**Chapter 5.2: Freshwater Pollution**

* Developing countries are making progress to clean polluted water supplies
* Some water still dangerously polluted in U.S.
* Water pollution in less developed countries = BIG PROBLEM
  + Soviet-bloc countries
  + Russia would need $200,000,000,000to clean up polluted water
* Industry not always the problem, pops. can outgrow water supply
  + Polluted with sewage/runoff
    - Leads to sickness/death from waterborne disease

**Water pollution** – introduction of chemical, physical or biological agents into water that degrades the quality of the water and affects the organisms that depend on it.

* 2 underlying causes
  + Industrialization
  + Human population explosion
* Both produce waste faster than it can be disposed

**Kinds of Pollutants**

**Pathogens** – disease causing organisms such as bacteria

* Pollution occurs when human sewage is untreated or enters water through storm sewers and when animal feces wash off the land into waters.

**Organic Matter** – biodegradable remains of plants/animals including feces

* Come primarily from non-point sources

**Organic Chemicals** – pesticides, fertilizers, plastics, detergents, gasoline, oil, other materials made from fossil fuels such as petroleum (consists of hydrocarbons originally found in ancient plants)

* Mostly nonpoint source pollution

**Inorganic Chemicals** – acids, salts, toxic metals

* Both point and nonpoint sources

**Toxic Chemicals** – poisonous to living things, heavy metals (lead, mercury, cadmium), industrial chemicals, some household chemicals.

**Physical Agents** – heat and suspended solids, such as oil

**Radioactive Waste** – from power plants or nuclear processing and defense facilities.

**Point Pollution**

* Pollution that is discharged from a single source such as a factory, wastewater treatment plant or an oil tanker.
  + Industry pipe flowing into river
  + Can clearly see where pollution is coming from
* Relatively easy to regulate and control
  + Easily ID’d and traced
* Sometimes difficult to enforce clean up

**Nonpoint Pollution**

* Pollution that comes from many sources rather than from a single specific site.
  + Reaches bodies of water via streets/storm sewers
  + Comes from anywhere: homes, lawns, farms, highways, etc.
    - Pesticides/fertilizers 🡪 farms
    - Animal feces 🡪 farms, parks, city streets
      * All washed away by rain
  + Extremely difficult to control due to many source variations
    - Small amounts add up to big problems
  + EPA – 96% polluted water is from nonpoint sources
    - Control depends on public awareness
    - Educating public most effective way to control and reduce

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| **Sources of Point Pollution** | **Sources of Nonpoint Pollution** |
| * 23 million septic tanks | * Highway construction and maintenance: eroding soil, toxic chemicals |
| * 190,000 storage lagoons for polluted waste | * Storm water runoff from city and suburban streets: oil, gasoline, dog feces, litter |
| * 9,000 municipal landfills | * Pesticides from 112 million hectares of cropland treated with these substances each year |
| * About 2 million underground storage tanks containing pollutants * i.e. gasoline | * 50 million tons of fertilizer applied to crops and lawns |
| * Thousands of public and industrial wastewater treatment plants | * 10 million tons of dry salt applied to highways for snow and ice control |

**Wastewater** – water that goes down the drain

* Flows through pipes to treatment plant
* Treated and returned to river
* May not remove all harmful substances
* Residential is easy to treat (biodegradable)
* Industrial/storm runoff from streets and fields usually contains toxic substances

**Sludge** – solid material that remains after treatment

* Often contains dangerous levels of toxic chemicals
* Usually designated “hazardous waste”
  + Incinerated and buried
* Large volumes, expensive disposal
* Contains plant nutrients (used as fertilizer)
  + Toxic free
* Can be combined with clay for bricks
  + Toxic free

**Pathogens** – disease causing organisms, such as bacteria, viruses and parasitic worms

* Enter water supplies in untreated waste water and animal feces
  + Ex cholera, hepatitis and typhoid
* Test water, check for bacteria
  + Most common: Escherichia coli ( E. coli)
    - Human intestinal bacteria

Fecal coliform test – tests for bacteria

* Ecosystems often suffer from pollution
  + Soil is tainted with toxic pesticides and enters river
    - Bottom dwellers have toxins enter their bodies
    - Fish eat bottom dwellers, bigger organisms eat fish
    - Eagle eats bigger fish
    - Etc, until it gets passed on and on
* Each organism stores toxins in tissues
* Toxin levels increase as passed on through food chain

Biological magnification – increase in concentration

* Ex: toxin concentration increases
* Water pollution 🡪 can do immediate damage to ecosystem
  + Chemicals into rivers/streams can kill living things miles down stream
  + Harmful to human health
    - Cancer, birth defects. Affect reproduction/nervous systems, liver, kidneys
  + In fish can cause:
    - Cancer, scale rot, fin rot
    - Toxins accumulate in tissues

**Eutrophic** – contain an abundance of nutrient

* Happens over a long period of time
  + Dead organism decompose, adding nutrients
* Decomposition uses lots of O2 which limits types of organisms in certain areas of water
* Plants thrive with nutrients, start in shallow waters
  + Water becomes swamp/marsh
    - Secondary succession occurs

**Artificial eutrophication** – caused by humans

* Runoff from sewage/fertilizers
* Inorganic plant nutrients
  + Phosphorous
  + Nitrogen

Phosphorous – plant nutrient found in detergents, animal waste, fertilizers

* Causes excessive growth of algae
* Algal form large mats 🡪 **algal blooms**
  + These float on water
* Algae die/decompose 🡪 uses lots of O2
  + Fish suffocate because they can’t breathe
* Bans have been placed on phosphate detergents
* Limitations of phosphorous have been created for detergents

**Thermal pollution** – excessive amounts of heat are added to a body of water

* When power plants/industries use water for cooling
  + Circulation
    - Cool water in
    - Warm water out
* Can kill fish if water is too warm
* Warm water holds less O2, deprives organisms
* Constant warm water can disrupt aquatic ecosystems

**Laws**

* 1972 Clean Water Act (CWA)
  + Restore and maintain chemical, physical and biological integrity of nations waters
  + Make water clean for fishing and swimming
* 1972 Marine Protection, Research and Sanctuaries Act
* 1975 Safe Drinking Water Act
* 1980 Comprehensive Environmental Response Compensation and Liability Act
* 1987 Water Quality Act
* Many improvements have occurred on state/federal levels
* Point pollution has been successful in being resolved
* Nonpoint is still a problem
  + Some ag wastes channel to lagoons, pollutants decomposed, then released into water ways
  + Waste treatment process in place in certain areas
  + Water recycling process help reduce pollution

**Groundwater pollution**

* Likely to plague for centuries
* Pesticides, chemical fertilizers, ag chemicals seep into ground water
  + Leaky chemical storage tanks/industrial lagoons also contribute
* EPA detects 200+ hazardous chemicals that can seep through soil into ground water
* If ground water pollution stopped tomorrow, water would be polluted for generations from now
* Ground water recharges very slowly
* Hard to decontaminate aquifers
  + Water dispersed among sand/rocks, clings to sand grains

Bottled water

* Sales keep increasing
* Just filtered, treated same was as tap water
* Bottled water plants regulated by the government
* Not tested for pollutants as often as public water supplies are