Life Processes - Class 10 Science Notes

1. Introduction to Life Processes

What are Life Processes?

Life processes are the basic functions performed by living organisms to maintain life. These processes are essential for survival and distinguish living organisms from non-living things.

The Seven Life Processes

1. **Nutrition** - Obtaining and utilizing food
2. **Respiration** - Breaking down food to release energy
3. **Transportation** - Moving substances within the organism
4. **Excretion** - Removing waste products
5. **Control and Coordination** - Responding to stimuli
6. **Growth** - Increase in size and mass
7. **Reproduction** - Producing offspring

Characteristics of Life Processes

- **Organized** - Well-coordinated activities
- **Energy-dependent** - Require energy (ATP)
- **Regulated** - Controlled by various mechanisms
- **Interconnected** - All processes work together

2. NUTRITION

Definition

Nutrition is the process by which organisms obtain and utilize nutrients for energy, growth, and maintenance of body functions.

Types of Nutrition

1. Autotrophic Nutrition

Organisms that can synthesize their own food from simple inorganic substances.

Types of Autotrophic Nutrition:

- **Photoautotrophic:** Use light energy (plants, some bacteria)
- **Chemoautotrophic:** Use chemical energy (certain bacteria)

2. Heterotrophic Nutrition

Organisms that depend on other organisms for food.

Types of Heterotrophic Nutrition:

- **Holozoic:** Ingestion of solid food (humans, animals)
- **Saprophytic:** Feed on dead and decaying matter (fungi, some bacteria)
- **Parasitic:** Live on/in other organisms (tapeworm, plasmodium)

Photosynthesis

Definition

The process by which green plants synthesize glucose using carbon dioxide, water, and light energy in the presence of chlorophyll.

Overall Equation

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + ATP$ (Light energy + Chlorophyll)

Site of Photosynthesis

Chloroplasts - contain chlorophyll pigments

Steps of Photosynthesis

1. Light Reaction (Photo-chemical phase):

- Occurs in thylakoids
- Chlorophyll absorbs light energy
- Water molecules split (photolysis): $2H_2O \rightarrow 4H^+ + 4e^- + O_2$
- ATP and NADPH are produced

2. Dark Reaction (Calvin Cycle):

- Occurs in stroma
- CO_2 is fixed into glucose using ATP and NADPH
- Also called Carbon fixation

Factors Affecting Photosynthesis

- **Light intensity:** Higher intensity increases rate (up to saturation point)
- **CO_2 concentration:** Higher concentration increases rate
- **Temperature:** Optimum temperature required (25-35°C for most plants)
- **Water availability:** Essential for the process

- **Chlorophyll concentration:** More chlorophyll increases efficiency

Nutrition in Humans

Human Digestive System Components

1. Alimentary Canal:

- Mouth → Esophagus → Stomach → Small intestine → Large intestine → Anus

2. Digestive Glands:

- Salivary glands, Liver, Pancreas

Process of Digestion

1. Ingestion (Mouth):

- **Teeth:** Mechanical breakdown of food
- **Saliva:** Contains salivary amylase
- **Enzyme:** Amylase breaks starch into maltose
- **pH:** Alkaline (7.4)

2. Esophagus:

- **Peristalsis:** Rhythmic contractions move food down
- No digestion occurs here

3. Stomach:

- **Gastric juice:** Contains pepsin, HCl, mucus
- **HCl functions:** Kills bacteria, activates pepsin, creates acidic medium
- **Pepsin:** Breaks proteins into peptones
- **pH:** Highly acidic (1.5-2.0)

4. Small Intestine:

- **Longest part:** About 7 meters long
- **Three sections:** Duodenum, Jejunum, Ileum

Pancreatic Juice (from Pancreas):

- **Trypsin:** Proteins → Amino acids
- **Lipase:** Fats → Fatty acids + Glycerol
- **Amylase:** Starch → Sugars

Bile (from Liver):

- **Emulsification:** Breaks large fat globules into smaller ones
- **Alkaline:** Neutralizes acidic food from stomach

Intestinal Juice:

- **Maltase:** Maltose → Glucose
- **Sucrase:** Sucrose → Glucose + Fructose
- **Lactase:** Lactose → Glucose + Galactose
- **Peptidases:** Peptides → Amino acids

5. Absorption:

- **Villi:** Finger-like projections increase surface area
- **Products absorbed:** Glucose, amino acids, fatty acids, glycerol, vitamins, minerals
- **Transport:** Through blood and lymph

6. Large Intestine:

- **Water absorption:** Remaining water is absorbed
- **Formation of feces:** Undigested food forms solid waste

Summary of Digestive Enzymes

Location	Enzyme	Substrate	Product	pH
Mouth	Amylase	Starch	Maltose	7.4
Stomach	Pepsin	Proteins	Peptones	1.5-2.0
Pancreas	Trypsin	Proteins	Amino acids	8.5
Pancreas	Lipase	Fats	Fatty acids + Glycerol	8.5
Small intestine	Maltase	Maltose	Glucose	8.5

Nutrition in Plants

Modes of Nutrition in Plants

1. Autotrophic Plants:

- Most green plants
- Perform photosynthesis

2. Heterotrophic Plants:

Parasitic Plants:

- **Total parasites:** Cuscuta (dodder) - no chlorophyll
- **Partial parasites:** Viscum (mistletoe) - some chlorophyll

Saprophytic Plants:

- Indian pipe, some fungi
- Feed on dead organic matter

Insectivorous Plants:

- Venus flytrap, Pitcher plant, Sundew
- Get nitrogen from insects in nitrogen-poor soils

3. RESPIRATION

Definition

Respiration is the process of breaking down glucose to release energy (ATP) for cellular activities.

Types of Respiration

1. Aerobic Respiration

Breakdown of glucose in the presence of oxygen.

Overall Equation: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 38$ ATP

Steps of Aerobic Respiration:

1. Glycolysis (Cytoplasm):

- Glucose breaks down into pyruvate
- 2 ATP molecules produced
- No oxygen required

2. Krebs Cycle (Mitochondria):

- Pyruvate enters mitochondria
- Complete oxidation occurs
- CO_2 is released

3. Electron Transport Chain (Mitochondria):

- Maximum ATP production (34 ATP)
- Oxygen acts as final electron acceptor
- Water is formed

2. Anaerobic Respiration (Fermentation)

Breakdown of glucose without oxygen.

In Muscle Cells (during heavy exercise): $C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + 2$ ATP (Glucose → Lactic acid + Energy)

In Yeast Cells: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 2$ ATP (Glucose → Ethanol + Carbon dioxide + Energy)

Comparison: Aerobic vs Anaerobic Respiration

Aspect	Aerobic	Anaerobic
Oxygen required	Yes	No
ATP yield	38 ATP	2 ATP
End products	$CO_2 + H_2O$	Lactic acid/Ethanol + CO_2
Location	Mitochondria	Cytoplasm
Efficiency	High	Low

Respiration in Plants

Gaseous Exchange

- **Stomata:** In leaves (day and night)
- **Lenticels:** In stems
- **Root surface:** Through root hairs

Day vs Night Respiration in Plants

- **Day:** Photosynthesis rate > Respiration rate (O_2 released)
- **Night:** Only respiration occurs (CO_2 released)

Respiration in Humans

Human Respiratory System

1. Respiratory Organs:

- **Nose:** Filters, warms, and moistens air
- **Trachea:** Windpipe with cartilage rings
- **Bronchi:** Branches of trachea
- **Bronchioles:** Smaller branches
- **Alveoli:** Site of gaseous exchange

Mechanism of Breathing

1. Inspiration (Inhalation):

- Diaphragm contracts and moves down
- Rib cage moves up and outward
- Lung volume increases
- Air pressure decreases
- Air rushes into lungs

2. Expiration (Exhalation):

- Diaphragm relaxes and moves up
- Rib cage moves down and inward
- Lung volume decreases
- Air pressure increases
- Air is pushed out

Gaseous Exchange in Alveoli

- **Structure:** Thin-walled, surrounded by blood capillaries
- **Process:** Diffusion based on concentration gradient
- **O_2:** Alveoli → Blood (high to low concentration)
- **CO_2:** Blood → Alveoli (high to low concentration)

Transport of Gases in Blood

Oxygen Transport:

- **97%** carried by hemoglobin as oxyhemoglobin
- **3%** dissolved in plasma

Carbon Dioxide Transport:

- **70%** as bicarbonate ions (HCO_3^-)
- **23%** by hemoglobin as carbaminohemoglobin
- **7%** dissolved in plasma

4. TRANSPORTATION

Transportation in Plants

Need for Transportation

- Plants have large surface area
- Leaves make food but roots need it

- Roots absorb water and minerals but leaves need them
- Efficient transport system required

Plant Transport System

1. Xylem:

- **Function:** Transport of water and minerals
- **Direction:** Upward (roots to leaves)
- **Components:** Tracheids, vessels, xylem parenchyma, xylem fibers

2. Phloem:

- **Function:** Transport of food (glucose)
- **Direction:** Bidirectional (source to sink)
- **Components:** Sieve tubes, companion cells, phloem parenchyma, phloem fibers

Mechanism of Water Transport

1. Root Pressure:

- Active absorption of minerals creates pressure
- Pushes water upward
- Evidence: Guttation in early morning

2. Transpiration Pull:

- **Major mechanism** for water transport
- Water loss from leaves creates suction
- Pulls water up through xylem

Transpiration:

- **Definition:** Loss of water vapor from plant surfaces
- **Main site:** Stomata in leaves
- **Functions:** Cooling, water transport, mineral transport
- **Factors affecting:** Temperature, humidity, wind speed, light intensity

Mechanism of Food Transport (Translocation)

- **Process:** Pressure flow hypothesis
- **Loading:** Active loading of sugars into phloem at source
- **Transport:** Mass flow from high pressure to low pressure

- **Unloading:** Active unloading at sink tissues

Transportation in Humans

Need for Transportation

- Complex multicellular organism
- Cells deep inside body need nutrients and oxygen
- Waste products need to be removed
- Coordination between organs required

Human Circulatory System

Components:

1. **Heart:** Pumping organ
2. **Blood vessels:** Arteries, veins, capillaries
3. **Blood:** Transport medium
4. **Lymphatic system:** Additional transport system

Structure of Human Heart

Four Chambers:

- **Right Atrium:** Receives deoxygenated blood
- **Right Ventricle:** Pumps blood to lungs
- **Left Atrium:** Receives oxygenated blood
- **Left Ventricle:** Pumps blood to body

Heart Valves:

- **Tricuspid valve:** Between right atrium and ventricle
- **Bicuspid valve:** Between left atrium and ventricle
- **Pulmonary valve:** Between right ventricle and pulmonary artery
- **Aortic valve:** Between left ventricle and aorta

Cardiac Cycle

1. Diastole (Relaxation):

- Heart muscles relax
- Blood fills atria and ventricles

2. Systole (Contraction):

- **Atrial systole:** Atria contract, push blood to ventricles
- **Ventricular systole:** Ventricles contract, pump blood out

Blood Circulation

1. Pulmonary Circulation:

- **Route:** Right ventricle → Pulmonary artery → Lungs → Pulmonary veins → Left atrium
- **Purpose:** Oxygenation of blood

2. Systemic Circulation:

- **Route:** Left ventricle → Aorta → Body organs → Vena cava → Right atrium
- **Purpose:** Supply nutrients and oxygen to body

Blood Vessels

1. Arteries:

- **Function:** Carry blood away from heart
- **Structure:** Thick, elastic walls
- **Pressure:** High pressure
- **Examples:** Aorta, pulmonary artery

2. Veins:

- **Function:** Carry blood toward heart
- **Structure:** Thin walls with valves
- **Pressure:** Low pressure
- **Examples:** Vena cava, pulmonary veins

3. Capillaries:

- **Function:** Exchange of materials
- **Structure:** Very thin walls (one cell thick)
- **Location:** Throughout body tissues

Composition of Blood

1. Plasma (55%):

- **Composition:** 90% water + proteins + nutrients + waste products
- **Functions:** Transport, maintains blood pressure

2. Blood Cells (45%):

Red Blood Cells (RBCs):

- **Function:** Oxygen transport
- **Hemoglobin:** Iron-containing protein
- **Shape:** Biconcave disc
- **Lifespan:** 120 days

White Blood Cells (WBCs):

- **Function:** Defense against infections
- **Types:** Lymphocytes, neutrophils, monocytes
- **Ability:** Can change shape and move

Platelets:

- **Function:** Blood clotting
- **Process:** Form fibrin network to stop bleeding

Lymphatic System

- **Function:** Returns tissue fluid to blood circulation
- **Components:** Lymph, lymph vessels, lymph nodes
- **Additional function:** Immune system component

5. EXCRETION

Definition

Excretion is the process of removing toxic metabolic wastes from the body.

Excretory Products

1. Nitrogenous Wastes:

- **Ammonia:** Most toxic, highly soluble (aquatic animals)
- **Urea:** Less toxic, less soluble (mammals)
- **Uric acid:** Least toxic, least soluble (birds, reptiles)

2. Other Wastes:

- Carbon dioxide, excess water, salts, bile pigments

Excretion in Plants

Excretory Products in Plants

- **Oxygen:** During photosynthesis
- **Carbon dioxide:** During respiration
- **Water vapor:** Through transpiration
- **Waste products:** Stored in vacuoles, bark, leaves

Methods of Excretion in Plants

1. **Diffusion:** Through stomata and lenticels
2. **Transpiration:** Water vapor loss
3. **Leaf fall:** Seasonal shedding
4. **Storage:** In bark, fruits, seeds

Excretion in Humans

Human Excretory System

Components:

1. **Kidneys (2):** Main excretory organs
2. **Ureters (2):** Tubes carrying urine to bladder
3. **Urinary bladder:** Storage of urine
4. **Urethra:** Tube for urine elimination

Structure of Kidney

External Structure:

- Bean-shaped organs
- Located below rib cage
- Protected by renal capsule

Internal Structure:

- **Cortex:** Outer region
- **Medulla:** Inner region
- **Pelvis:** Central cavity

Nephron - Functional Unit of Kidney

Components:

1. **Glomerulus:** Cluster of blood capillaries
2. **Bowman's capsule:** Cup-shaped structure around glomerulus

3. **Tubular system:** PCT → Loop of Henle → DCT
4. **Collecting duct:** Final tube

Process of Urine Formation

1. Glomerular Filtration:

- **Location:** Bowman's capsule
- **Process:** Blood pressure forces water, salts, glucose, urea through glomerular membrane
- **Product:** Glomerular filtrate

2. Tubular Reabsorption:

- **Location:** Proximal convoluted tubule, Loop of Henle
- **Process:** Useful substances (glucose, salts, water) are reabsorbed
- **Result:** Concentration of urine increases

3. Tubular Secretion:

- **Location:** Distal convoluted tubule
- **Process:** Additional waste products secreted into urine
- **Examples:** Excess salts, uric acid

Regulation of Kidney Function

1. Antidiuretic Hormone (ADH):

- **Source:** Hypothalamus
- **Function:** Regulates water reabsorption
- **Effect:** More ADH = more water reabsorption = concentrated urine

2. Aldosterone:

- **Source:** Adrenal cortex
- **Function:** Regulates sodium reabsorption

Artificial Kidney (Hemodialysis)

- **Need:** When kidneys fail
- **Process:** Blood is filtered through artificial membrane
- **Principle:** Diffusion removes waste products
- **Frequency:** 2-3 times per week

Other Excretory Organs

1. Lungs:

- **Waste:** CO_2 and water vapor
- **Process:** Exhalation

2. Liver:

- **Waste:** Bile pigments from RBC breakdown
- **Process:** Bile formation and secretion

3. Skin:

- **Waste:** Water, salts, small amounts of urea
- **Process:** Sweating

6. Integration of Life Processes

Interconnection of Life Processes

All life processes are interconnected and work together:

1. **Nutrition provides** raw materials for respiration
2. **Respiration provides** energy for all other processes
3. **Transportation system** supplies nutrients and removes wastes
4. **Excretion removes** toxic wastes that could harm the organism
5. **Control systems** coordinate all processes

Energy Flow in Living Organisms

Sun → Plants (Photosynthesis) → Herbivores → Carnivores

- Energy flows in one direction
- Each step involves energy loss as heat
- Maintaining energy balance is crucial for life

7. Important Points to Remember

1. **All life processes** require energy (ATP)
2. **Photosynthesis** is the foundation of life on Earth
3. **Respiration** releases energy stored in glucose
4. **Transportation** ensures distribution of materials
5. **Excretion** maintains chemical balance
6. **Aerobic respiration** is more efficient than anaerobic

7. **Double circulation** in humans ensures efficient oxygen supply
8. **Nephrons** are the functional units of kidneys
9. **Stomata** regulate gas exchange in plants
10. **Hemoglobin** is crucial for oxygen transport

8. Common Exam Questions

Short Answer Questions

- Define photosynthesis and write its equation
- What is the role of HCl in the stomach?
- How do plants excrete waste products?
- What is the function of hemoglobin?

Long Answer Questions

- Explain the process of digestion in humans
- Describe the mechanism of breathing
- How is water transported in plants?
- Explain the structure and function of nephron

Practical Questions

- Draw and label the human heart
- List factors affecting photosynthesis
- Compare aerobic and anaerobic respiration
- Explain the importance of transpiration

These comprehensive notes cover all essential topics in Life Processes for Class 10 Science. Focus on understanding the interconnections between different processes and their importance in maintaining life.