Semester - V

Subject - Botany

Course - Major - 9

Question :- Describe energy flow in ecosystem.

Answer :- Energy flow in Ecosystem

There is a "unidirectional or one way flow of energy" in ecosystem. The source of all energy is radiant or solar energy. 50% of incident solar energy is photosynthetically active radiation (PAR). A part of it is trapped by producers for their photosynthesis. In photosynthesis solar radiation is changed into chemical energy or potential energy with which organic matter or biomass is build up. Energy content or calorific value of organic matter per unit weight is determined by burning a known weight of dry biomass in "bomb calorimeter" in presence of oxygen. The amount of heat evolved gives information about the amount of energy trapped in forming that biomass.

Two Laws of Thermodynamics

i) First law of thermodynamics → It states that energy can neither be created nor destroyed but it can be transferred and transformed from one component to another and from one form to another. Thus energy of sunlight is changed into chemical energy of food and heat. As food energy passes from one trophic level to the next.

ii) Second law of thermodynamics → According to this law no transfer, or transformation of energy occurs unless and until it is accompanied by degradation or dissipation of energy from concentrated to dispersed form. Energy of food is in concentrated form while it is highly dispersed form in heat. The transfer of food energy from one trophic level or organism to another is accompanied by degradation and loss of major part of food energy as heat. Only a small fraction of food energy, roughly 10%. (Lindeman, 1942) is stored as biomass.

Under favourable conditions, 1-5% of incident solar radiation or 2-10% of incident PAR is captured by producers

in their photosynthesis as gross primary productivity. The remaining bulk of incident radiation is dissipated, mostly as heat. Some 20% of the trapped energy in gross primary productivity is utilized by producers in their own respiration. Therefore, net primary productivity (gross primary productivity minus respiratory loss) is 0.8 - 4.0% of total incident solar radiation or 1.6 - 8.0% of PAR

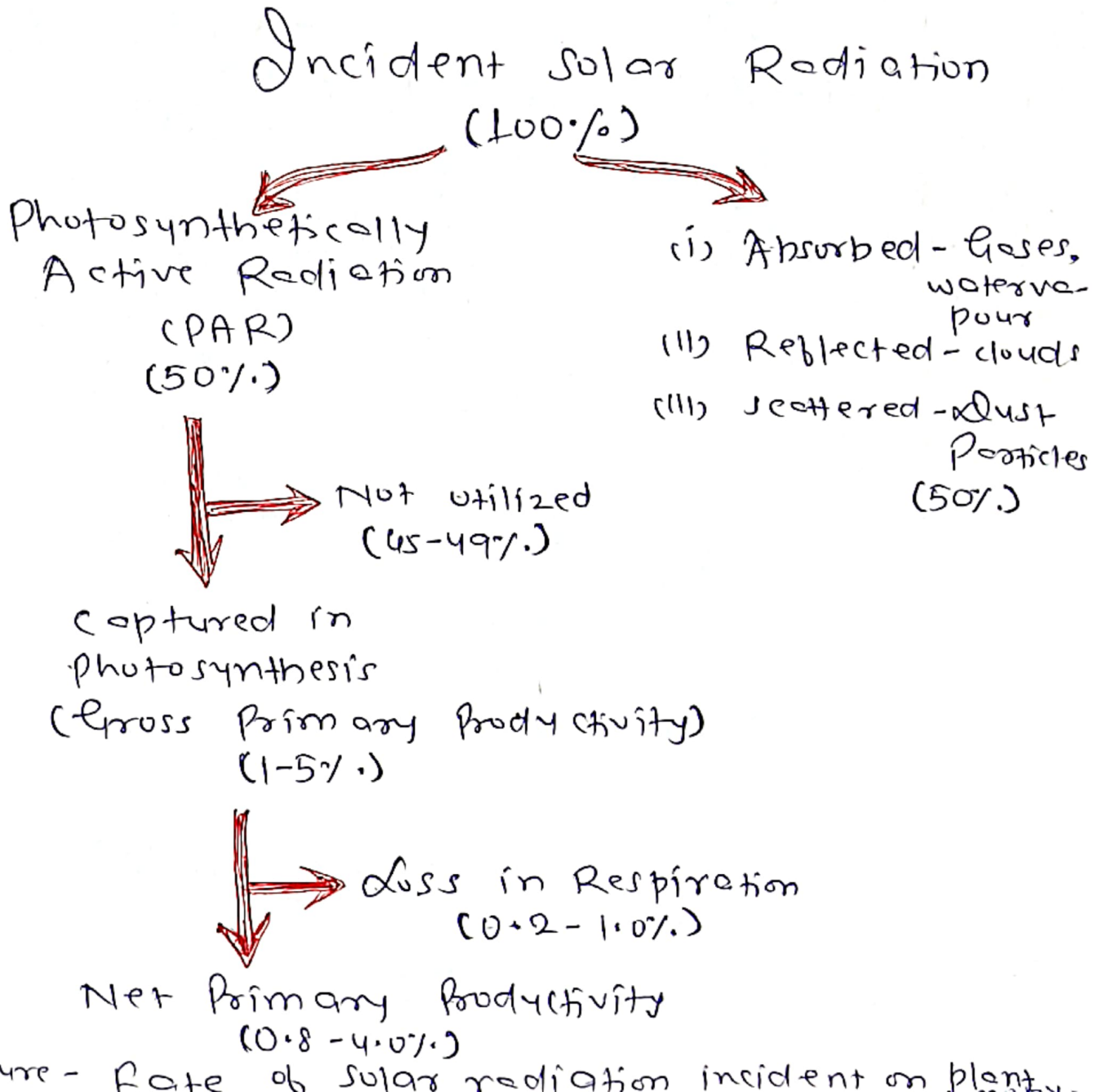
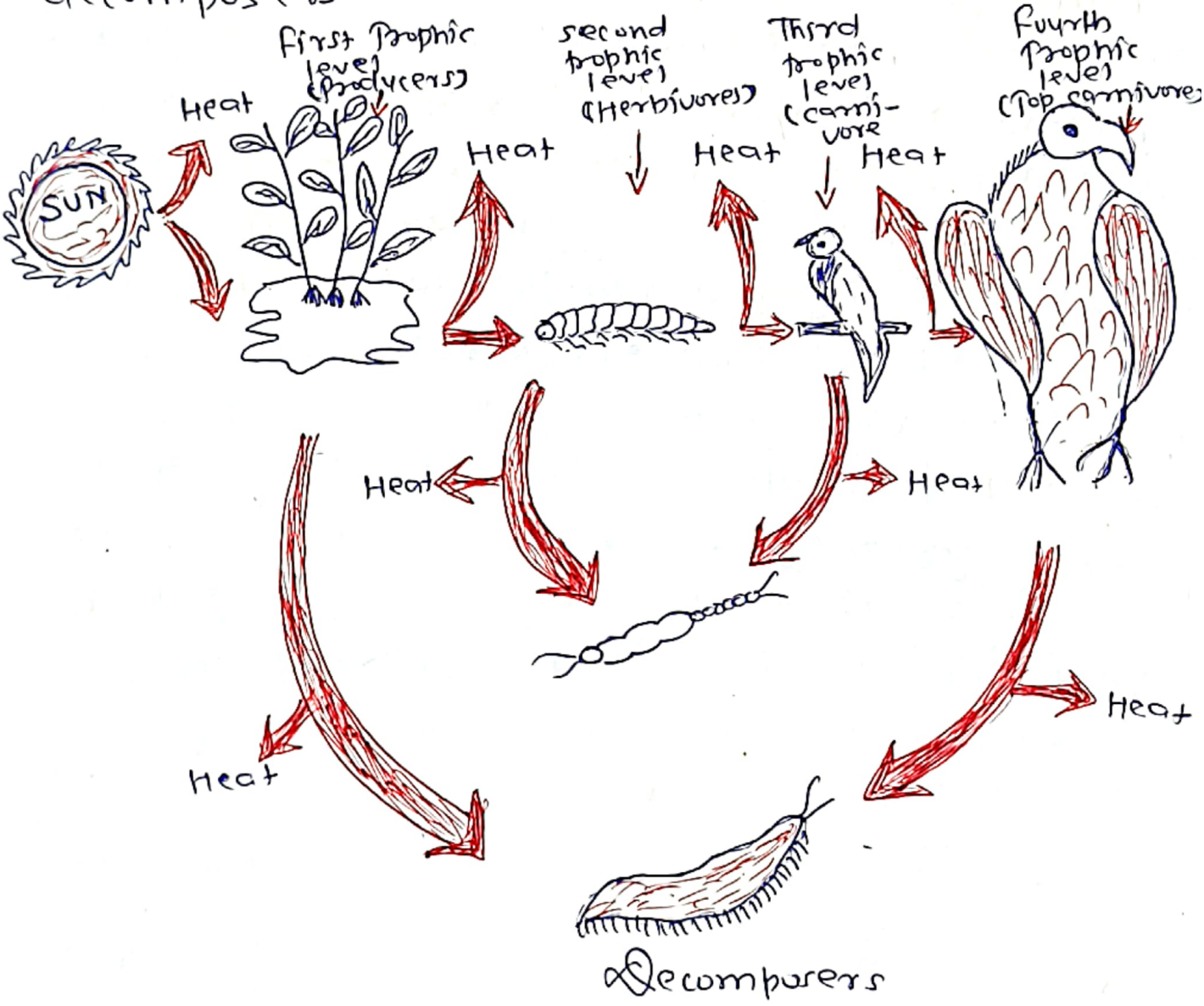


Figure - Fate of solar radiation incident on plant

The net primary productivity is available to herbivores (and hymons). Herbivory, however, removes only a part of net primary productivity. The remaining unutilized net primary productivity is ultimately changed into detritus. The later is the energy source of decomposers.



Figure→ Diagram showing energy flow through different trophic levels.

A good part of food energy remains unutilized at the herbivore level. Herbivores waste a lot of food energy during ingestion. A part of ingested food is not digested. It is allowed to come out as faecal matter which is acted upon by decomposers. Herbivores utilize about 30% of assimilated food in respiration. The energy made available to herbivores through respiration is used in performing various life activities as well as production of heat. The remaining assimilation is converted into herbivore biomass. It is about 10% of productivity of producers. The passage of about 10% of biomass energy from one trophic level to the next is called "ten percent law." It is proposed by Lindeman (1942). 90% of biomass energy is dissipated or passed over to detritus.

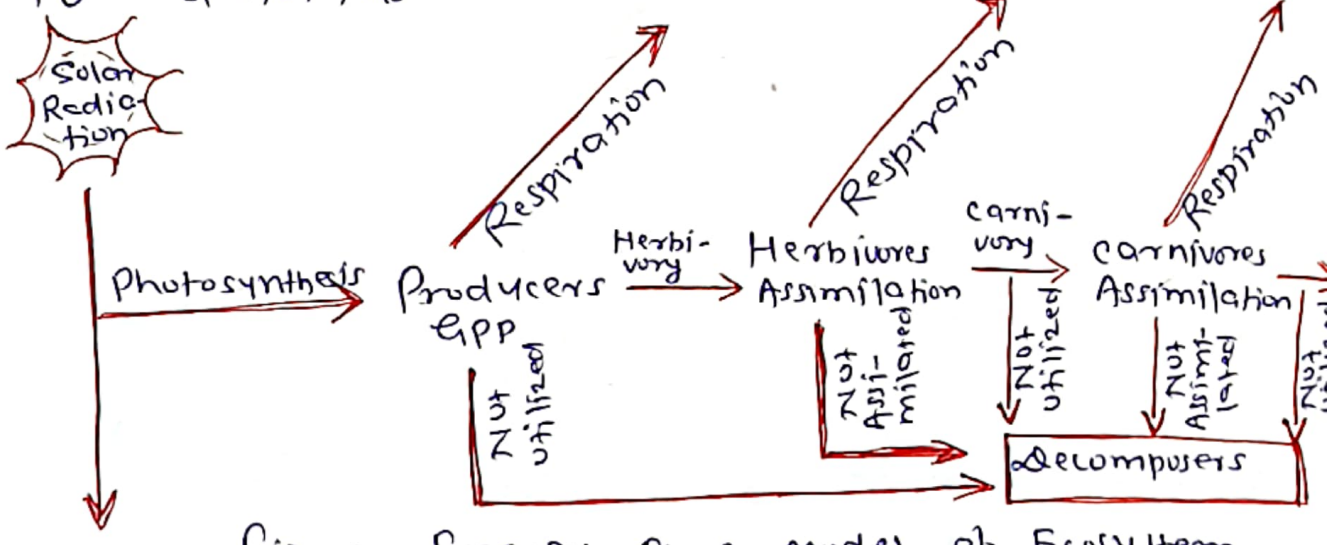
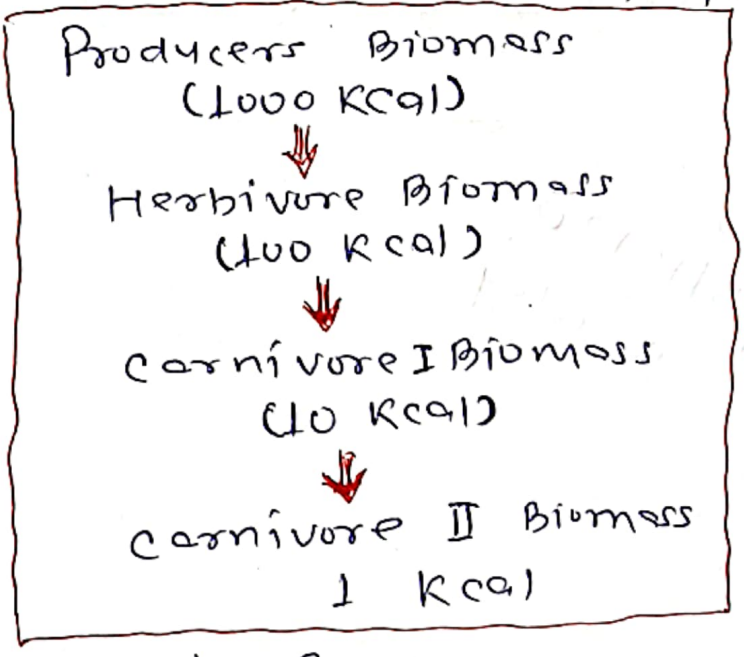


Figure- Energy flow model of Ecosystem

Some herbivores become food of primary carnivores. Herbivores not preyed upon by carnivores die a natural death. The energy available in their biomass is picked up by detrivores and decomposers. There is wastage during predation as the whole of herbivore is not eaten by carnivore. Some of the ingested matter comes out of the body in undigested form as faecal matter. The digested matter is assimilated energy in respiration. It is estimated that biomass energy available at herbivore level forms only 10% biomass energy of primary carnivore level. There is a similar reduction in biomass energy of successive higher carnivore level. As energy available at higher carnivore level becomes small, an ecosystem does not have more than 3-5 trophic levels, e.g.,



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