**Lab:1**

***TYPES OF MICROSCOPS***

1. **Light Microscopes**

**Light microscope** (**LM**) is an instrument that uses visible **light** and magnifying lenses to examine small objects not visible to the naked eye, or in finer detail than the naked eye allows.

**working Principle**

**Light** from a mirror is reflected up through the specimen, or object to be viewed, into the powerful objective lens, which produces the first magnification. The image produced by the objective lens is then magnified again by the eyepiece lens, which acts as a simple magnifying glass.

**Parts of a Compound Microscope**

1. **Eye piece:** The lens the viewer looks through to see the specimen. The eyepiece usually contains a 10X or 15X power lens.
2. **Diopter Adjustment:** Useful as a means to change focus on one eyepiece so as to correct for any difference in vision between your two eyes.
3. **Body tube (Head):** The body tube connects the eyepiece to the objective lenses.
4. **Arm:** The arm connects the body tube to the base of the microscope.
5. **Coarse adjustment:** Brings the specimen into general focus.
6. **Fine adjustment:** Fine tunes the focus and increases the detail of the specimen.
7. **Nosepiece:** A rotating turret that houses the objective lenses. The viewer spins the nosepiece to select different objective lenses.
8. [**Objective lenses**](https://www.microscopemaster.com/objective-lenses.html)**:** One of the most important parts of a compound microscope, as they are the lenses closest to the specimen. A standard microscope has three, four, or five objective lenses that range in power from 4X to 100X. When focusing the microscope, be careful that the objective lens doesn’t touch the slide, as it could break the slide and destroy the specimen.
9. **Specimen or**[**slide**](https://www.microscopemaster.com/microscope-slides.html)**:** The specimen is the object being examined. Most specimens are mounted on slides, flat rectangles of thin glass.The specimen is placed on the glass and a cover slip is placed over the specimen. This allows the slide to be easily inserted or removed from the microscope. It also allows the specimen to be labeled, transported, and stored without damage.
10. **Stage:** The flat platform where the slide is placed.
11. **Stage clips:** Metal clips that hold the slide in place.
12. **Stage height adjustment (Stage Control):** These knobs move the stage left and right or up and down.
13. **Aperture:**The hole in the middle of the stage that allows light from the illuminator to reach the specimen.
14. **On/off switch:** This switch on the base of the microscope turns the illuminator off and on.
15. **Illumination:**The light source for a microscope. Older microscopes used mirrors to reflect light from an external source up through the bottom of the stage; however, most microscopes now use a low-voltage bulb.
16. **Iris diaphragm:** Adjusts the amount of light that reaches the specimen.
17. **Condenser:**Gathers and focuses light from the illuminator onto the specimen being viewed.
18. **Base:**The base supports the microscope and it’s where illuminator is located.

**The types of Light Microscopes**

Some of the major types of light microscopes are as follows:

1. Dark-field Microscope.
2. Phase-Contrast microscope.
3. interference-contrast microscope.
4. Ultraviolet Microscope.
5. Fluorescence microscope.
6. Confocal microscope.



***(Parts of a Compound Light Microscope)***

[www.explainthatstuff.com](https://www.google.com/search?q=electron+microscope&hl=ar-IQ&authuser=0&tbm=isch&source=iu&ictx=1&fir=l1Rsy_dZHpgTXM%253A%252CHG1skZXuQVSlRM%252C_&vet=1&usg=AI4_-kRxnc7w54rEQcTqjEEGP7jHyYalOA&sa=X&sqi=2&ved=2ahUKEwjhzvG2-PbkAhWOT30KHdD3A1wQ9QEwAHoECAEQAw" \l "imgrc=l1Rsy_dZHpgTXM:)

1. **Electron microscope**

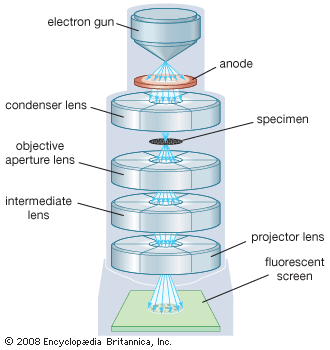
Electron microscope (EM) is a type of microscope that uses **electrons** to create an image of the target. It has much higher magnification or resolving power than a normal light microscope.

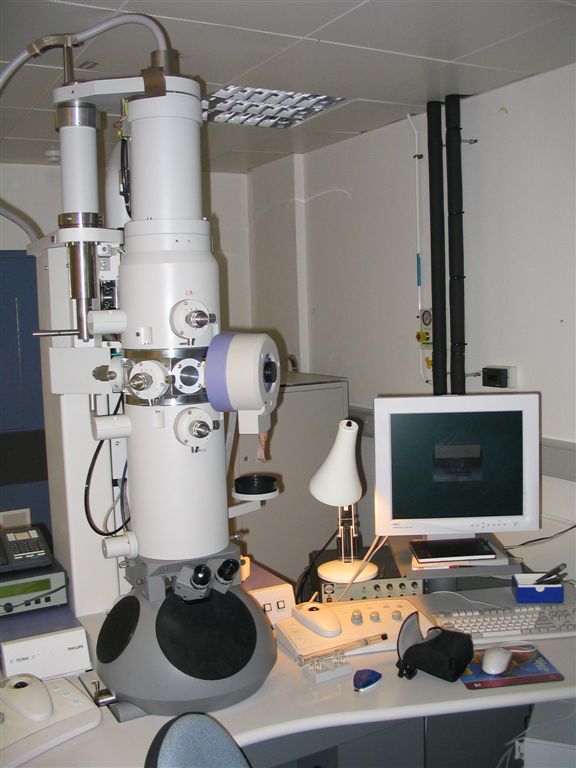
**working Principle**

An electron microscope uses an **'electron beam'** to produce the image of the object and magnification is obtained by 'electromagnetic fields'; unlike light or optical microscopes, in which 'light waves' are used to produce the image and magnification is obtained by a system of 'optical lenses.

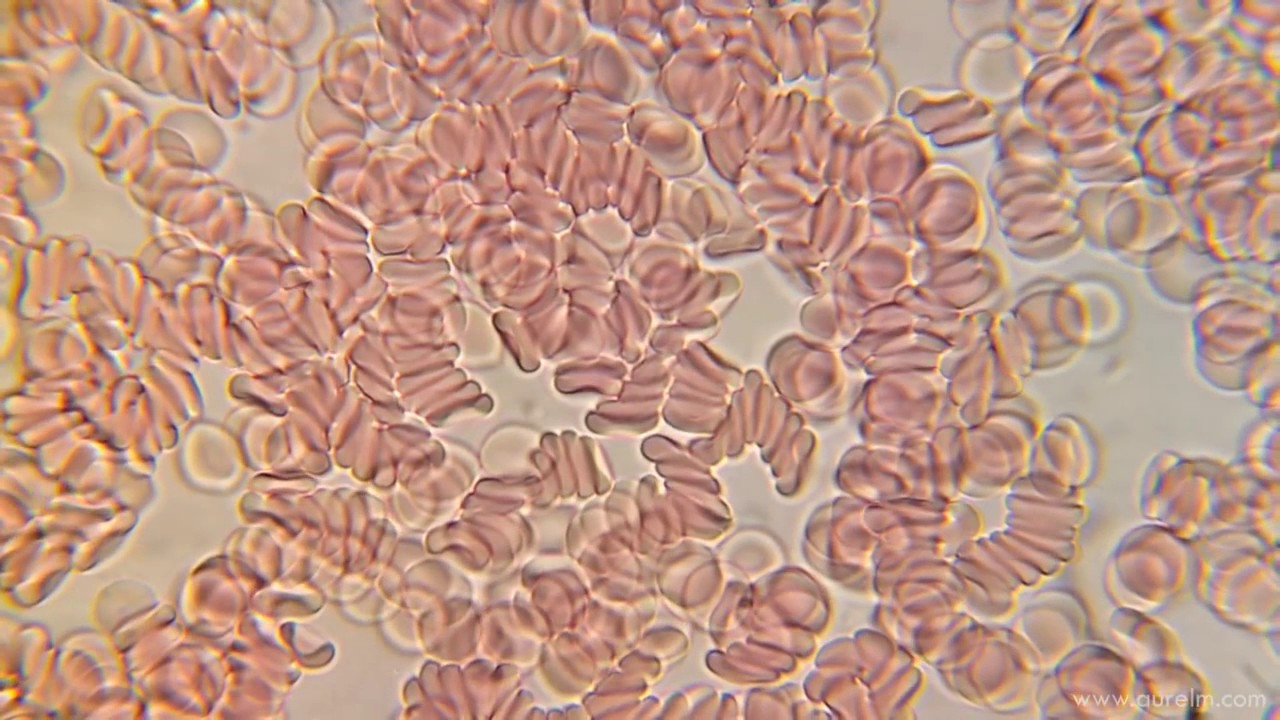
**Parts of an electron microscope**

1. Electron gun
2. Electron magnetic lenses :
3. Condenser lens
4. Objective lens
5. Projector lens
6. Fluorescent screen
7. Camera
8. Deflation device
9. Voltage measuring device

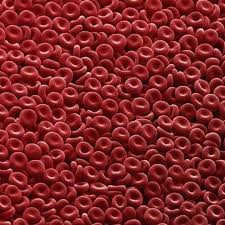




***(Parts of an Electron Microscope)***



***(Red blood cells in compound light microscope (L.M.) )***



***(Red blood cells in electron microscope (E.M.) )***

**The types of Electron Microscopes**

The major types of Electron Microscopes are as follow

1. Transmission electron microscope (TEM).

The transmission electron microscope (TEM) is used to view thin specimens (tissue sections, molecules, etc) through which electrons can pass generating a projection image.

1. Scanning electron microscope (SEM).

The scanning electron microscope  (SEM) scans a focused electron beam over a surface to create an image. The electrons in the beam interact with the sample, producing various signals that can be usedto obtain information about the surface topography and composition.

1. Reflection electron microscope (REM).

Is now well established as a technique for the study of the structure of surfaces of crystals.



1. ***(An image of***[***Bacillus subtilis***](https://en.wikipedia.org/wiki/Bacillus_subtilis)***taken with a transmission electron microscope)***



1. ***(An image of an***[***ant***](https://en.wikipedia.org/wiki/Ant)***in a scanning electron microscope)***

**\*Why is the light microscope called the compound microscope?**

Compound microscope are so called because they are designed with a compound lens system. The objective lens provides the primary magnification which is compounded (multiplied) by the ocular lens (eyepiece).

**\*What can you see in a light microscope?**

Using a light microscope, one can view cell walls, vacuoles, cytoplasm, chloroplasts, nucleus and cell membrane. Light microscopes use lenses and light to magnify cell parts. However, they usually can achieve a maximum of 2000x magnification which is not sufficient to see many other tiny organelles.

### \*How Does a Microscope Work?

### All of the parts of a microscope work together - The light from the illuminator passes through the aperture, through the slide, and through the objective lens, where the image of the specimen is magnified. Then magnified image continues up through the body tube of the microscope to the eyepiece, which further magnifies the image the viewer then sees.

**\*What is the difference between TEM and SEM?**

**TEM** is a high resolution tool (Transmission Electron Microscope) , able analyze at high resolution at nano level. **SEM** is based on scattered electrons while **TEM** is based on transmitted electrons. • **SEM** focuses on the sample's surface and its composition whereas **TEM** provides the details about internal composition. As a result, TEM offers valuable information on the inner structure of the sample, such as crystal structure, morphology and stress state information, while SEM provides information on the sample’s surface and its composition. **TEM** has up to a 50 million magnification level while **SEM** only offers 2 million as a maximum level of magnification. The resolution of **TEM** is 0.5 angstroms while **SEM** has 0.4 nanometers. However, **SEM** images have a **better** depth of field compared to **TEM** produced images

**\*Why would you use an electron microscope?**

An electron microscope allows us to see at these small scales. Electron microscopes work by using an electron beam instead of visible light and an electron detector instead of our eyes. An electron beam allows us to see at very small scales because electrons can also behave as light.

***LAB-2- The cell***

The **cell** is the basic structural, functional, and biological unit of all known [living](https://en.wikipedia.org/wiki/Life) [organisms](https://en.wikipedia.org/wiki/Organism). Cells are the smallest unit of life that can [replicate](https://en.wikipedia.org/wiki/Cell_division) independently. The study of cells is called [cell biology](https://en.wikipedia.org/wiki/Cell_biology).

Cells consist of [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm) enclosed within a [membrane](https://en.wikipedia.org/wiki/Cell_membrane), which contains many [biomolecules](https://en.wikipedia.org/wiki/Biomolecule) such as [proteins](https://en.wikipedia.org/wiki/Proteins) and [nucleic acids](https://en.wikipedia.org/wiki/Nucleic_acids).

**Organisms can be classified as**

1. [unicellular](https://en.wikipedia.org/wiki/Unicellular) (consisting of a single cell; including [bacteria](https://en.wikipedia.org/wiki/Bacteria))
2. [multicellular](https://en.wikipedia.org/wiki/Multicellular) (including [plants](https://en.wikipedia.org/wiki/Plant) and [animals](https://en.wikipedia.org/wiki/Animal))

\* Prokaryotes are [single-celled organisms](https://en.wikipedia.org/wiki/Unicellular_organism), while eukaryotes can be either single-celled or [multicellular](https://en.wikipedia.org/wiki/Multicellular_organism).

\* **Cells are of two types:**

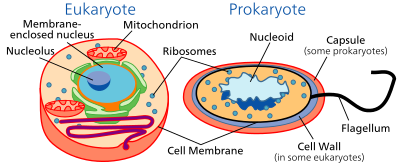
***A- Prokaryotic cells***

They are simpler and smaller than eukaryotic cells, and lack membrane-bound organelles such as the [nucleus](https://en.wikipedia.org/wiki/Cell_nucleus). Prokaryotes include two of the [domains of life](https://en.wikipedia.org/wiki/Domain_(biology)), [bacteria](https://en.wikipedia.org/wiki/Bacteria) and [archaea](https://en.wikipedia.org/wiki/Archaea" \o "Archaea). The DNA of a prokaryotic cell consists of a single chromosome that is indirect contact with the [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm). The nuclear region in the cytoplasm is called the [nucleoid](https://en.wikipedia.org/wiki/Nucleoid). Most [prokaryotes](https://en.wikipedia.org/wiki/Prokaryotes) are the smallest of all organisms ranging from 0.5 to 5.0 µm in diameter.

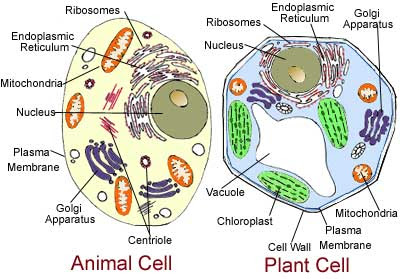
***B- Eukaryotic cells***

These cells are about fifteen times wider than a typical prokaryote and can be as much as a thousand times greater in volume. The main distinguishing feature of eukaryotes as compared to prokaryotes is the presence of membrane-bound [organelles](https://en.wikipedia.org/wiki/Organelle) .Eukaryotes include fungi, animals and plants cells.

|  |  |  |
| --- | --- | --- |
| ***Comparison of features of prokaryotic and eukaryotic cells*** | | |
|  | **Prokaryotes** | **Eukaryotes** |
| **Typical organisms** | [bacteria](https://en.wikipedia.org/wiki/Bacterium) | [fungi](https://en.wikipedia.org/wiki/Fungus), [plants](https://en.wikipedia.org/wiki/Plant), [animals](https://en.wikipedia.org/wiki/Animal) |
| **Typical size** | ~ 1–5 [µm](https://en.wikipedia.org/wiki/%CE%9Cm) | ~ 10–100 [µm](https://en.wikipedia.org/wiki/%CE%9Cm) |
| **Type of**[nucleus](https://en.wikipedia.org/wiki/Cell_nucleus) | [nucleoid region](https://en.wikipedia.org/wiki/Nucleoid_region); no true nucleus | true nucleus with double membrane |
| **DNA** | circular (usually) | linear molecules ([chromosomes](https://en.wikipedia.org/wiki/Chromosome)) with [histone](https://en.wikipedia.org/wiki/Histone) [proteins](https://en.wikipedia.org/wiki/Protein) |
| **RNA/proten synthesis** | coupled in the [cytoplam](https://en.wikipedia.org/wiki/Cytoplasm" \o "Cytoplasm) | [RNA synthesis](https://en.wikipedia.org/wiki/Transcription_(genetics)) in the nucleus [protein synthesis](https://en.wikipedia.org/wiki/Translation_(biology)) in the cytoplasm |
| [Cell movement](https://en.wikipedia.org/wiki/Chemotaxis) | [flagella](https://en.wikipedia.org/wiki/Flagellum) made of [flagellin](https://en.wikipedia.org/wiki/Flagellin" \o "Flagellin) | flagella and [cilia](https://en.wikipedia.org/wiki/Cilium) containing [microtubules](https://en.wikipedia.org/wiki/Microtubule); [lamellipodia](https://en.wikipedia.org/wiki/Lamellipodia" \o "Lamellipodia) and [filopodia](https://en.wikipedia.org/wiki/Filopodia" \o "Filopodia)  containing [actin](https://en.wikipedia.org/wiki/Actin) |
| [Mitochondria](https://en.wikipedia.org/wiki/Mitochondrium) | none | one to several thousand |
| [Chloroplasts](https://en.wikipedia.org/wiki/Chloroplast) | none | in [algae](https://en.wikipedia.org/wiki/Algae) and [plants](https://en.wikipedia.org/wiki/Plant) |
| **Organization** | usually single cells | single cells, colonies, higher multicellular organisms with specialized cells |
| [Cell division](https://en.wikipedia.org/wiki/Cell_division) | [binary fission](https://en.wikipedia.org/wiki/Binary_fission) (simple division) | [mitosis](https://en.wikipedia.org/wiki/Mitosis) (fission or budding) [meiosis](https://en.wikipedia.org/wiki/Meiosis) |
| [Chromosomes](https://en.wikipedia.org/wiki/Chromosome) | single chromosome | more than one chromosome |
| [Membranes](https://en.wikipedia.org/wiki/Membrane) | [cell membrane](https://en.wikipedia.org/wiki/Cell_membrane) | Cell membrane and membrane-bound organelles |

[](https://en.wikipedia.org/wiki/File:Celltypes.svg)

***Structure of a typical***[*prokaryotic*](https://en.wikipedia.org/wiki/Prokaryotic)***and eukaryotic cell***

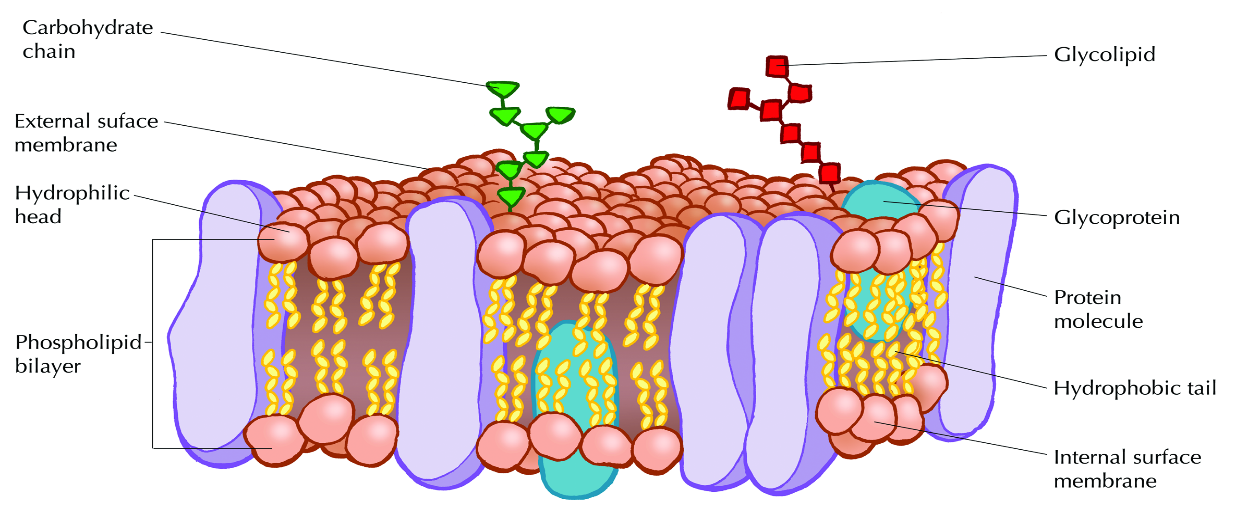


***Structure of a typical animal and***[*plant cell*](https://en.wikipedia.org/wiki/Plant_cell)

***Anatomy of the cell***

1. **Cell membrane**

There are semi – permeable membrane surrounding the cell. It helps in holding the cell together and allows entry and exits of nutrients into the cell.

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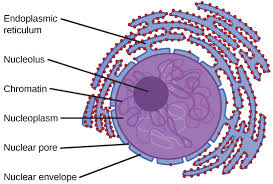
***Cell membrane***

1. **Cytoplasm**

A jelly types double membrane organelles, which are present in the inner region of the cell. It helps by keeping the cell in stable and protects the cell organelles by separating them from each other.

1. **Nucleus**

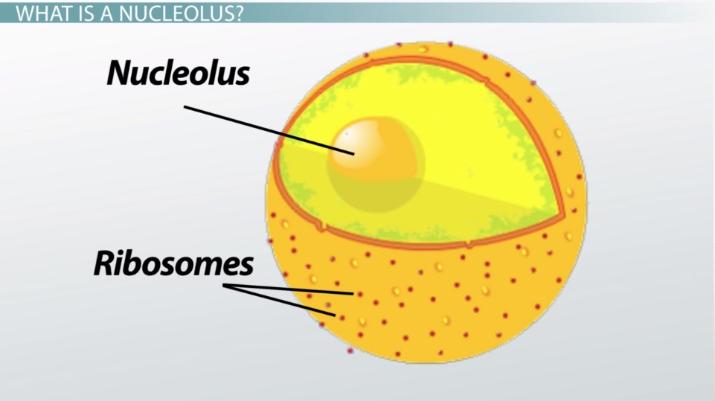
The largest organelle in the cell, which contains DNA and other cells hereditary information. The main role of nucleus in the cell is it controls all cellular activities.

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***Nucleus***

1. **Nucleolus**

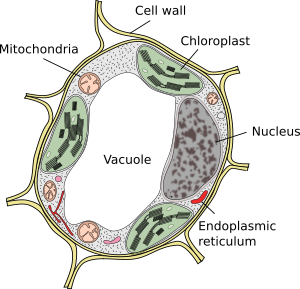
is a round body located inside the nucleus of a eukaryotic cell. It is not surrounded by a membrane but sits in the nucleus. The nucleolus makes ribosomal subunits from proteins and ribosomal RNA, also known as rRNA.



***Nucleolus***

1. **Vacuoles**

They are the fluid sacs, which are present in less numbers in animal cell compared to plant cells. The main function of this membrane is to store food and other waste materials.

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***Vacuoles***

**\*\*Examine vacuoles in:**

**A. Onion leaf**

1. Cut a red onion and remove a fleshy leaf.

2. Snap the leaf backward and remove the thin piece of the inner epidermis that formed at the break point. This tissue will be as thin and flexible as plastic wrap.

3. When you obtained your piece of onion, prepare a wet-mound slide by adding a drop of water on the middle of a clean slide. Then add cover slide and examine the tissue. The preparation should be one cell thick.

4. Stain the onion tissue by placing one drop of neutral red at the edge of the cover slip for 5-15 min.

5. Carefully focus to distinguish the vacuoles surrounded by the stained cytoplasm.

**B. Rose leaf**

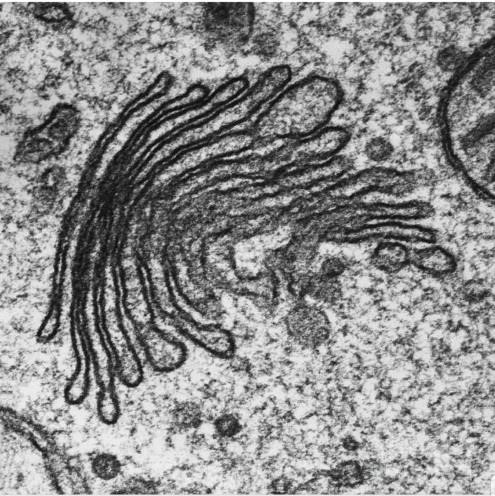
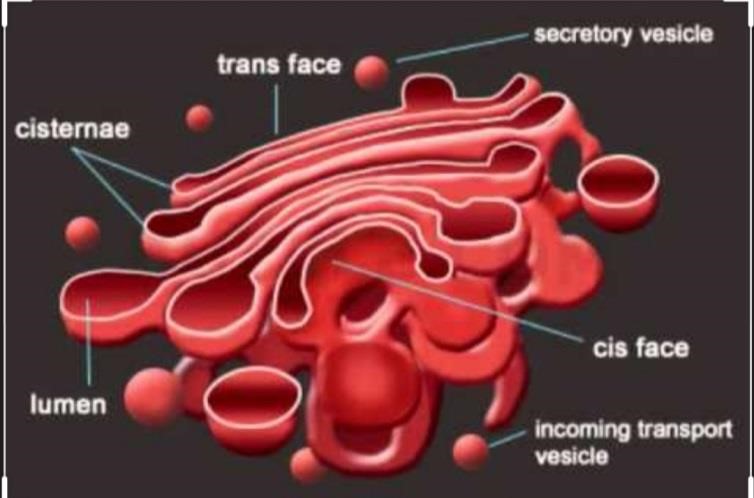
1. Snap a thin tissue from the toothed margin of a red leaf of rose plant using sharp lancet.

2. Mount it on a slide and add a cover slip.

3. Carefully focus to distinguish the colourless vacuoles near the margin. If you search far from the toothed margin, you can see red colour vacuoles because they contain anthocyanin in their cell sap**.**

1. **Golgi Bodies or Golgi complex**

The sac like structures, which are present in a cell to manufacture store, packing and shipping the selected particles throughout the cell.



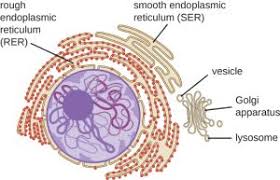
***Golgi Bodies Ribosome***

It is present in the cytoplasm. They are the site of protein synthesis, which are composed of ribosomal RNA and proteins.

1. **Endoplasmic reticulum**

The network of membrane, which helps in transporting materials around the cell and also helps in the synthesis of lipids and proteins. It forms a connection between nuclear envelope and the cell membrane of the cell. There are two types of ER:

1. **rough endoplasmic reticulum** **(RER)** The outer ([cytosolic](https://en.wikipedia.org/wiki/Cytosol)) face of the rough endoplasmic reticulum is studded with [ribosomes](https://en.wikipedia.org/wiki/Ribosome) that are the sites of [protein synthesis](https://en.wikipedia.org/wiki/Protein_synthesis).
2. **smooth endoplasmic reticulum (SER).** The smooth endoplasmic reticulum lacks ribosomes and functions in [lipid](https://en.wikipedia.org/wiki/Lipid) synthesis but not [metabolism](https://en.wikipedia.org/wiki/Metabolism), the production of [steroid hormones](https://en.wikipedia.org/wiki/Steroid_hormone), and [detoxification](https://en.wikipedia.org/wiki/Detoxification).

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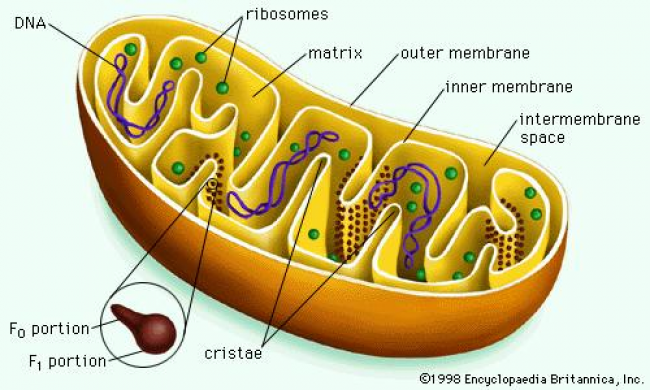
***Endoplasmic reticulum***

1. **Ribosomes**

Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the rough endoplasmic reticulum.  Ribosomes produce protein.  They could be thought of as "factories"  in the cell.

1. **Mitochondria**

They are rod shaped organelles, plays an important role in releasing energy and they are powerhouse of the cell.

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***Mitochondria***

**\*\*Examine mitochondria in onion cells:**

**Procedure**

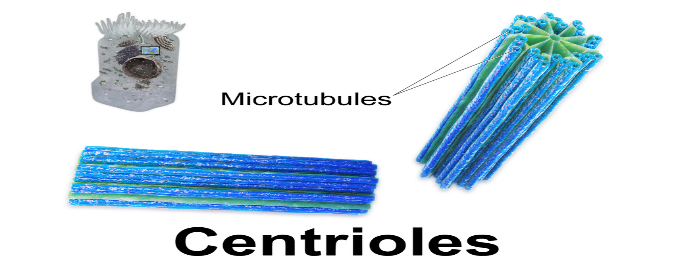
1. On a clean glass, add 2-3 drops of Iodine
2. Prepare a thin piece of onion epidermis and mount it in the staining solution:
3. Add the cover slip.

1. Search the periphery of the cells to locate stained mitochondria, they are small about 1mm in diameter.
2. Also examine slides for mitochondria in onion root tips and liver cells, the mitochondria will appear as black points around the nucleus.
3. **Lysosomes**

A lysosome is a membrane-bound [organelle](https://en.wikipedia.org/wiki/Organelle) found in many animal [cells](https://en.wikipedia.org/wiki/Cell_(biology)). They are spherical [vesicles](https://en.wikipedia.org/wiki/Vesicle_(biology_and_chemistry)) that contain [hydrolytic](https://en.wikipedia.org/wiki/Hydrolysis) [enzymes](https://en.wikipedia.org/wiki/Enzyme) that can break down many kinds of [biomolecules](https://en.wikipedia.org/wiki/Biomolecule).

1. **Centriole**

In [cell biology](https://en.wikipedia.org/wiki/Cell_biology) a centriole is a cylindrical [organelle](https://en.wikipedia.org/wiki/Organelle) composed mainly of a protein called [tubulin](https://en.wikipedia.org/wiki/Tubulin). The main function of centrioles is to produce [cilia](https://en.wikipedia.org/wiki/Cilium) during [interphase](https://en.wikipedia.org/wiki/Interphase) and the [aster](https://en.wikipedia.org/wiki/Aster_(cell_biology)) and the [spindle](https://en.wikipedia.org/wiki/Spindle_apparatus) during cell division.

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1. **Plastids ( in plants only)**

Its found in the [cells](https://en.wikipedia.org/wiki/Cell_(biology)) of [plants](https://en.wikipedia.org/wiki/Plants), [algae](https://en.wikipedia.org/wiki/Algae), and some other [eukaryotic](https://en.wikipedia.org/wiki/Eukaryotic) organisms. Plastids are the site of manufacture and storage of important chemical compounds used by the cells of [autotrophic](https://en.wikipedia.org/wiki/Autotroph) [eukaryotes](https://en.wikipedia.org/wiki/Eukaryote). They often contain [pigments](https://en.wikipedia.org/wiki/Biological_pigment) used in [photosynthesis](https://en.wikipedia.org/wiki/Photosynthesis), and the types of pigments in a plastid determine the cell's color.

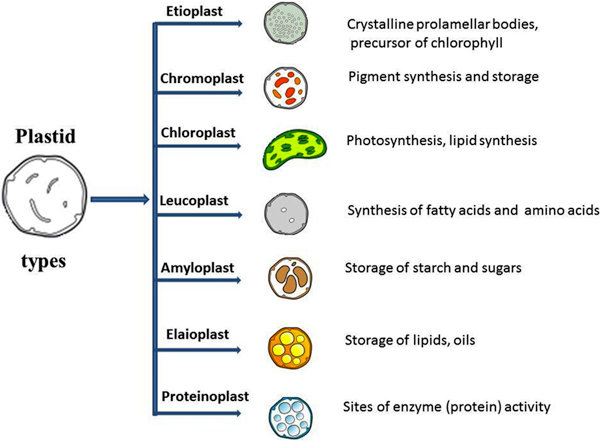
\*In [plants](https://en.wikipedia.org/wiki/Plant), plastids may [differentiate](https://en.wikipedia.org/wiki/Cellular_differentiation) into several forms :

1- [Chloroplasts](https://en.wikipedia.org/wiki/Chloroplast)

2- [Chromoplasts](https://en.wikipedia.org/wiki/Chromoplast)

3- [Leucoplasts](https://en.wikipedia.org/wiki/Leucoplast)

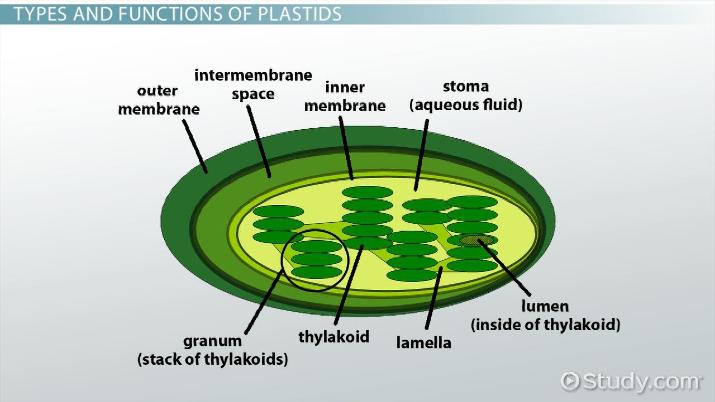
* 1. [Amyloplasts](https://en.wikipedia.org/wiki/Amyloplast)
  2. [Elaioplasts](https://en.wikipedia.org/wiki/Elaioplast)
  3. [Proteinoplasts](https://en.wikipedia.org/wiki/Proteinoplast)



***Types Of Plastids***

The plastids have a double membrane envelope consisting of the outer and inner membrane (phospholipid layers). The space within the double membranes is covered with an aqueous matrix known as **stroma**. This aqueous matrix contains various enzymes and proteins that are essential for cellular processes

\*\*Some of the other components of a chloroplast include:

* Grana - Thylakoids arranged in stacks (one on top of another)
* Peripheral reticulum - Membranous tubules arising from the inner membrane
* Chloroplast DNA
* Ribosome
* 

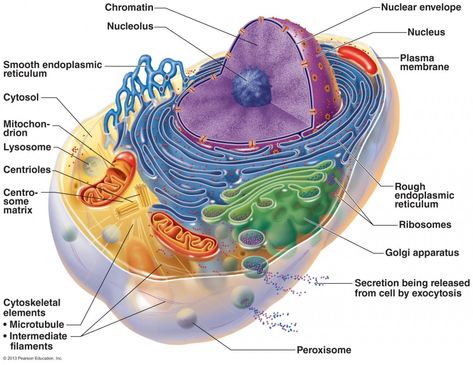
***Plastids***

1. **Vesicle**

It is a structure [within](https://en.wikipedia.org/wiki/Intracellular) or [outside](https://en.wikipedia.org/wiki/Extracellular) a [cell](https://en.wikipedia.org/wiki/Cell_(biology)), consisting of liquid or cytoplasm enclosed by a [lipid bilayer](https://en.wikipedia.org/wiki/Lipid_bilayer). Vesicles form naturally during the processes of secretion ([exocytosis](https://en.wikipedia.org/wiki/Exocytosis)), uptake ([endocytosis](https://en.wikipedia.org/wiki/Endocytosis)) and transport of materials within the plasma membrane.

1. **Cilia and Flagella**

Both cilia and flagella are hair-like organelles which extend from the surface of many animal cells.  the structure is identical in both, except that flagella are longer and whip like and cilia are shorter.  There are usually only a few flagella on a cell, while cilia may cover the entire surface of a cell. The function of cilia and flagella include locomotion for one-celled organisms and to move substances over cell surfaces in multi-celled organisms.



***Anatomy of the cell***

Lab -3-

shapes and functions of the cells

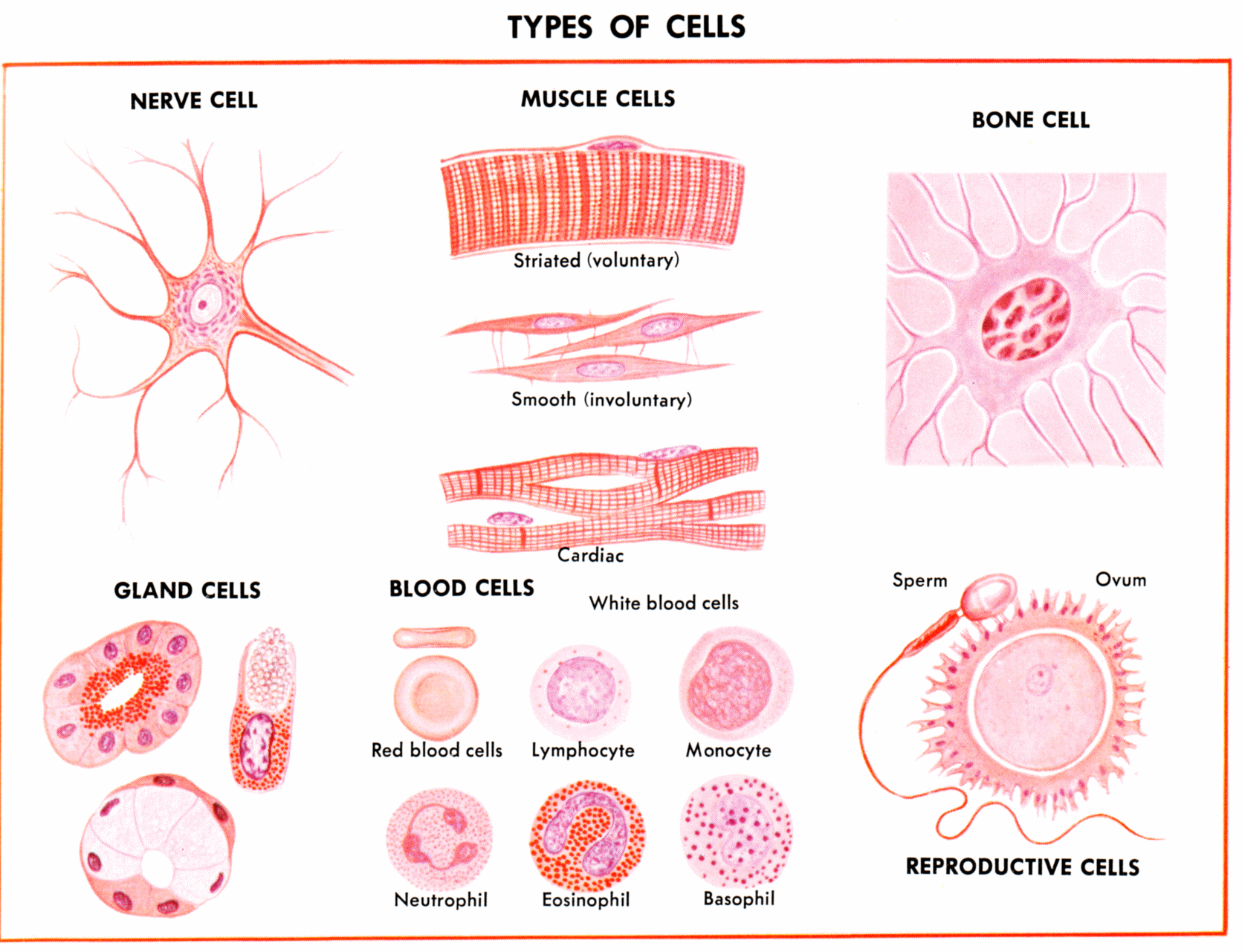
Cells are the building blocks of life – all living organisms are made up of them. Textbooks often show a single ‘typical’ example of a plant cell or an animal cell, but in reality, the shapes of cells can vary widely. Animal cells in particular come in all kinds of shapes and sizes. Plant cell shapes tend to be quite similar to each other **because of their rigid cell wall.**

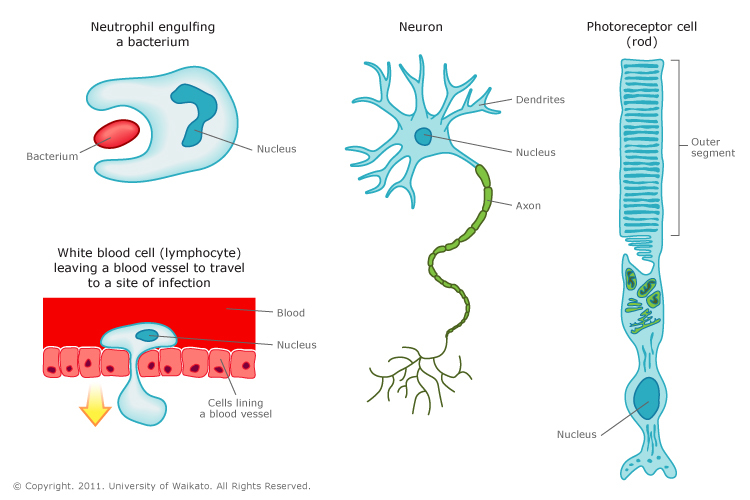
We can learn a lot about what a cell does by looking at its shape and size, and microscopes are the ideal tool for this.

**\*Shaped for the task**

Cells have different shapes because they do different things. Each cell type has its own role to play in helping our bodies to work properly, and their shapes help them carry out these roles effectively. The following cell types all have unusual shapes that are important for their function.

1. **The muscle cells** have a special structure which represented by the actin and myosin filament that perform special function (muscular contraction).
2. **The fatty connective tissues** have a large space in the cytoplasm which permit a formation of large fat drop in it and these cells perform special function (storage fatty energy and thermal barrier)
3. **The nervous cells** in the brain and nervous system, they have astral shape due to presence of branches which called dendrites, Their job is to carry electrical messages all the way from the brain to the rest of the body and back (almost like electrical wire).
4. **The photoreceptor cells**(rods and cones) are cells in the eye that detect light.
5. **The immune cells**are cells that respond when the body is infected (by a bacterium, for instance). To do their job, they need to be able to change shape. For instance, lymphocytes may need to move through body tissue to get to the site of infection, so they change their shape to squeeze past tightly packed tissue cells. Some immune cells (such as neutrophils) engulf bacteria and viruses, so they need to change their shape to ‘swallow’ them.
6. **The red blood cells** have a disk shape with concave edges, and have hemoglobin molecule that attach with O2 and CO2 molecules, this concave edges contribute to the transfer and carry these molecules between lung and other body system.



[](https://www.sciencelearn.org.nz/images/530-cells-with-distinctive-shapes)

***\*The Shapes of the cells\****

**\*Site of the cells**

The special functions of the cells determined by the site of the cells (organs and tissue) ex: **skin epithelial cells** are found on the external surface of the body because their function is the protection and excretion (sweating), while the same type of the cells found in the lining of the small intestine because their function is absorption of the digestive food.

The cells in the multicellular organisms carried out to **differential process or cellular specify**. In this process, each group of the cells are specialist to build special tissues to enter in organ build, according to this, the cells modified the shape to obtain new types of the cells that have special function.

**\*Factors that modifying the shape of the cell**

The shape of the cells can be modified according to many factors:

**1-Enternal factors:** include all the factors that are related to age of the cells, wall shape, rigidity, shape of cellular membrane, viscosity of cytoplasm and function.

**2-External factors:** include surface tension, viscosity of the media, and mechanical action of the cells.

**\*\*What are the factors that help cells to perform different functions ?**

**Genes:** are segments of deoxyribonucleic acid (DNA) which found in separated shape along the chromosomes in the nucleus. , each gene is code for synthesis of specific protein that is participating to give these properties.

Proteins are very important to perform different function ex: enzymes, hormones and growth factors. Proteins are composed of long chain of amino acid, and there are (20) known amino acid regulate in chains with different length and arrangement to give different proteins with different function. In addition to specialist body cells, there are non-specific cells called stem cells which responsible for the regeneration of body cells.

**\*Size of the cells**

Cells are varying in their sizes, some of them are large ex: bird egg, while others are very small and cannot see with naked eye, ex: human cells. Some of the cells have approximately constant size according to constant volume law and these differences due to the weight and number of the cells and not to the volume of the cell itself, ex: hepatic cell for human, rat, and horse. Also the age of the cells varies between one and the other ex: red blood cells in human body live for four months, while the skin cells live for some days only.

**Practical part:**

A-show slides and picture of the following:

1-Nervous cell (Astrocyte shape).

2- Smooth muscles (spindle shape).

3-skeletal muscles (cylindrical shape).

4- Cardiac muscles (cylindrical shape).

5-smear of blood to see human red blood cells (disk, concave)

6-forg red blood cell (ovoid shape).

***Lab -5-***

***osmosis***

To find out the concept of osmosis we must identify the three processes (Osmosis, diffusion, permeability) accurately. These processes differ among themselves on the basis of the presence or absence and type of membrane.

**\*Permeability include three types of membranes**

**1-Permeable membrane:** Allows the passage of solute and solvent molecules, it is called full permeability membrane such as : filter paper.

**2-Semi-permeable membrane:** Allows solvent molecules to pass But does not allow solute molecules to pass such as urinary bladder.

**3-Selective semi-permeable membrane:** the transport be according to the needs of the cell to the molecules.

\* **Diffusion:** is the random motion of molecules, atoms or ions from the high concentration to the low concentration region, Within the purely physical laws without the need for energy, That's where the movement will be, because these molecules possess kinetic energy can be transmitted through from one area to another.

\* **Osmosis:** is the process of transmission, or diffusion of molecules of the solvent (water) solution with a low concentration to a similar solution with a high concentration through semi-permeable Allows solvent molecules (water) to pass But does not allow solute ( sugar or salt) molecules to pass.

The osmosis is cases of permeability which required to occur by the presence of semi-permeable membranes.

**The osmosis mechanism:**

The kinetic energy of the water molecules or pure liquid be high therefore increases diffusion pressure, This pressure is greater than the diffusion pressure of water molecules in salty or sugary solution, This is because the water molecules collide with salt particles and decrease its kinetic energy and pressure which leads to transmission of water molecules from pure liquid to the sugary or salty solution.

The osmosis is called **membrane diffusion** phenomena, usually given pressure arises when the spread of the solvent so-called **osmotic pressure** be at the top of his grades when separating the solution from the pure solvent by semi permeable membrane.

**Types of fluids that surround the cell**

**1-Isotonic solution**: the number of input ions to the cell cross semi-permeable membrane is equal to the number of ions emerging from it.

2- **Hypotonic solution:** As a result entry of the ions into the cell, the cell increase in size and swell, this is because the extracellular concentration less than the entracellular concentration, and thus enter the water molecules inside the cells, causing **swelling** and increasing size.

**3-Hypertonic solution:** In this case the cell lose its water and ions, when it is placed in a hypertonic solution thus( **shrinking**).

This so-called **plasmolysis**: It is the process of cell shrinkage as a result of loss of water and it happens when you put the cell in high concentration of salty solution or in hypertonic solution, Here the shrinking in the cell protoplasm, membrane moves away from the wall will happen as a result of water out of the cell to the periphery.

**Factors affecting the permeability of the membrane to different substances:**

**1-Molecules size:** If the size of molecule is smaller or equal to the size of cell membrane pores, these molecules can cross easily and the largest molecules cannot cross.

**2-Distribution Coefficient:** The relationship between the solubility of substance in oil to the solubility in water, some of the substance have the ability to melting in lipid substances of cell membrane and enter across the membrane, there are proteins substances that carry molecules and called Carrier which attach with molecules and across within the membrane.

**3-Charge:** Some of the substances have high ionized degree and can be polarized the molecule of water ex: ethanol which enter to the cell as quickly as possible. Also the ionized substances across to the cell slowly from which non-ionized, also, the monovalent ions ex: CL-,I-,K+,Na+, across quickly compared to divalent ex:SO4,Mg+,Ca++'

***Practical part:***

Methods used for measurement of permeability of the cells.

**A-Experiment of onion epidermis cells**

Put part of onion epidermis with drop of water on glass slide and examined with microscope to ontic normal cell shape as a controlCoefficient. After that take transparence part of onion leaves and put in watch glass for 5 min in three concentrations:

0.9% NaclIsotonic solution

5% Nacl Hypertonic solution

0.1% Nacl Hypotonic solution

After 5 min take each segment according to concentration and examined to notice cell shape.

**B-Red blood cell:** Take drop of red blood cell and put in watch glass for 5 min in three concentrations after carried out control Coefficient.

**C-Fresh plant stem**: Take part from stem and draw with normal state, then make longitudinal split in stem which divide into 2 parts, the cutting parts were put in solution A, B, C after a period of time, notice If cutting part stay without variant, the solution is isotonic, If there are concave in cuticle part and swell in epidermis cells, the solution is hypotonic, If there are concave inside of epidermis and external of cuticle (shrinkage), the solution is hypertonic.

***LAB-6-***

***Separation of Photosynthesis pigment by chromatographic paper***

**Chromatography:** Is one of the methods of separation and diagnosis of organic compounds. The word chromatography means separation of colored compounds Where simple chromatography technique was used to separate natural colored outputs of plants.

* Chromatography divided into two types:

**1-Plate Chromatography**

**2-column chromatography**.

* Plate Chromatography divided to:

**1-paper Chromatography.**

**2- Thin layer chromatography(TCL).**

In this lab, we will use the paper Chromatography for separating pigments of colored chloroplast of Spinach or Chard leaf to identify and separate the pigments in plants. On this basis we will talk about the paper Chromatography.

***Paper Chromatography***

In this type of Chromatography the pigments are separated using two phases:

**A-Mobile phase**: A liquid substance represented by organic solvents Such as the use of saturated Butanol alcohol , acetyl acetone saturated with water , methanol alcohol with hydrochloric acid or ethyl methyl keton. In this experiment we used the ethanol 70% .

**B-Stationary phase:** mostly be a solution that are carried on paper cellulose fibers, Hence the name paper Chromatography. In this experiment, the solution that carried on filter paper fiber is supernatant that extracted from Spinach or Chard leaf juice.

In paper chromatography organic compounds are diagnosed by knowing the value of **Retention factor ( Rƒ)** for unknown compound and compared with the (Rƒ) for the standard compound (known), If they are matching, the unknown compound was identical to the standard compound. Photosynthesis occurred in special structures in plants called chloroplast that contain photosynthesis pigments which necessary for absorption photosynthesis pigments . In this process, the light energy which absorbed from plant pigments was transformed into chemical energy, and by this it can made organic materials from non- organic compound ex: CO2, H2O from chloroplast. In this way, photosynthesis process was essential process for product materials with high chemical energy from low chemical energy.

**CO2 H2O (CH2O)n O2**

The experiment of paper chromatography by using radioactive materials showed that there are many material of carbohydrate that made from photosynthesis process (triglyceride, tetra, penta, hexa), , where these sugars in form of phosphate and its one of final metabolic products of photosynthesis.

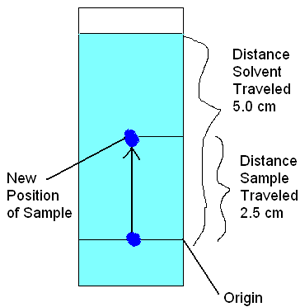
|  |  |
| --- | --- |
| **Presence** | **pigments of photosynthesis** |
| Chlorophyll a | all plants |
| Chlorophyll b | Higher plant and green algae |
| Chlorophyll c | diatoms and brown algae |
| Beta-carotene | some plants |
| Xanthophylls | some plants |
| Phycotyanin | blue green and red algae |
| Facoxanthol | diatoms and brown algae |
| Phycoerthrine | Red algae, green blue algae |

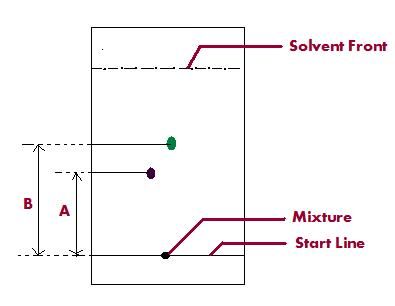
**The experiment of extraction and separation of pigments photosynthesis**

We take some of green leaves such as Spinach or Chard leaf and crushed well in ceramic mortar with addition of organic solvent acetone or alcohol 70%, then filtered by using gauze, put the streaming in centrifuge for 10-15 min, this lead to get deposit in the bottom of tube and supernatant (the supernatant neglects).Take chromatography paper or filter paper, the filter papers cut into longitudinal strips, draw by a pencil one point off 1 cm of edge of the paper. Then, by capillary tube takes one drop of the deposit and put it on pre-selected point, repeat the process three times for the purpose of increasing concentration, then, put it in special bakers that contain quantity of ethanol, then put the strip in way which attached with ethanol and leave it for a period of time. Notice that ethanol begin arise and carries with it pigments and separated depending on the molecular weight of the pigments and the degree of solubility in solvent and then applied the following equation:

**Rƒ= distance the solute moves (pigments ) / distance the solvent moves (ethanol)**

**Rƒ (retention factor)** **is a measure of the speed of the liquid movement to be diagnosed compounds relative to the front of the mobile phase as shown in figure (1) .**





***Fig (1) The Organic Compound Movement (pigments) in Paper Chromatography***

***LAB -7-***

***The Chromosomes***

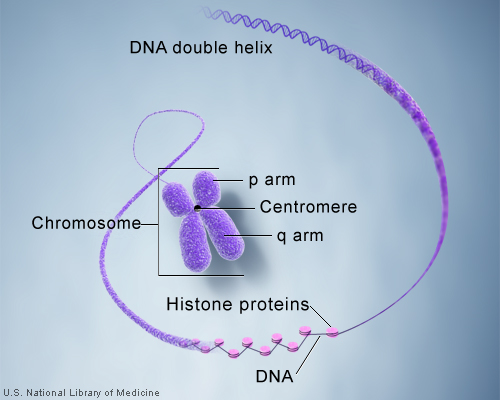
Is a concentric duple filament. The term chromosome is derived from the Greek words **"chroma"** or color and **"some**" or body and is so named because chromosomes have the ability to be stained with dyes. Each chromosome consist of two **chromatid** associated with each other by **centromere**. Depending on the centromere location, the chromosomes divided in to seven groups ( from A to G ) this is called **karyotype.**

The chromosome consists of a number of genes that have special sites on chromosomes. Chromosomes can be studied in metaphase in mitosis because during this phase of the division the chromosomes can be seen clearly as well as the composition study and the possibility of classification in to groups.

Chromosomes are found in cells in the form of pairs, in human cells 23 pair ( where 22 pair of them are **autosome** and a **pair of sexy** represented by X and Y chromosomes) .

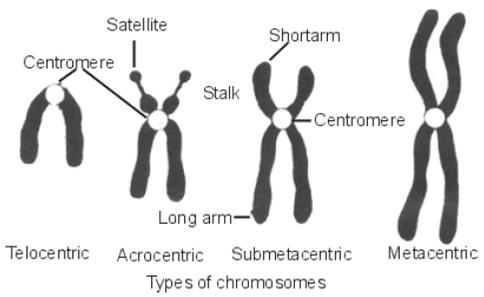
***Chromosomes forms***

Each chromosome has a constriction point called the **centromere**, which divides the chromosome into two sections, or “**arms**” The short arm of the chromosome is labeled **the “p arm”** The long arm of the chromosome is labeled the **“q arm”** The location of the centromere on each chromosome gives the chromosome its characteristic shape, and can be used to help describe the location of specific genes.



**depending on the centromere site the chromosomes devided to :-**

1. **Metacentric chromosomes** : the centromere in the center and the arms are often equal lengths.
2. **Submetacentric chromosomes** : The centromere is located between the midpoint and the end of the chromosome.
3. **Acrocentric chromosomes** : the centromere is very close to the end of the chromosome.
4. **Telocentric chromosomes** : the centromere be at the end of the chromosome.



depending on these divisions, it is possible to divide the chromosomes during metaphase in to seven groups ( A-G ) under the naming ( karyotype ):

**A** : includes the chromosomes number **1, 2, 3**.

**B** : includes the chromosomes number **4, 5.**

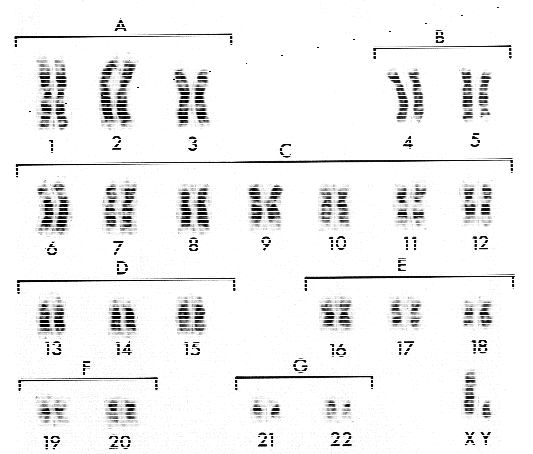
**C** : includes the chromosomes number **6,7,8,9,10,11,12**.

**D** : includes the chromosomes number **13,14,15**.

**E** : includes the chromosomes number **16,17,18**.

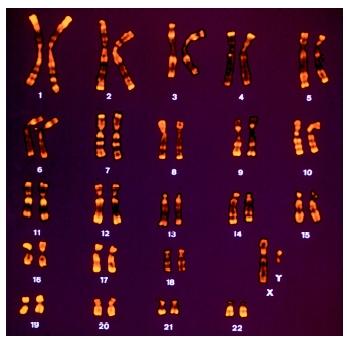
**F** : includes the chromosomes number **19,20**.

**G :** includes the chromosomes number **21,22**, and the **sex chromosome (23)** as shown in figure (1).



**Figure (1)**

Either the way of the division of the chromosomes into groups in humans are illustrated in figure (2).

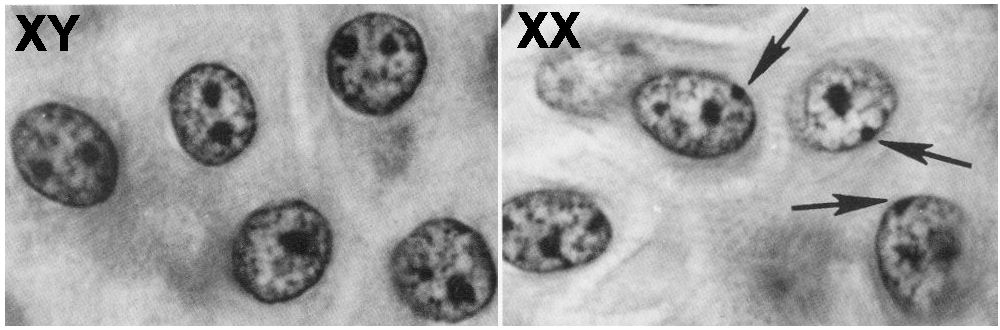


**Figure (2)**

**The sex chromatin or (barr body)**

Is a small condensed mass of the inactivated X-chromosome usually located just inside the nuclear membrane of the inter phase nucleus; Bar bodies can be easily found in the oral mucosa. cells that contain this chromatin called ( chromatin positive ) and that do not contain it called ( chromatin negative ). The number of sex chromatin bodies per nucleus is one less than the number of X-chromosomes; normal males and females with Turner syndrome (XO) have none (sex chromatin negative), normal females and males with Klinefelter syndrome (XXY) have one, and XXX-females have two. According to the equation :

**Barr bodies = (n-1)** **where: n = the number of X chromosome**



**Figure (3) The Sex-Chromatin**

**The MITOTIC INDEX**

Is a guide used to assess the effect of genetic poison of the cells mutagens that were physical or chemical Which often negatively affect the division **or** ( It is defined as the ratio between the number of cells in mitosis and the total number of cells ).

**The mitotic index % = number of division cells / total number of cells Χ 100**

For example, UV and X-ray suppress the building of DNA and causing a delay in the mitosis. The mitotic index influenced when treated cells with chemicals such as toxic drugs like **(Methotrexate (MTX))** **( Mitomycin-c (MMC))** which cause a significant reduction in mitotic index of the bone marrow cells for humans and mice, this reduction increases with the increasing the dose of the mutagenic drug.

**Lab -8-**

**cell Division**

- All cells are derived from per-existing cells (cell Theory).

-Cell division is the process by which cells produce new cells.

-Cell division differs in prokaryotes (bacteria) from eukaryotes (protests, fungi, 9plants and animals).

-Some tissues must be repaired often such as the lining of gut, white blood cells, and skin cells with a short lifespan.

-Other cells do not divide at all after birth such as muscle and nerve.

**\*Reasons for Cell division**

- Cell growth

- Repair and replacement of damaged tissue parts.

- Reproduction of the species-

**\*Cell Cycle**

-The cell cycle is the sequence of event that takes place in cells. It lead to cell division and replication (duplication).

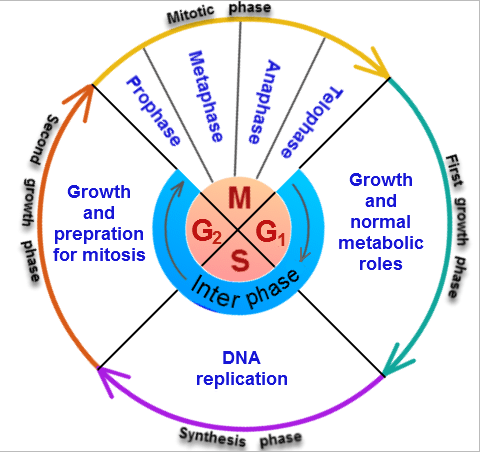
-The cell cycle includes 2 main parts **interphase,** and **cell division**.

-Cell division includes mitosis (nuclear division) and cytokinesis (division of the cytoplasm).

-Interphase is the longest part of a cells life cycle and is called the "resting stage" because the cell isn’t dividing.

-Cells grow,develop, & carry on all their normal metabolic functions during interphase.

-Interphase consists of 3 parts –G1, S & G2 phases.

***\*cell cycle\****

**\*Interphase**

-G1 or 1st growth phase occurs after a cell has undergone cell division.

- Cells mature & increase in size by making more cytoplasm & organelles while carrying normal metabolic activities in G1.

- S or synthesis phase follows G1and the genetic material of the cell (DNA) is copied or replicated.

-G2 or 2nd growth phase occurs after S phase and the cell makes all the structures needed to divide.

1. **Mitosis**

**\*Stages of Mitosis**

-Division of the nucleus or mitosis occurs first.

- Mitosis is an asexual method of reproduction.

- Mitosis consists of 4 stages: 1) Prophase, 2) Metaphase, 3) anaphase, 4) Telophase.

**1) Prophase**

- Chromosomes become visible when the condense into sister chromatids.

- Sister chromatids attach to each other by the centromere.

- Centrioles in animal cells move to opposite ends of cell.

- Spindle forms from centriole (animals) or microtubules (plants).

- Kinetochore fibers of spindle attach to centromere.

- Polar fibers of spindle extend across cell from pole to pole.

- Nuclear membrane dissolves.

- Nucleolus disintegrates.

**2) Metaphase**

-chromosomes line up in center or equator of the cell attached to kinetochore fibers of the spindle.

**3)Anaphase**

- kinetochore fibers attached to the centromere pull the sister chromatids apart.

- chromosomes move toward opposite ends of cell.

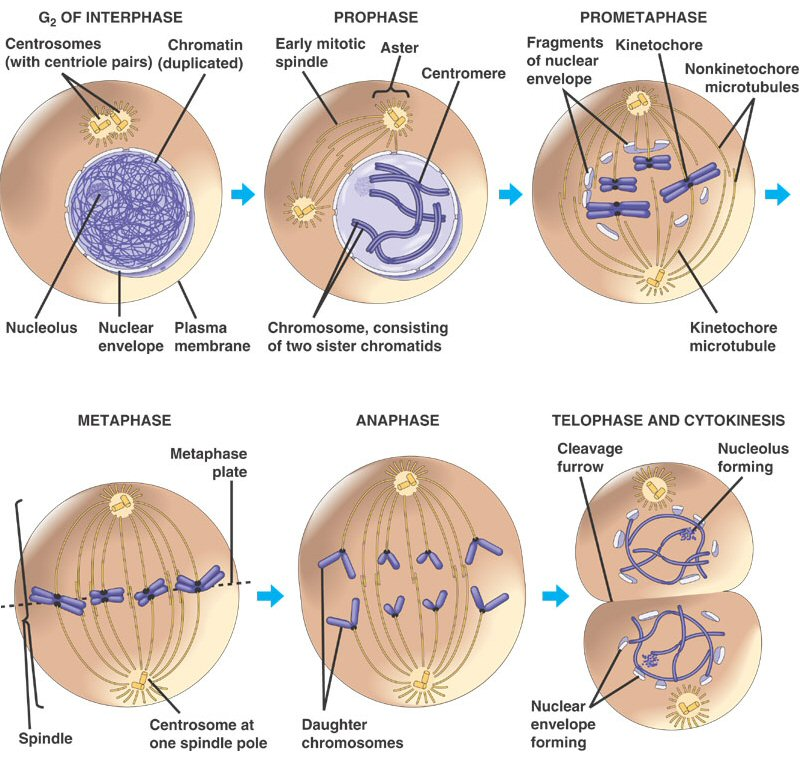
**4)Telophase**

- Nuclear membrane forms at each end of the cell around the chromosomes.

- Nucleolus reform.

- Chromosomes become less tightly coiled & appear as chromatin again.

- Cytokinesis begins.

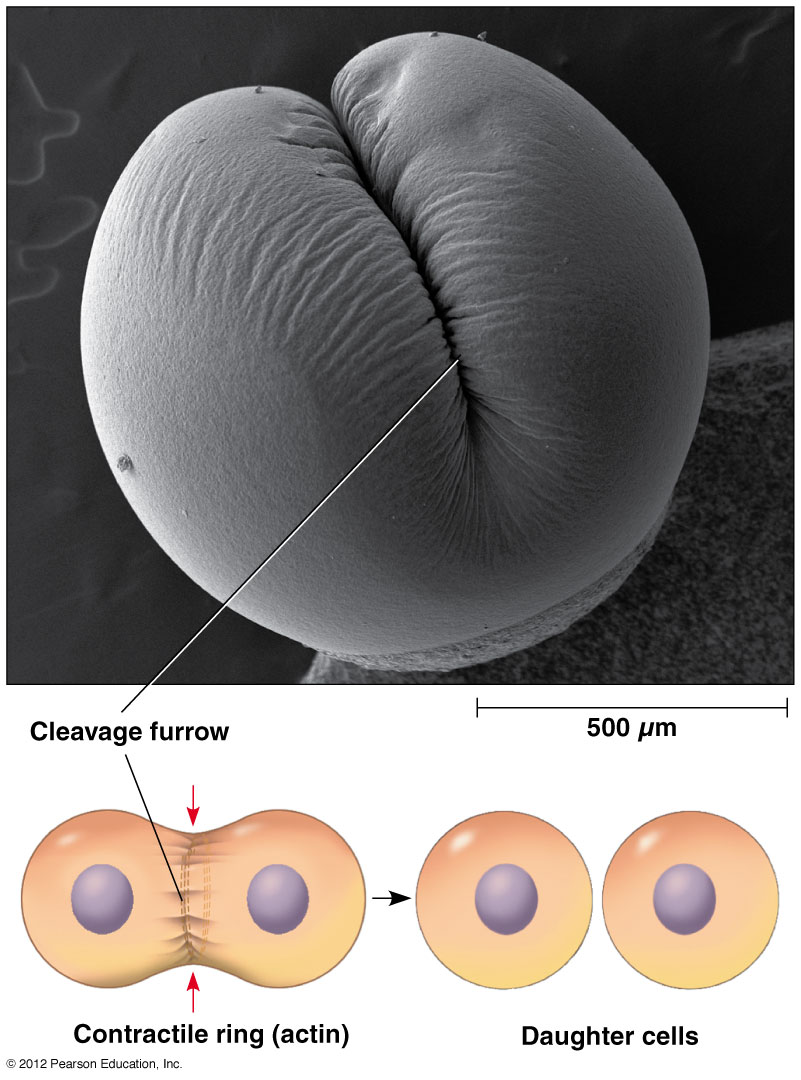


***\*Stages of mitosis division\****

**\*Cytokinesis**

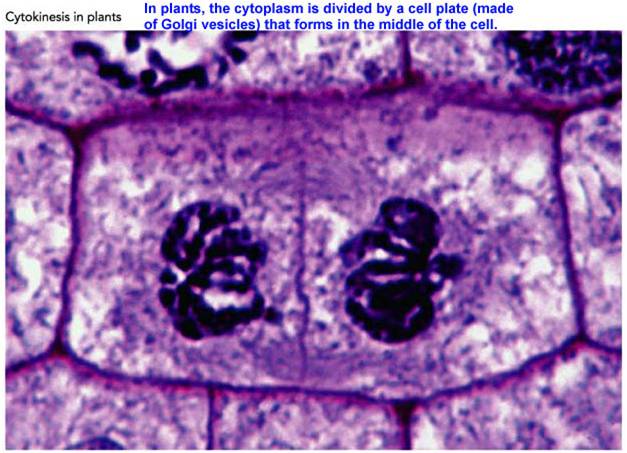
- Cytoplasm of the cell and its organelles separate into 2 new daughter cells.

- In animals, a groove called the cleavage furrow forms pinching the parent cell in two.



***\*Cytokinesis in animals (cleavage furrow***)\*

* - in plant, a cell plate forms down the middle of the cell where the new cell wall will be.



***\*Cytokinesis in plants***\*

**Lab -9-**

**Cell division**

**2) Meiosis**

-Reduces the number of chromosomes in new cells to half the number in the original cell.

- New cells have a single copy of chromosomes (23 total) but are not identical to each other or the original parent cell.

-Used for making gametes (sperm and eggs) with the haploid or n number.

- In meiosis, cells divide twice after a single DNA duplication.

-Meiosis I separates homologous chromosomes & the Meiosis II separates sister chromatids.

-**Meiosis I** stages are: 1) prophaseI 2) MetaphaseI 3) AnaphaseI 4) TelophaseI.

**- Meiosis II** stages are: 1) prophaseII 2) MetaphaseII 3) AnaphaseII 4) Telophase II.

-Produces 4 haploid cells or gametes.

-When a sperm fertilizes an egg to form a zygote, the diploid number of chromosomes is restored (23 +23=46).

-Egg cells or ova (ovum, singular) are larger, non-motile cells.-Gametogenesis is meiosis producing eggs & occurs in the females ovaries.

- Sperms contain less cytoplasm so they are smaller & have a flagellum to swim to the egg.

- Spermatogenesis is meiosis producing sperm cells & occurs in the testes.

**\*Meiosis I**

-The cell that undergoes meiosis I is a primary spermatocyte or oocyte.

**1) Prophase I**

-Chromosomes coil tightly and visible.

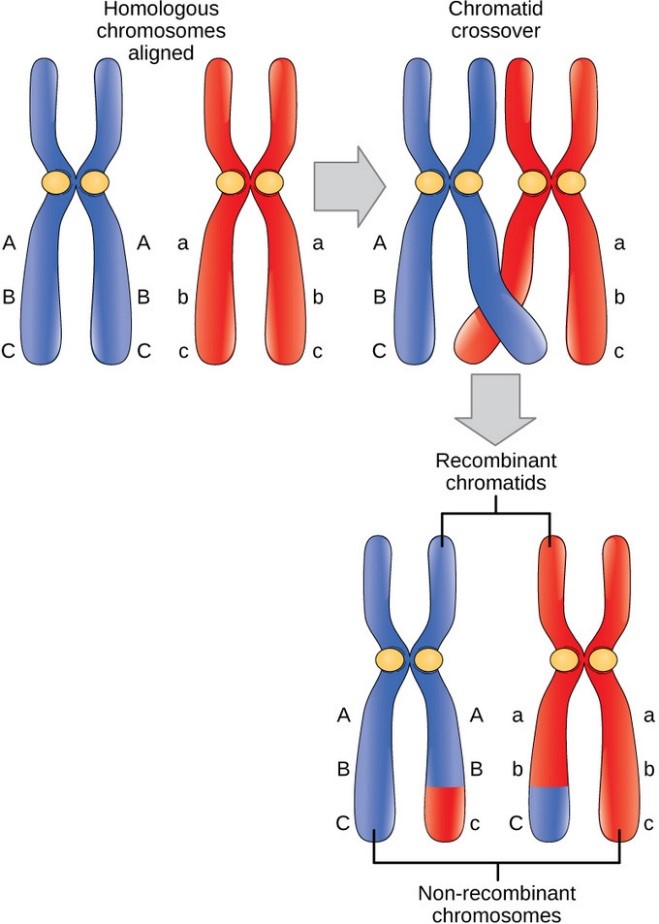
-Nuclear membrane & nucleolus disintegrate.

-spindle forms.

-Synapsis (joining) of homologous chromosomes occurs making tetrads.

-Kinetochore fiber forms on each chromosome.

-Chromosomes in tetrad exchange fragments by a process called crossing over.



***\*Crossing over process\****

**2) Metaphase I**

-Tetrads become aligned in the center of the cell attached to spindle fibers.

**3) Anaphase I**

-Homologous chromosomes separate.

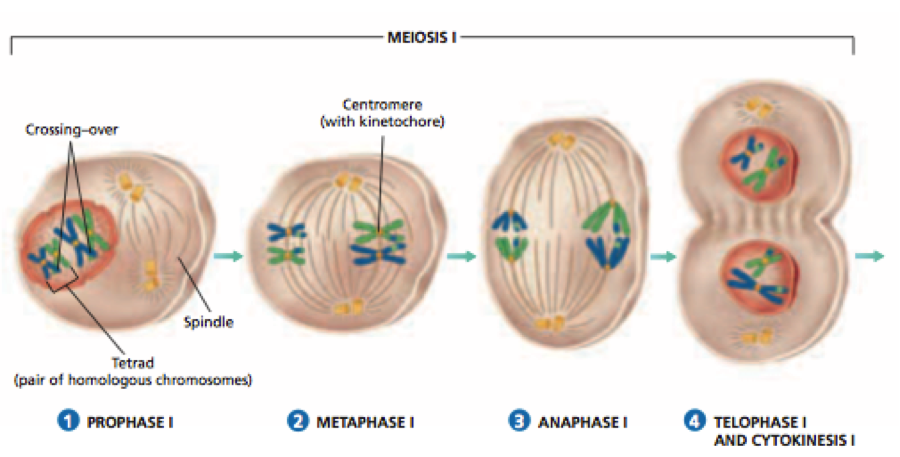
**4) Telophase I**

-May not occur in all species.

-Cytokinesis occurs producing 2 cells.

-In females, 2nd cell in females is called the 1st Polar Body.

-1st Polar Body dies due to uneven splitting of the cytoplasm.



***\*Stages of meiosis I \****

**\*Meiosis II**

**1) Prophase II**

-Cells called Secondary Spermatocytes or oocytes.

-DNA is not copied before cell divides.

-Chromatids attach to spindle fiber.

**2) Metaphase II**

-Chromosomes become aligned in the center of the cell attached to spindle fibers.

**3) Anaphase II**

-Sister chromatids separate randomly.

-Called independent assortment.

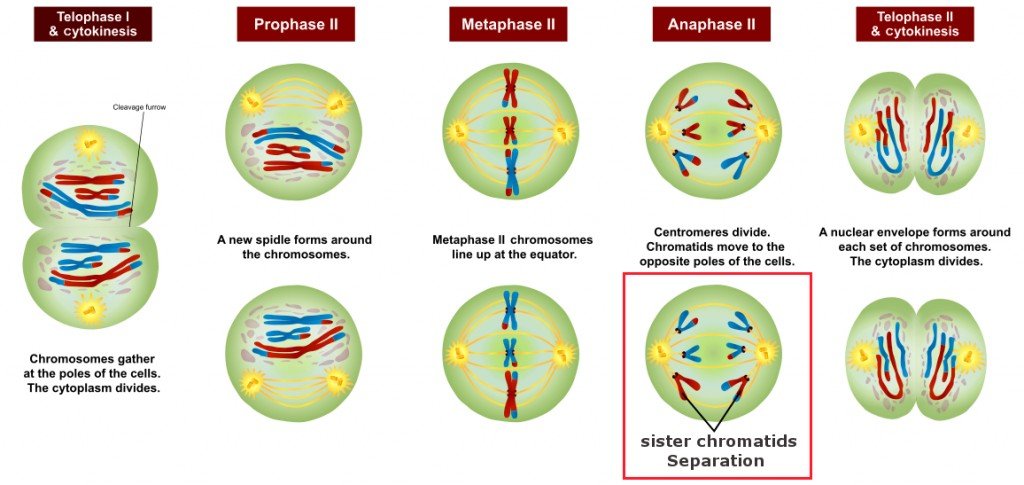
**4) Telophase II**

-Cytokinesis occurs producing 4 cells in males called spermatids.

-Spermatids mature & form flagellum to become sperm.

-Cytokinesis in females produces a 2nd Polar Body that dies and an ootid.

-Ootids mature to become ovum or egg.



***\*Stages of meiosis II\****

**\*\*Practical part**

**Cell squash method**

The Cell squash was used for study the mitosis of onion root edge.

Take the root edge and begin the process of squash, this process depend on fixation of the cell and press by finger (in the case of solid it must squash by needle edge and squash the sample directly then put slide cover directly and by wood part of needle press on slide cover (the fixer used was formalin acetic acid). It common fixer for plant product and put in root edge for 24 hr before examined. The fixer kills the cells rapidly and maintain on contents from spoilage.

**\*\*Method**

1- Cut the root of onion with distance 1 cm from apex edge of root and put it in fixative (formalin acetic acid ) for 24 hr.

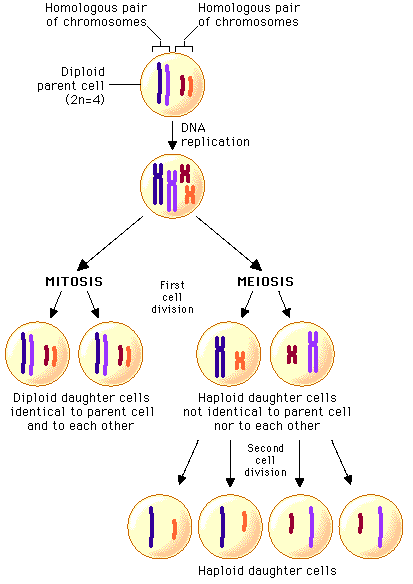
2- Take apex and put it on clean glass slide with droop of KOH , The fixation was done by needle. The useful of KOH for disassemble cellular plate.

3- Add drop of acetocarmin stain with pass on flame lamp without burned the sample.

4- Put the slide cover and press with finger and paper for disassemble the cells and complete differentiation.

**\*\*The difference between meiosis and mitosis**

|  |  |  |
| --- | --- | --- |
|  | Meiosis | Mitosis |
| End result | Normally four cells, each with half the number of chromosomes as the parent | Two cells, having the same number of chromosomes as the parent |
| Function | Sexual reproduction, production of gametes (sex cells | Cellular reproduction, growth, repair, asexual reproduction |
| Where does it happen? | Animals, fungi, plants, [protists](http://en.wikipedia.org/wiki/Protist" \o "Protist) | All eukaryotic organisms |
| Steps | Prophase I, Metaphase I,AnaphaseI,elophaseI, ProphaseII, Metaphase II,AnaphaseII,telophase II | Prophase, Metaphase, Anaphase, Telophase |
| Genetically same as parent? | No | usually |
| Crossing over happens? | Yes, in Prophase I | Sometimes |
| Pairing of homologous chromosomes? | Yes | No |
| Cytokinesis | Occurs in Telophase I and Telophase II | Occurs in Telophase |
| Centromeres split | Does not occur in Anaphase I, but occurs in Anaphase II | Occurs in Anaphase |



**The difference between meiosis and mitosis**