

Water Contaminants - Water Quality

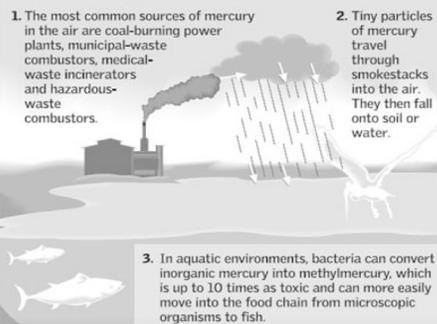
Unit 8: Water Resources
CIS Environmental Science
PLHS Site

1. Heavy metals

- ⊙ Mercury (Hg)- Biggest concern
 - Source: Power Plants, Bedrock, Industrial Uses
 - Mad Hatters suffered from Hg toxicity
 - Neural toxin (Affects brain and muscle coordination)
 - Fish consumption advisories
 - ⊙ Canned Tuna
 - ⊙ Pilot Whales (Faroe islands)
 - ⊙ Game Fish



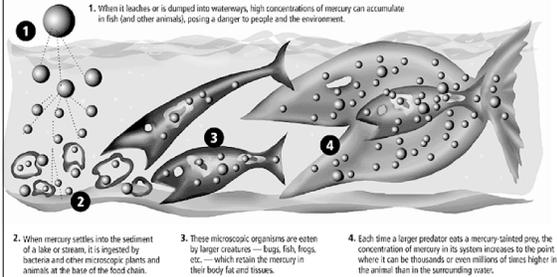
How mercury contamination spreads



Sources: EPA and Smithsonian Environmental Research Center USA Today and The Denver Post

Bioaccumulation/Biomagnification

THE PATH OF MERCURY CONTAMINATION



☉ Lead

- Also a neural toxin
- Sources:
 - ☉ Lead fishing tackle and lead shot
 - ☉ Motor fuel additives (banned in US and Canada)
 - ☉ Old plumbing fixtures

☉ Cadmium

- Also a neural toxin
- Sources:
 - ☉ Industrial pollution
 - ☉ Electronics batteries

2. Organic Toxins

☉ Chemicals manufactured as pesticides, herbicides, industrial cleaners and solvents.

☉ Examples:

- DDT - Pesticides
- PCBs - Wood Preservatives
- Dioxins
- Mirex
- Cyanide
- Atrazine

3. Nitrates

- ⊙ Expressed as NO₃.
- ⊙ EPA Maximum = 10mg/l (Drinking Water)
45mg/l (Surface Waters)
- ⊙ Health Risk: methaemoglobinemia (Blue Baby Syndrome)
- ⊙ Sources:
 - fertilizers and manure,
 - municipal wastewater
 - septic systems
 - N-fixation from atmosphere by legumes, bacteria and lightning.



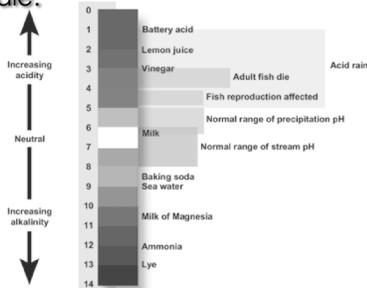
4. Phosphates

- ⊙ A plant nutrient needed for growth and metabolism
- ⊙ Excess phosphate causes extensive algae growth called "blooms". Lead to decreased oxygen levels.
- ⊙ Sources:
 - fertilizers and manure,
 - municipal wastewater and sludge,
 - septic systems, and
 - detergents and industrial waste



5. PH (Acidity and Alkalinity)

⊙ The pH scale:



- ⊙ Change in normal pH
 - Disrupts normal metabolic processes and alters ecosystems.
 - Increases heavy metal leaching
- ⊙ Sources:
 - Natural Processes
 - ⊙ Bedrock Buffering (Granite vs. Limestone)
 - ⊙ Wetland discharge (Tannic Acid)
 - Industrial Waste
 - Acid Rain:
 - ⊙ SO_x from power plants and industry
 - ⊙ NO_x from auto exhaust

6. Water Salination or Chloride Contamination



Field Salination from poor irrigation and soil management practices in Western Australia. Hundreds of thousands of hectares of farmland has been lost as a result.



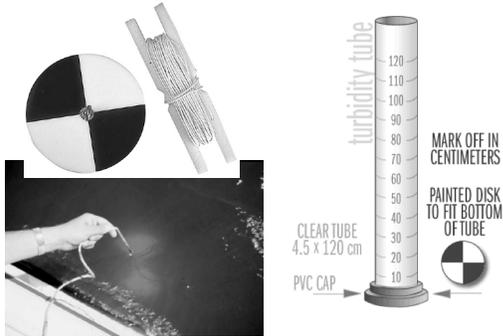
A recent study found chloride concentrations as much as 20X above federal standards in more than 40% of urban streams - likely due to winter road salt application.

- ⊙ High chloride levels can slow plant growth, impair reproduction and reduce the diversity of organisms in affected waters. It also can affect the taste of drinking water drawn from them.

7. Turbidity/Clarity

- ⊙ Measure of cloudiness in water. The more turbid the water, the murkier it is.
- ⊙ Turbid waters become warmer as suspended particles absorb heat.
- ⊙ Photosynthesis decreases with less light, resulting in lower oxygen levels.
- ⊙ Suspended solids in turbid water can clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. Settled particles smother eggs of fish and aquatic insects.

Secchi Disk Transparency Tube

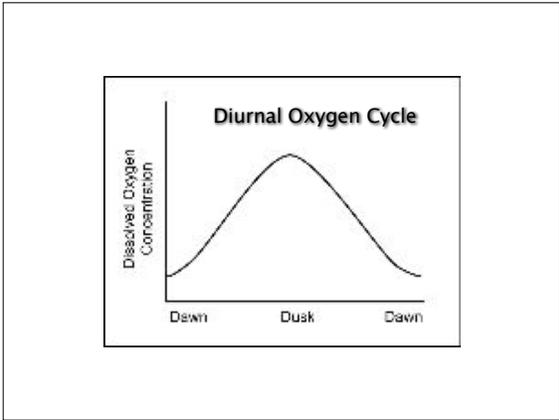


Caused by:

- Soil erosion
- Waste discharge
- Urban runoff and runoff from construction sites
- Bottom feeders like carp that stir up sediments
- Animals in the water (agriculture)
- Algal growth due to nutrient loading

8. Dissolved Oxygen (DO)

- ◎ Amount of oxygen (O_2) dissolved in water.
- ◎ Necessary for respiration/aquatic organisms
- ◎ DO below 5 mg/l – aquatic life is put under stress.
- ◎ DO below 1–2 mg/l – large fish kills.
- ◎ Three main sources of oxygen:
 - 1) direct diffusion from the atmosphere
 - 2) wind and wave action
 - 3) photosynthesis.



Oxygen Depletion

A. High BOD (Biological Oxygen Demand):
Living organisms use up all of the O₂

High BOD results from contamination by sewage or animal waste which is being broken down by oxygen consuming bacteria

B. Warm Water: Less capable of holding oxygen in solution than cool water.
For example, water that is 90° F can only hold 7.4 mg/L DO at saturation, whereas water that is 45° F can hold 11.9 mg/L DO at saturation.

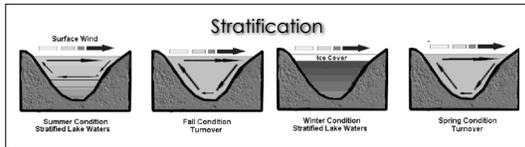
Temp. vs. DO at River Mile 10

Temperature (degrees C)	Dissolved Oxygen (mg/l)
10	10.0
12	9.0
14	11.0
16	8.0
18	6.0
20	7.0

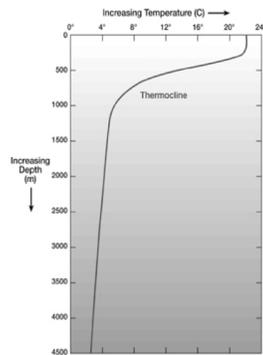
C. Cloudy, Still Weather: During cloudy weather, light is diminished, resulting in decreased photosynthesis. Oxygen consumption remains unchanged.

D. Stratification/Pond Turnover:

- 1. During hot weather, surface waters warm up more rapidly than deeper waters.



- 2. A thermocline develops. Area of rapid temperature change that acts as a physical barrier between warm water at the surface and cold water at the bottom.
- 3. There is no mixing of surface and deep layers of water. Deep layer becomes devoid of oxygen.



9. Coliform Bacteria

- ⊙ Bacteria which are found in animal feces and raw surface water.
- ⊙ Indicators of pathogens
- ⊙ The presence of *E. coli* in a drinking water sample almost always indicates recent fecal contamination.

