

JSR IAS ACADEMY

GENERAL SCIENCE

BIOLOGY

Main concepts of
Life Science

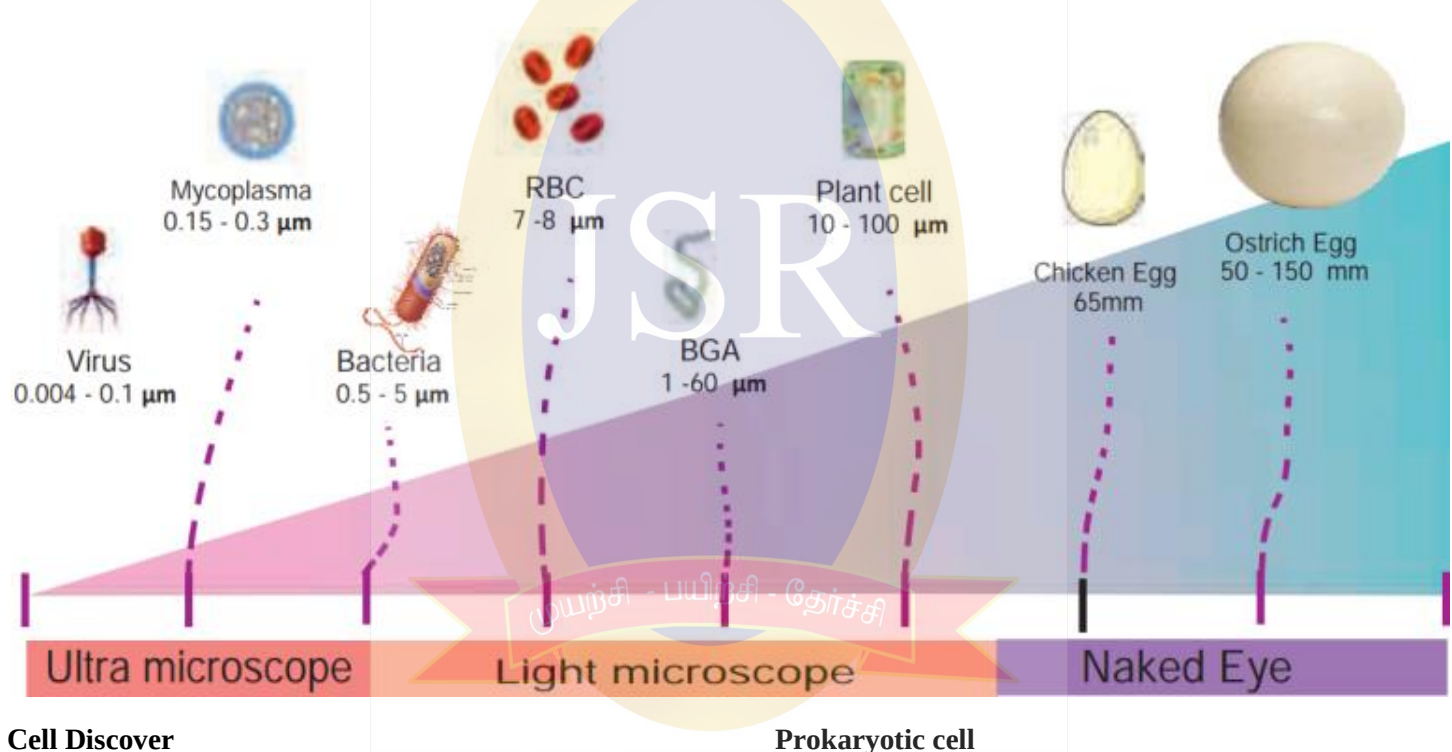
CELL

Cell

- The basic **functional unit of an organism** is called cell.
- Cells are the basic **building blocks of an organism**.

Organisms such as **Bacteria, Amoeba, Chlamydomonas, and Yeast** are **unicellular**.

On the other hand, organisms such as **Spirogyra, Mango, and Human beings** are **multicellular**. (i.e) made up of a few hundreds to million cells.

Animal cell Size**Cell Discover**

The Englishman **Robert hooke** was a scientist, published a book named **Micrographia** in the year **1665**, where he first used the term Cell .

In **Latin** the word '**cellua**' means a **small chamber**.

TYPES OF CELL

Generally cells are classified into **two types**.

1. First one is Prokaryotic cell .It has **No true nucleus** consisting of no nuclear membrane.
2. Another one is Eukaryotic cell. It has **True nucleus** consisting of nuclear membrane

- The size of cells varies in different animals which are measured in units of micron (μm).
- In human body, the smallest cell is **RBC ($7 \mu\text{m}$ in diameter)**, the longest one is the **nerve cell** which reaches a length of about **90 -100 cm**
- the **human egg (ovum)** is **100 μm** in size .
- Among multicellular animals, **the largest cell is, egg of an ostrich**.
- It measures about **170 mm $\times$ 180mm in diameter**.
- **Mycoplasma** with a **diameter of 0.0001 mm** is **the smallest bacterium**.

Prokaryotic cell

- ❖ These **cells were the first form of life on earth**.
- ❖ This type of nucleus is called as **nucleiod**.
- ❖ It is ranging from **0.003 to 2.0 micro meter in diameter**.
- ❖ **Eg. Eschericia coil bacteria**.

Eukaryotic cell

- ❖ It is **bigger than prokaryotic cells**.
- ❖ **Ex. Plants,animals, most of the fungi and algae**



Approximate number of cells in the human body is 3.7×10^{13} or 37,000,000,000,000.

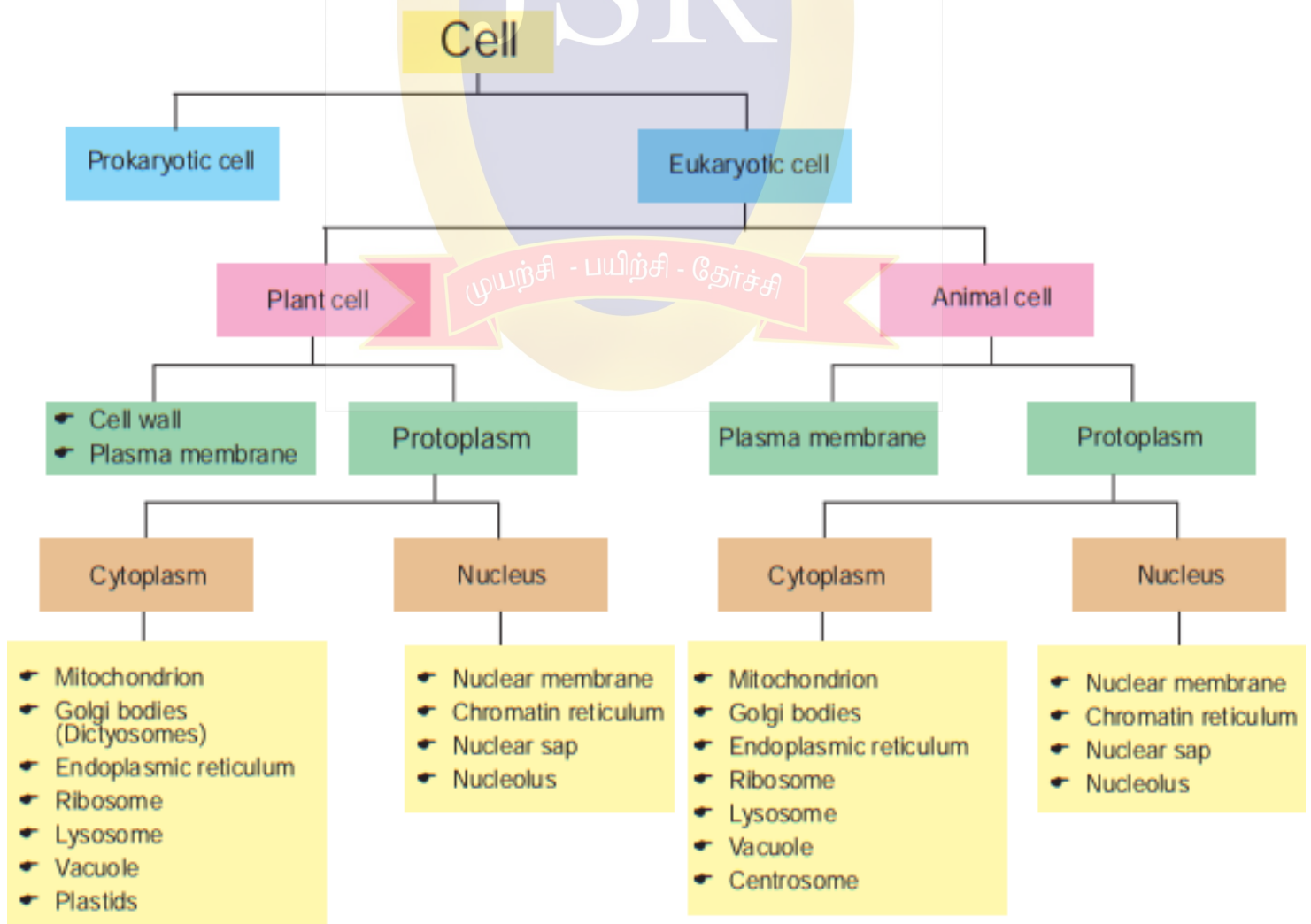
Sl. No.	Prokaryotic Cell	Eukaryotic Cell
1.	It is generally smaller (1-10 microns) in size.	It is comparatively larger (5-100 microns) in size.
2.	It lacks a well organized nucleus as its nuclear material is not surrounded by a nuclear membrane.	It contains a well organized nucleus as its nuclear material is surrounded by a nuclear membrane.
3.	It has a single chromosome.	It has more than one chromosome.
4.	Nucleolus is absent.	Nucleolus is present.
5.	It lacks membrane bound cell organelles.	It possesses membrane bound cell organelles.
6.	Cell division occurs by fission or budding. Mitotic and meiotic divisions are absent.	Cell division takes place by mitosis and meiosis.
7.	Ribosomes are small.	Ribosomes are large.

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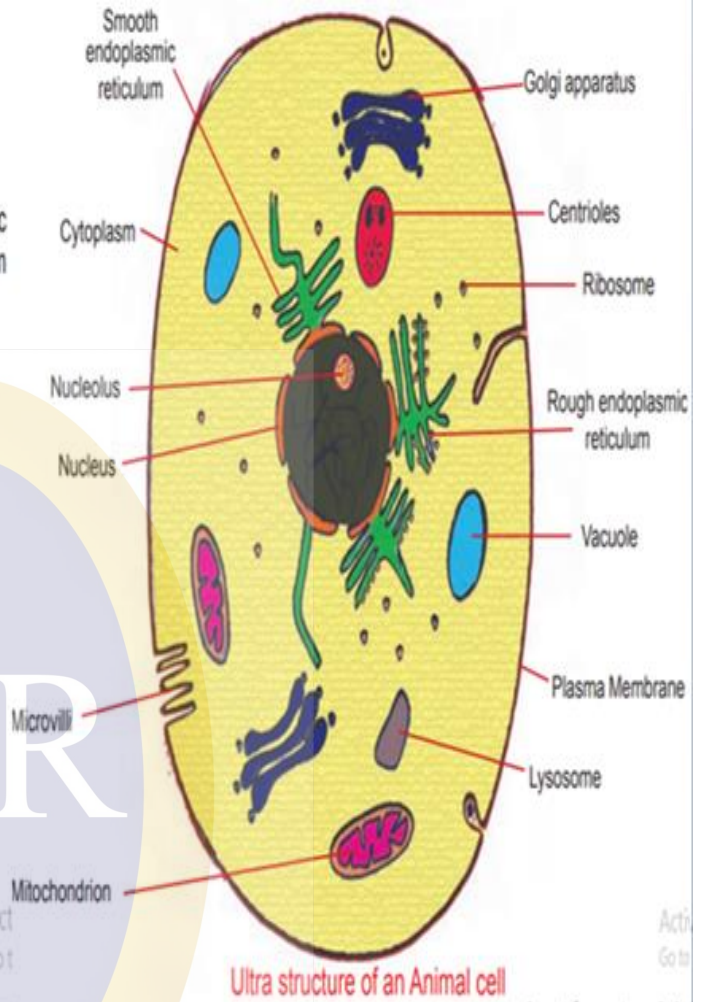
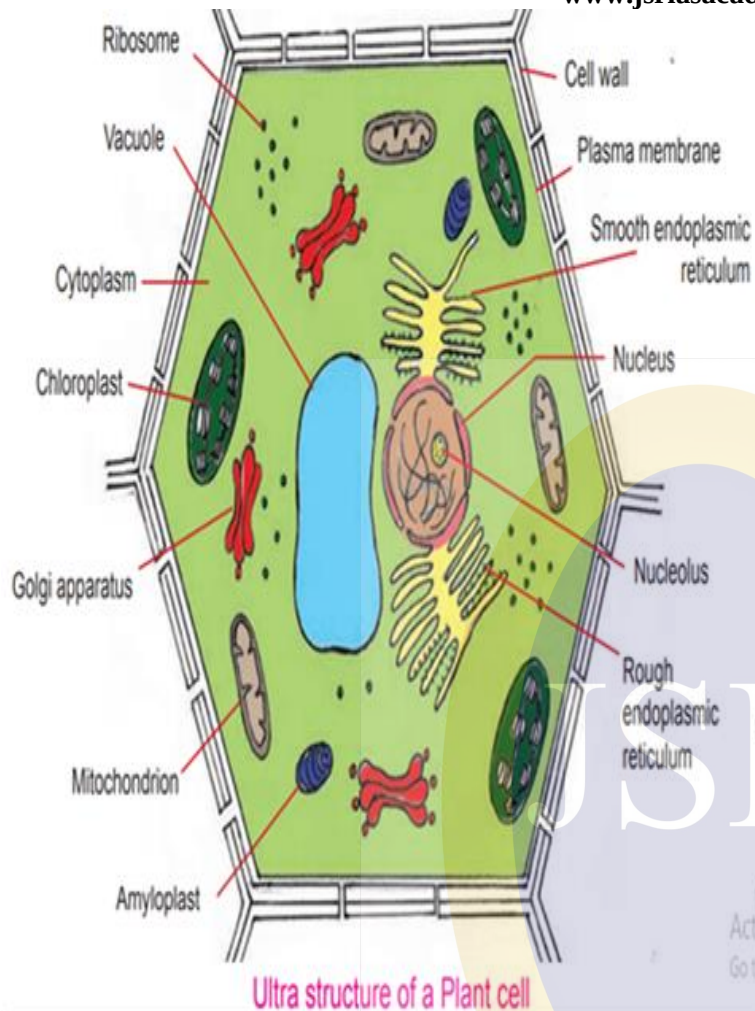
Features	Prokaryotes	Mesokaryotes	Eukaryotes
Size of the cell	~1-5 μ m	~5-10 μ m	~10-100 μ m
Nuclear character	Nucleoid, no true nucleus,	Nucleus with nuclear membrane	True nucleus with nuclear membrane
DNA	Usually circular without histone proteins	Usually linear but without histone proteins	Usually linear with histone proteins
RNA/Protein synthesis	Couples in cytoplasm	Similar with eukaryotes	RNA synthesis Inside nucleus/ Protein synthesis in cytoplasm
Ribosomes	50S+ 30S	60S + 40S	60S + 40S
Organelles	Absent	Present	Numerous
Cell movement	Flagella	Gliding and flagella	Flagella and cilia
Organization	Usually single cell	Single and colony	Single, colonial and multicellular
Cell division	Binary fission	Binary fission	Mitosis and meiosis
Examples	Bacteria and Archaea	Dinoflagellate, Protozoa	Fungi, plants and animals

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Year	Scientist	Events
1665	Robert Hooke	Coined word "Cell"
1670-74	Antonie van Leeuwenhoek	First living cells observed in microscope - Structure of bacteria
1831-33	Robert Brown	Presence of nucleus in cells of orchid roots
1839	Jan Evangelista Purkyne (J.E. Purkinje)	Coined "protoplasm"
1838-39	Schleiden & Schwann	Cell theory
1858	Rudolph Ludwig Carl Virchow	Cell theory ' <i>omnis cellula e cellula</i> '
1873	Anton Schneider	Described chromosomes (Nuclear filaments) for the first time
1882	Walther Flemming	Coined the word mitosis; chromosome behaviour
1883	Edouard Van Beneden	Cell division in round worm
1888	Theodor Boveri	Centrosome; Chromosome Theory



The cell and its components



Sl. No.	Plant cell முயற்சி - பயிற்சி	Animal cell தேர்ச்சி
1.	Plant cell has an outer rigid cell wall which is made up of cellulose.	Animal cell lacks a cell wall.
2.	Plant cell is larger than animal cell.	Animal cell is comparatively smaller in size.
3.	Plant cell has large vacuoles which occupy more space in the cell.	Animal cell usually lacks vacuoles. Even if they are present, they are minute in size.
4.	Centrosome is present only in the cells of some lower plants.	All animal cells contain centrosomes.
5.	Lysosomes are found only in the eukaryotic plant cells.	Lysosomes are found in all animal cells.
6.	Plant cell contains plastids.	Plastids are absent.
7.	Mostly, starch is the storage material.	Glycogen is the storage material.

A typical cell consists of three major parts:

1. An outer cell membrane.
2. A liquid cytoplasm.
3. A nucleus.

Cell Membrane (Plasma membrane or Plasmalemma)

- The content of a cell is enclosed by a membrane called **plasma membrane**.

Functions of plasma membrane:

- **controls how substances move in and out of a cell.**
- It provides an **outer boundary to the cell and protects it from injury.**
- It controls the substances that are allowed to enter and exit the cell. This regulation is called **selectively permeable membrane**.

Cell wall

- Plant cells have an additional layer on the outer side of the cell membrane. This is called as the **cell wall**,
- **“Supporter and Protector”**
- **plant cells** have a much **more regular and rigid shape**.
- It is **made of cellulose and lignin**.
- **Cellulose helps** to maintain the **shape of the plant cell**.
- Lignin is **water-resistant**.
- The **cell wall is slightly elastic** and its combined strength helps both small plants and tall trees maintain their shape, even when they sway in strong winds.

Plasmodesmata

Each cell is **interconnected with its neighboring cells** through openings called Plasmodesmata.

Protoplasm

- The entire content of a cell is referred to as protoplasm.
- **Cytoplasm** In particular, the material inside and outside the nuclear membrane is known as Protoplasm.
- Every aspect of protoplasm **takes care of the life of the organism**.
- Therefore, the protoplasm is described as the ‘physical basis of life’.

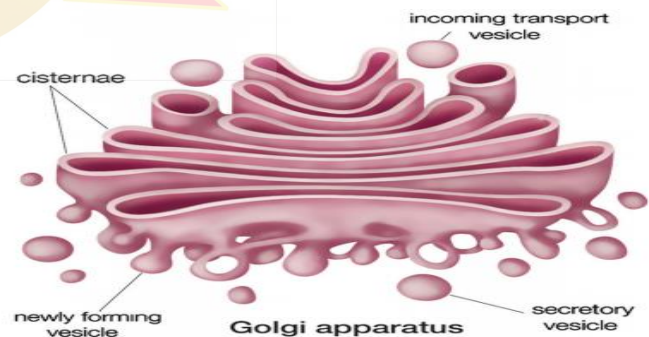
Cytoplasm

- **outside the nucleus** is called as **cytoplasm**.
- The cytoplasm includes all living parts of the cell with in the cell membrane, **excluding the nucleus**.
- The cytoplasm is **made up of the cytosol and cell organelles**.
- **The cytosol** is a watery, jellylike medium made up of **70% - 90% water and usually colourless**.
- ❖ The cytoplasm also moves around slowly carrying the organelles around in a process called **cytoplasmic streaming**.
- ❖ I am the **“Area of Movement”**.
- ❖ The portion of cytoplasm immediately below the cell membrane is gel-like and is called **ectoplasm**.
- ❖ The cytoplasm between the ectoplasm and the nuclear membrane is liquefied and is called **endoplasm**.

Inside the cytoplasm

Golgi Complex or Golgi Apparatus

- This apparatus was first discovered by **Camillo Golgi**.
- Membrane **bounded sacs are stacked on top of the other with associated secretory vesicles** are collectively known as golgi complex.
- They work closely with the ER and package substances in the form of **vesicles or cisternae** and transport nutrients to various parts of a cell.



Functions

- Golgi apparatus is involved in the **formation of lysosomes**.
- production of secretory substances, packaging and secretion.
- This is the **secret behind the change in the colour and taste of fruits**
- It is also responsible for the **synthesis of cell wall and cell membrane**.

Lysosome- “Suicidal Bag”

- They are the main **digestive compartments of the cell**.
- Lysosomes are often referred to as ‘suicide bags’ or ‘digestive bags’.

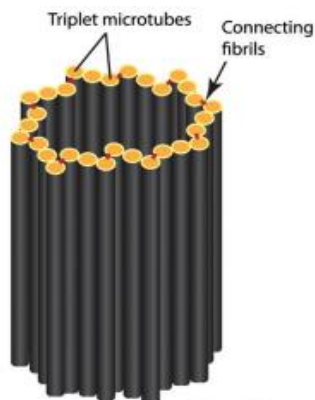
Functions

- 1. Lysosomes are involved in the intracellular digestion of food particles ingested by the cell through **endocytosis**.
- 2. The lysosomes of WBCs (White Blood Cells) **destroy pathogens and other foreign particles** and thus take part in **natural defence of the body**.

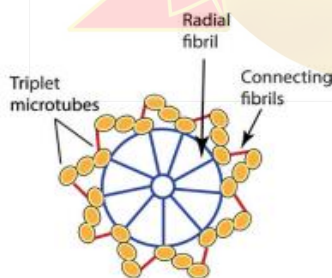
Lysosomes are involved in the destruction of aged and worn out cellular organelles. Therefore, they are also called demolition squads or scavengers or cellular housekeepers.

Centrioles

- They are generally found close to the nucleus and are made up of **tube-like structures**.
- Centrioles or centrosomes are **present only in animal cells**
- It **helps in the separation of chromosomes during cell division**.



Structure of a Centriole

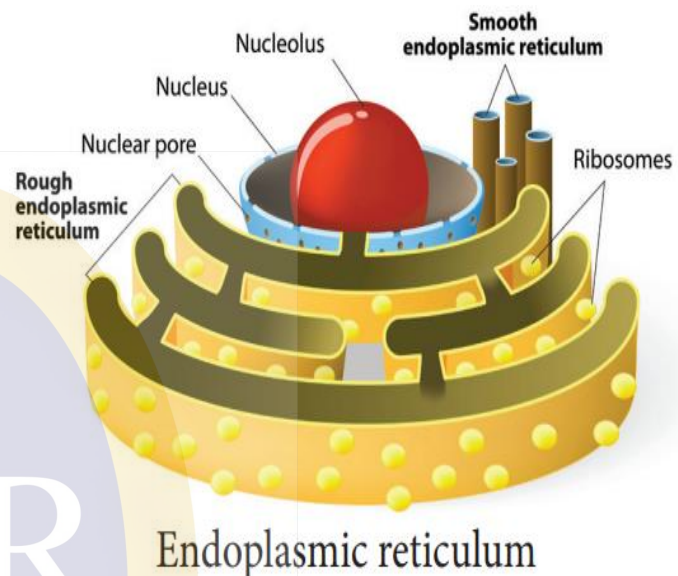
**Endoplasmic reticulum**

inter membranous network **made up of flat or tubular sacs** within the cytoplasm.

Endoplasmic reticulum is of two types.

- **Rough endoplasmic reticulum** are **rough due to the ribosomes attached** to the membrane. which helps in the **synthesis of protein**.

- **Smooth endoplasmic reticulum**. It is a network of tubular sacs **without ribosomes** on the membrane. They play a role in the **synthesis of lipids, steroids** and also **transport them within the cell**.

**Vacuoles**

- **Large fluid-filled sacs** called vacuoles are found more in plant cells than in animal cells.
- Mature plant cells are **found to have one large vacuole that almost fills up the entire cell**.
- They may play the part of a **contractile vacuole** where **excess water and waste is excreted from a cell**.
- They also **function as food vacuoles** where they **engulf material**.

Functions

- Vacuoles **store and concentrate mineral salts as well as nutrients**.
- They **maintain proper osmotic pressure in the cell to maintain its turgidity**.

Nucleus

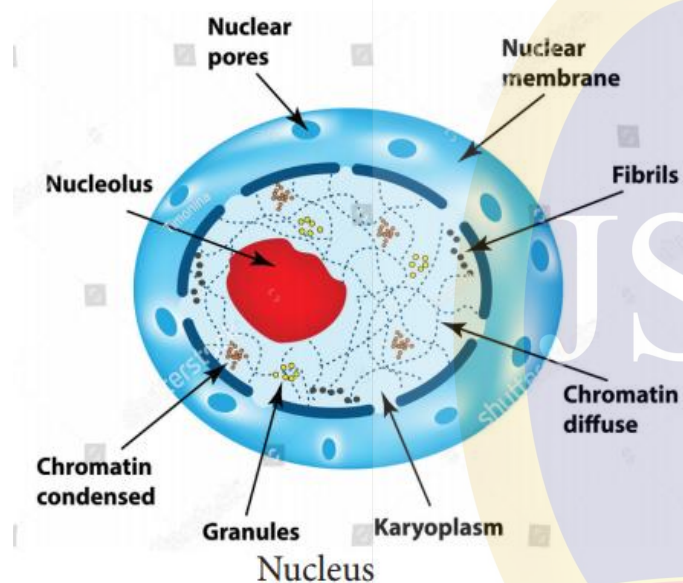
- Everyone **do what I say**.
- A nucleus is commonly seen as a **spherical structure surrounded by a double membrane called the nuclear envelope**.
- Acting like the **“Brain” of the cell**™
- Plant and animal cells have a **nucleus inside the cytoplasm**.
- During cell division, the **chromatin body is organised into a chromosome**.

The nuclear envelope

- has a **large number of holes or 'pores'** that allow the cell to move molecules across the nuclear envelope and in and out of the nucleus.

The nucleoplasm has two types of nuclear structures:**The nucleolus**

- a spherical **body rich in protein and RNA**.
- It is the **site of ribosome formation**.
- There may be **one or more nucleoli in the nucleoplasm**.

**Functions of Nucleus**

- It **controls all the processes and chemical reactions that take place inside the cell**.
- It controls the activity of the cell by **determining what proteins are produced and when they are produced by the cell**;
- it also stores the genetic information of the cell, which is then passed on to daughter cells during cell division.

Mitochondria - "Power house of the Cell".

- The food that you ate to be broken down in order to **release the energy** which can be used by your body to function.
- **Very active cells** have more mitochondria than cells that are less active.
- Mitochondrion is an **oval or rod shaped double membrane bounded organelle**.
- **Aerobic respiratory reactions** take place with in the mitochondrion to **release energy**.

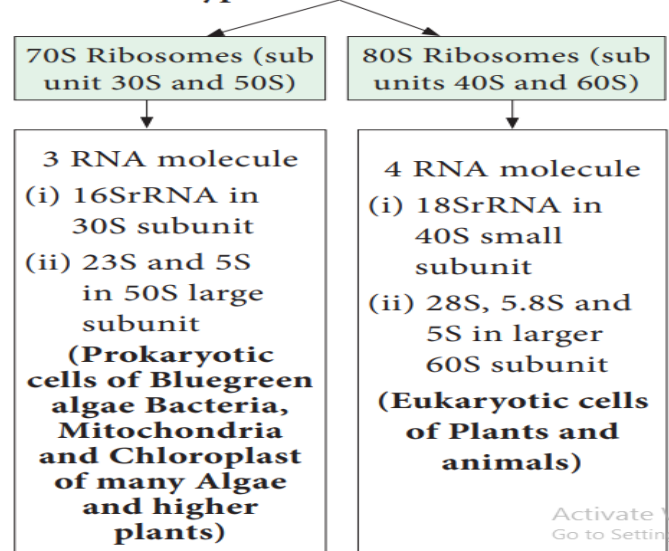
Chloroplast- "Food Producers".

- the **green organelles present in plant cells** and absent in animal cells.
- Chlorophyll can **absorb radiant energy from the Sun and convert it to the chemical energy**

Ribosome**Chromatin**

- Chromosomes **Strasburger (1875)** first reported its present in eukaryotic cell and the term 'chromosome' was introduced by **Waldeyer in 1888**.
- **Bridges (1916)** first proved that chromosomes are the physical carriers of genes.
- The genetic information is in the **form of a chromatin network of fine threads composed of genetic material DNA (Deoxy ribonucleic acid) and proteins**.
- During cell division, **chromatin is condensed into thick cord like structures called Chromosomes**.
- A chromosome **can separate itself into two halves called chromatids**.
- When separate, both sister chromatids remain attached to each other at the **centromere**, also known as the **kinetochore**.

- Ribosomes were first observed by **George Palade (1953)** as dense particles or granules in the electron microscope.
- Ribosome consists of RNA and protein: **RNA 60 % and Protein 40%**.

Types of Ribosomes

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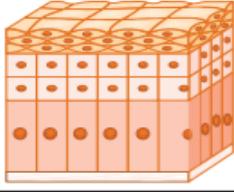
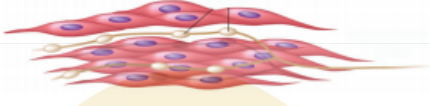
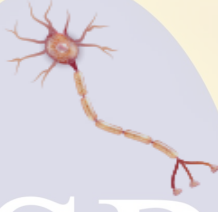
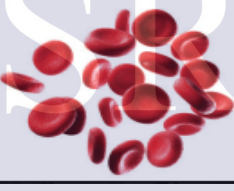
**Svedberg unit (s).**

The size of ribosomes and their subunits are usually given in Svedberg unit (named after Theoder Svedberg, Swedish Chemist Noble Laureate 1929), a measure of a particle size dependent on the speed with which particle sediment in the ultracentrifuge.

**Chromatin** is a

viscous gelatinous substance that contains DNA, histone & non-histone proteins and RNA. H1, H2A, H2B, H3 and H4 are the different histones found in chromatin. It is formed by a series of repeated units called nucleosomes. Each nucleosome has a core of eight histone subunits.

S.No	Cell Components	Main Functions	Special Name
1	Cell wall	- Surrounds and protects the cell - Make the cell stiff and strong	Supporter and protector
2	Cell membrane	- Holds and protects the cell - Controls the movement of materials in and out of the cell	Gate of the cell
3	Cytoplasm	A watery, gel-like material in which cell parts move	Area of movement
4	Mitochondria	Produce and supply most of the energy for the cell	Power house of the cell
5	Chloroplasts	- Contain green pigment chlorophyll - Capture the energy of sunlight and use it to produce food for the cell by photosynthesis.	Food producers for the cell (Plant cell)
6	Vacuoles	Store food, water, and chemicals	Storage tanks
7	Nucleus	- Acts as 'brain' of the cell - Regulates and controls all the cell activities	Control centre
8	Nucleus membrane	- Surrounds and protects the nucleus - control the movement of materials in and out of the nucleus	Gate of the nucleus

Specialised cell	Structure	Function
Epithelial cells – they are mostly flat and columnar in shape		They cover the surface of the body for protection
Muscle cells – they are long and spindle shaped		They can contract and relax allowing the cell for movement.
Nerve cells – the body of nervous cell is branched with an elongated nerve fiber.		Nerve cells are specialized to carry and conduct messages that coordinate the functions of the body.
Red blood cells – Round, biconcave and disc shaped		Red blood cells carry oxygen and collect carbon dioxide from various part of the body.



DO YOU KNOW?

Red blood cells

Red blood cells do not contain a



nucleus. Without a nucleus, these cells die quickly; about two million red blood cells die every second! Luckily, the body produces new red blood cells every day.