

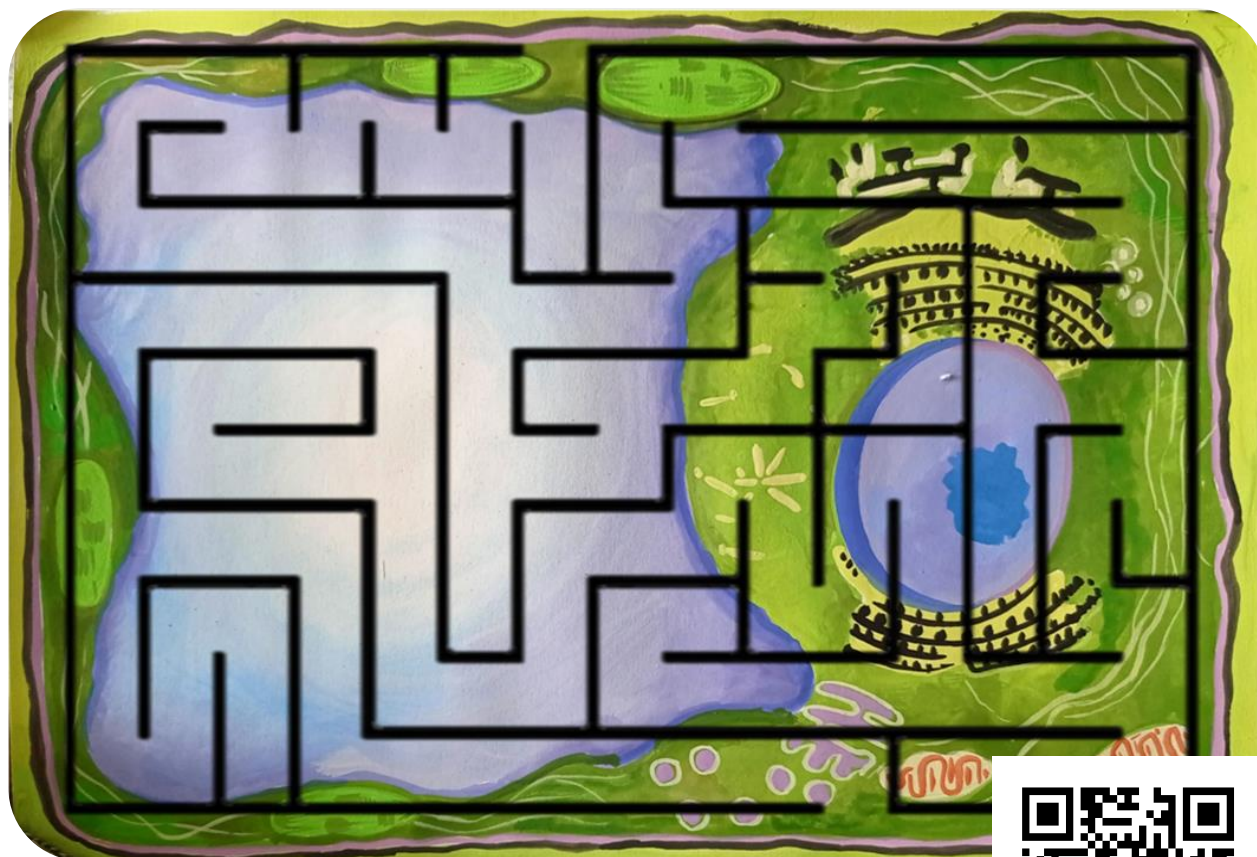


CELL-A-MAZE

Graphic Novel: Science

Grade: IX

Chapter-The Fundamental Unit of Life



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0964CH05

Delhi Public School, Jaipur

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Preface

This novel is an endeavour to introduce the concept of art integration with Science. It advocates innovation for good pedagogical, research-based reasons, to have a positive impact on the learning capabilities of the students.

The novel is an effort to explain the chapter '**The Fundamental Unit of Life**' in a simple way. Although Cytology is supposedly the 'easiest' of the Science disciplines, research on student learning has shown that even high calibre, high achieving students sometimes find it difficult to build a scientifically conceptual and contextual foundation of the same.

This novel features a paradigm shift in the way cell and its structure is taught. The story is set in an Inter-House Competition where four students compete to win glory for their respective Houses. Shantanu, Aadi, Pari and Jagruti are the four participants selected to participate from their respective Houses. What lies ahead of them is the daunting task of competing in the Cell-a-maze, an Inter-House Competition packed with clues that can only be solved with knowledge about the cell. Every riddle is a clue and every clue takes them closer to the exciting end!

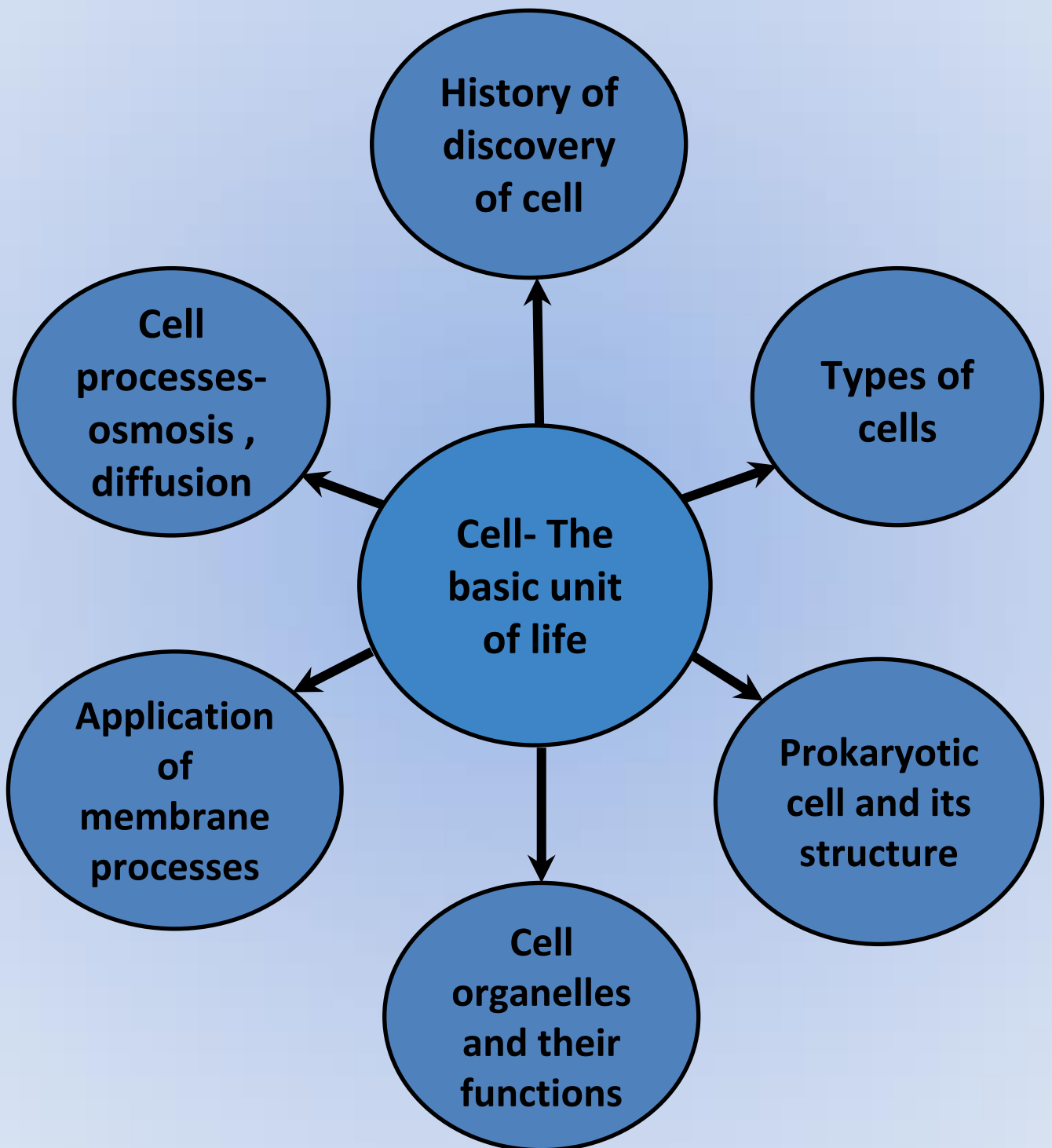
The reader is taken on an adventurous ride with twists and turns, whilst learning all about the cell and its structure. By the end of the novel, the readers not only gain knowledge about the cell but also learn interesting facts about the cell organelles and the scientists.

Learning Outcomes

The students will be able to-

1. Learn about the history of the discovery of cell and its organelles.
2. Define Prokaryotic and Eukaryotic cells.
3. Understand the structure and functions of each of the following -
 - a. Plasma membrane
 - b. Cell wall
 - c. Endoplasmic reticulum
 - d. Nucleus
 - e. Golgi apparatus
 - f. Lysosomes
 - g. Mitochondria
 - h. Plastids
 - i. Vacuoles
4. Explain and apply the concepts of cellular functions such as diffusion and osmosis.
5. Compare and contrast the plant cells and the animal cells.
6. Define and differentiate the types of cell division.

Story Board



The Characters

1. Ms Charu Joshi- Principal

She is a dynamic and versatile personality. She always encourages innovative ideas.



2. Ms Avanti Sharma- Science Teacher

She has her unique way of teaching Science to her students. She is dedicated to her subject.

3. Mr Ranjan Singh- Sports Teacher

He has a sturdy and athletic physique. He is a role model for the sports enthusiasts.



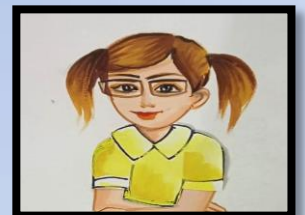
4. Shantanu- A reticent and shy boy, Shantanu doesn't take any initiative. He is the participating candidate from the Blue House.

5. Aadi- He escapes learning and practising his assignments. He is all set to win the title for the Red House.



6. Pari- She lacks focus and concentration. She has been chosen as the finalist from the Green House.

7. Jagruti- She is an innocent and simple girl. Academics is not her forte. She is the participant from the Yellow House.



The House Captains



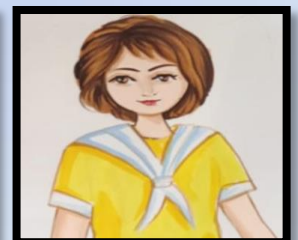
Yuvraj



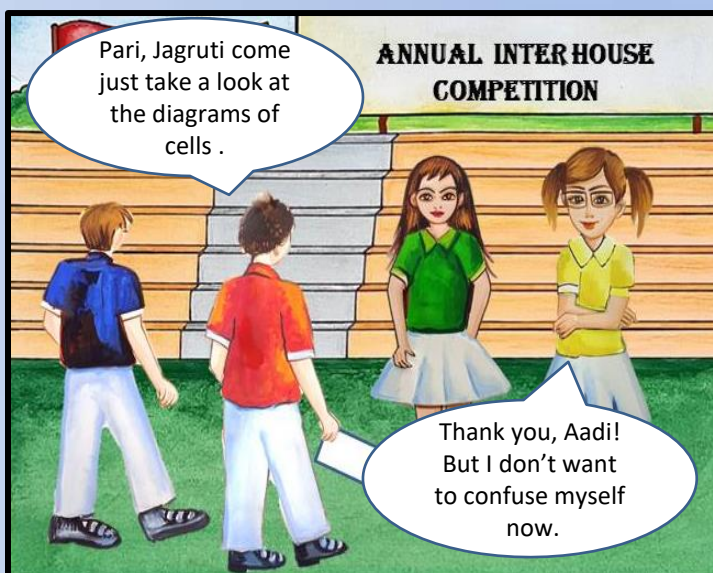
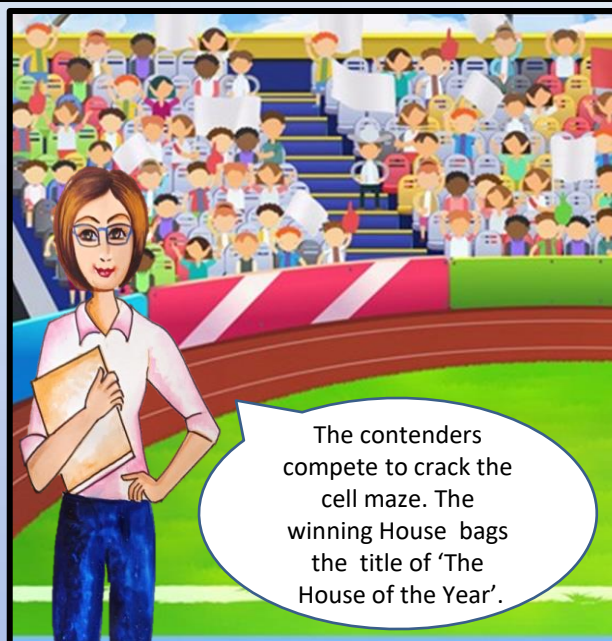
Rishi



Anoushka

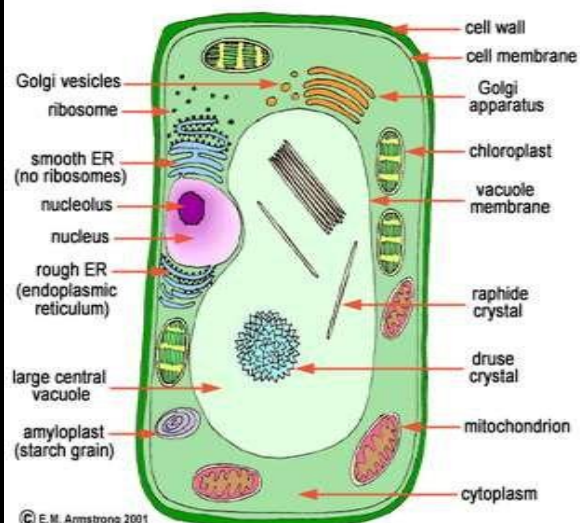


Shikha

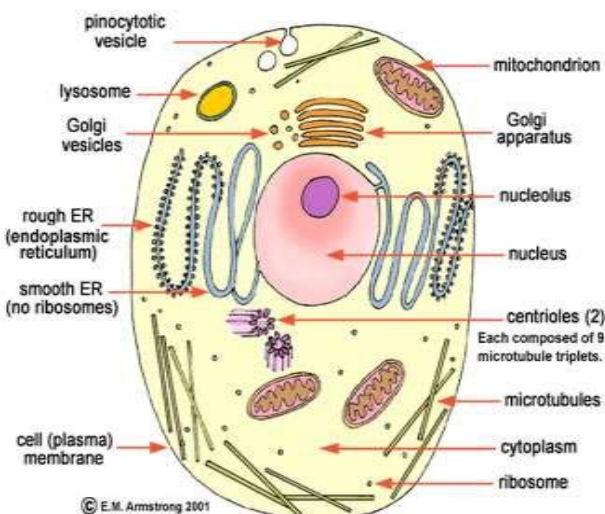


The **cell** (from Latin *cella*, meaning 'small room') is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life. Cells are often called the 'building blocks of life'.

Plant Cell

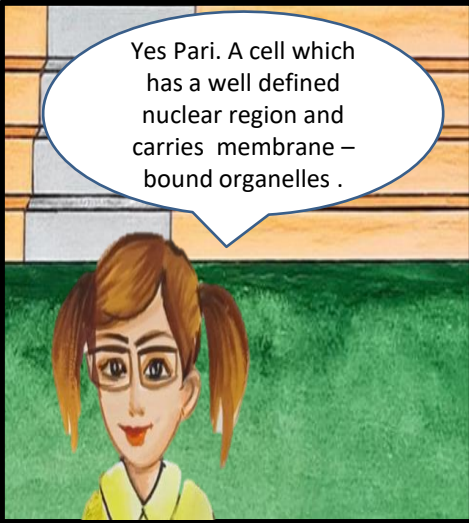


Animal Cell





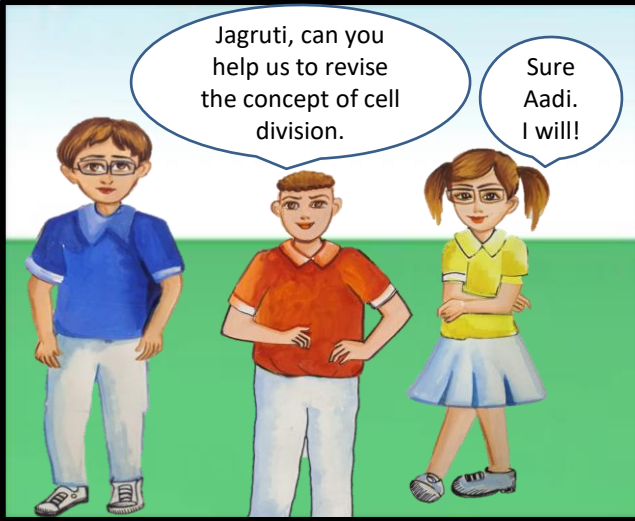
Jagruti, do you know what is a Eukaryotic cell ?



Yes Pari. A cell which has a well defined nuclear region and carries membrane – bound organelles .

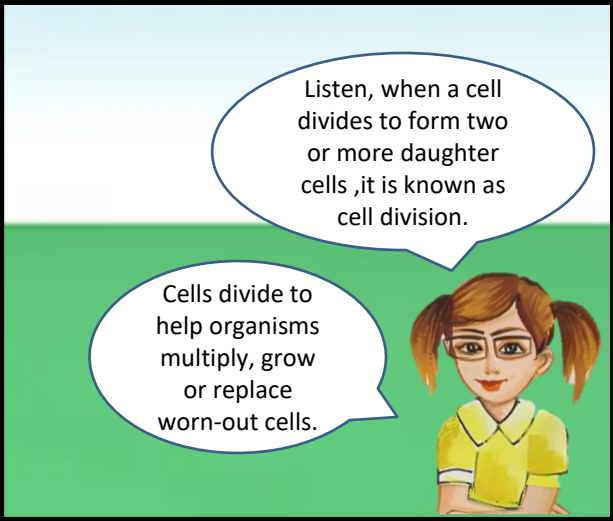


Oh! Just like the ones Aadi and Shantanu are revising?



Jagruti, can you help us to revise the concept of cell division.

Sure Aadi. I will!

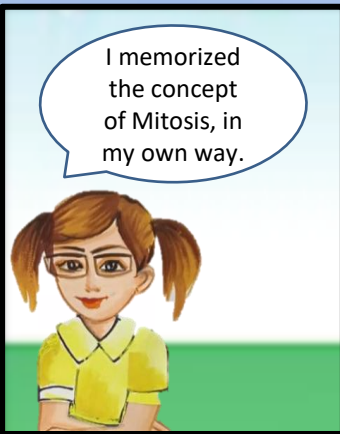


Listen, when a cell divides to form two or more daughter cells ,it is known as cell division.

Cells divide to help organisms multiply, grow or replace worn-out cells.



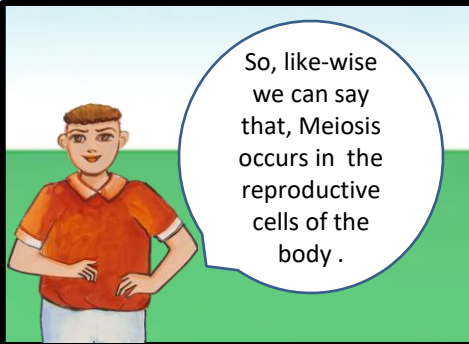
Now I remember- Mitosis and Meiosis. They are the two types of divisions.



I memorized the concept of Mitosis, in my own way.

MY
I DENTICAL
T WINS
O PERATES
S IMILARLY
I N
S YSTEMS

Mitosis is a process of cell division, in which one cell divides into two genetically identical diploid daughter cells. It occurs in the somatic cells.



So, like-wise we can say that, Meiosis occurs in the reproductive cells of the body .



.. And the four cells produced are haploid and non- identical



Okay! Now let's move towards the maze.

The House Captains

Cell! Is that going to decide the Inter-House Championship?

Listen, cell is fine but look at the participants.

Do you seriously think they will be able to perform today?

ANNUAL INTER HOUSE COMPETITION

Come on friends, we have been working with them. Let's at least have faith in our own efforts.

Avanti ma'am also has been giving her 100% to all of us.

Yes, let's see our contestants and cheer them up. They really are a nervous bunch today.

Inter House Competition - Teams

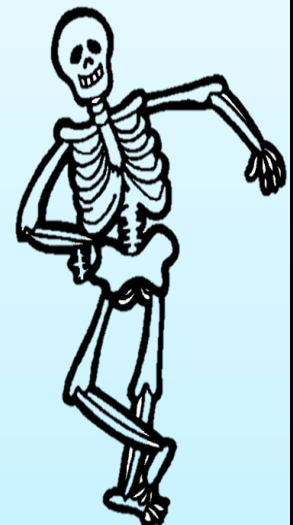
Ground set up as a cell maze



Each participant needs to pick up a chit which has clues related to cells.



A related fact file will be displayed on the board as participants solve the clues.



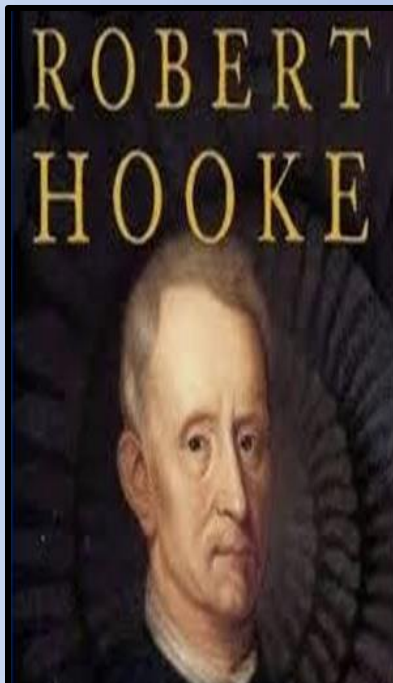
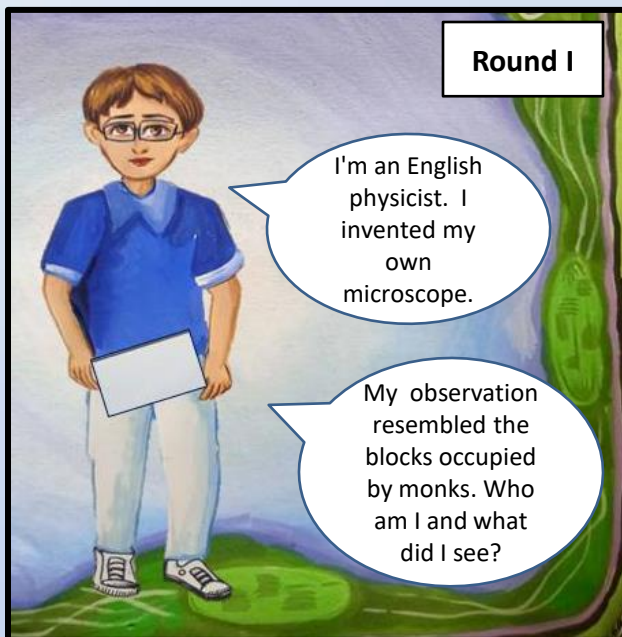
Once inside the maze, locate your House boards for clues.



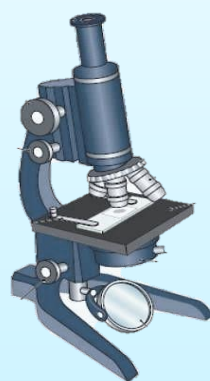
All the best!
Let's start with the Blue House..



The human bone is stronger than granite or concrete!
Compared to concrete, the human femur bone is four times greater in support strength! The human bone marrow produces 260 billion red blood cells and 135 billion white blood cells each day! Phew! That's a lot of work!



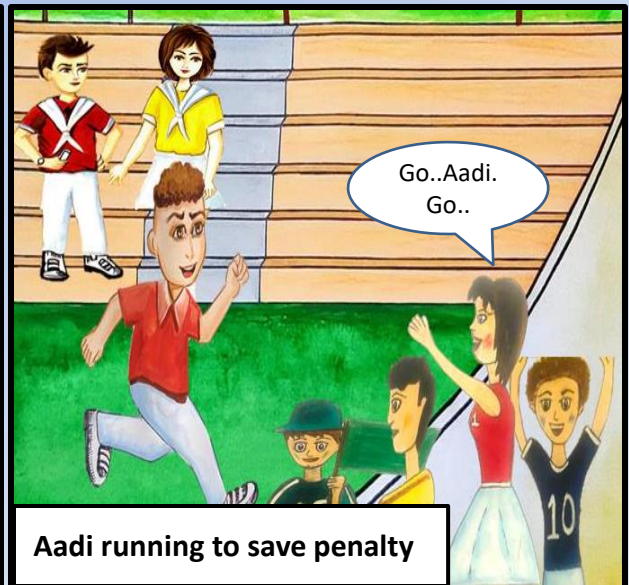
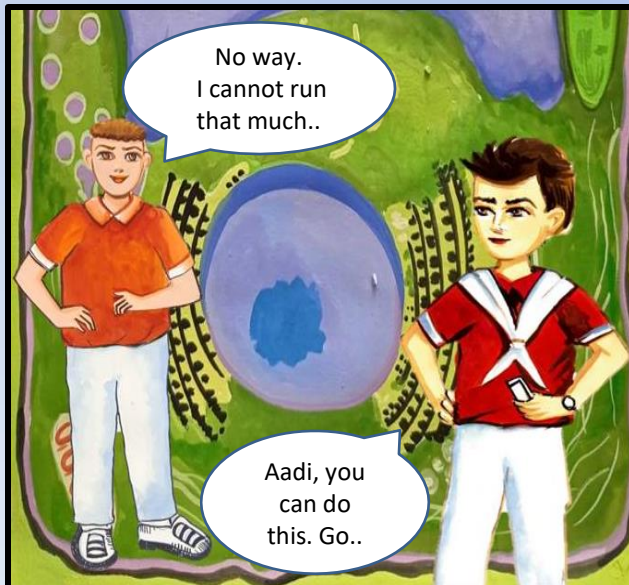
- Robert Hooke was a famous scientist, born in 1635. He discovered the Law of Elasticity (or Hooke's Law) and did a huge amount of work on **microbiology**.
- He published a famous book called *Micrographia*, which included sketches of various natural things under a microscope.
- He is referred to as a 'polymath' because he studied and contributed to so many subjects.
- There is a crater on the moon called the Hooke Crater, named after Robert Hooke.



The term microscope can be split into two separate words, 'micro' and 'scope', where the term 'micro' means small Or tiny, and 'scope' means to view or to observe. Therefore, a microscope can be understood as an instrument to observe tiny elements.

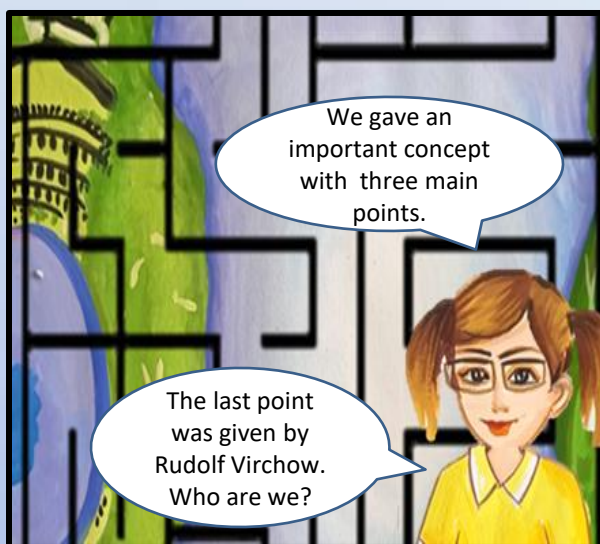
Robert Hooke observed a piece of cork under a crude self-designed microscope. The observations recorded by him led to the discovery of the CELL.







- Van Leeuwenhoek discovered 'protozoa' - the single-celled organisms and he called them 'animalcules'.
- Microbes are tiny living things that are found all around us and are too small to be seen by the naked eye.
- They live in water, soil, and in the air. The human body is home to millions of these microbes too, also called microorganisms.



Time to Reflect

1. Who discovered the cell?
2. What are microbes?
3. What was Rudolf Virchow's contribution to the cell theory?

Theodor Schwann and Matthias Schleiden stated that all living things are made of cells. (1839)



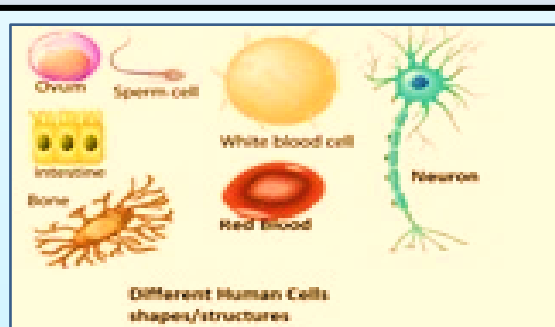
Matthias Schleiden
(plants)



Theodor Schwann
(animals)



- The cell theory was developed by Theodor Schwann and Matthias Jakob Schleiden.
- Rudolf Virchow used the theory that all cells arise from pre-existing cells.



Cells have different shapes because they have different functions, and their shapes help them carry out these roles effectively.

Do cells ever get confused about their roles ?

No, there is a **division of labour** in multicellular organisms such as human beings . This means that different type of cells present in the parts of the body perform different functions . Similarly division of labour is also seen within a single cell . In fact, each cell has got certain specific components within it , known as cell organelles . Each kind of cell organelle performs a special function , such as making new materials in the cell, clearing up waste material from the cell and so on. Division of labour in a cell is important, so that our cell can perform many activities efficiently, at the same time.



Exit the cell city.

You'll find me there, I am a few nanometres wide,

Selecting what leaves or gains entry

Call me a guard, bouncer, patrolman or a sentry.

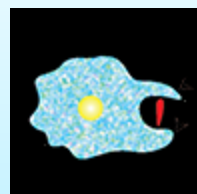
Flexibility is the tool, Control is the rule.

Name me and then run right. If not, find yourself in a spot too tight.



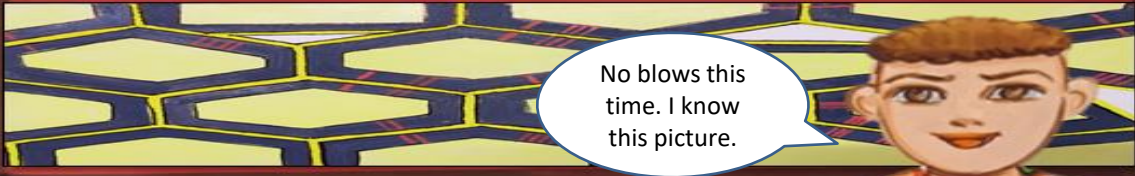
Cell Membrane Facts

- ◆ The cell membrane or the plasma membrane is the outermost covering of the cell, that separates the contents of the cell from its external environment.
- ◆ Cell membranes are soft, flexible, liquid bilayers of lipid with embedded proteins.
- ◆ Cell membranes are selectively permeable as they can direct the traffic of materials in and out of the cell. Thus membranes thus provide a stable internal environment for various cell processes.
- ◆ The significance of membranes can be illustrated with the example of viruses. Viruses are sub-microscopic infectious agents which lack any membranes and hence do not show characteristics of life until they enter a living body and use its cell machinery to multiply.

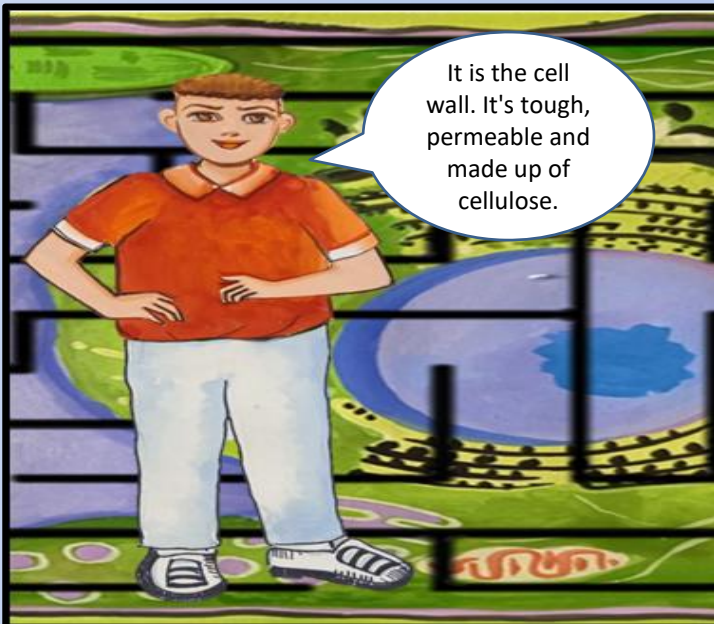


The flexibility of the cell membrane also enables the cell to engulf in food and other material from its external environment. Such processes are known as **Endocytosis**. Unicellular organisms such as amoeba acquire its food through such processes.

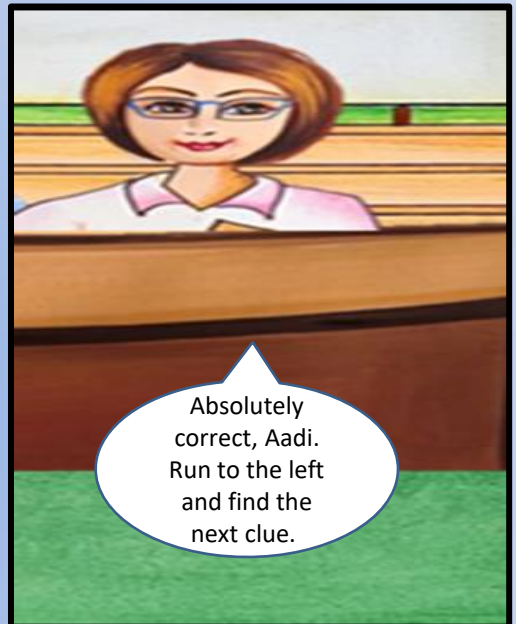
**I hold the cell up, so it doesn't fall.
My name is the game, the game is my name
Cell -U- Lose is my major component,
Permeability lies in my content.
If you get this, run to your left or take the blow-
right in your chest.**



No blows this time. I know this picture.



It is the cell wall. It's tough, permeable and made up of cellulose.



Absolutely correct, Aadi. Run to the left and find the next clue.

CELL WALL

- The cell wall is a rigid and protective layer around the plasma membrane which provides mechanical support to the cell..
- It is a non-living structure which is formed by the living protoplast.
- Animal cells do not have a cell wall. They are present in most plant cells, fungi, bacteria and algae.
- In-plant cells, the cell wall is made up of cellulose, hemicellulose, pectin, and protein.
- The cell wall has many important functions in a cell including protection, structure, and support.

I am the living substance of the cell,
Sol and gel, gel and sol, is all I can tell.
Clear as water, thick as jelly
All cell organelles suspended in my belly.
Name me and follow the trail or
else find yourself in the jail.



Ok, transparent jelly like substance with cell organelles .

Ma'am, can I get another clue?



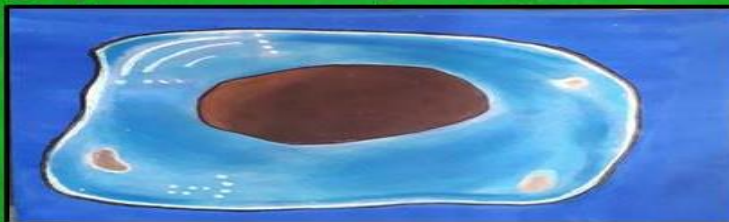
Avanti ma'am, can we give her another clue?

Pari, your second clue is- This substance fills the cell interior.

Ma'am, it is the cell cytoplasm.



- Ø **Cytoplasm is the transparent, jelly or jam-like substance present inside every living cell.**
- Ø **It is made up of around 80% water.**
- Ø **Cytoplasm fills up all of the spaces between the nucleus and the cell membrane.**
- Ø **Besides letting organelles and molecules move around, cytoplasm also acts to hold them in place.**
- Ø **Cytoplasm that surrounds the nucleus is called "endoplasm." Cytoplasm close to the cell membrane is called "ectoplasm."**
- Ø **Cytoplasm can actually be either watery or jelly-like, depending upon the activity within the cell.**



Fill ups

1. Cell membrane is composed of _____ and _____ .
2. Cell wall is made up of _____ .
3. _____ cells are not surrounded by a cell wall.
4. _____ is a jelly like substance which has living structures called _____ suspended in it.



The brain, the manager ,the control centre
Name me anything, I am the mentor.
DNA is the key to match,
Controlling production and dispatch.
Divide and Rule- that's my tool.



Ok, I hope they
have not
forgotten to put
the yellow ones.
Oh, here it is...



The brain, the manager ,the control centre
Name me anything, I am the mentor.
DNA is the key to match,
Controlling production and dispatch.
Divide and Rule- that's my tool.

Deoxyribonucleic Acid (DNA)

If uncoiled, the DNA in all of your body's cells would stretch 10 billion miles. That's long enough to reach from here to Pluto... and back!



The Amazing Nucleus

- Ø The cell nucleus was given its name by Scottish Botanist Robert Brown.
- Ø The nucleus was the first of the cell organelles to be discovered by scientists.
- Ø The nucleus consists of a perforated nuclear envelope.
- Ø The nucleus consists of a jelly-like substance , the nucleoplasm, a dense body nucleolus and a network of fibre-like structures called chromatin network.
- Ø During cell division and the chromatin fibres condense to form rod-like structures called chromosomes.
- Ø The word 'chromosome' comes from the Greek words 'Chroma', meaning colour, and 'soma', meaning body.
- Ø The chromosomes are made up of DNA and proteins.
- Ø Humans have about 30,000 genes in their 46 chromosomes. Genes are the basic units of inheritance.

SCORE BOARD

RED HOUSE - 10 points

BLUE HOUSE - 20 points

GREEN HOUSE - 05 points

YELLOW HOUSE - 20 points

Well done Jagruti!
Now run and find
Pari for the next
round.

Scores after
two rounds
of the
competition

The next round
is a partner task.
Red and Blue
Houses will
perform
together.

Green and
Yellow Houses
will work
together inside
the maze.

Round III

Hey! Aadi
hurry up.
Let's find
the next
clue.

Relax! I
need to eat
something
to re-
energize
myself.

How can you
think of
eating right
now?

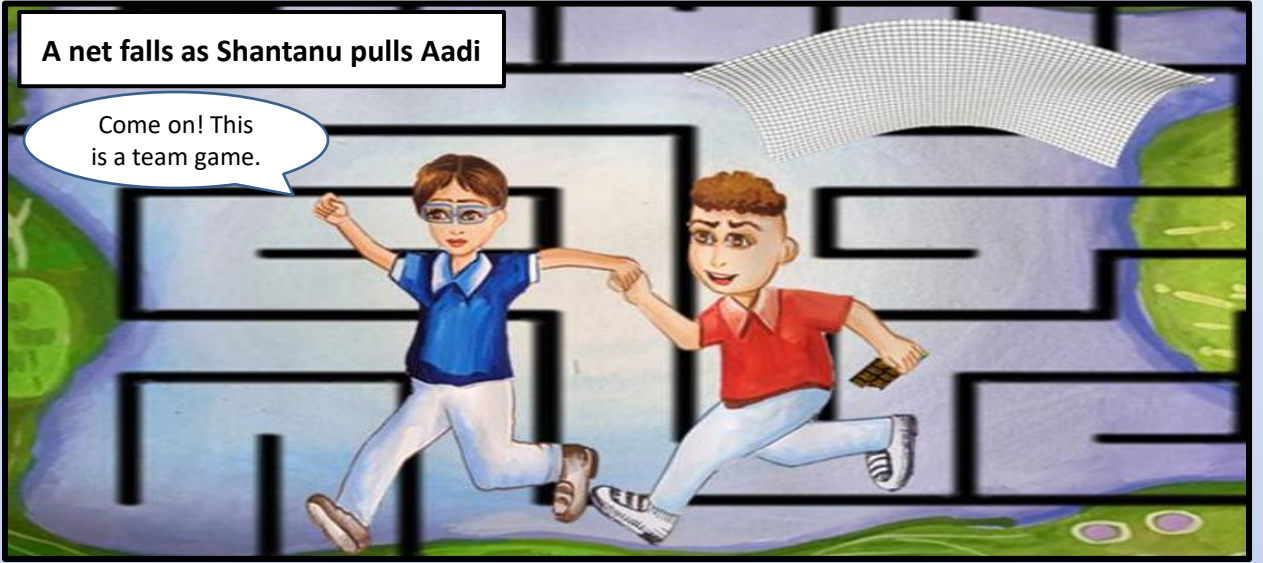
Oho! I can eat
any time.
See....

Chocolates

1. The very first chocolate bar was created by Fry and Sons, a British shop, in 1847. The shop combined cocoa butter, chocolate liquor, and sugar to form a mostly solid type of treat.
2. It is the only edible substance with a melting point of 93 degrees Fahrenheit. This is just below human body temperature, which is why it melts so easily in your mouth and in your hands.
3. It is a powerful mental stimulant.
4. It can improve your memory.

A net falls as Shantanu pulls Aadi

Come on! This is a team game.



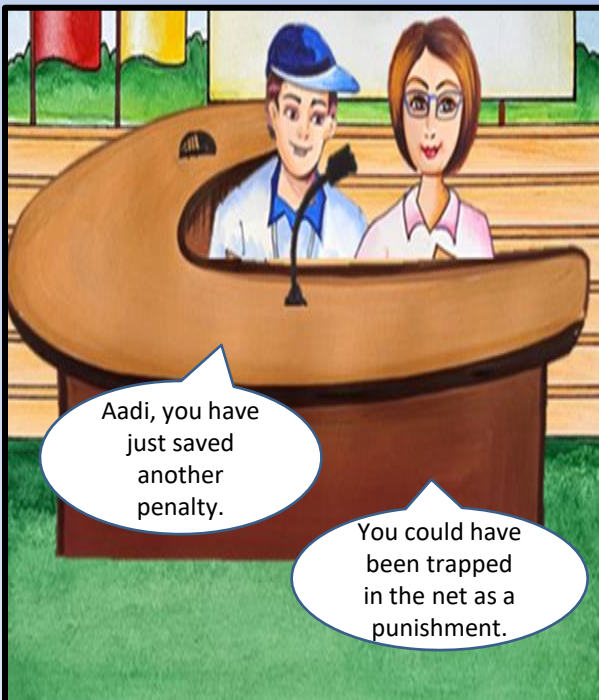
Oh! What is this?

Probably a trap!



Aadi, you have just saved another penalty.

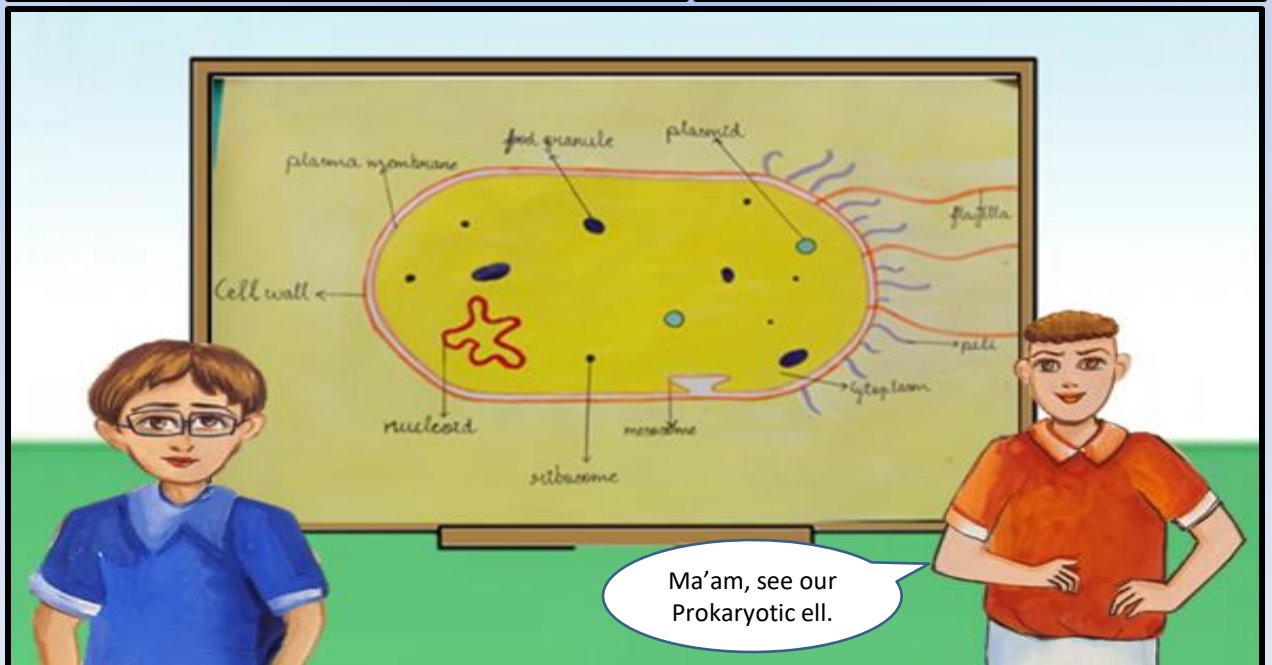
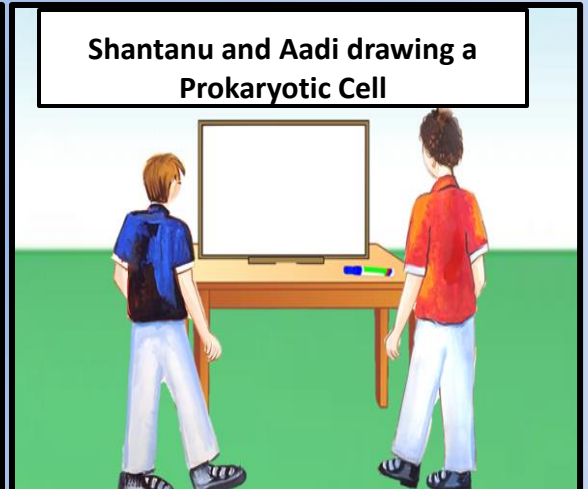
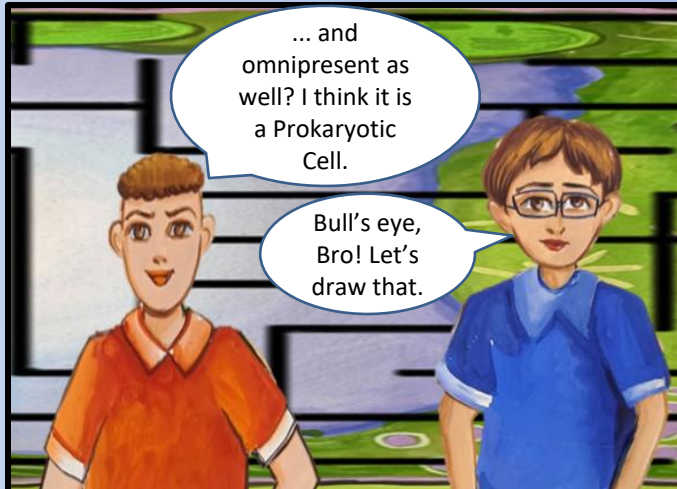
You could have been trapped in the net as a punishment.



I am leaving.

Hey! Wait, I am coming.





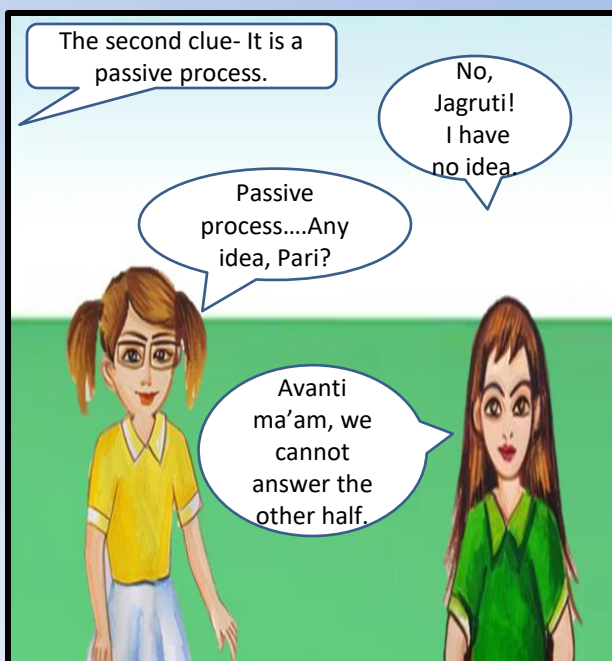
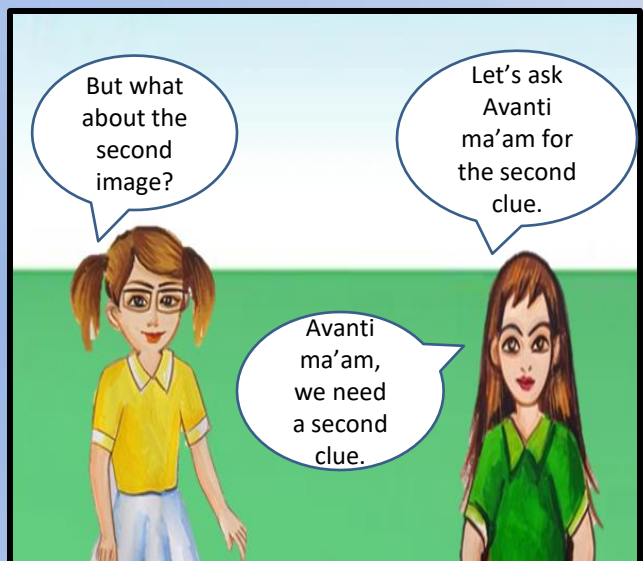
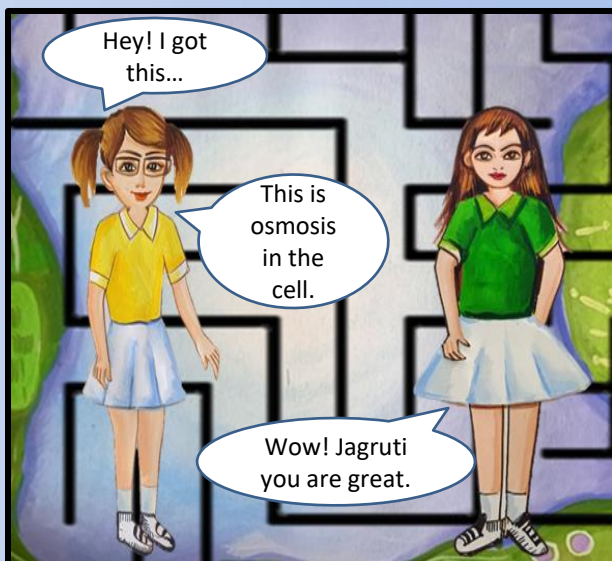
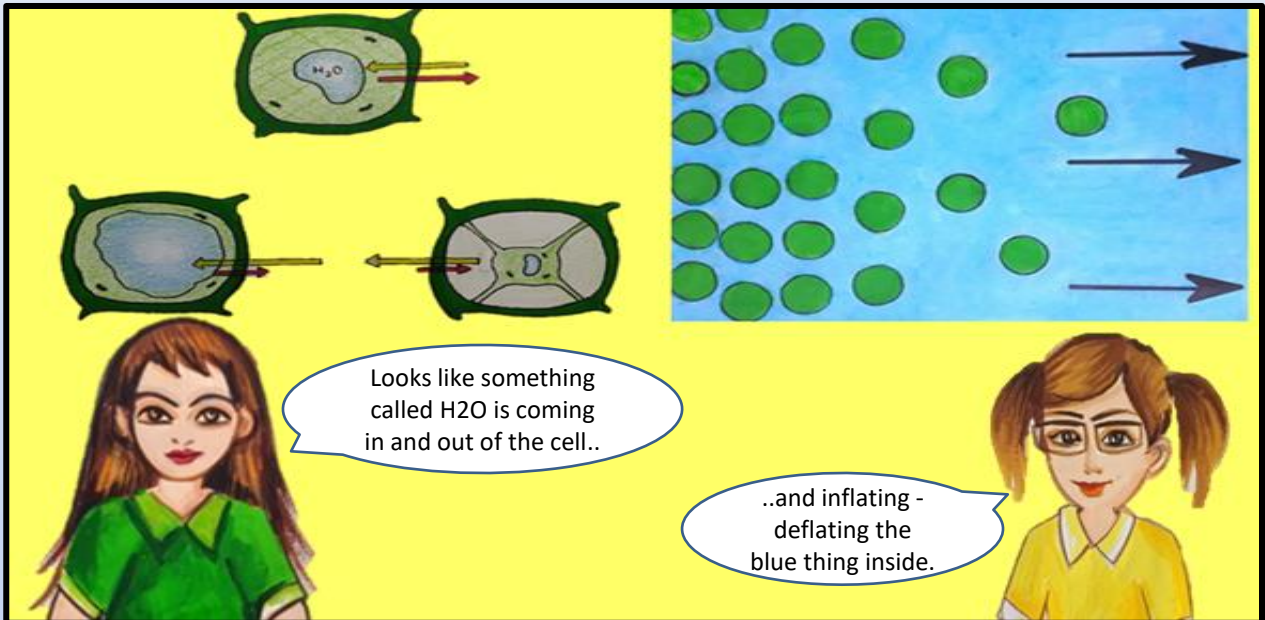
Prokaryotic cells are single-celled entities that are primitive in structure and function as they lack a membrane-bound nucleus and other membrane-bound organelles.

- **The genetic material of prokaryotic cells is a single chromosome made up of DNA.**
- **Prokaryotic cells also lack the nucleolus and the mitotic apparatus.**
- **The cell wall of prokaryotic cells is non-cellulosic and is made up of carbohydrates and lipids.**
- **Prokaryotic cells are asexual and thus, reproduce via asexual means without the formation of gametes.**
- **All prokaryotic cells have 70s ribosomes. The 70s ribosomes are made up of two subunits, 30s, and 50s.**
- **Prokaryotic cells are mostly found in extreme environments like hot springs, oceans, and marshlands.**



Time to Ponder

1. Expand the terms DNA and ATP.
2. How do Prokaryotic cells differ from eukaryotic cells?



SIMPLY OSMOTIC...

- ❖ Osmosis is a passive transport process directed towards the movement of solvent towards an area of higher solute concentration across a semi-permeable membrane.
- ❖ Ever wondered why slugs shrink when sprinkled with salt?
- ❖ The skin of the slugs is a semi-permeable membrane that, on exposure to salt, draws out water from the cells and in turn results in shrinking.
- ❖ The same principle prevents our jams and jellies from bacterial and fungal attack.
- ❖ A sore throat? Wonder why your doctor suggested gargles with salt water?
- ❖ If you ever placed your contact lenses in pure water, you will notice how uncomfortable it is the next day, or if you fail to rinse out your contact case it will get too salty. Saline solution for contact lenses is the same concentration of salt water as your eye.
- ❖ Making French fries – more salt makes the French fries crispier and less soggy. This is done by pre-soaking the potatoes in salt water before frying.

Jagruti and Pari skipping



Pari drops the rope while Jagruti continues skipping



SCORE BOARD

Blue House - 30	Yellow House - 30
Red House - 20	Green House - 10

Pari manages to score 5 points for her House.

Jagruti saves 10 precious points for the Yellow House.

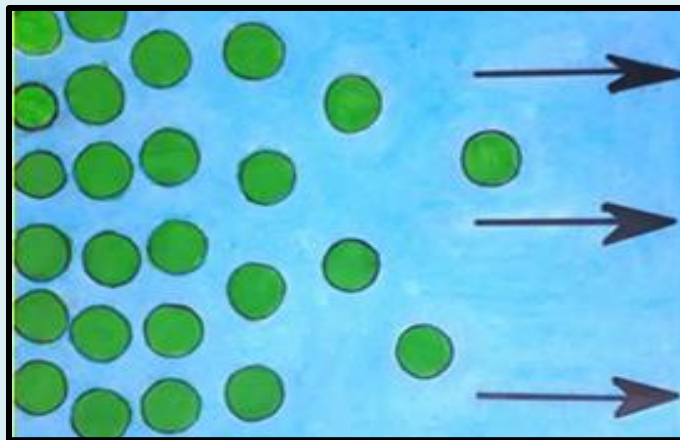
Let's take a look at the scores after 3 rounds of competition.

The girls could not identify the representation of diffusion.

Diffusion is the movement of a substance from an area of high concentration to an area of low concentration. Diffusion occurs in liquids and gases because their particles move randomly from place to place. It is an important process for living things; it is how substances move in and out of cells.



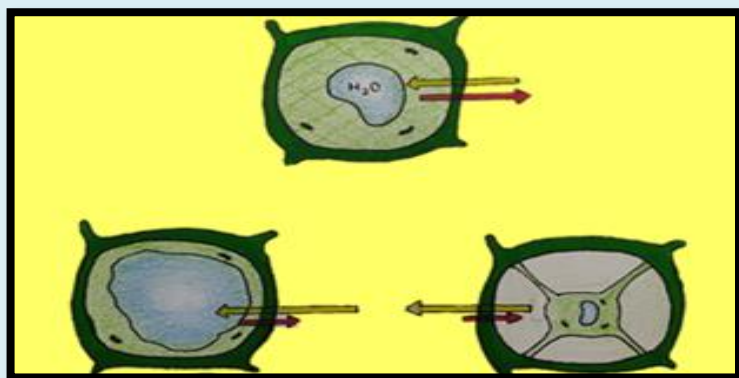
Confused about diffusion and osmosis? Let me explain in a simpler way.



Diffusion is the **spontaneous** movement of particles from a region of higher concentration to a region of lower concentration **down the concentration gradient**.

Diffusion is an important process, which is involved in the different life processes. Diffusion is important for the following reasons:

During the process of respiration, this process helps in diffusing the carbon dioxide gas out of the cell into the external environment. Similarly oxygen which is at a higher concentration outside diffuses into the cell.



Does movement of water in and out of cells also obey the law of diffusion ?

Yes. The movement of water across the semi permeable membrane is however called **Osmosis**. The movement of water is also affected by the concentration of substances dissolved in water.

Is the direction of movement of water particles affected due to concentration of dissolved substances in the external or internal medium?

If the **medium surrounding the cell** has a higher water concentration than the cell, meaning that the outside solution is **very dilute**, the cell will gain water by osmosis. Such a solution is known as a **hypotonic solution**. The process is known as **endosmosis** and the cell is likely to **swell** or become turgid.

If the medium has a **lower concentration of water** than the cell, meaning that it is a very **concentrated solution**, the cell will **lose water** by osmosis. Such a solution is known as a **hypertonic solution**. The process is called **exosmosis** and the cell will **shrink** or become flaccid.

In a hypertonic solution, a cell with a cell wall will lose water too. The plasma membrane pulls away from the cell wall as it shrivels, a process called **plasmolysis**.

If the medium has exactly **the same water concentration** as the cell, there will be **no net movement of water** across the cell membrane. Such a solution is known as an **isotonic solution**.

Transport, process and production
That's my humble introduction.
Lipids and proteins are my progeny,
Membrane system formation is my strategy.
Smooth and rough, these clues are enough.



Round IV



Endoplasmic Reticulum

- The endoplasmic reticulum was first seen in 1969 by Keith R. Porter, Albert Claude, and Ernest F. Fullam.
- The endoplasmic reticulum is made up of a series of phospholipid membranes.
- The ER behaves like a real-world factory. It builds the 'products' (proteins and lipids) a cell needs to function, then 'ships' (transports) them to where and when they need to go there.
- When you're looking at a cell diagram, look for the maze-like structure that's attached to the nucleus. That's the endoplasmic reticulum!
- The cell diagrams often picture some areas of the endoplasmic reticulum with bumps, while other sections look smooth. The ribosomes attached to the walls endoplasmic reticulum, gives it a bumpy appearance. The Rough ER synthesizes proteins.
- The smooth endoplasmic reticulum synthesizes lipids and helps, detoxify the cell by converting toxic organic chemicals into safer, water soluble products.
- The rough ER and the smooth ER together help in synthesis of cellular membranes, a process known as membrane biogenesis.

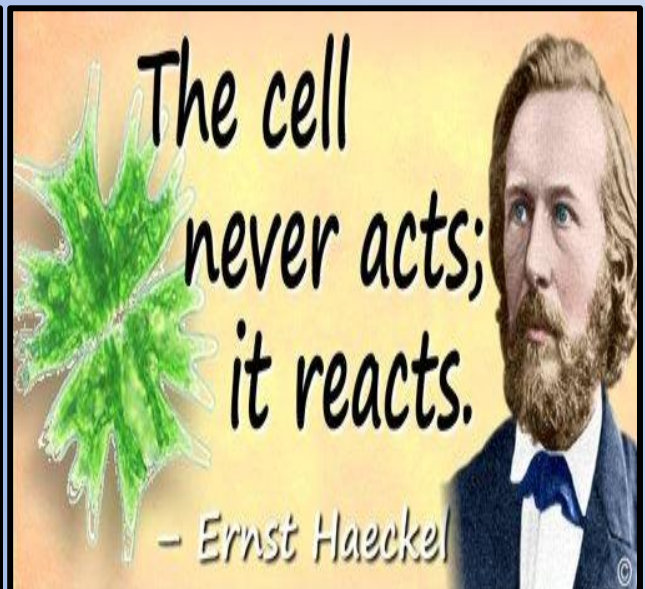
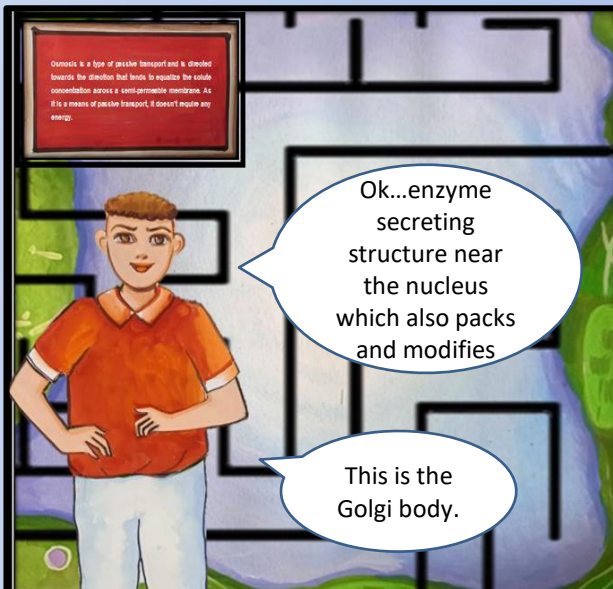
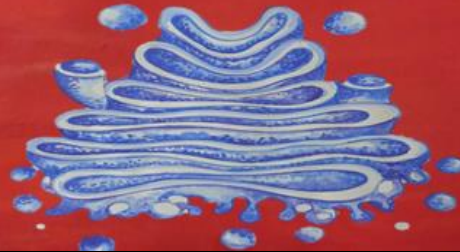


Time to Contemplate

1. How is endoplasmic reticulum involved in the process of membrane synthesis?
2. Define the term- Diffusion

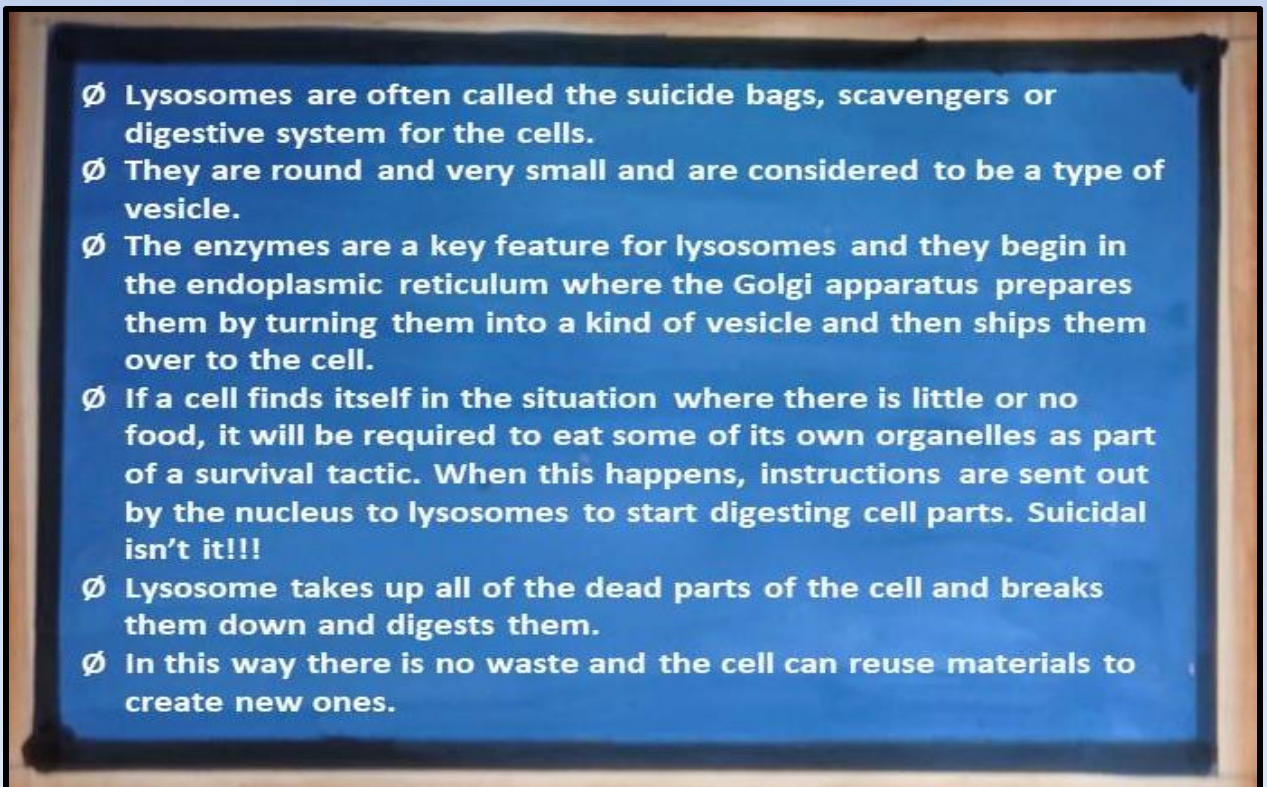


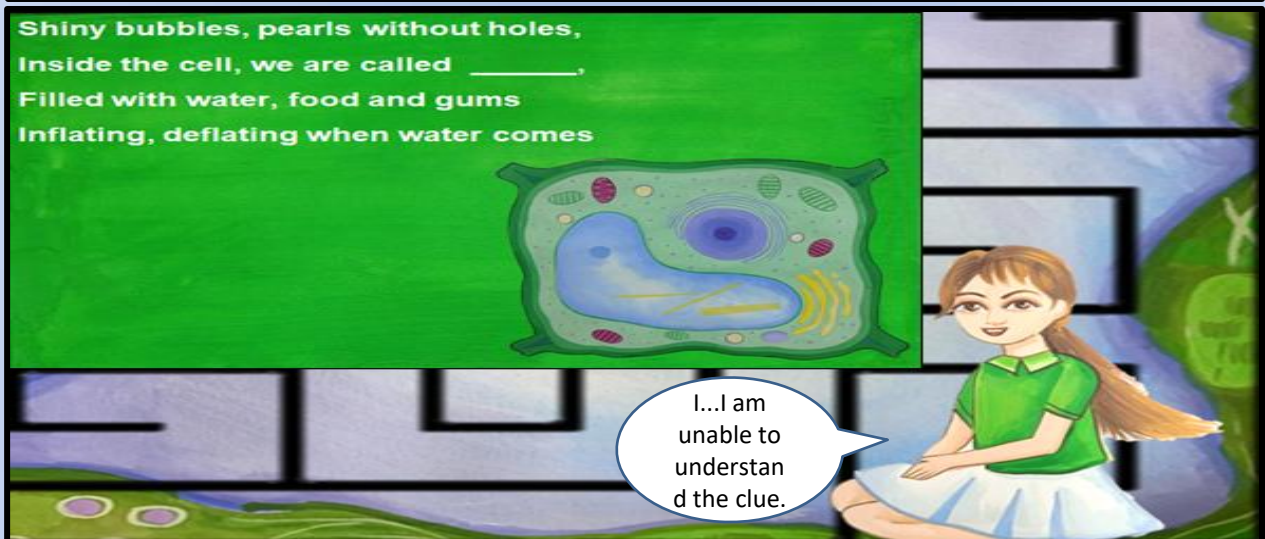
Flattened and bound, Vesicular and round
Pack, modify and secrete,
Always ready to deliver a treat
Near the brain, lies my display
Secreting enzymes, everyday



GOLGI BODY

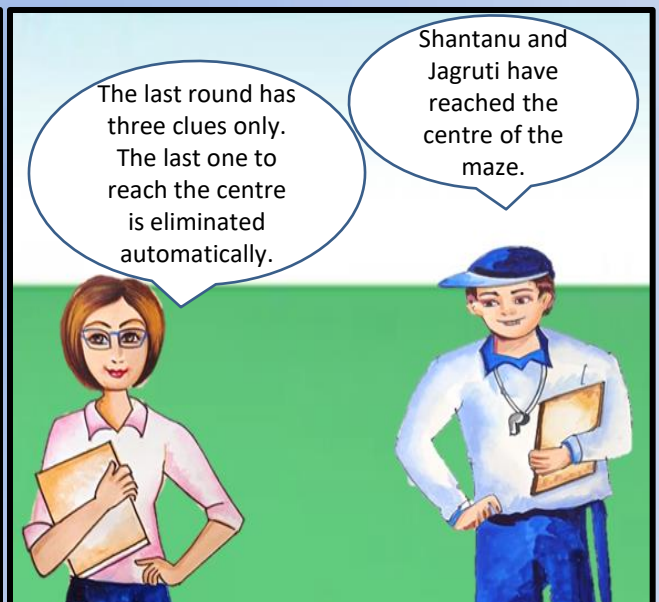
- Golgi apparatus is a stack of membranous bodies called cisternae, found near the nucleus.
- The Golgi apparatus, also known as Golgi body or Golgi complex, is a eukaryotic cell organelle discovered by Camillo Golgi, an Italian physicist, in 1897.
- Golgi bodies are found in cells of both, plants and animals. In plants they are known as Dictyosomes.
- The main function of Golgi apparatus is to carry out processing of proteins generated in the endoplasmic reticulum. Apart from processing the proteins, Golgi apparatus also transports them to different parts of cells.
- Functioning of the Golgi apparatus is often compared to working of a 'post-office'. The reason behind this is that proteins in the Golgi body are modified, sorted and then packaged before they are secreted.

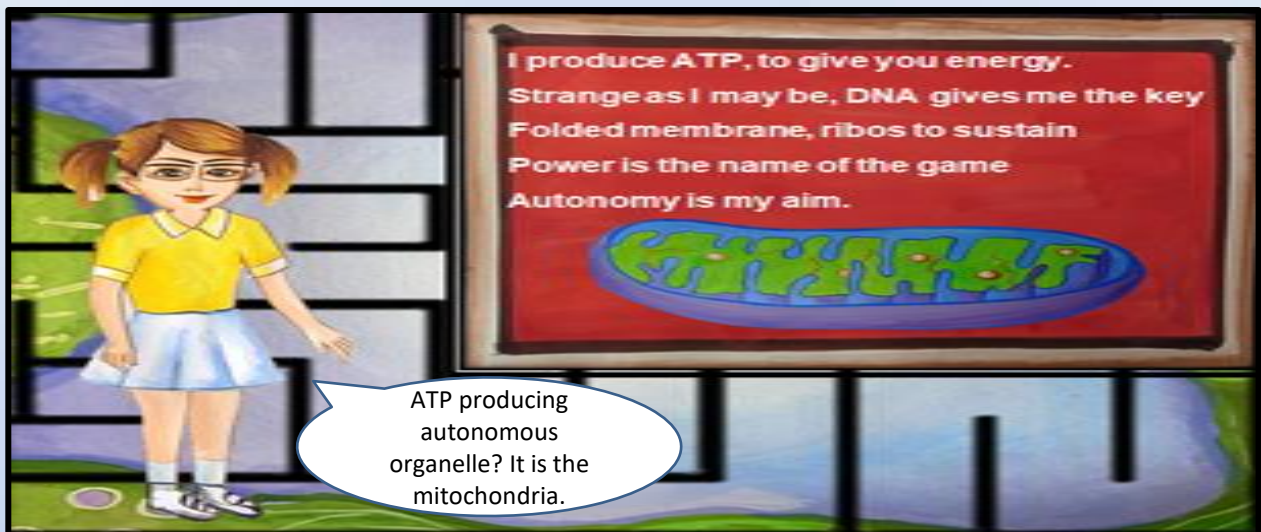




The solution to Pari's confusion- Vacuoles..

- Ø The vacuoles are called the cell's storage tanks.
- Ø Vacuoles in plants are larger than those in animals and therefore the number of vacuoles in a plant is less than those in animals.
- Ø Vacuoles have other jobs in plants besides storing water. They also play a part in seed germination and giving structure instructions to blooms and foliage, and in regulating the internal pH.
- Ø Vacuoles in a single-celled organism such as the amoeba are responsible for digestion of the food that they engulf.
- Ø There are vacuoles that exist in freshwater fish and other organisms that are similar, and these are called "contractile vacuoles." These vacuole types contract and extend to release the excess water that is brought into the body during feeding.





The Mighty Mitochondria

1. Mitochondria were first discovered in a cell in 1857 by physiologist Albert von Kolliker. The term 'mitochondria' was first used in 1898 by Carl Benda.
2. They can quickly change shape and move around the cell when needed.
3. When the cell needs more energy, the mitochondria can reproduce by growing larger and then dividing. If the cell needs less energy, some mitochondria will die or become inactive.
4. In addition to energy in the form of ATP, they also produce small amounts of carbon dioxide.
5. Mitochondria have their own DNA. Mitochondrial DNA looks like a microscopic bicycle tyre.
6. Mitochondria cause cell death by shutting off their part that spreads the energy they produce into the cell and other cells.



Time to Analyse

1. Why are mitochondria known as strange organelles?
2. Name the suicide bags of the cell. Why are they names so?
3. Enlist three functions of vacuoles.

Red, orange, green and yellows
DNA and Ribosomes are my fellows.
Trapping sunlight as a game
Kitchen of the cell is my name.



Kitchen of the cell with DNA and ribosomes.

Ma'am, these are the plastids and the green ones specifically are the chloroplasts.

Excellent, Shantanu !

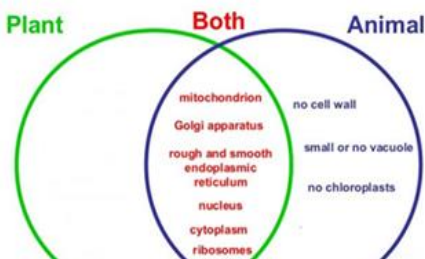
Now run out of the maze as fast as you can.

Aadi and Pari, hurry up only one of you gets to solve the third clue.

...seems like Aadi has reached the clue.

Green House gets eliminated automatically.

Compare and Contrast



Am I supposed to tell the differences between the two types of cells?

Plant cell has a cell wall, chloroplast and a big vacuole.

Plastids

Plastids are present in plant cells . There are many types of plastids such as the chloroplast, chromoplast and leucoplasts.

Chloroplasts synthesize green coloured pigments and chromoplast produce pigments of different colours. Leucoplasts are involved in the storage of compounds like starch, proteins or fats. Plastids are absent in animal cells.

Yes, Aadi.
Finally the
right answer.

Let's see, who
reaches the
finish line first.



Shantanu, Jagruti and Aadi running towards
the finish line



Did you know,
the power
generated by our
brain is enough
to illuminate a
bulb? When we
are awake, the
brain generates
enough power to
light up a ten
watt bulb!



Hey! Why
has Shantanu
stopped?

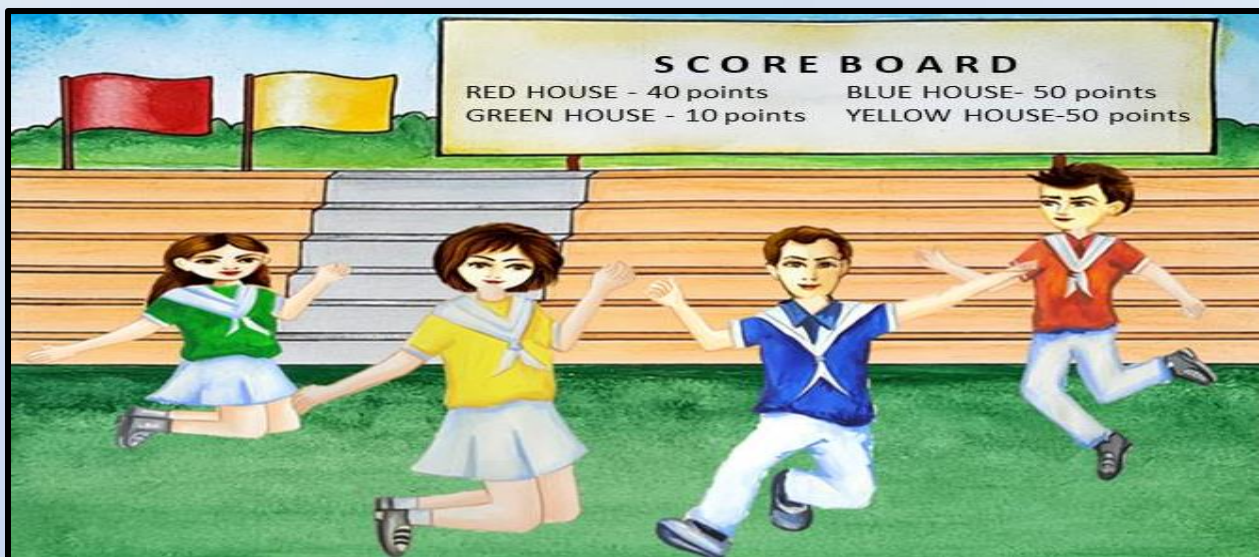


Amazing !
He is waiting
for Jagruti
and Aadi !



Shantanu, Jagruti and Aadi cross the finish line together







GLOSSARY

Cell - The fundamental unit of structure and function.

Cell membrane-Cell membrane is the outer covering of a cell. It is made up of phospho-lipid bilayer .It is selectively permeable in nature.

Cell Organelles- Membrane bound living structures present in the cell cytoplasm. Ribosomes are organelles which are not bound by membrane.

Cell wall-The cell wall is made of cellulose and gives a rigid structure to the plant cell. It is also present in algae ,bacteria and fungi.

Chromosomes- These are rod shaped structures made up of DNA and proteins, present inside the nucleus. During the growth phase of the cell, the chromatin condenses into a much thicker structure called chromosome.

Chromatin-Chromatin is a thread like structure which serves as the genetic material present inside the nucleus of the cell. Chromosomes diffuse into chromatin, when the cell is in resting phase.

Cytoplasm-Cytoplasm is the fluid found inside the cell. It gives the structure to the cell and houses different organelles of the cell.

Deoxyribose Nucleic Acid – It is a molecule composed of two polynucleotide chains that coil around each other to form a double helix carrying genetic instructions for the development, functioning, growth and reproduction of all known organisms and many viruses.

Diffusion-The movement of molecules from a region of their high concentration to a region of their lower concentration is known as diffusion.

Endoplasmic Reticulum- It is a membrane bound cell organelle that plays an integral role in the membrane genesis and cellular transport.

Genes -Segments of DNA located on chromosomes that exist in alternative forms called alleles.

Golgi Apparatus-Golgi apparatus is also called the post office of the cell. They package and transport the proteins across the cytoplasm.

Lysosomes-They are referred to as suicide bags of the cell as they contain potent enzymes that can digest a cell. Lysosome also helps in defense by attacking a foreign object.

Mitochondria-Mitochondria are also called power plant of the cell. They generate ATP via the electron transport chain. They also have DNA and ribosomes, which makes them semi-autonomous organelles.

Nucleus - It is a double membrane bound organelle which contains the genetic material for inheritance and controls cellular functions.

Osmosis -Osmosis is the movement of water across a semi-permeable membrane. Osmosis is a selective process since the membrane does not allow all molecules to pass through it.

Plastids-There are various types of plastids in different cells based on the pigment they contain. The chloroplast is the plastid where the photosynthesis occurs. Some of the other plastids are leucoplast and chromoplast.

Prokaryotic & Eukaryotic cells-Prokaryotic cells are primitive and lack well defined nucleus. Eukaryotic cells are more advanced and have well defined nucleus surrounded by a nuclear membrane. These cells have membrane bound cell organelles.

Ribosomes - Cell organelle that is responsible for protein synthesis. They are not bound by membrane and are found in both Prokaryotic and Eukaryotic cells.

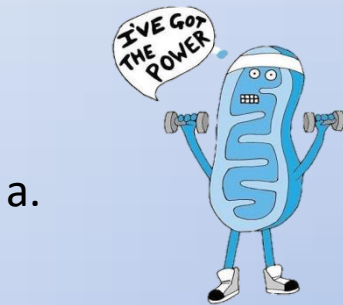
Rough Endoplasmic Reticulum-Rough ER has ribosomes attached on its surface. They are the sites for protein synthesis.

Smooth Endoplasmic Reticulum-Smooth ER does not have ribosomes and are involved in lipid synthesis and detoxifying poisonous molecules.

Vacuoles-Vacuoles are large vesicles that hold water in them and give structural rigidity to the cell. Vacuoles are common in plant cells. In animals the vacuoles are either very small or absent.

MASTER MIND

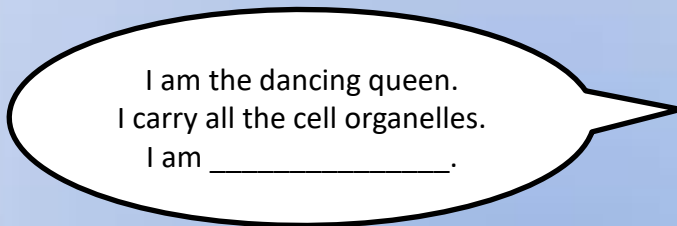
I. Identify the cell organelles.



I have got the power.

I am _____.

b.



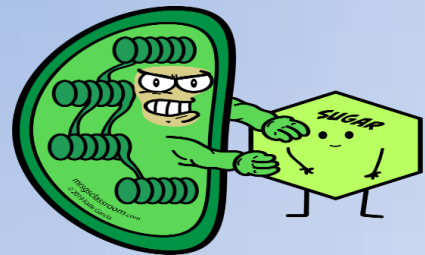
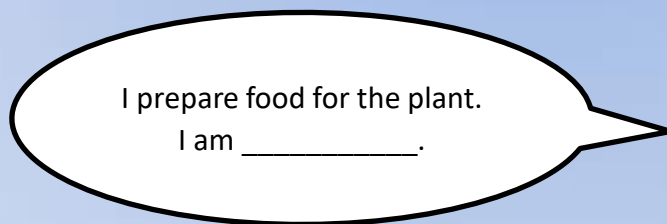
c.



With great power comes
great responsibilities.

I am _____.

d.



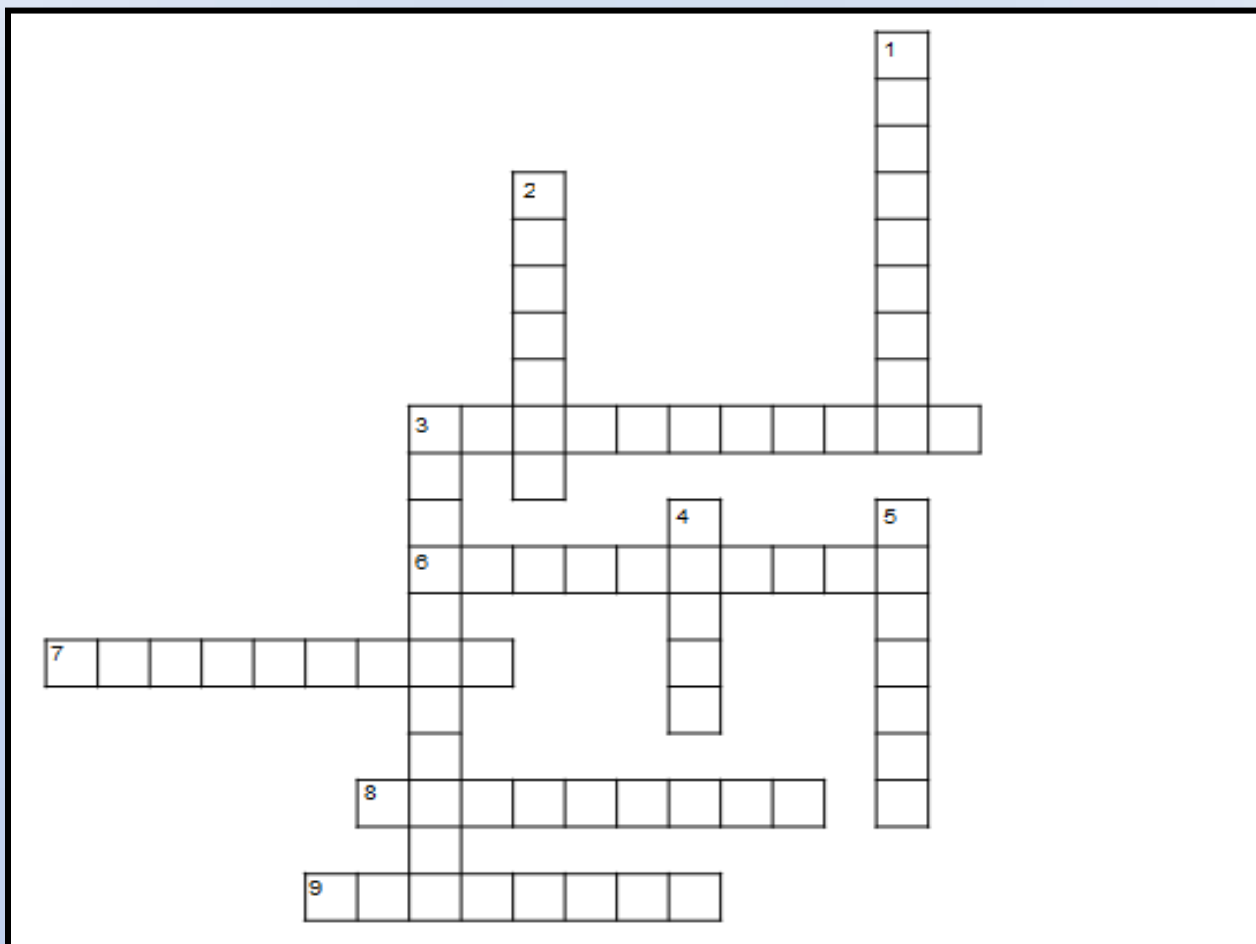
e.



I transport various
materials to different parts
of the cell.

I am _____.

II. Crossword



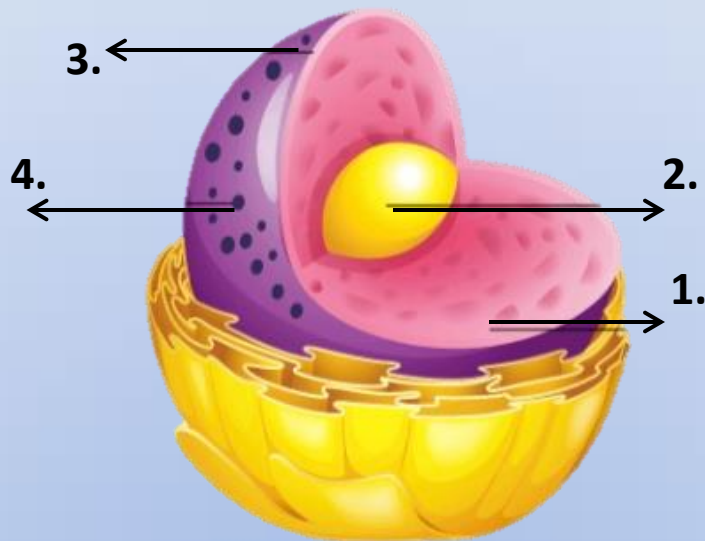
Across

3. Green plastids.
6. Living structures in the cytoplasm.
7. Passive spontaneous movement of particles.
8. Living substance of the cell.
9. It separates the cellular contents from the surroundings.

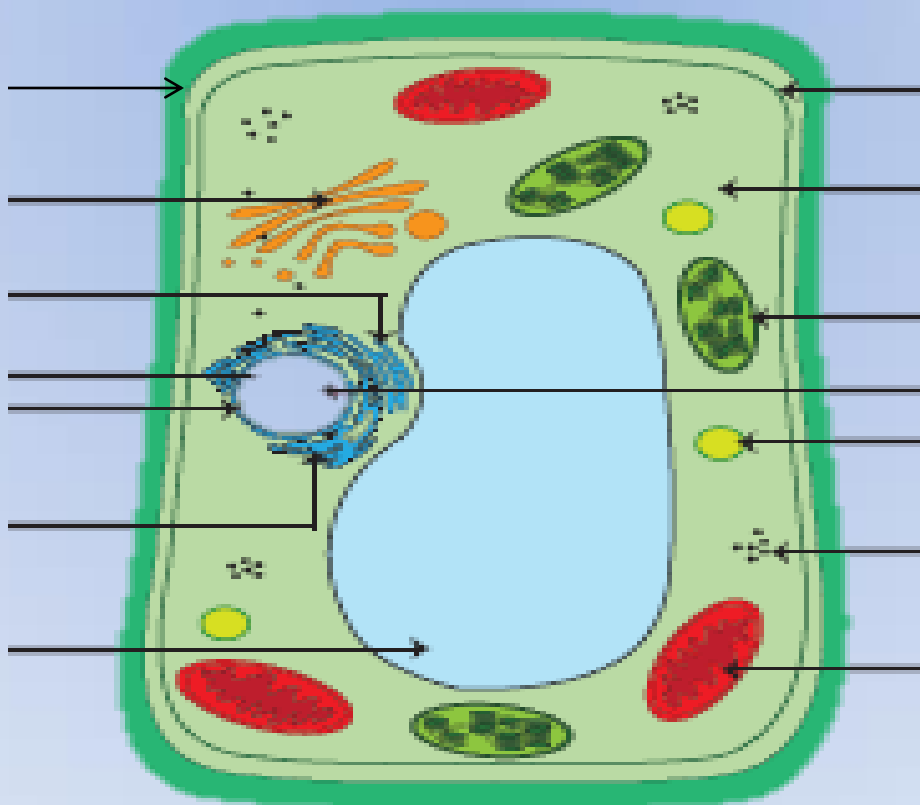
Down

1. Organelle involved in protein synthesis.
2. Empty structure in the cytoplasm.
3. A pigment is necessary for photosynthesis.
4. Units of inheritance present on the chromosome.
5. Membrane function involving movement of water.

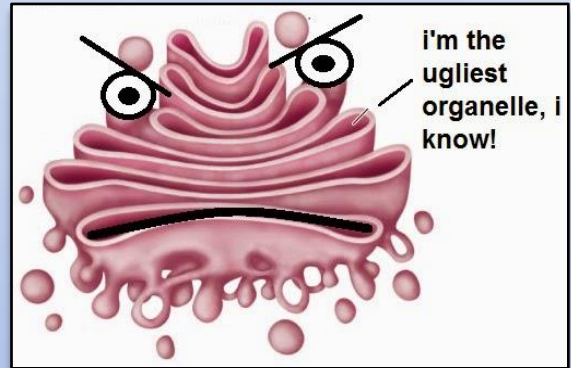
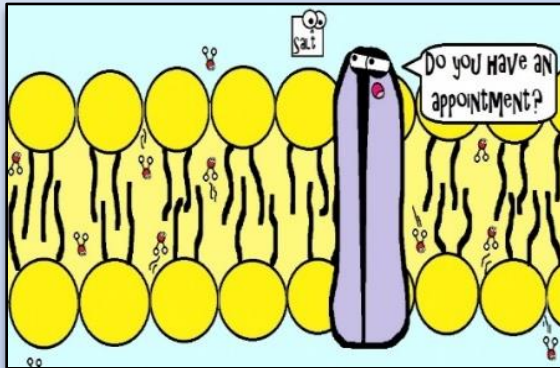
III. Label the parts of the nucleus.



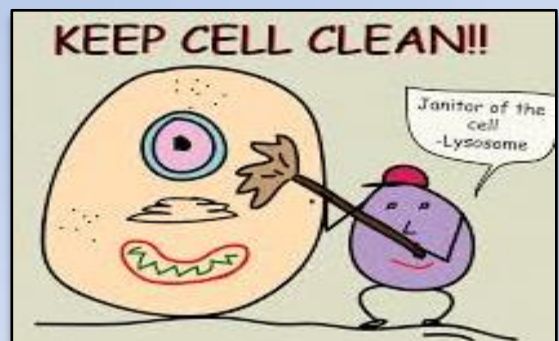
IV. Label the different parts of the cell.



V. Encircle the words in the word maze taking clues from the given pictures.



M	C	I	P	G	L	Y	S	O	S	O	M	E	S
S	H	H	J	O	U	E	I	H	E	R	A	P	E
A	R	A	C	L	T	A	M	B	M	I	R	C	B
L	O	L	E	G	A	C	U	O	I	E	H	O	T
P	M	H	L	I	R	A	U	E	P	R	H	H	U
O	O	V	L	A	A	I	P	E	E	O	I	S	E
T	S	E	M	P	P	E	R	M	R	B	B	L	L
Y	O	S	E	P	P	S	A	S	M	L	U	I	E
C	M	I	M	A	A	T	H	Z	E	N	A	R	R
B	E	C	B	R	I	B	I	E	A	N	X	T	T
T	S	L	R	A	G	E	D	A	B	S	S	E	D
O	N	E	A	T	L	E	S	M	L	A	N	R	I
A	H	S	N	U	N	U	C	L	E	O	L	U	S
B	D	O	E	S	G	C	C	Y	N	A	D	F	H



Answer Key

Page 13. Time to Reflect

1. Robert Hooke.
2. Microbes are very small organisms which cannot be seen by naked eyes.
3. Rudolf Virchow gave the principle that cells are not born anew. They arise from pre-existing cells.

Page 17. Fill ups

1. Lipids, Proteins
2. Cellulose
3. Animal
4. Cytoplasm, cell organelles

Page 22. Time to Ponder

1. Deoxyribose Nucleic Acid, Adenosine Tri Phosphate
2. A prokaryotic cell is a primitive type of a cell that is characterized by the absence of a true nucleus. The nuclear region is not bound by the nuclear membrane and is known as a nucleoid. Furthermore, prokaryotes do not possess membrane-bound cellular organelles. Prokaryotes are exclusively unicellular..
Eukaryotic cells are cells that possess a true nucleus along with membrane-bound organelles. Eukaryotes can either be unicellular or multicellular.

Page 25. Time to Contemplate

1. The rough endoplasmic reticulum synthesises proteins and the smooth endoplasmic reticulum synthesises lipids, which together make the cell membranes.
2. Diffusion is the spontaneous movement of a substance from an area of high concentration to an area of low concentration.

Page 30. Time to Analyse

1. Mitochondria contain their own DNA and ribosomes and are semi-autonomous. That's why they are also called strange organelles.
2. Lysosomes. They are known as suicide bags because they can digest the whole cell when the cell has lots of internal disturbances and cannot function properly.
3. Functions of vacuole-
 - a. Storage of food, water resins, gums etc.
 - b. Maintain cell turgidity.
 - c. Digestion of food in unicellular organisms such as amoeba.

MASTER MIND - Answers

Identify the cell organelles

a. Mitochondria b. Cytoplasm c. Nucleus d. Chloroplast e. Endoplasmic Reticulum

Crossword

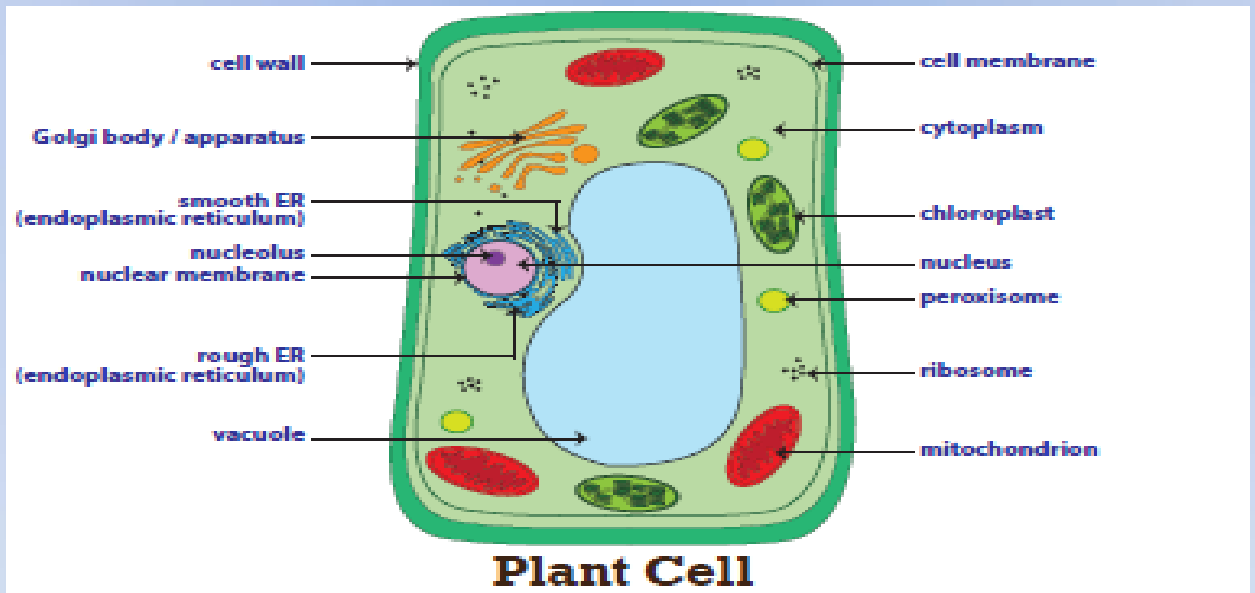
Across 3. Chloroplast 6. Organelles 7. Diffusion 8. Cytoplasm 9. Cell wall

Down 1. Ribosomes 2. Vacuole 3. Chlorophyll 4. Genes 5. Osmosis

Label the parts of the nucleus

1. NUCLEOPLASM 2. NUCLEOLUS 3. NUCLEAR MEMBRANE 4. NUCLEAR PORES

Label the different parts of the cell



Word Search

1. Cell Membrane 2. Golgi Body 3. Chromosomes 4. Lysosomes

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Disclaimer

This Graphic Novel is a supportive reading and learning material created by Delhi Public School Jaipur, to enable students to have a deeper and better understanding of the course content based on, Chapter-5 'The Fundamental Unit of Life' of the NCERT book for Class 9.

This publication is meant as a source of valuable information for the reader, however it is not meant as a substitute for direct expert assistance. If such level of assistance is required, the services of a competent professional should be sought.

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From the Principal's Desk

The National Education Policy 2020, Central Board of Secondary Education plays a significant role in bringing about the much required changes in the present education system. It helps to strengthen and develop the Life Skills, along with the Vocational Skills in students and teachers to build a firm foundation for the 21st century India. NEP 2020 has given a mantra of joyful and experiential learning by integrating visual and performing arts into academics.



Every project has a birth history and here I take pleasure to share the conceptualization of the 'Graphic Novel' project. It all started in 2019 when I and Mr Sandeep Sethi visited Ms. Anita Karwal, Secretary, Department of School Education and Literacy, Ministry of Education (Chairman CBSE, Delhi at that time) to present a book named 'Khichdi' to her.

Mr. Sandeep Sethi had conceived an ingenious idea of simplifying the complex concepts in an interesting manner by integrating arts and making it an experiential learning pedagogy and shared it with me for giving it a shape wherefore I started the compilation of the book 'Khichdi'.

Ms. Anita Karwal found 'Khichdi' to be very informative, engaging and child centric way of teaching. She coined a term, 'Comic Cast', pedagogy similar to Podcast, to be used to enthuse joyful learning among children. Ms Anita Karwal got it included as a supportive teaching aid for the Food and Nutrition course with QR code immediately and thus, her enthusiasm and support excited us to embark on our new journey of creating Graphic Novels at large scale.

To inspire and embolden the educators, Ms. Anita Karwal, Secretary Education MOE and Mr. Manoj Ahuja, IAS, Chairman, CBSE, Delhi willingly joined the WhatsApp group comprising fifty schools from different states of India to create different inter disciplinary projects of Graphic Novels.

I thank Ms. Anita Karwal for her vision which turned this project into a reality. She appreciated and recognized the diligent efforts of all the participating schools. Her hand holding at each step to direct, improve and enhance our work to make the Graphic Novels more fruitful and enriching, took the projects to greater heights and enabled them worthy to be uploaded on the Diksha portal to facilitate learning far and wide. This will set an example for all the other schools to think out of the box and use innovative strategies to integrate art and make learning joyful by demonstrating experiential learning, which is the need of the hour for our young children.

I thank my Mentor Ms. Aditi Misra, Director, Delhi Public School, Jaipur, for her constant support and always motivating us to put our best foot forward. Her undaunting spirit towards excellence moves us as a school towards performing better than before with each new project.

We owe our sincere gratitude to Mr. Sandeep Sethi for being a torch bearer and inspiring many schools to work collaboratively to bring out the true spirit of education.

I hope this Graphic Novel will enable our young learners to get a little more of learning.

Rita P Taneja
Principal
Delhi Public School, Jaipur

Summary

This novel gives an adventurous twist to the study of the fundamental unit of life: The Cell. The stakes are high in Delhi Public School's Annual Inter-House competition as the four competing participants are what they describe as the dark horses. A competition which will challenge their physical and mental aptitude with a series of mind-bending riddles. The reader is bound to be flooded with the bundles of knowledge.



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