

Water Pollution

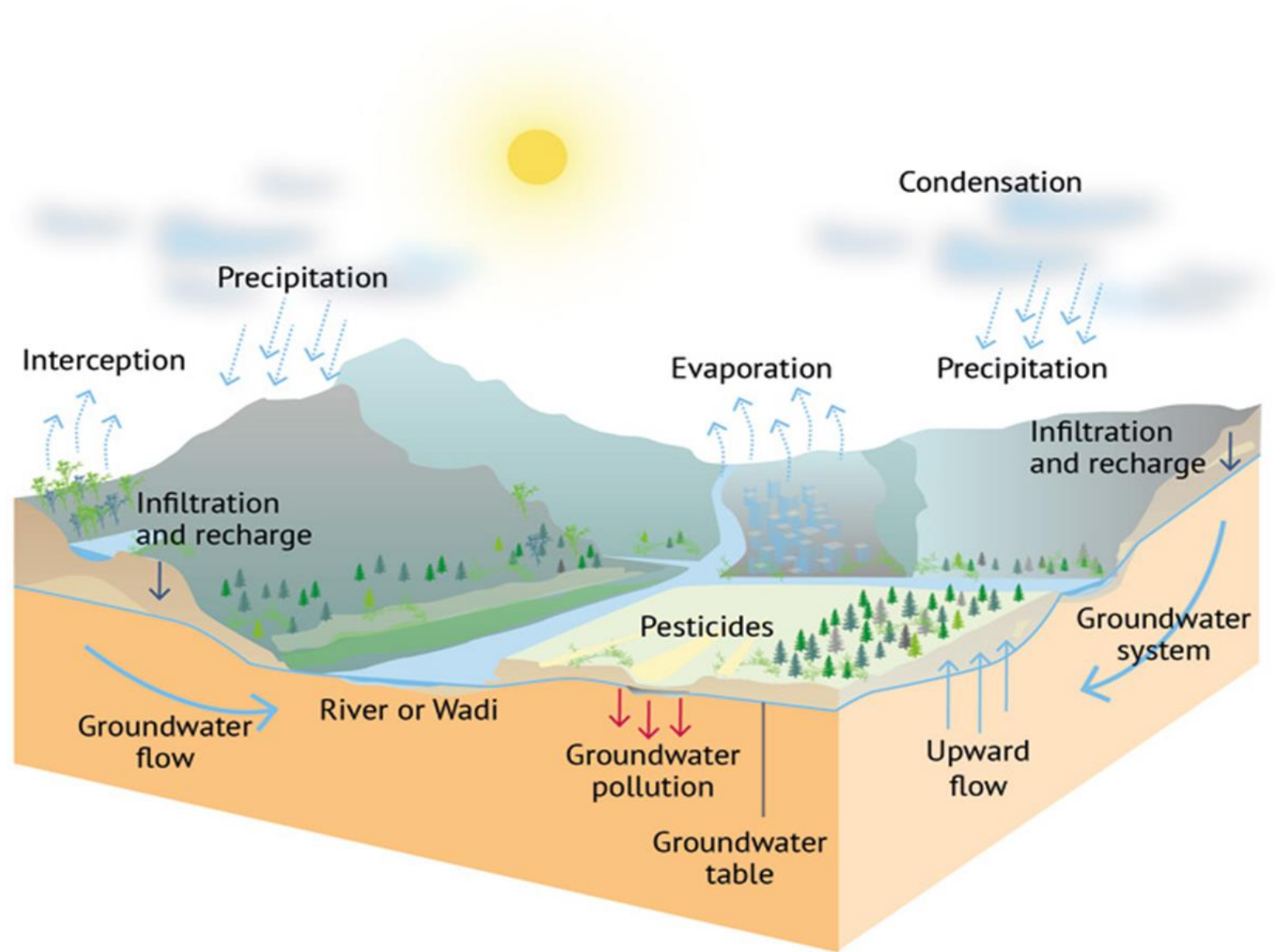


Dr. Sireen Alkhaldi/ Community Medicine

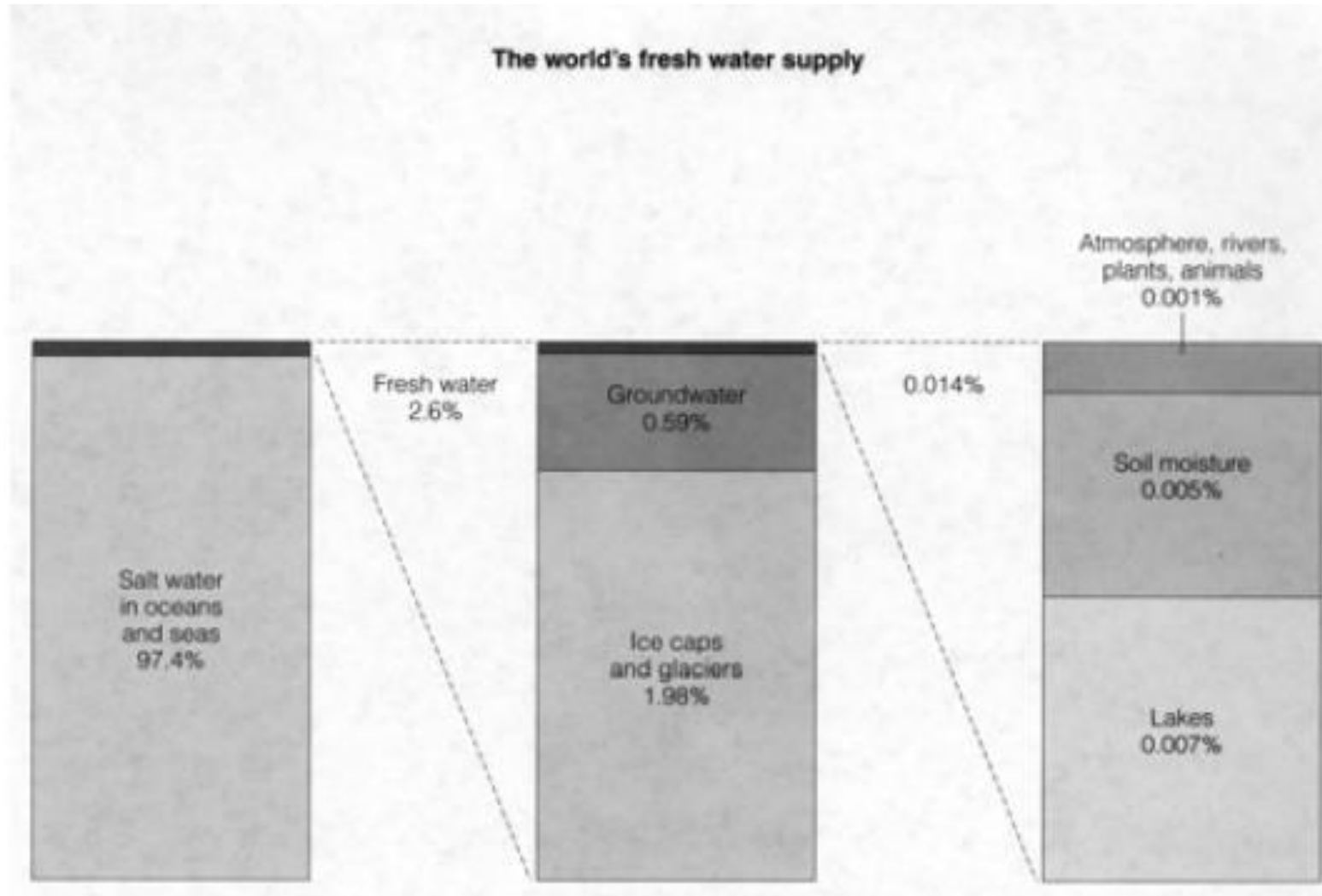
Water Situation

- * 85% of the world population lives in the driest half of the planet (United Nations, 2013)
- * 1 billion people do not have access to clean water and almost 2.5 billion do not have access to adequate sanitation.
- * 2 million people die each year due to unsafe water, sanitation and hygiene (WHO, 2015).

The Hydrologic cycle (the water cycle)



World Freshwater Supply



Water Pollution

According to the definition of the World Health Organisation (WHO) (1966), water pollution occurs when:

“foreign materials either from natural or other sources are contaminated with water supplies and may be harmful to life, because of their toxicity, reduction of normal oxygen level of water, aesthetically unsuitable effects and spread of epidemic diseases”.

Two Sources of Water Pollution

Although water pollution occurs from a variety of sources, there are two terms used to describe how the water becomes polluted:

1. Point sources
2. Non-point sources

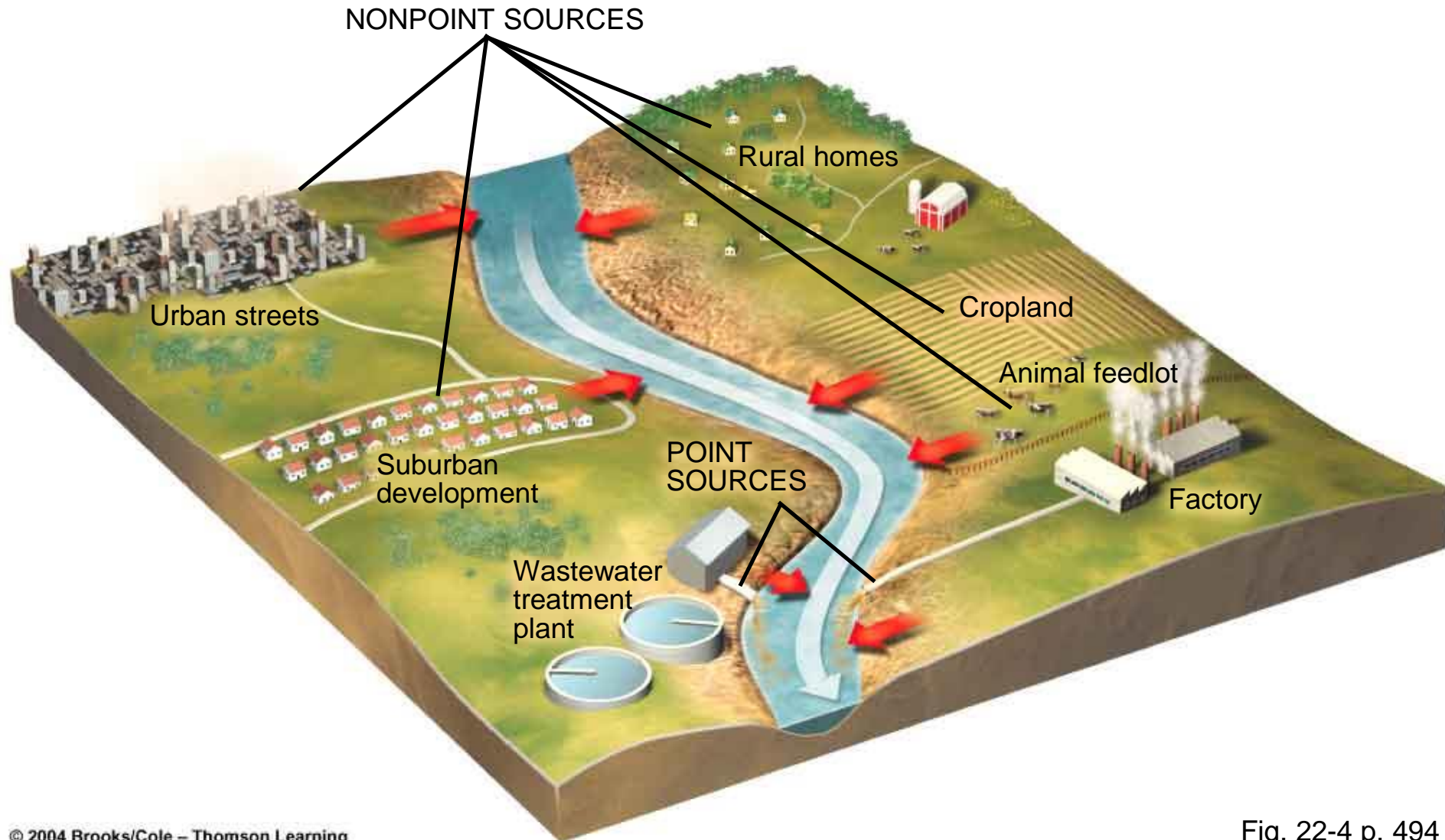


Point Source Pollution

1. comes from a specific source, like a pipe. Pollution will be located at a specific place.
2. Sources are: factories, industry, municipal treatment plants
3. Easy to identify, monitor and regulate.

The BP oil spill in 2010 is an example of point source pollution, because the massive amount of oil leaked from a single point of origin.

Point and Nonpoint Sources



What is nonpoint source pollution?

- ✓ Nonpoint Source (NPS) Pollution is pollution associated with storm water or runoff.
- ✓ Difficult to identify and control
- ✓ Broad and Diffuse area is affected
- ✓ Expensive to clean up.

For example, one water body (river or sea) may be contaminated by multiple sources like agricultural runoff, city street runoff, construction sites and residential lawns (e.g. The Mississippi River).

Nonpoint Sources

- **Agriculture activities: a leading cause of water pollution:**
 - Sediment eroded from the lands
 - Fertilizers and pesticides
 - Bacteria from livestock and food processing wastes
- **Industrial facilities**
- **Mining**
- **Transportation, roads and parking lots**
- **Human-made materials (E.g., plastics)**

Examples of NPS

- **oil & grease from cars**
- **fertilizers**
- **animal waste**
- **grass clippings**
- **septic systems**
- **sewage**
- **household cleaning products**
- **litter**

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

Pollutant Transport Mechanisms

- ❑ **NPS pollutants build up on land surfaces during dry weather**
 - **Atmospheric deposition**
 - **Fertilizer applications**
 - **Animal waste**
 - **Automotive exhaust/fluid leaks**
- **Pollutants are washed off land surfaces during precipitation events (stormwater runoff)**
- **Stormwater runoff will flow to lakes and streams**

Point Source of Polluted Water in Gargas, France



Nonpoint Sediment from Unprotected Farmland Flows into Streams



Linking Land Use to Water Quality



More Imperviousness = More Polluted Water

What is impervious cover?

Impervious cover is: roads, rooftops, parking lots, and other hard surfaces that do not allow stormwater to soak into the ground.

- ❑ provides a surface for accumulation of pollutants
- ❑ leads to increased polluted runoff and flooding
- ❑ inhibits recharge of groundwater

Potential Sources of Pollutants Found in Residential Areas



- ❑ **Nutrients:** Fertilizers and septic systems (sewage)
- ❑ **Pathogens:** Pet waste and septic systems (sewage)
- ❑ **Sediment:** Construction, road sand, soil erosion
- ❑ **Toxic:** Pesticides, household products
- ❑ **Debris:** Litter and illegal dumping
- ❑ **Thermal:** heated runoff

Pollutants Found in Runoff

Sediment

Soil particles
transported from
their source

Biochemical Oxygen Demand (BOD)

- Oxygen depleting material
 - Leaves
 - Organic material

Toxics

- Pesticides
 - Herbicides
 - Fungicides
 - Insecticides
- Metals (naturally occurring in soil, automotive emissions/ tires)
 - Lead
 - Zinc
 - Mercury
- Petroleum Hydrocarbons (automotive exhaust and fuel/oil)

Nutrients

- Various types of materials that become dissolved and suspended in water (commonly found in fertilizer and plant material):
 - Nitrogen (N)
 - Phosphorus (P)

Bacteria/ Pathogens

Originating from:

- Pets
- Waterfowl
- Failing septic systems

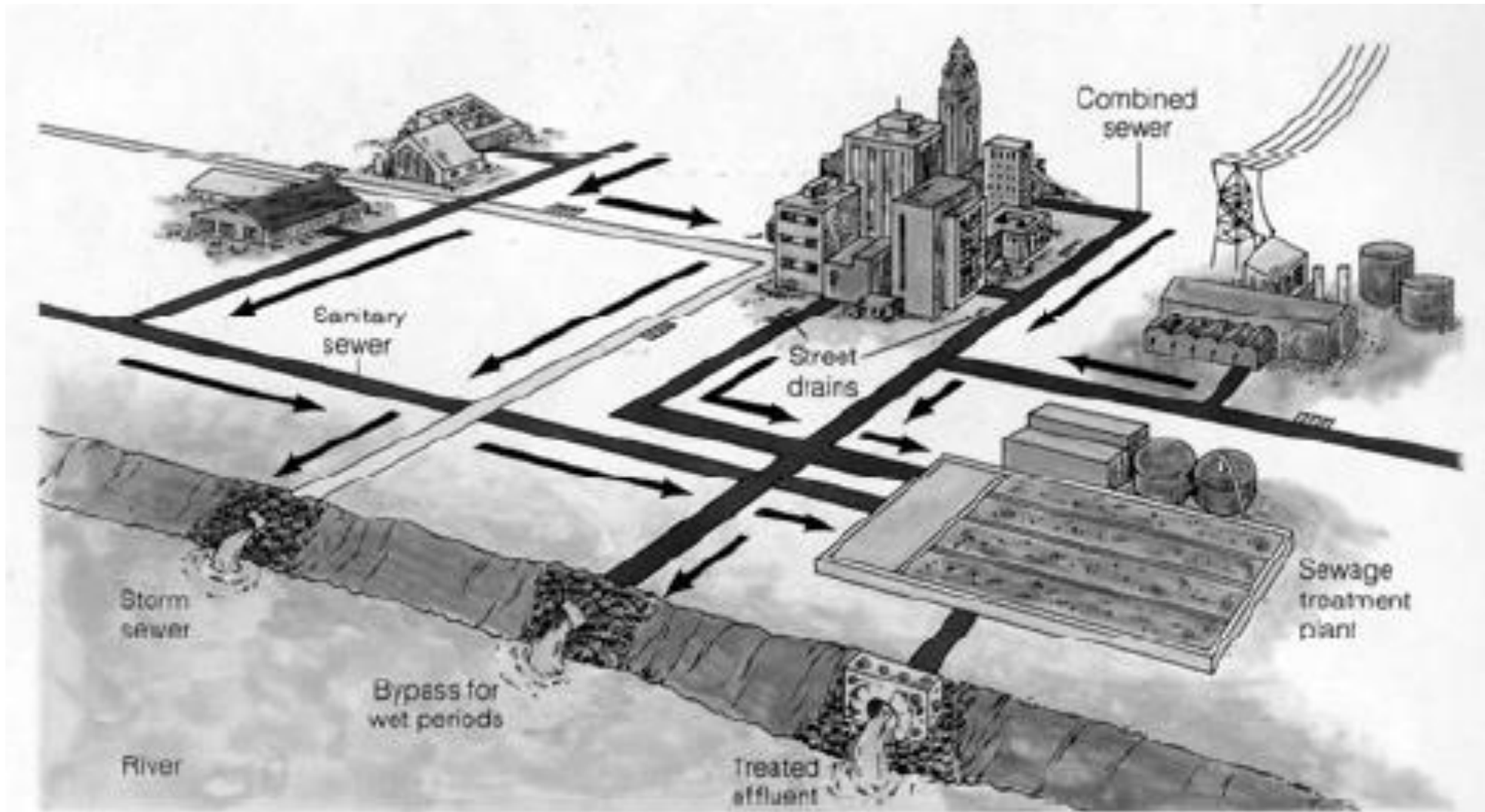
Thermal Stress

Heated runoff,
removal of
streamside
vegetation

Debris

Litter and illegal dumping

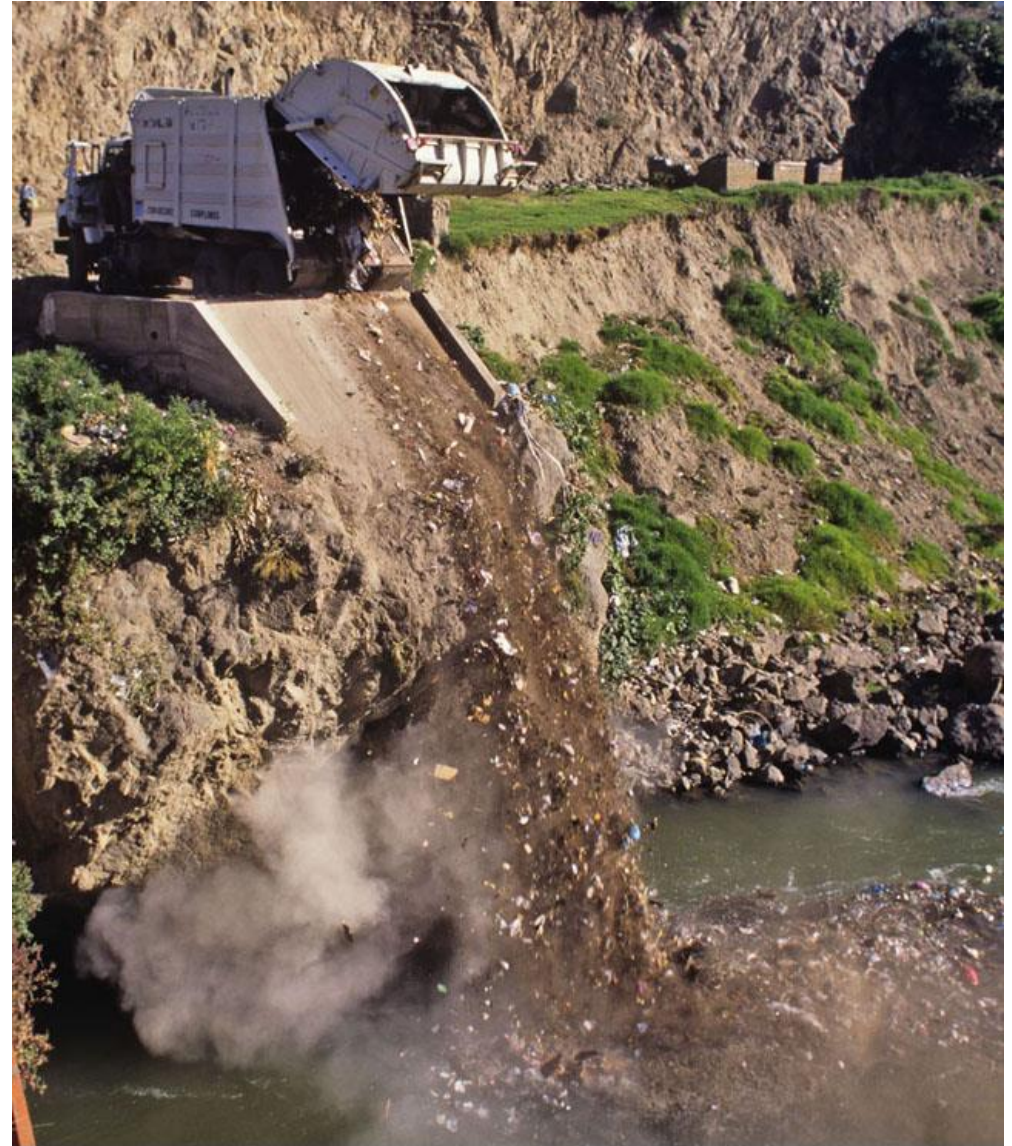
Storm Sewer and Sanitary Sewage System



Natural Capital Degradation: Highly Polluted River in China



Trash Truck Disposing of Garbage into a River in Peru



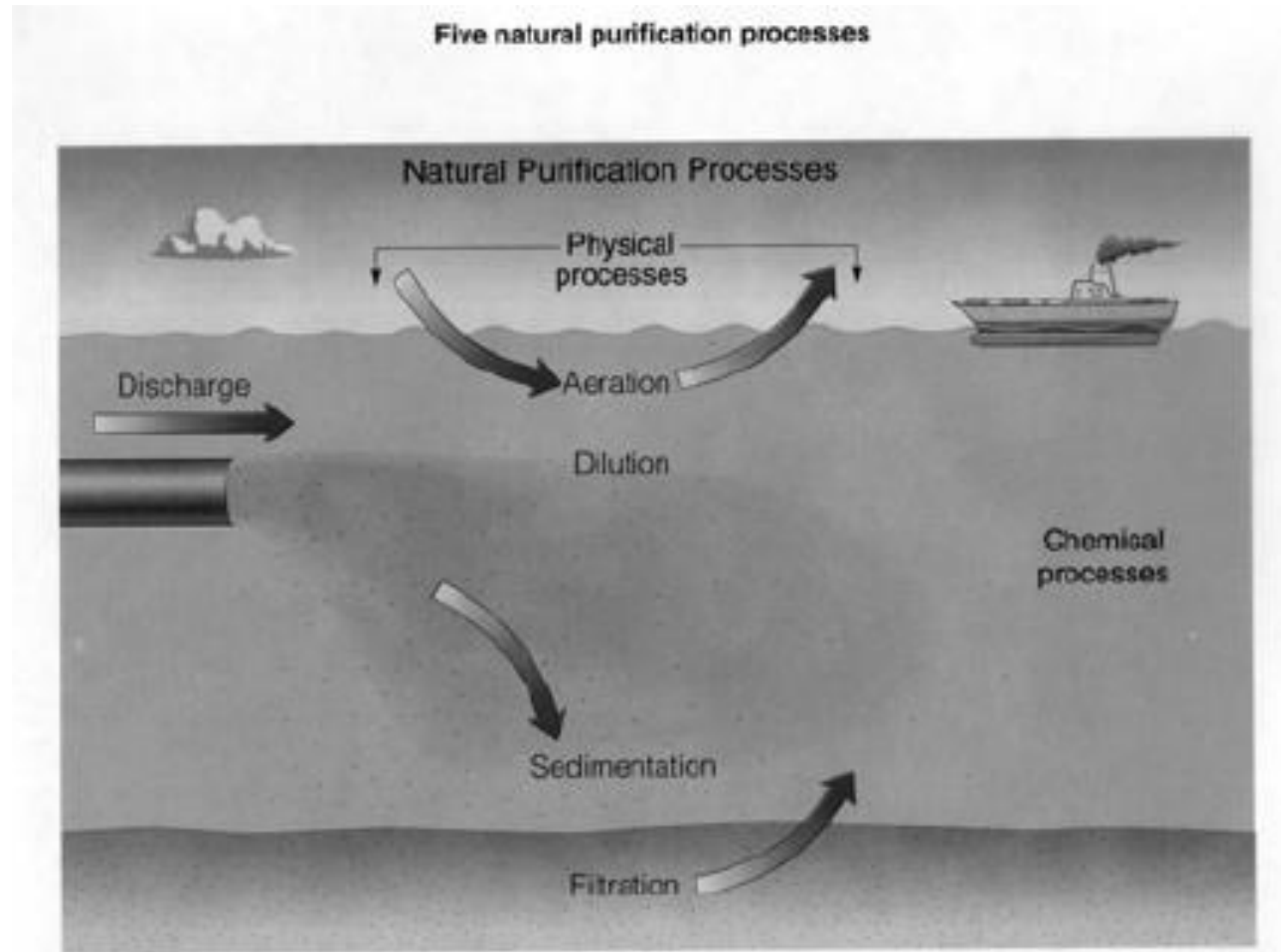
India's Ganges River



What Are the Major Water Pollution Problems in Streams and Lakes?

- While streams are extensively polluted worldwide by human activities, they can cleanse themselves of many pollutants if we do not overload them or reduce their flows.
- Addition of excessive nutrients to lakes from human activities can disrupt lake ecosystems, and prevention of such pollution is more effective and less costly than cleaning it up.
- Biodegradation of wastes by bacteria takes time.

Natural Purification Processes

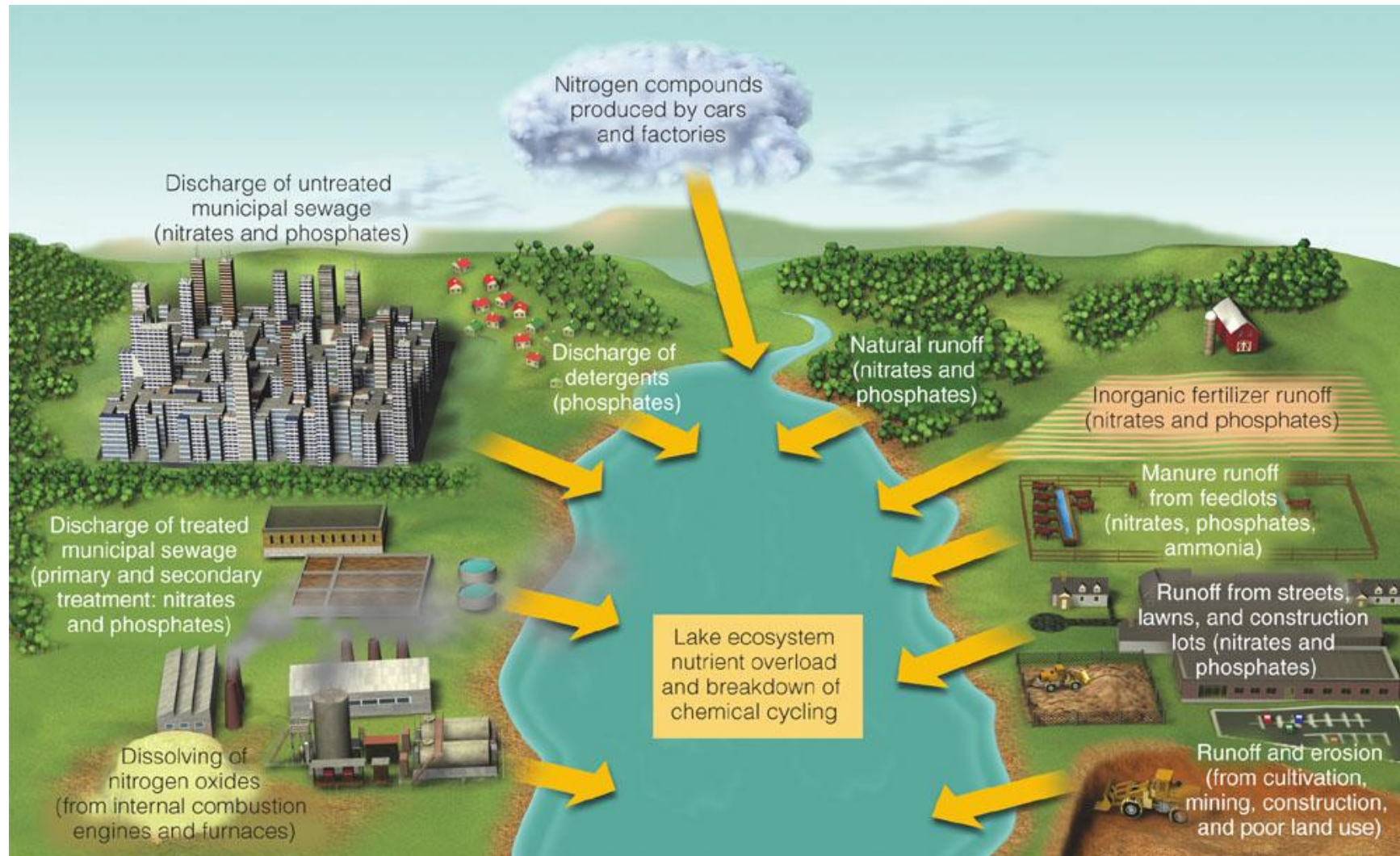


Eutrophication

“The enrichment of bodies of fresh water by nutrients (e.g. nitrate, phosphate). These typically promote excessive growth of algae.

❑ Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process (e.g. fertilizer runoff and sewage discharge) and is particularly evident in slow-moving rivers and shallow lakes.

Pollution of Lakes (eutrophication)

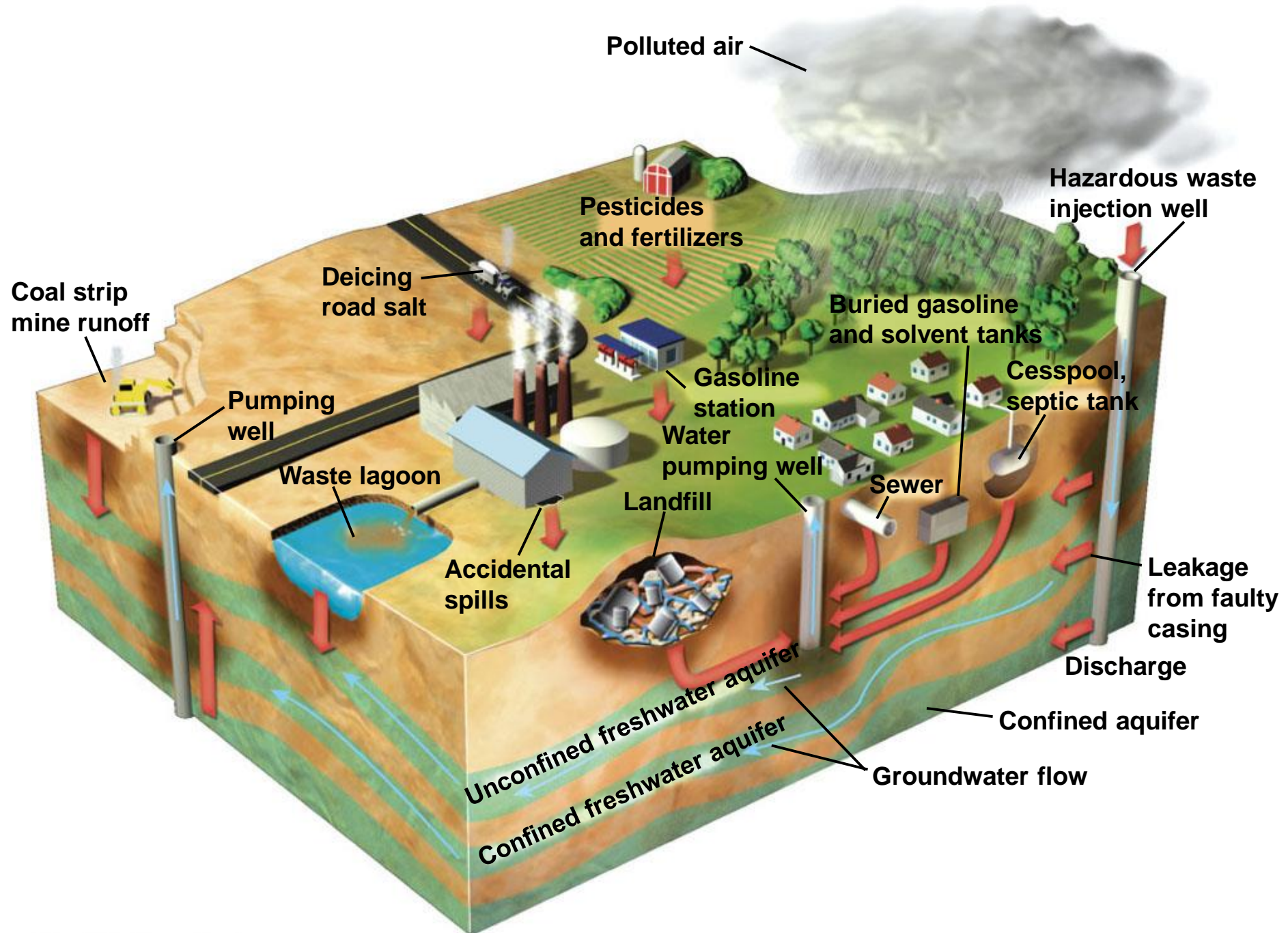


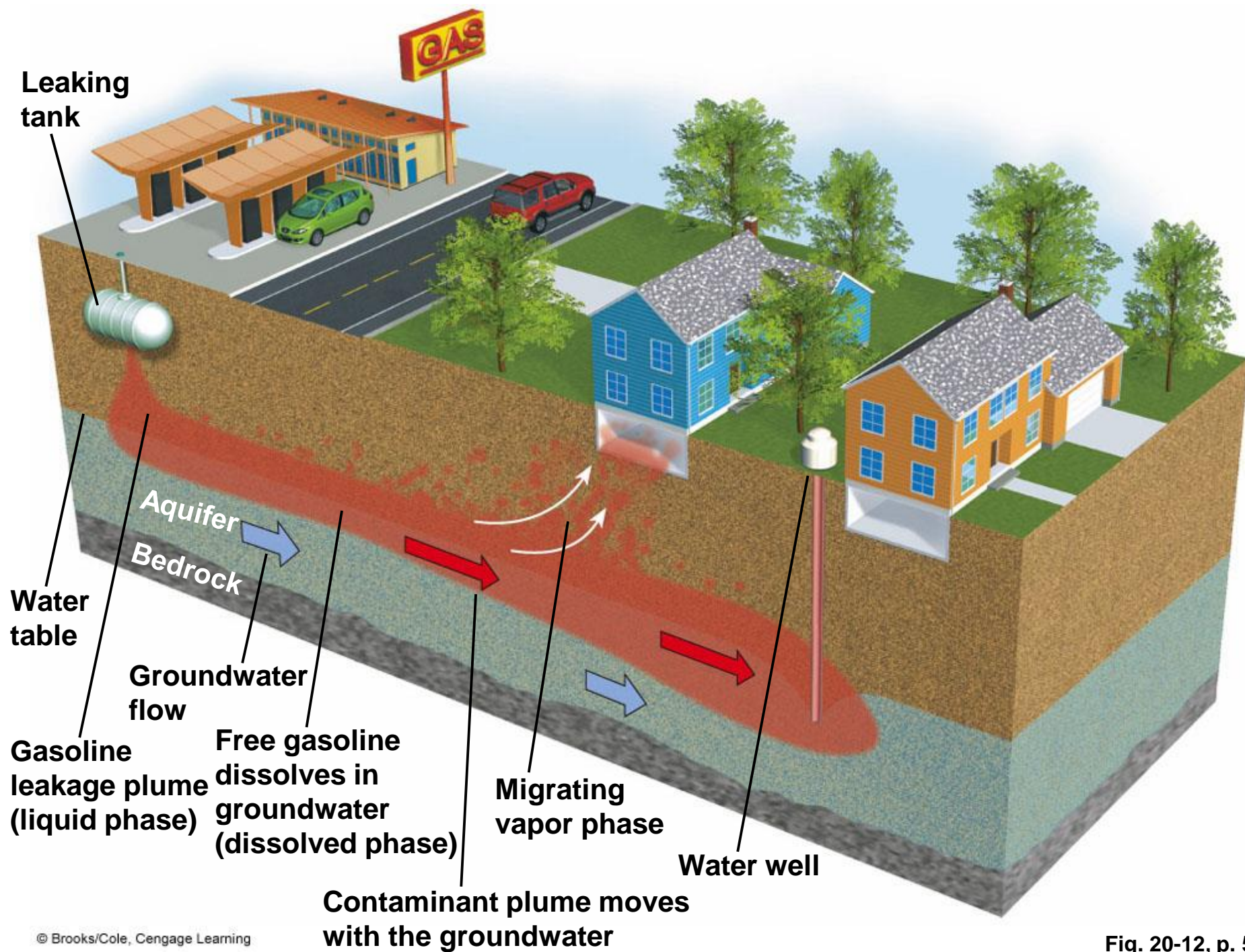
Pollution Problems Affecting Groundwater

- ✓ Ground water is a source of drinking water
- ✓ Chemicals used in agriculture, industry, transportation, and homes can spill and leak into groundwater and make it undrinkable.
- ✓ There are simple ways and complex ways to purify drinking water, but protecting it through pollution **prevention** is the least expensive and most effective strategy.

Ground Water Cannot Cleanse Itself Very Well

- ✓ **Common pollutants of ground water are:**
 - Fertilizers and pesticides, Gasoline, and Organic solvents
- ✓ **Pollutants are dispersed in a wide area.**
- ✓ **Slower chemical reactions in groundwater due to**
 - Slow flow: contaminants not diluted
 - Less dissolved oxygen
 - Fewer decomposing bacteria





Pollution Problems Affecting **Sea water and Oceans**

The great majority of ocean pollution originates on land and includes oil, sewage, agricultural runoff, and other toxic chemicals and solid wastes, which threaten aquatic species and other wildlife and disrupt marine ecosystems.

The key to protecting the oceans is to reduce the flow of pollutants from land and air and from streams emptying into these waters.

Industry Nitrogen oxides from autos and smokestacks, toxic chemicals, and heavy metals in effluents flow into bays and estuaries.

Cities Toxic metals and oil from streets and parking lots pollute waters; sewage adds nitrogen and phosphorus.

Urban sprawl Bacteria and viruses from sewers and septic tanks contaminate shellfish beds and close beaches; runoff of fertilizer from lawns adds nitrogen and phosphorus.

Construction sites Sediments are washed into waterways, choking fish and plants, clouding waters, and blocking sunlight.

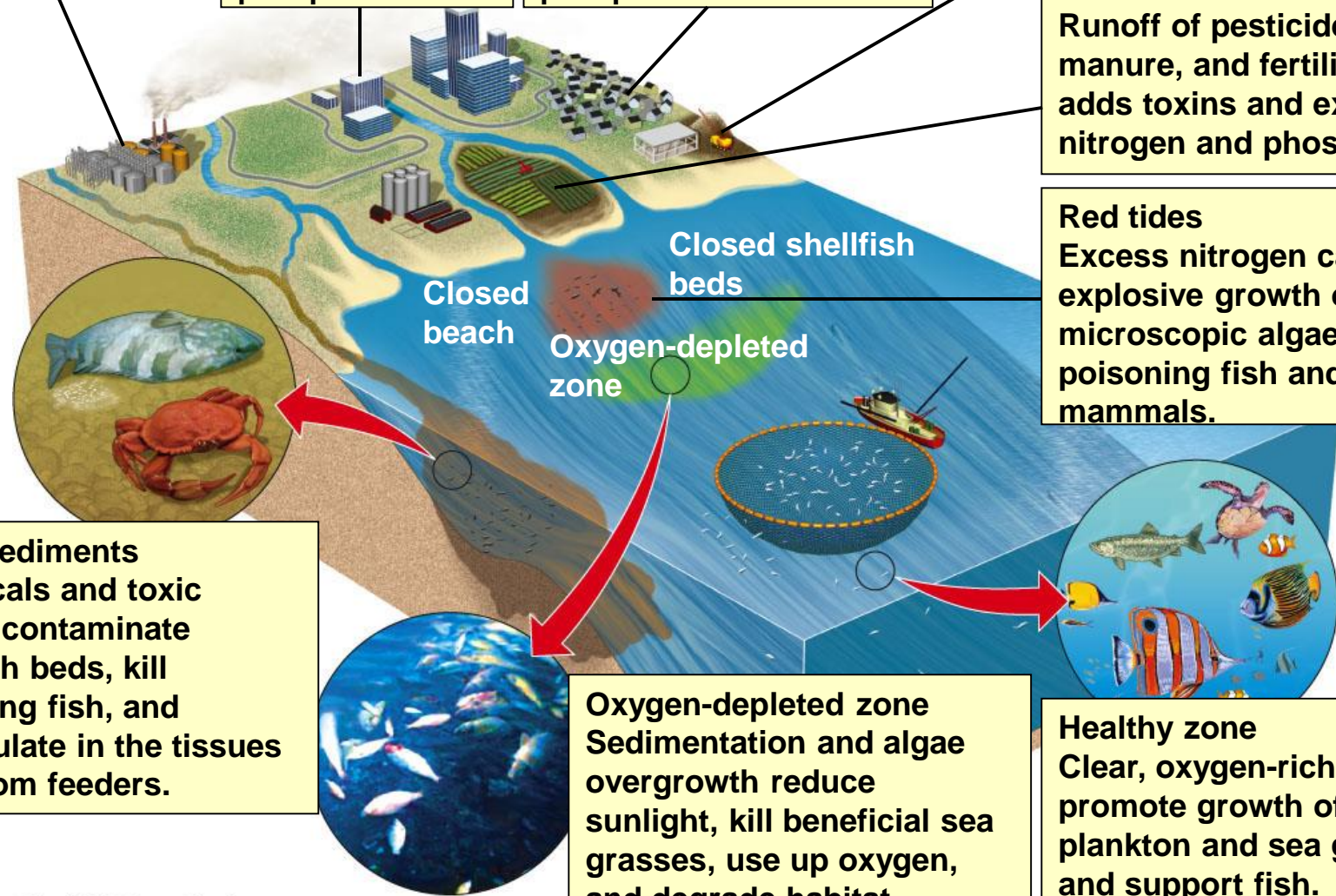
Farms Runoff of pesticides, manure, and fertilizers adds toxins and excess nitrogen and phosphorus.

Red tides Excess nitrogen causes explosive growth of toxic microscopic algae, poisoning fish and marine mammals.

Toxic sediments Chemicals and toxic metals contaminate shellfish beds, kill spawning fish, and accumulate in the tissues of bottom feeders.

Oxygen-depleted zone Sedimentation and algae overgrowth reduce sunlight, kill beneficial sea grasses, use up oxygen, and degrade habitat.

Healthy zone Clear, oxygen-rich waters promote growth of plankton and sea grasses, and support fish.



Ocean Oil Pollution Is a Serious Problem

- **Crude and refined petroleum are highly disruptive pollutants**
- **Largest source of ocean oil pollution is urban and industrial runoff from land**
- **Volatile organic hydrocarbons (Kill many aquatic organisms)**
- **Tar-like globs on the ocean's surface (Coat animals)**
- **Heavy oil components sink (Affect the bottom dwellers)**
- **Faster recovery from crude oil than refined oil**
- **Methods of preventing oil spills should be strictly used.**

Controlling Water Pollution:

There should be vigorous efforts to control water pollution with the involvement of individuals, communities, governments and social activist groups.

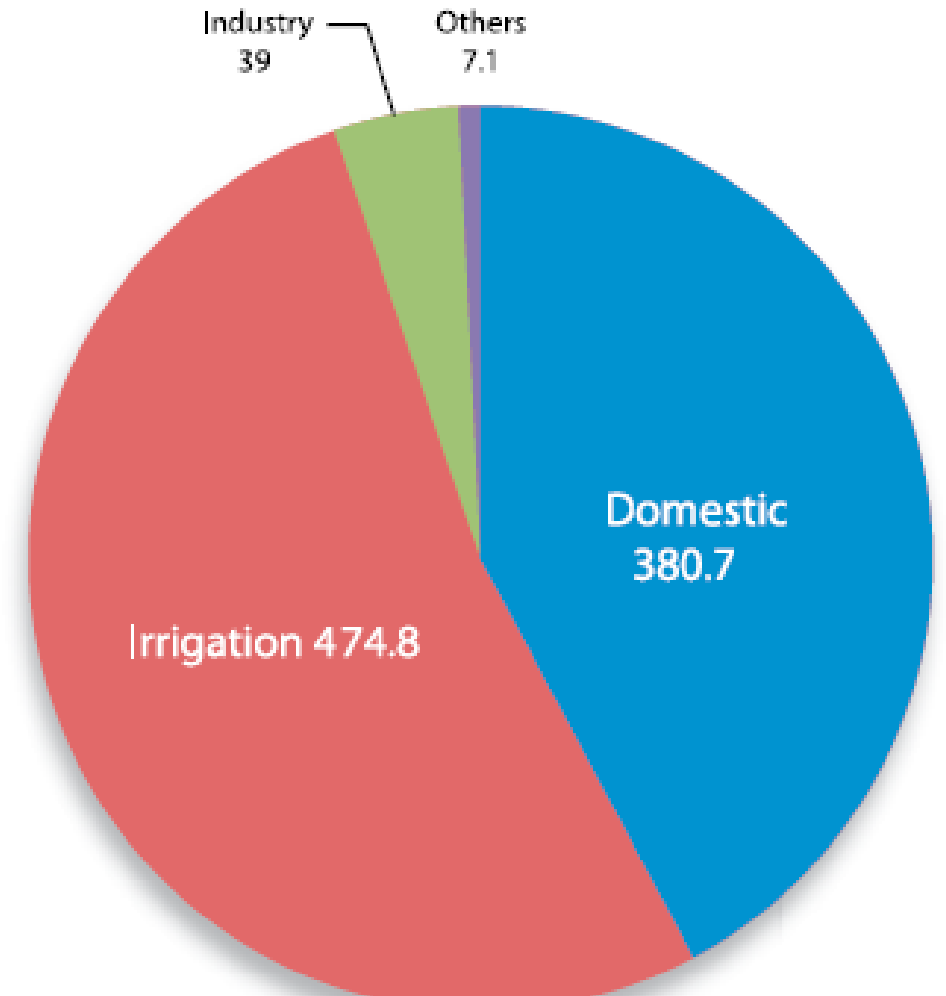
- ✓ Mass social awareness should be inculcated regarding the nature and effects of water pollution, and remedial measures.
- ✓ Strict laws should be enforced, and persons violating the provision of pollution control should be penalized.

Water use in Jordan

Water Uses in 2013 (Million M³)

Uses	Surface Water	Groundwater	Total Volume
Domestic	123	257	381
Irrigation	225	250	475
Industry	7	32	39
Others	7	0	7
Total	362	540	902

Water Uses 2013 (MCM)





Surface Water Budget 2013 (Million M³)

