Environmental Toxicology

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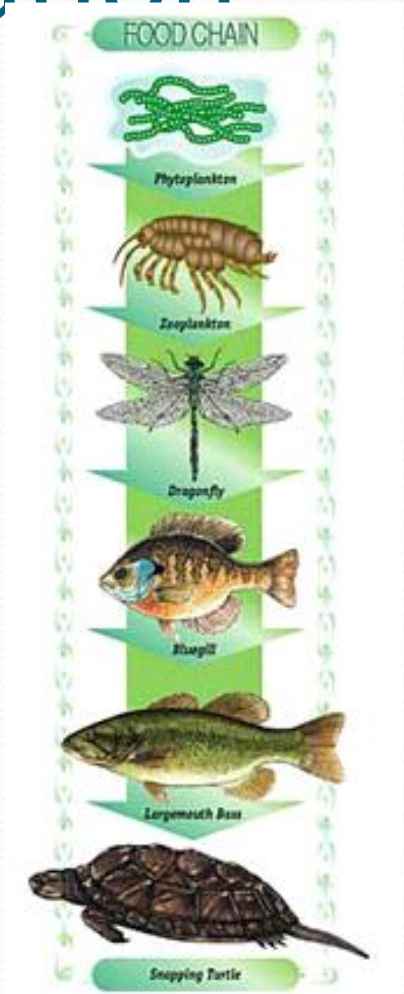
Aims and Objectives

- Understanding of bioaccumulation and bio magnification in ecosystem.
- Sources of various pollutants.
- To Study and understand the toxic effect of various Persistent organic pollutants and current status.

Biological Amplification

What is it?

- Toxic pollutants enter the ecosystem that are absorbed or ingested by organisms.
- Some substances accumulate in organism's tissue over time.
- Toxic effects on other cellular parts



Source: Pennsylvania Fish and Boat Commission

Bioaccumulation

- An increase in the concentration of a pollutant in a biological organism compared to its concentration in the environment
- It is how pollutants enter a food chain
- Different recommended concentrations of various pollutants

Where do pollutants come from?

- Coal burning power plants.
- Industries.
- Farms, lawns, and gardens.
- Non renewable energy source.
- Fertilizers preparation.
- Thermal power plants

Characteristics of pollutants:

- In order for biomagnification to happen, substance must be:
  - Long lived
  - Soluble in fat
  - Mobile
  - Biologically active
  - Frequent presence
  - Toxicity
  - Complexity

Characteristics of pollutants:

Putting it into perspective:

- Only some substances can biomagnify.
- Most substances are water soluble and are excreted into the water.
- Many breakdown quickly.
- Many are not biologically active.
- Toxicity

Pollutants that undergo biomagnification

- Mercury
- Persistent organic pollutants (POPs)
- Heavy metals
- Salts of heavy metals
- Radioactive compounds
- Some non metals and their compounds

Mercury

- Source: Emissions from coal-burning power plants, metal processing, medical and other waste

- Made bioavailable by bacteria
  - Inorganic mercury → Organic form of mercury that is biologically active.
  - Various diseases caused by mercury
  - Interaction with cellular biomolecules

Mercury

- Elementary Mercury (Hg)
- Methylmercury (CH_3Hg) – most toxic form
  - Form ingested by consuming fish
  - Concentrated in muscle tissue
  - More in older fish than younger fish
  - Note – changed from Hg to this form by bacteria
  - Resistance
  - Persistivity

Pathogenecity

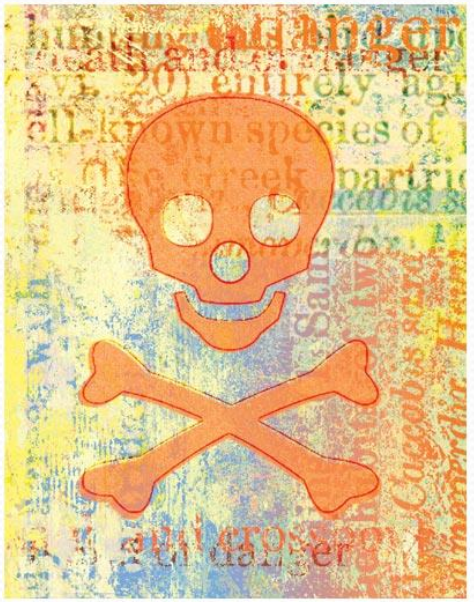
- Exposed by eating contaminated fish
- Pregnant women and children most at risk
  - 60,000 children born annually suffering from neurodevelopmental problems due to in utero exposure to mercury
  - Stunted growth

Persistent Organic Pollutants (POPs)

- Also Known as organochlorines
- Synthetic organic chemicals that persist in the environment and biomagnify through the food web
- Poses a risk to human health and the environment
- Pesticides, some plastics, paints, industrial chemicals, bleaching, burning garbage
- DDT, PCBs, dioxin

Restrictions on POPs

- 1995 UN estimated 20,000+ substances with properties of POPs
- Stockholm Convention 2004, banned 12 worst
  - "The Dirty Dozen"
  - U.S. signatory in 2001
  - Congress has not ratified
  - Signed by



International Convention Treaty

The Dirty Dozen

1. DDT - pesticide
2. PCBs - Industrial
3. Dioxin - waste
4. Furans - waste
5. Aldrin - pesticide
6. Chlordane - pesticide
7. Dieldrin - pesticide
8. Endrin - pesticide
9. HCB – pest/ waste
10. Heptachlor - pesticide
11. Mirex - pesticide
12. Toxaphane - pesticide

Exposure

- Environmental exposure – many will stay in soil or water for decades
  - Slow to breakdown
- Humans consume toxins via fish, meat and dairy
- Food chain
- Agriculture techniques

BOOKS RECOMMENDED

- General Microbiology by R.Y.Stanier
- Text book of Microbiology by Prescott
- A text book of environmental Microbiology by H.D.Kumar