CHAPTER: FUNDAMENTAL UNIT OF LIFE

Grade: **9**
Board: **CBSE**
Book: **NCERT**

1. CHAPTER SUMMARY AND PLACEMENT

<Read through the following to understand how this chapter is connected with the previous and next grades and also the important concepts covered in it.>

1. The basic components of cell and its structure has already been done in grade 8. In this chapter, students will study the cell structure in detail. This chapter lays the foundation for the cell: structure and function given in grade 11. In further grades, it evolves into cell: the unit of life, biomolecule, cell cycle and cell division.
2. In this chapter for the first time, certain histological terminology related to cell is introduced. The chapter starts with discovery of cell and cell theory postulates. Then the chapter discuss about the organization, shape, size and complexity in cell. The chapter ends with describing in detail the various components of cell and it organelles.
3. Since the central idea of the chapter is to discuss cell organization and various components of cell. The chapter's main idea is to let student understand in detail the structure and function of the cell.

2. LEARNING OUTCOMES

<On completion of the chapter, students will be able to:>

1. Sequence the timeline associated with the discovery of the cell
2. State the postulates of cell theory
3. Categorize cell based on their organization, cell complexity and existence as living or non- living
4. Classify cell according to its shape and size
5. Identify different components of cell
6. Explain different components of cell
7. Explain cell membrane and its function
8. Define osmosis and diffusion
9. Differentiate between different types of osmotic solution
10. Discuss the application of osmosis and diffusion
11. Discuss nucleus and its function
12. Differentiate between living and non-living component of cell
13. Identify and list different cell organelles
14. Explain the structure and function of mitochondria and plastids
15. Explain the structure and function of various cell organelles
16. Differentiate between plant and animal cell based on their structure

3. KEYWORDS

Definitions of some terms used in the chapter:

Permeable: if both solute and solvent can pass through membrane

Selective permeable: allows passage of solvent and selective solutes

Rigid: unable to bend

3. TEACHING PLAN

Follow this section for getting ideas on teaching the content covered in the chapter. The subtopic given in the first column with the matching learning outcome can be explained using instructions and resources listed subsequently

Subtopic and Learning Objective #1

Discovery of cell & Cell Theory

1. Sequence the timeline associated with the discovery of the cell
2. State the postulates of cell theory

Teacher Activity

Note: If possible, show an onion peel slide under the microscope to make student identify the structure of cell.

1. Ask students to share based on their previous knowledge about the discovery of the cell.
2. Show picture of Robert hook and his microscope. Share with students that he observe a slice of cork under the microscope and conclude by saying that it contain a number of small compartment that he named them as “cellulae”.
3. Simultaneously show all the pictures of other scientists and share their contribution in cell discovery. Also, write the year of their discovery and contribution to draw a timeline.
4. Now show the picture of M. J. Schleiden and T. Schwann.
5. Ask students do they know these two scientist.
6. Appreciate responses and inform students that these scientists has given the cell theory.

7. Discuss the postulates of cell theory
    a. All living beings are made of cells.
    b. All cells arise from the pre- existing cells.
    c. A cell is a mass of protoplasm containing a nucleus & bounded by cell membrane, & in many cases by cell wall.
    d. All cells are alike in structure & metabolic activities.
    e. The function of an organism as a whole is the result of activities and interaction of constituent cells.

Check your Understanding

a. What is the meaning of cellulae?
b. Which living thing was observe by Robert Hooke to discover cell?

Resources Suggested

Resources 1 (Picture of Robert hook, A. Van Leeuwanhoek, Robert Brown, J.E Purenkinje, M. J. Schleiden, T. Schwann, picture of Robert hook microscope), onion peel slide, microscope

Resource 1:



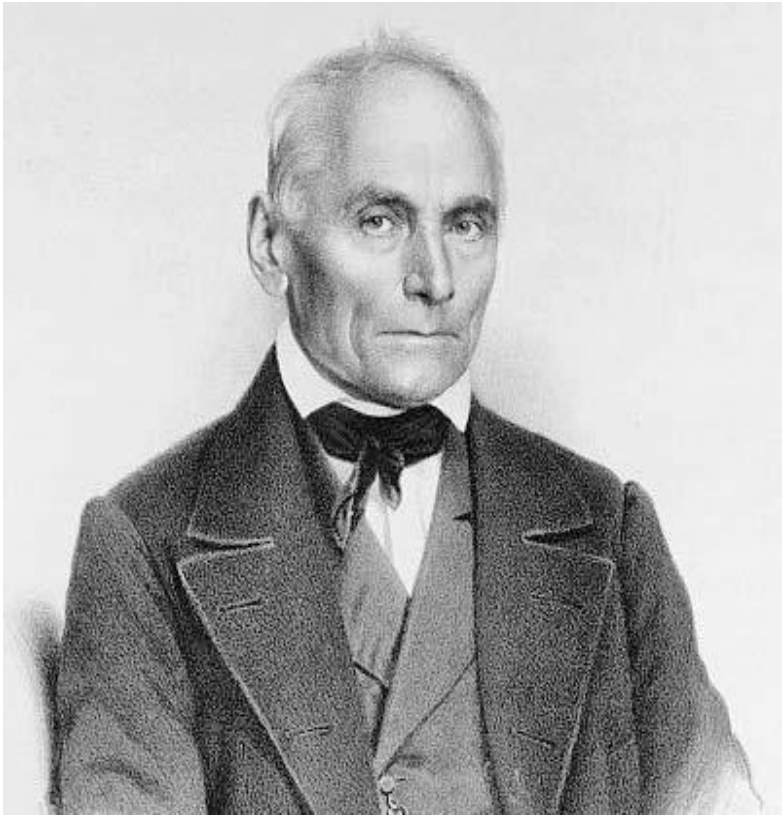
Robert Hooke



A. Van Leeuwenhoek



Robert Brown



J.E Purenkinje



M. J. Schleiden



T. Schwann



Robert hook microscope

Subtopic and Learning Objective #2

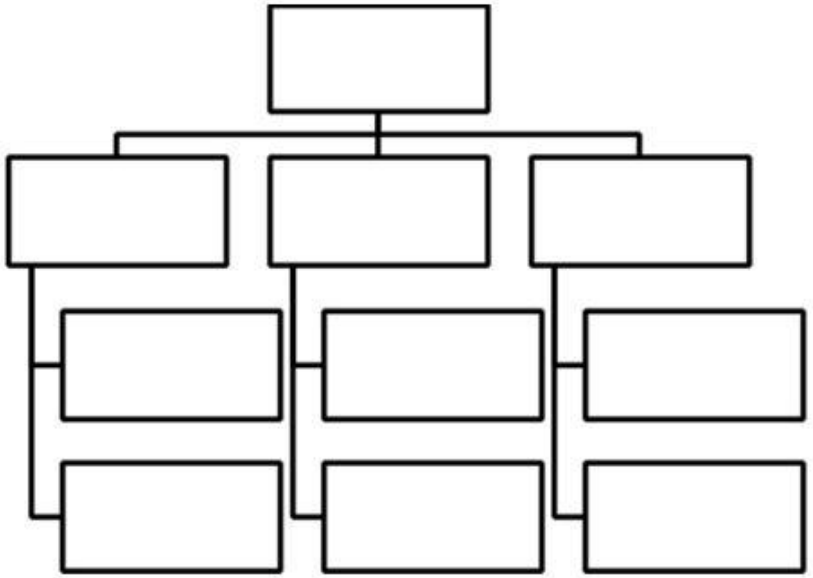
Classification of cell

1. Categorise cell based on their organisation, cell complexity and existence as living or non- living
2. Classify cell according to its shape and size

Teacher Activity

1. Show students the picture of amoeba cell and the onion peel cells
2. Ask students what is the difference between the two pictures.
3. Write the point of differentiation on the board. Conclude by saying that the cell of amoeba is classified as unicellular as this is a single cell whereas the onion peel cells group is multicellular as it contains a group of cells.
4. Now show them the picture of prokaryotic and eukaryotic cells. Ask them to differentiate between the two. Comprehend all the points on the board and add any missing points.
5. Prokaryotic cells – these include most primitive organism such as blue green algae (cynobacteria) & bacteria. These lack nuclear membrane & membrane bound organelles. The cells are smaller in size (1 – 10 μm). A single DNA molecule. Cell divisions occur by fission or budding. The chlorophyll in photosynthetic bacteria associated with membranous vesicles like structure but not the plastids. Eukaryotic cells - generally larger in size (5 – 100 μm). Distinct nucleus is present with nuclear membrane. Cell divisions occur by mitosis or meiosis. Several DNA molecules. Protists, fungi, plants or animals.
6. Ask students to guess, any other way by which we can classify cells.

6. Inform them that all living organisms can be categorized into non- cellular and cellular. Non-cellular organisms – these organism do not possess cellular structures in their body organization. Lack plasma membrane & cytoplasm. These are termed as living chemicals but do not show the characteristic of life until they enter the living body & uses the living body machinery to multiply. e.g.- virus. Cellular organisms – these are made of either one or many cells. E.g. fungi, plants or animals.



7. Show students the picture of smallest cell – mycoplasma, largest cell – ostrich egg and longest animal cell – nerve cell.
8. Discuss the unit to measure the cell and cell organelles.

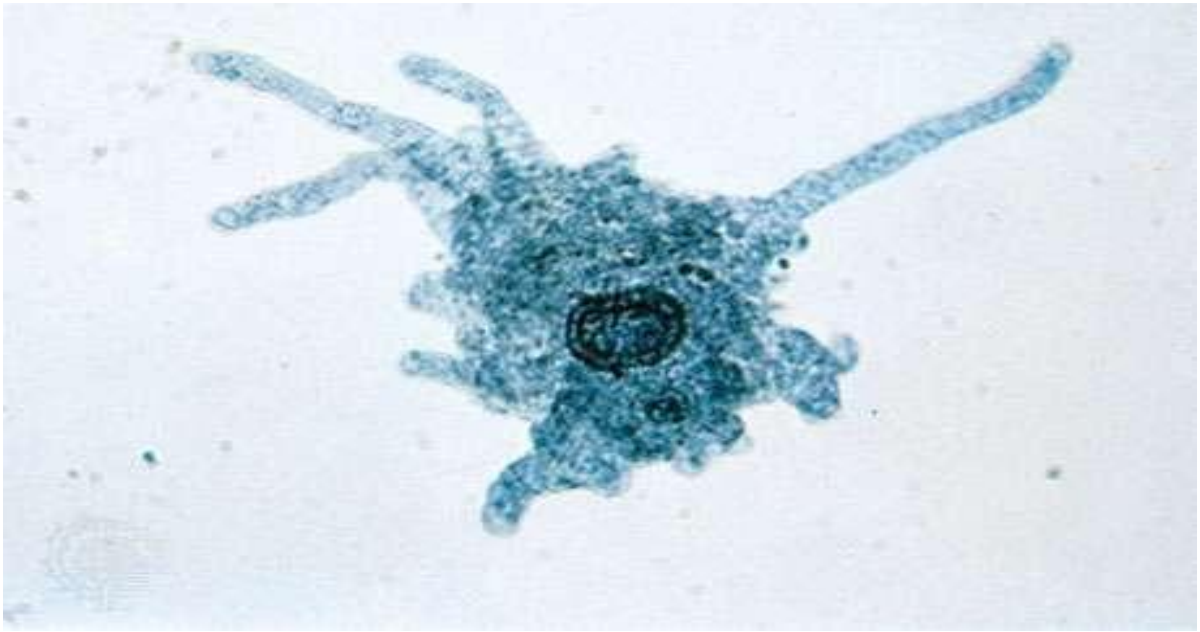
Check your Understanding

a. Define a non-cellular.
b. Give two example of prokaryotic cells.

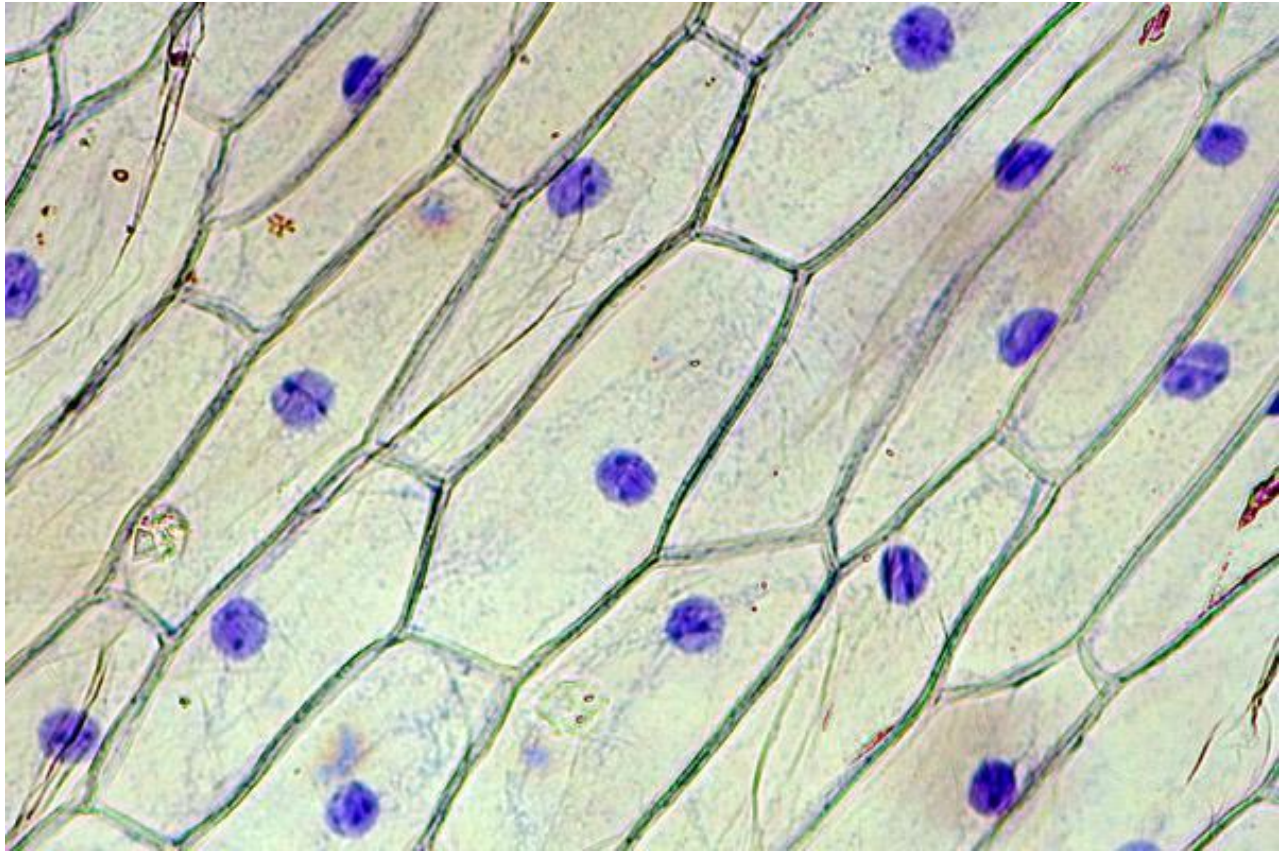
Resources Suggested

Resources 2 (Picture of Amoeba cell, onion peel cells, prokaryotic and eukaryotic cells, cellular and non –cellular organism, picture of smallest, largest and longest cells)

Resource 2:

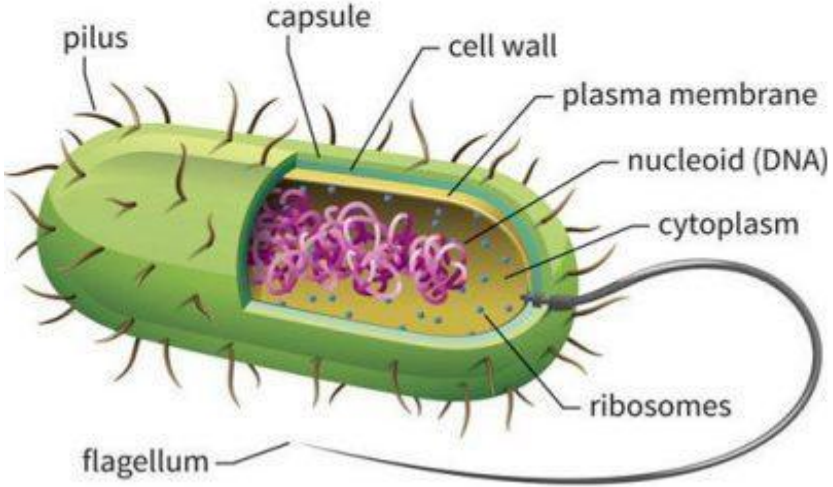


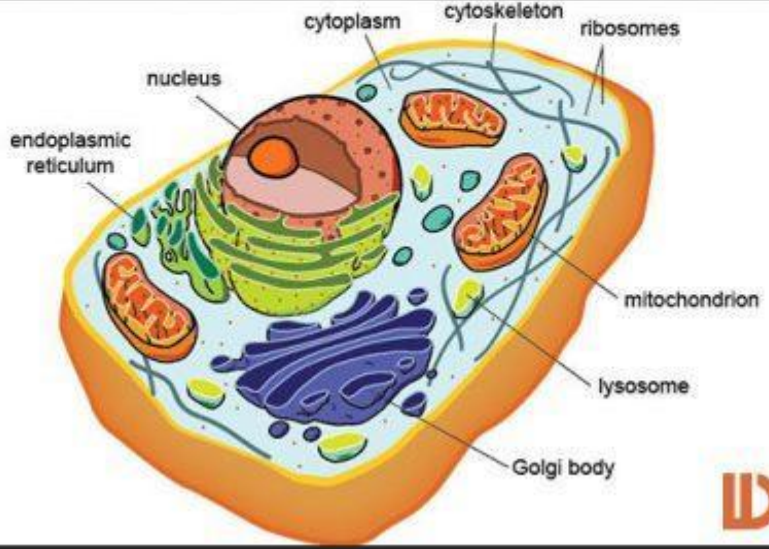
Amoeba

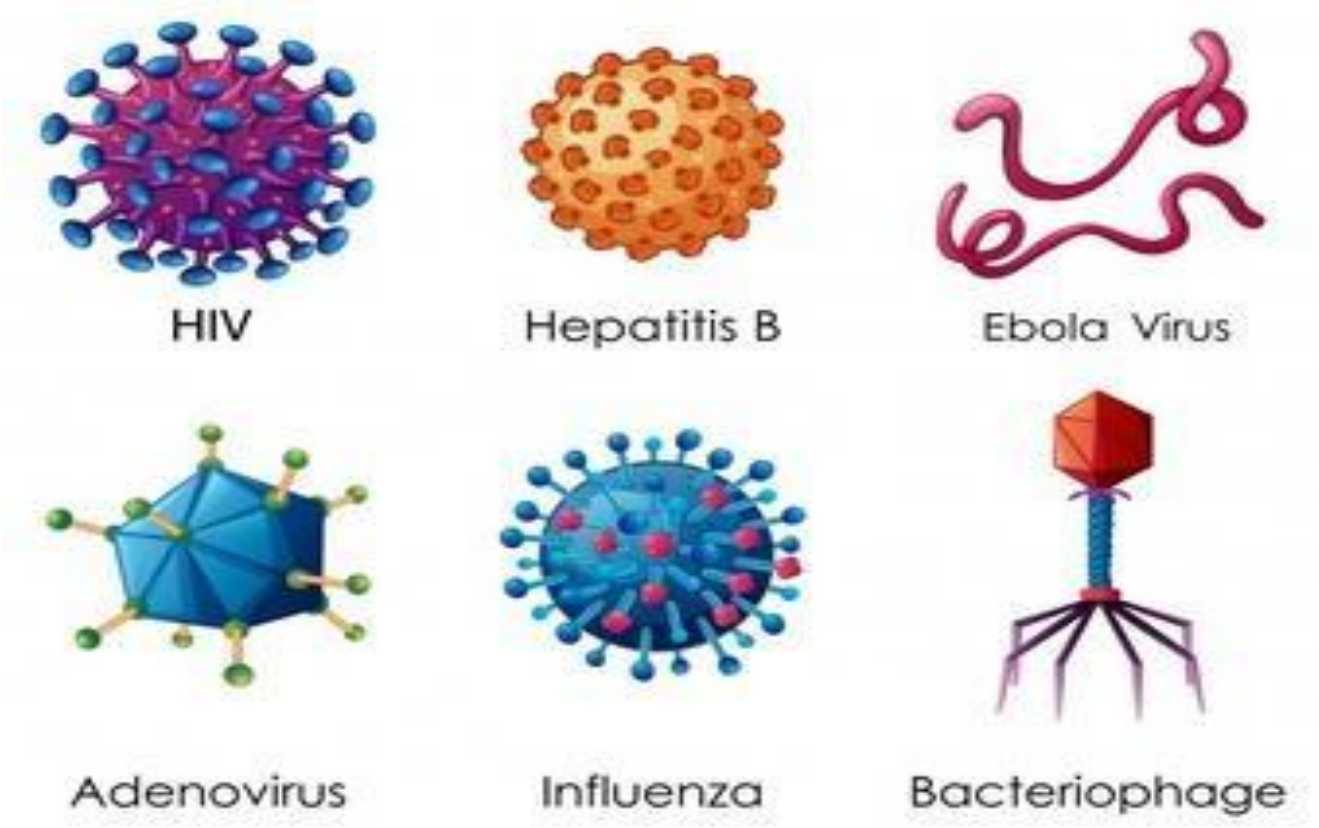


Onion peel cells

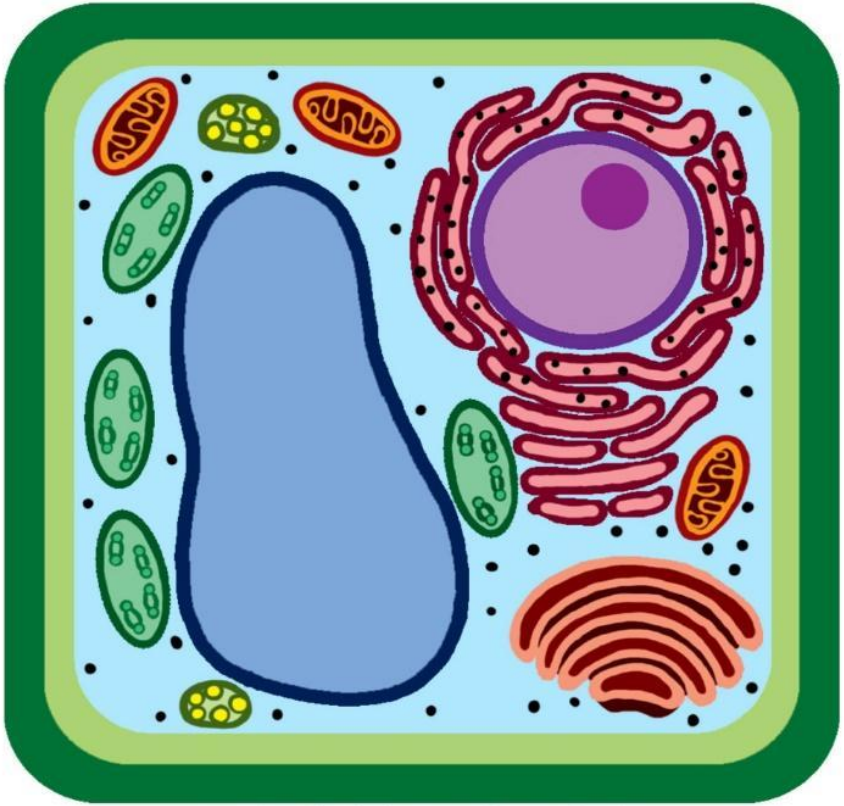
PROKARYOTIC CELL VS EUKARYOTIC CELL





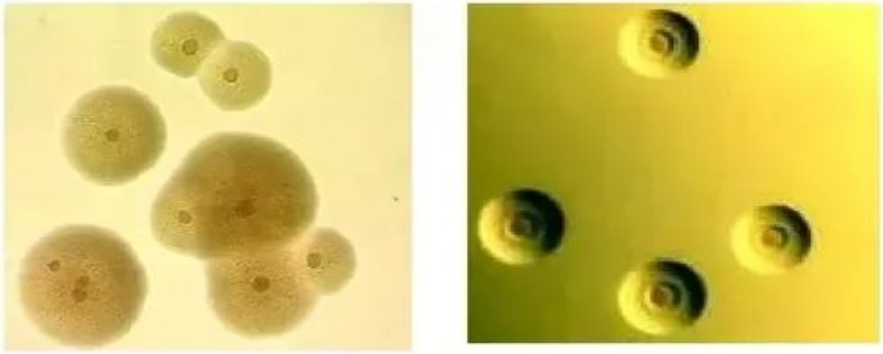


Non-cellular – virus



PLANT CELL

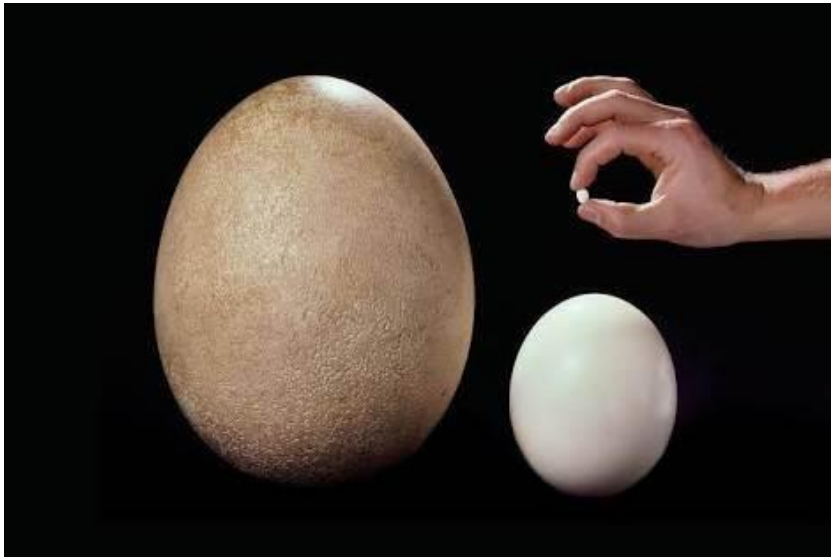
Cellular

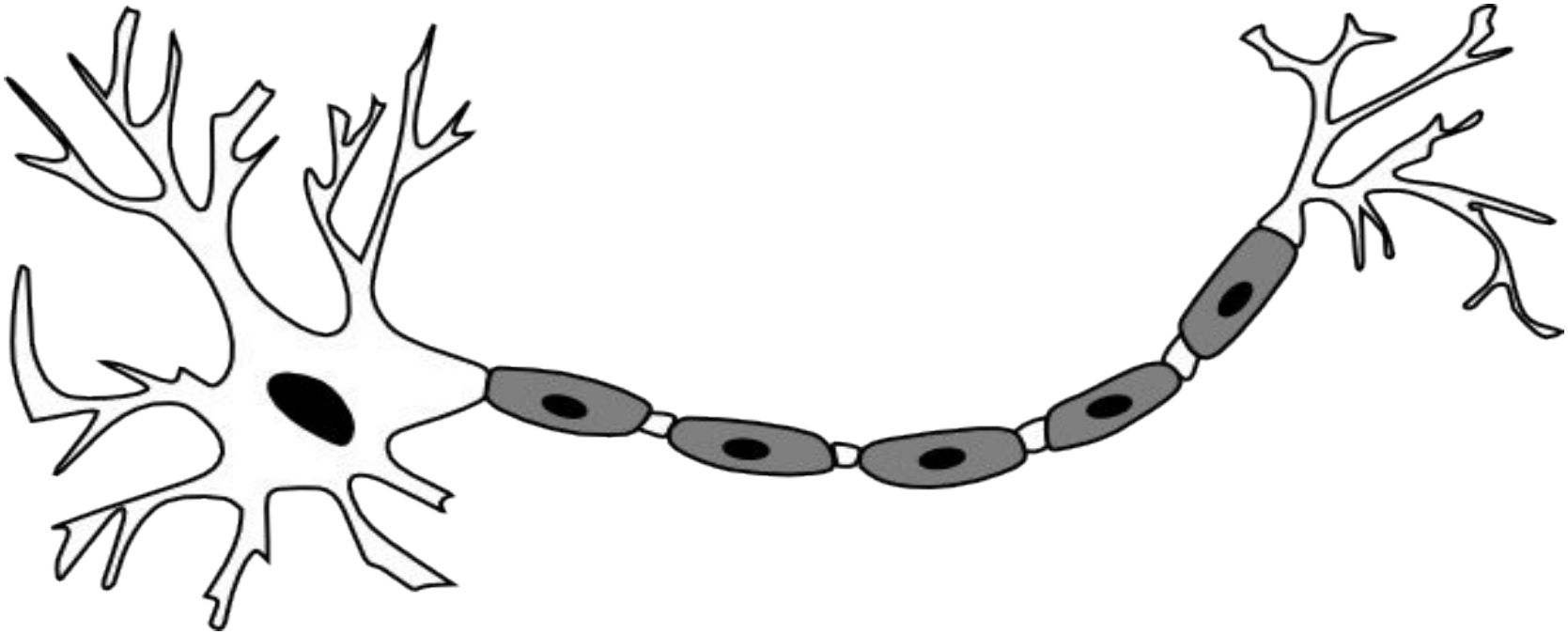


MYCOPLASMA GALLISEPTICUM

Smallest cell – mycoplasma

Largest cell – ostrich egg





Longest animal cell – nerve cell

Subtopic and Learning Objective #3

Cell Components

1. Identify different components of cell
2. Explain different components of cell
3. Explain cell membrane and its function

Teacher Activity

1. Show students the cell and ask them to identify the various cell components.
2. Conclude by pointing on the chart the cell membrane, nucleus and cytoplasm and inform students that these are the three cell components.
3. Ask students to draw the labelled cell structure in their notebook.
4. Ask students to name the boundary that demarcates a cell/the wall that borders the cell.
5. Discuss in detail the structure and function of plasma membrane. Plasma membrane or cell membrane is the outermost delicate, elastic, living membrane. It is selectively permeable in nature because it allows entry & exit of certain substances. Made up lipids & proteins. Function - Provide shape & rigidity. Protects from external environment. Membranes determine what substances are to allow in & out of the cell (selectively permeable).
6. Inform students that cytoplasm and nucleus together forms the protoplasm.
7. Discuss about cytoplasm and its function.

Cytoplasm is a fluid content inside the cell membrane. This region takes up very little strain. It is the viscous, homogenous, colloidal liquid that contain various molecule such as water amino acids, carbohydrate, lipids, protein etc. it also contain various organelles. Function - It is the place of metabolic process in the cell. It is the storehouse for raw material needed for metabolism. Streaming of cyotoplasmic matrix (cyclosis) serves many functions in cell.

8. Ask students to share names of some cell organelles.
9. List them on the board. Tell students that all these organelle are present floating in the cytoplasm.

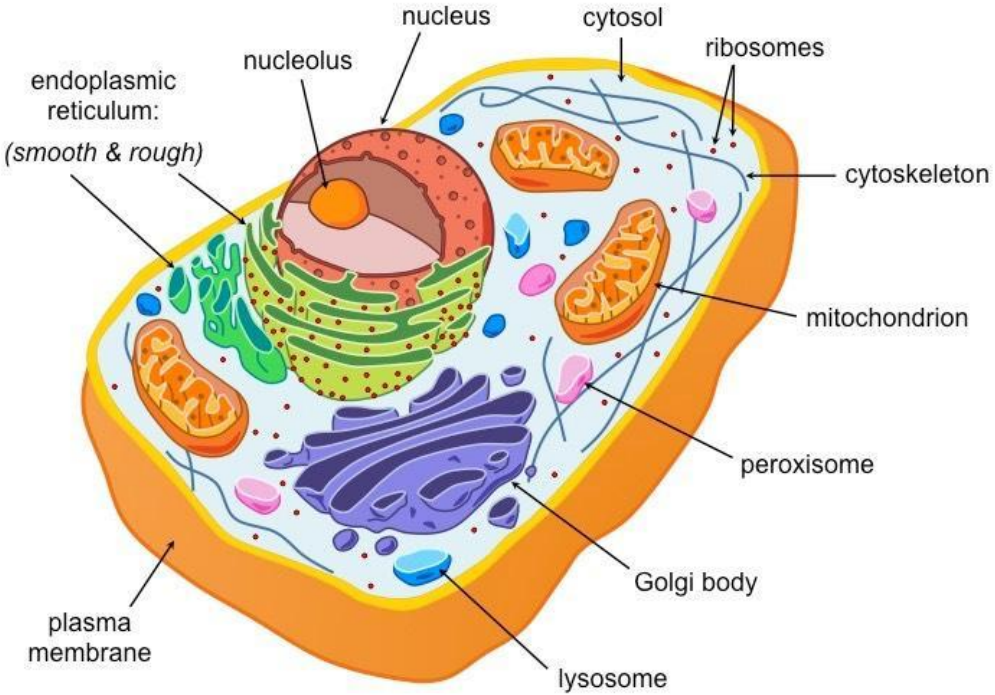
Check your Understanding

a. What is cytoplasm?
b. What is the other name for cell membrane?

Resources Suggested

Resources 3 (Chart of a cell with its components)

Resource 3:


nucleus
cytosol
ribosomes
nucleolus
endoplasmic
reticulum:
(smooth & rough)
cytoskeleton
mitochondrion
peroxisome
Golgi body
plasma
membrane
lysosome

Subtopic and Learning Objective #4

Osmosis & diffusion

1. Define osmosis and diffusion
2. Differentiate between different types of osmotic solution
3. Discuss the application of osmosis and diffusion

Teacher Activity

Note: before entering the classroom room, burn an incense stick outside the classroom. In the beginning of the period, place a resin in water. Keep it for some time.

1. Ask students if they can smell the fragrance of the incense stick. Ask students to guess how they were able to smell the fragrance. Inform students that through the process of diffusion we are able to smell the fragrance.
2. Inform students that the diffusion is the process of movement of substances (solid, liquid or gas) from a region of higher concentration to a region of lower concentration. Carbon dioxide & oxygen move in & out of the cell by this phenomenon. It equalized the concentration throughout.
3. Show student dry and water soaked resins. Tell students that water has entered into the resin through the process of osmosis. Explain the process of osmosis. Also, discuss the two forms of osmosis.
4. Perform Activity 1, to explain the type of solution and the process of osmosis.
5. Conclude by saying that raisin swell up when placed in water due to endosmosis while those swell in concentrated salt solution they shrink.

6. Discuss different type of solution like hypotonic – has less solute & more solvent concentration, Isotonic – equal concentration of solute & solvent, hypertonic – solution with more solute and less solvent concentration.
7. Inform students that in plant cell around the cell membrane another layer is present which is known as cell wall. Discuss the function of cell wall.
8. Ask students to differentiate between osmosis and diffusion in their notebook.
9. Add any missing point.
10. Also, list different application of osmosis and diffusion in our daily life.
11. Diffusion helps in exchange of respiratory gases, distribution and spread of substances in cytoplasm. Substance get dissolve in the medium through diffusion. It also helps in transpiration. Roots absorb water from soil by osmosis.

Check your Understanding

a. Give example of osmosis.
b. Define isotonic, hypertonic and hypotonic solution.

Resources Suggested

Incense stick, matchbox, dry resins, bowl, water, resins, water, concentrated salt solution (very salty water), beaker

Activity 1

Name of the activity – Swell big, shrink small
Type of activity – Class activity
Use it for – Osmosis & type of osmotic solution
Materials – raisins, water, concentrated salt solution (very salty water), beaker

Procedure –

1. Take a beaker and fill it with water.
2. Place 4-5 raisins in it.
3. Observe after 30 minutes.
4. Now place the raisins in concentrated salt solution.
5. Observe after 30 minutes.

Subtopic and Learning Objective #5

Nucleus

1. Discuss nucleus and its function

Teacher Activity

1. Show students onion peel slide. Ask them to identify the nucleus given in the slide.
2. With the help of the chart conclude by saying that nucleus is a dense protoplasmic body that contains hereditary information for controlling cell activity. It is the largest oval cell structure, lies in median. Has double layer covering called nuclear membrane, which has pore for the transfer of material. The fluid like structure present in the nucleus is called nucleoplasm. It also contains one or more round like structure called nucleolus. The nucleus contain chromosome which are rod shape contain information for inheritance of features from parents to next generation in the form of DNA (deoxyribose nucleic acid) molecules. Chromosomes are composed of protein & DNA. The DNA contains information for constructing &organizing the cell. Functional segment of DNA are called gene. Chromatin materials are entangled to form thread like structure the chromosome.

3. Ask students to share based on their understanding what is the function of the nucleus.
4. Discuss the function of the nucleus - It contains all genetic information not only for cell but also for the whole organism. It plays a central role in cellular reproduction. It also plays a crucial role with environment, in determining the way they will develop & what form it will exhibit at maturity, by directing the chemical activity in the cell.

Check your Understanding

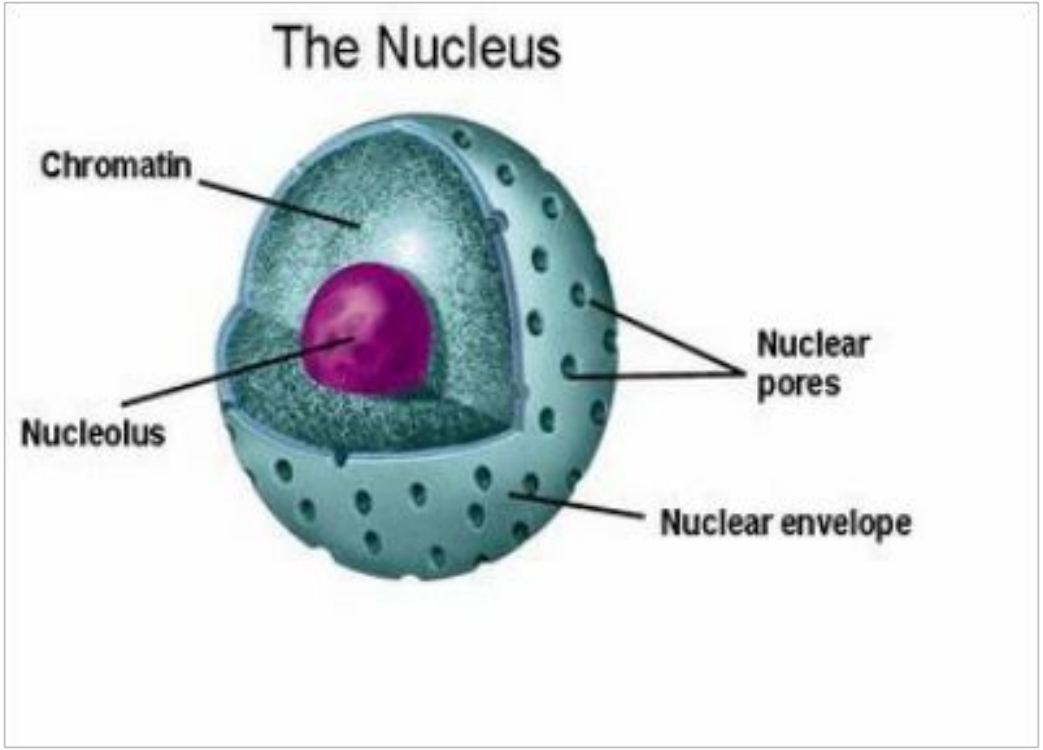
State whether the following are true or false.

a. Functional segment of the gene are DNA. _____
b. Cytoplasm is the fluid like structure inside the nucleus. _____
c. DNA is Deoxyribose nucleic acid. _____

Resources Suggested

Resources 4 (Chart of nucleus), onion peel slide, microscope

Resource 4:


The Nucleus
Chromatin
Nucleolus
Nuclear pores
Nuclear envelope

Subtopic and Learning Objective #6

Cell organelles

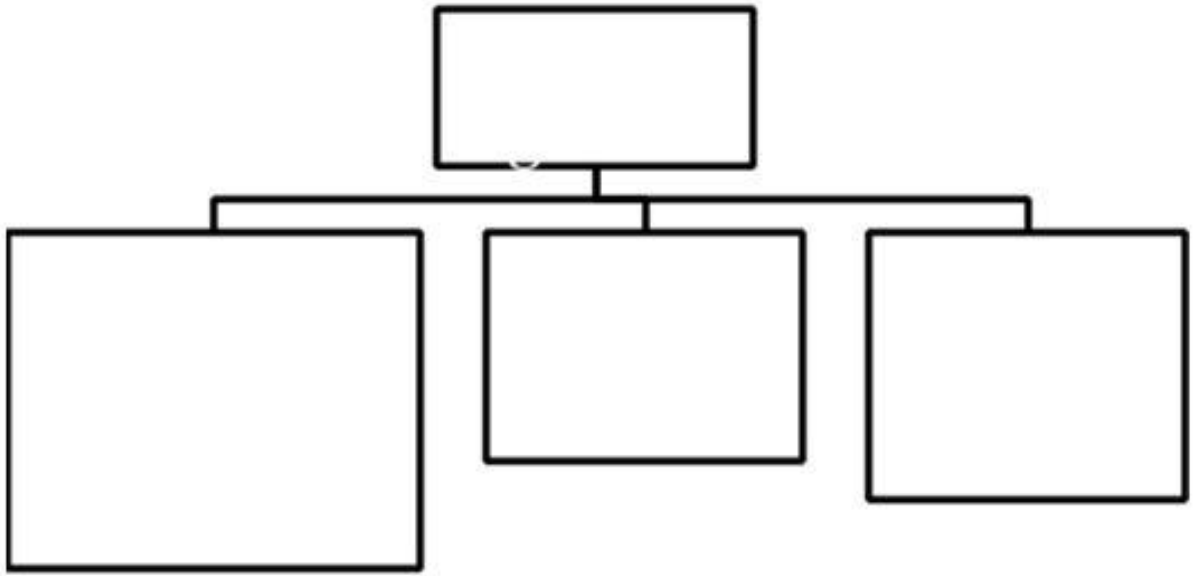
1. Differentiate between living and non-living component of cell
2. Identify and list different cell organelles
3. Explain the structure and function of mitochondria and plastids

Teacher Activity

1. Show students the internal cell structure chart, ask students to identify the cell components based on what they have learnt still now.
2. Write all the names of cell component on the board.
3. Conclude by saying that the various components of the cell are divided into two category living and non- living components.

Non-living component	Living component
Cell wall (fungi & plants only)	Plasma membrane
Vacuole	Cytoplasm
Granules or cell inclusion (are non-living, may be organic or inorganic like food material, secretion, excretion, inorganic salts).	Cell organelles Mitochondria, Lysosomes, Golgi apparatus, Endoplasmic reticulum, Ribosomes , Centrioles (in animal only) Plastids
	Nucleus

4. Inform students that cell organelles found are classify into three types based on presence /absence of membrane.



5. Ask students to share their previous knowledge for the cell organelle i.e. mitochondria and plastids. Appreciate their responses.
6. Conclude by saying that mitochondria are present only in aerobic cells but not in anaerobic protozoan, RBC etc. They are the powerhouse of cell because they releases ATP (adenosine tri phosphate) molecule needed by the cell for various chemical activity. ATP is the energy currency of the cell. These are double membrane bound structure. Function - They are the site for aerobic respiration. They provide energy in the form of ATP. They provide intermediates for synthesis of various chemical like fatty acids, steroids, amino acids, chlorophyll.
    - Tell students that plastids are present only in plants. They are double membrane bound, spherical organelle. Their matrix known as stroma that contains protein, DNA, lipids, ribosomes. Stroma has flat membrane bound sacs called thylakoids which stack together to form grana. There are three type of plastids chloroplast (green), chromoplast (colored), leucoplast (colorless). Function - Leucoplast is storage organelle for starch, oils, and proteins. Chloroplast contain chlorophyll, which absorb light, and is the site for photosynthesis. Chromoplast impart color to flowers & fruits

7. Tell students that both plastids and mitochondria are semi-autonomous in nature because they have their own ribosome & DNA so can make their own protein. They have cellular enzyme in which is energy released.

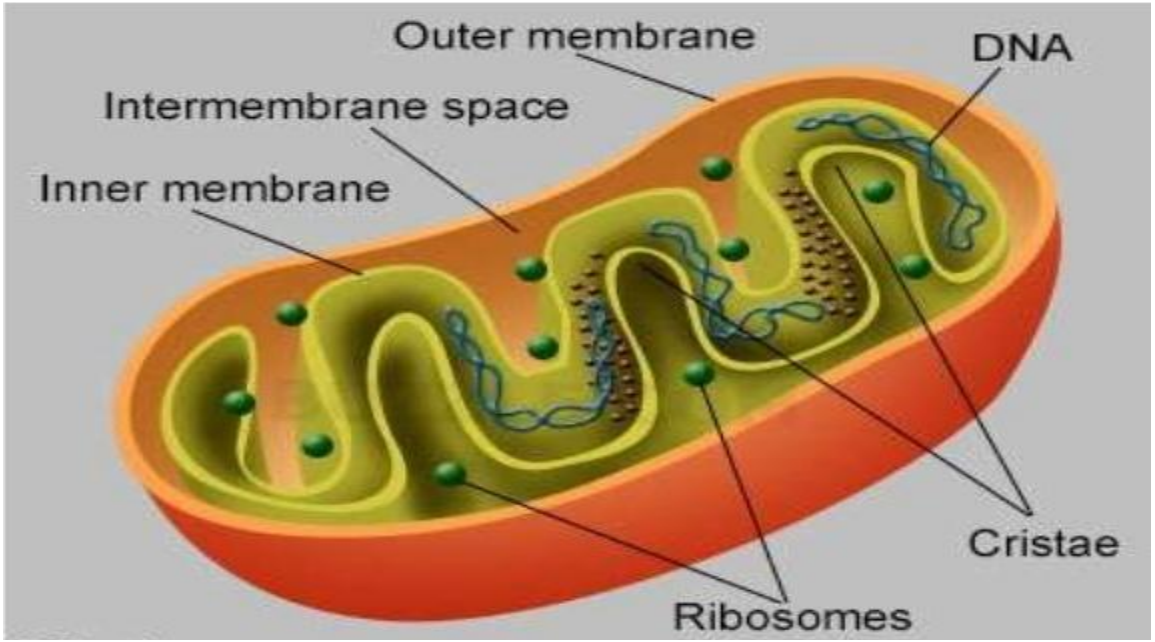
Check your Understanding

a. What is the matrix of plastids known as?
b. Why mitochondria are semi-autonomous?

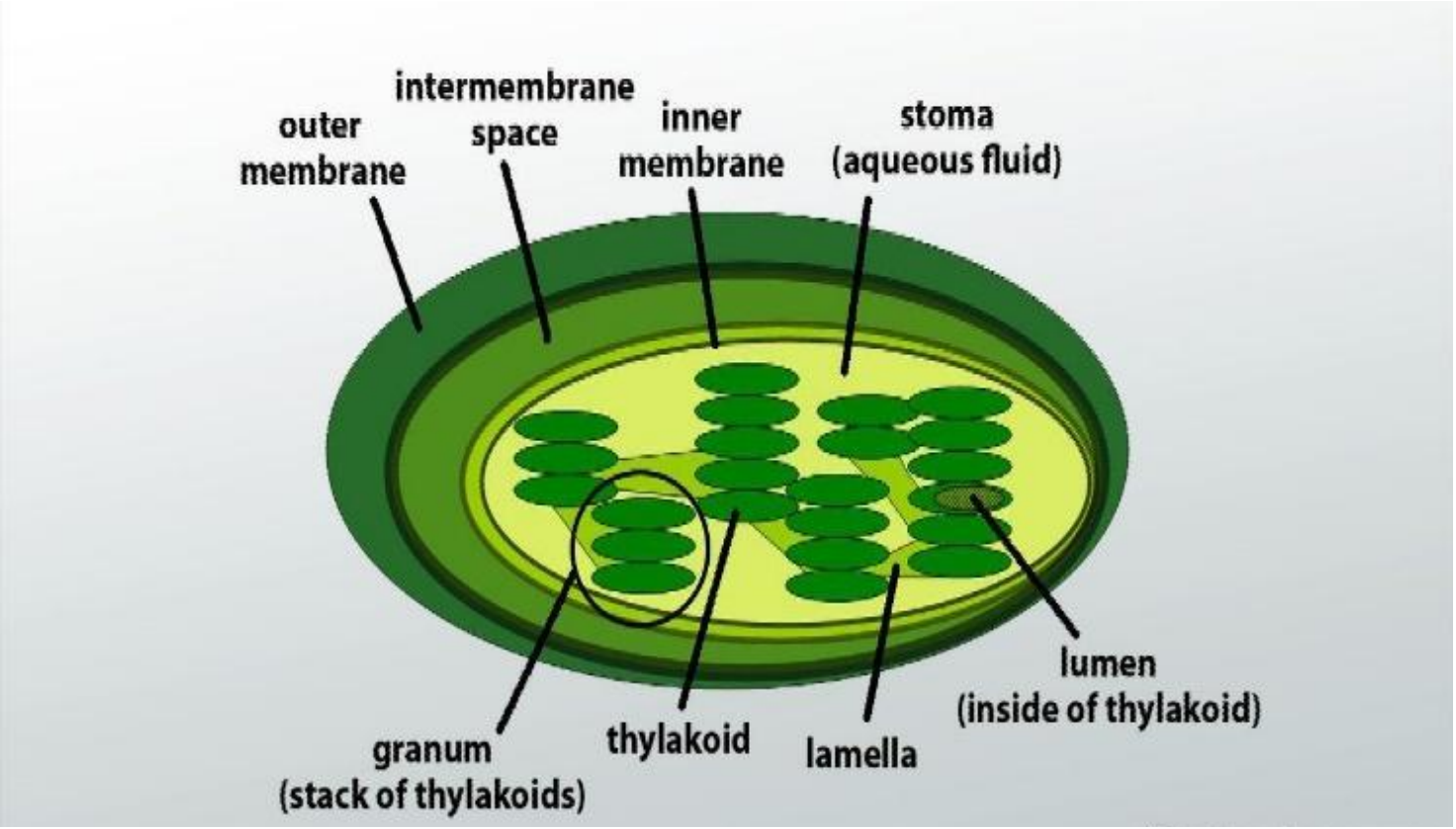
Resources Suggested

Resources 5 (Internal cell structure chart, Chart of mitochondria and plastids)

Resource 5:



Mitochondria


outer membrane
intermembrane space
inner membrane
stoma (aqueous fluid)
granum (stack of thylakoids)
thylakoid
lamella
lumen (inside of thylakoid)

Plastids

Subtopic and Learning Objective #7

Other Cell organelles

1. Explain the structure and function of various cell organelles

Teacher Activity

1. Show students the internal cell structure chart, ask students to identify the cell components based on what they have learnt still now.
2. Discuss all the organelle one by one.
3. Lysosomes are small spherical vesicles bounded by single membrane and contain enzyme for digestion & waste disposal so called digestive bags. They have hydrolytic enzyme synthesized by RER. They have the ability to kill & digest the cellular component so called suicidal bags. They found in all cells except RBC. Function - They help in destruction of foreign particles (bacteria & virus) thus providing protection. They help in intracellular digestion of food particles. They help in removing dead & worn out cellular organelles (cell debris) by digesting them.
4. Golgi apparatus - discovered by Camillo Golgi consists of membrane single bound vesicles arranged parallel to each other in stacks called cisterns. The membrane has connection with the membrane of ER. It is present in all cells except RBC. In plant cell, they forms separate unit called dictyosomes. Function - They help in repair & synthesis of cell membrane.
   They help in formation of lysosomes. They help in storage, modification & packaging of various biochemicals produced by different component of cell. They help in manufacture of complex sugar from simple sugar. The material synthesized by ER are packed & dispatched by Golgi.

5. Endoplasmic reticulum - is a large network of membrane bound tubes & sheets. It is a continuous network from nuclear membrane to plasma membrane. It is found in all cells except RBC. It is of two types:

Rough Endoplasmic reticulum (RER)	Smooth Endoplasmic reticulum (SER)
They are rough because they have ribosome over them.	They are smooth because they donot have ribosome over them.
They synthesized protein.	They synthesized lipids & steroids.

Function - They form skeleton network, helps in transport. They help in synthesis of protein, steroids, and lipids. SER help in detoxification in liver. They help in membrane biogenesis.

6. Ribosomes - are dense spherical particles. Found in both eukaryotic & prokaryotic cell. They are composed of ribonucleic acid & protein. Function - Site of protein synthesis.

Check your Understanding

a. Which organelle is known as suicidal bag?
b. Name the protein factory of the cell.

Resources Suggested

Internal cell structure chart

Subtopic and Learning Objective #8

Plant and Animal cell

1. Differentiate between plant and animal cell based on their structure

Teacher Activity

1. Show students the chart of plant and animal cell.
2. Ask students to differentiate between the two charts in terms of organelle and write them in their notebook.
3. Conclude by writing the points of differentiation on the board.

Plant Cell	Animal Cell
Cell wall, Plastid present.	Cell wall, Plastid absent
Vacuoles are large centrally located	Vacuoles are small & many in number.
They are larger in size	They are smaller in size
Nucleus is generally in the center of the cell	Nucleus is generally pushed to one side of the cell
Centrosome & centrioles are absent.	Centrosome & centrioles are present.

4. With Venn diagram, compare the similarity and difference between plant and animal cell.

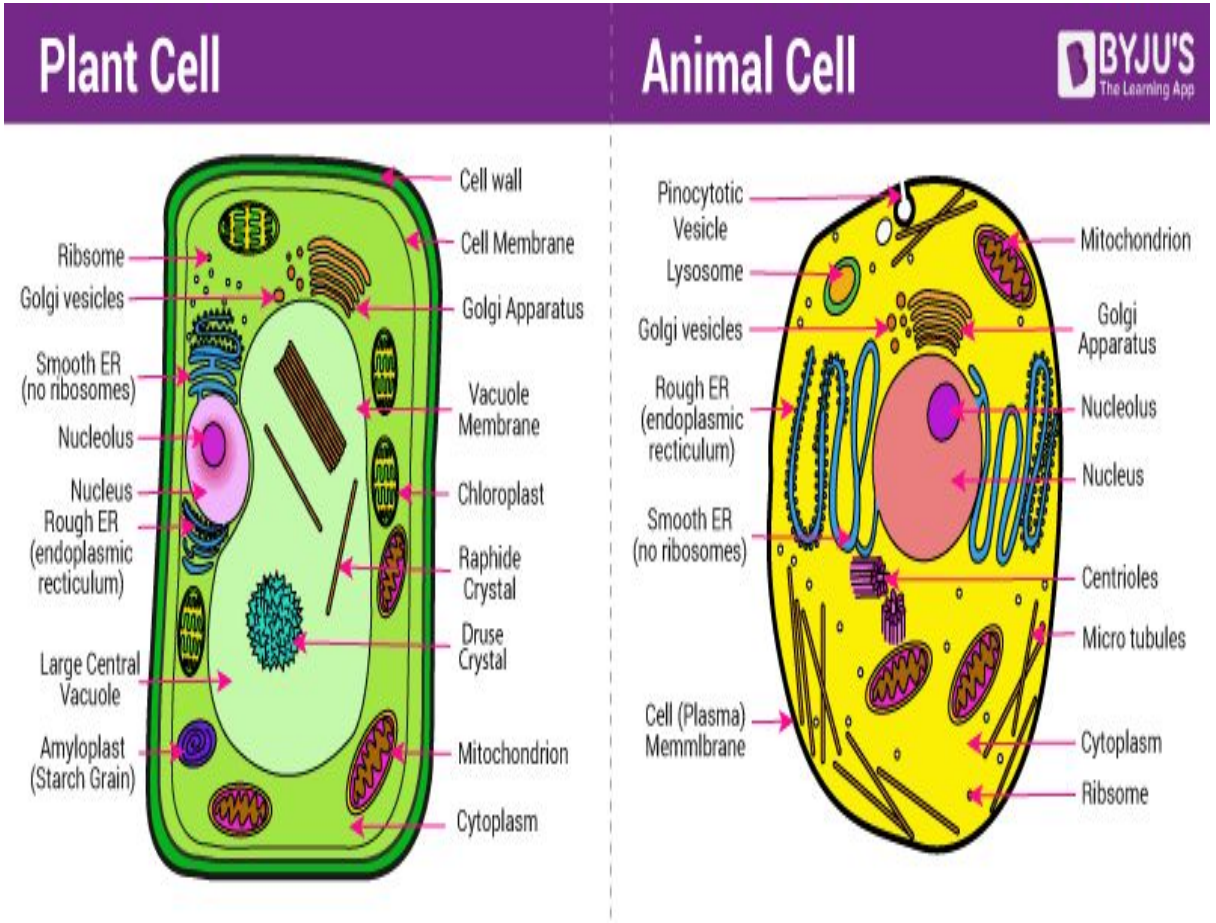
Check your Understanding

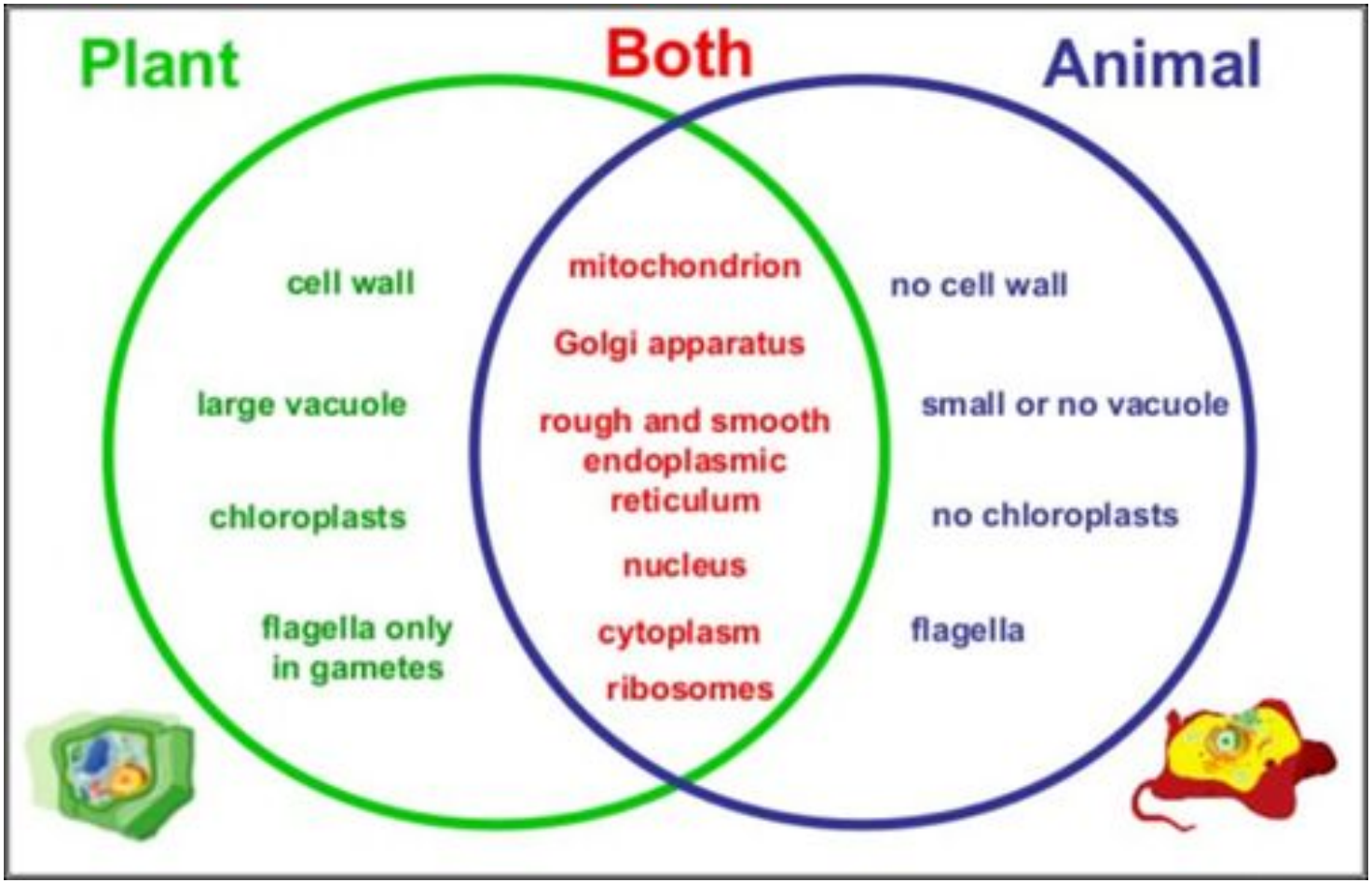
a. Which organelle is confine only to animal cell?
b. Why plant cell can prepare their own food?

Resources Suggested

Resources 6 (Chart of plant and animal cell, Venn diagram)

Resource 6:


Plant Cell
Animal Cell
BYJU'S
The Learning App
Cell wall
Cell Membrane
Golgi Apparatus
Vacuole Membrane
Chloroplast
Raphide Crystal
Druse Crystal
Mitochondrion
Cytoplasm
Ribsome
Golgi vesicles
Smooth ER (no ribosomes)
Nucleolus
Nucleus
Rough ER (endoplasmic recticulum)
Large Central Vacuole
Amyloplast (Starch Grain)
Pinocytotic Vesicle
Lysosome
Golgi vesicles
Rough ER (endoplasmic recticulum)
Smooth ER (no ribosomes)
Cell (Plasma) Memmlbrane
Mitochondrion
Golgi Apparatus
Nucleolus
Nucleus
Centrioles
Micro tubules
Cytoplasm
Ribsome


Plant
Both
Animal
cell wall
large vacuole
chloroplasts
flagella only in gametes
mitochondrion
Golgi apparatus
rough and smooth endoplasmic reticulum
nucleus
cytoplasm
ribosomes
no cell wall
small or no vacuole
no chloroplasts
flagella

4. WORKSHEETS

Print or copy the worksheet questions on the blackboard and ask the students to attempt them. They can be given as homework or a class test as well.

Worksheet 1

Use it like: test after the chapter is complete, homework

Answer the following questions in brief:

1. **Why bacteria and blue green algae not considered a true cell?**
2. **Why mitochondria called as semi –autonomous?**
3. **Differentiate between diffusion and osmosis.**
4. **Draw a Venn diagram to demonstrate the similarity and difference between plant and animal cell.**
5. **What would happen if cell is placed in hypertonic, isotonic, hypotonic solution?**

Worksheet 2

Use it like: checking students understanding in class, oral test

Multiple choice questions:

1. The term cell was coined by:

a) Robert Hook
b) Robert Brown
c) M.J. Schleiden
d) Robert Clown

2. Which is the following organelle is presence exclusively in tomato cell?

a. Mitochondria
b. Lysosomes
c. Nucleus
d. Plastids

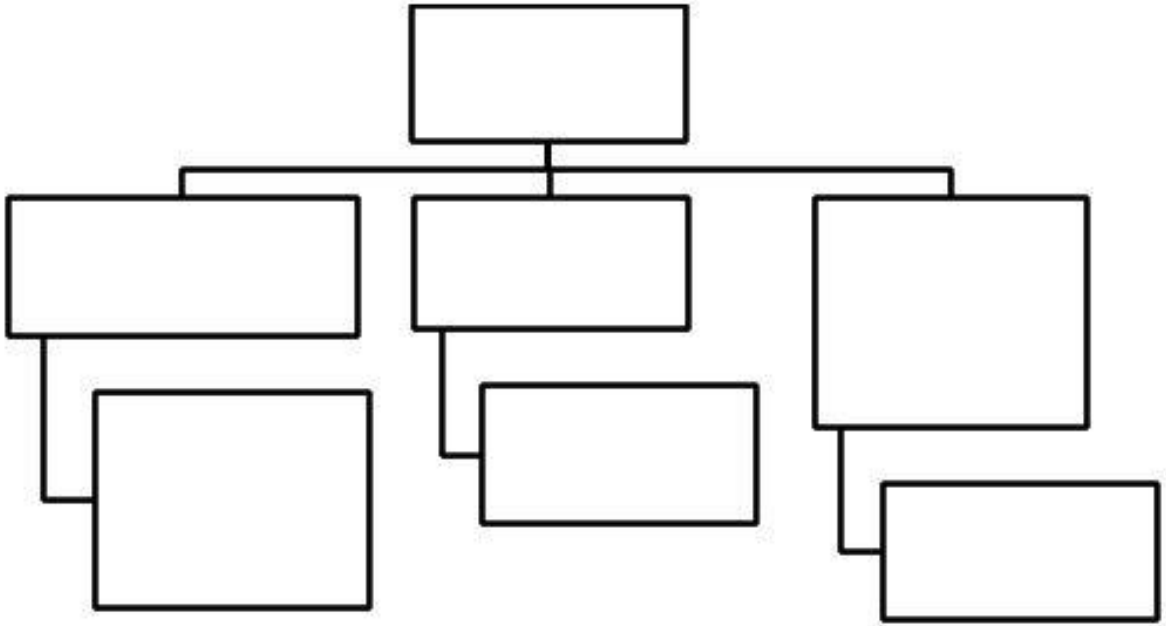
3. Give the full form of ATP.
a. Adenosine Triphosphate
b. Adenosine tetra phosphate
c. Adenosine triple phosphate
d. Adenosine two phosphate

4. Which of the following forms the physical basis of life?
a. Ectoplasm
b. Endoplasm
c. Protoplasm
d. Nucleoplasm

5. The outermost layer of human cheek cell is _____.
a. Cell wall
b. Nuclear membrane
c. Plasma membraneas
d. Protoplasm

Worksheet 3

Complete the given flow chart:



5. SOLUTIONS

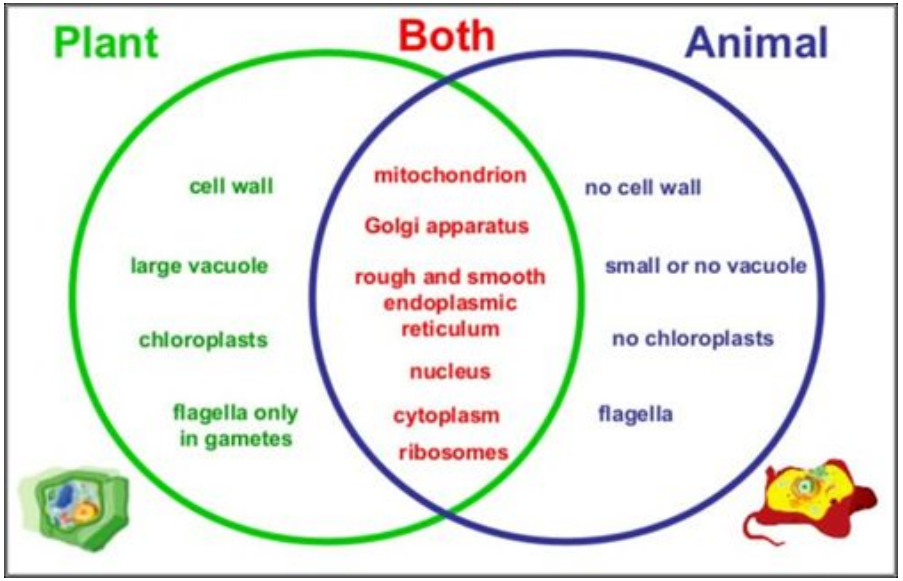
This section gives you sample answers for activities and questions listed above.

Worksheet 1

1. Bacteria and blue green algae not considered a true cell as they do not have nucleus and membrane bound organelles. They have single circular nucleoid.
2. Mitochondria are semi-autonomous in nature because they have their own ribosome & DNA so can make their own protein. They have cellular enzyme in which is energy released.
3.

Osmosis	Diffusion
In osmosis movement of molecules takes place through a semi-permeable membrane.	In diffusion there is no role of semi-permeable membrane.
It involves movement of only solvent molecules from one side to the other.	It involves passage of solvent as well as solute molecules from one region to the other.
Osmosis is limited to solutions only.	Diffusion can take place in liquids, gases and solutions.
Osmosis can be stopped or reversed by applying additional pressure on the solution side.	Diffusion can neither be stopped nor reversed

4.

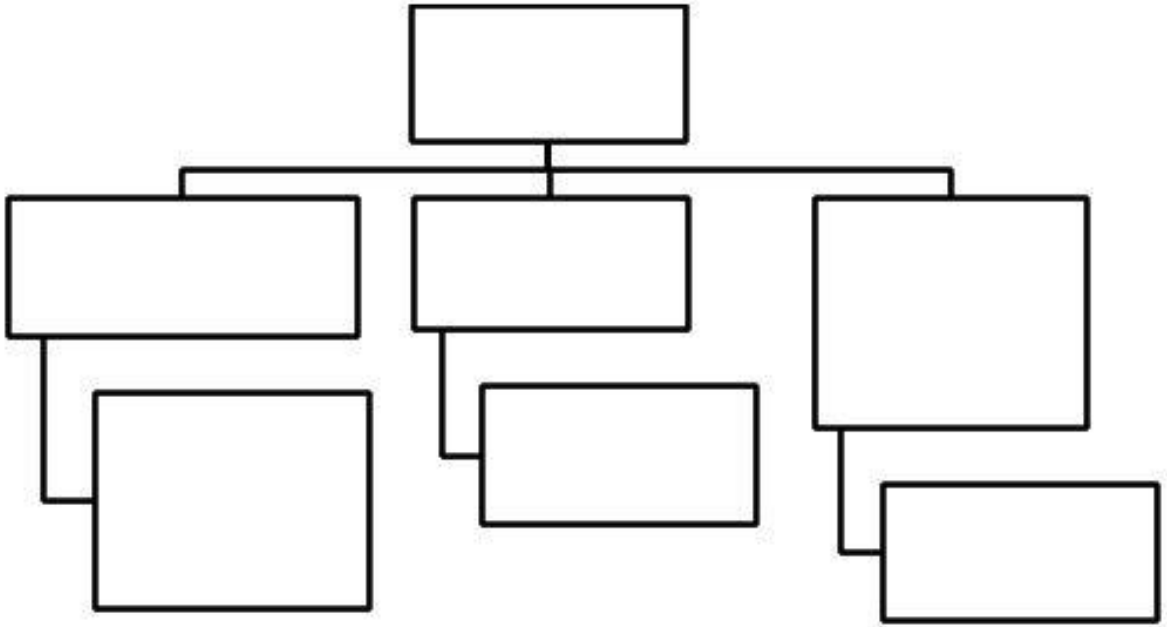


5. When a cell is placed in an isotonic solution it considered being in its normal state. This means that there is an equal amount of diffusible solute on both sides of the membrane. When a cell is placed into a hypotonic solution it will cause the cell to swell and in some cases even burst. This happens when the solution has a lower amount of solute and a higher amount of water than the cells. When a cell is placed into a hypertonic solution the cell will tend to shrink or even shrivel due to the loss of water. This happens when the solution has a higher amount of solute and a lower amount of water than do the cells.

Worksheet 2

1. a
2. D
3. A
4. B
5. c

Worksheet 3



6. EXTRA RESOURCES

Carry out the following suggested activities/ tasks if you have the time and resources to do them

1. **Video Links:**

Show the following videos to the students on computer/ tablet/ screen:

a) Cell organelle:
https://www.youtube.com/watch?v=URUJD5NEXC8

b) Diffusion & osmosis:
https://www.youtube.com/watch?v=zuNMVzTeCtw

c) Types of osmotic solution:
https://www.youtube.com/watch?v=BGtLQSfFQsA

2. **Extension involving more concepts:**
Purpose: Hands on activity
Create a clay model of plant and animal cell