

Lecture 2: Water Pollution

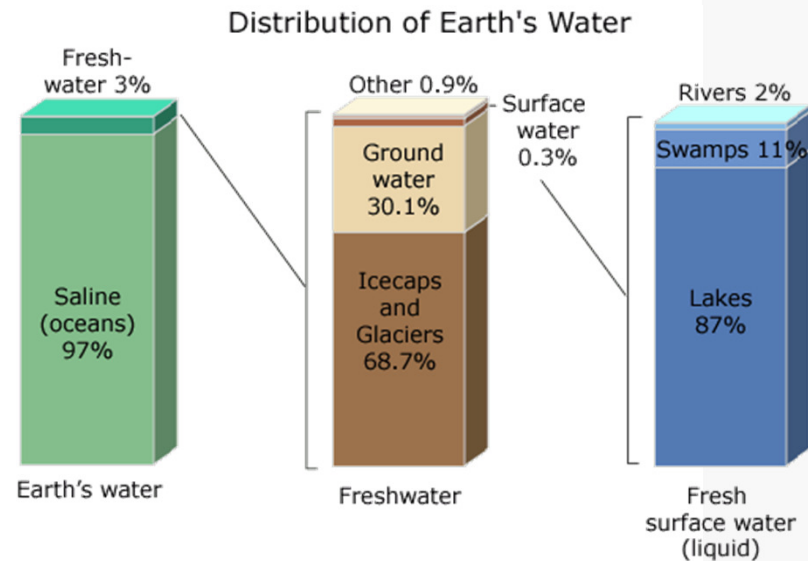
(Jan 6th 2015)

by Dr. Arun Kumar (arunku@civil.iitd.ac.in)

Objective

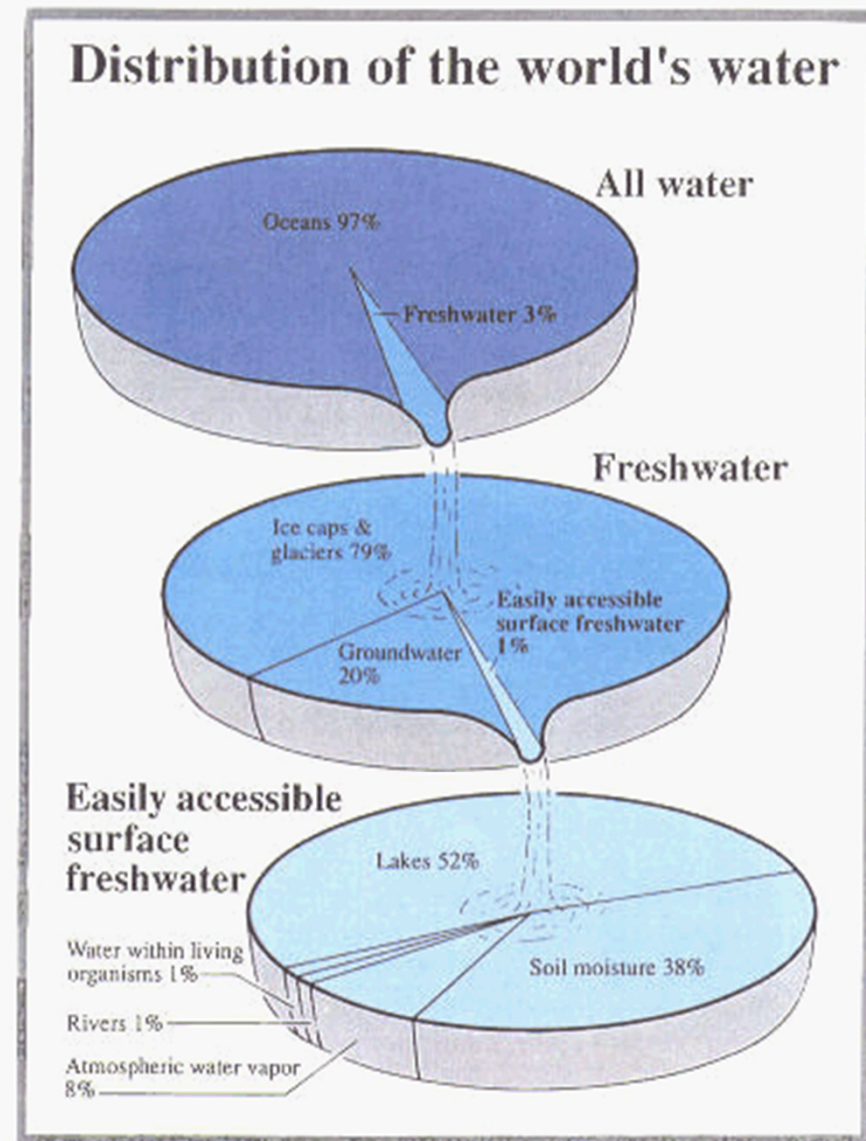
- To introduce water pollutants and their effects on human health
- To relate pollution with man-made activities

Accessible Fresh Water



Courtesy: Dr. Irene Xagorarakis, MSU (USA)

<http://ga.water.usgs.gov/edu/>



Source: WATER POLLUTION AND SOCIETY, By David Krantz and Brad Kifferstein

Locations of water pollution spots

- Can you identify locations where you think water might be polluted? In Delhi and in IIT D campus?
- What do you think about water in two nallahs in IIT D(near hospital and near Girls' hostel)
- Spots: river, lake, nallah, sea
- Man made pollution (domestic, industrial)
- Accidental water pollution (oil spill situation)



Courtesy: Dr. Irene Xagorarakis, MSU (USA)



Water Pollutants

TYPES:

- **Biological:**
 - Viruses
 - Bacteria
 - Parasites
 - Helminths
 - Bacterial Toxins
- **Chemical:**
 - Inorganic
 - Organic

EFFECTS:

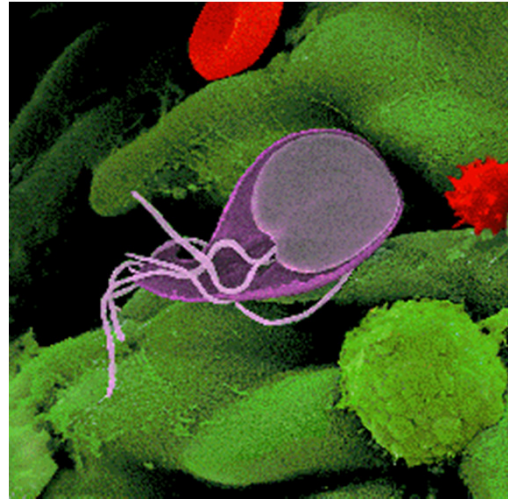
- **To Humans:**
 - Infections
 - Toxicity
 - Carcinogenesis
- **To Ecosystems:**
 - Oxygen Depletion
 - Environmental Toxicity
 - Accumulation in fish and sediments

Pathogenic Microorganisms in Water

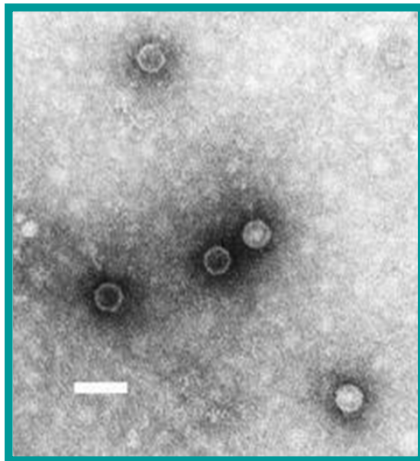
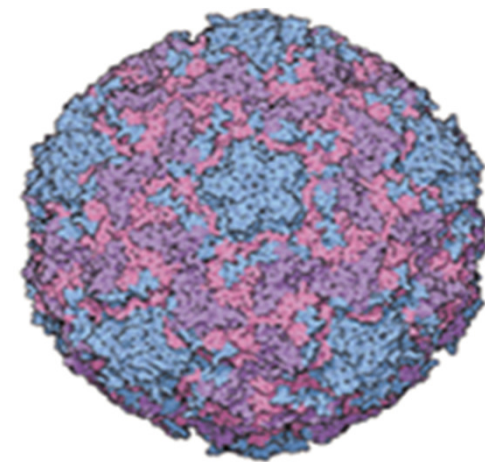
Bacteria



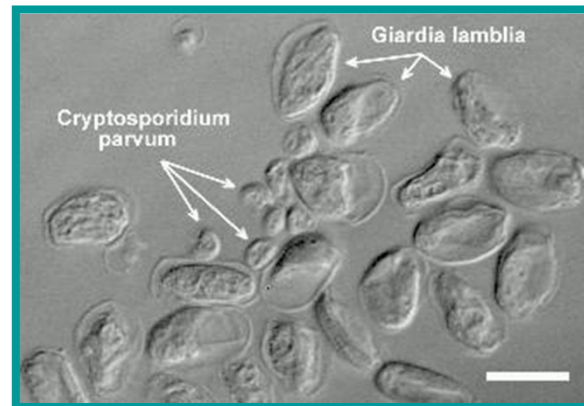
Parasites



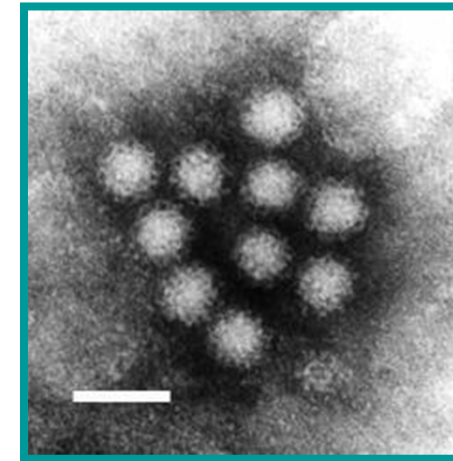
Viruses



Poliovirus
January 8, 2015



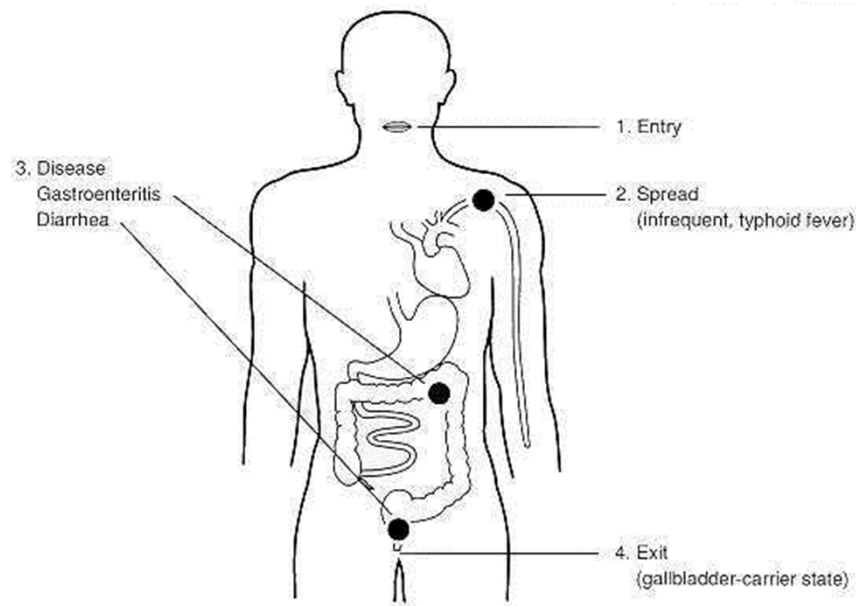
Arun Kumar
(arunk



Norwalk virus (norovirus) 7

Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Enteric Pathogens



- Exposure is via ingestion
- Primary site of infection is gastrointestinal tract
- Gastroenteritis symptoms
 - Nausea
 - Vomiting
 - Diarrhea
 - Fever
- May spread to other sites (blood, liver, nervous system)
- Shed in fecal material
- “Fecal-oral” route of transmission

Pathogens

- Pathogens can give different types of gastrointestinal diseases and it can last for different periods.
- Exposure could be from drinking contaminated water and/or consuming contaminated food items

Adverse Effects on Human Health and Ecosystems

- **Direct**
Infections,
Toxicity,
Carcinogenesis
Other disease acute or chronic
← Effects on HUMANS
- **Indirect**
Eutrophication,
Oxygen depletion - Hypoxia,
Harmful algal bloom formation,
Aquatic toxicity,
Accumulation in fish and sediments,
Bioaccumulation,
Endocrine disruption,
Antibiotic resistance development
← Effects on ECOSYSTEMS

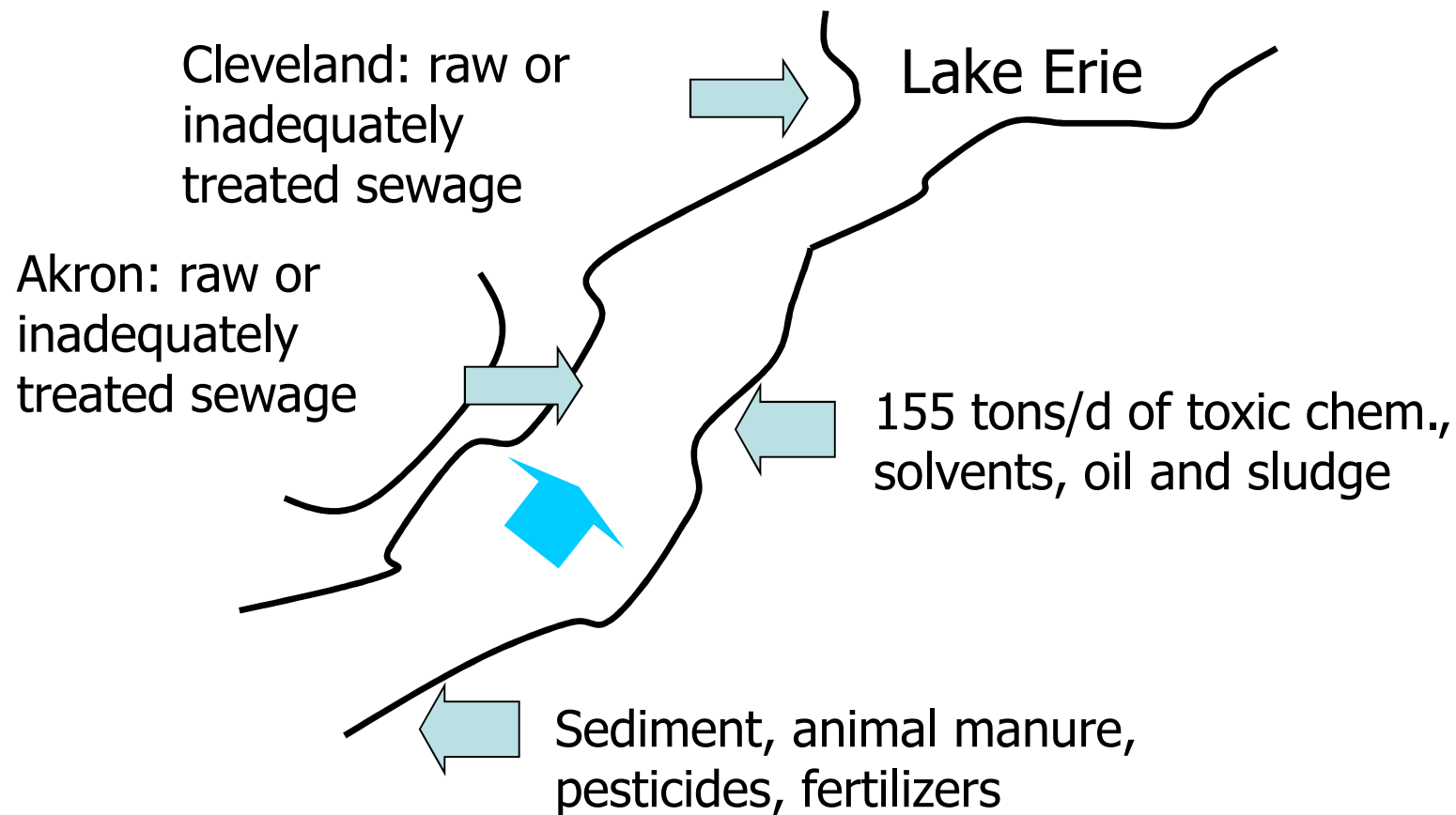
Effects on Ecosystems

(and indirect effects on human health)

Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Effects on Ecosystems (and indirect effects on human health)

The Cuyahoga River



Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Cuyahoga River and Lake Erie: Pollutants

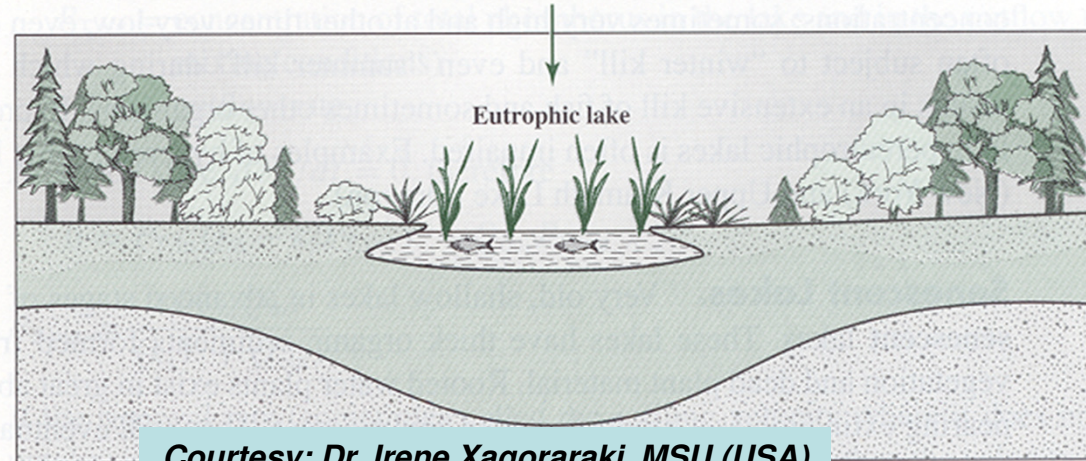
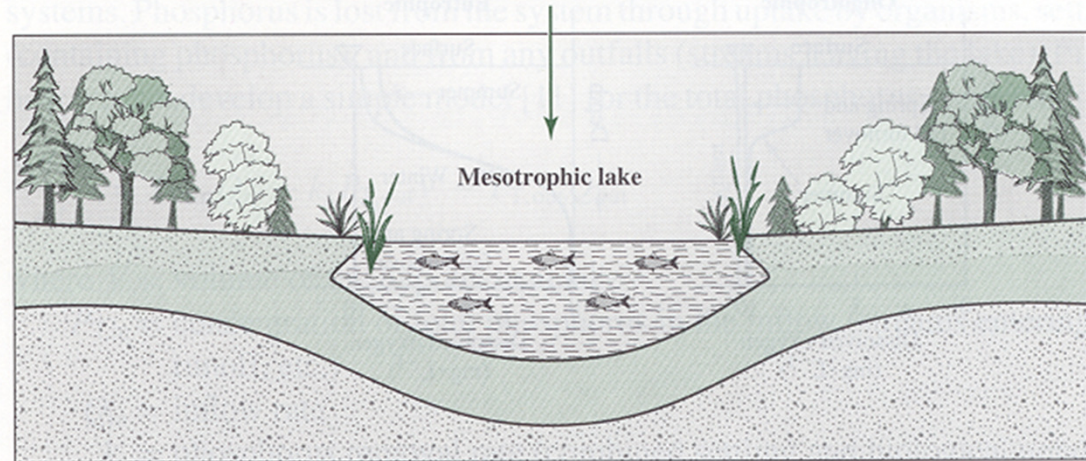
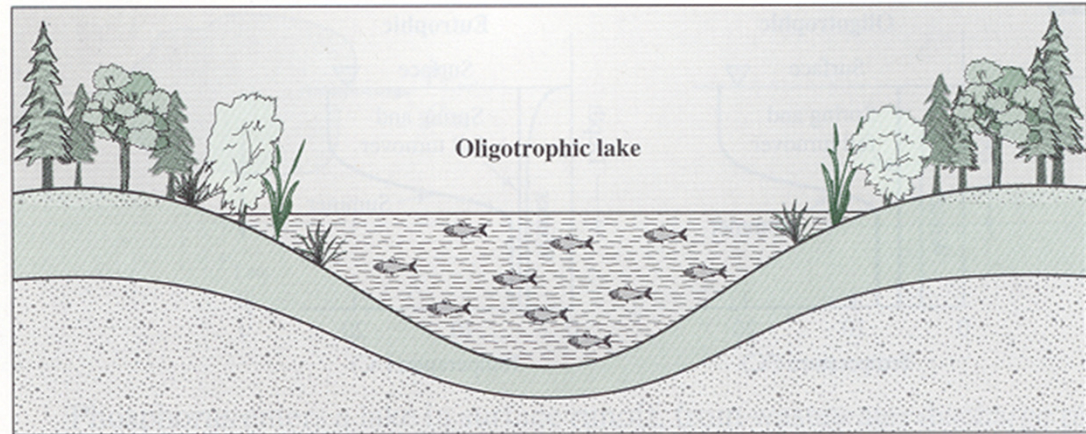
- Sewage, manure
 - nitrogen, phosphorus
 - pathogenic organisms
 - biodegradable organic chemicals – consume O₂
- Fertilizers
 - nitrogen, phosphorus
- Pesticides
- Oil
- Toxic chemicals
- Sediments

Eutrophication



Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Eutrophication



Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Harmful Algal Blooms (HABs)

Microcystis sp. bloom

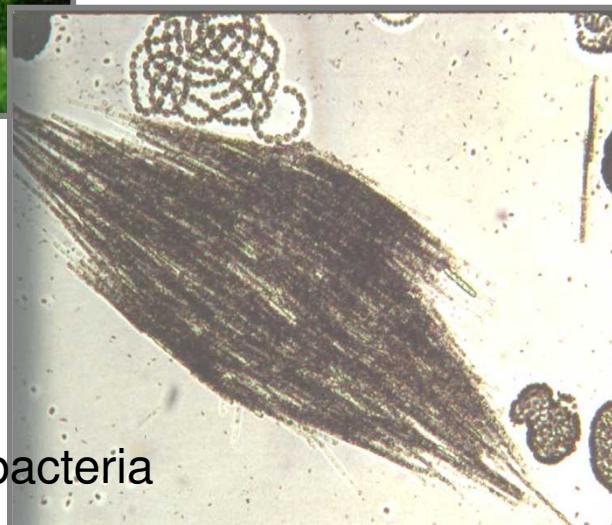


HAB



Anabaenopsis sp. bloom

mixture of cyanobacteria



Courtesy: Dr. Irene Xagorarakis, MSU (USA)

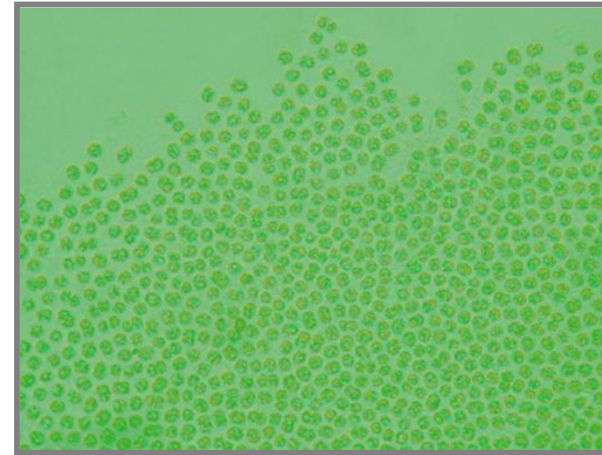
Microcystins (hepatotoxins)

Produced by:

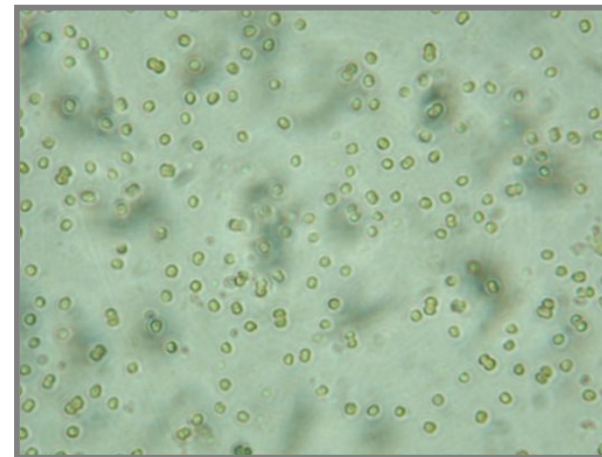
Microcystis,
Anabaena,
Oscillatoria,
Nostoc,
Anabaenopsis



Anabaena flos aquae



Microcystis aerogenosa



Microcystis aerogenosa

Courtesy: Dr. Irene Xagorarakis, MSU (USA)

Anatoxins (Neurotoxins)

Produced by:

Anabaena,

Oscillatoria,

Aphanizomenon,

Cylindrospermum,

Microcystis



Anabaena sp.

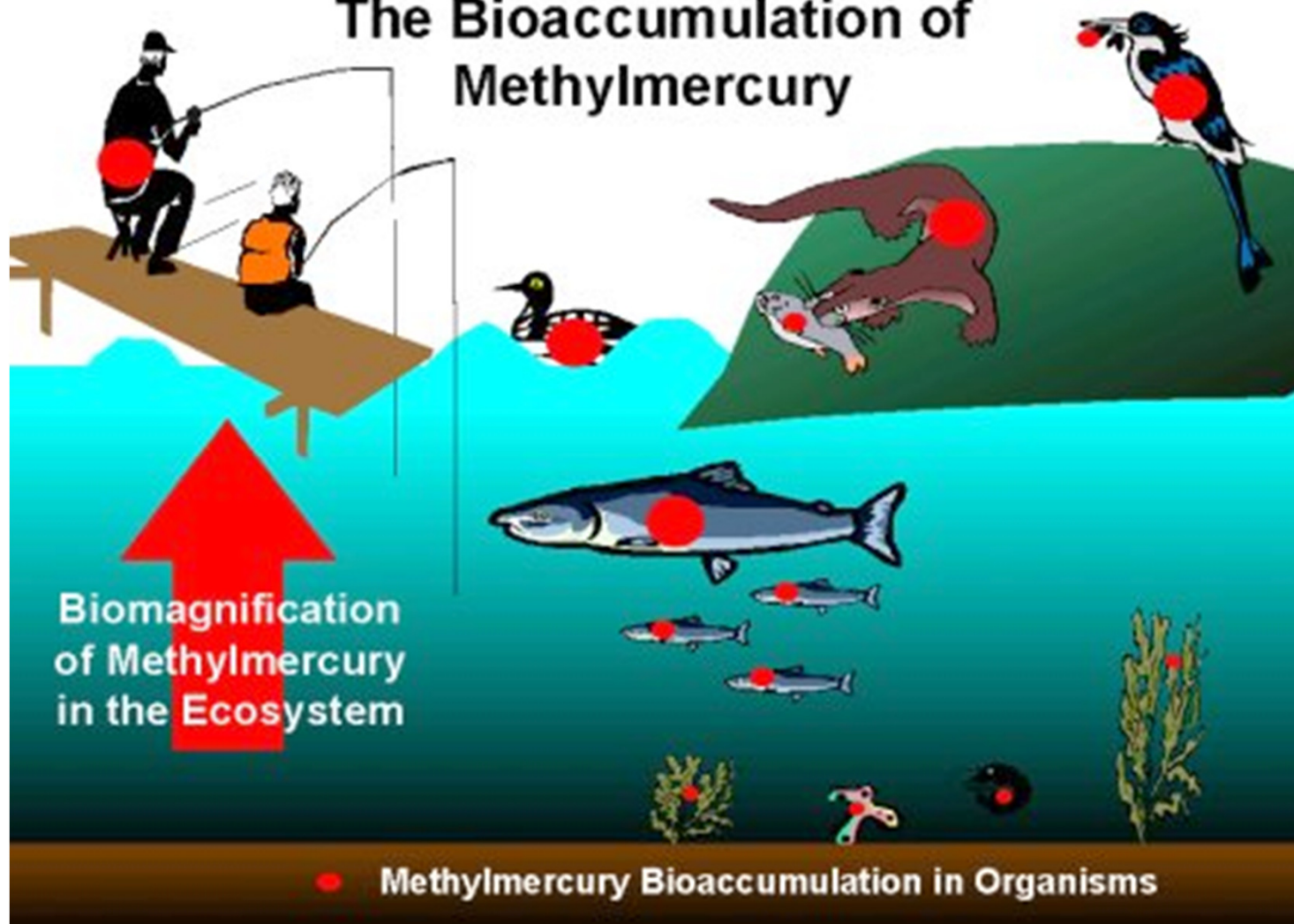


Anabaena variabilis

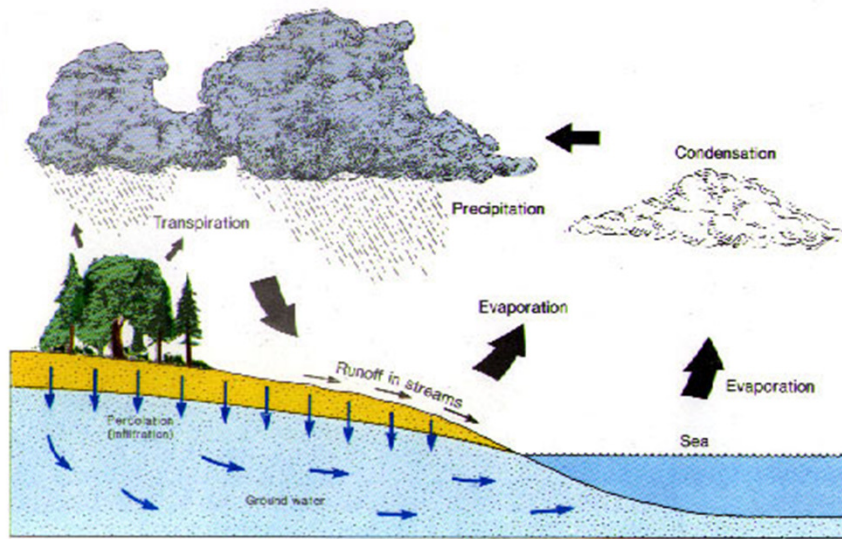


Anabaena shceremetievi

The Bioaccumulation of Methylmercury



Transport of viruses during sludge application on land



- Viruses can contaminate the surface water and groundwater by runoff and infiltration.

Pollutants that cause ecological damage

- Oxygen demanding wastes (hypoxia, eutrophication)
- Excess nutrients (hypoxia, eutrophication)
- Salts (fresh water population damaged)
- Suspended solids (settling)
- Toxicants (aquatic toxicity)
- Antibiotics (antibiotic resistance bacteria)
- Pharmaceuticals and personal care products (endocrine disruption)