

# WATER AND YOUR WORLD



# WATER IS A SCARCE AND VITAL RESOURCE

Fresh clean water is essential for life, yet it is one of our most endangered resources.

While the majority of the earth is covered by water, it is mostly salty and undrinkable ocean water. Only about 3% of all the planet's water is fresh water. Most of this is frozen in glaciers, so it's not possible for us to use it. That leaves less than 1% of all water on earth available for drinking and other activities.



## Get Water Wise

Water makes up 83% of our blood, 70% of our brain, and 90% of our lungs. Overall, our bodies are about 60% water!



## Water in Your Life

You may know you can't survive long without drinking water, but have you ever stopped to think about how many other ways you use water in your daily life? List all the ways you can think of that your family uses or enjoys water.

### Indoors

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### Outdoors/For Fun

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## Water Words

Find the definitions for the following water vocabulary words in this book. These and other new water words are highlighted in green.

**aquifers**  
**condensation**  
**evaporation**  
**groundwater**  
**percolates**  
**pollutants**  
**precipitation**  
**reservoirs**  
**runoff**  
**surface water**  
**transpiration**  
**watershed**



# THE WATER CYCLE

3

WATER AND YOUR WORLD

Water constantly moves and recycles itself. That means that all the water molecules on earth and in our atmosphere today are the same ones that existed when the dinosaurs roamed the earth! Here's how it works:

1. Heat from the sun causes water in the oceans and other large bodies of water to rise into the air (**evaporation**) in a gas form called vapor.
2. Water from plants evaporates into the air as well, through the process of **transpiration**.
3. The vapor cools off and forms clouds, and then changes back into a liquid (through **condensation**).
4. The liquid falls to earth as rain, snow, or hail (**precipitation**).
5. Some precipitation remains frozen in glaciers or ice caps for thousands of years. But most precipitation becomes **runoff**. Runoff either travels over the ground's surface and soaks into the earth (**percolates**), or finds its way to fill lakes, rivers, wetlands, and eventually, oceans.
6. Water evaporates again, and the cycle continues.



Label the illustration with the words in **green** (above).



## The Three States of Water

Water moves between three forms: solid (frozen and hard), liquid (the form we most often use), and gas (steam or vapor).

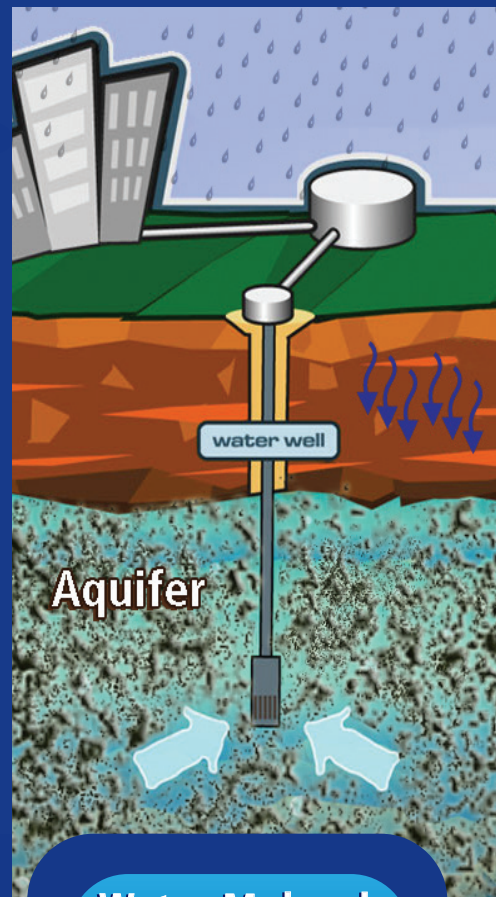


# WHERE DOES YOUR WATER COME FROM?

Our water supply travels quite a distance before it gets to us for daily use in our homes and schools. After falling as precipitation, it collects either underground, as groundwater, or aboveground as **surface water**.

**Groundwater** is stored in **aquifers**, which are layers of soil and rock saturated with water. Aquifers are refilled by rainfall, which soaks slowly down through the soil in a process called infiltration. To get groundwater to us, we pump it up through wells.

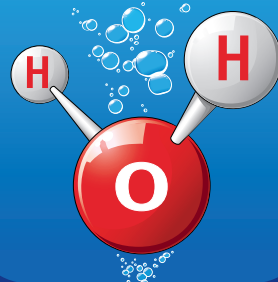
Surface water is stored in streams, ponds, lakes, or other fresh (not salty) sources. Surface water can also be kept in water tanks or **reservoirs** (natural or man-made lakes used for storing water). This is sometimes called collection or accumulation.



## H<sub>2</sub>O: All in the Numbers

A water molecule has three atoms: two hydrogen (H) atoms and one oxygen (O) atom. That's why it is sometimes referred to as H<sub>2</sub>O, which is the chemical formula of water. A single drop of water contains billions of water molecules!

### Water Molecule



## Track Your Water

People in the United States rely mostly on either surface water or groundwater, depending on the geological features of where they live. Do some Internet research and/or contact your local water agency to find out the source of your household water.

**Bonus:** Find out whether your water comes to you from a public water agency, a public well, or a private well.



# WATER MATTERS

5

WATER AND YOUR WORLD

There are many water issues on our minds today: how to conserve it, how to keep it clean, and how to keep it available for everyone.

## Thirsty World

By 2050 the world population will be about 10 billion. In addition, increased drought is making less water available for human use. Without more water conservation and recycling, water shortages will spread. With your class, brainstorm some ways people can save water. Then compare your ideas to those suggested on page 13 of this booklet.



## Great Lakes Walk

Over the course of six years, Canada's native Ojibway Elder Josephine Mandamin and other tribal members walked around all five of North America's Great Lakes. They found Lake Ontario very polluted, with a terrible odor and dead fish on the shore. In contrast, they found Lake Superior's water to be of "powerful majesty—so clean, so strong, so pure." Mandamin's journey has helped bring attention to the need to preserve all the Great Lakes for future generations.



## Such a Bargain!

Not only is water much healthier than soda, it's also a LOT cheaper! **If you drink five cups of tap water a day, the amount you would use in a year (120 gallons) would cost about 25 cents or less!** Do the following equations to find out how the price of water compares to soda. (There are about 10 cans of soda in a gallon.)

$$\begin{array}{ccc} \$1.00 & \times 10 = & \\ \hline \text{(price of can of soda)} & & \text{(price of gallon of soda)} \end{array}$$

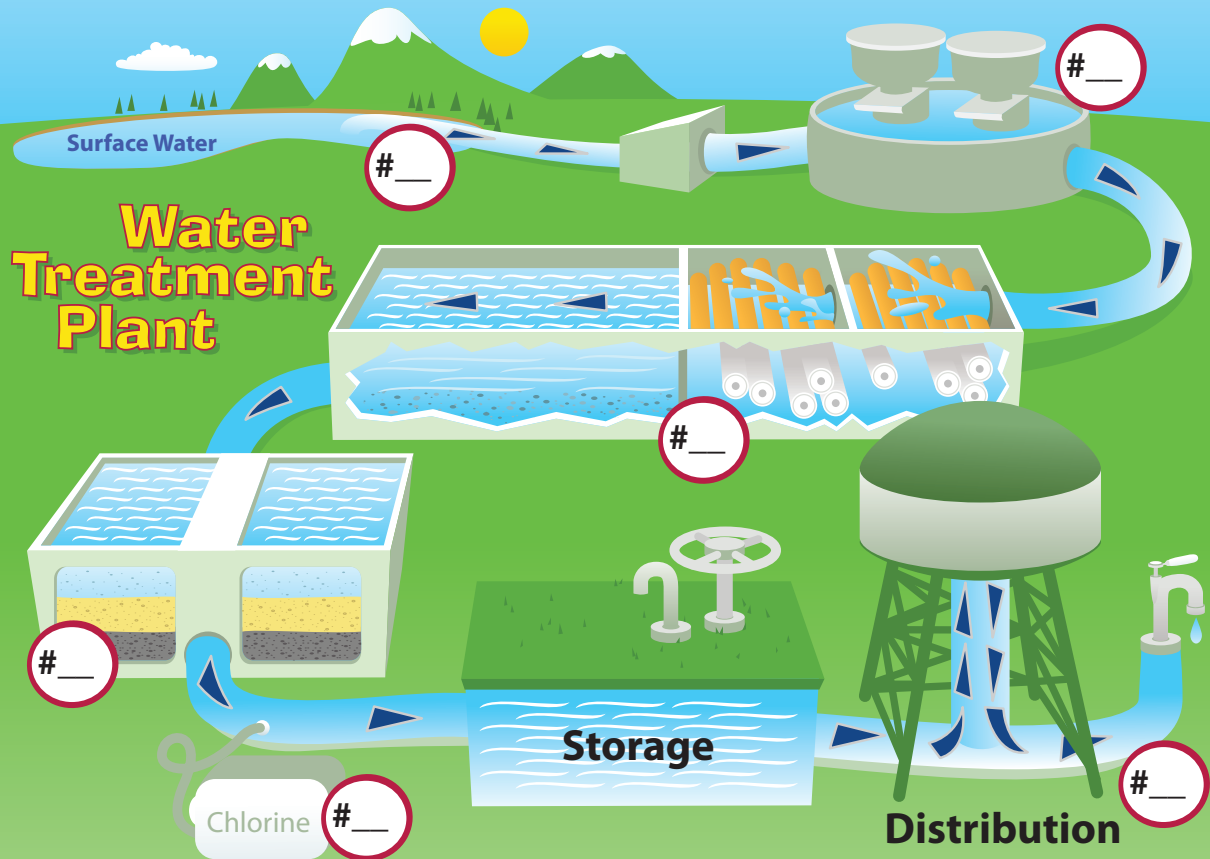
Now calculate the price of 120 gallons of soda and compare that to the cost of the same amount of water.

$$\begin{array}{ccc} 120 & \times & \\ \hline \text{(number of gallons)} & \text{(price of gallon of soda)} & \text{(price of 120 gallons of soda)} \end{array}$$

# MAKING WATER CLEAN

Long ago, most people in this country lived in rural areas and had to get their water from rivers or local wells. Some people still rely on private wells for their water supply. But today, most of us enjoy a public water supply system that does a lot of work to provide clean, treated water to our homes.

Because of water's ability to pick up pollutants and natural contaminants along its travels, it must be cleaned before people use it. This process happens at a water treatment plant. Look at the diagram and write in the number that stands for each of the six steps listed.



- 1 Water is piped in from its source.
- 2 Chemicals are added to remove impurities.
- 3 Substances are added to make dirt and large particles clump together (coagulation). Then they sink into a basin (sedimentation) while the cleaner water flows on.
- 4 Smaller particles are filtered out through layers of sand, gravel, charcoal, or fiber (filtration).
- 5 Small, safe amounts of chlorine are added to kill disease-causing bacteria (disinfection).
- 6 Clean water is distributed for use.



# BUILD YOUR OWN WATER FILTER

7

WATER AND YOUR WORLD

This experiment will help you understand the process of filtration. You will test how well various filtering materials clean a sample of dirty water.

## Materials:

- 1-liter plastic water bottle, cut in half
- 5-6 clear cups
- Several gauze pads\*
- Rubber band
- Filtering materials: sand, cotton ball, rice, small gravel
- 6-8 cups water
- ½ cup soil
- Measuring cup and spoon

**\*NOTE:** Separate the layers of the gauze pads and use only as many as you need to hold the filtering medium in place.



Rubber Band

Filtering Material

Gauze

- 1 Set Up:** Secure gauze over the mouth of the bottle with a rubber band. Put the top half of the water bottle upside-down (like a funnel) inside the bottom half. Put 1/4 cup of your filtering material (or 1 cotton ball) inside the top half, above the gauze.
- 2 Predict:** Which filtering material will clean the water best?
- 3 Investigate:** Mix 1 cup of water with a spoonful of soil to create "dirty water." Set this aside and label it as "Dirty Water." Create another cup of dirty water and pour it through your filter, letting it drain into the bottom half of the bottle. Pour the filtered water from the bottom half of the bottle into a cup and label it with the filtering material used.
- 4 Repeat:** Repeat with a new batch of dirty water for each of your filtering materials. If needed, add new gauze.
- 5 Observe and Reflect:** Compare your cups of filtered water with the dirty water and with each other. Which had the clearest water? Why do you think so? How do your results compare with your prediction?

**Going Further:** Try layering two or more of the filtering materials on top of each other inside your bottle filter, and do the experiment again. What do you notice about the water now? What happens if you change the order of the layers?

# EVERYONE LIVES IN A WATERSHED

No matter where you live—in an urban area, a suburban neighborhood, or rural countryside—you live in a **watershed**. A watershed is the land area that drains storm water **runoff** into a body of water. **Runoff** is precipitation that is not absorbed by soil.



## Where Runoff Goes

All watersheds get their water from storms; however, watersheds act differently depending on their location.

- In towns and cities, rain or snowmelt flows as runoff over pavement and other impervious (nonabsorbent) surfaces. It then runs into storm drains, and eventually to rivers and wetlands.
- In the countryside, where there are no storm drains, most water enters lakes and rivers directly as runoff from the surrounding landscape.



## Word Game

Unscramble these words and then use them to complete the paragraph.

**reath apvemnte offunr  
wtershdea oaks**

Excess \_\_\_\_\_ can cause problems in a \_\_\_\_\_ such as flooding and erosion (the wearing down or washing away of the \_\_\_\_\_). Flooding happens when the ground can no longer \_\_\_\_\_ up all the water passing over it, or when there is too much \_\_\_\_\_ and not enough ground to absorb it.



# CREATE YOUR OWN WATERSHED

9

WATER AND YOUR WORLD

See for yourself how a watershed works by building a model watershed with clay and rocks.



## Materials:

- Baking pan at least 9" x 13"
- Plastic wrap
- Modeling clay
- Rolling pin for clay
- Variety of small rocks
- Several sheets of newspaper
- Several sheets of aluminum foil
- 1-cup measuring cup full of water
- Blue food coloring
- Ground black pepper
- Thick black marker

**1 Set Up:** Make a landscape in your baking pan. Use rocks, foil, and newspaper to form mountains, hills, and valleys. Roll out several thin layers of clay and spread them over your landscape and part way up the inside edges of the baking pan. Now make rivers and lakes by pressing down into the clay.

**2 Predict:** Where will water flow if you pour it onto the highest point of your landscape? Cover your landscape with a sheet of plastic wrap. Use a marker to show the route that you predict the water will take, and where it will collect in pools. Take the plastic off and set it aside.

**3 Investigate:** Put several drops of food coloring into the water in your measuring cup. Pour at least 1/2 cup of water onto your landscape at its highest point. Observe the path it takes and where it collects in pools, and compare this to the prediction you made. Now put a pinch of "pollution" (black pepper) onto a few dry spots in your landscape. Pour another 1/2 cup of water onto the model from its highest point. Observe what happens to the pollution.

**Going Further:** In what direction did the water flow? Did it take the route you predicted? What happened to the pollution? What would it take for you to remove the pollution from your landscape now? How is your landscape like a real-life watershed? How is it different?

# RUNOFF AND THE ENVIRONMENT



As it flows along, runoff collects everything in its path. This includes litter, fertilizer and pesticides, spilled gas and oil, eroded soil, and soapy water from washing cars. These are examples of **pollutants**, substances that make the water dirty or toxic to life forms.

## Polluted runoff is the single biggest threat to the health of our waterways:

- Fertilizer carried into waterways contributes to “dead zones,” places where no plants, fish, or animals can live. The nitrogen in the fertilizer causes an overgrowth of algae, which consumes the oxygen in the water and blocks the sunlight needed by plants and animals. There is a dead zone in the Gulf of Mexico the size of the state of Massachusetts!
- Motor oil is another common pollutant carried by runoff. Just one quart of oil can make 250,000 gallons of water toxic to wildlife! (That’s as much water as it takes to cover an acre of land almost 1 foot deep.)

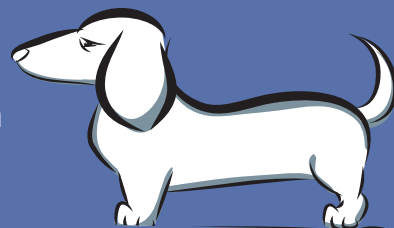


## Get Involved: Clean Up Your Watershed!

Find out if there are any river, beach, or highway cleanup projects in your area and see if you can participate, either with your family or your class.

## Pet Peeve

A day’s worth of solid waste from a large dog contains about 7.8 billion bacteria, which can make people or animals sick if they come in contact with it or if it gets into runoff. So keep your dog’s waste out of the watershed by always carrying a plastic bag and collecting it for proper disposal.





# PROTECT OUR WATER

Polluted water can endanger people, plants, and animals. So it's vital that everyone help keep our water clean. We're all in this pond together!

## What You Can Do:

- ☐ Keep trash and chemicals out of toilets and drains.
- ☐ Don't litter, and pick up any trash you see.
- ☐ Prevent garbage from getting into storm/sewer drains.
- ☐ Clean up after dogs and properly dispose of their waste in the toilet or garbage.



## What Your Family Can Do:

- ☐ Reduce use of chemical-based cleaning products and replace with nontoxic ones like baking soda and vinegar.
- ☐ Use laundry and dish soaps that contain no harmful chemicals.
- ☐ Dispose of unused prescription drugs at a local pharmacy or other collection point in your area, not down the drain.
- ☐ Fix leaks from cars, and properly recycle used motor oil.
- ☐ Take leftover or used paint, pesticides, fuels, batteries, and compact fluorescent light bulbs to proper collection sites.
- ☐ Wash cars at a car wash to keep soap out of water sources.
- ☐ Limit use of lawn fertilizers and yard pesticides. If needed, follow instructions for safe use.
- ☐ Rake up yard waste to keep it out of gutters and storm drains. Compost yard clippings and trimmings.
- ☐ To reduce erosion, replant bare areas of soil.



Place a checkmark beside each of the actions above that you and/or your family already do. Circle the ones you do not yet do but want to start doing, and tell your family about them.



## Spread the Word

Create a poster, short video, computer slide show, or blog post promoting your favorite water protection tips from this page. Include a new tip if you know of one not listed above. Present your creation to your class.

# OUR WATER SUPPLY IS LIMITED

A growing population and drier weather patterns have led to water shortages in many communities. Now more than ever, we must act to conserve our water supply for future generations.

## Use Water Wisely

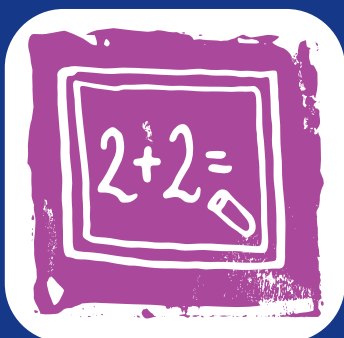


- **Help the environment.** You save water for fish and animals when you help preserve drinking water supplies. And the less water you send down the drain, the less work our wastewater treatment plants have to do to make it clean again.
- **Save energy.** You save the energy that your water supplier uses to treat and move water to you, and the energy your family or your school uses to heat your water.
- **Save money.** If you use less water, your family, your school, and your community will have more money left to spend on other things.



## Be a Leak-Buster!

- **A leaking toilet can waste 200 gallons of water per day.** Ask an adult to help you check your toilets for leaks. Lift the top lid and add a few drops of blue food coloring to the tank. Do not flush, and wait a few minutes. If color appears in the toilet bowl, water is leaking from the tank into the bowl—the flapper valve in the tank may need replacing.
- **A leaking faucet can waste up to 200 gallons per month.** Check the faucets in your home and school. If you spot any leaks, ask an adult to have them fixed.



## Water Math

Calculate: 1) How many gallons of water are saved per year by fixing a leaking toilet if it wastes 200 gallons per day? 2) How many gallons are saved per year by fixing a faucet that leaks 200 gallons per month?



# HERE'S HOW YOU CAN SAVE WATER!



Put a checkmark beside all the activities that your family already does.



13

WATER AND YOUR WORLD

- ☐ **1 Flush only when necessary.** Put paper, insects, hair, and other waste into the trash, not the toilet.
- ☐ **2 Take short showers, not baths.** Keeping your shower to 5 minutes or less can save up to 1,000 gallons per month! Use a shower timer to help with this. If you do take baths, take half-full ones.
- ☐ **3 Turn water off when brushing teeth.** This can save 4 gallons per minute. That's 200 gallons a week for a family of four.
- ☐ **4 Collect unused water.** A bucket in the shower or sink can catch water for plants and clean-up jobs.
- ☐ **5 Install water-saving fixtures.** Water-efficient showerheads, faucets, and toilets can save thousands of gallons per year. Remind adults to look for bathroom fixtures with the "WaterSense" label for additional water savings.
- ☐ **6 Wash clothes in cold water, and do full loads only.** Washing in cold water works just as well as using hot or warm—and it uses less energy.
- ☐ **7 Use less water for dishes.** Scrape your dishes clean to reduce rinsing, and run the dishwasher only when it's full. If you wash by hand, use basins rather than running water.
- ☐ **8 Limit outdoor water use.** Remind adults to follow the watering guidelines where you live. Be careful to water only the lawn and not the sidewalk or street and never during the heat of the day. Sweep walkways and driveways to remove leaves; don't hose them.
- ☐ **9 Stop leaks.** Turn off water faucets tightly so they don't drip. If you find a drippy faucet, tell an adult.
- ☐ **10 Reduce lawns.** Replace with native or water-efficient plants.



## Sign and Save!

Ask a parent to help your household commit to three water-saving activities listed above that you don't already do. Write them on the lines below and get your family members' signatures to show their commitment.

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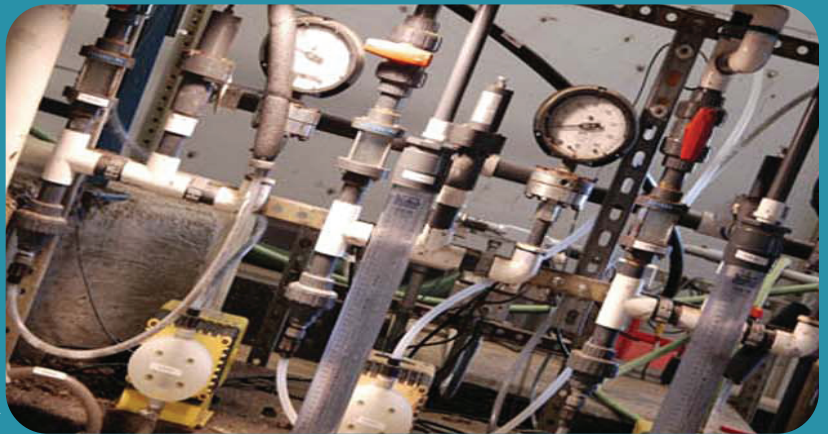
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Family Signatures:

Date:

# WHERE DOES OUR USED WATER GO?

All the water that goes down the drains inside our homes, businesses, and schools is cleaned before it enters our environment. This was not always the case. The first system for treating wastewater to keep disease-causing bacteria out of the water supply was not developed until the early 19th century. Today, the highly complex wastewater treatment system of one large city alone can clean and purify up to 1.8 billion gallons of used water per day.



## Inside a Wastewater Treatment Plant

1. After water swirls down our drains and toilets, it finds its way through a complex underground network of pipes to a wastewater treatment plant.
2. The treatment plant separates out sand, grit, and larger solids through screening, settling tanks, and skimming devices. Then it allows heavier particles to settle to the bottom, and skims off lighter particles from the top.
3. The water is then mixed with solids containing tiny organisms that “eat” any remaining particles.
4. Finally, harmful bacteria are destroyed.

After being cleaned, the water is released through pipes to lakes or rivers, which flow to oceans. Along the way, the water may be used again at places like farms and factories. Some of the water simply evaporates into the atmosphere to rejoin the water cycle.

## Sludge Cakes

The material that is removed from wastewater at the treatment plant is called sludge. After all excess water is pulled out of it and any harmful bacteria are destroyed, sludge takes the form of dry cakes. These cakes can be used by farmers, placed in landfills, or cleanly burned as fuel.

### Septic Exception

If your home is served by a private septic system, your used water does not go to a wastewater treatment plant.



# WATER INNOVATIONS

15

WATER AND YOUR WORLD

## What's Growing On Up There?

Have you ever seen a green roof? Rooftops with grass or plants growing on them are designed to reduce storm water runoff and save energy. Plants on green roofs absorb precipitation, thus greatly reducing the amount of runoff that is shed into the storm water system. The plant materials also help keep the buildings beneath them warmer in winter and cooler in summer.



## From Gray to Green

After sending used water down the drain, some people are reusing it for outdoor use. "Graywater systems" filter leftover water from bathtubs, showers, wash basins, and washing machines and redirect it to lawns and gardens. This water-saving innovation is already used in dry areas that need it most, such as Australia and the Middle East, and in some states in the United States, like Arizona. Using graywater for below-ground watering saves drinking water supplies and also reduces the amount of wastewater sent to water treatment plants.

## Save with Rain Barrels

Rain barrels are the simplest way to save water in your own backyard. All you need is a water-tight container placed at the bottom of your gutter system, with a spigot for dispensing the water to a hose. Water collected on rainy days can be used on dry ones for watering lawns and gardens. Before installing a rain barrel, research safety precautions needed for your area.



## What's Your Idea?

The methods described on this page for saving and protecting water came from innovative thinking. Science always has room for new ideas to address problems like water pollution and shortages. Do you have a water-saving idea of your own? It can be practical or wild! Describe it in a paragraph, and/or draw it. Share your idea with the class.

# GET WATER WISE!

Fill in the blanks of the sentences by choosing from among the words you see in the water droplet. Look on the pages listed for clues.

1. Water in its frozen form is stored in \_\_\_\_\_. (p. 2)
2. The gas form of water is also known as \_\_\_\_\_. (p. 3)
3. In the water cycle, after water reaches rivers, wetlands, and oceans, it \_\_\_\_\_ back into the air. (p. 3)
4. Groundwater is stored in \_\_\_\_\_, which are layers of soil and rock that are saturated with water. (p. 4)
5. A water treatment plant \_\_\_\_\_ water piped from its source in order to kill disease-causing bacteria before it gets to our homes. (p. 6)
6. Rainfall is not absorbed into paved surfaces because they are \_\_\_\_\_. (p. 8)
7. The land around where you live that drains storm water into a body of water is a \_\_\_\_\_. (p. 8)
8. Storm water runoff can collect and carry along \_\_\_\_\_ as it flows toward lakes and oceans. (p. 10)
9. Each of us must do our part to keep water \_\_\_\_\_. (p.11)
10. Cleaning up pet waste is one way to \_\_\_\_\_ water. (p. 11)
11. A faucet that \_\_\_\_\_ can waste up to 200 gallons of water per month. (p. 12)
12. Most treated wastewater eventually travels back to the earth's \_\_\_\_\_. (p. 14)

