



Cell Biology

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cell varies in size from 4 to 200 microns.

Cell

the smallest and the basic unit of a living body.

The cell can't be seen by naked eye but only by microscope.

The cell can carry on all the process of life.

tissue. ← Histology → science.

Microscopic study of tissues of the body and how these tissues form the organs.



« The Cell »

prokaryotic

- no membrane bound organelles.
- no true nucleus.
- unicellular.
- 0.1-5 micrometers.
- has cell wall.
- asexual reproduction.

Eukaryotic

- contains membrane bound organelles.
- contains true nucleus.
- uni-multicellular.
- 10-100 micrometers.
- asexual and sexual reproduction.

- DNA circular.

- DNA linear organized into chromosomes.

* Both (Pro and Eu cells) share 4 key elements

→ Cell membrane.

→ Cytoplasm.

→ genetic material.

→ ribosomes.

* In prokaryote cell .

1- The DNA strand is circular and is called **gonophore** and found in area called **nucleoid** .

2- prokaryotes divide by process called **Binary fission** .

* There are around 200 cell types in the human body .

very important.

- Equivalent lengths :-

1 millimeter (mm) = 1000 micrometer.

1 micrometer (um) = 1000 nanometer.

1 nanometer (nm) = 10 angstrom

The 4 basic types of tissues that make the human body.

1 - Epithelial tissue.

- cover the exterior surfaces of the body.
- line internal cavities and passageways.
- form certain glands.

2 - Connective tissue.

- binds the cells and organs of the body together.

3_ Muscular tissue.

- contracts forcefully when excited.
- providing movement.

4_ Nervous tissue.

- allowing for the generation and propagation of electrochemical signals in the form of nerve impulses that communicate between different regions of the body.

Composed of proteins and other molecules that provides structural and biochemical support to the surrounding cells.

ECM

Definition
is the substance (non cellular) that fills the spaces between cells.

is secreted by the cells.

Functions

- helps cells attach to and communicate with nearby cells.
- cell growth.
- cell movement.

« Types of ECM »

Basement Membrane.

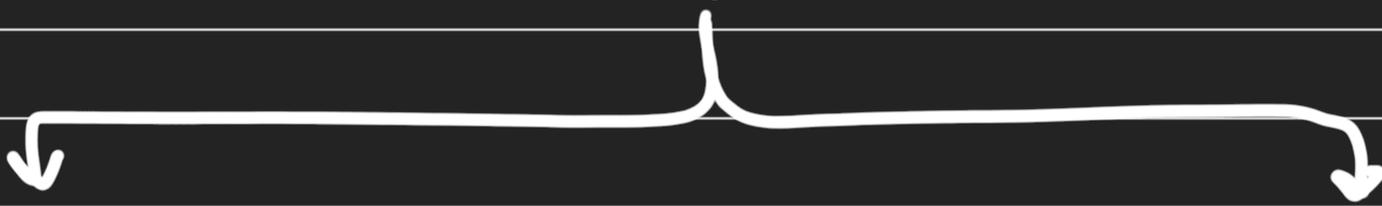
- is sheet-like depositions of ECM at the base of epithelial cells and surround muscle cells.
- always under epithelial cells.
- visible with light microscope.

Interstitial fluid.

- thin layer of fluid fill the spaces between the cells.
 - H₂O.
 - proteins electrolytes.
 - acids.
 - hormones.
 - waste materials.

Basement membrane

2 layers



Basal lamina.

- visible with EM about 20-100 nm in thickness.

- secreted by epithelial cells.

- consists of 2 layers

- main components

→ lamina lucida.

→ lamina densa.

→ IV (4) collagen.

Reticular lamina.

- is formed by reticular fibers.

- usually thicker than basal lamina.

- secreted by connective tissue cell (fibroblasts).

* In diabetes mellitus

↳ the basement membrane of small blood vessels especially in retina and kidney became → thick.

* Epithelia tissue → composed of cells laid together in sheet and tightly connected to one another.

* Epithelial cells → are avascular but innervated so it gets its nourishment from the underlying connective tissue.

Function of basement membrane :-

- 1 - Anchoring epithelial cells to underlying tissue.
- 2 - pathway for cell migration.
- 3 - Wound healing.
- 4 - Barrier between epithelial cell and connective tissue.
- 5 - participate in filtration of blood in kidney.
- 6 - Early stages in cancer called carcinoma.

Intracellular Matrix

↳ the substance that fill the inside of the cell = cytoplasm.

ECM amount ::

minimal → in epithelium tissue.

plenty → in connective tissue.

ECM consistency varies :-

jelly like → connective tissue.

rubbery → cartilage.

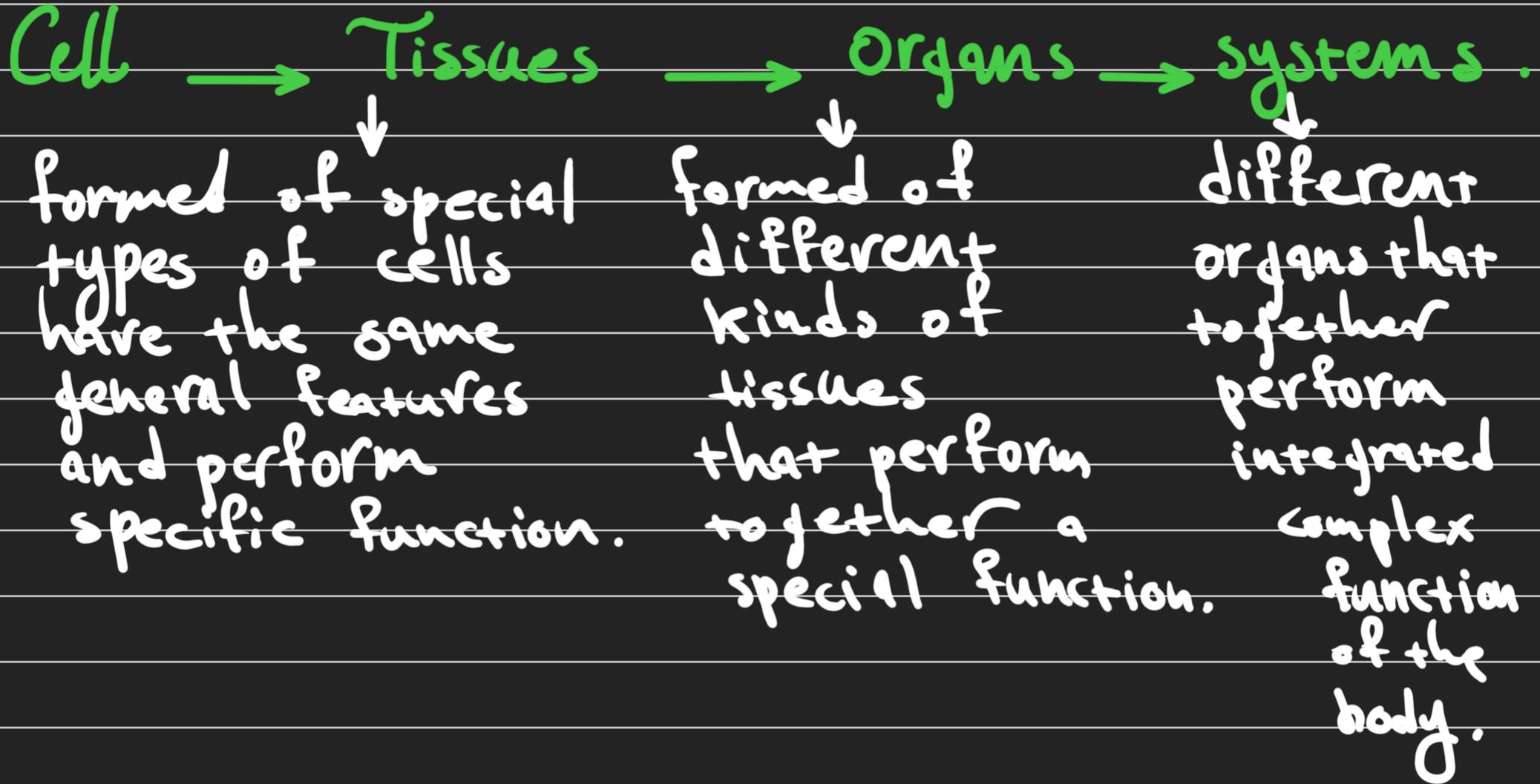
hard → bone.

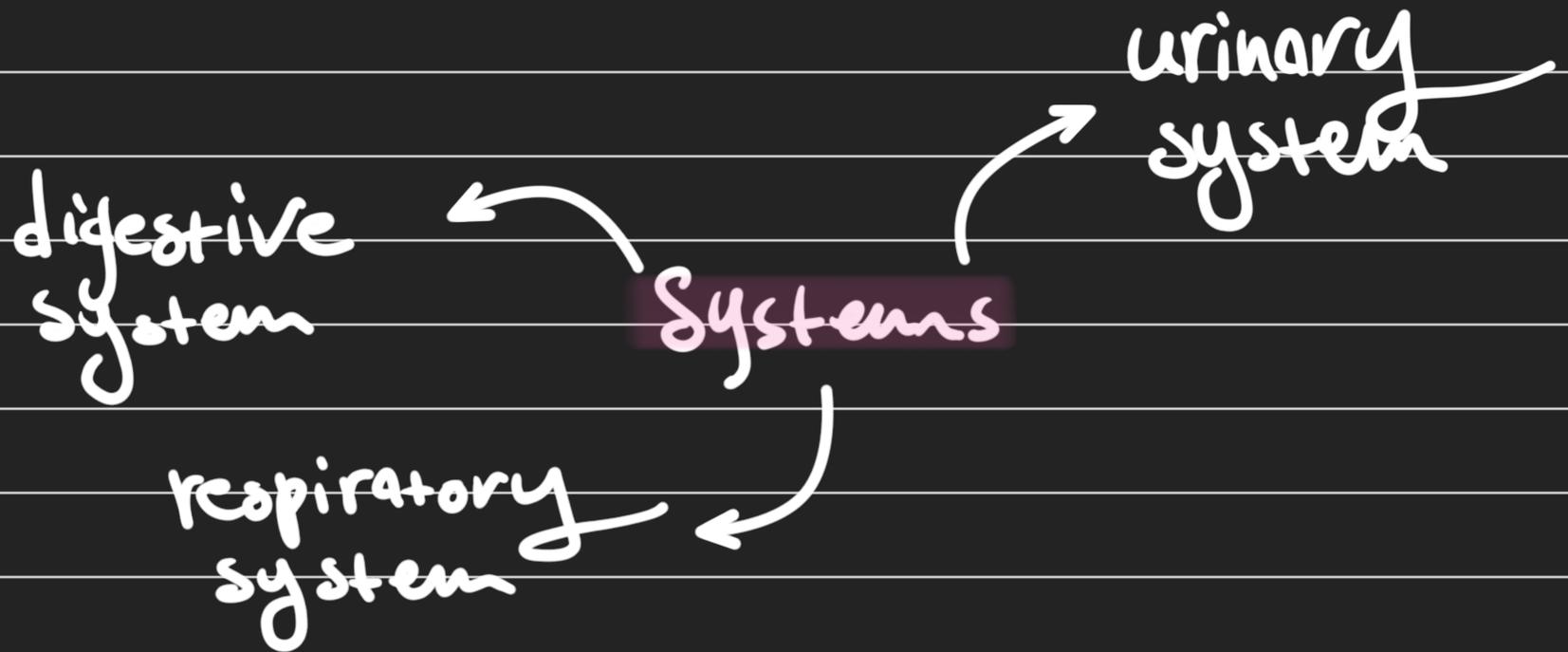
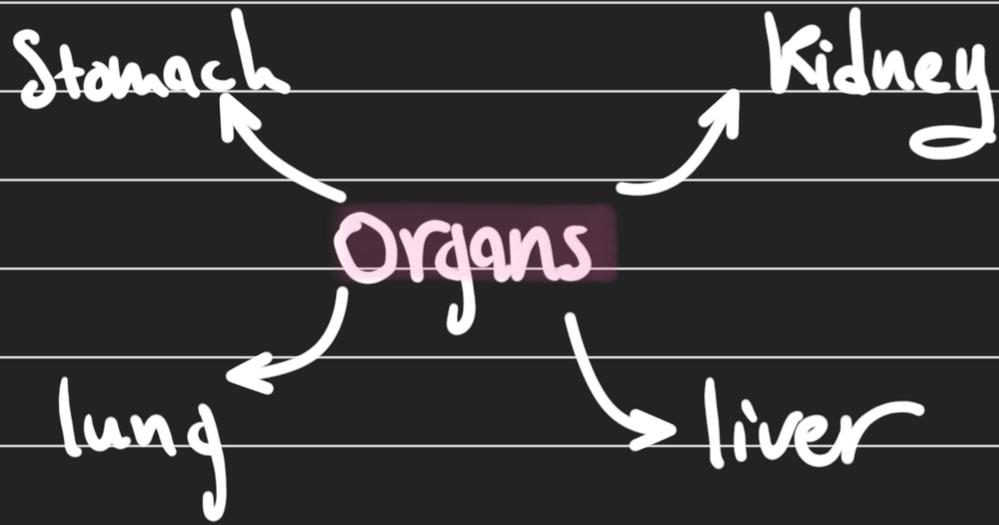
fluid → blood.

Functions of ECM :-

- Support of cells.
- Supply of nutrition and oxygen, communication.
- Removal of waste products.

• Organization of the human body.





cell fractionation

breaking the cells and separating its cellular components. by process called centrifugation.

Methods of studying cell Biology

cell culture

isolating the cells and make them grow under lab conditions.

Electrophoresis

separating of charged molecules using electrical field. size and charge.

Chromatography

Chemical analysis done in the lab.

2 phases → mobile
↳ stationary.

Genetic technology

Study the structure and function of genes.

- Isolating gene.
- copy genes = cloning.

« Microscopy »

Light microscopy.

- use visible light source.
condenser lens.

- The image of this object is magnified by two sets of lenses:

Ocular lens (10).

Objective lenses (5, 10, 40).

$$10 \times 5 = 50\times \text{ times.}$$

The capacity of microscopes depends on

↳ Magnification power.

↳ resolution power.

The resolution power of

Healthy naked eye → 0.2 (mm)

LM → 0.2 (μm)

EM → 0.2 (nm)

* Glass slides stained with Hand E of EM.

The Electron Microscope (EM):-

- source of light → Beam of electrons.
- Beam passes through a vacuum tube.
- The image formed from the interaction of the electrons with the specimen as the beam travelling through it.
- The lenses are electromagnetic coils instead of glass lenses.

Illuminating system consists of  electron gun.
condenser lens.

Condenser lens → is capable of generating circular magnetic field that act to focus electrons on the specimen.

objective lens → is used to refocusing the electrons after they pass through the specimen and form image.

projector lens → is to enlarge the image of the object and projecting it into the fluorescent screen.

- Images can be detected as :-

Light areas → electron lucent.

dark areas → electron dense.

- During preparation sections are stained with salts of heavy metals like

→ lead nitrate.

→ uranyl acetate.

- EM can magnify the image thousands of times (upto 200,000 times).

- The resolution power = 0.2 (nm).

« Types of EM »

Transmission EM

- It shows the details of internal structures of cells.

Resolution power
0.2 nm

Scanning EM

- gives a three dimensional image of a specimen.

Resolution power
10 nm

Phase contrast microscope.

↳ depends on the idea that some lens systems can produce visible images from transparent objects.

↳ The principal is that light changes speed when passes through cellular and extracellular structures and with different refractive indices.

→ Objects appear lighter or darker to each others.

→ useful in

→ living cells.

→ tissue cultures.

Differential interference contrast microscope:-

- The obtained image appears 3D-like appearance gives depth and texture perceptions.
- It utilizes two separate beams of polarized light.

Fluorescence Microscopy:

- Certain substances absorb invisible ultraviolet light of short wavelength

and emit (reflect) it as visible light of long wavelength and are known to exhibit fluorescence (physical property).

- used to visualize

- DNA.
- RNA.
- proteins.
- antigen antibody complex.

Confocal Laser Microscope (3D).

- source of light → laser source.
- The specimen should be labeled by fluorescent molecules.
- Uses → increase optical resolution and contrast
- The LASER light passes through a small hole (to avoid photo bleaching).
to examine fine details.
- It is connected to a computer system to reconstruct full image of the specimen.