Water pollution impact on health

Prof. Dr.Madi Jaghbir

introduction

Water is fundamental for life and essential for nearly every human endeavor. Each person on earth requires about two liters of clean drinking-water each day, which amounts to 10 million m per day for the world's population.

Animal consumption is considerably more, but does not require the same quality as the water for human consumption.

Fresh water is a renewable resource, constantly purified and redistributed by the hydrologic cycle, but the distribution is uneven. Much global precipitation falls when or where it is not useful to humans.

Uneven distribution, inequitable access, and increasing pollution of water supplies may become the next major environmental crisis.

Conflict between regions for limited water supplies could cause social, political, and economic disruptions.

The water Cycle

The water cycle consists of evaporation, condensation, and precipitation. There are three principal “loops” in the cycle:

- The surface runoff loop, in which water runs across the ground surface and becomes part of the surface water system.
- The evapotranspiration loop, in which water infiltrates, is held as capillary water, and then returns to the atmosphere by way of evapotran-spiration.
- The groundwater loop, in which water infiltrates, percolates down to join the groundwater, and then moves through aquifers, finallyu exiting through springs, seeps, or wells,

where it rejoins the surface water.

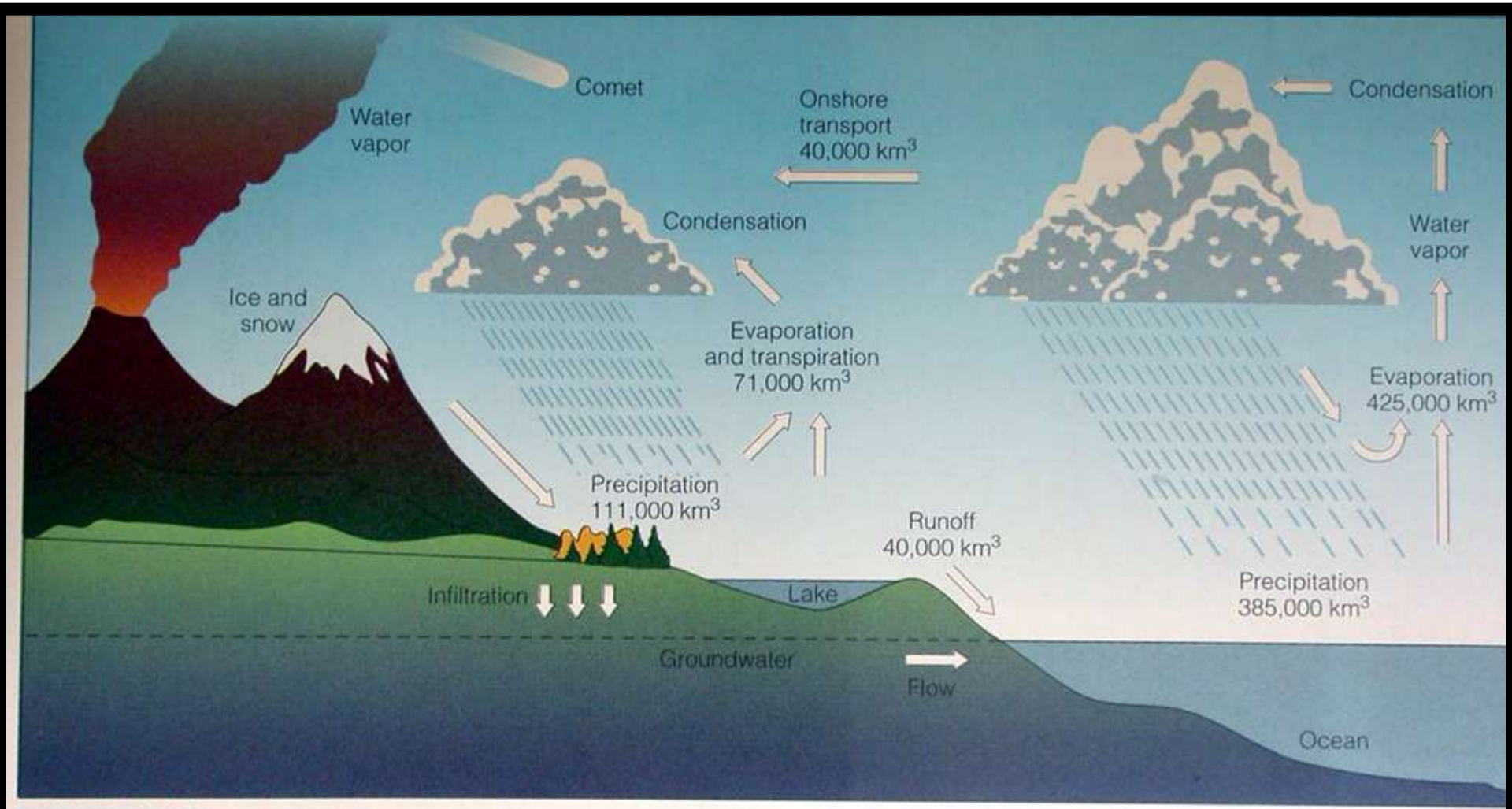
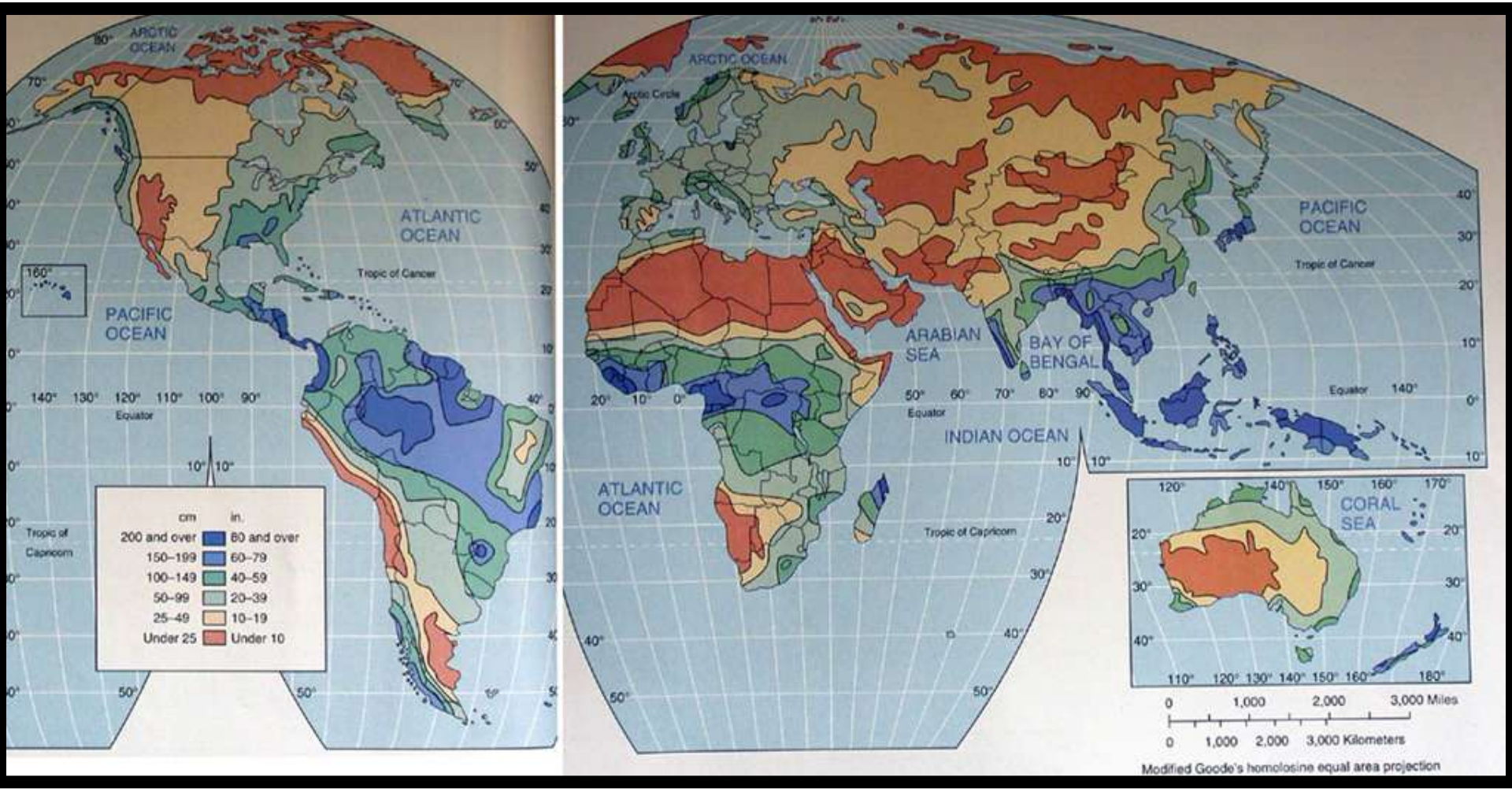


FIGURE 16.2 The hydrologic cycle moves water constantly between aquatic, atmospheric, and terrestrial compartments driven by solar energy and gravity. Total annual flows shown here are in thousands of cubic kilometers. The total annual runoff from land to the oceans is 10.3×10^{15} gallons.


ARCTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
Tropic of Cancer
Equator
Tropic of Capricorn
cm
in.
200 and over
80 and over
150–199
60–79
100–149
40–59
50–99
20–39
25–49
10–19
Under 25
Under 10
ARCTIC OCEAN
Arctic Circle
PACIFIC OCEAN
Tropic of Cancer
ARABIAN SEA
BAY OF BENGAL
Equator
INDIAN OCEAN
ATLANTIC OCEAN
Tropic of Capricorn
CORAL SEA
0 1,000 2,000 3,000 Miles
0 1,000 2,000 3,000 Kilometers
Modified Goode's homolosine equal area projection

Water resources

Of all the worlds water, 97% is in saline oceans and of the remaining 3% , of which by far the largest part-69%-is in the form of snow and ice, fresh water upon which humans depend accounts for only 0.008%. Humans take fresh water from whatever source they can. In some cases this means capturing precipitation directly in a rain barrel under a downspout. The major sources of fresh water, however, are surface water, namely rivers and lakes, and groundwater

Uses of fresh water

The major uses of fresh water are divided among three major categories:

Domestic

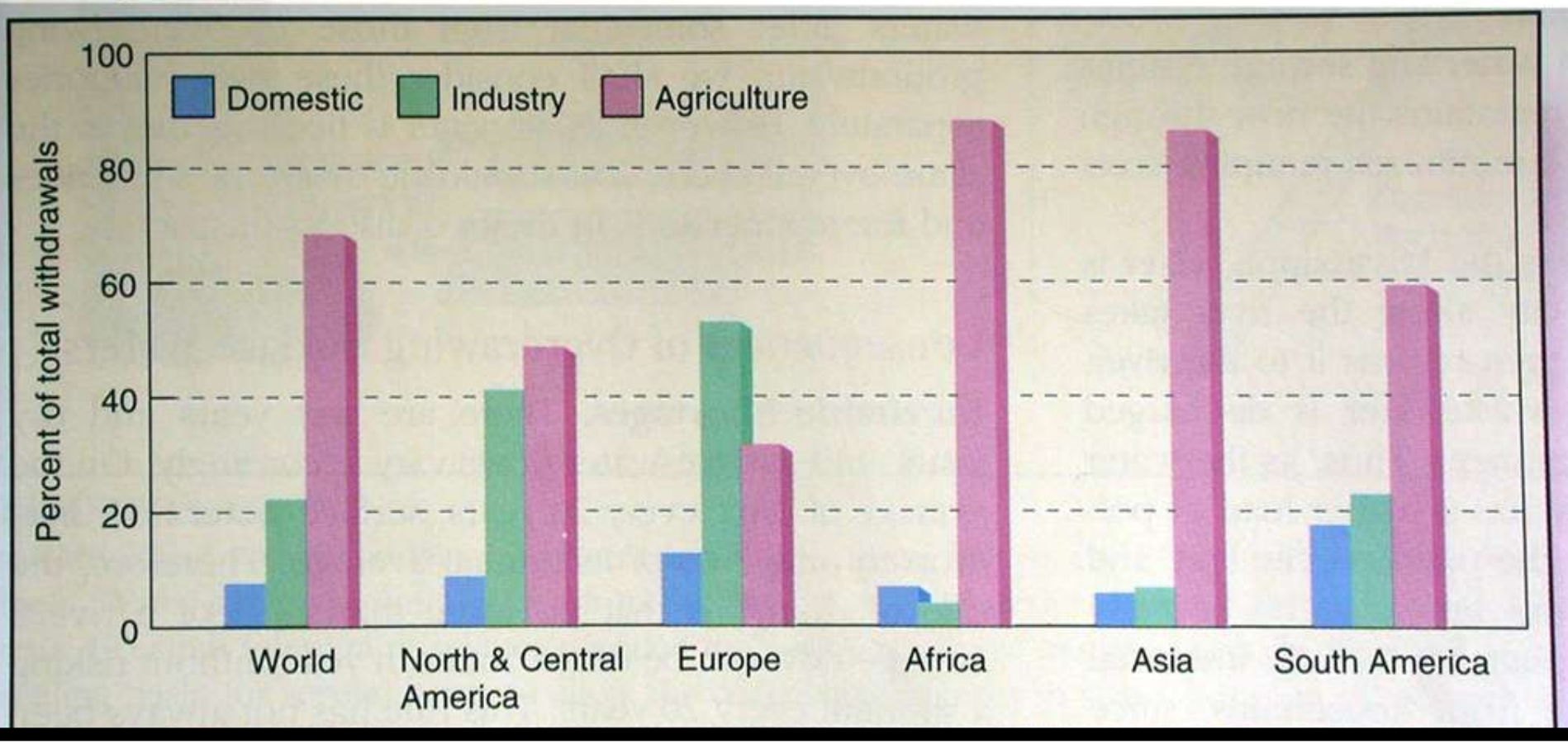
Industry

Agriculture

Worldwide, far and away the largest use of water is for irrigation (70%); second is for industry (23%); and third is for direct human consumption (8%).these percentages vary greatly from one region to anther, depending on natural precipitation and degree of development.

Water is also used in the generation of hydroelectric and thermoelectric power. Water is used as a vehicle for the transportation of goods and people, as a means of recreation through swimming and boating, and as a natural habitat for many forms of fish and wildlife.

Human usage of water is divided among three major categories, as shown. The percentage used in each category varies with climate and relative development of the country. A dry-climate, less-developed region uses most of its water for irrigation (e.g., Africa), whereas moist-climate, industrialized countries (e.g., Europe) require the largest percentage for industry. (From World Resources Institute, "World Resources," WRI, 1992/1993, p. 161.)



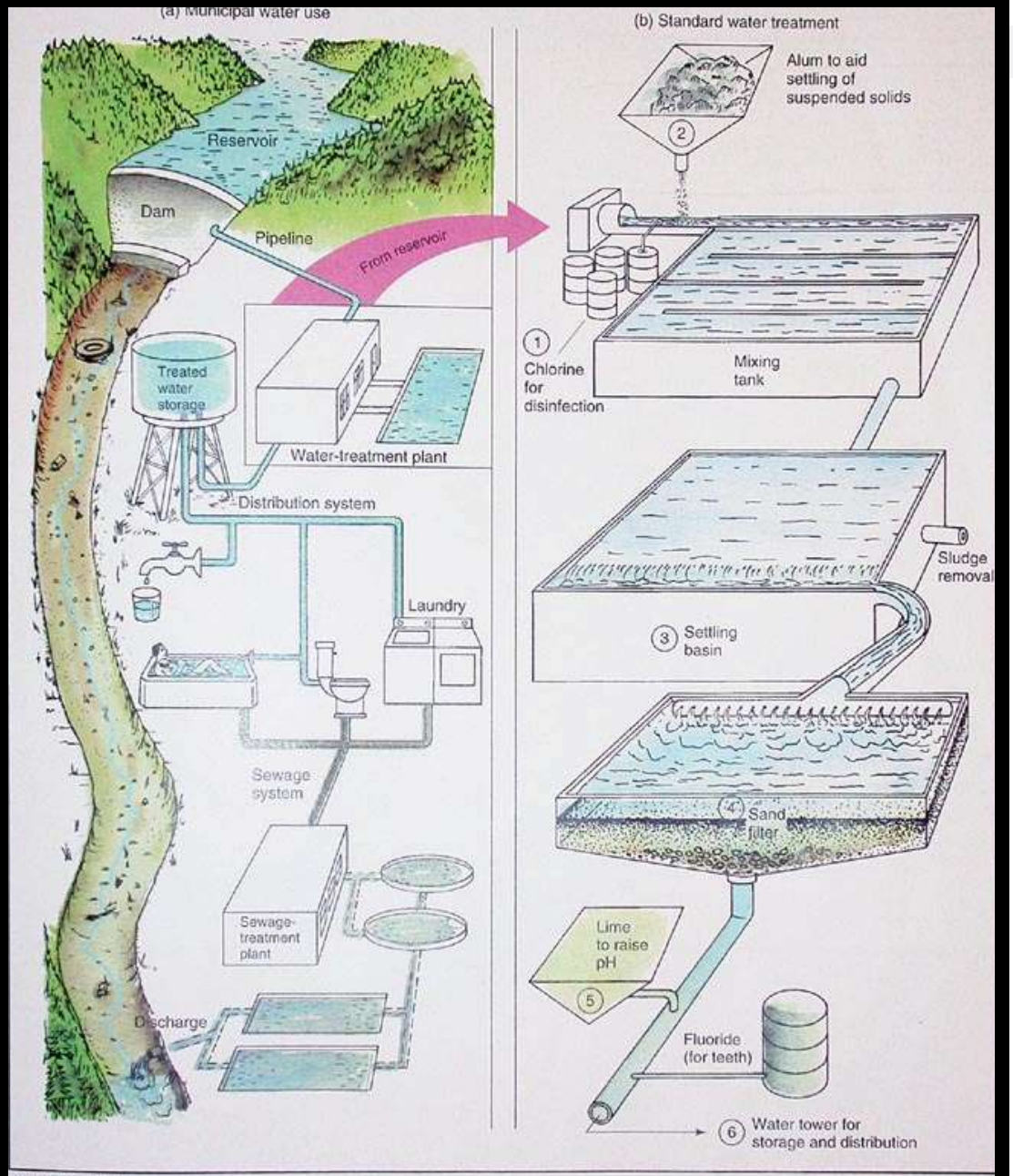
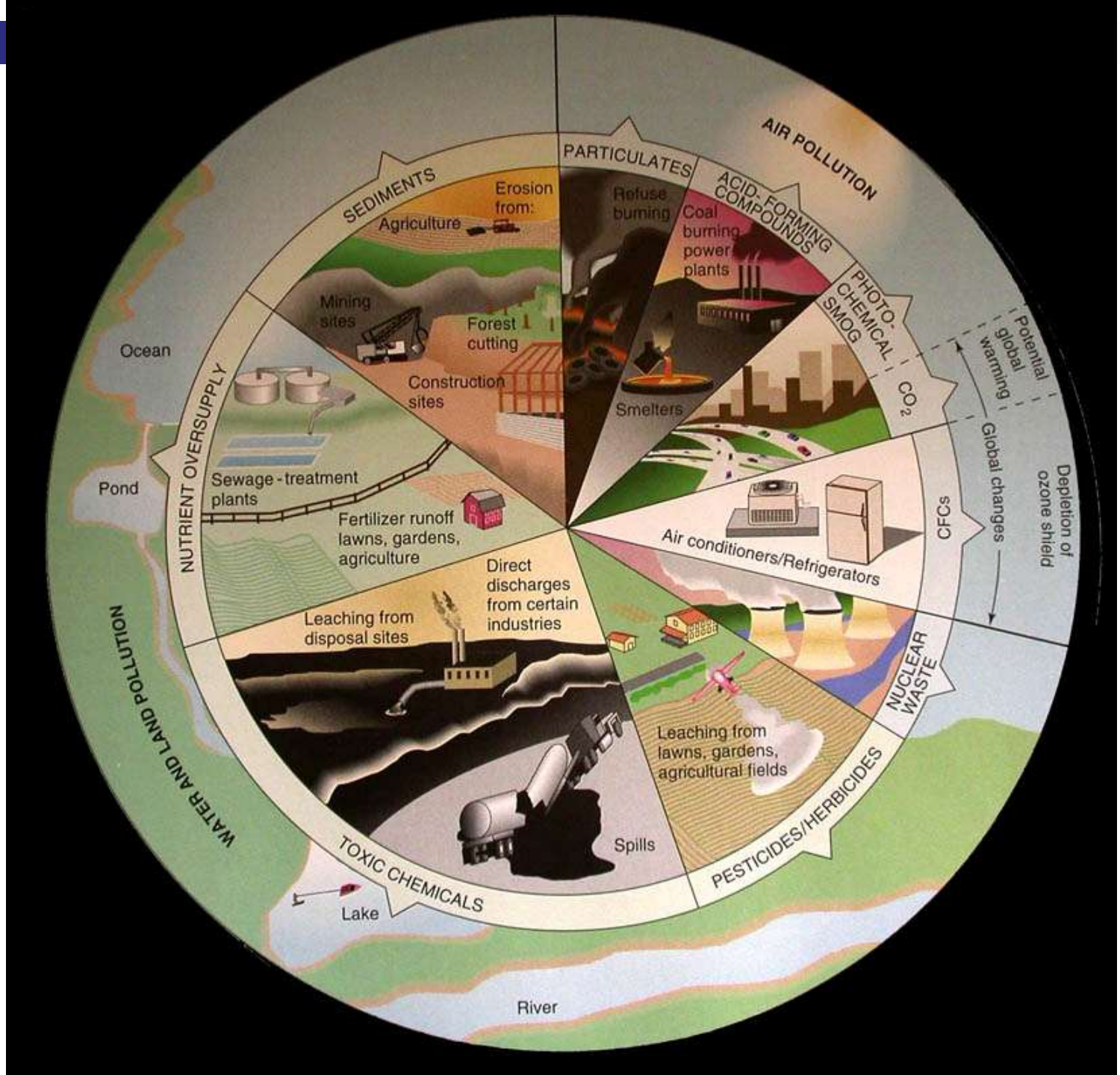


FIGURE 11-11

(a) Municipal water use. Water is often taken from a river, treated, used, then returned. (b) Water treatment. Water is piped from a reservoir to the treatment plant. At the plant, (1) chlorine is added to kill bacteria, (2) alum (aluminum sulfate) is added to coagulate organic particles, and (3) the water is put into a settling basin for several hours to allow the coagulated particles to settle. It is then (4) filtered through sand, (5) treated with lime to adjust pH, and (6) put into a storage water tower or reservoir until distribu-

Human impact on the water cycle

Changing the surface of earth
Polluting the water cycle
Withdrawing water supplies:
Overdrawing water resources
Consequences of overdrawing surface water
-inevitable shortage
- ecological effects
Consequences of overdrawing groundwater
- Falling water tables and depletion
- Diminishing surface water
- Land subsidence
-saltwater intrusion


AIR POLLUTION
PARTICULATES
Refuse burning
ACID-FORMING COMPOUNDS
Coal burning power plants
PHOTO-CHEMICAL SMOG
SEDIMENTS
Erosion from:
Agriculture
Mining sites
Forest cutting
Construction sites
Smelters
CO_2
Potential global warming
Global changes
Depletion of ozone shield
Ocean
NUTRIENT OVERSUPPLY
Sewage-treatment plants
Pond
Fertilizer runoff lawns, gardens, agriculture
Air conditioners/Refrigerators
CFCs
Direct discharges from certain industries
Leaching from disposal sites
NUCLEAR WASTE
WATER AND LAND POLLUTION
Leaching from lawns, gardens, agricultural fields
Spills
TOXIC CHEMICALS
PESTICIDES/HERBICIDES
Lake
River

Most of the diseases associated with water are communicable.

These diseases are classified in a number of ways:

Waterborne disease: These arise from the contamination of water by human or animal faeces or urine infected by pathogenic viruses or bacteria, which are directly transmitted when the water is drunk or used in the preparation of food. such as Cholera, typhoid, and cryptosporidiosis

Water-washed diseases: This category of diseases is affected more by quantity of water than by quality. Infrequent washing and inadequate personal hygiene are the main factors in these types of disease, such as diarrhea , and skin and eye infections.

Water-based disease: Water provides the habitat for intermediate host organisms in which some parasites pass part of their life cycle. These parasites are later the cause of disease in people as their infective larval forms in fresh water find their way back to humans, either by boring through wet skin or by being ingested with water plants, minute water crustacea, or raw or inadequately cooked fish. Schistosomiasis is an example of water-based disease.

Water-related disease: Water may provide a habitat for insect vectors of water-related disease. Mosquitoes breed in water and the adult mosquitoes may transmit parasite diseases such as malaria, and virus infections such as dengue, yellow fever and Japanese encephalitis.

Water-dispersed infections: The aforementioned categories are primarily problems of developing countries. A fifth category of diseases associated with water is emerging in developed countries infections whose agents can proliferate in freshwater and enter the body through the respiratory tract. Some freshwater amoebae that are not usually pathogenic can proliferate in warm water and, if they enter the host in large numbers, can invade the body along the olfactory tracts and cause fatal meningitis. These bacteria can be dispersed as aerosols from air-conditioning systems; such as Legionella.

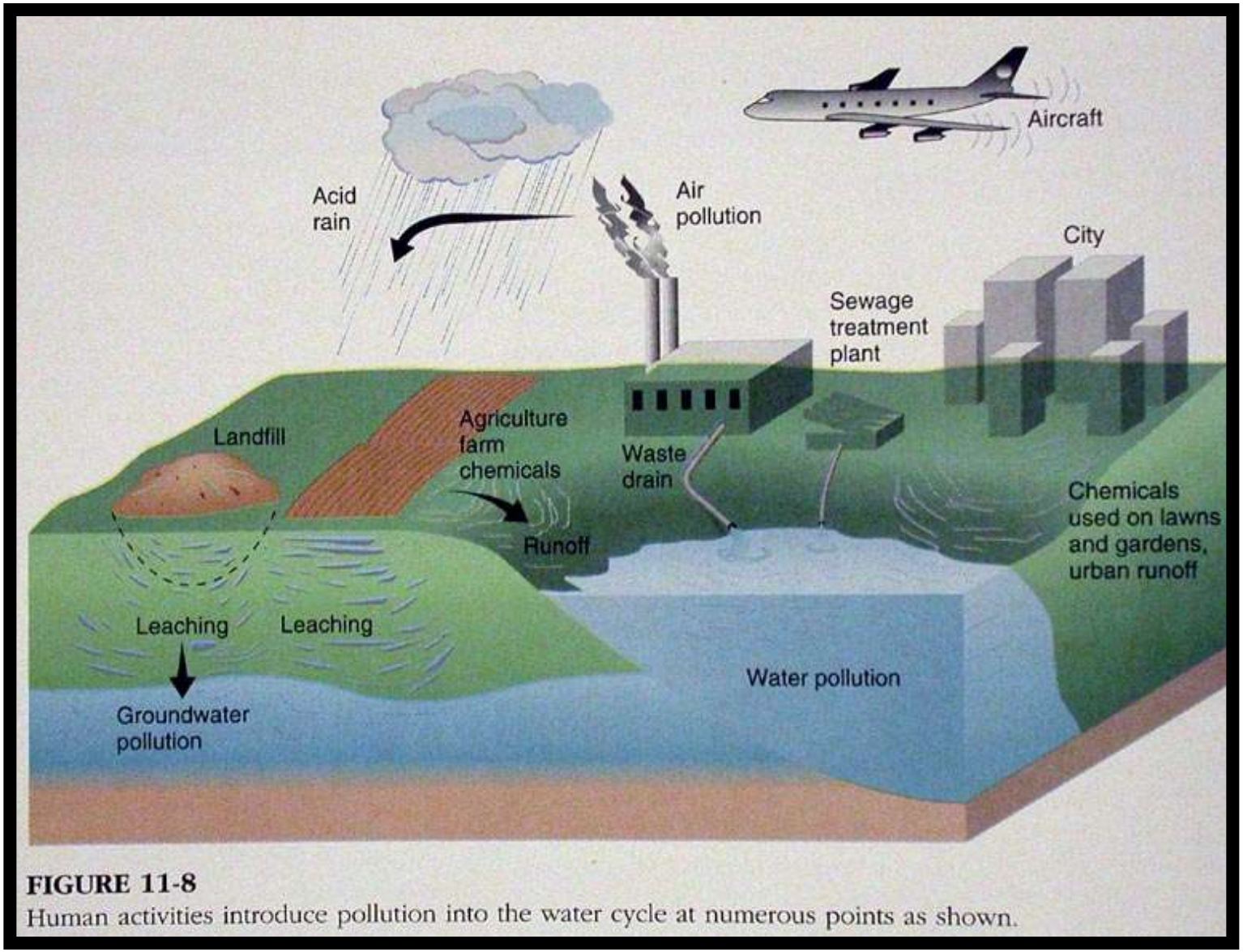


FIGURE 11-8
Human activities introduce pollution into the water cycle at numerous points as shown.

Chemical Pollutant

Elements and compounds that are directly harmful to living things are called **toxic chemicals**. Toxic chemicals are either inorganic or organic. *Inorganic* chemicals are elements or compounds that lack carbon. *Organic* chemicals are compounds that contain carbon. Many organic chemicals are derived from organisms.

Inorganic Chemicals

Inorganic chemicals include acids, salts, and heavy metals. A **heavy metal** *is a metallic element with a high mass number*.

Examples of dangerous heavy metals are mercury, lead, cadmium, nickel, and chromium. Heavy metal compounds are often by-products of industrial processes such as metal treatment and paint and plastics production. Factories sometimes discharge these materials directly into surface water.

Heavy metals are poisonous. Ingestion of these metals can cause brain, liver, and kidney damage, as well as coma and even death. Mercury poisoning in Minamata is one example of toxic chemical pollution. There are many others. Pesticides from agriculture are common inorganic pollutants. Acids from burning fossil fuels can accumulate in lakes, disrupting lake ecosystems

Organic chemicals:

Many of these chemicals come from living things,
while others are made in the laboratory. Synthetic organic substances include gasoline, oils, plastics, some pesticides and fertilizers, solvents, and wood

Crude oil is one of the most common and dangerous organic pollutants. Because crude oil is transported along rivers and across oceans in huge amounts, its potential as a pollutant is a major concern. Crude oil often enters surface water systems as a result of spills at drilling sites, or from shipwrecked or damaged oil tankers.

Radioactivity

Radioactive elements give off radiation when they decay. Radioactive elements such as Uranium-235 and Plutonium-239 are used as fuels in nuclear power plants. Other radioactive elements are used in medicine. Uranium mines and nuclear fuel refineries produce radioactive waste. Nuclear weapons detonations and power plant accidents produce the most radioactive waste of all.

The disposal of radioactive wastes, both solid and liquid, may result in water pollution. Liquid wastes are placed in steel storage containers. These containers are encased in concrete and buried. Over time, these containers may corrode and break down allowing radioactive material to leak into the soil. The waste may eventually contaminate groundwater.

plants nutrients and cultural eutrophication

Plants living in the water require a sufficient supply of nutrients to grow and mature properly. The most common nutrients found in our waters are nitrogen, phosphorous, and carbon. However, large amounts of nutrients in the water can cause problems such as algae blooms.

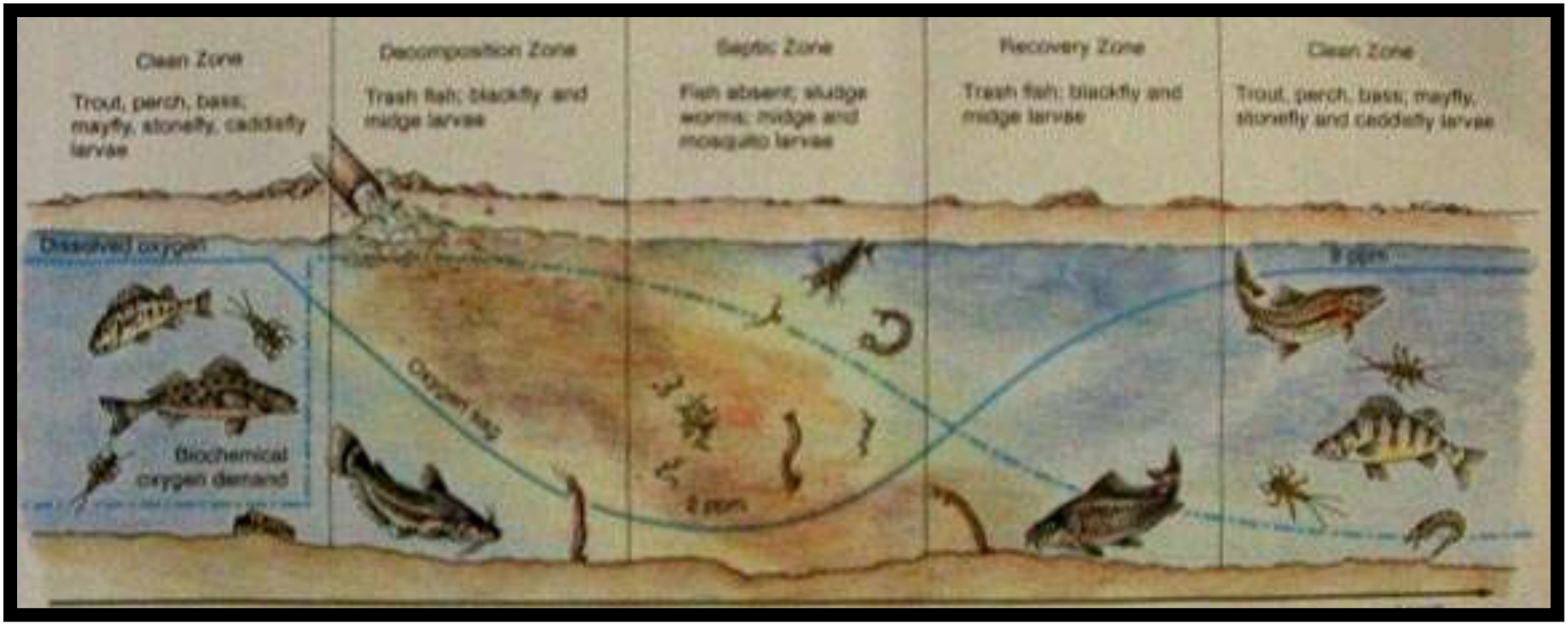
Algae is a general term for small, chlorophyll-containing plants such as seaweed and pond scum. When a body of water has a high level of nutrients, aquatic plants will grow and reproduce quickly. If algae grows in high density on the surface it will block sunlight from reaching plants at greater depths.

This will cause the plants to die. When algae die, the decaying process uses oxygen in the water. Decreasing the amount of dissolved oxygen will cause aquatic animals to die. The process of aquatic overgrowth, followed by death, decay, and oxygen depletion is called **eutrophication**. Eutrophication can result from human influences on the chemicals that enter our waters. This process causes an imbalance between plants and animals in the water. **Phosphates** are one of the more common nutrients to move through the ecosystem in large quantities. Phosphates enter the waterways through runoff from natural sources such as phosphate-containing rocks and from human sources such as fertilizers, pesticides, detergents, and industrial wastes.

Thermal

Power plants and other industrial facilities give off large amounts of heat, which can pollute water. *A large increase in water temperature due to human activity is called* **thermal pollution**. Thermal pollution usually occurs in lakes, rivers, or shallow bays located near power plants or industrial sites.

An increase in water temperature decreases the amount of dissolved oxygen the water can hold. The fish suffocate because they cannot get enough oxygen. The increased water temperature is also destructive to developing eggs and young fish.


Clean Zone
Trout, perch, bass, mayfly, stonefly, caddisfly larvae
Decomposition Zone
Trash fish; blackfly and midge larvae
Septic Zone
Fish absent; sludge worms; midge and mosquito larvae
Recovery Zone
Trash fish; blackfly and midge larvae
Clean Zone
Trout, perch, bass; mayfly, stonefly and caddisfly larvae
Dissolved oxygen
Oxygen sag
Biochemical oxygen demand
4 ppm
9 ppm