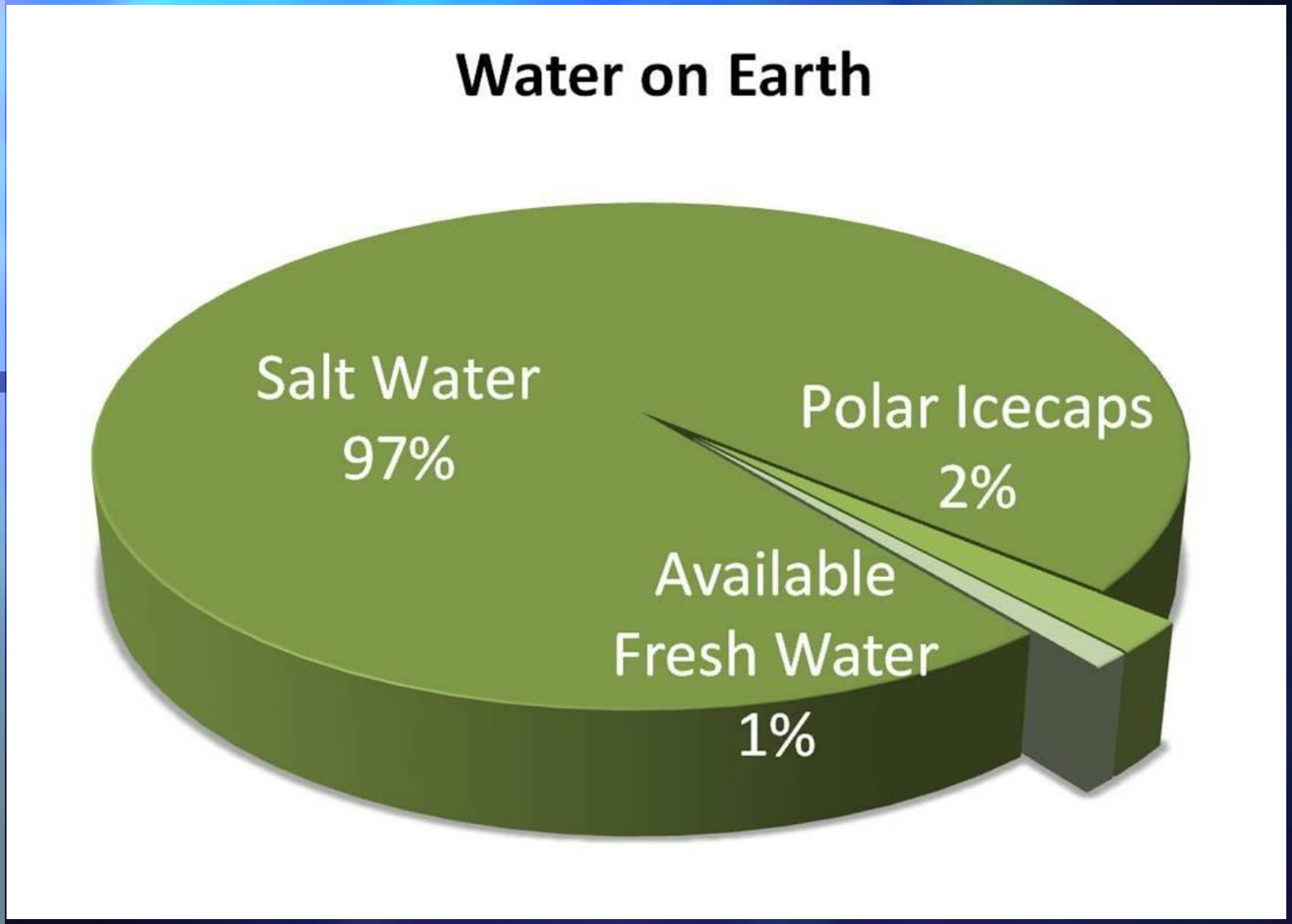
Water Management



Who owns the water?

Eastern US doctrine governing surface water: riparian doctrine (if live close to lake or river - have reasonable use).

Western US uses prior appropriation doctrine - allocates based on who started using it first.

Global Water Challenge

- If current projections for global population growth remain unchanged, about 34 countries will experience serious difficulties in obtaining water supplies by 2025.

Water

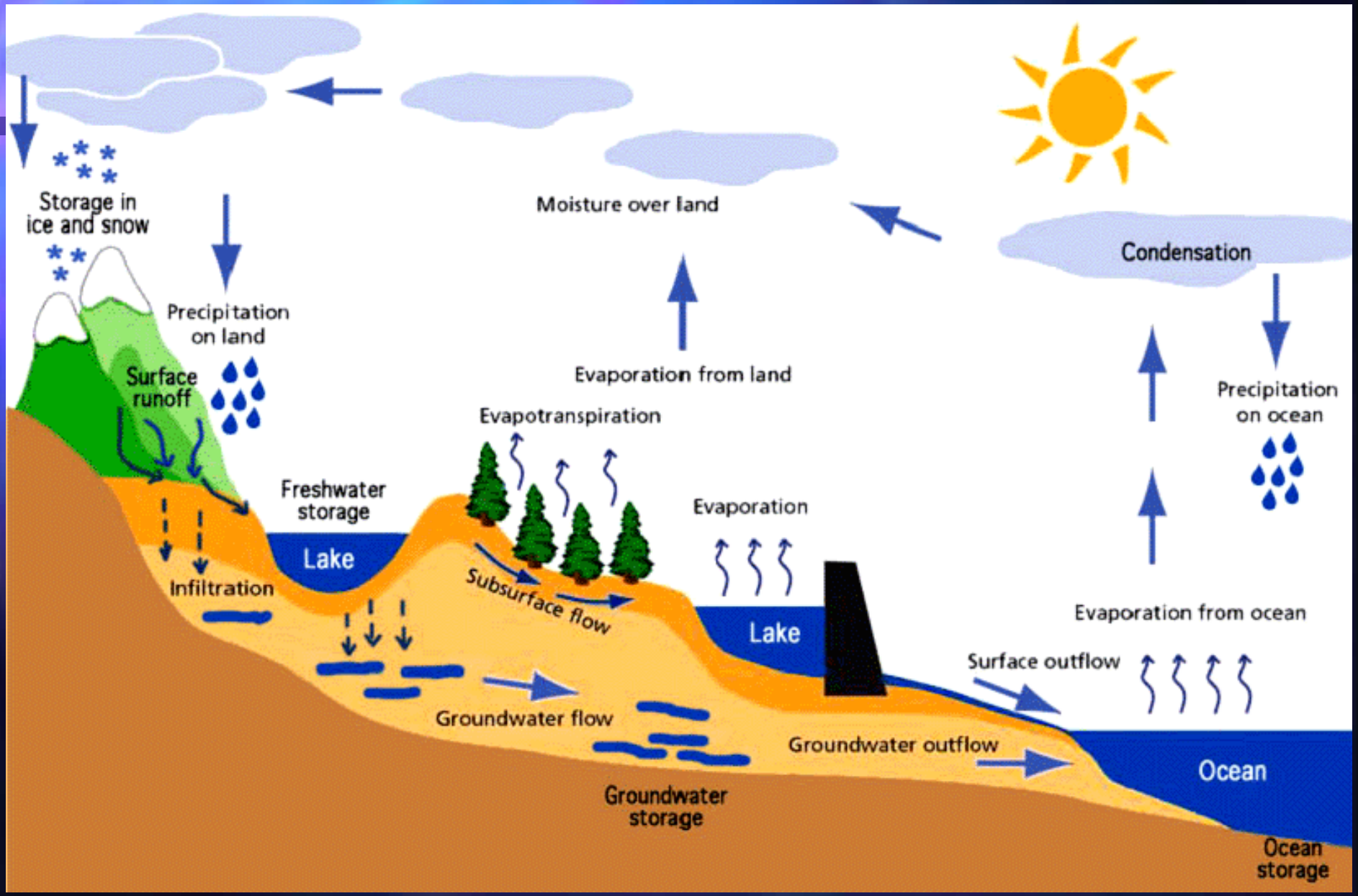
- Living organisms need water
- **Potable Water**: unpolluted freshwater suitable for drinking (finite supply)
- Universal solvent (due to its polarity)
- Capacity for heat storage

Estimated World Water Supply

1.38 Billion cubic kilometers (333 million cubic miles)

- 97.5% saltwater
- 2.5% freshwater:
  - 78% glaciers
  - 21% groundwater
  - <1% surface water
    - 87% lakes
    - 11% wetlands
    - 2% rivers

The Hydrologic cycle



Hydrologic Cycle Vocabulary

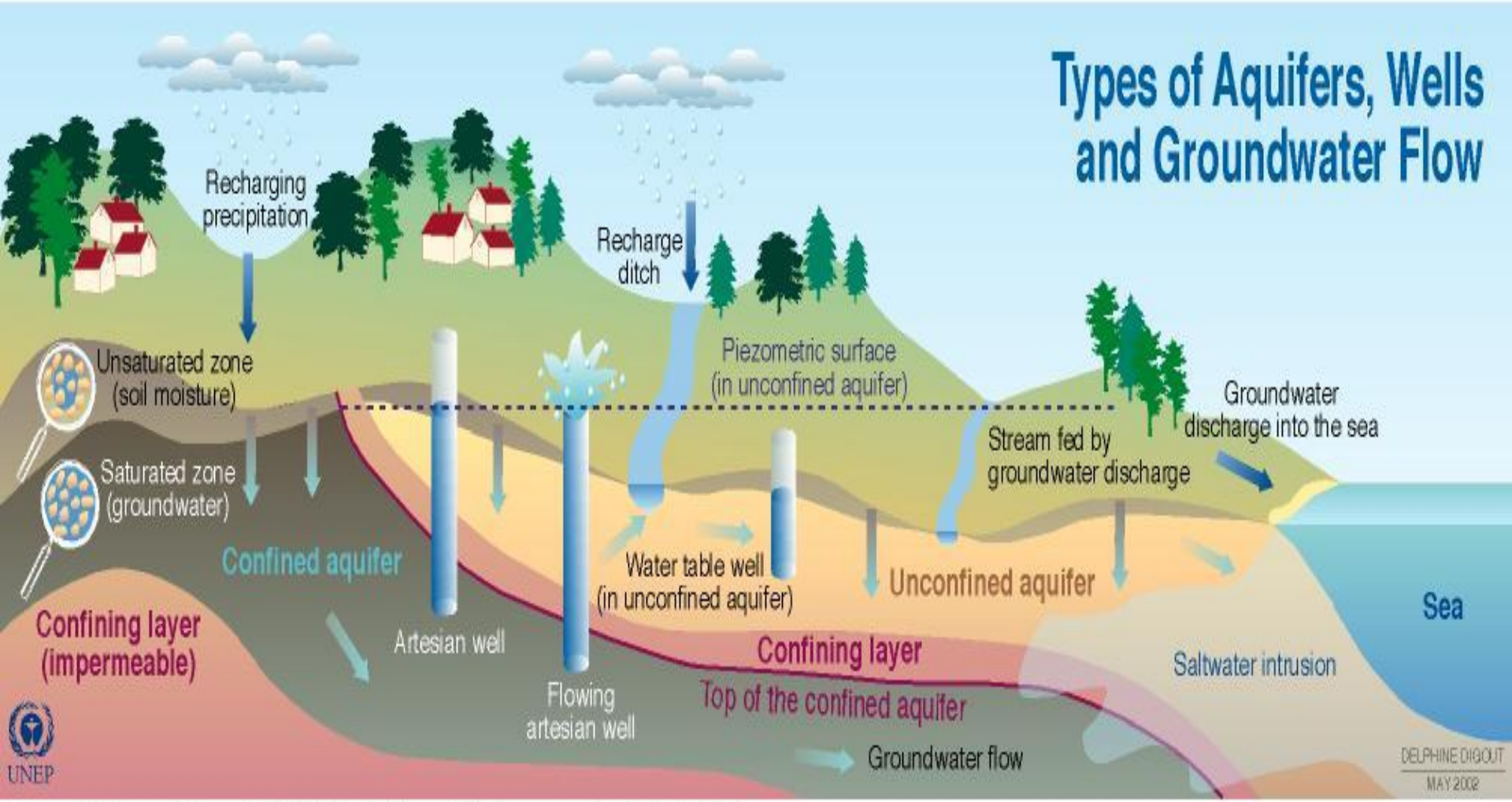
1. **Evapotranspiration**: evaporation of water from leaves
2. **Runoff**: surface water that moves across the surface of the land and enters streams and rivers
3. **Groundwater**: water that fills the spaces in the substrate
4. **Aquifer**: porous layer that becomes saturated with water (underground layer of gravel, sand or permeable rock that holds groundwater that can be extracted by wells.

Hydrologic Cycle Vocabulary Continued

5. **Unconfined aquifer:** usually occurs near the land's surface
6. **Water table**: top layer of unconfined aquifer
7. **Vadose zone**: Above the water table and below the land (also called unsaturated zone or zone of aeration).
8. **Confined aquifer:** bounded on top and bottom by layers impervious to water (aquicludes)

Hydrologic Cycle Vocabulary Continued

9. **Semiconfined aquifer**: If water can pass in and out of the confining layer (aquitard)
10. **Artesian wells**: If the recharge area is at a higher elevation than the place where the aquifer is tapped, water will flow up the pipe until it reaches the same elevation as the recharge area
11. **Porosity**: measure of the size and number of spaces in the substrate



Source: Environment Canada, 2001 (Adapted from: http://www.ec.ca/water/index.htm).

Human Influences on the Hydrologic Cycle

- Oceans are primary regulator of global climate and a sink for greenhouse gases

- long-term changes in climate
- sea, land ice, mountain glaciers
- ocean salinity
- ocean acidification
- sea levels
- precipitation patterns
- extreme weather events
- ocean's circulatory regime
- coastal ecosystems developed

Human Influences on the Hydrologic Cycle continued

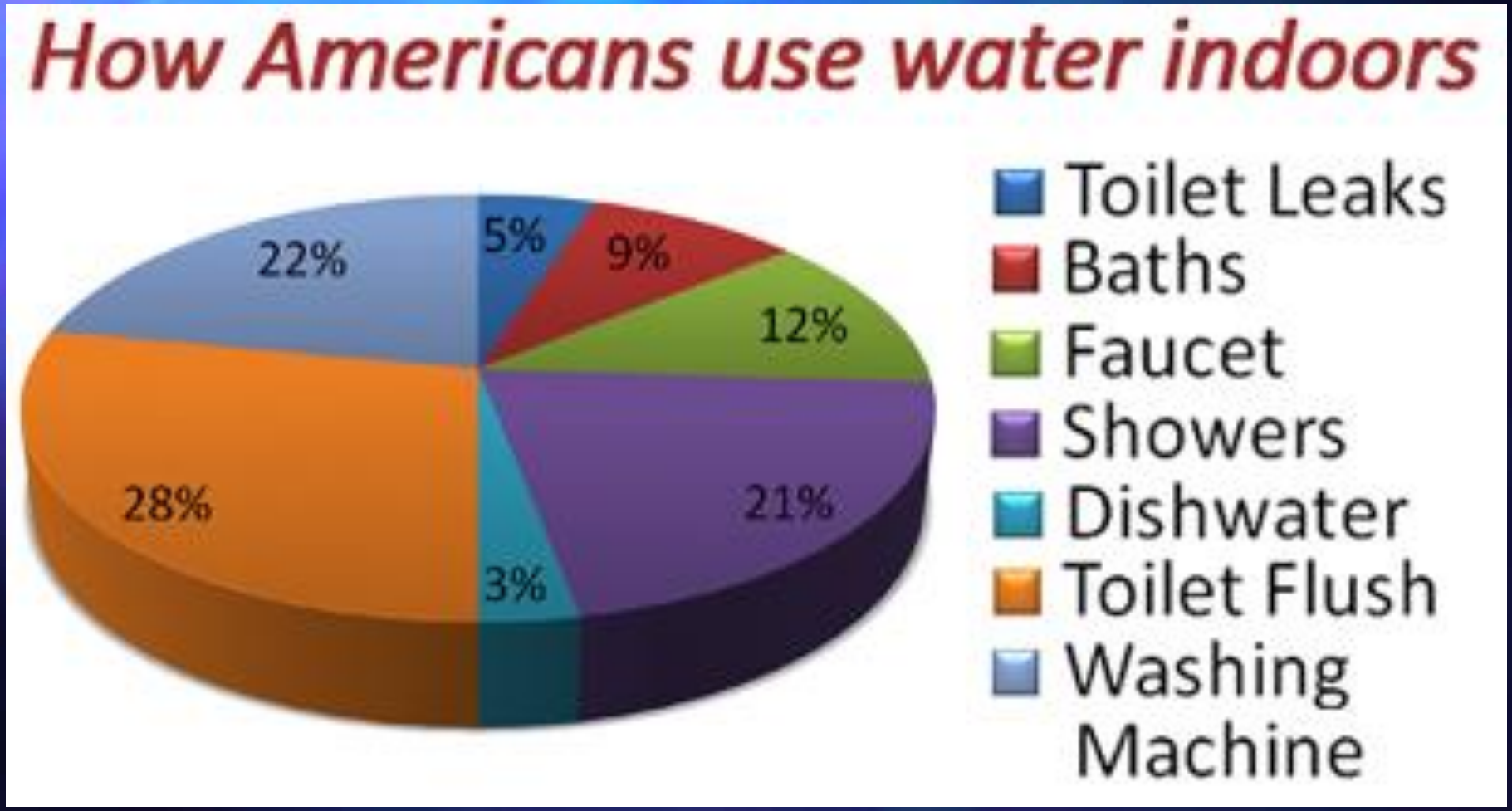
- Evaporation rates
- Runoff (crops, logging, paved areas etc.)
- Infiltration decreased (paved areas)
- Rapid evaporation rates from farming etc. can change local atmospheric conditions
- Storms can cause flooding of polluted water
- Pump water out of groundwater (actual amounts available are only estimates)

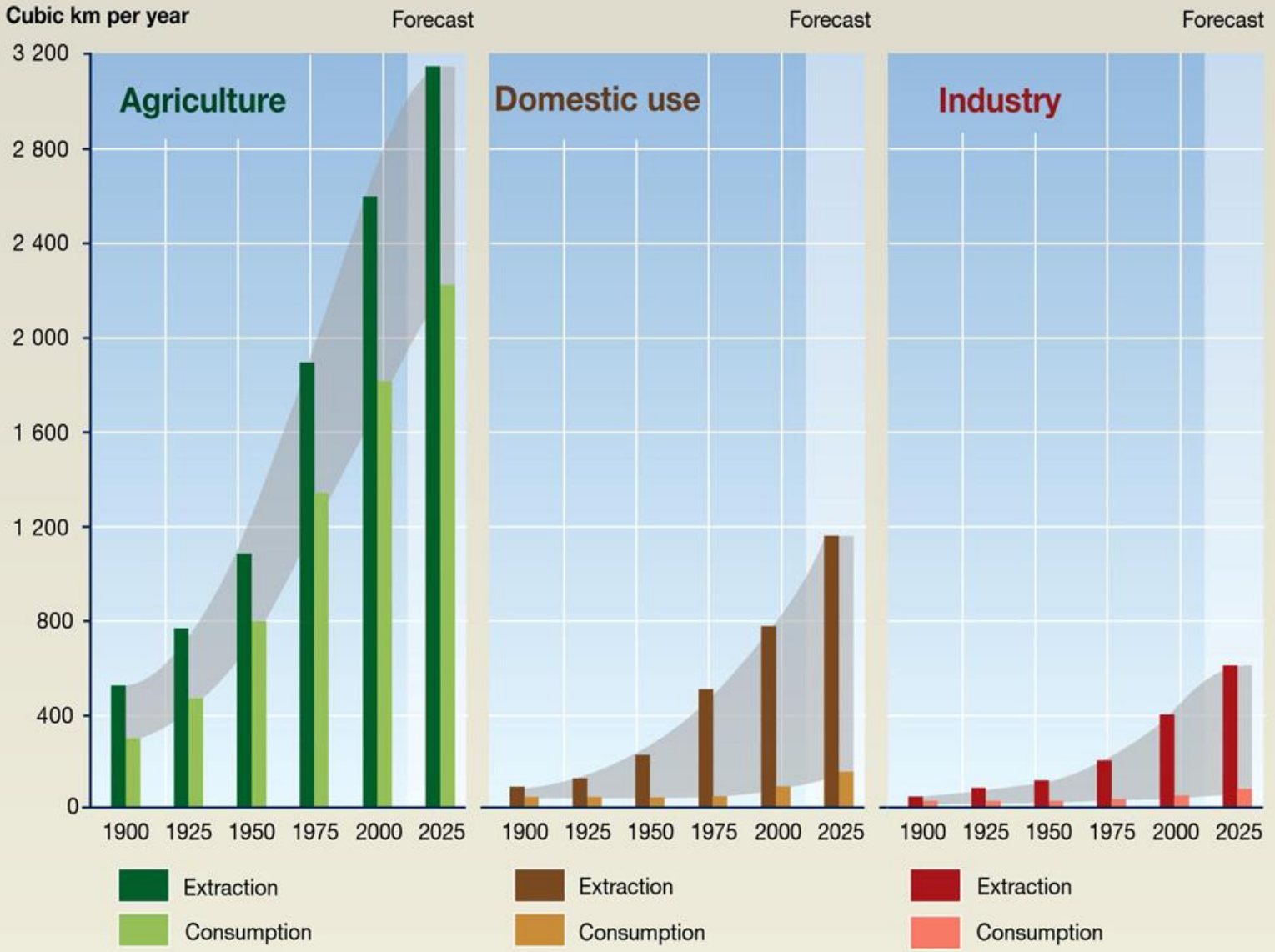
Water use

- California pumps 55 billion liters of groundwater a year
- Individual farmers and individual people with wells usually aren’t monitored but draw from groundwater
- Some water use returns to source (factories release into rivers etc.) but water lost in crops

What do you think the highest amount of indoor water use is from in the US?

Kinds of water use

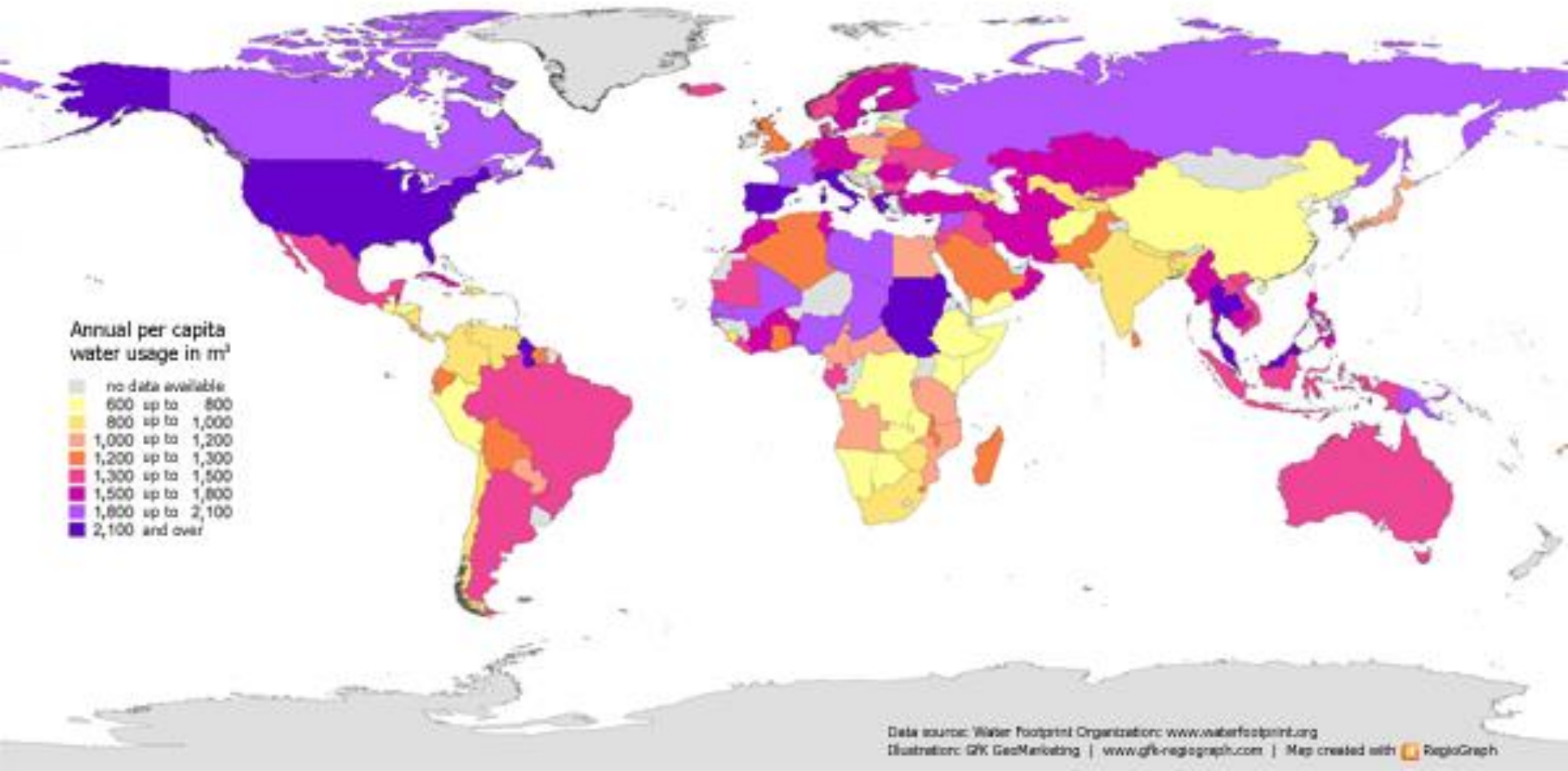




The grey band represents the difference between the amount of water extracted and that actually consumed. Water may be extracted, used, recycled (or returned to rivers or aquifers) and reused several times over. Consumption is final use of water, after which it can no longer be reused. That extractions have increased at a much faster rate is an indication of how much more intensively we can now exploit water. Only a fraction of water extracted is lost through evaporation.

Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational,Scientific and Cultural Organisation (UNESCO, Paris), 1999.

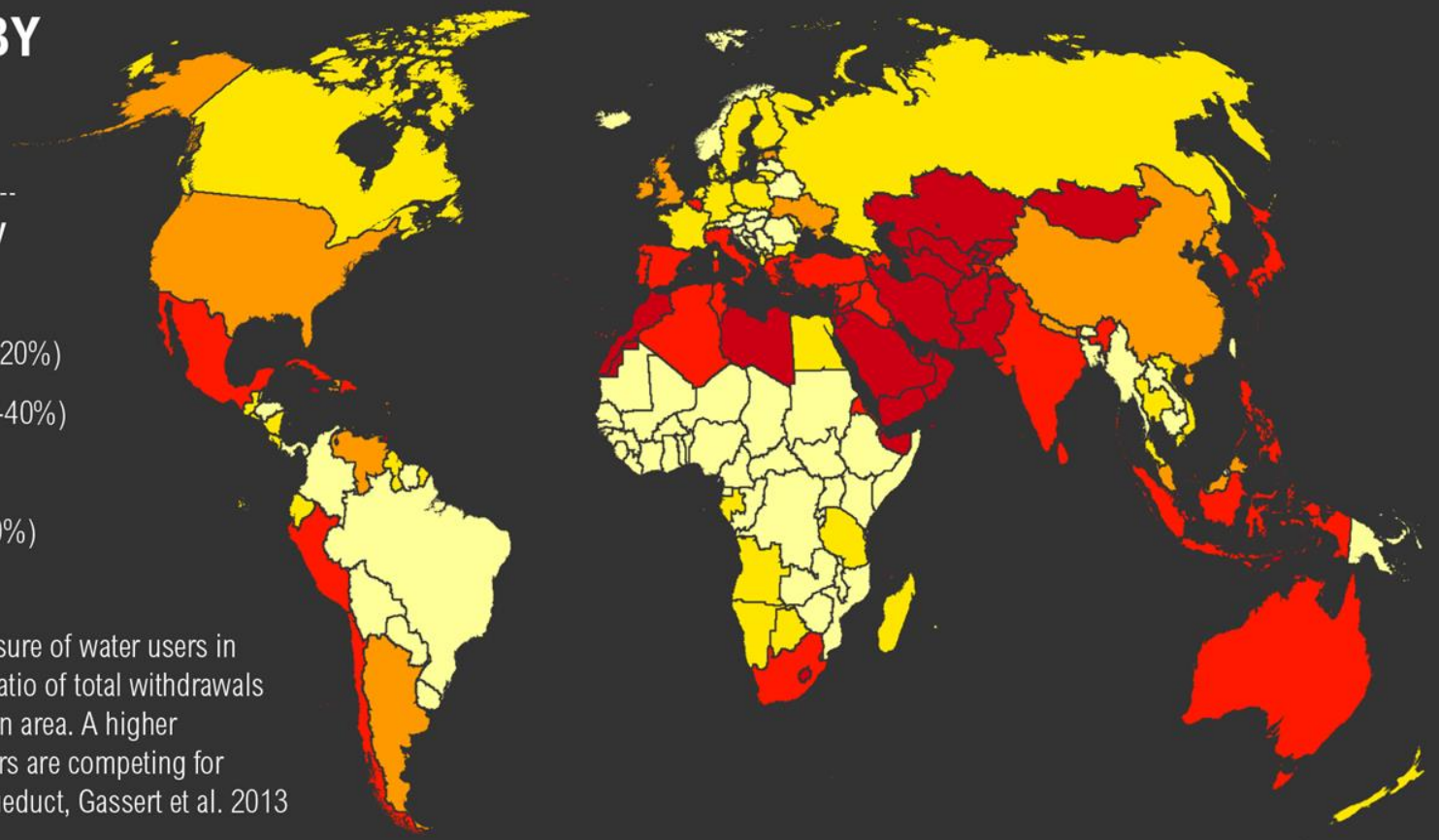
Worldwide water usage – "water footprints" of the nations



WATER STRESS BY COUNTRY

ratio of withdrawals to supply

- Low stress (< 10%)
- Low to medium stress (10-20%)
- Medium to high stress (20-40%)
- High stress (40-80%)
- Extremely high stress (> 80%)



This map shows the average exposure of water users in each country to water stress, the ratio of total withdrawals to total renewable supply in a given area. A higher percentage means more water users are competing for limited supplies. Source: WRI Aqueduct, Gassert et al. 2013

AQUEDUCT

WORLD RESOURCES INSTITUTE

Bottled Water Environmental Costs

- Some bottled water is not as pure as tap water and costs much more.
- Takes 3-4 times the amount of water in the bottle to make the plastic, uses oil and creates CO_2 during shipping to the store.
  - Don't buy bottled water
  - Or, buy water bottled nearby
- 28 billion water bottles purchased in US/yr
- 2.5 million discarded hourly

Is Bottled Water the Answer?

- Some bottled water is not as pure as tap water and costs much more.
  - 1.4 million metric tons of plastic bottles are thrown away.
  - Now finding "micro-plastics are ingested"
  - Fossil fuels are used to make plastic bottles.
    - The oil used to produce plastic bottles in the U.S. each year would fuel 100,000 cars.

Domestic Water

- Water treatment: sand (or other substrate filtration), chemicals added to remove dissolved materials, disinfected with chlorine, ozone, or UV light.
- If no freshwater is available to treat, expensive desalination is used

Pollution

- 25% of people don’t have access to safe drinking water
- 5-10 million deaths/year from water-related diseases
  - cholera, malaria, dengue fever, dysentery

2011 Study on US drinking water

- More than 200 unregulated chemicals in the tap water of 45 states
- Industrial solvents, weed killers, refrigerants, perchlorate (rocket fuel)
  - $50 billion/year to treat drinking water
  - $200 million/year to protect source waters

Flint Michigan Update

Sediment Pollution

Definition

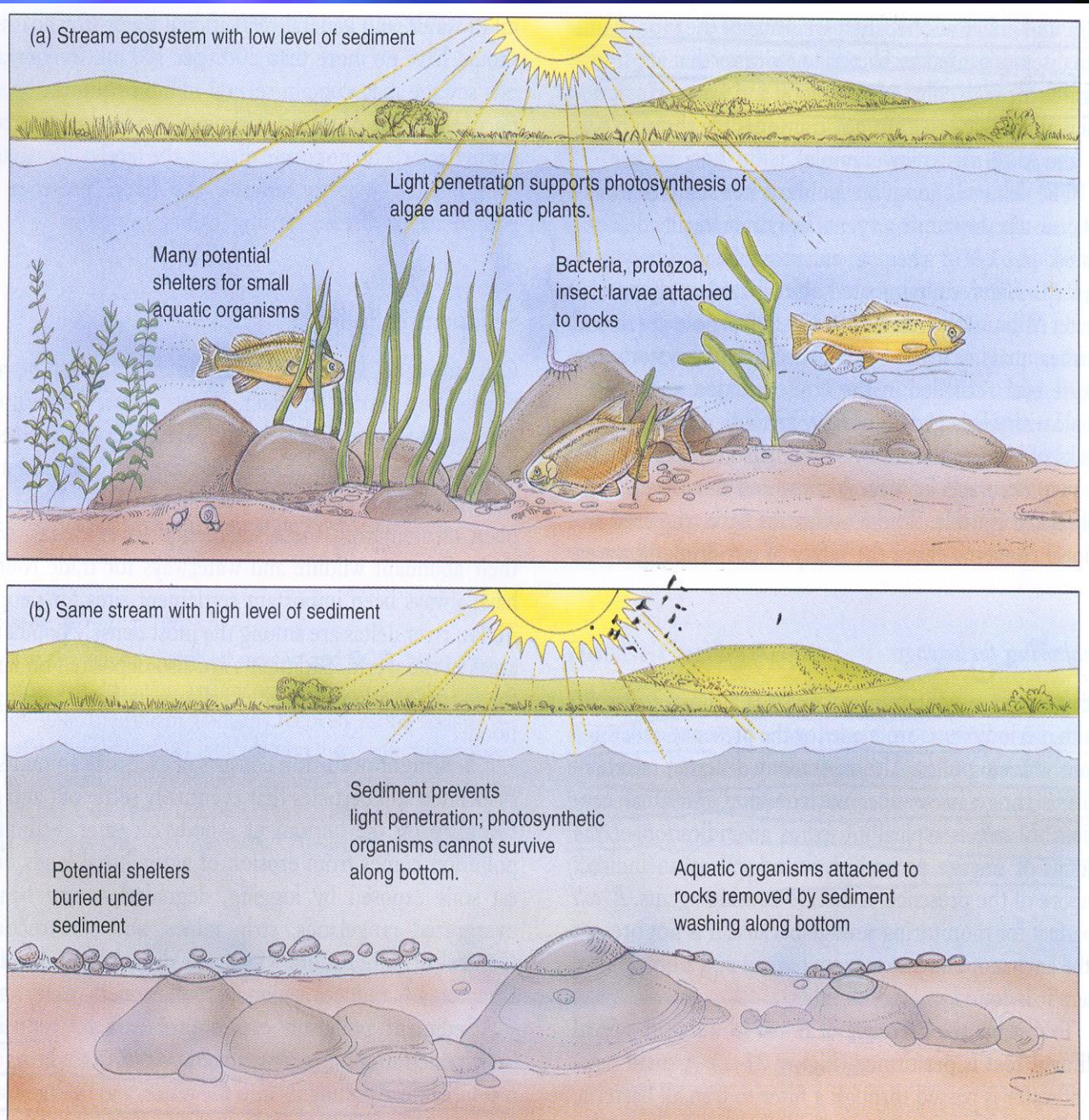
- Excessive amounts of suspended soil particles that eventually settle out and accumulate on the bottom of a body of water.

Causes

- Erosion of agricultural lands, forest soils exposed by logging, degraded stream banks, overgrazed rangelands, strip mines, and construction.

Environmental Effects

- Reduces light penetration, covering aquatic organisms
- Bringing insoluble toxic pollutants into the water
- Filling in waterways.



Dissolved Organic Matter

- Decays in water
- Microorganisms use up Dissolved Oxygen as they break up organic matter
- **Biogeochemical Oxygen Demand (BOD)**: amount of oxygen required to decay a certain amount of organic matter

BOD as indicator of pollution:

- Measure DO in ppm
- Water with a high BOD without means to replenish oxygen (ie. lakes or slow-moving streams) will not support aquatic life

Enrichment

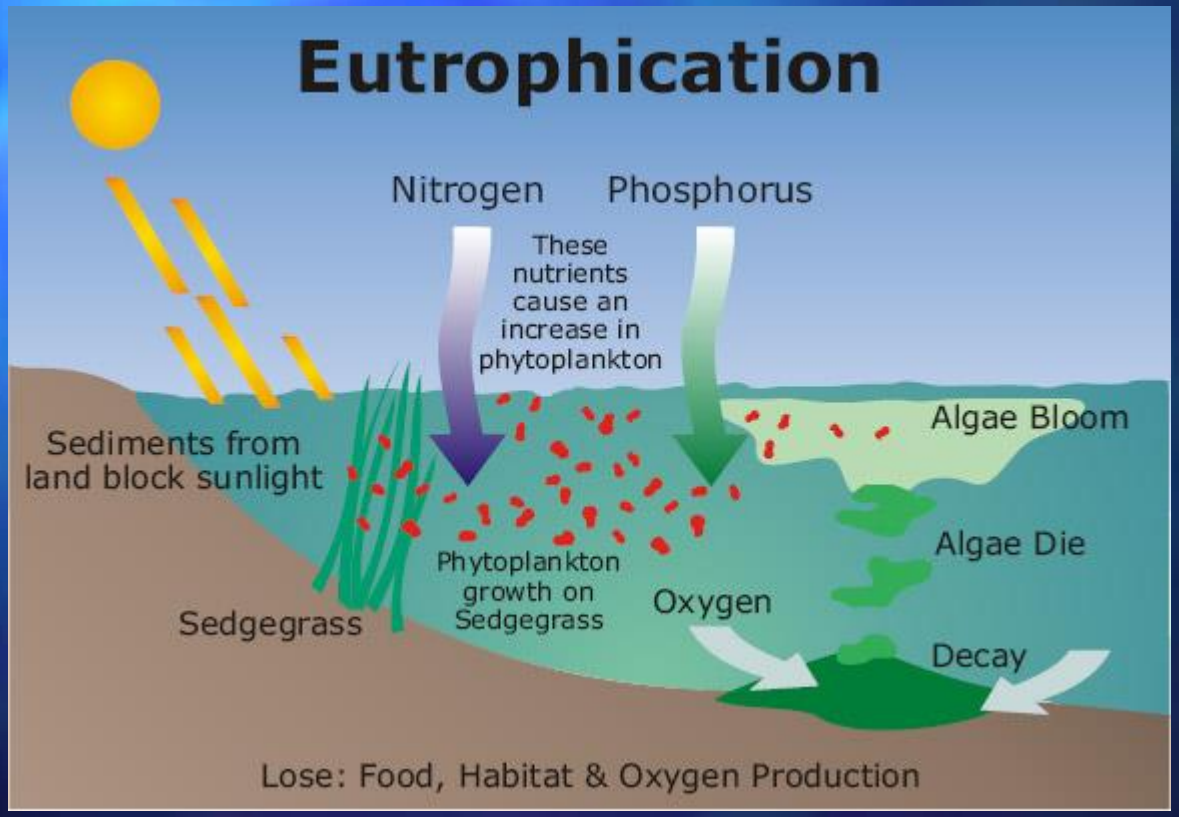
- Chemicals such as nitrogen and phosphorus that stimulate the growth of plants and algae.

Causes

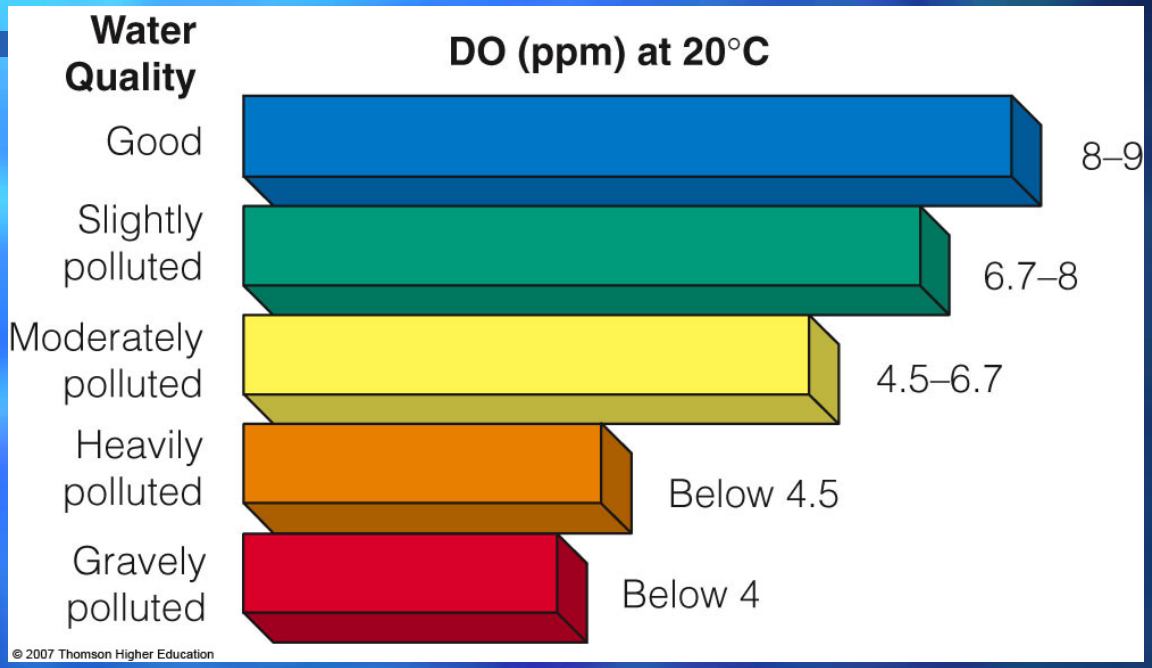
- Nitrates and phosphates come from sources such as human and animal wastes, plant residues, atmospheric deposition and residential land.

Eutrophication

- Excessive growth of algae and aquatic plants due to added nutrients



Major Water Pollutants and Their Effects



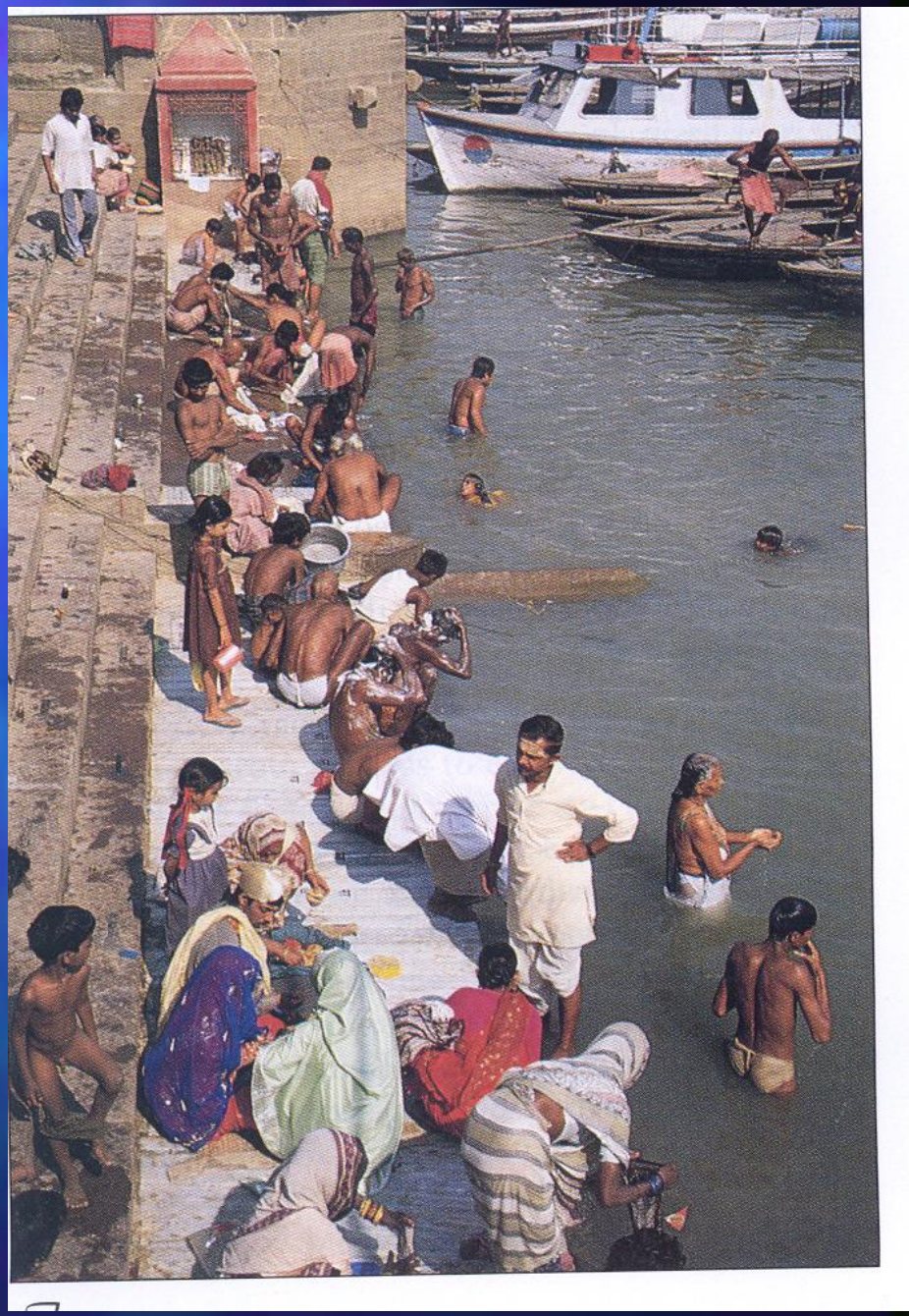
- Water quality and dissolved oxygen (DO) content in parts per million (ppm) at 20°C.
  - Only a few fish species can survive in water less than 4ppm at 20°C.

Figure 21-3

Health Effects

- Sediments adversely affect water quality by carrying toxic chemicals.
- The sediment particles provide surface area to which some insoluble, toxic compounds adhere; when the sediments enter the water, so do toxic chemicals.
- Disease-causing agents can also be transported into water via sediments.

Sewage



Causes

- Release of wastewater from drains or sewers (toilets, washing machines, and showers) and include human wastes, soaps and detergents.

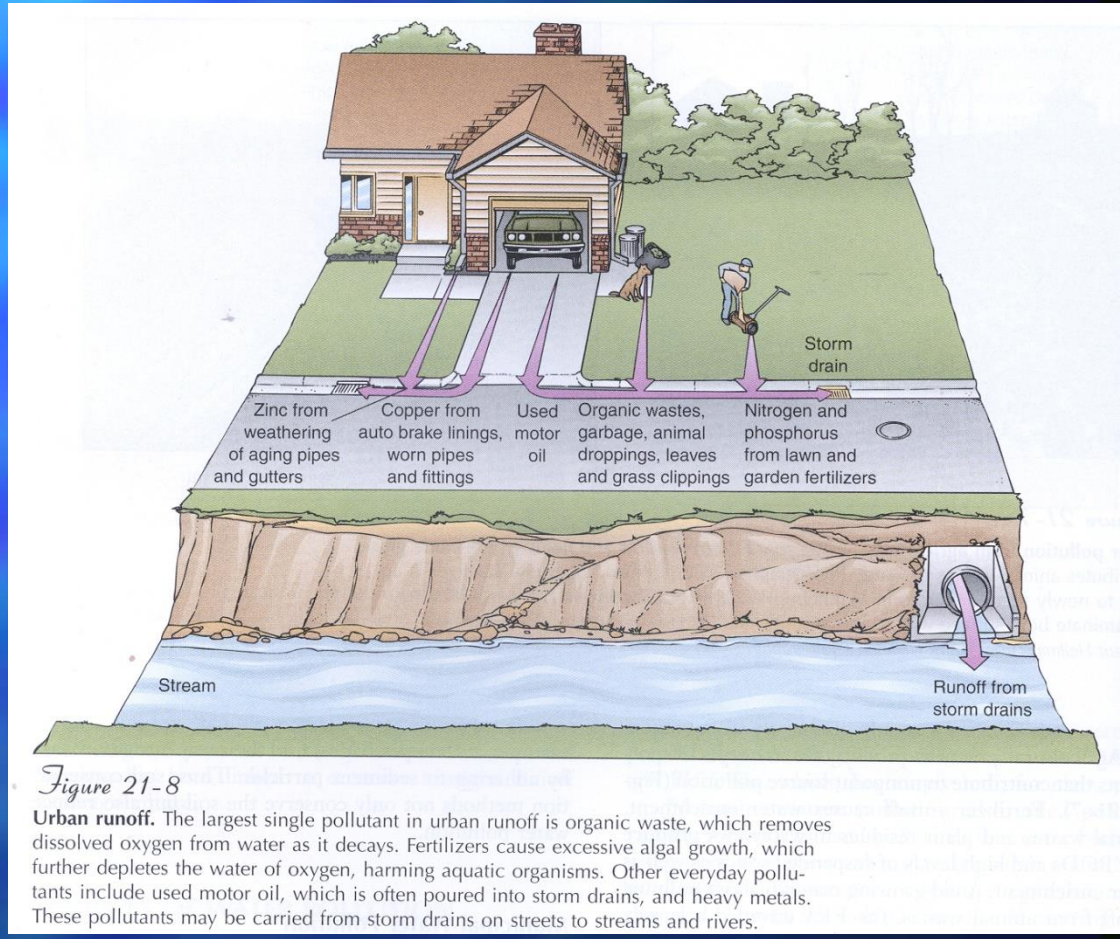


Figure 21-8

Urban runoff. The largest single pollutant in urban runoff is organic waste, which removes dissolved oxygen from water as it decays. Fertilizers cause excessive algal growth, which further depletes the water of oxygen, harming aquatic organisms. Other everyday pollutants include used motor oil, which is often poured into storm drains, and heavy metals. These pollutants may be carried from storm drains on streets to streams and rivers.

Cultural Eutrophication

- ***Cultural eutrophication***: human activities accelerate the input of plant nutrients (mostly nitrate- and phosphate-containing effluents) to a lake.
  - 85% of large lakes near major population centers in the U.S. have some degree of cultural eutrophication.

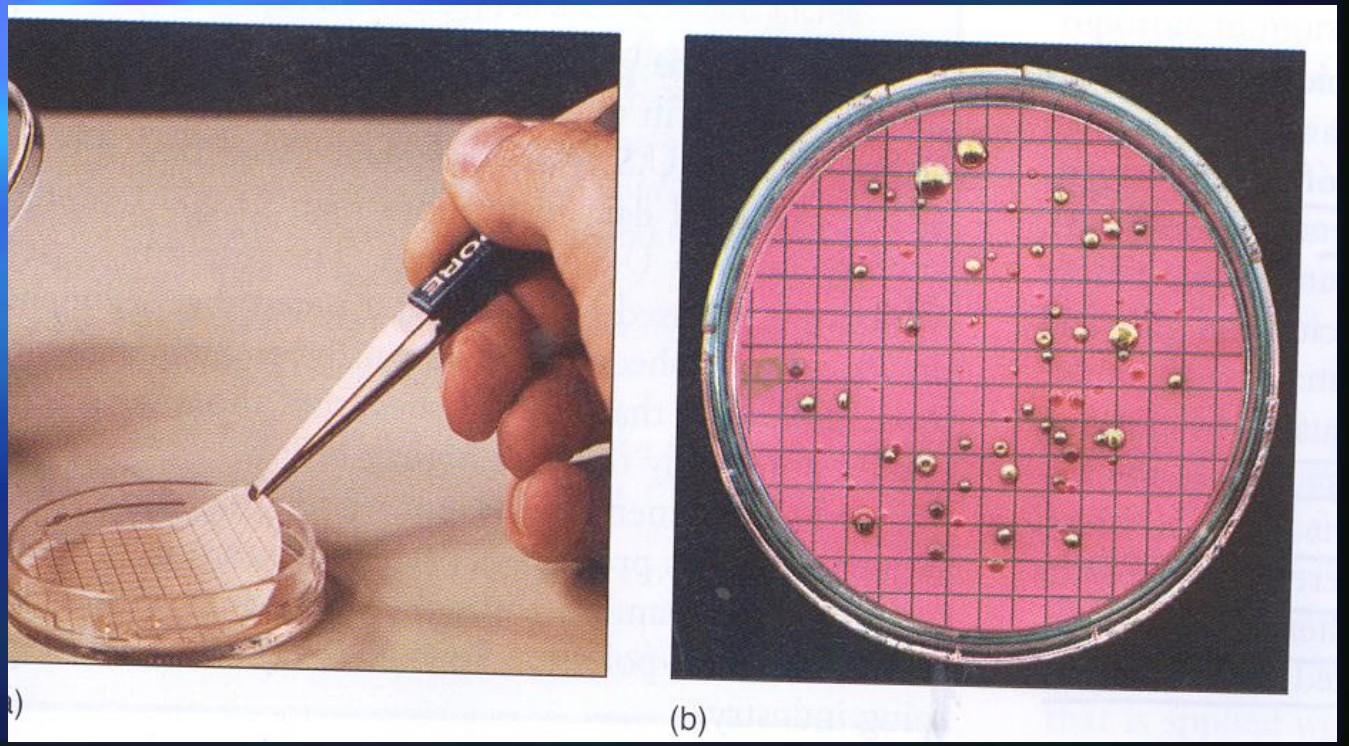
Health Effects

- Oxygen – dissolved oxygen is needed by organisms, like fish, but when sewage enters an aquatic ecosystem, the micro-organisms bloom, leaving less oxygen for the fish, etc., and then they die
- Sewage carries disease-causing agents.

Disease-Causing Agents

Definition

- Infectious organisms that cause disease.



Causes

Comes from the wastes of infected individuals.

Environmental Effects

- Municipal wastewater contains bacteria, viruses, protozoa, parasitic worms, and other infectious agents that cause human or animal diseases.

Health Effects

- Typhoid, cholera, bacterial dysentery, polio and infectious hepatitis are some of the more common bacteria or viruses that are transmitted through contaminated food and water.

Table 21-2 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; 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
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 and possible death for people with weakened immune systems
Parasitic worms	Schistosomiasis	Abdominal pain, skin rash, anemia, chronic fatigue, and chronic general ill health

Organic Compounds

Causes

- Chemicals that contain carbon atoms. Most of the thousands of organic compounds found in water are synthetic chemicals that are produced by human activities; these included pesticides, solvents, industrial chemicals and plastics, and seepage from landfills.

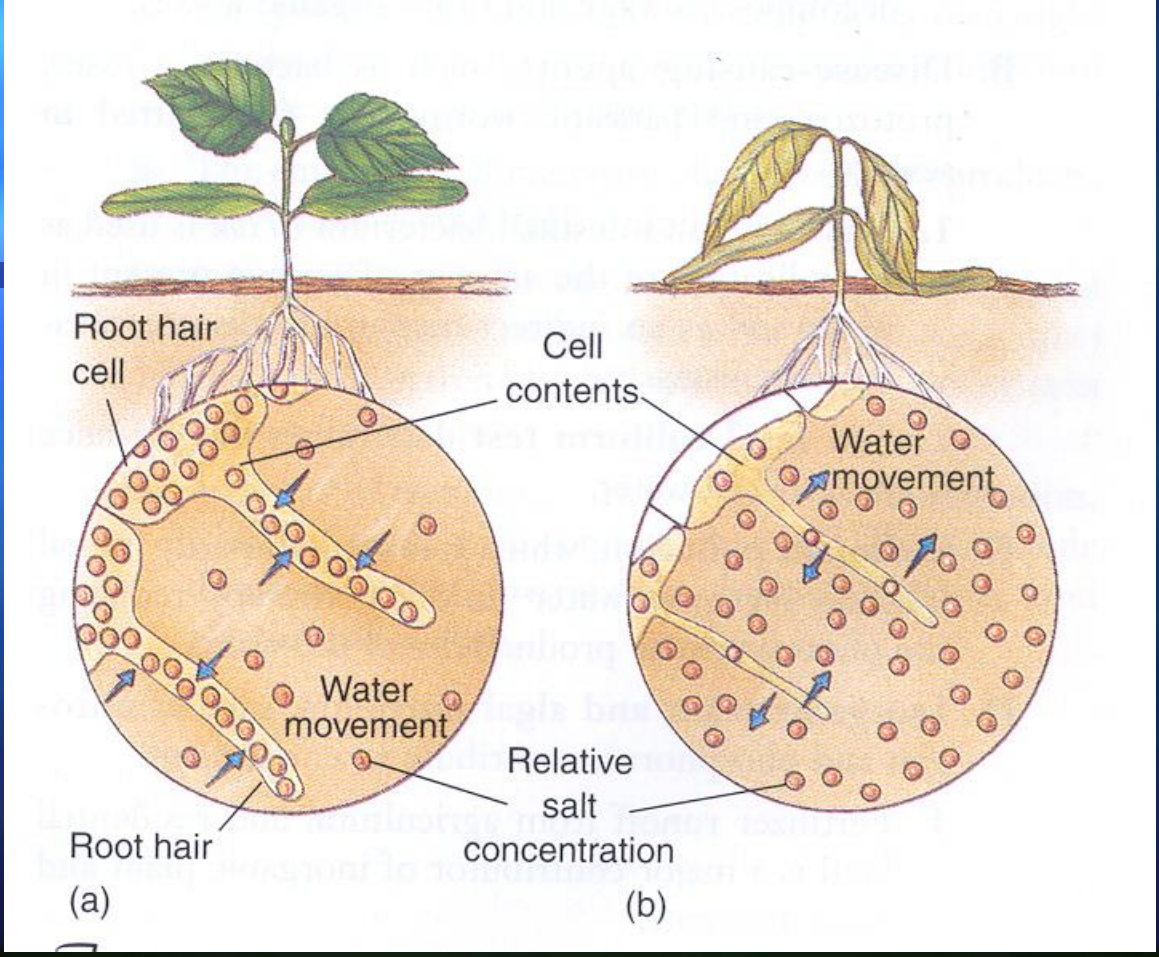
Health Effects

- Hundreds of synthetic organic compounds are toxic and some of these have been shown to cause cancer or birth defects.

Environmental Effects

- Pollutes streams and groundwater.

Inorganic Compounds



Causes

- Chemicals are contaminants that contain elements other than carbon. Examples include acids, salts, and heavy metals. Many inorganic chemicals find their way into both surface water and groundwater from sources such as industries, mines, irrigation runoff, oil drilling and urban runoff from storm sewers.

Environmental Effects

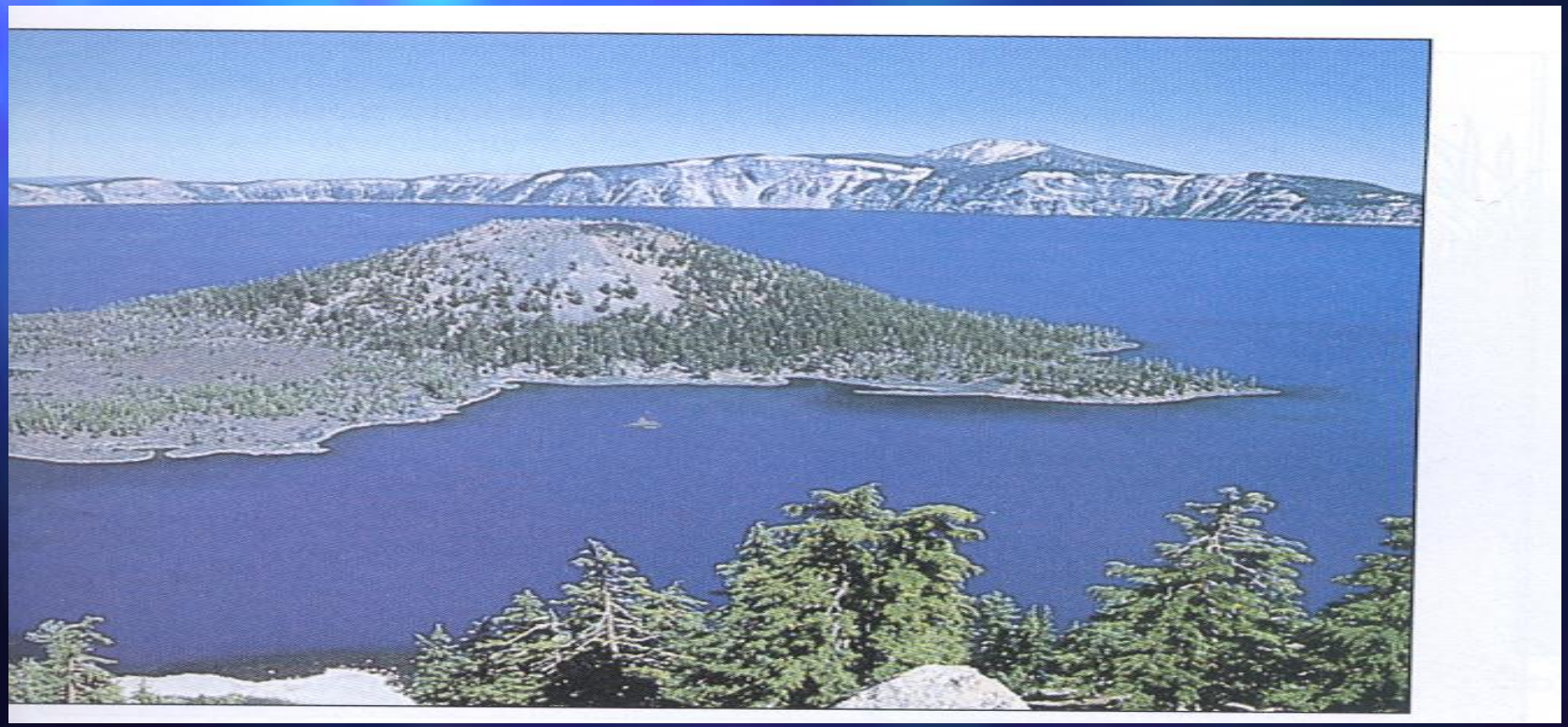
- Some of these inorganic pollutants are toxic to aquatic organisms.

Health Effects

- Lead and mercury are poisonous. Mercury exposure to developing fetuses in pregnant women has been linked to a variety of conditions such as mental retardation, cerebral palsy, and developmental delays, causes kidney disorders and several damage the nervous and cardiovascular systems.
- Low levels of mercury in the brain cause neurological problems such as headache, depression, and quarrelsome behavior.

Radioactive Substances

- Contains atoms of unstable isotopes that spontaneously emit radiation



Causes

- Radioactive substances get into water from several sources like the mining and processing of radioactive minerals such as uranium and thorium.
- The nuclear weapons industry use the largest amounts.
- Medical and scientific research facilities also use them.

Thermal Pollution

Causes

- When heated water produced during certain industrial processes is released into waterways (can also be adding cold water).
- Main source (Heated water to produce electricity).

Environmental Effects

- Temperature may influence metabolic, growth, and reproductive rates of organisms and change the chemical composition of the water.
  - Example: Fish spawning
  - Can change populations of plants/animals in areas
- Can use cooling towers/pond/other methods to reset the temperature

Environmental Effects

- Decomposition of wastes occurs faster, depleting the water of oxygen; this affects aquatic life. (Warm water has more dissolved oxygen (DO) than cold water.

Health Effects

- Typically affects animals, not humans.

WATER POLLUTION: SOURCES, TYPES, AND EFFECTS

- ***Water pollution*** is any chemical, biological, or physical change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses.
  - ***Point source***: specific location (drain pipes, ditches, sewer lines).
  - ***Nonpoint source***: cannot be traced to a single site of discharge (atmospheric deposition, agricultural / industrial / residential runoff)

Point Source Pollution

- Water pollution that can be traced to a specific spot (such as a factory or sewage treatment plant).

Non-Point Source Pollution

- Pollutants that enter bodies of water over large areas rather than being concentrated at a single point of entry. Ex. Agricultural fertilizer runoff and sediments from construction. Harder to trace!

Sources of Pollution

Agriculture
- Fertilizers, animal wastes, etc.

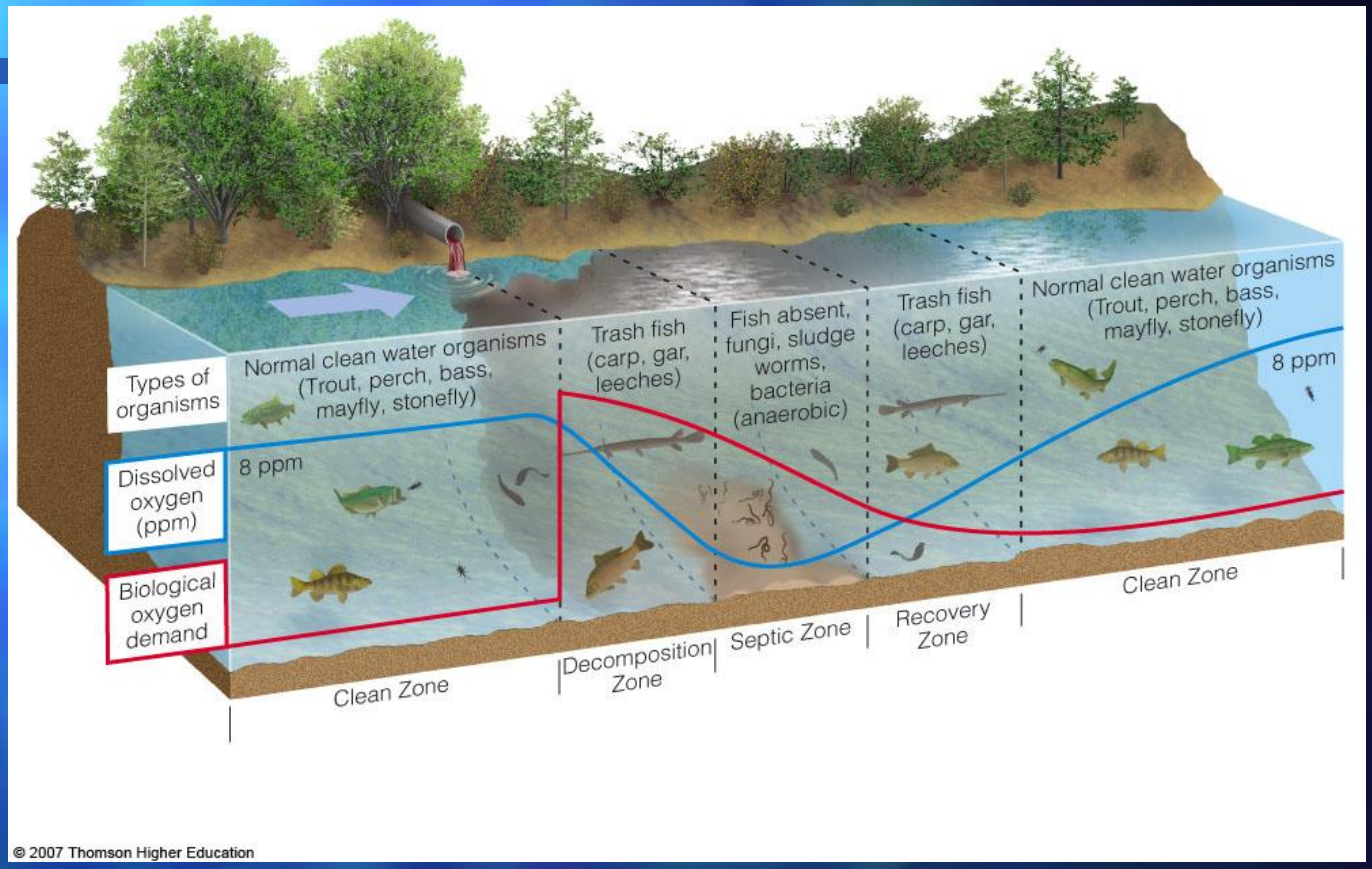
Municipal Waste
- Sewage, fertilizers, dumping into drainage ditches, etc.

Industrial Waste
- Chemicals left over from manufacturing, waste products, etc.

POLLUTION OF FRESHWATER STREAMS

- Flowing streams can recover from a moderate level of degradable water pollutants if they are not overloaded and their flows are not reduced.
  - In a flowing stream, the breakdown of degradable wastes by bacteria depletes DO and creates and ***oxygen sag curve***.
    - This reduces or eliminates populations of organisms with high oxygen requirements.

Water Pollution Problems in Streams



- Dilution and decay of degradable, oxygen-demanding wastes and heat in a stream.

Figure 21-4

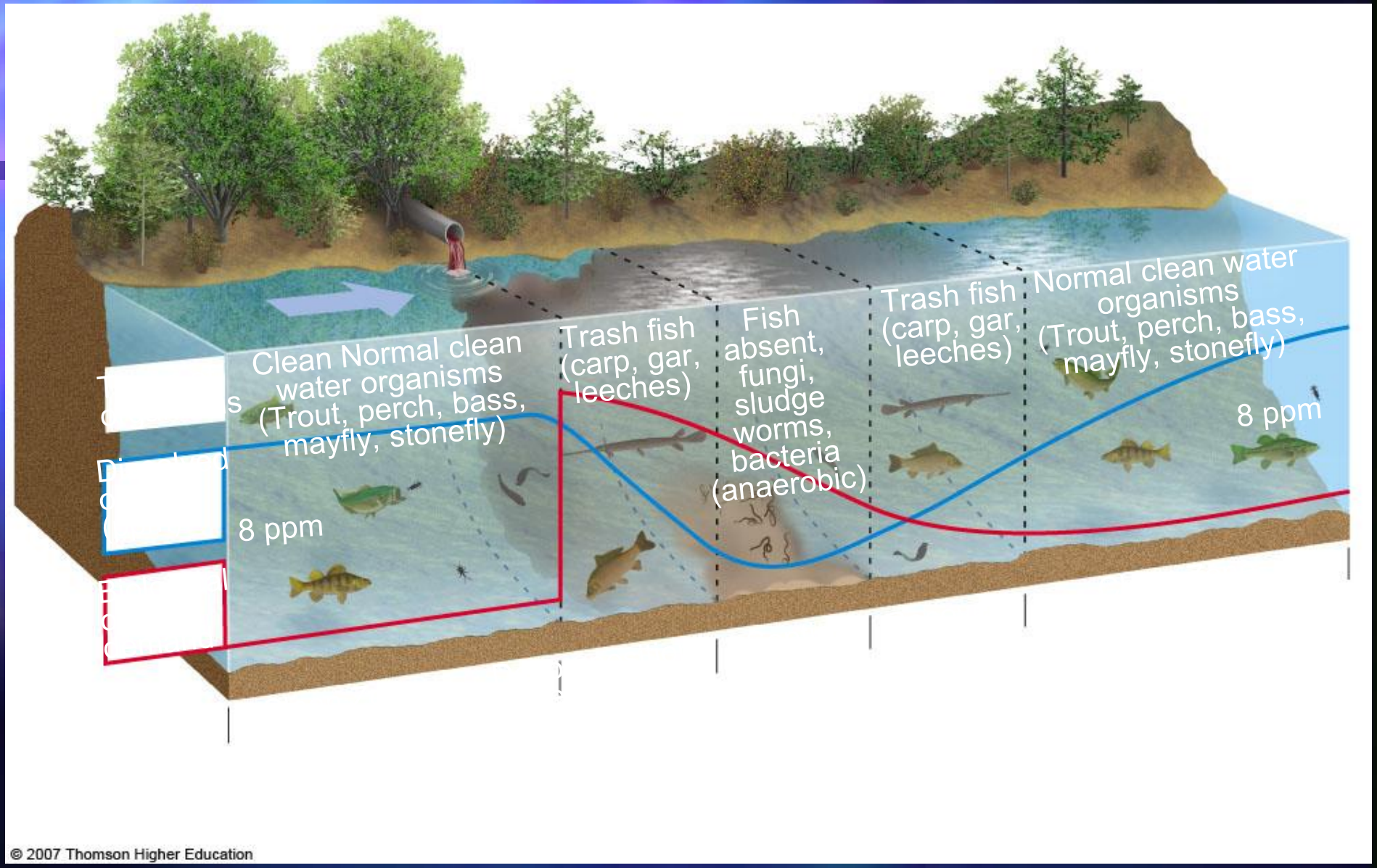


Fig. 21-4, p.

POLLUTION OF FRESHWATER STREAMS

- Most developed countries have sharply reduced point-source pollution but toxic chemicals and pollution from nonpoint sources are still a problem.
- Stream pollution from discharges of untreated sewage and industrial wastes is a major problem in developing countries.

Global Outlook: Stream Pollution in Developing Countries

- Water in many of central China's rivers are greenish black from uncontrolled pollution by thousands of factories.

Figure 21-5

Case Study: India's Ganges River: Religion, Poverty, and Health

- Religious beliefs, cultural traditions, poverty, and a large population interact to cause severe pollution of the Ganges River in India.
  - Very little of the sewage is treated.
  - Hindu believe in cremating the dead to free the soul and throwing the ashes in the holy Ganges.
    - Some are too poor to afford the wood to fully cremate.
    - Decomposing bodies promote disease and depletes DO.

Case Study: India's Ganges River: Religion, Poverty, and Health

- Daily, more than 1 million Hindus in India bathe, drink from, or carry out religious ceremonies in the highly polluted Ganges River.

Figure 21-6

POLLUTION OF FRESHWATER LAKES

- Dilution of pollutants in lakes is less effective than in most streams because most lake water is not mixed well and has little flow.
  - Lakes and reservoirs are often stratified and undergo little mixing.
  - Low flow makes them susceptible to runoff.
- Various human activities can overload lakes with plant nutrients, which decrease DO and kill some aquatic species.

Differences of Opinion

- Oceans dilute, disperse, and degrade large amounts of raw sewage, sewage sludge, oil, and some types of industrial waste, especially in deep-water areas.
- Marine life has proved to be more resilient than some scientists expected, some suggest it is safer to dump sludge & other hazardous wastes into the deep ocean than to bury them on land or burn them.

Differences of Opinion

Other scientists disagree, pointing out that we know less about the deep ocean than we do about space. They say that dumping waste in the ocean would delay urgently needed pollution prevention and promote further degradation of this vital part of the earth's life-support system.

Oil Spills

- When a tanker accident happens, it gets lots of publicity.
- But, more oil is released by normal operation of offshore wells, washing tankers & from pipeline or storage tank leaks.
- One estimate says that oil companies spill, leak, or waste per year an amount of oil equal to that shipped by 1000 huge Exxon Valdez tankers.

Floating Oil

- Oil coats the feathers of birds (especially diving birds) and the fur of marine animals, destroying the animal's natural insulation and buoyancy
- Many drown or die of exposure from loss of body heat.

Other Information

- Oil is broken down by bacteria over time; slower in cold waters
- Heavy oil components can smother bottom-dwelling organisms such as crabs, oysters, mussels, and clams, or make them unfit to eat.
- Oil spills have killed coral reefs. A recent study showed that diesel oil becomes more toxic to marine life with the passage of time.

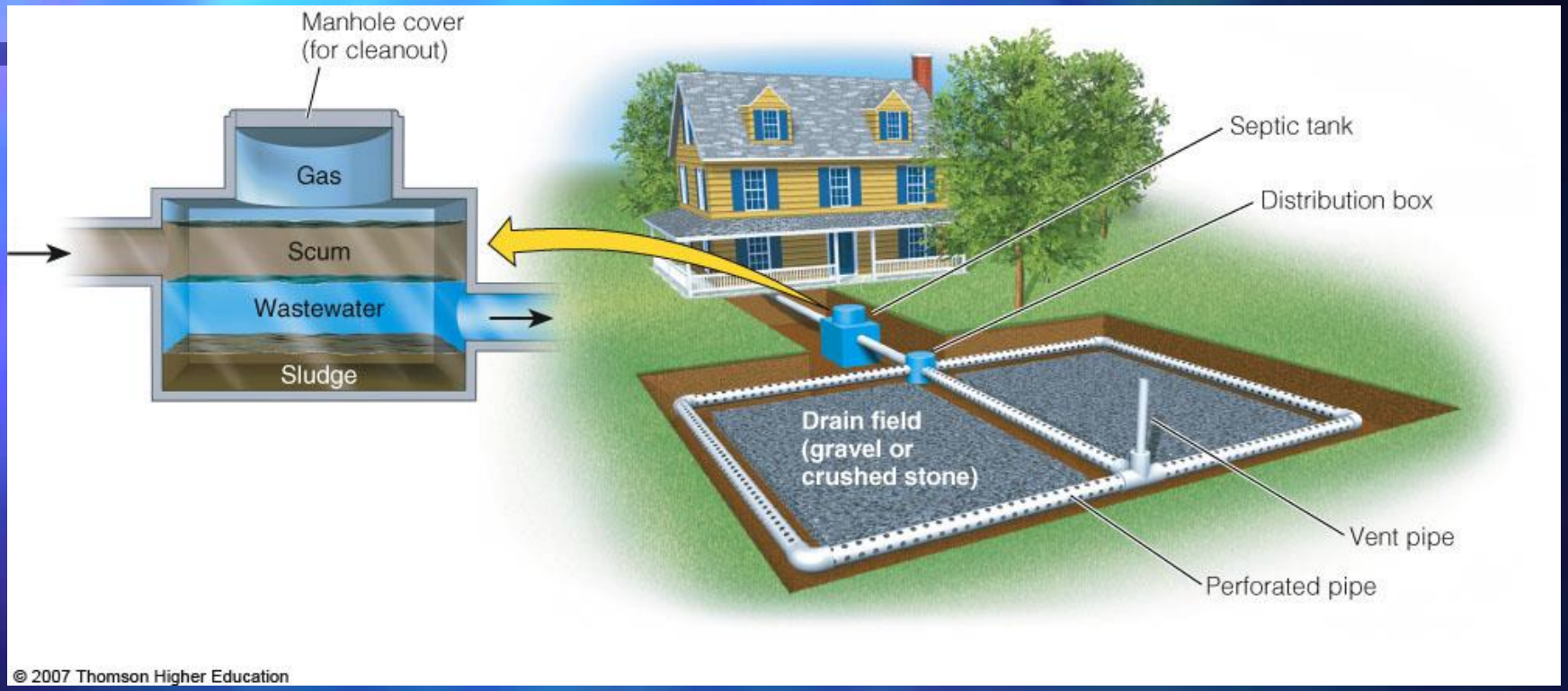
Most Common Oil-Spill Cleanup Methods

- Floating booms contain the oil spill or keep it from reaching sensitive areas
- Skimmer boats are used to vacuum up some of the oil into collection barges
- Absorbent pads or large feather-filled pillows are used to soak up oil on beaches or in waters that are too shallow for skimmer boats
- Genetically engineered bacteria can be added to degrade the oil

Chemical Methods

- Coagulating agents cause floating oil to clump together for easier pickup or sink to the bottom, where it usually does less harm.
- Dispersing agents break up oil slicks. However, these can also damage some types of organisms.
- Fire can also burn off floating oil, but crude oil is hard to ignite.

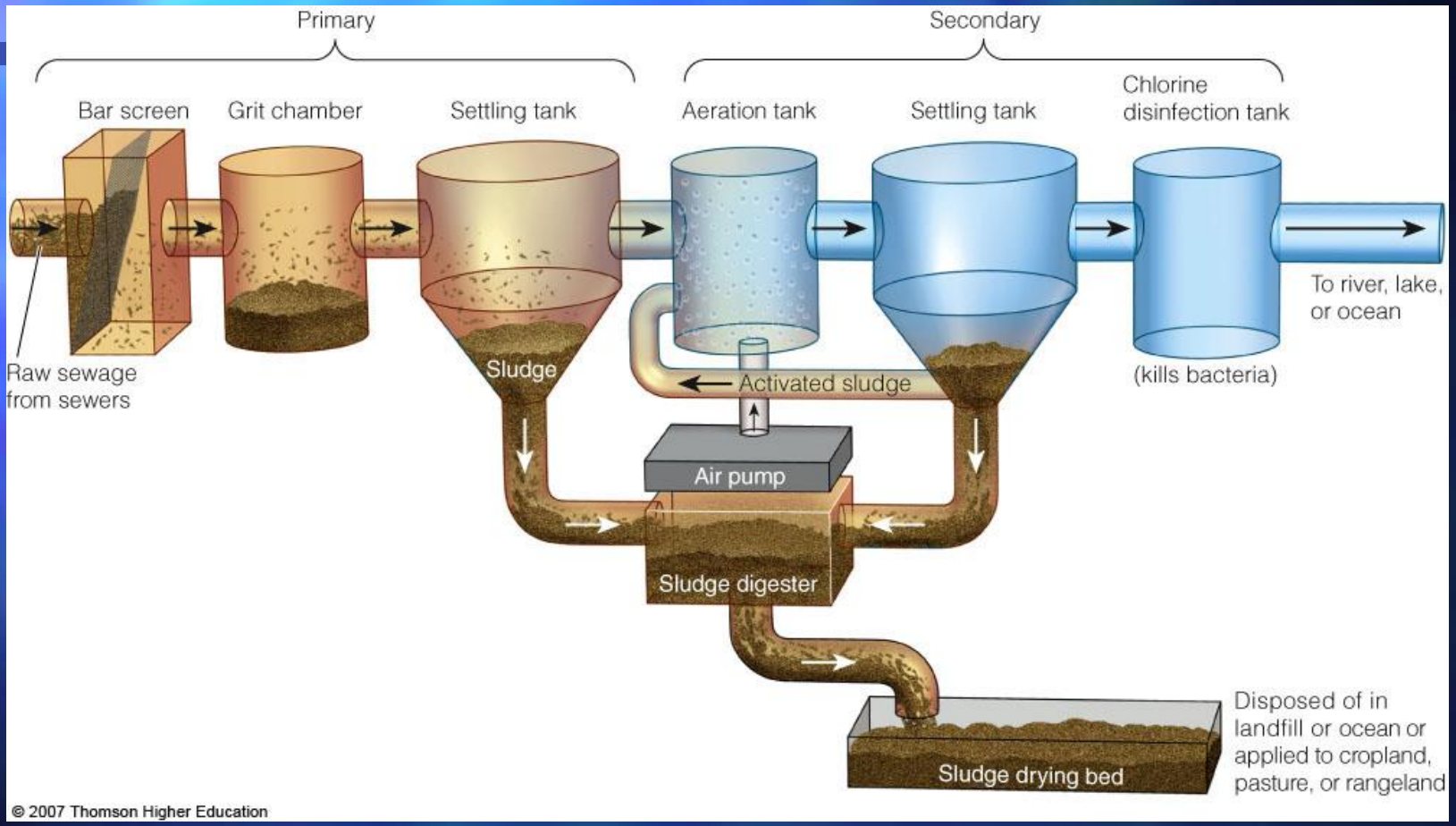
Reducing Water Pollution through Sewage Treatment



- Septic tanks and various levels of sewage treatment can reduce point-source water pollution.

Figure 21-15

Reducing Water Pollution through Sewage Treatment



- Primary and Secondary sewage treatment.

Figure 21-16

Reducing Water Pollution through Sewage Treatment

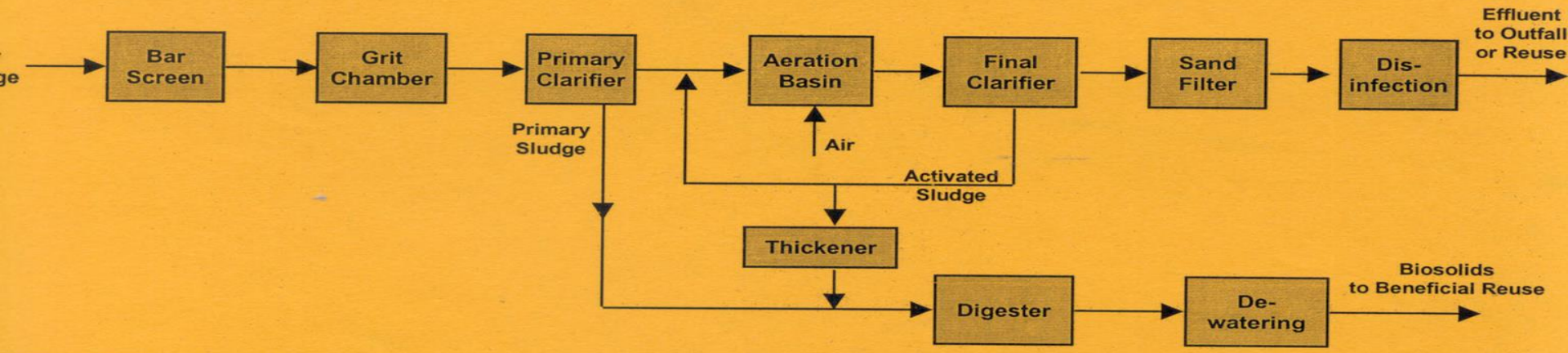
- Advanced or tertiary sewage treatment:
  - Uses series of chemical and physical processes to remove specific pollutants left (especially nitrates and phosphates).
- Water is chlorinated to remove coloration and to kill disease-carrying bacteria and some viruses (disinfect).

Reducing Water Pollution through Sewage Treatment

- Raw sewage reaching a municipal sewage treatment plant typically undergoes:
  - ***Primary sewage treatment***: a physical process that uses screens and a grit tank to remove large floating objects and allows settling.
  - ***Secondary sewage treatment***: a biological process in which aerobic bacteria remove as much as 90% of dissolved and biodegradable, oxygen demanding organic wastes.

Water Treatment

Water Recycling Process



Includes:

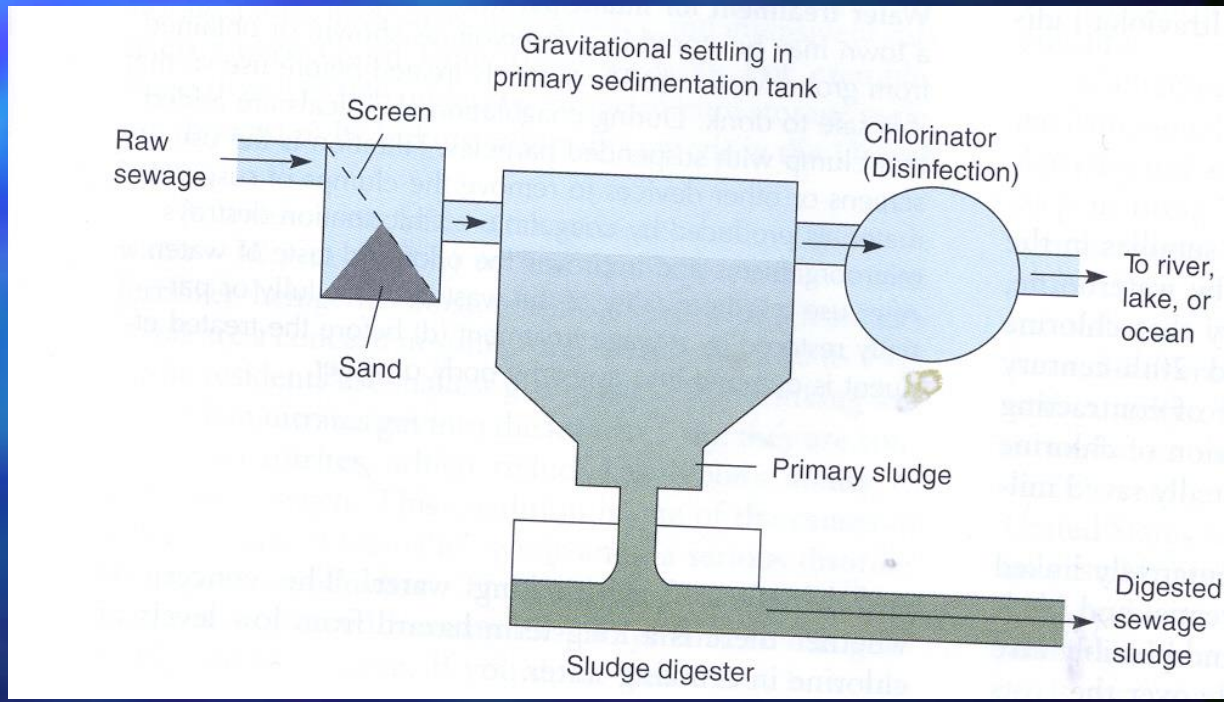
- *Physical systems*
- *Biological systems*
- *Chemical systems*

San Antonio

Primary

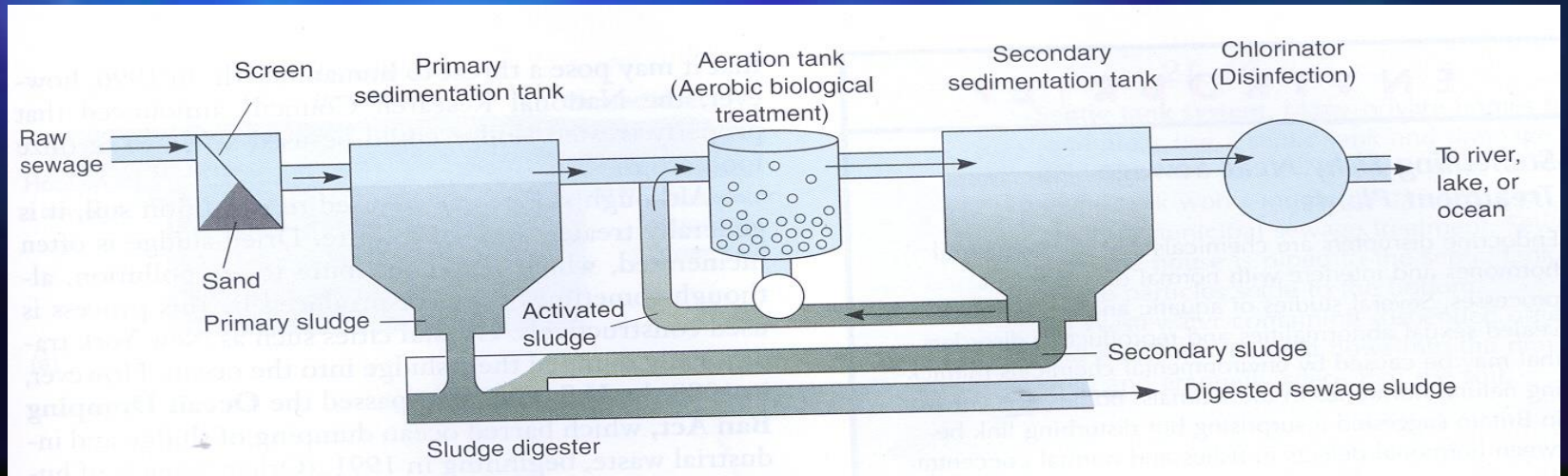
- Removes suspended and floating particles, such as sand and silt, by mechanical processes such as screening and gravitational settling. The solid material that is settled out is called primary sludge.

Bar screens, grit chambers, primary clarifiers, digesters and pre-aeration



Secondary

- Uses microorganisms to decompose the suspended organic material in wastewater. Ex. trickling filters – where wastewater trickles through aerated rock beds that contain bacteria and other microorganisms, which degrade the organic material in the water.



Secondary (Cont.)

- Or activated sludge process – wastewater is aerated and circulated through bacteria-rich particles; the bacteria degrade suspended organic material. After several hours, the particles and microorganisms are allowed to settle out, forming secondary sludge.
- Use aeration basins, settling tanks and sand filters

Tertiary

- This includes a variety of biological, chemical and physical processes used to remove phosphorus and nitrogen, the nutrients most commonly associated with enrichment. Tertiary treatment can also be used to purify wastewater so that it can be reused in communities where water is scarce.
- Use chlorine as a disinfection and then chlorine is removed by SO2 so it can be released into river.

Reducing Water Pollution through Sewage Treatment

- Natural and artificial wetlands and other ecological systems can be used to treat sewage.
  - California created a 65 hectare wetland near Humboldt Bay that acts as a natural wastewater treatment plant for the town of 16,000 people.
    - The project cost less than half of the estimated price of a conventional treatment plant.

Core Case Study: Using Nature to Purify Sewage

- Ecological wastewater purification by a ***living machine***.
  - Uses the sun and a series of tanks containing plants, snails, zooplankton, crayfish, and fish (that can be eaten or sold for bait).

Figure 21-1

Water Quality
United States

- Groundwater contamination still occurs, especially due to non-point source pollution, but laws like the Safe Drinking Water Act, Clean Water Act, and Water Quality Act have helped in the U.S.

Global Problems

- According to the World Health Organization, an estimated 1.4 billion people still do not have access to adequate sanitation systems. Worldwide, at least 250 million cases of water-related illnesses occur each year, with 5 million or more of these resulting in death.

Specific Water Quality Measures

Dissolved Oxygen

- The amount of oxygen gas dissolved in a given volume of water at a particular temperature and pressure.

Carbon Dioxide

- Enters aquatic systems from the atmosphere and from respiration by animals.
- The concentration of CO2 varies at different depths because of light/photosynthesis.

Nitrate

- Contaminates shallow groundwater (100 feet or less) and usually comes from fertilizers. It's a concern in rural areas where 80-90% of the residents use shallow groundwater for drinking. This harms humans because it reduces the blood's ability to transport oxygen.

Sulfate

- Problem because too much can kill fish. Gets in water from industrial processes and mining.

Iron

- Causes problems because it separates out of the water and forms particulates (sediment), it tastes bad if it gets in our water, and can coat fish's gills. Groundwater problems in wells, from natural minerals in rocks.

Phosphate

- Plant nutrients that cause algae blooms. It comes from detergents, human wastes and fertilizers.

Coliform

- General group of bacteria from animal wastes. It uses up available oxygen. Also causes e-coli disease and is used as an indicator of water safety.

Giardia

- Organism (protozoa) that can cause diarrhea if you drink unchlorinated water. It is a natural organism that lives in the guts of animals.

Chloride

- Part of salts, but too many can cause too much salt in the water. Too much is bad; a little is okay. It is naturally found in water, but can come from pollution.

pH

- Too high/too low can be bad; fish like 6.5-9.5; acid mine drainage can kill fish.

Hard Water

Definition

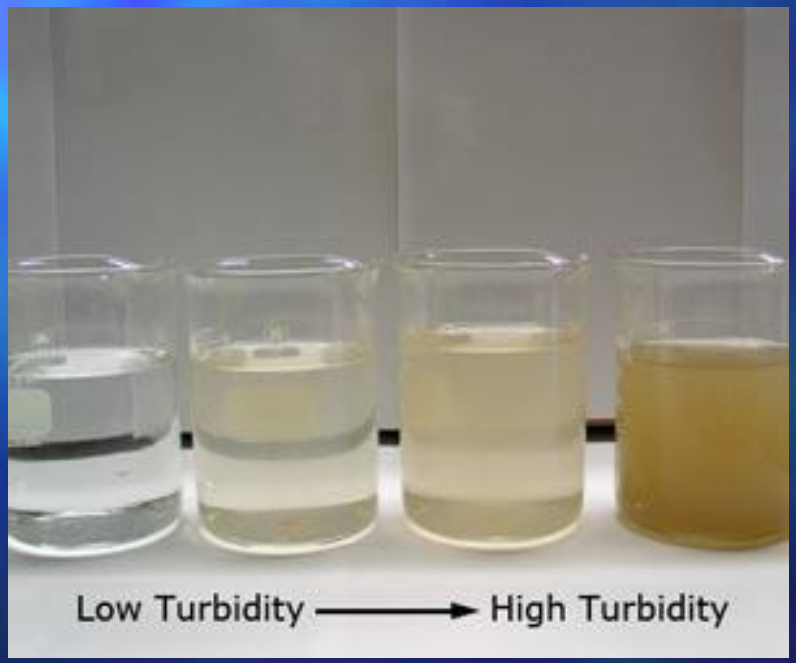
- Calcium and magnesium in the water. Can cause problems with cleaning clothes. Soap doesn't bubble as much.

Hardness

- Calcium and magnesium dissolved in the water. A little is good (50-400 ppm for fish is good), but very low or high is a problem. Low is more of a problem. Affects fish eggs, poor bone development.

Turbidity

- Cloudiness/muddiness; blocks the light; coats fish gills.



Methods of Treating

Ion Exchange

- Substitute sodium for calcium and magnesium. Water softeners usually do this.

Reverse Osmosis

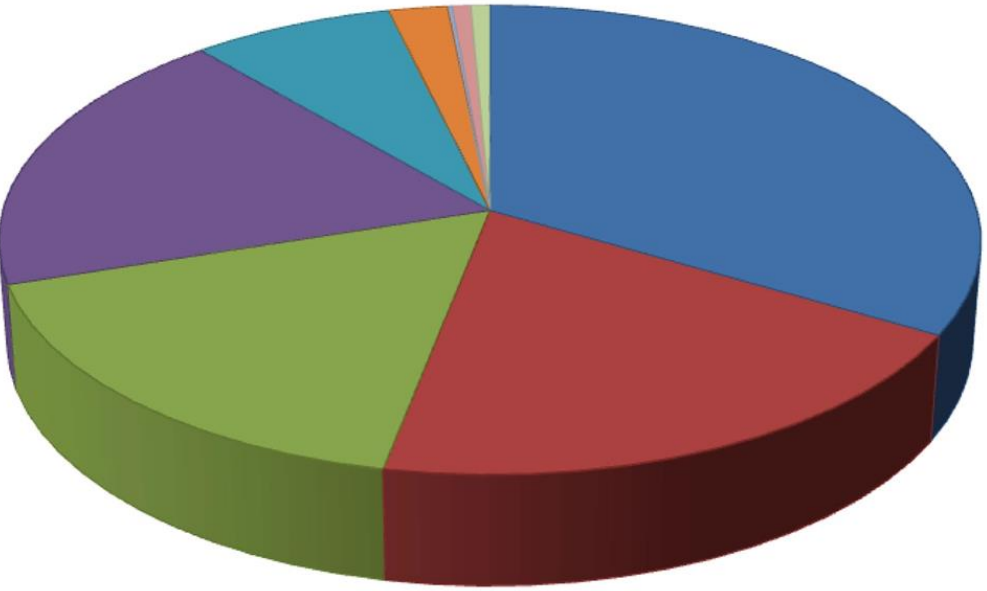
- Membrane system that allows water to go through but calcium and magnesium cannot.

POLLUTION OF GROUNDWATER

- Leaks from a number of sources have contaminated groundwater in parts of the world.
  - According the the EPA, one or more organic chemicals contaminate about 45% of municipal groundwater supplies.
  - By 2003, the EPA had completed the cleanup of 297,000 of 436,000 underground tanks leaking gasoline, diesel fuel, home heating oil, or toxic solvents.

Case Study: Arsenic in Groundwater - a Natural Threat

- Toxic Arsenic (*As*) can naturally occur at high levels in soil and rocks.
- Drilling into aquifers can release *As* into drinking water supplies.
- According to WHO, more than 112 million people are drinking water with *As* levels 5-100 times the 10 ppb standard.
  - Mostly in Bangladesh, China, and West Bengal, India.



- paralysis of the lower limbs
- arms and other body parts
- keratosis
- melanosis
- hyperkeratosis
- dipigmentation (leuco-melanosis)
- Cancers

33 As

Arsenic is a toxic element that is both naturally-occurring in Earth's crust and artificially-produced in agricultural and industrial processes. Most arsenic compounds have no color, smell, or taste—making the chemical dangerously difficult to recognize. In diverse climates and geographies, arsenic contaminates prominent groundwater sources. Exposure to arsenic, especially with the last few decades, has caused illness and death in societies from the United States to Bangladesh, where one in five deaths can be attributed to arsenic poisoning.

Arsenic can enter the air through rock erosion, mining activity, volcanic eruptions, or forest fires.

The main source of arsenic in drinking water (usually from wells) is arsenic-rich rocks through which the water has been filtered.

When contaminated groundwater is used to irrigate fields, the element accumulates in soil and crops, particularly rice.

Arsenic can enter surface water through runoff from certain agricultural and industrial activities.

In communities where residents cook with and drink from the same contaminated well, arsenic intake multiplies.

Salinization

- Another water-use problem caused by growing salt concentrations in soil
- More likely with long-term irrigation
- As water evaporates, salt concentrates

Groundwater Mining

- When water is removed from an

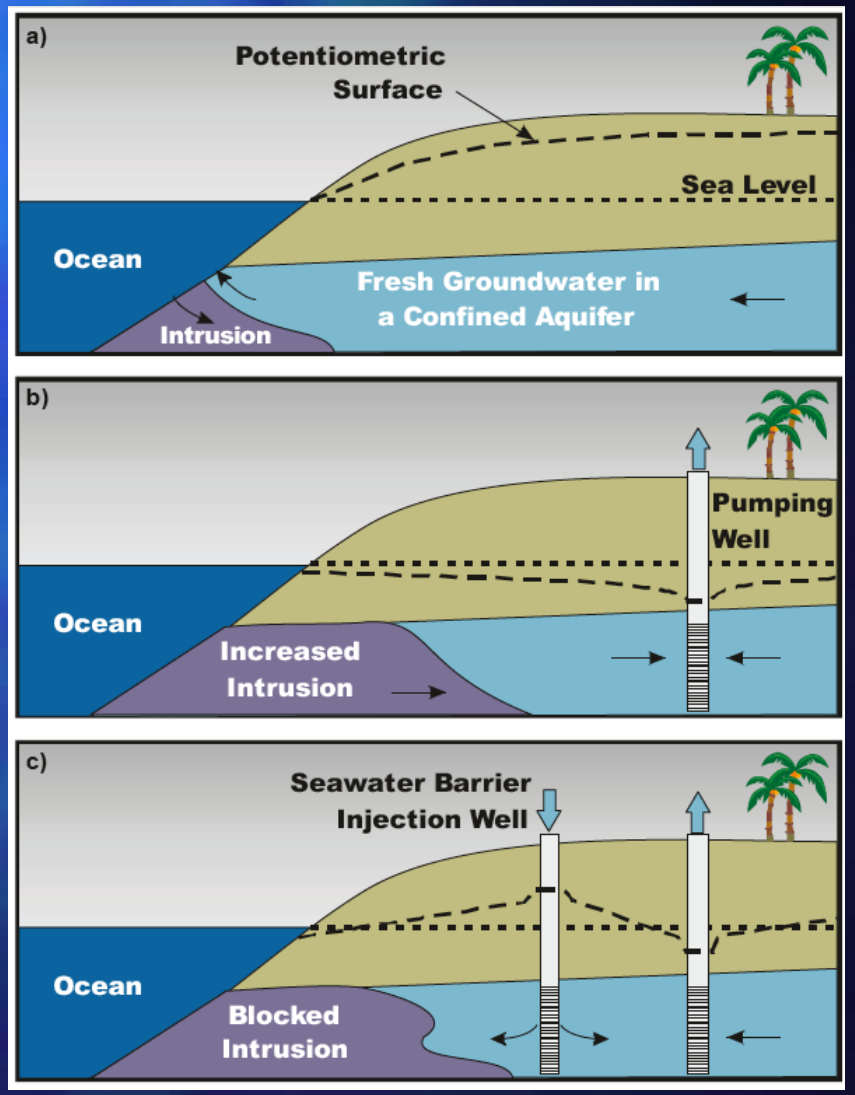
aquifer faster than it is replaced.

- Causes decline of water table and can eventually exhaust supply
- Can cause settling of ground surface (subsidence)

Saltwater intrusion

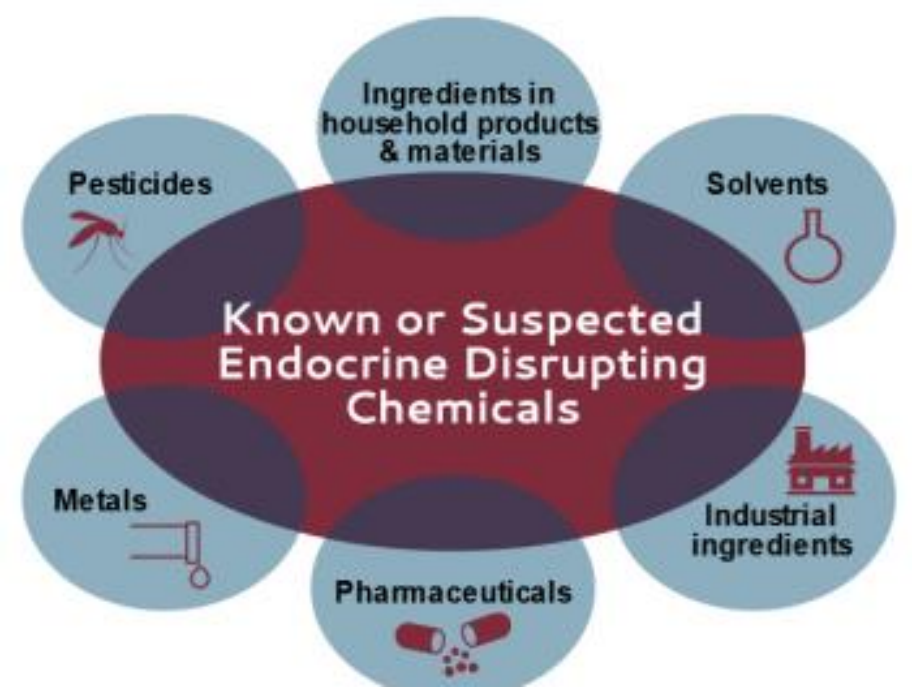
- Problem in coastal areas
- Freshwater pumped from wells moves saline groundwater inland

Saltwater Intrusion Destroys Crops



Endocrine disruptors

- Chemicals (like DDT, dioxin and PCBs) that can interfere with the endocrine system of animals
- Can lead to birth defects, developmental disorders, and gender imbalances in fish and other species



Water Legislation

Safe Drinking Water Act

- It required the EPA to determine the maximum contaminant level, the max permissible amount of any pollutant in community water supplies that might adversely affect human health.

PREVENTING AND REDUCING SURFACE WATER POLLUTION

- Most developed countries use laws to set water pollution standards, but such laws rarely exist in developing countries.
  - The U.S. Clean Water Act sets standards for allowed levels of key water pollutants and requires polluters to get permits.
  - EPA is experimenting with a ***discharge trading policy*** similar to that for air pollution control.

Clean Water Act

- Has two basic goals:
  - To eliminate the discharge of pollutants in U.S. waterways (mandates the restoration and maintenance of the chemical, physical, and biological integrity of water.
- To attain water quality levels that make these waterways safe to fish and swim in.

Water Quality Act

- controlling toxic pollutant discharges
- control non-point sources of pollution
- authorized $18 billion for wastewater treatment
- address problems such as coastal estuaries, the Great Lakes, and the Chesapeake Bay

Using Laws to Protect Drinking Water

- The U.N. estimates that 5.6 million Americans drink water that does not meet EPA standards.
- 1 in 5 Americans drinks water from a treatment plant that violated one or more safety standard.
- Industry pressures to weaken the Safe Drinking Act:
  - Eliminate national tests and public notification of violations.
  - Allow rights to pollute if provider cannot afford to comply.

Water Pollution Review