

Water Pollution

Chapter 20

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Water Pollution Comes from Point and Nonpoint Sources

□ **Water pollution**

◦ Any chemical, biological, or physical change in water quality that harms living organisms or makes water unsuitable for desired uses.


□ **Two types of pollution**

◦ **Point sources – pollutants located at a specific locations through drain pipes, ditches, or sewer lines.**

- Located at specific places
 - Easy to identify, monitor, and regulate
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Water Pollution Comes from Point and Nonpoint Sources


• Nonpoint sources

- Broad, diffuse areas
 - Difficult to identify and control
 - Expensive to clean up – because there is not one fix to the problem, you must identify the source first and then clean it up.
 - Examples – runoff of chemicals and sediments from cropland, parking lots, golf courses, feedlots, etc.
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Sources of Water Pollution

- **Agriculture activities: leading cause of water pollution**
 - Sediment eroded from the lands
 - Fertilizers and pesticides
 - Bacteria from livestock and food processing wastes

 - **Industrial facilities**
 - Harmful inorganic and organic chemicals (detergents, oil, toxic metals, acids)

 - **Mining**
 - Erosion of sediments and runoff of toxic chemicals due to land disturbance
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Sources of Water Pollution

□ Other sources of water pollution

- Parking lots – grease, toxic metals, and sediments. Can worsen flooding because ground water can't seep into ground.
- Human-made materials
 - E.g., plastics – polymers that make up plastics break down slowly and pollute waterways when discarded improperly into waterways. Also harm wildlife.
 - Climate change due to global warming – more rain will wash more pollution into waterways, drought will not allow dilution of wastes.


Major Water Pollutants and Their Sources

Table 20-1

Major Water Pollutants and Their Sources

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

Water Quality Testing

- Variety of tests to determine water quality:
 - **Coliform bacteria:** *Escherichia coli* – this is a bacteria found in fecal matter of animals and humans
 - **significant levels**
 - Safe for drinking – ½ cup should have no coliform bacteria
 - Safe for swimming – ½ cup should contain no more than 200 colonies
 - Chemical analysis
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Water Quality Testing

□ **Level of dissolved oxygen (DO)**

• This test is the most important of the nine water quality tests to measure water's ability to support plants and animals. There are many different factors that affect the amount of dissolved oxygen in water, the main one being temperature. As temperature rises, less gas will dissolve.

Water Quality Testing

□ Turbidity

• Turbidity measures water clarity, which allows sunlight to penetrate to a greater depth. The main sources of turbidity are erosion, living organisms, and those from human endeavors.

□ pH

• The PH of water is important to aquatic life. If the pH falls below 4 or above 9 everything is dead.

□ Temperature

• To measure temperature and flow rate you must find two places along the river that are about 1.6 kilometers apart that have the same conditions, then two people measure the temperature at approximately the same time. If the difference is greater than 2 degrees Celsius, then there is thermal pollution.

Water Quality Testing

□ Flow rate

- To find flow rate you use a buoyant object, we used an orange, and float it down the river.

□ Nitrates and phosphates

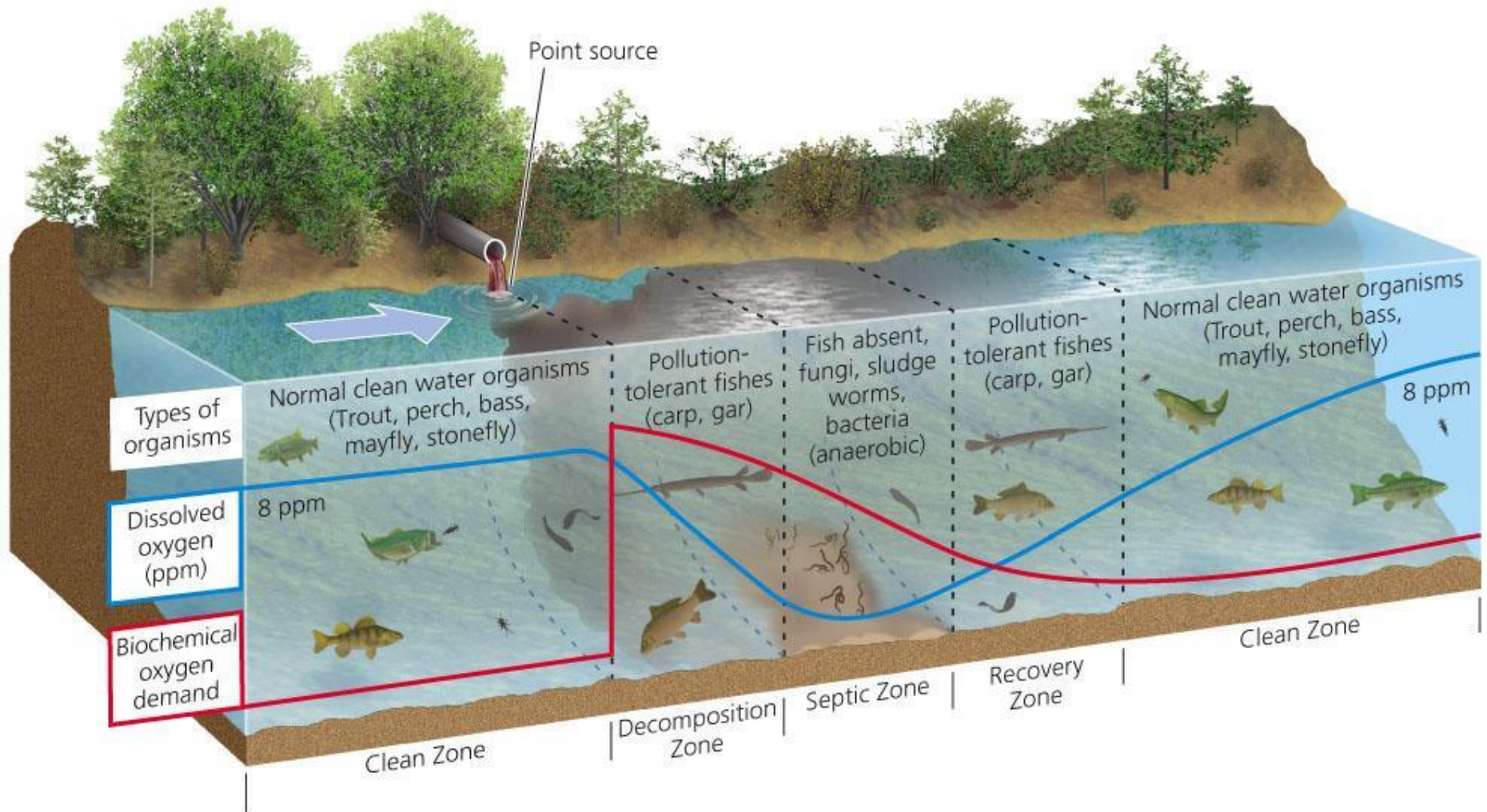
- Nitrogen is necessary for plant and animal life. Water is tested for nitrates to monitor and control eutrofication , which causes more plant growth and decay.

- Phosphates is a nutrient needed in growth. The phosphate ion is found in shells, bones, and in animal teeth. By removing phosphorous from sewage the amount of phosphate ions in the water will be lowered.


□ Biological Oxygen Demand (BOD)

- BOD is a measure of oxygen removed from an aquatic environment by aerobic microorganisms. It measures levels of organic pollution in lakes and streams.

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




Other Contaminants

- Lead
 - Arsenic
 - Mercury
 - Acid deposition
 - Pesticides
 - Fertilizers
 - Pharmaceuticals
 - Hormones
 - Military compounds
 - Industrial compounds
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Oil Pollution

- Sources
 - Deep sea oil drilling
 - Tankers
- Remediation methods
 - Oil vacuums
 - Chemical break-up
 - Genetically engineered bacteria
 - Animals
- Diasters
 - BP (2010), Exxon Valdez (1989)

There Are Many Ways to Purify Drinking Water

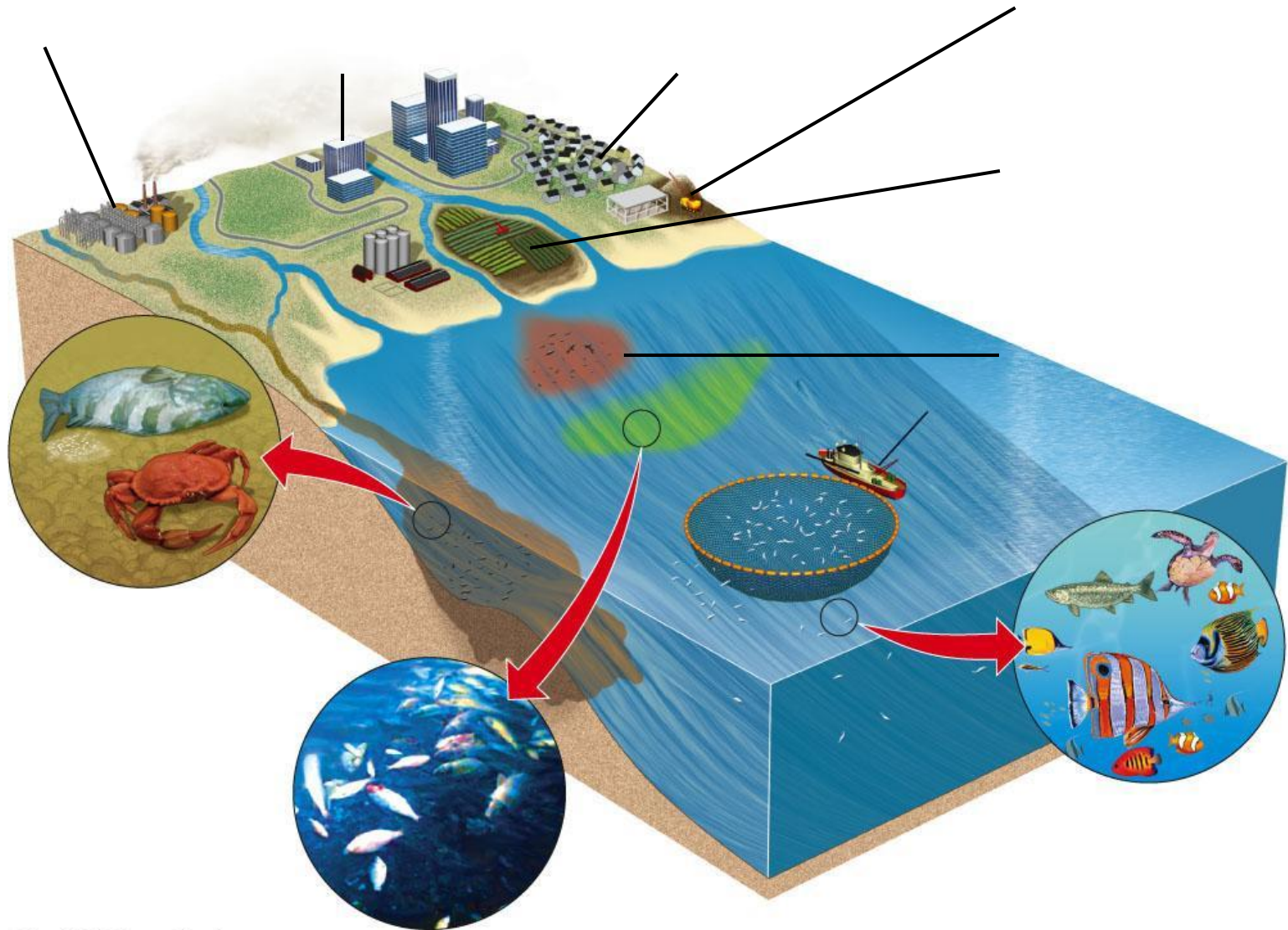
- Reservoirs and purification plants
 - Process sewer water to drinking water
 - Expose clear plastic containers to sunlight (UV)
 - Nanofilters
 - The LifeStraw
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The LifeStraw: Personal Water Purification Device



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
- Clean Water Act 1972 – deals only with surface water not groundwater nor water quantity. Used to sharply reduce point source water pollution, manage polluted runoff, and finance wastewater management
 - 5.6 million Americans are estimated to drink water that does not meet EPA standards
- Water-polluting companies: weaken the law by eliminating national tests and public notifications, allow states to give waivers to treatment plants if they can't afford to comply, reduce EPA funding



We Need to Reduce Surface Water Pollution from Nonpoint Sources

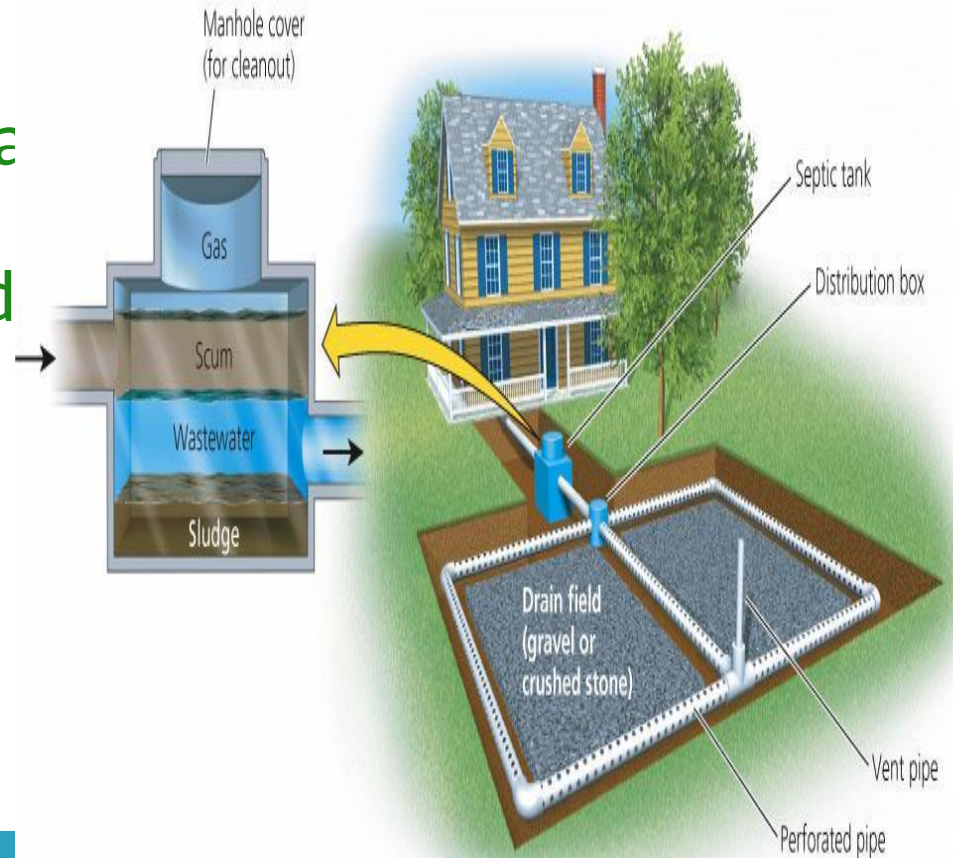
- Reduce erosion
 - Keep cropland covered with vegetation
- Reduce the amount of fertilizers
 - Plant buffer zones of vegetation
 - Use organic farming techniques

We Need to Reduce Surface Water Pollution from Nonpoint Sources

- Use pesticides prudently – only when necessary and relying more on IPM methods
 - Control runoff – use buffer zones
 - Tougher pollution regulations for livestock operations
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Sewage Treatment Reduces Water Pollution

- **Septic tank system** – typically used in rural areas and some suburban areas where waste is discharged from home into tank and large drainage field.



□ **Wastewater or sewage treatment plants** – most home in US use this system

◦ **Primary sewage treatment**

- Physical process – uses screens and grit tanks to remove large floating objects and to allow solids such as sand and rocks to settle out
- Settling tank – waste water is pumped through here where solid waste settles out as sludge
- 60% of suspended solids are filtered out in this step and 30–40% of oxygen-demanding organic wastes
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.Secondary sewage treatment

.Biological process – aerobic bacteria remove as much as 90% of dissolved and biodegradable oxygen-demanding organic wastes

.Tertiary or advance sewage treatment – used to remove specific pollutants such as phosphates and nitrates

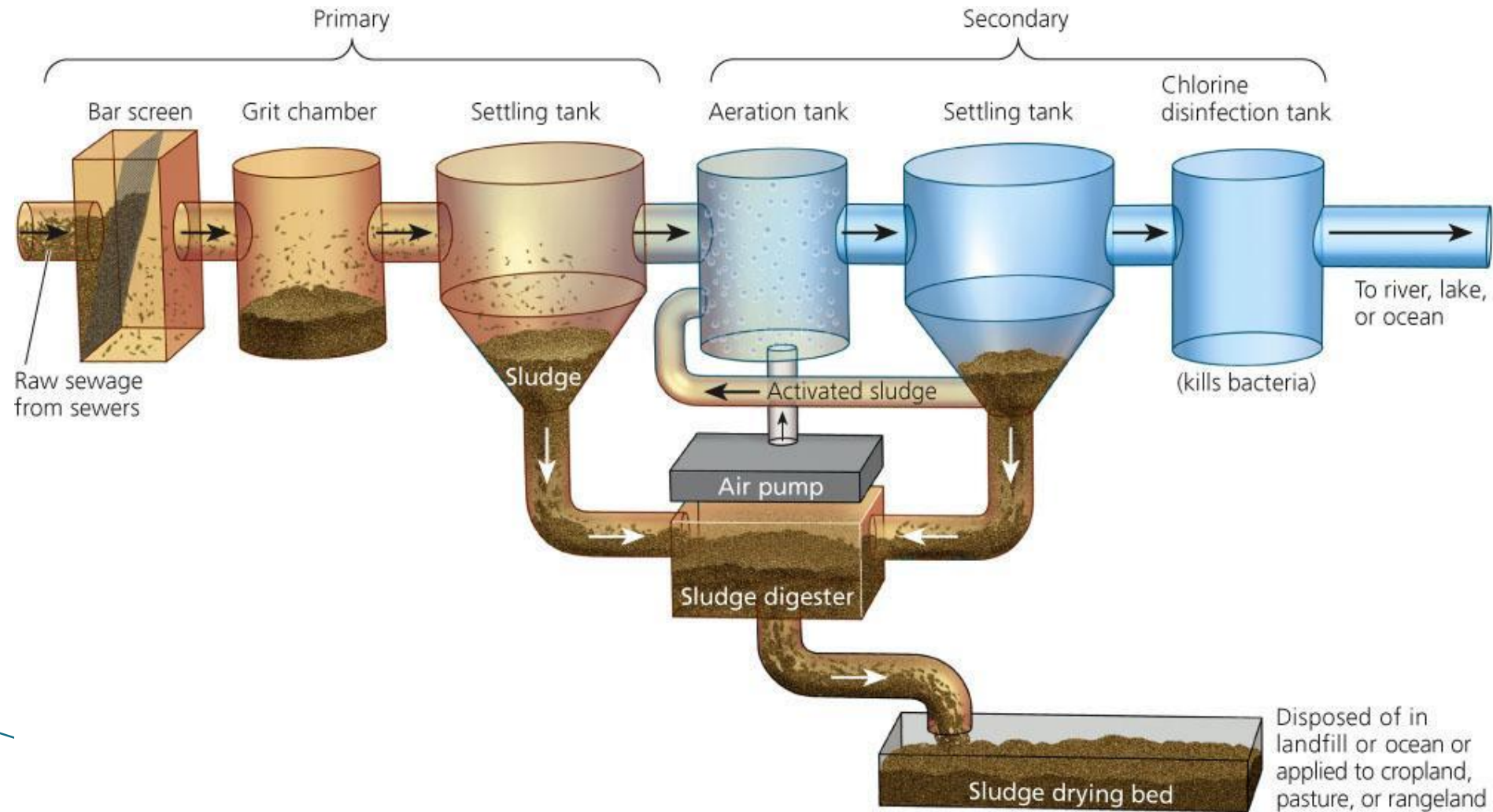
.Bleaching – done before water is discharged. Used to remove water coloration

.Disinfection – used to kill disease-carrying bacteria and some viruses. Most common way to do this is to use chlorine (chlorination).

.US requires primary and secondary treatment of all sewage



Primary and Secondary Sewage Treatment



Sewage Treatment Reduces Water Pollution

- Should there be separate pipes for sewage and storm runoff?
 - A lot of cities combine pipes because it is cheaper = can back up when there is heavy rain into homes or into water ways.

Water Pollution, Methods for Preventing and Reducing Water Pollution

SOLUTIONS

Water Pollution

- Prevent groundwater contamination
- Reduce nonpoint runoff
- Reuse treated wastewater for irrigation
- Find substitutes for toxic pollutants
- Work with nature to treat sewage
- Practice the three R's of resource use (reduce, reuse, recycle)
- Reduce air pollution
- Reduce poverty
- Slow population growth

What Can You Do? Water Pollution, Ways to Help Reduce Water Pollution

WHAT CAN YOU DO?

Reducing Water Pollution

- Fertilize garden and yard plants with manure or compost instead of commercial inorganic fertilizer
- Minimize your use of pesticides, especially near bodies of water
- Prevent yard wastes from entering storm drains
- Do not use water fresheners in toilets
- Do not flush unwanted medicines down the toilet
- Do not pour pesticides, paints, solvents, oil, antifreeze, or other products containing harmful chemicals down the drain or onto the ground