

CLASS 9

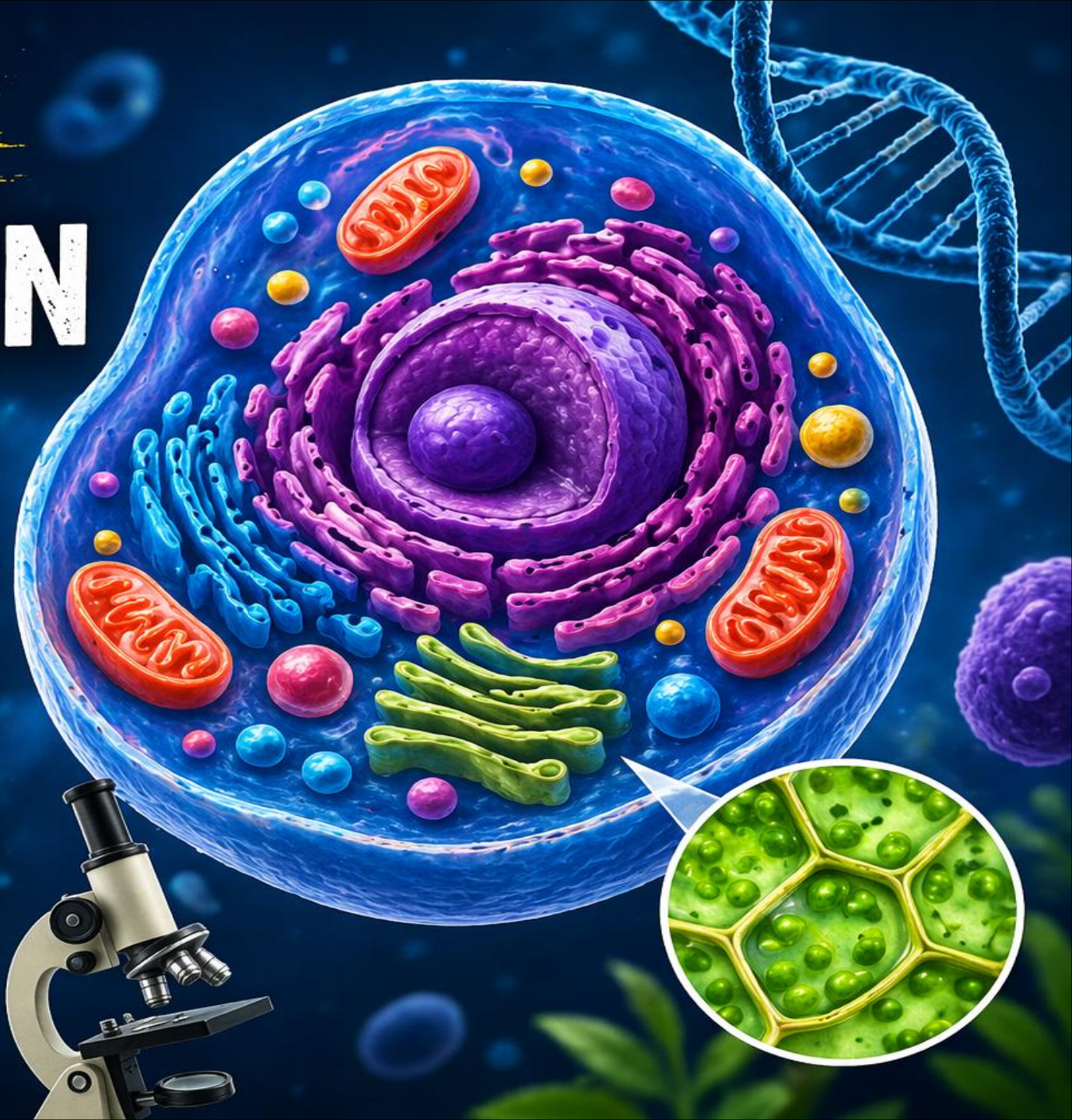
EXPLORATION

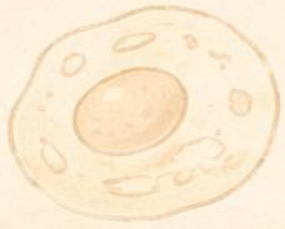


CHAPTER 2 -

CELL:

THE BUILDING BLOCK OF LIFE





?

THINK IT OVER



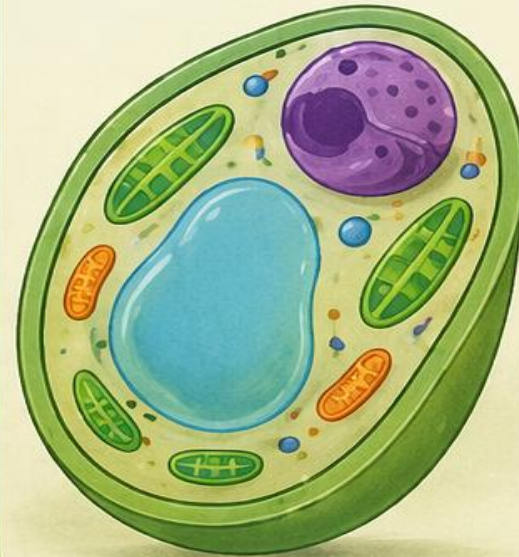
- Where does a cell come from?



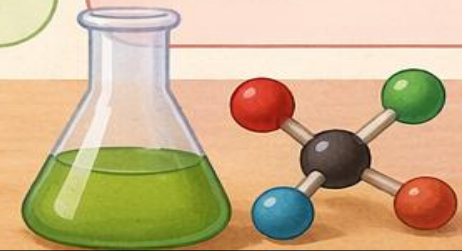
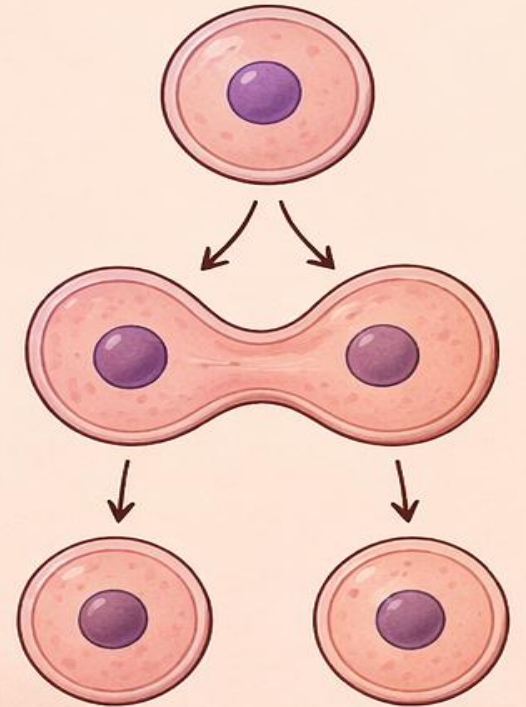
- How have technological interventions facilitated the creation of new knowledge in understanding the world beyond the naked eye?



- How is the cell structural and functional unit of life?



- How does a cell multiply?



ORIGIN OF LIFE



ORIGIN OF LIFE

- Life is believed to have started in water
- Some scientists suggest small water pools
- Changing conditions supported early life



SPECIAL ENVIRONMENTS

- Hot springs are ideal for early life
- Example: Puga Valley, Ladakh
- Very high temperature conditions



EARLY EARTH CONDITIONS

- Conditions similar to early Earth
- Around 3.5 billion years ago
- Extreme environment supported survival



THERMOPHILES

- Heat-loving bacteria
- Found in hot springs
- Unicellular organisms



Early life may have begun in hot springs where tiny organisms survived and evolved.



FROM HOT SPRINGS TO FIRST CELLS



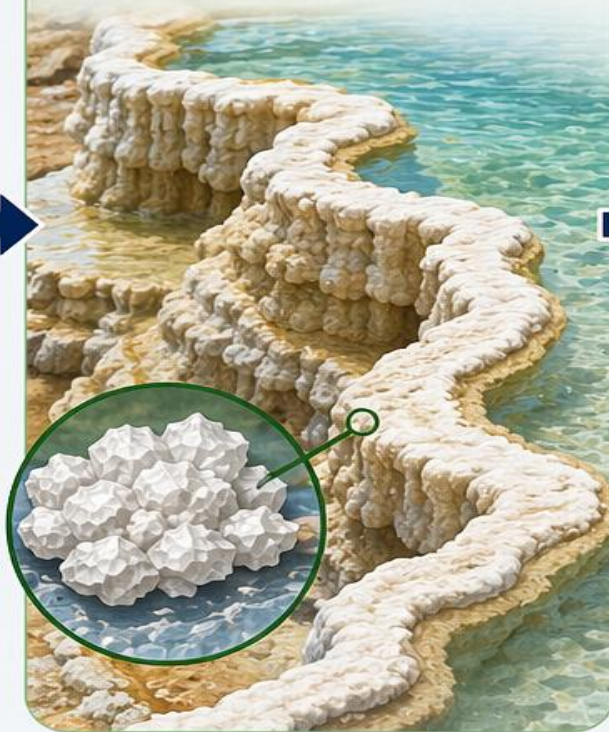
SCIENTIFIC STUDY

- Studied by Birbal Sahni Institute, Lucknow
- Research done on hot springs



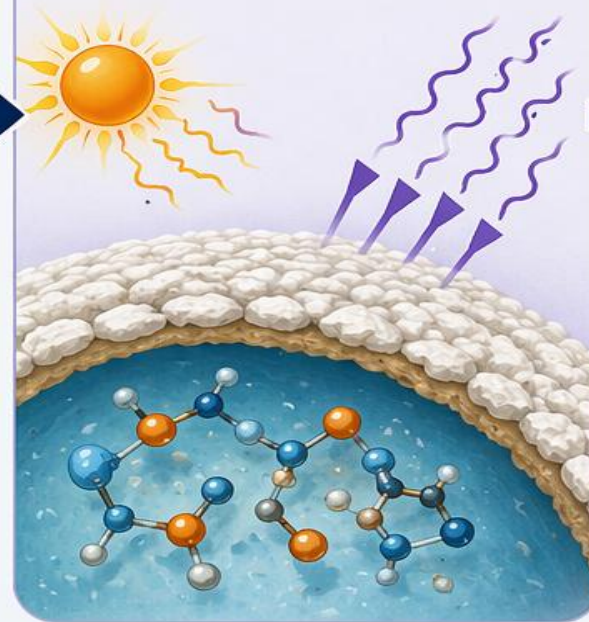
CALCIUM CARBONATE DEPOSITS

- Formed rapidly around hot springs
- Created protective layers



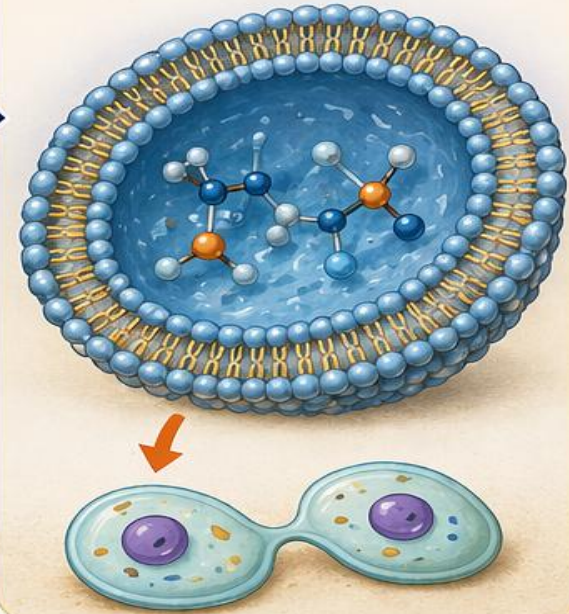
PROTECTION OF MOLECULES

- Protected early organic molecules
- Shielded from harmful radiation
- Helped survive extreme conditions



FORMATION OF CELL MEMBRANE

- Deposits helped form first membrane
- Membrane acts as protective barrier
- Led to formation of first cells



KEY IDEA: Hot springs provided the right environment for life to begin. Natural deposits protected molecules and helped form the first cellular membrane.

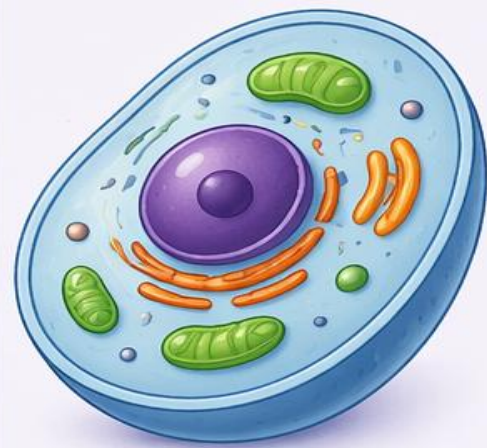


FROM CELLS TO ORGAN SYSTEMS

THE AMAZING ORGANISATION OF LIFE

CELL – BASIC UNIT OF LIFE

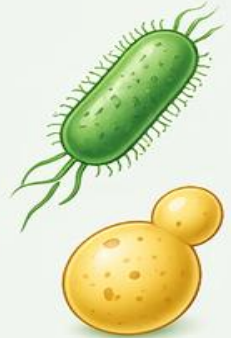
- All living organisms are made of cells.
- Cell is the basic unit of life.



UNICELLULAR & MULTICELLULAR

UNICELLULAR

- Some organisms have one cell (unicellular).
- Example: bacteria, yeast.

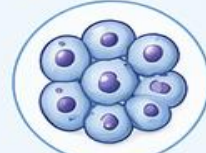


MULTICELLULAR

- Some organisms have many cells (multicellular).
- Example: plants, animals, humans.



ORGANISATION IN LIVING BEINGS



Similar cells form tissues.



Tissues form organs.

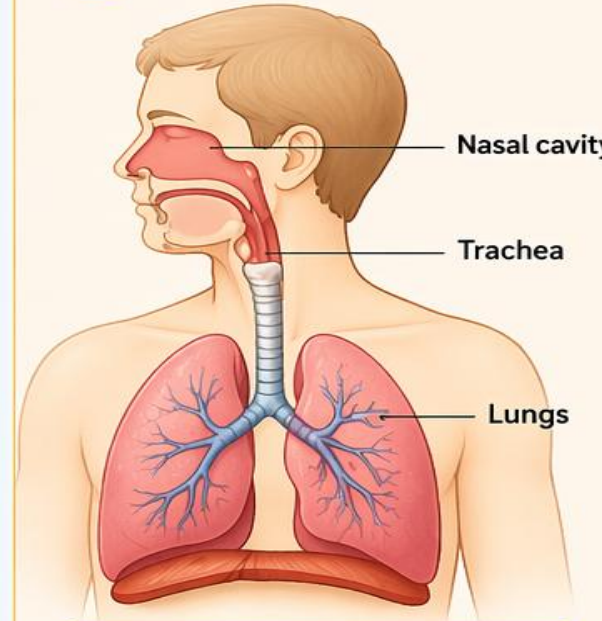


Organs work together as organ systems.



Organ systems work together to keep us alive.

EXAMPLE – RESPIRATORY SYSTEM



- Different organs work together for breathing.
- Example: nasal pores, nasal cavity, trachea and lungs form respiratory system.



SUMMARY: Cells are the building blocks of life. They work together in a well-organised way to form tissues, organs and organ systems, helping living beings perform all vital functions.



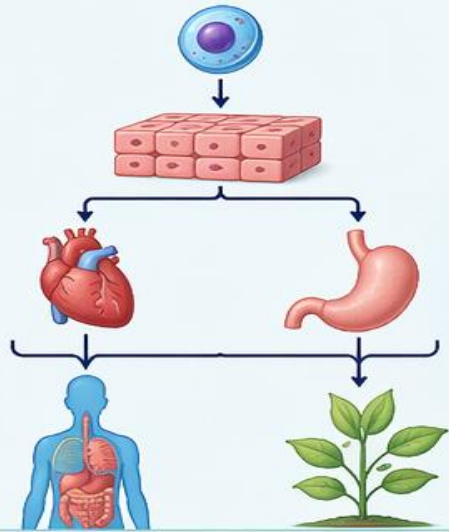
THE WONDERFUL WORLD OF CELLS

• Tiny Cells, Endless Possibilities! •



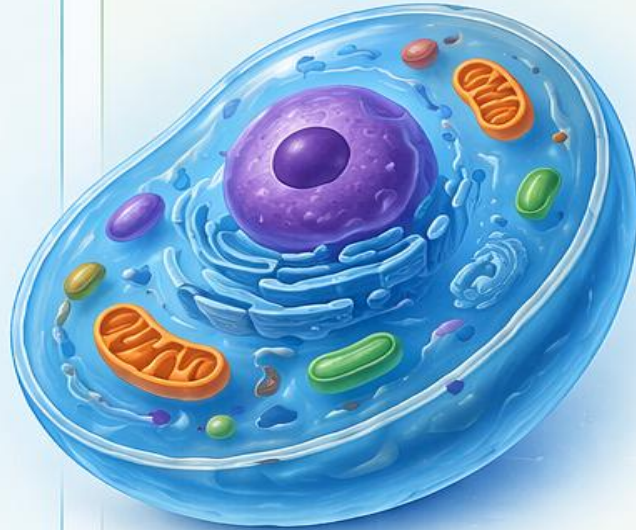
CELL – FUNDAMENTAL UNIT

- Cells are organised into tissues, organs, and organ systems.
- Cell remains the fundamental unit of structure and function in all living organisms.



IMPORTANCE OF CELLS

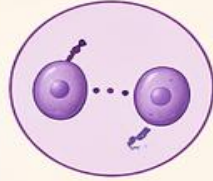
- Cells perform many essential life activities.
- Even tiny cells carry out complex and diverse functions.



QUESTIONS ABOUT CELLS



What are the different components of a cell?



How do cells in our body communicate with each other?



Do cells live forever, or do they die?



STUDY OF CELLS

- Scientists explore the structure and functions of cells.
- This helps us understand how living organisms work and survive.



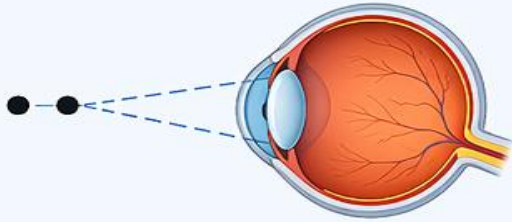
IN SHORT: Cells are tiny but powerful. They build our body, help it function, and make life possible!



HOW TO STUDY CELLS?

1 WHY CAN'T WE SEE CELLS WITH OUR EYES?

- Human eye cannot see two very close objects as separate and distinct.
- Very close objects appear as a single point.



EXAMPLE

Two dots very close to each other appear as a single point.



2 LIMIT OF RESOLUTION OF HUMAN EYE

- The near point of human eye is about 25 cm.
- Two points separated by about 0.1 mm can just be seen as distinct.
- This is called the **limit of resolution** of the human eye.
- Objects smaller than 0.1 mm cannot be seen.

KEY FACTS



Near point
≈ 25 cm



Minimum distance to see two points separately
≈ 0.1 mm



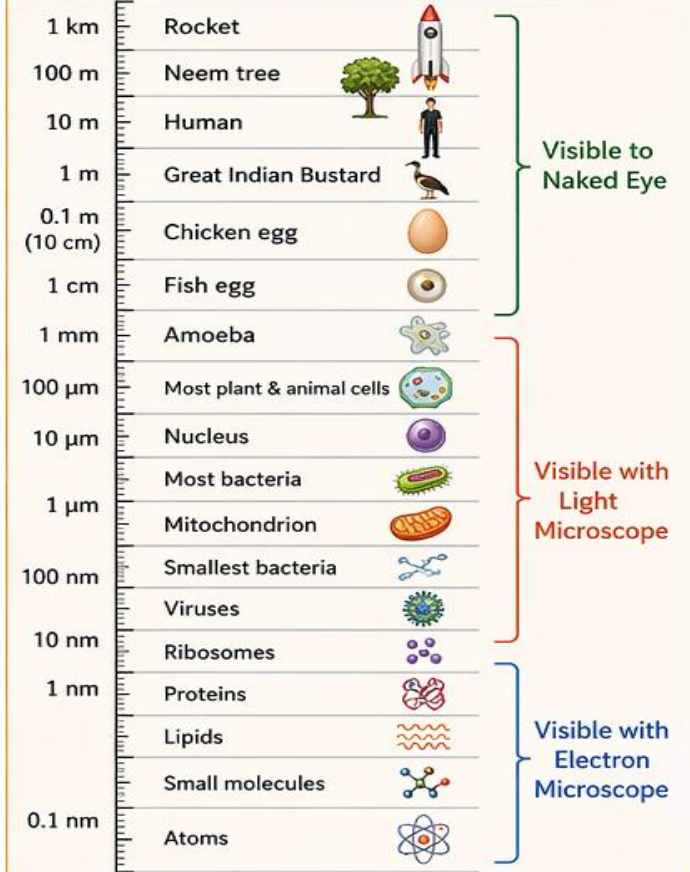
Smaller objects appear as a single point.

3 NEED FOR MICROSCOPE

- Cells are usually too small to be seen by the naked eye.
- They are much smaller than the limit of resolution.
- Microscopes are used to observe and study cells.



4 SIZE COMPARISON: FROM LARGE TO SMALL



IN SHORT

- Human eye has a limit of resolution of about 0.1 mm.
- Cells and many tiny structures are smaller than this limit.
- Microscopes help us see, study and understand the tiny world of cells.



Naked Eye



Can't see cells



Microscope



Cells become visible

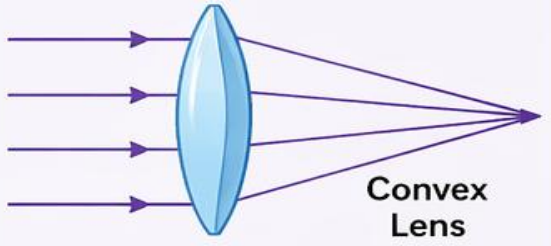


MICROSCOPE: THE KEY TO SEEING CELLS



1 MICROSCOPE & MAGNIFICATION

- Convex lens is used in microscopes.
- Combination of lenses increases magnification.
- Helps objects appear larger and clear.



MAGNIFICATION
Makes tiny objects look much bigger so we can see and study them.

2 IMPORTANCE OF MAGNIFICATION

- Used to observe very tiny objects.
- Makes cells visible clearly.
- Essential for studying the structure of cells.



3 DISCOVERY OF CELL

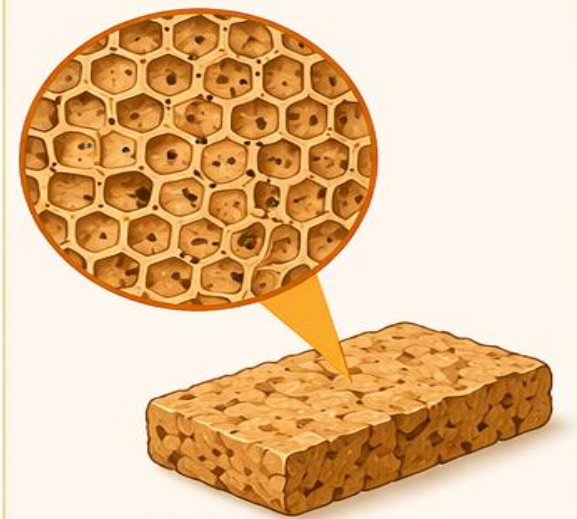
- Discovered by Robert Hooke.
- Year: 1665
- He was the first person to observe a cell.



Robert Hooke
(1635–1703)

4 OBSERVATION OF CELL

- Observed a thin slice of cork.
- Saw small box-like compartments.
- Named them **“cells”**.



Thin slice of cork

KEY TAKEAWAY

Convex lens used → Magnification increases → Tiny objects become visible → Helps us study cells better

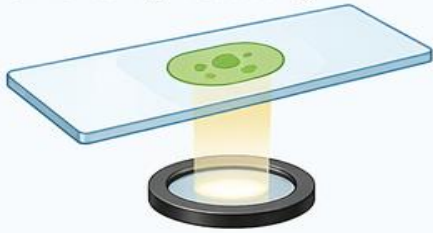


LIGHT MICROSCOPE: SEEING THE TINY WORLD



1 LIGHT MICROSCOPE

- Used in school laboratories.
- Helps us observe tiny objects and structures.
- Works using visible light.



2 MAGNIFICATION

- Different objective lenses are used.
- Example: 10X, 40X
- These lenses make objects appear larger and clearer.



10X



40X

3 MAIN PARTS OF THE MICROSCOPE

Eyepiece

The part we look through.

Body Tube

Connects the eyepiece and objective lenses.

Objective Lens

Magnifies the object.

Stage

Holds the slide with the specimen.

Mirror

Provides light to the specimen.

Base

Supports the microscope.

Handle

Used to hold and carry the microscope.



4 ADJUSTMENT KNOBS



Coarse Adjustment Knob

- Moves the stage up or down.
- Helps in rough focusing.



Fine Adjustment Knob

- Makes small adjustments.
- Helps in sharp and clear focusing.

5 WORKING

- The light from the mirror passes through the specimen.
- The objective lens forms a magnified image.
- The eyepiece lens magnifies it further.
- We see a magnified image with fine details.



KEY TAKEAWAY



Light microscope helps us see things that are too small.



Different lenses provide higher magnification.



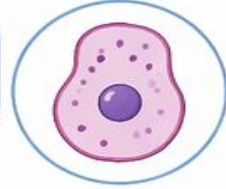
Knobs help in focusing and getting a clear image.



It reveals the fine details of cells and other tiny structures.



ACTIVITY: ESTIMATING THE SIZE OF A CELL



Simple steps to measure and calculate the actual size of a cell using a light microscope

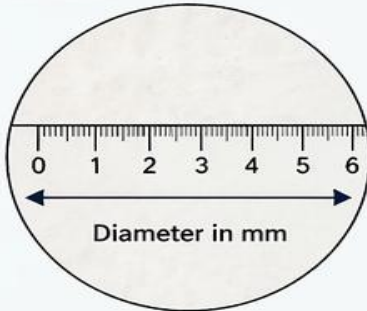
MATERIALS NEEDED

- Light microscope
- Transparent ruler (mm scale)
- Onion peel slide
- Adjustment knob



MEASURE FIELD OF VIEW

- Place the transparent ruler on the stage.
- Focus using the adjustment knob.
- Observe the circular field of view.
- Measure its diameter in mm.



Example: 5 mm

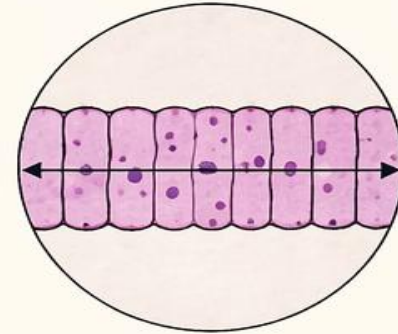
UNIT CONVERSION

- Convert the diameter from mm to micrometre (μm).
- 1 mm = 1000 μm
- Example:
 $5 \text{ mm} = 5 \times 1000$
 $= 5000 \mu\text{m}$

Diameter of field of view = 5000 μm

OBSERVE CELLS

- Remove the ruler.
- Place the onion peel slide on the stage.
- Focus the image.
- Count the number of cells along the diameter in one straight line.



Example: 25 cells

CALCULATE SIZE OF A CELL

- Use the formula:

$$\text{Size of one cell} = \frac{\text{Diameter of field of view}}{\text{Number of cells}}$$

- Example:
 $5000 \mu\text{m} \div 25$
 $= 200 \mu\text{m}$

Estimated size of one cell = 200 μm

MAGNIFICATION



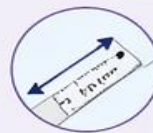
Total magnification = Magnifying power of eyepiece \times Objective lens

Example:
 $10\text{X (eyepiece)} \times 10\text{X (objective)} = 100\text{X}$
The cell will appear 100 times larger.

KEY TAKEAWAY



Measure field of view



Convert to μm



Count cells



Calculate size



Understand the real size



This activity helps us understand how microscopes work and how scientists measure tiny structures accurately.



ELECTRON MICROSCOPE: SEEING THE UNSEEN



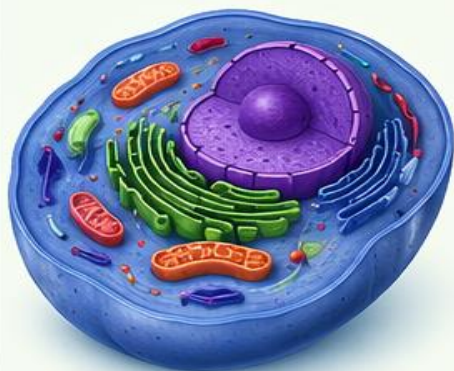
ELECTRON MICROSCOPE

- Used apart from light microscopes.
- Uses a beam of electrons instead of light.
- Produces highly magnified images.



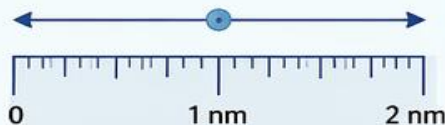
HIGH DETAIL OBSERVATION

- Reveals fine details of cell structure.
- Enables study at extremely small levels.
- Provides remarkable clarity and detail.



NANOMETRE SCALE

- Works at the nanometre scale.
- 1 nanometre = one-billionth of a metre.
- Helps scientists study structures too small to see with light microscopes.

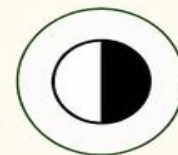


1 nanometre (nm) = one-billionth of a metre

IMPROVEMENTS IN MICROSCOPES



Resolution
Improved clarity of fine details.



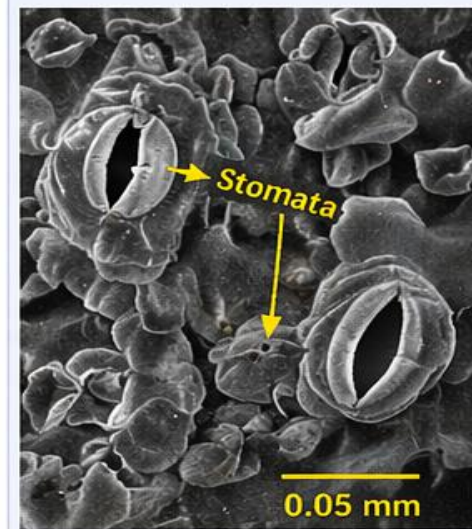
Contrast
Better difference between light and dark areas.



Magnification
Greater enlargement of the image.

EXAMPLE OBSERVATION

- Surface of a leaf observed using electron microscope.
- Stomata (tiny pores) are clearly visible.



KEY TAKEAWAY



Electron microscopes use electrons, not light.



They reveal ultra-fine details of cell structures.



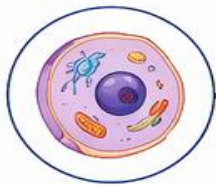
They work at the nanometre scale for extreme precision.



Better resolution, contrast and magnification.



They help us see and understand the unseen world.



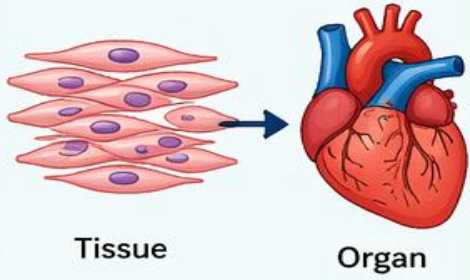
STRUCTURE OF A CELL



Cells: The Basic Units of Life

CELLS BUILD LIFE

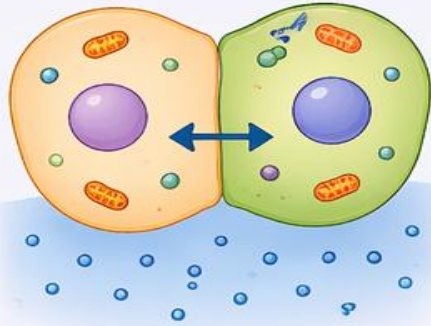
- Cells are organised into tissues and organs.
- Together, they perform specific functions.



Cells work together to keep the body running.

INTERACTION OF CELLS

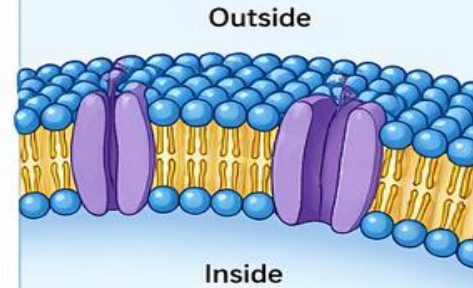
- Cells interact with each other.
- They also interact with their surroundings.



Interaction is essential for proper functioning.

CELL BOUNDARY (CELL MEMBRANE)

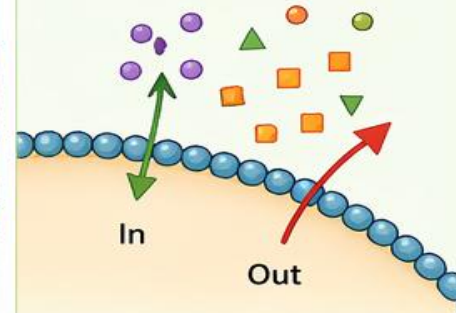
- Interaction occurs at the cell boundary.
- It acts as a selective barrier.



The membrane regulates what enters and leaves the cell.

EXCHANGE OF MATERIALS

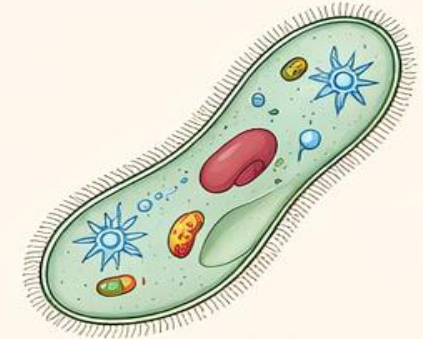
- Substances move in and out of the cell.
- Exchange of materials happens with the environment.



This exchange is vital for survival.

UNICELLULAR ORGANISMS

- Even single-celled organisms interact with their environment.
- They exchange materials through the cell membrane.



Cell membrane is the key to interaction and survival.



KEY TAKEAWAY



Cells are the basic units that build and organize life.



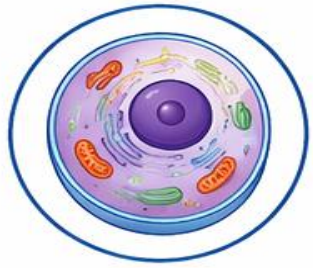
Cells must interact with each other and their surroundings.



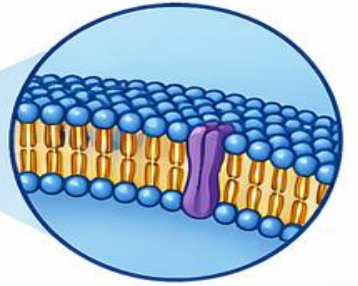
The cell membrane controls the exchange of substances.



This exchange helps cells and organisms perform their functions.



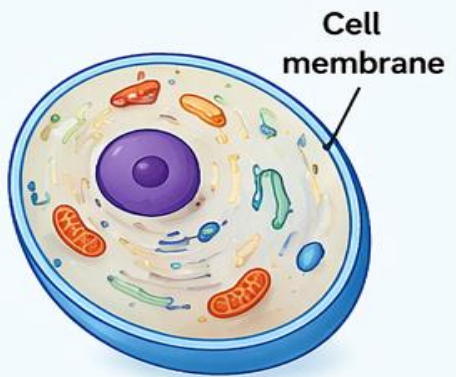
CELL MEMBRANE



The Universal Feature of a Cell

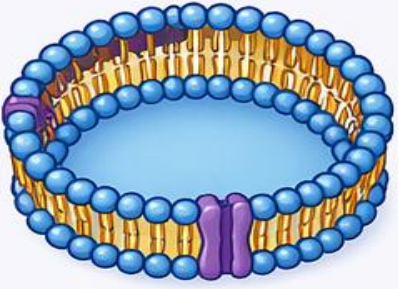
WHAT IS CELL MEMBRANE?

- Thin boundary that surrounds the cell.
- Protects and supports the cell.



PLASMA MEMBRANE

- Also called plasma membrane.
- Defines individuality of the cell.



Plasma membrane

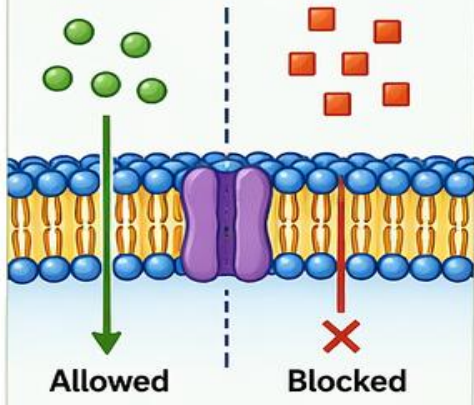
FUNCTION

- Protects the contents inside the cell.
- Separates cell from its external environment.



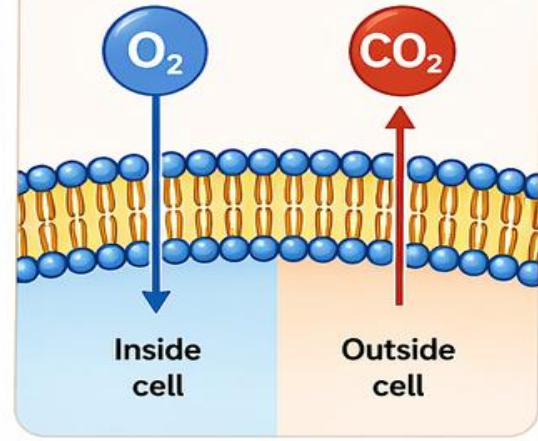
SELECTIVE PERMEABILITY

- Allows some substances to pass through.
- Blocks unwanted substances.



EXCHANGE OF GASES

- Oxygen moves into the cell.
- Carbon dioxide moves out of the cell.



KEY TAKEAWAY



Cell membrane is a thin protective covering.



It gives each cell its unique identity.



It is selectively permeable.

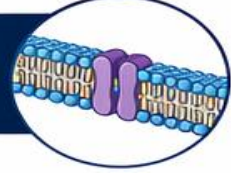


It controls what enters and leaves the cell.



It helps in the exchange of gases like oxygen and carbon dioxide.

OSMOSIS: ACTIVITY AND CONCEPT



OSMOSIS ACTIVITY

- Two potato pieces of roughly equal size taken.
- Initial weight of both pieces measured.



EXPERIMENT SETUP

Beaker A
(Plain water)



Beaker B
(20% salt or sugar solution)



Left undisturbed for about an hour.

OBSERVATION (AFTER 1 HOUR)

Beaker A
(Plain water)



- Potato swells.
- Weight increases.

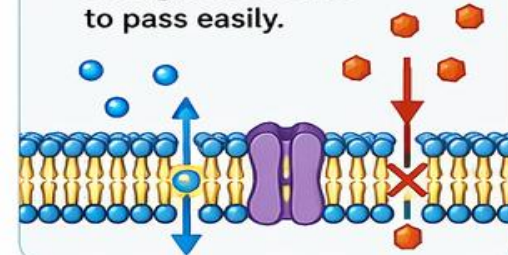
Beaker B
(Salt/Sugar solution)



- Potato shrinks.
- Weight decreases.

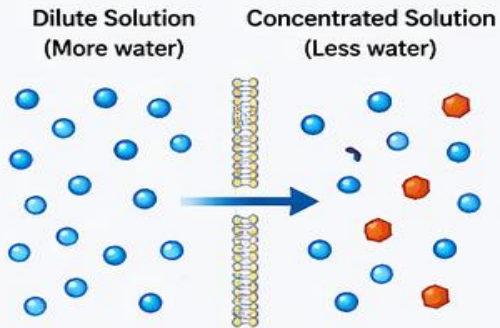
REASON

- Cell membrane allows water to move in and out of the cell.
- It does not allow salt or sugar molecules to pass easily.



OSMOSIS

- Movement of water through a selectively permeable membrane.
- Water moves from an area of higher water concentration (dilute solution) to an area of lower water concentration (concentrated solution).

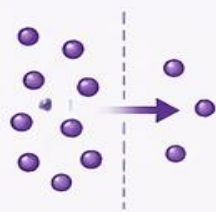


This movement of water is called **OSMOSIS**.

DIFFUSION vs OSMOSIS

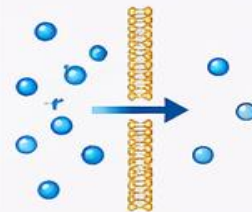
DIFFUSION

Movement of any particles from higher to lower concentration.



OSMOSIS

Movement of water only through a selectively permeable membrane.



REAL LIFE EXAMPLE

- In plants, water from the soil enters root cells.
- This helps plants absorb water and stay healthy.



WHAT IF?

If mung bean seeds are kept in a concentrated solution after soaking in water for 12 hours:

- They will shrink.
- Because water will move out of the seeds through osmosis.



KEY TAKEAWAY



Osmosis is the movement of water through a membrane.



It helps maintain water balance in cells and organisms.



It plays a vital role in plant water uptake and cell function.



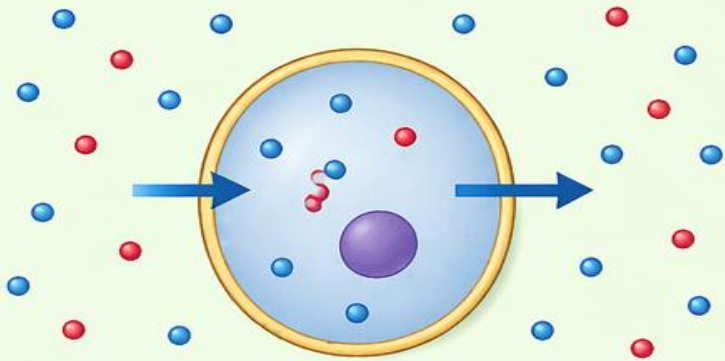
Life processes depend on proper movement of water by osmosis.

EFFECT OF SOLUTIONS ON A CELL

Osmosis in Living Cells

ISOTONIC SOLUTION

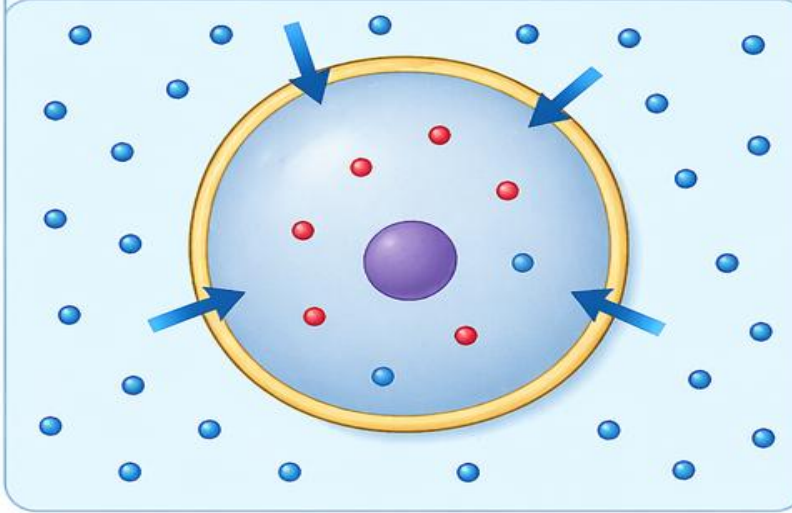
- Same solute concentration inside and outside the cell
- Water movement is equal in both directions
- Cell size remains same



● Water molecules ● Solute molecules

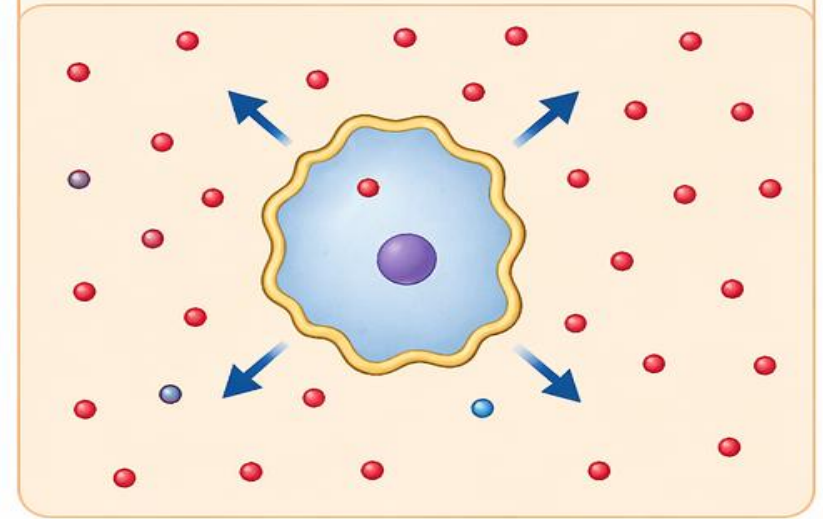
HYPOTONIC SOLUTION

- Less solute concentration outside the cell
- Water enters the cell
- Cell swells



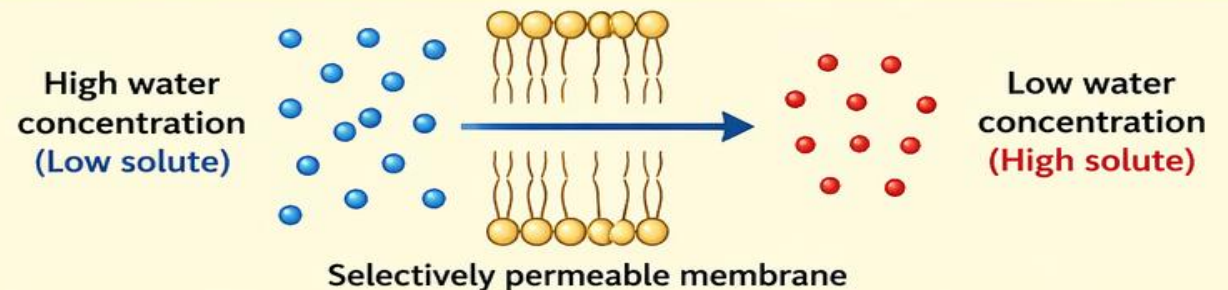
HYPERTONIC SOLUTION

- More solute concentration outside the cell
- Water leaves the cell
- Cell shrinks



KEY IDEA

- Osmosis is the movement of water through a selectively permeable membrane.
- Water moves from a region of high water concentration to a region of low water concentration.



CELL MEMBRANE

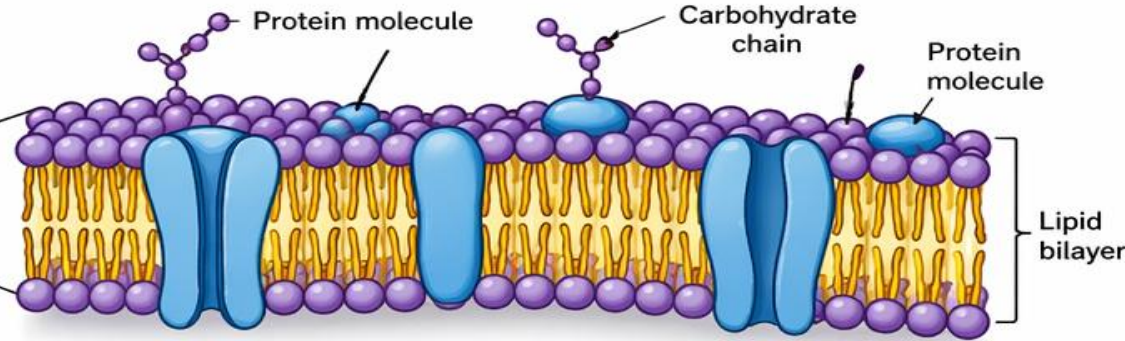
STRUCTURE AND FUNCTIONS

CELL MEMBRANE – STRUCTURE

- Thin outer covering of the cell
- Thickness about 7–10 nanometres
- Made of lipids and proteins



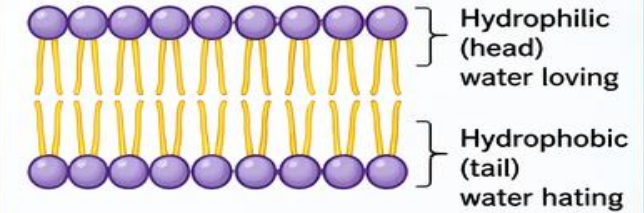
FLUID MOSAIC MODEL



- Membrane is called fluid mosaic
- “Fluid” → molecules can move
- “Mosaic” → arranged like tiles

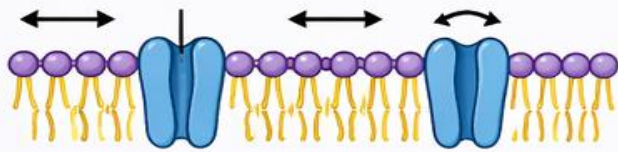
LIPID BILAYER

- Two layers of lipids present
- Outer heads attract water
- Inner tails repel water



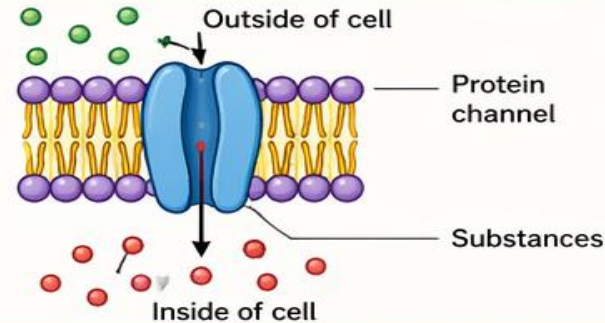
FLUID NATURE

- Molecules move sideways
- Membrane remains flexible
- Helps in easy movement of substances



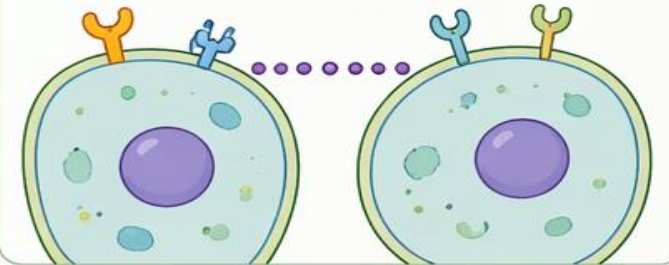
ROLE OF PROTEINS

- Proteins present in membrane
- Act like gatekeepers
- Control entry and exit of substances



CELL INTERACTION

- Helps cells communicate
- Interacts with surroundings



CELL WALL (EXTRA LAYER)

- Present in plant, fungi, bacteria
- Provides extra protection and support to the cell



Plant Cell



Fungi Cell



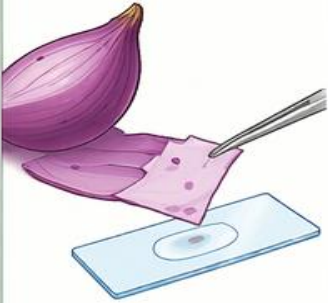
Bacteria Cell

ACTIVITY: OBSERVING CELLS

Comparing Plant Cells (Onion Peel) and Animal Cells (Cheek Cells)

PREPARATION OF SLIDES

Take a thin peel of onion leaf or *Rhoeo* leaf.



Similarly, collect cheek cells using a cotton swab or the blunt end of a toothpick.



Spread the cells on a clean glass slide.



Add a drop of water followed by a few drops of methylene blue stain and place a cover slip.

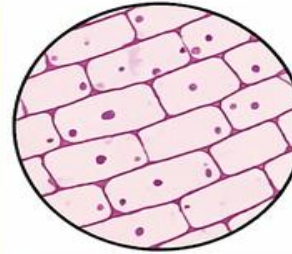


Observe both the slides under a microscope.



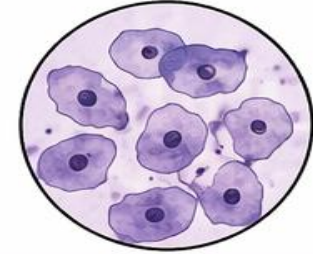
OBSERVATION UNDER MICROSCOPE

ONION / RHOEO LEAF CELLS (PLANT CELLS)



- Box-shaped cells
- Arranged in regular pattern

CHEEK CELLS (ANIMAL CELLS)



- Irregular shaped cells
- Arranged randomly

WHY THIS DIFFERENCE?

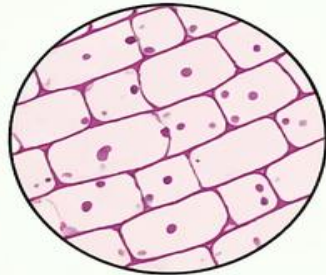


Plant cells have a cell wall which gives them a fixed shape. Animal cells do not have a cell wall.



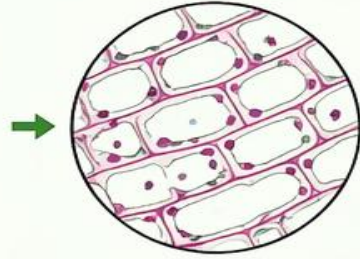
EFFECT OF 20% SUGAR SOLUTION

PLANT CELLS (ONION / RHOEO LEAF)



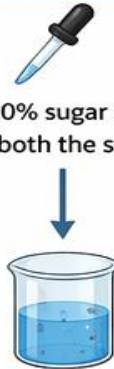
Before

- Outer boundary (cell wall) remains the same.
- Inner content shrinks.
- Space between the cell wall and the inner content increases.

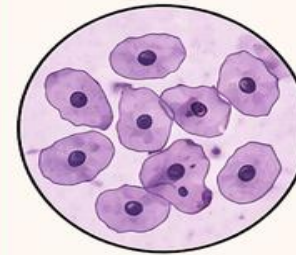


After

Add 20% sugar solution to both the slides.



CHEEK CELLS (ANIMAL CELLS)



Before

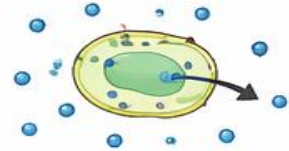
Cells shrink considerably as there is no rigid outer layer (cell wall).



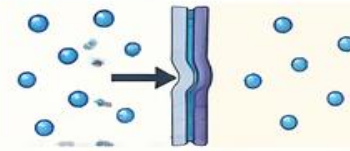
After

KEY CONCEPT

Water moves out of the cells when placed in concentrated sugar solution.



This is called **OSMOSIS**.



Water moves from a region of high water concentration to low water concentration.



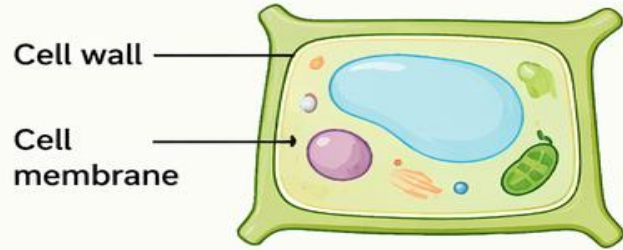


CELL WALL – THE OUTER COVERING OF PLANT CELLS



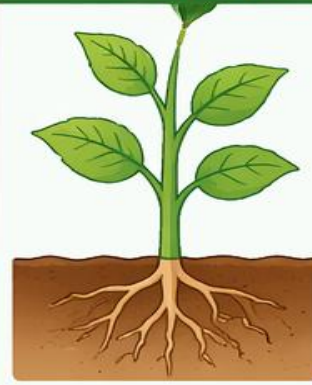
A rigid layer present outside the cell membrane in plant cells.

WHAT IS CELL WALL?



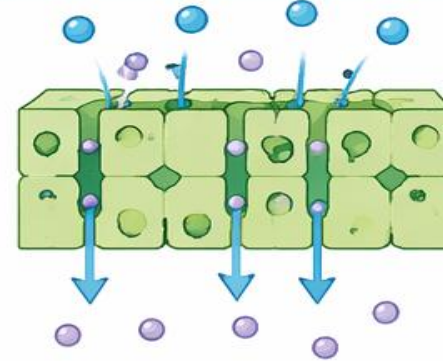
It is a strong, non-living layer outside the cell membrane.

FUNCTIONS OF CELL WALL



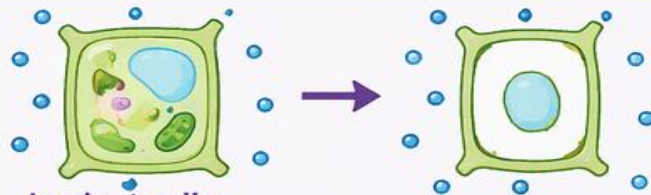
- Gives shape and rigidity to the cell
- Protects the cell from mechanical damage
- Helps the plant remain upright
- Provides structural support

PERMEABILITY OF CELL WALL



- Cell wall is permeable.
- Water and dissolved minerals can pass through it.
- Helps plant roots absorb water and nutrients from soil.

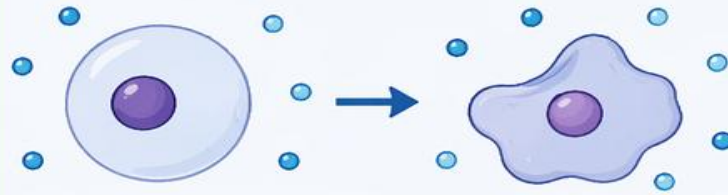
EFFECT OF CONCENTRATED SUGAR SOLUTION (OSMOSIS)



In plant cells:

- Water moves out of the cell.
- Inner content shrinks.
- Cell wall is rigid, so outer shape remains the same.

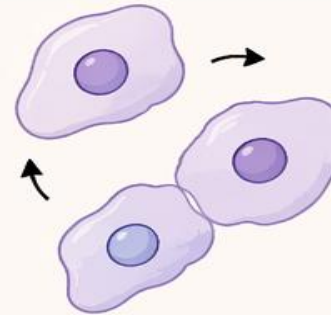
ANIMAL CELLS (NO CELL WALL)



In animal cells:

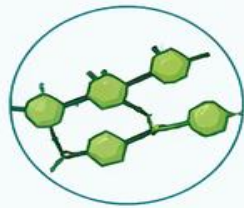
- No cell wall is present.
- Water moves out.
- Cells shrink and change shape.

FLEXIBILITY IN ANIMAL CELLS



- Without a rigid cell wall, animal cells can change shape easily.
- This flexibility helps in movement and proper functioning of tissues and organs.

COMPOSITION OF PLANT CELL WALL



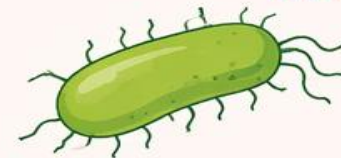
- Mainly made of cellulose, a type of carbohydrate.
- Cellulose is made of many glucose units joined together.
- Cellulose acts as roughage in our diet and helps in digestion.

CELL WALL IN OTHER ORGANISMS



Fungi

- Cell wall present in fungi.
- Provides protection and support.



Bacteria

- Cell wall present in bacteria.
- Gives shape, protection and structural support.



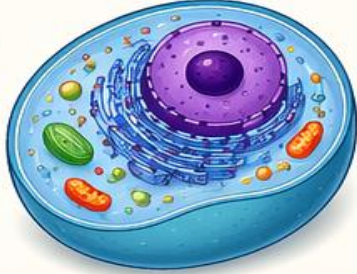
CELL INTERIOR



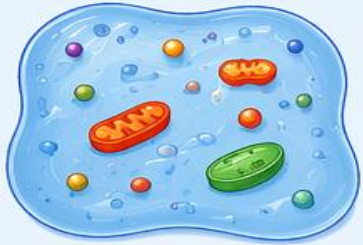
- Cell works as a coordinated system.
- Different parts work together.

MAIN PARTS OF A CELL

- Cell membrane
- Cytoplasm
- Nucleus



CYTOPLASM



- Jelly-like substance
- Present inside the cell
- Holds cell components

ORGANELLES

- Present in cytoplasm
- Perform specific functions
- Very small structures



Mitochondria



Golgi body



Endoplasmic reticulum



Lysosome



Chloroplast

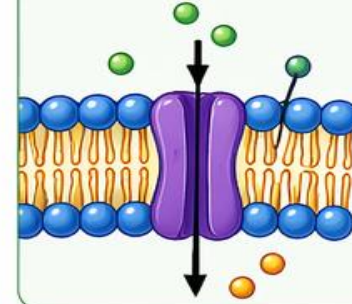


Ribosomes



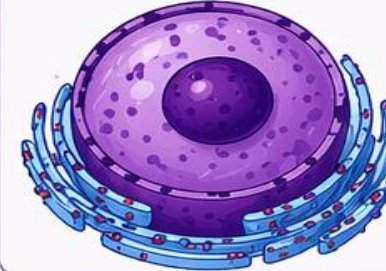
All these parts work together in a coordinated way to keep the cell alive and perform all functions.

CELL MEMBRANE



- Outer covering of cell
- Selectively permeable
- Controls entry and exit

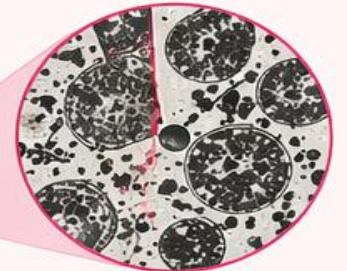
NUCLEUS



- Important cell part
- Controls cell activities
- Acts as control centre

VISIBILITY

- Most organelles are very small
- Seen clearly with electron microscope



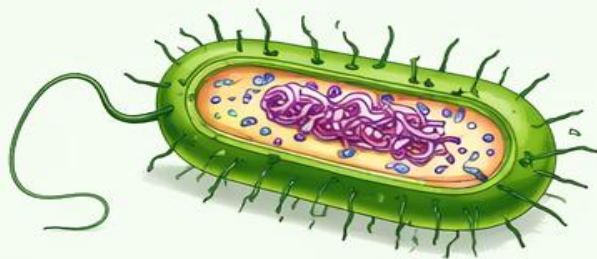


TYPES OF CELLS



Cells are of different types. They vary in size, structure and functions.

BACTERIAL CELL (PROKARYOTIC)



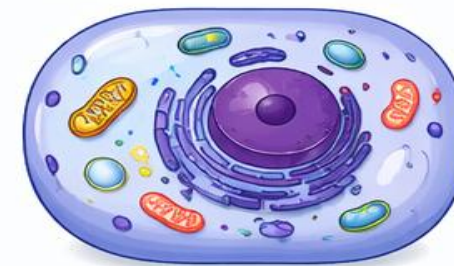
- Simple and small cell
- No well-defined nucleus
- Genetic material in cytoplasm
- No membrane-bound organelles
- Example: Bacteria

PLANT CELL (EUKARYOTIC)



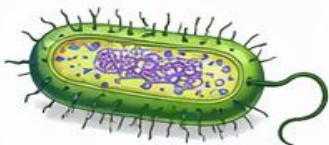
- Has a well-defined nucleus
- Cell wall present
- Chloroplast present
- Large vacuole present
- Example: Leaf cell

ANIMAL CELL (EUKARYOTIC)



- Has a well-defined nucleus
- No cell wall
- No chloroplast
- Contains organelles
- Example: Human cheek cell

PROKARYOTIC CELLS



- No true nucleus
- Simple structure
- Activities occur in cytoplasm

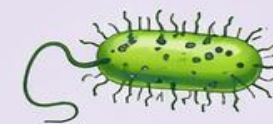
EUKARYOTIC CELLS



- True nucleus present
- Complex structure
- Membrane-bound organelles present

KEY DIFFERENCE

PROKARYOTIC



Simple cell

VS

EUKARYOTIC



Complex cell



SUMMARY

Bacterial cells are prokaryotic and lack a true nucleus. Plant and animal cells are eukaryotic and have a well-defined nucleus with other organelles.

PROKARYOTIC CELLS

- ◆ No true nucleus
- ◆ Simple structure
- ◆ Activities occur in cytoplasm



EUKARYOTIC CELLS

- ◆ True nucleus present
- ◆ Complex structure
- ◆ Membrane-bound organelles present



EXAMPLES



Bacteria



Plant Cell



Animal Cell

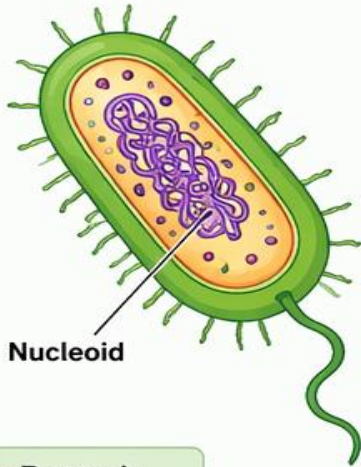


COMPARISON OF CELL TYPES



BACTERIAL CELL (PROKARYOTIC)

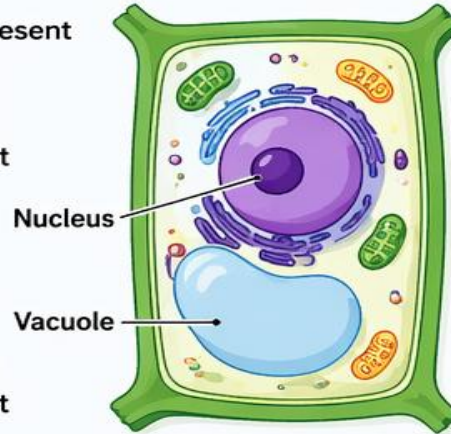
- Cell membrane present
- Cell wall present
- Cytoplasm present
- No well-defined nucleus
- Nucleoid present
- No membrane-bound organelles



Example: Bacteria

PLANT CELL (EUKARYOTIC)

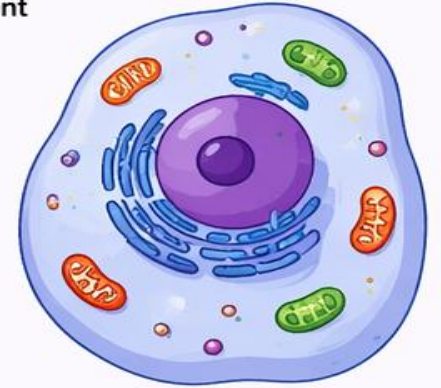
- Cell membrane present
- Cell wall present
- Cytoplasm present
- Well-defined nucleus present
- No nucleoid
- Membrane-bound organelles present



Example: Leaf cell

ANIMAL CELL (EUKARYOTIC)

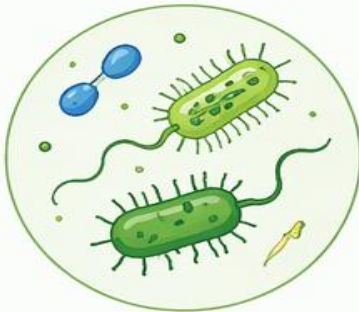
- Cell membrane present
- No cell wall
- Cytoplasm present
- Well-defined nucleus present
- No nucleoid
- Membrane-bound organelles present



Example: Human cheek cell

PROKARYOTIC CELLS

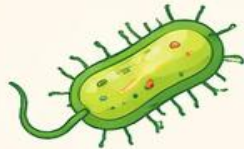
- Primitive nucleus present
- Size: 1 – 10 μm
- Usually unicellular
- No membrane-bound organelles



Example: Bacteria

KEY DIFFERENCE

PROKARYOTIC



Simple cell

EUKARYOTIC



Complex cell

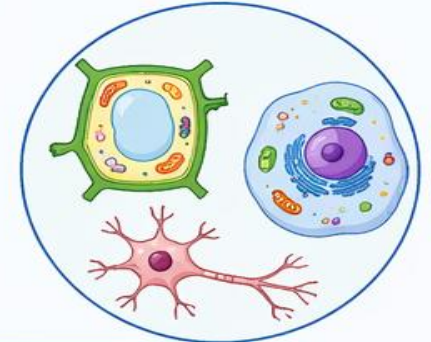
VS

Prokaryotic → simple cell

Eukaryotic → complex cell

EUKARYOTIC CELLS

- True nucleus present
- Size: 10 – 100 μm
- Unicellular or multicellular
- Membrane-bound organelles present



Examples: Plant cells, Animal cells



Cells are of different types. They vary in size, structure and functions.

THANK YOU!

PART 1

JOIN **ICTSCIENCE** **REKHA**
WHATSAPP CHANNEL

TO GET **ECONTENT**
FOR **ALL CLASSES**

(1 - 12)

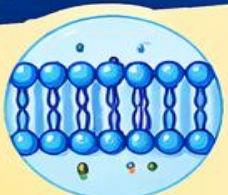


THANK YOU!

PART 1

FOR WATCHING

SEE YOU IN PART 2!



CELL
MEMBRANE



CYTOPLASM



NUCLEUS

Keep Learning,
Keep Exploring! ★