

Effects of Human Activity on Surface Water and Groundwater

People use a lot of fresh water! In the United States, daily indoor water use is about 265 liters of water per person per day! And that doesn't include all the water used in farming, manufacturing, and other industrial uses.

Fresh water is scarce on Earth. About ninety-seven percent of Earth's water is salty ocean water, which cannot be used for drinking or watering crops. About three quarters of Earth's fresh water is ice, so only one quarter of Earth's fresh water is liquid. Most of the liquid fresh water is groundwater. **Groundwater** is water stored in soil and rock beneath Earth's surface. The rest of Earth's liquid fresh water is surface water. Surface water is found in rivers, streams, lakes, and ponds on Earth's surface. People get the water they need from both groundwater and surface water.

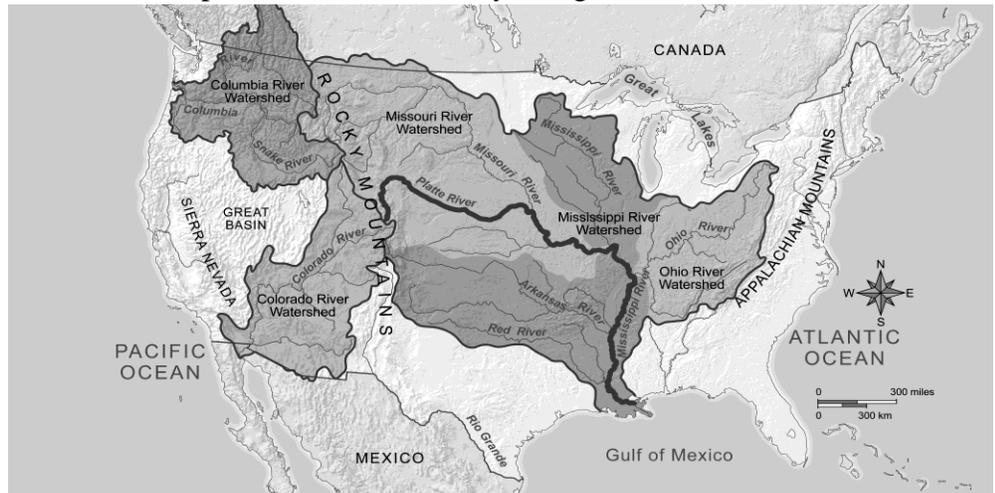
What is a watershed?

Just as all the water in a bathtub flows toward the drain, all the water in a river system drains into a main river. The land area that supplies water to a river system is called a **watershed**. Watersheds are sometimes known as drainage basins.

As you can see on the map, the Missouri and Ohio Rivers flow into the Mississippi River. When rivers join another river system, the areas they drain become part of the largest river's watershed. The Mississippi's watershed drains nearly one third of the United States!

What keeps watersheds separate? One watershed is separated from another by a ridge of land called a **divide**.

Streams on each side of the divide flow in different directions. The Great Divide (also called the Continental Divide) is the longest divide in North America. It follows the line of the Rocky Mountains. West of this divide, water flows toward the Pacific Ocean. Some water is trapped between the Rockies and the Sierra Nevada, in the Great Basin. Between the Rocky and Appalachian Mountains, water flows toward the Mississippi River and into the Gulf of Mexico.



How can human activity affect surface water in a watershed?

You have learned that fresh water makes up only a tiny portion of all the water on Earth. Fortunately, this water is renewable. Remember that water continually moves between the atmosphere and Earth's surface in the water cycle. Even though fresh water is renewable, there is not always enough of it in a given place at a given time. Human activities can also reduce water supplies in an area.

Water Shortages: Water shortages occur when people use water faster than the water cycle can replace it. This is likely to happen during a drought, when an area gets less rain. Many places never receive enough rain to meet their needs, and so they use other methods to get water. Desert cities in Saudi Arabia get more than half of their fresh water by removing salt from ocean water, which is very expensive.

Pollution: Many human activities have an effect on watersheds. Wastes produced by agriculture, households, industry, and mining can end up in water as pollution. Some pollutants, such as iron and copper, make water unpleasant to drink or wash in. But other pollutants, such as mercury or benzene, can cause illness or even death.

- **Agricultural Wastes:** Animal wastes, fertilizers, and pesticides are also sources of pollution. **Pesticides** are chemicals that kill crop-destroying organisms. Rain washes animal wastes, fertilizers, and pesticides into rivers and ponds, causing algae to grow. The algae block light and deplete the oxygen in the water.

- **Household Sewage:** The water and human wastes that are washed down sinks, showers, and toilets are called **sewage**. If sewage is not treated to kill disease-causing organisms, the organisms quickly multiply. People can become ill if they drink, swim in, or wash with water containing these organisms.
- **Industry and Mining Wastes:** Some plants, mills, factories, and mines produce wastes that can pollute water. Chemicals and metal wastes can harm organisms that live in bodies of water. Animals that drink from polluted bodies of water or eat the organisms that live in the water can also become ill.
- **Sediments:** Water that causes erosion picks up **sediments**, or particles of rock and sand. Sediments can cover up the food sources, nests, and eggs of organisms in bodies of water. Sediments also block sunlight, preventing plants from growing.
- **Heat:** Heat can also have a negative effect on a body of water. Some factories and power plants release water that has been used to cool machinery. This heated water can kill organisms living in the body of water into which it is released. This type of pollution is also known as thermal pollution.
- **Oil and Gasoline:** An oil spill can pour millions of gallons of oil and other chemicals into a body of water from a damaged well or a leaking tanker. It can take many years for an area to recover from an oil spill because the oil floats on water and is difficult to collect. An even larger source of this type of pollution is the petroleum products carried into waterways by rainwater runoff. The small drips of oil and other fluids from cars and trucks, drops of gasoline spilled at filling stations, and drips from machinery combine to have a large impact on water sources.

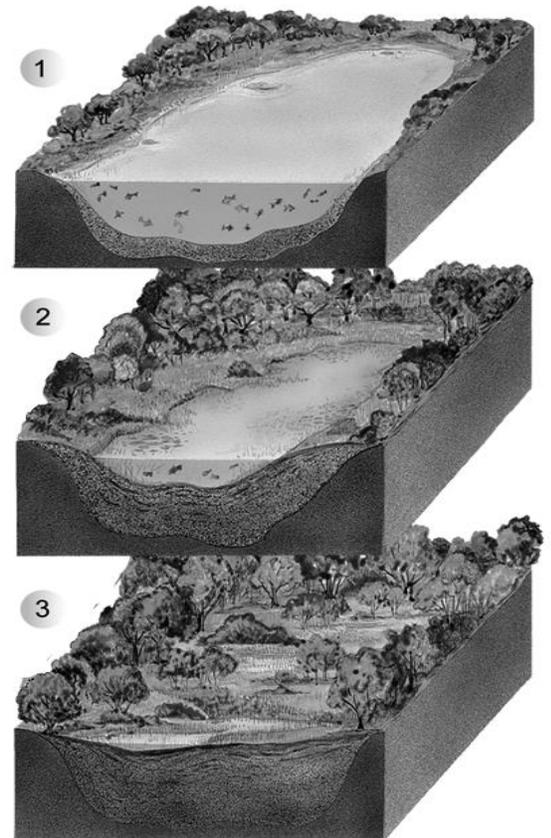
Pollution of Lakes: Lakes and ponds may become polluted in the same ways as rivers and streams. In addition, lakes and ponds have a unique natural process called eutrophication (yoo troh fih KAY shun) that speeds up when a lake or pond is polluted. **Eutrophication** is the buildup of nutrients in a lake or pond over time. In eutrophication, a lake or pond gradually shrinks and becomes shallower, as shown in the diagram on the next page.

1. Dead organisms decay and release nutrients, such as nitrogen and phosphorus, into the water. These wastes are nutrients for algae, which spread and form a layer on the lake's surface.
2. The thickening layer of algae blocks sunlight. Plants die because they cannot carry out photosynthesis. Without food and oxygen from the plants, animals die. Decaying material from dead organisms piles up on the bottom, making the lake shallower.
3. As the area fills in, land plants grow in the mud. Over time, the area fills with plants, and a meadow replaces the former lake.

Although eutrophication occurs naturally, certain human activities can increase how quickly it happens. For example, fertilizer from farms runs off into ponds and lakes, providing extra nutrients to the algae. The extra nutrients speed up the growth of algae, leading to faster eutrophication.

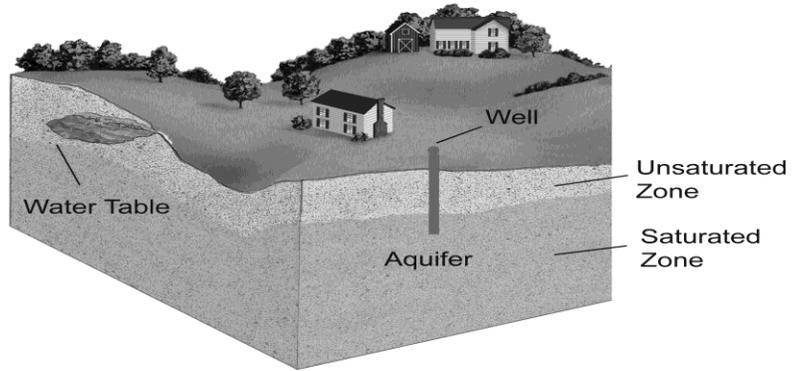
How can human activity affect groundwater in a watershed?

Recall that groundwater is water stored in rocks and soil beneath Earth's surface. Like surface water, groundwater generally comes from precipitation. Precipitation soaks into the ground, pulled by gravity. The water fills up the spaces between particles of soil and the cracks and spaces in layers of rock. Any underground layer of permeable rock or sediment that holds water and allows it to flow is called an **aquifer**. Aquifers can range in size from a small patch to an area the size of several states.



Aquifers have different zones. In the saturated zone, all the underground spaces are filled with water. The **water table** is at the top of the saturated zone. Above the water table, air fills the empty spaces between particles of soil and rock. This is the unsaturated zone.

Groundwater Pollution: There are many sources of groundwater pollution. Some homes have underground septic tanks to collect waste. These tanks sometimes leak, as do landfills. Underground storage tanks can leak oil and gasoline into the soil. People contribute directly to the contamination of underground water by pouring oil, paint thinners, and other chemicals onto the ground.



Aquifers that become polluted do not recover quickly, because groundwater flows slowly. An aquifer cannot easily flush itself to dilute or wash away pollution. Groundwater is also cold and has fewer microorganisms than surface water. So the natural chemical reactions that break down wastes occur more slowly.

Groundwater Depletion: Aquifers provide much of our drinking water. People obtain groundwater from an aquifer by drilling a well below the water table, into the saturated zone. But aquifers are not unlimited sources of water. Pumping water out of an aquifer lowers the water level near the well. If people take water from the aquifer faster than the aquifer refills, the level of the aquifer will drop. If the water table drops below the bottom of the well, the well will run dry and water cannot be obtained from it.

Withdrawal of large quantities of water from an aquifer can also cause the land on the surface above it to sink. In places near coasts, heavy withdrawal of freshwater from aquifers has allowed salt water from the ocean to seep in and contaminate wells.

1. **Define:** What is a watershed? _____

2. **Identify:** Which type of pollution are pesticides?

- A. industry and mining wastes B. household sewage C. agricultural wastes D. sediments

3. **Restate:** Define eutrophication, and describe the ultimate result of this process.

4. **Identify:** List two reasons why polluted groundwater sources recover more slowly than polluted surface water sources.

Lesson Check

1. **Predict:** What is a possible effect on the land above an aquifer if large amounts of water are pumped out?

2. **Explain:** Even though Earth's freshwater resources are limited, they are essential to sustaining life and to carrying out a large range of human activities.

a. How can human activity affect surface water?

b. How can human activity affect groundwater?

4. **Draw Conclusions:** Why is the effect that human activities have on Earth's freshwater supplies important?

TEKS Check

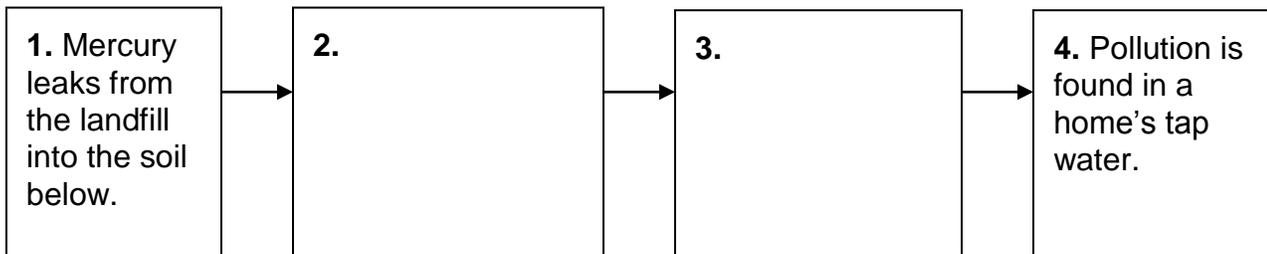
1. **Identify** Which is the largest source of water pollution by oil and gasoline?
A runoff from farms B mining wastes C industrial wastes D pollutants carried by runoff
2. **Predict** What type of human activity would result in salt water infiltrating groundwater supplies?
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3. **Draw Conclusions** Pollution causes various effects on surface water in watersheds.
a. What is the effect of sewage on surface water in a watershed?

b. What is the effect of an oil spill on surface water in a watershed?

c. What is the effect of sediment on surface water in a watershed?

4. Model the effects of human activity on groundwater. Suppose that a landfill is leaking mercury into the soil beneath it. Beneath the soil is an aquifer. Wells drilled into the aquifer provide water for many homes. Complete the graphic organizer to model a possible sequence of events, as the pollution moves from the landfill to a water tap at one of the homes.



5. Model the effects of human activity on groundwater. In the space below, draw two pictures to model how human activities affect an aquifer. The first drawing should show the aquifer after several weeks of extremely heavy rainfall. The second should show the same aquifer after heavy pumping has removed much of the water from the aquifer. Both drawings should have the following features: *zone of saturation*, *zone of unsaturation*, and *water table*.

1.

2.