Cell

Human Anatomy And Physiology

D.Pharma 1st year notes According to PCI new Syllabus

10/6/2021

In this Notes we provide you Human Anatomy & Physiology Notes Chapter – 2

Cell

The cell has been variously defined as the unit of structure and function in animals and plants.

The smallest living unit capable of independent existence as a small mass of living matter containing a nucleus or nuclear material.

History of cell

The cell was first discover and named by Robert Hook (1665) and first Saw living cell by – Leeuwenhoek cell theory proposed by Schwann – 1839.

Electron Microscopic Structure of Cell

All the cells are made up of protoplasm a viscid granular substance which consist of water, electrolytes, proteins, lipids and carbohydrates.

The protoplasm remain differentiated into an outer cytoplasm and the denser inner nucleus. Surrounding the cytoplasm there is covering called Cell Membrane.

CELL MEMBRANE

- Cell Membrane is thin elastic and has highly complex structure composed of proteins and lipids. It is a semi – permeable membrane, containing 'pores' that allow the passage of water, oxygen, co2 & some solutes in and out of the cell and plays a vital role in maintaining the homeostatic balance of the cell.
- The cytoplasm consists of a number of structures called the Organells.

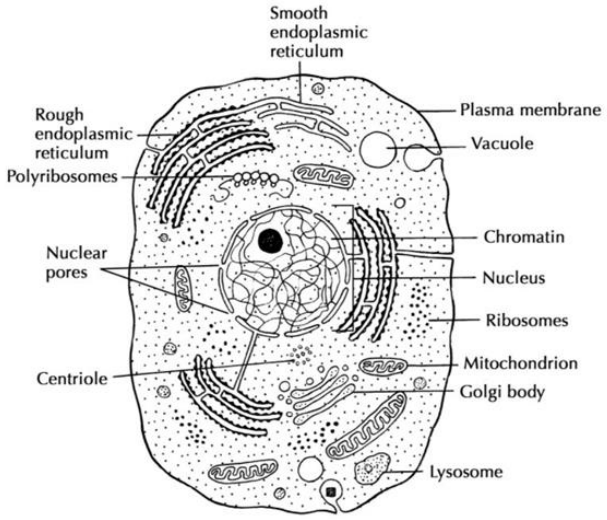
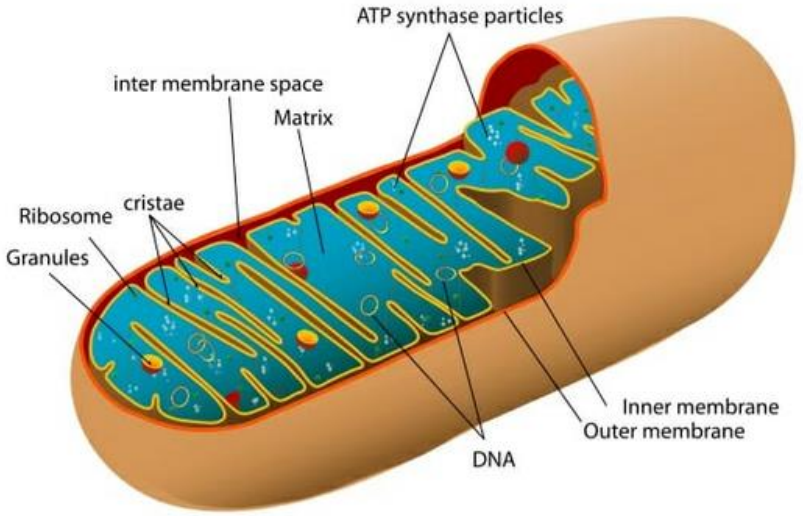


Fig of Cell

Mitochondria

- It is largest cytoplasmic organelles and energy house of the cell as it consist of enzymes which convert chemical energy of the food nutrients into usable energy from (T.P.) which is internally available for cellular activity.
- It is also known as Power house of the cell. ·
- Mitochondria is discover by Albert von Kolliker
- It appears like filamentous structure or rod shaped. It consists of oxidative enzymes which convert chemical energy of the nutrients into form of A.T.P. and this energy is available for cellular activity. The mitochondria supply 95% of cell energy and so called power house of the cell.



Cytoplasm

- It is the region lying between the cell membrane and nucleus. The cytoplasm contain Cell organ like – Endoplasmic reticulum, Golgi bodies, Mitochondria.

Endoplasmic reticulum

- These are scattered in cytoplasm. They are two types of endoplasmic reticulum depending upon the presence or absence of ribosomes which are responsible for protein synthesis.
- Endoplasmic Reticulum is two type

1. **Smooth Endoplasmic Reticulum**: - Smooth Endoplasmic Reticulum without the presence of ribosomes. They found Lipid
2. **Rough Endoplasmic Reticulum: -** Rough Endoplasmic Reticulum with the presence of ribosomes. They found Protein

Lysosomes

- They are minute structures containing enzymes that digest or remove the particles which are useless or may be harmful to the cell. ·
- Lysosomes produce hydrolyzing enzymes such as phosphatase acid ribonuclease.

Golgi bodies

- They are the double membranous vacuolar channels which traverse the cytoplasm. The membrane appears to be formed of phospholipids, proteins, and a number of enzymes.
- Golgi bodies act as a sort of intercellular pump that regulates the movement of fluids in the cell and expulsion of secretary products from the cell.
- Golgi bodies synthesise polysaccharide part of glycoprotein secretion.

Centrosome

- This lies close to the nuclear and is made up of two centrioles, small structures that play a major role in initiating cell division.
- It is enveloped by a porous nuclear membrane that separates it from the surrounding cytoplasm.
- During cell divisions, it breaks up and soon after the mitosis it is reconstituted.

Nucleus

- It is a vital center of the cell.
- It controls both chemical reactions and reproduction of cell.

Chromosomes

- They are minute threads like structure within the nucleus and appear as a mass of darkly-staining material called chromatin. ·
- Chromosomes determine the specific characteristics of the cell and hereditary characters pass from one generation to the next generation.

Cell Junction & Transport across Cell Membrane

Cell Junction

- Cell Junction are the modified structure of the cell membrane which communicate the Neirbouring cell.

- Cell Junctions are mostly abundant in Epithelial tissue and connect through glycoproteins called cadherin
- Cell junction is true for the animal cell because plasmodesmal connations are found in plant for commenieeting the Neighboring cell.

Type of Cell Junction

1. **Tight Junction**
2. **Adhering Junction / Desmosomes**
3. **Gap Junction / Communicating junction**

1. Tight Junction :-

- Adjacent plasma membranes are joined tightly together
- This help to stop substances from leaking.
- It is permeable in for many ions
- Pass the ion through diffusion or active transport.

2. Adhering Junction:-

- It performs cementing keep neighboring cells.
- Adhering junction is defined as a cell junction whose cytoplasmic face is linked to the actin cytoskeleton.
- Protein forms the encircling bands and attach to the extracellular material
- It stabilizes the surface of epithelia.

3. Gap Junction:-

- Gap junctions facilitate the cells to communicate with each other, share nutrients & transfer chemical / electrical signals
- Proteins form holes between adjacent animal cells allows various ions and molecules to pass freely between cells.
- Abundant in cardiac muscle and smooth muscle where they transmit electrical activity

- Assembly of six proteins that create gap between two plasma membranes called Conn exons.

Regulation of Gap Junction communication

I. Intra Cellular Calcium
II. pH
III. Voltage
IV. Extracellular signals

Cell membrane

- Cell Membrane is the universal structure present in both prokaryotes and eukaryotes
- Cell membrane possess lipid, Protein and carbohydrates
- Cell membrane contain lipid bilayer which is directly attached to protein layer
- Total thickness of cell membrane is 75A.

Transportation through cell membrane-

- Passive Transport
- Active Transport

Passive transport

- Many molecules can move across the membrane without any energy requirement
- Molecule transport higher concentration-> Lower concentration
- Water transport through membrane called diffusion
- Some carrier protein also help in the transportation and it is called facilitate diffusion.

Active transport

- Few molecules ions can move across the membrane by using the Energy (A.T.P)
- Molecule move from lower concentration-> Higher concentration
- Example-> Sodium potassium pump (Na+/K+ Pump)

Endocytosis

- In this procedure bulk amount of solid & liquid material transports.
- Bulk structure are formed vesicles or bag like structures
- Easily diffuse to cell membrane

Exocytosis

- Removal of waste material from Cell through plasma membrane
- Maintain the Electrolytic balance

Cell Division

- Cell division is a very important process in all living organism.
- It is induce due to disturbing the ratio between the nucleus and cytoplasm
- The sequence procedure follow by the cell and eventually divides into two daughter cells is termed cell cycle
- During the cell division DNA replication and cell growth also takes place.

On the basis of chromosome number cell follow two path for divisions

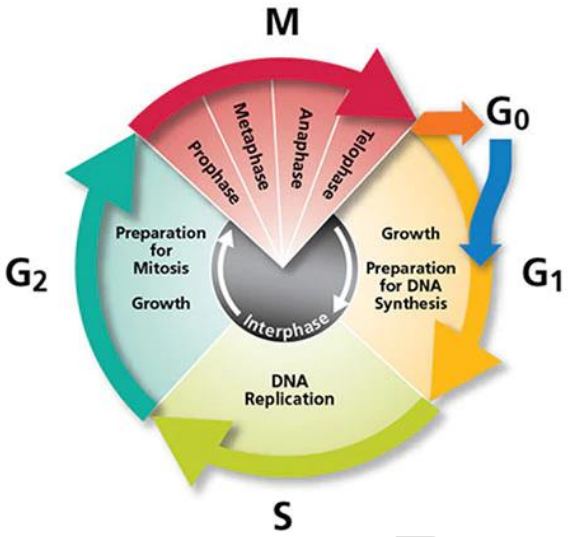
- Mitosis
- Meiosis

Mitosis

The cell cycle is devided into two basic phases

1. Inter Phase

2. M Phase / Mitosis Phase



Inter Phase

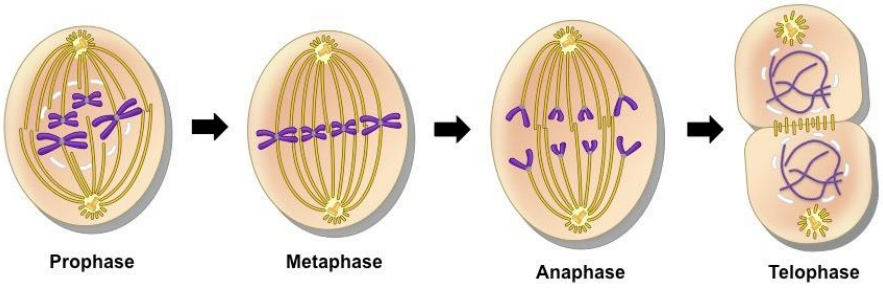
- Inter Phase
  - Cell is metabolically active
  - Cell growth also takes place
- Inter Phase
  - Also called synthesis phase because DNA synthesis or replication takes place in nucleus
  - Centriole duplicate in cytoplasm
- Inter Phase
  - Mitosis preparation phase.
  - Protein synthesized during this phase

M-Phase (Mitosis Phase)

During M-Phase equal distribution of chromosome occurs in progeny cells

M.Phase divided in Four Stage (On the basis of Chromosomal arrangement)

- Prophase
- Metaphase
- Anaphase
- Telophase



Prophase

- Initiation of condensation of chromosomal material.
- Centrosome move towards opposite poles of cell & radiates out microtubules called asters.
- End of Prophase Golgi complex, endoplasmic reticulum, nuclear envelope disappear.

Metaphase

- Easily study the morphology of chromosome
- Chromosome made up of two sister chromatids and join together by the centromere.
- Small disc shaped structure present on the centromere called kinetochores.
- Spindle fiber attaches to the kinetochores and arranged the chromosome at equator and forms the metaphase plate.

Anaphase

- Centromere split and chromatid separate with each other
- In the microscope single chromatid chromos structure appear on the opposite poles.

Telophase

- Chromosome lost their identity and form the cluster of chromatin
- Nuclear envelope, endoplasmic reticulum, Golgi complex reform
- Also called opposite of prophase.

Cytokinesis

- After the distribution of genetic material all form the furrow in the plasma membrane.
- The furrow gradually deepens and ultimately divide the cell into two daughter cell.

Meiosis

- Cell division that reduces the chromosome number by half results in the production of haploid daughter cells.
- Into phase of this division some as mitosis division

M.Phase of this division divided into two parts

- Meiosis-I
- Meiosis-II

Meiosis-I :- further divided into four parts.

Prophase-I

- It is drvided into 5-steps.
- Leptotene
- zygotene
- Pachytene
- Diplotene
- Diakinesis

It this stage crossing over occurs between non-sister chromatids of the homologous chromosomes.

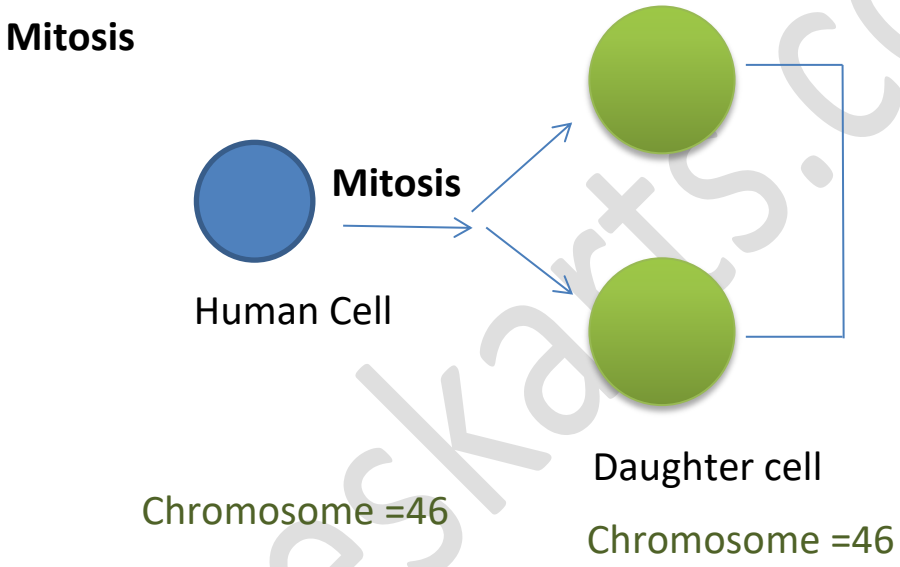
Site of crossing over form the x-shaped structure are called chiasmata.

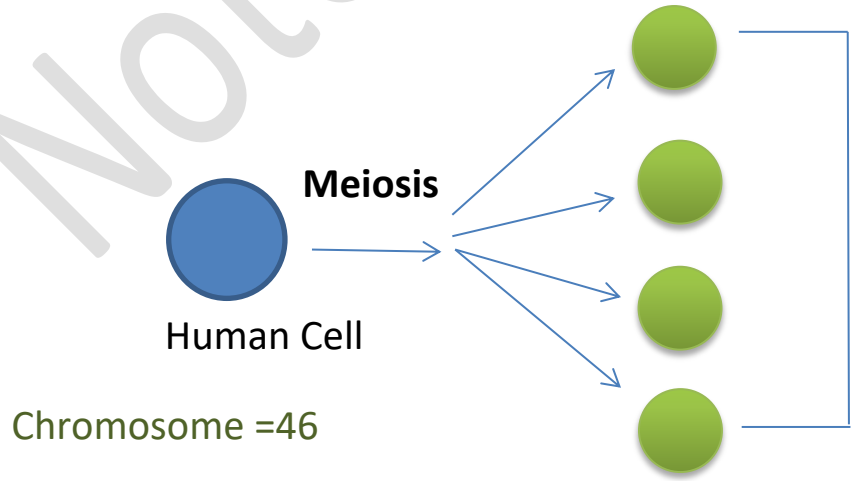
Metaphase-I

- Anaphase-I
- Telophase-I

Cytokinesis occur at the end & form the two cells.

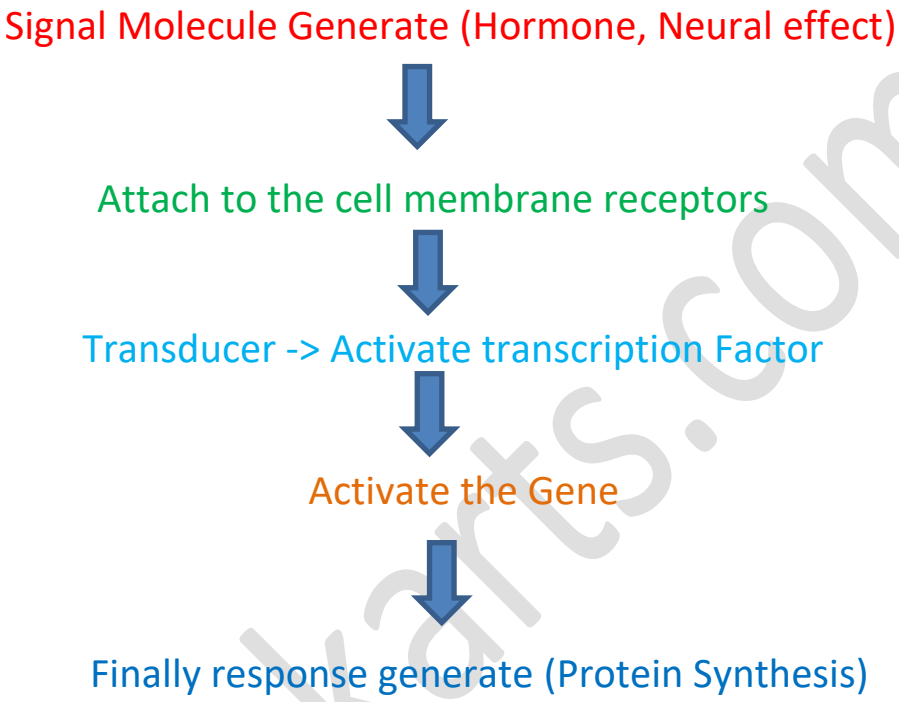
Meiosis-II :- Further Meiosis-II start after cytokinesis. If is also divided into four stage.





Only germ cell

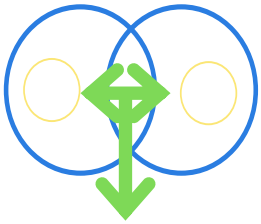
General principle of Cell communication



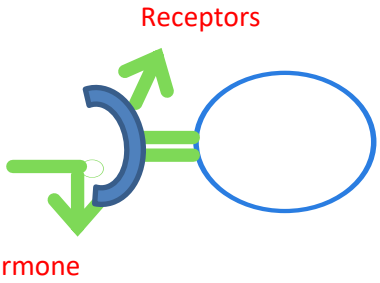
- All cells have some ability to sense and respond to specific chemical, Neural signals.
- Signal transmitted through chemical messenger and receptor which are located on the surface of cell.
- Two main types of chemicals signals generate in the cells-
- Cytoplasmic connection between cells
- Hormones communication

- Receptors are molecule generally made up of protein, that recieues the signal for cell
- Chemical messenger are bind to the cell receptors and perform the function
- Mainly three types of Receptors are present on the cell

Ion-Channel linked receptors/Ligand gated ion channels Inotropic receptors



Cytoplasmic Connection



Receptors are directly bound with legend (Specific)

↓

Then receptors are activated (Conformational change)

↓

Then signal molecule bind with the receptor

↓

Finally signal reaches to cell nucleus

2. G-Protein linked receptors

Signal molecule bind to the receptor

↓

To Activated receptor bandito the G-Protein

↓

Then G-Protein also activate and conformational change occurs

↓

Then Signals receiver by cell Nucleus and give response

3. Enzyme linked receptors

Initially two receptor domain are separated to each other

When signal molecule comes to contact then it form dimer

And finally conformational change occurs (activated enzymes)

Then signal receive by cell nucleus and give response

Forms of intracellular signaling

In the cell communication intracellular signaling is known as very important expect for living organisms.

There are four basic types of signaling found in the organisms.

(1)Paracrine signaling.

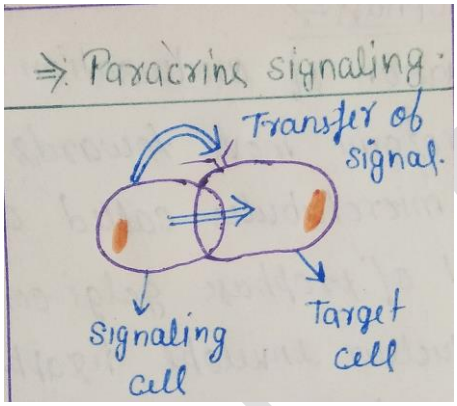
(2)Autocrine signaling.

(3)Endocrine signaling.

(4)Direct contact signaling.

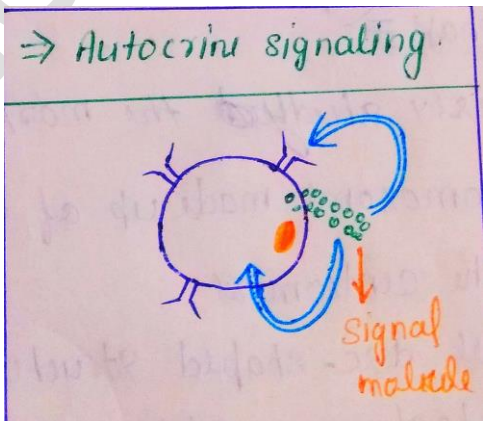
1. Paracrine signaling— In this signaling , cell are cordinated with the neighbouring cell by generating the potential gradient and altering the behaviour of those cells.Chemical which are involved in the signaling process is known as paracrine factors and it is transfer by diffusion process. Once a signaling molecule binds to its receptor it causes a conformational change in it that results in a **cellular response.**

- **The same ligand can bind to different receptors causing different responses (e.g.. acetylcholine). On the other hand, different ligands binding to different receptors can produce the same cellular response (e.g. glucagon, epinephrine).**
- **Example - Nerve and muscle signaling.**

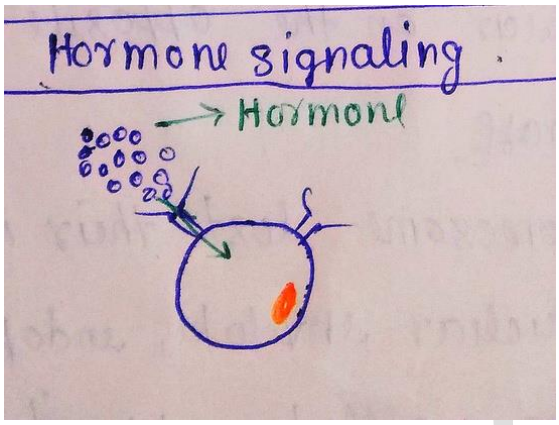


2. Autocrine signaling— It is also called as self signaling. Cell secrete the chemical known as autocrine factors which co-ordinate the self cell and give the response.

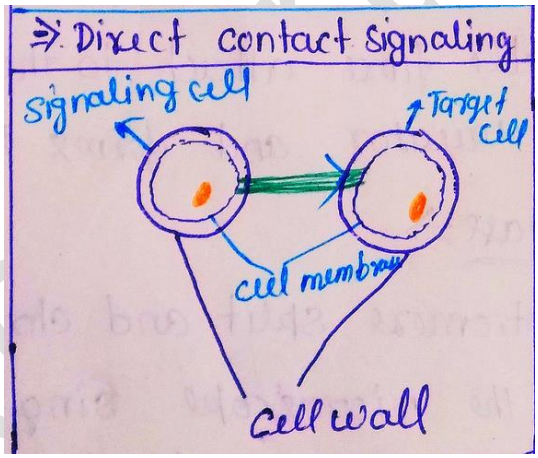
- Example - Growth factors.



3. Endocrine signaling— Hormone is required for this signaling. Hormones are binding to the cell receptors and give the response.



4. Direct contact signaling — Cell are fuse to each other by the plasmodesmetal connections in plant and transfer the signal from one cell to another cell. It is mainly found in the plants.



Noteskarts.com

Subscribe Our YouTube Channel and Join Our WhatsApp Group & Telegram Channel