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Relevance of General Science in UPSC Exam

Which one of the following statements best describes the role of B cells and T cells in the human body? 2022

- (a) They protect the environmental allergens. body**
- (b) They alleviate the body's pain and inflammation.**
- (c) They act as immunosuppressants in the body.**
- (d) They protect the body from the diseases caused by pathogens.**

Human
body

Relevance of General Science in UPSC Exam

Water can dissolve more substances than any other liquid because. 2021

- (a) It is dipolar in nature.**
- (b) It is a good conductor of heat**
- (c) It has high value of specific heat**
- (d) It is an oxide of hydrogen**

Chemistry

Relevance of General Science in UPSC Exam

In a pressure cooker, the temperature at which the food is cooked depends mainly upon which of the following? 2021

- 1. Area of the hole in the lid**
- 2. Temperature of the flame**
- 3. Weight of the lid**

Select the correct answer using the code given below.

- (a) 1 and 2 only**
- (b) 2 and 3 only**
- (c) 1 and 3 only**
- (d) 1,2 and 3**

Relevance of General Science in UPSC Exam

Which of the following statements are correct regarding the general difference between plant and animal cells ? 2020

- (1) Plant cells have cellulose cell walls whilst animal cells do not.**
- (2) Plant cells do not have plasma membranes unlike animal cells which do.**
- (3) Mature plant cell has one large vacuole whilst an animal cell has many small vacuoles.**

Select the correct answer using the code given below :

- (a) 1 and 2 only**
- (b) 2 and 3 only**
- (c) 1 and 3 only**
- (d) 1, 2 and 3**

Relevance of General Science in UPSC Exam

Which of the following is/are the example/examples of chemical change? (2014)

(1) Crystallization of sodium chloride

(2) Melting of ice

(3) Souring of milk

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 3 only

(c) 1, 2 and 3

(d) None

Relevance of General Science in UPSC Exam

Rainbow is produced when sunlight falls on drops of rain. Which of the following physical phenomena are responsible for this? 2013

- (1) Dispersion**
- (2) Refraction**
- (3) Internal reflection**

Select the correct Solution using the codes given below.

- (a) 1 and 2 only**
- (b) 2 and 3 only**
- (c) 1 and 3 only**
- (d) 1, 2 and 3**

General
Science

What we are going to Study?

Day	Subject	Theme
Day 01	Biology	Cell, <u>Types</u> & Classification
Day 02	Biology	Plant and Animal Kingdom
Day 03	Biology	Human <u>Body</u> & Related Diseases Part 01
Day 04	Biology	Human Body & Related Diseases Part 02
Day 05	Biology	<u>Nutrients & Diseases</u>

What we are going to Study?



Day 06	Physics ✓	Forces of Nature & their application
Day 07	Physics ✓	Light, Sound, Electricity, magnetism etc
Day 08	Physics →	<u>Space & Astronomy</u>
Day 09	Chemistry →	<u>General Chemistry</u>
Day 10	Chemistry	<u>Common Substances & their application</u>

What is Cell?

Components of Cell & their functions

Classification of Cell

Eukaryotic and Prokaryotic cell

Plant Cell and Animal Cell

Stem cell and Somatic Cell

Cell

heart →

lungs

Kidney

Atom →

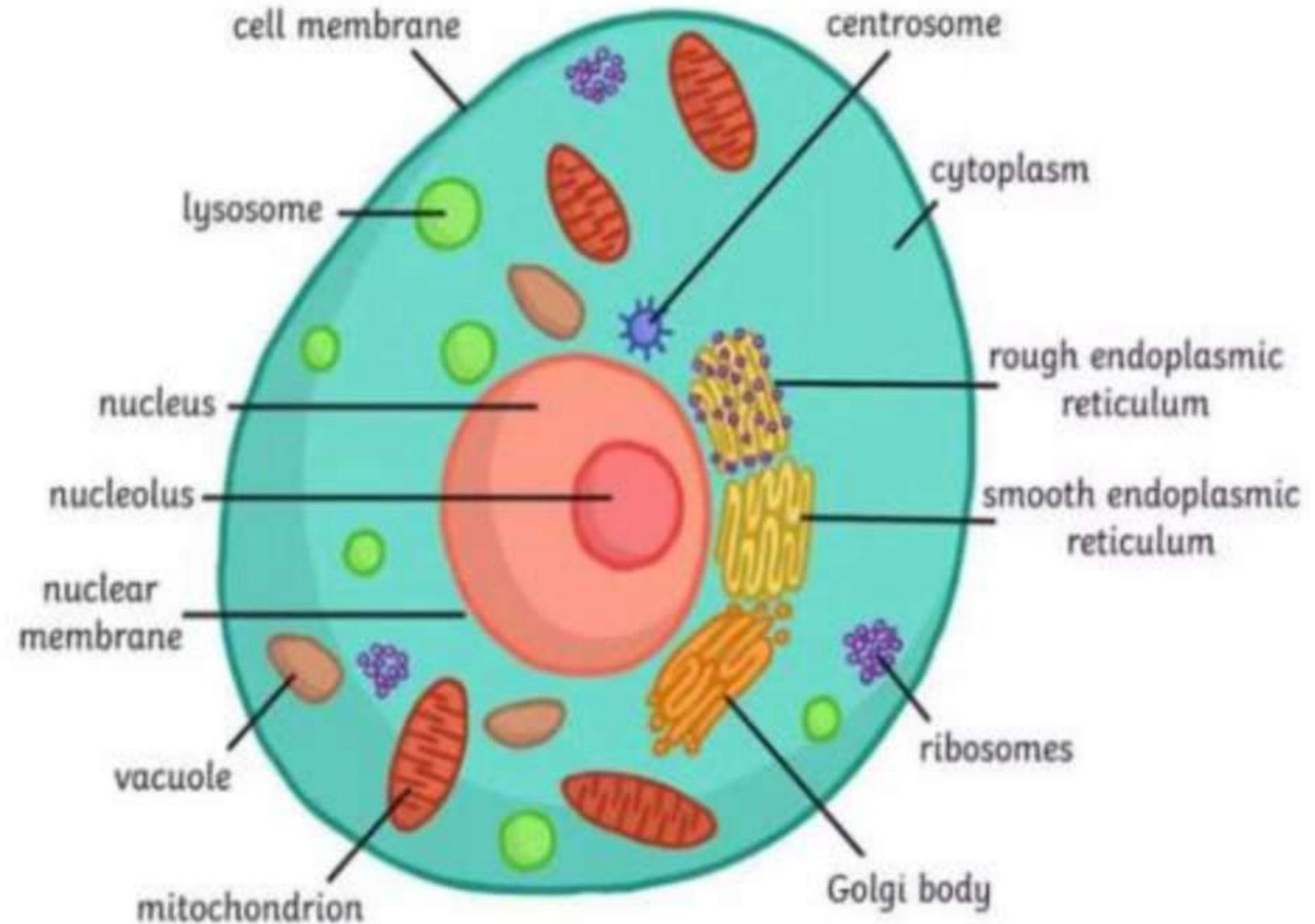
Nerve

Cell →

basic building
block of
life

Cell

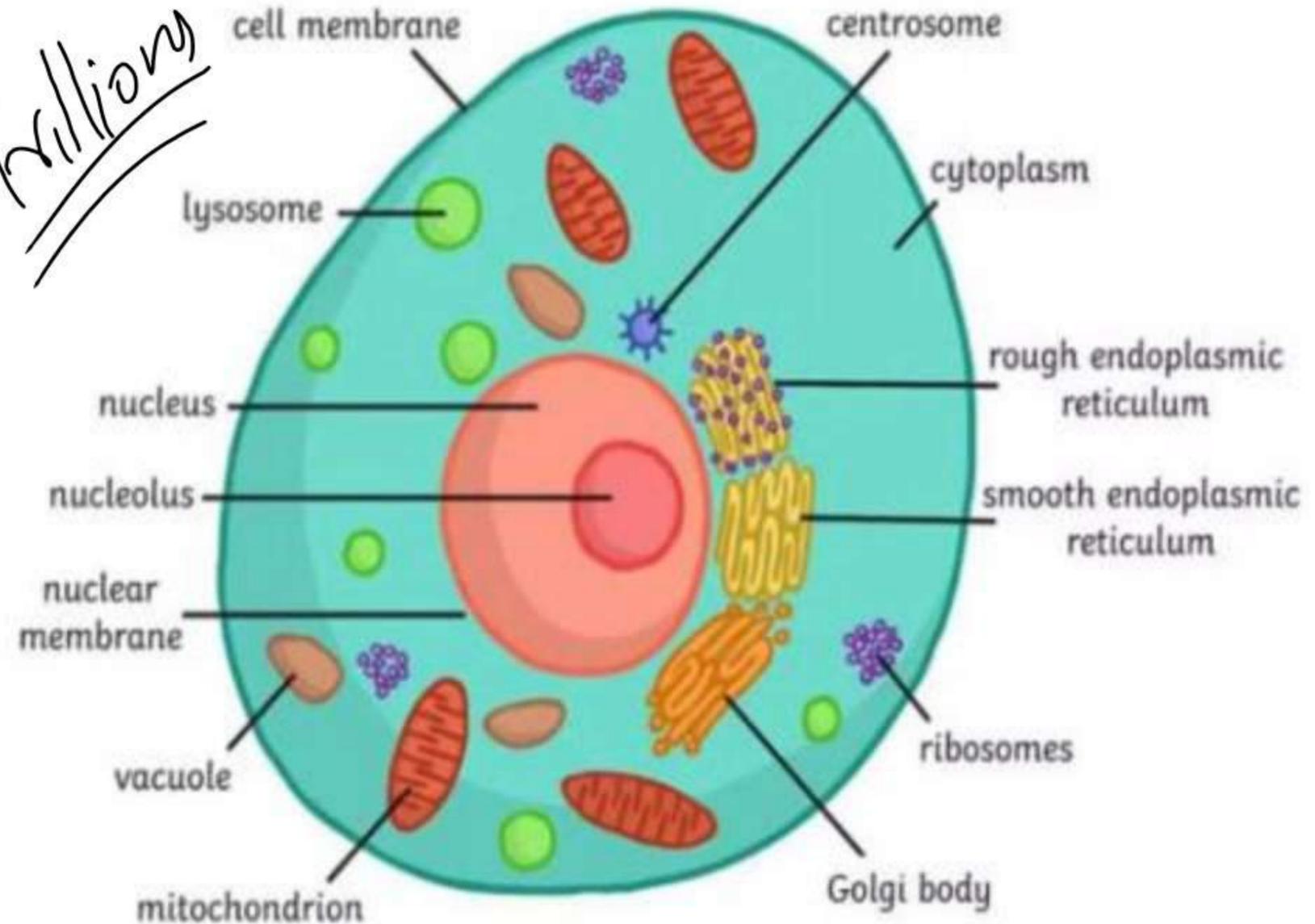
- **For the first time, Robert Hooke discovered and coined the term cell in 1665.**
- **After that Robert Brown discovered the Cell Nucleus in 1831. The cell theory, that all the plants and animals are composed of cells and that the cell is the basic unit of life was proposed by Schleiden & Schwann in 1839.**



Cell

- **Cells are the basic building blocks of all living things.**
- **The human body is composed of trillions of cells.**
- **They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.**
- **Cells also contain the body's hereditary material and can make copies of themselves.**

Trillions

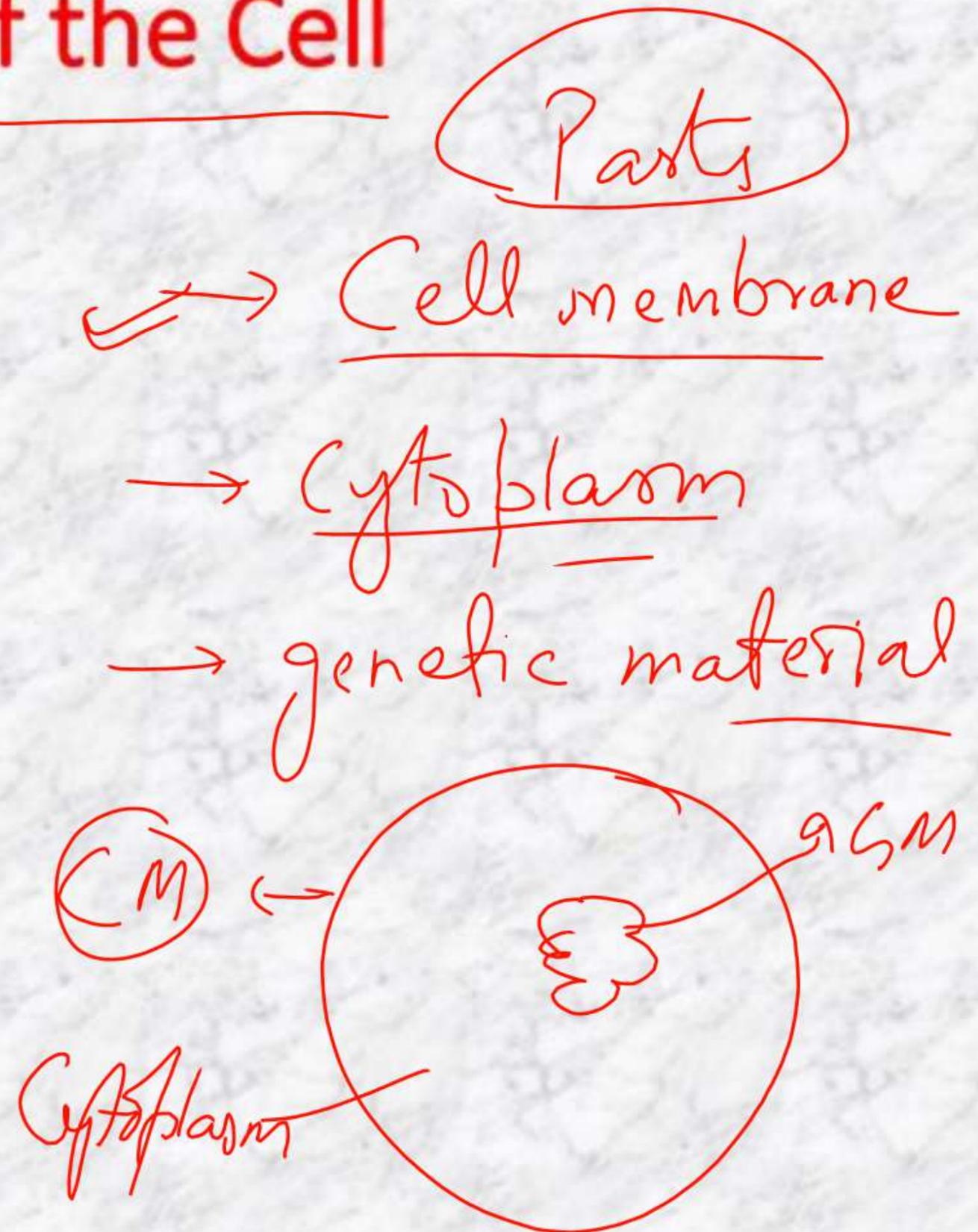


Functions of Cell

- providing structure
 - performing specific functions
 - generating energy
 - passing the genetic material to future offsprings
 - fighting diseases
- - - -

Components of the Cell

- Cell Membrane
- Cell membrane is also called the plasma membrane.
- It can be observed only through an electron microscope. Plasma membrane is the outermost covering of the cell that separates the contents of the cell from its external environment.
- The plasma membrane is flexible and is made up of organic molecules called lipids and proteins.
- The flexibility of the cell membrane also enables the cell to engulf in food and other material from its external environment.
- Note: Viruses lack any membranes and hence do not show characteristics of life until they enter a living body and use its cell machinery to multiply.



Components of the Cell

Functions

(i) The plasma membrane encloses the cell contents.

(ii) It provides cell shape (in animal cells) e.g. the characteristic shape of red blood cells, nerve cells, and bone cells.

(iii) It allows transport of certain substances into and out of the cell but not all substances so much it is termed 'selectively permeable'

2ml H₂O

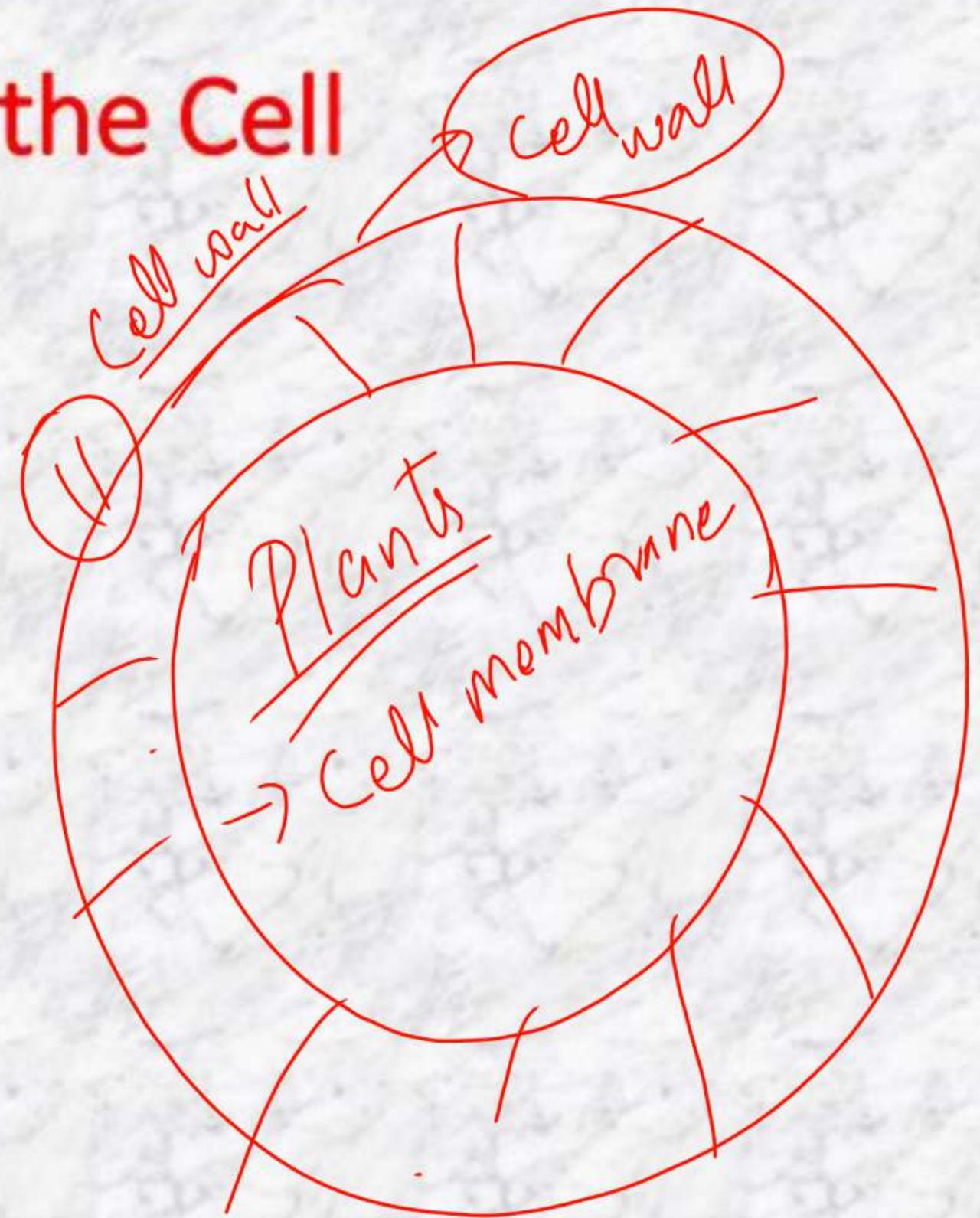
COMMON

Components of the Cell

Cell wall: In bacteria and plant cells the outermost cell cover, present outside the plasma membrane is the cell wall.

Structure:

- Outermost non-living layer present in all plant cells.
- Secreted by the cell itself.
- In most plants, it is chiefly made up of cellulose but may also contain other chemical substances such as pectin and lignin



Components of the Cell

Function:

The cell wall protects the delicate inner parts of the cell.

- Being rigid, it gives shape to the cell.
- As it is rigid, it does not allow distension of the cell, thus leading to turgidity of the cell that is useful in many ways
- It freely allows the passage of water and other chemicals into and out of the cells



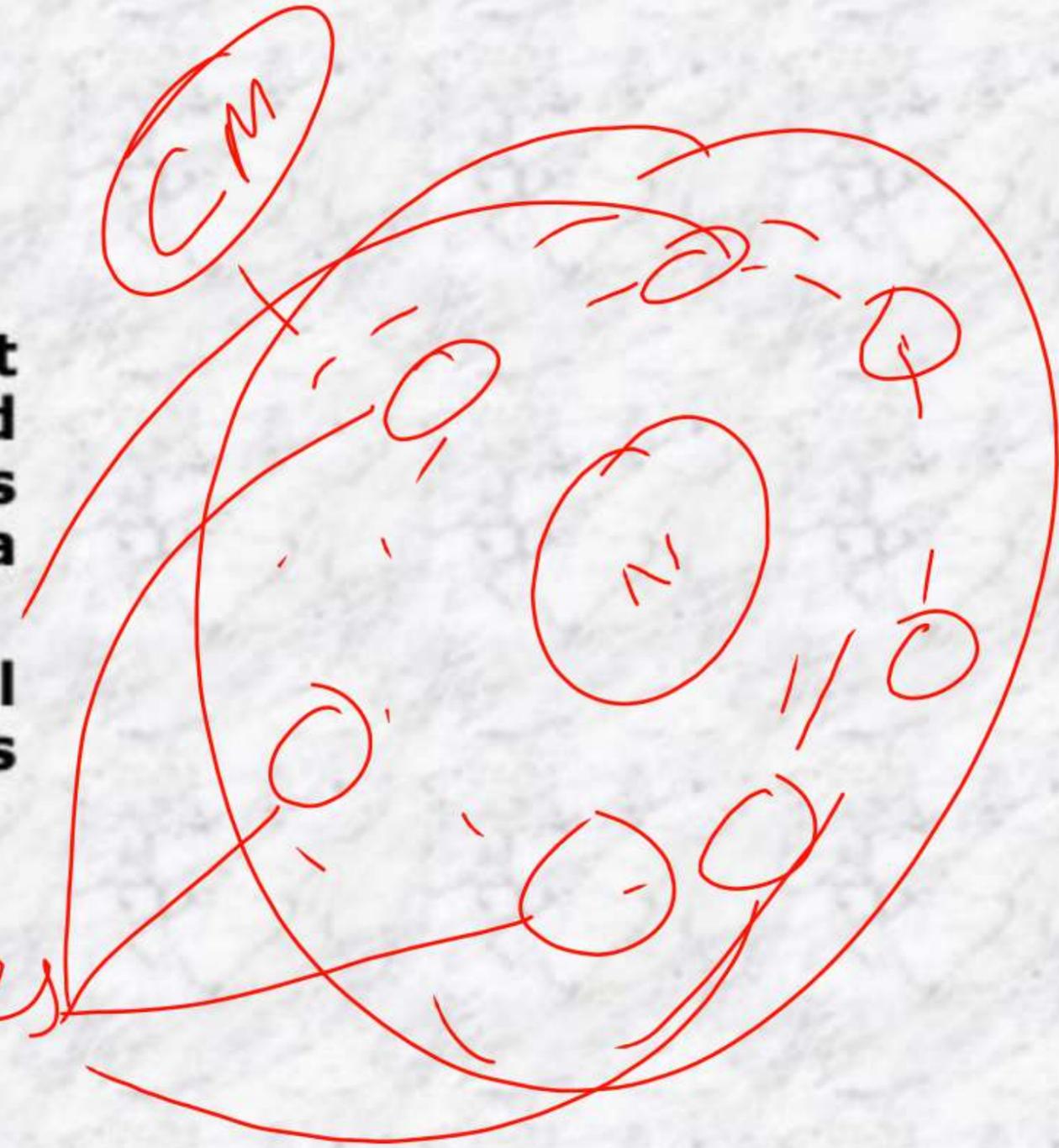
Cell Organelles

Cytoplasm

It is the jelly-like substance present between the cell membrane and the nucleus. The cytoplasm is the fluid content inside the plasma membrane.

It also contains other specialized cell organelles. Each of these organelles performs a specific function for the cell.

Organelles



Cell Organelles

Nucleus

It is an important component of the living cell. Nucleus is the control center of the cell.

Nucleus is separated from the cytoplasm by a double layered membrane called the nuclear membrane. This membrane is also porous and allows the movement of materials between the cytoplasm and the inside of the nucleus.

Nucleus

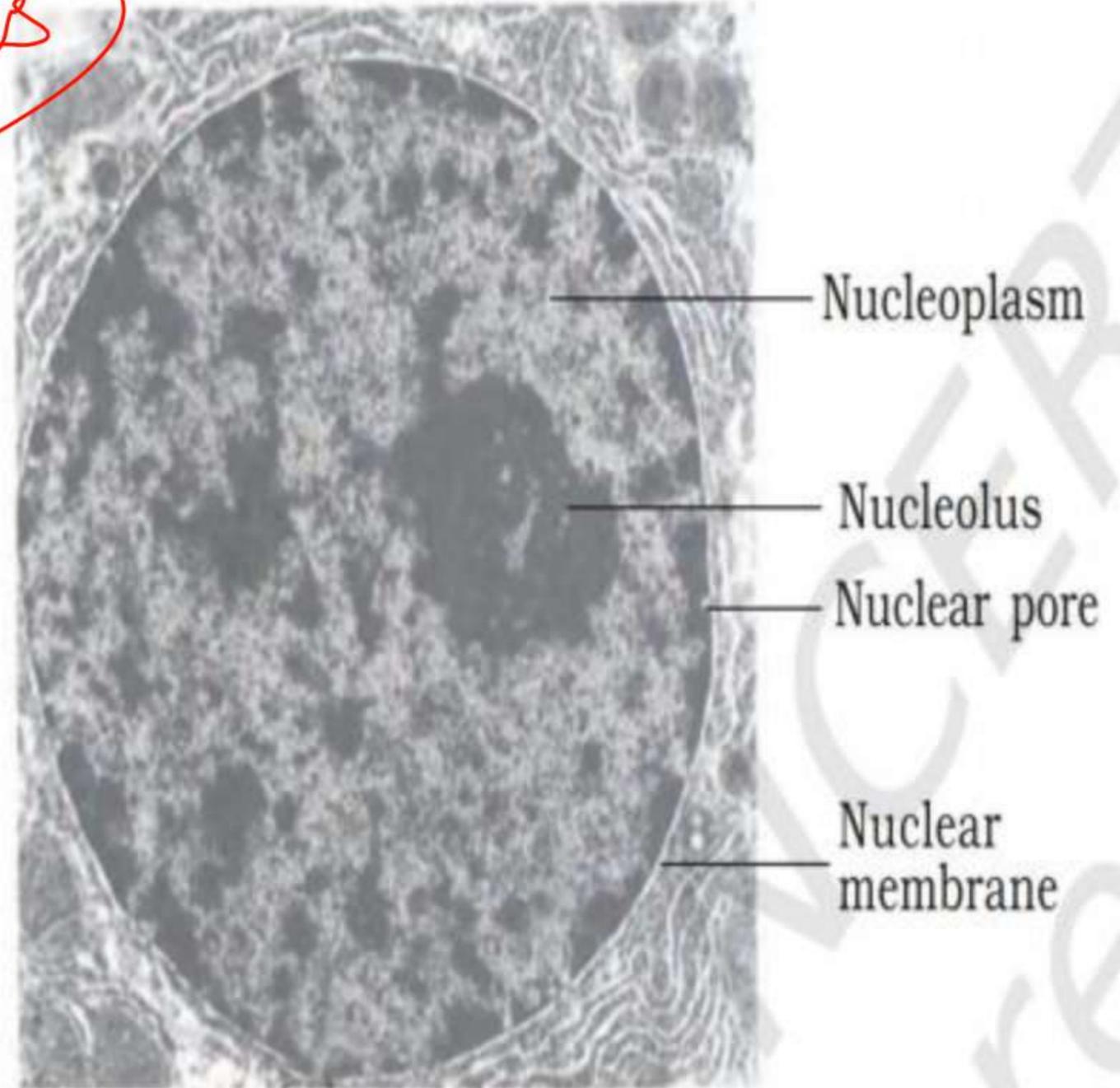
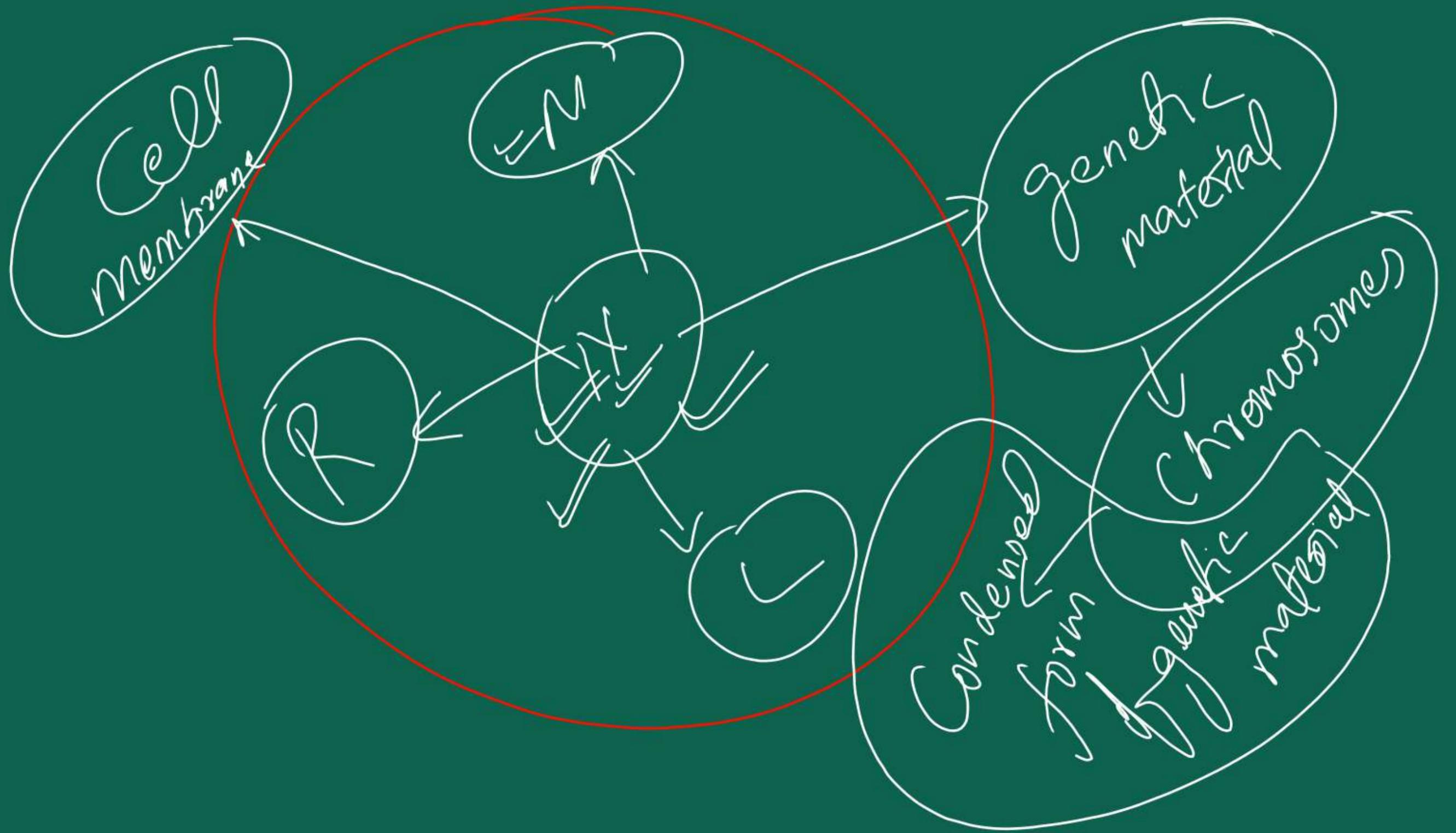


Figure 8.11 Structure of nucleus



Cell Organelles

Nucleus

Nucleus contains nucleolus and thread-like structures called chromosomes.

Chromosomes carry genes and help in inheritance or transfer of characters from the parents to the offspring. The chromosomes can be seen only when the cell divides.

The entire content of a living cell is known as protoplasm which is (cytoplasm + nucleus).

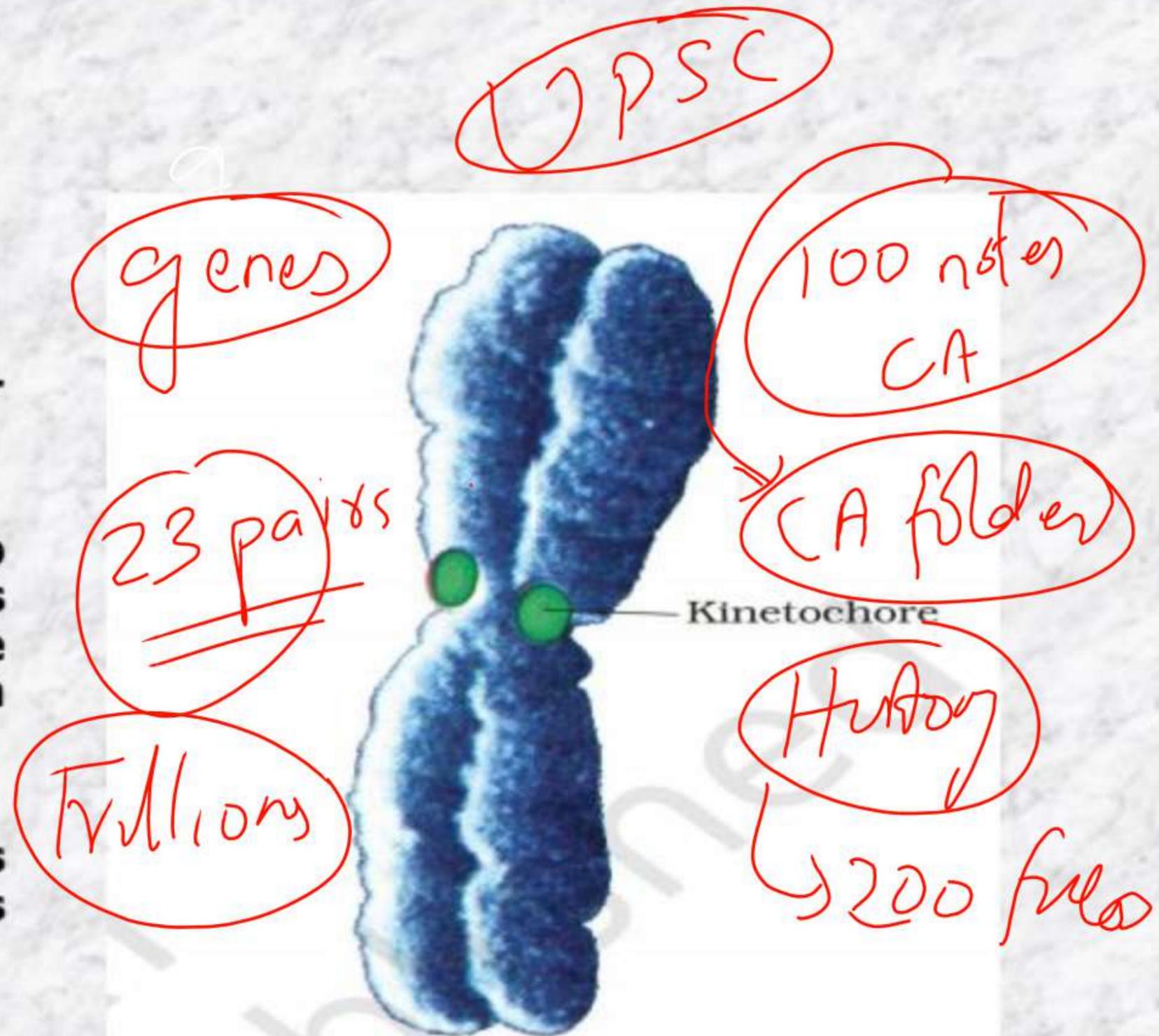


Figure 8.12 Chromosome with kinetochores

Cell Organelles

Vacuoles ✓

Empty structures in the cytoplasm is called vacuole. It could be single and big or multiple & small.

Vacuoles are storage sacs for solid or liquid contents.

Many substances of importance in the life of the plant cell are stored in vacuoles. These include amino acids, sugars, various organic acids and some proteins. ✓

Large vacuoles are common in plant cells. Vacuoles in animal cells are much smaller. The central vacuole of some plant cells may occupy 50-90% of the cell volume.

~~Cell~~
Cytoplasm



Cell Organelles

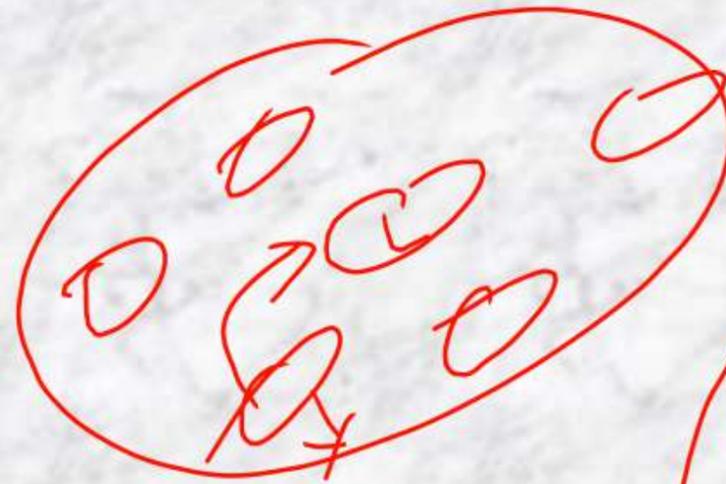
Lysosomes

Lysosomes are a kind of waste disposal system of the cell.

Lysosomes help to keep the cell clean by digesting any foreign material as well as worn-out cell organelles.

Lysosomes are able to digest these because they contain powerful digestive enzymes capable of breaking down all organic material.

During the disturbance in cellular metabolism, for example, when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell. Therefore, lysosomes are also known as the 'suicide bags' of a cell.



Cell Organelles

Golgi Apparatus or Golgi Complex

Golgi apparatus is membrane-bound organelle of eukaryotic cells that is made up of a series of flattened, stacked pouches called cisternae.

The Golgi apparatus is responsible for transporting, modifying, and packaging proteins and lipids into vesicles for delivery to targeted destinations.

It is located in the cytoplasm next to the endoplasmic reticulum and near the cell nucleus. While many types of cells contain only one or several Golgi apparatus, plant cells can contain hundreds.

The golgi apparatus is also involved in the formation of lysosomes.

Golgi Apparatus

Ribosome

Endoplasmic

Reticulum



Production

and delivery of proteins.

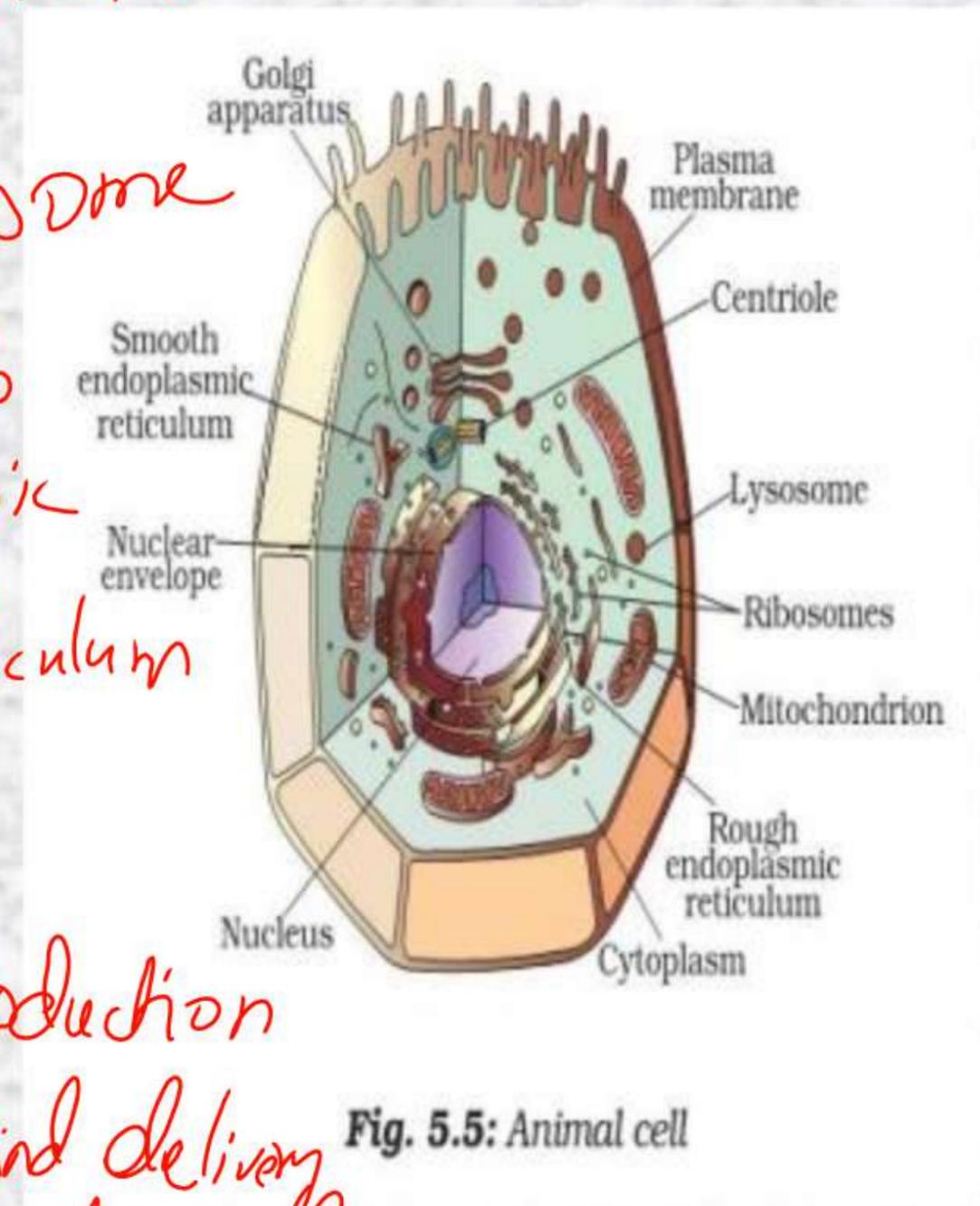


Fig. 5.5: Animal cell

Cell Organelles

Ribosome

Ribosomes are very important cell organelles composed of RNA and protein that converts genetic code into chains of amino acids.

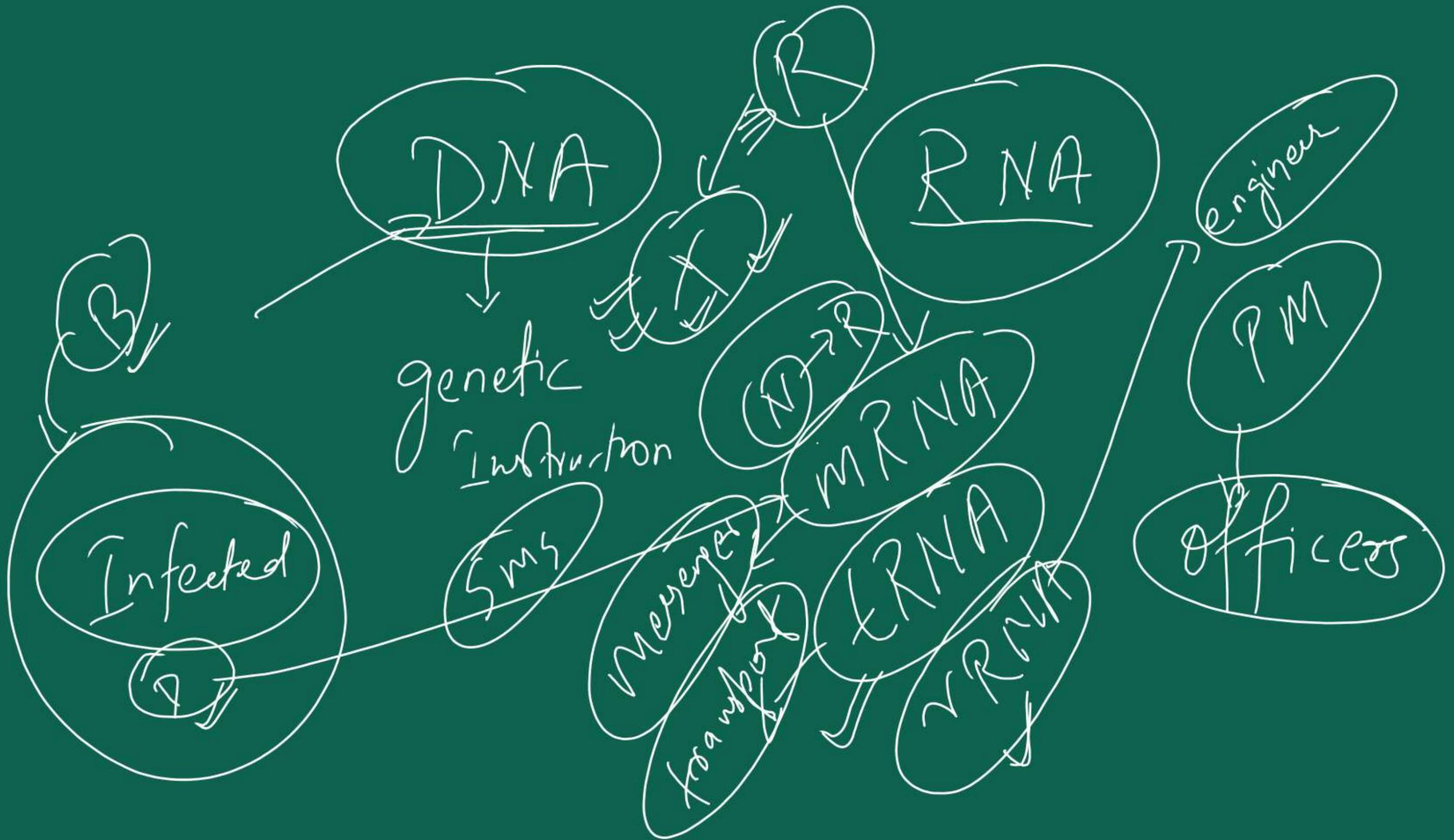
A ribosome is a complex molecular machine found inside the cells that produce proteins from amino acids during a process called protein synthesis or translation.

The process of protein synthesis is a primary function, which is performed by all living cells.

Ribosomes are known as the protein factory of the cell

Protein

mRNA



Cell Organelles

Endoplasmic Reticulum (ER)

The endoplasmic reticulum (ER) is a large network of membrane-bound tubes and sheets. The ER membrane is similar in structure to the plasma membrane.

There are two types of ER -- rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER).

RER looks rough under a microscope because it has particles called ribosomes attached to its surface.

SER helps in the manufacture of fat molecules, or lipids, important for cell function.

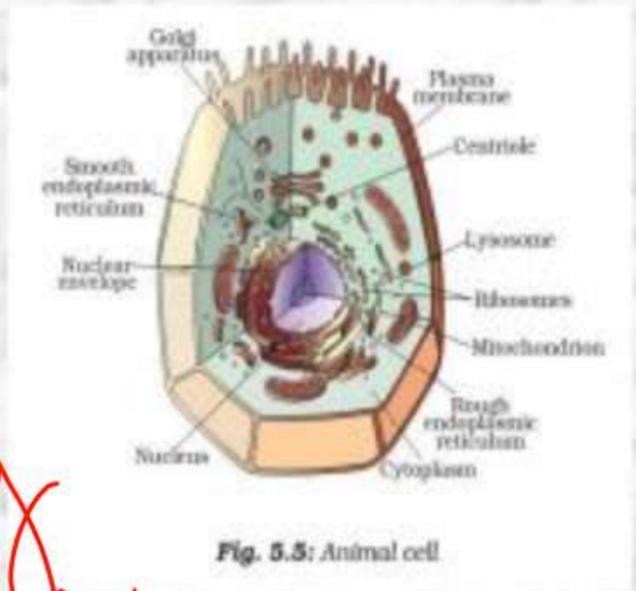
Cell Organelles

Endoplasmic Reticulum (ER)

Endoplasmic Reticulum (ER) helps in production & utilization of proteins & lipids. Some of these proteins and lipids help in building the cell membrane. Some other proteins and lipids function as enzymes and hormones.

ER also serves as channels for the transport of materials especially proteins between various regions of the cytoplasm or between the cytoplasm and the nucleus.

→ Protein
→ Lipids
→ facilitating the transfer of substances



Cell Organelles

Mitochondria

Mitochondria is known as the powerhouse of the cell.

The primary function of Mitochondria is to generate large quantities of energy in the form of adenosine triphosphate (ATP).

Our body uses energy stored in ATP for making new chemical compounds and for mechanical work.

Mitochondria have two membrane coverings instead of just one. Mitochondria have their own DNA and ribosomes. Therefore, mitochondria are able to make some of their own proteins.

→ DNA
→ Ribosome

ATP

Cell Organelles

Plastids

→ Plants

Plastids are small colored bodies in the cytoplasm. Plastids are present only in plant cells.

They are of different colours. Some of them contain green pigment called chlorophyll. Green coloured plastids are called chloroplasts. They provide green colour to the leaves.

Some plastids are also colorless called Leucoplasts in which materials such as starch, oils and protein granules are stored.

Plastids are similar to mitochondria in external structure. Like the mitochondria, plastids also have their own dna and ribosomes.

bacteria
chlorophyll → green

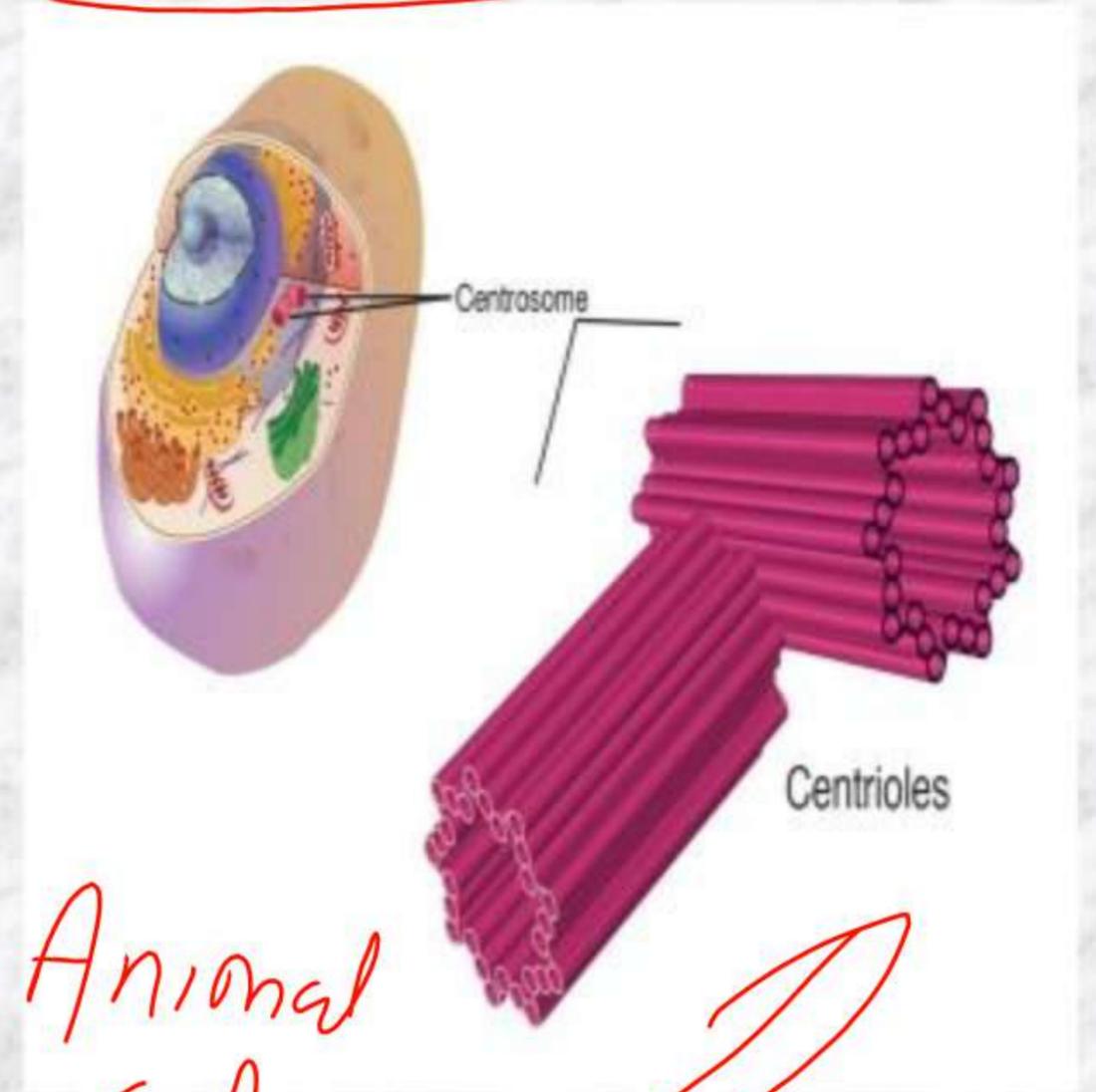
Cell Organelles

Centrosome & Centriole

cell division

Centrioles are paired barrel-shaped organelles located in the cytoplasm of animal cells near the nuclear envelope. Centrioles play a role in organizing microtubules that serve as the cell's skeletal system. They help determine the locations of the nucleus and other organelles within the cell.

Centrioles play very important for cell division. When the cell is going to divide, those centrioles go to opposite ends of the nucleus.



Animal cell



Classification of Cells

A. PROKARYOTIC AND EUKARYOTIC CELL

Prokaryotic cell (Gk. Pro-before; karyon-nucleus):

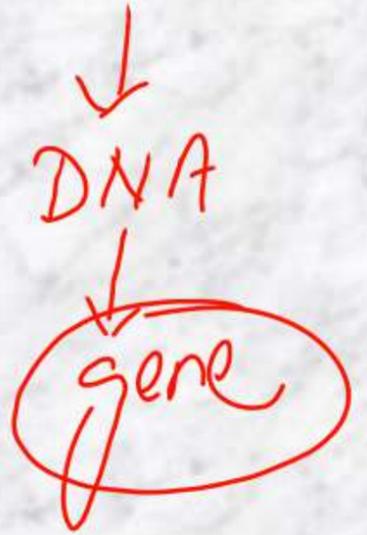
These cells do not have a well-organized nucleus.

The genetic material is a single molecule of DNA lying in the cytoplasm.

Not only is the nuclear membrane absent, cell organelles like mitochondria, lysosomes, endoplasmic reticulum, chloroplast, nucleolus, etc are also not present in prokaryotic cells.

Examples: Bacteria and blue-green algae.

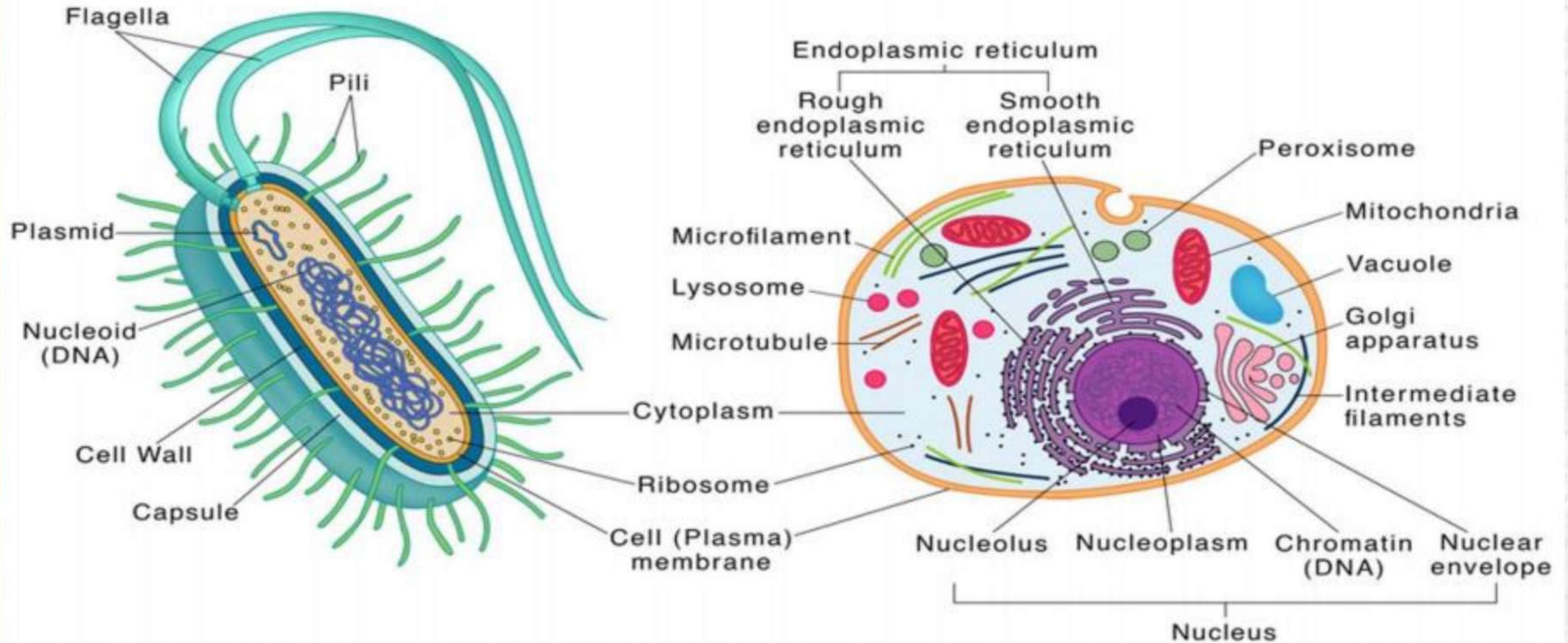
Chromosomes



Prokaryotic Cells

VS

Eukaryotic Cells



Classification of Cells

A. PROKARYOTIC AND EUKARYOTIC CELL

**Eukaryotic cell (Gk. Eu-true; karyon-nucleus):
DNA is enclosed in a nuclear membrane forming a nucleus.**

The genetic material is made of two or more DNA molecules, which are present as a network of chromatin fibres when the cell is not dividing.

Membrane-bound organelles, such as mitochondria, endoplasmic reticulum, lysosome, chloroplast, nucleolus, etc. are present within the cytoplasm.

Examples: Cells of plants, fungi, protozoa and animals.

Plant Cells & Animal Cells:

Feature	Plant cell	Animal cell
Size and Shape	Larger in size and rectangular in shape.	Smaller in size and oval in shape.
Cell wall	Cell wall is made up of cellulose.	Cell wall absent.
Vacuoles	Vacuoles are large. In a mature plant cell, usually a single large central vacuole is present.	Vacuoles are mostly absent or if present are small in size and scattered.
Golgi bodies	Golgi bodies are diffused in the plant cells and are called dictyosomes.	Golgi bodies are well-developed and present near nucleus.
Centrosome	Centrosome and centrioles are absent.	Centrosome and centrioles are present.
Plastids	Present	Absent
Storage of reserve food	Reserve food is stored in the form of starch or oil.	Reserve food is stored in the form of glycogen.

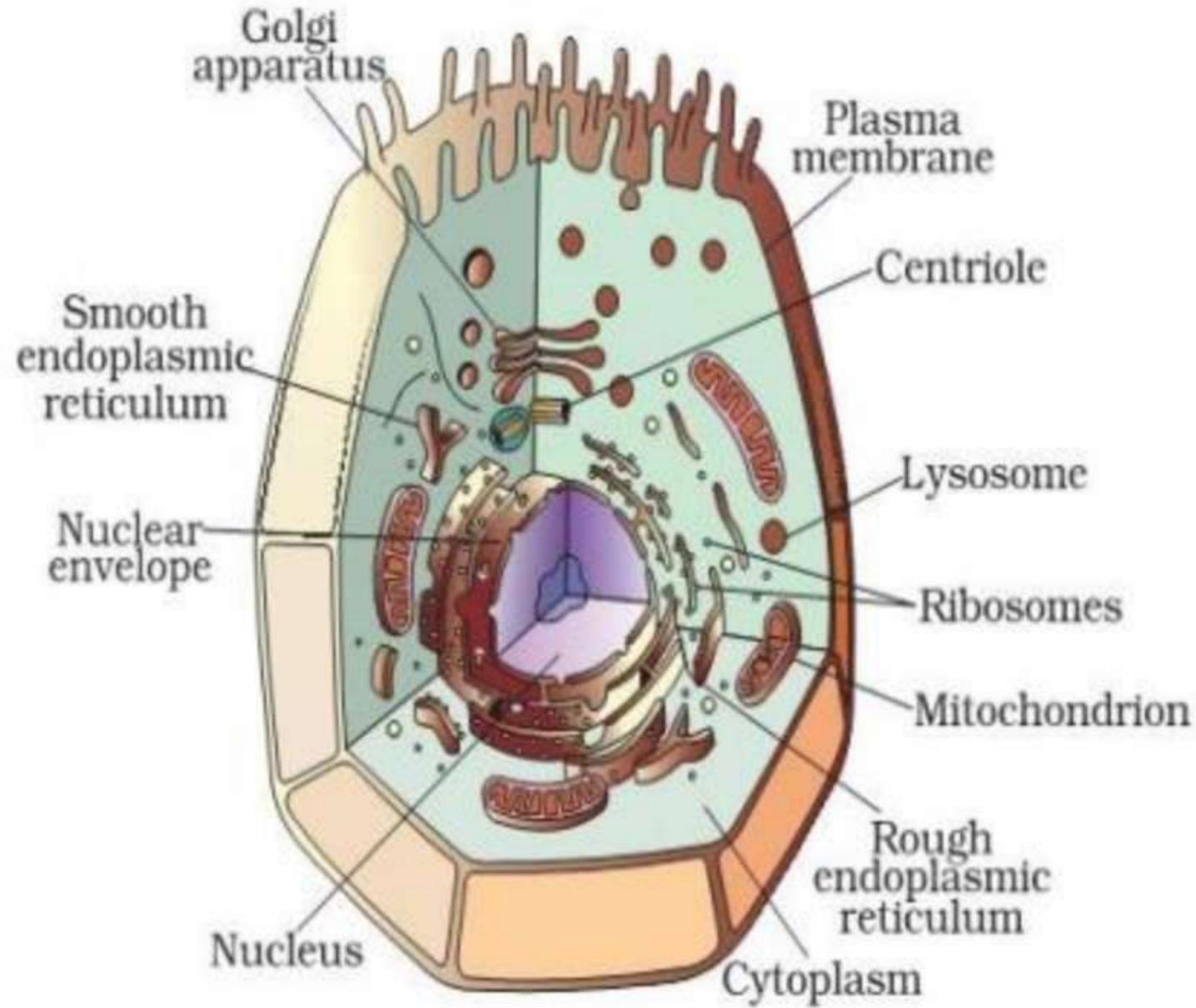


Fig. 5.5: Animal cell

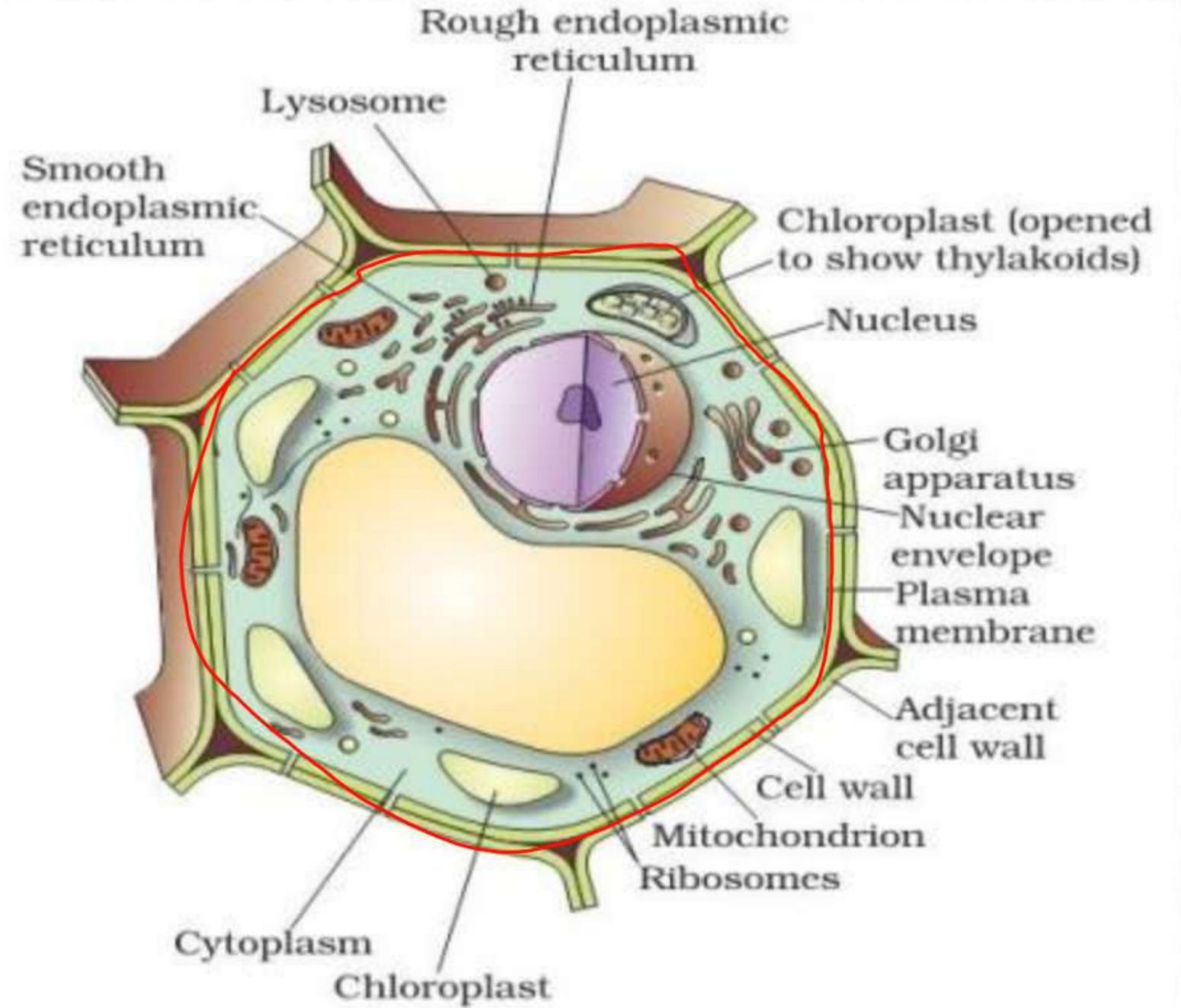


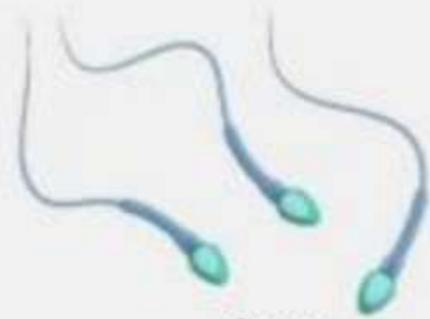
Fig. 5.6: Plant cell

Germ Cells & Somatic Cell

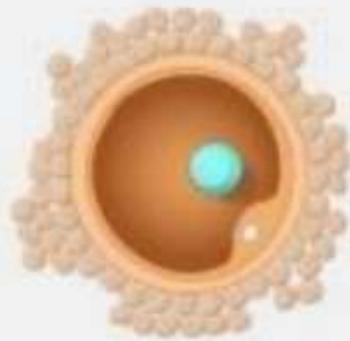
Germ line (germ cells)

Haploid

23 chromosomes (n) in human



Sperm



Ovum (egg)

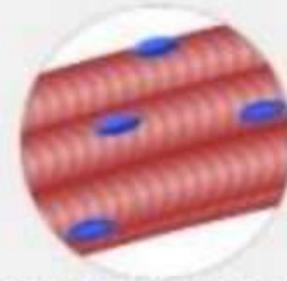
Somatic cells

Diploid

46 chromosomes (2n) in human



Fertilized egg



Skeletal and muscle cells



Blood cells



Stem cells



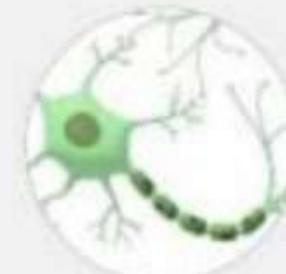
All other cells



Organ and tissue cells



Fat cells



Neuron cells

Classification of Cells

- **Difference Between Somatic Cells and Germ Cells**
- **Somatic Cells:** Somatic cells are any cells in a multicellular organism that are not involved in the production of gametes.
- **Germ Cells:** Germ cells are the cells that create reproductive cells or gametes.
- **Types**
- **Somatic Cells:** Various types of somatic cells are arranged into different types of tissues in the body of multicellular organisms, performing specific functions.
- **Germ Cells:** Germ cells produce male and female gametes.

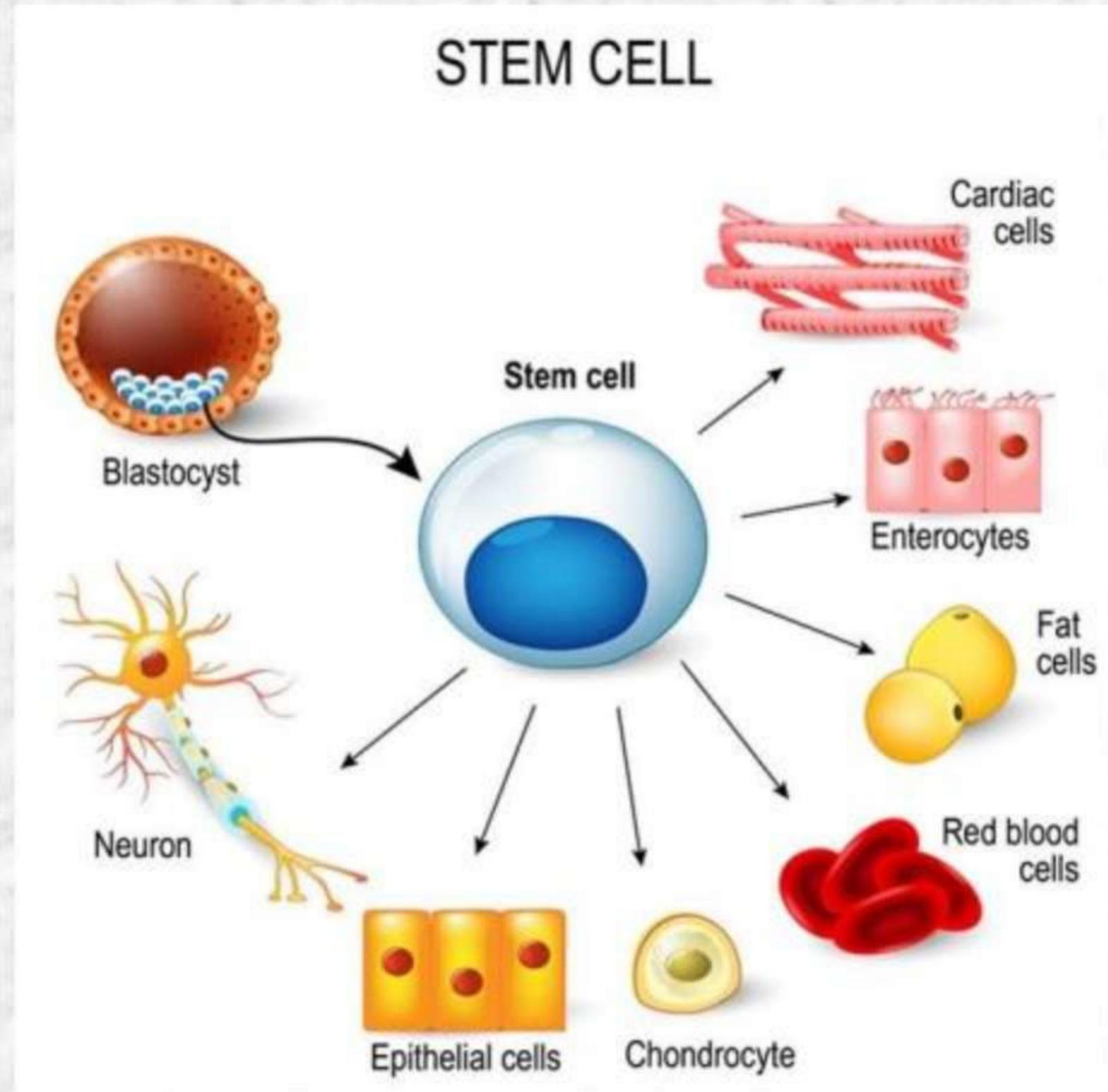
Classification of Cells

- **Difference Between Somatic Cells and Germ Cells**
- **Amount**
- **Somatic Cells: Majority of the body cells in multicellular organisms are somatic cells.**
- **Germ Cells: Germ cells are very few in number.**
- **Functions**
- **Somatic Cells: Somatic cells perform various functions in the body.**
- **Germ Cells: Germ cells produce gametes, which participate in sexual reproduction.**

Stem Cell and Somatic Cell

- **Stem cells are unspecialized cells with self-renewal capacity. They can divide through mitosis limitlessly to replenish other cell types of multicellular organisms throughout their life.**
- **After stem cell division, each newly produced cell can either remain as a stem cell or differentiate to form any other cell type with more defined functions, such as muscle cell, blood cell, or neural cell.**
- **There are mainly two types of stem cells: embryonic stem cells, which are derived from embryos, and somatic or adult stem cells, which are undifferentiated cells residing in a tissue or organ along with other differentiated cells (somatic cells).**

The major difference between embryonic and somatic stem cells is that embryonic stem cells have the potential to differentiate into all cell types of the body, as they are pluripotent stem cells (cells that are able to differentiate into three primary germ cell layers of the early embryo and, thus, into any cell type of the body); whereas, it is believed that somatic stem cells can differentiate only into different cell types present in the tissue of their origin.



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