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Friend, Philosopher, Guide

Ecology

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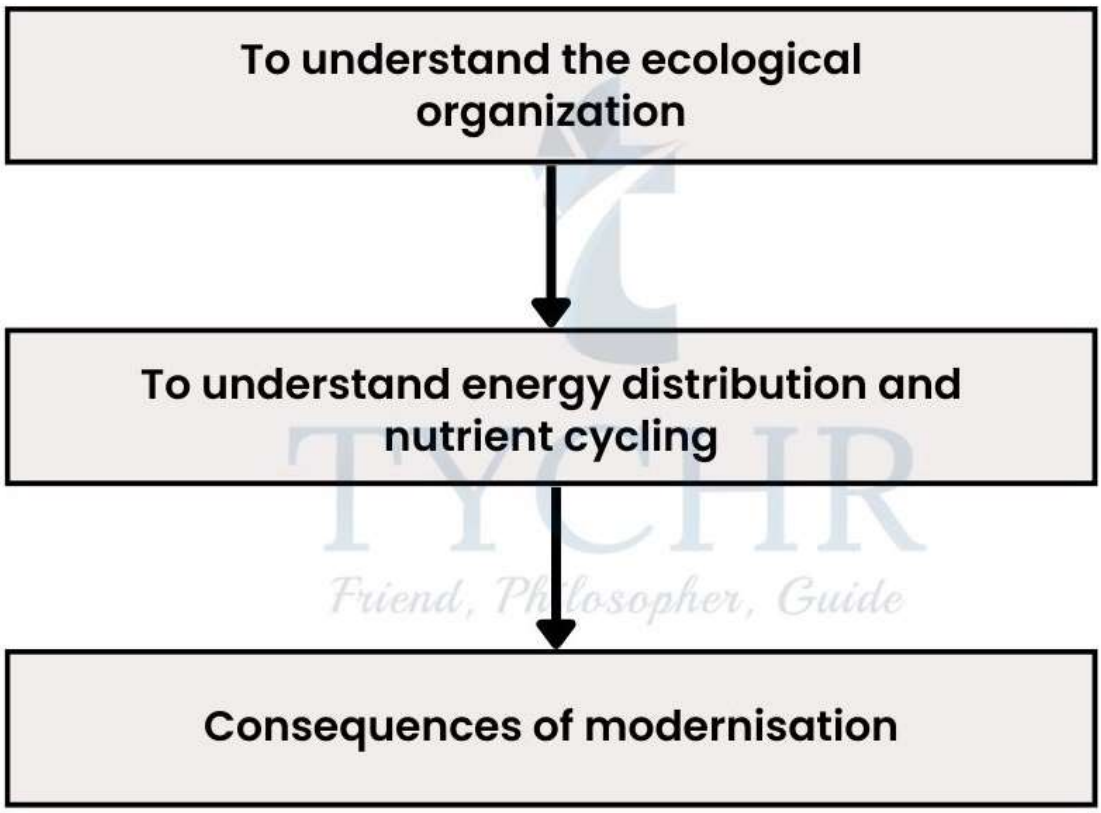
Ecology

Approaching The Topic:

- **Understanding the topics**

- **Application of these concepts**



Basic Terms To Ponder:-

1. **Habitat**: A natural environment in which an organism lives.
2. **Phylogeny**: It is the history of evolution of species or groups of organisms (family tree).
3. **Breed**: Group of animals within a species but distinctive in appearance.
4. **Autotrophs**: Organisms which produce their own food using sunlight and inorganic nutrients.
5. **Heterotrophs**: Organisms which cannot produce their own food and depend on others for food..
6. **Biomass**: The amount of living matter present at specific trophic level.
7. **Lithification**: This is the process of converting unconsolidated sediment into solid sedimentary rock.
8. **Carbon sequestration**: The process of taking up carbon from the atmosphere and locking it up is called carbon sequestration.

Ecology

Levels Of Ecological Organisation

Biosphere:

All the ecosystem of the world are collectively called as biosphere.

Biome:
The large unit of environment consists of a major vegetation type and its associated fauna in a specific climatic zone.

Ecosystem:
Sum total of biotic and abiotic components of a particular geographical area being integrated through exchange of energy and nutrient cycling.

Community:
The assemblage of all the populations of different species, interacting with each other present in an area.

Population:
Sum total of all the individuals of a species in a geographical area

Individual organism of a specific species:

Species:

- It is a group of organisms that can interbreed and produce fertile offspring.
- The organisms belonging to the same species have the same physiological and morphological characteristics.
- They must have different genetic backgrounds from other species and a common phylogeny.

Wonder!
What are hybrids then and can we distinguish them as a new species?
These are the organisms which are made artificially, using nature's technique of reproducing. They possess the characteristics of both the species but are **unfertile**.
Examples are;

Hinny was produced by **crossing female donkey and a male horse**, the two different species of the same family **Equidae**.
Similarly, **mules** are produced by **crossing female horse and male**

donkey. Also, female horse and male zebra are crossed top produce **zorse** and female tiger and male tiger can be crossed to produce **liger**.
Since they are unfertile (**non-reproductive**) therefore can't be declared as a new species but called hybrid only.

Decomposers

- These are the organisms which help in breakdown of the organic waste material and dead animal and plant matter into inorganic useful material.
- These are of two types:
    - **Detritivores**; which eat non- living matter. Ex- earthworms, woodlice and dung beetles
    - **Saprotrophs**; which live on living or non-living matter and secretes enzymes which decay the matter.
      Ex- fungi and bacteria
- They have a useful hand in **nutrient recycling** in the ecosystem, as the enzymes released from the saprotrophs convert organic proteins from dead organism into inorganic ammonia which is further converted into nitrates by the bacteria.
- They formulate the soil for better growth of the plants.

Energy Flow

- **Food chain and food web**
    - It starts from the producers and ends at secondary or tertiary consumer level.
    - Every position which is occupied by certain organism in the food chain is called its trophic level.
- There are generally 3-4 trophic levels in a food chain but may go up to 5.

A FOOD CHAIN

Trophic Levels		Examples
First trophic level	Autotrophs or Producers	grass

Second trophic level	Primary consumers	grasshopper
Third trophic levels	Secondary consumers	rats
Fourth trophic level	Tertiary consumers	snakes
Fifth tropic level	Quaternary consumers	hawks

- The interlinking of two or many food chains is called **food web**.

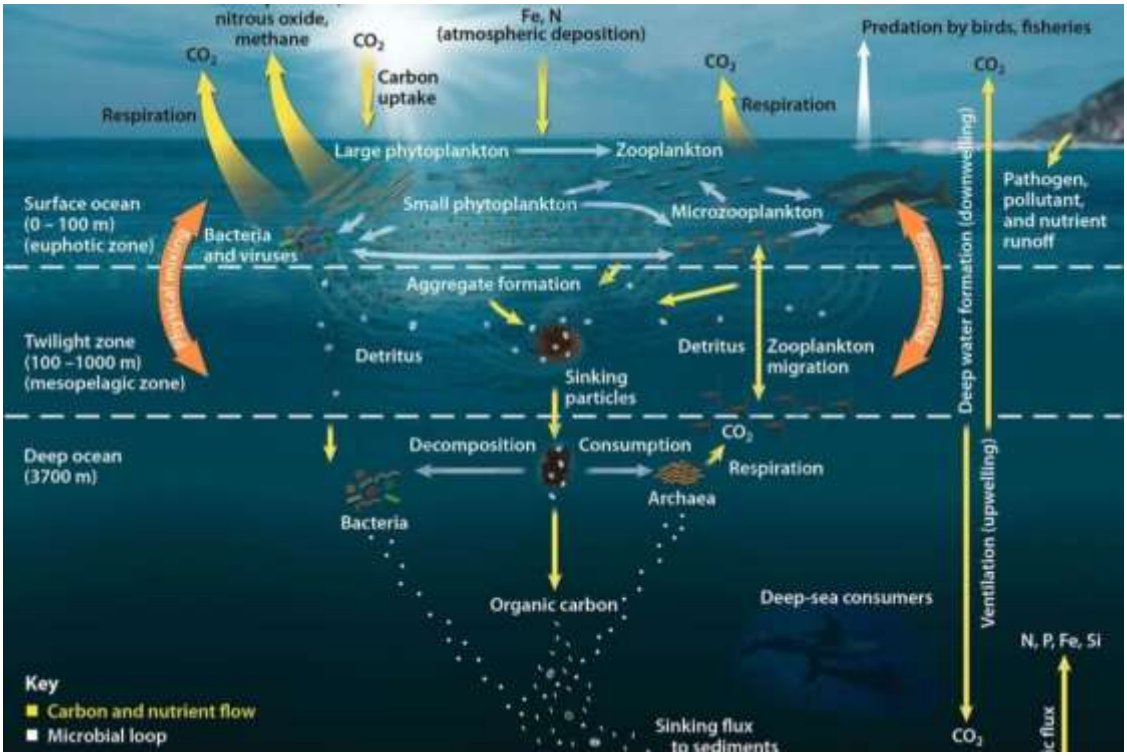


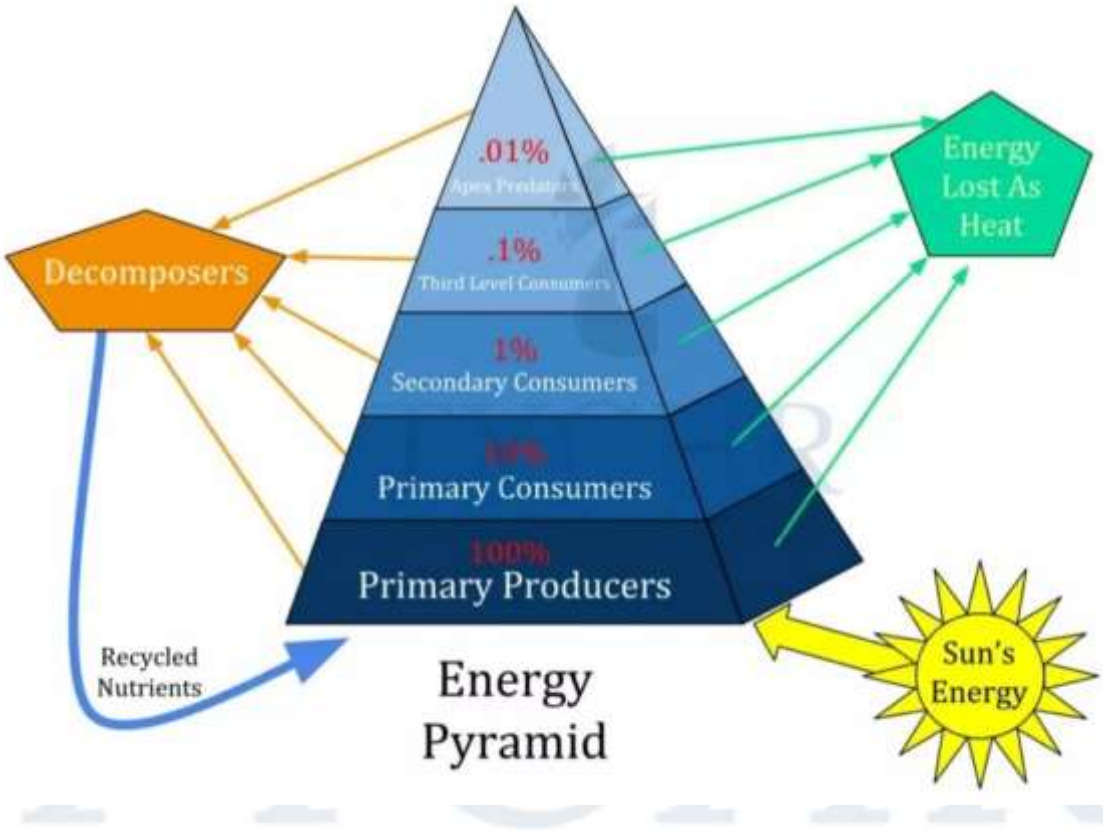
Figure 4.1 A food web

Energy Distribution

- Autotrophs absorb the sunlight and take up inorganic nutrients from the soil to make organic food for the rest of the food chain.
- Primary consumers feed on the producers to get energy. And similarly secondary consumer feed on primary consumer to get energy and so on.
- The **energy gets transferred from one trophic level to the next** but with a loss of 90% at each level i.e. **only 10% of the energy gets transferred** from each trophic level to the next.

- From the total energy one received, 90% of it gets lost to the environment in the respirational activity and undigested matter which gets out in excreta of the organisms.
- This loss of the energy is in the form of heat, which can't be used ever again but then contributes to global warming.

Pyramid Of Energy



- This pyramid tells the energy usage or dissipation in successive trophic levels per unit time.
- As not all the energy gets passed on to the next trophic level, not all biomass gets passed on either.

Carbon Cycling

Carbon Cycle

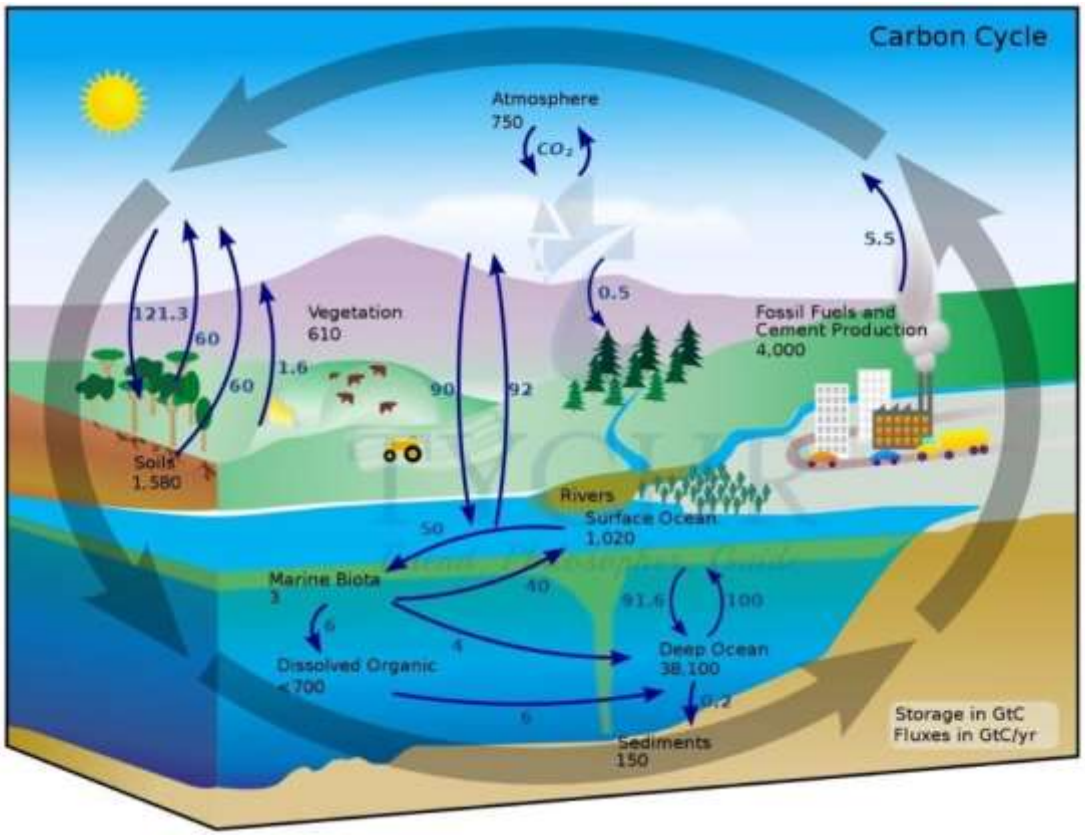


Figure 3.2 Carbon cycle

- The producers takes up the carbon in the form of CO_2 and coverts it into and organic carbohydrate, glucose ($C_6H_{12}O_{12}$).
- Water can also absorb carbon in the form of CO_2, which ultimately **increases its pH** due to formation and dissociation of carbonic acid (H_2CO_3).
- CO_2 is released when fossils fuels are burnt in air.

Role Of Methane

- **Methanogens** (members of **Archaea**) produces methane (**CH_4**) as a waste gas while metabolizing its These are present in the digestive tract of mammals and that's why cow dung is used in the formation of biogas.
- Methane is found in natural gas and its oxidation produces CO_2.

- Natural gas is formed after millions of years of decomposition i.e. CO_2 was taken million years ago by the organisms which is now converted into CH_4.

Peat

- It is a dark coloured, waterlogged soil mixture of dead organic matter, found in wetlands.
- It is acidic in nature and therefore not conducive to decomposers.
- It also takes thousands of years to form and can also be used as non-renewable fuel.
- Coal formed from peat is also obtained after compressing the peat from over millions of years.

Limestone

- Many organisms in the oceans take up the dissolved CO2 from the water and form their carbonated shells and coral polyps take up the carbonate ions and calcium which combines to form calcium carbonate ($CaCO_3$).
- Similarly molluscs form their shells out of $CaCO_3$, which ultimately sheds off in the ocean when they die.
- The accumulated $CaCO_3$ shells after lithification forms limestone.

Climate Change

Greenhouse Effect

- This effect refers to the ability of a planet to use its atmosphere to retain heat and warmth even when no sunlight is hitting its surface.
- Sunlight (having shorter wavelength) is not warm itself but when it hits an object, it transfers its energy into heat energy (having longer wavelengths). This produced heat energy gets trapped in the atmosphere (greenhouse) due to some certain gases.
- Greenhouse gases (GHGs) include water vapour, CO2, CH4, nitrous oxide (NO2) etc.

- Enhancement in the greenhouse effect causes global warming.
- Methane due to its greater potential to warm and CO2 due to its much longer retaining ability are the two main gases of greenhouse effect.

Interesting fact

Light colour objects absorb much less of the sunlight and reflects it back but dark coloured objects absorbs much of the sunlight and gets more warmer than light coloured objects.

Yes, cellulose!

The French scientist, Anselme Payen first discovered the cellulose back in 1838. It is the most available and most usable polysaccharide in this very globe. Cotton is 90% cellulose and wood is 40-50% cellulose. It is now also contributing in making biofuels. It can also replace plastic use and be a good biodegradable product instead of non-biodegradable plastic. It also has insulation properties and is very economical to process. It can be broken down into glucose by treating with mineral acids, because it is nothing but polymer of glucose units.

What Does Human Do?

We started setting up industries in early 1800s to produce the products in large quantities with very much less efforts. And the effects of which can be seen on the environment. The carbon waste gets emitted out of the chimneys. It has been shown 35% of increase in the CO2 in the atmosphere after the industrial revolution.

We increased the greenhouse gases in the atmosphere by burning out fossil fuels and causing carbon emission through the vehicles. We used artificial fertilizers on the crops, which releases nitrogen oxides in the atmosphere. We caused deforestation for our needs of wood, latex and other natural products.

Our activities are affecting marine life also. Increased carbon dioxide in the atmosphere increases its content in the water bodies and more the acidic the water is becoming. Ocean acidification leads to the death of coral polyps and algae. And the organism depend on them for food also dies, thereby affecting the whole food chain.

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