**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