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
- Butcher paper or sticky notes (optional)
- Empty gallon jugs (optional)

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.* Then 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.

*The Grade 3 math sheet ties into the grade-level standards for studying area.

To help students conceptualize how much water could be collected on a building's roof, you may want to introduce the concept of area with the "Introducing Area" activity below before doing the Harvest the Rain math sheets with your students.

Understanding Area:

Have each of your students measure out a 1 x 1 square foot piece of paper and decorate it so they can easily identify it. Add squares as needed to create even columns and rows to find the area of a rectangle with whole number side lengths. For example, with a class of

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 3:

3.OA.A.3

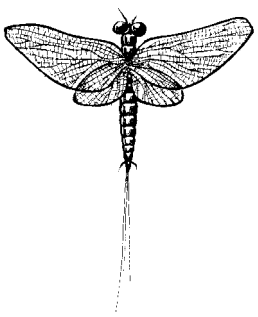
3.NF.A.1

3.NF.A.3

3.MD.C.5

3.MD.C.6

3.MD.C.7, a, b, c



25, make it 30 so the group can relate area to multiplication and addition by comparing how 30 square feet can be represented by the different products of 5 x 6, 3 x 10, 2 x 15, and 1 x 30. Have the students work together to build these different grid configurations in an open space, holding or laying their papers together end to end with no gaps. Calculate the area for each configuration. (You can also scale this down and have the students cut out smaller squares of paper to represent square feet and put them on a chart paper "roof" on a classroom wall.)

To tie it into rainwater harvesting, bring two empty gallon jugs. Have three students hold their squares and the gallon jugs to represent how every three square feet of roof can collect about two gallons of water in a one-inch rain storm. Have everyone group into threes and calculate how many gallons the whole class could collect in the same storm. They will be doing the same thing on the math sheets but to a smaller scale. This will get them thinking about how much water could be collected on a roof to direct to landscape plants.

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

OTHER RESOURCES

Here are additional resources for teaching water conservation and calculating water use within our 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

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

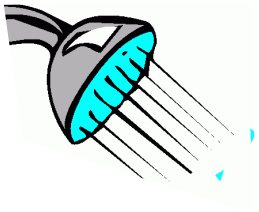
A similar version as an interactive online game is found at: http://www.epa.gov/safewater/kids/flash/flash_matching.html

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. 3 Name_____

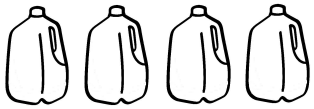
In the Desert Waters program, you learned that every drop of water in the desert is precious. You discovered that by saving water, we save habitat for animals and plants, as well as money.

Water Saving Indoors - Shower Power

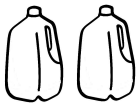


One way to save water is by using a water-saving showerhead. A regular shower-head uses almost 4 gallons of water per minute. A water-saving, low-flow shower-head uses just 2 gallons of water per minute.

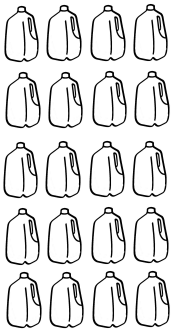
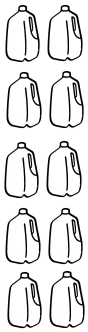
Regular shower head gallons per minute



Low-flow shower head gallons per minute



1. How much water would you use if you took a 5 minute shower with each kind of shower-head? Use the arrays below to calculate your water use. Write the two different multiplication sentences that each array shows.

Regular Shower Head Water Use	vs.	Low-flow Shower Head Water Use
 _____ X _____ = _____ gallons _____ X _____ = _____ gallons		 _____ X _____ = _____ gallons _____ X _____ = _____ gallons

2. If 4 people live in your family, and each person takes a 5 minute shower, how much water would your family use with each kind of showerhead? Show your calculations.

Regular Shower Head Water Use	vs.	Low-flow Shower Head Water Use
_____ X _____ = _____ gallons (water use one person) (number of people)		_____ X _____ = _____ gallons

3. Complete the table below to compare how much water a low-flow showerhead uses versus a regular shower head when everyone takes a five minute shower. How much less water would you use if you switched to a low-flow shower head? Write a fraction that shows the savings.

People	Regular Showerhead	Low-flow Showerhead	Fraction of Water Used (LFS)
You			
Family of 4			

Water Savers Math: Shower Power Gr. 3 *Answer Key*

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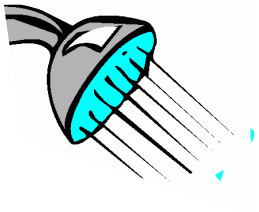
Water Saving Indoors - Shower Power



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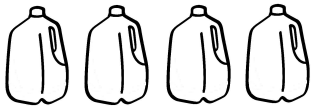
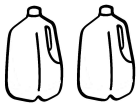
Regular shower head gallons per minute



Low-flow shower head gallons per minute



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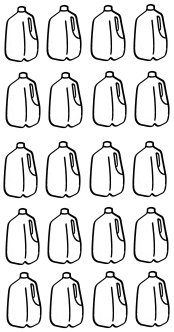
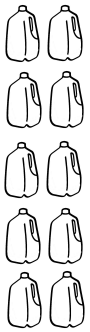
 __4_ X __5__ = _20_ gallons __5___ X __4___ = _20_ gallons		 _2_ X _5_ = __10_ gallons _5_ X _2__ = __10_ gallons

2. If 4 people live in your family, and each person takes a 5 minute shower, how much water would your family use with each kind of showerhead? Show your calculations.

Regular Shower Head Water Use	vs.	Low-flow Shower Head Water Use
_20_ X _4_ = _80 gallons (water use one person) (number of people)		_10_ X _4__ = _40_ gallons

3. Complete the table below to compare how much water a low-flow showerhead uses versus a regular shower head when everyone takes a five minute shower. How much less water would you use if you switched to a low-flow shower head? Write a fraction that shows the savings.

People	Regular Showerhead	Low-flow Showerhead	Fraction of Water Used (LFS)
You	*20*	*10*	*1/2*
Family of 4	*80*	*40*	*1/2*

Water Savers Math Gr. 3: 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.

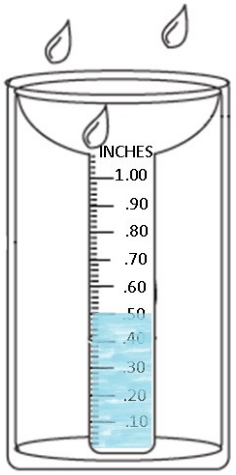
Water Saving Outdoors - Harvest the Rain

One way to save water is by collecting rain water for outdoor plants. Rain can be collected off of roofs or streets to basins that let rain water sink slowly into plantings. It can be stored in barrels to use during dry times. 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 help keep homes cool in summer, and if native plants are used, create backyard wildlife habitat.

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

Measuring Rainfall:

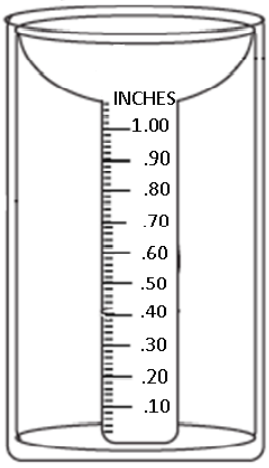
We measure rainfall by catching rain in a rain gauge. Rain water in the gauge is calculated in tenths of an inch. For example, a rain storm filled this gauge with $^{5}/_{10}$ of an inch of rain. Reduce this fraction to its lowest terms to describe the amount of rain that fell:

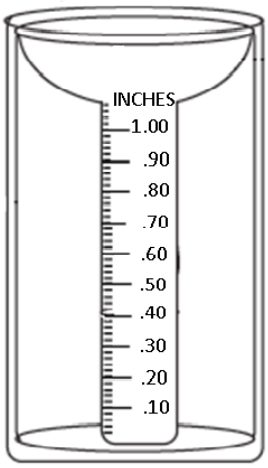


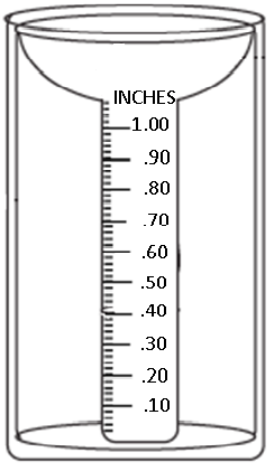
$\frac{5}{10} = \frac{\quad}{\quad}$ The storm produced ____ of an inch of rain.

Each of the rain gauges below has caught rainfall in a storm. Color in each gauge the amount of rainfall shown above it. Then reduce each fraction to its lowest terms.

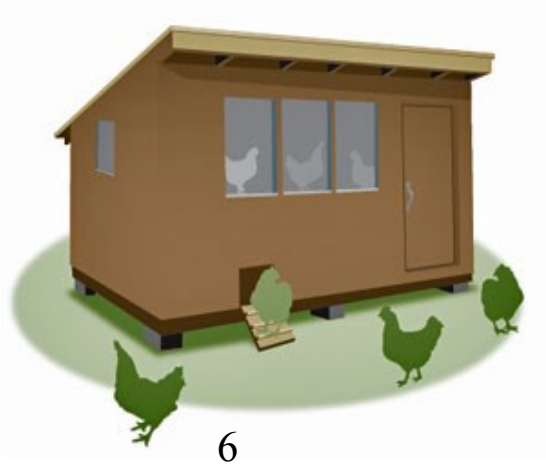
$\frac{2}{10} = \frac{\quad}{\quad}$ of an inch of rain $\frac{6}{10} = \frac{\quad}{\quad}$ of an inch of rain $\frac{10}{10} = \frac{\quad}{\quad}$ inch of rain







Water Savers Math Gr. 3: Harvest the Rain



Catching Rainfall:

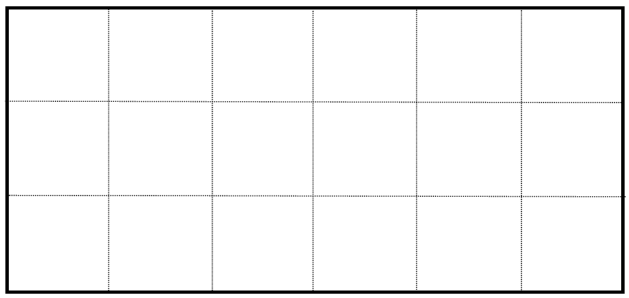
Area is the amount of space that a shape covers. For example, Amy has a chicken coop in her yard with a roof that is 6 feet long and 3 feet wide. To find the total roof area, Amy needs to multiply the length times the width. What is the coop's roof area?

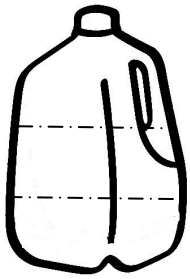
_____ feet X _____ feet = _____ square feet

Here is another view of the roof.

What is the area of each small square?

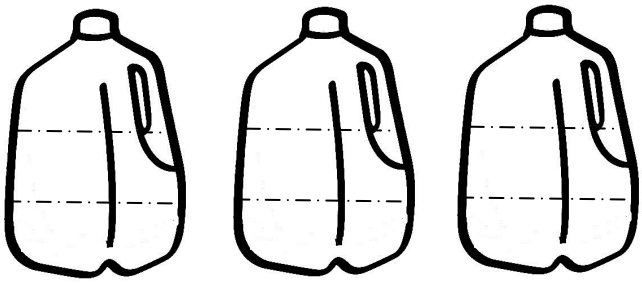
_____ foot X _____ foot = ____ square foot





Lots of Water! In a one-inch rain storm, each square foot of roof can collect $^2/_3$ of a gallon of water. Color in this jug with $^2/_3$ of a gallon of water.

Now color in each jug with $^2/_3$ of a gallon of water. Add all three jugs together.

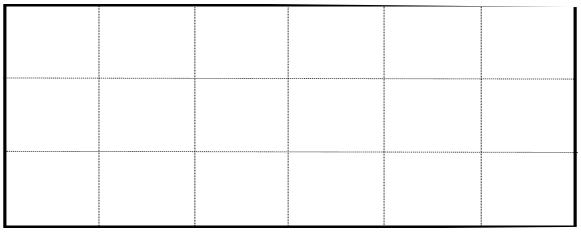


$$\frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{\quad}{\quad}$$

Now reduce this fraction to its lowest terms.

___ = ___ = ____ gallons*

In other words, if one square foot of roof can collect $^2/_3$ of a gallon of water, three square feet of roof collect _____ gallons of water.



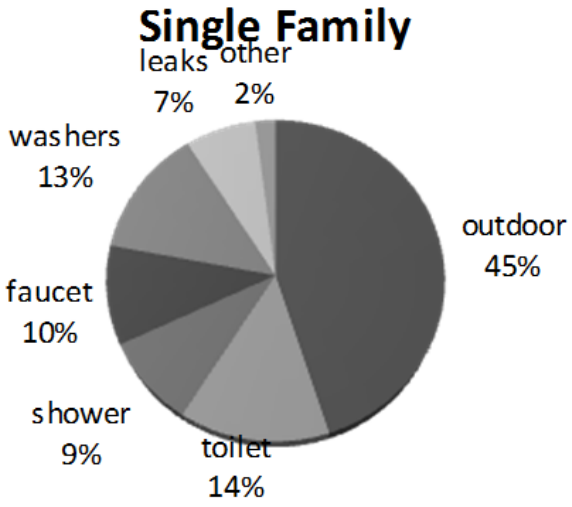
Amy's chicken coop roof can collect a lot of water in a one inch rain storm! Find out how many. Below each column of three square feet, mark the number of gallons it collects, then add them together.

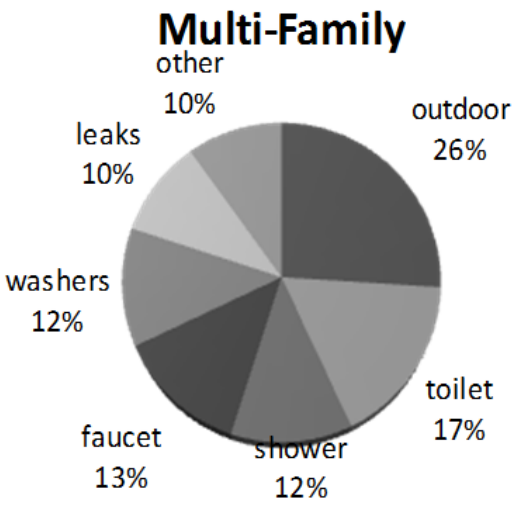
___+___+___+___+___+___= _____ gallons of water in a one inch rain storm

Imagine how much water she could catch off of her 900 square foot house roof to give to her plants!

How Much Water Do We Use?

The average Tucson resident uses 112 gallons of water per day.** These two graphs show average water use in single family and multi-family (an apartment or home with more than one family living in it) homes in Tucson.





1. Which type of water use is greatest in Tucson?

_____

2. Which water use <u>inside</u> the home takes the most water?

_____

3. List three things that you can do to help save water at home.

_____

_____

_____

_____

_____

** 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. 3: Harvest the Rain *Answer Key*

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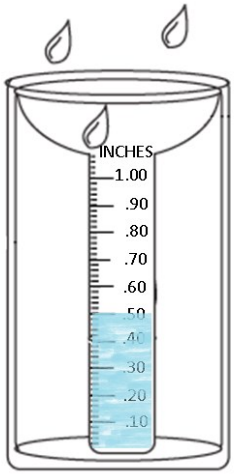
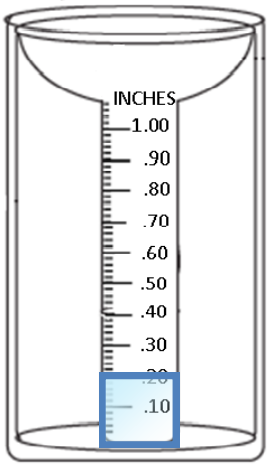
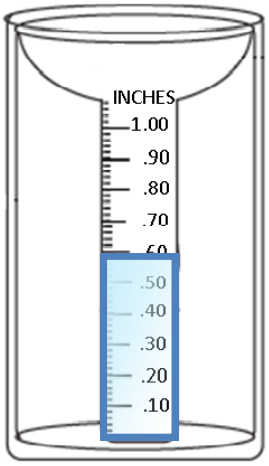


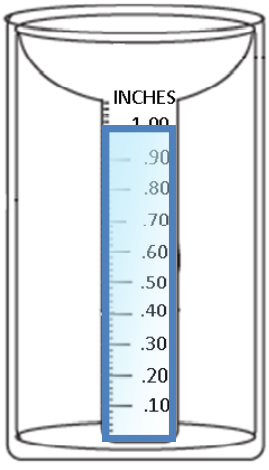
$\frac{5}{10} = \frac{1}{2}$ The storm produced $\frac{1}{2}$ of an inch of rain.

Each of the rain gauges below has caught rainfall in a storm. Color in each gauge the amount of rainfall shown above it. Then reduce each fraction to its lowest terms.

$\frac{2}{10} = \frac{1}{5}$ of an inch of rain $\frac{6}{10} = \frac{3}{5}$ of an inch of rain $\frac{10}{10} = \frac{1}{\quad}$ inch of rain







Water Savers Math Gr. 3: Harvest the Rain *Answer Key*

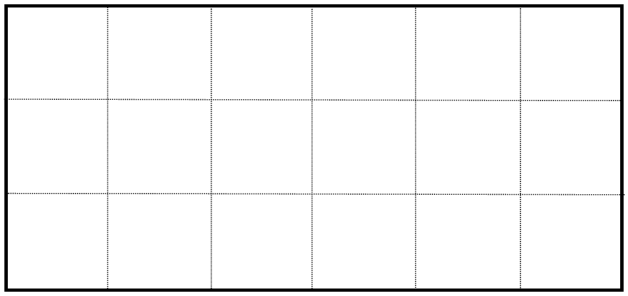
Catching Rainfall:

Area is the amount of space that a shape covers. For example, Amy has a chicken coop in her yard with a roof that is 6 feet long and 3 feet wide. To find the total roof area, Amy needs to multiply the length times the width. What is the coop's roof area?

_3_ feet X _6__ feet = __18_ square feet

6

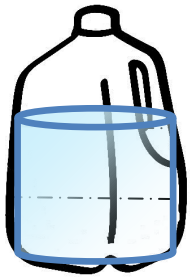
3



Here is another view of the roof.

What is the area of each small square?

_1_ foot X _1_ foot = _1_ square foot



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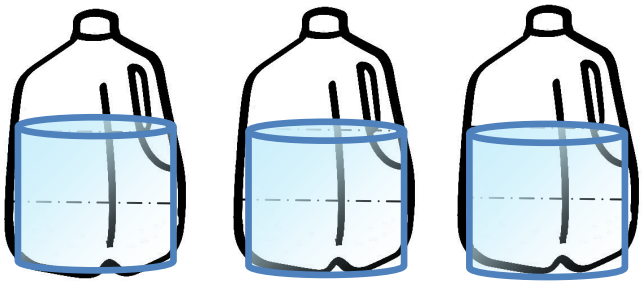
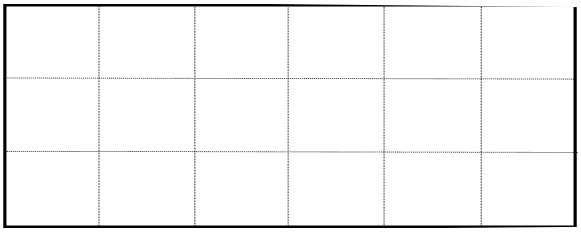


$$\frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{6}{3}$$

Now reduce this fraction to its lowest terms.

$$\frac{6}{3} = \frac{2}{\quad} = \underline{2}\ \text{gallons*}$$

In other words, if one square foot of roof can collect $^2/_3$ of a gallon of water, three square feet of roof collect _2__ gallons of water.



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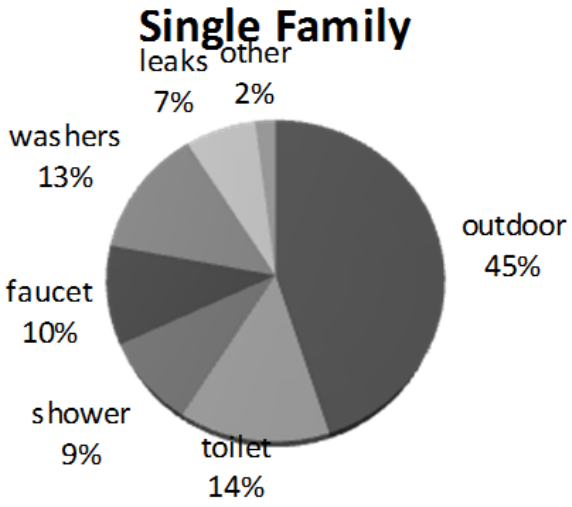
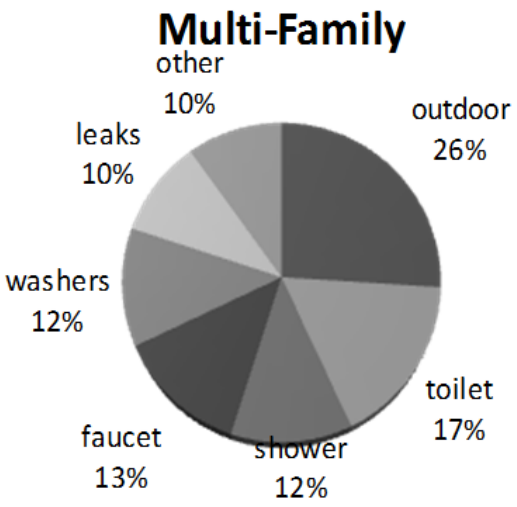
$\frac{2}{\quad} + \frac{2}{\quad} + \frac{2}{\quad} + \frac{2}{\quad} + \frac{2}{\quad} + \frac{2}{\quad} =$ _12_ gallons of water in a one inch rain storm

Imagine how much water she could catch off of her 900 square foot house roof to give to her plants! *(if 3 ft^2 of roof = 2 gallons, then 3/2 = 900/x or 600 gallons)*

How Much Water Do We Use?

The average Tucson resident uses 112 gallons of water per day.** These two graphs show average water use in single family and multi-family (an apartment or home with more than one family living in it) homes in Tucson.





1. Which type of water use is greatest in Tucson?

Outdoor

2. Which water use inside the home takes the most water?

Toilets

3. List three things that you can do to help save water at home.

Catch rain water for giving to landscape plants

Save a flush ("If it's yellow let it mellow, if it's brown, flush it down.")

Take shorter showers

Turn off the water while brushing teeth

Fix leaks, etc.

** 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