SKAA 3913 – ENVIRONMENTAL MANAGEMENT

CHAPTER 3

WATER POLLUTION

WATER POLLUTION: DEFINITION

"water pollution" means…the presence in water of harmful and objectionable material obtained from sewers, industrial waste and rainwater runoff in sufficient concentration to make it unfit for use

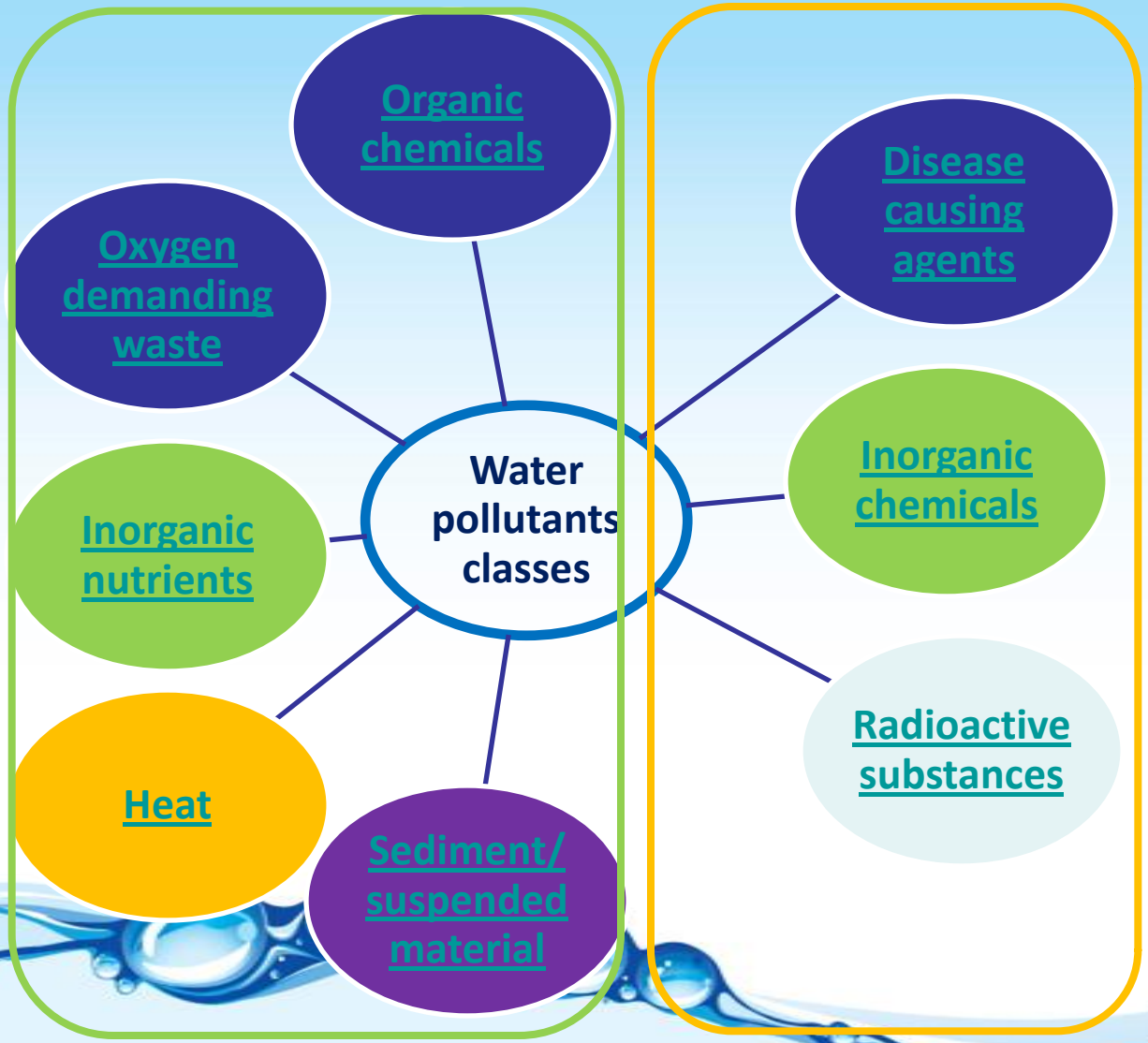
VIDEO ON WATER POLLUTION

Water Pollution.1080p.mp4

Principal forms of water pollutions

Pollutants that caused ecosystem disruption

Pollutants that caused health problem



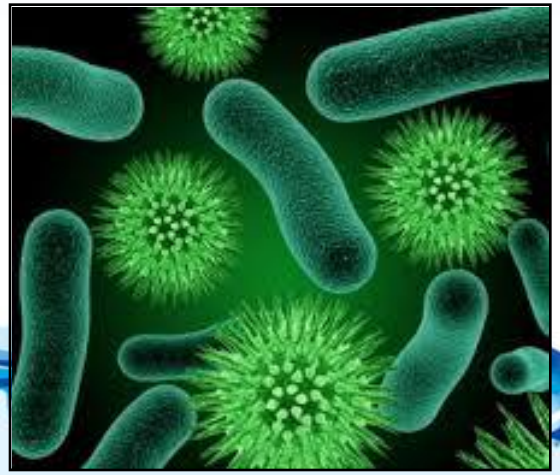
DISEASE CAUSING AGENT

- Also known as **Pathogens**: any organism that causes a disease
- Most of pathogenic organism are **microscopic or just barely visible** to unaided eye including bacteria, viruses, protozoa and parasitic worms

Source: google.com

DISEASE CAUSING AGENT CONT’

Bacteria, **viruses**, **protozoa** and **parasitic worms** that enter water from domestic and human/animal waste

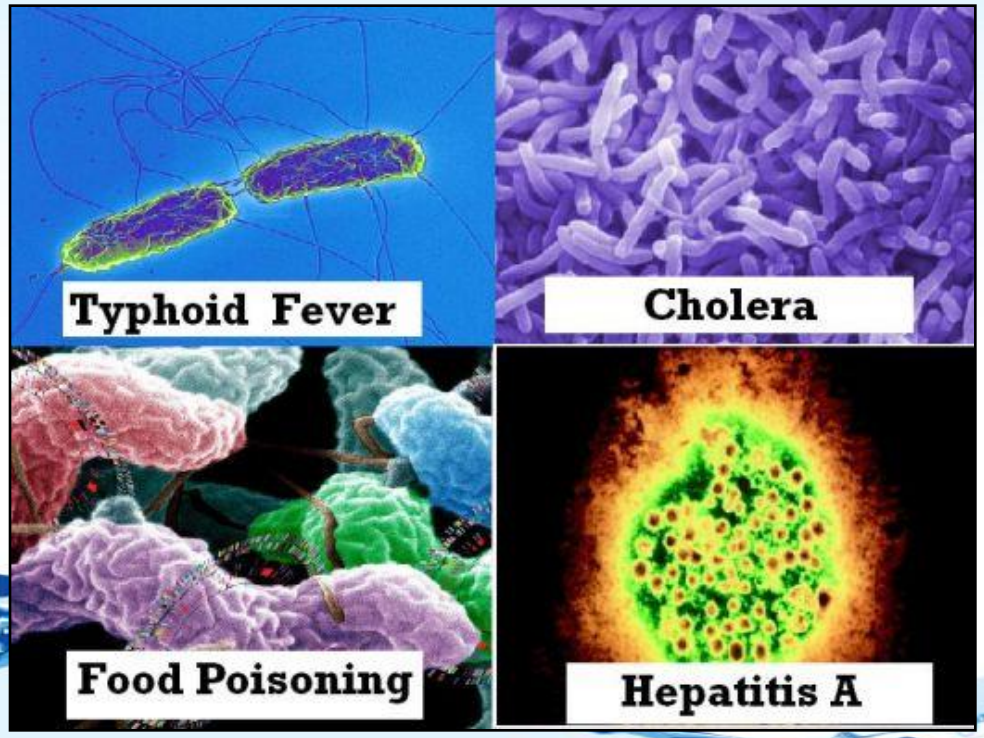


DISEASE CAUSING AGENT CONT'

- World Health Organization says that every year, more than 3.4 million people die as a result of water related diseases, making it the leading cause of disease and death around the world.
- In **developed countries** →caused by insufficiently disinfected water; by implementing non-hygienic food preparation; by insufficient personal hygiene.

DISEASE CAUSING AGENT CONT'

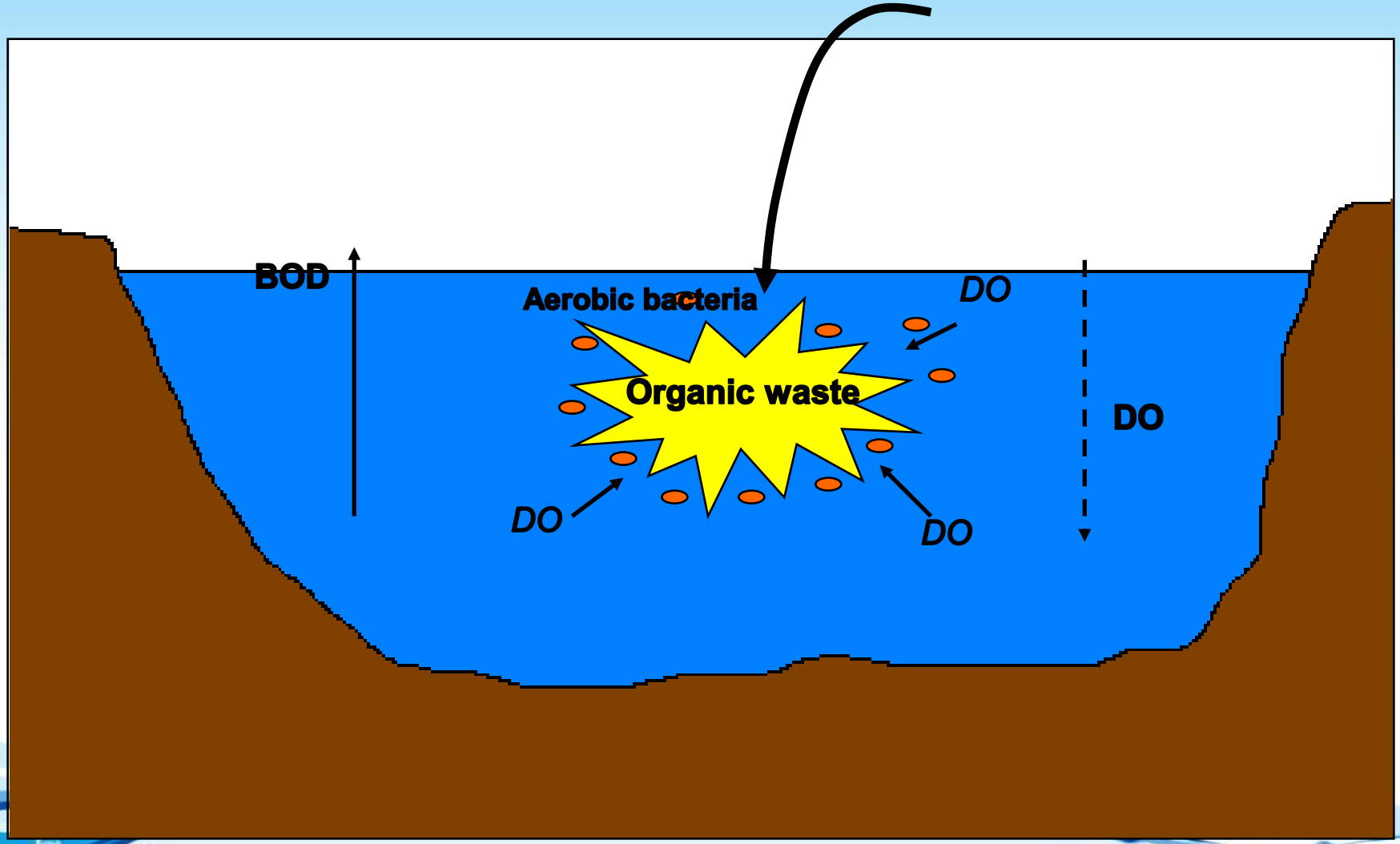
After the Tsunami attack in Asia on Sunday (26th of December 2004), people faced the threat of Shigellosis, Cholera, Hepatitis A, Leptospirosis, Typhoid Fever, Malaria and Dengue fever.



OXYGEN DEMANDING WASTE

- Oxygen demanding waste refer to organic matter that accumulates in an aquatic environment
- Decomposed by aerobic bacteria using oxygen in the water during process of degrading this matter
- Caused oxygen that dissolved in water reduce
- Large population of bacteria supported by these waste can deplete the level of **dissolved oxygen (DO)**

OXYGEN DEMANDING WASTE (CONT')

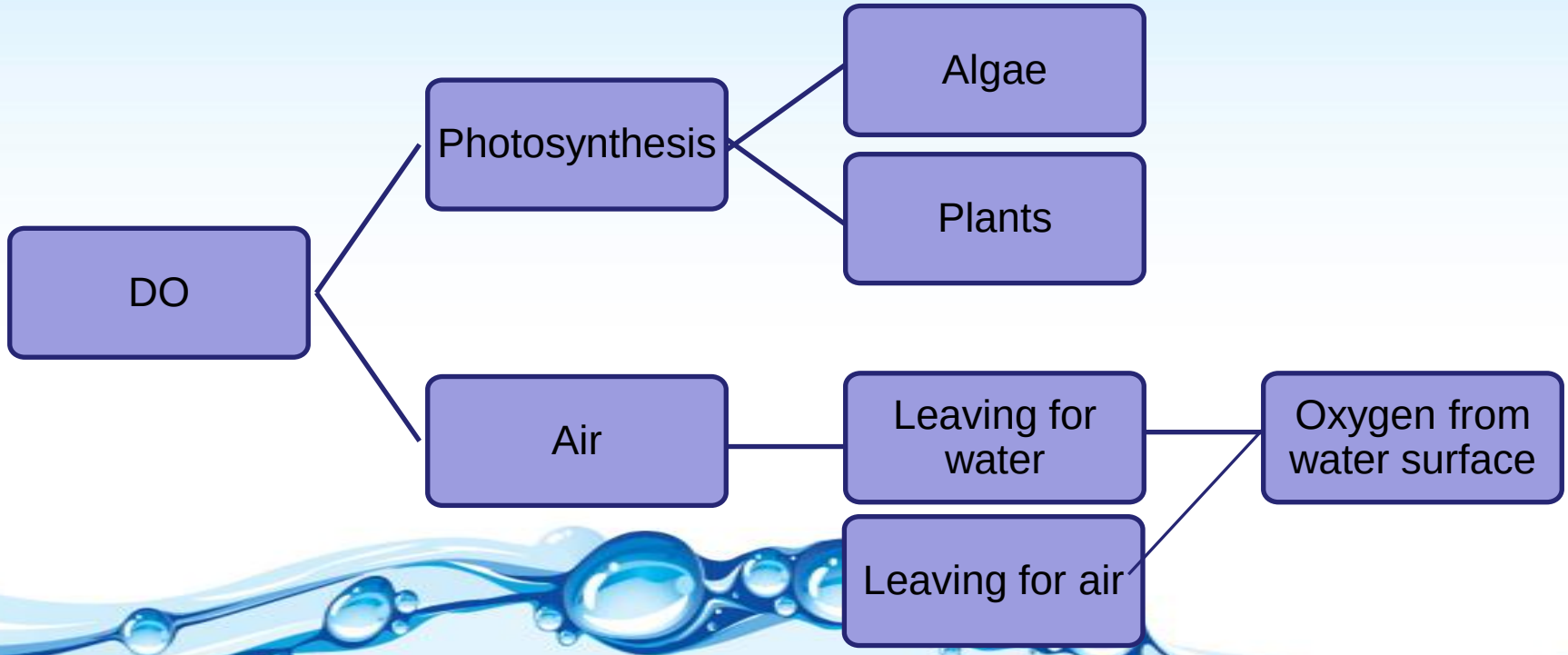


OXYGEN DEMANDING WASTE (CONT')

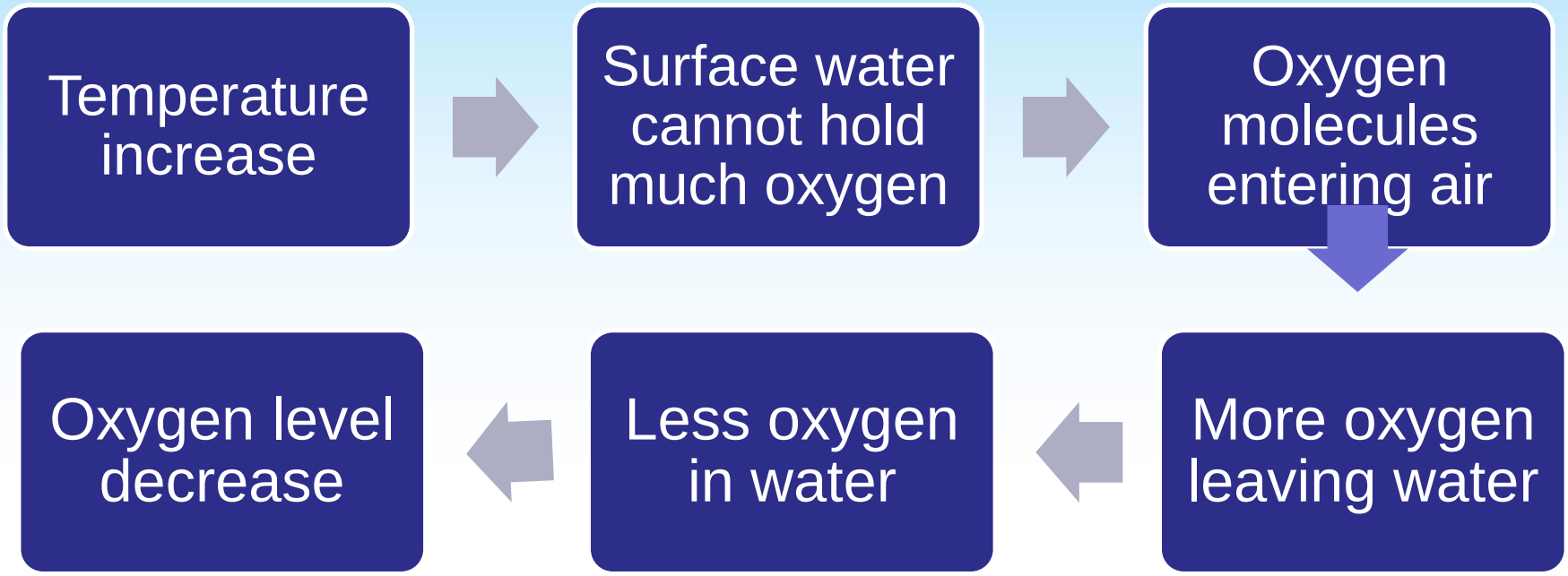
OXYGEN SAG

- Oxygen levels decline downstream from a pollution source as decomposers metabolize waste materials
- Effect of oxygen sag is the death of oxygen-breathing animals
- Effects of oxygen-demanding wastes on rivers depends on volume, velocity, distance from effluent entrance point, and temperature of water
- **The lower the temperature, the more oxygen can dissolve in the water**.

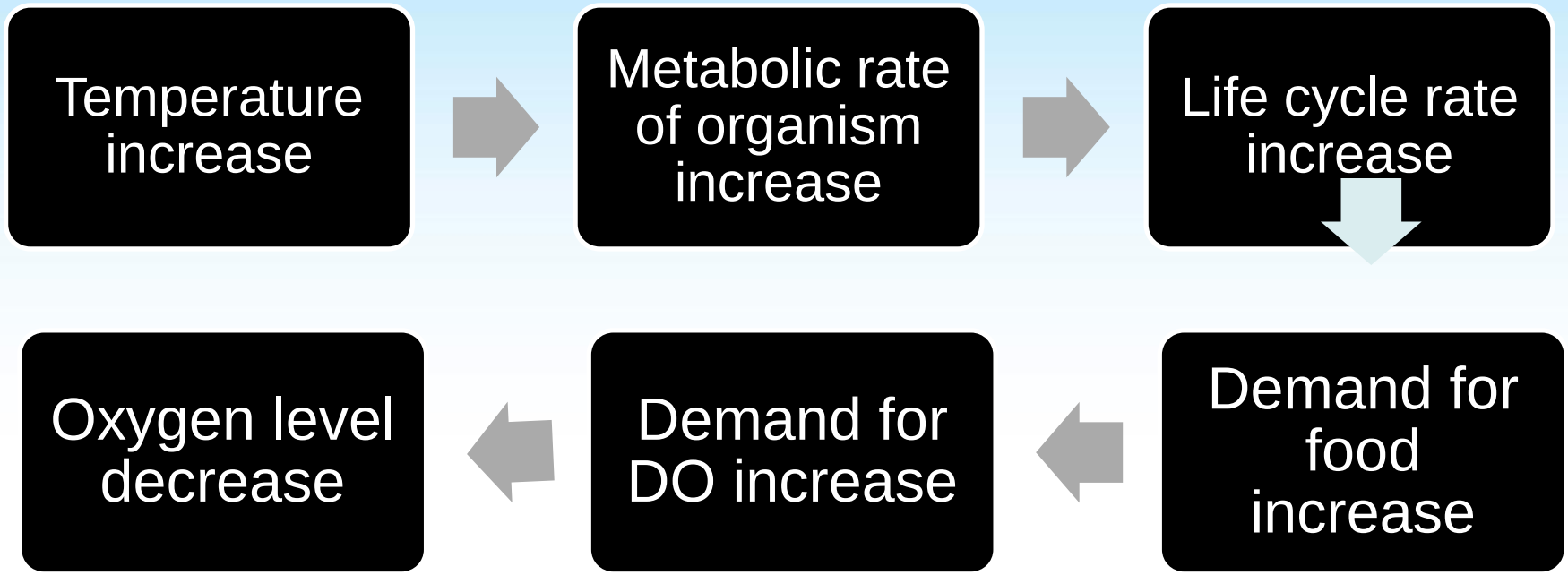
- Temperature affects DO level →How? Why?
  - Important facts you should know:
    - 2 main sources of DO→ photosynthesis & air
    - Cold water can hold more dissolved oxygen than warm water



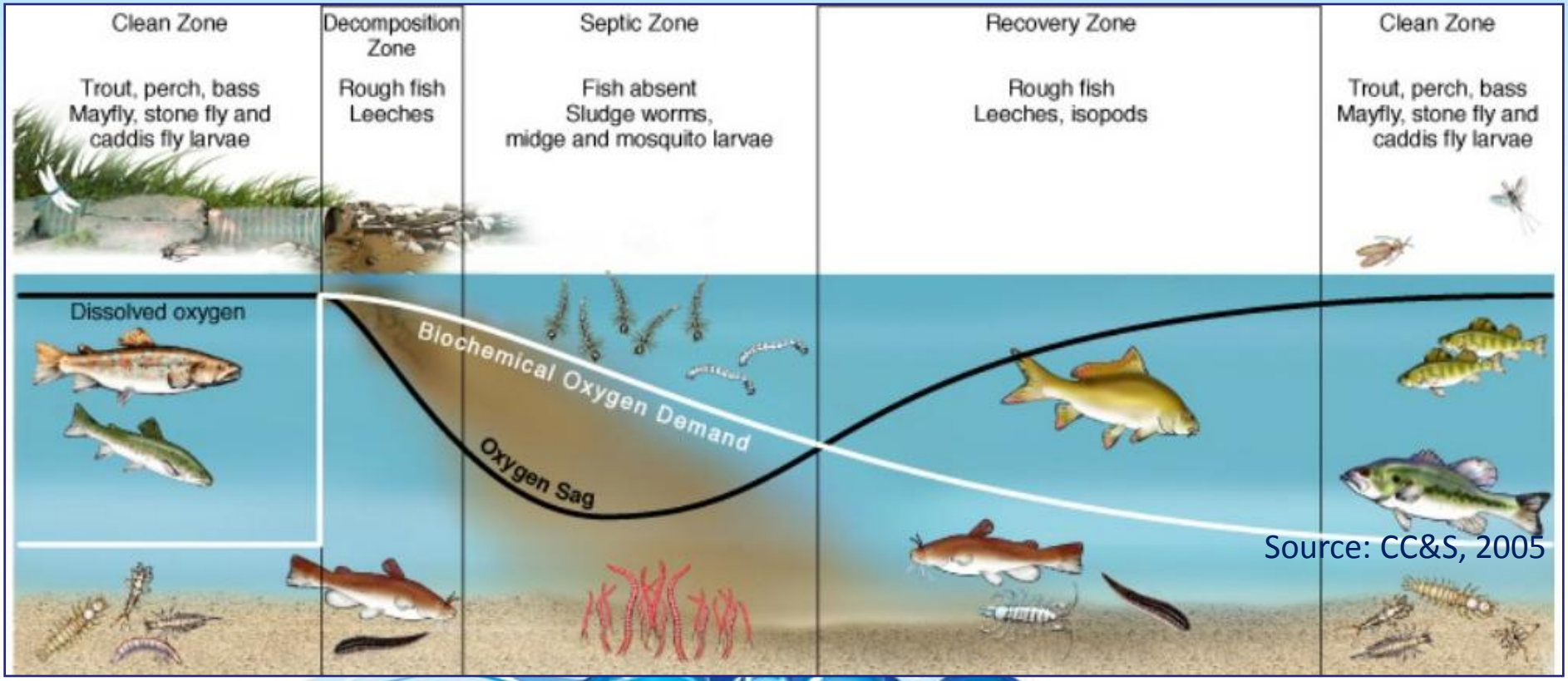
WHAT IF AT ↑ TEMPERATURE? (IN TERMS OF SURFACE AREA)



(IN TERMS OF BACTERIA UTILIZATION)



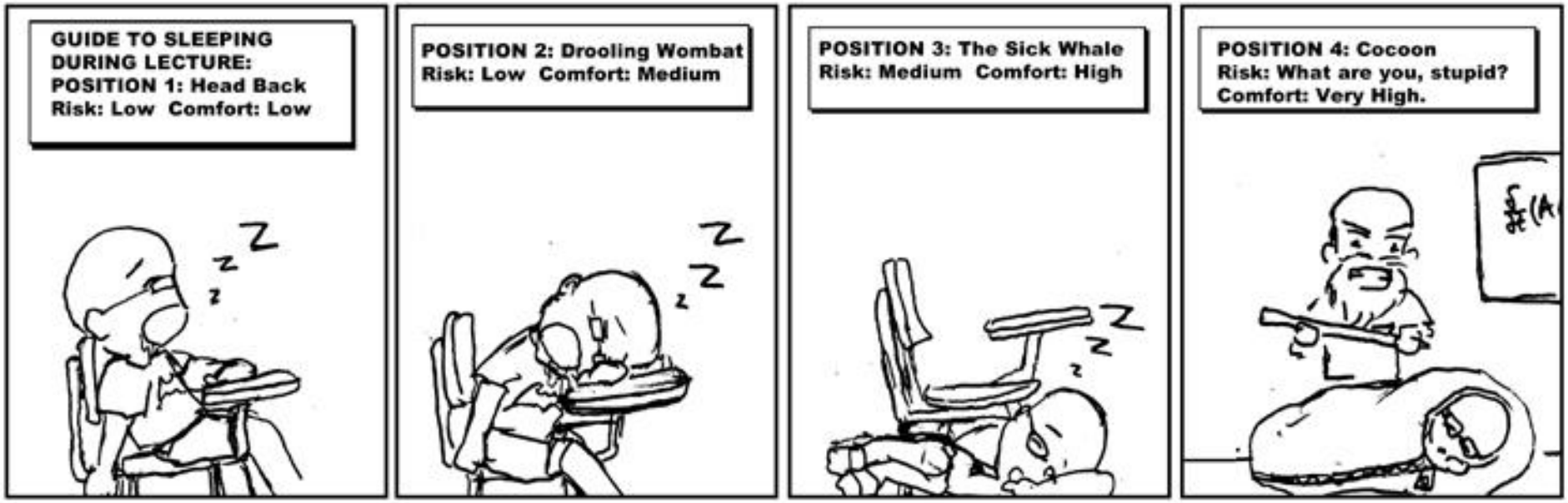
OXYGEN DEMANDING WASTE (CONT')



Source: CC&S, 2005

- DO level high in clean zone, start decreasing in decomposition zone create oxygen sag curve till septic zone
- Oxygen concentration begins to increase further downstream at recovery zone.

CLASS ACTIVITY ON OXYGEN SAG CURVE



Illustrates oxygen sag curves (Few tips):

- Effluent point of discharge
- Variations of the concentration of **dissolved oxygen** (DO)→ Drops in the decomposition zone; remains low and approx. constant in the septic zone; increases in the recovery zones
- For each increment time decomposition rate of **biological oxygen demands** (BOD)→ increase of oxygen consumed, maintain relative high concentration compared to DO and slowly drops in recovery zones

ORGANIC CHEMICAL

- Oil, gasoline, plastic, pesticide, detergents and many water soluble and insoluble chemicals that threaten human and aquatic life
- Improper disposal of industrial and household wastes and runoff of pesticides

Source: google.com

ORGANIC CHEMICAL (CONT')

Oil spill satellite image of cases in Alaska and India

Source: google.com

VIDEO ON OIL SPILL

Oil Spills in the Ocean and Oil Pollution.mp4

INORGANIC CHEMICALS

Natural or **man-made**

Acids, **salts** & compounds of **toxic metals**
eg. lead, & mercury



NATURAL

- Some toxic inorganic chemicals are released from rocks by weathering, are carried by runoff into lakes or rivers, or percolate into groundwater aquifers

MAN-MADE

- Human can accelerate the rate of release of these inorganic chemicals through the mining, processing, using and discarding minerals

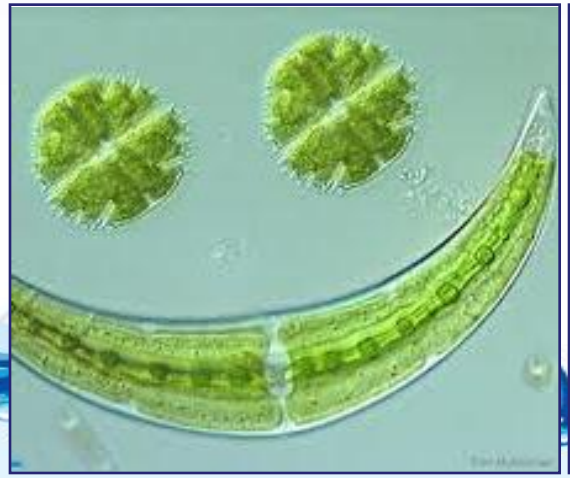
Toxic metals	Acids and bases	Salts
• Mine drainage • Leaching of mining waste	• Released as by-products of industrial processes	• Desert soil often contain high concentrations of soluble salts

INORGANIC CHEMICALS (CONT’)

- High levels of these dissolved inorganic chemicals can make :
  - ❖Water unfit for drinking
  - ❖Harm aquatic life
  - ❖Accelerate corrosion of equipment that uses water

INORGANIC NUTRIENT

Soluble **nitrate** and **phosphate** compounds that can cause excessive growth of **algae**



INORGANIC NUTRIENT (CONT')

- Algae are vitally important to marine and fresh-water ecosystems, and most species of algae are not harmful.
- BUT, **algal bloom** exhibited adverse effect.

First, the fertiliser is spread on the land.

Then it gets washed away by the rain and absorbed into the soil.

Then the fertilser is transported to a lake by an underground river.

The fertiliser causes overgrowth of aquatic plants and algae in the lake.

This means the sunlight cannot reach the bottom of the lake, so algae dies.

The bacteria decomposes the algae, taking up all the oxygen, making the lake anoxic.

This causes other organisms in the lake to die.

- Case in Malaysia

INORGANIC NUTRIENT (CONT')

- Effects of algal bloom
  - Destroy aesthetics of lake
  - Bad taste and odor and increase the expense of purifying water for drinking purposes
  - Some algae release poisons
- Excessive levels of nitrate in drinking water can also reduce oxygen carrying capacity of human blood

SEDIMENT OR SUSPENDED MATERIAL

- Suspended material
  - reduce the ability of some organism to find food
  - reduce photosynthesis
  - disrupts food webs
  - carries pesticides and other harmful substances

SEDIMENT OR SUSPENDED MATERIAL (CONT')

- Harmful effects
  - Loss of soil quality for farming
  - Toxic compound are adsorbed onto particle surface
  - Buries breeding ground for fish
  - Shortens life spans of reservoirs

Sediment Pollution Short.mp4

SHORT VIDEO ON SEDIMENTATION

HEAT

- Excessive input of water that is heated from power plants, contained high temperature that lowers DO
- Effects:
  - Decreases DO level in water
  - Interferes with reproduction
  - Increase vulnerability to disease

HEAT (CONT’)

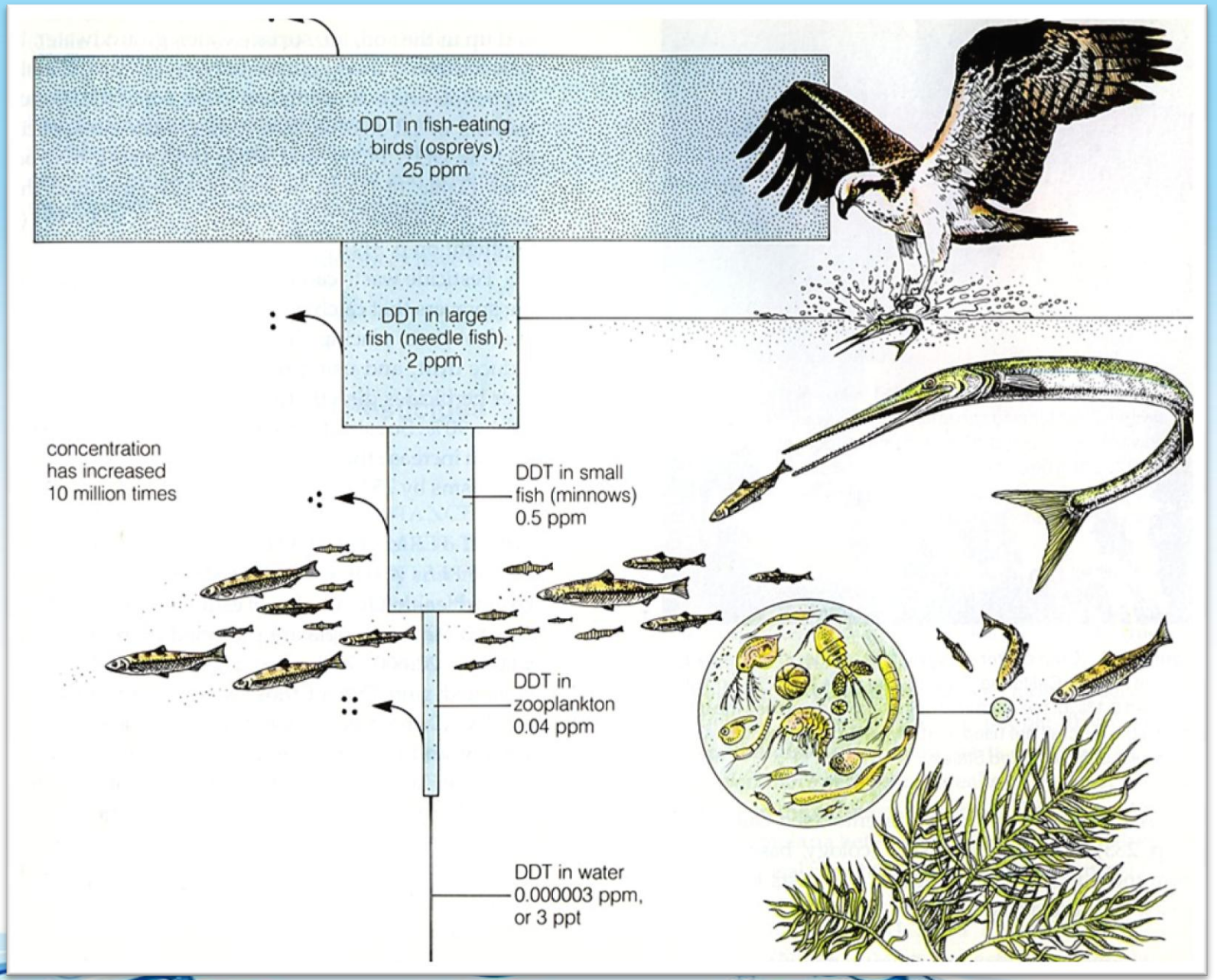
- Urban runoff can also become the source of thermal pollution, i.e. storm water passes over hot parking lots and roads and enters the water body.
- Many industries use water as a coolant, and release heated water into rivers, which causes thermal pollution

RADIOACTIVE SUBSTANCES

- Uranium, DDT = Radioactive wastes
- Radioactive wastes move through the various trophic levels in an ecosystem
  - **Bioaccumulation** : how pollutants enter a food chain
  - **Biological magnification** : the process certain substances such as pesticides or heavy metals move up the food chain

RADIOACTIVE SUBSTANCES (CONT')

- Radioisotopes that are capable of being biologically **magnified to higher concentrations** as they pass through food chains. Ionizing radiation such as isotopes can cause birth defects, cancer and genetic change

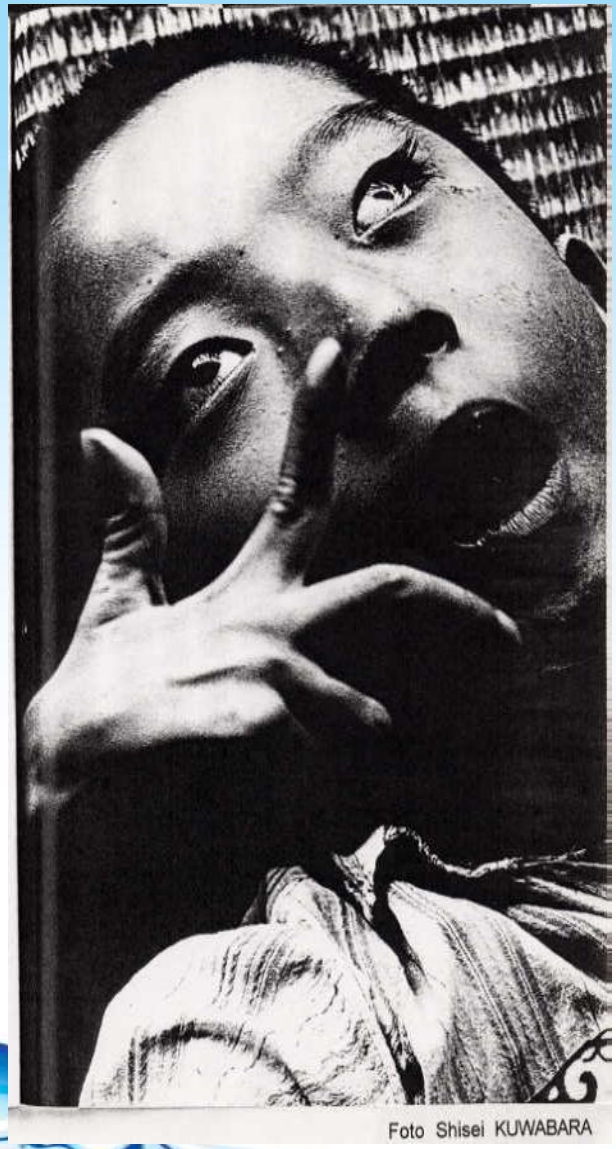


DDT : dichoro diphenyl trichloroethane

- Itai-itai Disease
  - Cadmium pollution due to mining activities
  - Jinzu river basin, Toyama Prefecture, Japan
  - The cadmium and other heavy metals accumulated in the river→ used to irrigate rice fields
  - The cadmium accumulated in the people eating contaminated rice

Source: JICA, 2010

- Minamata Disease
  - Mercury poisoning due to industrial wastewater
  - Minamata Bay, Kumamoto Prefecture, Japan.
  - Neurological disorder caused by the intake of methyl mercury accumulated in fish and shellfish in the 1950s and 1960s



Source: JICA, 2010

CRITICAL THINKING SESSION

Conduct group discussion and answer below questions:

- Describe how suspended solids can affect water quality.
- Rivers can recover naturally. Describe factors that can slow down a river's recovery process.
- Sketch and explain the biological magnification.