

Types of Pollution

- **Nonpoint source water pollution** = pollution from numerous, widely dispersed origins.
 - Gases from car exhaust, chemicals spread on fields.

The U.S. Clean Water Act

- Addressed point sources
- Targeted industrial discharge
- In the U.S., nonpoint sources have a greater impact on quality
 - Limit development on watershed land surrounding reservoirs

Bottle Water Article

- How safe is your bottled water?
- Read the scenario and answer the following questions we are going to share them in 10 minutes.
- 20/20 – Tap water vs. Bottle Water
 - <http://www.youtube.com/watch?v=3QBZac3MSY>

Pathogens cause massive human health problems

- Currently, 1.1 billion people are without safe drinking water
- 2.4 billion have no sewer or sanitary facilities
 - Mostly rural Asians and Africans
- An estimated 5 million people die per year
- Solutions:
 - Treat sewage
 - Disinfect drinking water
 - Public education to encourage personal hygiene
 - Government enforcement of regulations

Human Diseases Transmitted by Polluted Water

- **Cholera**– Severe diarrhea, vomiting, can lose up to 20 quarts of water a day.
- **Dysentery** – painful diarrhea, blood stools
- **Enteritis** – loss of appetite, abdominal cramps, diarrhea
- **Typhoid** – headache, loss of energy, fever,
- **Hepatitis A** - nausea, vomiting, severe loss of appetite

Sediment Pollution

- Excessive amounts of suspended soil particles that eventually settle out and accumulate at the bottom of a large body of water.

SEQUENCE OF SEDIMENT POLLUTION

Block sunlight

Carry inorganic and organic toxic chemicals.

Organic Compounds

- Chemicals that contain carbon atoms
- Most are produced by human activities; pesticides, industrial chemicals and plastics. Can come from landfills.

Figure 1. Volatile organic compounds (VOCs) were not detected in samples from 82 percent of the 3,497 domestic or public wells at a threshold of 0.2 part per billion. VOC concentrations were greater than human-health benchmarks in 45 well samples (about 1 percent of all well samples).

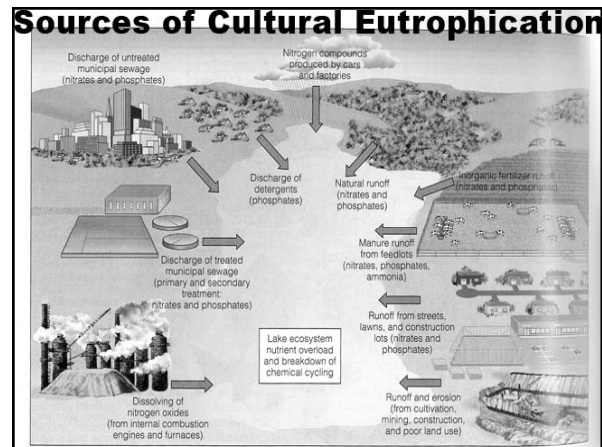
- Oligotrophic** - minimal levels of nutrients
- Eutrophication** – enrichment of a lake by inorganic plant and algal nutrients – phosphorus & nitrates.

(a) Oligotrophic lake

- low nutrient levels
- good light penetration
- high dissolved oxygen
- deep waters
- low algal growth
- small mouth bass, lake trout, pike, sturgeon, whitefish

(b) Eutrophic lake

- high nutrient levels
- poor light penetration
- low dissolved oxygen
- shallow waters
- high algal growth
- carp, bullhead, catfish



The Great Lakes

- Great Lakes Toxic Substance Control Agreement. (1986)
- DDT levels have declined
- Invasive Species are still a problem – zebra mussels.
- <http://www.youtube.com/watch?v=0qZ-FVEnFkw&feature=related>

Lake Erie

Play video

How Oxygen Depletion Develops

Cross-section of Lake Erie in summer

Top Layer
Warm, Sunlit, Mixes with Oxygen from the Air

Bottom Layer
Cool, Dark, Cut Off from the Air

Phosphorus Fertilizes Algae, Which Grow in the Top Layer, But which Sink to the Bottom when they Die. Bacteria and Fungi Decompose the Algae near the Bottom, Using up the Oxygen which is Dissolved in the Water.

Inorganic Chemicals

Lead exposure


About 310,000 U.S. children ages 1 to 5 have elevated blood lead levels, which can accumulate over months and years and cause serious health problems.

Effects on children

- Kids absorb up to 70 percent of lead, adults about 20 percent
- Often undetected; no obvious symptoms
- Can lead to learning disabilities, behavioral problems, malformed bones, slow growth
- Very high levels can cause seizures, coma, death

Sources

- Lead-based paint, contaminated dust in homes built before 1978
- Drinking water from lead pipes
- Contaminated food
- Soil (lead does not biodegrade, decay)
- Toys*



What parents can do

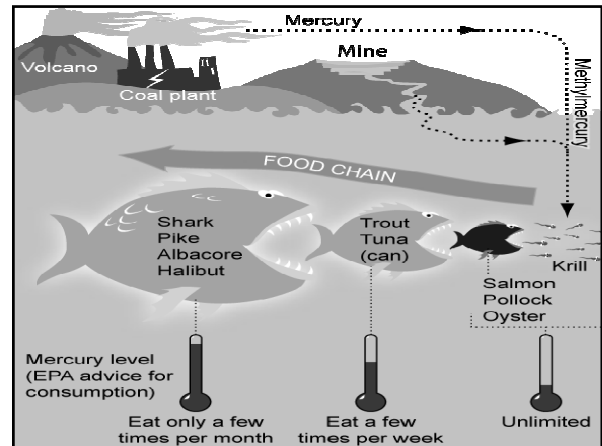
- Have child screened if there is concern of lead exposure

- Frequently wash child's hands, toys, pacifiers

- Only use cold tap water for drinking, cooking

- Test paint, dust in home if it was built before 1978

*Old toys with lead paint a known risk, but new toys from China now have come under scrutiny
Source: U.S. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. © 2007 MCT



Biomagnification!

BIOMAGNIFICATION!

4,800,000 ppt

???

690,000 ppt

98,000 ppt

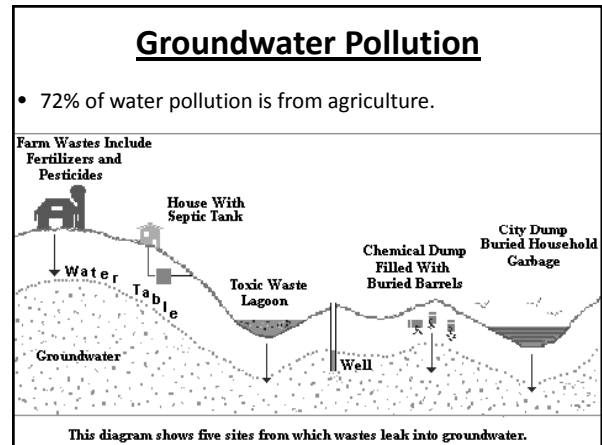
14,000 ppt

2,000 ppt

0.10 ppt

ppt = parts per trillion (mercury concentration)

- Mercury - Bioaccumulates because the body can not break it down naturally and then in MAGNIFIES up the food chain to the highest trophic level!



Ways to measure (Chemical Indicators)

Water Quality

- * Dissolved Oxygen
- * pH
- * Phosphate
- * Nitrate
- Salt
- Ammonia

RANGE OF TOLERANCE FOR DISSOLVED OXYGEN IN FISH

PARTS PER MILLION (PPM) DISSOLVED OXYGEN

< 3.0 PPM too low for fish populations

3.0 - 5.0 PPM range of tolerance / stressful conditions

6.0 PPM supports spawning

> 7.0 PPM supports abundant fish populations

> 9.0 PPM supports abundant fish populations

BOD (Biological Oxygen Demand)

- Determined by:
 - The number of aerobic organisms in that area
 - Their rate of respiration
 - Take a sample of water, measure the DO, place in a dark area around 20 degrees Celsius and take a DO measurement again.
 - The BOD is the difference between the first and the second measurement.
- Organic Pollutants cause a high BOD.
 - Organisms that break down the pollutant require a lot of oxygen.

Save the river

“Trent” Biotic Index

- Based on the “disappearance” of the indicator species as the level of the organic pollutant increases.
- This can lead to a change in diversity.
- See handout on the different groups for the biotic index.

Nutrition Facts
 Giant water bug
 Serving size: 100g
 Amount per serving
 Calories 67
 Total Fat 30mg
 Phosphorus 200mg
 Iron 14mg
 Calcium 44mg
 Carbohydrate 2.1g
 Protein 19.9g



Table 2: Biotic Index

Example from Table 2:

- Find # of each Taxon x Pollution Tolerance Value = Total Tolerance Value
- Sum the Total Tolerance Value column = 23,047.2
- Divide: $\frac{\text{Total Tolerance Value} = 23,047.2}{\text{Total \# of Individuals} = 4,900} = 4.63$
- Look up the Biotic Index Value on Table 3.
- Biotic Index = 4.63 = Good Water Quality

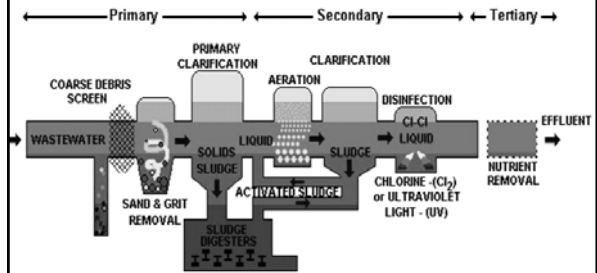
Table 3: Evaluation of Water Quality from Biotic Index

BIOTIC INDEX	WATER QUALITY	DEGREE OF ORGANIC POLLUTION
<3.5	EXCELLENT	ORGANIC POLLUTION UNLIKELY
3.6-7.0	GOOD	SOME ORGANIC POLLUTION
7.1-8.5	Fair	SUBSTANTIAL POLLUTION LIKELY
8.6-10.0	POOR	SEVERE ORGANIC POLLUTION LIKELY

Improving Water Quality

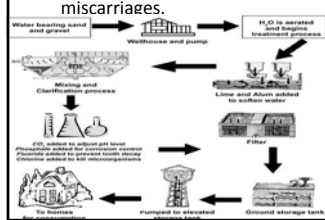
- The US has nearly 60,000 municipal water facilities that serve 232 million people.

Wastewater Treatment Process



Purification of Water

- Chlorine Dilemma**
 - Kills waterborne, disease causing organisms.
 - Can be linked to rectal, pancreatic and bladder cancer and increased miscarriages.
- Fluoridation**
 - Small amounts has been added to drinking water to prevent tooth decay.
 - Dentists think that fluoride is the main reason for the 50-60% decrease in tooth decay.
 - 66% of public water supplies contain fluoride.



Soil Pollution

- Salinization – irrigation of agricultural fields often results increased amount of salt in soils.
- Eventually can be toxic for plants and will reduce plant productivity.

