

#### LO: Briefly describe the non-cyclical nature of energy flow

Name:

- Energy flows in a <u>linear manner</u>. It does not flow in a cycle. Hence energy cannot be recycled.
- Chemical energy is transferred from one trophic level to another upon predation and finally <u>released as heat</u>.
- Energy flow can be represented by a food chain: <u>Producers (plants)</u> <u>primary</u> <u>consumer (herbivore)</u> <u>secondary consumer (carnivore)</u> <u>tertiary consumer</u> (carnivore / omnivore)



#### **Energy flow and trophic levels**

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## LO: Explain the terms producer, consumer and trophic level in the context of food chains and food webs

- Food chain: a series of organisms through which energy is transferred in the form of food.
- Food web is made up of many interconnecting food chains.



Name:



- Trophic level: <u>feeding position</u> in a food web or chain, beginning with producers at trophic level one.
- Producer: Organism, which <u>produces their own food, glucose through</u> <u>photosynthesis</u> by <u>absorbing light energy and converting it into chemical energy</u> in food. Producers are the <u>first organisms in the food chain or food web and</u> <u>occupy the first trophic level</u>.
- Consumer: Organism that <u>obtains energy by feeding on other organisms.</u>







Name:

## LO: Explain how energy losses occur along food chains, and discuss the efficiency of energy transfer between trophic levels

- As energy is passed on from one trophic level to another, <u>90% of it is lost</u> as <u>heat</u> <u>energy due to respiration</u> and <u>chemical energy in excreted or egested waste</u> <u>products</u> such as uneaten body parts, faeces, etc.
- Only <u>10% of energy stored as tissues</u> is transferred to the next trophic level.
- The <u>shorter the food chain</u>, <u>the less energy is lost</u> to the environment. Hence <u>more efficient in energy transfer</u>.







#### LO: Describe and interpret pyramids of numbers and biomass

#### Pyramid of numbers

- Allows for comparison of the number of organisms present in each trophic level at a particular time.
- Can be inverted (narrow based) or upright (broad-based).



Fig. 14.15. Pyramids of numbers : A. In pond ecosystem; B. In parasitic food chain; C. Tree ecosystem.

#### **Pyramid of biomass**

- Allows for the comparison of the <u>dry standing mass of organisms present in each</u> <u>trophic level at a particular time.</u>
- Mostly upright (broad-based)
- Can be <u>inverted if the producer reproduces fast enough to support the</u> <u>consumers</u> despite their <u>smaller biomass at any one time.</u>



Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels





#### Removal of carbon dioxide from the environment:

• Green plants absorb carbon dioxide during photosynthesis to manufacture glucose.





- Through <u>feeding</u>, carbon compounds are moved through the food chains of the ecosystem.
- Preserved as fossil fuels

#### Release of carbon dioxide into the environment:

- Respiration
- Combustion
- Decomposition

#### Importance of the carbon cycle:

- Ensures that there is a <u>continuous supply of carbon dioxide for plants to</u> <u>photosynthesise</u>. Thus, food can be produced and fed upon by other organisms to stay alive.
- Enables energy to flow through the ecosystem in the form of carbon compounds.

#### Role of forests and oceans as carbon sinks:

- A carbon sink is an area that <u>stores carbon compounds</u> for an <u>indefinite period of</u> <u>time</u>.
- It stores more carbon than it releases.

#### Oceans (largest carbon sinks)

- The <u>carbon dioxide that dissolves in the ocean's water is absorbed and used by</u> <u>phytoplankton and algae in photosynthesis to make carbon compounds/ glucose.</u>
- A portion of the carbon compounds found in oceans is buried in the seabed and is in the form of <u>fossil fuels</u> such as natural gas and oil.

#### Forests

- Atmospheric carbon dioxide is absorbed by the plants and used in photosynthesis.
- A large amount of carbon compounds is stored in trees.
- Remains of dead trees form coal, a fossil fuel.

#### LO: Evaluate the effects of

- water pollution by sewage and by inorganic waste
- pollution due to insecticides including bioaccumulation up food chains and impact on top carnivores

#### Water pollution by sewage:

- Sewage is waste matter from homes or industries.
- Untreated sewage is a good source of food for bacteria.
- Bacteria grow and multiply rapidly, depleting the oxygen in the water.
- Thus, other organisms may die due to insufficient oxygen.

### If sewage contains excessive fertilizers (inorganic waste), <u>eutrophication</u> may occur.





- Excess nitrates and phosphates promote rapid growth of algae on the surface of the water body (river, lake or sea).
- This prevents sunlight from reaching the submerged plants.
- Submerged plants cannot photosynthesise and die.
- Dead plants are <u>decomposed by bacteria.</u>
- Bacteria thus grow and multiply rapidly, using up the oxygen in the water.
- Other organisms die due to lack of oxygen.

#### Water pollution due to excessive insecticides

- Insecticides such as DDT are <u>non-biodegradable</u> (cannot be broken down by microorganisms)
- DDT <u>cannot be excreted</u> due to its insolubility in water, thus it is <u>stored in the fatty</u> <u>tissues of the organism</u> and will <u>accumulate in the bodies of consumers</u>.
- This process is known as bioaccumulation.
- As it gets passed along the food chain along the trophic levels, it increases in concentration as the organisms higher up the trophic levels consume more organisms of the lower trophic levels.
- Organisms in the top trophic level usually have the <u>highest concentration of the</u> <u>insecticide</u> and suffer or die from its harmful effects.
- This is known as **bioamplification**.

#### Bioaccumulation



## LO: Outline the roles of microorganisms in sewage treatment as an example of environmental biotechnology

• Bacteria is used to secrete enzymes that digest organic waste into harmless soluble substances.



Name:



- Environmental biotechnology: making use of biological science to provide environmentally friendly or 'green' solutions to reduce pollution and keep the environment clean.
- The sewage treatment process takes place in water reclamation plants through several stages:
  - i. **Settling tanks**: Heavier and bigger particles settle at the bottom and are removed as sludge.
  - ii. **Aeration tanks**: Bacteria is mixed with sewage. Bacteria secrete enzymes to digest organic waste into harmless soluble substances and carbon dioxide.
  - iii. **Final settling tank**: Microogranisms are removed from the treated sewage before being discharged into the sea.
  - iv. Anaerobic digesters: Sludge from settling tank is treated.
  - v. Treated sludge is dewatered and disposed of as a soil conditioner.



# LO: Discuss reasons for conservation of species with reference to the maintenance of biodiversity and how this is done, e.g. management of fisheries and management of timber production

**Conservation:** protection and preservation of natural resources.

- 1. Maintenance of biodiversity
- 2. Prevent extinction of plant and animal species
- 3. Maintain a stable and balanced ecosystem



- 4. <u>Maintain large gene pool</u>. By cross-breeding different varieties of wild plants and animals, agricultural produce can be improved
- 5. Scientific value that provides useful information to humans, eg. Studies on evolution
- 6. Preserves natural scenery and wildlife
- 7. Habitat for many animals and plants
- 8. Source of raw materials for medicinal drugs, natural insecticides and food

#### Management of fisheries

Name:

- Banning the use of drift nets, trawlers and dredges
- Using nets with a <u>certain mesh size</u>
- Limiting the number of ships allowed in fishing grounds at any one time
- Raising endangered species of fish in hatcheries for release into the sea

#### Management of timber production

- Creation of laws to regulate the logging industry
- <u>Reforestation</u>: The planting of new trees or seedlings to replace trees that have been destroyed
- Designation of lands as <u>forests reserves</u>
- <u>Research</u> to improve quality of forests and making them more productive