
Q. No. 2

- a. Describe the structure of universe according to big bang theory.
- b. Define urinary system & explain the working of nephron.
- c. What is Un-balanced diet? How it affects the healthy living?
- d. Describe the structure and functions of cell wall, cell membrane, cytoplasm and mitochondria.

Q. No. 3

- a. How global warming can be reversed?

(a) Structure of Universe according to Big Bang Theory

This theory was proposed by George Lemaitre and advocated by George Gamow. It explains that the universe began about **13.8 billion years ago** from a singularity. It was created in **gigantic explosion** called big bang and has since expanded into vast cosmos of galaxies, stars and planets we see today. Its structure is shaped by expansion, cooling and formation of matter, supported by strong scientific evidence such as cosmic microwave background radiation and galactic distribution.

→ Origin of Universe: The universe started as a singularity: a point of infinite density and temperature. Within a fraction of second, rapid inflation occurred, expanding space itself. As T.S Eliot once wrote: "In my beginning is my end" — the cosmos began from nothingness into everything.

→ Expansion and Cooling: Over 13.8 billion years, the universe expanded and cooled. Subatomic particles formed, followed by

atoms, leading to stars and galaxies.

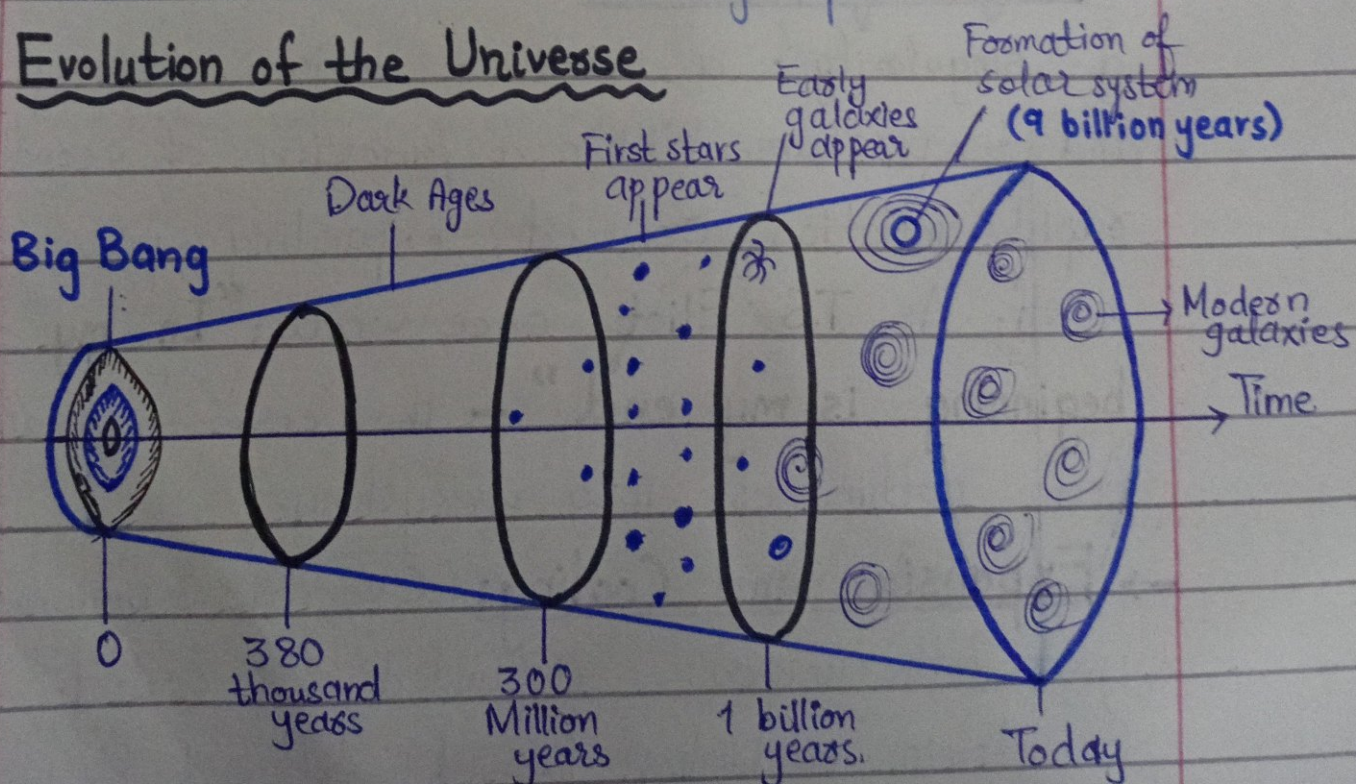
- Edwin Hubble's 1929 observation of red-shift in galaxies proved the universe is expanding.

→ Formation of Structures: Galaxies and clusters emerged due to gravitational attraction. The universe today consists of visible matter (5%), dark matter (27%) and dark energy (68%). As Carl Sagan poetically said: "We are made of star stuff."

→ Case Study: Hubble Space Telescope:

The Hubble telescope provided deep-field images showing billions of galaxies, reinforcing the vastness and structured expansion of universe. These observations confirm that galaxies are not static but moving apart.

→ Evolution of the Universe



→ Conclusion:-

The Big Bang Theory provides the most accepted explanation of the universe's structure, from its fiery birth to its ever-expanding present. Supported by evidence like cosmic microwave background radiation, galactic redshift and elemental abundance, it reveals a cosmos governed by relativity and expansion. As Shakespeare wrote, "What a piece of work is man!", yet humanity itself is but a fragment of this grand cosmic design. The universe, vast and mysterious, continues to expand, reminding us of our small but significant place within it.

(b) Urinary System and Working of Nephron.

→ Urinary System:-

The urinary system is the body's excretory mechanism responsible for removing nitrogenous wastes, maintaining water balance and regulating blood pressure.

- It consists of kidneys, ureters, urinary bladder and urethra.
- As Hippocrates said: "The natural forces within us are the true healers of disease." The urinary system embodies

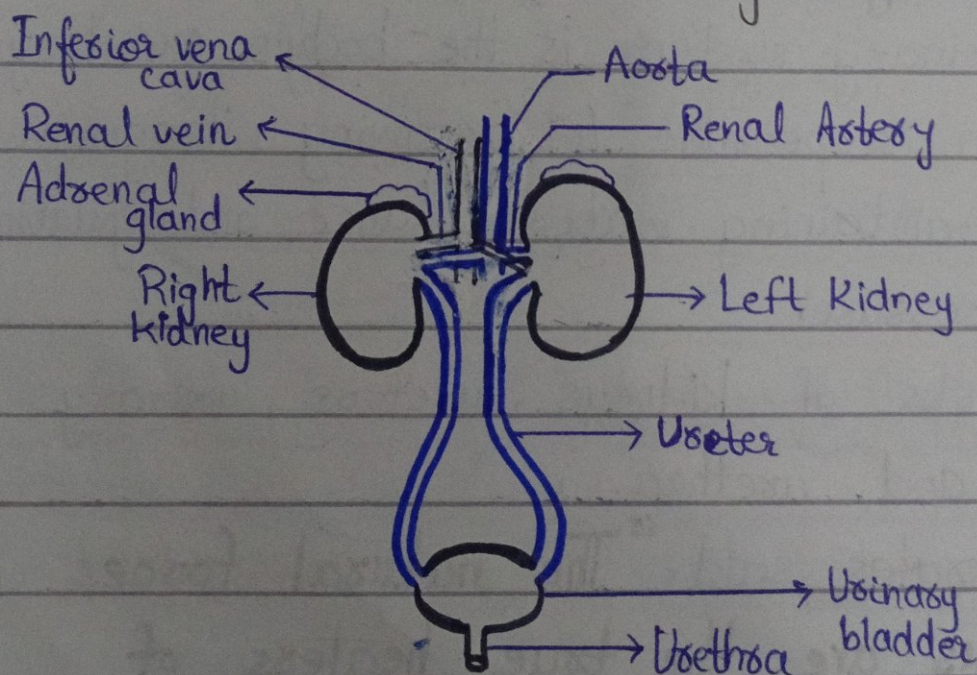
this healing force by cleaning the blood.

- A pair of kidney is present in the body for excretion of metabolic waste products. They are attached to the dorsal body wall, on either side of vertebral column.
- 20% of the blood during each heart beat is supplied to each kidney.
- Each kidney consists of about 2 million tiny tubes called nephrons.

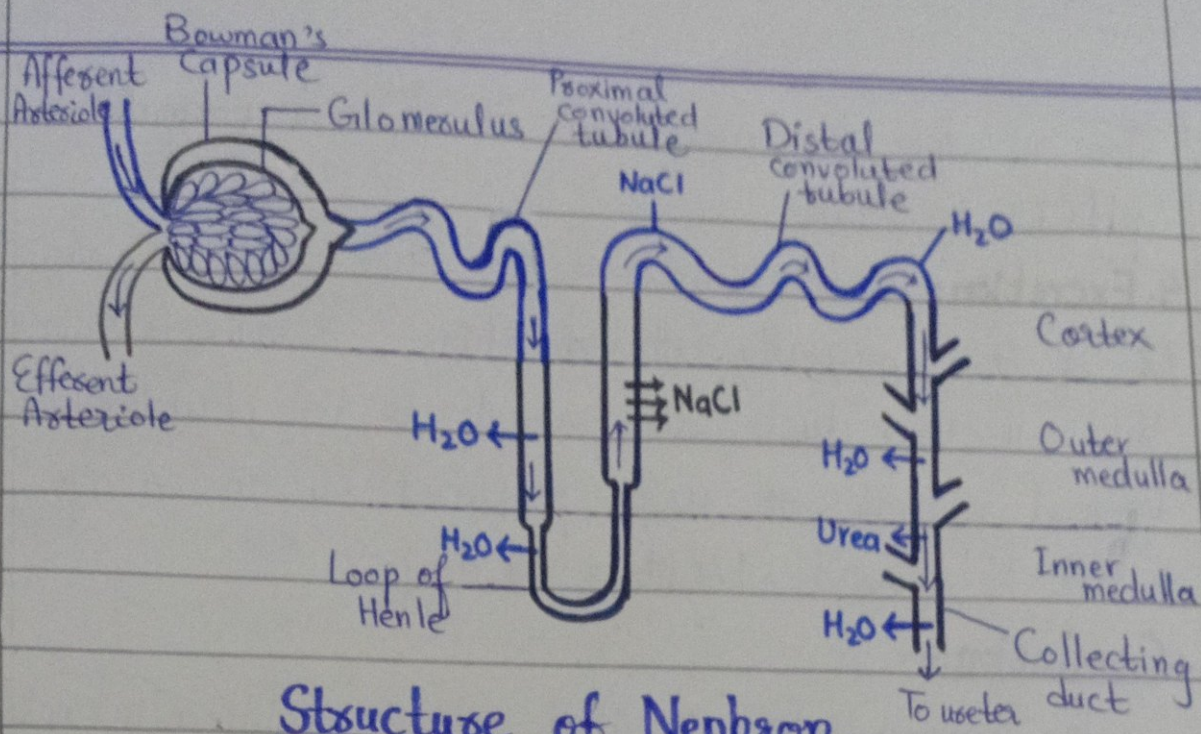
→ Structure of Nephron:-

Nephron is the basic structural and functional unit of kidney. Nephrons are arranged along the both cortex and medulla regions.

It consists of Bowman's capsule, glomerulus, proximal convoluted tubule, loop of Henle, distal convoluted tubule and collecting duct.



Urinary System



Structure of Nephron

→ Working of Nephron

- 1. Filtration:** Blood containing waste products enters glomerulus. Due to high blood pressure and porous walls of the glomerulus, blood is filtered here. Blood cells and proteins remain in the Glomerulus while glucose, urea, uric acid, water and some salts are filtered here. That filtrate enters into Bowman's Capsule, and ^{is now called} Glomerular filtrate.
- 2. Reabsorption:** All the useful constituents of the filtrate like glucose, salts, amino acids and water are reabsorbed in the proximal convoluted tubule and Loop of Henle by peritubular capillaries which are surrounding these parts.
- 3. Secretion:** Different ions like hydrogen ions and drugs, creatinine, urea etc. are secreted from blood into the filtrate in renal tubule.

This is done to maintain blood at a normal pH (7.35 to 7.45).

4. Excretion: In the final step, urine that is only 1% of the originally filtered volume, is collected in the collecting duct and passed to the bladder. The typical volume of urine produced by an average adult is around 1.4 litres per day.

→ Conclusion:-

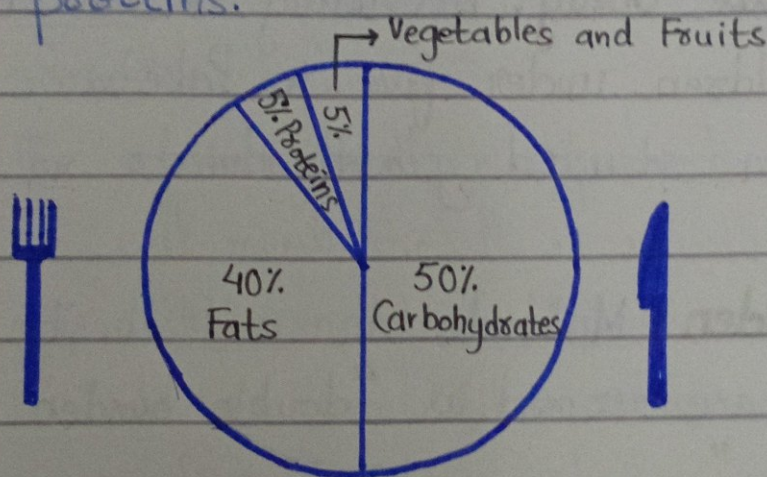
The urinary system is vital for maintaining internal balance by eliminating wastes and conserving essential nutrients. The Nephron, its microscopic architect, performs filtration, reabsorption and secretion with precision. Supported by medical evidences, it proves indispensable to human survival.

(C) Unbalanced Diet and its Effects on Healthy Living

→ Unbalanced Diet: An unbalanced diet is the one that lacks proper proportions of carbohydrates, proteins, fats, vitamins and minerals.

- It either provides excess calories or deficiency of essential nutrients, disturbing the body's equilibrium.
- **Nutritional Deficiencies:** Not getting enough iron, calcium, vitamins (like Vit-D or B-12), or minerals, causing conditions like anemia or weakened bones.

- **Nutritional Excesses:** Consuming too much calories, unhealthy fats, sugar or salt, often from processed foods, increasing risks for heart disease, obesity and diabetes.
- **Monotonous Eating:** Eating a very limited range of foods, missing out on diverse nutrients, even if calorie intake seems sufficient.
- **Wrong Food Choices:** A regular diet dominated by Chips, cookies or fast food instead of whole grains, fruits, vegetables and lean proteins.



Pie Chart Showing Imbalanced Diet → Effects on Healthy Living

- **Malnutrition:** Leads to stunted growth, weakness and poor immunity.
- **Chronic Diseases:** Excess saturated fats, sugars and salts cause weight gain

(obesity), type 2 diabetes and heart diseases.

- **Nutritional Deficiencies:** Lack of vitamins & minerals causes rickets (Vitamin D deficiency), scurvy (Vitamin C deficiency), anemia (Iron deficiency).
- **Mental Health Impact:** Poor nutrition affects concentration, mood and productivity.

→ Case Studies and Evidences:-

- **WHO Report:** Nearly 2 billion people worldwide suffer from micronutrient deficiencies, while over 650 million adults are obese.
- **Pakistan Case Study:** According to UNICEF, 40% of children under five in Pakistan suffer from stunted growth due to poor diet.
- **Global Burden:** Malnutrition and obesity together are termed as "double burden of disease."

→ Conclusion:-

An unbalanced diet is a silent enemy of healthy living leading to malnutrition, obesity and chronic diseases. On the other hand, balanced diet is the corner stone of physical

and mental well-being.

(d) Structure and functions of Cell Wall, Cell Membrane, Cytoplasm and Mitochondria

Cell Wall

The cells of bacteria, fungi, plants and some protists (algae) have a rigid, non-living wall around cell membrane. It is called cell wall.

→ Structure of Cell Wall

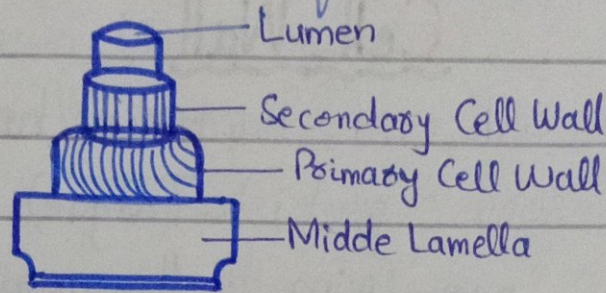
The plant cell wall consists of three layers i.e., middle lamella, primary wall and secondary wall.

- The primary wall is present just above the cell membrane. It is mainly composed of cellulose, hemicellulose, and pectin. Cellulose forms fibres that crisscross over one another to form strong primary wall.
- Middle Lamella holds together the primary walls of adjacent cells. It contains magnesium, calcium and pectin.
- Some plant cells e.g., Xylem cells make secondary wall on the inner side of primary wall. It is mainly made of cellulose, lignin and

other chemicals.

The cell wall of algae is composed of cellulose. The cell wall of prokaryotes is made of peptidoglycan. The cell wall of fungi is made of chitin.

- Cell wall is absent in animal cells.



~ Diagram of Plant Cell Wall ~

→ Functions of Cell Wall:-

- Structural Support and Shape: It provides rigidity, strength and a definite shape to cells, preventing them from collapsing.
- Protection: It acts as a ^{robust} barrier against physical damage, harsh chemicals and invading pathogens like microbes.
- Osmotic Regulation: Cell wall resists internal water pressure (turgor pressure), stopping the cell from swelling and bursting (lysis) in hypotonic environments.
- Transport: Cell wall contains pores (like plasmodesmata in plants), allowing controlled movement of water, minerals and nutrients in and out of cell.

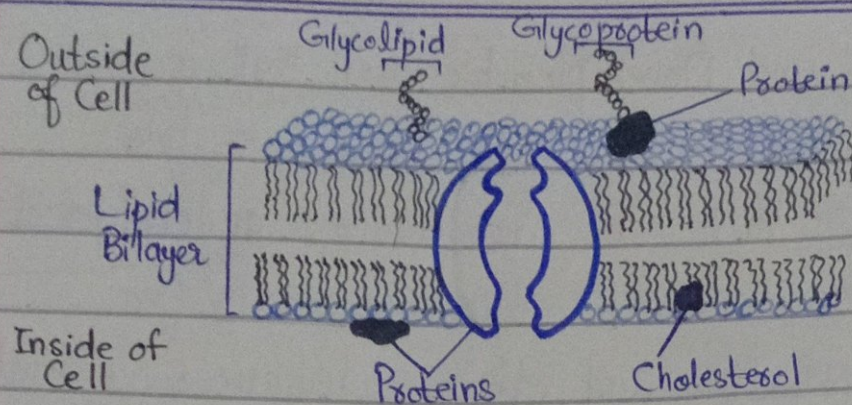
- **Growth and Development:** Cell wall regulates cell expansion and growth and can store regulatory molecules for defense or development.
- **Storage:** It serves as a reservoir for carbohydrates and other substances needed for growth.

Cell Membrane

All cells have a thin and elastic cell membrane around the cytoplasm. It is selectively-permeable as it allows very few molecules to pass through it while blocks many other molecules.

→ Structure of Cell Membrane

Cell membrane is composed of ^(60-80%) proteins and ^(20-40%) lipids and small quantities of carbohydrates. The structure of cell membrane is described as fluid-mosaic model. According to this model, the phospholipids make a fluid-like bilayer in which protein molecules are embedded. The lipids and proteins can move laterally. Due to these movements, the pattern or "mosaic" of lipids and proteins constantly changes. Carbohydrates are joined with proteins (in the form of glycoproteins) or with lipids (in form of glycolipids).



~The Fluid-Mosaic Model of Cell Membrane~

→ Function of Cell Membrane:-

- **Barrier and Protection:** Cell Membrane separates the cell's internal environment from the outside world, protecting it from damage.
- **Selective Transport:** It regulates the flow of ions, nutrients and waste in and out via diffusion, osmosis and active transport.
- **Cell Signaling and Communication:** Cell membrane contain receptors to receive chemical signals (hormones, neurotransmitters) and communicate with other cells.
- **Cell Recognition:** Carbohydrates on the surface of plasma membrane help identify the cell type (e.g. for the immune system).
- **Cell Adhesion:** It helps cell stick together to form tissues.
- **Structural Support:** It interacts with the cytoskeleton to help maintain cell shape and movement.

Cytoplasm

Cytoplasm is the semi-fluid jelly-like substance that fills the inside of cell. It is sometimes described as non-nuclear content of the protoplasm.

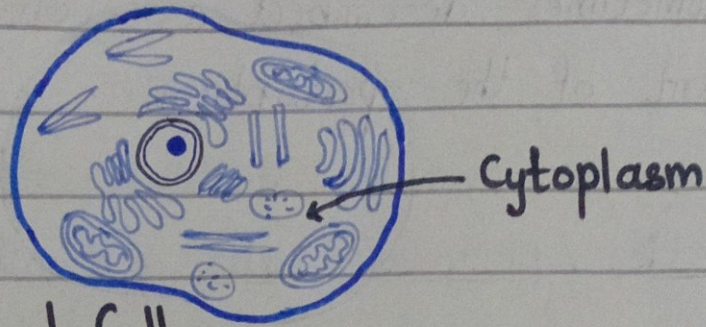
- It is a complex mixture of water, proteins, enzymes, salts and other substances.
- In a prokaryotic organism, all the cellular contents are contained within cell's cytoplasm.
- In eukaryotic organisms, the nucleus of the cell is separated from the cytoplasm.
- The cytoplasm is made of 70%-90% water and is colorless usually.
- Many of cellular activities occur in cytoplasm.

→ Structure/Composition of Cytoplasm

- The outer clear and glassy layer of the cytoplasm is called the ectoplasm or cell cortex and the inner granular mass is called endoplasm.
- Cytosol is a liquid part of the cytoplasm that includes molecules and small particles, such as ribosomes, but not membrane-bound organelles.

Cytosol is further divided into two parts:

- Sol is the non-viscous, true solution.
- Gel is the viscous, colloidal solution.



Animal Cell

→ Functions of Cytoplasm

- Structural Support and Shape:** The cytoskeleton within the cytoplasm maintains cell shape, facilitates movement and provides internal structure, preventing it from collapsing.
- Site for Metabolic Reactions:** It is the location for vital processes including glycolysis (energy production) and building proteins (translation) that are crucial for maintaining life.
- Transport:** Cytoplasmic streaming moves organelles, nutrients and waste throughout the cell.
- Storage:** Cytoplasm stores water, nutrients, enzymes, and other molecules needed for cell functions.
- Protection:** Cytoplasm acts as a cushion, protecting organelles and nucleus from damage.

and shock,

(vi) Medium for organelles: Cytoplasm suspends and houses organelles (except the nucleus) in a gel-like substance (cytosol).

Mitochondria

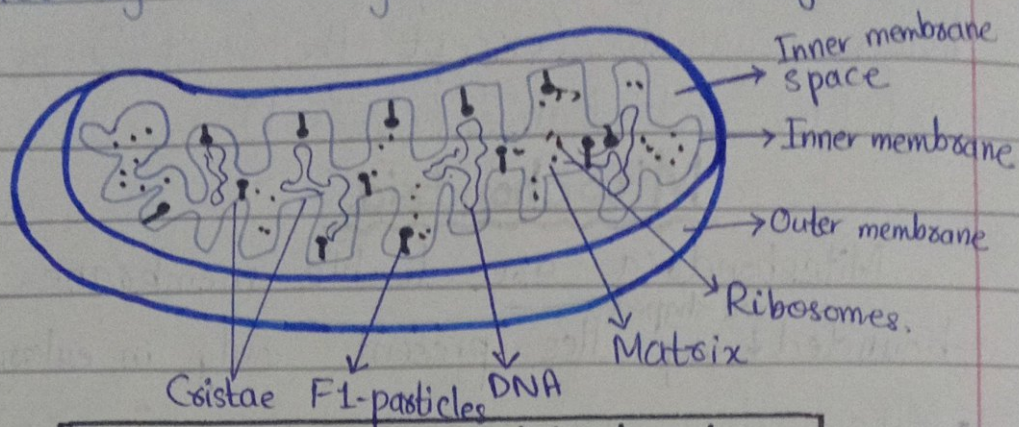
Mitochondria are double membrane-
bounded ^{rod-shaped} organelles present only in eukaryotes.

- Mitochondria are also known as "powerhouse of the cell" because they generate energy.
- Their number is different in different cells, depending upon the nature of the cell.

→ Structure of Mitochondria

- They have two membranes; The outer membrane is smooth while inner membrane forms many finger-like foldings called Cristae. They increase the surface area for respiration.
- The inner fluid-like material is called matrix.
- Mitochondria contain their own DNA and ribosomes. They are self-replicating bodies.
- Mitochondrial DNA is maternally inherited, used in forensic science and ancestry studies.
- The inner surface of the cristae has knob-like extensions into the matrix.

known as F-1 particles. These particles are actually the enzymes called ATP-synthase.



Structure of a Mitochondrion

→ Key Functions of Mitochondria

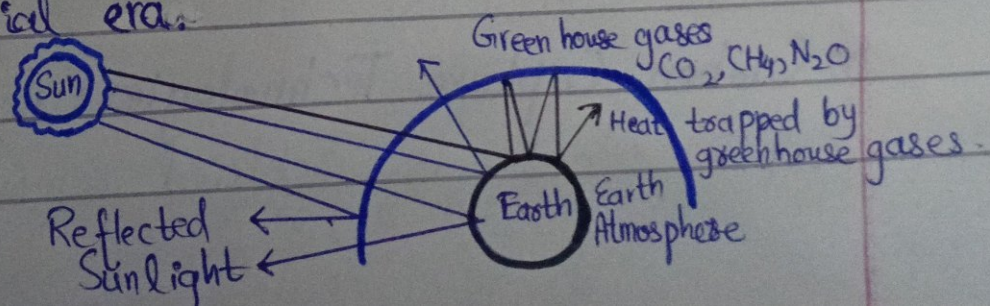
- (i) **Energy Production (ATP Synthesis):** It produces energy (ATP) through cellular respiration. It converts nutrients (carbs, fats, proteins) into usable energy (ATP) through oxidative phosphorylation, powering cellular activities.
- (ii) **Calcium Homeostasis:** It stores and releases calcium ions, crucial for cell signaling, muscle contraction, and nerve impulses.
- (iii) **Apoptosis (Programmed Cell Death):** It initiates and regulates the controlled death of damaged or old cells, preventing harmful buildup.
- (iv) **Thermogenesis (Heat Generation):** It produces heat, especially in brown fat to maintain body temperature.
- (v) **Cell Signaling & Growth:** It is involved in

- communication between cells, regulating cell cycle, growth and differentiation.
- (vi) Detoxification: It helps detoxify ammonia in liver cells.
- (vii) Cellular Respiration: It is the site for Krebs cycle and electron transport chain to generate ATP.

⇒ Q.no. 3:-

(a) **Answer:** Global warming can be reversed through a combination of reducing greenhouse gas emissions, adopting renewable energy, protecting forests and transforming agriculture. Evidence shows that coordinated global action can achieve "drawdown", the point where greenhouse gas levels begins to decline.

→ **Global Warming** refers to long-term rise in Earth's average temperature due to human activities, especially burning fossil fuels. According to the **UN**, the Earth is now **1.42°C** warmer than the pre-industrial era.



→ Major Strategies to Reverse Global Warming

As Paul Hawken rightly said, "We cannot call climate change a problem—it is a reality. The problem is our response."

(i) **Renewable Energy Transition:** Shifting from coal, oil, and gas to solar, wind and hydro power. Project drawdown estimates the renewable energy could cut 1051 gigatons of CO_2 by 2050.

(ii) **Energy Efficiency:** Improving building insulation, efficient appliances and smart grids reduces unnecessary emissions.

(iii) **Reforestation and Afforestation:** Forests can act as carbon sinks.

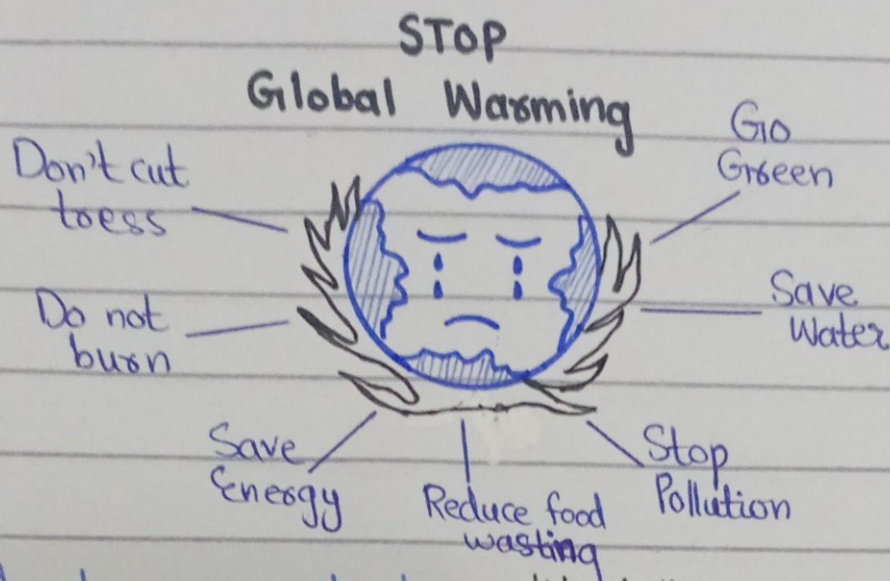
• **Case Study:** Pakistan's Billion Tree Tsunami Project restored 350,000 hectares of forest, absorbing millions of tons of CO_2 .

(iv) **Sustainable Agriculture:** Practices like regenerative farming and reduced food waste can lower methane and nitrous oxide emissions.

(v) **Carbon Capture Technologies:** Direct air capture plants in Iceland remove thousands

of tons of CO_2 annually.

(iv) **Lifestyle Changes:** Reduced meat consumption, electric vehicles and circular economy practices also help reverse global warming.



As it is said by Wendell Berry:

“The Earth is what we all have in common.”

→ **Conclusion:** Reversing global warming is not impossible but requires collective will, technological innovation, and behavioral change. Thus, through renewable energy, reforestation and global cooperation, humanity can move from crisis to recovery and secure a livable planet for future generations.
