

ECOLOGY

→ study of inter relationships between living organisms and their environment

habitat: environment in which an organism lives

population: total no. of organisms of the same species living in the same geographical area

community: populations of all different ~~types~~ species that live in the same habitat

ecosystem: both the biotic and abiotic factors of life and how they interact

→ the environment is made up of 2 factors:

i. Biotic Factors

ii. Abiotic Factors

i. BIOTIC FACTORS

1. Food availability

2. New Predator

↳ effect existing predators if they are competing for the same prey

↳ causes population of prey to fall

3. Competition b/w species

↳ if a species is outcompeted it can cause the population to fall to the point of extinction

4. New Pathogens

↳ infectious diseases wipe out entire populations

ii. ABIOTIC FACTORS

1. Light intensity

↓ L.I = ↓ photosynthesis = ↓ growth of plants

2. Temperature

3. Water



4. pH & mineral content of soil

↳ aquatic organisms are sensitive to pH changes in water

5. Wind intensity

6. CO_2

↳ rate of photosynthesis \uparrow or \downarrow

7. O_2

↳ in hot temperature $O_2 \downarrow$

stable community: where all the biotic and abiotic factors are in balance
population is in balance with the abiotic factors

producer: an organism that makes its own organic nutrients, usually using energy from sunlight through photosynthesis.
e.g. green plants

consumer: organisms depending on other organisms to get energy by feeding
primary consumers are animals that directly depend upon plants for their food e.g. herbivores (eat plants)
secondary consumers are animals that depend upon primary consumers e.g. carnivores (eat other animals)

decomposers: fungi and bacteria that depend upon plants and animals for energy
an organism that obtains its energy from dead or waste organic matter

Competence & Interdependence:

→ plants compete each other for light, space, water & mineral ions in the soil

→ animals compete for food, water, mating partners and territory

- the principle source of energy is sunlight
- sunlight is trapped by green plants and is converted into chemical energy
 - ↳ used by plants themselves
- primary consumers feed upon producers
 - ↳ the chemical energy transferred from producers to primary consumers is not all used in growth
 - some of it's lost in ~~growth~~ respiration in the form of heat which is not returned back to the food chain
 - some of the energy is lost in faeces & excretion and so the flow of energy in a food chain is non-cyclical in nature

Food Chains and Food Webs

food chain: a chart showing the flow of energy from one organism to the next, beginning with the producer

Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer

food web: shows all possible feeding relationships in a community at each trophic level

represents a network of interconnected food chains

- ecosystems with more complex food chains are more stable than those with simple ones
- it is advantageous to have shorter food chains
 - ↳ more energy available to the final consumer because less energy is lost to the surroundings

TROPHIC LEVELS

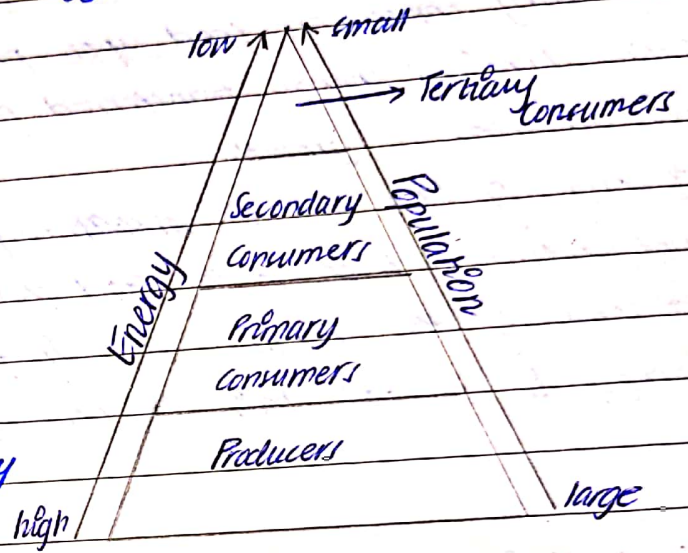
↓
feeding

→ position on the food chain or each link in a food chain is called a trophic level

→ represent a feeding step in the transfer of energy and matter in an ecosystem

- Trophic Level 1 — Producer
- Trophic Level 2 — Primary Consumer
- Trophic Level 3 — Secondary Consumer
- Trophic Level 4 — Tertiary Consumer

Pyramid of Energy



→ as we move up the food chain, both available energy & biomass decrease

→ energy is transmitted upwards but is diminished with each transfer

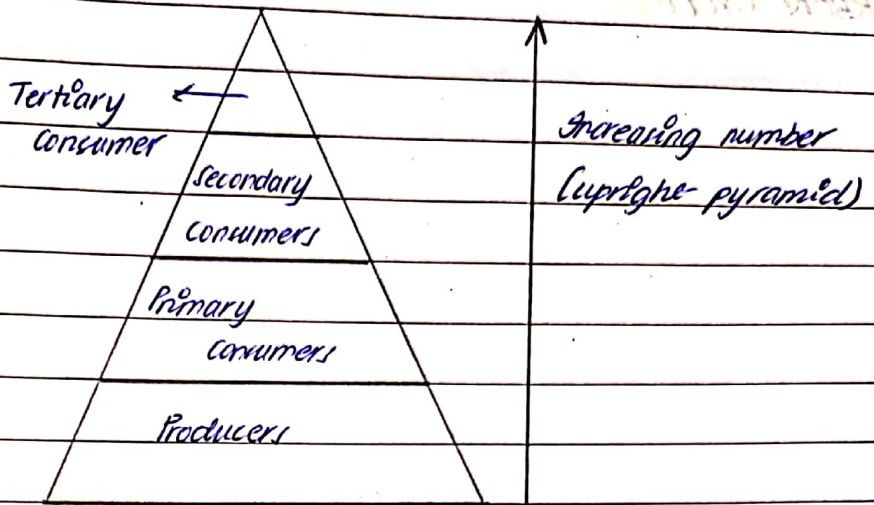
Why is there a decrease in biomass?

- only 1% of the light that falls is absorbed
- some of the absorbed biomass is converted to waste products of metabolism & released
- biomass is used in respiration to release energy
- 10% of primary is absorbed by secondary

$$\text{efficiency} = \frac{\text{gain in biomass}}{\text{total biomass intake}}$$

** 100 for percentage

Pyramid of number



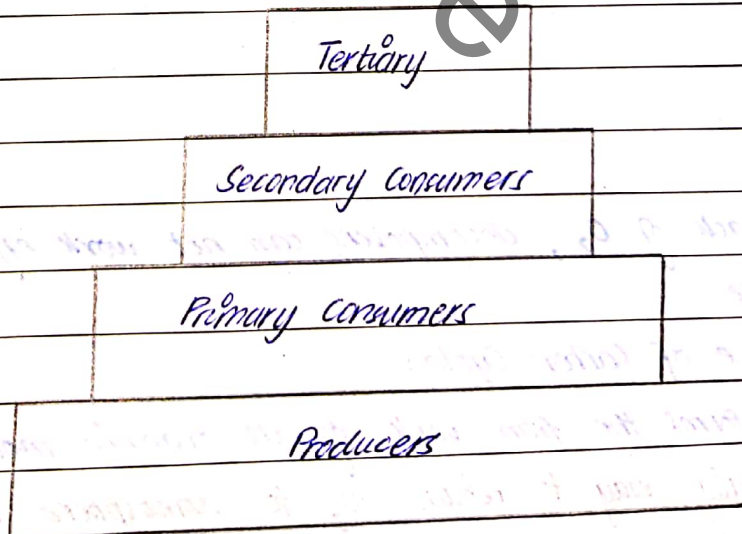
→ in pyramids of number however, the size of organisms is a problem

→ as the no. of organisms decrease along the food chain, the size of organisms increases

→ in some cases however the size of producers may be larger than the size of primary consumers and can support large number of organisms on it

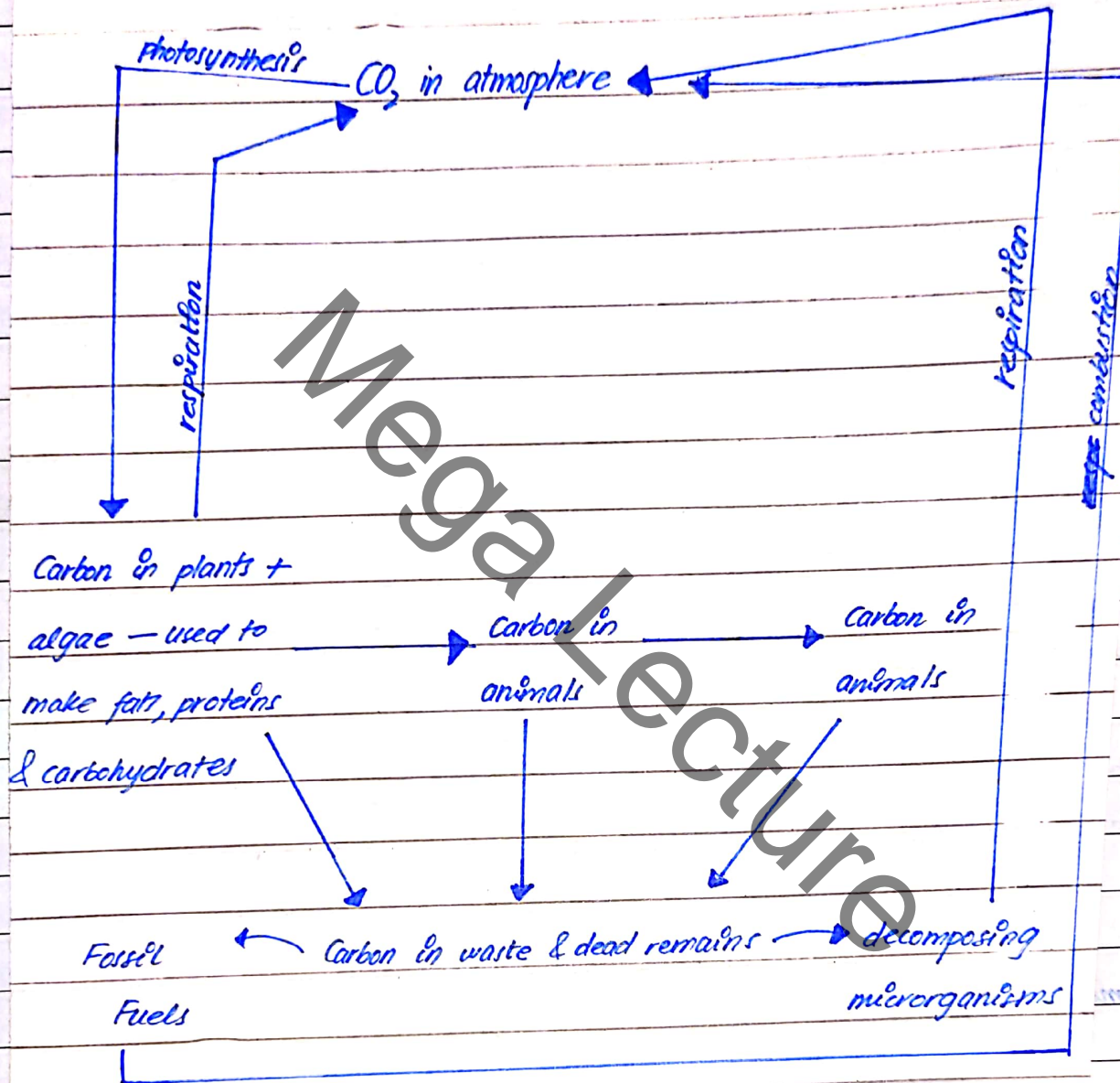
→ the problem is solved by making the pyramids of biomass which always make the regular pyramid

Pyramid of biomass



CARBON CYCLE

→ starts with CO_2 in atmosphere



* under lack of O_2 , decomposers can not work effectively so fossil fuels are made

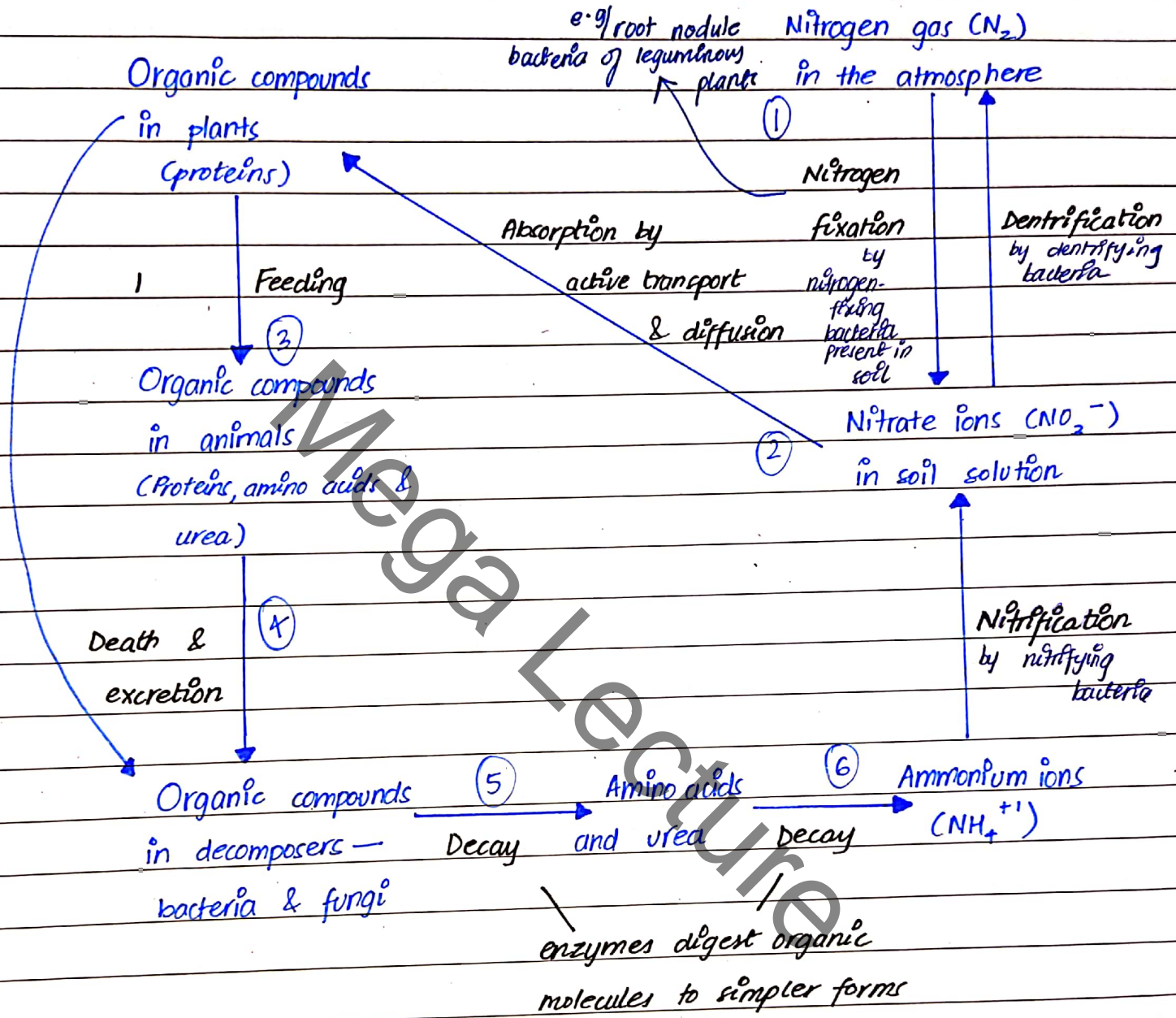
Importance of Carbon Cycle:

→ carbon forms the framework of all organic molecules

* the only way to return CO_2 to atmosphere is through respiration

NITROGEN CYCLE

→ the process of nitrification, absorption, feeding, death, excretion and decay lead to the cycling of nitrogen between living organisms and their environment



→ the soil does not have the correct enzymes to ~~absorb~~ ^{use} nitrogen directly so they have to absorb it as nitrate

→ in nitrogen fixation, nitrogen and hydrogen are combined to form ammonium ions and then nitrate

→ in nitrification, ammonium ions produced by decomposition of aa & proteins are oxidized first to nitrite and then nitrate

→ if oxygen is not present denitrification is done which converts nitrate to N_2 gas.



corn - bushy
* crop rotation
planting pear
corn
head
MegaLecture

PARASITISM

- parasites are organisms that live in or on the body of another organism from which it gets nourishment
- the other organism is called the host
- parasites cause damage, disease & sometimes death of the host

The Malarial Pathogen:

- caused by certain species of plasmodium (unicellular animal protozoan)
- endemic (always present)
- malaria is transmitted by the female anopheles mosquito
- in the salivary glands of an infected female anopheles lives plasmodium
- plasmodium will live and reproduce in the liver and RBCs of a man
- they also release toxins in the bloodstream, causing fever which is a characteristic symptom of malaria

Signs and Symptoms:

- high fever followed by shivering
- profuse sweating
- recurring attacks
- vomiting / diarrhoea
- tender abdomen, head & muscle aches
- anaemia caused by damage in RBCs

Transmission:

- by insect vector & female anopheles mosquito
- the female anopheles is well adapted for its role as a vector of the malarial pathogen
- it has a long mouth which pierces through human skin to drink blood
- the mosquito is small in size & has wings so it can fly from host to host transmitting the disease

Egg → Larva → Pupa → Adult

Control of insect vector & preventing the bite

→ drain breeding sites

→ spray insecticides

→ spray kerosene on water bodies

→ (biochemical control) use minnow fish which eats insect larvae

→ preventive drugs can be taken if a person is travelling to malarial regions

→ sleep indoors

→ wear long sleeves

→ using mosquito repellents

→ using nets while sleeping

→ using drugs like fanstidar will kill the plasmodium

• an uninfected mosquito (at least) must feed twice on human blood to transmit the malarial parasite

• herbicides are a class of pesticides used to remove nuisance plants such as grass & weeds

vectors: an animal that transmits a pathogen from one host to another (they pass the disease)

DEFORESTATION

→ the removal of woodland provides firewood, building materials, cleared land for crops or for grazing cattle

Effects of deforestation

→ rapid soil erosion in the absence of trees (wind and rain will blow away the soil) and ~~the~~ it can no longer be stabilized by tree root systems

→ reduced transpiration rates and drier atmosphere affect the water cycle and reduce rainfall

→ rapid heat absorptions by the soil raises the temperature of the

lower atmosphere in some areas, causing thermal gradients which result in more frequent & intense winds

- many species are dependant on forest conditions, including some local human populations
- many plant species have medicinal properties, e.g as tranquilizers, reproductive hormones, painkillers and antibiotics
- decrease in gene pool & low quality timber
- loss of robust wild species that can be used in artificial breeding

POLLUTION

Green house effect

- CO_2 , CH_4 & CFCs are greenhouse gases
- the greenhouse gases present in atmosphere allow the sun rays to pass through and reach the earth
- light rays are high frequency rays, as they collide with any particle, they lose their energy and turn into heat rays
- which these greenhouse gases do not allow to escape out of the atmosphere
- they return back from atmosphere and increase the temperature of the earth — global warming

Effects of global warming

- * weather changes
- * decrease of annual rainfall, extreme climatic conditions
- * increase of evaporation leading to deserts formation
- * melting of glaciers
- * rise of water levels of rivers
- * floods
- * erosion of soil due to floods and strong winds
- * erosion of top fertile soil leads to loss of fertility

shortages of food
& famine

Acid rain

1. Carbon monoxide (CO)

- incomplete combustion of fossil fuels (car exhaust, industrial smoke)
- combines ~~with~~ irreversibly with hemoglobin to make carboxy HB and reduces oxygen carrying capacity of the blood
- remedy: combustion in availability of O_2

2. Sulphur dioxide / oxides of nitrogen

- come from combustion of organic fuels and industrial smoke
- the oxide of nitrogen and sulfur dissolve in moisture and precipitate as acid rains
- remedy: use of scrubber or use of catalytic converters

Effects of acid rain:

- causes leaching of minerals, that reduces soil fertility and plant growth
- tissues of plants are damaged and reduces plant growth
- low pH of the soil damages the roots and reduces nutrients uptake

Fertilizers

- human beings and animals are sources
- more fertilizers run off of water into the water bodies
- more nutrients for aquatic plants, growth of algae is encouraged
- more growth of ~~the~~ plants & formation of algae blooms \Rightarrow eutrophication
- block passage of light & oxygen into the water bodies

- the weeds and aquatic plants die
- bacteria perform ~~anaerobic~~ aerobic decomposition & the no. of bacteria increases significantly
- they deplete amount of oxygen in water
- since there is a reduction in photosynthesis and a decrease in amount of dissolved oxygen available, both consumer and producer populations fall greatly
- it is also caused by discharge of untreated sewage, detergents and animal wastes into the waterways
- the organic waste pollutants are also decomposed by bacteria (aerobic) that deplete oxygen
- remedy: don't apply fertilizers before rain forecast
- don't apply when there is no crop on the soil
- don't over irrigate
- remove the organic waste from the water bodies
- aerate the water with oxygen
- crop rotation
- ↳ different mineral requirements help the soil in regaining the lost nutrients back and restore nitrogen compounds to soil — no need of fertilizers

Insecticides

- agricultural wastes
- may accumulate in higher concentration in the top consumers and become toxic, can kill a wide range of species — known as pollutants
- DDT, lowered the population of coastal birds
- remedy: biodegradable pesticides
- seek alternative sources of pest control (biological control)
- pest resistant crops

CONSERVATION

→ preservation and maintenance of natural resources is called conservation

→ (1) Preservation

↳ keeping some part unchanged

(2) Reclamation

↳ restoration of damaged

(3) Creation

↳ producing new habitats

Biodiversity

→ variety of all different species of organisms on earth

↑ level = ↑ different species = ↑ stable ecosystem

→ it will be more stable b/c there is less dependence in the ecosystem on one type of specie

i. Reforestation / Afforestation

→ done as a cash crop, providing timber for building

→ to reverse soil erosion, particularly valuable in areas that have become deserts

→ to provide valuable wildlife habitats and death of species b/c of loss of habitat

→ recreational areas, providing leisure activities such as camping and

mountain-biking

→ sources of medicine

→ maintains moderate climatic conditions

ii. Management of Fisheries

- sources of food
- use a recommended mesh size of net
- fishing should be banned in breeding seasons
- licences be issued to fisherman
- if endangered species are caught, they should be returned back to the water
- artificial farming
- fish should be highly productive

Mega Lecture

RECYCLING

- human refuse contains plastic bags, glass, remains of food and ash
- recycling is done because:
 - ↳ it is inconvenient, and gets in the way of people, their vehicles and their animals
 - ↳ it is unpleasant to look at
 - ↳ it could act as breeding ground for organisms which transmit disease
 - ↳ recycling can make scarce resources last for longer, and can reduce the energy requirements of industry



Fermentations make products which can be used as fuel
biomass fuels use raw materials produced by photosynthesis
these materials are from plants and can therefore be regenerated
they include:

- * solid fuels: wood, charcoal, vegetable waste
- * liquid fuels: alcohol and vegetable oil
- * gaseous fuels: biogas

[can help to reduce our use of fossil fuels]

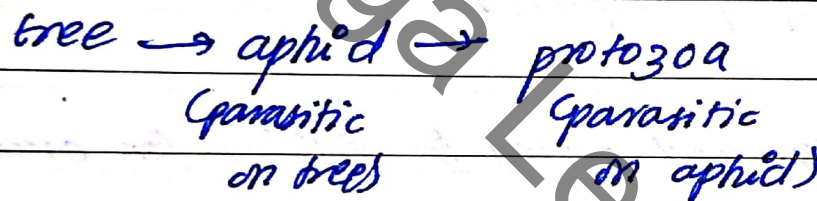
e.g/ plastic bottles can be molten and reused in clothing for example

e.g/ it can take just 7 days for paper to be recycled and transformed into new paper products such as newsprint, cardboard, packaging, tissue and office items

EFFECTS OF HUMANS ON THE ECOSYSTEM

Variation in the ecological pyramid of numbers is observed when:-

- ①. organisms of one trophic level are parasitic on organisms of another trophic level (Parasitic gets a larger bar)
- ②. many small organisms on one trophic level feed on a large organism of another trophic level



Pyramid of numbers

However, the pyramid of biomass is a regular one.

• shorter food chains are more efficient in energy transfer b/c less energy is lost to the environment this way