WATER SAVERS MATH

Students calculate water savings in the home (using low flow shower heads) and outside the home (collecting rainwater for watering landscape plants.)

OBJECTIVES

Students should:

- Calculate water savings using water conservation technologies.
- Identify some ways people can conserve and protect limited water resources to ensure that they remain to meet the needs of humans and other living things.

MATERIALS

- Copies of *Water Savers Math: Shower Power and Harvest the Rain* worksheets for each student

VOCABULARY

- Conservation
- Native plants
- Rainwater harvesting

INTRODUCTION

The USGS recently released the report "Estimated Use of Water in the United States in 2010" (see http://pubs.usgs.gov/circ/1405/.) It documents how between 1980 and 2010, 85 million more people and a growing economy were supported while reducing water use by 57 billion gallons per day. This reduction was across the board—in municipal, agricultural, mining, and power sectors' water use. Reductions in municipal use are attributed to increased efficiency standards for appliances and fixtures, as well as the declining interest in turf and backyard pools in landscaping. These reductions in water use show how improved technology and changing attitudes about appropriate water use can have a big impact in the municipal sector.

In the Desert Waters program, students will explore ways that they can save water at home. They will see how reducing their water use can impact habitat for wildlife and save money in their family's utility expenses. These follow-up math activities allow students to calculate real-world water savings both indoors and outdoors to quantify the impact of different kinds of water saving practices at home.

DOING THE ACTIVITY

Discuss what the group learned at the Desert Waters program, reviewing the connection between use of groundwater and its impact on surface water and habitat. Why is it important to try to save water at home? (When we use water it draws from our aquifer and the Colorado River. Water supplies are limited in our region so we need to conserve.) Ask the students to recall the water saving station in the Desert Waters program. Can they remember some of the ways that people can reduce their water use? They should remember low-flow shower heads, dual-flush toilets, rainwater harvesting, and landscaping with native plants. Explain that they are going to be able to make calculations about these real-world types of water savings with two math activities. Pass out the *Water Savers Math* sheets. Do the problems as a group or individually. Have students do the calculations, showing their work below each problem. See the calculations on the answer sheets that follow each activity sheet.

DISCUSSION

What kind of water savings did they calculate from switching to a technology like a low-flow shower head? What would happen if additional technologies, such as efficient appliances or dual flush toilets, could be used? What kind of savings did they see with rainwater harvesting? Discuss other ways that people can reduce their use of water outdoors even more (drip irrigation, plant native plants, not put in a pool, etc.)

EXTENSION

Have students do a personal, classroom, or school-wide water audit using Arizona Project WET's School Water Audit Curricula: http://arizonawet.arizona.edu/programs/school_water_audit/swap_curriculum

WATER SAVERS MATH

ARIZONA STATE STANDARDS: SCIENCE

GRADE 3:

S-3 C-2 P.O. 1

GRADE 4:

S-4 C-3 P.O. 4

GRADE 5:

S-1 C-3 P.O. 1

S-3 C-1 P.O. 2

ARIZONA'S COLLEGE AND CAREER READY STANDARDS—MATHEMATICS

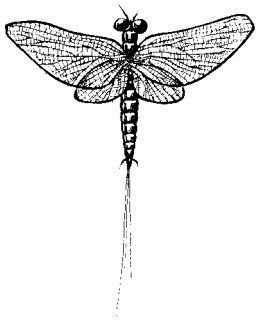
GRADE 4:

4.NBT.B.5

4.NF.B.3

4.NF.B.4

4.MD.A.2



OTHER RESOURCES

Here are additional resources for teaching water conservation within and around our target grade range :

Grades 2-3: Don't Be Such a Drip: Water Conservation. Students discover how water is commonly wasted, the importance of conserving it, and how to draw conclusions from graphs. See http://alliance.la.asu.edu/geomath/GeoMath3/lesson_files/GorryGail/DRIP/GorryGDripT.pdf

A few other sites with ideas for calculating how much water you use:

Grades 4-8: A matching sheet that lets students try to match up how many gallons of water are used for various activities from household use to manufacturing: http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_4-8_funfactsmatchinggame.pdf

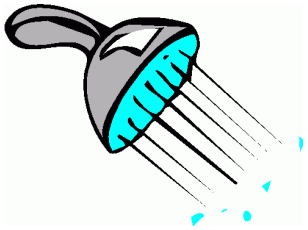
A similar version as an interactive online game is found at: http://www.epa.gov/safewater/kids/flash/flash_matching.html

For a quiz students can take to test their water sense, go to: http://www.epa.gov/watersense/docs/kidsquiz.pdf

Water Savers Math: Shower Power Gr. 4-5 Name_____

In the Desert Waters program, you learned that every drop of water in the desert is precious. You discovered that by saving water, we save habitat for animals and plants, as well as money.

Water Saving Indoors - Shower Power



One way to save water is by using a water-saving showerhead. A regular showerhead uses almost 4 gallons of water per minute (some older showers use up to 8 gallons a minute.) A water-saving, low-flow showerhead uses just 2 gallons of water per minute. Calculate how much water you and your family would use showering with each kind of showerhead. Show your work.

1. If you take 5 minutes to shower, and a shower uses about 4 gallons a minute, about how much water would you use?_____ gallons.

2. If 4 people live in your family, and each person takes a 5 minute shower with a showerhead that uses 4 gallons a minute, about how much water would your family use?_____ gallons.

Fill in your answers in the chart below, then calculate how many gallons of water would be used by larger groups using a regular showerhead and a low-flow showerhead if everyone took five-minute showers. Show your calculations in each section of the chart or on the back of this page.

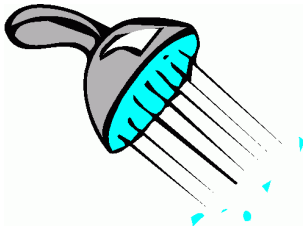
Daily Water Use for Showering: Regular vs. Low-flow Showerheads

People **(5 minute shower/person)**	**Showerhead Flow Rate** **Regular (4 gallons/minute)**	**Showerhead Flow Rate** **Low-flow (2 gallons/minute)**
You		
Family of 4		
Street of 100		
Neighborhood of 500		
City of 100,000		

Water Savers Math Gr. 4-5: Shower Power *Answer Key*

In the Desert Waters program, you learned that every drop of water in the desert is precious. You discovered that by saving water, we save habitat for animals and plants, as well as money.

Water Saving Indoors - Shower Power



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1. If you take 5 minutes to shower, and a shower uses about 4 gallons a minute, about how much water would you use?_____*20*_____ gallons.

5 x 4 = 20

2. If 4 people live in your family, and each person takes a 5 minute shower with a showerhead that uses 4 gallons a minute, about how much water would your family use _____*80*____gallons.

5 x 4 = 20 gallons/minute for 1 person

4 x 20 = 80 gallons/minute for 4 people

Fill in your answers in the chart below, then calculate how many gallons of water would be used by larger groups using a regular showerhead and a low-flow showerhead if everyone took five-minute showers. Show your calculations in each section of the chart or on the back of this page.

Daily Water Use for Showering: Regular vs. Low-flow Showerheads

People (5 minute shower/person)	**Showerhead Flow Rate Regular (4 gallons/minute)**	**Showerhead Flow Rate Low-flow (2 gallons/minute)**
You	*20*	*10*
Family of 4	*80*	*40*
Street of 100	*2,000* *(20 x 100 = 2,000)*	*1,000* *(10 x 100 = 1,000)*
Neighborhood of 500	*10,000* *(20 x 500 = 10,000)*	*5,000* *(10 x 500 = 5,000)*
City of 100,000	*2,000,000* *(20 x 100,000 = 2,000, 000)*	*1,000,000* *(10 x 100,000 = 1,000,000)*

Water Savers Math Gr. 4: Harvest the Rain Name_____

In the Desert Waters program, you learned that every drop of water in the desert is precious. You discovered that by saving water, we save habitat for animals and plants, as well as money.

Water Saving Outdoors - Harvest the Rain

One way to save water is by collecting rain water for outdoor plants. Gutters can direct water off of a roof into containers for later use. Rain water can be channeled off of roofs or streets to basins that let rain water sink slowly into plantings. By using rain water, landscapes do not need to be watered with city drinking water. This means less water use and a lower water bill. Shady landscapes reduce utility costs to cool homes in summer, and if native plants are used, create backyard habitat for wildlife.

Illustration from *Rainwater Harvesting for Drylands and Beyond* by Brad Lancaster

Roof Runoff:

Do the math to answer the following questions. Show your calculations below each answer.

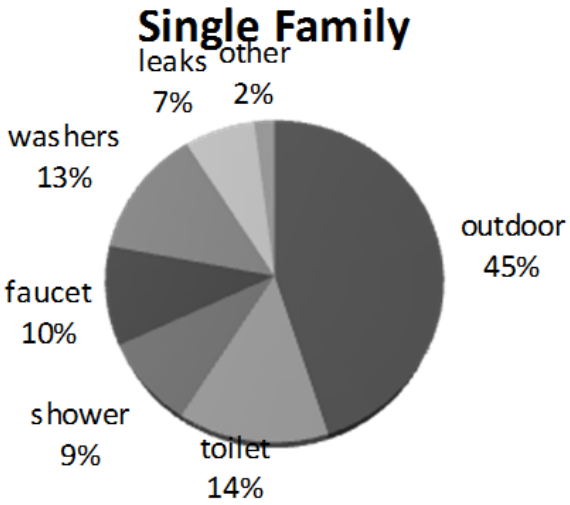
1. A square foot of roof can collect about 2/3 of a gallon of rainwater in a one-inch rainstorm. How many gallons would a 1,200 square foot (ft^2) roof collect in that same rainstorm?

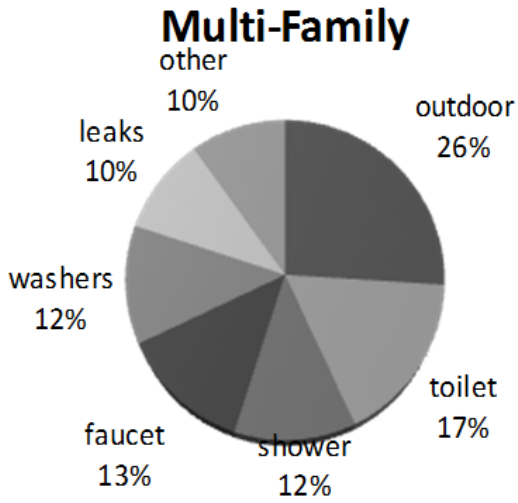
   _____ gallons.

How many gallons would a 1,200 ft^2 roof collect in a 1/4 inch rainstorm? _____ gallons.

4. The average Tucson resident uses 112 gallons of water per day.* How many gallons of water does the average Tucsonan use in one year? _____ gallons

5. These two graphs show average water use in single family and multi family homes in Tucson. Which type of water use is greatest in Tucson? _____





Almost half the water an average Tucsonan uses goes to outdoor landscape use.** How many gallons of water per year does the average resident use for landscaping? (use your answer from question 4 to calculate an answer to this question.) _____ gallons

6. Maria is a Tucsonan whose water use is about average. She wants to use even less. She decides to dig rainwater collecting basins and put in a tank to gather rainwater off of her roof. Maria has a 1,500 ft^2 roof. If she gets 12 inches of rain each year at her house, how many gallons of water could she collect to water her outdoor plants each year?
_____ gallons.

After collecting rainwater to water her landscape, how many gallons of water would she have to pay to use during the year? _____ gallons. What a savings!

** About 45% of the water used by the average Tucsonan goes to outdoor use. Data from http://www.azwater.gov/azdwr/WaterManagement/documents/FMolina.pdf, p. 5

Water Savers Math Gr. 4: Harvest the Rain *Answer Key*

In the Desert Waters program, you learned that every drop of water in the desert is precious. You discovered that by saving water, we save habitat for animals and plants, as well as money.

Water Saving Outdoors - Harvest the Rain

One way to save water is by collecting rain water for outdoor plants. Gutters can direct water off of a roof into containers for later use. Rain water can be channeled off of roofs or streets to basins that let rain water sink slowly into plantings. By using rain water, landscapes do not need to be watered with city drinking water. This means less water use and a lower water bill. Shady landscapes reduce utility costs to cool homes in summer, and if native plants are used, create backyard habitat for wildlife.

Illustration from *Rainwater Harvesting for Drylands and Beyond* by Brad Lancaster

Roof Runoff:

Do the math to answer the following questions. Show your calculations below each answer.

1. A square foot of roof can collect about 2/3 of a gallon of rainwater in a one-inch rainstorm. How many gallons would a 1,200 square foot (ft^2) roof collect in that same rainstorm?

___*800*____ gallons.

if $\frac{1\ ft^2\ of\ roof}{In\ a\ 1\ inch\ storm}$ *collects* $\frac{2}{3\ gallon\ of\ water}$ *then,* $\frac{1200}{1} \times \frac{2}{3} = \frac{2400}{3} = 800$

How many gallons would a 1,200 ft^2 roof collect in a .25 inch rainstorm? ___*200*_____ gallons.

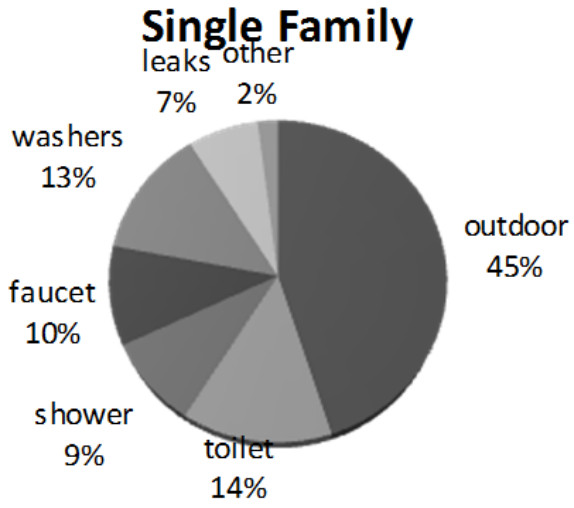
$$\frac{1}{4}\ of\ 800 = \quad 800\ gallons \times 1/4 \quad = \frac{800}{4} = 200$$

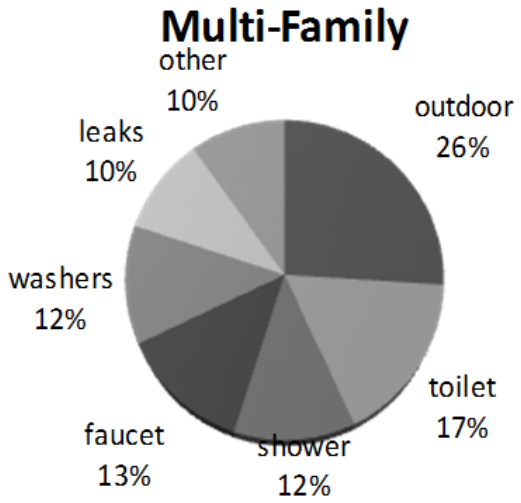
4. The average Tucson resident uses 112 gallons of water per day.* How many gallons of water does the average Tucsonan use in one year? ____*40,880*____ gallons

365 x 112 = 40,880

* data from http://www.tucsonaz.gov/files/water/docs/homeowner.pdf, p. 4

5. These two graphs show average water use in single family and multi family homes in Tucson. Which type of water use is greatest in Tucson? ___*Outdoor*_____





Almost half the water an average Tucsonan uses goes to outdoor landscape use.** How many gallons of water per year does the average resident use for landscaping? (use your answer from question 4 to calculate an answer to this question.) ____20,440___ gallons

$$\frac{1}{2} \text{ of } 40{,}880 \quad = \quad 40{,}880 \text{ gallons} \times 1/2 \quad = \quad 20{,}440$$

6. Maria is a Tucsonan whose water use is about average. She wants to use even less. She decides to dig rainwater collecting basins and put in a tank to gather rainwater off of her roof. Maria has a 1,500 ft^2 roof. If she gets 12 inches of rain each year at her house, how many gallons of water could she collect to water her outdoor plants each year? ___*18,000*_____ gallons.

If a 1 ft^2 roof collects 2/3 of a gallon of water in a 1 inch rainstorm, then a

$$\frac{1500 \text{ ft}^2 \text{ roof}}{1 \text{inch storm}} \times \frac{2}{3} = \frac{4500}{3} = 1000 \text{ gallons of water in a 1 inch storm}$$

After collecting rainwater to water her landscape, how many gallons of water would she have to pay to use during the year? _____*8,400*_____ gallons. What a savings!

1000 gallons x 12 inches = 12,000 gallons per year

20,400 gallons per year used outdoors — 12,000 gallons per year = 8,400 gallons instead of 20,400! 12,000 gallons for free!

** About 45% of the water used by the average Tucsonan goes to outdoor use. Data from http://www.azwater.gov/azdwr/