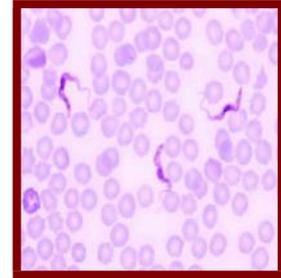
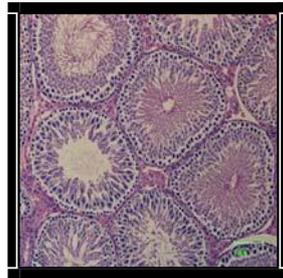


*Kingdom of Saudi Arabia
King Saud University
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Practical (109) Zoo

Manual of Histology

Prepared by

AMIN A. M. AL-DOAISS

LAB (1): The Microscope

The microscope is an instrument which use to magnify and study of small objects which are not visible by naked eye.

Types of the microscopes: The microscopes are divided into two types according to the lenses:

- 1- **Simple microscope:** this type has one lens, (hand lens)
- 2- **Compound microscope:** this type has two lenses, then this type of microscope subdivided into two types:

A: **Monocular:** with one eye lens.

B: **Binocular:** with two eye lenses.

According to source of illumination we can classification the microscopes into many types:

- 1- **The Light microscope (L.M).**
- 2- **The Electron microscope (E.M) (Transmission and Scanning).**
- 3- **The Ultraviolet microscope.**
- 4- **The Fluorescent microscope.**
- 5- **The Phase-contrast microscope.**
- 6- **The Inverted microscope.**

The resolution power of the microscope: is the ability of the microscope to show minimum distance between two particles(naked eye = 0.2mm, L.M = 0.2 μ m, E.M = 0.2nm).

The magnification power: is the ability of microscope to enlarge the size of the image (L.M=1000-1500 \times , E.M=1000-200,000 \times).

Structure of the compound light microscope:

Consist of three systems:

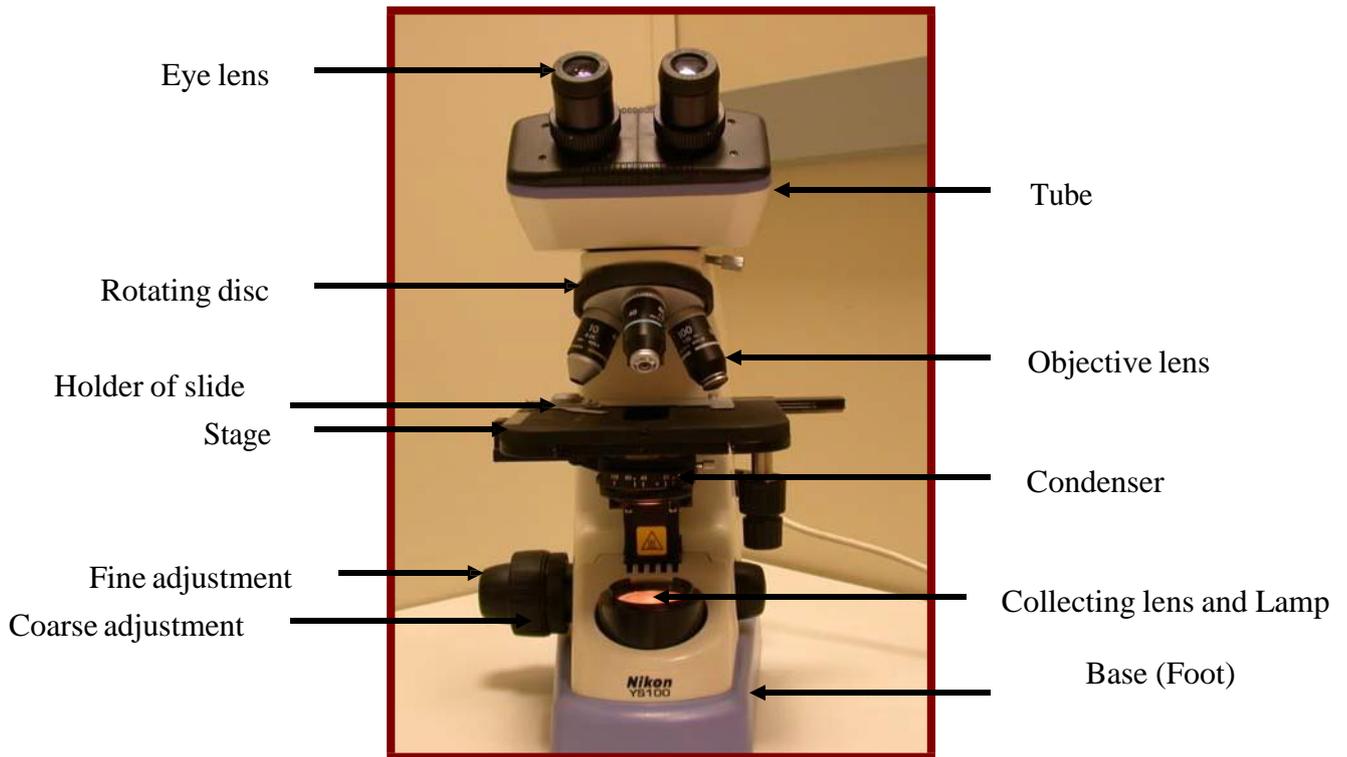
- 1- **The mounting and movement system:** which includes(base (foot), arm, stage and holder of slide, coarse adjustment, fine adjustment, ocular tube).
- 2- **The illumination system:** which includes electrical light.
- 3- **Then magnification system:** which includes (eye lenses 10 \times , objective lenses 4 \times , 10 \times , 40 \times , 100 \times , condenser, collecting lens)

Make the different slide from the cells of onion (plant cells) and from human cheek squamous cells (animal cells). Compare between the animal and plant cell.

How to use the microscope to examine your prepared slide (practical description).

Calculate the magnification power of the microscope =

Power of the eye lens \times power of the objective lens

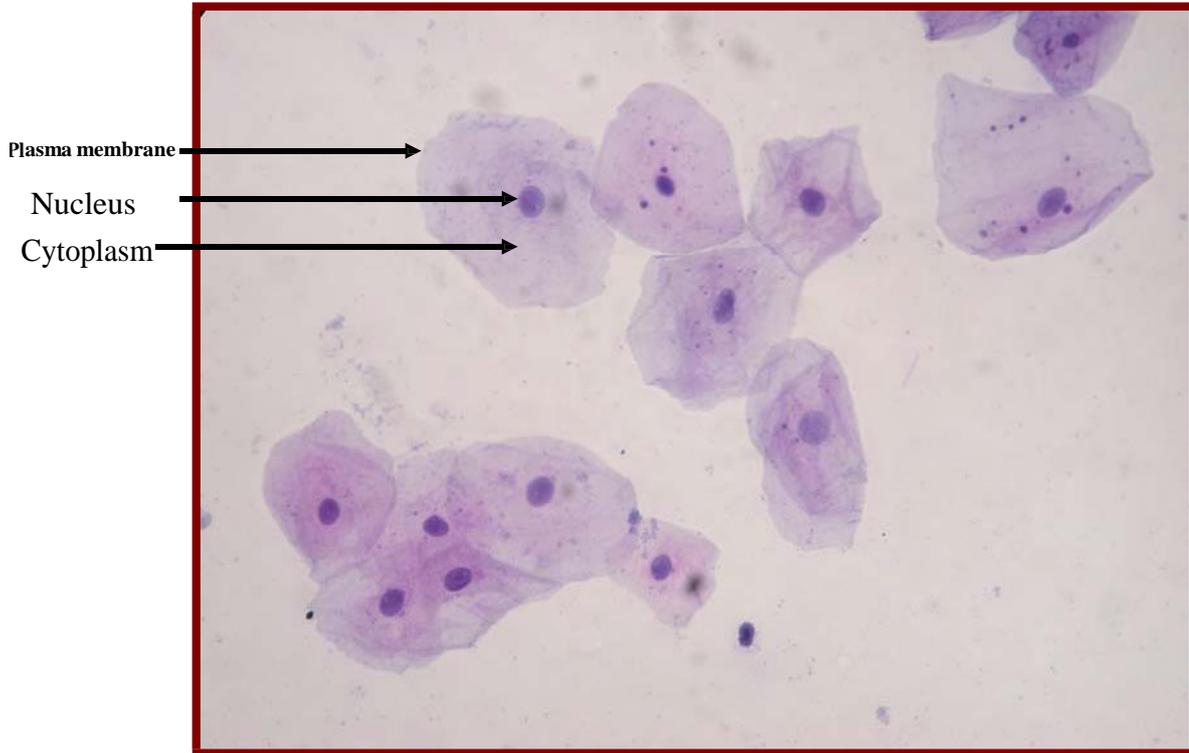


The compound light microscope

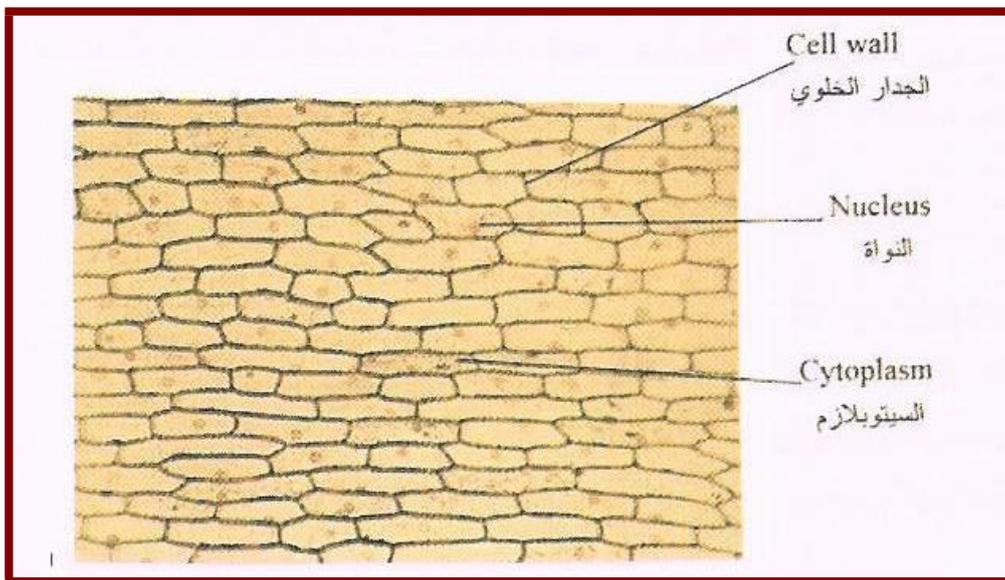
Q: Calculate the magnification power of the microscope?

The magnification power = magnification power of eye lens \times magnification power of objective lens

$$\begin{aligned} \text{Example} &= 10\times \times 40\times \\ &= 400\times \end{aligned}$$



Isolated squamous cells (Animal cells)



Polygonal cells (Plant cells)

LAB (2): The cell

The cell: is the smallest part of the life and considered as the basic structural and functional unit of the life.

The Tissue: composed of grouping of similar types of cells which performing certain function.

The Organ: different tissues combine together to form an organ.

The System: different organs combine together to form a system.

The Body: different systems combine together to form an individual animal or body.

Some cells are capable to live independent which called **single celled** or **unicellular** organisms like the protozoa.

Classification of the cell:

1- **Prokaryotic cell:** they are devoid of the true nucleus.

2- **Eukaryotic cell:** they have true nucleus (surround by nuclear membrane).

Structure of the cell: the true cell consist of three parts:

1- The Central part (nucleus).

2- The Peripheral part (cytoplasm).

3- The Cell membrane encases both of these parts.

The cells variations in size (small and large), shape(round, oval, polygonal, ..etc) and structure.

Paramecium:

- Single-celled organism
- Shoe-shape
- The cilia are the locomotary organs
- It has two nuclei (macronucleus and micronucleus) and contractile, food vacuoles

Euglena:

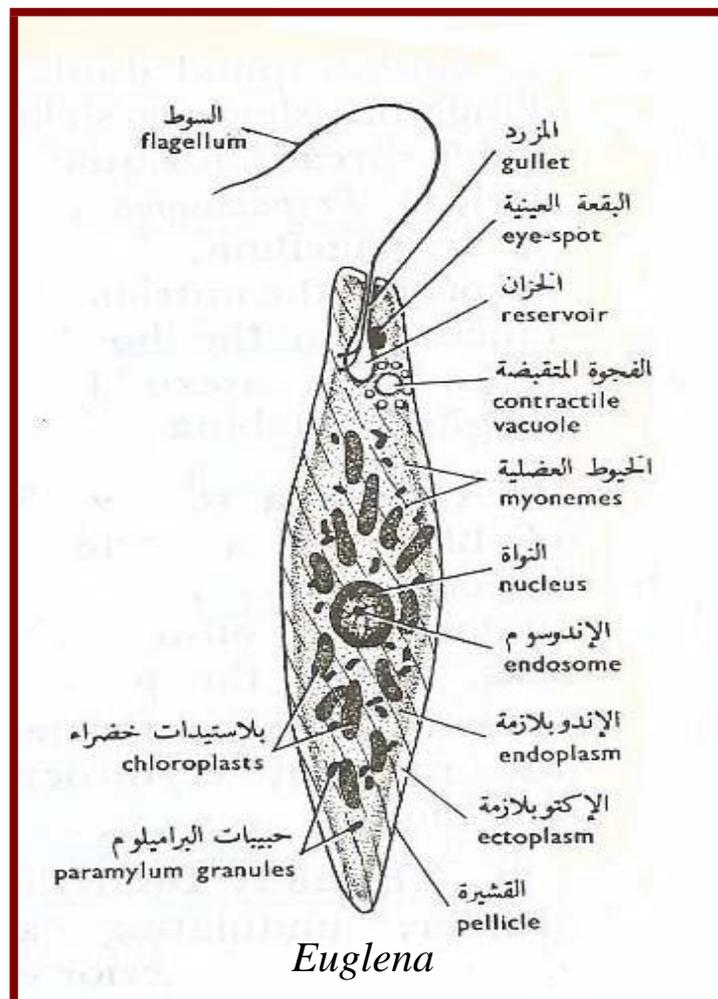
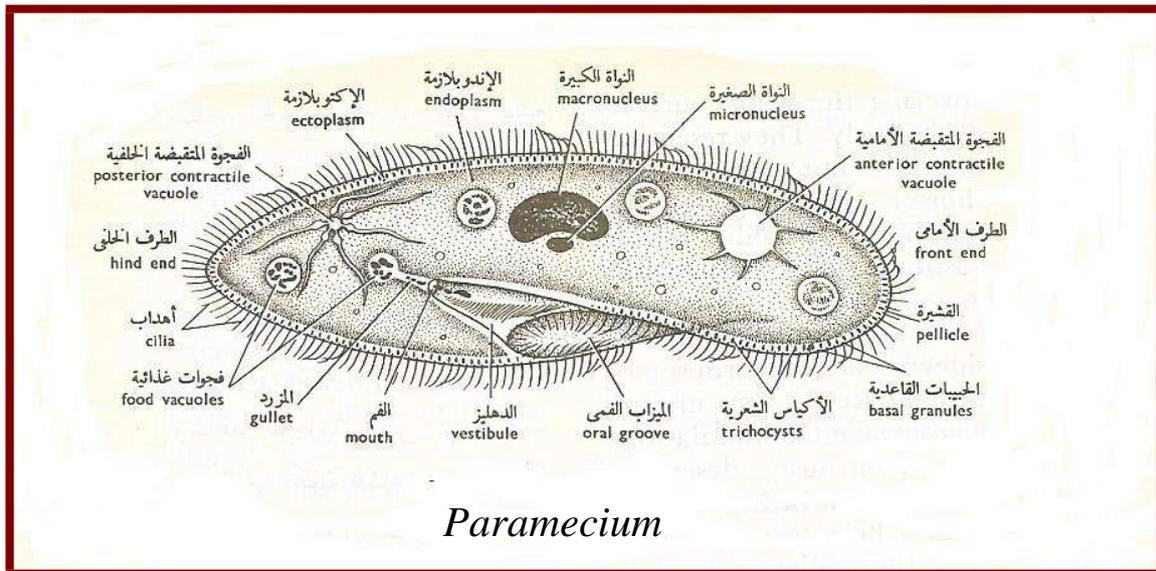
- Single-celled organism
- Carrot in the shape
- The flagellum is the locomotary organ
- It has one nucleus and chloroplasts

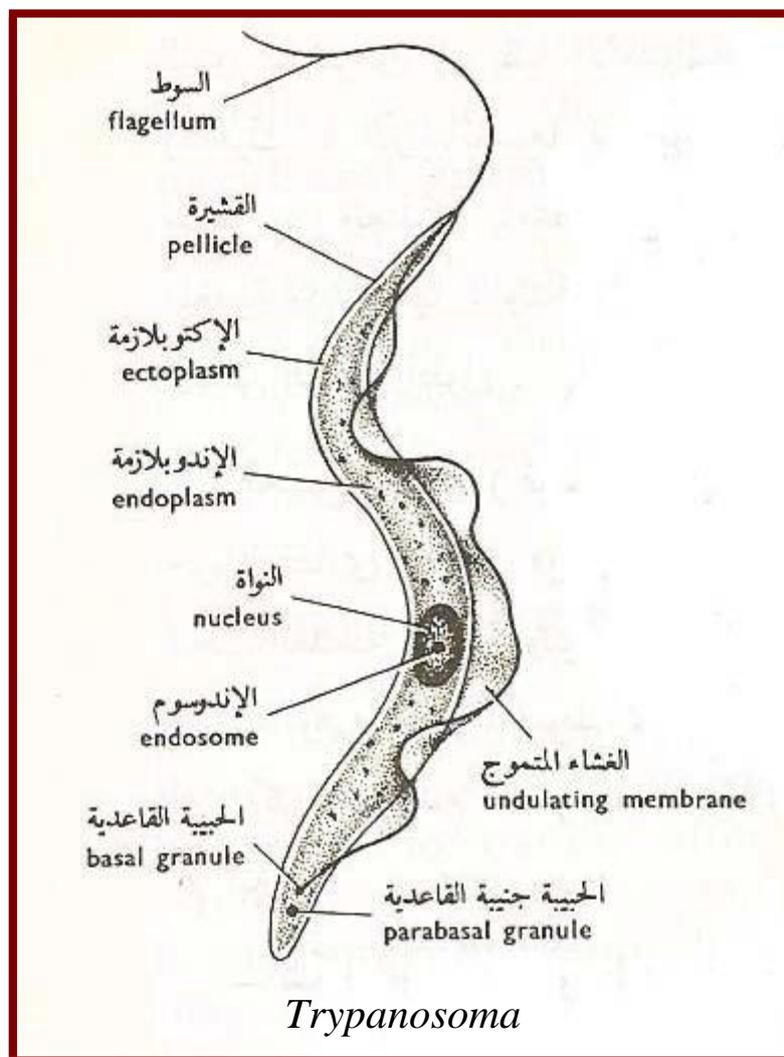
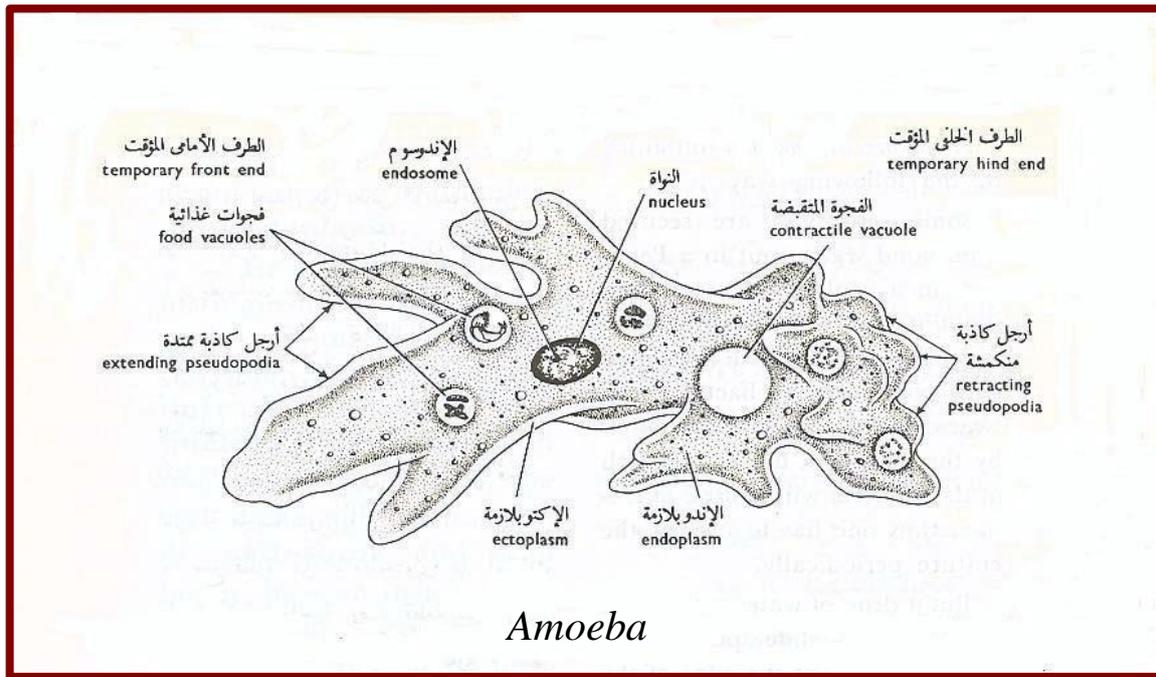
Amoeba:

- Single-celled organism
- Irregular in the shape
- The pseudopodia are the locomotary organs
- It has one nucleus contractile and food vacuoles

Trypanosoma:

- Single-celled organism
- Fusiform or sickle in the shape
- The flagellum is the locomotary organ
- It has one nucleus, parabasal granule and undulating membrane







Paramecium sp.



Euglena sp.

Pseudopodium

Nucleus

Contractile vacuole



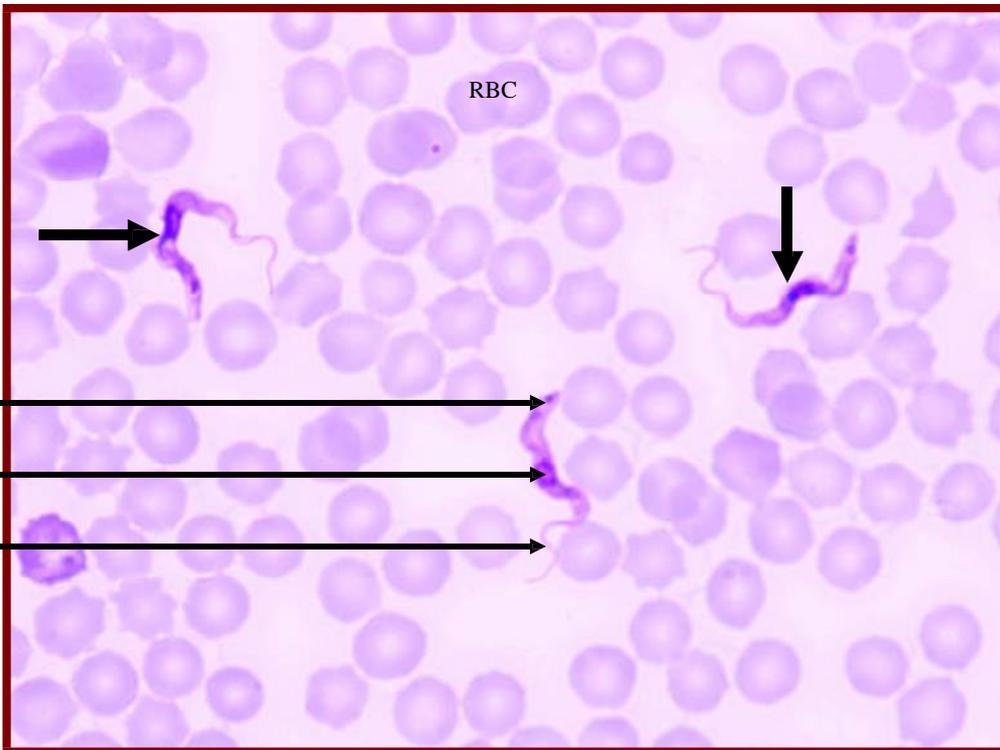
Amoeba sp.

RBC

Parabasal granule

Nucleus

Flagellum



Trypanosoma sp. (blood smear)

LAB(3):Cell division: Mitosis

Cell cycle: is the changes which occur in the cell during its division (mitosis) and during its rest (interphase).

Types of cell divisions:

1- **Amitosis**(direct cell division) :

- It is simple division
- It occurs in lower animals as amoeba and in certain cells of placenta and embryo
- Function of this type: reproduction of the cells

2- **Mitosis**(indirect cell division) :

- The term mitosis (mitos= threads, osis= process)
- It occurs in general cell of the body (somatic cells) except the nerve cell
- Mother cell gives two daughter cells each one contains diploid number of chromosomes (2n)
- Function of this type: responsible for growth of the organism and repair of damaged tissues.

3- **Meiosis** (reduction cell division):

- Is special type of cell division
- It occurs in germ (sex) cells or in gonads (testes and ovaries) during formation the gametes (sperms and unfertilized ova)
- Mother cell gives four daughter cells each one contains haploid number of chromosomes (n)
- It is much more complicated than mitosis because has long process
- Function of this type: formation of the gametes

Mitosis:

Mitosis has four stages:

1- **Prophase:**

- Each pair of centrioles move to one pole of dividing cell
- Nuclear membrane and nucleolus are disappear
- Chromosomes become visible

2- **Metaphase:**

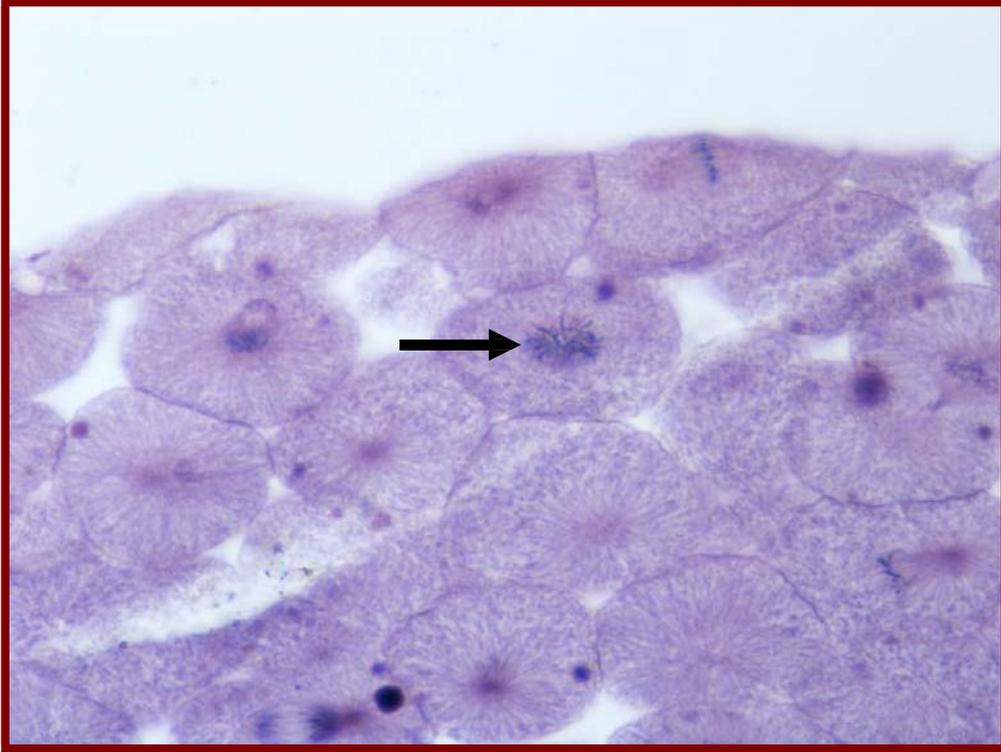
- The spindle fibers(chromosomal and cytoplasmic) are well developed
- The chromosomes are align at the equatorial(middle) plate of the cell

3- **Anaphase:**

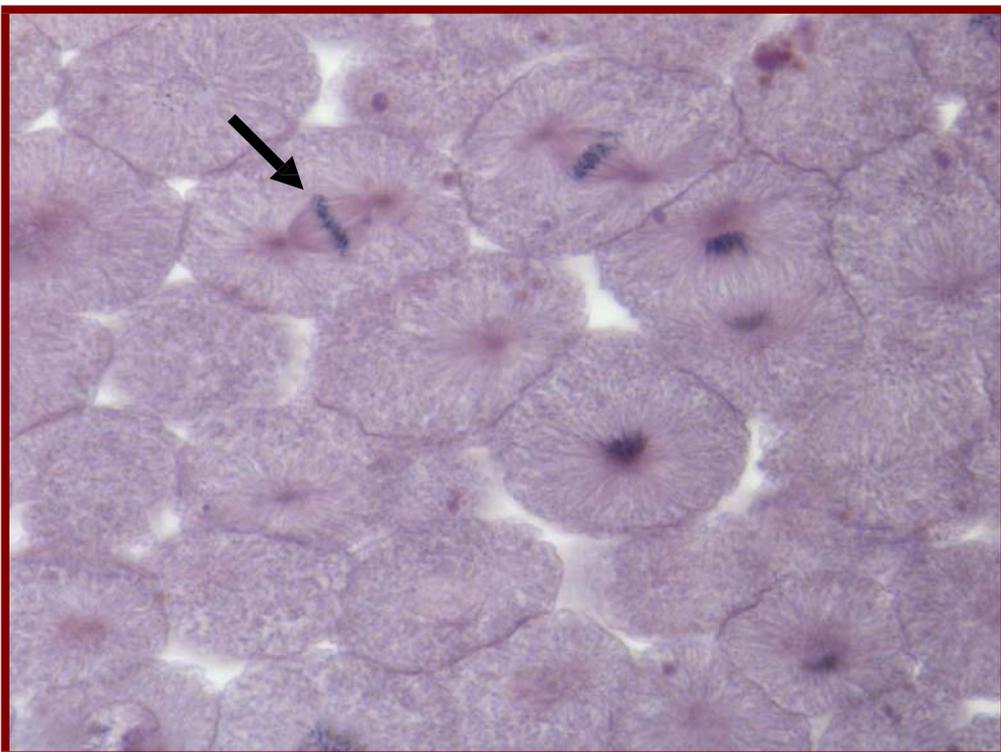
- At this stage each chromosome split into two chromatids at the centromer
- Half number of chromosomes move to one pole of dividing cell and the other half move to the opposite pole

4- **Telophase:**

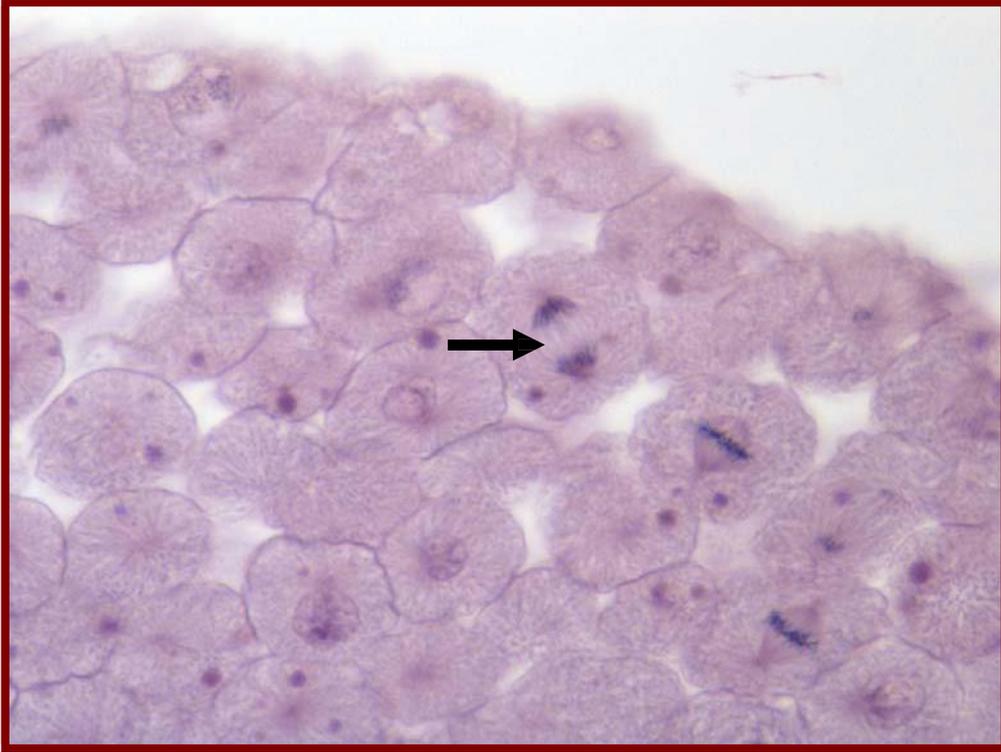
- Two nuclei of two daughter cells are formed
- Nuclear membrane and nucleolus are reappear
- Karyokinesis follows by cytokinesis to form 2 independent daughter cells



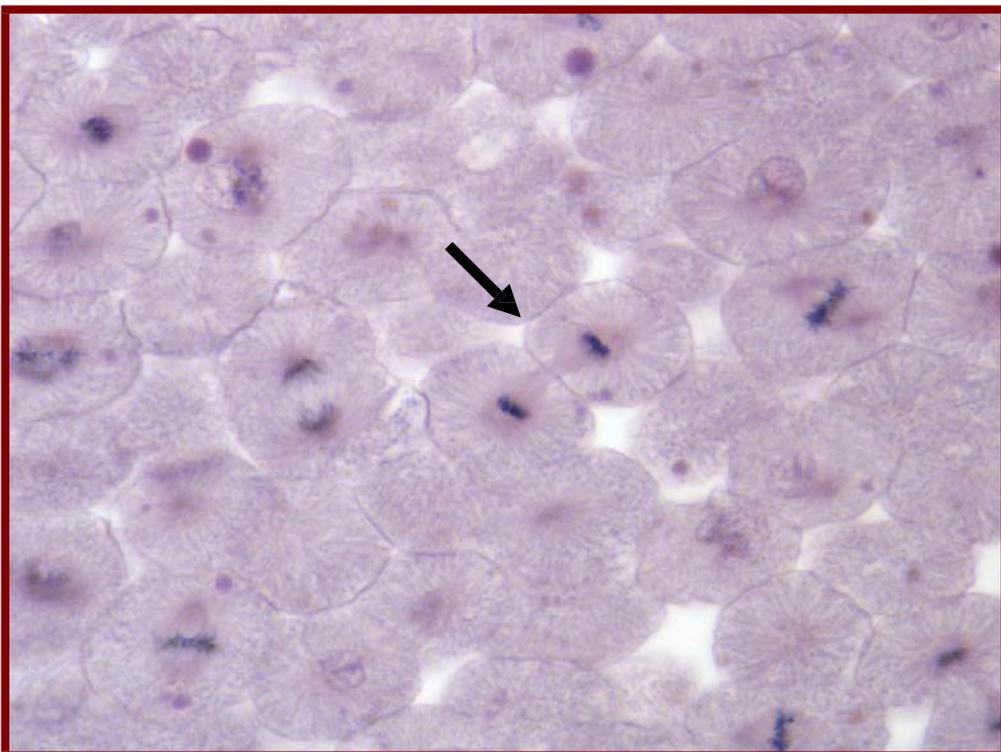
Prophase stage – Mitosis cell division



Metaphase stage – Mitosis cell division



Anaphase stage – Mitosis cell division



Telophase stage – Mitosis cell division

LAB(4):Meiosis

The meiotic cell division has two subdivision in sequence:

- 1- **The first meiosis:** Reductional division ($2n \rightarrow n$)
- 2- **The second meiosis:** Equational division (similar to mitosis)

The first meiosis C. D.: It has 4 stages:

1- **ProphaseI:** is long stage and includes 5 substages:

- **Leptotene (Leptonema):** 46 chromosomes become visible thin and long as beads
- **Zygotene (Zygonema):** pairing occurs, 46 chromosomes form 23 pairs of homologous chromosomes which called "Bivalent" or "Tetrad"
- **Pachytene (Pachynema):** crossing over takes place between homologous chromosomes and forming points of contact (chiasmata)
- **Diplotene (Diplonema):** terminalization occurs, chromosomes separation after crossing over and new sets of chromosomes are formed
- **Diakinesis:** chromosomes reach to the maximum thickness and shortness

2- **MetaphaseI:** spindle fibers are formed, 23 pairs of chromosomes align on both sides of equatorial plate

3- **AnaphaseI:** half number of chromosomes move to the opposite pole of the cell

4- **TelophaseI:** 2 nuclei of daughter cells are formed

The second meiosis C. D.: similar to the mitosis, it has 4 stages:

- **ProphaseII:** the chromosomes become visible in 2 daughter cells
- **MetaphaseII:** the chromosomes fall on the equatorial plate in two daughter cells
- **AnaphaseII:** each chromosome breaks to 2 chromatides, half number of chromatides move to the opposite pole of the cell in two daughter cells
- **TelohaseII:** 4 nuclei of daughter cells are formed, and cytokinesis follows the karyokinesis to form 4 independent cells, each one contains haploid number of chromosomes (n)

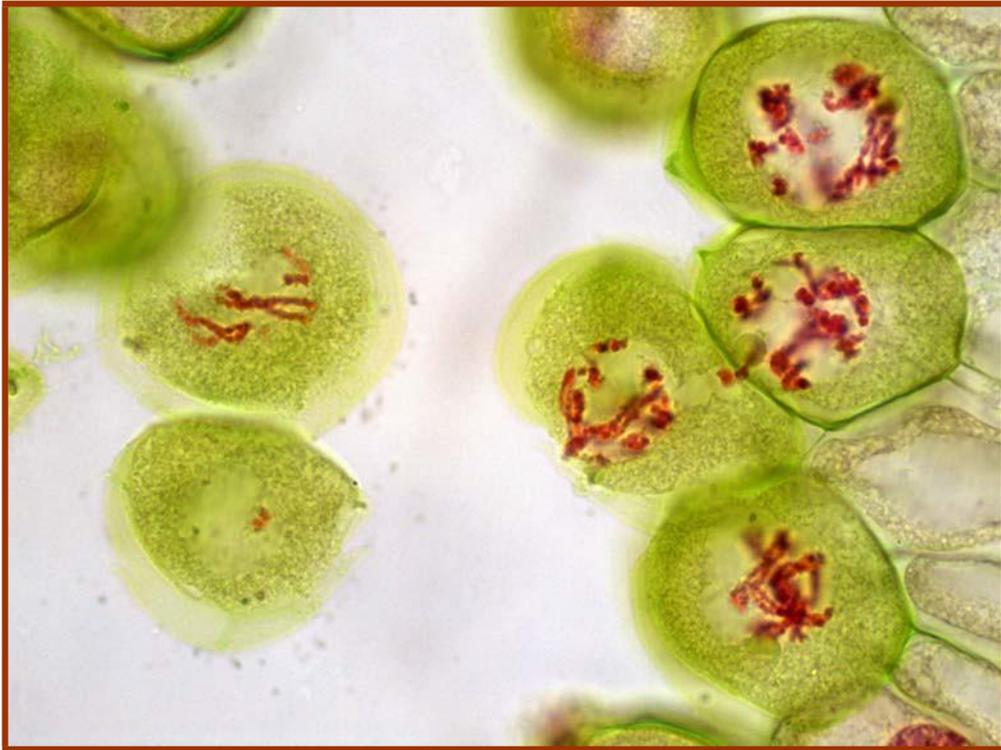
Process of formation the sperms is called **spermatogenesis** while the process of formation the ova is called **oogenesis**.



Leptotene substage – Meiosis-I- cell division



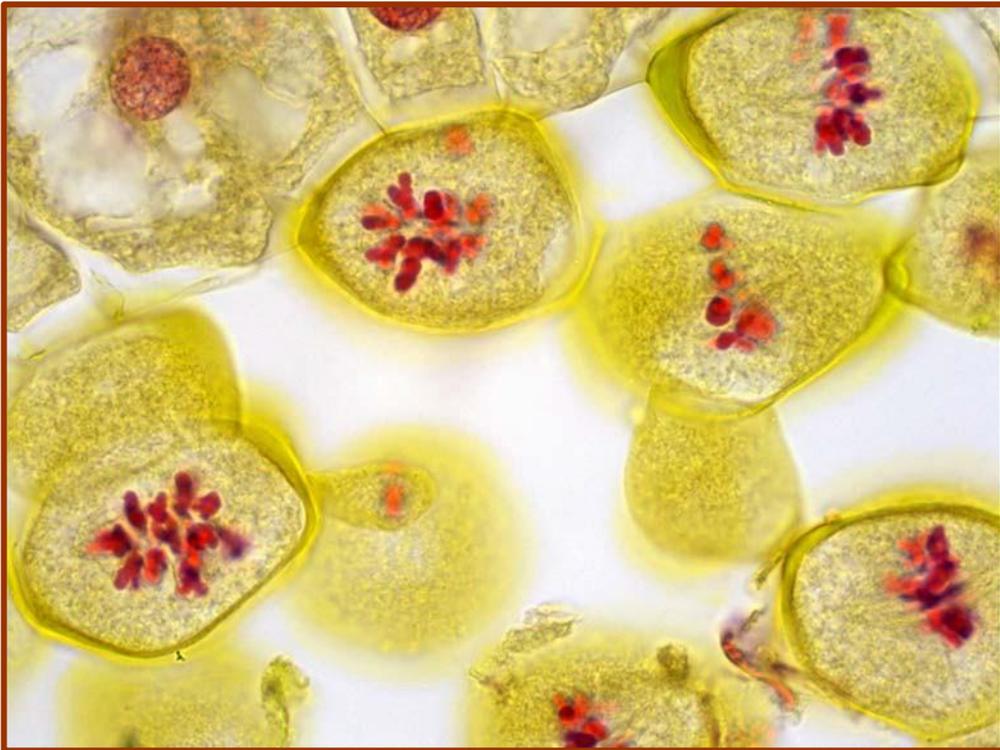
Zygotene substage – Meiosis-I- cell division



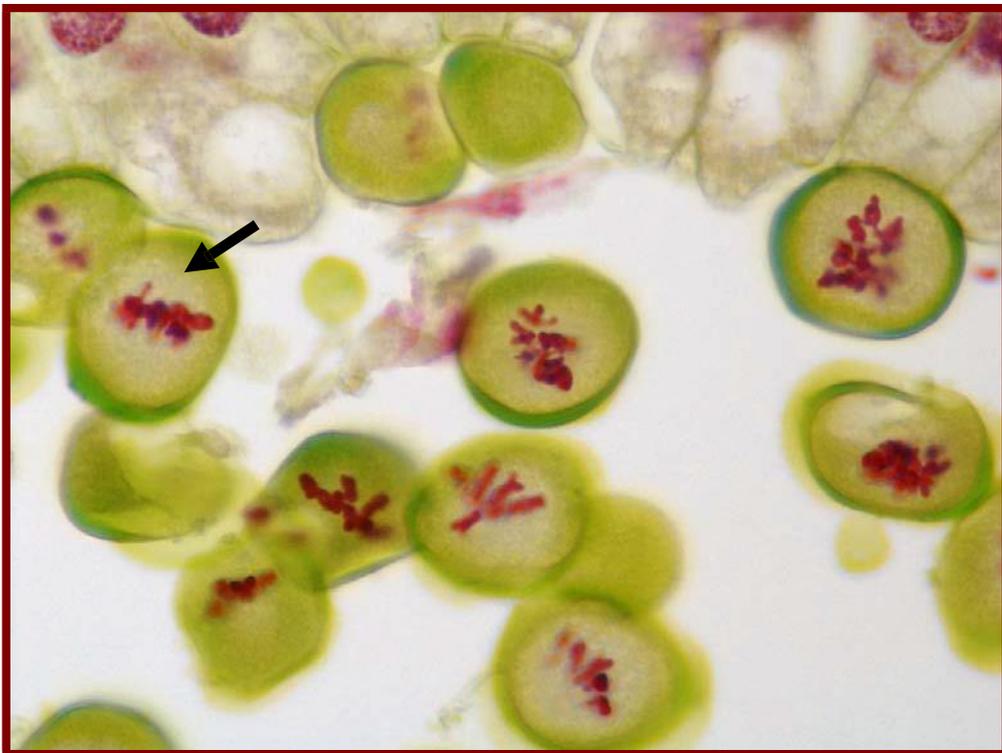
Pachytene substage – Meiosis-I- cell division



Diplotene substage – Meiosis-I- cell division

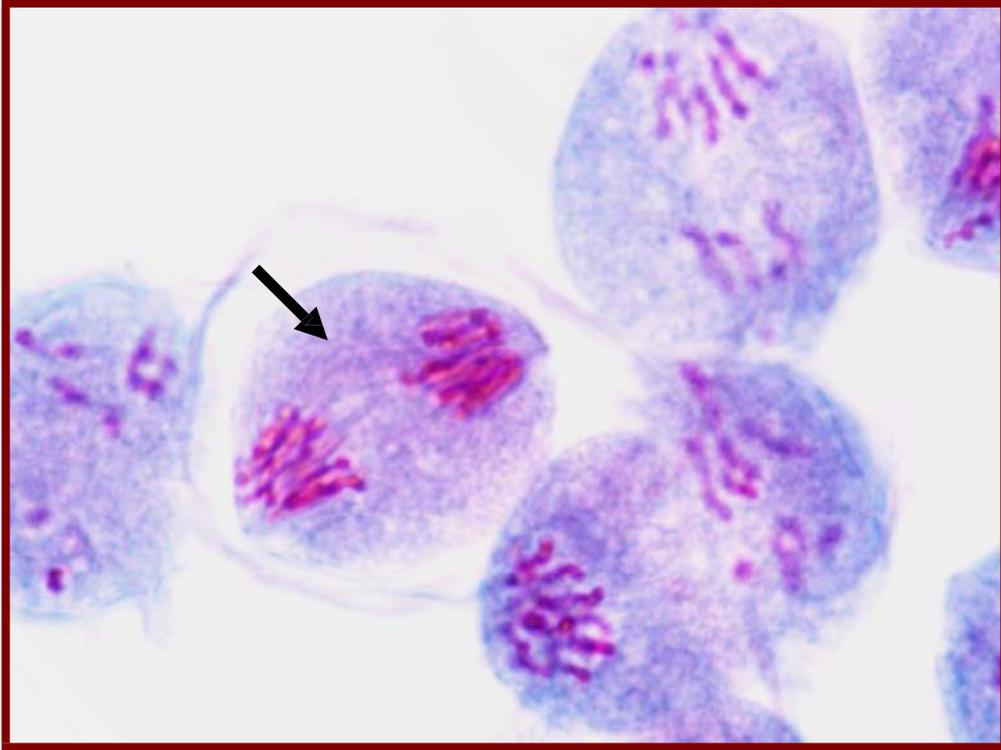


Diakinesis substage – Meiosis-I- cell

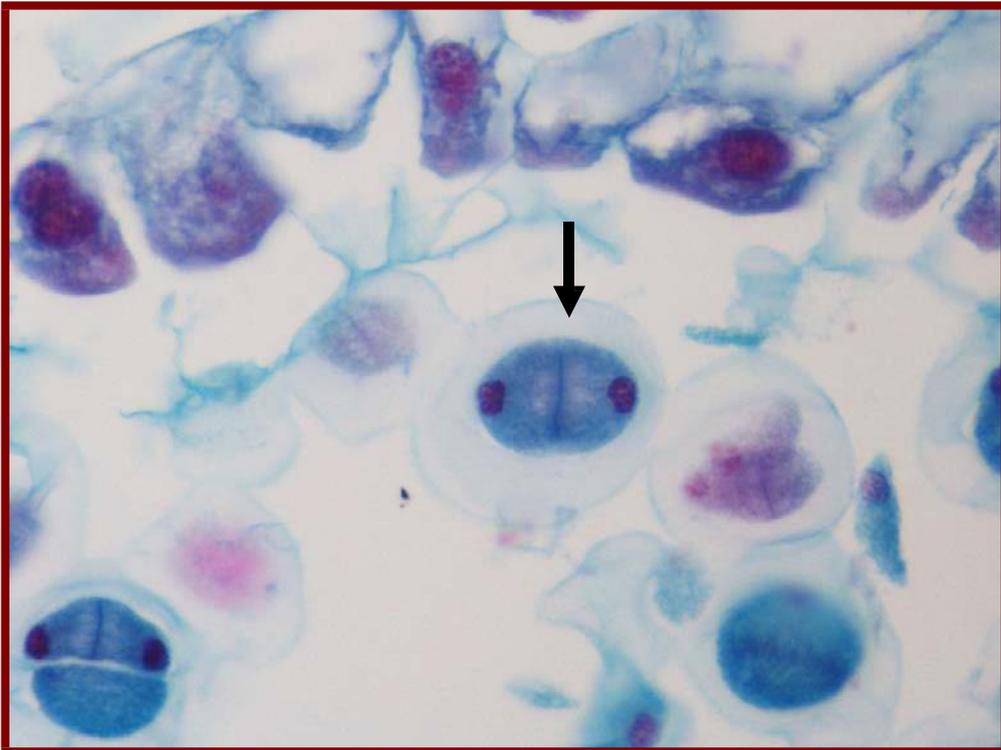


Metaphase I stage – Meiosis-I- cell division

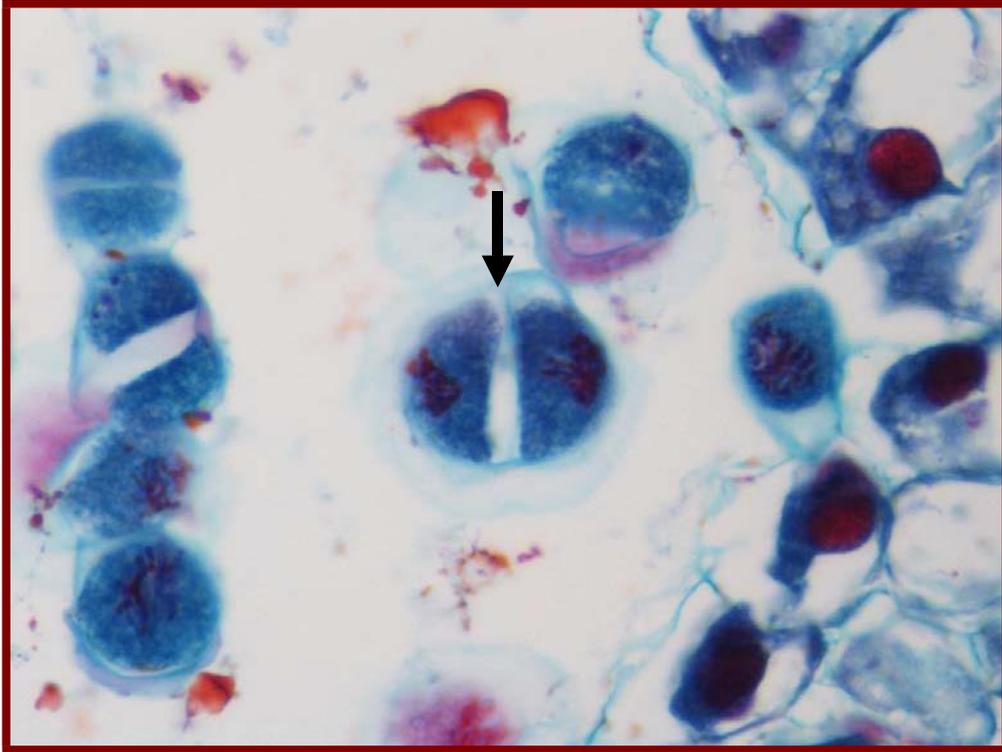




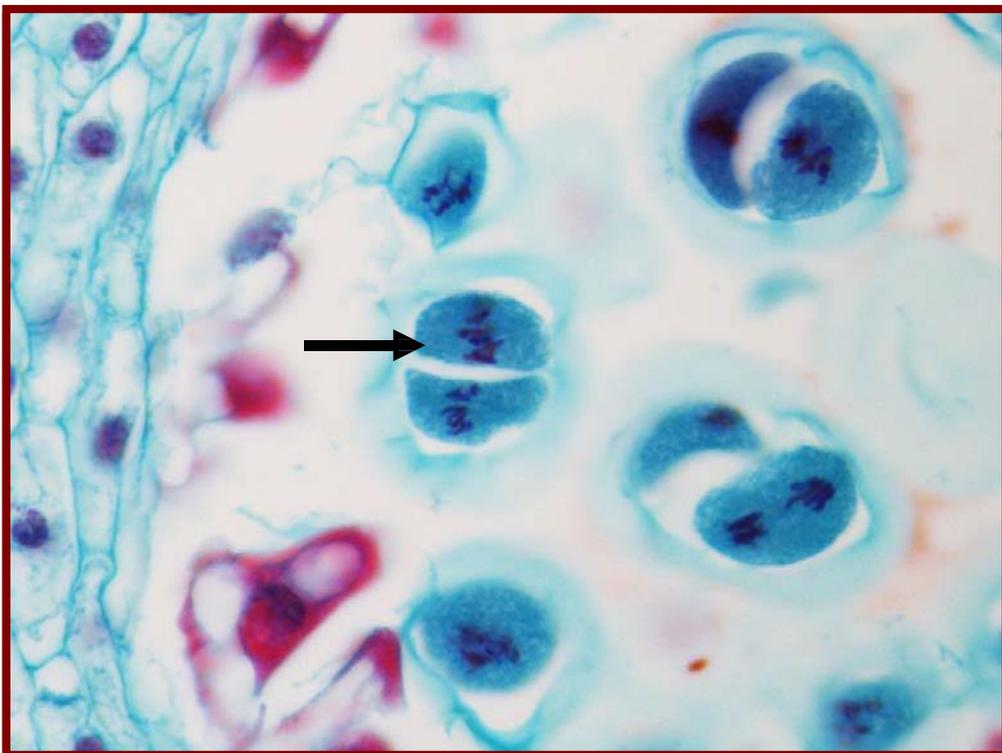
Anaphase I stage – Meiosis-I- cell division



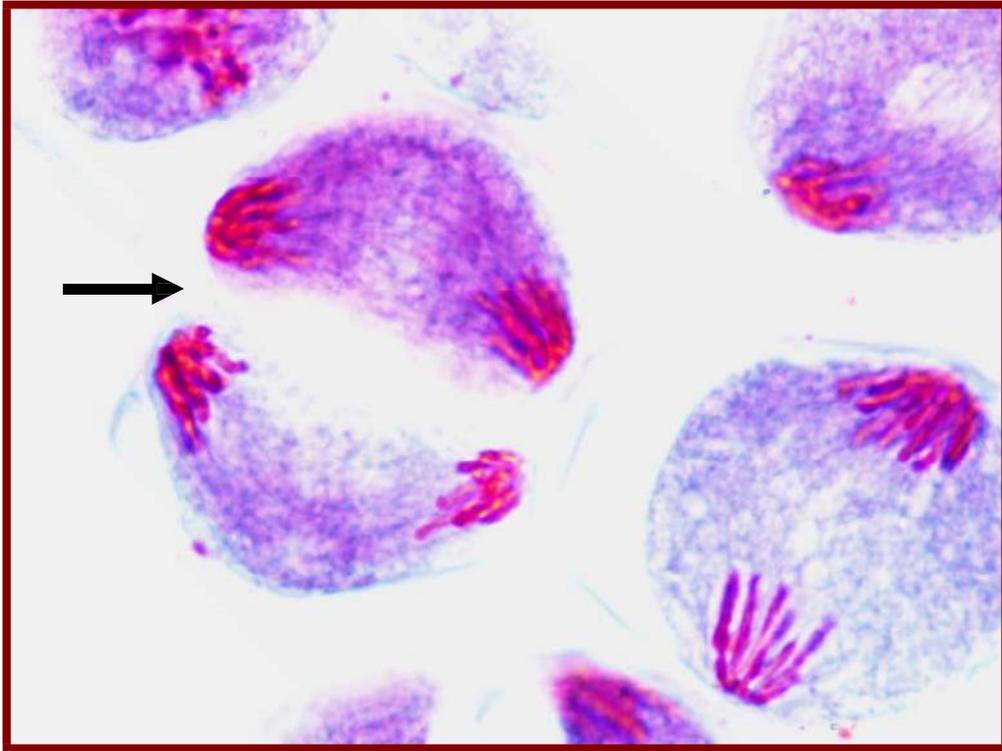
Telophase I stage – Meiosis-I- cell division



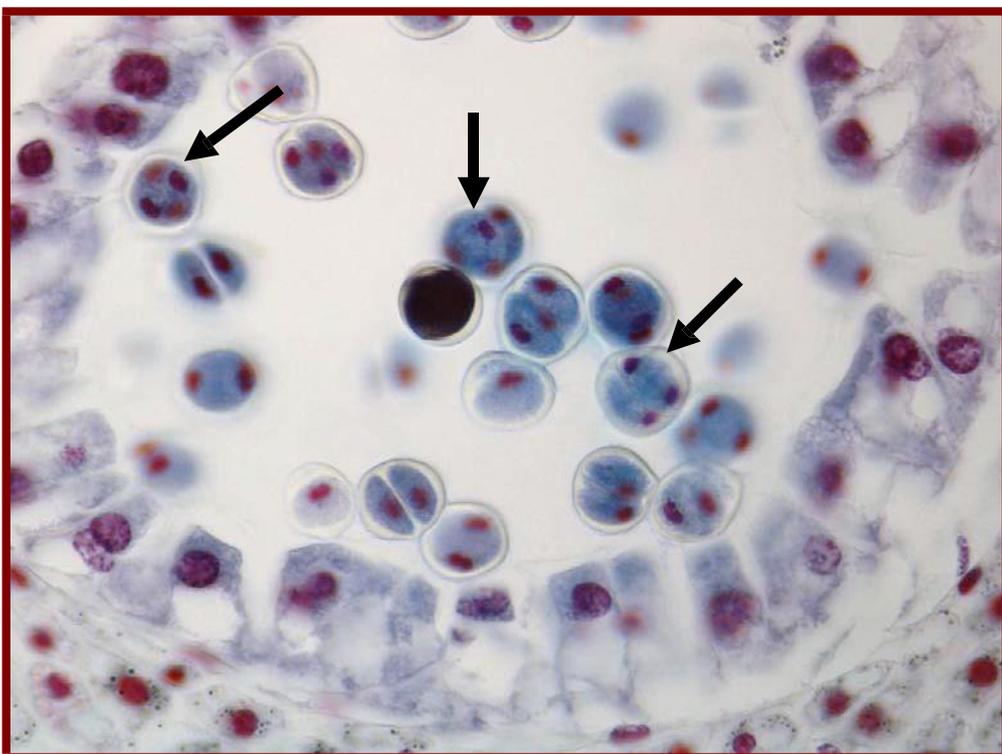
Prophase II stage – Meiosis-II- cell division



Metaphase II stage – Meiosis-II- cell division



Anaphase II stage – Meiosis-II- cell division



Telophase II stage – Meiosis-II- cell division

LAB(5): Histology

The anatomy science divide into two branches:

- 1- **Gross Anatomy:** is the science which study the structure of the organs on cadaver or corpse by naked eye.
- 2- **Microscopic Anatomy (Histology):** is the science which study the microscopic structure of the tissues, organs and systems under the microscope.

Cells → tissues → organs → systems → body

Types of the tissues:

- 1- **Epithelial tissue**
- 2- **Connective tissue**
- 3- **Muscular tissue**
- 4- **Nervous tissue**

The muscular tissue:

- Structural unit of muscular tissue is large cell which called muscle fiber
- The cell membrane of muscle fiber is called sarcolemma
- The cytoplasm of muscle fiber is called sarcoplasm

Types of muscles: there are 3 types of muscles:

- 1- **Skeletal muscles:** striated, voluntary
- 2- **Cardiac muscles:** striated, involuntary
- 3- **Smooth muscles:** unstriated, involuntary

Skeletal muscle fiber characterized by:

Extremely elongated, unbranched cylindrical fiber, multinucleated peripheral position, has transverse (cross) striations

Cardiac muscle fiber characterized by:

Short fiber, branched, has one or two nuclei central position, has transverse (cross) and intercalated discs as a unique features.

The Connective tissue (C. T) or Supporting tissue: named connective or supporting tissue because connects and supports the different tissues and organs to each other.

C.T consist of 3 structures: C.T cells, C.T fibers and matrix

C.T classification:

- 1- Proper C.T: Loose(Areolar, Reticulum, Mucoïd, Adipose,...etc) Dense(White Collagene, Yellow Elastic)
- 2- Special C.T: Bone, Cartilage, Blood and Lymph.

The Cartilage: there are 3 types of cartilage: Hyaline cartilage, Elastic cartilage, White-Fibro cartilage.

Hyaline cartilage: surround by fibrous layer which called perichondrium, composed of chondrocytes cell and fibers embedded in the matrix, the chondrocytes present in space which called lacuna and when group of chondrocytes present in common capsule called cell nest, hyaline cartilage present in respiratory passage (Trachea, Bronchi).

Nervous Tissue:

Nervous system: includes C.N.S(Brain and spinal cord)

P.N.S(nerve fibers, nerve endings and ganglia)

The structural and functional unit of the nervous tissue is **nerve cell (neuron)**, the neuron consist of cell body and processes (dendrites and axon)

Spinal cord:

Is cylindrical structure present inside the vertebral column. In transverse section, the central mass of grey matter has the shape of a butterfly (H-shaped) consist of dorsal horns which touch the surface of the section while the ventral horns are away from it, grey matter containing cell bodies of nerve cells and central canal penetrate the grey matter. The peripheral structure of spinal cord is white matter containing tract (myelinated nerve fibers). The spinal cord surround by 3 protective membranes which called meninges (Pia matter, Arachnoid and Dura matter).

Artery and Vein:

The basic structure of the wall of blood vessel composed of 3 layers or coats from inside outwards, these layers are: 1-

Tunica Intima:

- simple squamous endothelium
- subendothelial layer of C.T
- Internal elastic lamina (a layer of elastic fibers)

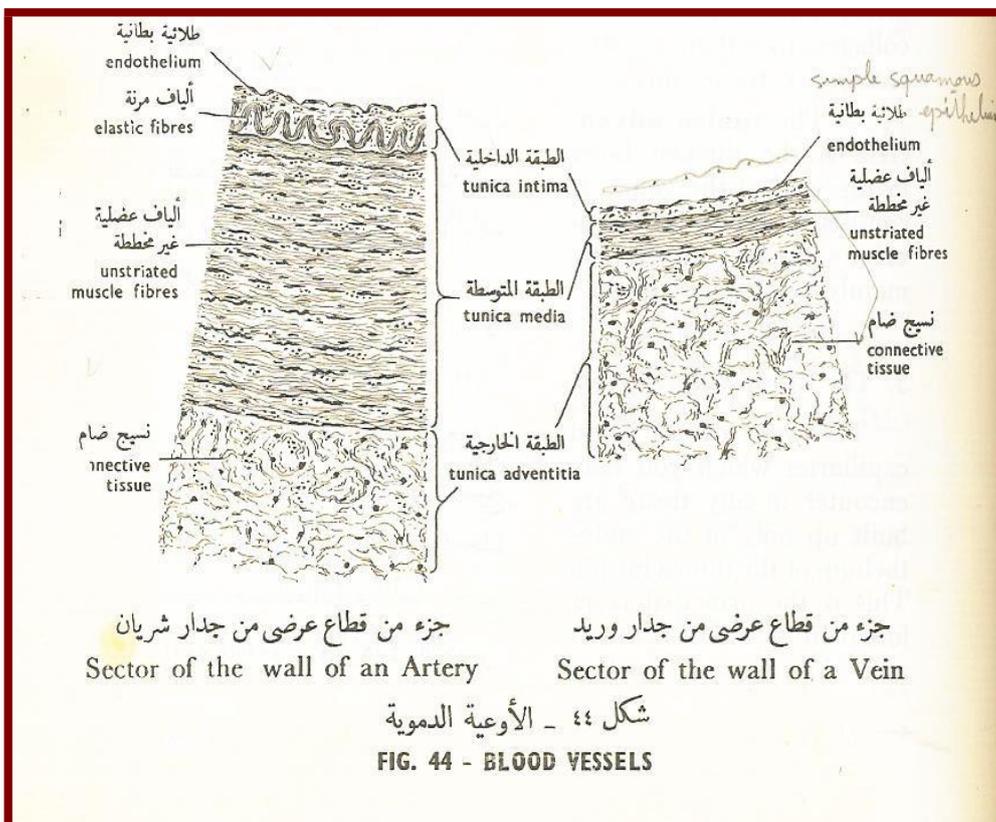
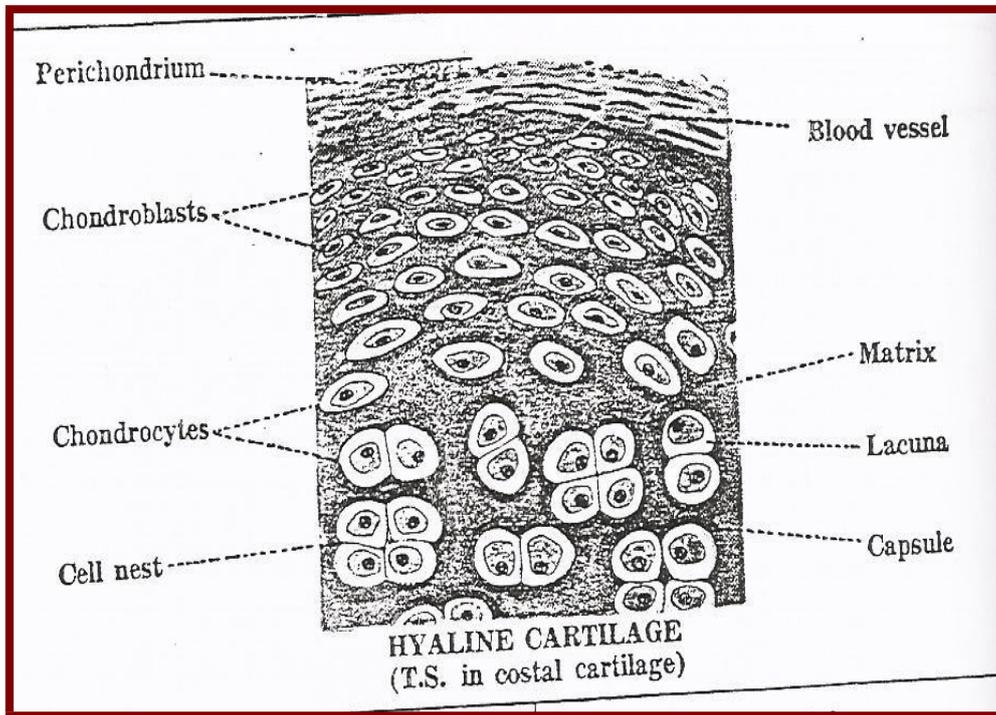
2- Tunica Media:

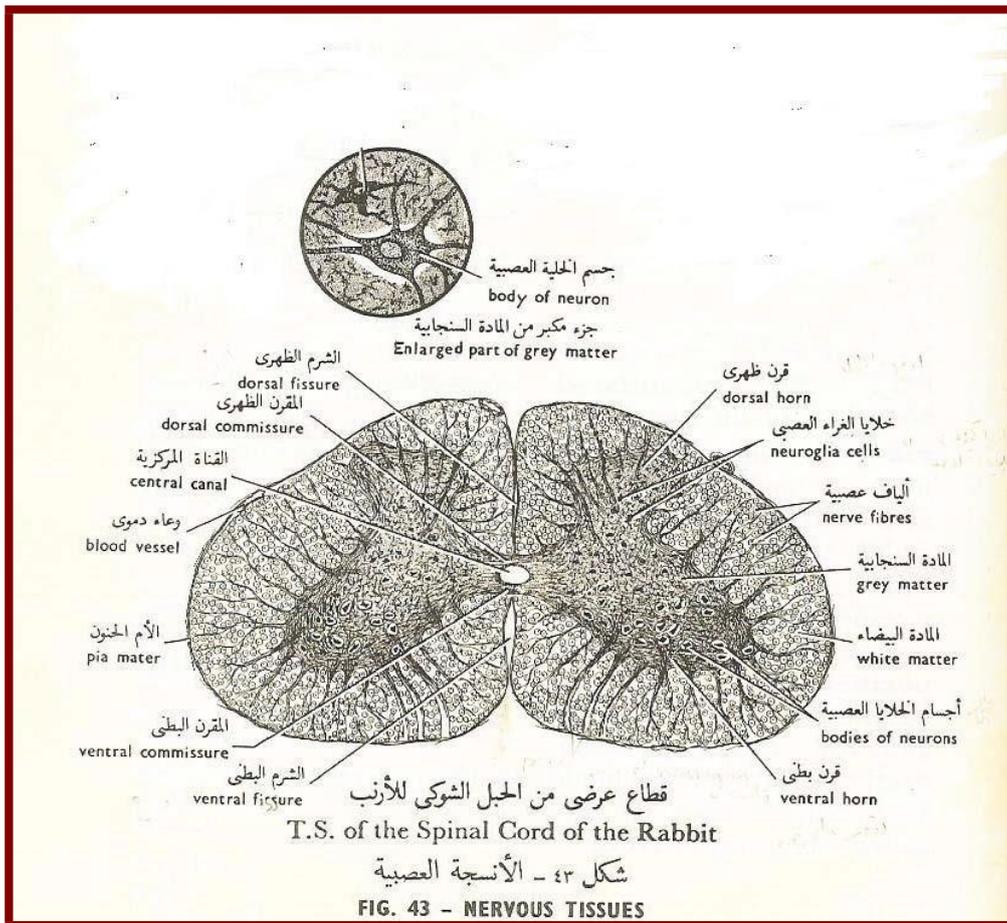
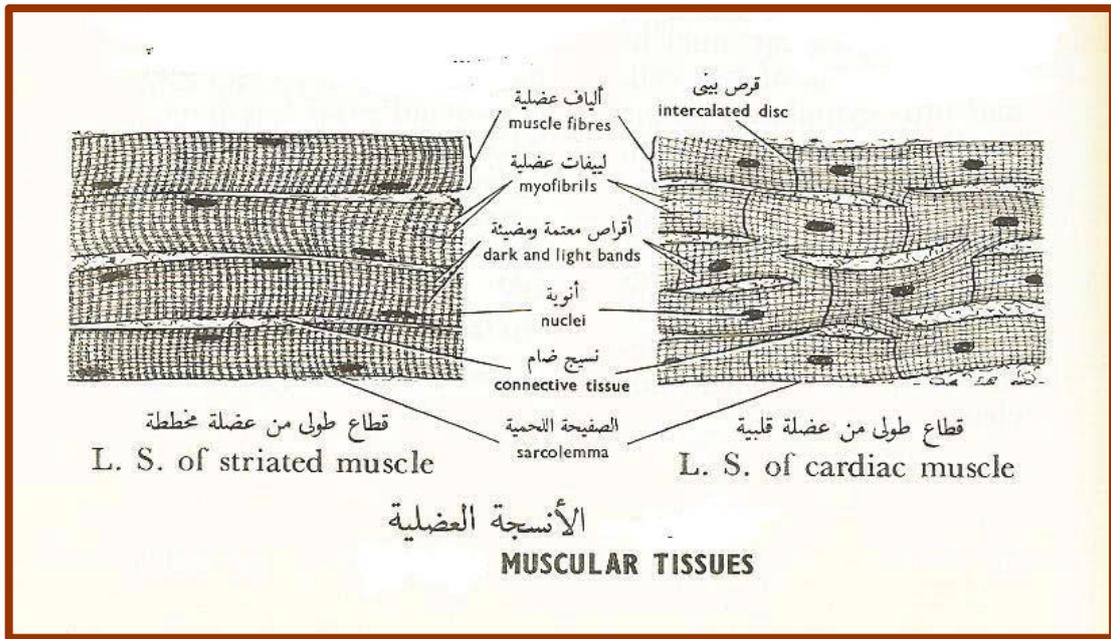
- Circular smooth muscles fibers
- Few scattered elastic fibers
- Fine collagen fibers

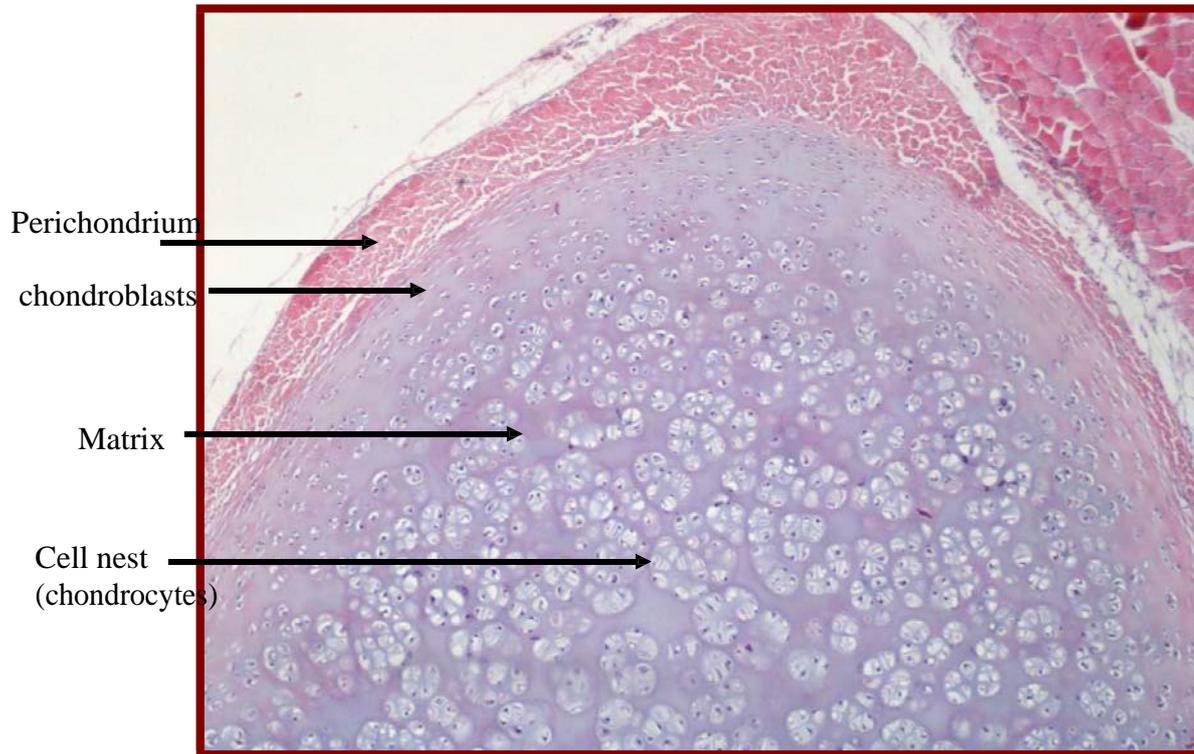
4- Tunica Adventitia:

- Outermost layer C.T

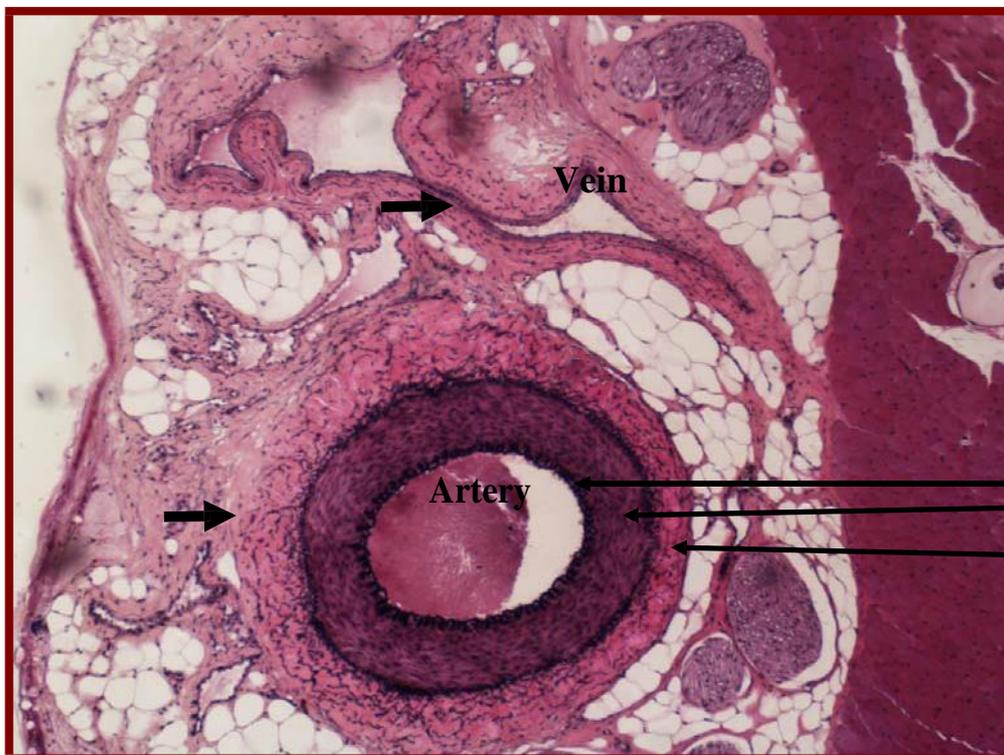
Artery	Vein
The lumen appears rounded (intact)	The lumen appears collapsed
It has thick wall with narrow lumen	It has thin wall with wide lumen
The 3 layers from inside: thick, thick, thin	The 3 layers from inside: thin, thin, thick
The lumen contains no blood after death	The lumen contains blood after death
They are no valves	They often have valves



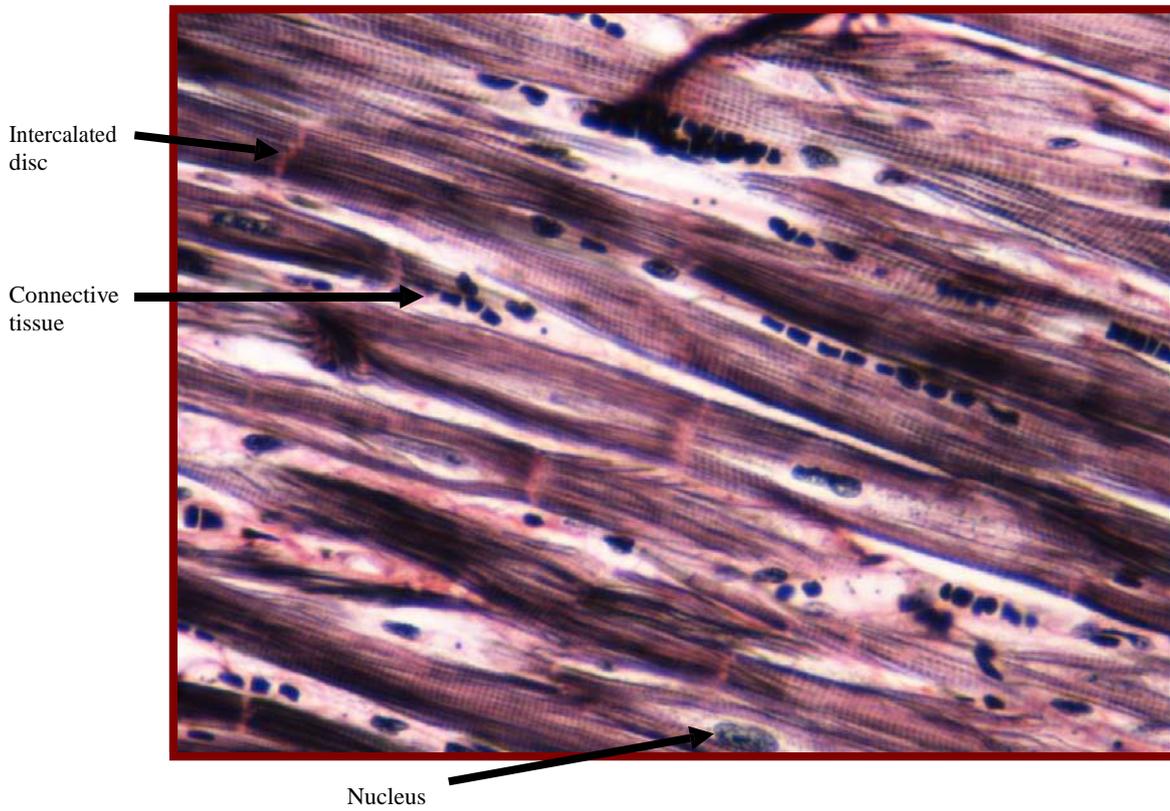




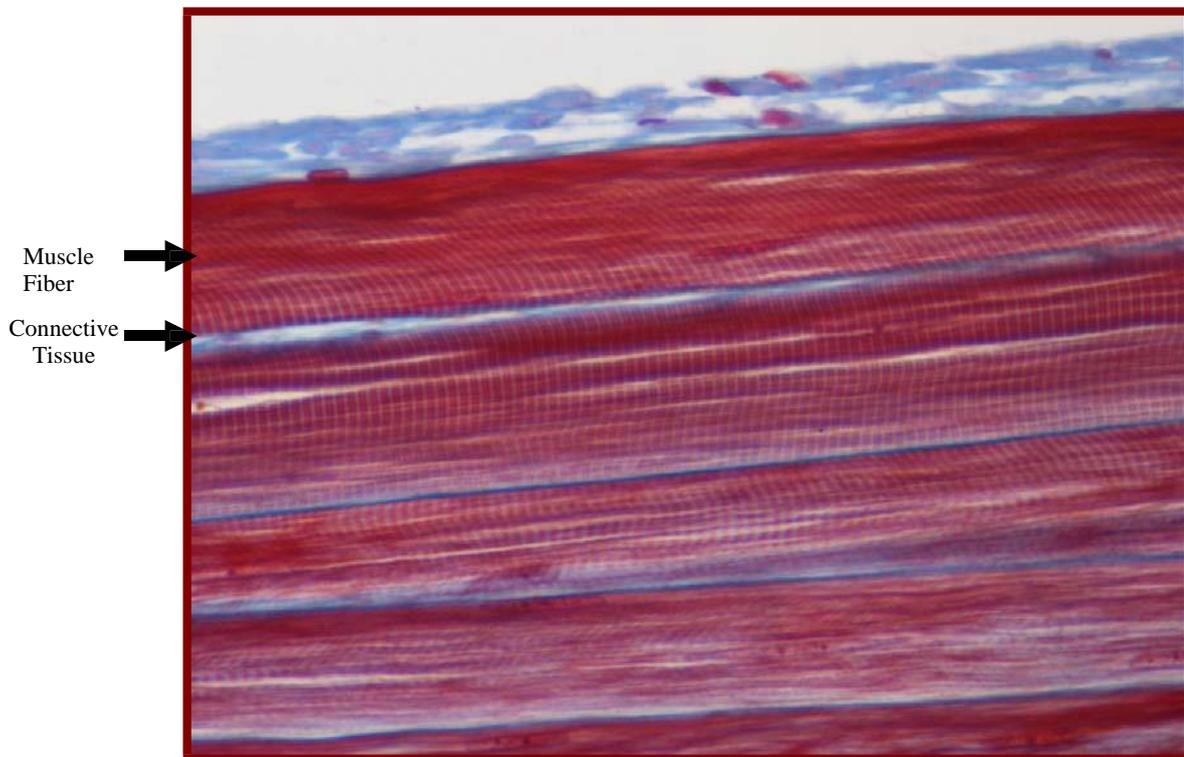
Hyaline cartilage (Connective tissue)



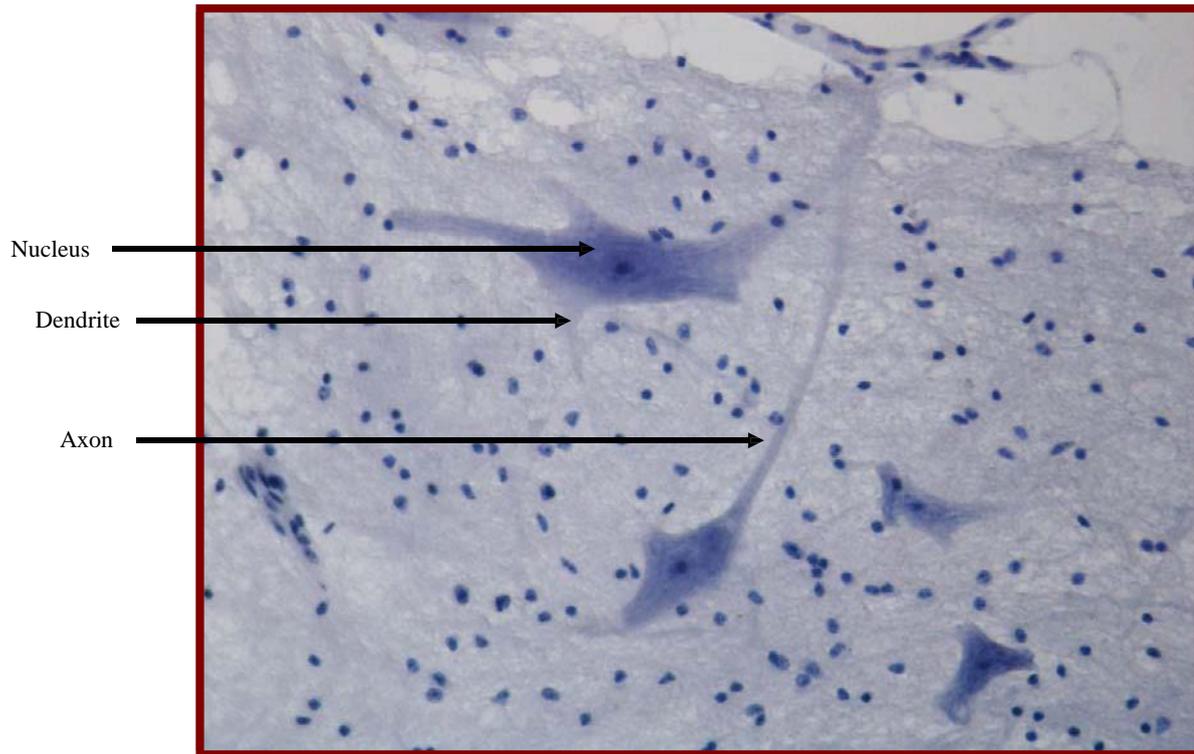
T.S. in Artery and Vein(different tissues)



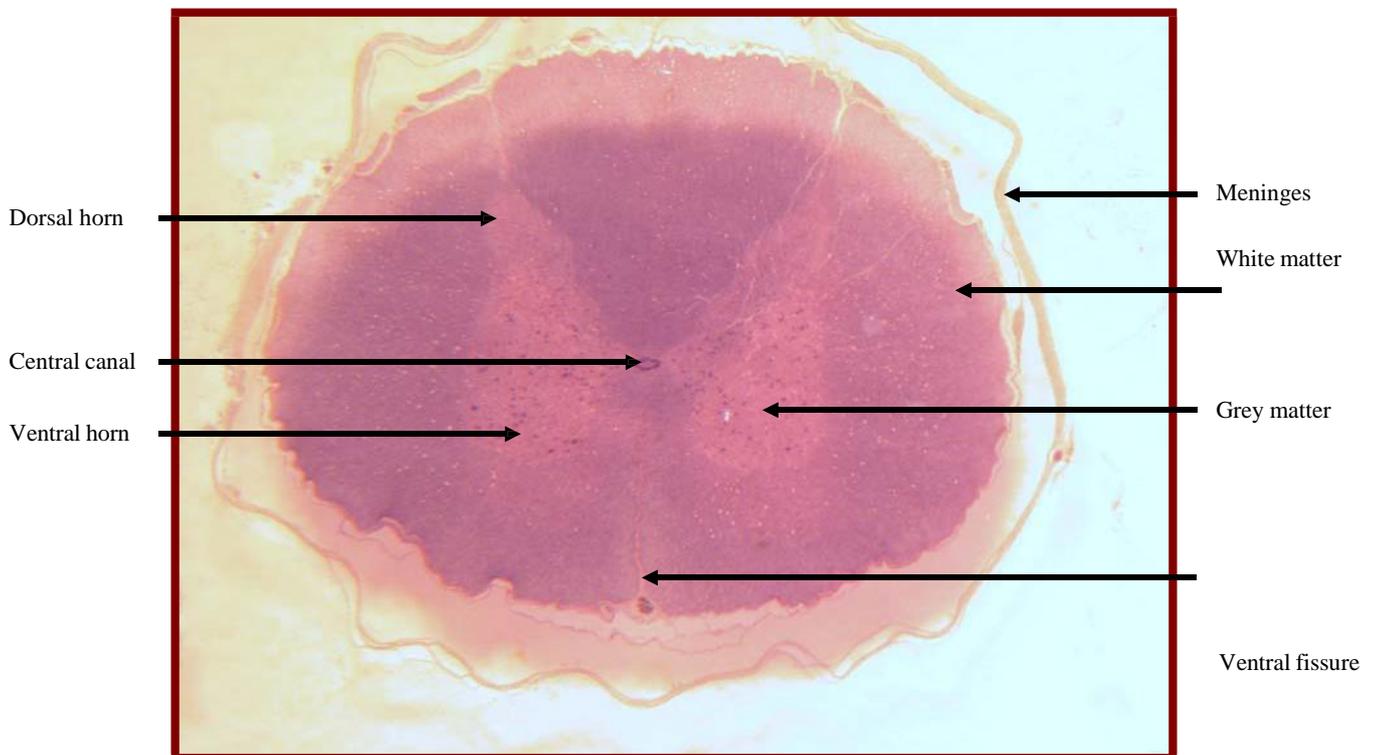
L.S. in Cardiac muscles (Muscular tissue)



L.S. in Skeletal muscles (Muscular tissue)



Nerve cells (Neurons) (Nervous tissue)



T.S. in Spinal cord (Nervous tissue)

LAB(6):Histology of Digestive system

The digestive system consist of oral cavity with its accessories parts and the digestive tract with its accessories glands.

The digestive tract includes: Oesophagus, stomach, small intestine and large intestine.

The wall of all parts of the digestive tube is formed of four layers, from the lumen outwards these layers are:

- 1- **Mucosa**
- 2- **Submucosa**
- 3- **Musculosa**
- 4- **Serosa or Adventitia**

The oesophagus: Is a muscular tube connects the pharynx with the stomach.

Its wall consist of four layers:

- 1- **Mucosa:**
 - Non keratinized stratified squamous epithelial
 - Corium or layer of C.T
 - Muscularis mucosa(inner circular muscle fibers and outer longitudinal M. F)
- 2- **Submucosa:** Areolar loose C.T
- 3- **Musculosa:** Inner longitudinal, middle circular and outer longitudinal M.F
- 4- **Fibrosa or Adventitia:** Areolar loose C.T

The Stomach: Is the dilated segment of the digestive tract

The wall of the stomach is formed of four layers:

- 1- **Mucosa:**
 - is thicker than the mucosa of oesophagus
 - simple columnar epithelium
 - lamina propria which contains gastric glands (oxyntic and peptic cells) and muscularis mucosa (inner C.M.F and outer L.M.F)
- 2- **Submucosa:** areolar C.T
- 3- **Musculosa:** inner circular and outer longitudinal M.F
- 4- **Serosa:** C.T and simple squamous mesothelium

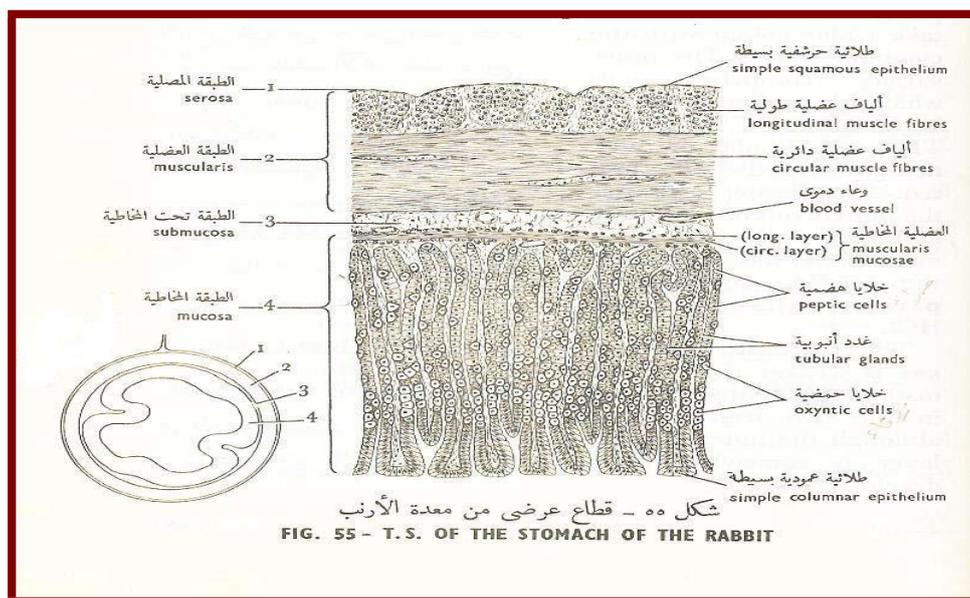
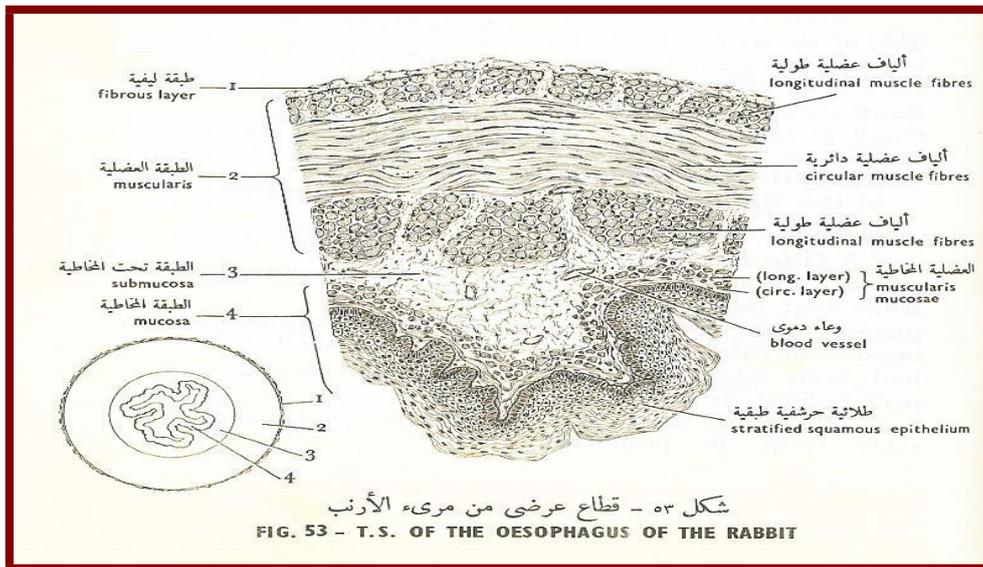
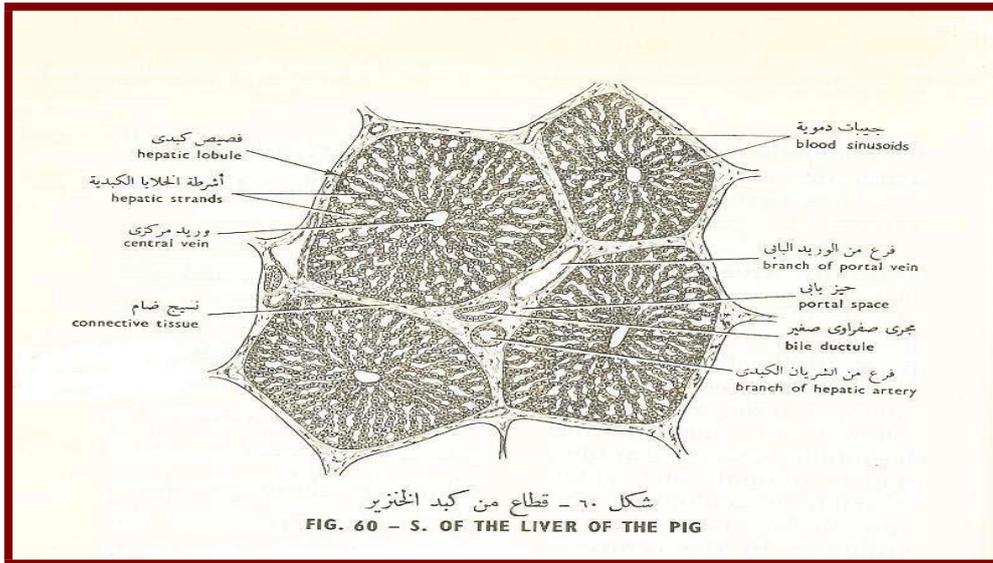
The liver: Is the largest metabolic organ in the body

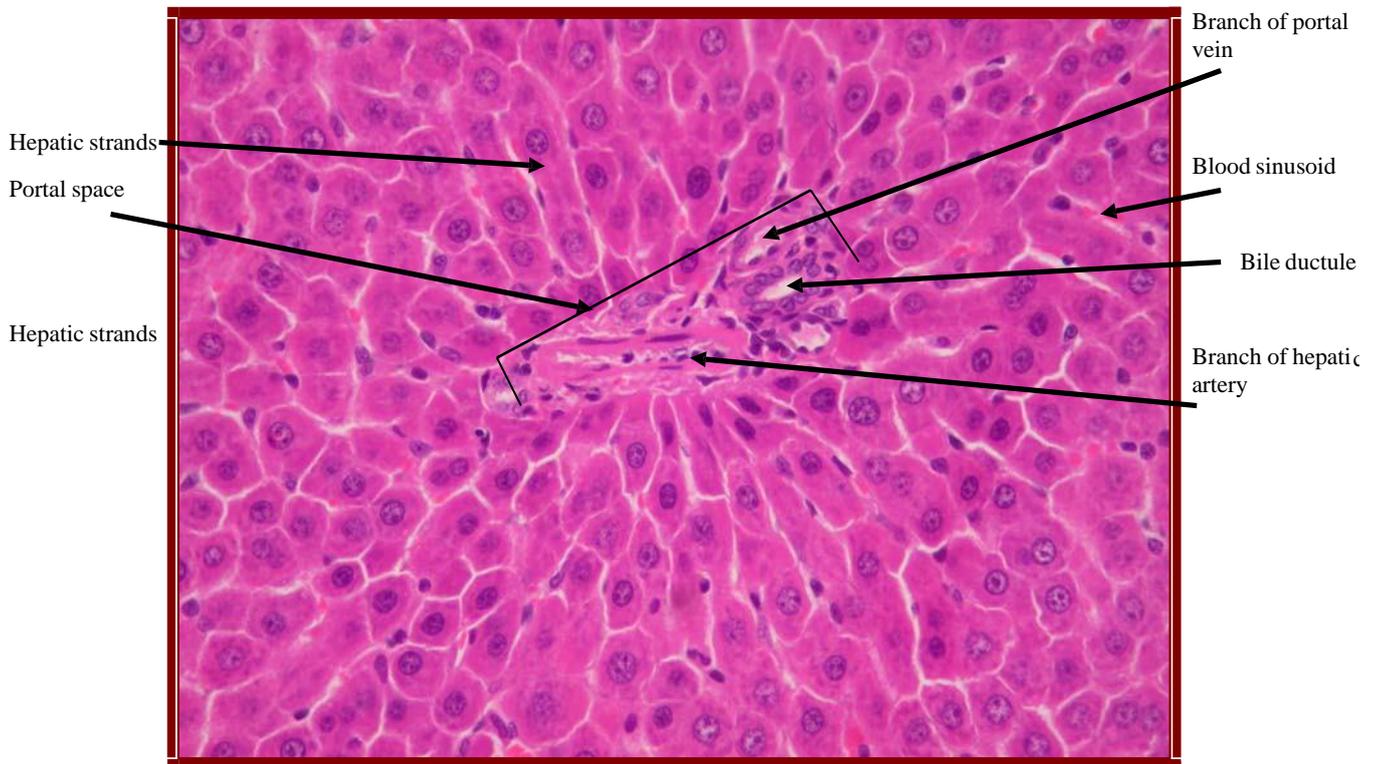
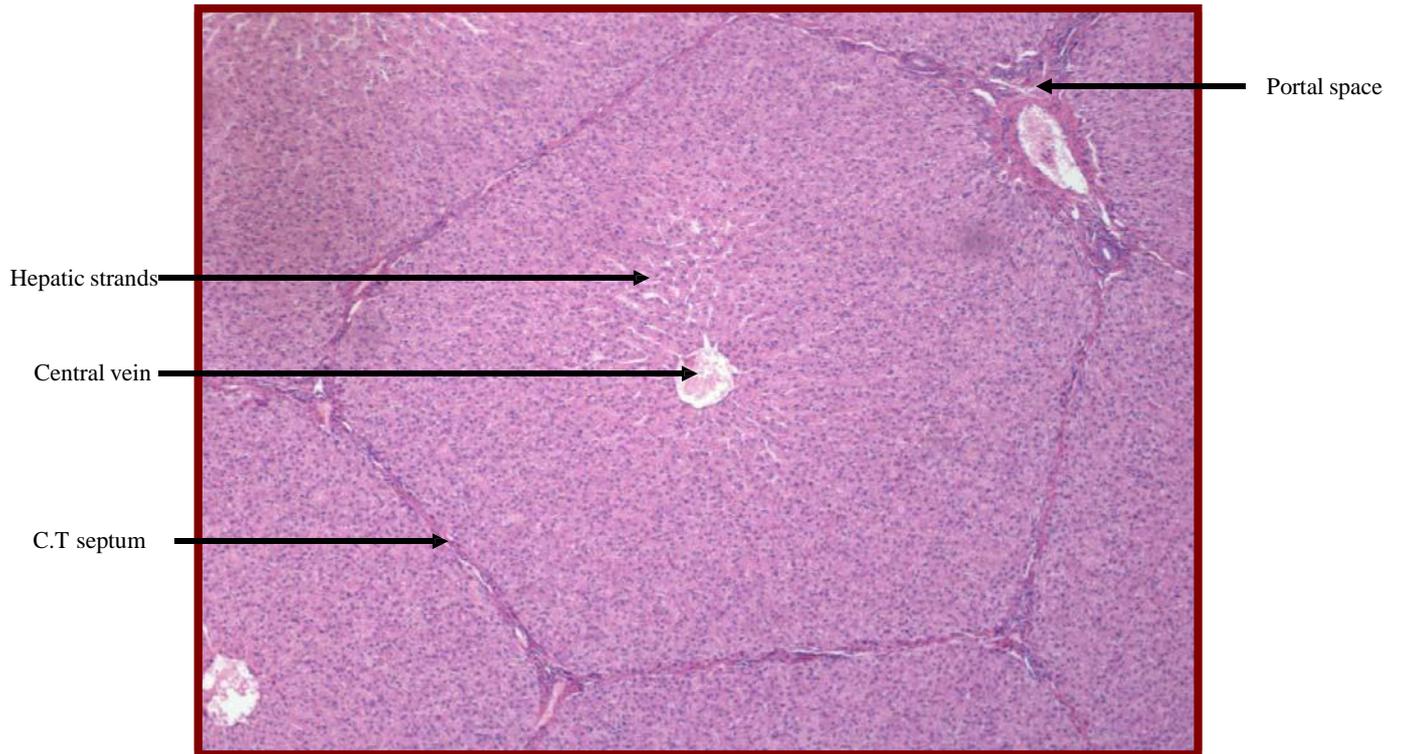
Histological structure of the liver: the liver formed of a stroma of C.T and parenchyma of liver cells(hepatocytes).

The stroma: Capsule, Trabeculae and Reticular C.T

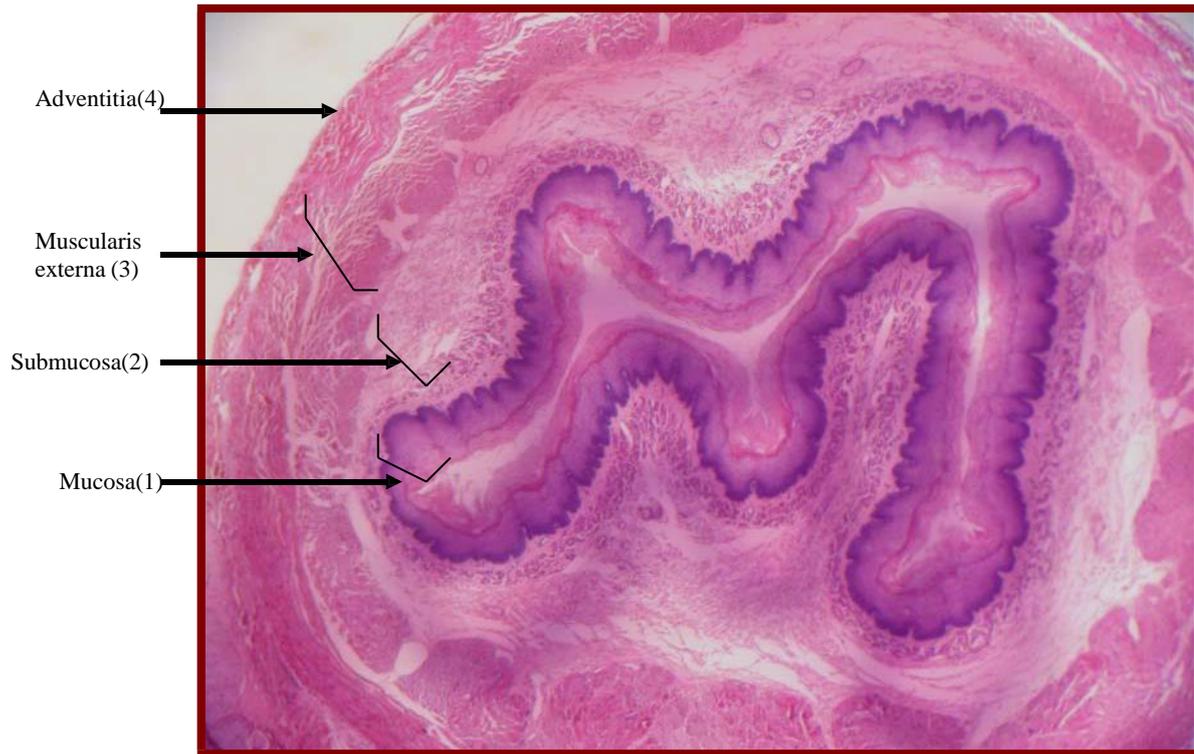
The liver formed of lobes and lobules, each hepatic lobules is hexagonal in outline of C.T septa, the hepatic lobule formed of hepatocytes which arranged in hepatic strands or cords which radiate from the central vein, the hepatic strands enclosed between them blood sinusoids, The C.T. septa cornered between 3 hepatic lobules is called portal space or area, which contains the following structures:

- 1- Branch of hepatic artery
- 2- Branch of portal vein
- 3- Bile ductule
- 4- Lymph vessel

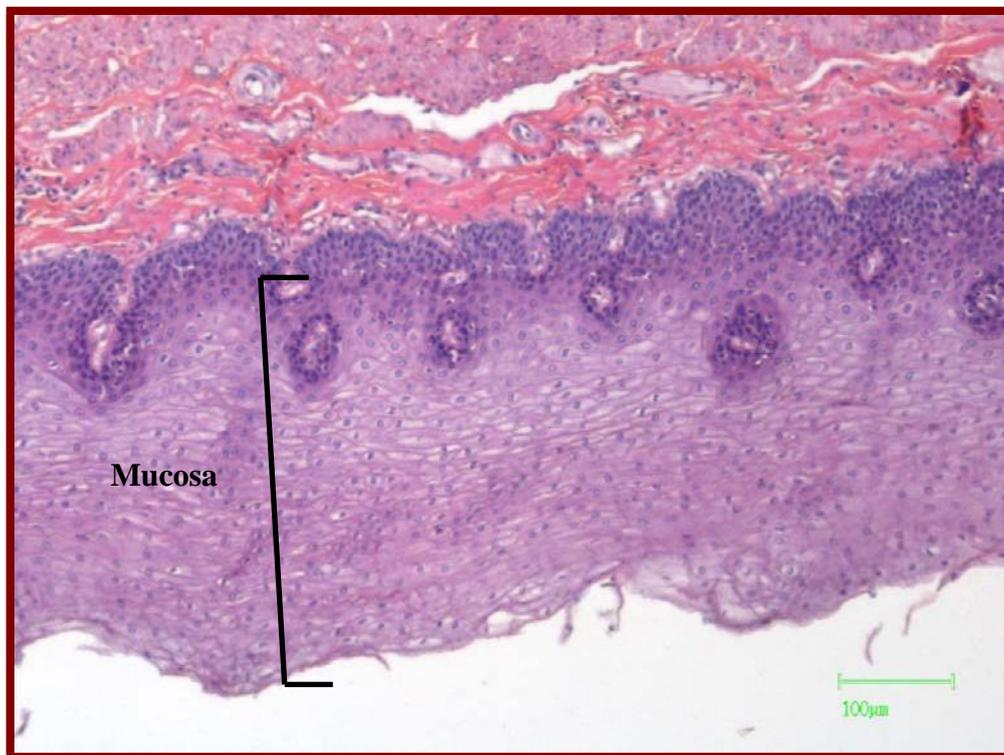




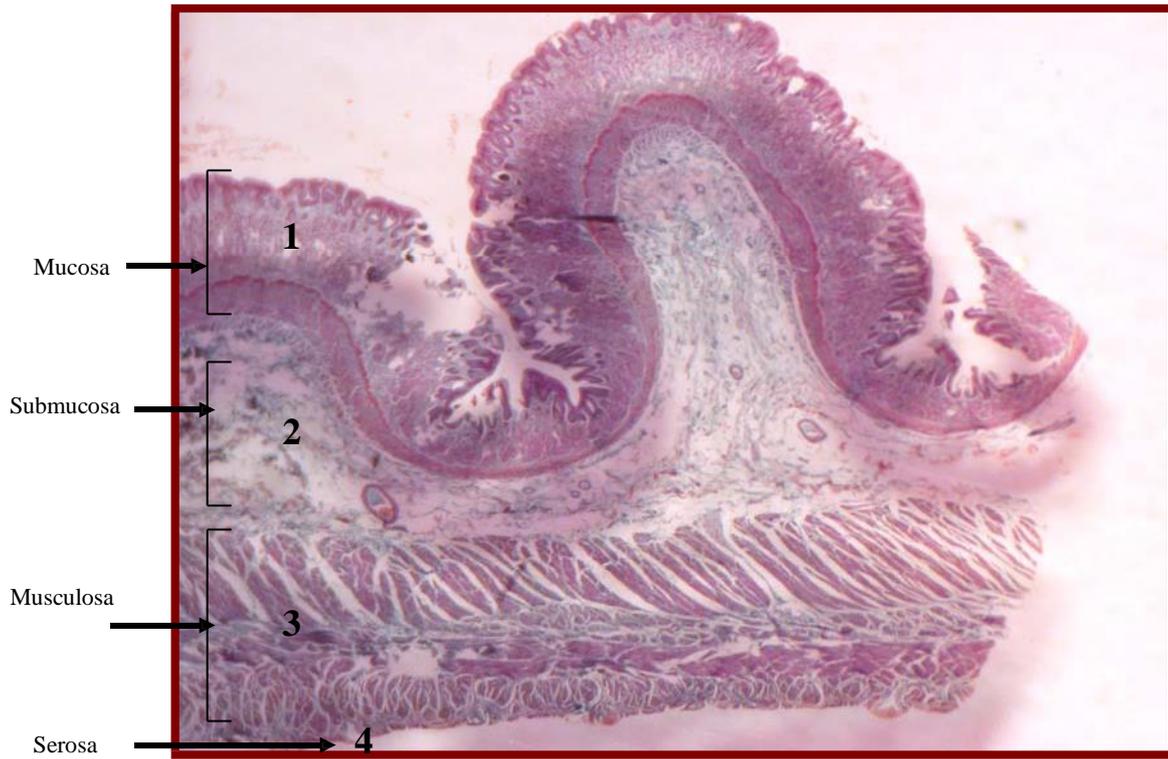
The Liver (Hepatic lobule)



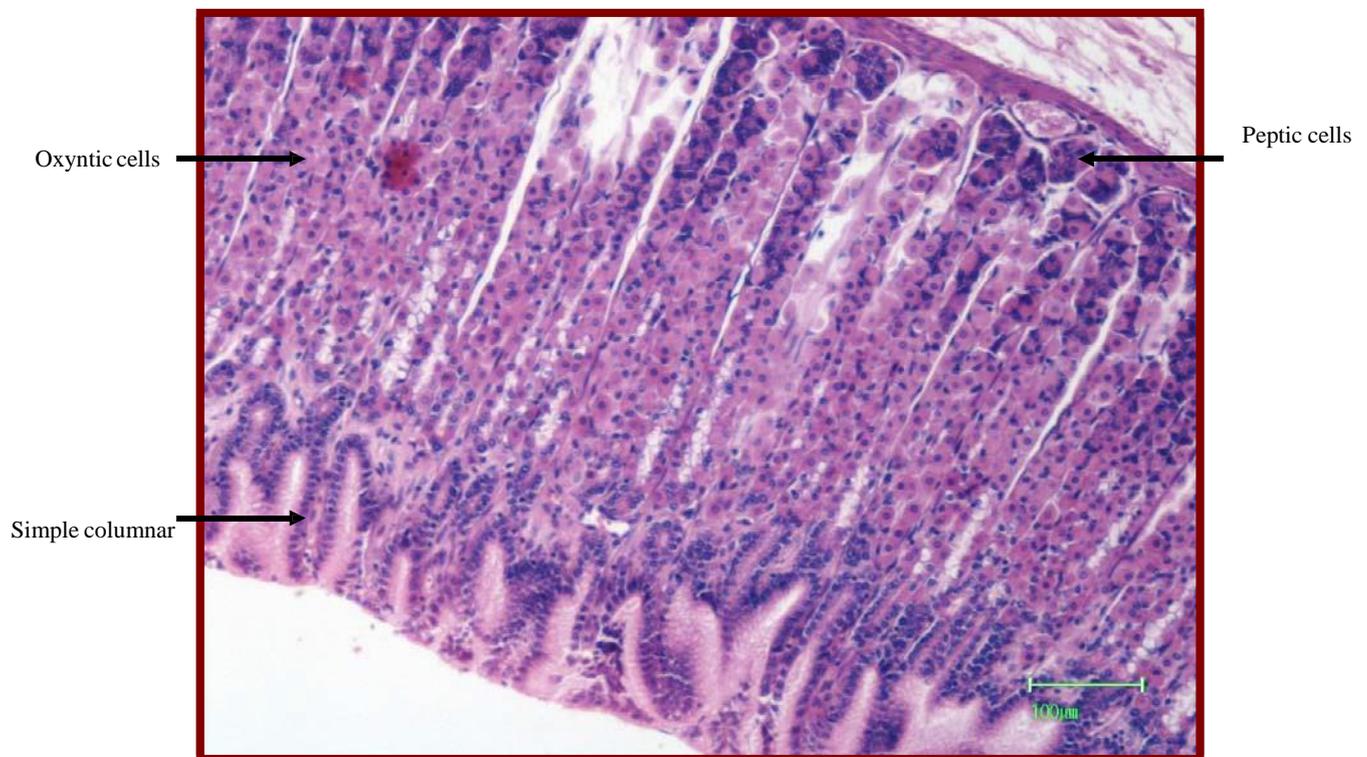
T.S. in wall of the Oesophagus



Mucosa of the Oesophagus(Stratified squamous epithelial tissue)



T.S. in wall of the Stomach



Mucosa of the Stomach (Simple columnar epithelial tissue)

LAB(7):Histology of Urinogental system

The urinary system consist of 2 kidneys, 2 ureters, 1 urinary bladder, 1 urethra.

The kidney: is compound tubular gland covered with C.T. capsule, the renal tissue divided into an outer cortex and an inner medulla, the cortex has granular appearance due to presence **Malpighian Renal Corpuscles**, The parenchyma of the kidney is formed of the urineferous tubules which formed of :

- 1- **Nephrons:** secretory parts
- 2- **Collecting tubules:** excretory parts

The nephron is the functional and structural unit of the kidney, each nephron formed of:

- **The Malpighian renal corpuscle**(capillaries tuft, podocytes, Bowman's capsule)
- **The proximal and distal convoluted tubules** (simple cuboidal epithelium)
- **The loop of Henle** (thin and thick segments)

The collecting tubules lined with simple cuboidal epithelium, Duct of Billini is lined with simple columnar epithelium.

The male reproductive system consist of 2 testes, different tubules(epididymis, vas deferens and ejaculatory duct) and accessories glands(seminal vesicles, prostate, Cowper's glands).

The testes: is compound tubular glands, consist of stroma and parenchyma
Stroma includes: capsule (3 coats Tunica vaginalis, T. albuginea, T. vasculosa, T.)
Parenchyma formed of seminiferous tubules and interstitial cells (Leydig cells)
The seminiferous tubule highly convoluted tubule lined by the following cells:

- 1-**Spermatogenic cells:** spermatogonia, primary spermatocyte, secondary spermatocyte, spermatid and spermatozoa
- 2-**Sertoli cells**

The female reproductive system consist of 2 ovaries, 2 oviducts, 1 uterus, 1 vagina, external genitalia and 2 mammary glands.

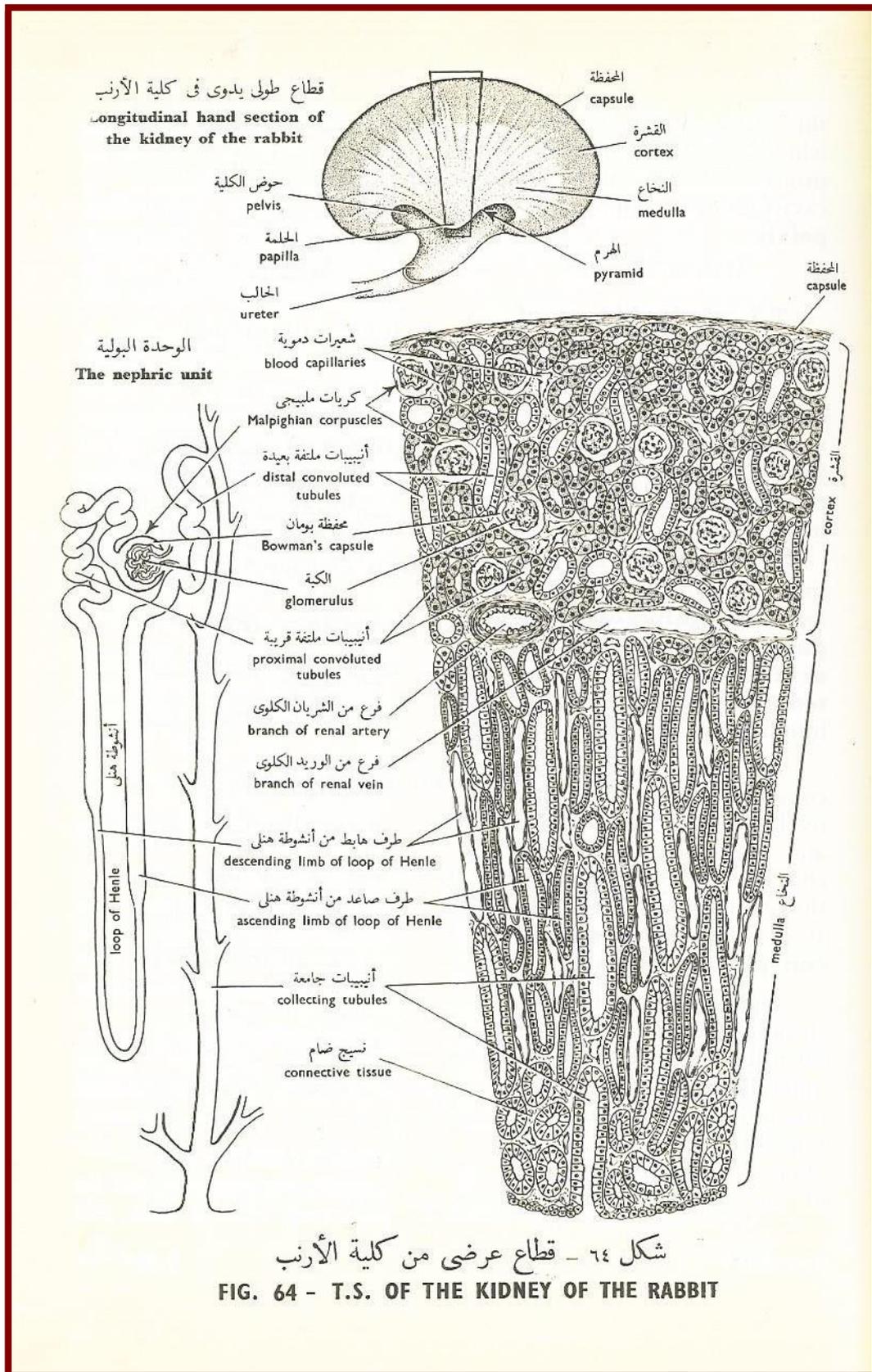
The ovary: is a flattened almond-shaped small body covered by germinal epithelium which rest on the C.T. capsule or tunica albuginea.

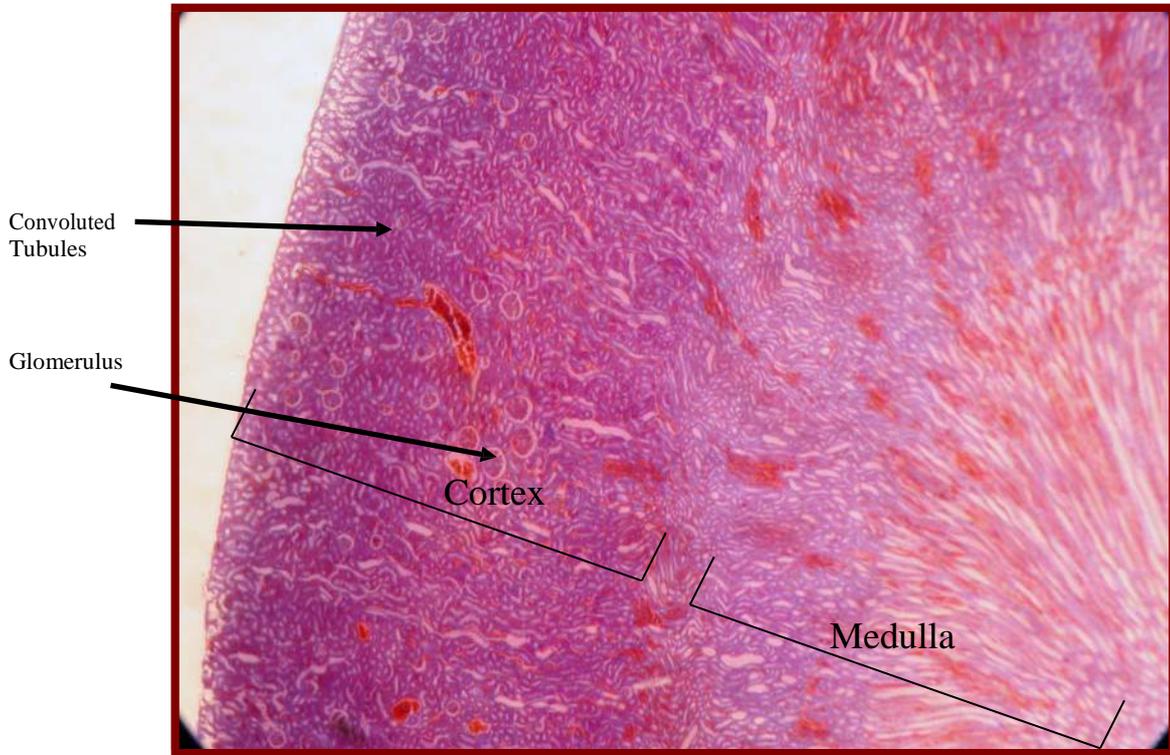
The ovary consist of :

- 1- **Peripheral cortex .**
- 2- **Central medulla.**

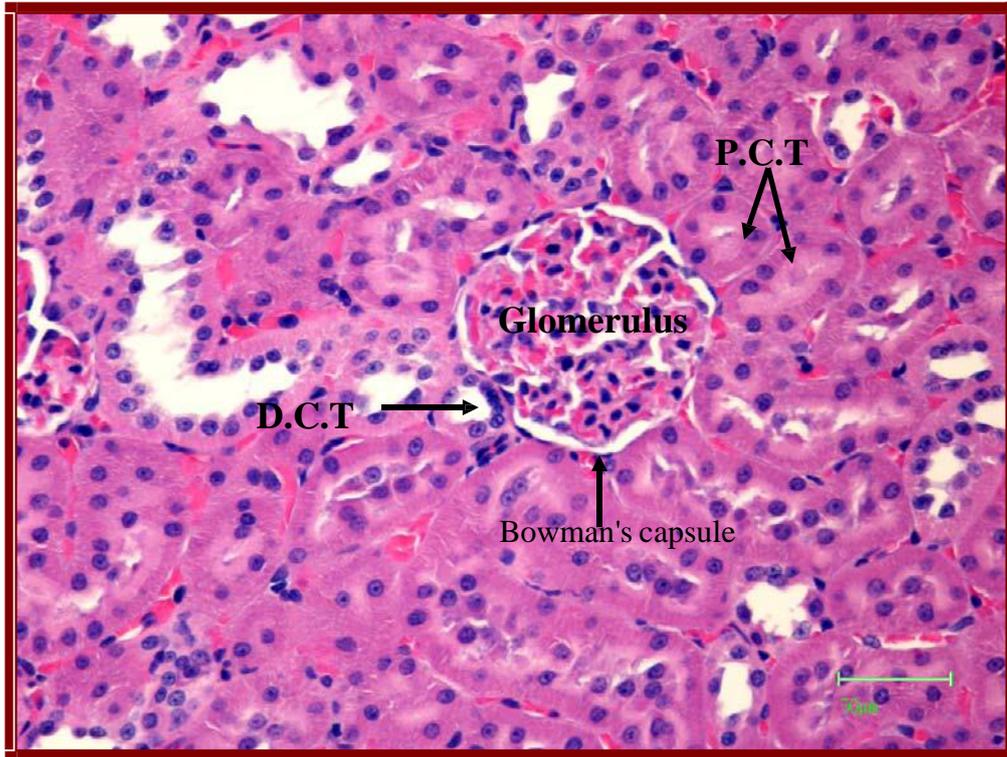
The cortex of ovary contains ovarian follicles (primordial, primary, secondary, mature Graaffian, atretic and corpus luteum).

The medulla of ovary is small part compared to the cortex, its C.T. contains many spiral arteries and convoluted veins.

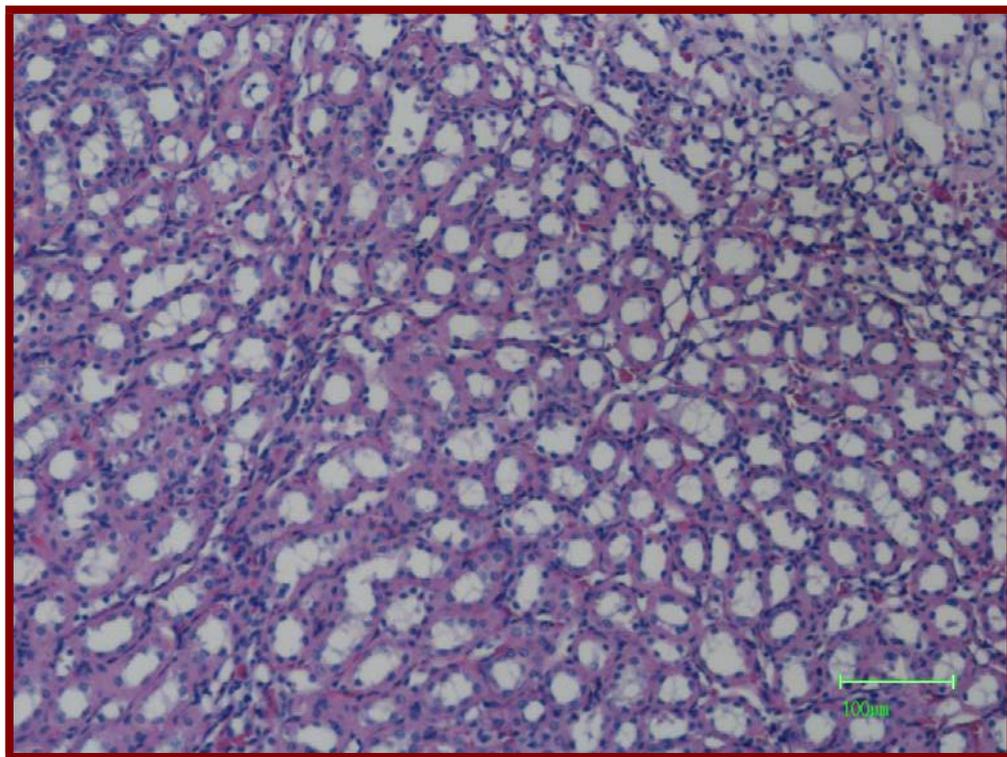




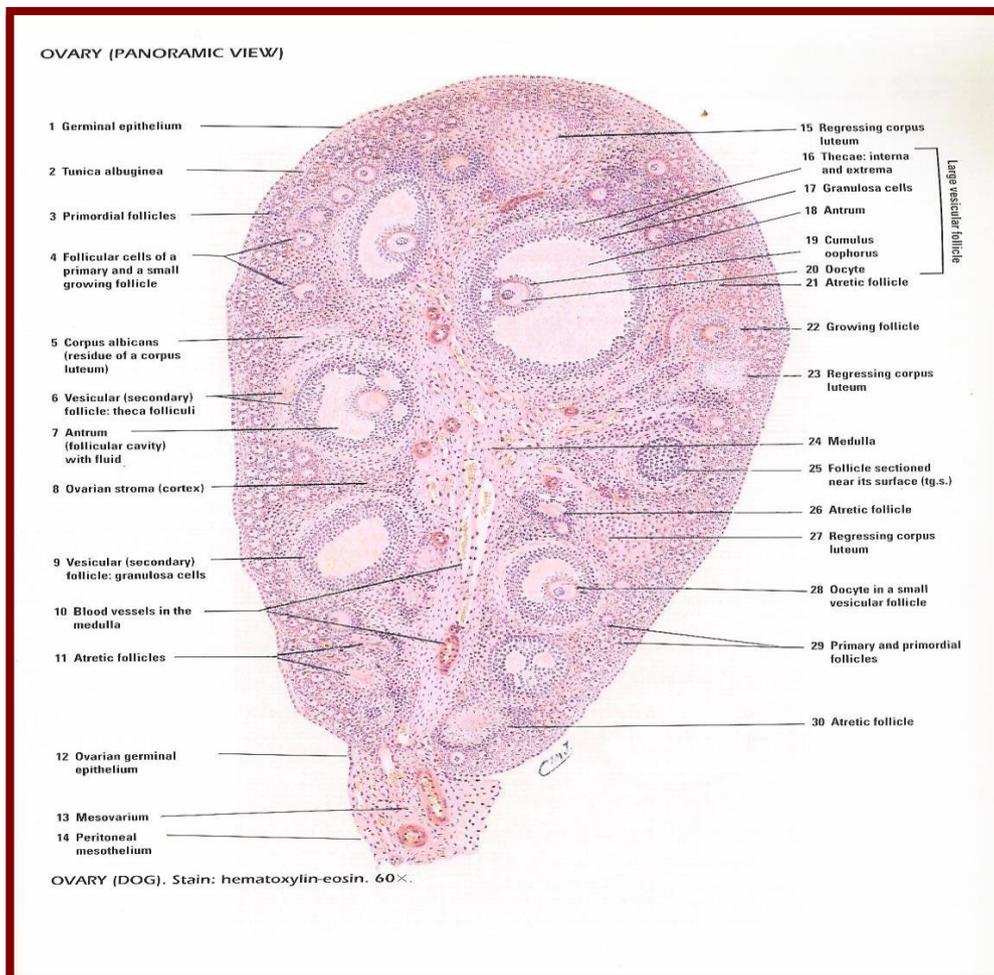
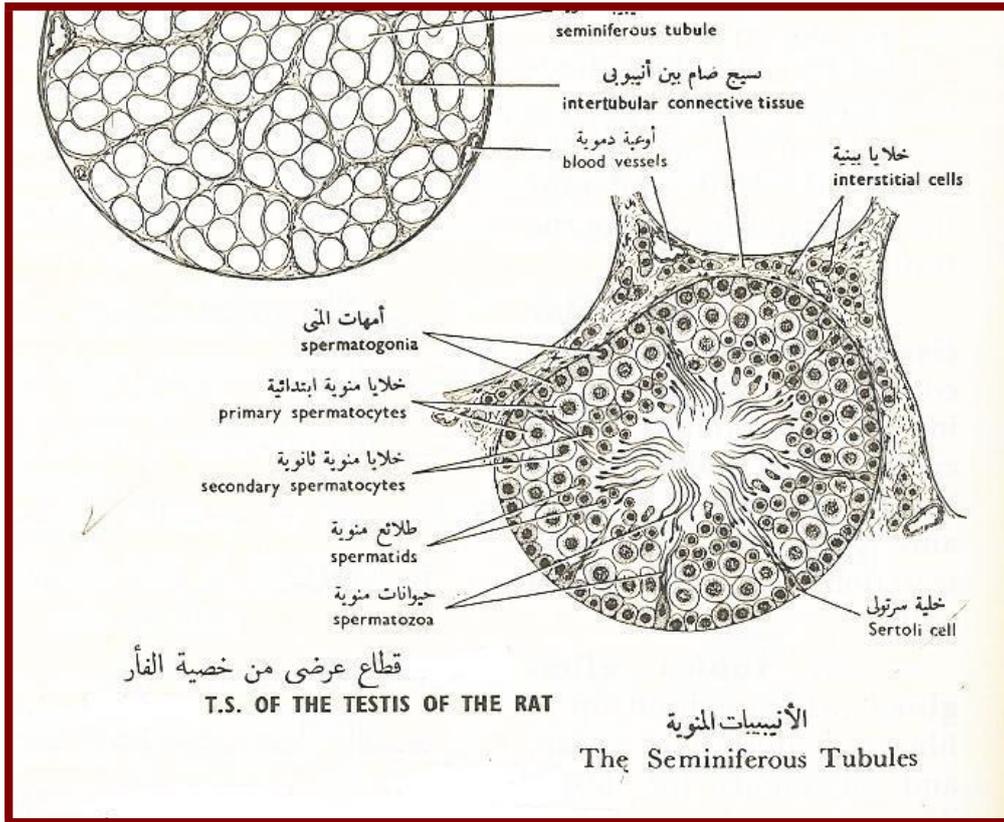
The Kidney

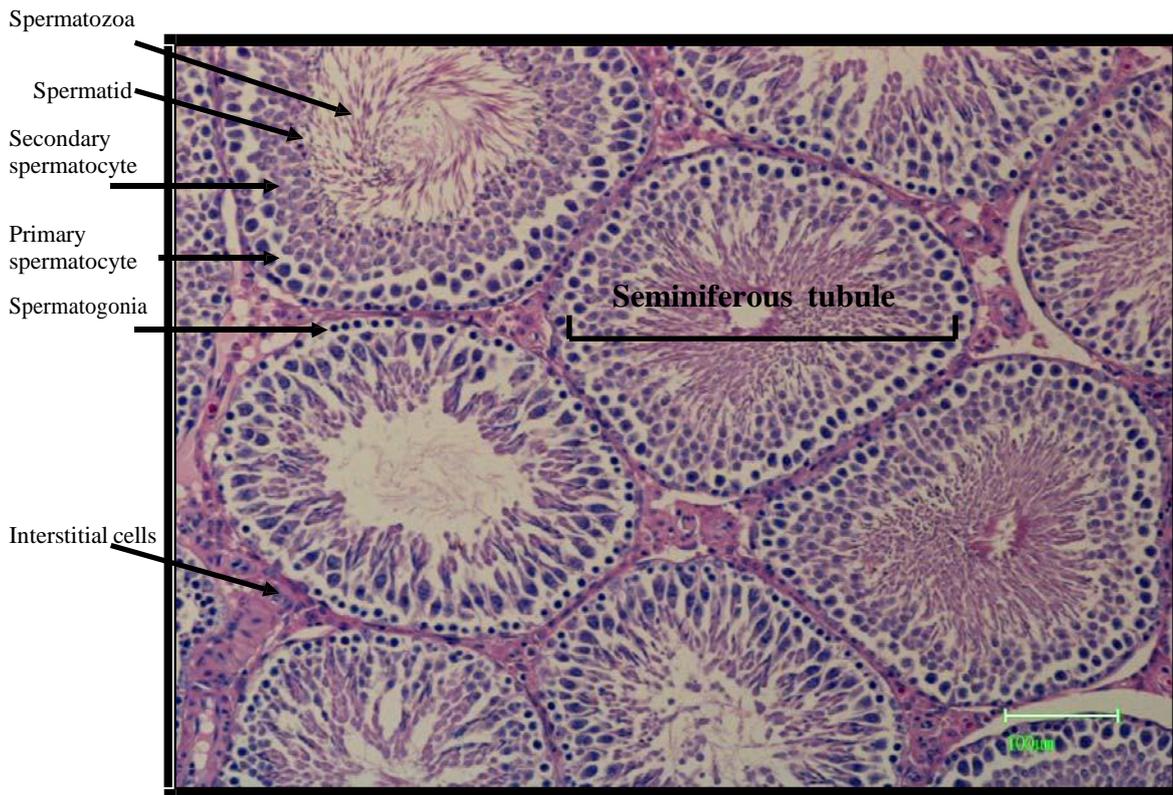


Cortex of the Kidney



Medulla of the Kidney





T.S. in the Testes (seminiferous tubules)



T.S. in Ovary