The opening must be large enough to catch all the shower spray. Mention that cold water is okay - they can save a bit of energy, too! You might also encourage students to reuse the water.) Timing should begin just as they start catching the water.

Students should bring two things to school: the size of the container they used and the time (in seconds) it took for the water to fill the container. Teachers should measure their own shower or one at school just in case some teams have no members with data.

- SAVING WATER AT HOME worksheet, one per team
- calculators, at least one per team

### RE-USING WATER AT HOME

- SAVING WATER AT HOME worksheet, one per team

## Procedure

1. Explain that during the hour, their teams will be participating in three activities. Mention that besides conservation or using water more efficiently and using less water to do what students normally do, there are three other ways to save water: installing water saving devices in showers and toilets, stopping leaks in faucets and toilets, and reusing water. In this activity, students will participate in activities about the other three methods of saving water. Tell students not to start working until you brief them on all three activities.

2. **THE LEAKING FAUCET.** Students work in teams to find out how much water a dripping faucet wastes. Teams will have different size leaks, so students should not worry if their neighbors are getting different results. This activity should be started first. NOTE: The leak made with a straight pin may take as long as 20 minutes to fill 1/4 of a cup. Either tell these students to multiply their time by two when they reach 1/4 cup full, or plan at least 40 minutes for them to get to 1/2 cup!

**THE WATER CONSUMPTION OF YOUR SHOWER** activity uses data gathered for homework to illustrate the impact water

saving devices, like a low-flow shower head, can have on water rates and on water savings. Provide data from your shower at home or from a school shower for students who may have forgotten their homework.

### **RE-USING WATER AT HOME**

is a discussion activity. Tell students: *"Used water is often suitable for other purposes, even with no treatment or filtration. The space shuttle is one example where water must be conserved and reused. Throughout the Valley of the Sun, golf courses, cemeteries and other facilities with lots of grass rely on reused water for irrigation. Reused water is also called grey water and reclaimed water. It is your challenge to think of ways you could reuse water at home, reclaiming it before it goes down the drain."* Have students point out where water is not suitable for reuse (such as drinking).

3. Conclusion. Allow students to compare the result of their experiment and their calculations. Have them show the size of their leak-makers as they share their results for **THE LEAKING FAUCET**. This may not seem like much water, but if all the faucets of all the students in the class were dripping at these rates, how much water would be wasted? Mention that a leaking toilet can waste as much as 100 gallons per day, and solicit methods by which they might measure this loss.

From **THE WATER CONSUMPTION OF YOUR SHOWER**, compare the water and money that can be saved by adding a water-saving device and changing behavior. Then generate a master list of water reuse possibilities around home from students' **RE-USING WATER AT HOME** activity. Discuss ideas for changing plumbing, asking: *"Could you flush the toilet with water from the dish washer?"*

Point out that conservation and these other methods of saving water are the best means we have of increasing our water supply. Arizonans are now required by law, through the Groundwater Management Code administered by the Department of Water Resources, to conserve water.

## **Extensions**

1. Contact your local water conservation department or use the per gallon costs determined in **WATER IN OUR DESERT COMMUNITY** activity, **How Much Will You Pay?**, to calculate how much a consumer would pay per year for water leaking down the drains the students created in their plastic bags. Some water conservation offices have water-saving devices schools may borrow. Others provide staff to show methods of saving water. All have pamphlets that can enrich your study of saving water.

2. Call your electric utility company to find out how much you would save in energy costs for heating the water lost to leaks in the activity.
3. Studies of the technology used to detect underground leaks or of the chemistry involved in repairing copper tubing (with flux and solder) might challenge students seeking extra credit.

## Evaluation

1. Pretest and post test: Estimate the volume of water a leak in a faucet can lose in one day. Be sure to give the unit of measurement.
2. Estimate what volume of water and cost savings could be generated for a family of 4 over a year if they changed

from a 5-gallon per minute showerhead to a 2.5 gallon per minute shower head?

3. Describe five ways water could be re-used at your home and in your community.

## Resources

Arizona Department of Water Resources. 1981. **The ABCs of Water Conservation.**

Arizona Department of Water Resources. **Arizona Water Conservation Requirements: 1980-1990.**

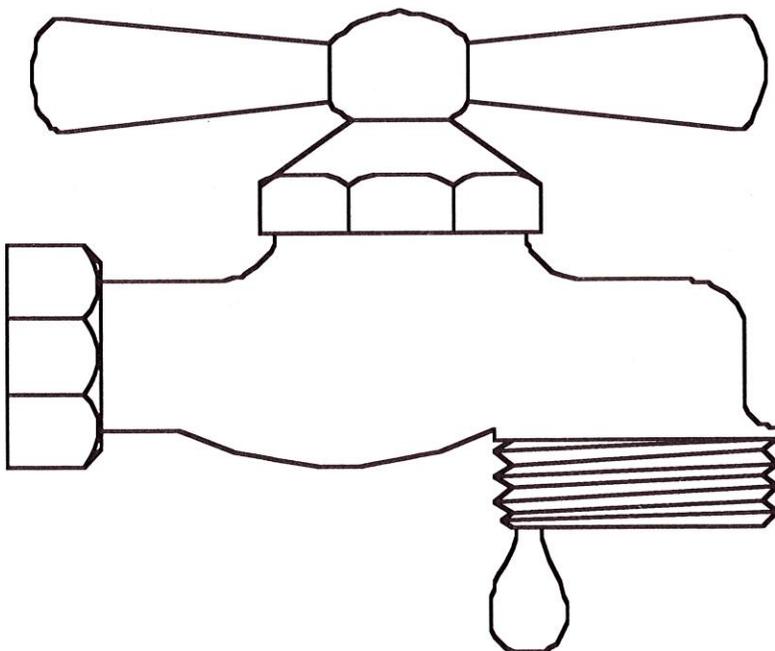
Arizona House Bill #2440.

Arizona Municipal Water Users Association. **Water Wise Tips.**

Massachusetts Water Resource Authority. **Water Wisdom.**

Macmillan/McGraw-Hill School Division. 1991. **Science in Your World: Activity Center, Teacher's Guide, Level 3.**

Ventura County Water Conservation Program. **Water Activities Manual: Grades 6-8.** Ventura, CA.



# Answers & Problem Solving Methods

## THE LEAKING FAUCET

The exact values students get for items 4 and 5 on the Student Page will depend on the leak rates. To guide you through the problem solving steps your students may use, we present the example of a 1/2 quart per hour leak rate (or 2 cups per hour). This rate would have taken 15 minutes to fill 1/2 cup.

Item 6.  $(1/2 \text{ cup})/15 \text{ minutes} \times 60 \text{ minutes}/1 \text{ hour} = \mathbf{2 \text{ cups per hour}}$   
 $2 \text{ cups}/\text{hour} \times 1 \text{ quart}/4 \text{ cups} = \mathbf{1/2 \text{ quart}/hour}$   
 $1/2 \text{ quart}/\text{hour} \times 24 \text{ hours}/\text{day} = \mathbf{12 \text{ quarts}/\text{day}}$   
 $12 \text{ quarts}/\text{day} \times 1 \text{ gallon}/4 \text{ quarts} = \mathbf{3 \text{ gallons}/\text{day}}$   
 $3 \text{ gallons}/\text{day} \times 30 \text{ days}/\text{month} = \mathbf{90 \text{ gallons}/\text{month}}$   
 $90 \text{ gallons}/\text{month} \times 12 \text{ months}/\text{year} = \mathbf{1,080 \text{ gallons}/\text{year}}$

Item 7.  $1,080 \text{ gallons}/\text{year} \times \$2/1000 \text{ gallons} = \mathbf{\$2}/\text{year}$  down one drain

## THE WATER CONSUMPTION OF YOUR SHOWER

The exact values students get for item 1 will depend on the flow rates of their showers. We present the example of a shower head with a 5 gallon per minute flow rate to guide you through the problem solving steps your students may use.

Item 2.  $5 \text{ gallons}/\text{minute} \times 10 \text{ minutes}/\text{day} = \mathbf{50 \text{ gallons}/\text{day}}$ . (You might challenge students to use the amount of time they really spend in the shower besides this rate.)

Item 3.  $50 \text{ gallons}/\text{day} \times 365 \text{ days}/\text{year} = \mathbf{18,250 \text{ gallons}/\text{year}}$

Item 4.  $18,250 \text{ gallons}/\text{year} \times \$2.00/1000 \text{ gallons} = \mathbf{\$36.50}/\text{year}$

Item 5.  $18,250 \text{ gallons}/\text{year} \times 4 = \mathbf{73,000 \text{ gallons}/\text{year}}$   
 $73,000 \text{ gallons}/\text{year} \times \$2.00/1000 \text{ gallons} = \mathbf{\$146.00}/\text{year}$

Item 6. A 2.5 gallon/minute flow rate uses 1/2 the amount of water of the 5 gallon/minute shower head. Students may take 1/2 of the values in #5 or calculate from scratch. Regardless, by changing to a 2.5 gallon/minute shower head, the family of 4 would use **36,500 gallons/year** ( $73,000 \text{ gallons}/\text{year} \times 1/2$ ; saving 36,500 gallons/year) which would cost **\$73.00/year, saving \$73.00**.

Item 7. If the family cut their showering time in half, costs and water use would be cut in half. They would use (and save) **18,250 gallons/year**, and pay (and save) **\$36.50/year**.

Item 8. By showering every other day, the family would cut their costs and water use in half again. They would use (and save) **9125 gallons/year**, and pay (and save) **\$18.25/year**.

Item 9. In addition, saving hot water also saves the energy required to heat the water. Further savings would occur in communities that base their sewage rates on the volume of water used.

# SAVING WATER AT HOME - STUDENT PAGE

## THE LEAKING FAUCET

### Directions

1. Make sure you have these materials: plastic bag, a beaker, a timer or clock with second hand, a leak-maker (pin or nail) and water. **Find the 1/2 cup mark of the beaker.**
2. Fill your plastic bag with water. Seal the bag.
3. While holding the bag over the beaker, make a hole in the bottom of the bag with the leak-maker (pin or nail) you have been given.
4. Start timing when water begins to drip into the beaker.

**Start time:** \_\_\_\_\_

5. Stop timing when the beaker has a 1/2 cup of water in it.

**End time:** \_\_\_\_\_

6. Now that you know how long it takes for this volume of water to drip from your "leak," find out how much water would drip from this leak in one hour . . . in one day . . . in a 30-day month . . . in a year. (Helpful hints: There are 60 seconds in a minute, 60 minutes in an hour, 24 hours in a day, and 365 days in a year. There are 4 cups in a quart and 4 quarts in a gallon.)

**How much water would drip in one hour?** \_\_\_\_\_

**... in one day?** \_\_\_\_\_

**... in a month?** \_\_\_\_\_

**... in a year?** \_\_\_\_\_

7. If you pay \$2 per 1000 gallons of water used, how much would that drip cost in a year?

8. Compare your findings with other teams. What might account for different results?

## SAVING WATER AT HOME - STUDENT PAGE

# THE WATER CONSUMPTION OF YOUR SHOWER

### Directions

1. Calculate the rate of flow of your shower head or that of one of your team members. You must first know the size of the container and the number of seconds it took to fill it.  
Size of container: \_\_\_\_\_ (quarts/gallons?)  
Time container took to fill: \_\_\_\_\_ seconds  
To learn the flow rate in gallons per minute, first determine how long it would take to fill a one gallon container. You know there are 4 quarts in one gallon.

$$\text{Flow rate in gallons per minute} = \frac{1 \text{ GALLON}}{\text{NUMBER OF SECONDS TO FILL 1 GALLON}} \times \frac{60 \text{ SECONDS}}{1 \text{ MINUTE}}$$

**Example:** If it takes 5 seconds to fill a 2-quart container, it would take 10 seconds to fill the pitcher twice, making one gallon. (1 gallon/10 seconds to fill 1 gallon) x (60 seconds/1 minute) = 6 gallons/minute

2. If you take a 10-minute shower, how much water would you use with this shower head?  
\_\_\_\_\_ **gallons**
3. If you take a 10-minute shower with this shower head every day for one year, how much water would you use? \_\_\_\_\_ **gallons**
4. If you pay \$2 per 1000 gallons of water used, how much does your year of showers cost?
5. If there are three other people in your family who shower for 10 minutes every day for a year under this shower head, how much would it cost? How much water would be used?
6. What would one year of showers cost this family if the shower head were replaced by a shower head with a 2.5-gallon per minute flow rate shower head? How much water would be saved?
7. What would one year of showers cost this family with a 2.5-gallon per minute flow rate shower head, if each only showered for 5 minutes a day? How much water would be saved?
8. What would one year of showers cost this family using a 2.5-gallon per minute flow rate shower head, if each showered for 5 minutes every other day? How much water would be saved?

## RE-USING WATER AT HOME

Imagine there is a severe drought. No one has enough water to do all the things wanted. List at least five ways you could reuse water at home. Be as specific as possible.