

CHAPTER

14

Water Resources

YOUR WORLD
YOUR TURN





Looking for Water . . . in the Desert

- The 2300-kilometer Colorado River once flowed deep and wide across the Southwest to Mexico's Gulf of California.
- Since the Colorado River Compact, in 1922, seven states—Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming—have relied on the river's water for human use.
- Today, drought, dams, and diversion have caused the once-raging Colorado River to run nearly dry.
- Las Vegas, Nevada city officials have turned to an unlikely source for water—the desert. Their proposal to mine groundwater from beneath a scenic area of the Great Basin Desert is controversial.



Talk About It *Is the human need for fresh water reason enough to mine in an area that may threaten area ecology? What other ideas might states in the Colorado River Basin try?*

Lesson 1.1 Earth: The Water Planet

Although the vast majority of Earth is covered in water, one in eight people lacks access to clean freshwater.



Where Is Our Water?



- Fresh water is both a renewable resource and a limited resource.
- Earth's fresh water is distributed unequally. How much water people use depends on where they live and the time of year.

Did You Know? *If all Earth's water were in a two-liter bottle, only about two capfuls would be fresh, liquid water.*

Surface Water



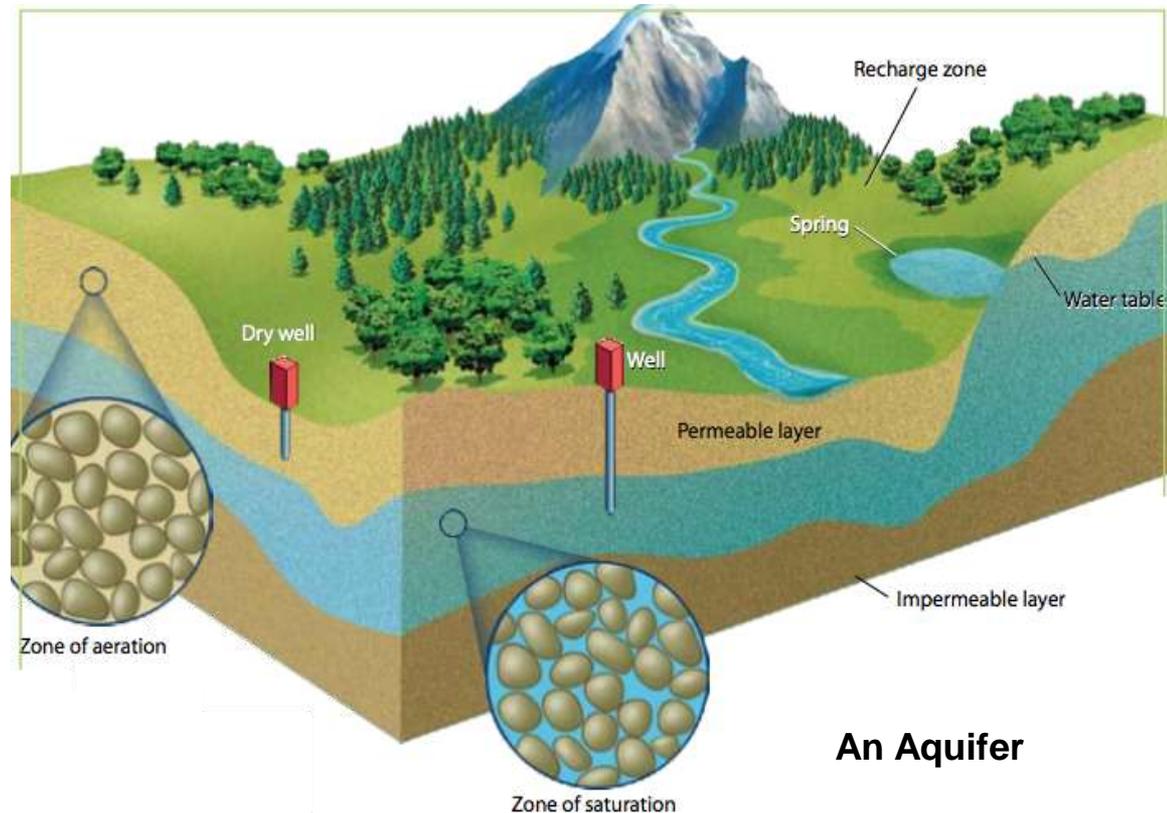
Watersheds of the U.S.

- Surface water includes still bodies of waters and river systems.
- Watersheds include all of the land area that supplies water to a river system.
- Every waterway defines a watershed.

Did You Know? *The Mississippi River Basin covers 3 million square kilometers (1.2 million sq mi), making it the third largest watershed in the world. It drains 41% of the land area of the contiguous US.*

Groundwater

- Groundwater seeps through the soil and becomes contained in underground aquifers.
- Aquifers are permeable layers of rock and soil that hold water.
- The water table separates the zone of saturation from the zone of aeration.



Did You Know? *The average age of groundwater is 1400 years. Groundwater recharges very slowly.*

Groundwater

- Aquifers release 1.9 trillion L (492 billion gal) of groundwater to the surface each day via springs, geysers, and wells.



Old Faithful, a well-known geyser in Yellowstone National Park, shoots groundwater over 100 feet into the air many times a day.

Lesson 14.2 Uses of Fresh Water

A photograph showing a wide expanse of dry, cracked earth. The ground is light-colored and covered in a network of dark, irregular cracks that form a mosaic-like pattern. In the foreground and along the left side, there are clumps of dry, brownish-yellow grasses and some darker, reddish-brown plants, indicating a lack of water. The background shows more of the cracked earth stretching towards the horizon under a bright sky.

One third of all the people on Earth are affected by water shortages.

How We Use Water



- Three main uses of fresh water include:
 - **Agricultural**
 - **Industrial**
 - **Personal**

Did You Know? *The average American uses 250 L of fresh water a day for personal uses, such as bathing and brushing teeth.*

Using Surface Water

- Most freshwater used in the U.S. is surface water.
- Surface water is diverted by canals and dams.
- Drought and overuse have caused significant surface water depletion.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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Did You Know? *The Aral Sea was once the fourth largest body of fresh water.*

Aral Sea, 1997

Aral Sea, 2009

Using Groundwater

- 68% of groundwater in the U.S. is used for irrigation, most of which is very inefficient.
- Groundwater mining turns groundwater into a nonrenewable resource because it is withdrawn from the ground faster than it can be replaced.
- When groundwater is depleted, the falling water tables can cause cities to sink, and undrinkable saltwater to move into the depleted aquifers.



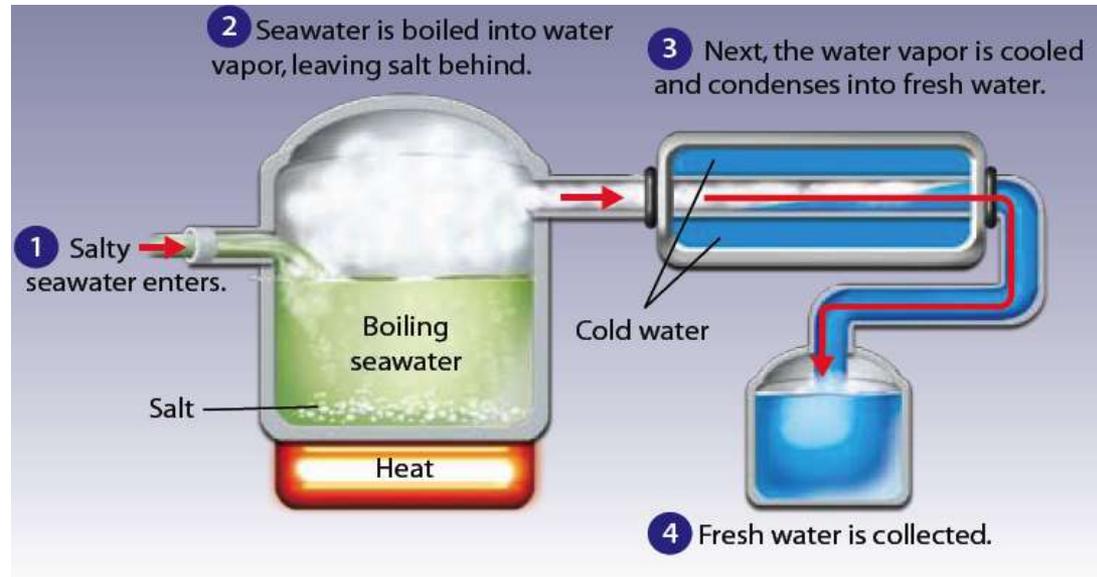
Solutions to Freshwater Depletion

- **Increase supply:**

- **Desalination:** “Making” fresh water by removing salt from saltwater.

- **Decrease demand:**

- **Agricultural:** Drip-irrigation, climate-appropriate plants
- **Industrial:** Water-conserving processes, recycling wastewater to cool machinery.
- **Personal:** Xeriscaping, water conservation



Desalination

Lesson 14.3 Water Pollution

3,800 children die every day from diseases associated with unsafe drinking water.



Types of Water Pollution

- **Point-source pollution:** From a discrete location, like a factory or sewer pipe
- **Nonpoint-source pollution:** From many places spread over a large area, such as when snowmelt runoff picks up pollutants along its path



Point source oil pollution
Oil after a spill, Trinity Bay, Texas

Point Source of Polluted Water in Gargas, France



Nonpoint Sediment from Unprotected Farmland Flows into Streams



Fig. 20-4, p. 530

Lake Polluted with Mining Wastes



Fig. 20-5, p. 531

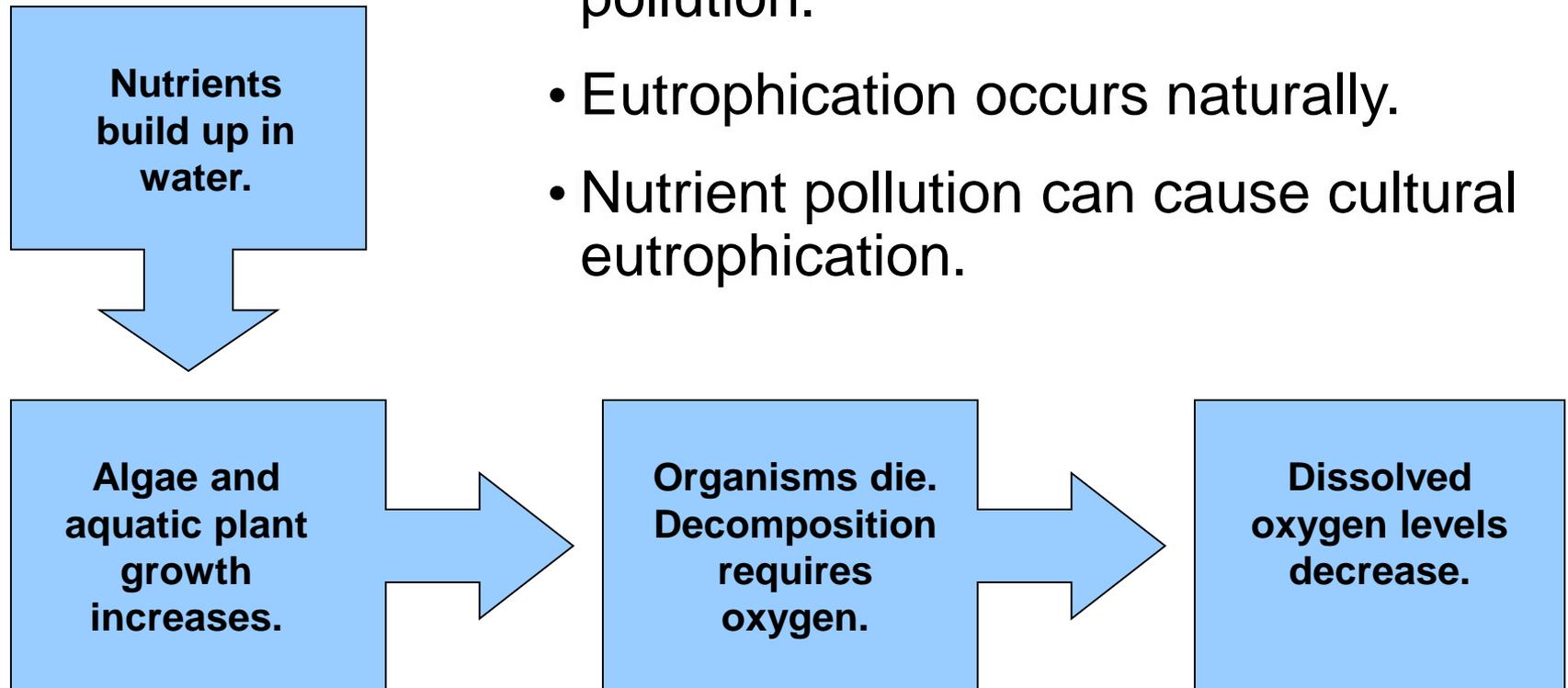
Plastic Wastes in Mountain Lake



Fig. 20-6, p. 531

Nutrient Pollution

THE PROCESS OF EUTROPHICATION



- Excess phosphorous and other nutrients in the water is nutrient pollution.
- Eutrophication occurs naturally.
- Nutrient pollution can cause cultural eutrophication.

Toxic Chemical Pollution

- Occurs when harmful chemicals are released into waterways
- Can be organic or inorganic
- Harms ecosystems and causes human health problems



Sediment and Thermal Pollution

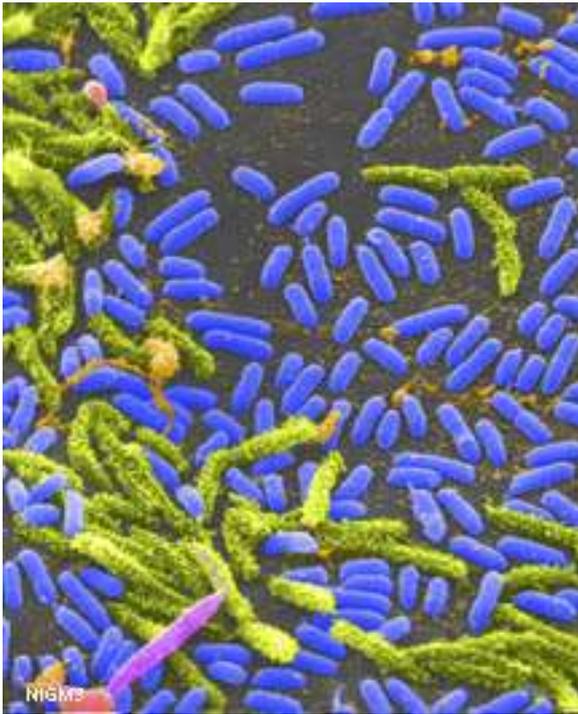
- **Sediment pollution:**

- Unusually large amounts of sediment that change an aquatic environment
- Sediment pollution results from erosion.
- Can degrade water quality, cause photosynthesis rates to decline, and disrupt food webs

- **Thermal pollution:**

- A heat source that raises the temperature of a waterway
- Heated water holds less oxygen.

Biological Pollution



Cholera bacteria

- Biological pollution occurs when pathogens enter a waterway.
- Biological pollution causes more human health problems than any other form of water pollution.
- Water treatment reduces biological pollution.

Did You Know? *Giardiasis is the most common form of waterborne disease in the U.S.*

Dilution and Decay of Degradable, Oxygen-Demanding Wastes in a Stream

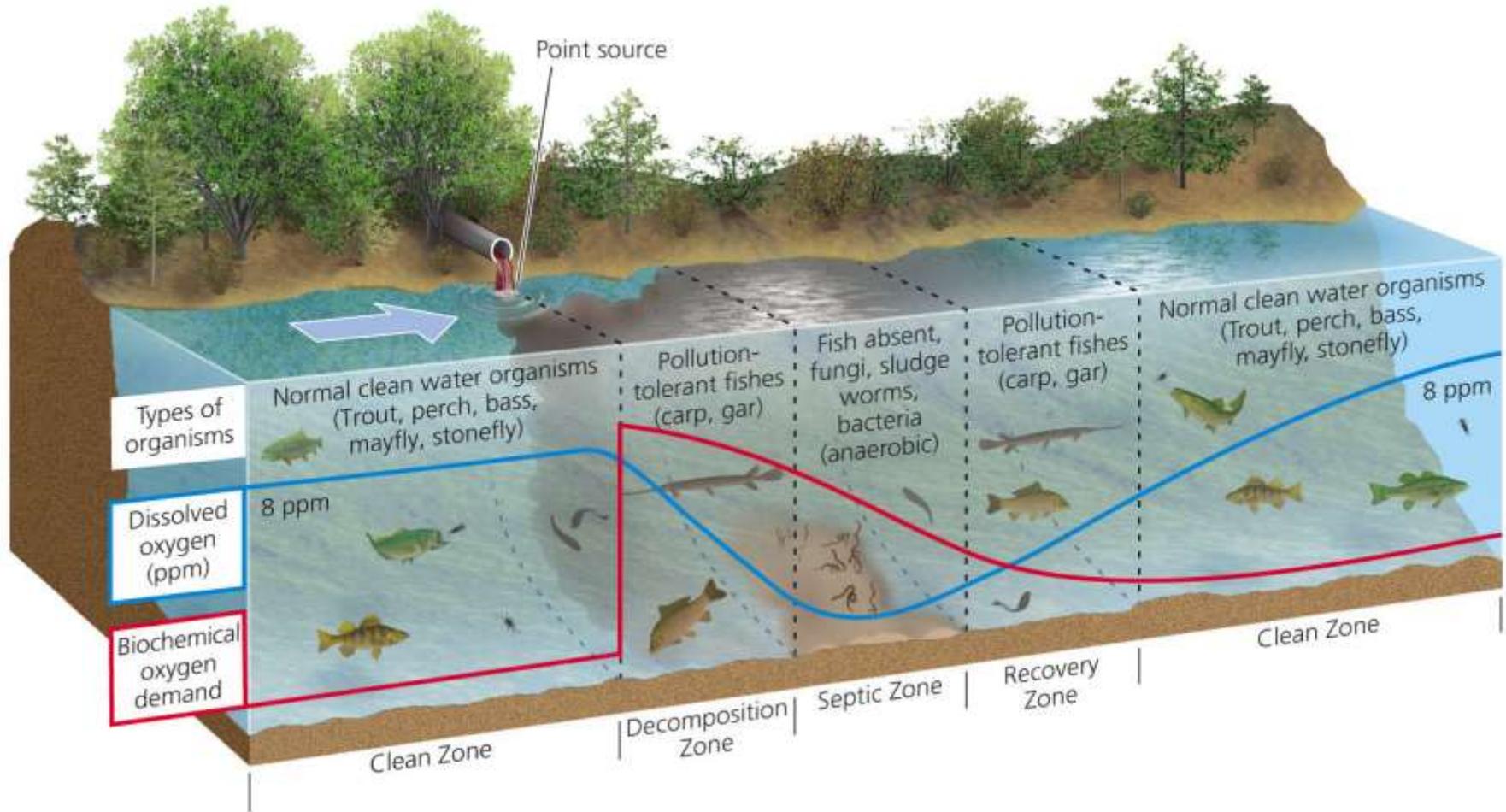


Fig. 20-7, p. 534

Groundwater Pollution

- Sources of groundwater pollution include natural sources, surface pollutants leaching through soil, and leaky underground structures.
- Chemicals break down more slowly in groundwater than in surface water.
- Most efforts to reduce groundwater pollution focus on prevention.

Did You Know? *The EPA repairs and replaces leaky underground gas storage tanks to reduce groundwater pollution. Over the last 25 years, over 1.7 million tanks have been repaired or replaced.*



Acid drainage from a coal mine

Ocean Water Pollution



A 2004 oil spill off the Alaskan coast

- Oil pollution in the ocean comes from many widely spread small sources. Natural seeps are the largest single source.
- Ocean organisms bioaccumulate mercury pollution.
- Nutrient pollution can cause red tides.

Did You Know? According to the U.S. Oil Pollution Act of 1990, by 2015, all oil tankers in U.S. waters must have double hulls to help prevent against leaks.



- *The Cuyahoga River on fire in 1952. When it happened again in 1969 it helped kick start the modern environmental movement including the establishment of the Clean Water Act and the founding of the EPA.*

Controlling Water Pollution



Lake Erie

- Government regulation decreases water pollution.
- The Clean Water Act
 - Set water pollution standards
 - Required permits to release point-source pollution
 - Funded sewage treatment plant construction

Did You Know? *The Great Lakes show that humans can change their ways and clean up trouble spots. In the 1970s, Lake Erie was declared “dead” but is now home to some flourishing species, especially the walleye.*

Ground Water Cannot Cleanse Itself Very Well (2)

- Slower chemical reactions in groundwater due to
 - Slow flow: contaminants not diluted
 - Less dissolved oxygen
 - Fewer decomposing bacteria
 - Low temperatures

Principal Sources of Groundwater Contamination in the U S

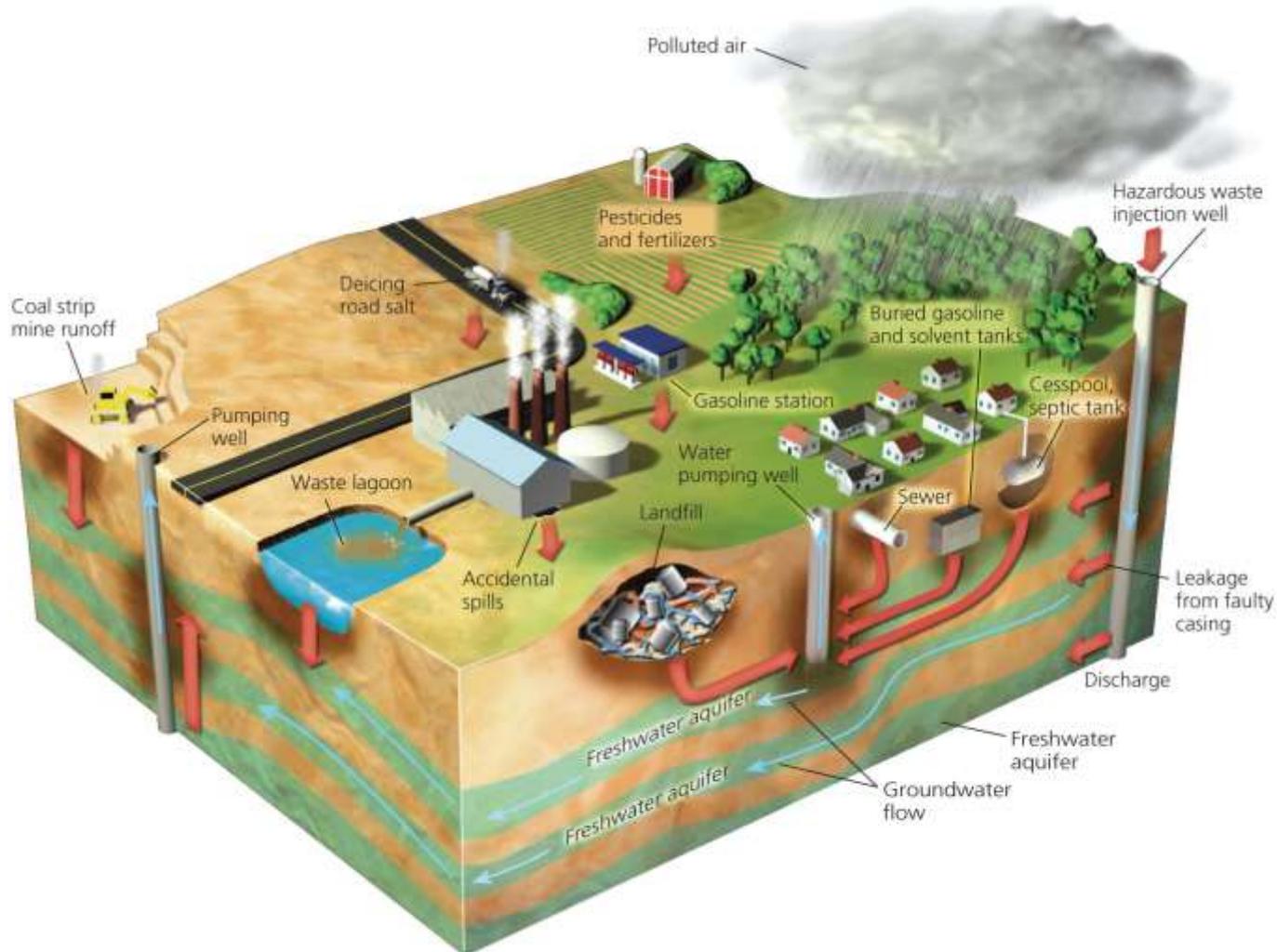


Fig. 20-13, p. 540

There Are Many Ways to Purify Drinking Water

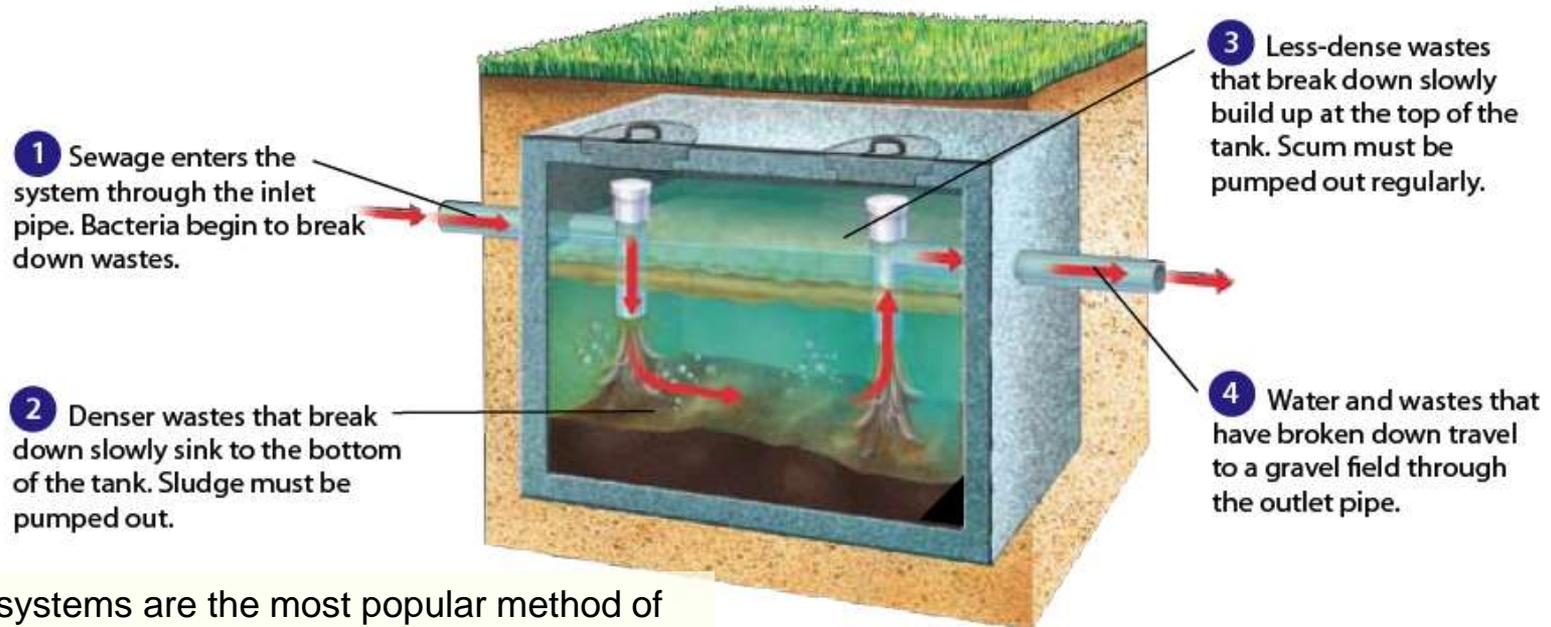
- Reservoirs and purification plants
- Process sewer water to drinking water
- Expose clear plastic containers to sunlight (UV)
- The LifeStraw
- PUR: chlorine and iron sulfate powder

The LifeStraw: Personal Water Purification Device



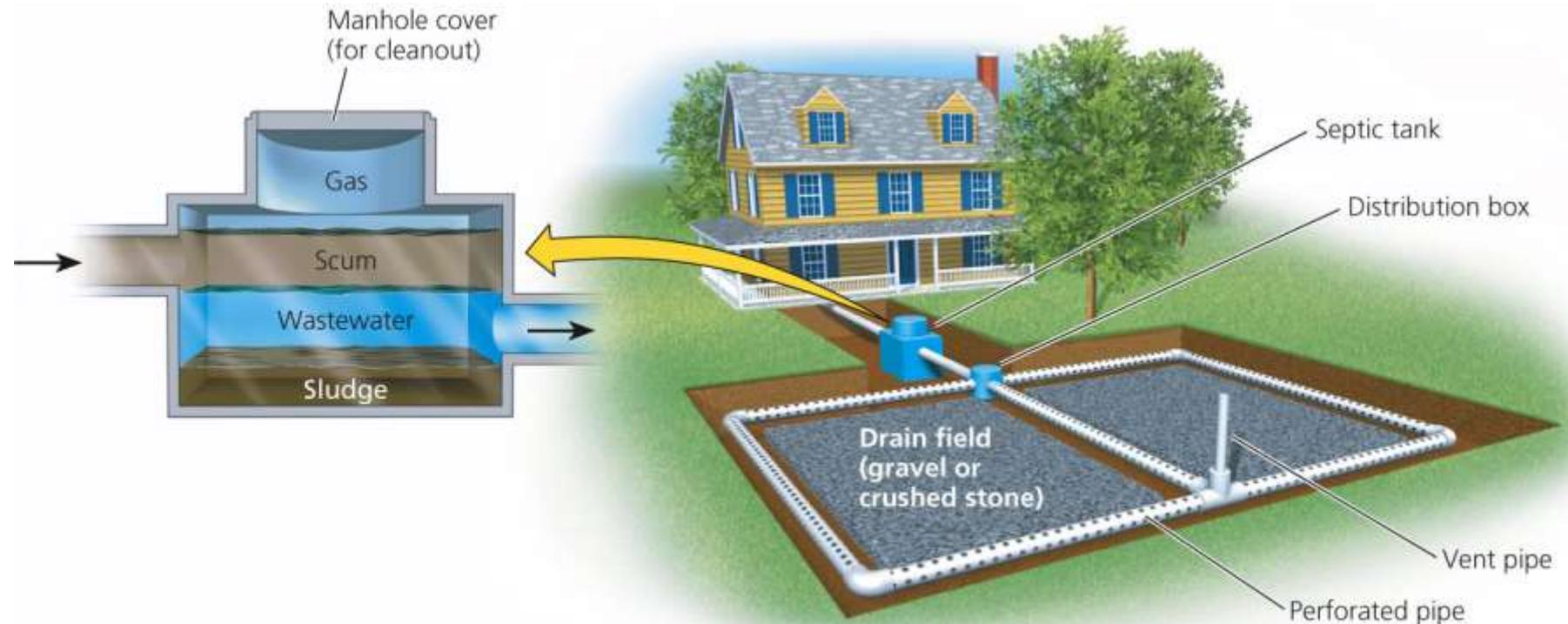
Water Treatment

- Drinking water is treated to remove pollutants before humans consume it.
- Wastewater is treated to remove pollutants before human-used water is released back to the environment.



Septic systems are the most popular method of wastewater disposal in rural areas of the U.S.

Solutions: Septic Tank System



Solutions: Primary and Secondary Sewage Treatment

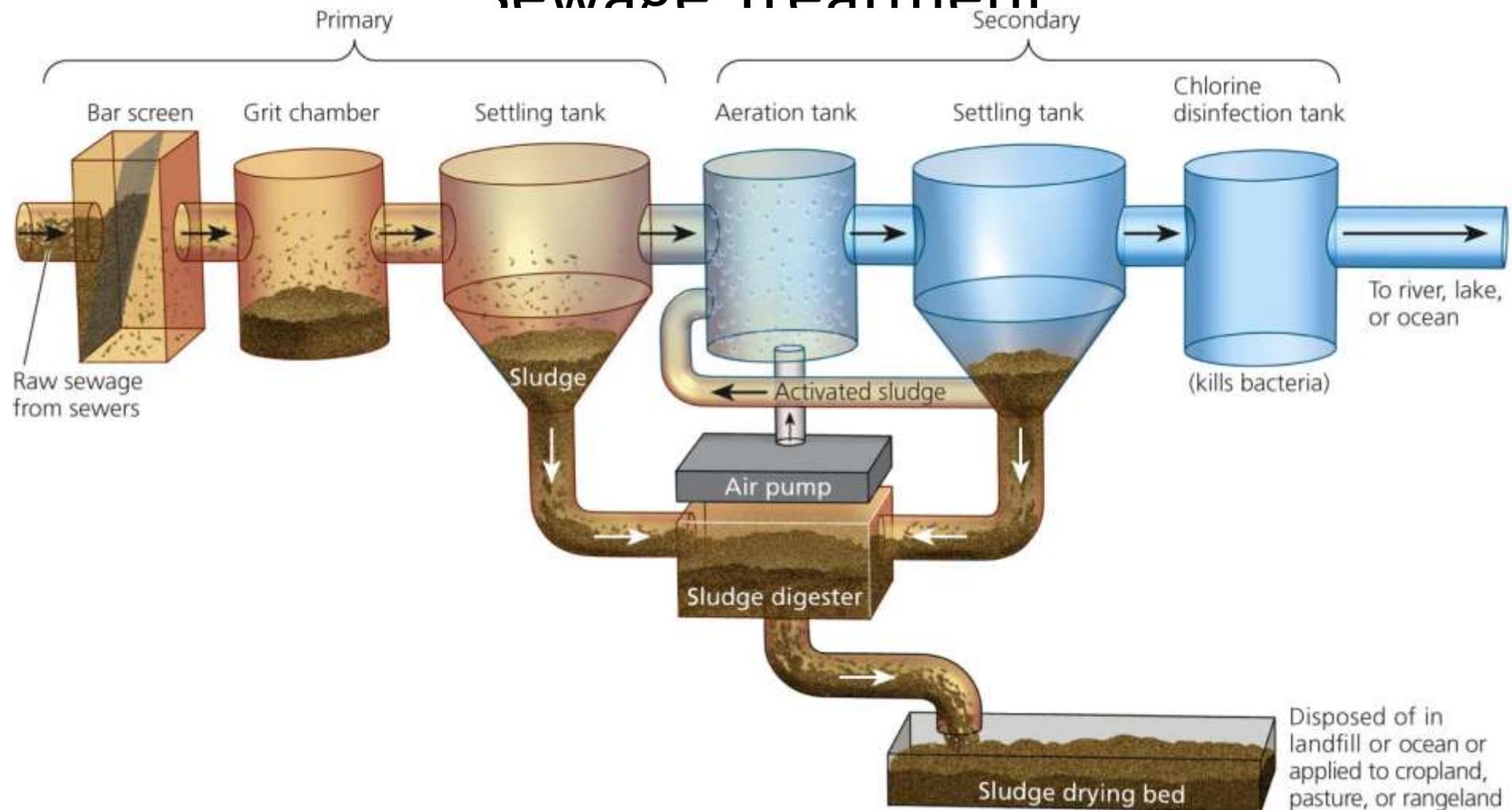


Fig. 20-20, p. 551

Solutions: Ecological Wastewater Purification by a Living Machine, RI, U.S.



Fig. 20-C, p. 553