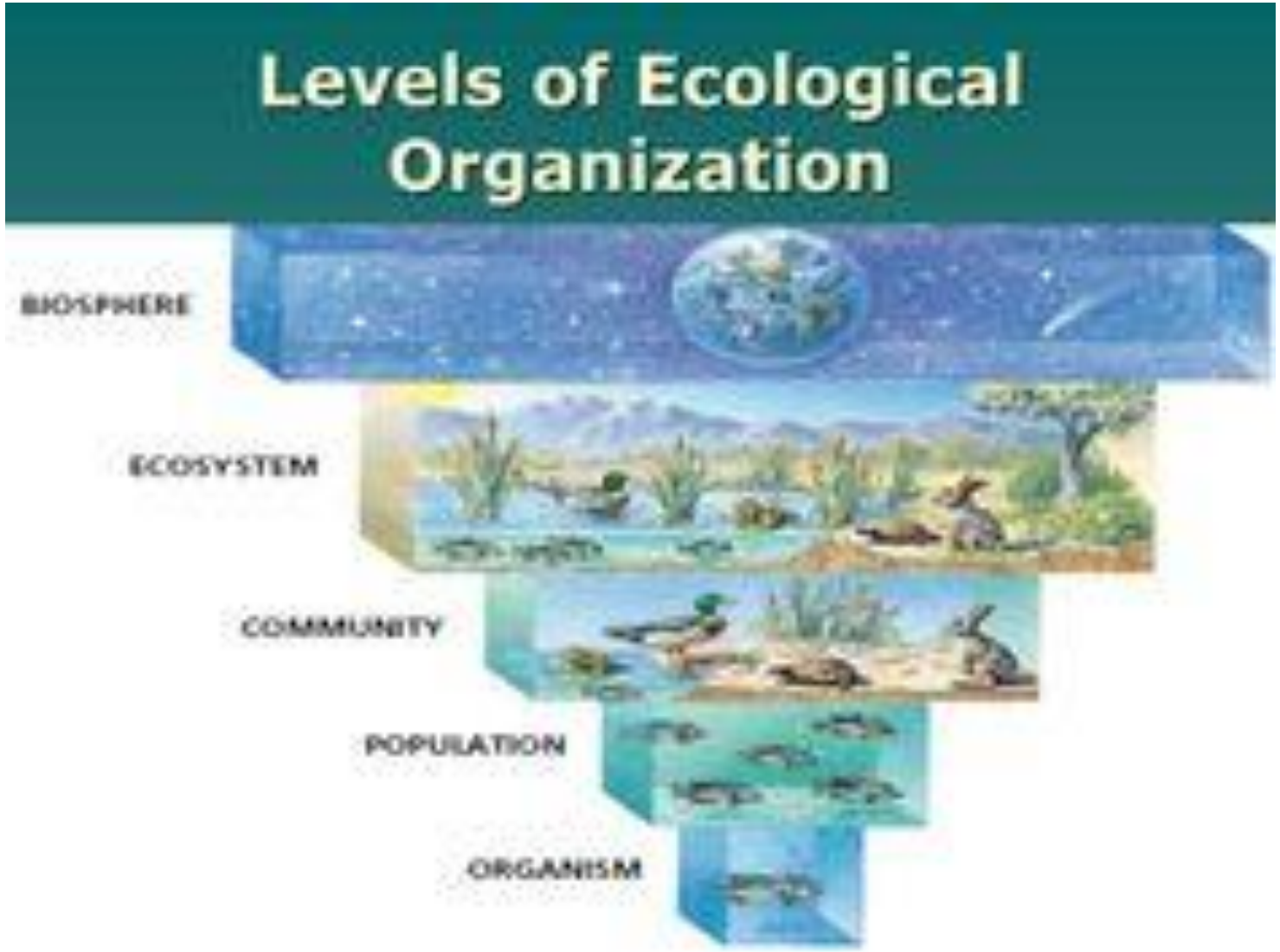
Advanced Aquatic Ecology ZOO-673

Promy Virk

Course Content: Advanced consideration of the aquatic ecology of aquatic animals species emphasizing current issues which include: community structure, population growth, population regulation, dispersion, species interaction, diversity, competition, predation, age composition, density and niche theory. Recent advances of the interrelationships between aquatic fauna and their environment. In depth studies, of recent advances of statistical design and analysis of ecological measurement of selected aquatic populations.


Levels of Ecological Organization
BIOSPHERE
ECOSYSTEM
COMMUNITY
POPULATION
ORGANISM

Aquatic Ecosystems

- The types of organisms that live in an aquatic ecosystem is determined by the water's salinity
- Salinity is the amount of dissolved salts the water contains.
  - Freshwater= <0.5 ppt
  - Saltwater= 30-50 ppt
- Aquatic Ecosystems are divided into Freshwater and Saltwater or Marine

Freshwater vs Saltwater

- Freshwater
  - Lakes and Ponds-Slow
  - Rivers and Streams-Fast
  - Wetlands-water logged land
  - Marshes and Swamps
- Saltwater or Marine
  - Marshes and Swamps-Coastal
  - Coral Reefs
  - Deep Oceans









Characteristics of Aquatic Ecosystems

- Aquatic Ecosystems are characterized by
  - Temperature
  - Sunlight Depth
  - Oxygen Concentration
  - Available Nutrients
- Aquatic Organisms are grouped by their location at water depths and adaptations
  - Plankton-Surface, provide most of food, producers
    - Zooplankton-microscopic animals
    - Phytoplankton-microscopic plants
- Nekton-Free swimming organisms
  - Fish, Turtles, Whales
- Benthos-Bottom dwelling organism, lived attached to hard surfaces
  - Mussles, worms and Barnacles

CHARACTERISTICS

ABIOTIC CHARACTERISTICS

Some of the important abiotic environmental factors of aquatic ecosystems include:

- substrate type
- water depth
- nutrient levels
- temperature
- salinity
- flow
- dissolved oxygen
- Nutrient levels

Freshwater Ecosystem

- There are different types of freshwater regions:
- Ponds and lakes
- Streams and rivers
- Wetlands

A.Lentic environments: Lakes and Ponds

- Lakes are inland bodies of freshwater ranging in size from less than one acre to several thousands of acres. Simply stated, lakes are the bodies of water that fill depressions in the earth's surface.
- Lakes may be further described by their origin and classified by trophic status according to their characteristics.

The main difference between lakes and ponds is size, but ponds are also usually artifically created and are not natural.

Lakes are deeper and larger bodies of water that can influence local climate if large enough.

Ponds are much smaller than lakes and usually have the same temperature from top to bottom, whereas lakes can have dramatically different temperatures from the surface to the bottom waters.

❖**Many ponds are seasonal, lasting just a couple of months (such as sessile pools) while lakes may exist for hundreds of years or more.**

❖ **Ponds and lakes may have limited species diversity since they are often isolated from one another and from other water sources like rivers and oceans.**

❖**Lakes and ponds are divided into three different "zones" which are usually determined by depth and distance from the shoreline.**

Classifying Lakes and Ponds

Lakes, ponds, and reservoirs are classified many different ways. Some ways are according to the overall clarity of the water (trophic state), the parts of the water where sunlight reaches, or the temperature differences from top to bottom.

Trophic State:Trophic" means nutrition or growth. A eutrophic ("well-nourished") lake has high nutrients and high plant growth. An oligotrophic lake has low nutrient concentrations and low plant growth. Mesotrophic lakes fall somewhere in between eutrophic and oligotrophic lakes

Lake Trophic Classification	Nutrient Concentration	Biological Productivity(photosynthesis)
oligotrophic	low	low
mesotrophic	moderate	moderate
eutrophic	high	high
hypereutrophic	very high	very high

Lake Zonation :

Lakes are divided into zones based on amount of sunlight.
There is the: 1) littoral at the lake's shoreline where sunlight can reach the bottom;

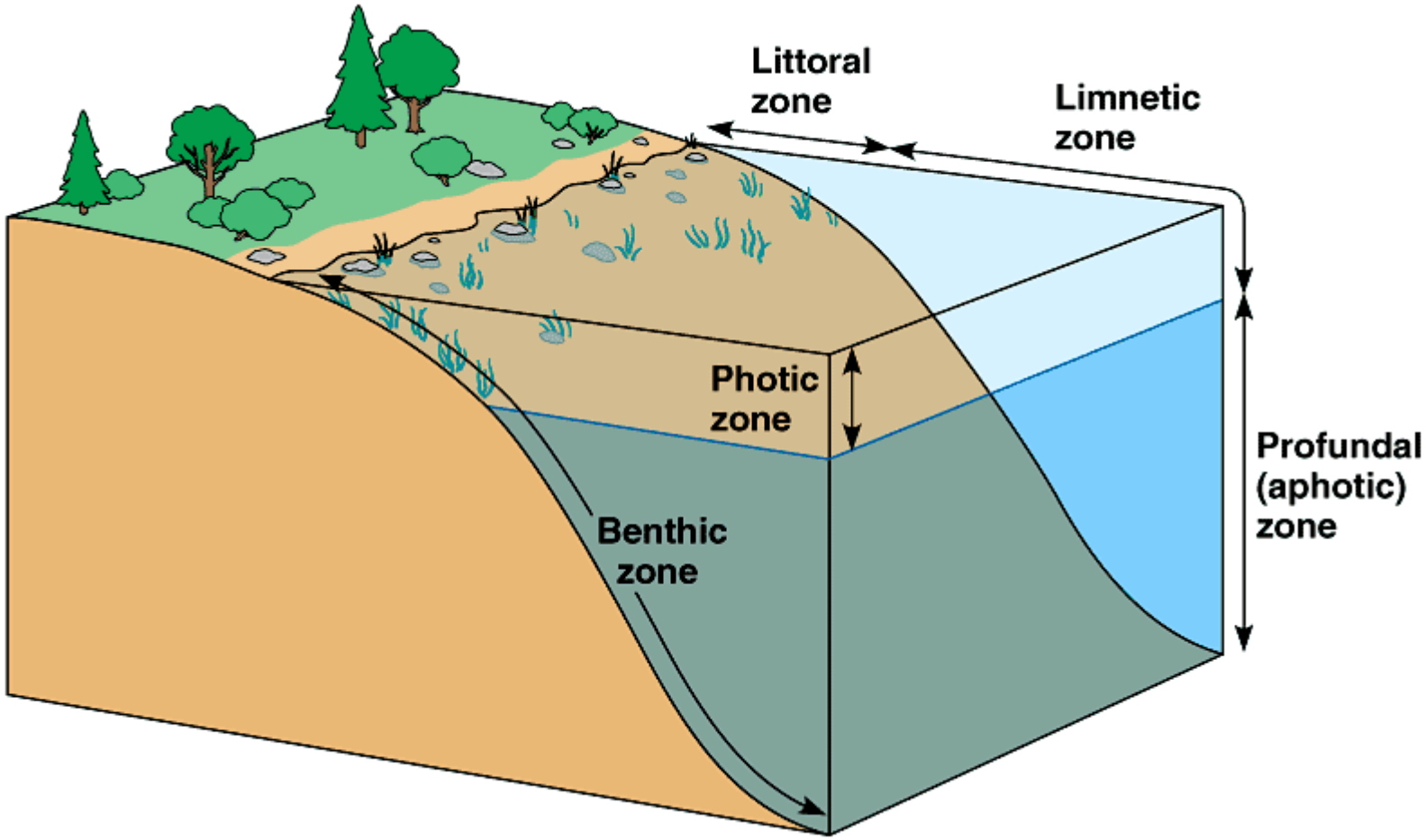
2) the limnetic, which is commonly recognized as the open waters; and

3) the profundal, or deep water where sunlight does not penetrate.

And based on the temperature:
❖The water column of deep-water lakes is further divided into three zones called the **epilimnion (surface water),**

❖**hypolimnion (bottom water), and**

❖ **the metalimnion (or thermocline), which is the transitional area between the bottom and surface water.**



- **The topmost zone near the shore of a lake or pond is the *littoral zone*. This zone is the warmest since it is shallow and can absorb more of the Sun's heat.**

- **It sustains a fairly diverse community, which can include several species of algae (like diatoms), rooted and floating aquatic plants, grazing snails, clams, insects, crustaceans, fishes, and amphibians. In the case of the insects, such as dragonflies and midges, only the egg and larvae stages are found in this zone.**

- **The vegetation and animals living in the littoral zone are food for other creatures such as turtles, snakes, and ducks.**

❖**The near-surface open water surrounded by the littoral zone is the *limnetic zone*.**

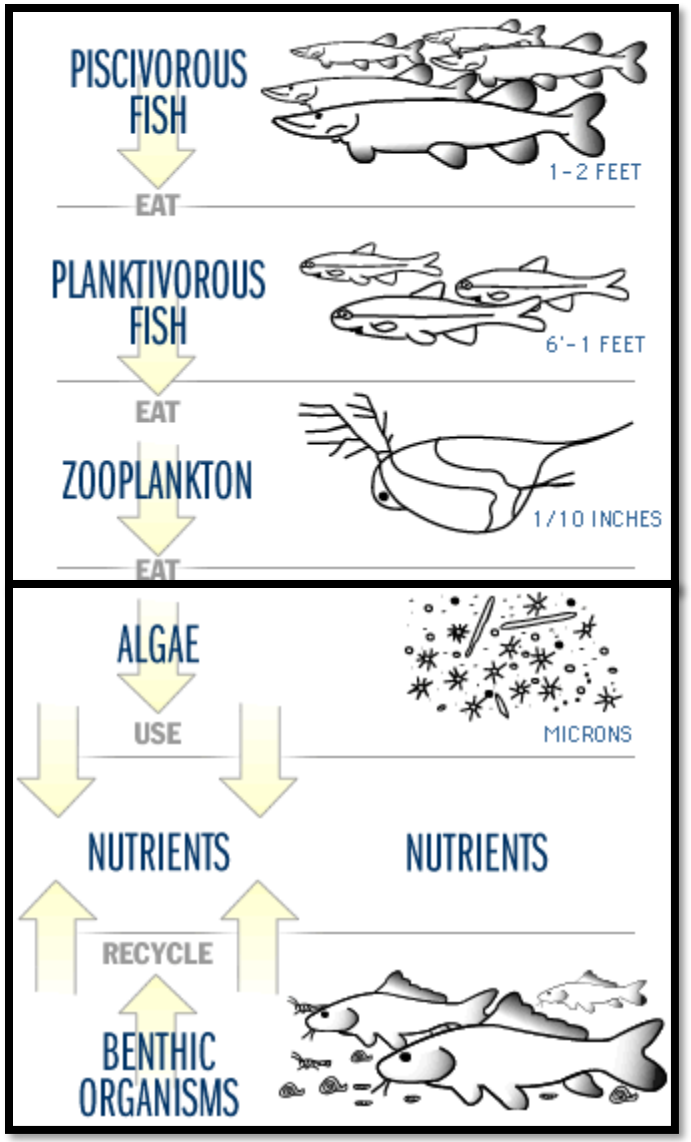
❖**The limnetic zone is well-lighted (like the littoral zone) and is dominated by plankton, both phytoplankton and zooplankton. Without aquatic plankton, there would be few living organisms in the world, and certainly no humans. A variety of freshwater fish also occupy this zone.**

❖**Plankton have short life spans — when they die, they fall into the deep-water part of the lake/pond, the *profundal zone*. This zone is much colder and denser than the other two. Little light penetrates all the way through the limnetic zone into the profundal zone. The fauna are heterotrophs, meaning that they eat dead organisms and use oxygen for cellular respiration.**

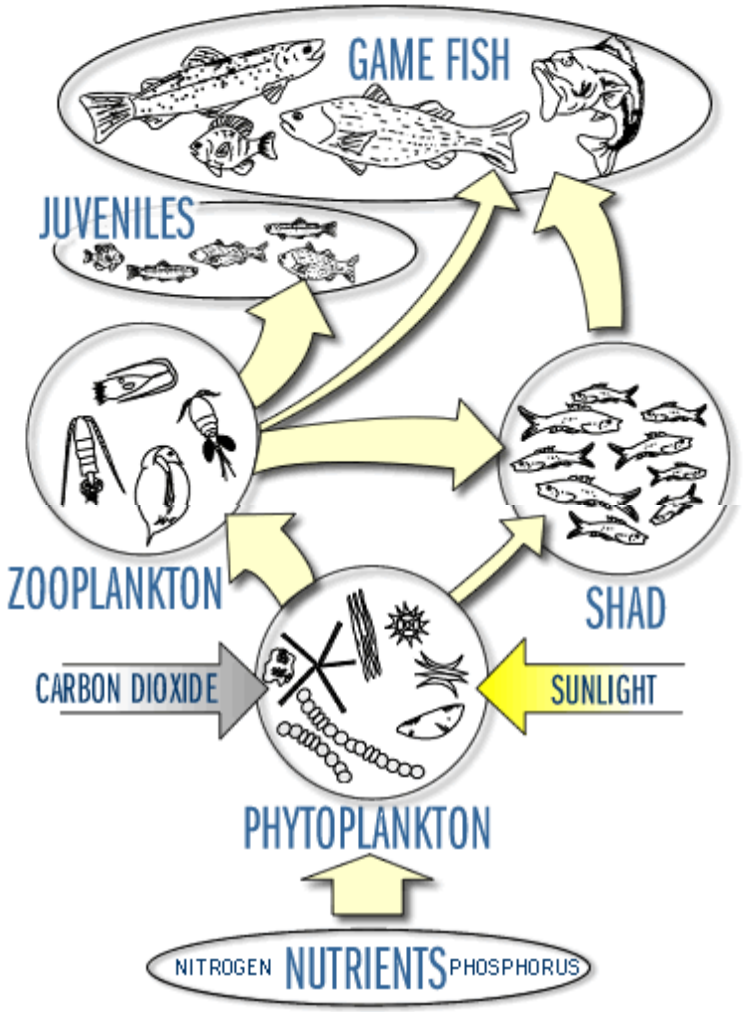
A Glimpse at the Structure of a Food Web

- Primary producers dominate the open water of the limnetic zone. Photosynthesis occurs in this zone where phytoplankton that oxygenate the water are ingested by the slightly larger zooplankton.
- Insects and fish eat zooplankton, and are eaten by larger fish, insects, amphibians, and other animals.

- The rate of production by phytoplankton is directly related to nutrient concentrations, phytoplankton variety and the flushing rate of the water body.
- Rapid influxes of nutrients lead to blooms, or rapid, abundant growth of phytoplankton.
- Blooms give lakes and ponds their familiar dark green color. Of course, the presence of herbivorous zooplankton may greatly affect the growth of phytoplankton.



TYPICAL FOOD CHAIN

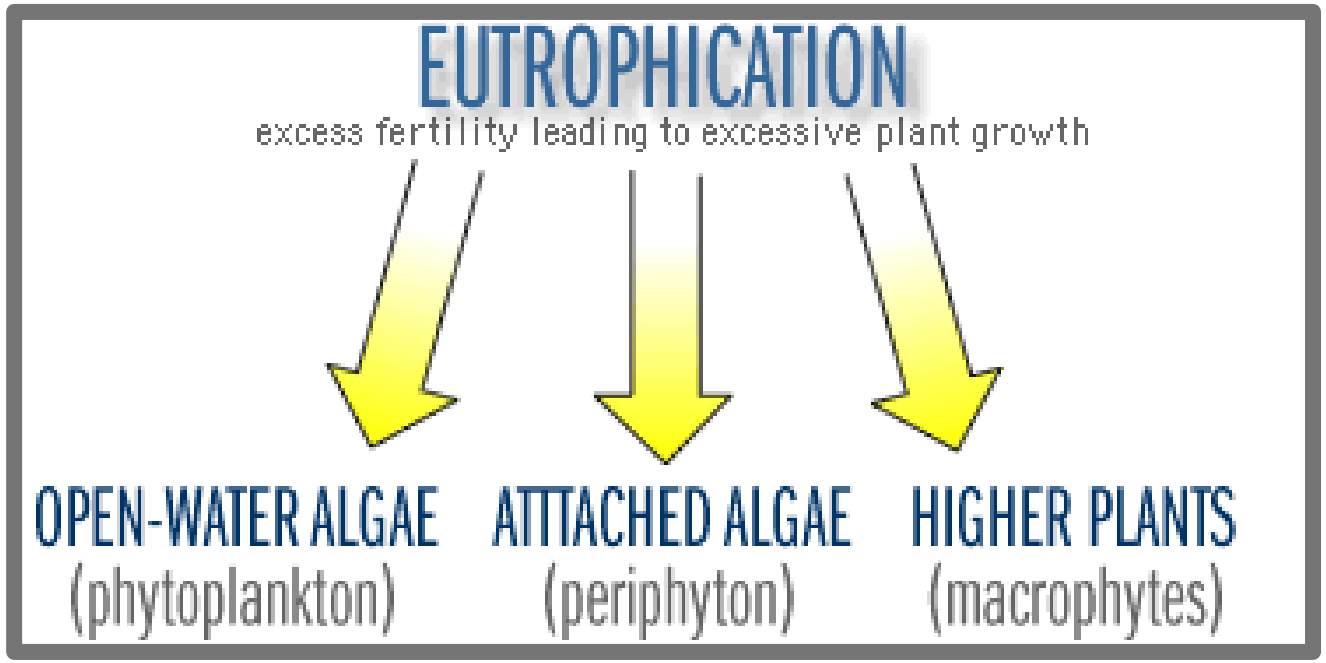


FOOD WEB FOR A LAKE

Nutrients in Lakes

- Lakes with an abundant amount of nutrients, causing overgrowth of plants, algae and bacteria are known as Eutrophic Lakes
- Depletion of oxygen in these lakes called Eutrophication-kills off oxygen requiring organisms
- Rainwater runoff carrying sewage, fertilizers and animal wastes from land into the water accelerates Eutrophication

EUTROPHICATION



WATER QUALITY IMPACTS ASSOCIATED WITH EUTROPHICATION

- Noxious algae (scums, blue-greens, taste and odor, visual)
- Excessive macrophyte growth (loss of open water)
- Loss of clarity (secchi depth goes down)
- Possible loss of macrophytes (via light limitation by algae and periphyton)
- Low dissolved oxygen (loss of habitat for fish and fish food)
- Excessive organic matter production (smothering eggs and bugs)
- Blue-green algae inedible by some zooplankton (reduced food chain efficiency)
- "Toxic" gases (ammonia, H_2S) in bottom water (more loss of fish habitat)
- Possible toxins from some species of blue-green algae
- Drinking water degradation from treatment disinfection byproducts
- Carcinogens, such as chloroform (from increased organic matter reacting with disinfectants like chlorine)

- Algal blooms can be very dangerous to the health of their respective ecosystems.

- Algal blooms are the result of too much food for the algae making them grow and reproduce. The food is in the form of nutrients, often washed in from the land during a rainfall.

- The bad part is that they grow so fast that they become so thick, they block the sunlight from reaching algae below the surface. The algae without the sunlight begin to die and drop to the bottom of the lake or pond.
- When they die, bacteria help decompose the cells in a process that uses up the oxygen dissolved in the water. This decreases the oxygen concentration which affects the aquatic life.

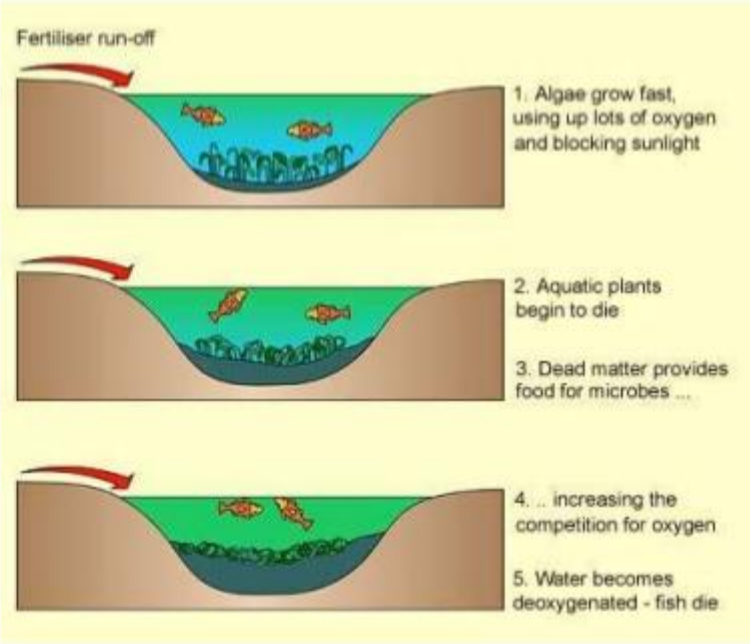
Dead zones are areas of water bodies where aquatic life cannot survive because of low oxygen levels. Dead zones are generally caused by significant nutrient pollution, and are primarily a problem for bays, lakes and coastal waters since they receive excess nutrients from upstream sources.

Excess nitrogen and phosphorus cause an overgrowth of algae in a short period of time, also called algae blooms. The overgrowth of algae consumes oxygen and blocks sunlight from underwater plants. When the algae eventually dies, the oxygen in the water is consumed. The lack of oxygen makes it impossible for aquatic life to survive. The largest dead zone in the United States – about 6,500 square miles – is in the Gulf of Mexico and occurs every summer as a result of nutrient pollution from the Mississippi River Basin.

When some types of algae blooms are large and produce chemicals, or toxins, the event is called a harmful algal bloom. Harmful algal blooms can occur in lakes, reservoirs, rivers, ponds, bays and coastal waters, and the toxins they produce can be harmful to human health and aquatic life. Harmful algal blooms are mainly the result of a type of algae called cyanobacteria, also known as blue-green algae.

What factors can alter aquatic ecosystems?

- Natural Succession- normal cycle of pond becoming forest
- Artificial Succession- humans add N & P to water via fertilizer & sewage causing succession to happen faster = EUTROPHICATION



What factors can alter aquatic ecosystems?

- Water Pollution
- Exccessive use of Fertilisers
- Industries
- Waste Disposal