Environmental microbiology

Aquatic Microbiology

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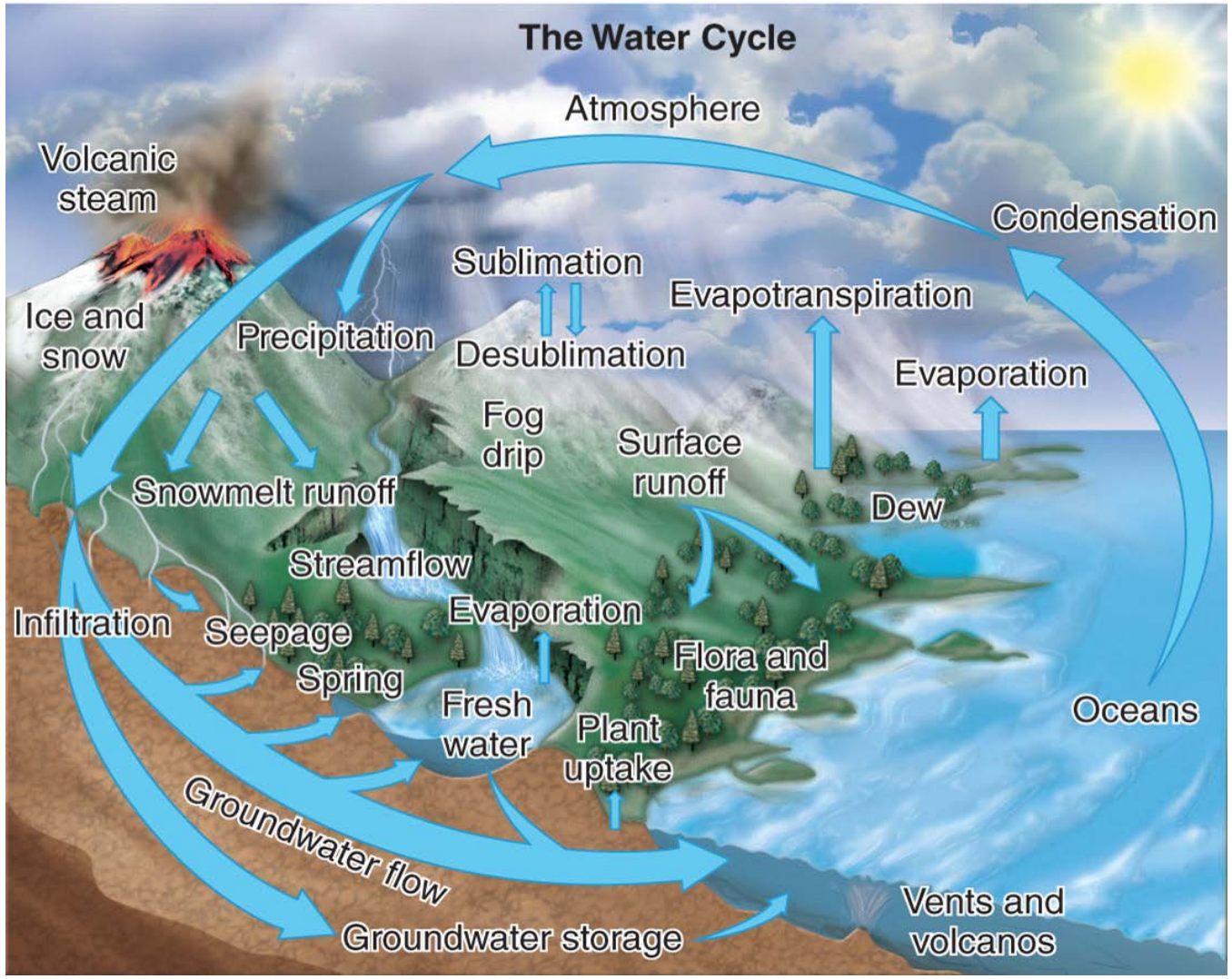
Aquatic Microbiology

- Water is the dominant compound on the earth; it occupies ¾ of the earth's surface
- Water is continuously cycled between hydrosphere, atmosphere, and lithosphere

hydrologic cycle

Hydrologic Cycle

- Water evaporates, accumulates in the atmosphere, and returns to the earth through condensation and precipitation
- Surface water collects in subterranean pockets forming **groundwater** source, called an **aquifer** – resurfaces through springs, geysers, and hot vents, also tapped as primary supply for ¼ of water for human consumption

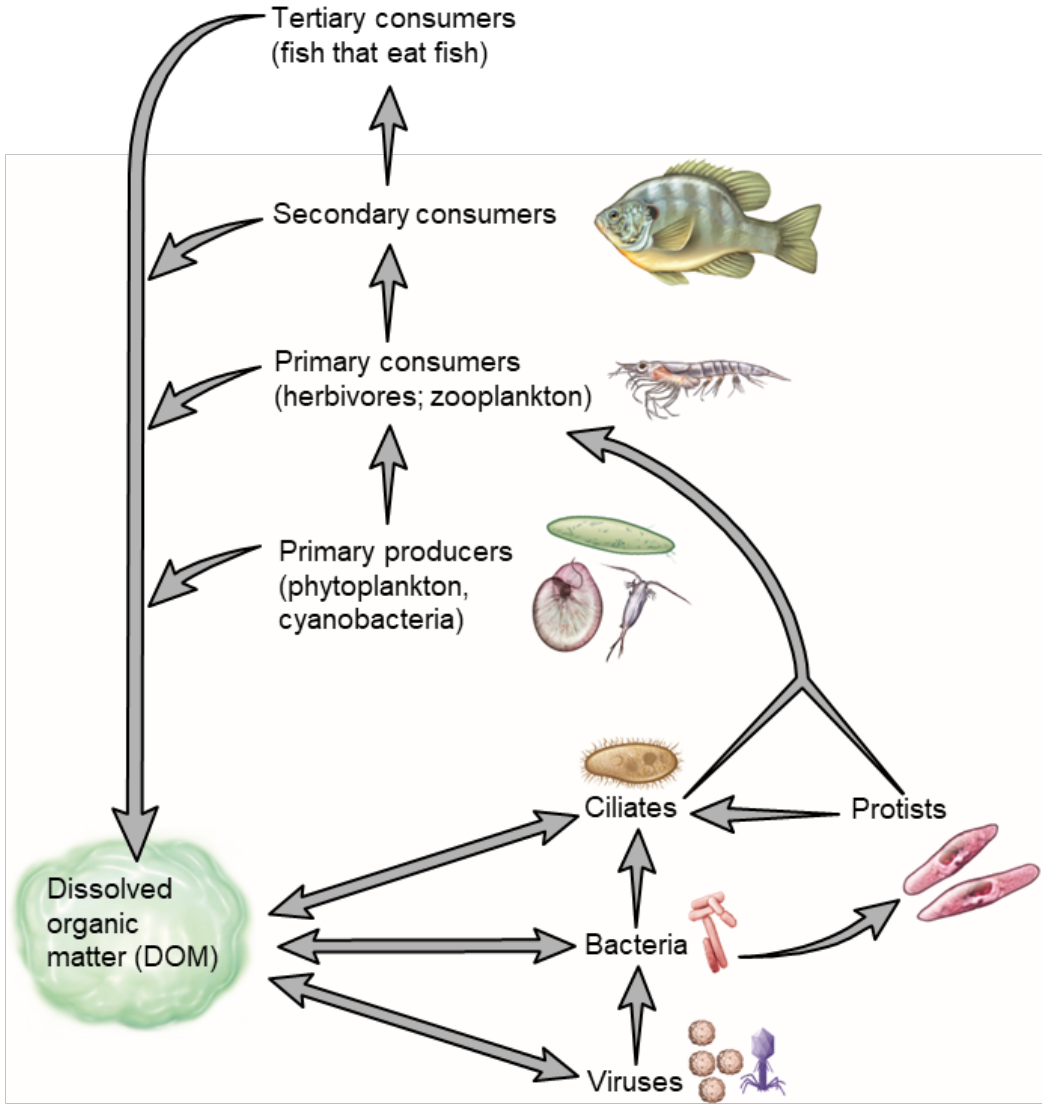


The Structure of Aquatic Ecosystems

- Surface waters differ considerably in size, geographic location, and physical and chemical character
- Sunlight, temperature, aeration, and dissolved nutrient content are factors that contribute to the development of zones
- Lake is stratified both vertically and horizontally into several zones or strata

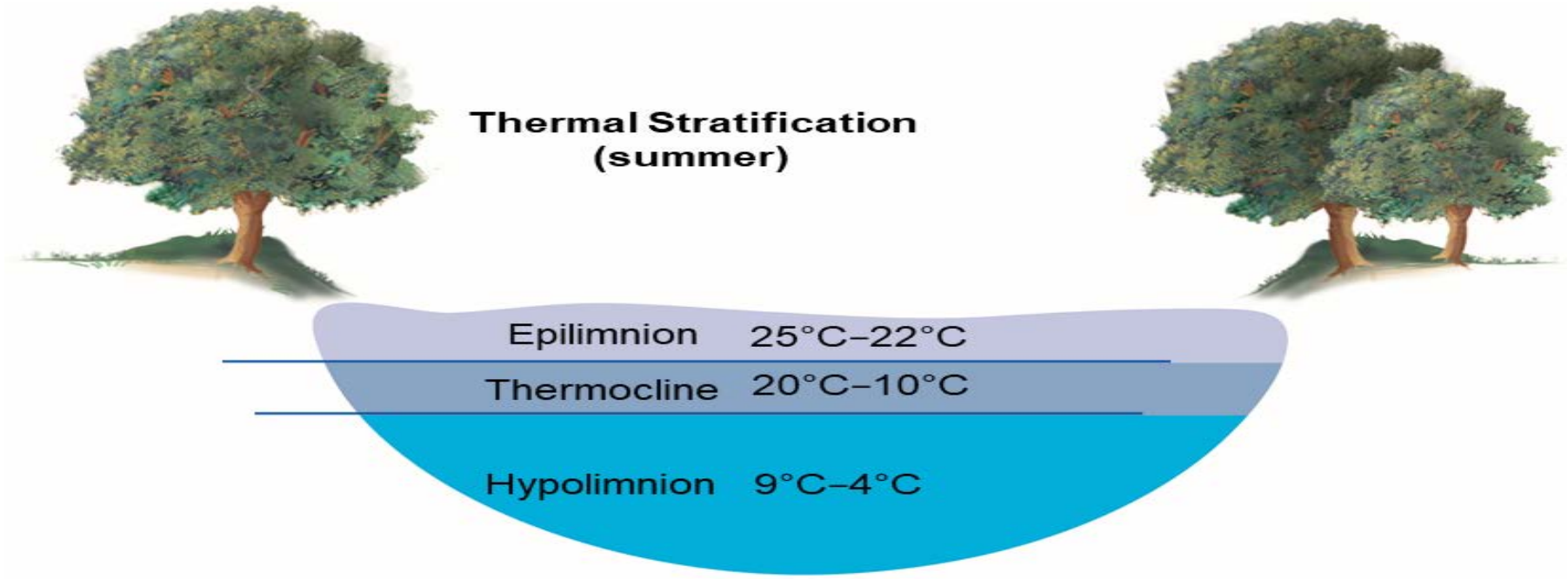
Aquatic Communities

- Microbial distribution is associated with sunlight, temperature, oxygen levels, and available nutrients
- Photic zone is most productive – contains **plankton**
  - **Phytoplankton** – variety of photosynthetic algae and cyanobacteria
  - **Zooplankton** – microscopic consumers; filter feed, prey, or scavenge
- Benthic zone supports variety of organisms including aerobic and anaerobic bacterial decomposers



Lake Profiles

- Large bodies of standing water develop thermal stratification
  - **Epilimnion** – upper region, warmest
  - **Hypolimnion** – deeper, cooler
  - **Thermocline** – buffer zone between warmest and coolest layers; ordinarily prevents the mixing of the two



A-Water surface and Epilimnion

Microbial flora consist of:

1-photosynthetic bacteria ,

2- cyanobacteria ,3- mesophilic contaminating bacteria ,

4-psychrotrophic.

- **Microbial activity of this part of water column are:**

1 -photosynthesis , 2- Aerobic nitrogen fixation ,3- Aerobic decomposition of organic matter

B- Thermocline

Microbial flora consist of Psychrophilic facultative anaerobic bacteria.

Microbial activity of this part of water column are Aerobic and Anaerobic decomposition.

C-Hypolimnion

Microbial flora consist of psychrophilic anaerobic bacteria .

Microbial activity are : 1- Anaerobic nitrogen fixation bacteria (Clostridium pasteurianum), 2- Anaerobic decomposition of organic matter , 3- production of CH4 ,H2S,NH3.

Pollution

Water pollution is the contamination of water bodies (e.g. lakes, rivers) , oceans and ground waters. pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds

Main Sources of Water Microbial Pollution

1-Sewage

Most treated waste water goes into rivers, lakes, and oceans Occasionally, heavy rains overwhelm sewer systems, causing them to overflow increasing the risk of water borne-diseases. This can put communities at risk from high concentrations of microbial pollutants in raw, untreated sewage. The mian source of water pollution with all microorganisms through dumping untreated sewage into water bodies

2-Agricultural and Animal Wastes

Over the past few decades, the increase in population and advances made in farming technology has increased the demand for crops and livestock from the agricultural industry.

water-borne diseases

Definition: water-borne diseases are diseases caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogens.

Many bacteria, viruses, protozoa and parasites can cause disease when ingested. The majority of these pathogens derive from human or animal faeces, and are transmitted through the faecal-oral route

Microbiology of Drinking Water Supplies

- **Potable** (drinkable) water – free of pathogens, toxins, turbidity, odor, color, and taste
- Most prominent water-borne pathogens – *Giardia, Cryptosporidium, Campylobacter, Salmonella, Shigella, Vibrio, Mycobacterium*, HAV, and Norwalk viruses
- Most assays of water purity focus on detecting fecal contamination – indicator bacteria *E. coli, Enterobacter,*

Bacteria Found In Surface Water

Bacteria	Disease/ infection	Symptoms
Aeromonas	Enteritis	Very thin, blood- and mucus-containing diarrhea
Campylobacter	Campilobacteriose	Flue, diarrhea, head- and stomachaches, fever, cramps and nausea
Escherichia coli	Urinary tract infections, meningitis, intestinal disease	Watery diarrhea, headaches, fever, homiletic uremia, kidney damage
Typhus	Typhoid fever	Fevers
Salmonella	Salmonellosis	Sickness, intestinal cramps, vomiting, diarrhea and sometimes light fevers
Streptococcus	(Gastro) intestinal disease	Stomach aches, diarrhea and fevers, sometimes vomiting
Vibrio	Cholera	Heavy diarrhea

Protozoa Found in Surface Water

Microorganisms	Disease	Symptoms
Amoeba	Amoebic dysentery	Severe diarrhea, headache, abdominal pain, chills, fever; if not treated can cause liver abscess, bowel perforation and death
Cryptosporidium	Cryptosporidiosis	Feeling of sickness, watery diarrhea, vomiting, lack of appetite
Giardia	Giardiasis	Diarrhea, abdominal cramps, flatulence, belching, fatigue
Toxoplasm	Toxoplasmosis	Flu, swelling of lymph glands With pregnant women subtle abortion and brain infections

Viral Sources of Waterborne Disease

- Hepatitis A: inflammation and necrosis of liver
- Rotaviruses: acute gastroenteritis, especially in children
- Enteroviruses: many types affect intestines and upper respiratory tract
- Reoviruses: infects intestines and upper respiratory tract

Main indicators of microbial water quality

- **1-Coliform Organisms (Total Coliform)**

Coliform bacteria are metabolically defined as gram-negative, rod-shaped bacteria capable of growth in the presence of bile salts and able to ferment lactose at an optimum 35ºC. The main reason is because they are easy detect and enumerate in water and are representative enough for determining microbial contamination of drinking water

2-Thermotolerant Coliform Bacteria

This group of bacteria comprises the bacteria genus Escherichia, and to a lesser extent, Klebsiella, Enterobacter, and Citrobacter. They are defined as a group of coliform organisms that are able to ferment lactose at 44 to 45°C. Sometimes, this group is also called Fecal Coliform (FC) to specify

- **3- Fecal Streptococci**

Most of the species under the genus Streptococcus are of fecal origin and can be generally regarded as specific indicators of human fecal pollution.

However, certain species may be isolated from the feces of animals. streptococci seldom multiply in polluted water and they are more persistent

4- Sulfite-Reducing Clostridia

Sulfite-reducing clostridia are gram-positive, anaerobic, spore-forming bacteria. Clostridial spores can resist treatment and disinfection processes better than most pathogens. One of the members, Clostridium perfringens, like *E.coli,* is normally present in feces, but in much smaller numbers.

5- Bacteriophages

Bacteriophages (phages) are viruses that infect and replicate in specific bacteria. The ability to identify phages (coliphages) of E.coli, also detects fecal contamination. This is because the presence of coliphages also indicates the presence of E.coli. The significance of coliphages as indicators of sewage contamination, and their greater persistence compared.

Water Quality Assays

- **Standard plate count** – number of colonies that develop provide estimate of the total population
- **Membrane filter method** – after filtration, filter is placed on selective and differential media, incubated, colonies are presumptively identified and counted
- **Most probable number** (MPN) – presumptive, confirmatory and completed tests
- No acceptable level for fecal coliforms, enterococci, viruses, or pathogenic protozoans in drinking water

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