



# Water Investigation

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# What Will You Do?



In the Water Investigation you will:

- ✓ Assess water use in your school and on the school grounds.
- ✓ Collect data about the consumption of water at the school.
- ✓ Understand how individual and collective student actions can affect water conservation.
- ✓ Learn about sustainable approaches to water use and why it is important to adopt sustainable practices.
- ✓ Generate a plan to improve your school's water conservation practices and overall sustainability.
- ✓ Implement one or more of your water conservation improvement strategies.

# Directions

## FOR GREEN TEAM MEMBERS



### ❑ Gather Documents and Supplies.

If possible, gather the following documents and supplies before the team begins the Investigation:

- Monthly or annual billing statements from the school's water provider
- Water quality reports on the school's water
- Any written policies that the school may have related to water management or conservation

### ❑ Review and Conduct the Investigation.

Review the [Water Investigation](#) to determine if the questions are appropriate for your school. Also determine if there are additional questions that you'd like to add.

Provide a printed copy of the entire [Water Investigation](#) to the Green Team members to use as they conduct the investigation. They should answer the questions to the best of their ability according to the time allotted and materials available.

### ❑ Develop and Implement an Action Plan.

Using the data collected from the Investigation, prioritize your ideas for action projects and implement one or more of your plans.

### ❑ Celebrate Success.

Communicate your findings and achievements with other students, school administrators, and the community. For suggestions on how to share your achievements, see the [Celebrate Success](#) tip sheet available on page 11 of the Adult Leader Guide.

### ❑ Apply for GreenSchools Certification.

Once you have completed all five PLT GreenSchools Investigations and taken action in at least one area, you can be recognized for your hard work and achievements through this national certification program. Certified schools are eligible for great recognition items, such as buffs and wristbands for students, weatherproof signs and banners for the school grounds, and more! You can view the certification requirements at <https://www.plt.org/green-schools/certification-requirements>.



# Why Investigate Water?



## Water Resources

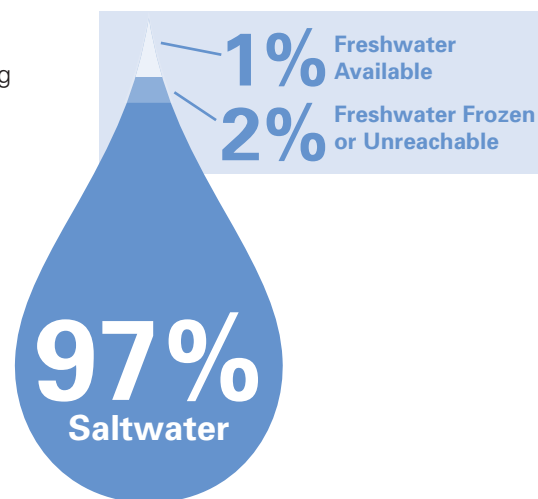
Most of us don't think of water as a limited resource. After all, 70 percent of the Earth is covered with water! However, the amount of **fresh water** that is available for drinking, cooking, and other uses is actually very limited. Less than 1 percent of the water on Earth is fresh water available for human use. The remainder of the water on the Earth's surface is either in the oceans (97 percent), or locked up in polar ice caps and **glaciers**, or located too deep in the ground to extract (2 percent).

Definitions for the words in bold text can be found in the Glossary on page 6.

Because water is essential to life's processes, maintaining adequate fresh water supplies and delivery systems will continue to be an important issue for generations to come. As the Earth's population continues to grow, ever-increasing demands will be placed on our water resources. Water distribution and use are also highly unequal among the world's population. For example, every day, the average American family uses about 552 gallons of water. Compare this to the average African family, which uses about 5 gallons of water a day.

Although water can be recycled—and in fact this must be done to ensure an adequate supply—water treatment is expensive and does not solve the problem of limited availability. In some parts of the world, including the western United States, drought is becoming a serious problem. According to some estimates, 40 percent of the world's people live in areas that are water-stressed. Compounding the problem, many sources of fresh water are being contaminated by pollution. (Source: <https://freshwaterwatch.thewaterhub.org/content/water-limited-resource>)

## Distribution of Water on Earth



## Water Conservation and Challenges

Conserving water and preventing water pollution are critical to ensuring an adequate supply of usable water. Learning to use water wisely will help protect the quantity and quality of our water resources. Wise water use can also help people save money on water, sewer, and energy costs.

Water consumption and its associated challenges bring together the fields of science, technology, engineering, math, sociology, economics, political science, management, and health. As you investigate water issues at your school and look for solutions, you'll gain real-world experience in science, technology, engineering, and math (STEM). You'll identify your watershed and gather information about the source, cost, and quality of your school's water supply. You'll also collect data on water conservation practices at your school and learn how individual and collective student actions can affect water usage. After you've completed the Water Investigation, you'll brainstorm ideas to improve your school's water conservation, such as by fixing leaks, installing automatic water-efficient faucets, or installing a rain barrel.





# Why Investigate Water?



## Forest to Faucet

Although you may not think about it when you turn on a faucet, the water you use each day probably originated in a forest. In fact, almost 80 percent of U.S. freshwater resources originate in forests, and some 180 million people directly depend on forests for their drinking water. (Source: [www.fs.fed.us/openspace/fote/fote-6-9-05.pdf](http://www.fs.fed.us/openspace/fote/fote-6-9-05.pdf).) Forests help maintain freshwater supplies by absorbing rainfall, cooling and cleansing water, slowing stormwater runoff, and refilling underground **aquifers**.

Even though not all of us live within forested areas, every one of us lives within a **watershed**. A watershed is the land area that delivers runoff water and sediment to a major river or stream and its tributaries. Watersheds cross city, state, and national boundaries, a fact that has implications for the management of forests and other landscapes. Our actions can affect the ability of watersheds to function as sources of clean water.

Many communities attempt to use technology—at great expense—to replace some of the **ecosystem services** provided by forests at little or no cost. For example, billions of dollars are invested in the construction and upgrade of water treatment plants to clean public water supplies that have been degraded by pollution. In fact, water utilities spend 19 times more on water treatment chemicals every year than the federal government invests in protecting lakes and rivers from pollution by conserving forest land. (Source: <https://www.cwp.org/forests-and-drinking-water/>.) Hence, it is vitally important that we protect our forests and watersheds.

## Students Making a Difference

You can do your part to ensure that water resources are not wasted at your school. This will save water for other users, and it will allow more water to remain in the reservoirs, lakes, and rivers of your local watershed, where it can benefit wildlife and the environment. Saving water will also save your school money.

In addition, you can take what you've learned at school to your home to help family members save water and money, too! For useful tips, see [Green Your Home: Improving Water Conservation](#) found at the end of this Investigation. You can also download it at [www.plt.org/activities-for-families/around-your-home/](http://www.plt.org/activities-for-families/around-your-home/).



## PLT GreenSchool Videos

To learn more about why conserving water at your school is important and to see how other GreenSchools across the country are taking action, watch PLT's short videos **Investigating Water** and **GreenSchools in Action: Water**. These videos are available on PLT's YouTube channel: <https://www.youtube.com/user/ProjectLearningTree>.



# Careers



This investigation may stimulate your interest in a variety of careers related to water resources, water quality, and water conservation. Here are a few of the fields that you may discover as you conduct the investigation.

- Civil engineer
- Hydrogeologist
- Hydrologist
- Water chemistry scientist
- Water resources planner
- Water rights law and policy specialist
- Water treatment technician
- Xeric landscape specialist



# Glossary



**Aquifer**—An underground layer of porous, water-saturated sand, gravel, or bedrock from which water can be extracted.

**Contaminant**—A substance that makes something impure or unclear. For example, bacteria in drinking water are a contaminant because they can render the water unsafe to drink.

**Ecosystem services**—The services that humans derive from environmental functions, such as water purification, oxygen production, photosynthesis, and carbon sequestration.

**Erosion**—The wearing away of the land surface by wind or water. Erosion occurs naturally from weather or runoff, but it is often intensified by human practices.

**Faucet aerator**—A device that can be placed on the end of a faucet head to add air to the waterflow and reduce the amount of water used.

**Fresh water**—Water that is not salty; typically defined as having a salt concentration below 1%.

**Glacier**—A flowing body of ice, formed in a region where the rate of snowfall exceeds the rate at which snow and ice melt.

**Native plant**—A plant that occurs naturally in an area or habitat.

**Rain barrel**—A system that collects and stores rainwater, which would otherwise be lost to runoff, from a roof. The collected water can be used at a later time to water lawns and gardens.

**Retention pond**—A basin designed to control flooding and stormwater runoff.

**Runoff**—Surface water that flows downhill due to gravity, sometimes carrying away soil as it flows.

**Watershed**—The land area that delivers runoff water and sediment to a major river or stream and its tributaries.





## PART I: SCHOOL INFORMATION



## Overview

This investigation will help you document and evaluate water use in your school and on your school grounds. You will gather information about the source, quality, and cost of water. You will also collect data on water conservation practices. The results will help you see where your school could make improvements, such as fixing leaks and installing automatic water-efficient faucets. You'll see the power that individual and collective student actions can have on water conservation.

**School Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**GREEN TEAM:**

*(Please include administrators, teachers, school staff, students, community members, parents, and others involved in this investigation.)*

[illegible]

## PART II: WATER SOURCE, QUALITY, AND QUANTITY



1. In which **watershed** is your school located? You can use the following U.S. EPA website to locate your watershed:  
<http://cfpub.epa.gov/surf/locate/index.cfm>.

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2. What is the name and what is the approximate distance of the closest body of water to your school? (For example, stream, river, lake, aquifer)

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Definitions for the words in bold text can be found in the Water Investigation Glossary on page 6.

3. What is the source of your school's drinking water supply?

☐ Municipal water supply    ☐ School has its own well

4. If the school's drinking water comes from a municipal supply, what is its source?

☐ Groundwater (well, **aquifer**)    ☐ Surface water (lake, river, reservoir)

5. Where does used water (wastewater) go?

☐ Municipal sewer system (name): \_\_\_\_\_

☐ Onsite septic system and drainage field

☐ Holding tank

6. If the school's drinking water comes from a private well, who monitors and tests the water quality? How often is the water quality tested?

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7. If the school's drinking water comes from a municipal supply, what is the name of the supplier? How often is the water quality tested?

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8. Using water bills from the last year, record the following information:

a. Water bill year: \_\_\_\_\_

b. Amount of water the school used that year: \_\_\_\_\_

c. Cost of water for that year: \$\_\_\_\_\_

9. Complete the [Water Quality Test Results Chart](#) that follows on page 9. If the school's water comes from a municipal supply, a water quality report should be available to the public. The reports are often mailed to customers and made available at the supplier's website. If the school's water comes from a well, routine water quality tests should be performed, and the test results should be available from the testing lab.





### WATER QUALITY TEST RESULTS CHART

Directions: This chart shows contaminants for which water quality testing companies commonly test. Using the water quality report, indicate which of these contaminants was detected. Also note whether the contaminant exceeded allowable standards.

Contaminant Name	Was the contamination detected? (Yes/No)	Was the action level set for the contaminant exceeded, causing a violation? (Yes/No)
E. coli bacteria		
Coliform bacteria		
Arsenic		
Barium		
Cadmium		
Chromium		
Copper		
Cyanide		
Fluoride		
Lead		
Nitrate		
Nitrite		
Selenium		
Others:		

1. Brainstorm and then record a list of ways that your school could improve its drinking water quality. (For example, installing water filters.) If there are no issues with the water quality, continue monitoring it annually.



## PART III. WATER DEVICES



In this section, you will investigate whether the faucets, sinks, water fountains, toilets, and other water devices in your school are in good repair. You will also analyze how the devices operate and whether or not they are low-flow models (which conserve water).

1. Use the [Classroom Water Devices Chart](#) below to analyze any water devices found inside classrooms. You will tally this information and include it on the “classrooms” line of the [Schoolwide Water Devices Chart](#) on the next page.

### CLASSROOM WATER DEVICES CHART

Directions: Write the number of water devices found in each classroom and indicate whether the device is operated automatically (A), with a sensor (S), or manually (M). Also note the number of leaking devices.

A = Automatic: must be turned on manually but turns off automatically or is on a timer

S = Sensor: turns on and off in response to the movement of the person using the equipment

M = Manual: must be physically turned on and off by user

Location	Faucets		Water Fountains		Toilets/Urinals	
Classroom Name/#	Total Number/ A – S – M	Number Leaking	Total Number/ A – S – M	Number Leaking	Total Number/ A – S – M	Number Leaking
Sample: Room 102	2/A	1	1/M	0	1/S	1



2. Use the [Schoolwide Water Devices Chart](#) that follows to record how many water using devices your school has and if any of the devices are leaking. Use the [Classroom Water Devices Chart](#) on the previous page to record information about water using devices inside classrooms.

**Some signs of a leaking toilet:** Sounds of running water or a faint hissing or trickling noise even if the toilet has not been flushed, the need to jiggle the toilet handle to make it stop running, and water trickling down the sides of the toilet bowl long after it has been flushed.

**Some signs of a leaking urinal:** Water running after the flush is complete, and water leaking from the edge of the urinal on the wall.

### SCHOOLWIDE WATER DEVICES CHART

Directions: Write the number of water devices found in each location and indicate whether the device is operated automatically (A), with a sensor (S), or manually (M). Note the number of leaking devices. If needed, make additional copies of this chart.

A = Automatic: must be turned on manually but turns off automatically or is on a timer

S = Sensor: turns on and off in response to the movement of the person using the equipment

M = Manual: must be physically turned on and off by user

\* Compile the data from the **Classroom Water Devices Chart** (page 10) and insert it on the Classrooms line of this chart. For how the device is operated (Automatic, Sensor, Manual), indicate the type most commonly found.

Location	Faucets		Water Fountains		Toilets/Urinals		Other Water Devices	
	Total Number/ A – S – M	Number Leaking	Total Number/ A – S – M	Number Leaking	Total Number/ A – S – M	Number Leaking	Total Number/ A – S – M	Number Leaking
<b>Classrooms*</b>								
<b>Bathroom 1</b>								
<b>Bathroom 2</b>								
<b>Bathroom 3</b>								
<b>Bathroom 4</b>								
<b>Bathroom 5</b>								
<b>Bathroom 6</b>								
<b>Hallways</b>								
<b>Cafeteria</b>								
<b>Gymnasium</b>								
<b>Other:</b>								
<b>Other:</b>								







3. According to the [Schoolwide Water Devices Chart](#), how many faucets out of the total number of faucets are leaking? \_\_\_\_\_  
What percentage is this? \_\_\_\_\_
4. According to the [Schoolwide Water Devices Chart](#), how many water fountains out of the total number are leaking? \_\_\_\_\_  
What percentage is this? \_\_\_\_\_
5. According to the [Schoolwide Water Devices Chart](#), how many toilets/urinals out of the total number are leaking? \_\_\_\_\_  
What percentage is this? \_\_\_\_\_

*Note: You may want to ask the school's building engineer/maintenance staff for help with answering questions 6-10.*

6. Does your school have newer water-efficient toilets that use 1.6 gallons of water per flush or less? (Information on how much water is used per flush can often be found on the device. The abbreviation "gpf" stands for gallons per flush.)  
☐ Yes ☐ No
7. Does your school have newer water-efficient urinals that use .5 gallons of water per flush or less?  
☐ Yes ☐ No
8. Does your school use low-flow water faucets or have low-flow faucet aerators placed on faucets to conserve water?  
☐ Yes ☐ No
9. Does your school have low-flow showerheads installed in the shower areas?  
☐ Yes ☐ No
10. Does your school have a swimming pool?  
☐ Yes ☐ No

If yes, answer the following questions:

How many gallons of water does it take to fill the pool?

Use the following equation to figure out how many gallons of water it takes to fill your school's pool  
(every cubic foot can hold 7.5 gallons):

Length (in feet) x Width x Average Depth x 7.5 = \_\_\_\_\_ gallons of water to fill pool

How often is the pool water changed? \_\_\_\_\_

11. Brainstorm and then record a list of ways that your school could conserve water and improve the water using fixtures.



## PART IV. WATER USAGE ON SCHOOL GROUNDS



1. How many water faucets are located outside the building? \_\_\_\_\_ How many of them leak? \_\_\_\_\_
2. How many water hoses are located outside the building? \_\_\_\_\_ How many of them leak? \_\_\_\_\_
3. Does your building have gutters and/or downspouts?  
☐ Yes ☐ No  
  
If yes, is this water collected and reused? (For example, rain **runoff** from the roof can be collected in a **rain barrel** to water flowers or a garden later.)  
☐ Yes ☐ No
4. Where does water go after it runs off the roof, parking lots, and grounds? (Check all that apply.)  
☐ Storm drain      ☐ Recessed grassy areas      ☐ Rain garden      ☐ **Retention pond**  
☐ Drainage ditch      ☐ Natural pond, stream, or wetland      ☐ Rain barrel
5. Do staff use hoses to wash sidewalks and parking areas? (Sweeping areas clean with brooms saves water.)  
☐ Yes ☐ No
6. Does your school have a plan for managing and reducing runoff from roofs, sidewalks, pavement, and other impervious surfaces?  
☐ Yes ☐ No
7. Are lawns and athletic fields managed in a way that conserves water? (See the box on **Watering Green Spaces Efficiently** for ways to conserve water.)  
☐ Yes ☐ No
8. Do school grounds make use of **native plant** species that require less watering?  
☐ Yes ☐ No
9. Brainstorm and then record a list of ways that your school could improve water conservation on its grounds.

### Watering Green Spaces Efficiently

- Water only as much as is necessary.
- Adjust the watering schedule to reflect seasonal changes in temperature, wind, humidity, and rainfall.
- Use an efficient watering system such as drip or soaker hoses to minimize water loss through evaporation or runoff.
- Equip automatic irrigation systems with a soil moisture sensor or a rain sensor so it only turns on when needed.
- Water during the cooler parts of the day to minimize evaporation loss.
- Check the irrigation system regularly for leaks, broken heads, faulty valves, and other malfunctions that waste water.
- Be sure to direct water onto green areas and not onto parking lots, sidewalks, or streets.



# PART V. EDUCATION, TRAINING, AND COMMUNITY CONNECTIONS



To answer the following questions, you may want to interview the staff member who manages the school's environmental policies and teacher training. Information on academic standards may be available on school websites.

1. Have at least two members of your staff participated in PLT Professional Development? ..... ☐ Yes ☐ No
2. Are PLT Professional Development opportunities available to all teachers? ..... ☐ Yes ☐ No
3. Do least 10% of classes or courses embed environmental education, including PLT? ..... ☐ Yes ☐ No
4. Do your school's academic standards include water conservation education? ..... ☐ Yes ☐ No

If yes, in which grades is it taught? \_\_\_\_\_

5. Does your school participate in any water projects that benefit the community (for example, erosion control through plantings, stream cleanup, or water monitoring)? ..... ☐ Yes ☐ No

If yes, list the projects here.

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6. Some water management facilities can be used as educational resources. Which are found in your community?  
☐ Drinking water treatment plant? Location: \_\_\_\_\_  
☐ Wastewater treatment plant? Location: \_\_\_\_\_
7. Has your school or class ever taken a tour of any of those facilities? ..... ☐ Yes ☐ No
8. Does your school website, or other media outlet, such as a newsletter, emphasize the school's water conservation goals or programs? ..... ☐ Yes ☐ No

9. What community partners in your region support water conservation and education?

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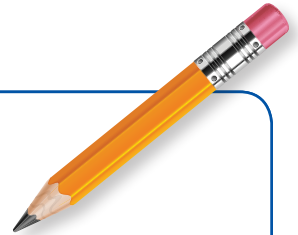
10. Brainstorm and record a list of ways that your school could improve its water education, community outreach on water conservation, and community water conservation projects.

## PART VI: WATER ACTION PLAN



Review the list of ideas for improving water conservation at your school that you brainstormed for each section of this investigation. Prioritize the ideas listed, and decide on a few action projects that you can do to improve water conservation at your school. See the next page for examples of action projects.

List your action project ideas for each section of the Water Investigation.



### **Water Source, Quality, and Quantity**

### **Water Devices**

### **Water Usage on School Grounds**

### **Education, Training, and Community Connections**



## Water Action Project Ideas

Here are just a few ideas to help get you started. You can check out what other PLT GreenSchools are doing by watching PLT's short video [GreenSchools in Action: Water](#) (available on PLT's YouTube channel at <https://www.youtube.com/user/ProjectLearningTree>) and by reading stories posted at [www.plt.org/teacher-stories](http://www.plt.org/teacher-stories).

- Encourage others to conserve water through poster contests, school TV broadcasts, local TV broadcasts, school and local newspaper articles, persuasive essays, public service announcements, poetry, posters, and assemblies.
- Install signs in all restrooms that encourage water conservation.
- Work with school administrators to install low flow faucets, toilet tanks, and showerheads.
- Work with school administrators to install automatic or sensor faucets to reduce water waste.
- Investigate and repair leaking fixtures (with the help of school maintenance staff members or a custodian).
- Install rain barrels to capture rain runoff from roofs and gutters for use in school and community gardens.
- Install a rooftop garden to capture rain and to reduce runoff.
- Use mulch around schoolyard plants and gardens to conserve water.
- Plant native vegetation, which needs less watering because it is adapted to local rainfall amounts and climate.
- Build a rain garden to capture runoff and improve the health of your local watershed.
- If grassy areas must be watered, encourage watering during the cooler parts of the day to minimize water evaporation loss.
- Use drip irrigation systems rather than conventional sprinklers to conserve water.
- Encourage the sweeping of sidewalks and parking lots instead of using running water to clean them.
- Sponsor or join a stream clean up event.
- Volunteer to help your city mark storm sewers with "No Dumping" signs, reminding people that the water that enters these drains ends up in the local body of water.
- Plant native trees and plants next to streams or bodies of water.
- Plant trees to intercept and clean water and prevent erosion.





# Green Your Home:

## Improving Water Conservation



It's easy to waste water and even easier to take clean water for granted. Water pours out of our faucets as though it were endlessly available. But the truth is that the supply of good quality fresh water is limited.

Fortunately, it's just as easy to save water as it is to waste it. Use the following questions and tips to help you identify places where you can make changes to save water, and money, too!



### Inside the House

- |  |                              |                             |
|--|------------------------------|-----------------------------|
| Has your family discussed water conservation and implemented any water conservation plans? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have all leaking faucets, toilets, and showerheads been repaired?                          | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the dishwasher run only when full so you conserve water?                                | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the washing machine run only when full so you conserve water?                           | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are silverware and dishes presoaked in a container instead of rinsed with running water?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have low-flow faucets been installed?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have toilets been installed that use 1.6 gallons/flush or less?                            | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Do you turn off the water while brushing teeth and soaping hands?                          | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Do you turn off the faucet when scrubbing dishes and pots?                                 | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

### Outside the House

- |  |                              |                             |
|--|------------------------------|-----------------------------|
| Are driveways and sidewalks swept rather than cleaned with water?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Has native vegetation been planted that is adapted to local rainfall amounts and climate?                                | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Has mulch been placed around plants and trees to retain moisture?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| If the lawn and plants need to be watered, is this done during the cooler parts of the day to minimize evaporation loss? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are sprinklers and hoses directed at grassy areas and not the pavement when watering?                                    | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is rainwater collected for irrigating and watering plants?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

# Green Your Home:

## Improving Water Conservation

### Household Water Conservation Tips

Use this chart to identify ways that you can conserve water in your home.

Activity	Typical Method	Water Conservation Method
<b>Toilet Flushing</b> About 40% of domestic water use is from flushing the toilet.	Older toilets use about 5.5 gallons per flush.	Newer toilets use about 1.6 gallons per flush.
<b>Bathing</b> About 30% of domestic water use is from bathing.	Regular showerheads have a flow rate of about 5–7 gallons per minute.	Low-flow showerheads have a flow rate of about 2.5 gallons per minute.
<b>Laundry</b> About 20% of domestic water use is from washing machines.	One load in a top-loading washer uses about 40 gallons.	Be sure to adjust the level of the water to the amount of clothes in the machine. Full loads are the most efficient.  Newer front-loading washers can use as little as 12-15 gallons per load.
<b>Washing Dishes</b>  Dishwasher 1 Load = 10–25 gallons  By hand, with water running 1 Load = 30 gallons  In sink, with stopper 1 Load = 10 gallons	Older dishwashers are not as energy and water efficient as newer models. Older models use about 13–25 gallons of water per load.	Water-efficient dishwashers use about 10 gallons of water per load.
<b>Brushing Teeth</b>	With water running for 2 minutes = 6 gallons	With water off except to rinse = 0.25–0.5 gallons



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## NOTES:





Project Learning Tree educates teachers and youth about forests and the environment.

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