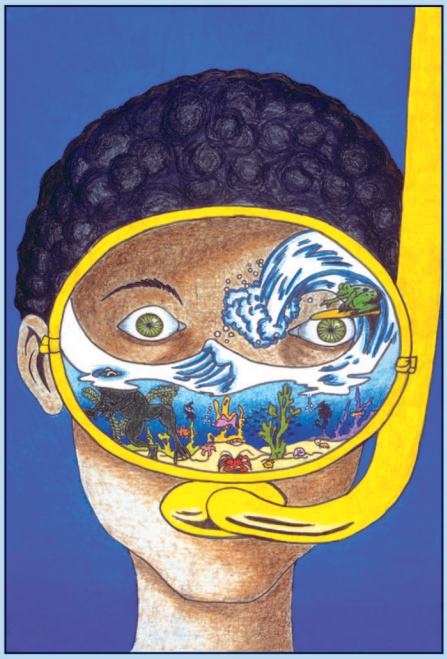
What's Up with our Nation's Waters?



Cover: Artwork from The River of Words 2000 art contest

"River Otter in the Wilderness," Molly J., Age 10, California, Art Finalist (top left)

"Quick as My Thought," Rachel R., Age 8, California, Art Winner Category II (Grades 3-6) (top center)

"Submerge in the Wonder," Courtney M., Age 17, Georgia, Art Finalist (top right)

"Heal the World," Eon H., Age 15, Georgia, Art Winner Category IV (Grades 10-12) (bottom)

What's up with our nation's waters?

A status report on the quality of our waters and what you can do to make a difference

We all need clean water. After all, our bodies are at least 65 percent water. Fish and wildlife depend on clean water to survive. We need clean water to grow crops and to operate factories, and we need clean water for drinking, swimming, surfing, fishing and sailing.

What's inside?

Inside this report you'll find out the following:

- **What scientists measure in our water**
- **What percentage of our waters are clean**
- **Major pollutants in our waters**
- **Suggestions of what you can do to help**
- **Projects you can do for school or fun**
- **A quiz to test your water smarts**
- **A glossary that defines some common terms**

Test your water smarts!

1. True or false: Watersheds are located mainly in mountainous regions with high rainfall.

2. Circle the correct answer: Most of the pollutants entering our waters come from the following sources:
   A. Wastewater treatment plants
   B. Runoff from fields and streets
   C. Factories along rivers

3. True or false: Students can join organizations to help monitor their waters.

Now read the rest of this booklet and then take the rest of the quiz at the back to test your water smarts!

What is the U.S. Environmental Protection Agency?

The U.S. Environmental Protection Agency, or EPA, is responsible for protecting human health and the natural environment from pollution. EPA does this by conducting research, enforcing laws, developing national policies, and providing information and technical help to states and communities.

How often does EPA report on the nation's waters?

EPA and the states* are directed by the Clean Water Act (CWA) to help protect the health of our nation's waters. The CWA gives states the authority and responsibility to establish water quality standards, which set minimum requirements for fish habitat, swimming, and drinking water sources. States, under Section 305(b) of CWA, are required to assess the health of their waters and submit the information to EPA every two years. EPA gathers the information from every state and prepares a report called the *National Water Quality Inventory*. To see the latest 305(b) report or other information on the quality of our nation's waters, visit www.epa.gov/305b on the Internet.

When EPA says "state," it means states, territories, Indian tribes, and other jurisdictions.

How do we measure the quality of our waters?

Doctors use instruments like thermometers and stethoscopes to check on your health. Scientists use instruments like Secchi (sek'-ee) disks, probes, nets, gauges, and meters to determine how healthy the water is. They take measurements of the physical and chemical condition of the water and the health of the critters that live in it.

Scientists collect water in lots of different ways. They use boats to go out in the middle of lakes, they wade into streams wearing rubber boots that go up to their chests, they drop buckets over the sides of bridges—they'll do almost anything to get a sample.

Water samples aren't the only things scientists collect. They take photographs from airplanes and even satellites. They use their eyes to observe what's happening along streams, lakes, and bays to get an overall sense of the health of the water. They also collect fish, plants, dirt, and aquatic bugs, and study what's happening on the land that's next to the water.

secchi disk

dissolved oxygen probe

What do scientists measure?

Temperature - When you don't feel well, chances are the first thing someone does is take your temperature. Scientists measure water temperature for several reasons. First, it determines the kinds of animals that can survive in a stream. If the temperature gets too hot or too cold for some organisms, they die. Temperature also can affect the chemistry of the water. For example, warm water holds less oxygen than cold water. A healthy cluster of trees and vegetation next to a stream or river helps keep temperatures cool for trout and other fish.

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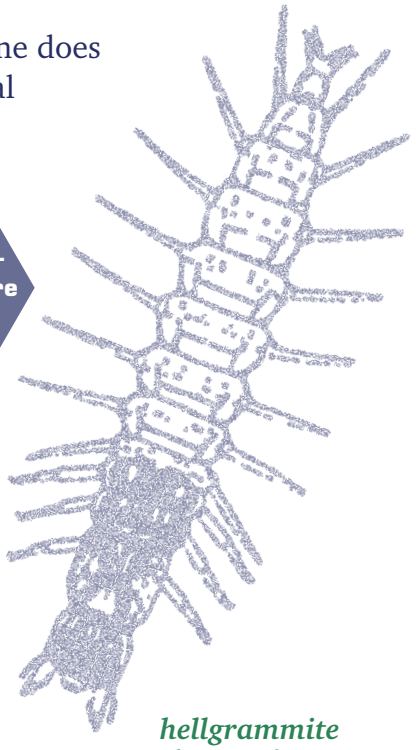
The words highlighted in bold are defined in the glossary.



hellgrammite (larva of a dobsonfly)

Dissolved oxygen - Scientists measure **dissolved oxygen**, or DO (pronounced dee-oh). This tells them how much oxygen is available in the water for fish and other aquatic organisms to breathe. Healthy waters generally have high levels of DO (some areas, like swamps, naturally have low levels of DO). Just like human beings, aquatic life needs oxygen to survive. Several factors can affect how much DO is in the water. These include temperature, the amount and speed of flowing water, the plants and algae that produce oxygen during the day and take it back in at night, pollution in the water, and the composition of the stream bottom. (Gravelly or rocky bottoms stir up the water more than muddy ones do, creating bubbles that put more oxygen into the water.)

pH - Scientists measure **pH** to determine the concentration of hydrogen in the water (The p stands for "potential of" and the H is hydrogen.) pH ranges from 0 (very acidic) to 14 (very basic), with 7 being neutral. Most waters range from 6.5 to 8.5. Changes in pH can affect how chemicals dissolve in the water and whether organisms are affected by them. High acidity can be deadly to fish and other aquatic organisms.

Nutrients - Just as **nutrients** are critical for you to grow (check out what's inside a box of cereal—essential nutrients), they are critical to plants and animals. The two major nutrients scientists measure are **nitrogen** and **phosphorus**. The presence of too many nutrients can hurt aquatic organisms by causing lots of algae to grow in the water. Nutrients can also affect pH, water clarity and temperature, and cause water to smell and look bad.

Aren't nutrients good for you?

Just like anything in life, moderation is the key (consider television). Although every living thing needs nutrients to grow, too many nutrients in the water cause algae to grow out of control. At night, they suck all of the oxygen out of the water so the fish and other organisms can't breathe. Also, when algae die, they are decomposed by oxygen-breathing bacteria that pull DO out of the water.

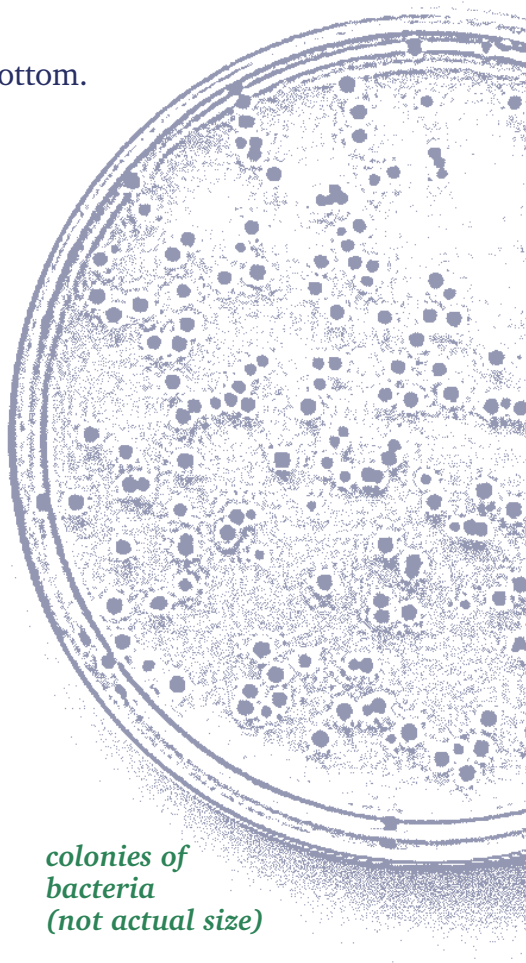
Toxic substances - Scientists also test for many harmful (toxic) things like metals, pesticides, and oil. For example, scientists are finding mercury in certain types of fish, especially in lakes and estuaries. Mercury comes from mining, natural sources and air pollution from power plants and incinerators. People are warned not to fish if mercury or other harmful substances are a problem in a stream, lake or bay.

Turbidity - Scientists measure the **clarity** of water to determine how many particulates (little bitty particles of stuff) are floating around. If you're sitting on a

dock in a pond on a warm summer day, you might be able to see to the bottom. That's low turbidity. On the other hand, if you visit the dock after a rainstorm when all the muck has been stirred up, you won't be able to see the bottom; that's high turbidity. Scientists use **turbidity** measurements to calculate the inputs from erosion and nutrients.

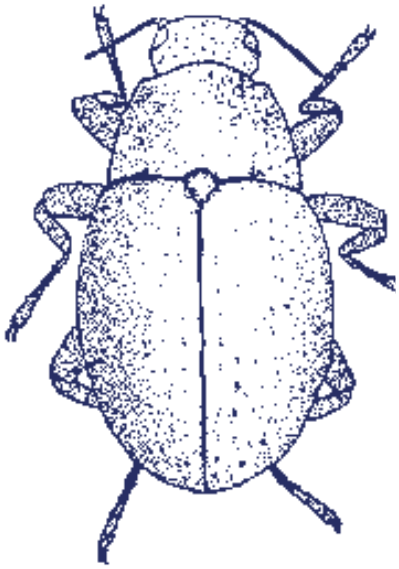
Bacteria - Scientists sample for certain types of bacteria that are found only in the stomachs and intestines of warm-blooded animals and humans. These bacteria are not necessarily harmful, but they usually hang out with some bad characters like viruses and germs that can make you sick. Scientists test for bacteria that indicate that those more dangerous organisms might be in the water.

Visual surveys - Not all measurements are chemical or physical. Scientists take measurements of the landscape surrounding a stream to determine things like the amount of trees and shrubs along a stream, the amount of shade that is created by trees overhanging the stream, and woody debris (sticks and leaves) in the stream. The more vegetation, tree cover, and woody debris, the more habitat is created for wildlife and fish. Vegetation can even trap pollutants before they enter the stream. Tree cover also helps regulate water temperature, which is important to trout and other fish that need cold water to survive.



colonies of bacteria (not actual size)

Biological sampling - Scientists determine the health of waters by taking samples of fish, plants and smaller organisms called **macroinvertebrates** (mack-row-in-ver-tuh-brets). Macroinvertebrates include things like snails, worms, fly larvae, and crayfish ("crawdads"). You find them under rocks and tree roots in the water. These critters tell a story about the health of the stream. Some of them love to live in water that's dirty, so if scientists find a lot of those in a sample, they know there's a problem. Other organisms can survive only in water that's very clean, so finding those means the water is probably healthy.



riffle beetle— found in clean water

Raise your hand if you live in a watershed

Is your hand up? Good. Everyone lives in a watershed. A watershed is simply an area of land that drains the rainwater (or snow) into one location such as a stream, lake, or wetland. This means that the runoff from streets, fields, and lawns will eventually drain into those streams, lakes, or wetlands. Cup your hands as if you are going to drink water from a faucet. Your thumbs and fore fingers are like the ridges of a watershed and your palms are like the waterbody that catches the rainwater. Watersheds can vary in size and shape from a couple of square miles to hundreds of thousands of miles. We all live, work, and play in watersheds, and what we do affects everything and everyone else in the watershed.

How many uses for water can you think of?

Make a list of how water is used by people, plants and animals. Here are a few ideas:

- **drinking**
- **swimmimg**

- **showering**
- **watering the lawn**
- **homes for fish, bugs and wildlife**
- **irrigating crops**
- **navigation**

Scientists group these uses into a few overall categories, like Aquatic Life, Drinking Water, and Recreation. They then decide what categories of uses a waterbody *should* support (for example, virtually all waterbodies should support aquatic life), and monitor the waterbody to see if it supports its uses.

How is the quality of our waters determined?

Every state adopts goals or standards that need to be met for its waters, based on the intended uses of the waterbodies. Different goals are set for different waterbody uses. For example, if the water is going to be used for cooling machinery in a factory, it doesn't have to be as clean as water used for drinking. Scientists monitor the waters and give them one of the following scores:

(GOOD) The waterbody fully supports its intended uses

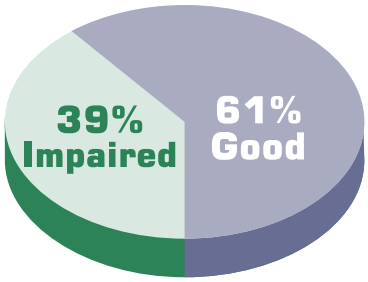
(IMPAIRED) The waterbody does not support one or more of its intended uses

What is the quality of our waters?

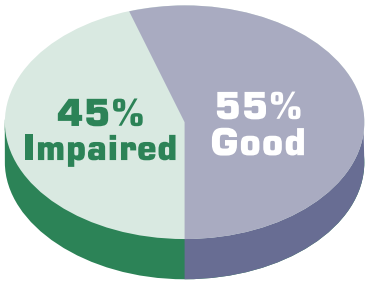
Surface waters are waters that you can see. These waters include rivers and streams, lakes, ponds, reservoirs, **wetlands**, coastal waters, and **estuaries**.

For the U.S. waterbodies sampled most recently, about 45% are rated as impaired. The charts here show, by the type of waterbody, what percentage of the assessed waters were rated GOOD and what percentage were rated IMPAIRED.

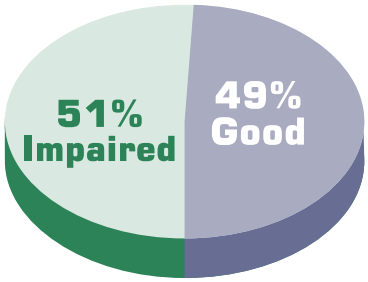
Assessed River and Stream Miles



Assessed Lake, Pond, and Reservoir Acres



Assessed Estuary Square Miles



What percentage of all waterbodies are assessed?

We don't have the money or technology to sample all the waterbodies in the U.S. The nation has more than 3,600,000 miles of rivers and streams alone! If all the rivers and streams were placed end-to-end, they could wrap around the earth 144 times. Each state assesses only a portion of its waters. Here are the latest numbers we have for percentage of U.S. waters assessed:

19% of rivers and streams
43% of lakes, ponds, and reservoirs
36% of estuaries
6% of ocean shorelines
92% of Great Lakes shoreline

Three Big Pollutants

For the waterbodies listed as IMPAIRED in the *National Water Quality Inventory*, top pollutants causing problems are dirt, bacteria, and nutrients.

1 Dirt

That's right, dirt. Dirt was listed as a leading cause of pollution in our rivers and streams. When rain washes dirt into streams and rivers, it smothers the little critters in the stream and kills any fish eggs clinging to rocks. Dirt can also clog the gills of fish, suffocating them. Have you ever walked into a pond or lake and noticed huge swirls of muck rising up and clouding your view of the bottom? Well, if the plants that use the sun to make food (yes, that's right, **photosynthesis**) can't get enough sunlight because the water is murky, they die.

Where does all this dirt come from?

Most of the dirt washing into lakes and streams comes from activities that remove trees and shrubs and leave the earth exposed. This exposed earth includes fields that have just been plowed, construction sites that have been bulldozed, and areas that have been logged or mined. Bare patches in your lawn or ballfield can also contribute to the problem. Some of the dirt polluting streams comes from the stream banks. The problem is that fast-moving water erodes the banks of streams. The water moves faster because the vegetation that would slow it down has been replaced with pavement and buildings.

What's being done to control dirt?

The solution is to stop the dirt from getting into the stream in the first place by disturbing the land as little as possible. Farmers are using different methods to grow their crops so they leave less earth exposed, and they plant grasses in fields that aren't being used. Construction workers are putting up silt fences and hay bales to trap the dirt and contain it while they build. Developers can design new home sites that leave more natural areas and less pavement to reduce the amount of earth they disturb.

2 Bacteria

Bacteria are a big water quality problem in our nation's waters. Not all bacteria are harmful (yogurt contains live bacteria cultures!), but the presence of some indicator bacteria is a clue that other germs and viruses that can make you sick might be in the water too.

Where do the bacteria come from?

The major sources of bacteria are **combined sewers** (which can overflow in a rainstorm and dump untreated sewage directly into our waters) and runoff of animal waste (including wild animal droppings!) from farmland and city streets.

What's being done to control bacteria?

Cities and towns are improving their sewage systems to keep untreated sewage from overflowing. Farmers are developing better ways to manage livestock manure. Dog owners are picking up after their pets (yes, dog waste pollutes too).

3 Nutrients

Nutrients were listed as the number one cause of water quality pollution in our lakes, ponds, and reservoirs. They caused impairment in more than 3.8 million acres! (That's more than 2.9 million football fields!) The two most common nutrients are nitrogen and phosphorus, which cause algae to grow and can turn the water green.

Where do nutrients come from?

The major sources of nutrients are runoff of fertilizers and animal waste from farms and cities (lawn fertilizers can wash away in heavy rain), sewage treatment plants, and failing **septic systems**.

What's being done to control nutrients?

Farmers are learning new ways to apply fertilizers and manage livestock. Homeowners are being educated about maintaining their lawns and septic systems. Cities and towns are fixing their sewage treatment plants.

Where are These Pollutants coming From?

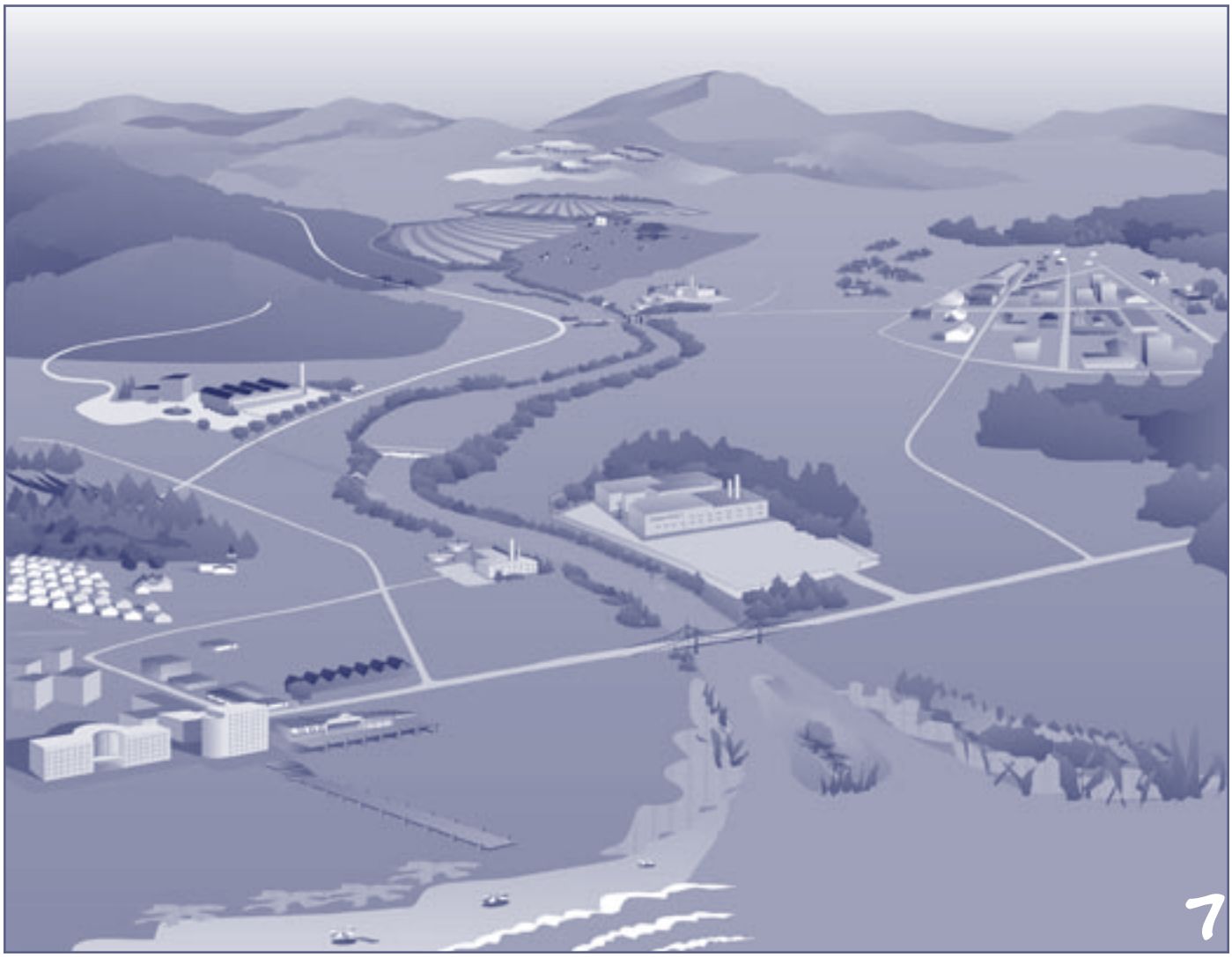
True or false? Factories are the major source of pollutants in our waters.

False. Thirty years ago that statement was true, but since then we've made a lot of progress cutting down on pollution from factories and sewage treatment plants. Although these can still pollute in some areas, today most of the problems in our waters comes from **polluted runoff** draining into rivers, lakes, and bays after a rain storm. Rain washing over the landscape carries dirt, oil, fertilizer, pesticides, animal waste and many other substances off streets and farms and into our waters.

As we pave over natural areas to make parking lots, driveways and roads (known as **impervious** surfaces) the rainwater doesn't slowly soak into the ground like it used to. Instead it's channeled into gutters, culverts, and storm drains. These tend to be convenient places for people to illegally dump used motor oil, trash, and yard waste. These pollutants then are whisked directly into our streams, wetlands, bays, and lakes.

Areas where water can slowly soak into the ground are described as **pervious**. Pervious areas include lawns, fields, wooded areas, and even brick walkways and gravel driveways that allow rainwater to soak in.

And there's more. All over the country, streams have been straightened and physically altered to flow in a certain direction; some have been lined with concrete. This makes water rush faster after a rainstorm (increasing erosion) and makes it difficult or impossible for plants and aquatic



If you were a trout or a mayfly, where would you rather live?

Does your nearby stream look like this?

or this?

creatures to live and thrive. Wetlands have been dredged and filled to make way for houses, golf courses, and shopping malls. Dams constructed to control the flow of water also prevent migratory fish, such as salmon, shad and sturgeon, from swimming upstream to spawn.

What's being done?

We all need to work together to reduce and prevent polluted runoff. For example, the federal government works to ensure that lands belonging to the government are properly managed to cut down on soil erosion. Farmers are learning how to manage their land, crops, and animals to keep them from affecting nearby waters. Your city, town or county has local laws controlling what can be built where, and how construction sites should be managed to keep rainwater from washing bare dirt away. You can play an important role by practicing water conservation and by changing certain everyday habits (see What Can I Do??? on p. 11).

As for all those straightened and channeled streams and impervious surfaces, prevention is the key. Once a stream has been altered or an area has been paved over, it's very difficult (and it costs a lot of money) to undo the damage. Some communities are beginning to realize the value of clustering new buildings where roads and paved areas already exist, and leaving open spaces like woods and farmland alone. Laws that make it illegal to drain or fill a wetland are being enforced. And many streams that were altered in the past are now being restored to flow in a more natural way.

What are wetlands?

Wetlands are a very important part of the environment. They help slow down and clean up polluted runoff from the land and provide habitat for animals.

You will find wetlands in areas where water covers the soil or is present at or near the ground surface for part or all of the year. Sometimes a wetland will actually appear dry at certain times of the year! You can often tell if something is a wetland by the types of plants that are growing in it. Most of these plants, like cattails and swamp roses, are adapted to living in the water and can't live in dry soil for very long.

Over one-third of all the threatened and endangered species live in wetlands, and nearly half use wetlands at some time in their lives.

Why are wetlands important for our environment?

Wetlands as sponges

Have you ever poured water onto a damp sponge? The sponge will hold a lot of water before it slowly starts to leak. The same happens in a wetland. A wetland will trap runoff water that flows into it during a rainstorm and will slowly release the water later. This helps to prevent flooding.

Other names for wetlands include swamps, bogs, marshes, fens, and pocosins.

Wetlands as filters

After being trapped by the wetland sponge, polluted runoff water moves slowly through a wetland, finding its way around plants and through small spaces in the soil. While it moves, the nutrients are absorbed by the plant roots that poke through the soil spaces. Some spaces are very small and pollutants get trapped. Sometimes the pollutants just stick to the soil. By the time the water leaves the wetland it is much cleaner than it was when it entered. This is why many people think of wetlands as nature's filter system.

Wetlands as habitat

Wetlands are home to many types of macroinvertebrates, fish, amphibians, birds, mammals, and reptiles. These animals rely on the plentiful food, water, and shelter that the wetland offers. While some animals spend their whole lives in a wetland, many use it only for a particular time in their lives, such as for hatching eggs and raising young.

Back in the early 1970s the United States was losing over 450,000 acres every year to development. Since then we've tried harder to protect wetland areas. But, today we are still losing over 58,000 acres of wetlands EVERY YEAR. That is an area equal to about 44,000 football fields! Wetlands are being destroyed to make way for farmland, highways, houses, and development of commercial sites like malls. We need to try harder to control changes in our watersheds so we can stop losing wetlands.

What is Ground Water?

Ground water is the water that is found beneath the earth's surface. Have you ever driven on a road cut along the side of a hill and seen what looked like layers inside the earth? If we could see the ground beneath us, it would look very similar. The top layer of earth is dirt, but as you get deeper, the dirt changes into layers of solid rock. Believe it or not, each of these layers has many small spaces and cracks filled with water. Ground water moves slowly as it finds its way from space to space in the rock.

Why is Ground Water Important?

Ground water is an important water source for all of us. The United States uses about 77,500 million gallons of ground water each day for all sorts of uses like drinking water, washing clothes, watering crops, and making food products. Over half of the people in the U.S. rely on ground water for drinking.

Is our Ground Water Clean?

States report that their ground water quality is good overall. Unfortunately, many states do have areas with polluted ground water. The most commonly cited pollutants in ground water include manufactured compunds (like gasoline products) and nitrates.

What Causes Ground Water Pollution?

States report that most pollution is caused by gasoline and other fuels that leak from tanks buried underground. Gas stations aren't the only places with buried tanks. People who use oil for heat in the winter often have tanks buried in their backyards. Other potential pollution sources that you can't see include leaky septic systems and leaky landfills.

Ground water pollution can also begin above ground. If man-made ponds that are used to treat wastewater are not properly installed and maintained, they can leak polluted water into the ground. Pollution such as chemicals spilled on the ground, bacteria and nutrients from livestock areas, and pesticides and nutrients from farmland can also seep down to the ground water.

Can We Fix the Problems?

Sometimes ground water pollution is caused by different types of sources that slowly leak a little pollution. Because the sources are spread out, environmental managers have a difficult time finding and controlling the pollution. In other cases, one pollution source (such as a buried fuel tank) can leak a large amount of pollution into the ground water. Once this pollution is discovered, environmental managers can often pinpoint the source and stop the pollution. However, even if a source is pinpointed and removed, the pollution already in the ground water is difficult to clean up. Therefore, the best way to fix ground water pollution is to keep it from happening in the first place.

What Can I do to Protect My Ground Water?

First of all, become informed. A great place to start is EPA's ground water and drinking water homepage at *www.epa.gov/ogwdw*. Does your drinking water come from ground water? How often is it tested? What products in use around your house (paints, cleaners, lawn chemicals) could pollute your ground water if they were poured down the drain or dumped outside? What activities on the land might affect your ground water quality? Next, do something with what you've learned. Encourage your family to switch to environmentally safe products. Help others learn about the importance of ground water through a class project or a booth at a fair. Visit the Ground Water Foundation's web site at *www.groundwater.org* for more ideas and information on the annual Children's Ground Water Festival and Ground Water University.

What Can I do???

These problems didn't happen overnight, so it's going to take time to clean them up. People in your state and county are doing lots of things to keep waters healthy, but they can't do it all. Do you think someone is watching how much fertilizer your mom puts on her garden or whether you pick up after your pup? Everyone's actions every day can make the difference. Here are 12 ideas to get you started, but don't stop there!

1. Survey your home. Before we can come up with solutions, we have to know the problems. Use the survey at the end of this booklet to see how you and your family rate and how you can help be part of the solution instead of part of the problem.

2. Conserve water—inside and out. By conserving the amount of water we use, we reduce the amount that needs to be treated.

- Check to see if your toilets are leaking. Squirt a couple drops of food dye into the top of the tank and wait a few minutes to see if the dye shows up in the toilet bowl. If it does, you've got a leak.
- Help your family install low-flow devices for your showers and toilets that reduce the amount of water used.
- Water the lawn early in the morning or in the evening to reduce evaporation and increase the amount the plants drink. Make sure the sprinkler isn't also watering the driveway or sidewalk.

3. Love your lawn—naturally. Ask your parents to convert some of the grassed areas in your yard into natural areas. This eliminates the need for fertilizers, provides habitat for birds and animals, and frees up your time from mowing the lawn. Where you do have to mow, leave the grass clippings on the lawn to provide natural fertilizer to the grass, and let the grass grow to at least 3 inches before you cut it.

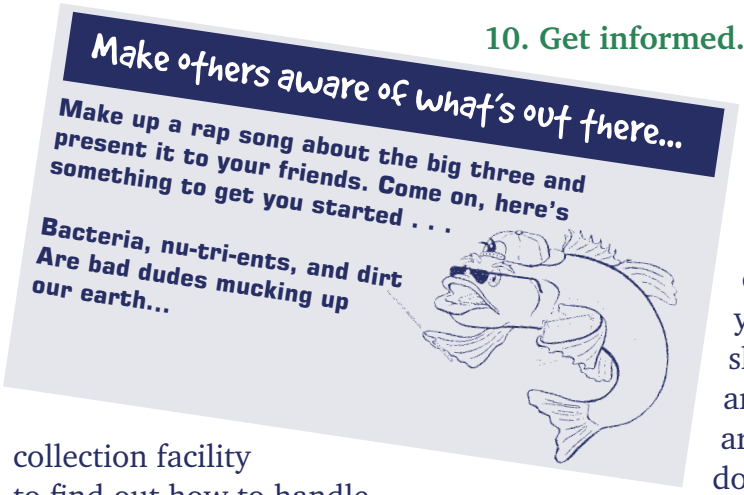
4. Build a compost pile. Composting yard and food wastes is a great way to make your own organic fertilizer and reduce waste that goes into landfills. Be sure to keep meat and dairy products out of your compost pile—they can attract rodents. Call 1-888-LANDCARE for more information on backyard conservation or go to *www.nrcs.usda.gov/feature/backyard/*.

5. Take a day off each week from using cars. Many of the metals and pollutants that wash into streams come from our cars—copper from brake pads, cadmium from tires, oil from the crankcase. Get your whole family involved. Ride bikes, walk, or take public transportation at least one day a week. Convince your parents to treat to you to a movie with all the money they save in gas.

6. Stop storm drain pollution. Those hollow drains along your curb are meant to carry storm water off the street during heavy rains. Chances are that whatever goes into a storm drain winds up in your local stream. Storm drain stenciling is a good way to let others know not to dump anything down there such as oil, leaves, pet waste, grass clippings, or cigarette butts. Produce and distribute a door hanger or flyer for local households to make them aware of your stenciling

project and remind them that storm drains dump directly to the local waterbody. Visit *www.earthwater-stencils.com* for more information on how to do a storm drain stenciling project.

7. Dispose of hazardous waste properly. We're not talking about drums of nuclear waste. We're talking car batteries, solvents, pesticides and cans of oil-based paint. Contact your local waste collection facility to find out how to handle these materials. Many facilities have free collection days when you can bring in these materials for disposal.



8. Adopt a stream. Find out if there is a volunteer monitoring organization or watershed group in your community—and join it. If not, start one as part of your science class or other local organization. Check out EPA's web site (*www.epa.gov/adopt*) for a list of watershed groups in your community. Read EPA's brochure *Getting Started in Volunteer Monitoring* at *www.epa.gov/owow/monitoring*.

9. Participate in the International Coastal Cleanup. The annual event is sponsored by the Ocean Conservancy every September. For more information call 1-800-CMC-BEACH or visit *www.oceanconservancy.org*.

10. Get informed. Knowledge is one of the most powerful tools around. Find out all you can about your watershed. What are the boundaries? Where does your drinking water come from? How is it treated? Get a copy of your state's water quality report (visit *www.epa.gov/305b*) to find out the major water quality issues in your area. A good starting place is EPA's Watershed Information Network at *www.epa.gov/win*.

11. Enter the River of Words Poetry and Art Contest. Co-sponsored by the Library of Congress and United States Poet Laureate (1995-1997) Robert Haas, the River of Words Poetry and Art Contest seeks to foster responsibility, imagination and action in young people and to publicly acknowledge their creativity and concerns. Visit *www.riverofwords.org,* send an email to info@riverofwords.org, or call (510) 548-POEM.

12. Spread the word. Once you've learned about your watershed and its major water quality issues, tell others. Make a presentation in your school. Write an article for your school or community newspaper. Organize an environmental fair at your school. The Groundwater Foundation (1-800-858-4844) has several guides on hosting water festivals, including *Making More Waves: Ideas from Across the U.S. and Canada for Organizing Your Watershed Festival.*

There's a method to this madness:

How to use the scientific method

The following pages contain ideas for projects that you can do for school or for fun. Before starting any of them, check with your parent or teacher first. These projects are designed to increase your awareness and concern for the environment. Make sure you share what you learn with your family and friends.

Scientists use the scientific method to solve problems. For each of the projects listed in this report follow the same steps:

1 **Describe a problem and formulate a question to answer.**

2 **State your hypothesis. A hypothesis is a statement that predicts what you think will happen.**

3 **Conduct the experiment. Make observations about what is happening.**

4 **Analyze the information.**

5 **State your conclusion. Was your hypothesis incorrect? What have you learned, based on the information you collected?**

Science Project – The Wonders of Wetlands
Build a Working Wetland Model

Materials:
- ☐ 2 large aluminum roasting pans
- ☐ Sand
- ☐ Modeling clay
- ☐ Carpet
- ☐ Ground pepper
- ☐ Twigs, branches

Background: Wetlands are amazing natural areas that are in between deep open water and dry land. Sometimes it is easy to see the water in a wetland. At other times the wetness lies just below the surface of the soil, where the plant roots grow. Maybe you think of wetlands as swamps, bogs, or marshes—muddy places that smell like rotten eggs, are full of mosquitos and leave your sneakers caked in muck. Maybe you think of them as cool places full of turtles, frogs, and birds.

Wetlands provide more benefits than most people realize. First, wetlands provide nurseries and homes for birds, fish, reptiles, insects, amphibians, and mammals. Wetlands also can filter out pollutants before they reach the stream. Wetlands can slow down the flow of waters to reduce the chances of flooding and protect areas from erosion. Finally, wetlands provide opportunities for recreational activities such as canoeing and birdwatching. When you finish this experiment, you will be better able to understand how wetlands are beneficial to our environment.

Hypothesis: State a hypothesis about the ability of a wetland to filter pollutants and soak up excess water. Give reasons for your hypothesis.

Experiment: In the first roasting pan make a model of a wetland. Build the wetland using materials such as sand, clay, carpeting, and twigs (hey, be creative). Leave the other pan empty. Raise both pans at one end approximately 2 inches. Measure equal amounts of water. Pour the water over the wetland pan and into the empty pan. Observe and record what you see. How long did it take the water to settle in the end of the pans? How much water was in the lower end of both pans?

Repeat the experiment several times. Each time, add more and different materials to the empty pan. Observe and record how long it takes the water to travel to the ends of the pans. Which materials soaked up the most water?

Repeat the experiment with your wetland pan adding pepper to the water. Observe and record how much pepper ends up at the end of the pan. What happened to the remaining pepper?

Conclusion: What conclusions can you draw from this project? In what ways are wetlands beneficial to an ecosystem?

Science Project - From the Rain to the Drain

Measure changes in pH as water goes from your house to a stream

Materials:

- ☐ 4 clean containers to collect water samples (cut the tops off empty plastic ½-gallon milk containers)
- ☐ pH testing kit (ask your science teacher where you can get a kit)
- ☐ Graph paper
- ☐ Measuring tape

Background: As rainwater falls and moves across your yard, down the driveway, and into a storm drain, it picks up pollutants. These pollutants come from many sources such as the exhaust from our cars, fertilizers on our lawns, dirt from bare patches, and wastes from our pets. These pollutants can affect the pH of the water, making it more acidic. pH is the measure of how acidic or basic a solution is. Changes in pH can affect how chemicals dissolve in the water and whether organisms can use these chemicals to grow. Most aquatic organisms prefer a pH range of 6.5–8.0

Hypothesis: State a hypothesis about how the pH readings of your water samples will change as the water flows from your yard down to a storm drain. Record your hypothesis.

Experiment: Identify four sampling locations starting at the highest point (hopefully near your house) and ending in a storm drain. Measure the distance between your sampling locations, and space the locations at least 30 feet apart (or measure 30 paces with your feet). Leave the first container outside your door to collect rainwater. Laying each container on its side, collect the runoff from the other three locations. Test the pH of each container and record your findings. Repeat the sampling two more times on different days. Each time record the number of days since the last rain event before you sampled.

Plot your measurements on a graph with the pH concentration on one axis and the sampling location (distance from your house) on another axis.

Conclusion: Does the pH in the water samples increase, decrease, or stay the same? What conclusions can you make about the changes in the pH from your house to the storm drain? How do you think these changes affect the pH level of the river water? Did the pH level change from one rain event to another? What do think are the major sources of pollutants in the rainwater?

Science Project - Watershed Awareness Campaign

Background: Clean, healthy watersheds depend on an "informed public" to make choices that help the environment. Hundreds of thousands of dollars are poured into education campaigns each year to make communities aware of the sources of water pollution in their watershed and what can be done to prevent these problems. Marketing firms conduct research on their markets before they develop an ad campaign. They identify their markets, find out what messages appeal to them, and then develop ways to get the messages out.

Conduct your own research to gauge the awareness of your community on watershed issues, and design a marketing campaign to improve awareness of the issues.

Hypothesis: State a hypothesis about the current understanding of watershed issues in your community. Predict which audiences are the most informed and which messages you think will appeal to which audiences.

Materials: Interview forms
List of questions

Experiment: Identify at least three different audiences from which to gather information on watershed issues (for example, students in grades 6-9, homeowners, local elected officials). Develop a 1- or 2-page interview form to ask questions that will help you determine their level of knowledge on various issues. (For example, do they know what a watershed is? Where does their drinking water come from?) [Hint: Use some of the questions on the Test Your Water Smarts in this report to get you started.] Determine how you will get the information. (During lunch period? Stopping people at the grocery store? After a board of supervisors meeting?) After you collect and analyze the information, develop a campaign to address the major gaps of knowledge in your community and outline strategies to fill in these gaps (a watershed fair, articles in the local newspaper, etc.). Show examples of materials you would use to get the message out.

Conclusions: What audiences were the most informed about watershed issues? Which messages appealed to the different audiences? How did the different audiences get their information on watershed issues?

Want to know more?

This is just a starting point. There's a ton of information out there about the water quality in your state and who's doing what to protect it. Thanks to the cyber world, much of this information is only a mouse click away. Dig in to find out what the water quality is like in your local watershed and what you can do to make a difference.

organizations/contacts

Use the government pages of your telephone book to locate addresses and phone numbers of local agencies in your community or state. The following list includes some of the organizations that may be helpful to you:

Cooperative Extension Service

Department of Agriculture

Department of Health

Department of Natural Resources

Environmental Quality Department

Soil and Water Conservation District

Waste Water Departments

1-800-RECYCLE. You can call anytime to get information on how and what to recycle.

Adopt-A-Watershed. Adopt-A-Watershed uses a local watershed as a living laboratory in which students engage in hands-on activities, making science applicable and relevant to their lives. To get more information on activities you can do in your state/community go to www.adopt-a-watershed.org/contacts.htm and click on your state. You can also call (530) 628-5334 for a list of contacts for your state.

Coastal Cleanups (www.oceanconservancy.org). Visit this site or call the Ocean Conservancy at 1-800-CMC-Beach for information about beach cleanups or to participate in the annual International Coastal Cleanup.

Earth Force (G.R.E.E.N) Earth Force is youth driven. Through Earth Force, kids discover and implement lasting solutions to environmental issues in their community. In the process they develop lifelong habits of active citizenship and environmental stewardship. For more information, call (703) 299-9400 or visit the web site at www.earthforce.org.

Earthwater Stencils. Their mission is to foster public awareness of, involvement in, and support for stormwater pollution prevention. This is accomplished through community-based storm drain stenciling and related programs in local watersheds. For more information, call (360) 956-3774 or visit www.earthwaterstencils.com.

EPA Safe Drinking Water Act Hotline (1-800-426-4791). You can call this number to report problems or to get information on safe drinking water practices.

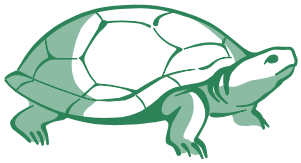
EPA Wetlands Helpline (1-800-832-7828). You can obtain free fact sheets, coloring books, and other useful materials on wetlands.

Global Learning and Observations to Benefit the Environment (GLOBE) is a worldwide network of students, teachers, and scientists working together to study and understand the global environment. GLOBE students make environmental observations at or near their schools and report their data through the Internet. For more information on getting involved, call 1-800-858-9947 or visit GLOBE's web site at www.globe.gov.

Izaak Walton League of America's Save Our Streams program provides educational material on stream and wetland monitoring. Visit www.iwla.org/sos or call 1-800-BUG-IWLA.

National Wildlife Federation's Backyard Wildlife Habitat program shows you how to help save a place for wildlife in your own backyard. Visit www.nwf.org/backyardwildlifehabitat/.

Project WET is a nonprofit water education program for educators and young people, grades K-12, located on the Montana State University campus in Bozeman, Montana. The goal of Project WET is to facilitate and promote awareness, appreciation, knowledge, and stewardship of water resources. At project WET's homepage (www.ProjectWET.org) you can get more information from the contact in your state (see the State Contacts list) or call (866)337-5486.



River of Words Poetry and Art Contest. The River of Words Contest is a national poetry and poster contest for grades K-12 that invites children to explore their own watershed, discover its importance in their lives, and express what they learned, felt and saw in words or images. For more information on entering the next River of Words contest, visit www.riverofwords.org, email info@riverofwords.org, or call (510) 848-1155.

River Network keeps a directory of river and watershed conservation groups. Visit www.rivernetwork.org/library/libnetdir.cfm.

The Groundwater Foundation is a nonprofit organization dedicated to educating the public about ground water. Visit www.groundwater.org or call 1-800-858-4844.

The Water Environment Federation is an international technical and educational services organization. Visit www.wef.org for hands-on water environment activities for kids K–12.

Publications

50 Simple Things Kids Can Do to Save the Earth by Earthworks Group. This book shows kids how specific elements of their environment (like a light switch or a toilet) are connected to the rest of the world. The book provides practical tips to kids on how they can conserve energy, recycle waste, and take on important environmental projects. Available in bookstores.

Backyard Conservation. Whether you have acres in the country, an average-sized suburban yard, or a tiny plot in the city, this booklet can show you things you can do to the land around your home to help protect the environment and add beauty and interest to your surroundings. Tip sheets and this colorful 28-page booklet on Backyard Conservation are available free by calling 1-888-LANDCARE (single copies only). You can also visit the web site at www.nrcs.usda.gov/feature/backyard/.

Earth Book for Kids: Activities to Help Heal the Environment by Linda Schwartz, Beverly Armstrong (Illustrator). This book contains arts and crafts projects, experiments, and experiences that encourage children to enjoy and heal the environment. The book covers acid rain, endangered wildlife, pesticides, energy, recycling, pollution, landfills, rain forests, water conservation, and related topics. Available in bookstores.

Getting Started in Volunteer Monitoring. A brochure introducing volunteer monitoring and how to get involved. Visit the EPA web site at www.epa.gov/owow/monitoring/vol.html.

Watershed Patch Project. The purpose of this project is to encourage kids to make a difference in their communities by becoming watershed stewards. For more information or to obtain a copy of the booklet, call the National Service Center for Environmental Publications (NSCEP) at 1-800-490-9198 or visit the web site at www.epa.gov/adopt/patch. Don't forget to give them the EPA docu-

ment number when ordering (EPA 840-B-02-001).

Give Water a Hand Activity Guide (www.uwex.edu/erc). This guide provides information for youth about watersheds and ways to protect and improve them.

National Water Quality Inventory: Report to Congress. This report includes information about the condition of our nation's waters. Visit www.epa.gov/305b or contact the National Service Center for Environmental Publications (NSCEP) at 1-800-490-9198.

Splash (CD-ROM). This interactive tool provides information on nonpoint source pollution. For more information, contact the Conservation Technology Information Center at (765) 494-9555.

Turning the Tide on Trash: A Learning Guide on Marine Debris. Call the National Service Center for Environmental Publications (NSCEP) at 1-800-490-9198 or visit the web site at www.epa.gov/owow/ocpd/Marine/contents.html. EPA document number 842-B-92-003.

Waters to the Sea: Rivers of the Upper Mississippi (CD-ROM). This interactive tool presents fundamental concepts of ecology, the water cycle, and watershed hydrology. The cost is $39.95 plus shipping and handling. For more information, contact the Center for Global Environmental Education at (651) 523-2480.

Web Sites

http://environment.about.com
This web site contains information on environmental issues, where to get free environmental materials (CDs and posters), kids' stuff (fun and games), clip art, environmental news, online environmental mapping, and other links to environmental issues.

www.afandpa.org/kids_educators/index.html
Hey Kids, Its Time to Take Action. All types of recycling programs and information for kids from the American Forest and Paper Association. One feature of the site lists 20 ways to reuse a paper grocery bag.

www.epa.gov/305(b)
At this site, you can find reports on the quality of our nation's waters, including summaries for your state.

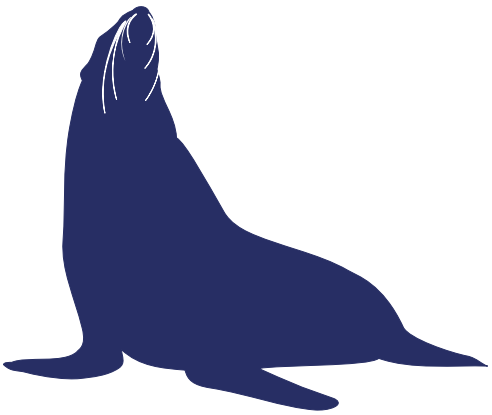
www.epa.gov/kids/
EPA's Explorer's Kids Club. Provides information and activities for kids to become familiar with the environment and what they can do to make a difference.

www.epa.gov/owow/monitoring/vol.html
EPA's Volunteer Monitoring Homepage. At this web site you'll find information on volunteer monitoring, including a directory of U.S. programs and documents on how to monitor.

www.epa.gov/surf
Locate Your Watershed. Using the Watershed Information Network, you can check out local water conditions, find out about watershed training opportunities, identify volunteer monitoring and watershed programs to get involved in, or connect with federal and state agencies.

www.epa.gov/water/kids.html
This web site is loaded with information for kids of all ages, including projects, experiments, educational materials and games.

www.epa.gov/win
Watershed Information Network. You can get information on your watershed from this web site.



Test Your Water Smarts

Take this quiz (don't worry, you won't get graded) to test your water smarts. Then give the quiz to your family and friends to test their knowledge on water quality. We can't solve all these problems if people don't know they exist. Be the ball . . .

1. True or false. Watersheds are located mainly in mountainous regions with high rainfall.
2. Circle the correct answer. Most of the pollutants entering our waters come from the following sources:
   - A. Wastewater treatment plants
   - B. Runoff from fields and streets
   - C. Factories along rivers
3. True or false. Students can join organizations to help monitor their waters.
4. True or false. Dirt, bacteria, and nutrients are the most common pollutants in our waters.
5. True or false. Leaves should be raked down a storm drain so they can decompose in the stream and provide food for the fish.
6. True or false. To test if your toilet is leaking, you can squirt a couple drops of food dye in the top of the tank and wait a few minutes to see if the dye shows up in the toilet bowl.
7. Circle the correct answer. The following organizations monitor the quality of our waters:
   - A. Volunteer organizations, including kids like you
   - B. State, local and tribal agencies
   - C. The federal government
   - D. All of the above
8. Circle the correct answer. Nutrients that enter our waters come from the following sources:
   - A. Leaking septic systems
   - B. Excess fertilizers washing off lawns
   - C. Pet waste
   - D. All of the above
9. What percentage of rivers and streams assessed in the most recent national water quality report scored a GOOD rating, meaning the waters fully supported their designated uses?
   - A. 10%
   - B. 32%
   - C. 65%
   - D. 93%

How do you rate?

More than five wrong: Uh oh. Better read this report again!

3 to 5 wrong: You've gotta do better than that if you're going to make a difference. Check out some of the web sites listed on page 18.

1 to 3 wrong: Pretty good. Find the correct answers and start spreading the word.

0 wrong: Excellent! You've got the smarts to be an environmental champion. Now, go out there and make a difference!

Answers:

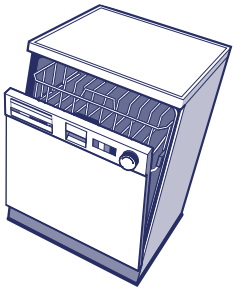
1. F, we all live in a watershed; 2. B; 3. T; 4. T; 5. F, decomposed material uses up the oxygen and then fish die; 6. T; 7. D; 8. D; 9. C.

Home Survey

To improve your home's environmental friendliness, you need to know where you and your family stand on the environmentally-friendly meter. Please answer the questions below and then calculate your score. If some questions don't apply to you, try answering them anyway, using good ol' common sense (lots of us don't have yards, garages, or dogs!).

1. Your family runs the dishwasher and washing machine
   a. Only when they're full
   b. When they are about half full
   c. When they have only a few items in them

2. Your house has low-flow devices (which use less water than standard devices) in the
   Bathroom sink (number____)
   Shower (number ____)
   Toilets (number ____)
   Kitchen
   Dishwasher

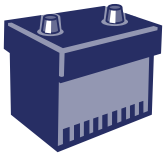


3. Take a look at all of the faucets in your house. How many leak? ____

4. Your family recycles
   a. Glass
   b. Plastic
   c. Newspapers
   d. Metal

5. When you look into your garage or shed, you see
   a. No cans of paint, fertilizer, yard chemicals, or car batteries. Your family recycles them at the local hazardous waste facility.
      Bonus: Where is the facility located? _____
   b. One can of paint, but your family is redecorating and it will be used
   c. Plenty of cans of paint, fertilizers, chemicals, and old car batteries.
   d. No cans of paint or old car batteries. Your family threw them away in the regular trash.

6. When you look at the floor of your garage and/or driveway, you see
   a. No oil or chemical stains
   b. A few drops of oil or chemicals
   c. A lovely collage of chemical stains and leaked oil



7. If you have a family dog, whoever walks it
    a. Always picks up after the pooch
    b. Sometimes picks up after the pooch
    c. Never picks up after the pooch, except when someone steps in it

8. Describe how your family deals with your lawn
    a. Constantly fertilizes, spreads chemicals for weed and bug control, and waters it like crazy. Your parents pay more attention to the lawn than to you!
    b. Hires a lawn care company to do everything in choice "a"
    c. Fertilizes infrequently, uses little or no chemicals for weed and bug control, and waters occasionally in the early morning or late afternoon
    d. Your "lawn" only has native grasses and plants (native means that the plants grow naturally in your area of the country and usually don't require any watering or fertilizers), and your family removes the weeds by hand (really)

9. Your yard is mostly:
    a. Patches of dirt and/or a patio
    b. Grass, shrubs, flowers, trees, and pervious (water absorbing) surfaces

10. Your family disposes of yard waste (leaves and grass clippings) by
    a. Throwing it into the nearby pond or stream
    b. Raking it into the storm drain
    c. Collecting it to be recycled by the town or county public works department
    d. Composting it and using it in the garden or planting beds

11. If you have a stream or pond in your yard or neighborhood, you see
    a. A healthy watercourse with lots of fish and with vegetation, like overhanging trees and shrubs, along the edge
    b. No sign of fish and has mowed grass or impervious surfaces right along the edge
    c. No water because that's where you dump your trash

12. If you have a septic system
    a. When was the last time that it was pumped? _____
    b. By whom?_____

So, how did you score?

Mom Nature thinks that you're pretty cool for doing this survey. Give yourself 5 points to start out.

1. To be most efficient with water and energy, the dishwasher and washing machine should only be run when they're full.
    a. add 3 points
    b. subtract 1 point
    c. subtract 3 points

2. Low-flow devices can save lots of water, plus there will be less water to clean at the water treatment plant.
    * add 1 point for every low-flow device in your house

3. Water conservation is always environmentally friendly. Leaking water faucets waste precious water.
    * subtract 2 points for each leaky faucet

4. Recycling is good for the environment. Recycling materials into useful products uses less energy and water than using new natural resources.
    a. add 2 points
    b. add 2 points
    c. add 2 points
    d. add 2 points

5. Cans of oil-based paint and old car batteries should never be put into the regular trash. They are a hazardous waste and should be recycled by a special facility.
    a. add 5 points
       BONUS add 10 points (good for you!)
    b. add 5 points
    c. subtract 3 points
    d. subtract 5 points

6. When it rains or you hose down the garage, oils and other gunk on the floor of the garage or driveway will be washed into a storm drain that leads into a stream. That's bad news for the fish and other critters living in the stream.
    a. add 5 points
    b. add no points
    c. subtract 5 points (A collage of oils and chemicals is certainly NOT art!)

7. Pet waste should always be picked up and put into the trash or flushed down the toilet. If left on the ground, it can wash into a storm drain or directly into a stream.
    a. add 5 points
    b. add 1 point
    c. subtract 5 points (Ewwwww! That's gross!)

8. Lawns should be fertilized sparingly, and weed and bug chemicals applied only when absolutely necessary. Native plants need little care and often provide improved habitat for animals. If the lawn is fertilized too much, the excess

fertilizer will just wash into a storm drain or directly into a stream.

a. subtract 3 points
b. subtract 5 points
c. add 3 points
d. add 5 points

9. When it rains, the runoff picks up dirt from bare patches in the yard and washes it into a storm drain or directly into a stream. Dirt can clog fish gills, smother stream critters, and change the flow of water in the stream. A yard with lots of bare patches and impervious surfaces is bad news!
    a. subtract 5 points
    b. add 5 points

10. Composting or recycling leaves and grass clippings creates new topsoil. Yard waste should never be thrown into the regular trash or any other sensitive area such as a wetland or stream. Too many leaves and grass clippings can clog up those sensitive areas and add too many nutrients. Yard waste clogs storm drains and ends up in our waterways.
    a. subtract 5 points
    b. subtract 5 points
    c. add 5 points
    d. add 5 points

11. A "buffer area" is an area with many plants along a streambed. A buffer area filters pollutants such as phosphorus and dirt out of rainwater before it enters the stream or pond. A buffer area also shades the water to keep it cool for the critters in the summer. And as we learned, cool water holds more oxygen than warm water.
    a. add 5 points
    b. add no points
    c. subtract 5 points (Try using a trash can!)

12. Septic systems require maintenance, such as regular pumping of the tank every few years.
    a. add 5 points if it was within the past three years
       subtract 5 points if it was over 5 years ago
    b. add 5 points if it was by a certified contractor
       subtract 5 points if it was by your Uncle Bob

What Mom Nature thinks of your score . . .

50 points or more

You and your family are environmentally friendly! Mom Nature is really proud of you! Keep up the good work!

20 to 50 points

You and your family are really close to environmentally friendly. Mom Nature is pleased, but she would like you to do a bit better.

negative points to 20 (eek!)

Mom Nature is pretty upset and wants you and your family to go to your rooms and reread this report until you learn more about protecting the environment!

Technically Speaking – Glossary of Terms

Algal bloom: A sudden, excessive growth of algae in a waterbody.

Clarity: A measure of the amount of particles suspended in water; determined by using a secchi disk or turbidity test.

Combined sewers: Pipes that carry both storm water and household sewage to sewage treatment plants. During a big storm, thay may overflow and dump untreated sewage into streams, lakes and coastal waters. These overflows are called combined sewer overflows or CSOs.

Designated use: The desired use a waterbody should support (like fishing or swimming).

Dissolved oxygen (DO): The amount of oxygen dissolved in water. The amount is usually expressed in parts per million (ppm) or milligrams per liter (mg/L).

Estuary: The area where the fresh water of a river meets and mixes with the salt water of the ocean.

Ground water: The supply of fresh water that is found under the earth's surface in underground rock formations or soil.

Impervious surface: A paved or other hard surface that does not allow water to penetrate.

Livestock operation: A facility that raises animals such as cows, sheep, or hogs. Bacteria are present in livestock waste.

Macroinvertebrate: Organism that lacks a backbone and is large enough to be seen with the naked eye.

Meandering stream: One that follows its natural course creating winding curves.

National Water Quality Inventory: A report EPA prepares every 2 years summarizing information from states about the quality of the nation's waters.

Nitrogen: A nutrient that is essential to plants and animals.

Nutrients: Substances necessary for the growth of all living things, such as nitrogen, carbon, potassium, and phosphorus. Too many nutrients in waterbodies can contribute to algal blooms.

Particulates: Small pieces of material (such as sand) floating in the water.

Pervious surface: A surface which allows water to soak into it.

pH: A symbol for expressing the degree to which a solution is acidic or basic. It is based on a scale from 0 (very acid) to 14 (very basic). Pure water has a pH of 7.

Phosphorus: A nutrient that is essential to plants and animals.

Photosynthesis: The conversion of light energy to chemical energy. At night, this process reverses: plants and algae suck oxygen out of the water.

Runoff: Water from rain, snowmelt, or irrigation that flows over the ground and returns to streams. It can collect pollutants from air or land and carry them to streams and other waterbodies.

Secchi disk: A black-and-white disk used to measure the clarity of water. The disk is lowered into the water until it cannot be seen and then the depth of the disk is measured.

Septic system: A system that treats and disposes of household wastewater under the ground.

Turbidity: A measure of the degree of clarity of a solution. For cloudy water, turbidity would be high; for clear water, turbidity would be low.

Watershed: The area of land that drains into a specific waterbody.

Wetland: An area where water covers the soil or is present either at or near the surface of the soil all year (or at least for periods of time during the year).

U.S. Environmental Protection Agency
Office of Water (4503T)
Washington, DC 20460

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or by contacting the National Service Center for Environmental Publications, 1-800-490-9198.