Using Laws to Protect Drinking Water Quality

- 1974: U.S. Safe Drinking Water Act
  - Sets maximum contaminant levels for any pollutants that affect human health
- Health scientists: strengthen the law
- Water-polluting companies: weaken the law

Laws Can Help Reduce Water Pollution from Point Sources

- 1972: Clean Water Act
  1987: Water Quality Act

- EPA: experimenting with a discharge trading policy that uses market forces
  - Cap and trade system
  - Could this allow pollutants to build up?

Questions 4-6 refer to the following.

(A) Safe Drinking Water Act
(B) Clean Water Act
(C) Comprehensive Environmental Response Compensation and Liability Act (CERCLA)
(D) Resource Conservation and Recovery Act
(E) Toxic Substances Control Act

4. Requires minimum safety standards for community water supplies

Questions 4-6 refer to the following.

(A) Safe Drinking Water Act
(B) Clean Water Act
(C) Comprehensive Environmental Response Compensation and Liability Act (CERCLA)
(D) Resource Conservation and Recovery Act
(E) Toxic Substances Control Act

5. Mandates the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters

Questions 4-6 refer to the following.

(A) Safe Drinking Water Act
(B) Clean Water Act
(C) Comprehensive Environmental Response Compensation and Liability Act (CERCLA)
(D) Resource Conservation and Recovery Act
(E) Toxic Substances Control Act

6. Establishes cradle-to-grave tracking of hazardous waste

Water Pollution Comes from Point and Nonpoint Sources (1)

- **Water pollution**
  - Change in water quality that can harm organisms or make water unfit for human uses
  - Contamination with chemicals
  - Excessive heat

- **Point sources**
  - Located at specific places
  - Easy to identify, monitor, and regulate
  - Examples

Water Pollution Comes from Point and Nonpoint Sources (2)

- **Nonpoint sources**
  - Broad, diffuse areas
  - Difficult to identify and control
  - Expensive to clean up
  - Examples

Case Study: The U.S. Experience with Reducing Point-Source Pollution (1)

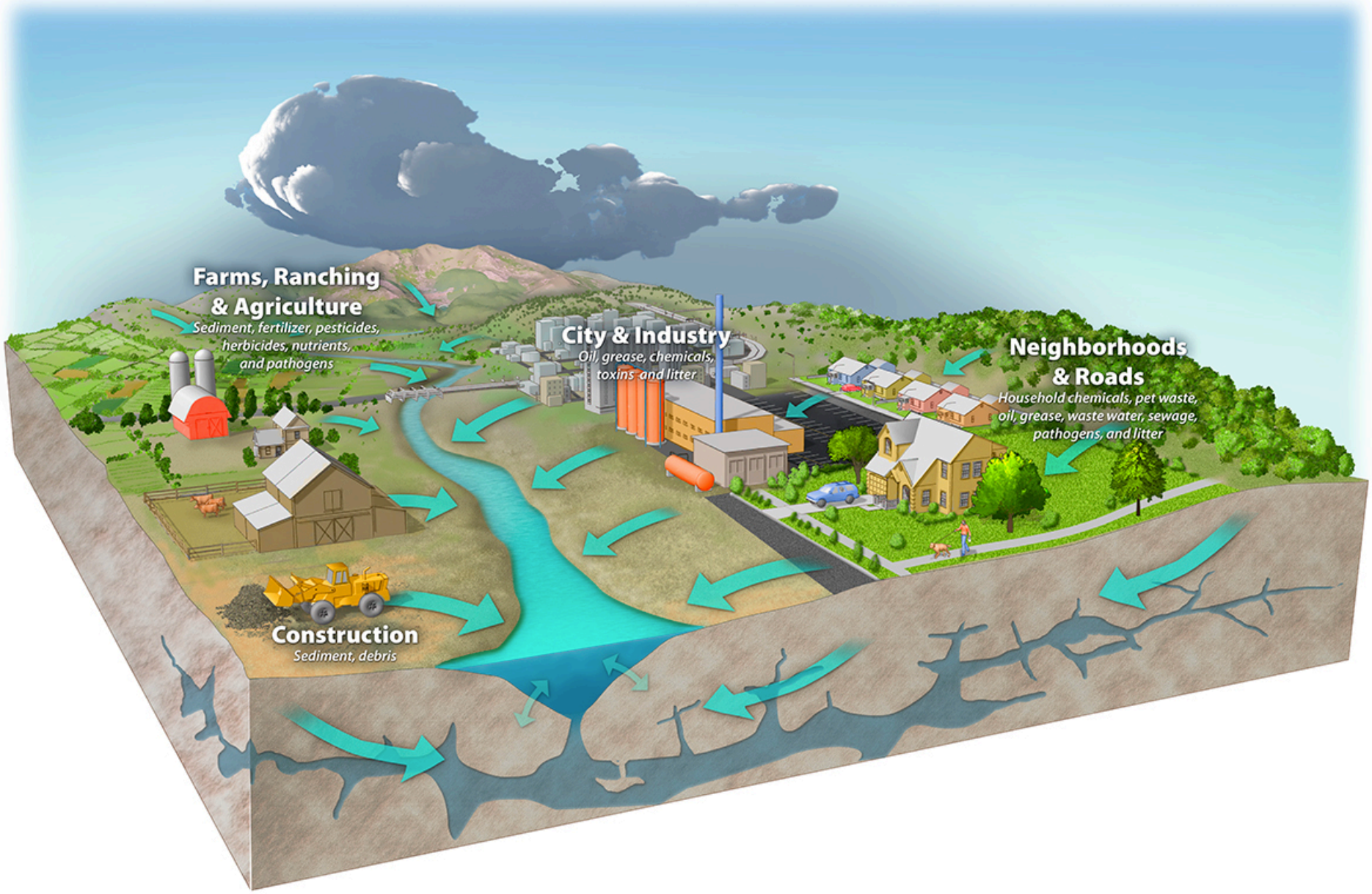
- Numerous improvements in water quality
- Some lakes and streams are not safe for swimming or fishing
- Treated wastewater still produces algal blooms
- High levels of Hg, pesticides, and other toxic materials in fish

Case Study: The U.S. Experience with Reducing Point-Source Pollution (2)

- Leakage of gasoline storage tanks into groundwater
- Many violations of federal laws and regulations
- Need to strengthen the Clean Water Act

Water Pollution Comes from Point and Nonpoint Sources (3)

- Leading causes of water pollution
  1. Agriculture activities
     - Sediment eroded from the lands
     - Fertilizers and pesticides
     - Bacteria from livestock and food processing wastes
  2. Industrial facilities
  3. Mining


Farms, Ranching & Agriculture
Sediment, fertilizer, pesticides, herbicides, nutrients, and pathogens
City & Industry
Oil, grease, chemicals, toxins and litter
Neighborhoods & Roads
Household chemicals, pet waste, oil, grease, waste water, sewage, pathogens, and litter
Construction
Sediment, debris

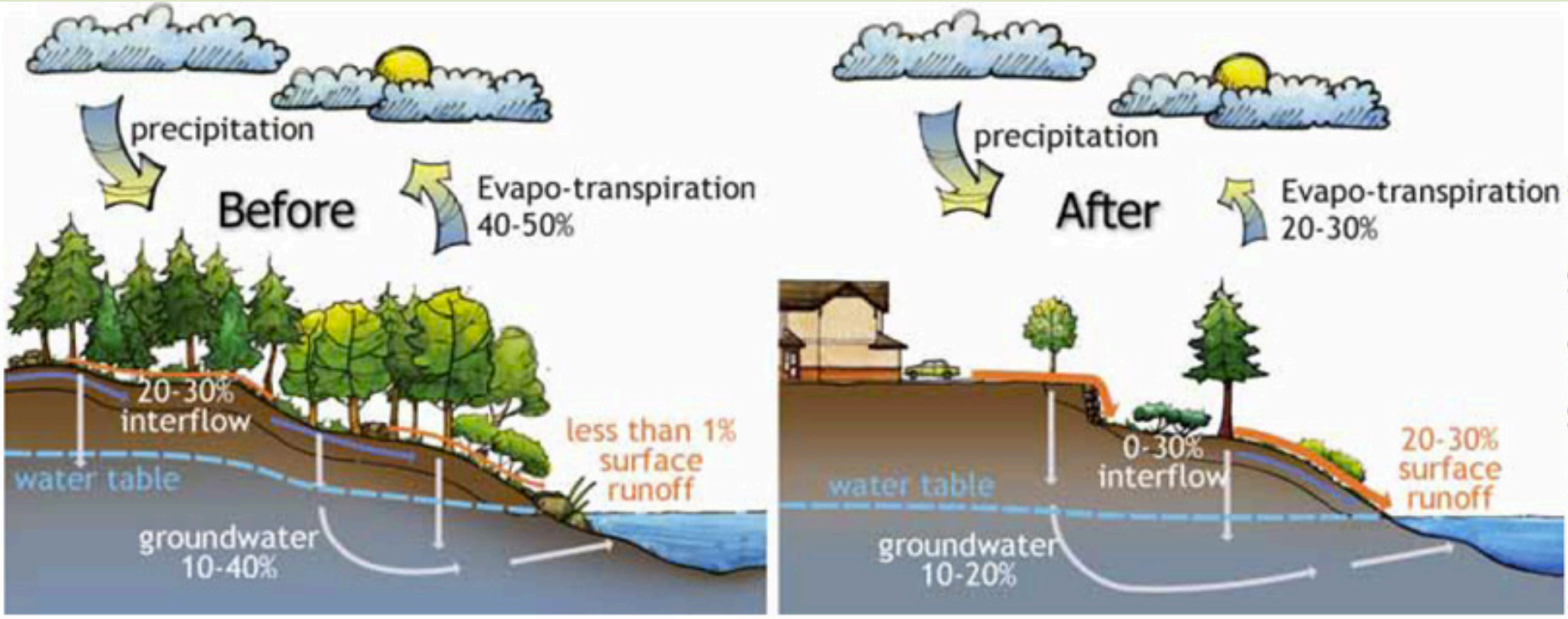
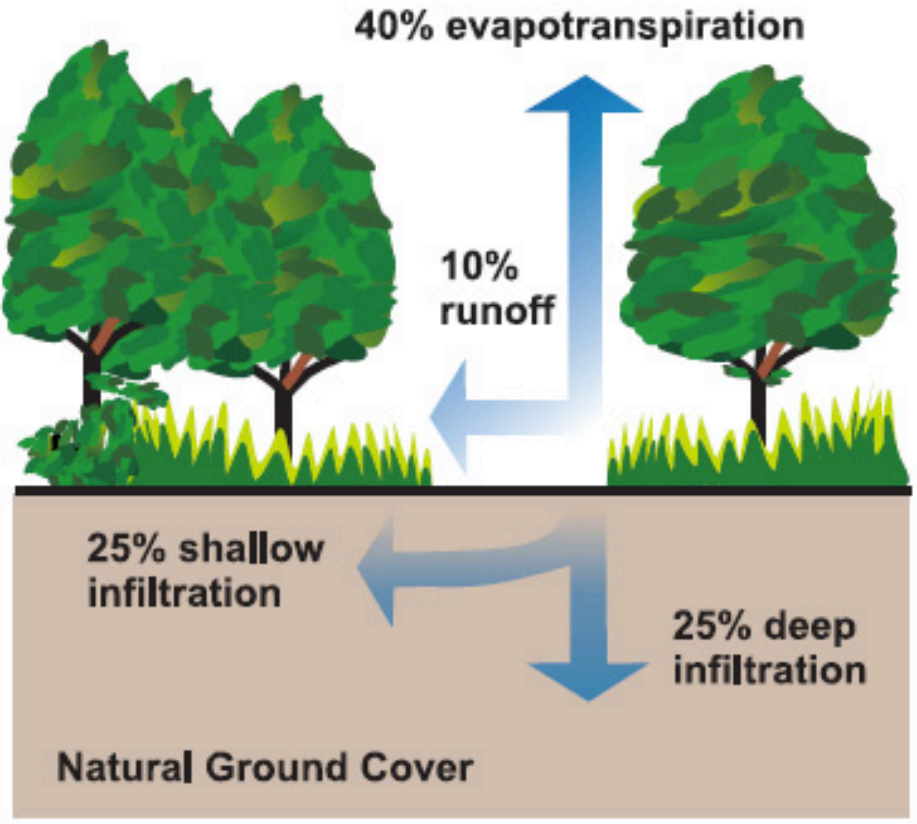
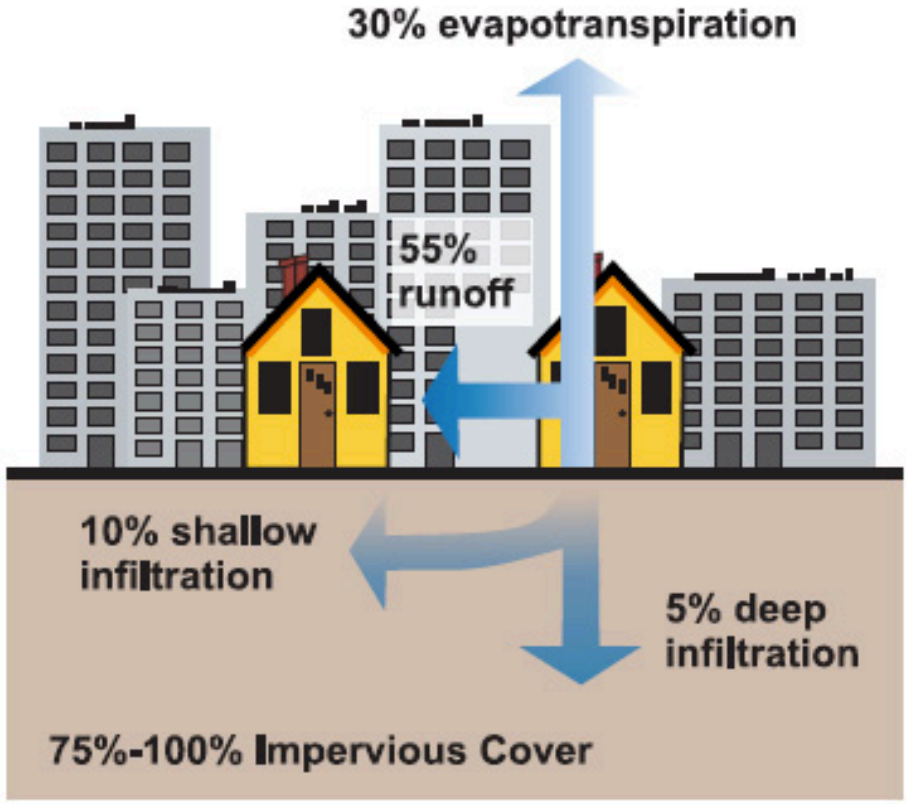
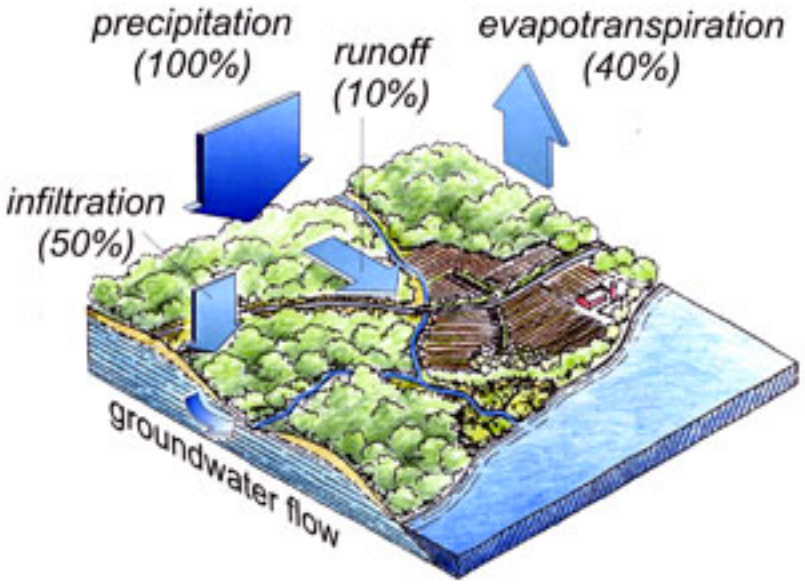


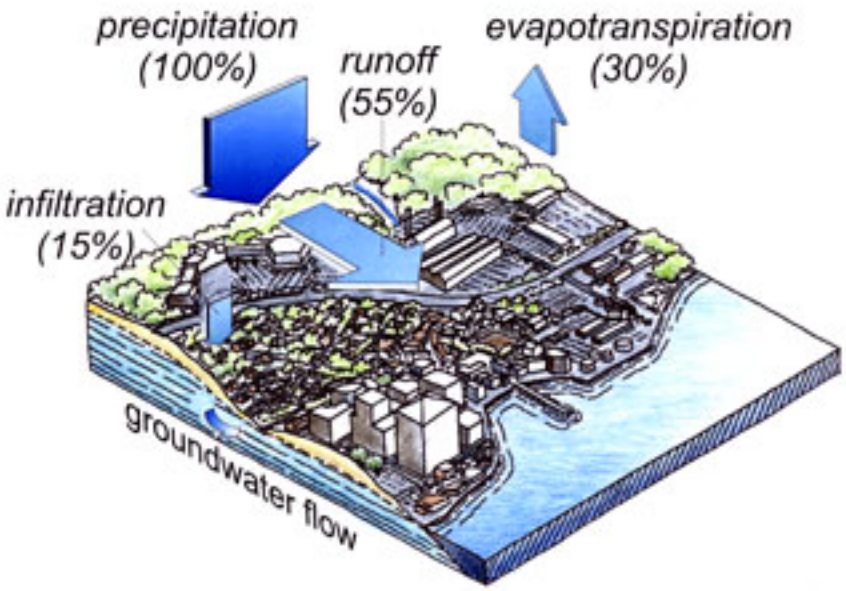
Image courtesy of Puget Sound Partnership

Before *development almost all rainfall is taken up by plants, evaporates or infiltrates through the ground.*
After *conventional development, surface runoff increases significantly while evaporation and infiltration into the ground decrease.*


40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover


30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Cover


precipitation
(100%)
runoff
(10%)
evapotranspiration
(40%)
infiltration
(50%)
groundwater flow


precipitation
(100%)
runoff
(55%)
evapotranspiration
(30%)
infiltration
(15%)
groundwater flow

Potential Pathways on Which Toxic Chemicals Move Through the Environment

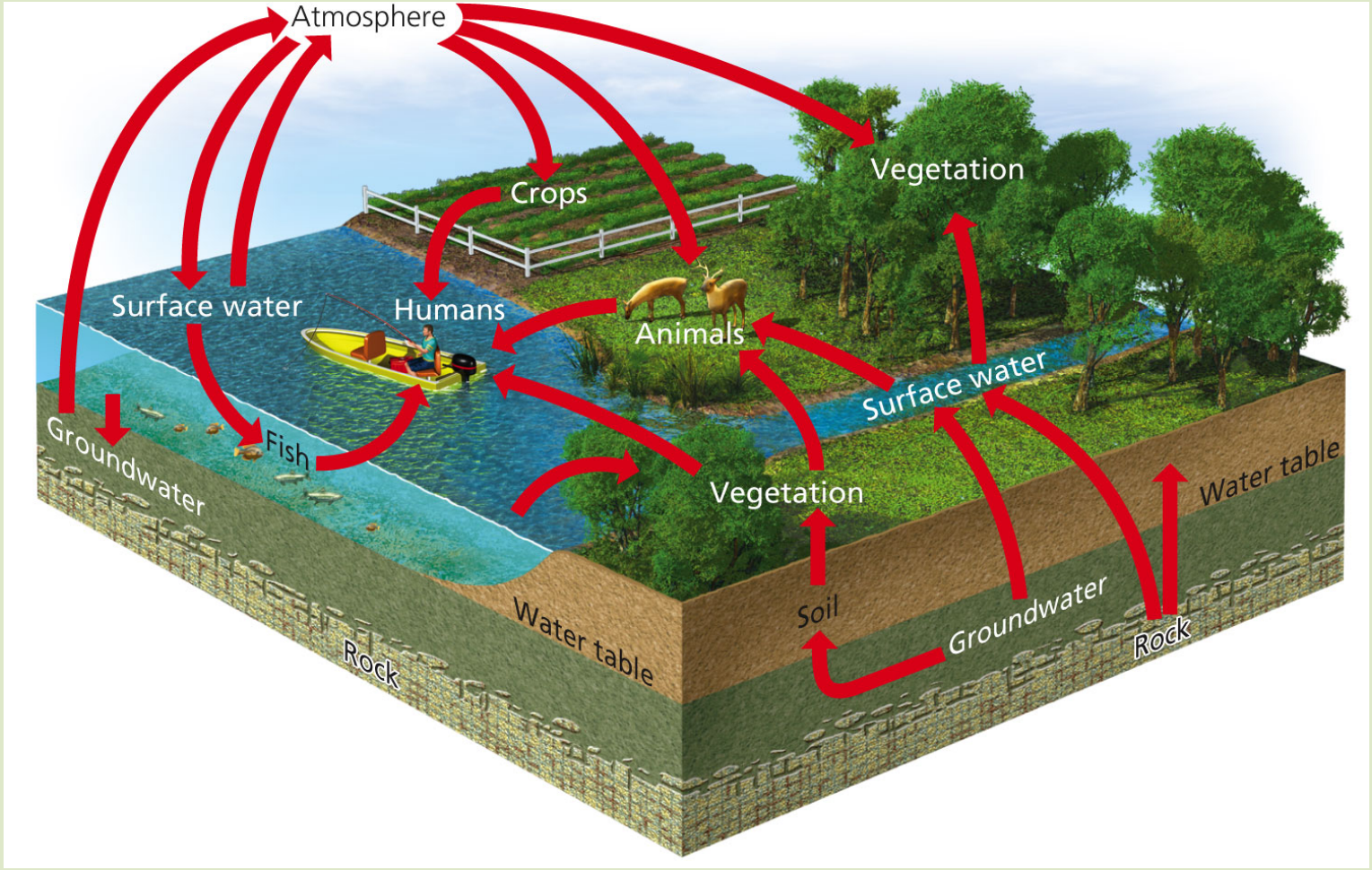


Fig. 17-9, p. 447

Principal Sources of Groundwater Contamination in the U.S.

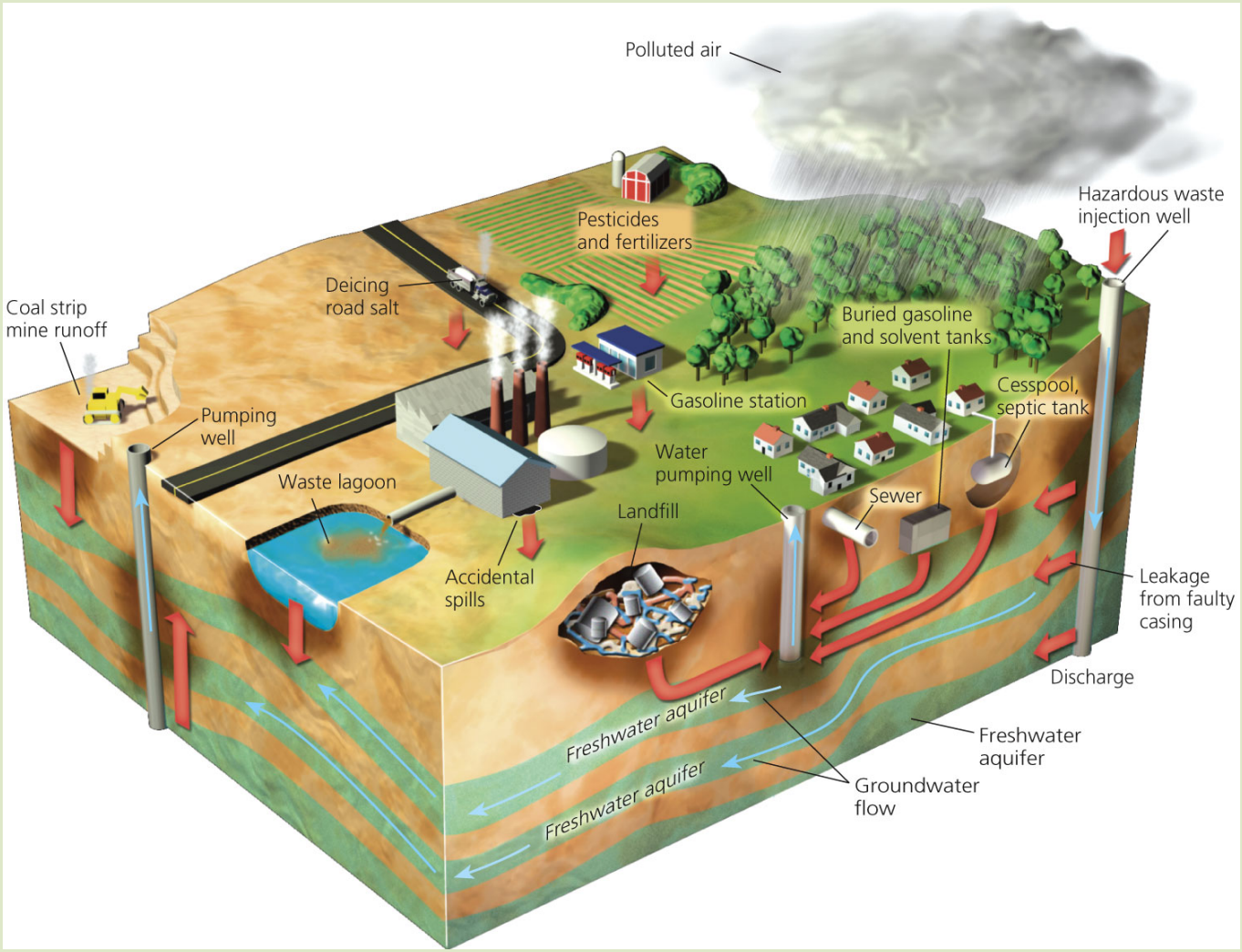


Fig. 20-13, p. 540

Point Source of Polluted Water in Gargas, France

Fig. 20-3, p. 530

Lake Polluted with Mining Wastes

Fig. 20-5, p. 531

Plastic Wastes in Mountain Lake

Fig. 20-6, p. 531

Major Water Pollutants Have Harmful Effects

- Infectious disease organisms: contaminated drinking water

- The World Health Organization (WHO)
  - 1.6 million people die every year, mostly under the age of 5

Major Water Pollutants and Their Sources

Table 20-1 Major Water Pollutants and Their Sources

Type/*Effects*	Examples	Major Sources
Infectious agents (pathogens) *Cause diseases*	Bacteria, viruses, protozoa, parasites	Human and animal wastes
Oxygen-demanding wastes *Deplete dissolved oxygen needed by aquatic species*	Biodegradable animal wastes and plant debris	Sewage, animal feedlots, food-processing facilities, paper mills
Plant nutrients *Cause excessive growth of algae and other species*	Nitrates (NO_3^-) and phosphates (PO_4^{3-})	Sewage, animal wastes, inorganic fertilizers
Organic chemicals *Add toxins to aquatic systems*	Oil, gasoline, plastics, pesticides, fertilizers, cleaning solvents	Industry, farms, households, mining sites, runoff from streets and parking lots
Inorganic chemicals *Add toxins to aquatic systems*	Acids, bases, salts, metal compounds	Industry, households, mining sites, runoff from streets and parking lots
Sediments *Disrupt photosynthesis, food webs, other processes*	Soil, silt	Land erosion from farms and construction and mining sites
Heavy metals *Cause cancer, disrupt immune and endocrine systems*	Lead, mercury, arsenic	Unlined landfills, household chemicals, mining refuse, industrial discharges
Thermal *Make some species vulnerable to disease*	Heat	Electric power and industrial plants

Table 20-1, p. 532

Common Diseases Transmitted to Humans through Contaminated Drinking Water

Table 20-2 Common Diseases Transmitted to Humans through Contaminated Drinking Water

Type of Organism	Disease	Effects
Bacteria	Typhoid fever	Diarrhea, severe vomiting, enlarged spleen, inflamed intestine; often fatal if untreated
	Cholera	Diarrhea, severe vomiting, dehydration; often fatal if untreated
	Bacterial dysentery	Diarrhea, bleeding; rarely fatal except in infants without proper treatment
	Enteritis	Severe stomach pain, nausea, vomiting; rarely fatal
Viruses	Infectious hepatitis (Type B)	Fever, severe headache, loss of appetite, abdominal pain, jaundice, enlarged liver; rarely fatal but may cause permanent liver damage
	Poliomyelitis	Fever, diarrhea, backache, sore throat, aches in limbs; can infect spinal chord and cause paralysis and muscle weakness
Parasitic protozoa	Amoebic dysentery	Severe diarrhea, headache, abdominal pain, chills, fever; if not treated can cause liver abscess, bowel perforation, and death
	Giardiasis	Diarrhea, abdominal cramps, flatulence, belching, fatigue
	Cryptosporidium	Severe diarrhea, cramps for up to 3 weeks, and possible death for people with weakened immune systems
Parasitic worms	Schistosomiasis	Abdominal pain, skin rash, anemia, chronic fatigue, and chronic general ill health
	Ancylostomiasis	Severe anemia and possible symptoms of bronchial infection

Persistent Organic Pollutants (POPS)

- **"Dirty Dozen"**
  - **12 chemicals: includes DDT and 8 other chlorine containing persistent pesticides, + PCB's, dioxins, furans...**
  - Stockholm Convention regulated POP's 2009
  - Can accumulate in fatty tissues of humans and other organisms that occupy high trophic levels in food webs...can be transported long distances b/c they don't break down
  - They can reach levels thousands of times higher than the general environment through bioaccumulation and biomagnification

Some Chemicals May Affect Our Immune and Nervous Systems

- Some natural and synthetic chemicals in the environment can weaken and harm
  - Immune system
  - Nervous system
    - Neurotoxins: PCBs, arsenic, lead, some pesticides
  - Endocrine system

Case Study: PCBs Are Everywhere—A Legacy from the Past

- Class of chlorine-containing compounds
  - Very stable
  - Nonflammable
  - Break down slowly in the environment
  - Travel long distances in the air
  - Fat soluble
  - Biomagnification
  - Food chains and webs

- Banned, but found everywhere

87. Waste from which of the following is an example of nonpoint source pollution?

(A) Overflow from a sewage treatment plant
(B) Outgassing from a municipal landfill
(C) Dumping at a food-processing plant
(D) Drainage from an abandoned mine
(E) Runoff from agricultural fields

Of the following, which is the best example of a point source of water pollution?

(A) Factory effluent
(B) Storm water
(C) Acid precipitation
(D) Agricultural runoff
(E) Residential pesticide runoff

Questions 21-24 refer to the following qualities of water samples.

(A) Acidity
(B) Turbidity
(C) Hardness
(D) Dissolved oxygen
(E) Salinity

21. Measured on the pH scale

22. Caused by suspended particulates

23. Decreased by the breakdown of organic waste

24. Measured by the amount of Ca^{2+} and Mg^{2+}

As urbanization increases and natural soil surfaces are covered, the groundwater supply is reduced due to

(A) increased evaporation and transpiration
(B) decreased surface runoff
(C) loss of recharge area
(D) confinement of aquifers
(E) capping of artesian wells

91. If an area was originally forested and then underwent urban development, which of the following shows the most likely effects on various parts of the water cycle in the area?

(Note: ↑ represents an increase; ↓ represents a decrease)

	Evaporation and Transpiration	Runoff	Groundwater Recharge
(A)	↓	↑	↓
(B)	↓	↑	↑
(C)	↓	↓	↓
(D)	↑	↑	↓
(E)	↑	↓	↓

Which of the following is most likely to occur in a forested region that has been recently clear-cut?

(A) The concentration of nitrates in streams running through the region will increase.
(B) The average depth of topsoil will increase.
(C) The water temperature in streams running through the region will decrease.
(D) Volume of runoff after rains will decrease.
(E) The frequency of landslides will decrease.

Science Focus: Testing Water for Pollutants (1)

- Variety of tests to determine water quality
- Coliform bacteria: *Escherichia coli*, significant levels
- Level of dissolved oxygen (DO)
- Chemical analysis

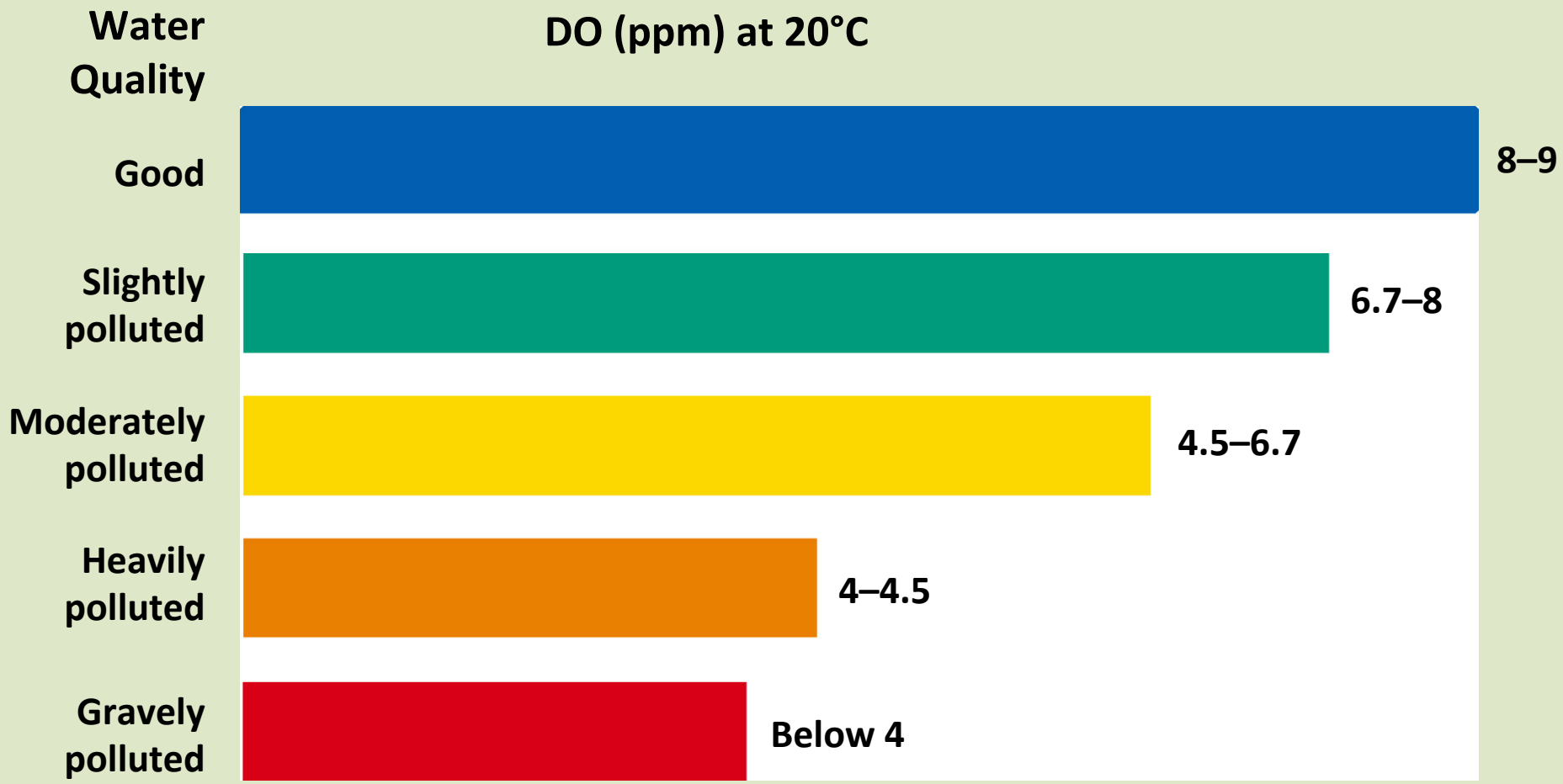

Water Quality
DO (ppm) at 20°C
Good
8–9
Slightly polluted
6.7–8
Moderately polluted
4.5–6.7
Heavily polluted
4–4.5
Gravely polluted
Below 4

Fig. 20-A, p. 533

Streams Can Cleanse Themselves If We Do Not Overload Them

- Dilution
- Biodegradation of wastes by bacteria takes time
- Oxygen sag curve

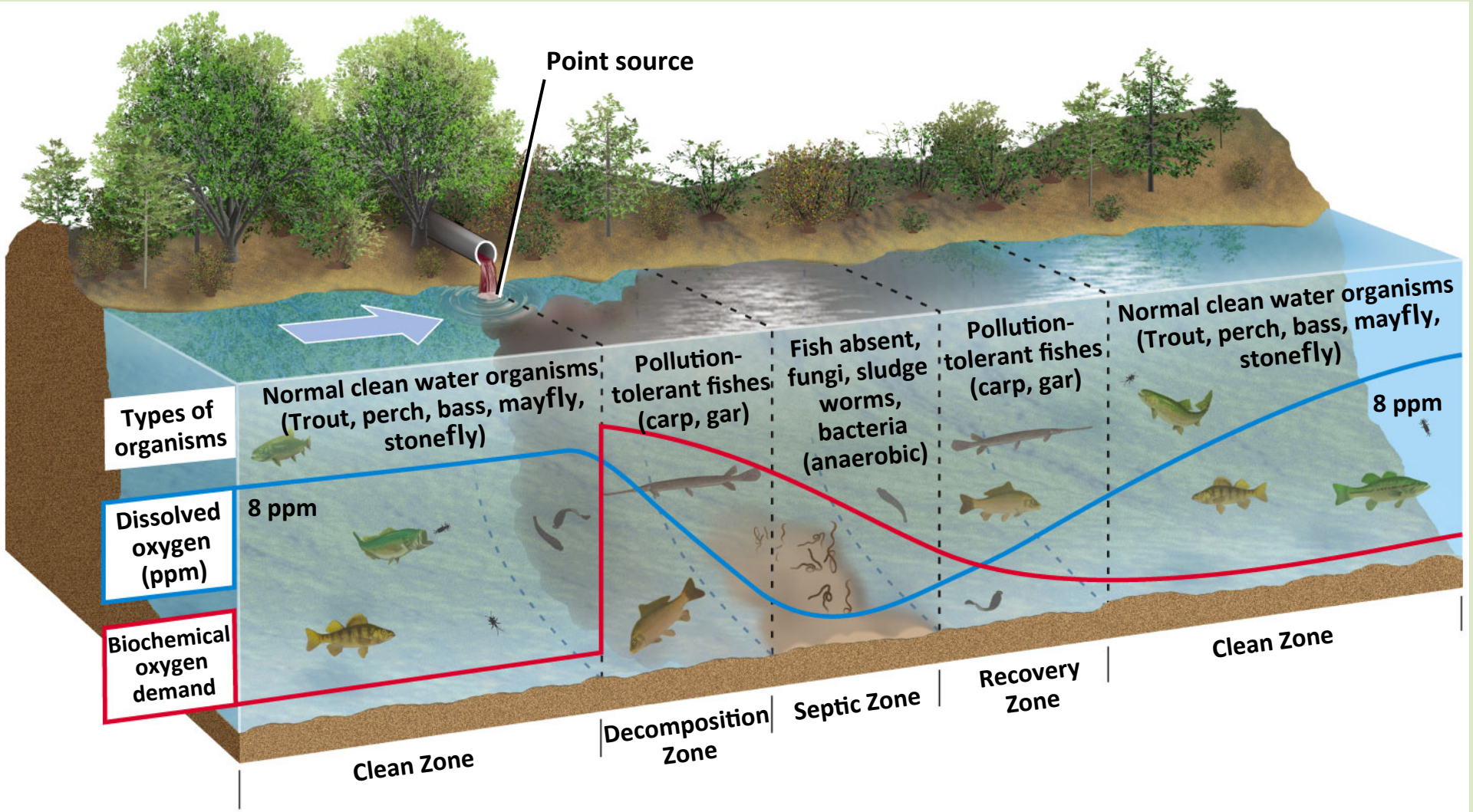
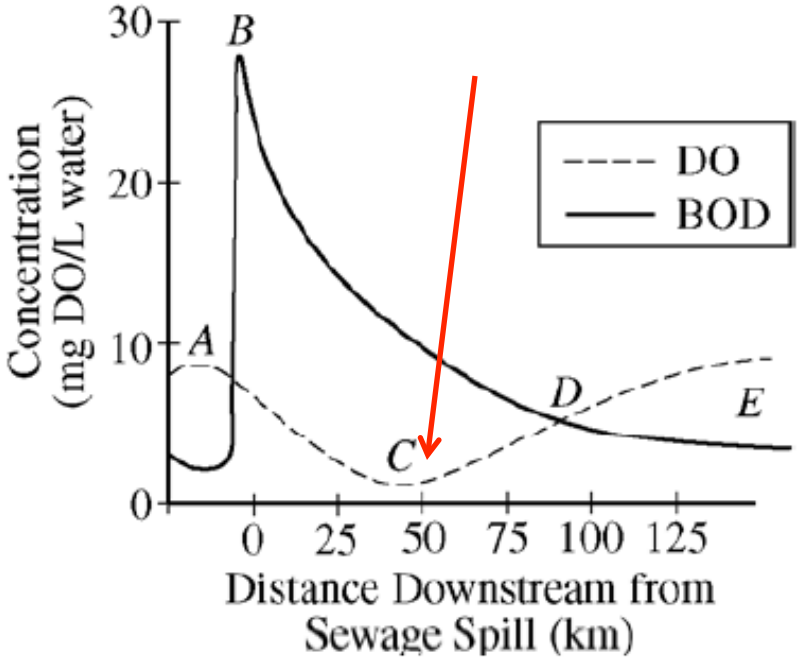

Point source
Types of organisms
Dissolved oxygen (ppm)
Biochemical oxygen demand
Normal clean water organisms (Trout, perch, bass, mayfly, stonefly)
8 ppm
Pollution-tolerant fishes (carp, gar)
Fish absent, fungi, sludge worms, bacteria (anaerobic)
Pollution-tolerant fishes (carp, gar)
Normal clean water organisms (Trout, perch, bass, mayfly, stonefly)
8 ppm
Clean Zone
Decomposition Zone
Septic Zone
Recovery Zone
Clean Zone

Fig. 20-7, p. 534



19. The graph above shows the effect of sewage on biological oxygen demand (BOD) and dissolved oxygen (DO) in a flowing stream. The smallest fish populations will most probably be found at point

(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

Questions 27-29

A laboratory experiment was done to show the effects of organic waste on the dissolved oxygen (DO) content in water. Five tanks were set up, each containing fresh water and a small amount of single-celled green algae. Specified amounts of organic waste were added to the tanks. The results below show the amount of DO in each tank after a period of one week.

	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5
Initial DO	10 ppm	10 ppm	10 ppm	10 ppm	10 ppm
Amount of organic waste added	0 g	10 g	20 g	30 g	40 g
DO after one week	10 ppm	10 ppm	8 ppm	5 ppm	0 ppm

27. What is the main purpose for the experiment?

(A) To determine how much O_2 the algae can produce

(B) To show how much CO_2 is consumed by decomposition

(C) To collect data to determine how waste in water can be useful

(D) To demonstrate that initial DO is not important

(E) To observe the effect of organic waste on DO

Questions 27-29

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Initial DO	10 ppm	10 ppm	10 ppm	10 ppm	10 ppm
Amount of organic waste added	0 g	10 g	20 g	30 g	40 g
DO after one week	10 ppm	10 ppm	8 ppm	5 ppm	0 ppm

28. Why did the DO after one week decrease as the amount of waste increased?

(A) The algae could not consume the waste fast enough.

(B) The turbidity of the water increased, and the algae population increased.

(C) The algae multiplied and then died and decomposed.

(D) The CO_2 increased due to algal respiration.

(E) The oxygen came out of solution into the air in the laboratory.

Questions 27-29

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Initial DO	10 ppm	10 ppm	10 ppm	10 ppm	10 ppm
Amount of organic waste added	0 g	10 g	20 g	30 g	40 g
DO after one week	10 ppm	10 ppm	8 ppm	5 ppm	0 ppm

29. Which of the following would best improve the validity of the experiment?

(A) Eliminating tank 1, because the DO stayed the same

(B) Observing the results of adding organic waste to tanks containing salt water

(C) Repeating the experiment several times and comparing the results

(D) Increasing the amounts of green algae in each of the tanks, with tank 5 having the greatest amount

(E) Adding different types of waste to each tank and then checking the results

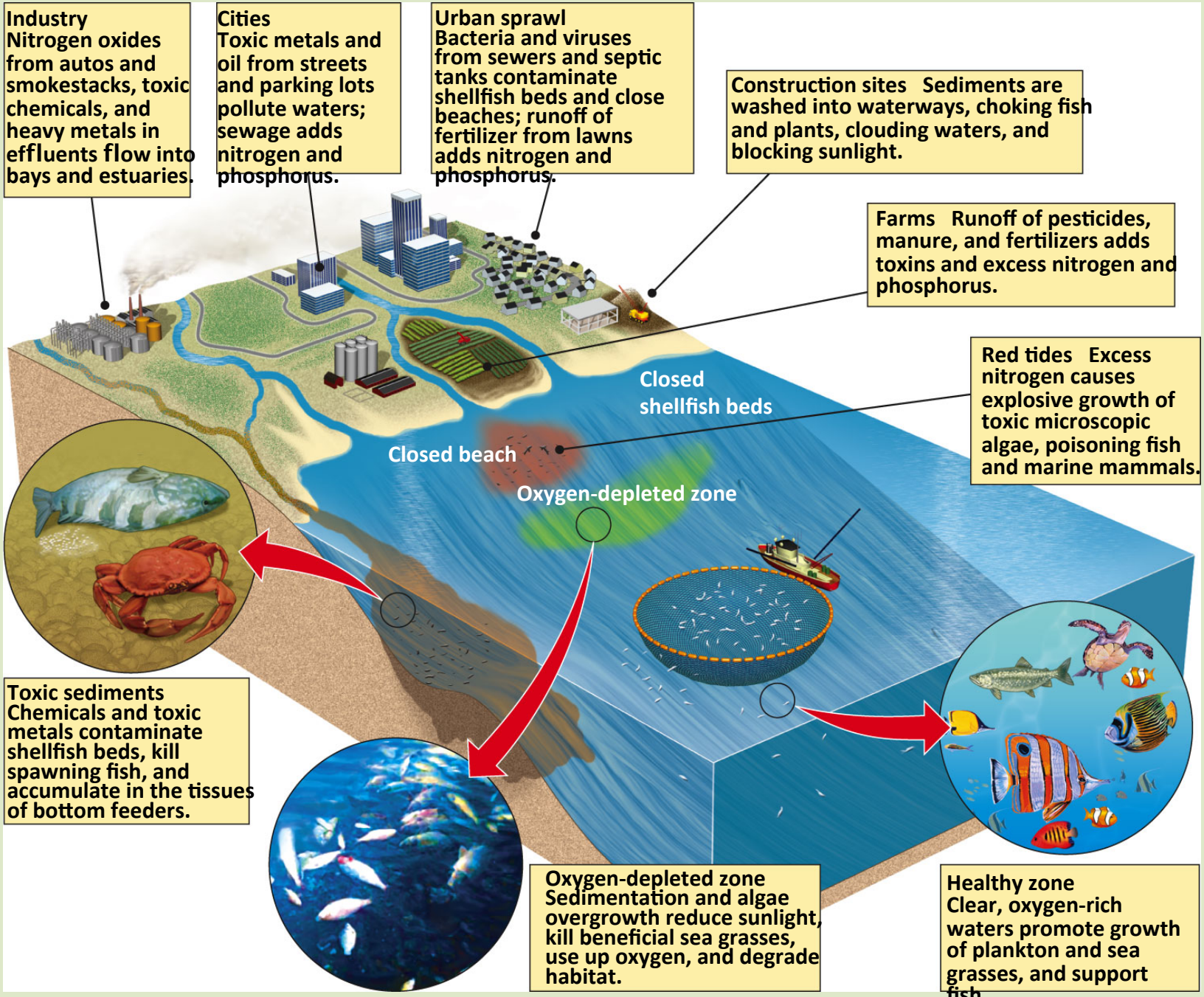


Fig. 20-16, p. 545

Science Focus: Oxygen Depletion in the Northern Gulf Of Mexico

- Severe cultural eutrophication
- Oxygen-depleted zone
- Overfertilized coastal area
- Preventive measures
- Will it reach a tipping point?

A Large Zone of Oxygen-Depleted Water in the Gulf of Mexico Due to Algal Blooms

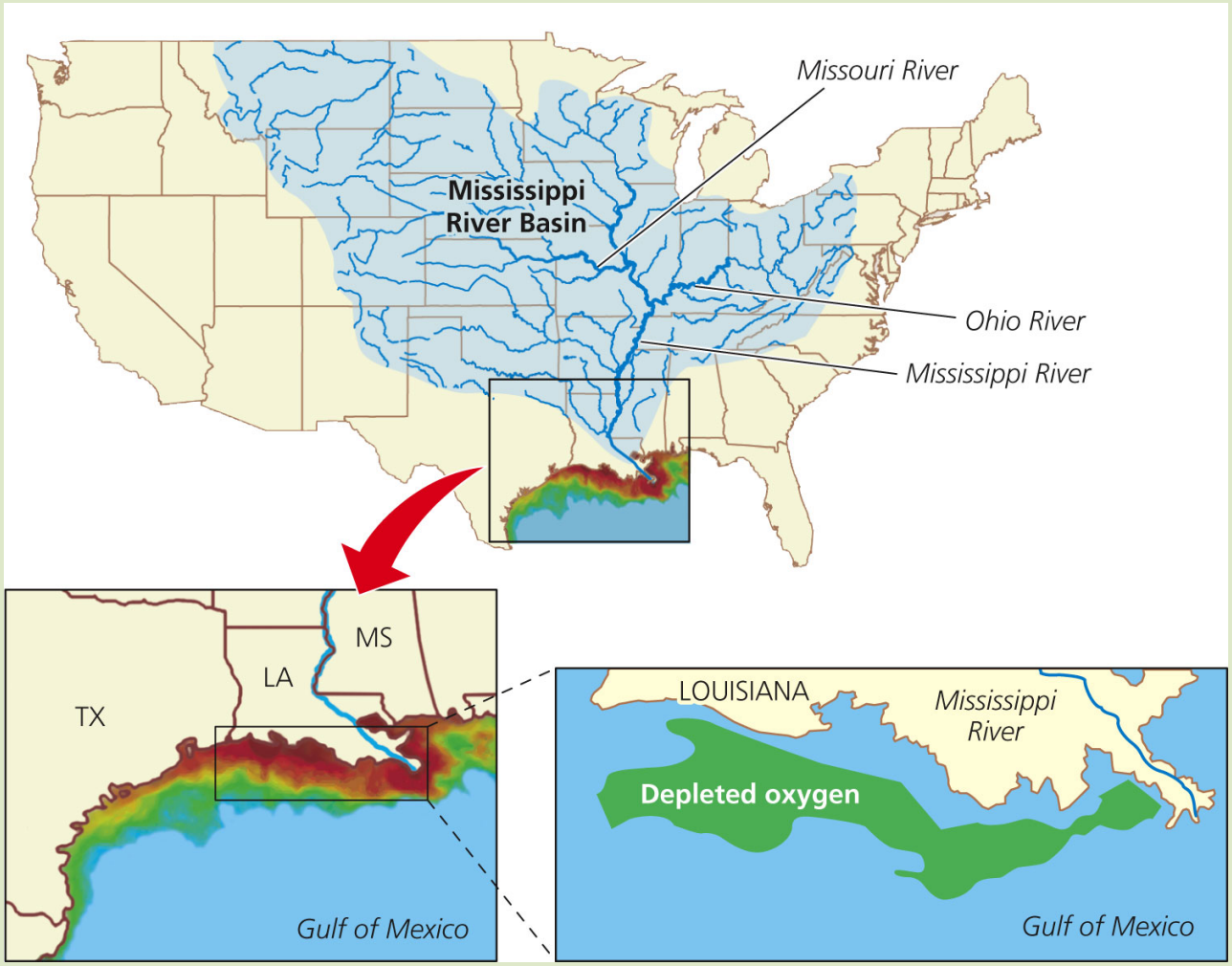


Fig. 20-B, p. 546

Sewage Treatment Reduces Water Pollution (1)

- **Septic tank system**

- Wastewater or sewage treatment plants
  - **Primary sewage treatment**
    - Physical process
  - **Secondary sewage treatment**
    - Biological process with bacteria
  - Tertiary or advance sewage treatment
    - Special filtering processes
    - Bleaching, chlorination

Sewage Treatment Reduces Water Pollution (2)

- Many cities violate federal standards for sewage treatment plants
- Should there be separate pipes for sewage and storm runoff?
- Health risks of swimming in water with blended sewage wastes

Solutions: Primary and Secondary Sewage Treatment

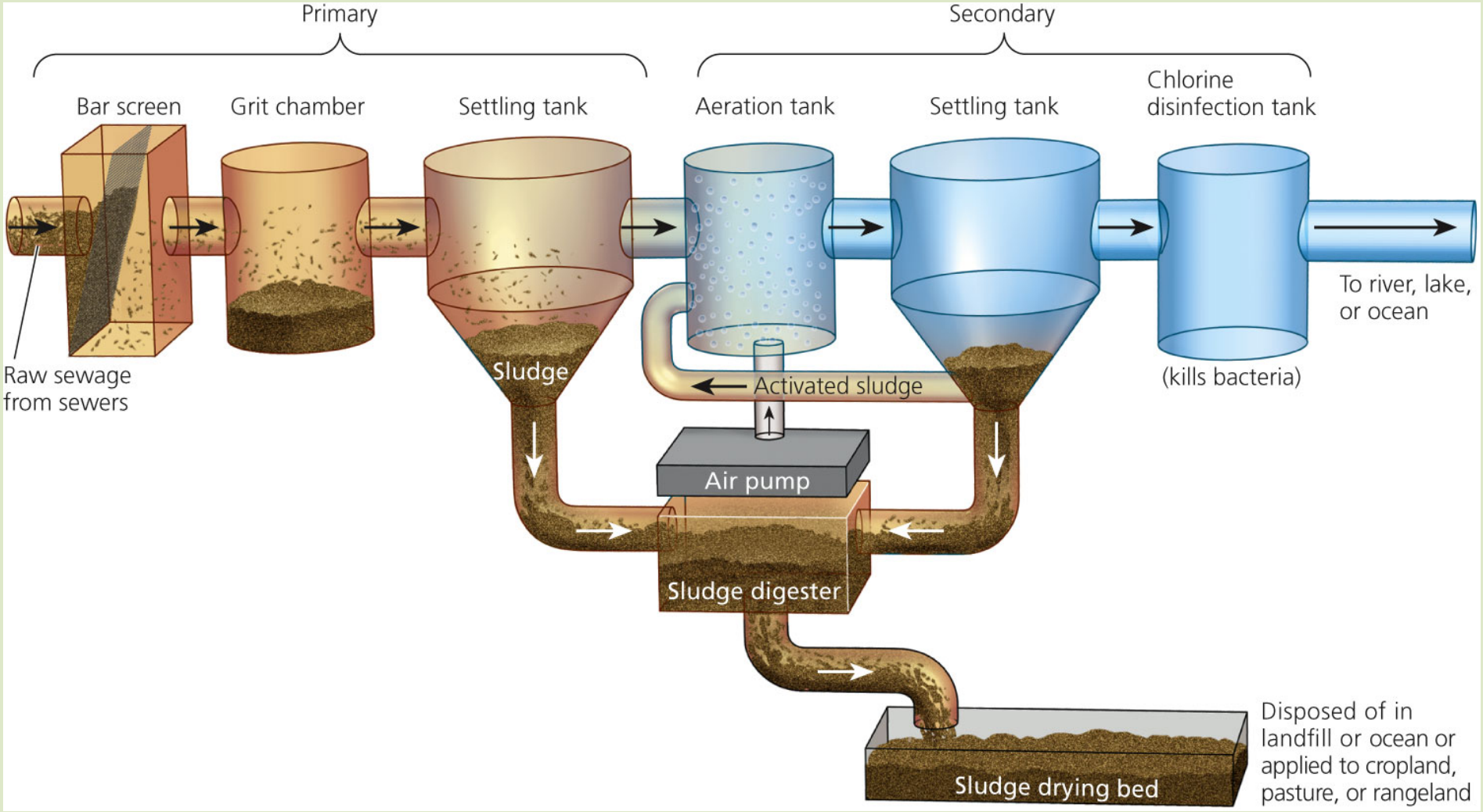


Fig. 20-20, p. 551

Which of the following components of a wastewater treatment plant is designed to facilitate the decomposition of organic material by aerobic microorganisms?

(A) Bar screen
(B) Grit-settling tank
(C) Activated-sludge tank
(D) Chlorination tank
(E) Ultraviolet-light array

Which of the following is an effective alternative to chlorine for disinfecting wastewater in a municipal treatment plant?

(A) Freon
(B) Alcohol
(C) Phosphate
(D) Ammonia
(E) Ozone

51. Step P. Water is passed through a screen to remove debris.

Step Q. Pathogenic organisms are killed by chlorination, UV, or ozone.

Step R. Suspended particles clump and settle out.

Step S. A floccing agent, such as alum, is added to the water.

The processes described above are steps in the purification and treatment of municipal wastewater. The steps are listed in random order. Which of the following lists the steps in the correct sequence?

(A) S → P → R → Q
(B) S → R → P → Q
(C) Q → S → P → R
(D) P → Q → R → S
(E) P → S → R → Q

62. Which of the following is true of sewage treatment plants in the United States?

(A) They release wastewater before solids are removed from the sewage.
(B) They use stormwater runoff to assist in the treatment process.
(C) They are not designed to remove pharmaceutical chemicals from wastewater.
(D) They have largely eliminated cultural eutrophication in Chesapeake Bay.
(E) They release wastewater that is not regulated by the Clean Water Act.

Scientists Use Live Lab Animals and Nonanimal Tests to Estimate Toxicity (1)

- Mice and rats
  - Systems are similar to humans
  - Small, and reproduce rapidly
  - Is extrapolation to humans valid?

- **Dose-response curve**: median lethal dose (LD50)
  - Nonthreshold dose-response model
  - Threshold dose-response model

Scientists Use Live Lab Animals and Nonanimal Tests to Estimate Toxicity (2)

- More humane methods using animals
- Replace animals with other models
  - Computer simulations
  - Tissue culture and individual animal cells
  - Chicken egg membranes
- What are the effects of mixtures of potentially toxic chemicals?

Hypothetical Dose-Response Curve Showing Determination of the LD50

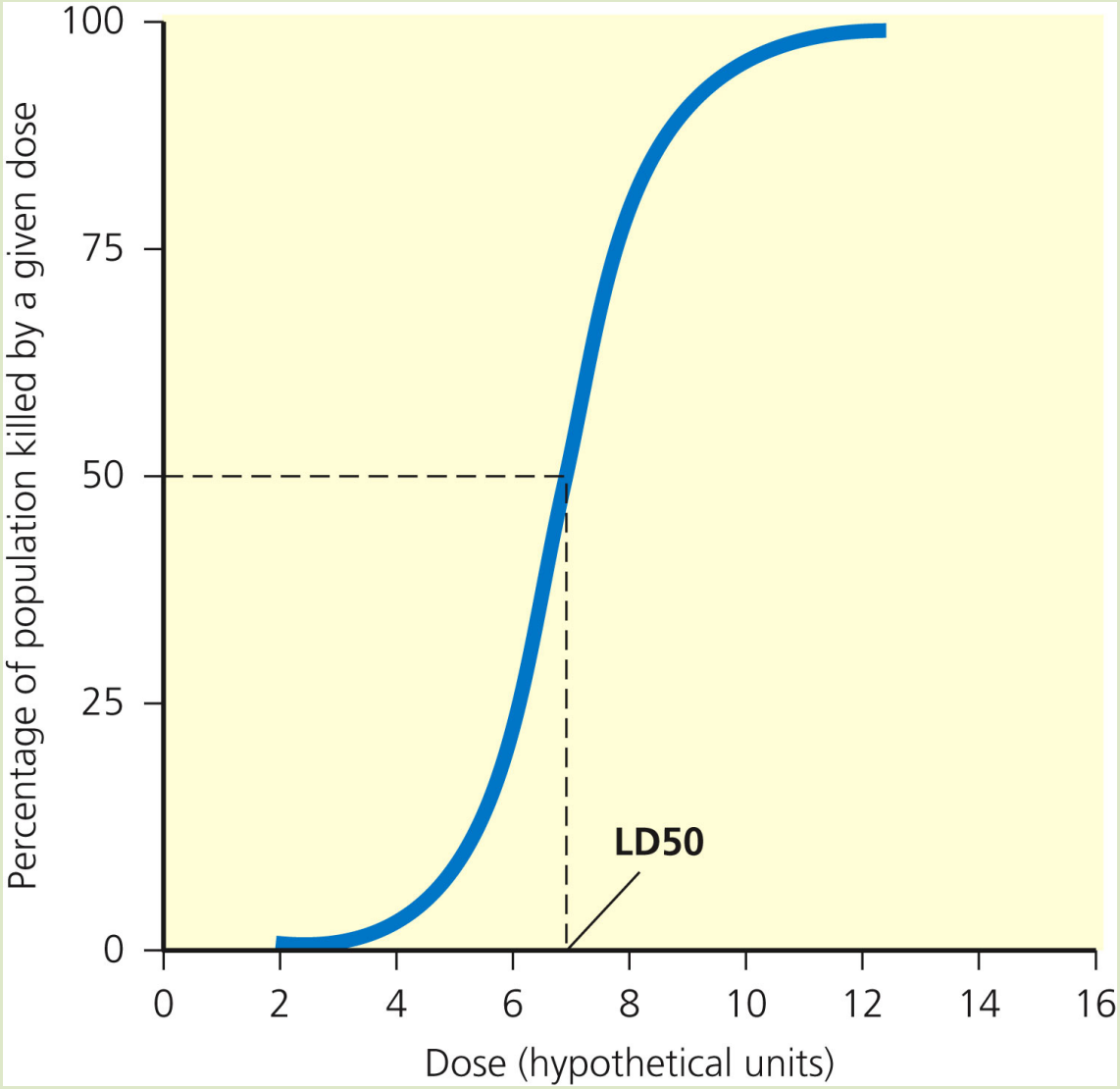
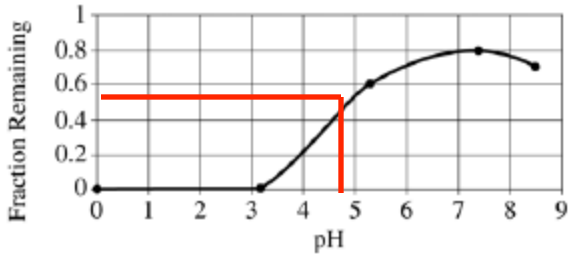


Fig. 17-13, p. 453

Questions 98-100

DAPHNIA TOXICITY EXPERIMENT



DAPHNIA TOXICITY EXPERIMENT

pH	Daphnia Remaining After Two Hours	Fraction of Daphnia Remaining
0	0	0
3.2	0	0
5.3	24	0.6
7.4	32	0.8
8.5	28	0.7

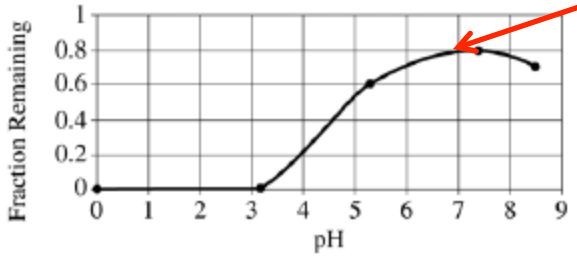
The data shown were collected in a laboratory experiment in which the effect of pH on the survival of water fleas (*Daphnia pulex*) was examined. In each trial, 40 live water fleas were added to a solution with the pH as indicated. After two hours, observations were made to determine the number of fleas remaining alive in the sample. Results are presented in the table and in graphical form above.

98. The pH at which 50 percent of the *Daphnia* survive after 2 hours of exposure can be predicted from the data. This pH is closest to

(A) 2.5
(B) 3.5
(C) 4.5
(D) 7.5
(E) 8.5

Questions 98-100

DAPHNIA TOXICITY EXPERIMENT



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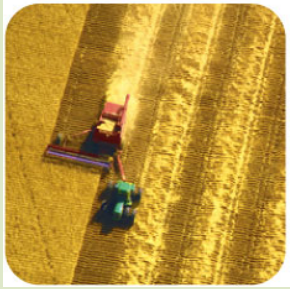
100. On the basis of the data, the best prediction of the pH of the water in which *Daphnia* normally are found in the wild is

(A) 1
(B) 3
(C) 5
(D) 7
(E) 9

Natural Capital Degradation

Food Production



Biodiversity Loss

Loss and degradation of grasslands, forests, and wetlands in cultivated areas

Fish kills from pesticide runoff

Killing wild predators to protect livestock

Loss of genetic diversity of wild crop strains replaced by monoculture strains

Soil

Erosion

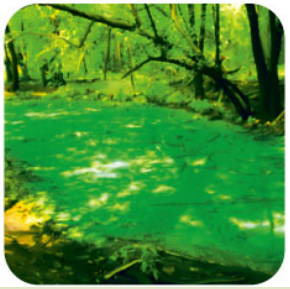
Loss of fertility

Salinization

Waterlogging

Desertification

Increased acidity



Water

Water waste

Aquifer depletion

Increased runoff, sediment pollution, and flooding from cleared land

Pollution from pesticides and fertilizers

Algal blooms and fish kills in lakes and rivers caused by runoff of fertilizers and agricultural wastes

Air Pollution

Emissions of greenhouse gas CO_2 from fossil fuel use

Emissions of greenhouse gas N_2O from use of inorganic fertilizers

Emissions of greenhouse gas methane (CH_4) by cattle (mostly belching)

Other air pollutants from fossil fuel use and pesticide sprays

Human Health

Nitrates in drinking water (blue baby)

Pesticide residues in drinking water, food, and air

Contamination of drinking and swimming water from livestock wastes

Bacterial contamination of meat

Fig. 12-10, p. 289

Topsoil Erosion Is a Serious Problem in Parts of the World

- **Soil erosion**
  - Movement of soil by wind and water
  - Natural causes
  - Human causes

- Two major harmful effects of soil erosion
  - Loss of soil fertility
  - Water pollution

Topsoil Erosion on a Farm in Tennessee

Fig. 12-11, p. 289

Reducing Surface Water Pollution from Nonpoint Sources

- Agriculture
  - Reduce erosion
  - Reduce the amount of fertilizers
  - Plant buffer zones of vegetation
  - Use organic farming techniques
  - Use pesticides prudently
  - Control runoff
  - Tougher pollution regulations for livestock operations
  - Deal better with animal waste

Fig. 12-11, p. 289

The presence of fecal coliform bacteria in a sample of river water suggests which of the following?

(A) The pH of the river is very high.
(B) The water is contaminated with animal waste.
(C) The river is devoid of plant life.
(D) The dissolved oxygen level of the river is high.
(E) Fish caught from the river will be free of parasites.

Cultural Eutrophication Is Too Much of a Good Thing (1)

- **Eutrophication**
  - Natural enrichment of a shallow lake, estuary, or slow-moving stream
  - Caused by runoff into lake that contains nitrates and phosphates

- Oligotrophic lake
  - Low nutrients, clear water

Cultural Eutrophication Is Too Much of a Good Thing (2)

- **Cultural eutrophication**
  - Nitrates and phosphates from human sources
  - Farms, feedlots, streets, parking lots
  - Fertilized lawns, mining sites, sewage plants

- During hot weather or droughts
  - Algal blooms
  - Increased bacteria
  - More nutrients
  - Anaerobic bacteria

Cultural Eutrophication Is Too Much of a Good Thing (3)

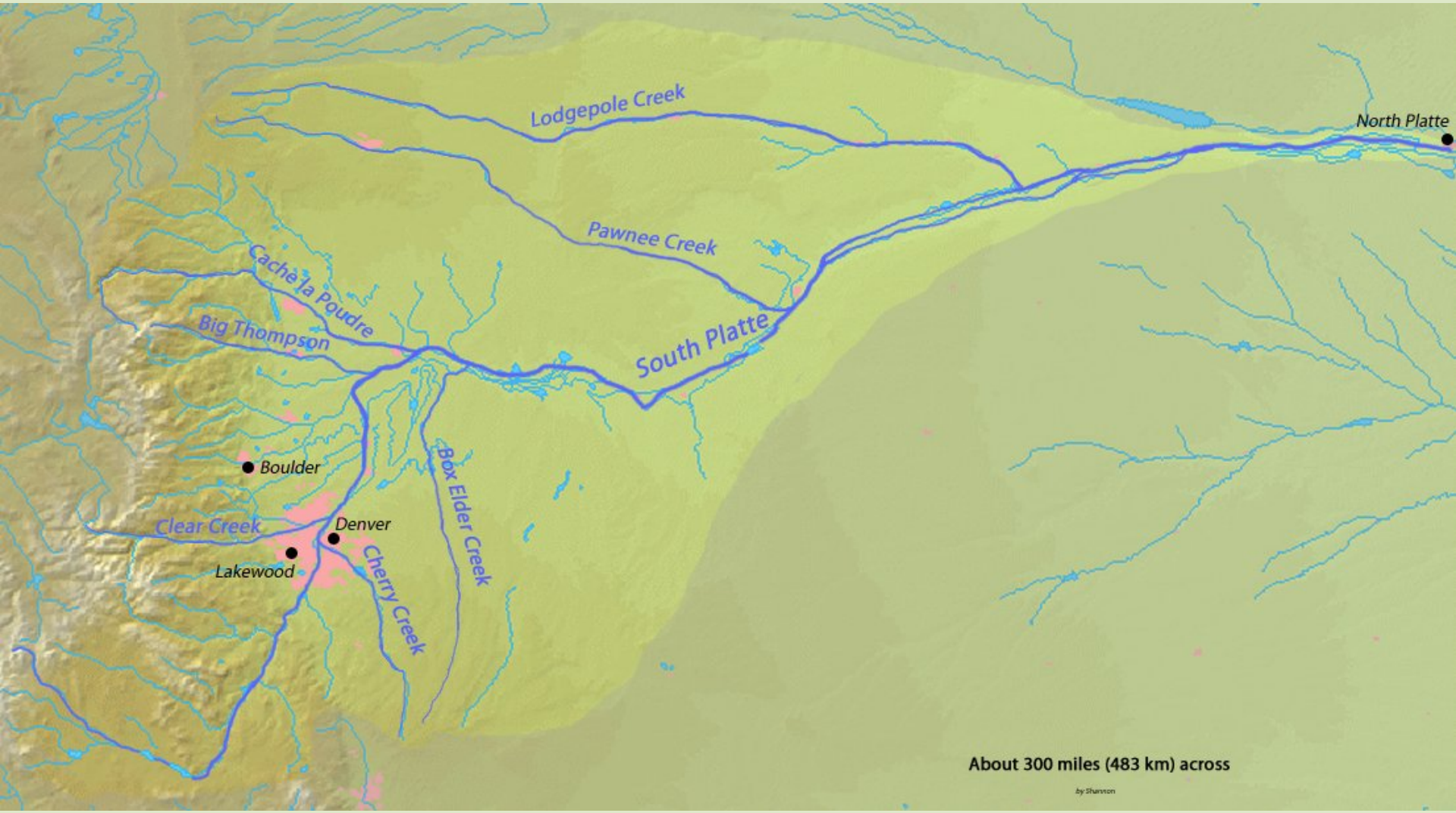
- Prevent or reduce cultural eutrophication
  - Remove nitrates and phosphates
  - Diversion of lake water
- Clean up lakes
  - Remove excess weeds
  - Use herbicides and algaecides; down-side?
  - Pump in air

Cultural Eutrophication of Chinese Lake

Fig. 20-11, p. 537

Lake Fish Killed by Water Pollution

Fig. 20-10, p. 536


Lodgepole Creek
North Platte
Pawnee Creek
Cache la Poudre
Big Thompson
South Platte
Boulder
Box Elder Creek
Clear Creek
Denver
Lakewood
Cherry Creek
About 300 miles (483 km) across


ALBERTA
SASKATCHEWAN
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
NEBRASKA
WYOMING
COLORADO
KANSAS
OKLAHOMA
TEXAS
NEW MEXICO
IOWA
MISSOURI
ARKANSAS
LOUISIANA
MISSISSIPPI
ILLINOIS
WISCONSIN
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
ALABAMA
GEORGIA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
Milk
Missouri
Yellowstone
Little Missouri
Grand
James
Minnesota
Mississippi
Wisconsin
Big Sioux
Des Moines
Iowa
Illinois
Kankakee
Wabash
Kaskaskia
Ohio
Scioto
Kanawha
Monongahela
Allegheny
Tongue
Bighorn
Wind
Cheyenne
Niobrara
North Platte
South Platte
Platte
Loup
Republican
Smoky Hill
Kansas
Arkansas
Osage
Neosho
Canadian
Red
White
Black
Cumberland
Tennessee
Green
Kentucky
Holston
New
Ouachita
Yazoo
Atchafalaya
Billings
Minneapolis
Chicago
Omaha
Des Moines
Lincoln
Peoria
Springfield
Indianapolis
Columbus
Cincinnati
Pittsburgh
Denver
Kansas City
Topeka
St. Louis
Evansville
Lexington
Tulsa
Oklahoma City
Memphis
Baton Rouge
New Orleans
About 2,000 miles (3,219 km) across

Case Study: Pollution in the Great Lakes (1)

- 1960s: Many areas with cultural eutrophication

- 1972: Canada and the United States: Great Lakes pollution control program
  - Decreased algal blooms
  - Increased dissolved oxygen
  - Increased fishing catches
  - Swimming beaches reopened
  - Better sewage treatment plants
  - Fewer industrial wastes
  - Bans on phosphate-containing household products

Case Study: Pollution in the Great Lakes (2)

- Problems still exist
  - Raw sewage
  - Nonpoint runoff of pesticides and fertilizers
  - Biological pollution
  - Atmospheric deposition of pesticides and Hg

Case Study: Pollution in the Great Lakes (3)

- 2007 State of the Great Lakes report
  - New pollutants found
  - Wetland loss and degradation
  - Declining of some native species
  - Native carnivorous fish species declining
  - What should be done?

The Great Lakes of North America

Fig. 20-12, p. 538

Which of the following is the usual cause of cultural eutrophication in surface waters of both developed and developing countries?

(A) Lack of proper filtration devices for power plant effluents
(B) Introduction of cyanobacteria to streams and rivers
(C) Runoff of metal ions in bodies of water
(D) Runoff of nitrate compounds into bodies of water
(E) Runoff of herbicides into bodies of water

If wastewater treatment plant effluent that contains nitrates and phosphates is allowed to flow into a body of water, which of the following may result?

(A) Chlorination
(B) Decomposition
(C) Eutrophication
(D) Oxygenation
(E) Methylation

Which of the following will result in accelerated eutrophication when introduced into streams, lakes, and bays?

(A) Bacteria and viruses
(B) Pesticides
(C) Herbicides
(D) Phosphates
(E) Acid wastes and salts

35. Which of the following elements is most likely to limit primary production in freshwater lakes?

(A) Oxygen
(B) Calcium
(C) Phosphorus
(D) Carbon
(E) Iron

26. All of the following are commonly used to deal with the side effects of eutrophication in lakes EXCEPT

(A) applying herbicides to kill nuisance plants
(B) dredging out lakes to deepen them
(C) pumping oxygen into the lowest layers of water
(D) introducing insects that eat certain nuisance plants
(E) adding nitrates

The major biological source of dissolved oxygen in the ocean comes from

(A) decomposition of organic sediments on the ocean floor
(B) metabolic processes of coral in reefs
(C) oxidation of sulfur by bacteria in ocean vent communities
(D) photosynthesis by phytoplankton
(E) respiration by zooplankton