

Energy flow in ecosystem

- ① The flow of energy through living organisms in an environment is known as energy flow.
- ② The flow of power that occurs along a food chain is called energy flow.
- ③ Fuel enters the food chain at the level of producers in the form of solar energy.
- ④ The plants convert solar energy into chemical energy through the process of photosynthesis.
- ⑤ This chemical energy is passed from one trophic level to the next trophic level along a food chain or from one trophic level to another.
- ⑥ There is a direct relationship b/w energy flow and thermodynamics or it can be said that energy flow follows the laws of thermodynamics.

Energy flow is based on two different laws of thermodynamics:

i) First Law of Thermodynamics:

The first law of thermodynamics states that energy can neither be created nor destroyed.

Here, the source of energy i.e. solar energy can neither be created nor destroyed. It can only be transferred from one system to another or from one form to another form.

ii) Second Law of Thermodynamics :

In the second law, it is stated that during the transformation, a portion of the energy is dissipated into the surroundings as heat energy.

⇒ The energy flow in the ecosystem is one of the major factors that supports the survival of such a great no. of organisms.

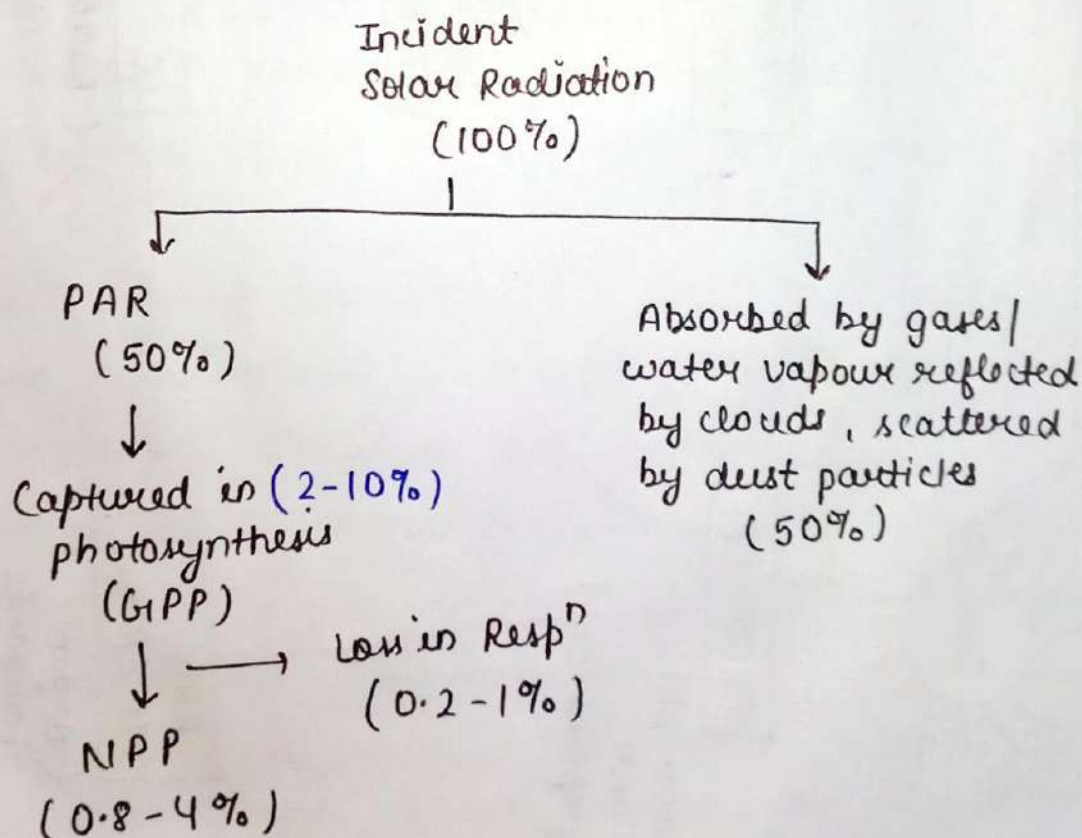
- ⊙ It is amusing to find that we receive less than 50% of sun's effective radiation on earth.
- ⊙ When we say effective radiation, we mean the radiation, which can be used by plants to carry out photosynthesis.
- ⊙ Most of the sun's radiation that falls on the earth is usually reflected back into space by the earth's atmosphere. The effective radiation is termed as **Photosynthetically Active Radiation (PAR)**
- ⊙ Overall, we receive about 40-50% of energy having PAR and only around 2-10% of it is used by plants for the process of

photosynthesis.

Thus, this % of PAR supports the entire world as plants are the producers in ecosystem and all the other organisms are either directly or indirectly dependent on them for their survival.

- ① The energy flow takes place via the **food chain** and **food web**.

During the process of energy flow in the ecosystem, plants being the producers absorb sunlight with the help of the chloroplasts and a part of it transformed into chemical energy in the process of photosynthesis.



ENERGY FLOW IN ECOSYSTEM



Solar Energy

PRODUCERS
(Autotrophic plants, phytoplankton)

PRIMARY CONSUMERS
(Herbivores)

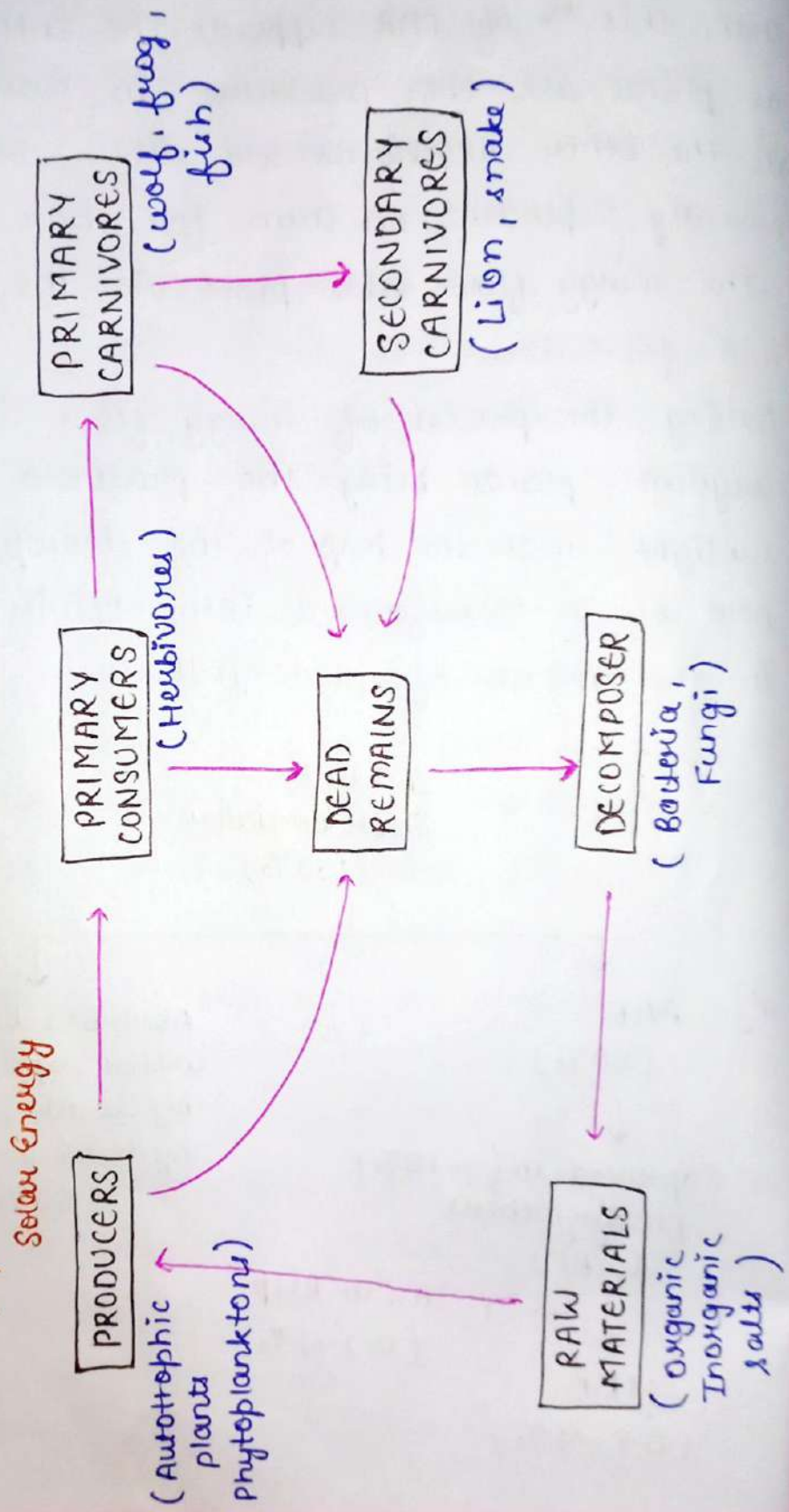
PRIMARY CARNIVORES
(wolf, frog, fish)

DEAD REMAINS

SECONDARY CARNIVORES
(Lion, snake)

RAW MATERIALS
(Organic, Inorganic salts)

DECOMPOSER
(Bacteria, Fungi)



Energy Flow in Ecosystem is Unidirectional or Bidirectional :

1) Energy flow in an ecosystem is consistently unidirectional or one way, i.e. solar radiations - producers - herbivores - carnivores.

It cannot pass in the reverse direction.

There is a decrease in content and flow of energy with the rise in trophic levels.

⇒ 6% of solar radiation is trapped by producers in their photosynthetic activity.

The rest is dissipated as heat.

⊙ The capability of producers in the absorption and then conversion of solar energy into a chemical form of energy.

⊙ The use of this is built into the form of energy by the consumers.

⊙ The sum of assimilated energy is the form of food or edibles.

- ⊙ The loss of energy through respiration, heat and excretion.
- ⊙ Gross Net Production.

Flow of Energy in a Food Chain Models:

① Single Channel Energy Flow Model:

- a) It illustrates the unidirectional flow of energy.
- b) Whatever the energy captured by the green plants does not revert back to solar input.
- c) The system would crash if the primary source, the sun, were cut off.
- d) There is a progressive decline in energy level at each trophic level.
So, the shorter the food chain, the greater would be the available food energy.

② Y-shaped or 2-channel Energy Flow Model

- a) It is applicable to both terrestrial and aquatic ecosystems.

In this energy model, one arm represents the herbivore food chain and the other arm represents the decomposer (detritus) food chain.

- b) The primary producers (green plants) are entirely different for each arm.

⇒ This model indicates that two food chains are

in fact, under natural conditions, not completely isolated from one another.

- i) It conforms to the basic stratified structure of an ecosystem.
- ii) It separates the eating and detritus food chain in both time and space.
- iii) Microconsumers and macro consumers differ greatly in size and metabolic reactions.

For example:

In Marine Bay, the energy flow through grazing food chain is larger than the energy flow via detritus food chain.

Whereas reverse is true for forest food chain where 90% or more of net primary production is normally utilized in detritus food chain.

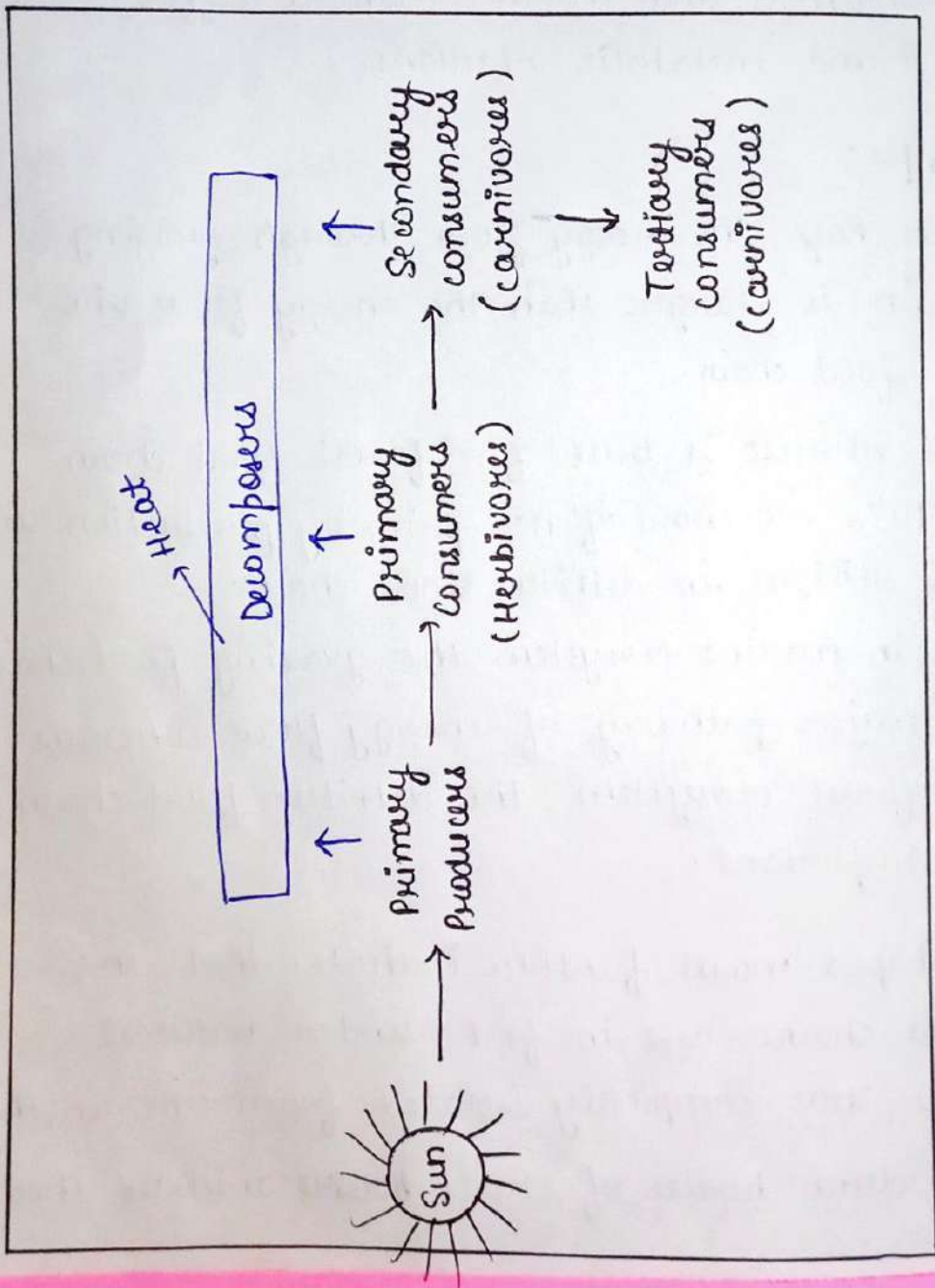
→ Thus, in marine ecosystem the grazing food chain is the major pathway of energy flow whereas in the forest ecosystem, the detritus food chain is more important.

The Y-shaped model further indicates that the two food chains are in fact, under natural conditions, not completely isolated from one another.

For eg: dead bodies of small ~~animals~~ animals that

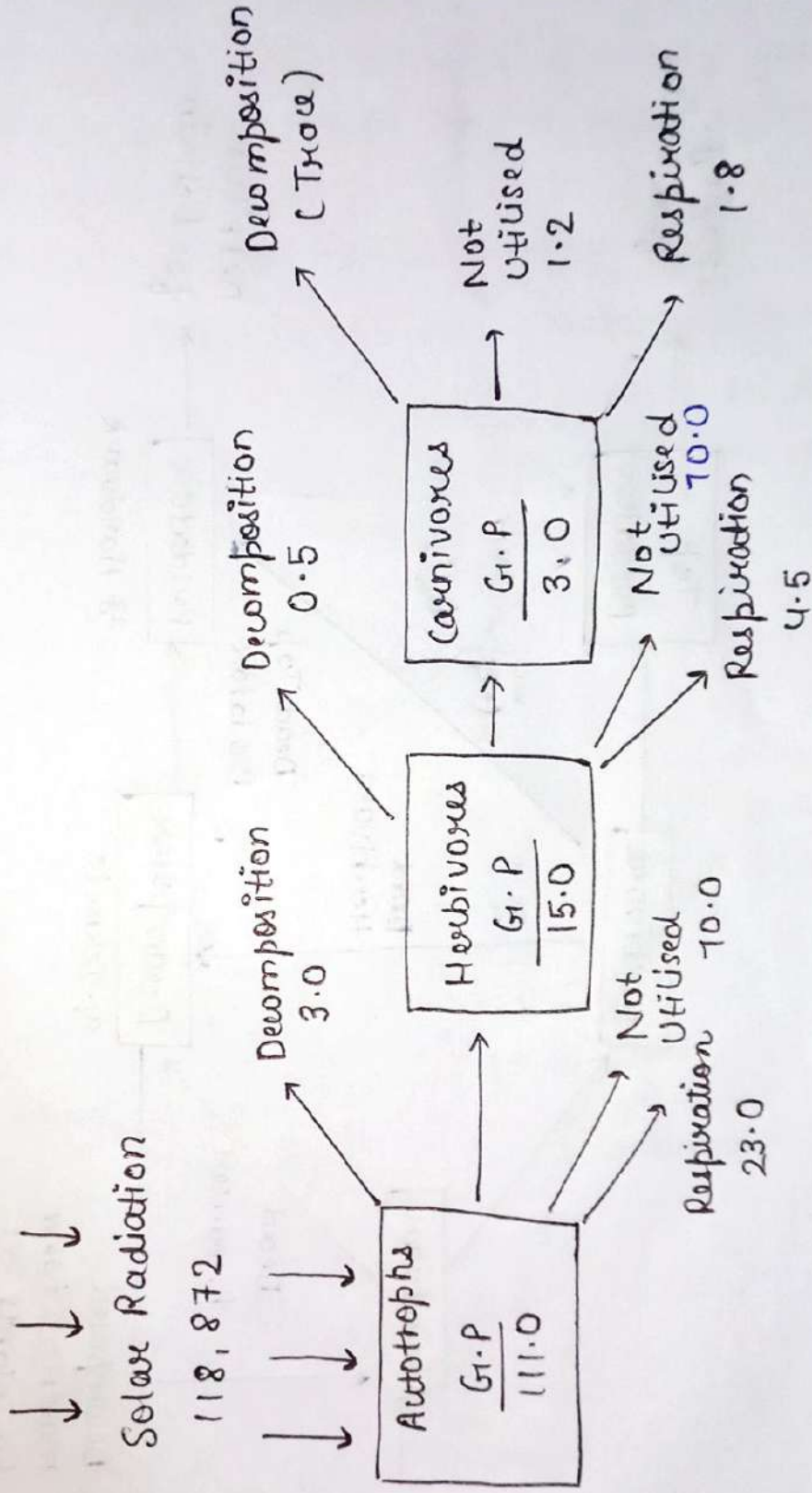
were once part of grazing food chain become incorporated in the detritus food chain as do the feces of grazing food animals.

The importance of two food chains may differ in different ecosystem, in some cases, grazing is more imp. and in other detritus is more important.



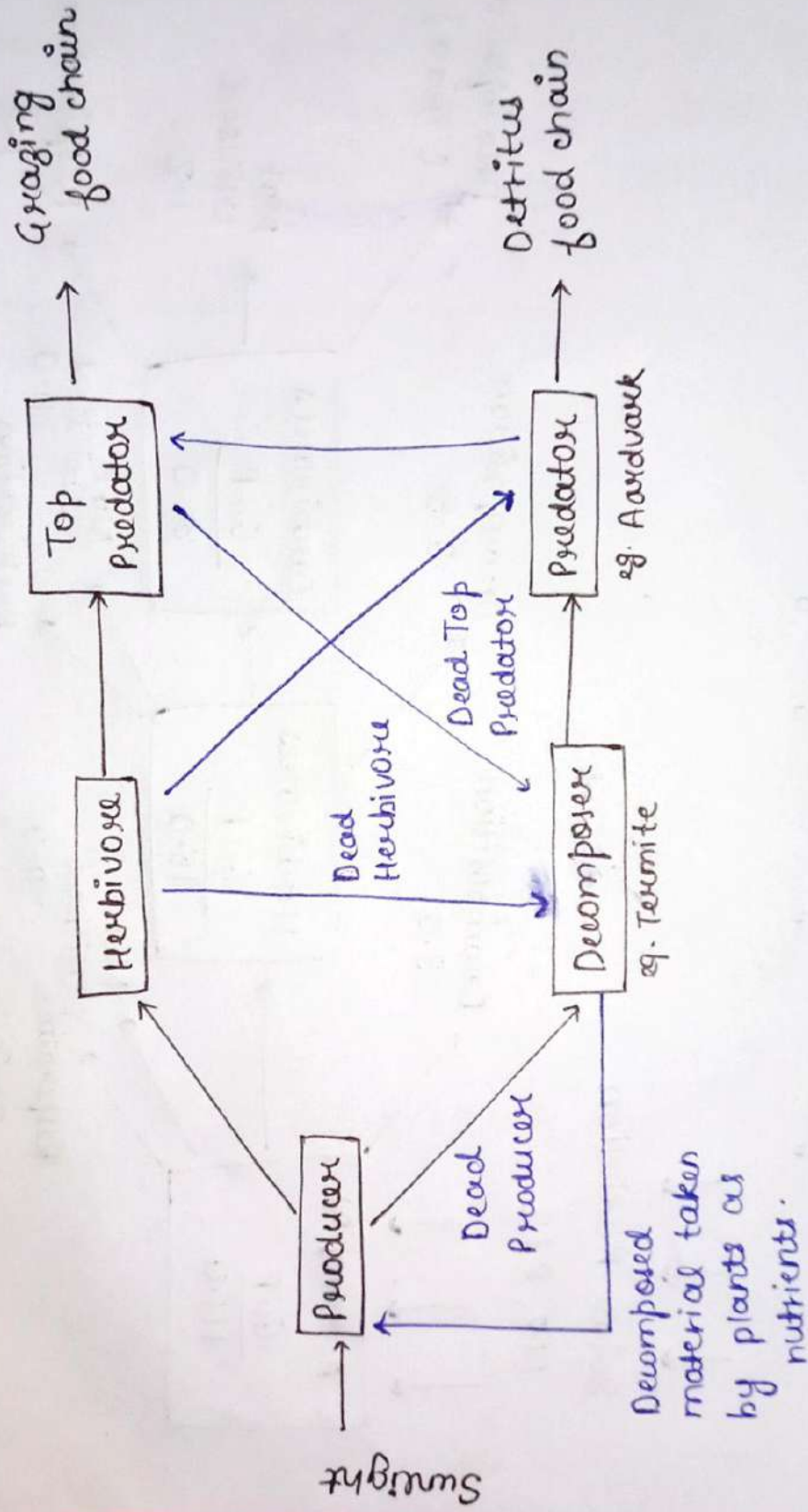
Single Channel Energy Flow.

Energy flow diagram for a lake (Freshwater ecosystem)
 in $g\ cal/cm^2/yr$ (modified from Lindeman, 1942)



G.P. → Gross Production

Y-Shaped / Double Channel Energy Flow Model



10% Law of Energy :

- Given by Raymond Lindeman, 1942.
- There is only 10% of the transfer of energy from each lower trophic level to the next/higher trophic level.

This Law, known as the 10% energy law.

- The primary consumers do not acquire 100% of the energy transfer from the plants/producers, some of the energy of the sun is consumed by the plants during the process of photosynthesis.

