

10. Cell and Cell Organelles



Can you recall?

1. How many types of cells are found in living organisms ?
2. Which instrument had you used to observe cells ?

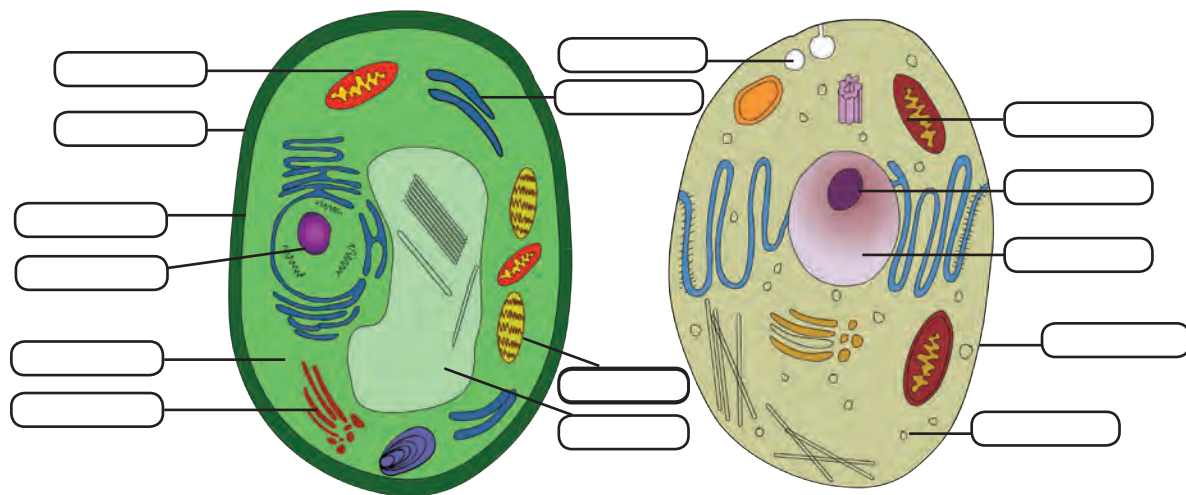
Last year, we studied that cell is the structural and functional unit of living organisms. According to the functions, cells of different sizes and structures are found in different organs.

Structure of the cell



Observe

Observe the following figures, write the names and complete the chart.



10.1 : Plant cell and Animal cell

Component	Animal cell	Plant cell
Cell membrane	Present	Present
Cell wall	.....	.....
.....	Present	Absent
Plastids	.....	.....
.....	Present	Present
Vacuole	.....	.....
Golgi complex	.....	.....
Mitochondria	.....	.....

We must study each and every part of the cell to understand the processes occurring within the cell.

Components of a cell

1. Cell wall : It is found around cells of algae, fungi and plants. Animal cells lack cell wall. Cell wall is an elastic and strong coat around cell membrane. It is mainly composed of carbohydrates like cellulose and pectin. Afterwards, polymers like lignin, suberin, cutin are added in cell wall as per need. Functions of cell wall are to support and to protect the cell by preventing entry of excess water in the cell.

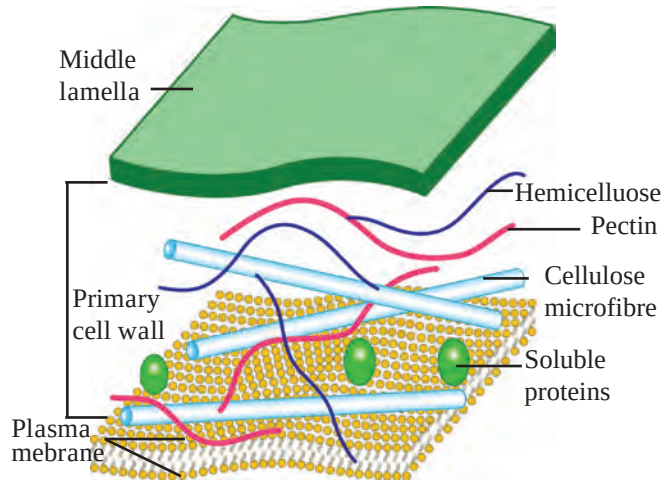
2. Plasma membrane/cell membrane : It is a thin, fragile and elastic covering that separates the cell components from outer environment.

Structure of plasma membrane - Protein molecules are embedded in two layers of phospholipids.

Plasma membrane is said to be a selectively permeable membrane as it allows some substances to enter the cell, while prevents other substances.

Due to this property, useful molecules of water, salt and oxygen enter the cell and CO_2 exits the cell.

If any changes occur outside the cell, the cellular environment does not change due to plasma membrane. This condition is called homeostasis.



10.2 Structure of cell wall



Can you tell?

How do substances travel in the cell ?

Activities that consume cellular energy

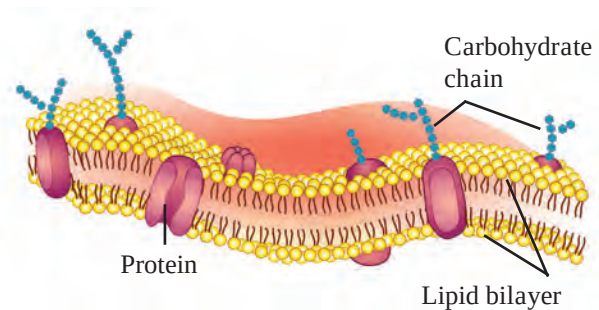
1. Endocytosis - To gulp/engulf food and other substances from outer environment.

2. Exocytosis - To excrete waste materials out of cell.

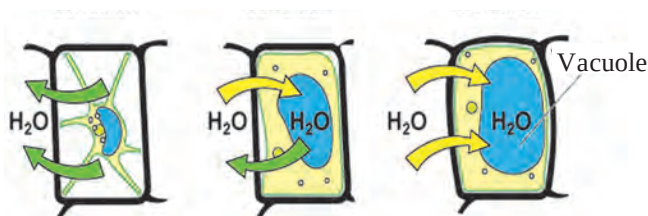
Processes those that don't consume cellular energy

1. Diffusion - Entry or exit of small molecules like O_2 , CO_2

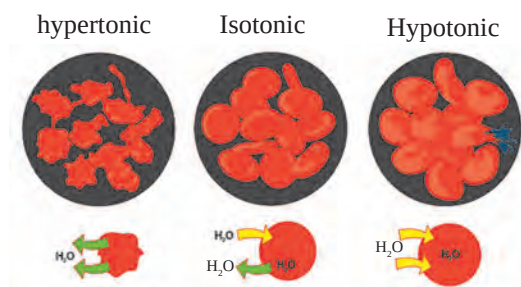
2. Osmosis - The travelling of water from a part with more water to a part with less water, through a selectively permeable membrane is osmosis. It is a physical process with 3 possibilities.



10.3 Structure of Plasma membrane



Osmosis in plant cell



Osmosis in animal cell

10.4 Osmosis



Research

1. Keep 4-5 raisins in water and observe after an hour. Afterwards, keep the same raisins in sugar solution and observe after an hour. Note down the observations and discuss in the classroom.
2. Wooden doors fit very tightly in rainy season. Why does it happen ?

a. Isotonic solution - Medium outside and inside the cell has same proportion of water, water doesn't go in or out.

b. Hypotonic solution - The cell has less water than outside medium, so water enters the cell. This is called endomosis. Eg. If raisins are kept in water, after sometime they swell and become turgid.

c. Hypertonic solution -

The cell has more water than the outside medium so water comes out of the cell. Eg. If fruit pieces are kept in thick saturated sugar solution, the water from fruit pieces enter the sugar solution. So the fruit pieces shrink after a while. If plant cell or animal cell is kept in hypertonic solution, water comes out of the cell by the process of exosmosis and there is contraction of cytoplasm. This process is called plasmolysis.

3. Cytoplasm -



Can you recall?

Have you seen the fully turgid, rectangular cells of onion peelings ?

Cytoplasm is the fluid between plasma membrane and nucleus. It is a moving, sticky substance. Many cell organelles are suspended in cytoplasm. Cytoplasm is the medium for cellular chemical reactions. The part of cytoplasm other than organelles is the cytosol. Cytosol stores vital substances like amino acids, glucose, vitamins, etc. In animal cells, cytoplasm is more granular and dense while in plant cells, it is thin and mostly pushed to the periphery due to a larger central vacuole.

Cell organelles : An organelle is a specialized subunit having specific function within the cell. They are 'organs of the cell.' Each organelle has its own lipoprotein membrane. Except nucleus and chloroplast, all other organelles can be seen only with electron microscope.

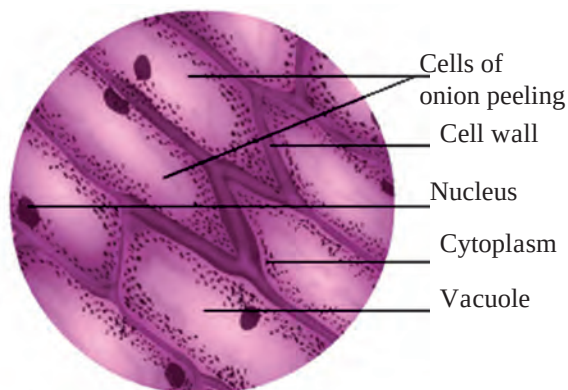
Nucleus



Try this

Activity - Take a drop of water on a clean glass slide. Using an ice-cream spoon, gently scrape the inner surface of your cheek. With a needle, transfer a little material from spoon to the water drop on the slide and spread it evenly. Put a drop of methylene blue stain on the smear. Put a cover slip and observe under microscope. Did you observe the cells with blue nucleus ?

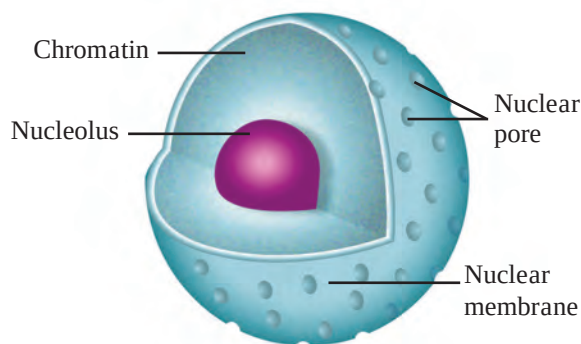
The dark round spot seen under the microscope while observing the onion peeling stained with iodine is the nucleus of the cell.



10.5 Onion peeling



10.6 Electron microscope



10.7 Nucleus

When observed under electron microscope, we can see nucleus covered by a double layered membrane with small pores. These pores allow the passage of material in and out of the nucleus. Nucleus has one round nucleolus and a network of chromatin fibres. Chromatin fibres are thin thread like structures, which condense to form short thick chromosomes at the time of cell division. Functional segments on chromosomes are called genes.

Functions of nucleus

1. It controls all metabolic activities of the cell and also the cell division.
2. It is involved in the transmission of hereditary characters from parents to offsprings.



Do you know?

- Due to loss of nucleus, large quantity of haemoglobin can be accommodated in the RBC and thereby large amount of oxygen can be transported.
- Due to the loss of nucleus of sieve tubes of the plant phloem, they become hollow and thereby transportation of food becomes easy.

Endoplasmic Reticulum (ER)

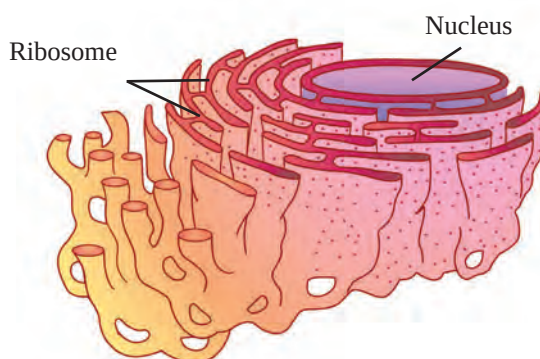


Think about it.

How many types of pipelines are there in your building/home ?
What are their functions ? What will happen if they weren't there ?

The organelle which conducts various substances inside the cell is called endoplasmic reticulum. E.R. has a net like structure consisting of interconnected miniature tubes and sheets filled with fluid. E.R. is connected to nucleus from innerside to plasma membrane from outer side.

Rough ER has ribosome granules on its outer surface.



10.8 Endoplasmic Reticulum

Functions of ER

1. It is the framework that supports cell.
2. Conduction of proteins.
3. Toxins that have entered the body through food, air and water are made water soluble by ER and then flushed out of the body.



Think about it.

- What materials are used to pack your favorite biscuits and chocolates?
- What is the function of 'Packing department' of any factory ?

Golgi Complex : It is made up of 5-8 hollow and flat sacs placed parallel to each other. These sacs are called 'cisternae' and are filled with different enzymes. The proteins coming from ER are enclosed in vesicles, which come towards golgi complex via cytoplasm. They fuse with the formation face of the golgi membranes and empty their contents in the cisternae.

As they pass through the cisternae, they are chemically modified with the help of enzymes. They are again packed in the vesicles. These vesicles exit from the maturation face. Thus, cisternae work like a packing department that packs and distributes substances.

Functions

1. Golgi complex is the secretory organ of the cell.
2. It modifies, sorts and packs materials synthesized in the cell (enzymes, mucus, proteins, pigments etc.) and dispatches them to various targets like plasma membrane, lysosome etc.
3. It produces vacuoles and secretory vesicles.
4. It helps in the formation of cell wall, plasma membrane and lysosomes.

Lysosomes



Can you tell?

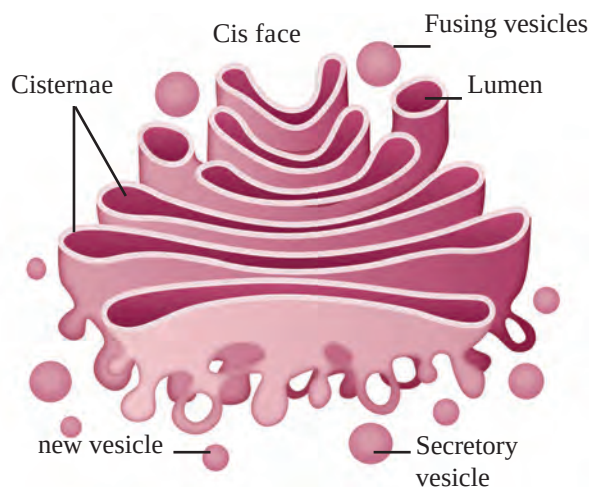
What happens to the agricultural waste after a few days when it is dumped in a compost pit ?

Due to various metabolic activities in the cell, organic waste is generated. Lysosomes digest the waste.

Lysosomes are simple, single membrane bound sacs, filled with digestive enzymes.

Functions

1. Immune system - It destroys viruses and bacteria that attack the cell.
2. Demolition squads - It destroys worn out cellular organelles and organic debris. (Autolysis)
3. Suicide Bags - When a cell becomes old or is damaged, lysosomes burst and enzymes digest their own cells.
4. During starvation, lysosomes digest stored proteins, fats.

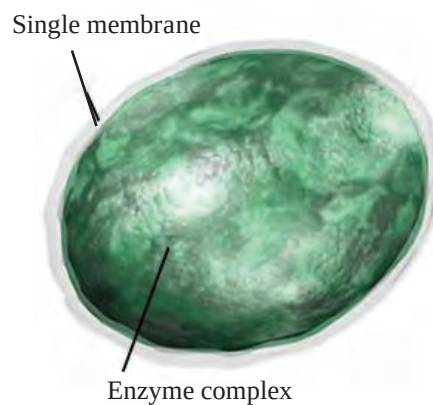
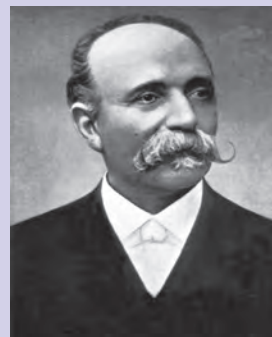


10.9 Golgi Complex

Introduction to scientists

Camilio Golgi described the Golgi complex for the first time. He developed the staining technique called 'Black reaction' and with the help of it, he studied nervous system.

He won the Nobel prize of 1906 along with Santiago Cajal for the study of structure of nervous system.



10.10 Lysosomes

Mitochondria



Can you tell?

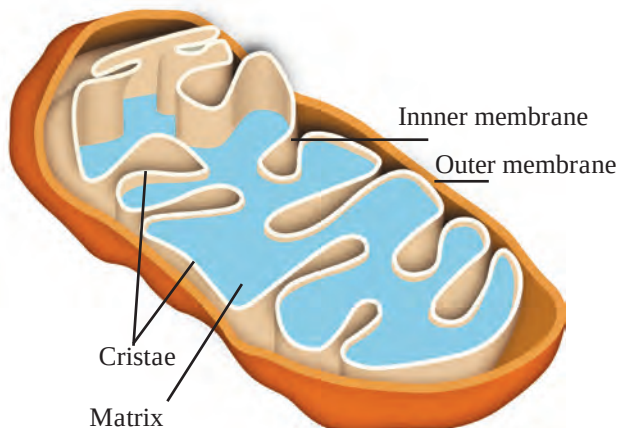
Which type of energy is required to run the fans, computers and electric bulbs ? Where is this energy produced ?

Each cell requires energy and this energy is produced in the mitochondria. Under the electron microscope, a mitochondrion is seen as a double membrane structure.

The outer membrane is porous and the inner membrane is deeply folded. These folds are called 'cristae'. The inner cavity is filled with proteinaceous gel like matrix containing ribosomes, phosphate granules and DNA. Therefore it can produce its own proteins. With the help of enzymes, mitochondria oxidise carbohydrates and fats in the cell. The energy released in this process is stored in the mitochondria in the form of ATP (Adenosine Tri Phosphate). Plant cells have less mitochondria than animal cells.

Functions

1. To produce energy-rich compound- ATP.
2. Synthesis of proteins, carbohydrates, lipids etc. by using the energy in ATP.



10.11 Mitochondria



Do you know?

Mitochondria are absent in RBCs. Due to this, the oxygen which is carried by them is not used for themselves.



Use your brain power

What is the benefit of foldings of inner membrane in mitochondria ?

Vacuoles

Vacuoles are the storage sacs for solid or liquid contents. They don't have any typical shape or size. The structure of the vacuole changes according to the need of the cell. Vacuole is bound by single membrane.

Functions

1. To maintain the osmotic pressure of the cell.
2. To store metabolic byproducts and end products. (Glycogen, proteins, water etc).
3. In animal cell, they store waste products and food, while in amoeba it stores food before digestion.
4. In plant cell, vacuoles are full of cell sap and provide turgidity, rigidity to them.



10.12 Vacuoles

Plastids : Why are plant leaves green and flowers red, yellow, orange or blue ? The organelle which gives such colours is present only in the plant cells - it is called plastid. Plastids have double membrane and are of two types

Colour of the plant part	Pigment
Green (ex. Leaves)	Chlorophyll
Orange (ex. Carrot)	Carotene
Yellow	Xanthophyll
Purple, blue	Anthocyanin
Dark pink (ex. Beet)	Betalains
.....	

1. Leucoplasts - White or colourless plastids
2. Chromoplasts - Coloured plastids

Chloroplast can get converted into other types of chromoplasts. Eg. Raw green tomatoes turn red due to breakdown of chlorophyll and synthesis of lycopene.

Chloroplast

Activity - Take out a thin peel of Rheo or Croton leaf and observe the chromoplasts under the compound microscope.

Chloroplasts are important for the photosynthesis process that takes place in the leaves. Chlorophyll in chloroplast traps solar energy and converts it to chemical energy. Stroma in the chloroplast contains enzymes, DNA, ribosomes and carbohydrates that are necessary for photosynthesis.

Functions

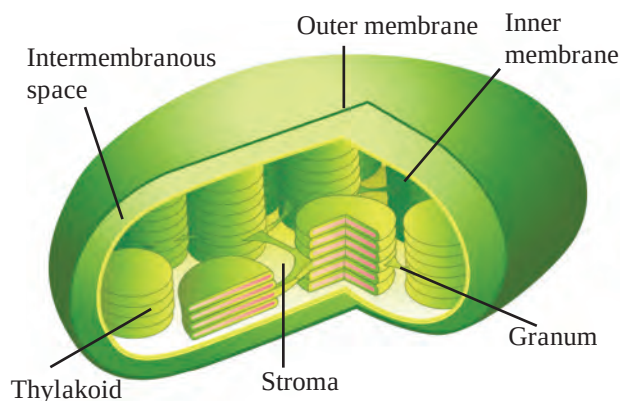
1. Chloroplasts convert solar energy to chemical energy (food).
2. Chromoplasts give different colours to flowers and fruits.
3. Leucoplasts are involved in the synthesis and storage of food like starch, oils and proteins.

Mitochondria and plastids can produce proteins as well as replicate themselves, as they have their own DNA and ribosomes.

After studying the cell and cell organelles, you must have come to know that all the functions in plant and animal cells are taking place smoothly due to the cell organelles. Such developed cells are called eukaryotic cells. Last year, you have studied prokaryotic cells of bacteria. Let's now compare them.

Internet my friend

Collect the information about more colors observed in flowers and fruit and the responsible pigments and complete the above chart.



10.13 Chloroplast

Work of institute : National Centre for Cell Science - NCCS is an independent institute working under biotechnology department of Government of India. It is located in the campus of Savitribai Phule Pune University, Pune and involved in research in cytology. It provides services for National Animal cell repository. It is mainly working on research about cancer treatment.

Eukaryotic cell	Prokaryotic cell
• Size - 5-100 micrometer • Number of chromosomes - More than one • Nucleus - with nuclear membrane, nucleolus and nucleoplasm • Mitochondria and plastids - present • Examples - Present in highly evolved unicellular and multicellular plants and animals.	• 1-10 micrometer. • Only one. • Nucleoid resembling nucleus • They don't have membrane bound cell organelles • Bacteria

Exercises

1. Who am I ?

- I am ATP producing factory.
- I am single layered, but maintain cellular osmotic pressure.
- I support the cell, but I am not cell wall. I have a body resembling net.
- I am chemical factory of the cell.
- Leaves are green because of me.

2. What would have happened ? If.....

- RBCs had mitochondria.
- There had been no difference between mitochondria and plastids.
- Genes had been absent on the chromosomes.
- Plasma membrane had not been selectively permeable.
- Plants lacked anthocyanin.

3. Who is odd man among us? Give reason.

- Nucleolus, mitochondria, plastids, endoplasmic reticulum
- DNA, Ribosomes, Chlorophyll

4. Give functions.

- Plasma membrane
- Cytoplasm
- Lysosome
- Vacuole
- Nucleus

5. Who gives me the colour? (Select the correct option.)

- | | |
|---------------|----------------|
| a. Red tomato | 1. Chlorophyll |
| b. Green leaf | 2. Carotene |
| c. Carrot | 3. Anthocyanin |
| d. Violet | 4. Lycopene |

Project :

1. Prepare model of a cell using different ecofriendly materials.
2. Study osmosis using parchment paper or a similar membrane.
3. Form a friends' group in your class. Give each one role of a cell organelle. Present a skit accordingly.



Useful apparatus for studying cells

