

Water Pollution

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Overview

- Types of Water Pollution
 - Sewage
 - Disease-causing agents
 - Sediment pollution
 - Inorganic plant and algal nutrients
 - Organic compounds
 - Inorganic chemicals
 - Thermal pollution
- Water Quality Today
- Improving Water Quality
- Laws Controlling Water Pollution

Types of Water Pollution

1. Water pollution

1. Any physical or chemical change in water that adversely affects the health of humans and other organisms
2. Varies in magnitude by location

2. Major water pollution issue globally

1. Lack of disease-free water

3. Eight categories

1. Sewage, disease-causing agents, sediment pollution, inorganic plant and algal nutrients, organic compounds, inorganic chemicals, radioactive substances, and thermal pollution

Sewage

- The release of wastewater from drains or sewers
 - Includes human wastes, soaps, and detergents
- Causes 2 serious environmental problems:
 - Enrichment
 - Fertilization of a body of water by high levels of plant and algal nutrients (nitrogen and phosphorus)
 - Increase in Biological Oxygen Demand (BOD)
 - Amount of oxygen needed by microorganisms to decompose biological wastes
 - As BOD increases Dissolve Oxygen (DO) decreases

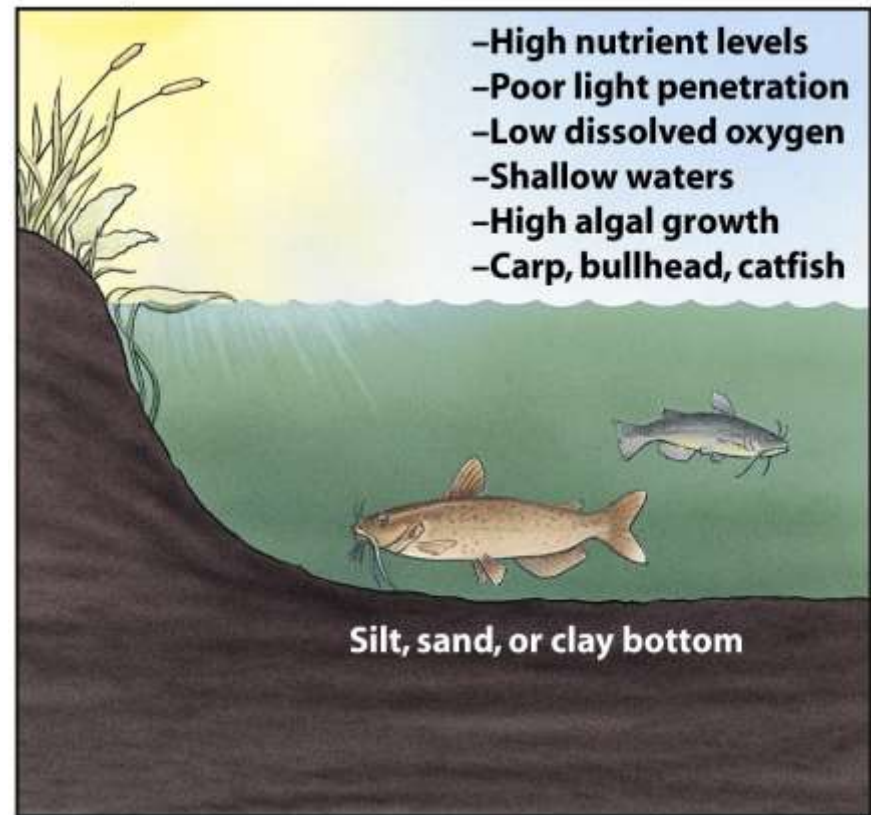
Sewage- Eutrophication

- **Eutrophic-**

- **Slow-flowing stream, lake or estuary enriched by inorganic plant and algal nutrients such as phosphorus**
- **Often due to fertilizer or sewage runoff**



Eutrophic lake



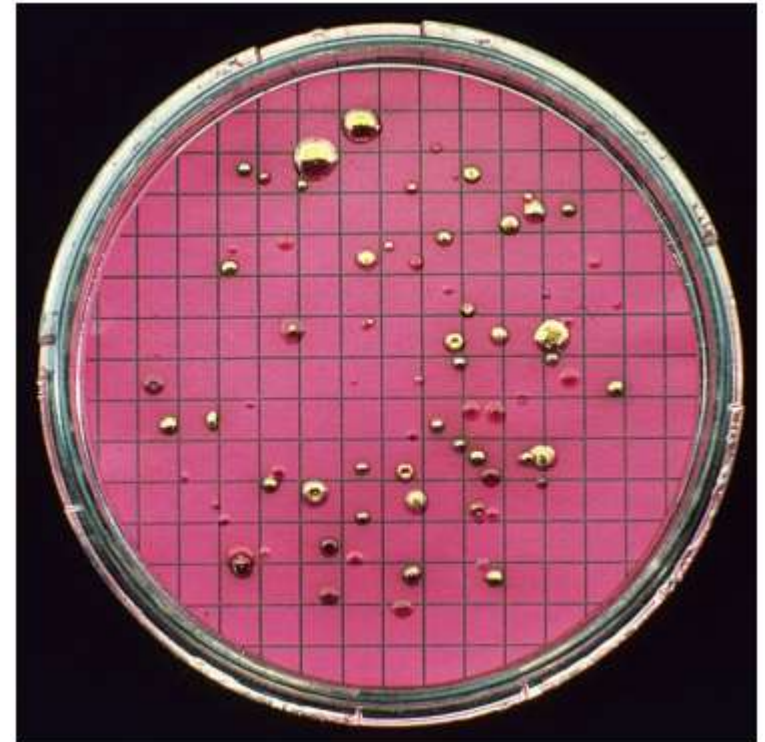
Disease-causing Agents

- Infectious organisms that cause diseases
 - Originate in the wastes of infected individuals
- Common bacterial or viral diseases:
 - Typhoid, cholera, bacterial dysentery, polio, and infectious hepatitis

<i>Disease</i>	<i>Infectious Agent</i>
Cholera	<i>Vibrio cholerae</i>
Dysentery	<i>Shigella dysenteriae</i>
Enteritis	<i>Clostridium perfringens</i>, other bacteria
Typhoid	<i>Salmonella typhi</i>
Infectious hepatitis	Hepatitis virus A
Poliomyelitis	Poliovirus
Cryptosporidiosis	<i>Cryptosporidium</i> sp.
Amoebic dysentery	<i>Entamoeba histolytica</i>
Schistosomiasis	<i>Schistosoma</i> sp.
Ancylostomiasis	<i>Ancylostoma</i> sp.

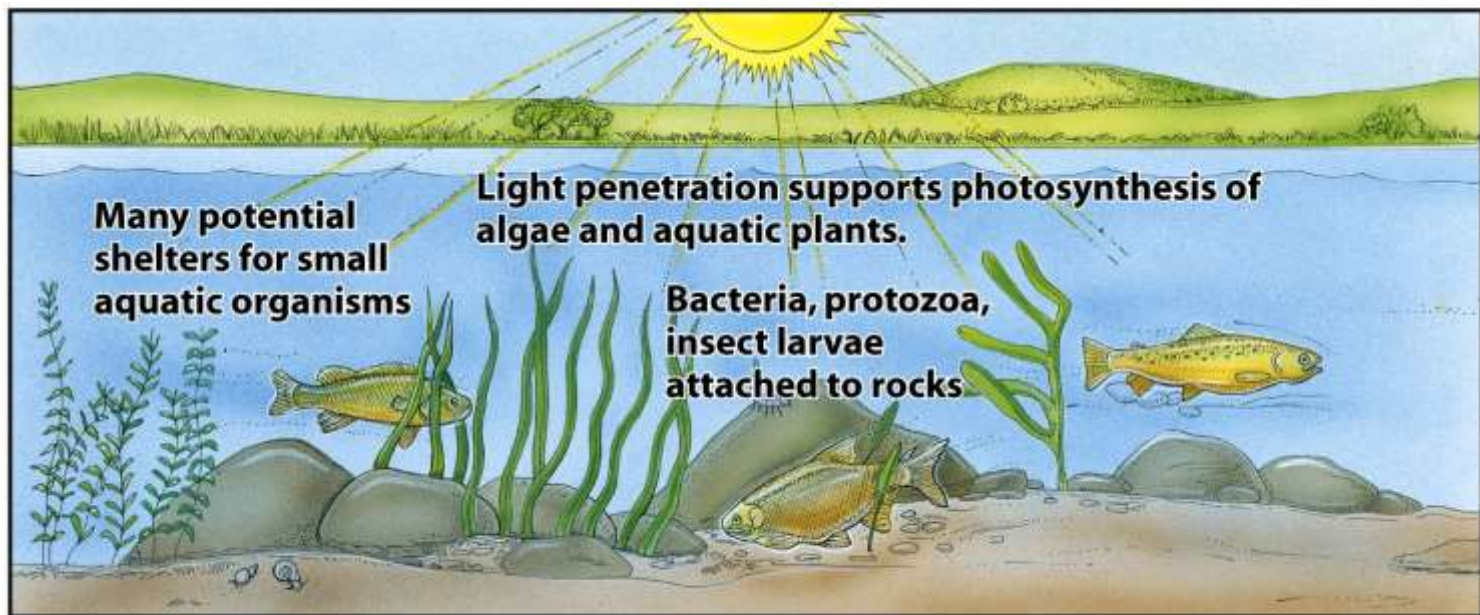
Disease-causing Agents

- Monitored by testing for presence of E. coli in the water via a fecal coliform test
 - Indicates the presence of pathogenic organisms

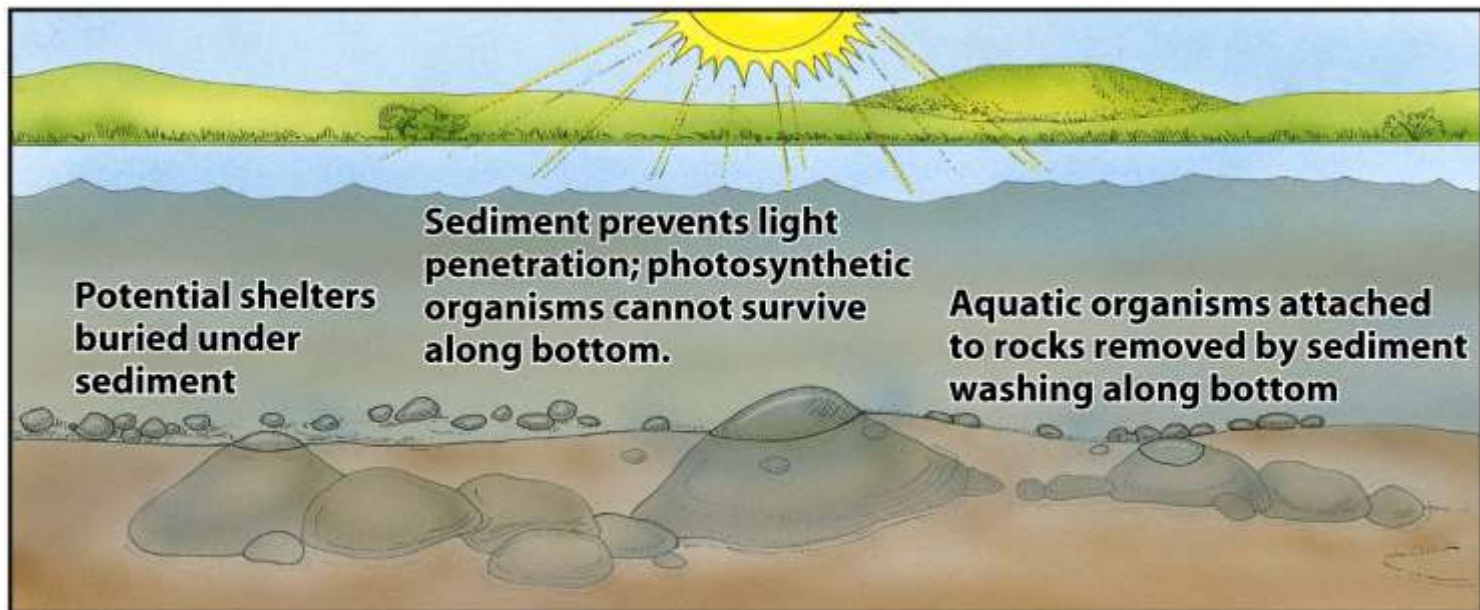


Sediment Pollution

- Excessive amounts of suspended soil particles
 - Originates from erosion of agricultural lands, forest soils exposed by logging, degraded stream banks, overgrazed rangelands, strip mines, and construction
- Problems
 - Limits light penetration
 - Covers aquatic animals and plants
 - Brings insoluble toxins into waterways



Stream ecosystem with low level of sediment



Same stream with high level of sediment

Inorganic Plant and Algal Nutrients

- Chemicals such as nitrogen and phosphorus that stimulate the growth of plants and algae
 - Harmful in large concentrations
- Sources:
 - Human and animal wastes, plant residues, atmospheric deposition, and fertilizer runoff
- Causes:
 - Enrichment, bad odors, and a high BOD

Organic Compounds

- Chemicals that contain carbon atoms
 - Natural examples: sugars, amino acids, and oils
 - Human-made examples: pesticides, solvents, industrial chemicals, and plastics

Table 22.2 Some Synthetic Organic Compounds Found in Polluted Water

<i>Compound</i>	<i>Some Reported Health Effects</i>
Aldicarb (pesticide)	Attacks nervous system
Benzene (solvent)	Associated with blood disorders (bone marrow suppression); leukemia
Carbon tetrachloride (solvent)	Possibly causes cancer; liver damage; may also attack kidneys and vision
Chloroform (solvent)	Possibly causes cancer
Dioxins (TCDD) (chemical contaminants)	Some cause cancer; may harm reproductive, immune, and nervous systems
Ethylene dibromide (EDB) (fumigant)	Probably causes cancer; attacks liver and kidneys
Polychlorinated biphenyls (PCBs) (industrial chemicals)	Attack liver and kidneys; possibly cause cancer
Trichloroethylene (TCE) (solvent)	Probably causes cancer; induces liver cancer in mice
Vinyl chloride (plastics industry)	Causes cancer

Inorganic Chemicals

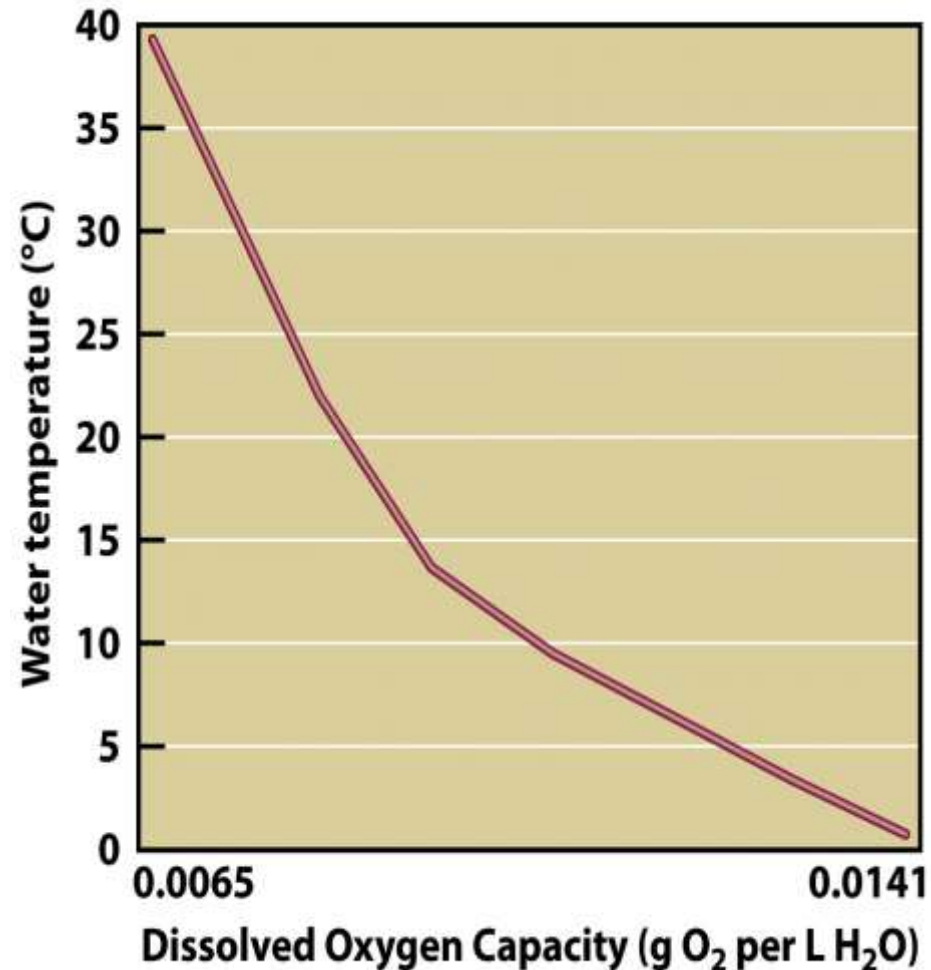
- Contaminants that contain elements other than carbon
 - Examples: acids, salts, and heavy metals
- Do not degrade easily
- Lead
 - Found in old paint, industrial pollutants, leaded gasoline
- Mercury
 - Mercury bioaccumulates in the muscles of top predators of the open ocean

Radioactive Substances

- Contain atoms of unstable isotopes that spontaneously emit radiation
- Sources
 - Mining
 - Processing radioactive materials
 - Nuclear power plants
 - Natural sources

Thermal Pollution

- Occurs when heated water produced during industrial processes is released into waterways
- Organisms affected
 - Temperature affects reproductive cycles, digestion rates, and respiration rates
 - Warm water holds less DO than cold water



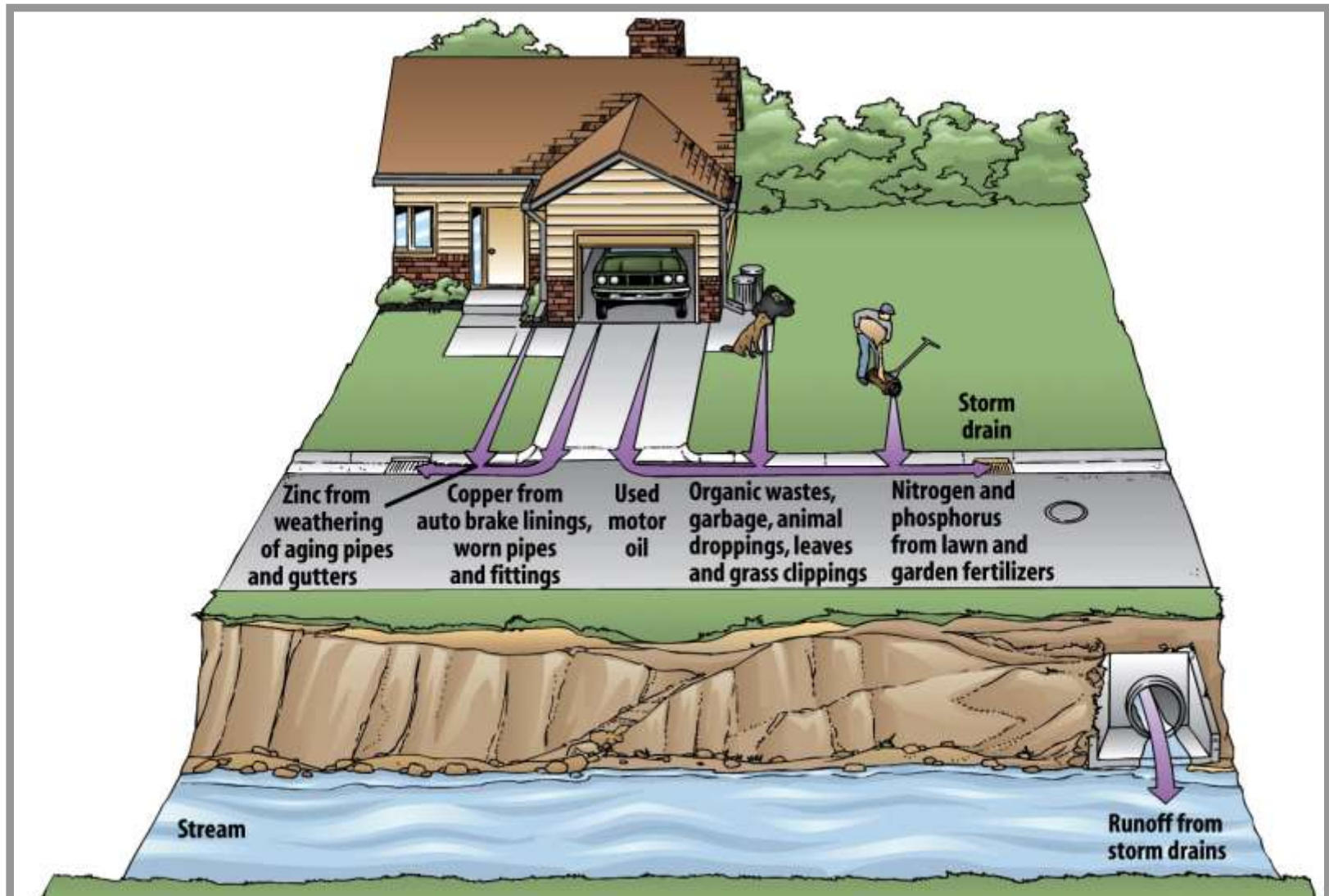
Water Quality Today

- Two Types of Water Pollution
- -Point Source Pollution
 - water pollution that can be traced to a specific origin
 - Discharge via pipes, sewage, and ditches
- -Non-point Source Pollution
 - Pollutants that enter bodies of water over large areas rather than being concentrated at a single point of entry
 - Diffuse, but its cumulative effect is very large
 - Ex: runoff from agricultural fields or parking lots

Water Pollution from Agriculture

- Agriculture is leading source of water pollution in US
 - Animal wastes and plants residues have high BOD
 - Chemical pesticides can leach into groundwater
- Almost all streams and rivers are polluted with agricultural pesticides

Municipal Water Pollution



Industrial Wastes in Water

- Different industries generate different pollutants
 - Food processing plants- high BOD
 - Paper mills- High BOD and toxic compounds
- Many industries recover toxins before they go into the waste stream

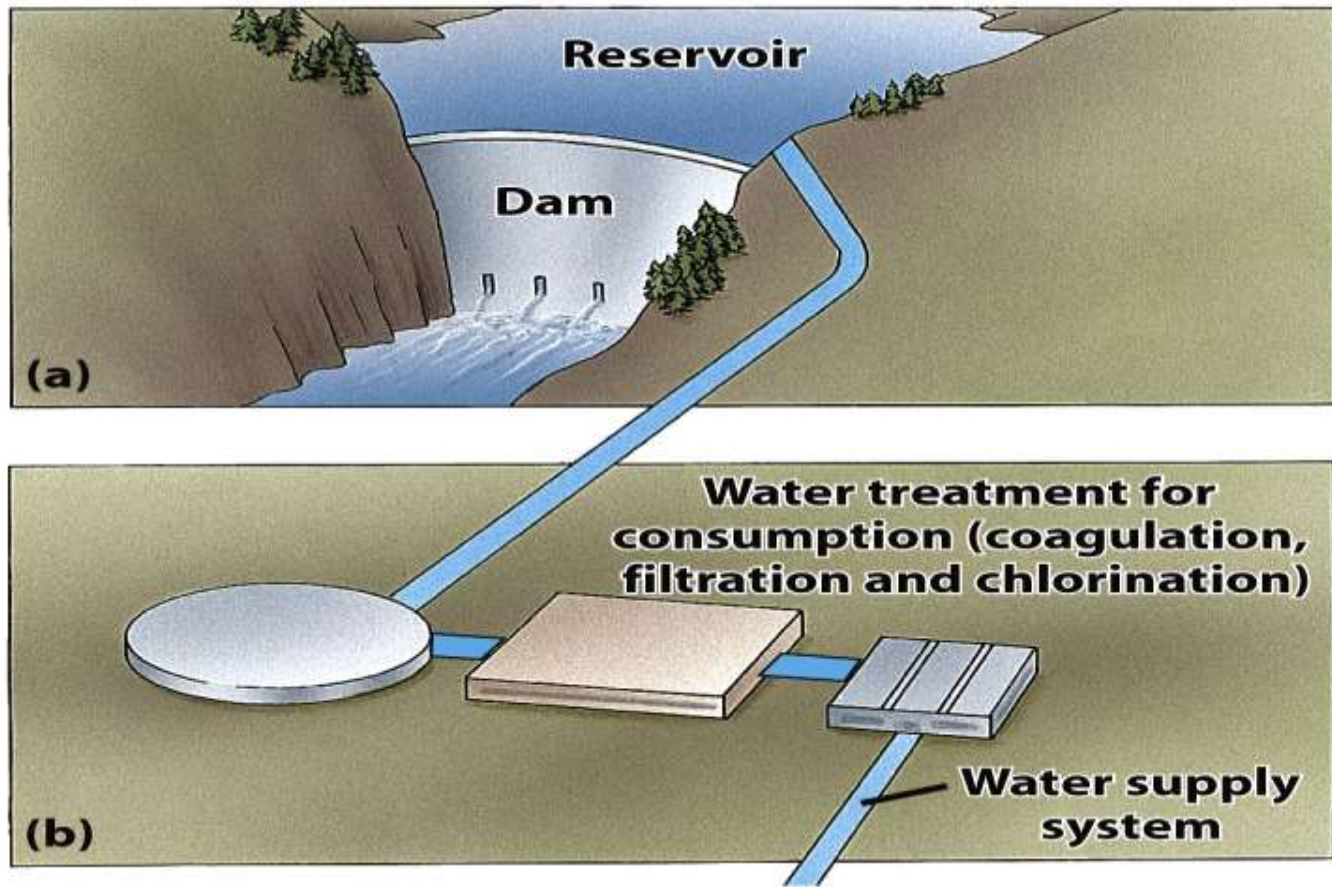
Water Pollution in Other Countries

- Ganges River, India
 - Used for bathing and washing clothing
 - Sewage and industrial waste discharged into river
 - Ganga Action Plan initiated by government
 - Construction of 29 sewage treatment plants



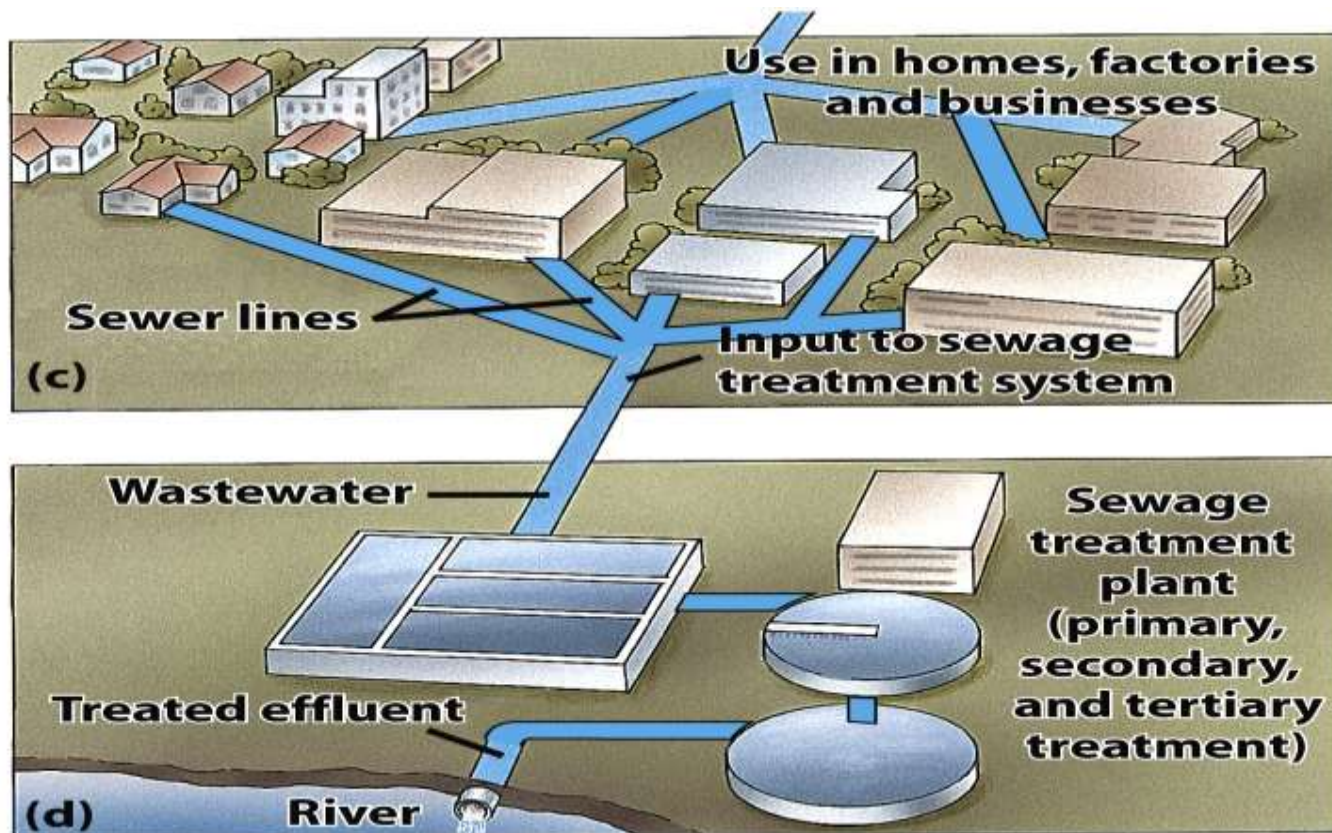
Improving Water Quality-Purification of Drinking Water

- In US most municipal water supplies are treated
- Collected from water or reservoir
- Treated



Improving Water Quality-Purification of Drinking Water

- Treated water distributed to customers
- Sewer lines bring sewage to treatment plant
- Sewage treated at sewage treatment plant



Purification of Drinking Water

- Chlorine Dilemma

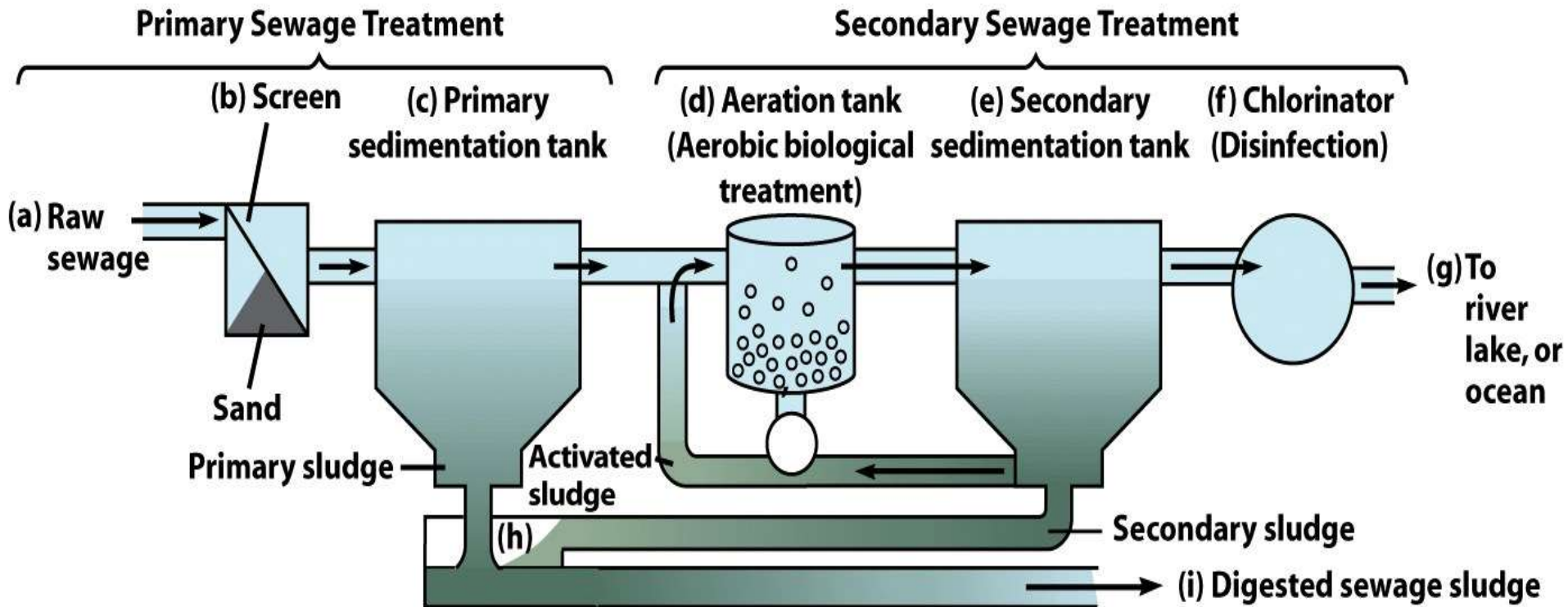
- Chlorine kills disease causing organisms
- Chlorine byproducts are linked to numerous cancers, miscarriages and birth defects
- Peru stopped using chlorine
 - 1991- huge cholera epidemic that infected 300,000 people

- Fluoridation

- Prevents tooth decay
- Linked to cancer, kidney disease

Municipal Sewage Treatment

- Primary treatment
 - Removing suspended and floating particles by mechanical processes
- Secondary treatment
 - Treating wastewater biologically to decompose suspended organic material; reduces BOD



Municipal Sewage Treatment

- Sewage Sludge
 - Solids remaining after primary and secondary sewage treatment has been completed
- Tertiary treatment
 - Advanced wastewater treatment methods that are sometimes employed after primary and secondary treatments
 - Reduce phosphorus and nitrogen