Life Processes
Topics

1. Nutrition
2. Respiration
3. Transportation
4. Excretion
1. Nutrition

**Nutrients**

Organic or inorganic chemical substances required for survival

- Carbohydrates
- Proteins
- Fats
- Vitamins
- Minerals

1.1 Types of Nutrition

- **Autotrophic Nutrition**
  - Auto - Self, Trophic - Feeding
  - Prepare their own food
  - Chemosynthesis
    - Preparing food using chemical energy
    - e.g., Sulphur Oxidising Bacteria
  - Photosynthesis
    - Preparing food using light energy
    - e.g., Plants, Algae

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

  *Sunlight* - Main source of energy for all organisms
  *O_2* - By product, Used for respiration

- **Heterotrophic Nutrition**
  - Hetero - Other/Different
  - Depend on others for food
  - Saprophytic
    - Absorption of nutrients from dead and decaying matter e.g., Fungi
  - Parasitic
    - Absorb nutrients from the host organism e.g., Leech, Cuscuta
  - Holozoic
    - Food is taken in solid or liquid form from the outside and is digested inside the body e.g., Humans, Amoeba
1.2 Holozoic Nutrition

Involves 5 stages

1. Ingestion: Process of intake of solid or liquid food
2. Digestion: Conversion of complex food particles into simple and absorbable form
3. Absorption: Process of taking up of digested food or nutrients by the body
4. Assimilation: Utilisation of absorbed nutrients for body functions
5. Egestion: Removal of undigested food through anus

1.2. a) Nutrition in Amoeba

Phagocytosis: Processes of engulfing food, other particles or entire cell
1.2. b) Human Digestive System

**i) Digestive Tract**

- **Alimentary canal**
  - **Mouth**: Site of ingestion
  - **Pharynx**: Common passage for food and air
  - **Oesophagus or Food pipe**: Part which connects mouth to stomach
  - **Stomach**: Churning of food occurs by stomach muscles
  - **Small intestine**: Has 3 parts – duodenum, jejunum & ileum, Digestion is completed and site for absorption
  - **Large intestine**: Has 3 parts – caecum, colon & rectum, Absorption of water and minerals
  - **Anus**: Exit point of faeces

**ii) Digestive Glands**

- **Associated glands**
  - **Salivary glands**: Secrete saliva which contain Salivary amylase
  - **Liver**: Secretes bile juice, Bile helps in emulsification of fat
  - **Gastric glands**: Secrete gastric juice which contains - HCl, mucus and pepsinogen
  - **Gallbladder**: Stores and releases bile juice into the duodenum
  - **Pancreas**: Secrete pancreatic juice which contains - trypsin, lipase & amylase
  - **Intestinal glands**: Secrete intestinal juice

Note: Peristalsis is the series of wave-like muscle contractions that helps the food to move through the digestive tract.
1. Ingestion
Food is ingested into the mouth where teeth and tongue break it into smaller parts

2. Digestion
 Begins in mouth and ends in small intestine

Enzymes in Digestion

**Mouth**
- **Carbohydrates**: Salivary amylase → Maltose
- **Proteins**: Not ingested
- **Fats**: Not ingested

**Stomach**
- **Carbohydrates**: Not ingested
- **Proteins**: Pepsinogen → HCl → Pepsin → Peptides
- **Fats**: Not ingested

**Small intestine**
- **Starch**: Intestinal enzymes → Glucose
- **Proteins**: Intestinal enzymes → Amino acids
- **Fats**: Intestinal enzymes → Fatty acids + glycerol

**Pancreas**
- **Alkaline medium**: Trypsinogen → Trypsin
- **Proteins**: Trypsin → Peptides
- **Fats**: Pancreatic lipase → Fatty acids + glycerol
- **Starch**: Pancreatic amylase → Maltose

Carbohydrates: Yes!  Proteins: Yes!  Fats: Yes!

Note: Pancreatic secretions are released into the small intestine.
3. Absorption

- Occurs in small intestine

- Microvillus
  Increases the surface area for absorption of digested food

- Blood capillaries
  Absorb and transport food to each cell of the body

- Lacteal
  Absorbs fats

- Villi

- Lymph vessel carrying fats

4. Assimilation

Assimilation is utilisation of absorbed nutrients for:

- Growth and repair
- Energy production
- Storage
- Production of complex molecules

5. Egestion

Removal of undigested food through the anus
Mind Map

**Autotrophic**
- Chemosynthesis
  - Sulphur oxidising bacteria
- Photosynthesis
  - Plants, Algae

**Nutrition**

**Heterotrophic**
- Saprophytic
  - Fungi
- Holozoic
  - Amoeba (Phagocytosis)
- Parasitic
  - Leech, Cuscuta

**Human Digestive System**
- Digestive Glands
  - Salivary glands, Liver, Pancreas, Intestinal glands
- Digestive Tract
  - Mouth, Oesophagus, Stomach, Small Intestine, Large Intestine, Anus
2. Respiration

It is the process in which complex organic material is oxidised (broken down) to release energy in the form of ATP.

**ATP**
- Adenosine triphosphate
- Energy currency of cells

**GLUCOSE**

**GLYCOLYSIS**
- In cytoplasm

(Presence of O₂)

**PYRUVATE**

(Absence/Lack of O₂)

**2.1 AEROBIC**

- Carbon dioxide + Water + Energy
  - (In Mitochondria)

End products

- a) Complete oxidation of glucose
- b) Energy = up to 38 ATP (more)
- c) Occurs in cytoplasm and mitochondria

**2.2 ANAEROBIC**

Lack of O₂

- Lactic Acid + Energy
  - (In Muscle cells)

- Absence of O₂

- Ethanol + CO₂ + Energy
  - (In Yeast)

End products

- a) Partial oxidation of glucose
- b) Energy = 2 ATP (less)
- c) Occurs in cytoplasm of cell.
2.3 Human Respiratory System

NOSTRILS
Opening through which air enters and leaves the body

NASAL CHAMBER
Filters and warms air, senses smell

PHARYNX
Common passage for air and food

LARYNX
- Voice box
- Guarded by epiglottis while swallowing

TRACHEA
Windpipe supported by C-shaped cartilage

BRONCHI
Respiratory tube with cartilage

BRONCHIOLES
Terminal branch of bronchi

ALVEOLI
Air sac

DIAPHRAGM
Membrane that separates thoracic and the abdominal cavity

Site of gaseous exchange
External Respiration (Breathing)
Involves breathing in air rich in oxygen into the lungs and breathing out air rich in carbon dioxide.

1. Lungs
2. Alveoli
3. Alveolus
4. RBC’s carries O₂ to body cells
5. Blood rich in CO₂ is taken to the heart
6. Heart pumps blood rich in CO₂ to the lungs

Gaseous Exchange
- O₂
- CO₂
- RBC with O₂
- RBC with CO₂

Heart

Cellular Respiration
- Cell use O₂ to generate energy

Internal Respiration
- The exchange of gases between the bloodstream and cells
2.4 Mechanism of Breathing

**2.4 (a) Inhalation**
- 1. Ribs and sternum raised
- 2. Diaphragm contracted
- 3. Thoracic Cavity
  - Volume ↑
  - Pressure ↓
- 4. Air entering lungs

**2.4 (b) Exhalation**
- 1. Ribs and sternum returned to original position
- 2. Diaphragm relaxed and arched upwards
- 3. Thoracic Cavity
  - Volume ↓
  - Pressure ↑
- 4. Air expelled from lungs

<table>
<thead>
<tr>
<th></th>
<th><strong>INHALATION</strong></th>
<th><strong>EXHALATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Process</strong></td>
<td>Active</td>
<td>Passive</td>
</tr>
<tr>
<td><strong>Diaphragm and intercostal muscles</strong></td>
<td>Contracts</td>
<td>Relaxes</td>
</tr>
<tr>
<td><strong>Ribs</strong></td>
<td>Moves upward and outward</td>
<td>Moves downward and inward</td>
</tr>
<tr>
<td><strong>Diaphragm</strong></td>
<td>Moves downward</td>
<td>Moves upward</td>
</tr>
<tr>
<td><strong>Thoracic cavity</strong></td>
<td>Volume ↑&lt;br&gt;Pressure ↓</td>
<td>Volume ↓&lt;br&gt;Pressure ↑</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>Air moves in</td>
<td>Air moves out</td>
</tr>
</tbody>
</table>
2.5 Respiratory Organs in Other Organisms

2.5.a In Plants

Special pores ➔ stomata - on leaf ➔ lenticels - on stem, root

2.5.b In Animals

- Respiratory organs
  - Moist Skin / Lungs ➔ Frog
  - Moist Skin ➔ Earthworm
  - Gills ➔ Fish
  - Trachea ➔ Insects
  - Lungs ➔ Mammals

2.5.c In Unicellular organisms

- Via cell membrane (direct diffusion)
  - O₂ diffuses into Amoeba
  - CO₂ diffuses out

Note: Breathing and Respiration are NOT same

Breathing

- Physical process
- No release of energy
- Modes of breathing differ among organisms

Respiration

- Chemical process
- Energy is released
- Process of respiration is same in all
3.1. The Heart
(The pumping organ)

**Aorta**
Largest artery of the body that distributes oxygenated blood throughout the body.

**Pulmonary Artery**
Carries deoxygenated blood from the RV to the lungs for oxygenation.

**Superior Vena Cava**
Collects deoxygenated blood from the superior part of the body to the RA of the heart.

**Pulmonary Vein**
Carries oxygenated blood from the lungs to the LA of the heart.

**Right Atrium (RA)**
- Receives deoxygenated blood from the vena cava.
- On contraction, it pumps blood into the RV through tricuspid valve.

**Left Atrium (LA)**
- Receives oxygenated blood from the lungs through pulmonary veins.
- On contraction, it pumps blood into the left ventricle through bicuspid valve.

**Tricuspid Valve**
Prevents backflow of blood from RV to RA when RV contracts.

**Bicuspid Valve**
Prevents backflow of the blood from LV to LA when LV contracts.

**Inferior Vena Cava**
Collects deoxygenated blood from lower part of the body to the RA of the heart.

**Right Ventricle (RV)**
- Receives deoxygenated blood from the RA.
- Pumps blood into the pulmonary artery.

**Left Ventricle (LV)**
- Thickest chamber of the heart.
- Responsible for the pumping of oxygenated blood to all parts of the body through the aorta.

**Semilunar Valve**
Semitransvalve prevents backflow of blood from pulmonary artery or aorta.

*Part of the body that lies above heart - Superior*
*Part of the body that lies below heart - Inferior*
### 3.2. Blood Vessels

- Heart ➔ Aorta ➔ Arteries ➔ Arterioles ➔ Capillaries ➔ Venules ➔ Veins ➔ Vena cava

<table>
<thead>
<tr>
<th>Artery</th>
<th>Vein</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗ Carries blood away from heart</td>
<td>✗ Carries blood towards the heart</td>
</tr>
<tr>
<td>✗ Blood flows under high pressure</td>
<td>✗ Blood flows under low pressure</td>
</tr>
<tr>
<td>✗ Has thick elastic wall</td>
<td>✗ Has thin inelastic wall</td>
</tr>
<tr>
<td>✗ Does not have valves.</td>
<td>✗ Has valves to prevent backflow of blood</td>
</tr>
<tr>
<td>✗ Carries oxygenated blood except pulmonary artery.</td>
<td>✗ Carries deoxygenated blood except pulmonary vein.</td>
</tr>
</tbody>
</table>

#### Blood pressure

- The pressure exerted by blood on the walls of the blood vessels.
- Normal blood pressure
  - **120** Systolic pressure: Pressure of blood on walls of artery during ventricular contraction.
  - **80** Diastolic pressure: The pressure of blood on walls of artery during ventricular relaxation.

**Sphygmomanometer**
3.3. Blood components

**RED BLOOD CELLS**
Contain hemoglobin and transport oxygen

**WHITE BLOOD CELLS**
Identify and destroy pathogens

**PLASMA**
Fluid part of the blood. Carries small amounts of hormones, electrolytes, waste products and gases.

**PLATELETS**
Involved in blood clotting.

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**Lymph**

- Colorless tissue fluid that mostly consists of white blood cells.
- Functions — Carries digested and absorbed fat from intestine into the blood.
  - Drains excess fluid from extra cellular spaces back into the blood.
3.4. Double Circulatory System

**Double Circulation**

Blood passes through the heart twice during each cycle.

**PULMONARY ARTERY**
It carries deoxygenated blood from the RV to the lungs for oxygenation of blood.

**PULMONARY VEIN**
It carries oxygenated blood from the lungs to the LA of the heart.

**VENA CAVA**
Carries the deoxygenated blood from the body to the RA of the heart.

**AORTA**
Carries the oxygenated blood from the LV of the heart to the rest of the body.

**BLOOD CAPILLARIES**
Very thin walled and allow the exchange of materials between and blood and adjacent tissues of the body.
3.5. Transport in other animals

Circulatory system of amphibians and reptiles

- Three chambered heart
- Double circulation

**Two atriums:**
Right atrium receives deoxygenated blood while left atrium receives oxygenated blood.

**Ventricle**
Mixing of oxygenated and deoxygenated blood occurs in ventricles.

Blood capillaries for rest of the body
Blood capillaries in lungs

These animals does not use energy to maintain body temperature.

Circulatory System of fish

- Two chambered heart
- Single circulation

Gills blood capillaries
Body blood capillaries

BLOOD CIRCULATION

Gills

Body

Heart
3.6. Transportation in Plants

- Transportation of food and water takes place separately in plants.

**Xylem**

- Transports *water* and *minerals* from root to all other parts of the plant.
- The flow is unidirectional.

**Forces responsible for transportation in xylem**

**ROOT PRESSURE**
- Osmotic pressure in roots which causes sap to rise in the plant.

**TRANSPIRATIONAL PULL**
- It pulls the water column upwards as there is a continuous loss of water from leaves.

**Phloem**

- Transport of food through phloem is called translocation.
- Translocate sugar, amino acids, proteins and other ions.
- ATP is used to transport sugar from leaves to phloem.
- The flow is bidirectional.

**Forces responsible for translocation in phloem**

**Osmotic Pressure**
- Osmotic pressure is responsible for the transfer of substances from phloem to tissues where food is required.
4. Excretion

4.1 Human Excretory System

Process of removing metabolic waste from the body.

**Metabolic Waste**
- Nitrogenous waste (Ammonia → Kidney)
- Urea, uric acid
- CO₂ → Lungs
- H₂O → Skin

**PAIR OF KIDNEYS**
Bean shaped

**FUNCTION**
- Excretion of N - waste (urea + uric acid)
- Formation of urine
- pH Balance
- H₂O and salt balance

**RENAL VEIN**

**FUNCTION**
- Blood free from toxic waste comes out of kidney via renal vein

**URIINARY BLADDER**
Pear shaped bag, muscular and elastic

**FUNCTION**
- Receives urine from ureters
- Stores urine temporarily

**URETHRA**
Opening of urinary bladder, it has two sphincters

**FUNCTION**
- Expels urine

**PAIR OF URETERS**
Muscular elastic tube, connected to urinary bladder

**FUNCTION**
- Carries urine from kidney to urinary bladder (by peristalsis)

**RENAL ARTERY**

**FUNCTION**
- Supplies blood along with some impurities into the kidney.
4.2 Structure of Nephrons

- Each kidney has about 1 million nephrons.
- Functional unit of Kidney

**Steps of Urine Formation**

1. **Ultrafiltration**
   - Filtration of blood under high pressure to form primary urine which is 180L/day

2. **Selective Reabsorption**
   - Amino acids, glucose, salts and water are reabsorbed back in surrounding blood by diffusion

3. **Tubular Secretion**
   - Renal tubules extract additional N wastes from blood and forms final urine which is 1-2 L/day

- **Glomerulus**
  - Cluster of capillaries which forms a knot

- **Bowman's Capsule**
  - Cup shaped tubule around glomerulus. Collects primary urine.

- **Renal Tubule**
  - Long tubule with coiled and looped region.
  - Processes the primary urine and forms final urine.

**Excretory Pathway**

- Kidney
- Renal Vein
- Circulation
- Renal Artery
- Nephrons
- Urine
- Urinary bladder
- Ureter
- Urethra
4.3 Artificial kidney

- Used during kidney failure
- Filters blood via dialysing fluid
- Only removes wastes like urea and uric acid by diffusion
- No tubular reabsorption

Excretion in Plants

Plants do not possess special excretory organs, but they excrete either by eliminating wastes from their body or by storing them.

**Gaseous Exchange**
- $\text{CO}_2$ and $\text{H}_2\text{O}$ released during respiration
- $\text{O}_2$ released during photosynthesis

**Storage**
- Converted in gum, resins or latex and stored in old xylem (wood)
- Waste products stored in the leaves, bark and fruits are removed by shedding of leaves, peeling of bark and felling of fruits.

**Transpiration**
- Excess water is eliminated