

EDUVISTA INFOGRAPHIC SMART NOTES

CLASS 10 NCERT SCIENCE — CHAPTER 5: LIFE PROCESSES

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1. WHAT ARE LIFE PROCESSES?

- **Definition:** All basic biological maintenance functions performed by living organisms to sustain life, growth, cellular repair, and prevent breakdown are called **Life Processes**.
- **Criteria for Life:**
 - Invisible molecular movement is the true defining characteristic of life.
 - Visible movement (running, breathing, visible growth) is NOT sufficient on its own (e.g., plants that aren't visibly growing are still alive).
- **Virus Controversy:** Viruses do not exhibit molecular movement until they infect a host cell \$ \rightarrow \$ positioned on the border of living and non-living.
- **Why Maintenance is Required:** Living structures are highly organized (tissues \$ \rightarrow \$ cells \$ \rightarrow \$ organelles \$ \rightarrow \$ molecules). Environmental action constantly breaks down this order. Molecular repair is mandatory to prevent death (entropy).

WHY IS DIFFUSION INSUFFICIENT IN MULTICELLULAR ORGANISMS?

In single-celled organisms (e.g., Amoeba), the entire cell surface is in direct contact with the environment. In multicellular organisms (e.g., Humans), most cells are not in direct contact with the surroundings. Simple diffusion is too slow to deliver oxygen to internal tissues (oxygen diffusion from lungs to human toes would take **3 years!**). Multicellular organisms require specialized respiratory, circulatory, and excretory systems.

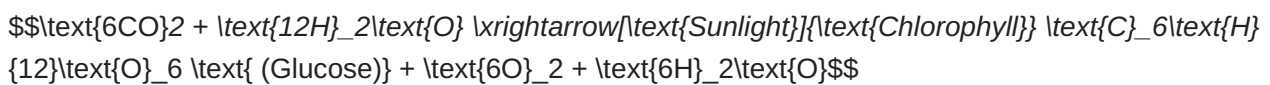
2. 4 ESSENTIAL LIFE PROCESSES

1. **Nutrition:** Intake & processing of external carbon-based energy sources (food) into uniform cellular energy.
 2. **Respiration:** Intake of O_2 to oxidize food molecules and release cellular energy (ATP).
 3. **Transportation:** Internal distribution system carrying nutrients, O_2 , and waste across body tissues.
 4. **Excretion:** Biological removal of toxic nitrogenous metabolic by-products (urea, uric acid) from the body.
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3. AUTOTROPHIC NUTRITION & PHOTOSYNTHESIS

Autotrophs (green plants, cyanobacteria) synthesize complex high-energy organic compounds (glucose) from simple inorganic materials (CO_2 , H_2O) using sunlight and chlorophyll.

- **Chemical Equation of Photosynthesis:**



MEMORY TRICK: 3 STEPS OF PHOTOSYNTHESIS (A-C-R)

1. **A — Absorption:** Chlorophyll absorbs solar light energy.
2. **C — Conversion & Splitting:** Conversion of light energy to chemical energy; splitting of water ($\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$).
3. **R — Reduction:** Reduction of CO_2 to carbohydrates (Glucose).

EXAM TIP (DESERT PLANTS): Desert plants open stomata **at night** to absorb CO_2 and store it as an intermediate compound. During daytime, sunlight is absorbed by chlorophyll to process this intermediate, preventing transpiration water loss during hot day hours.

- **Internal Energy Reserves:**

- Plants store unused glucose as **Starch**.
 - Humans/Animals store excess energy as **Glycogen**.
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4. STOMATA & GUARD CELL MECHANISM

- **Stomata:** Microscopic pores present on leaf surfaces (stems & roots too) for gaseous exchange (CO_2 / O_2).
 - **Guard Cells Mechanism:**
 - **Opening:** Water enters guard cells $\rightarrow$ Guard cells **swell** & curve $\rightarrow$ Stomatal pore OPENS.
 - **Closing:** Water exits guard cells $\rightarrow$ Guard cells **shrink** $\rightarrow$ Stomatal pore CLOSES.
 - **Plant Raw Materials:**
 - **CO_2 :** Absorbed from atmosphere via stomata.
 - **H_2O & Minerals (N, P, Fe, Mg):** Absorbed from soil by roots.
 - **Nitrogen:** Essential for protein synthesis; absorbed as inorganic nitrates/nitrites or organic bacterial compounds.
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5. NCERT MANDATORY PRACTICAL ACTIVITIES

Activity 5.1: Chlorophyll is Essential for Photosynthesis

- **Procedure:** Take variegated leaf plant (Money plant/Croton) $\rightarrow$ De-starch in dark (3 days) $\rightarrow$ Sunlight (6 hrs) $\rightarrow$ Boil leaf in water $\rightarrow$ Heat in alcohol water-bath (leaf de-colorizes) $\rightarrow$ Rinse & add Iodine solution.
- **Result:** Only the original green areas turn **blue-black** (starch present). Non-green areas show no color change.

Activity 5.2: CO_2 is Essential for Photosynthesis

- **Procedure:** Two de-starched potted plants in sealed bell jars. Jar A has **Potassium Hydroxide (KOH)** to absorb CO_2 . Jar B has no KOH . Keep in sunlight 2 hrs $\rightarrow$ Iodine test.
- **Result:** Leaf from Jar A shows NO starch (absence of CO_2). Leaf from Jar B turns blue-black.

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6. HETEROTROPHIC NUTRITION MODES

Mode	Mechanism	NCERT Examples
Saprotrophic	Break down food outside the body and absorb nutrients.	Fungi: Bread Moulds, Yeast, Mushrooms.
Holozoic	Ingest solid complex food, digest & absorb inside body .	Amoeba, Paramoecium, Humans, Animals.
Parasitic	Derive nourishment from host plant/animal without killing them .	Cuscuta (Amar-bel), Ticks, Lice, Leeches, Tapeworms.

Nutrition in Unicellular Organisms:

- **Amoeba:** Pseudopodia (temporary finger-like extensions) enclose food particle $\rightarrow$ Forms **Food Vacuole** $\rightarrow$ Enzymes digest complex food $\rightarrow$ Simple nutrients diffuse into cytoplasm $\rightarrow$ Undigested waste moved to surface & expelled.
- **Paramoecium:** Definite cell shape. Food is taken in at a specific spot by sweeping action of microscopic **Cilia** covering the cell.

7. HUMAN DIGESTIVE SYSTEM (PATHWAY & SECRETIONS)

MOUTH $\rightarrow$ OESOPHAGUS $\rightarrow$ STOMACH $\rightarrow$ SMALL INTESTINE $\rightarrow$ LARGE INTESTINE $\rightarrow$ ANUS

Mouth (Buccal Cavity)

- **Teeth:** Mastication & physical crushing.
- **Tongue:** Muscular mixing of food.
- **Salivary Glands:** Secretes **Saliva** containing enzyme **Salivary Amylase** (Ptyalin). $\text{Starch} \rightarrow \text{Salivary Amylase} \rightarrow \text{Maltose (Simple Sugar)}$

- **Peristalsis:** Rhythmic wave-like muscular contractions pushing food along the gut.
- **Activity 5.3:** Starch + Saliva + Iodine $\rightarrow$ No blue-black colour (Amylase digested starch).

Stomach Secretions (Gastric Glands)

- **Hydrochloric Acid (HCl):** Creates acidic medium ($\text{pH} \approx 1.5 - 2.0$), activates Pepsin, kills microbes.
- **Pepsin:** Protein-digesting enzyme (active only in acidic medium).
- **Mucus:** Protects inner stomach lining from acid corrosion.
- **Sphincter Muscle:** Regulates small releases of chyme into small intestine.

EXAM TIP (SMALL INTESTINE LENGTH):

- **Herbivores (Cow):** Have a **longer** small intestine to digest cellulose.
- **Carnivores (Tiger):** Have a **shorter** small intestine because meat is easily digested.

8. COMPLETE DIGESTION IN SMALL INTESTINE

The **Small Intestine** is the site of complete digestion of carbohydrates, proteins, and fats.

Organ / Gland	Secretion / Enzyme	Action & Final Product
Liver	Bile Juice	Neutralizes acidic stomach food to alkaline for pancreatic enzymes.
Liver	Bile Salts	Emulsification: Breaks large fat globules into small droplets.
Pancreas	Trypsin	Converts proteins & peptones into smaller peptides.
Pancreas	Lipase	Breaks down emulsified fats into fatty acids and glycerol.
Intestinal Glands	Intestinal Juice	Final Breakdown: • Proteins $\rightarrow$ Amino Acids • Carbohydrates $\rightarrow$ Glucose • Fats $\rightarrow$ Fatty Acids + Glycerol

ABSORPTION & ROLE OF VILLI

- **Villi:** Millions of microscopic finger-like projections in the small intestine inner wall.
- **Functions:** (1) Enormously increases surface area for absorption; (2) Richly supplied with blood vessels to deliver nutrients to body cells.

LARGE INTESTINE & DENTAL CARIES

- **Large Intestine:** Reabsorbs excess water from unabsorbed food. Waste eliminated via **Anus** (regulated by anal sphincter).
- **Dental Caries:** Bacterial plaque on teeth converts sugars into acid $\rightarrow$ demineralizes enamel & dentine. Brushing removes plaque before acid production.

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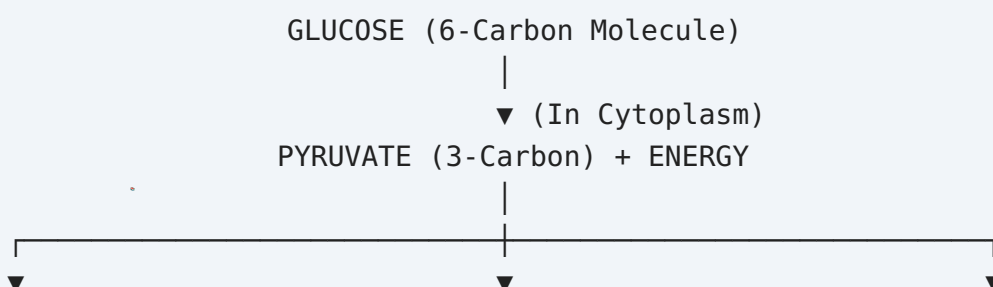
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9. RESPIRATION & EXHALED AIR TESTING

- **Respiration:** Cellular process of oxidizing food (glucose) to release energy in the form of ATP .
- **Activity 5.4 (CO_2 in Exhaled Air):** Exhaled air turns lime water milky much faster than air pumped by a pichkari $\rightarrow$ Exhaled air contains higher CO_2 concentration.
- **Activity 5.5 (Yeast Fermentation):** Sugar solution + Yeast produces CO_2 (turns lime water milky) and ethanol.

10. BREAKDOWN PATHWAYS OF GLUCOSE



(1) ABSENCE OF O_2
(Yeast Fermentation)



Ethanol (2C) + CO_2 + Energy
(2 ATP)

(2) LACK OF O_2
(Human Muscle Cells)



Lactic Acid (3C) + Energy
(Causes Cramps!)

(3) PRESENCE OF O_2
(In Mitochondria)



3 CO_2 + 6 H_2O +
(38 ATP)

CAUSE OF MUSCLE CRAMPS

During sudden strenuous exercise, oxygen supply to muscle cells becomes deficient. Pyruvate undergoes anaerobic conversion into **Lactic Acid (3-Carbon)**. Build-up of lactic acid causes severe muscle cramps.

MEMORY TRICK: ATP — CELLULAR ENERGY CURRENCY

- Respiration energy synthesizes ATP from $\text{ADP} + \text{P}_i$.
- Hydrolysis of terminal phosphate bond using water releases **30.5 kJ/mol** of energy.
- Drives muscle contraction, nerve impulses, and protein synthesis.

11. RESPIRATION IN PLANTS, AQUATIC & TERRESTRIAL ANIMALS

- **Plants:** Gas exchange via stomata. Night $\rightarrow CO_2$ elimination is major event; Day $\rightarrow O_2$ release is major event.
- **Aquatic Animals (Fish):** Dissolved O_2 in water is low $\rightarrow$ **Breathing rate is MUCH FASTER** than terrestrial animals. Fish gulp water in mouth and force it past **gills**.
- **Terrestrial Animals:** Utilize atmospheric oxygen ($\approx 21\%$), resulting in slower, efficient breathing via lungs.

12. HUMAN RESPIRATORY SYSTEM

NOSTRILS $\rightarrow$ PHARYNX / TRACHEA $\rightarrow$ BRONCHI $\rightarrow$ BRONCHIOLES $\rightarrow$ ALVEOLI

- **Nostrils:** Filter air using fine hair and mucus.
- **Rings of Cartilage:** Present in trachea/throat to prevent air passage collapse when pressure drops.
- **Alveoli:** Thin-walled balloon-like sacs providing **$\approx 80 \text{ m}^2$** surface area (size of tennis court!) wrapped in blood capillaries.
- **Breathing Mechanism:**

- **Inhalation:** Ribs lifted + Diaphragm flattened $\rightarrow$ Chest cavity expands $\rightarrow$ Air sucked into alveoli.
- **Exhalation:** Ribs lower + Diaphragm dome-shaped $\rightarrow$ Chest cavity shrinks $\rightarrow$ Air pushed out.
- **Residual Volume:** Lungs always retain residual volume of air for continuous O_2 absorption and CO_2 release.
- **Haemoglobin:** Respiratory pigment in RBCs with high affinity for O_2 .
- **Health Warning:** Smoking destroys cilia (hair-like structures sweeping germs/dust) leading to lung cancer. Tobacco causes high incidence of oral cancer.

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13. HUMAN CIRCULATORY SYSTEM & HEART

Blood Components:

1. **Plasma:** Fluid medium transporting food, CO_2 , and nitrogenous wastes.
2. **RBCs:** Contain Haemoglobin for O_2 transport.
3. **Platelets:** Cell fragments that clot blood at injury sites, plugging leaks to preserve pumping pressure.

Human Heart Architecture (4 Chambers):

- **Atria (Left & Right):** Upper thin-walled receiving chambers.
- **Ventricles (Left & Right):** Lower thick muscular-walled pumping chambers.
- **Valves:** Prevent backflow of blood.

14. BLOOD FLOW PATHWAY & DOUBLE CIRCULATION

[OXYGENATED] Lungs → Pulmonary Vein → Left Atrium → Left Ventricle → Aorta → Body Organs

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[DEOXYGENATED] Body Organs → Vena Cava → Right Atrium → Right Ventricle → Pulmonary Artery → Lungs

VERTEBRATE HEART CHAMBER COMPARISON

- **4 Chambers (Mammals & Birds):** Complete separation of blood streams → highly efficient O_2 supply to maintain constant body temperature (Endotherms).
- **3 Chambers (Amphibians & Reptiles):** Tolerates some mixing of blood; body temp depends on environment (Ectotherms).
- **2 Chambers (Fish):** Single circulation (Heart → Gills → Body → Heart).

15. BLOOD VESSELS, BLOOD PRESSURE & LYMPH

Property	Arteries	Veins	Capillaries
Direction	Away from heart to organs	From organs back to heart	Connects arterioles to venules
Wall	Thick, elastic muscular walls	Thin walls	One-cell thick wall
Valves & Pressure	High pressure; NO valves	Low pressure; HAS valves	Exchange site across thin wall

- **Blood Pressure:** Measured using **Sphygmomanometer**. Normal: **120 mm Hg (Systolic) / 80 mm Hg (Diastolic)**. High BP (Hypertension) causes arteriole constriction & potential rupture.
- **Lymph (Tissue Fluid):** Fluid escaped from capillaries into intercellular spaces. Colourless, less protein than plasma. Carries digested fat from intestine & drains excess fluid back to blood.

16. TRANSPORTATION IN PLANTS (XYLEM VS PHLOEM)

Feature	Xylem (Water & Minerals)	Phloem (Translocation of Food)
Substances	Water and mineral salts	Photosynthetic products (Sucrose), amino acids
Direction	Unidirectional (Only Upward)	Bidirectional (Upward & Downward)
Driving Force	• Root Pressure: Active ion uptake (Night) • Transpiration Pull: Leaf evaporation suction (Day)	Active process utilizing ATP energy to increase osmotic pressure

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17. EXCRETION IN HUMANS & EXCRETORY ORGANS

Excretion is the biological removal of harmful nitrogenous metabolic wastes (urea, uric acid) from the body.

Excretory Organs:

1. **Pair of Kidneys:** Located in abdomen on either side of backbone. Filter blood & produce urine.
2. **Pair of Ureters:** Tubes carrying urine from kidneys to bladder.
3. **Urinary Bladder:** Muscular storage reservoir under **nervous control**.

4.  **Urethra:** Channel for expelling urine.
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18. NEPHRON STRUCTURE & URINE FORMATION

The **Nephron** is the microscopic structural & functional filtration unit of the kidney.

Structure:

- **Glomerulus:** High-pressure capillary cluster.
- **Bowman's Capsule:** Cup-shaped tube end collecting filtrate.
- **Tubular Part:** Long coiled tube for selective reabsorption.

3 Steps of Urine Formation:

1. **Glomerular Filtration:** Nitrogenous wastes, glucose, amino acids, salts, water filtered into Bowman's capsule.
2. **Selective Reabsorption:** Essential substances (glucose, amino acids, salts, water) reabsorbed back into blood capillaries.
3. **Tubular Secretion & Collection:** Urine enters collecting duct $\rightarrow$ Ureter.

INITIAL FILTRATE VS EXCRETED URINE:

- Initial filtrate produced daily = **180 Litres / day**.
- Excreted urine volume daily = **1 to 2 Litres / day**.

Reason: 99% of initial filtrate is **selectively reabsorbed** in nephron tubules!

19. ARTIFICIAL KIDNEY & PLANT EXCRETION

Artificial Kidney (Hemodialysis):

- Device used during kidney failure. Contains semi-permeable tubes in dialysing fluid.
- Dialysing fluid has same osmotic pressure as blood but **devoid of nitrogenous wastes**.
- Waste diffuses out. **Key Difference:** Hemodialysis involves **NO selective reabsorption**.

Excretion in Plants (All 5 NCERT Methods):

1. **Gaseous Wastes:** O_2 and CO_2 via **Stomata**.
2. **Excess Water:** Expelled via **Transpiration**.
3. **Vacuolar Storage:** Wastes stored in central **cellular vacuoles**.
4. **Falling Leaves & Old Xylem:** Wastes stored in leaves that **fall off**; stored as **resins and gums** in old xylem.

5. **Soil Excretion:** Excreted directly into soil surrounding roots.

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20. MASTER NCERT COMPARISON TABLES

Aerobic vs Anaerobic Respiration

Basis	Aerobic Respiration	Anaerobic Respiration
Oxygen	Requires O_2	Absence or lack of O_2
Location	Cytoplasm & Mitochondria	Cytoplasm only
End Products	$\text{CO}_2 + \text{H}_2\text{O}$	Ethanol/Lactic Acid + CO_2
Energy Yield	High (38 ATP)	Low (2 ATP)

Alveoli vs Nephron Comparison

Feature	Alveoli (Lungs)	Nephron (Kidneys)
System	Respiratory System	Excretory System
Function	Gas Exchange (O_2 / CO_2)	Nitrogenous Waste Filtration
Structure	Balloon-like capillary-wrapped sacs	Coiled tubule with Bowman's capsule
Reabsorption	No reabsorption step	Selective Reabsorption occurs

21. HIGH-YIELD BOARD EXAM QUESTIONS WITH ANSWERS

Q1: How are fats digested in our body? Where does this process take place? (3 Marks)

- **Answer:** Fat digestion occurs in the **Small Intestine**.
- **Emulsification:** Bile salts from liver break large fat globules into small droplets.
- **Enzymatic Action:** Pancreatic **Lipase** converts emulsified fats into fatty acids and glycerol.
- **Final Action:** Intestinal juice enzymes complete conversion into Fatty Acids and Glycerol.

Q2: Describe double circulation in human beings. Why is it necessary? (3 Marks)

- **Answer:** Blood passes through the heart **twice** during each complete body cycle (Pulmonary + Systemic circulation).
 - **Necessity:** Prevents mixing of oxygenated and deoxygenated blood, maintaining high oxygenation efficiency required by warm-blooded animals (birds and mammals) to regulate body temperature.
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22. 2-MINUTE REVISION CHECKLIST

- ✓ **Life Processes:** Nutrition, Respiration, Transportation, Excretion.
- ✓ **Photosynthesis:** $6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow{\text{Sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$ {Chlorophyll}
- ✓ **Energy Storage:** Plants = Starch | Humans = Glycogen.
- ✓ **Stomach Juices:** HCl (acidic medium), Pepsin (protein digestion), Mucus (lining protection).
- ✓ **Glucose Pathways:** Yeast (Ethanol + 2 ATP), Muscle (Lactic acid / cramps), Mitochondria ($\text{CO}_2 + \text{H}_2\text{O} + 38\text{ATP}$).
- ✓ **ATP Yield:** Hydrolysis releases 30.5 kJ/mol .
- ✓ **Alveoli Surface Area:** $\approx 80\text{ m}^2$ for gas exchange.
- ✓ **Blood Pressure:** Normal Systolic 120 mm Hg / Diastolic 80 mm Hg (Sphygmomanometer).
- ✓ **Plant Conductors:** Xylem (Water/Transpiration pull) | Phloem (Food translocation via ATP).
- ✓ **Nephron Filtration:** 180 L initial filtrate $\rightarrow 1-2\text{ L}$ urine daily (99% selective reabsorption).

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