15/3/25
Saturday

LIFE PROCESSES

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» All the processes which are necessary to maintain life in an organism are known as life processes.

Q. What criteria defines if an organism is living or dead?

1. They perform movement.
2. They breathe.
3. Their heart pumps.
4. They reproduce.
5. They perform life processes

Food → Fuel → Energy

NUTRITION

» The process of utilization of food by living organisms to obtain energy.

» Nutrients:
- Carbohydrates, Proteins, Fats } (big molecule size) Macro-nutrients
- Vitamins, Minerals } Micro-nutrients (small molecule size)

Types of Nutrition

(Auto)trophic (self nourishment)
- » make their own food
- » They synthesise their food
- » blue-green algae, plants

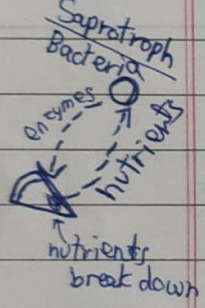
(Hetero)trophic (others)
- » Depends on others for food
- » They consume already synthesised food
- » animals, fungi

» Autotrophs undergo photosynthesis.
It is a biochemical process by which green plants synthesise nutrients from CO_2 & H_2O in the presence of sunlight and chlorophyll.

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

» Heterotrophs

(i) Parasites – Obtain nutrition from the body of the host without killing them
Eg - Lice, Mites, Ascaris, Tapeworms



(ii) Saprotrophs – feed on dead and decaying organisms, release digestive enzymes outside, and then absorb nutrition.
Eg - Bread mould (Rhizopus), Yeast, Mushroom

(iii) Symbionts – they mutually benefit each other
Eg - Lichens

(green) Algae	Fungi
Photosynthesis - provide food	Provides water and shelter

(iv) Holozoic nutrition – Complete digestion takes place inside the body.
Breakdown of food inside the body, unlike Saprotrophs and parasites.

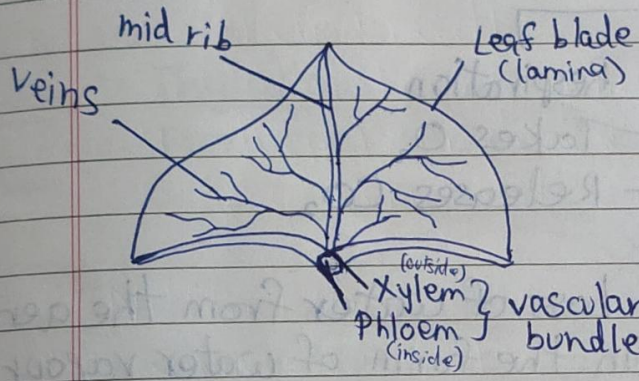
Eg - Unicellular	Multicellular
Amoeba Paramoecium	Humans

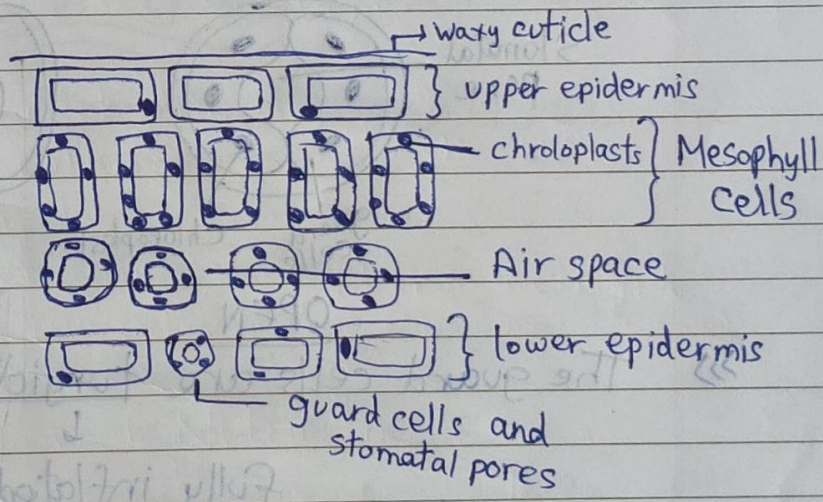
Steps involved for holozoic nutrion:

1. Ingestion
2. Digestion
3. Absorption
4. Assimilation
5. Egestion

AUTOTROPHIC NUTRITION

Cross section of leaf





a) Epidermis [upper epidermis
lower epidermis

Upper epidermis: prevents excessive water loss through evaporation and protects internal leaf tissue.

Lower epidermis: Contains stomata, helps gaseous exchange

b) Guard cells: - bean shaped
- Contains Chloroplast
- Controls opening and closing of Stomata

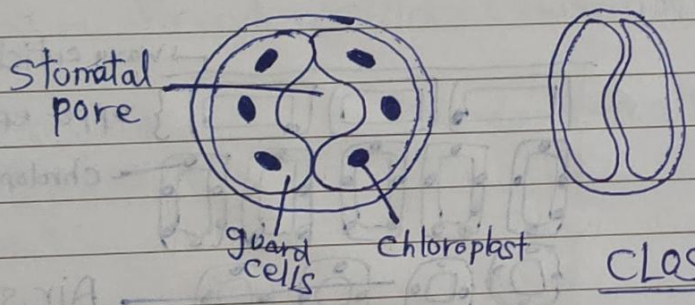
c) Stomata: Tiny pores on the lower surface of the leaves

Functions:

i) Exchange of gases

Photosynthesis	Respiration
- Takes CO_2	- Takes O_2
- Releases O_2	- Releases CO_2

ii) Transpiration: Loss of water from the aerial parts of the plant in the form of water vapour



OPEN

CLOSE

» The guard cells are turgid (mouth opens) for water loss

↓

fully inflated with water due to high sugar content

» The guard cells become flaccid after water loss (mouth closes)

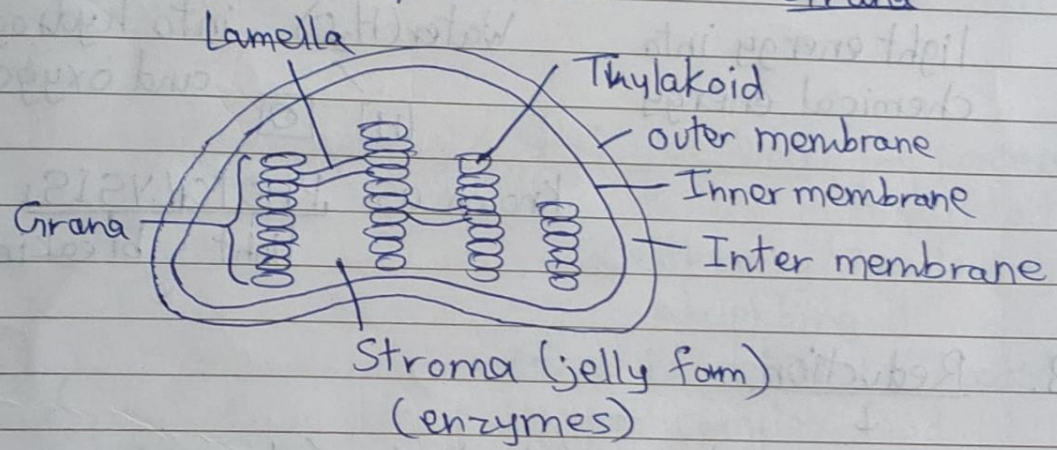
» During photosynthesis, stomata open less in CO_2

» When dark, stomata closes to minimize water loss through transpiration.

» Desert plants open stomata after sunset.

(d) Chloroplast: Minute oval bodies bounded by double membrane which contains coin-like structures.

» Thylakoid: site of photosynthesis
Arranged in piles called – Grana



» Grana: Stack of thylakoid
↓
Responsible for photosynthesis

(e) Chlorophyll: It is contained in the chloroplast.
- Traps the spectrum of light and reflects green colour

(f) Stroma: The piles of grana lie in a colourless jelly-like substance called stroma.

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* Events in Photosynthesis:

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

1. **Absorption and activation**
   - ↓ light energy (photons) — by → chlorophyll
   - (Light energy is absorbed by chrolophyll when activated)

> Photon – smallest unit of light

2. **Conversion / splitting**
   - ↓ light energy into chemical energy
   - ↓ Water (H_2O) into hydrogen and oxygen
     - H O
   - Known as **PHOTOLYSIS**, light breaking

3. **Reduction**
   - ↓ of CO_2 into carbohydrates (glucose)

$$CO_2 \xrightarrow{H_2} C_6H_{12}O_6$$

↓ converted into starch

⋙ Oxygen component is given out as molecular oxygen [O_2]

⋙ Electrons convert ADP (Adenosine diphosphate) into ATP (Adenosine triphosphate).

$$ADP + P \xrightarrow{\text{energy}} ATP$$

⋙ Carbohydrates are utilised for energy.

⋙ Remaining carbohydrates are stored in the

form of starch and used whenever required in the plants.

HETEROTROPHIC NUTRITION

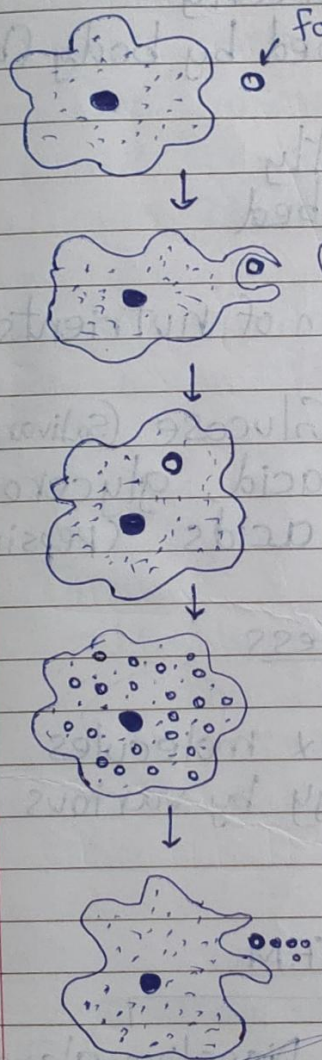
Paramoecium – another unicellular organism

Holozoic nutrition

» In amoeba – by phagocytosis (engulfing food)

↓

It is a unicellular microscoping aquatic organism



5 steps in nutrition:

① »» Ingestion: The process of taking in food into the body either by swallowing or absorbing it.

② »» Digestion: Breakdown of complex food
- Amoeba – food taken in food vacuole where complex food breaks into soluble molecules ready to be absorbed by certain enzymes. (biocatalyst)

③ »» Absorption (in blood): Movement of digested food.
- This food is absorbed by cytoplasm.

④ »» Assimilation (in cell): utilization of food products.
- Nutrition reaches every part of cell
- to derive energy for all metabolic activities (eg: growth)

⑤ Egestion: Removal of waste.
- Undigested food material is removed by cell membrane, which ruptures at any place and eliminates out the undigested food.

* In humans / animals

>>> Intake of essential nutrients
↓
from food
↓
With the help of digestive enzymes

>>> Nutrients:

Carbohydrates, Proteins, Fats	Not directly absorbed by body (breakdown)
Vitamins, Minerals	Directly absorbed

>>> Digestion - "Simplification of nutrients"

1. Carbohydrates —breakdown→ Glucose (Salivary amalyase)
2. Fats —bld→ Fatty acid, glycerol
3. Protein —bld→ amino acids (pepsin)

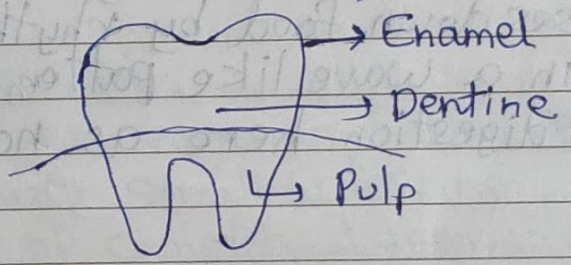
>>> It is a Catabolic process
↓
break downs complex molecules and releases energy by various enzymes.

Alimentary canal

1. Buccal cavity : Digestion begins from here
Mechanical breakdown

Mouth
- Teeth
- Tongue
- Salivary juice

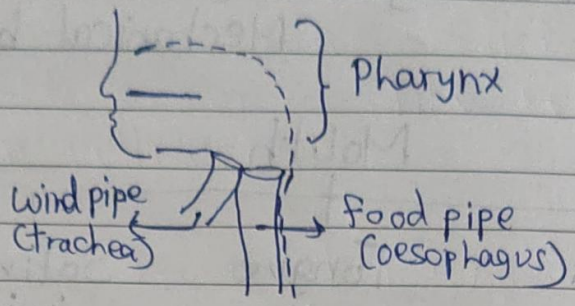
»» TEETH :
- Present in the upper and lower jaw
  - Incisors — 8 [Cutting / biting]
  - Canines — 4 [Tearing]
  - Pre-molars — 8 } [Grinding / crushing]
  - Molars — 12
  - 32 total



»» TONGUE :
- Highly muscular sensory organ at the floor of the buccal cavity
- Has several taste buds
- Helps in mastication
  ↓
  mixing of food with saliva
- Helps in speech

Salivary juice : Juice is secreted from glands
↓
secrete salivary amylase (enzymes)
↓
helps in breakdown:
Starch → sugars

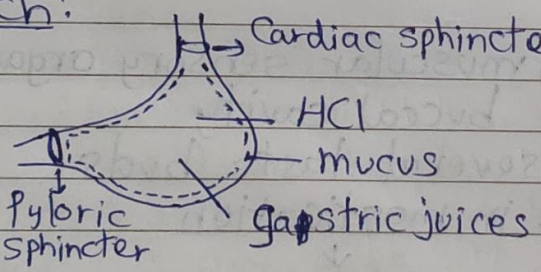
2. Pharynx:



- Small funnel-shaped chamber located behind the oral cavity
- Serves both as respiratory and digestive functions.

3. Oesophagus:
   - 25 cm long
   - Connects buccal cavity to the stomach
   - Passes down food by rhythmic contractions in a wave like pattern called PERISTALSIS
   - No digestion here as no enzymes here

4. Stomach:



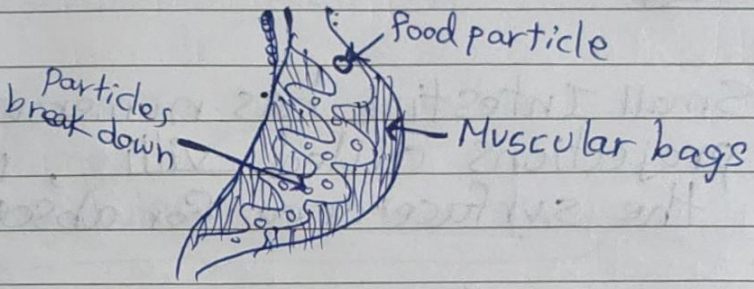
- J-shaped, thick walled, elastic muscular bag
- Located on the left side below the diaphragm.
- Thick mucus protects the inner layer of stomach.
- HCl kills harmful bacteria
- HCl provides optimum condition for pepsin to act.
- Stomach has ~~digestive~~ gastric juices, contains gastric enzymes which converts

INACTIVE PEPSINOGEN (as it requires acidic medium)

converted to (Conversion takes place with HCl)

ACTIVE PEPSIN to break down protein

- Stomach is the storehouse of food where partial digestion takes place.
- Muscular walls help in mixing food properly.



5. Small intestine:
   - Receives secretion from liver, pancreas and wall of small intestine.
   - Site of complete digestion and absorption.

Small Intestine

Duodenum	Jejunum	Ileum
(First opening of small intestine)	(has villi for digestion)	(has villi for absorption)

- It is the longest part of the alimentary canal. (7.5 m long).
- Herbivores - have longer intestine to facilitate digestion

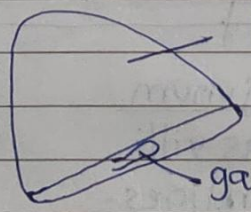
- Cellulose is not digested in human alimentary canal as they have no digestive enzymes like cellulase which act on cellulose.

- Carnivores - have shorter small intestine as meat is easily digestable.
  - Small Intestine is the site of complete digestion.

- Small Intestine has numerous finger-like projections called villi, which increases the surface area for absorption.

⇒ Intestinal enzymes
- Amylalytic – starch → simple sugars
- Proteolytic – protein → amino acids
- Lipolytic – fats → fatty acids, glycerol

6. Liver:



- largest gland
- Reddish brown
- Secretes Bile juice to break down fats.
- Situated on the right side of the abdominal cavity, just below the diaphragm.
- Bile juice is yellowish green

Bile juice

Bile salts	Bile pigments
↓	↓
helps in digestion and absorption of fats.	are the waste products resulting from the breakdown of RBCs in liver

- Bile salts help in
  ↓
  breakdown of large fat globules → smaller fat globules

"Emulsification of Fats"

⋙ Functions of liver:
- Secretion of Bile juice
- Production of urea
- Detoxification – Excess drugs, toxins, harmful chemicals are changed into harmless form by liver cells.

⋙ Function of Bile:
(i) • Makes food alkaline – so that pancreatic enzymes act on food
(ii) • Emulsification of Fats

7. Pancreas:
- soft, greyish-pink gland
- located posterior to stomach
- secretes pancreatic alkaline juice

- pH - 7.8

Pancreas

Enzymes	Hormones
1. Trypsinogen	1. Insulin
2. Lipase	2. Glucagon
3. Pancreatic Amylase	

ENZYMES

- Trypsinogen (Inactive) → Trypsin (Active) - Protein b/d
- Lipase → fat b/d (emulsified fats)
- Pancreatic Amylase → starch → sugar

HORMONES

- Insulin → reduces blood sugar level
  ↓
  Glucose → Glycogen
- Glucagon → increases blood sugar level
  ↓
  Glycogen → Glucose

Organ	Juice	Enzyme	Breakdown
Mouth	Saliva	Amylase	Starch → sugar
Stomach	gastric	HCl mucus pepsin	→ protein
Liver	Bile	(no enzymes)	Bile salt: Large fat globules → Smaller fat globules "Emulsification of Fats"
	↓ Bile salt	↓ Bile pigment	
Pancreas	Pancreatic juice	P. Amylase Trypsin Lipase	→ starch → sugar → protein → amino acids → fats → fatty acids, glycerol
Small Intestine	Intestinal juice	Amylolytic Proteolytic Lipolytic	→ starch → sugar → protein → amino acids → fats → fatty acids, glycerol

SUMMARIZING DIGESTION