

# Cell Biology

Lecture 1

4: Introduction  
27/oct/2024



\* Histology (histo: tissue, ology: science)  
علم الأنسجة

↳ Microscopic study of tissues of the body  
and how they form organs

Cells  $\xrightarrow{\text{together Form}}$  tissues  $\rightarrow$  organs

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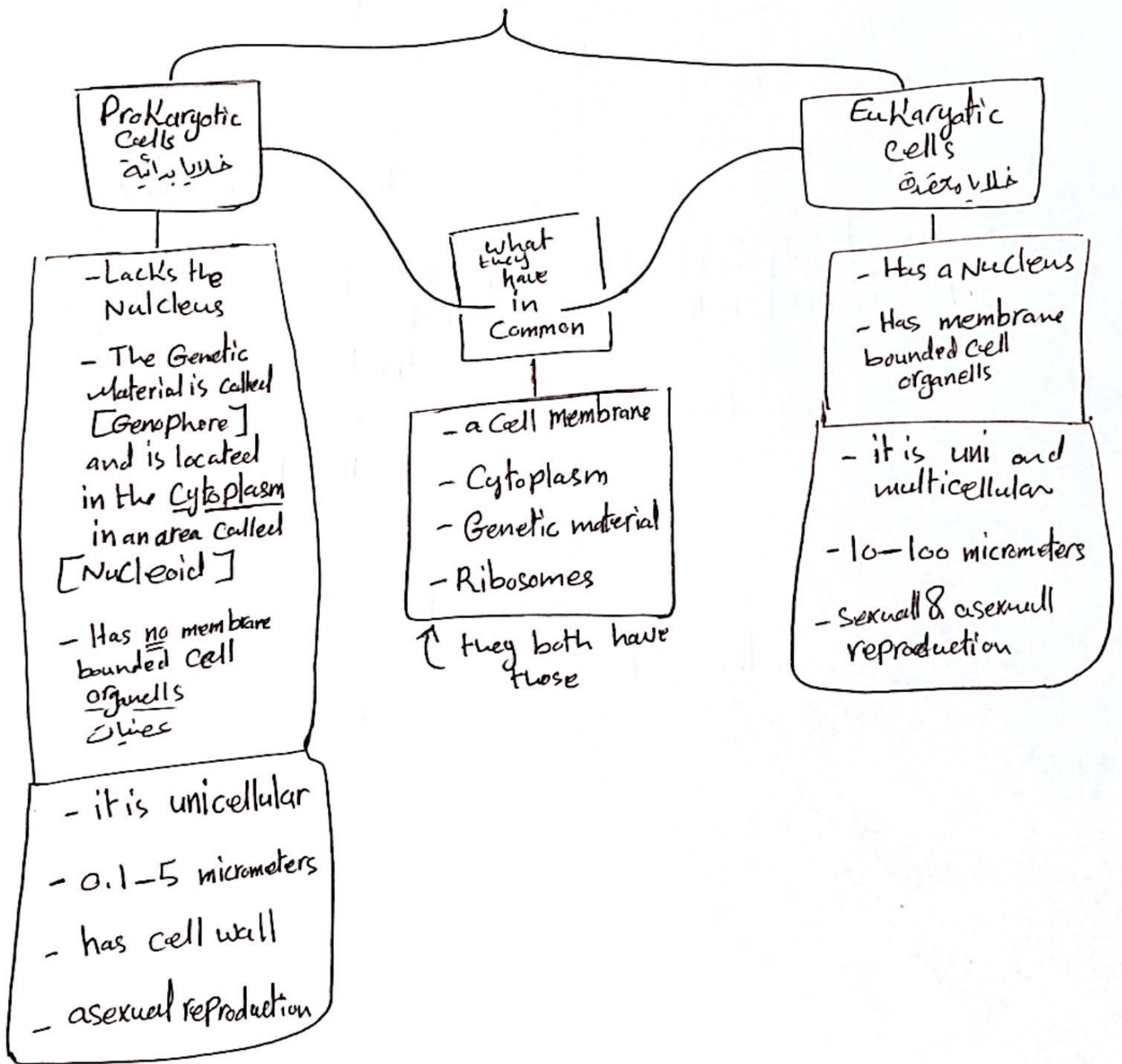
Body is made of :

- cells
- Extracellular Matrix

↳ مادة حول الخلايا  
من الحياة

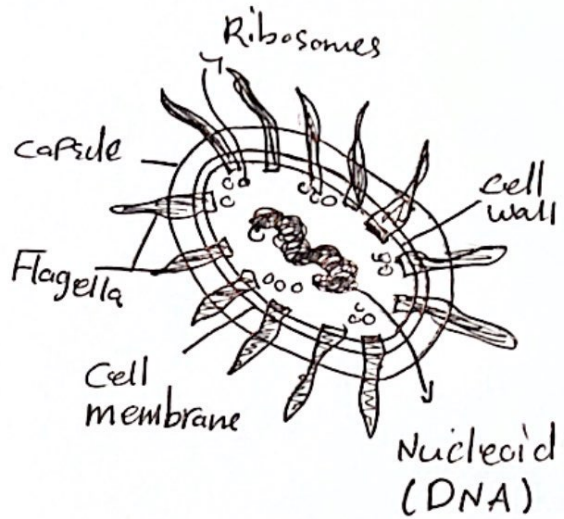
# \* The Cell \*

Classified into

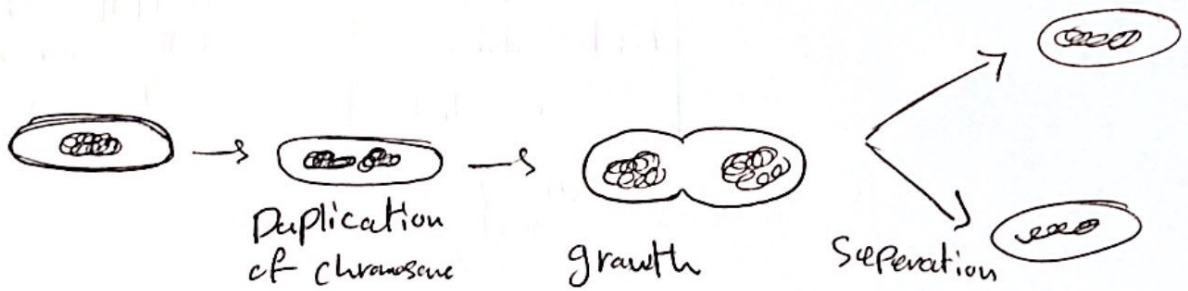


# \* Prokaryote cells :

- The DNA strand is **Circular** and called **Genophere** and found in an area called **Nucleoid**



- Prokaryotes divide by a process called :  
[Binary Fission]  
الانقسام الثنائي



There is only one type of division in Prokaryotes and it is ~~asexual~~ reproduction

asexual  
لا جنسي

\* important to memorize \*

1 millimeter (mm) = 1000 micrometer (micron)

1 micrometer ( $\mu\text{m}$ ) = 1000 nanometer

1 nanometer (nm) = 10 angstrom

- There are around 200 cell types in the human body which look different and do different functions

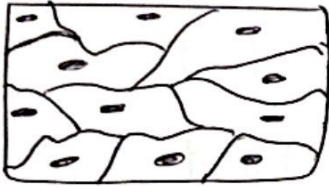
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- There are 4 basic types of tissues that make the human body:

- ① Epithelial tissue: groups of cells that [cover the exterior surfaces of the body, line internal cavities, form certain glands]
- ② Connective tissue: binds the cells and organs of the body together [includes: Bone, cartilage, Blood]
- ③ Muscular tissue: Contracts forcefully when excited  
Providing movement } both are excitable
- ④ Nervous tissue: is excitable - allowing for the generation and propagation of electrochemical signals in the form of nerve impulses that communicate with different regions of the body

⑤

\* Epithelial tissue :



\* Connective tissue :



\* Muscle tissue :



\* Nervous tissue :

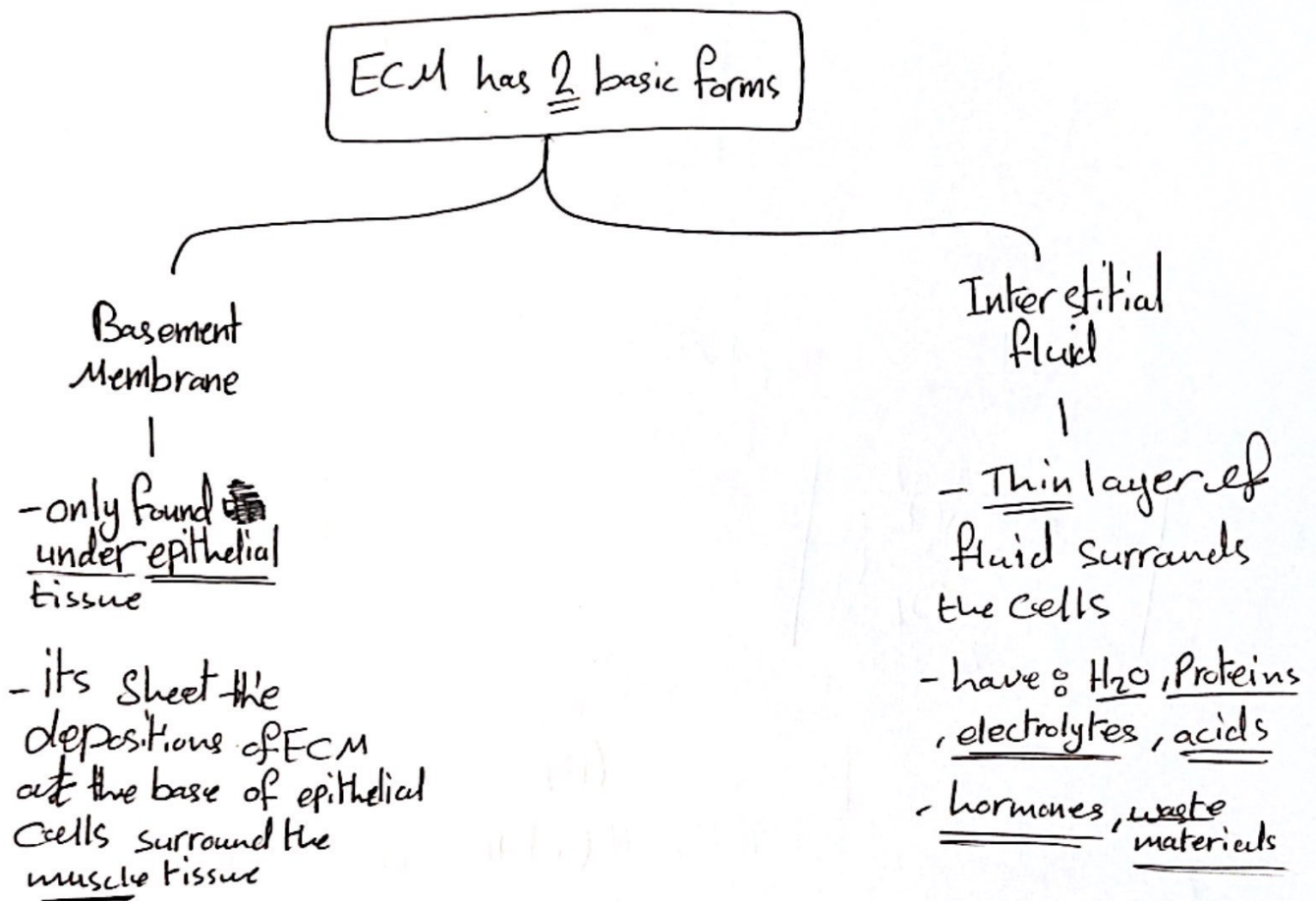


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\* Extra Cellular matrix (ECM)

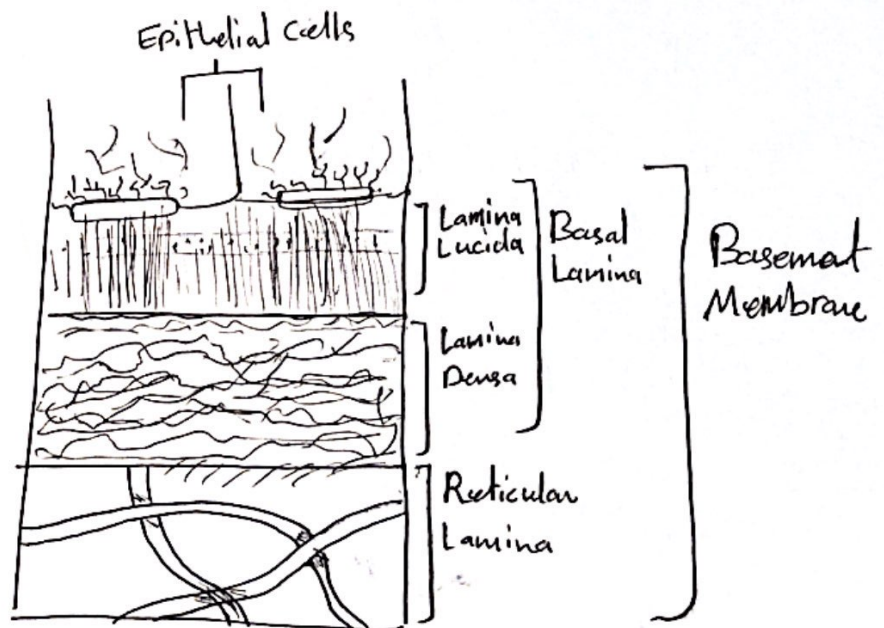
- A substance (non-cellular) that fills the spaces between cells & is secreted by the cells
- It is composed of Proteins & other molecules that [surround, support, and give] structure to cells and tissues
- It helps cells attach to, and communicate with nearby cells
- Plays an important role in [growth, cell movement, and other cell functions]

# \* Types of (ECM) :



\* Most epithelial cells are separated from the connective tissue beneath it by a sheet of (ECM) called basement membrane

- The basement membrane is usually visible with light microscope
- The basement membrane is formed by two layers :
- basal lamina
- reticular lamina





## \* The Basal Lamina :

- visible with EM about 20-100 nm in thickness  
secreted by epithelial tissue

- Consists of 2 layers :

\* Lamina Lucida  
(Light)

\* Lamina Densa  
(Dark)

Note: In diabetes mellitus (السكري), the basement membrane of small blood vessels especially in retina (الشبكية) & kidney (الكلى), became thick

- The main components of Basal Lamina are:

[ Type IV Collagen ]  
↓  
4

## The Reticular Lamina :

- formed by reticular fibers
- usually thicker than basal lamina
- secreted by connective tissue cells (fibroblasts)

\* Epithelial tissue Compose of cells laid together in sheet & tightly connected to one another

- Epithelial cells are <sup>doesn't have blood vessels</sup> avascular but innervated so it gets its nourishment from the underlying connective tissue

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\* Function of basement membrane :

- Anchoring epithelial cells to underlying tissue
- Pathway for cell migration
- wound healing
- barrier between Epithelial cells and <sup>Connective tissue</sup> C.T
- Participation in filtration of blood in Kidney
- early stages in cancer called Carcinoma in situ [limited to epithelial layer]

(a)

## \* Plasma membrane :

- Also called Cell membrane
- Surrounds the cell
- Separates the interior of the cell from the outside
- Protects the cell

## \* Intracellular Matrix :

- The substance that fills the inside of the cell  
[Cyttoplasm]

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## \* ECM amount varies according to : tissue type

- Least amount : in Epithelial tissue
- Most amount : in Connective tissue

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## \* Also ECM consistency varies :

- Jelly like : Connective tissue Proper
- Rubbery : Cartilage
- Hard : Bones
- Fluid : Blood

## \* Functions :

- Support cells
- Supply nutrition & oxygen , Communication
- Removal of waste products

# \* Organization of the human body :

Cells → Tissues → Organs → Systems

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## \* Methods of studying Cell Biology :

- ① Cell Culture : Isolation of cells and making them grow under controlled conditions
- ② Cell Fractionation : Separating cellular components while preserving the individual functions of each component by breaking the cells with a process called ~~fractionation~~ centrifugation & size.

③ <sup>کیمیائی</sup> Chromatography : Chemical analysis done in the lab for separation of a mixture into its components. Composed of 2 phases :

- Mobile
- Stationary

④ Electrophoresis : separating charged molecules using an electrical field based on

- size
- charge

⑤ Genetic technology : Study the structure & function of genes

- isolating genes
- Copy genes = cloning
- Determine unknown DNA sequence

## \* Microscopy:

- is the standard optical instrument for generating magnified images for different purposes

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Types of microscopes:

- ① Light Microscope (LM)
- ② Electron Microscope (Transmission & scanning)
- ③ Phase contrast microscope
- ④ Differential interference microscope
- ⑤ Fluorescence microscope
- ⑥ Confocal microscope

# ① light microscopy (LM)

- The widely used microscope

- it uses visible light source + Condenser lens  
to send light through the object

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- The image of an object is magnified by two sets of lenses

① ocular lens (10)

② objective lenses (5, 10, 40)

- Total magnification power = Lens (1) • Lens (2)

$$= 10 \times 40 = 400X \text{ times}$$

or

$$10 \times 10 = 100X$$

or

$$10 \times 5 = 50X$$

\* Light microscope parts  
must be memorized \*

go back to the  
document on  
slide #32

★ The capacity of microscopes depends on :

① Magnification power : the Power to enlarge objects

② The resolution power : its the smallest distance between two particles that can still be seen by eye or camera, as two separate objects and Not as a single object

- this is done by lenses

- Magnification is valuable only when accompanied by high resolution

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★ The resolution power of :

- Healthy naked eye = 0.2 millimeter

- LM = 0.2 micrometer ( $\mu\text{m}$ )

- EM = 0.2 nanometer (nm)

★ Memorize ★



## \* The Electron Microscope (EM)

- Technique used to obtain high resolution images
- the light source is an: Electron Beam
- the image is formed from the interaction of the electrons with the specimen as the beam travel through it
- the Beam passes through a vacuum tube
- the lenses are electromagnetic coils instead of glass lenses

- illuminating system consists of :

- Electron gun
- condenser lenses

↳ it is capable of generating circular magnetic field that act to focus electrons on the specimen

\* Memorize its Parts

- the image appears on screen plate that glows when being hit by electrons

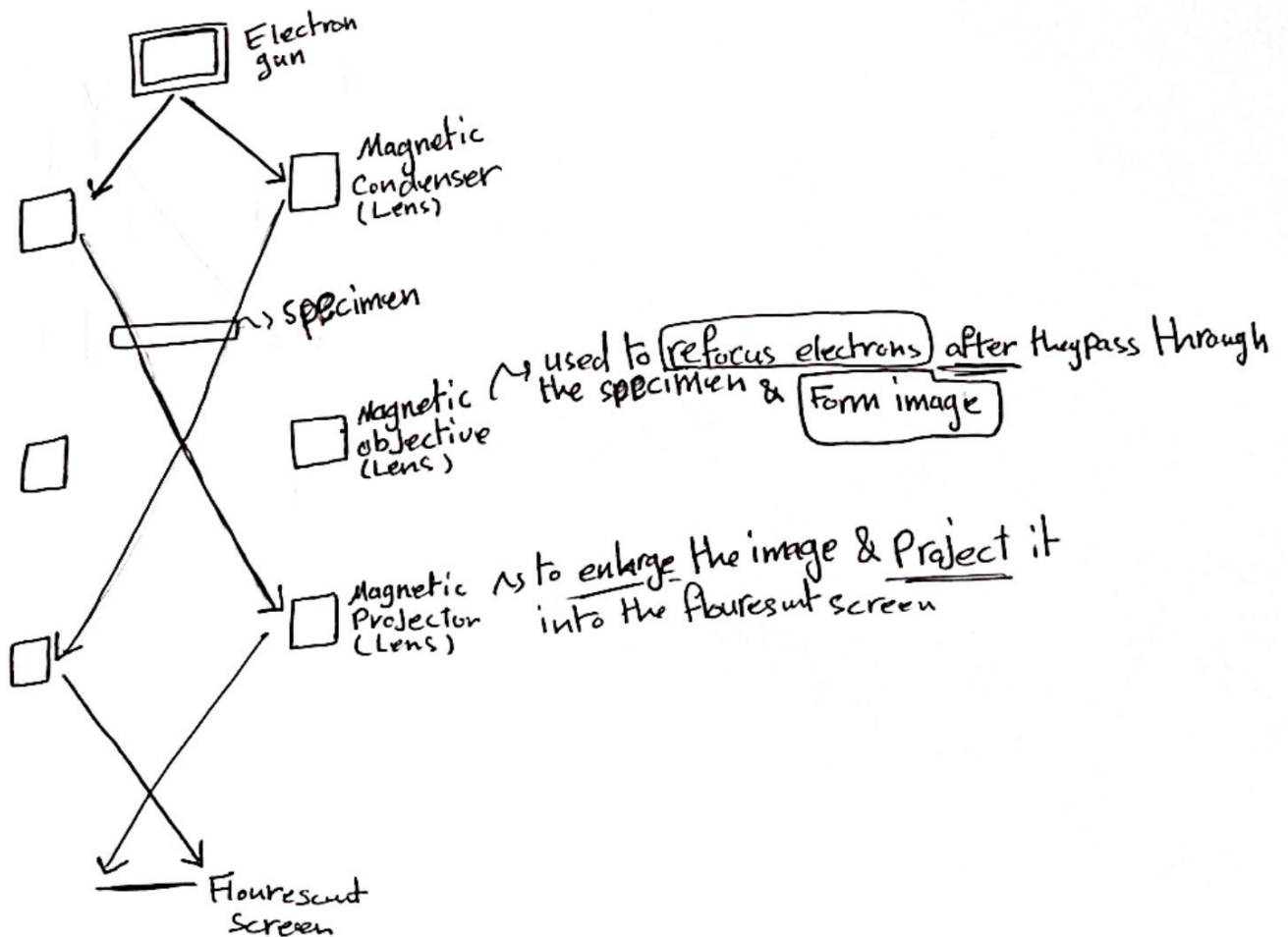
- images can be detected as :
- \* Light areas [electron Lucid]
  - \* Dark' areas [electron Dense]
- corresponding to areas through which electrons readily passed

\* The tissues cells need special preparation & then cut into very thin sections

[Ultra thin sections = 0.1 of the micron  
= 10 nanometers  
= 100 angstroms] important

Then they are collected on a Copper metal grid  
Embedded in resin

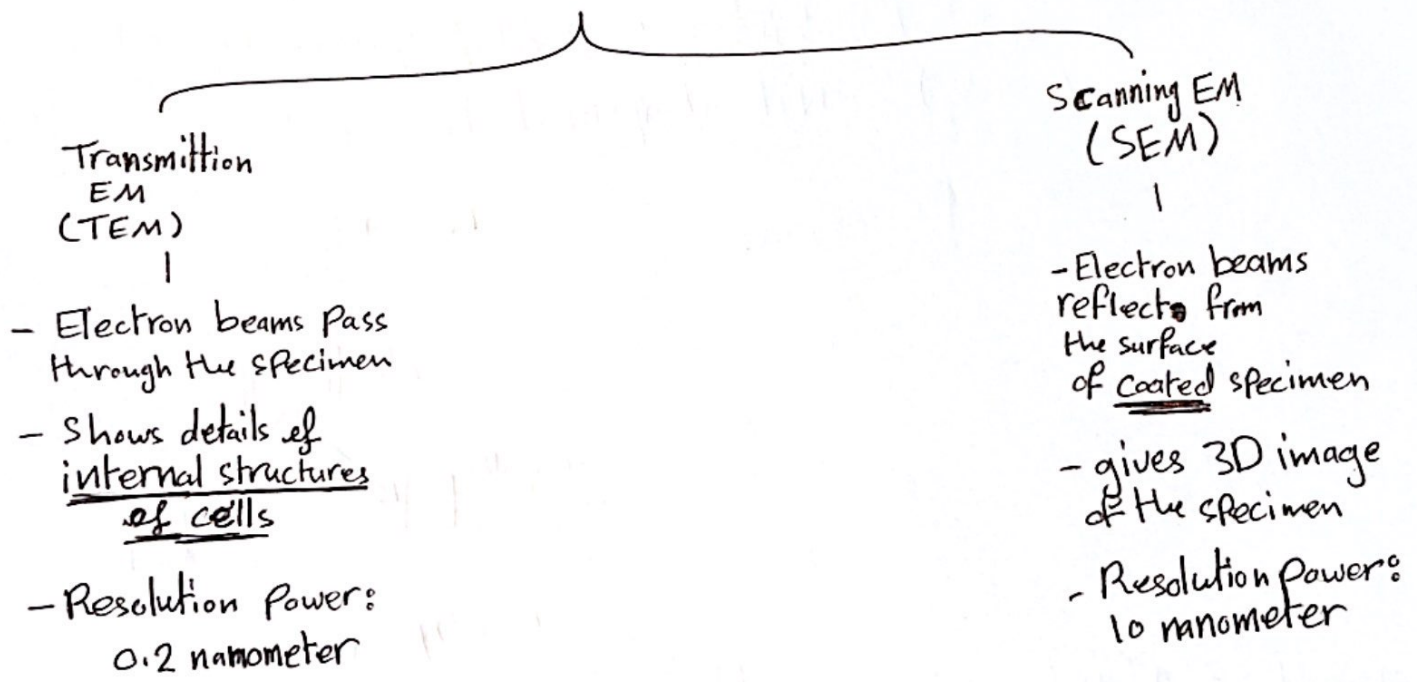
\* The imaging system consists of:  
- Another electromagnetic lenses (2-3)  
- Screen



\* During Preparation of the thin sections they are stained with salts of heavy metals like: [lead nitrate, uranyl acetate] that precipitates in tissues

- EM can magnify the image up to (200,000 times) two hundred thousand with a resolution power of 0.2 nanometers (nm)

## \* Types of Electron Microscope (EM)



TEM resolution Power 0.2 nm > SEM resolution Power 10 nm  
↑ Better

\* The smaller the better \*

## \* Phase contrast microscope

- Depends on the idea that some lens systems can produce visible images from transparent objects (unstained)
- because light changes speed when passes through cellular & extracellular structures & with different refractive indices
- Objects appear lighter & darker to each other
- useful to examine:
  - living cells & tissues like [blood cells & sperms]

\* Look the image slide 41

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## \* Differential interference contrast microscope

- \* is advanced version of the phase contrast microscope
  - also used for transparent or unstained samples
  - the obtained images appear 3D
  - it utilizes two separate beams of light

\* Look images slide 42

## \* Fluorescence Microscope

- Certain substances absorb invisible ultra violet of short wavelength

} then  
they reflect (emit) it as visible light  
of long wavelength

these are known to exhibit fluorescence

↓  
is a physical property

- this microscope is provided with a special lamp  
that can emit [ultra violet ~~light~~ <sup>rays</sup>]  
that pass through the tissue

- it can be used to visualize:

DNA

RNA

Proteins & antigen antibody complex

[Antibodies labeled with fluorescence]

\* The image on slide # 43 is important  
[the cells], [how the microscope looks]

~~the image~~

## ★ Confocal Laser Microscope (3D)

- the illumination is provided by a **laser source**
- Specimen should be labeled with:  
**Flourescent molecules**
- Uses:
  - increase optical resolution & contrast (better image)
- The Laser passes through a **small hole** to examine fine details  
↓  
to avoid photo bleaching
- its connected to a computer system to reconstruct full image of the specimen

★ see the image at slide 44★

- it'll ask you : this photograph  
was taken by which  
microscope