

وزارة التعليم العالي والبحث العلمي

الجامعة التقنية الوسطى

المعهد الطبي التقني / المنصور

قسم تقنيات فحص البصر / المرحلة الأولى

# Microbiology

الأحياء المجهرية

بإشراف

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## **(Lecture 1)**

## **Introduction**

**Biology:-** Study of living organism.

- Study of life.

**Biology is divided into:-**1- Zoology (Study of animals).

2- Botany (Study of plant).

### **Branches of Biology:-**

- 1. Anatomy:** Study of body structure.
- 2. Cytology:** Study of living cell.
- 3. Embryology:** Study the developments of embryo.
- 4. Genetics:** Study the transmission of characters from generation to generation.
- 5. Histology:** Microscopic study of tissue.
- 6. Pathology:** Study the diseases and abnormalities.
- 7. Physiology:** Study the function of each part of the body.
- 8. Microbiology:** Study of small organism cannot be seen by naked eye.
- 9. Taxonomy:** Study the classification of living organism.
- 10. Evolution:** Study the developmental changes through life.

## **Origin of life on earth:-**

Earth was hot with a high energy, which helped to form complex chemicals from simple atoms and molecules. These complex chemicals became the first building unit of life (cell). These units have the capacity to produce copies of them self. This is called spontaneous creation. This means that living things had originated from non-living things.

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## **Darwin's theory:-** Theory of natural selection

Better-adapted individuals survive and reproduce while the less-adapted individuals not to live and reproduce.

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## **Characteristics of life:-**

- |                 |                 |                          |
|-----------------|-----------------|--------------------------|
| 1. Organization | 4. Irritability | 7. Feeding & Respiration |
| 2. Metabolism   | 5. Motion       | 8. Adaptation            |
| 3. Growth       | 6. Reproduction |                          |

## Living cells

### (Lecture 2)

**Living cell:** Is defined as the basic functional unit of living bodies that possesses all characteristic features of life in human body there are different types of cell as each one has a defined function to do in coordination with other cells that have different functions.

### Shapes of living cells:

1. spherical shape as red blood cells.
2. spindle shape as fibroblast.
3. Irregular shape as nervous cell.
4. cuboidal shape as cuboidal epithelial cells.
5. squamous shape as squamous epithelial cells.
6. oval shape as platelets.
7. columnar shape columnar epithelial cells.
8. polyhedral shape as liver cells.

### Animal cell structure

**Eukaryotic cell:** mean that the cell contains a defined true nucleus and nuclear membrane as it seen with animal and plant cells.

**Prokaryotic cell:** on the other hand means that primitive cells that have no defined or true nucleus with no nuclear membrane.

	Feature	Eukaryotic	Prokaryotic
1	Presence of membrane	Yes	No
2	Way of division	Binary	Sexual
3	Presence of Mitochondria	Present	Absent
4	Presence of Golgi	Present	Absent

## (Lecture 3 )

## Organelles of living cells

Cell components are:-

**1. Cell membrane (Plasma membrane):** Double layer of phospholipids.

**Function:-**

1- To regulate the interaction between the cell and the external environment.

2- To pass the waste from and to the cell.

3- To pass the bulk materials.

**2. Endoplasmic reticulum ER:** Membrane weaving in sheets making channels.

**Function:-**

To transport the materials inside the cytoplasm and the nucleus.

Animal cell has two kind of ER:-

- Rough ER (with ribosomes).

- Smooth ER (with no ribosomes).

Ribosomes : for synthesis of protein.

**3. Golgi complex:** Flattened sacs parallel to each other.

**Function:-**

Collecting and packaging and distributing the molecules to the needed places of the cell.

**Lysosomes:** Vesicles contains digestive enzymes.

### **Function:-**

1-To digest and destroy any foreign materials enter the cell.

2- To digest the old part of the cell.

3- To destroy whole cell in the development stages of life.

**5. Mitochondria:** Power house of cell.

- energy is stored in mitochondria as a chemical compounds called adenosine triphosphate (ATP).

**6. Flagella & Cilia:** Locomotion organelles.

**7. Centrioles:** Dark bodies next to the nucleus.

### **Function:-**

Forming spindle fibers during cell division.

**8. Cytoskeleton:** Network of protein fibers to support the shape of the cell.

**9. Nucleus:** The center of genetic information and control the activities of living cell.

The nucleus is surrounded by lipid layer (N. membrane).Nuclear membrane has small pores which control the passing of molecules from and to the nucleus.

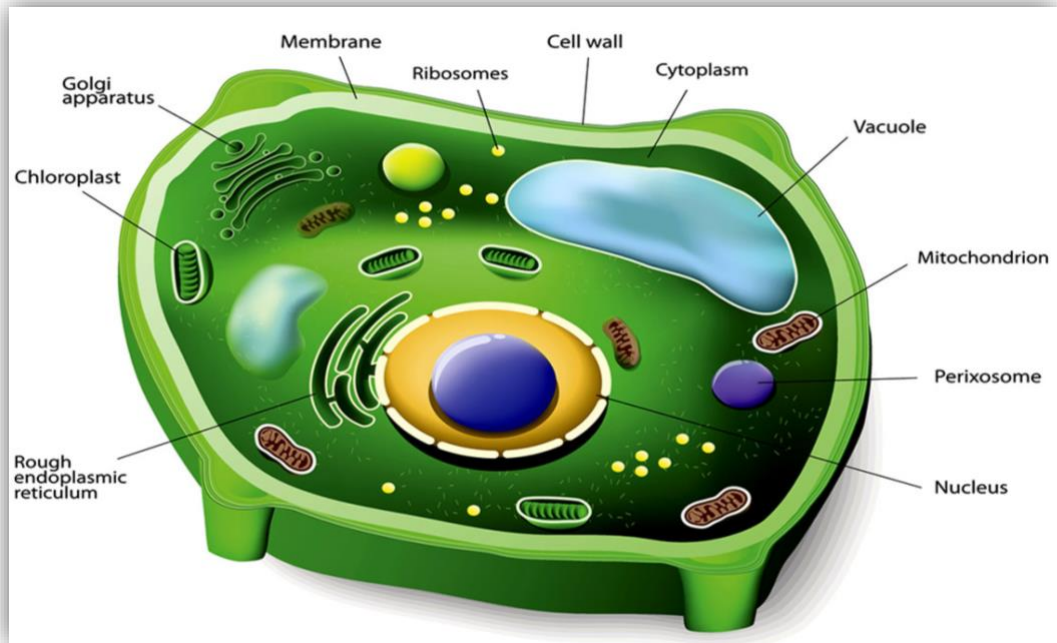
Protein molecules → nucleus

RNA → cytoplasm

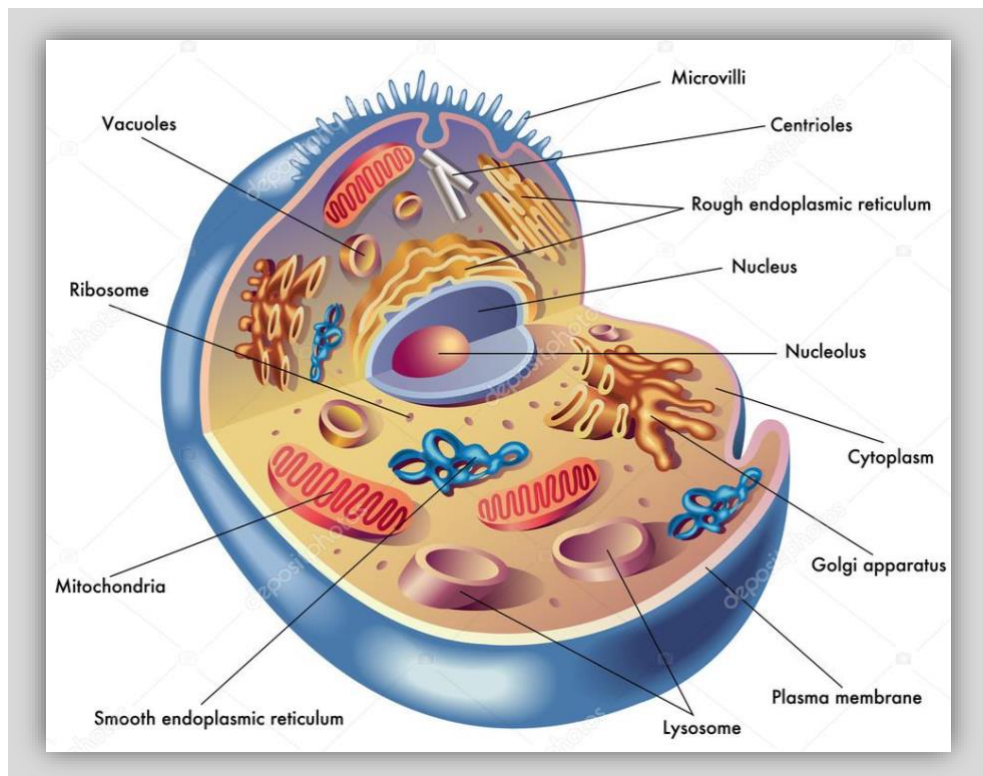
Nucleus has two parts :-

1-Nucleolus.

2- Chromosomes.



**Plant cell diagram**



**Animal cell diagram**

(Lecture 4 )

## Cell division

**Chromosomes:** Elongated threads like clearly visible during cell division, that carry the gene.

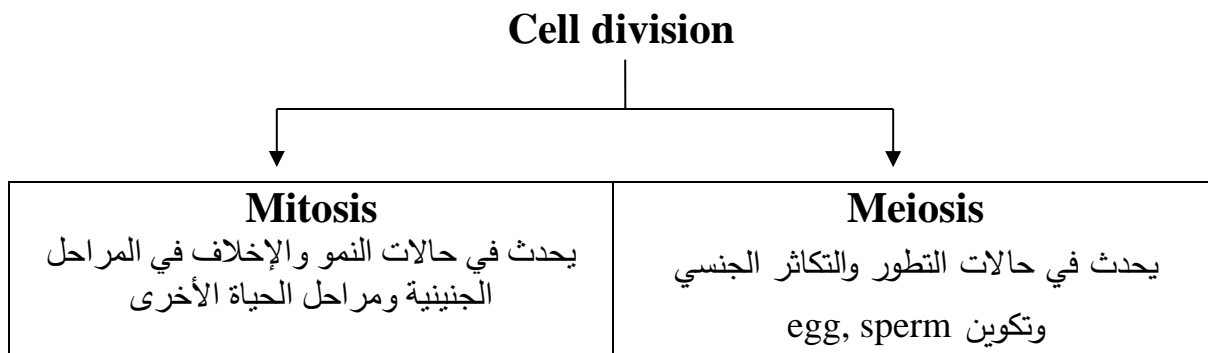
Chromosomes are composed of:- 40% DNA and 60% protein.

Chromosomes are the basic unit of heredity.

**Chromatid:** One of the two strands of duplicated chromosomes.

**Centromere:** Joining region of the two chromatids.

Human cell has 46 chromosomes.



**Mitosis:** A sexual cell division.

**Importance:-**

- 1.** To keep the same chromosomal number from generation to generation.
- 2.** To replace the aged or damaged cell by new one.
- 3.** Method of reproduction in unicellular organism.



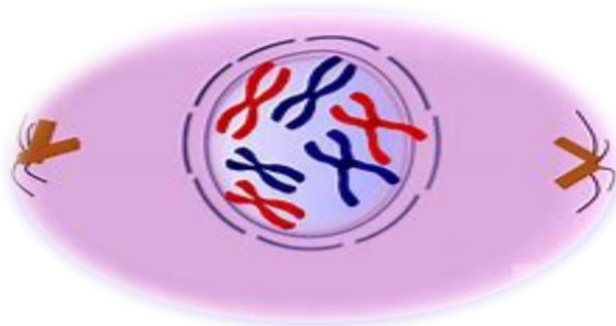
## Stages:- (Phases) الأطوار, المراحل

1. Prophase. التمهيدي
2. Metaphase. الاستوائي
3. Anaphase. الانفصالي
4. Telophase. النهائي

### Prophase

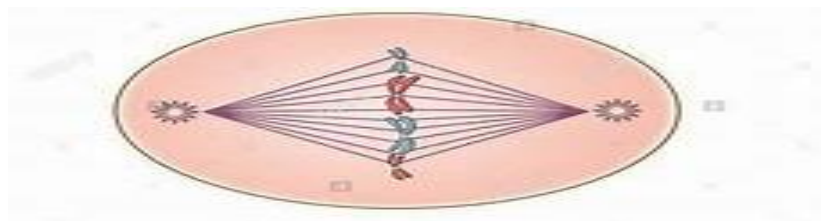
- 1-Chromosomes become thicker and shorter.
- 2-Two Centrioles move away and form spindle fibers.
- 3-Two Centrioles reach two poles of the cell with spindle fibers.
- 4-Nuclear membrane breaks down.

**Aster:-** Rays for fixing Centrioles to the cell membrane.



### Metaphase

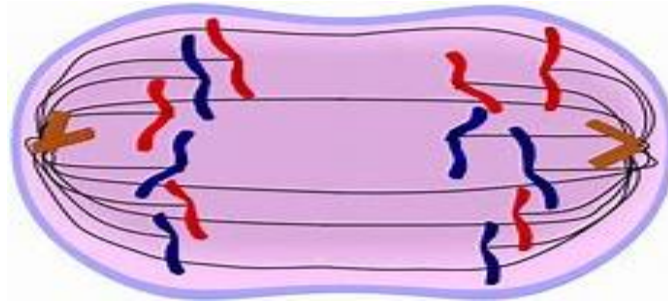
- 1-Arrangement of the chromosomes in the equator of the cell.
- 2-Each chromosome will be divided into two sister chromatids to form new chromosomes.
- 3-Each Chromatid becomes a new chromosome.



## Anaphase

1-Separation of sister chromatids.

2-Sister chromatids pushed away to opposite poles of the cell.



## Telophase

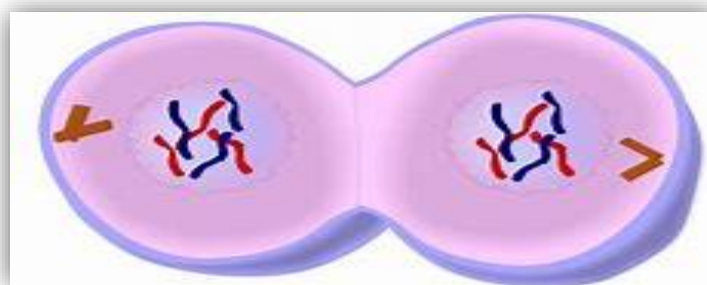
1-Each set of chromosomes reaches the opposite pole of the cell.

2-Nuclear membrane reforms around each set of chromosome.

3-chromosomes become thinner and longer.

4-Cytoplasm starts to divide.

5-Cell division into two daughter cell (contain same number of chromosome).



## Meiosis:-

الانقسام الاختزالي

Is the sexual division of the cell which takes place in the sexual organs of male and female.

The importance of meiosis is to form male and female sexual gametes.

The phases of meiosis consist of 2 successive cell division as each division is consists of 4 phases:

Prophase → Metaphase → Anaphase → Telophase

Which results in 4 cells with half the original chromosomal numbers (haploid cells).

\* Comparison between mitosis and meiosis

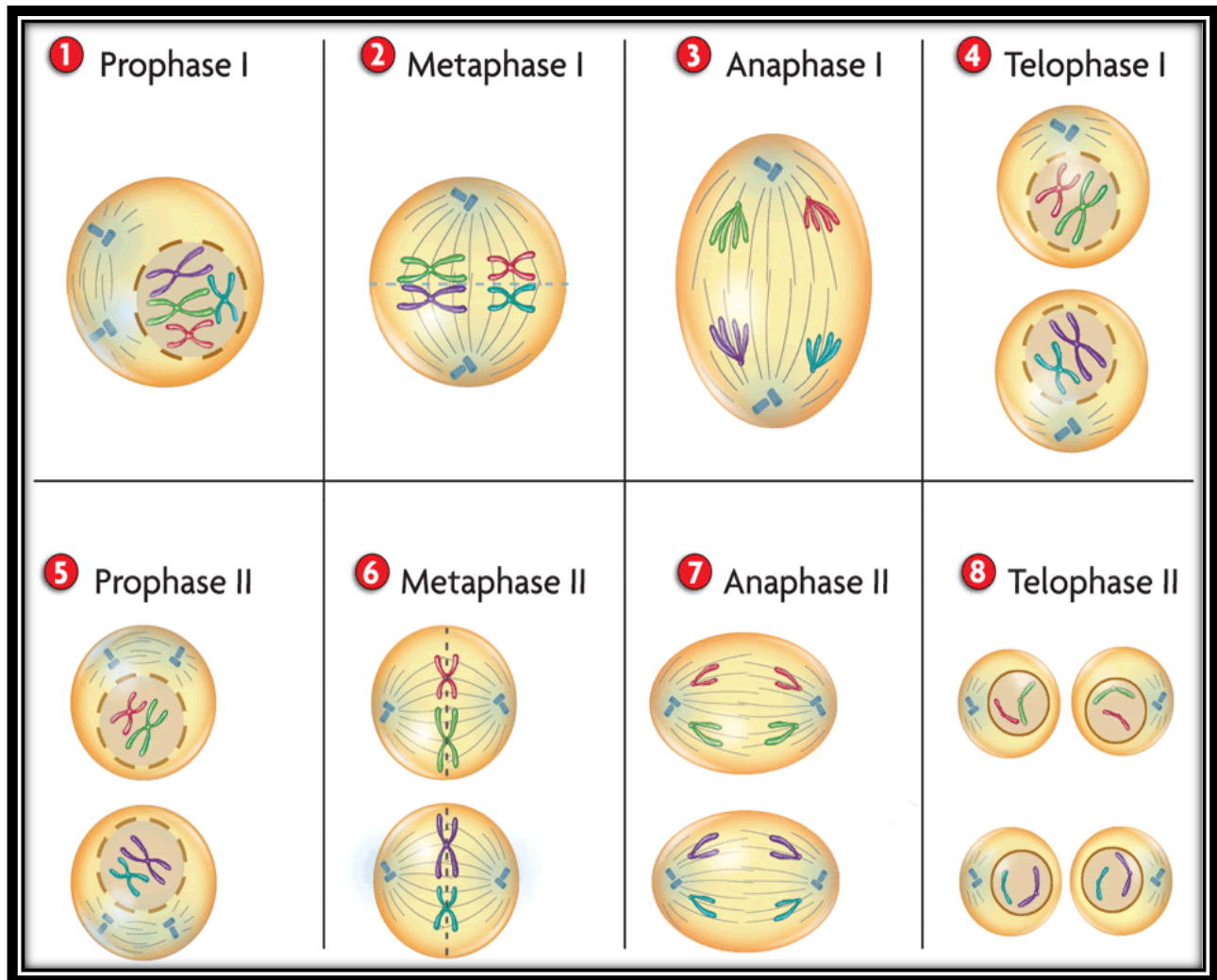
Mitosis: is a sexual division of living somatic cells in which each parent cell will result in 2 daughter cells with the same chromosomal numbers as the parent cell (diploid cells).

Meiosis: is a sexual division of living germ cells in which each parent cell will result in 4 daughter cells with half the chromosomal number of the parent cell (haploid cell).

	Mitosis	Meiosis
1	Occurs in all somatic cells	Occurs in germ cells only
2	Has one set of cell division	Has 2 sets of cell division
3	Results in 2 cells	Results in 4 cells
4	Diploid cells	Haploid cells

\*Gametes: Reproductive cells of both sexes (ovum, sperm)

\*Zygote: Fusion of two gametes.



## Meiosis

**(Lecture 5 )**

**Animal development**

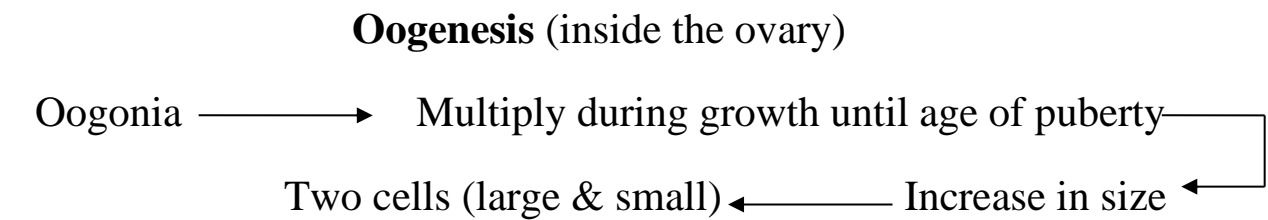
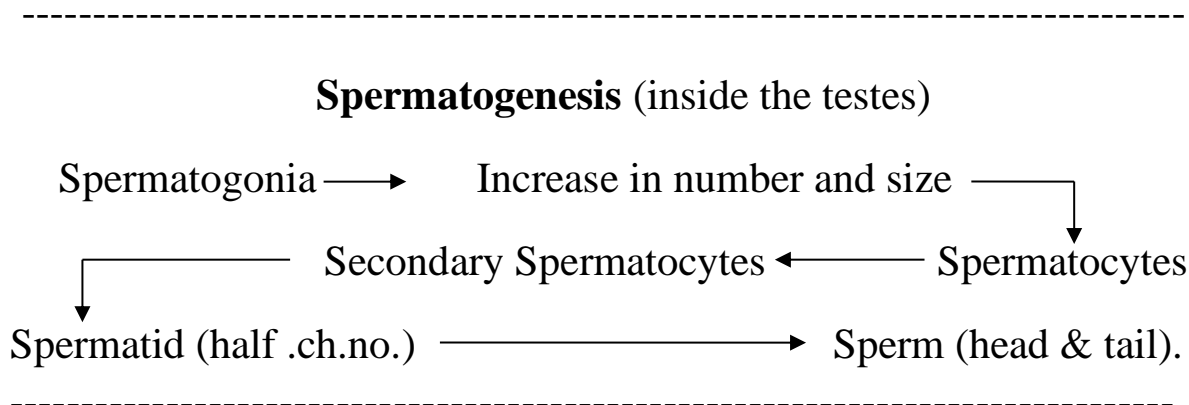
**Gametogenesis:** is the formation of both the female gametes (ova) and the male gametes (sperms) inside the sex organs (ovary and testes).

**Spermatogenesis:** Production of sperms by male.

**Oogenesis:** occurs inside the ovary, Oogonia will give two cells; one is large and other is small.

The small one will vanish and the large one will be active and continue to grow and become ready for fertilization.

**Fertilization:** Unit male and female gamete.



\*Large cell is active (ovum).

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## ( Lecture 6 )

## Fertilization

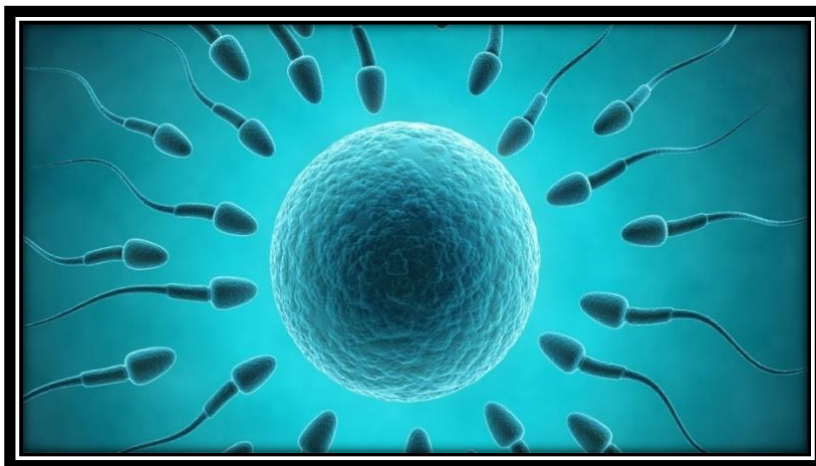
Fertilization: is the process by which male and female gametes are fused together, initiating the development of a new organism.

Unite (male gamete + female gamete).

The male gamete or 'sperm', and the female gamete, 'egg' or 'ovum' are specialized sex cells, which fuse together to begin the formation of a zygote during a process called sexual reproduction.

### Stages of fertilization

1. Sperm penetration : Sperm penetrates the eggs protective layer, sperm nucleus moves into the ovum nucleus and immediately its chromosomes will pair the female chromosomes.
2. When the egg and sperm nuclei come together, two sets of chromosomes yield diploid set of chromosomes form a new organism, first round of DNA synthesis can begin and prepares for mitotic cleavage division.
3. Egg will prevent any other sperm to penetrate the egg by producing a fertilized membrane on the egg surface and no sperm will enter.

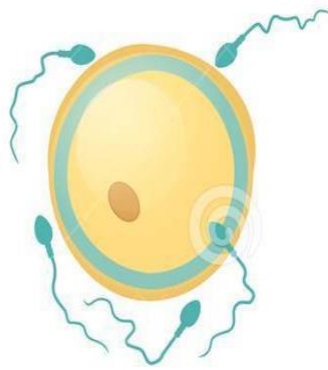


# HUMAN FERTILIZATION

Oocyte



Fertilization



Zygote



Two-cell cleavage



Four-cell cleavage



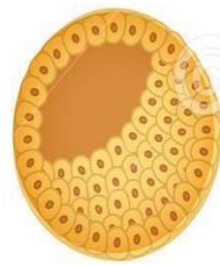
Eight-cell cleavage



Morula



Early blastocyst



Late blastocyst





## ( Lecture 7)

### Embryonic development

Embryonic development: starts from the point of fertilization of the female gamete (ova) by the male gamete (sperm) to produce the fertilized egg (zygote). This is followed by many cleavages (mitosis) of the zygote to produce the primary embryonic mass or Morula which is followed by the formation of the germ layers of gastrulation and the formation of the organ systems or organogenesis.

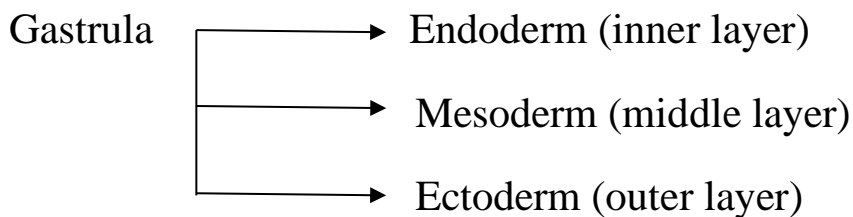
**Cleavage:** Special kind of mitosis (cell division of zygote).

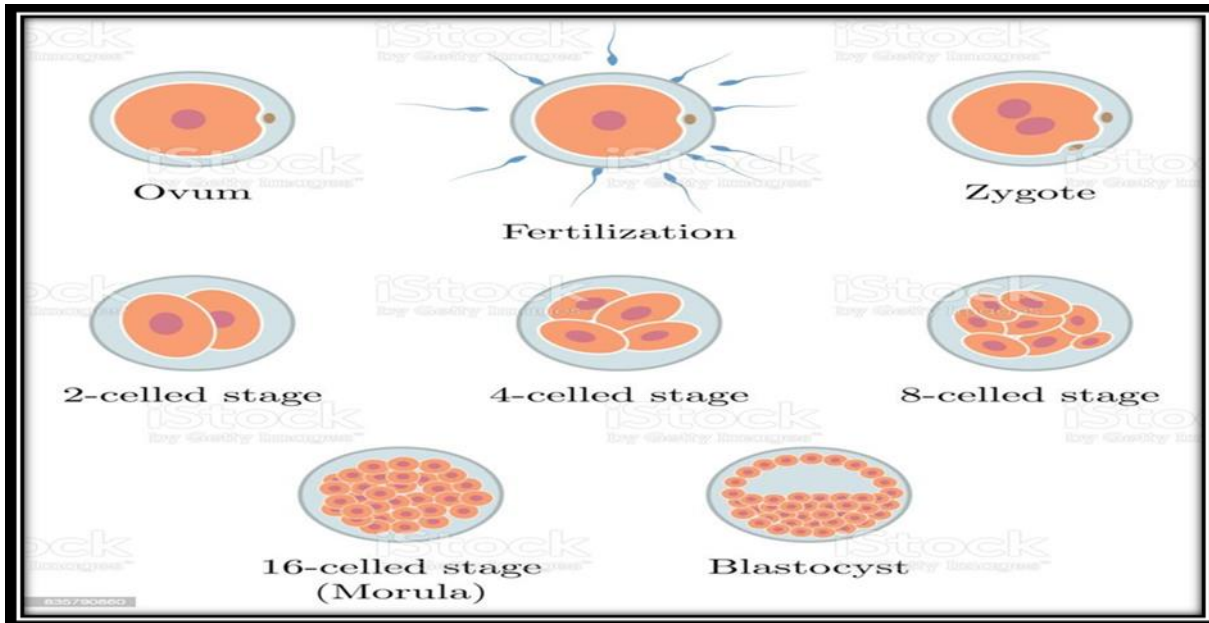
Zygote → 2, 4, 8, 16, ..... Cells.

Morula → Blastula

Blastula → Gastrula

Gastrula: has three different layers ( external, middle and inner layer) which can be considered as the origin of all organs and system formation. To explain the embryonic membrane and their function.





After gastration → Organogenesis will take place.

Organogenesis: Formation of body's organs and tissue.

After organogenesis → Morphogenesis will take place (changes in the shape of the cell).

- **Ectoderm** → hair, skin, glands, and sense organs.
- **Mesoderm** → connective tissue, circulatory system, immune system, gonads, skeleton & muscle.
- **Endoderm** → lining of the gut and epithelial tissue of organs.

### Embryonic membrane & fluid

For protecting embryo

In mammals four embryonic membrane

- 1.yolk sac.
- 2.chorion.
- 3.amnion.
- 4.allantoise.

The fluid called ( amniotic fluid).

## **(Lecture 8 )**

### **Anatomy of living organism**

The concept of anatomy and physiology of closed circulatory system of the vertebrate and the main component of the system, and explain the different kinds of blood cells.

Animals have several internal system and four kinds of tissue:-

1. Epithelium (epithelial tissue)
2. Connective tissue
3. Muscle tissue
4. Nerve tissue

- 
- Epithelial cells are protectors of the body.
  - Connective tissue is supporting tissue.
  - Muscle tissue is the work tissue.
  - Nerve tissue for transmission of nerve impulses.

### **Circulatory system**

All vertebrates have closed circulatory system, the blood is enclosed with blood vessels and is separated from the rest of the body's fluids.

#### **Function:-**

1. Nutrient and waste transport.
2. Oxygen and carbon dioxide transport.
3. Temperature maintenance.
4. Hormonal circulation.

The closed circulatory system is composed of:-

1. Heart
2. Blood vessels
3. Blood

Blood is composed of:-

- A. Blood plasma
- B. Blood cells

**Blood plasma:** Is a complex solution of three different components dissolved in water.

- A. Metabolites & wastes.
- B. Salt & ions.
- C. Proteins.

Proteins like antibody (globulin).

Globulin: blood protein active in body immunity.

Fibronogene: blood protein active in blood clotting.

## Types of blood cells

### i. Erythrocytes (RBC)

Each milliliter of blood contains about 5 billion erythrocyte.

RBC can live 4 months.

RBC has been synthesized by bone marrow.

### ii. Leukocytes (WBC)

1% of human blood cells, it plays areole in body defense against bacteria.

It divided into two main groups:

1. granular: ( basophil , Neutrophil, eosinophil).
2. Agranular (Monocyte, lymphocyte).

**Blood platelets:** Large cells with no nuclei and they play an important role in blood clotting.

-In human heart there are two separated pumping systems:

- 1.To the lung.
- 2.To the rest of the body.

**Erythrocyte:** are enucleated cells and uniform in shape & size.

**Leukocytes:** are subdivided into two groups according to granular

- 1.granular: have granules .
- 2.Agranular:have no granules.

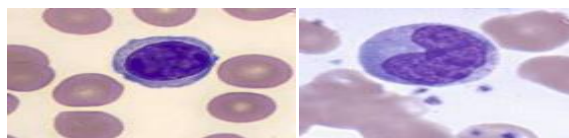
### Granular

- 1.Neutrophil ( lobulated N. with pink granules).
- 2.Basophil ( large N. with blue granules).
- 3.Eosinophil ( bilobed N. with orange or red granules).



### A granular

- 1.Lymphocyte (large N. with no granules).
- 2.Monocyte ( Kidney shape N. with no granules).



### Blood platelets

Small irregular masses of basophilic cytoplasm containing no nucleus ( Fragments of cytoplasm).