Ecology: Ecosystems and Energy Pathways

Text Book Reference: 1.10, page 32-39

Energy: ability to do work (units Joules, J)

No ecosystem can exist without a source of energy.
The biosphere depends on a continuous supply of energy from the sun.

The energy needed to support life on Earth comes from the Sun. Sunlight provides the energy required for the evaporation of H_2O cycle.

Nuclear fusion in the Sun radiates energy out into space, only ~ 10^{-9} energy of the Sun reaches the Earth.
Harmful high energy cosmic rays, X-rays, X-rays and UV radiation are all filtered out before reaching the Earth, as these are either reflected or absorbed by chemicals in the atmosphere.

Only a very small portion, ~ 0.023% is used by plants for photosynthesis, because 44% heats Earth's surface, 30% is reflected back into outer space from clouds or Earth's surface, 25% evaporates H_2O, and 1% generates winds and waves.

Photosynthesis is a chemical process by which plants produce sugars.
Equation for Photosynthesis

$$6CO_2 + 6H_2O \xrightarrow{\text{UV light energy, chlorophyl}} C_6H_{12}O_6 + 6O_{2(g)}$$

Carbon dioxide — Water — Glucose — Oxygen

The plants use some of the stored energy for a process called respiration.
Equation for Respiration

$$C_6H_{12}O_6 + 6O_{2(g)} \longrightarrow 6CO_2 + 6H_2O$$

The energy that is not used is passed up the food chain to the herbivores. The herbivores in turn use some of the energy for growth, movement, reproduction, digestion, etc. and pass the unused energy up the food chain.

Plants —> collect solar energy from the abiotic environment —> convert to chemical energy and stored as food energy

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stored food energy is used by herbivores <— transferred to carnivores when they eat herbivores

Answer Questions: page 33 #1 - 4

Classification of Consumers

Text Book Reference: 1.11 page 34

A trophic level tells how a consumer interacts with the producers of its ecosystem.
[FYI: trophic refers to feeder, trophic level refers to feeding level];
i.e., a trophic level refers to the position of a species on a food chain.

5th Trophic level {Quaternary consumers — 4th order consumer

↑

4th Trophic level {Tertiary consumers generally carnivores — 3rd order consumer

↑

3rd Trophic level {Secondary consumers, these rely on primary consumers for their food and one directs dependant on the autotrophs. They are carnivores/omnivores e.g. frog — 2nd order consumer

↑

2nd Trophic level {PRIMARY CONSUMER These feed on the producers and are Herbivores, e.g., cattle, sheep, grasshoppers, and they feed at the 2nd trophic level — 1st order consumer

↑

1st Trophic level
Producers or Autotrophs
These use sunlight to make their own food, e.g., plants, algae, some type of bacteria.

Consumers at any trophic level are referred to as HETEROTROPHS, and are directly or indirectly dependant on producers.
A heterotroph can not produce its own food, but consumes other organisms to obtain its needs.
A top carnivore eats lower-order consumers and is not eaten itself by any other organisms.

Make a food chain using the following, and state each trophic level and the order of consumers:

Clover Rabbit Fox Wolf

Energy and Food Chain

A food chain is a diagram that shows that direction in which energy and matter is transferred from organism to organism.

x ⟶ y: indicates that x is being "eaten" by y

(i.e., the arrow indicates the direction of energy flow)

E.g.1 spruce tree —> deer —> wolf

E.g.2 wheat —> mouse —> cat

E.g.3 grass —> cow —> human

Food webs are made up of two or more different food chains.

Both food chains and food webs consist of producers and consumers
e.g., grass—> grasshopper —> frog —> snake —>hawk

A food chain has a single path while a food web includes branches that show several feeding relationships.

Food chains and food webs always start with a producer.
Some examples of producers include grass, algae, seaweed, shrubs, berries and seeds.

Why is a producer necessary in all food chains?
Producers manufacture their food directly from the abiotic environment green plants which are producers are able, through the process of photosythesis, to take raw materials, CO_2 and H_2O, and convert them to food.
Therefore, the producer serves as a link in the food chain between the abiotic and biotic environments.

In a food chain, would you expect a greater number of:
(a) herbivores or carnivores?
One would expect a greater number of herbivores then carnivores because the larger number of herbivores could be supported by the larger number of producers in the food chain.

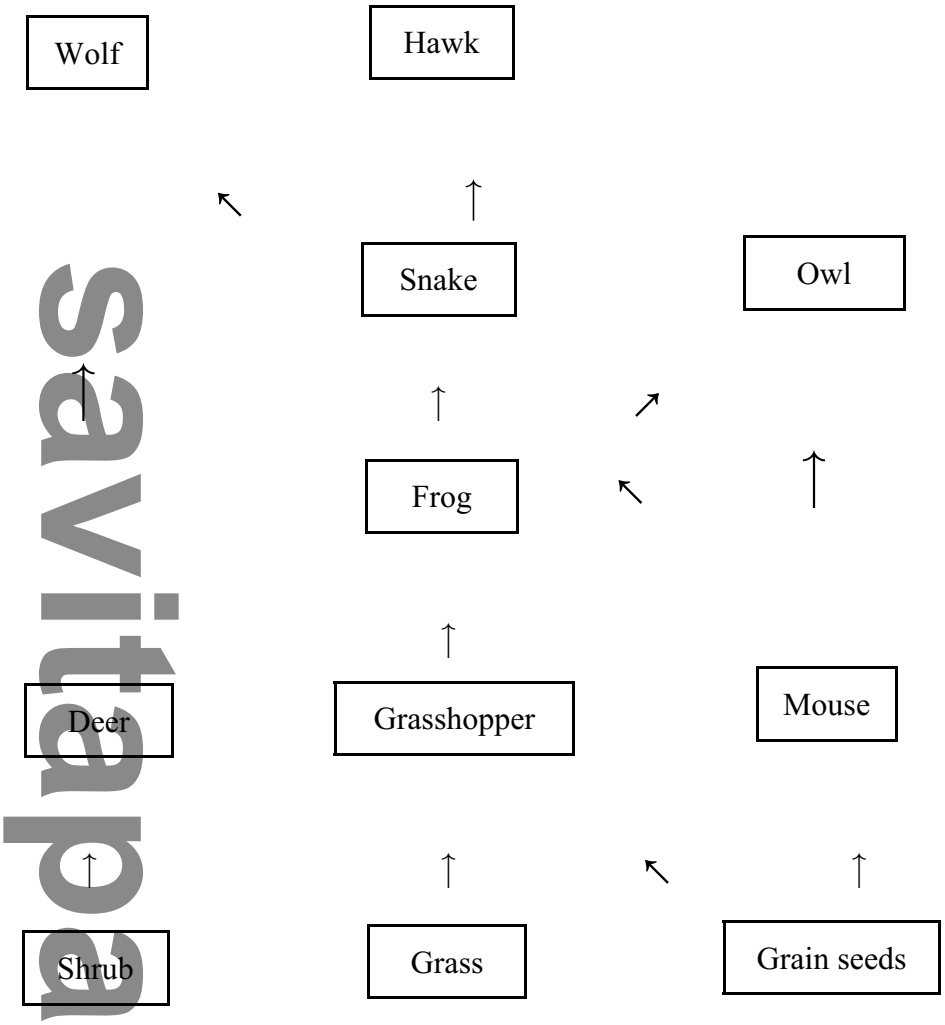
(b) producers or consumers?
Green plants, or producers are autotrophs that have an abundant energy supply to help them manufacture food.

The consumer's food supply is dependant on the availability of producers or other heterotrophs in the environment. Hence, there should always be more producers than consumers.

Food Pyramid: Trophic level Consumer order

2^0 consumer
↑
1^0 consumer
↑
Producer

Example of a Food Web:



Humans are food sources for animals such as polar bears, killer whales, and some species of shark, when hungry or provoked. Humans are always food for such micro-organisms as bacteria and microscopic worms.

Another category of feeders is DETRITIVORES, (from the Latin words for "wearing down" and "devouring"), these are omnivores that can be primary, secondary, or tertiary consumers.

Detritivores break down waste or dead organisms in the decaying process recycling nutrients back into the soil; these include earthworms, mites, centipede, protozoans, some insects and scavengers such as vultures, crows and ravens.
Decomposers are usually fungi and bacteria.

Homework:
1. Read page 32-39, section 1.10
2. Answer the following:
(i) What is the source of energy in an ecosystem
(ii) How does this energy enter the ecosystem
(iii) Sketch a food chain that begins with a green plant and includes a mouse, an owl, a beetle, a robin
(iv) Distinguish between producers and consumers
3. Write the equation for the photosynthesis reaction.