
Arizona Project WET's

Water Scene Investigation (WSI) Program



AZ1594

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Table of Contents

Introduction	4
Advance Preparations to Ensure Success	4
Adapting the Classroom Presentation for Use by Non-formal Educators	5
Reporting WSI Data Online	5
Viewing WSI Data Online	6
WSI Presentation Outline and Timing:	8
Summary:	8
Objectives:	8
Materials/Supplies:	8
Lesson Guide:	8
<u>Day 1:</u>	8
1. Introductions (5 minutes).....	8
2. Warm-up: Discussion of Water Uses (5 minutes).....	8
3. Exploration: Technological Ways to Save Water – Water Savers’ Mystery Box (10 minutes)	9
4. Demonstration: Measuring Faucet Flow Rate (15 minutes)	11
5. Brainstorm: Bathroom faucet water uses & variables (10 minutes).....	13
6. Wrap-up/Homework Discussion (10–15 minutes) – Technological and behavioral ways to save water	13
<u>Day 2:</u>	14
7. Homework Review, Data Analysis and Discussion (50 minutes).....	14
Appendix A: Sample Parent Letter.....	15
Appendix B: Home Faucet Audit Procedure	16
Appendix C: Sample Data Sheet.....	18
Appendix D: Faucet Audit Data Sheet.....	19
Appendix E: Faucet Water Audit Report.....	20

The Water Scene Investigation - WSI



Introduction

The Water Scene Investigation (WSI) was developed by Arizona Project WET for use by local water providers and water educators in middle school classrooms to inspire simple actions that result in real water savings. This guide is the result of several iterations of writing, classroom testing, revision, and retesting. The WSI is a two-day, in-classroom project; the two days are separated by a week to allow for homework completion. To date, the WSI has reached 4,025 students and saved over 12 million gallons of water. Arizona Project WET is a program of the University of Arizona's College of Agriculture and Life Sciences, Arizona Cooperative Extension, the Water Resources Research Center and the Department of Agricultural Education.

The Water Scene Investigation (WSI) is a valuable tool, effective in many different scenarios, for raising water use awareness and empowering individuals to make their water use more efficient. This guide was written for presenters from businesses, public agencies, nonformal education and the community to engage 5th through 9th grade students in a project focused on water conservation, efficiency and water auditing. One may adapt it easily for non-classroom use, whether that is in community groups or clubs, with youth or with adults.

The WSI is a participatory method of learning where students learn effective ways of conserving water indoors, while developing specific STEM skills. Students utilize math skills by measuring

water use before and after the installation of new faucet aerators in their own homes; and then calculate annual water use in gallons per year using mathematical thinking skills. Aerators reduce the flow of water without reducing the pressure needed to accomplish tasks such as hand washing and dishes, so they are a simple, yet effective technology for students to install. By using aerators and tracking water savings, people of all ages can gain a better understanding of how a small investment in a simple technology can save precious water resources over time.

Advance Preparations to Ensure Success

The most important item used in the WSI is the faucet aerator. Collect water efficient aerators ahead of time so that you can provide at least one to each of your participants. These are often available from your water provider at low or no cost, especially for groups involving youth. Otherwise, they can be purchased from any home improvement store, a plumbing store or through online retailers. We have found that plumbing stores and online retailers have a wider selection and often lower prices, but you must allow for shipping time. Online retailers that offer good service and low prices when you order bulk quantities include AM Conservation Group (<http://www.amconservationgroup.com>) and New Resources Group (<http://www.nrgideas.com>).

Aerators do come in a variety of thread specifications. Adaptors are available to fit unusual faucets to standard aerator threads. Whenever possible, check the target faucets ahead of time and take an old aerator into the store to compare with new. In our experience, the best aerator to buy to achieve the best retrofit rate (meaning families actually keep the new aerator on after the home water audit) is a dual-threaded, standard size aerator with a 1.0 gpm flow rate. Dual-thread can fit on both male and female threaded faucets.

Although many retailers won't list the standard size dimensions, standard is: female – 55/64 inch diameter, 27 threads/inch; male – 15/16 inch diameter, 27 threads/inch. An aerator gauge can be purchased if you are auditing many different models and sizes of faucets (<http://www.threadtoolsupply.com/faucet-aerator-thread-gauge.html>).

Manufacturers do make 0.5 gpm aerators, but the radial flow and low water volume deter many from keeping them on. These aerators work well in public restrooms where the faucet's only purpose is handwashing.

Think ahead to prepare your own Mystery Box.

The Mystery Box is used as the hands-on hook to get students interested in the WSI. Suggested items for a Mystery Box are listed on page 11 of this guide. Any water-saving equipment will do, though you may want to ask your favorite plumber, landscaper, water provider or home repair clerk for good, inexpensive ideas and samples. Remember, it's called a "mystery" box, so participants shouldn't be told what the items are before having the chance to examine and guess. If you are unable to obtain a good selection of items, printed pictures of these items would be an acceptable alternative.

If you don't have flow rate measuring bags, use a bowl instead. The measuring bags (for flow rates as low as 0.5 gpm measurement) are often available from your water provider, particularly if you are addressing a community forum or group and if you are involving youth. Bags are also available for purchase online at bulk rates as low as \$0.30 each (<http://www.nrgideas.com/fg-060>). If you don't have access to a measuring bag, don't let it stop you. Capture the water in any container as it flows for five seconds at full-on. Measure the water captured. Multiply the amount measured by 12 and you will have the quantity per minute. This works because there are 12 five-second periods in one minute. For example, if you measured 3 cups in five seconds and multiplied by 12, your flow rate would be 36 cups/minute. Convert to gallons per minute using the appropriate conversion factor from this table.

16 cups	1 gallon
128 ounces	1 gallon
3.79 liter	1 gallon
0.13 cubic feet	1 gallon

For Example:

$$36 \text{ cups/minute} \times 1 \text{ gallons}/16 \text{ cups} = 2.25 \text{ gallons/min (gpm)}$$

Adapting the Classroom Presentation for Use by Non-formal Educators

The Water Scene Investigation was developed by Arizona Project WET for use in middle school classrooms. Since this guide was written for classroom use, you will see many references to "students." We are all life-long learners, so you may think of all of your participants as "students," regardless of their age or occupation. "Cooperative learning groups" are just small groups of 3-5 participants who for a brief time will work together on a small task. As you prepare for your presentation, think about how you will divide your large group into small groups. You can let it happen naturally, have the participants count off, or separate your group by age, t-shirt color or any other criteria that lends itself to the situation. Keep it fun and quick. In multi-age settings, a mix of ages in each group will help to ensure that someone in the group has the requisite math skills to complete the data sheets.

Reporting WSI Data Online

Encourage your participants to share their data by reporting it online. You and all of your participants will be able to calculate and visualize the group's success through Arizona Project WET's online water-savings website. The data entry form requires only the water measurement and daily use data. It will calculate the annual water use and water savings for you. The online form can be a fun way to validate the students' calculations.

1. Before your presentation, select a *Group ID*. This can be any combination of letters and numbers that you choose. Consider the potential ease of mis-typing the Group ID. Every participant will have to enter it

exactly the same way or their data will not be grouped for display with the others’.

2. Write your Group ID at the top of the data sheet before distributing copies.
3. You may create an account and enter your students’ household water savings at: <http://arizonawet.arizona.edu/wsi/>. Or you may have individual participants report their results via their own login at this same website. Either way, the site will generate water savings graphs that will enable comparisons of water savings across your group.
 - a. You will be required to either create an account or log into your account in order to submit data to the system. Account creation requires a valid email address. Please register yourself as a group leader. Students may also register but should indicate that they are not group leaders.
 - b. When logged in, hover over the *Water Scene Investigation* menu and click the *Report Water Savings* link to enter a single student’s data.

Group ID – enter the Group ID exactly – it is sensitive to capitalization.

Participant Initials or ID – this value will appear as the data label on the group data graph; enter any combination of letters and/or numbers that would identify each unique participant.

Participant Name – this name will not show up on the graph, but will show up in the listing of all water savings reports submitted under the group leaders login.

Faucets – enter data in the “If you already have your ...” field if a flow bag was used to capture the water. Enter data in the “If you need help ...” field if an alternate container was used to capture the water. The system will not accept data in both fields.

Add Another Faucet – click this button only if the single user has audited more than one faucet in his/her home.

Save – click the save button after this user’s data is complete. A summary of the user’s annual audit and water savings will display.

- c. Click again on the *Report Water Savings* link in the *Water Scene Investigation* menu to display a new reporting form where the next student’s data can be entered. Please note that students who enter data via a group leader’s login will not be able to view the group graphs on their own. Their data will be viewable only through the group leader’s login.
- d. Click the *Your Group Savings* tab to see a comparison of all of your group members’ savings.
- e. Click the *Compare to Top 10* tab to see the latest user’s data compared to the top-ten water savers across the entire program, whether they are members of your group or not. This comparison graph can only be done one participant at a time.

Viewing WSI Data Online

Return to the Water Scene Investigation website to watch your group’s water savings grow.

You will also be able to track the group’s participation through the water-savings website.

1. Log into the website at <http://arizonawet.arizona.edu/user/login/>.
2. Hover your mouse over the *Water Scene Investigation* menu item and click on the *View List of Water Savings Reports* link.
3. Select one of the water data savings data sets from the group ID that you are interested in viewing.

4. Select the *Compare to Top 10* tab to view the selected data as compared to the top-10 water savers participating in the program. Select the *Your Group Savings* to view the data from all of the participants in the selected Group.
5. To view data from one of your other groups, return to the *View List of Water Savings Reports* link and select a water data savings data set from another Group.

Water Scene Investigation - WSI: Classroom Presentation

WSI Presentation Outline and Timing:

Day 1:

1. Introductions (5 minutes)
2. Warm up: Discussion of Water Uses (5 minutes)
3. Exploration: Technological Ways to Save Water – Water Savers’ Mystery Box (10 minutes)
4. Demonstration: Measuring Faucet Flow Rate (15 minutes)
5. Brainstorm: Bathroom faucet water uses & variables (10 minutes)
6. Wrap-up/Homework Discussion: Technological and behavioral ways to save water (10–15 minutes)

Day 2:

7. Homework Review, Data Analysis and Discussion (50 minutes)

Summary:

Students will inventory their families’ use of home bathroom faucets (number of times used per day, length of time with each use) and determine the flow rate of those faucets with and without aerators to calculate water savings through the use of water efficient devices. The Water Scene Investigation is a two day in-classroom project, separated by a week to allow for homework completion.

Objectives:

Students will:

- Follow a set procedure
- Measure water flow
- Collect scientific data through observations and interviews
- Analyze data and draw conclusions from mathematical calculations
- Make claims and recommendations based on evidence for more efficient water use

Materials/Supplies:

- Flow rate measuring bag* (see picture on page 14)
- Mixing bowl
- Stopwatch or timing device
- Faucet aerator*
- Pair of pliers
- 5 gallon bucket
- Water Savers’ Mystery Box*

*See Introduction on page 3 for sources and alternatives for these items.

Per student for Homework:

- Parent/Guardian Letter about Homework (Sample Parent Letter is found in Appendix A)
- *Home Faucet Audit Procedure* (Appendix B)
- *Sample Data Sheet* (Appendix C)
- *Faucet Audit Data Sheet* (Appendix D)
- *Faucet Water Audit Report* (Appendix E)
- One aerator per faucet (1 gpm)
- Measuring bag

Lesson Guide:

Day 1:

1. Introductions (5 minutes)

Presenters should introduce themselves, explain their jobs/interests and briefly mention why they are in the classroom. Talk about the need for water conservation. Tip: It would be interesting to share some water use or water availability statistics with the group. This would be a good way to transition into the warm-up activity.

2. Warm-up: Discussion of Water Uses (5 minutes)

Focus questions:

How do we use water?

How do we conserve it?

Activity:

Ask the question, “How do we use water?” Have students brainstorm all the ways they can think of that water is used in their daily lives, both at home and at school.

Example list:

- Cooking
- Drinking
- Watering plants
- Showering
- Washing dishes
- Washing clothes
- Cleaning
- Filling swimming pool
- Watering grass

After they have a fairly comprehensive list (at least 8–10 ways), pose the question, “How do we conserve water?” Make another list. This question will most likely be answered with actions people can take to reduce water use, like taking shorter showers, etc. These are called **Behavioral Changes**, because people change their behaviors to reduce water use.

To wrap up this warm-up activity, ask students how they would describe the ways they have listed to save water and who is responsible for making these changes. Facilitate the discussion so that the students figure out for themselves that their water conservation list includes mostly behavioral ways to save water. Make sure the discussion ends with the ideas that many of these ways to save water are called **Behavioral Changes** and that **they** are responsible for these changes!

3. Exploration: Technological Ways to Save Water – Water Savers’ Mystery Box (10 minutes)

Focus question:

How can we reduce water use or use water more efficiently at home?

Activity:

Pass out the inquiry items from the Water Savers’ Mystery Box, one item per cooperative learning group. Ask students to examine the item and try to determine what the item is and how it can be used to save water. Give each group 3–5 minutes to answer these questions:


- 1) What is it?
- 2) How can it be used to save water?


Have each group report out on their findings.


Ask students what all of these devices have in common. They are all **Technological Devices**. They all can be used to save water.

Water Savers' Mystery Box


- Water meter** – A water meter is a gauge that measures water use. If you want to assess whether there is a leak at your house using your water meter, you can check it once before the whole family leaves one day (record number) and again when you return. If no automatic water use occurred while you were gone, it should be the exact same reading when you return. If not, you have a leak.


- Faucet aerator** – lowers the amount of water coming out of your faucet each minute by mixing in air. If an aerator is already installed on your faucet, it will have its rated flow imprinted on the side. For most homes the aerator will likely read 2.2 gpm (gallons per minute). Most people are satisfied with 1.0 gpm flow in the bathroom faucets. You can replace the aerator easily. If no aerator is installed, check to see if there are threads just inside the tip of the faucet. Most modern faucets are threaded to accept aerators.



- Toilet tablets** – are used to check for leaks in toilets that have a tank in back. Put the tablet in the tank and do not flush. Check the toilet again in 10 minutes. If you have a leaky flapper you will see dye in the bowl of your toilet. The toilet flapper needs replacing.





- Toilet flapper** – is pulled up when you flush the toilet which allows water in the tank to replace the water flushed from the toilet bowl. The flapper then seals so the tank can fill up with water again. To learn how to replace a flapper, view the video at: <http://arizonawet.arizona.edu/wsi/>.



- Water efficient shower head** – uses less water at a higher pressure than a traditional shower head. To test shower head flow, set a 2 quart saucepan in the middle of the shower stream. With the shower on full, count how many seconds it takes to fill the pan. If it takes less than 12 seconds, you could use a water efficient shower head. Water efficient shower heads are 2 gpm or less. You can also use a flow rate measurement bag.


- Catch cans** – are used to measure irrigation uniformity, how evenly you apply water over a turf area.


- Irrigation timer** – is used to control the timing (how many days per week) and duration (run time) of watering on a landscape. These timers can be programmed for different plant needs and seasonal changes in water use.



- **Irrigation tubing & emitters** – are used to apply water to shrubs and plants instead of using a hose. The emitters control how much water is applied to specific plants and when used with an irrigation timer, water will be applied to a landscape automatically for a set amount of time, ensuring that water doesn't accidentally get left on.



- **Dual-flush toilet valve** – is a \$25 valve that replaces the toilet flapper and handle and can be installed in an existing toilet to convert it to a dual-flush toilet. This allows the user to flush with less or more water by choosing “number one or number two,” respectively.



- **Spray nozzles** – are used to stop or restrict the flow of water from a hose, yet have it available for use when needed. This keeps water from running constantly if you are washing a car or watering plants.



4. Demonstration: Measuring Faucet Flow Rate (15 minutes)

Focus question:

How can we determine the flow rate of a classroom faucet?

Activity:

This activity is an example of implementing one of the technological devices from the mystery box, the aerator. Introduce the *Faucet Audit Data Sheet* (Appendix D), specifically **Table 2** where students will record water audit data at home. Have students review the Home Faucet Audit Procedure (Appendix B) and let them lead the demonstration

by telling you what the next step is. Demonstrate as the students' direct you how to measure the faucet flow rate: baseline, without an aerator and with a new aerator. Students should record the data that you measure as a class in the first row of the data sheet. To reinforce the procedure, show the 1-minute video, How to Change an Aerator (found at: <http://arizonawet.arizona.edu/wsi/>).

Measuring Bathroom Faucet Flow Rate Procedure:

1. Examine the faucet for leaks:
 - a. Look and feel around the faucet as well as under the sink along the drain pipe.
 - b. Indicate the presence of leaks on your data sheet.
2. Measure the flow of water from the faucet for 5 seconds (you will need help from a family member):
 - a. With the mixing bowl in the sink, turn on the faucet all the way.
 - b. Put the opening of the flow rate measuring bag (page 14) under the running faucet and start the stopwatch simultaneously. (If you have a stopwatch, use it to time for 5 seconds, otherwise use a watch with a second-hand).
 - c. Collect water for EXACTLY 5 seconds by counting aloud 1, 2, 3, 4, 5 in time with the stopwatch.
 - d. On the count of “5,” immediately remove the bag.
 - e. Turn the water off.
 - f. Read the water level from the flow rate measuring bag and record the measurement in gallons per minute (gpm).
 - g. Pour the water from the measuring bag and mixing bowl into a bucket.
 - h. Repeat steps a–g, two more times for a total of three measurements.
 - i. Average the three measured values. This is your Baseline Flow Rate.

3. Check for an existing faucet aerator.
 4. If an aerator is on the faucet, remove it (pliers will likely be needed).
 5. Make a note of the aerator's condition.
 6. Repeat directions in Step 2 to measure Flow Rate Without an Aerator and record your data.
 7. Install a new aerator (pliers will likely be needed and 1.0 gpm is recommended).
 8. Repeat directions in Step 2, recording the data. This is your Flow Rate With a New Aerator. Please leave the new aerator on if it's okay with your family.
 9. Pour the water collected in the bucket on plants outside.
 10. Repeat steps 1–9 to audit all other bathroom faucets in your home.
 11. Report how many faucet aerators were installed at your home.
 12. Complete the *Faucet Audit Data Sheet* (Appendix D) and the *Faucet Water Audit Report* (Appendix E).
 13. Return "old, used" aerators that were replaced and unused aerators to school.
- To ensure students fill out the *Faucet Audit Data Sheet* (Appendix D) correctly, you may want to give them copies of the *Sample Data Sheet* (Appendix C) to take home.

New Resources Group, Inc.
P.O. Box 320049
Fairfield, CT 06825
Phone: 203-366-1000 Fax: 203-366-1004
www.NRGIDEAS.com

How Much Can You Save?

Save water and energy (energy used to heat your hot water) and money with high efficiency lower flow shower heads and aerators.

Determine the flow at showers and sinks.
Flow is measured as volume per minute. This handy tool will show you the flow in gallons and liters per minute, and help guide you to saving water, energy and money.
Easy Instructions on how to test your showers and faucets.

- 1) Turn on the fixture to be tested - shower head, faucet, or hose. Adjust the flow to how you would normally use the fixture.
- 2) Hold the bag open and place under the fixture for exactly FIVE seconds.
- 3) Remove from the flow, hold the bag up and read the flow rate measurement on the bag. Pour water out and repeat. It is important to get the FIVE seconds correct. Practice counting with a watch. Repeat the test to check your results.
- 4) Below we have indicated efficient shower head, kitchen aerator and bathroom aerator guidelines. NOTE: These are maximum recommendations. You can always go lower if you are comfortable with the performance at the lower flow. The lower the flow, the more water, energy and money you will save.

Showerheads

Compare the water level for your shower heads to the efficient one. Look in the **Potential Savings** column to see how much you can save by installing a new shower head.
The most efficient shower heads are available at www.nrgideas.com.

Water Level	Flow Rate		Potential Savings on your utility bills
	Gallons (US)	Liters	
— 5 GPM	19 LPM	\$207/year	
— 4 GPM	15.2 LPM	\$124/year	
— 3 GPM	11.4 LPM	\$41/year	
— 2 GPM	7.6 LPM		
— 1.5 GPM	5.7 LPM		
— 1 GPM	3.8 LPM		
— .5 GPM	1.9 LPM		

Faucets

(Bathroom and Kitchen)
Compare the water level for faucet to the efficient one. Look in the **Potential Savings** column to see how much you can save with a low flow faucet aerator.
The most efficient aerators are available at www.nrgideas.com.

Water Level	Flow Rate		Potential Savings on your utility bills
	Gallons (US)	Liters	
— 5 GPM	19 LPM	\$16/year	
— 4 GPM	15.2 LPM	\$11/year	
— 3 GPM	11.4 LPM	\$6/year	
— 2 GPM	7.6 LPM		
— 1.5 GPM	5.7 LPM		
— 1 GPM	3.8 LPM		
— .5 GPM	1.9 LPM		

Calculations assume 2 people per household, 2.5 gpm shower head, 8 minutes per shower, 6 showers per person each week.
Water sewer and energy savings are all included.

Calculations assume 2 people per household. Potential Savings are for two 2.2 aerators one in the kitchen and one in the bathroom.
Water sewer and energy savings are all included.

EPA WaterSense Flow • Showers: 2.0 gpm, Bath Faucet: 1.5 gpm

Figure 1 - Flow rate measurement bag.

5. Brainstorm: Bathroom faucet water uses & variables (10 minutes)

Focus Questions:

How much water is used by your family at home bathroom faucets each year?

How much water can be saved each year by installing new aerators on all home bathroom faucets?

Activity:

Recall the ways water is used at home. Ask the question, “How is water used by your family at the bathroom faucets in your home?” Have students brainstorm a list of specific uses of the bathroom faucets for a family each day.

Example list:

- Men may shave using the faucet
- All members brush their teeth
- All members wash their hands
- Getting washcloth wet to wash face

Discussing Frequency and Duration:

State the focus question, “How much water is used by your family at the bathroom faucets in your home each year?” From the measurement that we made, we know how much water comes out of the faucet each minute that it’s on (Section 4). This is called the **flow rate**. Ask the students, “What else do we need to know to figure out how much water we use from a bathroom faucet in your home **in a day**?” Allow cooperative learning groups to discuss this for 3 minutes. (This is a real critical thinking question and needs time for thought).

Answers:

- Duration – How long water is run for each use.
- Frequency – How many times each use happens per day.

Using the *Faucet Audit Data Sheet* (Appendix D), add any brainstormed uses of water not already listed to the first column in Table 1. Note that Table 1 is for one bathroom faucet location and that there

is a different section for each water user as you move across the page from left to right. Conduct an example interview with a few of the students. Have them estimate how long they leave the faucet on for each use and how many times per day they use the faucet for each use. Calculate the total number of minutes per day for each use, based on frequency and duration of use.

Explain to the students that they will follow a similar process, interviewing each family member to determine the number of times they conduct each of the uses in a day. They will also do one of two things: estimate the length of time the water is on for each use or time family members as they use the water. Students will use Table 1 on the *Faucet Audit Data Sheet* (Appendix D) to collect this water use data and then they will bring the completed inventory back to class to complete the calculations to determine annual water use and water savings.

6. Wrap-up/Homework Discussion (10–15 minutes) – Technological and behavioral ways to save water

- Ask students: What is the difference between **Behavioral Changes** and **Technological Devices**? What do they have in common? How are they different?
- Ask students: What is the goal of the home water audit? Ask students if changing aerators is a behavioral or a technological change. Emphasize that changing aerators is a technological change that can be supplemented with a commitment to change how water is used (i.e. behavioral change).
- Review homework
 - Review faucet audit assignment, equipment needed to complete home faucet audit, procedure, data sheet and technological device (aerators).
 - Hand out aerators, flow rate measuring bags (if available) and extra data sheets (one per faucet).
 - Remind students that they need

to bring back old aerators that are replaced as well as any new aerators that do not get installed.

Day 2:

7. Homework Review, Data Analysis and Discussion (50 minutes)

Have students finalize their calculations on the *Faucet Audit Data Sheet*, and quantify their water savings in Table 3. After students have calculated annual water savings through the installation of new faucet aerators, calculate a total water savings for the entire class in gallons per day and gallons per year. Also, discuss variables that would influence overall usage. Variables include: family size, daily routines, working in/out of the home, travel, etc.

To conclude, make some comparisons. On the Sample Data Sheet (Appendix C), 13.06 gallons of water was saved per day, or 4,767 gallons per year, by installing new aerators. If 30 students do the same thing, the entire class saves 143,010 gallons. Ask students what could be done with that saved water?

Saving 143,010 gallons per year is equivalent to the water uses listed below. With 143,000 gallons per year, you could:

- Grow and maintain 24 low-water use trees (Lancaster, Brad. *Rainwater Harvesting for Drylands and Beyond – Volume 1*. Tucson: Rainsource Press, 2008. Print)
- Collect the amount of rain that falls on one acre in a 0.4" storm (1 acre-foot = 325,851 gallons)
- Fill 9 'typical' pools. A typical swimming pool uses ~ 15,000 gallons of water (http://cms3.tucsonaz.gov/water/terms_and_definitions)
- Provide the needs for a family of 4 for one year, based on 100 gallons per person, per day (Arizona Dept. of Water Resources)
- Grow and produce 54 pairs of cotton jeans (www.waterfootprint.org)
- Grow and produce 226 hamburgers (Hoekstra, A.Y. and Chapagain, A.K. (2007)

Water footprints of nations: water use by people as a function of their consumption pattern, *Water Resources Management*. 21(1): 35–48. Retrieved October 1, 2012 from www.waterfootprint.org)

- Produce 4 new cars (www.amwater.com)

Introduce the EPA WaterSense “I’m for Water” Pledge. The pledge is a national effort sponsored by the EPA to encourage individuals to find new ways to conserve water. We’d like all the students participating in the WSI to take the pledge as part of their homework. (<http://www.epa.gov/watersense/pledge/>)

- The pledge involves:
 - Installing water efficient aerators (Done!)
 - Checking toilets for leaks
 - Installing water efficient showerheads

In-classroom presenters have two options for making sure that data gets reported for every household. The first option is to collect all *Data Sheets* and *Water Audit Reports* for each student and enter the data at: <http://arizonawet.arizona.edu/wsi/>. This option enables you as the presenter to track water savings generated by your efforts (you will define your own Group ID). The second option is to assign a follow-up homework assignment to the students to enter their own home bathroom faucet audit data including water savings at <http://arizonawet.arizona.edu/wsi/>. To do this, students will need a valid email address. This option enables students to check their math by entering their data and having the site generate the calculations. Water savings graphs are generated on this site for comparing home water savings. A group comparison graph shows water savings from all of your group’s participants (students would have to have the Group ID). The top 10 comparison graph compares the currently identified participant’s water savings to the top 10 water savers in the program. We invite you to share any insights you have as you use this tool to inspire water conservation in your own work. Directions for both reporting options are located in the Introduction (see page 5).

April 1, 2013

Dear Parents and Guardians,

Arizona Project WET and *Tucson Water* are working with *Tucson Unified School District* to offer relevant, projectbased learning to 6th grade students. Students learn to audit a faucet during the **Water Scene Investigation** inclassroom presentation. People learn and remember more through application of knowledge. After the presentation, students will be asked to audit all the bathroom faucets in their homes as a **homework assignment**. This is an opportunity for students to apply their new knowledge, and in the process, show you what they have learned. They will be measuring each bathroom faucet's flow rate and determining how many times and for how long each faucet is used in a day. They will use this data to calculate your home's bathroom faucet water use in gallons per day.

In addition to determining how much water is used, students have the opportunity to install a simple technology that will save water. The *Tucson Water Department* has provided each student with a faucet aerator for each bathroom faucet in your home and a flow rate measurement bag with pre-printed gallons per minute markings. They will be measuring the faucet flow rate for three conditions: baseline flow, without an aerator and with the new aerator. Your student also has a procedure sheet, a data sheet and an audit report to guide the audit; please have your student explain these to you. Please allow your student to install the new aerator for this assignment and please leave the new 1-gallon per minute aerator on if you are happy with the result. This will save water and money. **After installing new aerators, please return old aerators to the classroom. Please have your child enter the bathroom faucet water audit data for your home at:** <http://arizonawet.arizona.edu/wsi/>.

This project hopefully inspires students to save water through their behavior, but also provides them with an opportunity to discover how simple technology can be used to save a significant amount of water over time. Water efficient devices that really work are readily available to consumers (see: <http://www.epa.gov/WaterSense/>)! Since 2006, WaterSense has helped save 287 billion gallons of water, which is the amount of water needed for all Arizona homes for one year.

According to the Report to the President entitled: Prepare and Inspire: K-12 Education in Science, Technology, Engineering and Math (STEM) for America's Future (September 2010), "We must prepare students so they have a strong foundation in STEM (Science, Technology, Engineering and Math) subjects and are able to use this knowledge in their personal and professional lives. And we must inspire students so that all are motivated to study STEM subjects in school and many are excited about the prospect of having careers in STEM fields. Furthermore, the report states that STEM education is most successful when students develop personal connections with the ideas." The Water Scene Investigation does all of these things.

We hope that you will be as excited as we are to be partners in this endeavor. Students shine when they are engaged in relevant, projec-based learning. In advance, we thank you for the time, dedication and support you give to your child and his/her education. We sincerely appreciate you and your efforts.

Sincerely,



Request Parent Letter for adaptation at arizona.wet@gmail.com.

Interview (Table 1): to determine how many minutes per day water flows from the bathroom faucet.

1. Start with the bathroom faucet that you think gets used the most; write down the faucet location.
2. Enter the names of all the users of this faucet, one in each section as you move horizontally across the data sheet. If you have more than three users, you will need a second data sheet.
3. Ask each user:
 - a. "What do you use this faucet for?" For example, the uses could be to brush teeth, wash hands, wash face etc. Record this information under the column titled Water Use.
 - b. "How many times each day is water used for this reason?" For example, if the user brushes his/her teeth twice a day, record the number 2 into the column titled # of Times per Day.
4. Time each water use, once for each user. You can measure the time using a stopwatch, clock or timer to capture the number of seconds the faucet is running. Record the amount of time the faucet runs in the column titled Duration for Each Time. (If you cannot time the water use, ask the water user to estimate how long the water is on for each use.)
5. Calculate the Total seconds per day that the water runs for each water use by multiplying the # of Times per Day value by the Duration for Each Time value.
6. Calculate the Each User's Total per Day by adding all the values in the Total Seconds per Day column. Each user will have their own Total per Day.
7. Calculate the total number of minutes per day that water flows from this faucet by adding all user's Total per Day, then dividing by 60 seconds/minute.

New Resources Group, Inc.
 P.O. Box 220649
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 Phone: 203-366-1000 Fax: 203-366-1004
 www.NRGIDEAS.com

How Much Can You Save?
 Save water and energy (energy used to heat your hot water) and money with high efficiency lower flow shower heads and aerators.

Determine the flow at showers and sinks.
 Flow is measured as volume per minute. This handy tool will show you the flow in gallons and liters per minute, and help guide you to saving water, energy and money.
Easy Instructions on how to test your showers and faucets.

- 1) Turn on the fixture to be tested - shower head, faucet, or hose. Adjust the flow to how you would normally use the fixture.
- 2) Hold the bag open and place under the fixture for exactly FIVE seconds.
- 3) Remove from the flow, hold the bag up and read the flow rate measurement on the bag. Pour water out and repeat. It is important to get the FIVE seconds correct. Practice counting with a watch. Repeat the test to check your results.
- 4) Below we have indicated efficient shower head, kitchen aerator and bathroom aerator guidelines. NOTE: These are maximum recommendations. You can always go lower if you are comfortable with the performance at the lower flow. The lower the flow, the more water, energy and money you will save.

Showerheads			Faucets (Bathroom and Kitchen)		
Compare the water level for your shower heads to the efficient one. Look in the Potential Savings column to see how much you can save by installing a new shower head. The most efficient shower heads are available at www.nrgideas.com.			Compare the water level for faucet to the efficient one. Look in the Potential Savings column to see how much you can save with a new faucet aerator. The most efficient aerators are available at www.nrgideas.com.		
Water Level	Flow Rate	Potential Savings on your utility bills	Water Level	Flow Rate	Potential Savings on your utility bills
Gallons (US)	Liters		Gallons	Liters	
5 GPM	19 LPM	\$207/year	5 GPM	19 LPM	\$16/year
4 GPM	15.2 LPM	\$124/year	4 GPM	15.2 LPM	\$11/year
3 GPM	11.4 LPM	\$41/year	3 GPM	11.4 LPM	\$6/year
2 GPM	7.6 LPM		2 GPM	7.6 LPM	
1.5 GPM	5.7 LPM		1.5 GPM	5.7 LPM	
1 GPM	3.8 LPM		1 GPM	3.8 LPM	
.5 GPM	1.9 LPM		.5 GPM	1.9 LPM	

Calculations assume 2 people per household, 2.0 gpm shower head, 8 minutes per shower, 4 showers per person each week. Water, sewer and energy savings are not included.

Calculations assume 2 people per household. Potential Savings are for two 2.2 aerators one in the kitchen and one in the bathroom. Water, sewer and energy savings are not included.

EPA WaterSense Flow • Showers: 2.0 gpm, Bath Faucet: 1.5 gpm

Measure (Table 2): to determine how much water flows from the bathroom faucet in gallons per minute.

1. Examine the faucet for leaks:
 - a. Look and feel around the faucet as well as under the sink along the drain pipe.
 - b. Indicate the presence of leaks on your data sheet.
2. Measure the flow of water from the faucet for 5 seconds (you will need help from a family member):
 - a. With the mixing bowl in the sink, turn on the faucet all the way.

- b. Put the opening of the flow rate measuring bag under the running faucet and start the stopwatch simultaneously. (If you have a stopwatch, use it to time for 5 seconds, otherwise use a watch with a second-hand).
 - c. Collect water for EXACTLY 5 seconds by counting aloud 1, 2, 3, 4, 5 in time with the stopwatch.
 - d. On the count of "5," immediately remove the bag.
 - e. Turn the water off.
 - f. Read the water level from the flow rate measuring bag and record the measurement in gallons per minute (gpm).
 - g. Pour the water from the measuring bag and mixing bowl into a bucket.
 - h. Repeat steps a–g, two more times for a total of three measurements.
 - i. Average the three measured values. This is your Baseline Flow Rate.
3. Check for an existing faucet aerator.
 4. If an aerator is on the faucet, remove it (pliers will likely be needed).
 5. Make a note of the aerator's condition.
 6. Repeat directions in Step 2 to measure Flow Rate Without an Aerator and record your data.
 7. Install a new aerator (pliers will likely be needed and 1.0 gpm is recommended).
 8. Repeat directions in Step 2, recording the data. This is your Flow Rate With a New Aerator. Please leave the new aerator on if it's okay with your family.
 9. Pour the water collected in the bucket on plants outside.
 10. Repeat steps 1–9 to audit all other bathroom faucets in your home.
 11. Report how many faucet aerators were installed at your home.
 12. Make sure the data is recorded in the Faucet Audit Data Sheet (Appendix D).
 13. Return "old, used" aerators that were replaced and unused aerators to school.
- Calculate (Table 3): to determine whether the new aerator results in water savings**
1. Copy:
 - a. the Total Time in min/day from Table 1 in to appropriate two boxes in Table 3.
 - b. the Average Flow Rate for Baseline Water Use from Table 2 into Table 3.
 - c. the Average Flow Rate for New Aerator Water Use from Table 2 into Table 3.
 2. Calculate:
 - a. Avg. Baseline Flow Rate X Total Time = Baseline water use/day
 - b. Avg. New Aerator Flow Rate X Total Time = New Aerator water use/day
 - c. Baseline water use/day – New Aerator water use/day = Water Savings
 3. Mark the form for whether you will keep the new aerator on the faucet or not and enter the water savings in gallons per day.
- Repeat: complete a separate data sheet for each bathroom faucet that will receive a new aerator. Each faucet may involve different water users and therefore different water use will be recorded.*
- Summarize: the overall impact of your Home Water Audit in the Faucet Water Audit Report (Appendix E)**

Student Name: _____ Group ID: _____ Class Period: _____ Date: _____

Faucet Location: kid's bathroom

Table 1 Focus Question: How many minutes per day does water flow from this faucet on an average day?

Water use	Water User #1: Me			Water User #2: Sister			Water User #3:		
	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day
Brushing teeth	2 <input checked="" type="checkbox"/>	30 <input type="checkbox"/>	60	2 <input checked="" type="checkbox"/>	120 <input type="checkbox"/>	240	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Washing Hands	5 <input checked="" type="checkbox"/>	15 <input type="checkbox"/>	75	4 <input checked="" type="checkbox"/>	20 <input type="checkbox"/>	80	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other uses: Washing face	1 <input checked="" type="checkbox"/>	60 <input type="checkbox"/>	60	1 <input checked="" type="checkbox"/>	45 <input type="checkbox"/>	45	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Each User's Total Seconds Per Day	⇒⇒⇒⇒⇒⇒⇒⇒		195	⇒⇒⇒⇒⇒⇒⇒⇒		365	⇒⇒⇒⇒⇒⇒⇒⇒		

Total seconds this faucet runs per day: **User #1's total + User #2's total + User #3's total = 560** sec/day

For how many minutes per day does water flow from this faucet? **Total seconds/60 = 9.33** min/day

Table 2 Focus Question: How much water flows from the bathroom faucet when you turn it on? (in gallons per minute = gpm)

<input checked="" type="checkbox"/> if Leaking	Baseline Flow Rate (how you found the faucet, i.e. may or may not have an aerator)				Flow Rate <u>Without</u> Aerator				Flow Rate With <u>New</u> Aerator			
	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg
<input type="checkbox"/>	2.6	2.3	2.4	2.43	4.0	3.8	3.7	3.83	0.9	1.1	1.1	1.03

What is the **Average Baseline** flow rate (gpm) = **2.43** What is the **Average New Aerator** flow rate (gpm) = **1.03**

Notes: (leak location, old aerator's condition, observations, etc.)

Table 3 Focus Question: Does the New Aerator result in water savings?

Baseline Water Use				New Aerator Water Use			
Average Flow Rate (gpm)	Total Time min/day	Baseline Water Use per Day (Avg x total time = gal/day)		Average Flow Rate (gpm)	Total Time min/day	New Aerator Water Use per Day (Avg x total time = gal/day)	
2.43 <input checked="" type="checkbox"/>	9.33 <input type="checkbox"/>	22.67		1.03 <input checked="" type="checkbox"/>	9.33 <input type="checkbox"/>	9.61	

Change in daily water use due to aerator installation:

Baseline Water Use/day – New Aerator Water Use/day = 13.06 gal/day

What will you do to use **LESS** water each day? Mark one of the following:

- Re-install OLD aerator = 0 gallons/day savings Keep new aerator = **13.06** gallons/day water savings
- _____ Old aerator has a lower flow rate.
- _____ My family chose not to keep the new aerator.

Student Name: _____ Group ID: _____ Class Period: _____ Date: _____

Faucet Location: _____

Table 1 Focus Question: How many minutes per day does water flow from this faucet on an average day?									
Water use	Water User #1:			Water User #2:			Water User #3:		
	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day	# of Times per Day	Duration for Each Time (seconds)	Total Seconds per Day
Brushing teeth	X	≡		X	≡		X	≡	
Washing Hands	X	≡		X	≡		X	≡	
Other uses:	X	≡		X	≡		X	≡	
Each User's Total Seconds Per Day	⇒⇒⇒⇒⇒⇒⇒⇒⇒			⇒⇒⇒⇒⇒⇒⇒⇒⇒			⇒⇒⇒⇒⇒⇒⇒⇒⇒		

Total seconds this faucet runs per day: **User #1's total + User #2's total + User #3's total** = _____ sec/day

For how many minutes per day does water flow from this faucet? **Total seconds/60** = _____ min/day

Table 2 Focus Question: How much water flows from the bathroom faucet when you turn it on? (in gallons per minute = gpm)												
<input checked="" type="checkbox"/> if Leaking <input type="checkbox"/>	Baseline Flow Rate <small>(how you found the faucet, i.e. may or may not have an aerator)</small>				Flow Rate <u>Without</u> Aerator				Flow Rate With <u>New Aerator</u>			
	1	2	3	Avg	1	2	3	Avg	1	2	3	Avg

What is the **Average Baseline** flow rate (gpm) = _____ What is the **Average New Aerator** flow rate (gpm) = _____

Notes: (leak location, old aerator's condition, observations, etc.)

Table 3 Focus Question: Does the New Aerator result in water savings?					
Baseline Water Use			New Aerator Water Use		
Average Flow Rate (gpm)	Total Time min/day	Baseline Water Use per Day (Avg x total time = gal/day)	Average Flow Rate (gpm)	Total Time min/day	New Aerator Water Use per Day (Avg x total time = gal/day)
X	≡		X	≡	

Change in daily water use due to aerator installation:

Baseline Water Use/day – New Aerator Water Use/day = _____ gal/day **Water Savings**

What will you do to use **LESS** water each day? Mark one of the following:

- Re-install OLD aerator = 0 gallons/day savings
 Keep new aerator = gallons/day water savings
 _____ Old Aerator has a lower flow rate
 _____ My family chose not to keep the new aerator.



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This information has been reviewed by University faculty.
cals.arizona.edu/pubs/water/az1594.pdf

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