Lec 5 : Specialized connective tissues : Blood

Blood : is considered to be a type of connective tissue. Like other connective tissue types, blood is derived from mesoderm, the middle germ layer of developing embryos.

- The blood is composed of elements or cells suspended in a fluid matrix called plasma . the volume of blood in healthy adult human is about 5 liter .

The cellular element composed of

a. Erythrocyte **(Red blood cell**)

b. Leucocytes **(White blood cell)**

c. Platelets or **Thrombocytes.**

Blood functions involved:

1. Transport of oxygen , carbon dioxide and hormones.
2. Maintenance of acid –base balance .
3. Removal of waste products of cell metabolism
4. Temperature control of the body
5. Defense against infections .

*Plasma is the extracellular matrix of blood with red blood cells, white blood cells, and platelets suspended in the
plasma.

1.water (90%) 2. Proteins (7%) 3. Organic salt (1%) organic compound (2%) such as amino acids, lipid and vitamins.

2. The ratio of erythrocyte to the total blood volume is about 43% and known as hematocrit.

1. Leukocytes (WBC)

Leukocytes are colorless because they do not have hemoglobin however each cell has a nucleus .

- In the blood stream leukocyte are spherical in shape and capable of amoeboid movement.

*** WBCs fight infection in two ways:**

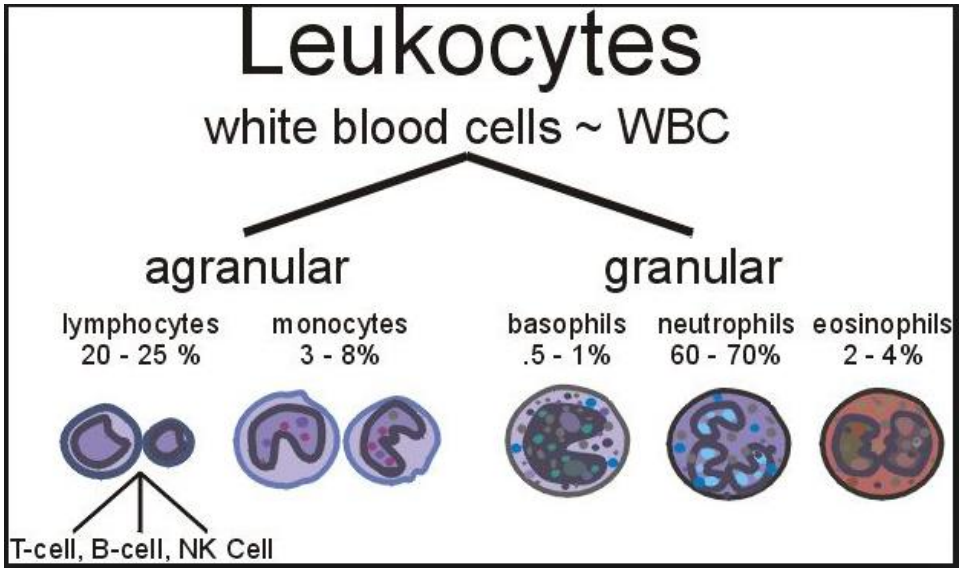
1. Some white blood cells are phagocytic and engulf pathogens.

2. Other white blood cells either produce antibodies , molecules that combine with foreign substances to inactivate them or they kill cells outright .

- According to the type of cytoplasmic granules and the shape of nuclei Leukocyte are classified into: .

a. granular leukocytes.

b. A granular leukocytes.



a. granular leukocytes :

They contain specific granular and lobulated nuclei . this type of leukocytes involved:

1. Neutrophils

- Compose 60 to 70% of the blood leukocytes.
- Nuclei have 3-5 lobes, which are connected together by thin strands of chromatin.

Bar body: is a drumstick chromosome or condensed chromatin visible in neutrophils contain all the organelles that make up a typical cell .

-The neutrophil cytoplasm contains fine violet or pink granules that are difficult to see with a light microscope . as result , the cytoplasm appears clear or neutral .

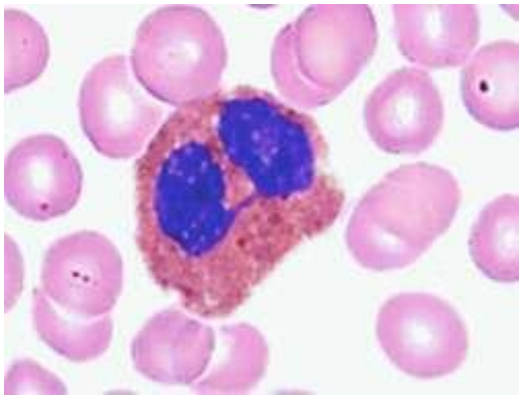
- First line of cellular defense against microorganism ,especially bacteria phagocyte small particles and microorganisms.

2. Eosinophils

- Compose 2 to 4% of the blood leukocytes.
- Eosinophils are identified in a blood smear by their cytoplasm, which is filled with distinct ,large ,esoinophils granules .

- **Nucleus** is bi-lobed but a small third lobe may be present.
- The cytoplasm granules are stained red or pink with eosin or other similar dyes.

- Recognize and phagocytose antigen- antibody complexes, and particles that are associated with these complexes that are formed during an immune response.



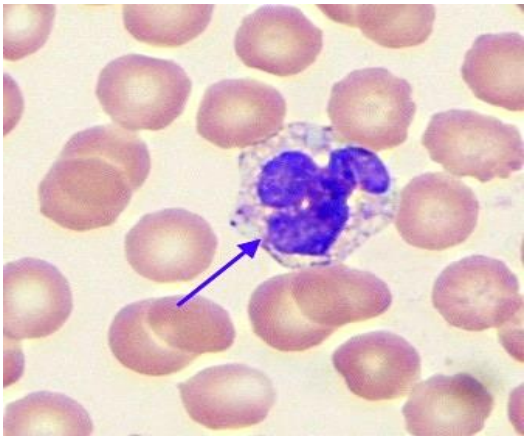
3. Basophils

- The basophils constitute less than 1% of the blood leukocyte and therefore the most difficult to find and identify in a blood smear.

-The nucleus is bi-lobed which hidden by the large cytoplasmic granules.

-The granules is basophil are not as numerous as in esinophils; however , they are more variable in size , less densely packed , and stain dark blue or brown.

- These cell carry histamine ,heparin and various mediators of inflammation and other protein chemicals.



b. Non Granular Leukocytes

They do not have specific granule with non lobulated nuclei .this type can be sub divided into:

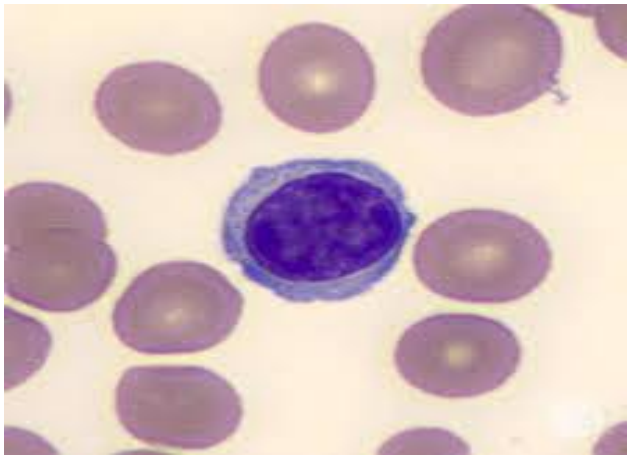
1. Lymphocytes

- Lymphocytes represent 20 to 40 % of the differential white cell count
- There are two structure types:

a. Small lymphocytes : ~5µm in diameter, and represent 3% of lymphocytes in peripheral blood. Most small lymphocytes in the blood stream belong to either the group or B- lymphocytes (~5%) Or the group of T- lymphocytes (~90%).

b. Large lymphocytes : 9 to 15µm in diameter, possibly natural killer cells; possibly dividing lymphocytes

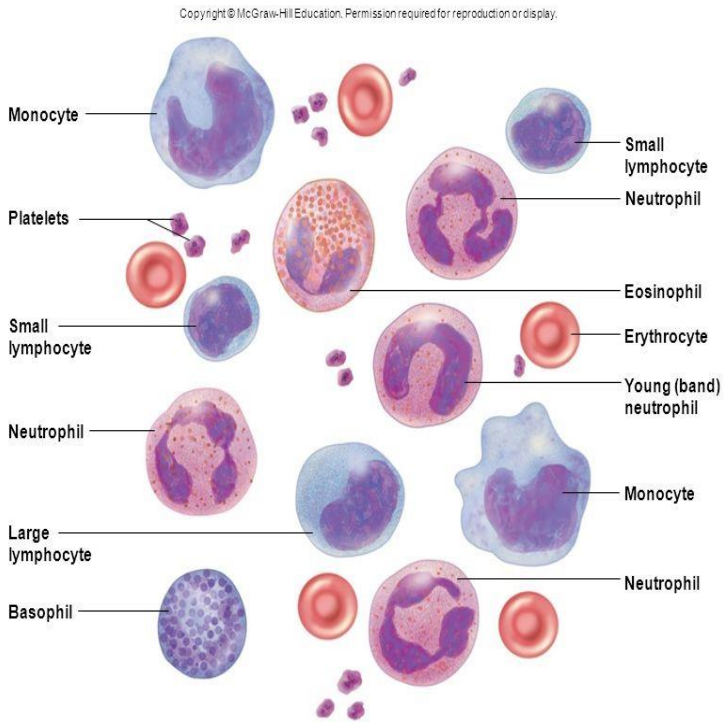
-The cell is rounded with densely stained nucleus, small amount of pale basophilic cytoplasm with free ribosomes ; short microvilli more numerous on B lymphocytes than T lymphocytes ,Only blood lymphocyte capable of division outside of bone marrow.



2- Monocytes

- Monocytes are large cells, 12-18µm in diameter; represent 2 to 10% of the differential white cell count.
- Monocytes are highly motile and phagocytic cells; i.e. they are the precursor of tissue phagocytes that migrate into tissues; engulf and destroy tissue debris & foreign material.
- Their nucleus less dense than lymphocytes ; deeply indented, C-shaped or kidney shaped.
- Their cytoplasm is pale grayish blue with small pink to purple stained lysosomal granules , and contain cytoplasmic vacuoles (frosted glass).
- Monocytes contain granules ,which are similar to the primary granules of neutrophils, i.e. Lysosomes containing acid phosphatase, aryl granules.
- They contain also secondary granules of unknown function.

Fig. 18.1



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2. Erythrocytes (RBCs)

-In the normal male the average number of (RBC) is about 5-6 million/cubic millimeter , in the female it is about 4.5-5 million /cubic millimeter.

- The life span of RBC is 4moths .

- Mature RBCs are flexible and oval biconcave disk.

-They lack a cell nucleus and most organelles, in order to accommodate maximum space for hemoglobin .

Erythrocytes function involved:

1. Transport oxygen from the lungs to the tissues.

2. Transport carbon dioxide from the tissue to the lungs.

3. Blood platelets or thrombocytes

- Platelets or thrombocytes are small fragments of cytoplasm measuring about 2-5 µm in diameter.

- Blood platelets do not contain nucleus, they are cytoplasmic fragments of very large thrombocyte (megakaryocytes) that are found in the bone marrow.

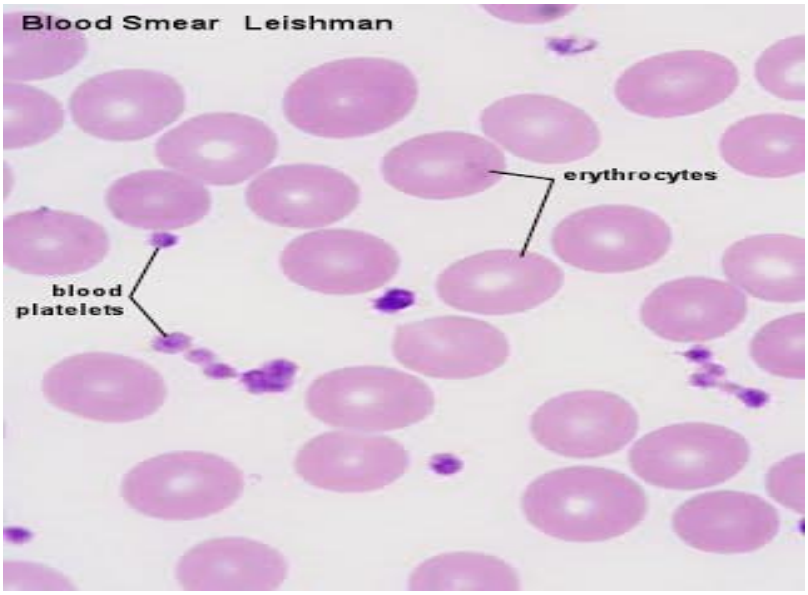
-Their number is 150,000-400,000/mm3.

-They are rounded or oval, biconvex discs.

-The cytoplasm is divided into two zones: an outer **hyalomere**, and an inner **granulomere**, which contains bluish staining granules.

- The hyalomere contains **cytoskeletal fibers,** which include actin and myosin.

- Their cytoplasm is purple-staining, granular, organelles concentrated toward center; granules constitute about 20%
volume.



Lec 6:

Bone marrow

- Bone marrow compose 5% of the total body weight .

- It is responsible for the formation of blood cells (hemopoiesis) and store fat.

-There are two type of bone marrow based on their appearance at gross examination :

1- Red bone marrow

2- Yellow bone marrow

- Form birth to early puberty , they majority of the bone marrow is Red marrow.

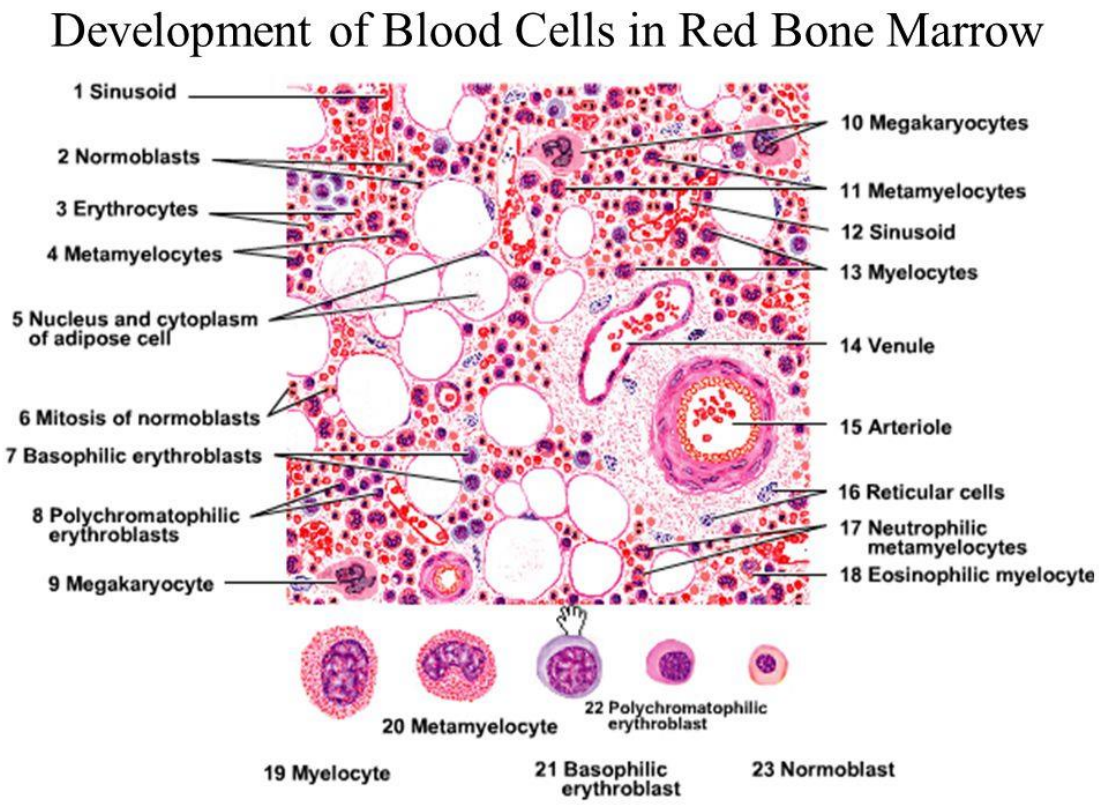
- As a person grows and matures, increasing amounts of red marrow is replaced by yellow marrow.

- Bone marrow is separated into a vascular section and non-vascular sections.

-The vascular sections contains blood vessels that supply the bone with nutrients and transport blood stem cells and mature blood cells away from the bone and into circulation.

- The non-vascular section of the bone marrow are where **hematopoiesis** or blood cell formation occur . This area contains immature blood cells , fat cells, white blood cells(macrophage and plasma cell), and thin , branching fibers of reticular connective tissue.

- While all blood cells are derived from bone marrow , some white blood cells mature in other organs such as the spleen , lymph nodes and thymus gland.



Hematopoiesis : The formation of blood cellular components – occurs during embryonic development and throughout adulthood to produce and replenish the blood system.

The pluripotent stem cells proliferate two major cell lineages :

1.Lymphoid cells (lymphocytes).

2.Myeloid cells (Gr.myyelos, marrow) that develop in bone marrow . myeloid cells include granulocytes, erythrocyte and megakaryocytes.

The cells include:

1.Hemocyteblast : A type of stem cell found in bone marrow . It is able to produce all blood cell.

2.Megakaryocytes: is a large cell , irregularly shaped that has a greatly lobulated nucleus.

3.Normoblast : A nucleated red blood cell , the immediate precursor of a normal red blood cell in humans.

4.Acidophilic myelocyte : a cell with a round –oval nuclei with condensed chromatine , the cytoplasim contain coarse , deep red , uniformly sized granules , and is the source of Acidophil.

5. Netrophilic metamyelocyte : a cell with kidney –shaped nucleus . the nuclear chromatin stains dark purple and is condensed into irregular strands and is the source of neutrophilic

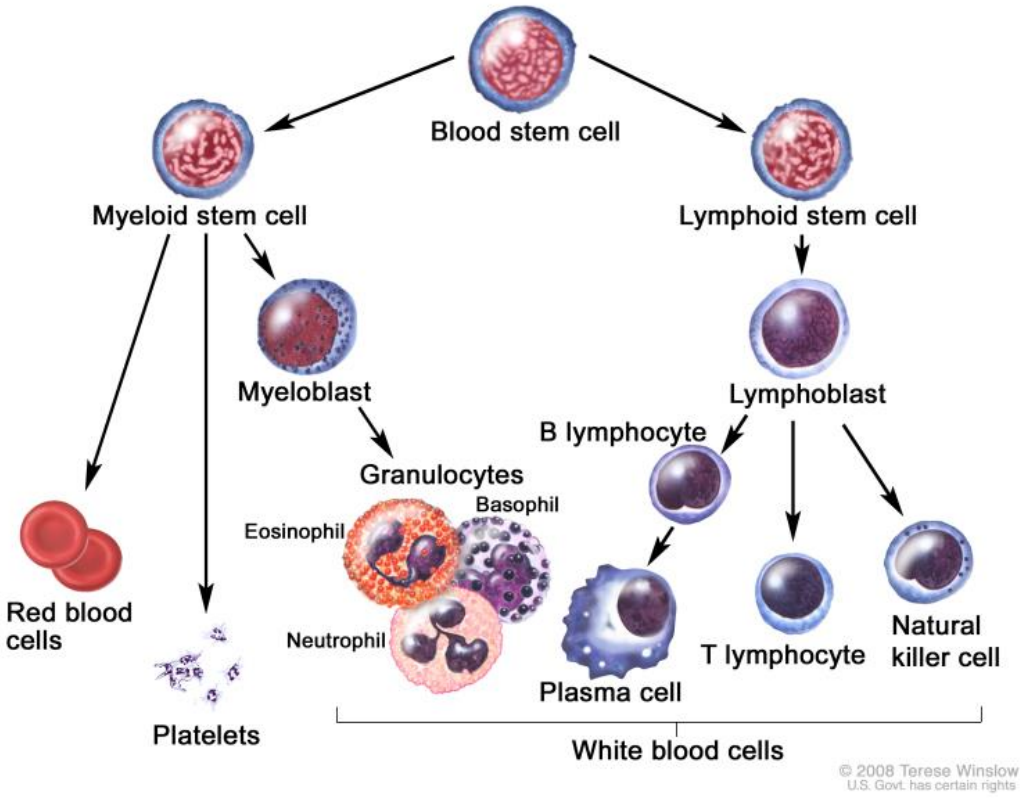
.

6. Basophilic metamyelocyte: a basophilic precursor in the granulocytic series , being a cell intermediate in development between a basophilic myelocyte and a band form basophili. The nucleus becomes indented where the indentation is smaller than half the distance to the farthest nuclear margin ; chromatin becomes coarse and clumped specific granules predominate while primary granules are rare.

7. promonocyte : is a cell which is developing into a monocyte . in the promonocyte stage of development , the nucleolus is still visible while the nucleus begins to indent and fold . this may be observed as pleated or creased looking chromatin or as a definite flattening or indenting of the nucleus .

the chromatin will begin to condense but will still be finer and more lacy than what is found in a mature monocyte.

8. lymphoblast : immature white blood cell that gives rise to a type of immune cell known as a lymphocyte . the nucleus contains moderately fine chromatin and has a well –defined nuclear membrane . there are one or two nuclei ,and the cytoplasm is small or moderate in amount.



Lec 7: muscular tissues:

General characteristics of muscles :

1. The structural and functional units of muscles are formed of special elongated cells known as muscle fibers.

2. A muscle fiber is enclosed by plasma membrane called the sarcolemma.

3. The cytoplasm of these muscle fibers is known as sarcoplasm.

4. Within the sarcoplasma . the T- tubules allow transport of substances throughout the muscle fiber and sarcoplasmic reticulum stores calcium.

5. The structure and functional subunits are myofibrils which found in sarcoplasm.

6. Two types of myofilament , thin (protein actin) and thick (protein myosin), associated with muscle contraction.

7. This tissue is responsible for:

a. Movement of the body and its parts.

b. Changes the size and shape of internal organs.

8. The fibers rest on the basement membrane .

Basic physiological property of muscle tissue

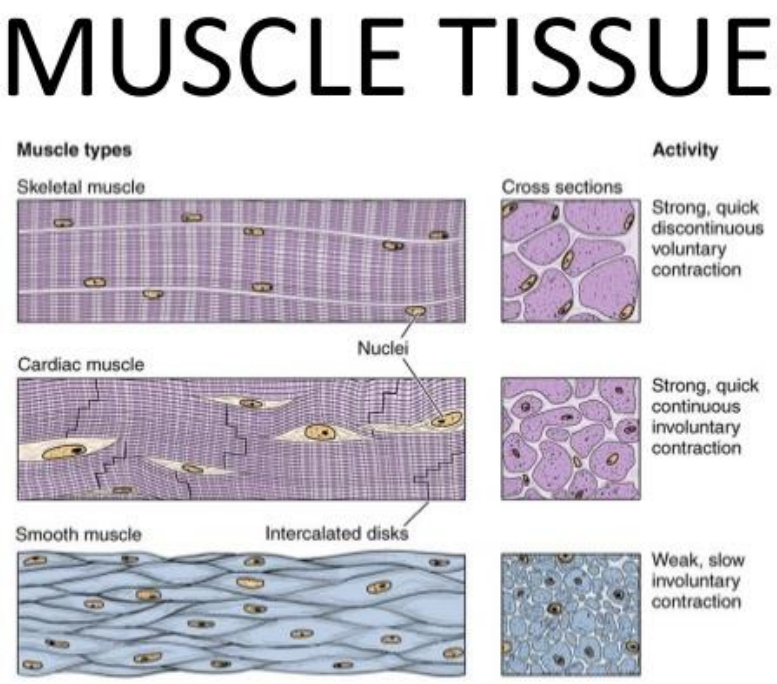
1. Contractibility
2. Excitability
3. Extensibility
4. Elasticity

There are three types of muscle tissue:

♣ **Skeletal muscle**—Skeletal muscle tissue moves the body by pulling on bones of the skeleton.

♣ **Cardiac muscle**—Cardiac muscle tissue pushes blood through the arteries and veins of the circulatory system.

♣ **Smooth muscle**—Smooth muscle tissues push fluids and solids along the digestive tract and perform varied functions in other systems.



1. Skeletal muscle:

- It acquires its name because most of the muscles involved are attached to skeleton, and make it move.
- Also known as **Striated** muscle -because it cell (fiber) are composed of alternating **light** and **dark band (stripe).**
- Also known as **voluntary muscle**.

Structure

1. Composed of **muscle fibres.** Each muscle fibre is long, cylindrical shaped with multinucleate with peripheral location immediately beneath the sarcolemma.

3.Each fiber contains numerous **myofibrils**, which are made up of thick and thin threads .

4. found :attached to the bones and in some visceral organs.

5. voluntary contraction.

6. The fibers held together by sheaths (**a.Endomysium b. Perimysium , c. Epimysium) .**

a. Endomysium: is a delicate layer that immediately surround the individual fibers.

b.Perimysium: is a thick layer of connective tissue, surround group of fibers that form fascicle .

c. **Epimysium:** is the sheath of dense connective tissue that surround a collection of fascicle.

Structure of skeletal fibers :

1.Under light microscope the skeletal muscle showed light bands **(I-band)** and dark bands **(A-band)**.

2. each **I-band** is bisected by transverse line called **Z-line**

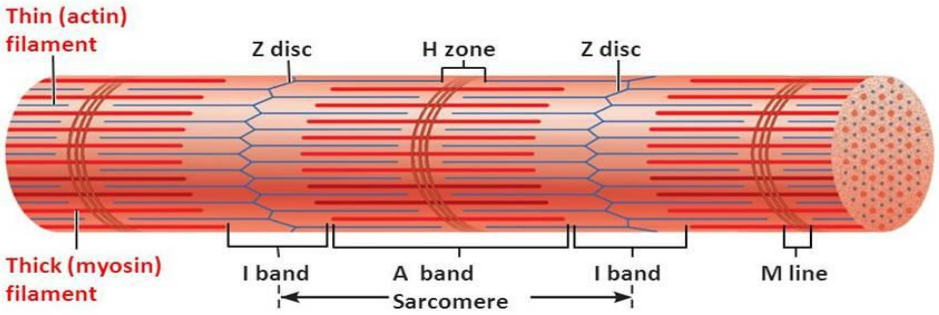
3. The area between two Z line is known as **sarcomere,** which is the **fundamental contractile unit of myofibril.**

4. The **A-band** has a lighter zone in center called (**H-zone**) which bisected by **M –line**.

*** light I band = (isotropic band); allow light to pass.**

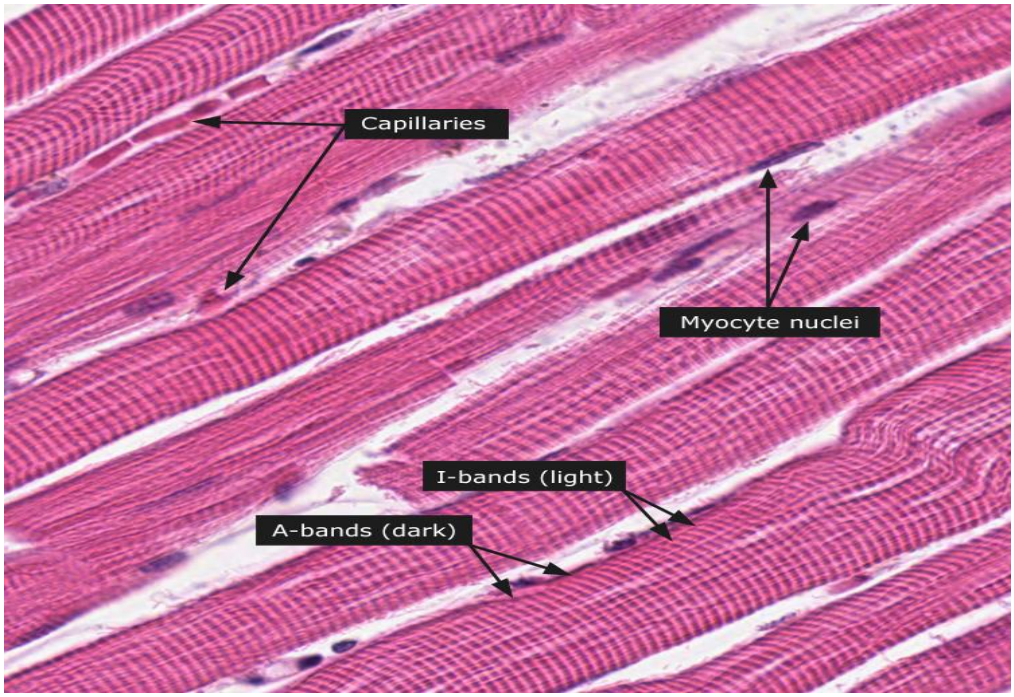
***dark A band (anisotropic band) ; doesnot allow light to pass**.

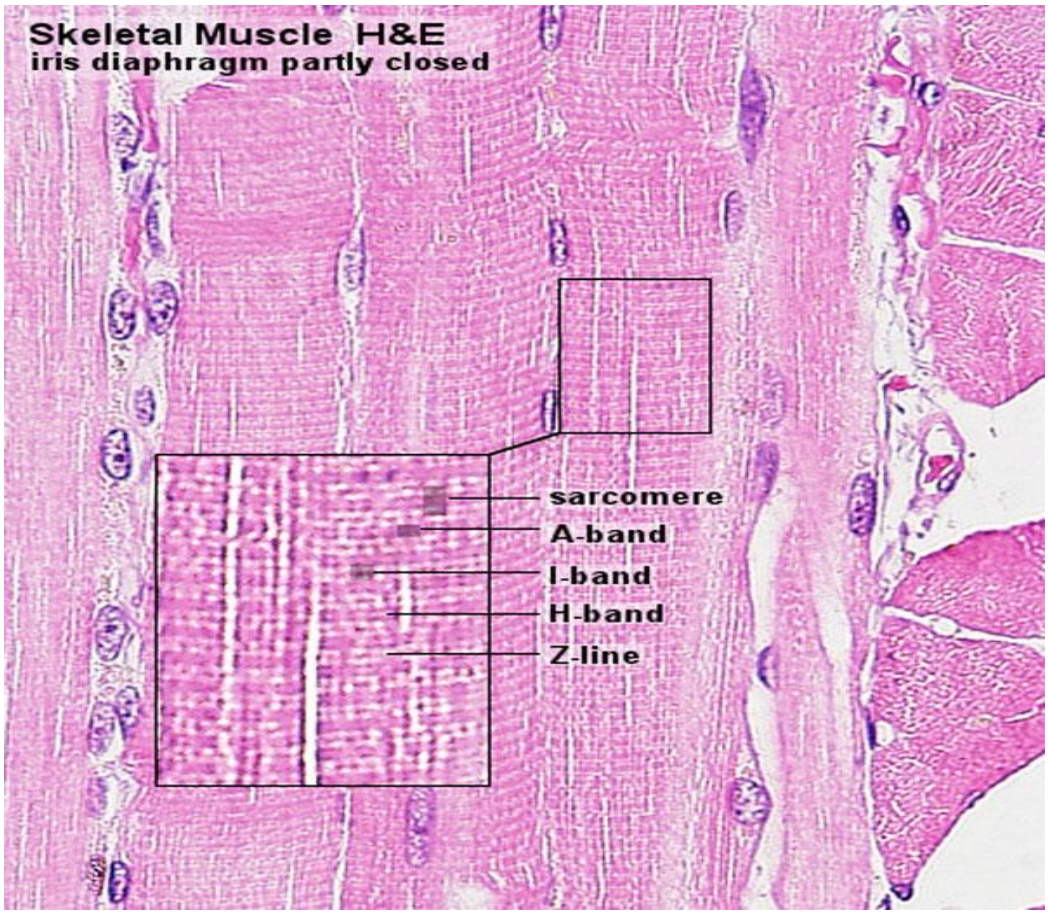
Figure 9.2c Microscopic anatomy of a skeletal muscle fiber.



(c) Small part of one **myofibril enlarged to show the myofilaments** responsible for the banding pattern. Each **sarcomere** extends from one Z disc to the next.

Pg 280



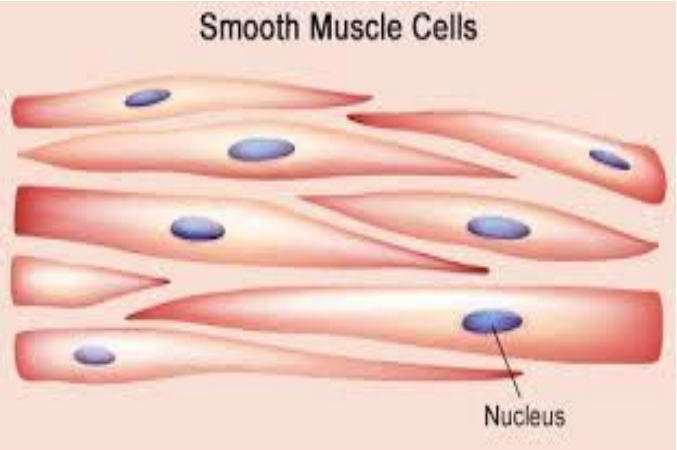


Skeletal muscle under microscope

2. Smooth muscle:

- It get its name because it is **not striated**, and appear smooth under microscope.

Structure



1. **Muscle fiber** is long (but not nearly as long as skeletal muscle fiber, spindle shaped and slender. Contain only one nucleus, situated at the centre of the fiber at the broadest part.

2. Smooth muscle fiber is enclosed by sarcolemma, and contain numerous longitudinal myofibrils.

3. **Actin and myosin myofilaments** within myofibrils are **very thin** and are **arranged more randomly** than in skeletal muscle, so there is no stripes.

4. **found :** in vessels and visceral organs as bundles or sheets.

5. involuntary muscle.

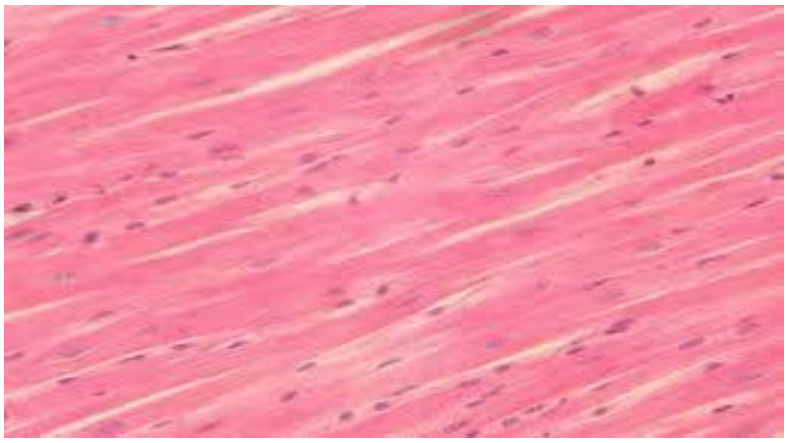
6. Endomysium Sheath is present.

7. The cross striation is none.

2 main characteristics

-Its contraction and relaxation period are slower

-Its action is **rhythemical**. Its contraction may last for 3o sec or more, but it doesnot tired easily. Such sustained contraction puls the **ability to stretch** made it suitable to muscular control of **stomach, intestine, urinary bladder, uterus**.

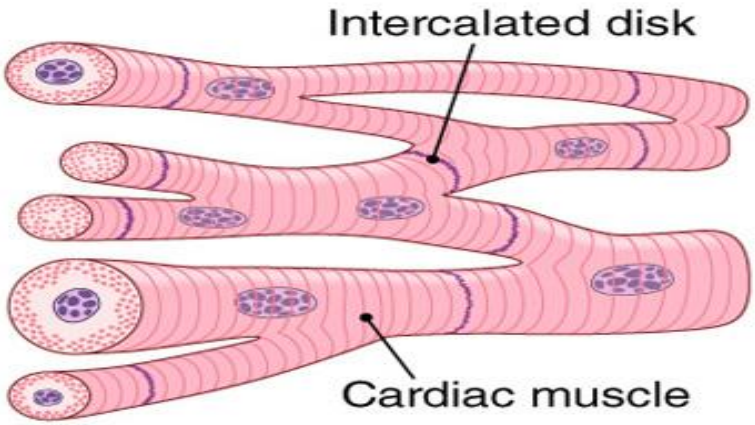


Smooth muscles

3. Cardiac muscle:

It is present only in **heart**

Structure-



1. Under microscope, they have similar striation as skeletal muscle

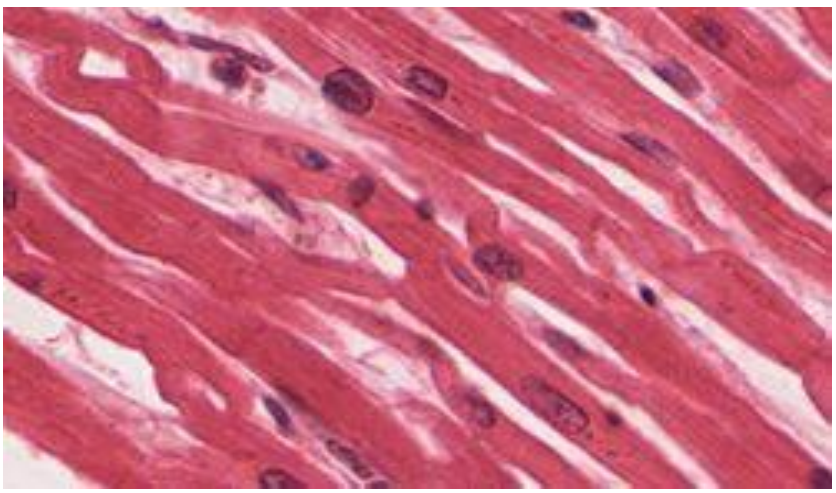
2. Cardiac muscle cells are closely packed but each cell are nucleated and separated from each other

3 . The cells are joined end to end by the specialized cell junctions called **(intercalated disks)** that attach one cell to another with **desmosomes,** connect the myofibril filaments of adjacent cells and contain gap junctions that help to syncronise the contraction of cardiac muscle, by allowing impulse transmission from one cell to another.

4. They contain **light I** and **dark A band,** the **intercalated disk** always occur at the **location of Z-line**

5. Purkinje fibers are specialized and modified cardiac muscle fibers which found in the heart . cardiac muscle has spontaneous rhythmic contraction .

6. Involuntary muscle.



Cardiac muscles

Comparison of Structure and Properties of Muscle Tissue Types			
Tissue	**Histology**	**Function**	**Location**
Skeletal	**Long cylindrical fiber, striated, many peripherally located nuclei**	**Voluntary movement, produces heat, protects organs**	**Attached to bones and around entrance points to body (e.g., mouth, anus)**
Cardiac	**Short, branched, striated, single central nucleus**	**Contracts to pump blood**	**Heart**
Smooth	**Short, spindle-shaped, no evident striation, single nucleus in each fiber**	**Involuntary movement, moves food, involuntary control of respiration, moves secretions, regulates flow of blood in arteries by contraction**	**Walls of major organs and passageways**

***Comparison of Structure and Properties of Muscle Tissue Types**

Skeletal muscle fibers	Smooth muscle fibers
The muscle fibers are long cylindrical in shape	The muscle fibers are spindle in shape
Multinucleated cells with spherical nuclei.	Mono-nucleated with central location.
Striated muscles	Non-striated muscles
Voluntary muscles	Involuntary muscles
Conjunction with skeletal bone	Lining of visceral hollow organs and blood vessels

Cardiac muscle fiber	Skeletal muscle fibers
Located in the walls and septa of the heart	Conjunction with skeletal bone
Shorter and branched	Longer and unbranched
Striated muscles	Striated muscles
Contain intercalated discs	Un contain intercalated discs
Contain one or two central nuclei	Contain multinucleated cells with peripheral nuclei
Involuntary muscles	Voluntary muscles

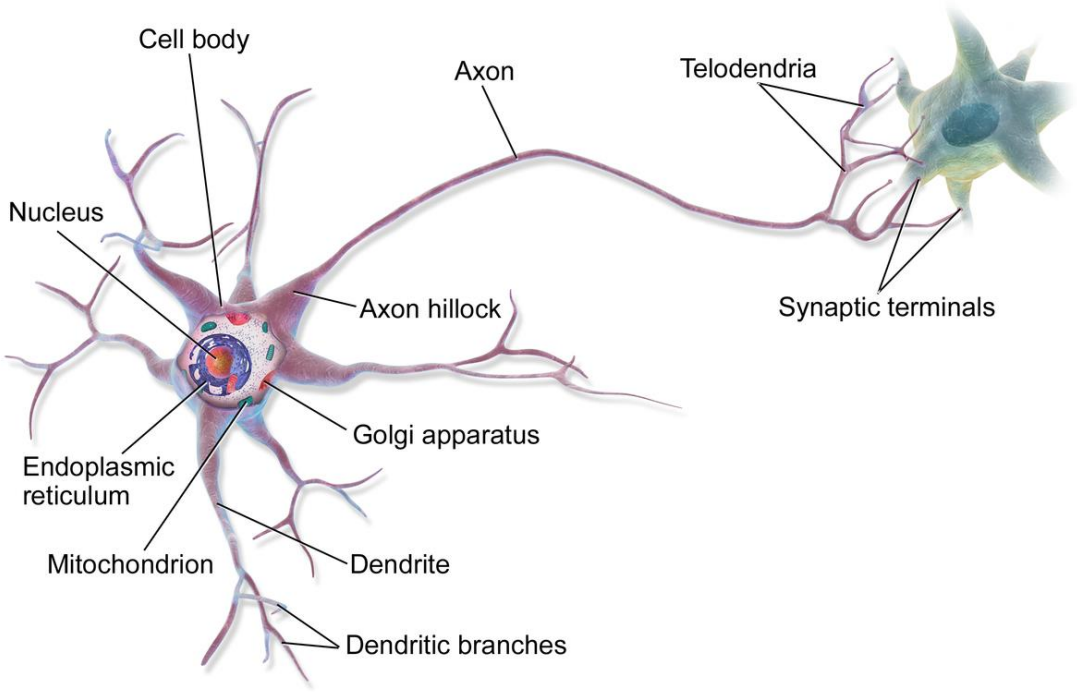
Lec 8: Nervous tissue:

Is one of four major classes of tissues. It is specialized tissue found in the central nervous system and the peripheral nervous system. It consists of neurons and supporting cells called neuroglia.

The nervous system is responsible for the control of the body and the communication among its parts. Nervous tissue contains two categories of cells—neurons and neuroglia.

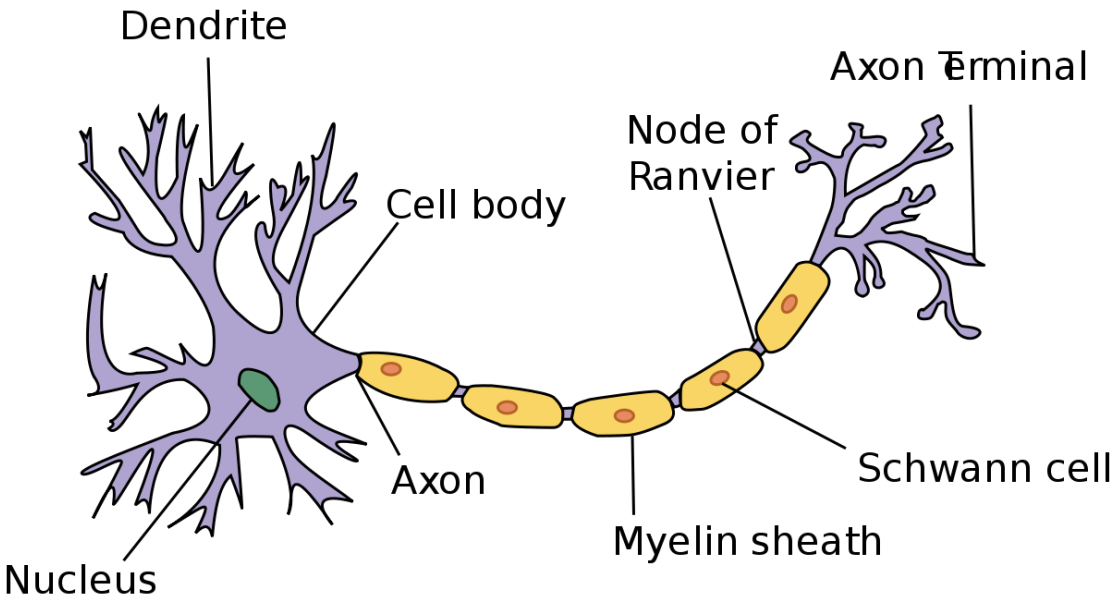
1. Central nervous system (CNS) : Composed of the brain and spinal cord. Its major functions are to integrate sensory information, and to initiate and co-ordinate efferent responses.

2. Peripheral nervous system (PNS) : Composed of all nervous tissue outside the CNS. The PNS is represent by cranial nerves from the brain , spinal nerves from the spinal cord , and nodules known as ganglia, that contain the neural cell bodies.



Neurons (Nerves cell):

Neurons are highly specialized nerve cells that generate and conduct nerve impulses. A typical neuron consists of dendrites, the cell body, and an axon.



Dendrites:

- Numerous short –branched structures emerging from the soma are called Dendrites they are often covered with small , branched projections known as dendritic spines.
- The function of dendrites are receptor of a neuron that receive electrical signals from other neurons.
- The function of dentritic spines involved to increased the surface area of the dendrite vastly , thus helping in receiving impulses fromm other axon.

2. Cell body (perikaryon)

Cell body- central unit of neuron. Contains nucleus, cytoplasm, etc.

- The nucleus is central ,large ,single.

-The cytoplasm has granules called (**Nissl bodies**) which are distributed In the cytoplasm of the cell body except in the region close to the axon called axon hillock .

- Mitochondria , Golgi complex, lysosomes and other cell organelles are present.

3. Axon

Process (a single nerve fiber) that takes impulses away from the cell body. Neurons have at least 1 axon.

- The cytoplasm of the axon is termed axoplasm.
- The plasma membrane bounding the axon is called axolemma.
- The axon is covered with a white fatty layer known as the myelin sheath , this sheath serves two major functions protecting and insulating the axon and accelerating the electrical signals during transmission.
- The myelin sheath layer has a cellular covering known as the neurilemma or the Schwann cell sheath . this sheath is essential for regeneration of nerves. It is present only in the peripheral nervous system . in the central nervous system , nerurilemma is absent , thus nerves here are incapable of regeneration .
- The medullary sheath is not continuous layer on the axon ;it has joints or node –type interruptions known as the **nodes of Ranvier**

Classifications of neuron:

A. according to the number of processes

1. Pesudounipolar neuron:

These neurons consist of one dendrite and one axon.

The nerve cell body has two processes which are adherent to each other forming one pole.

-It is seen in spinal sensory ganglia.

2. Biopolar neurons:

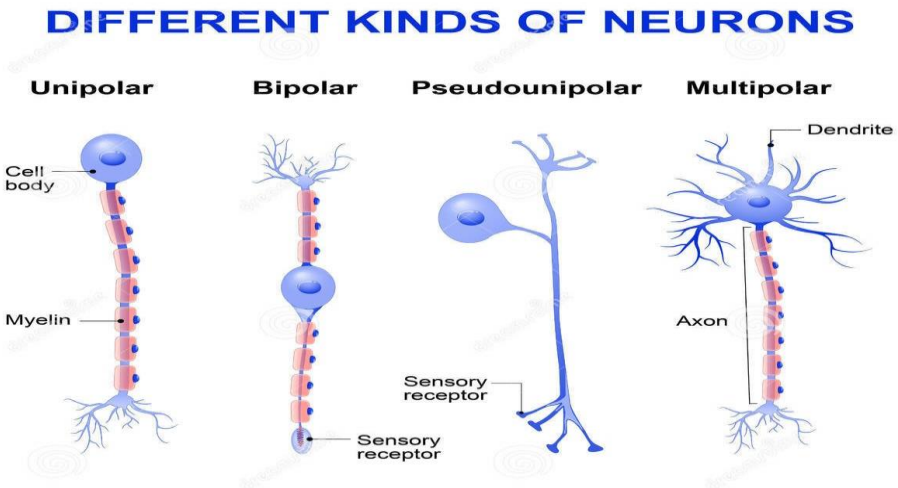
The nerve cell body has spindle shape and has two processes from the two pols , a short dendrite and a long axon.

-It is seen in the olfactory epithelium of the nasal cavity.

3. Multipolar neurons

The nerve cell have a single long axon and many short dendrites.

They represented most of the neuron in the brain and spinal cord.



B. according the functions

1. Motor (Efferent) neurons

- This type carry motor impulses from central nervous system (CNS) to peripheral end organ.

- The site of this type is a motor nuclei in anterior horn cell of spinal cord.

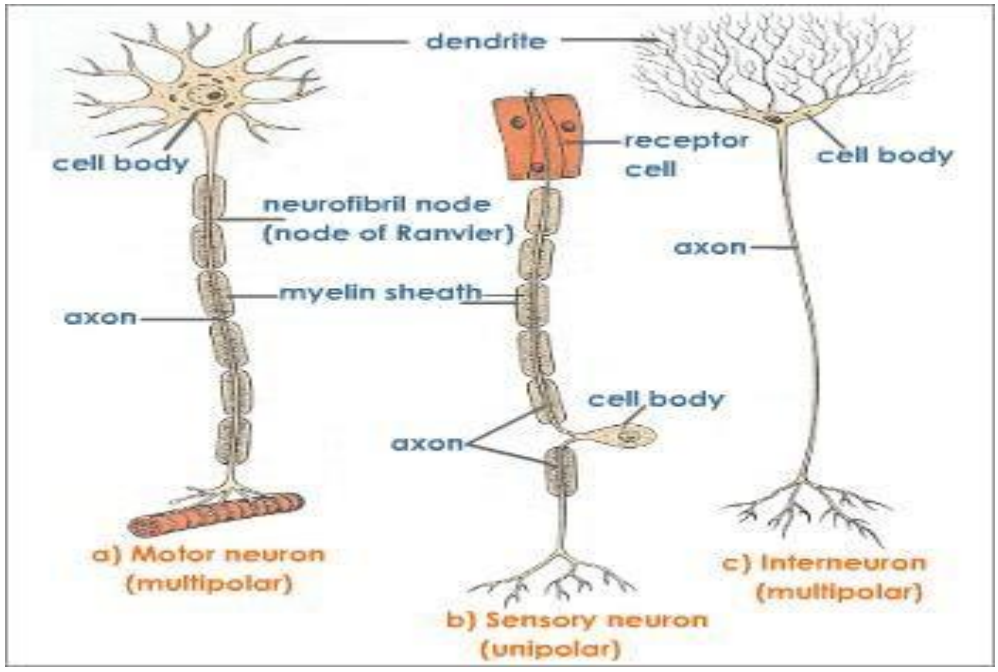
2. Sensory (Afferent) neurons

-This type receive impulses from peripheral sensory cells and organ and then carry them toward CNS

-The site of this type is sensory spinal ganglia.

3. Interneurons

- This type have short neurons that connect a sensory and motor neuron, The site of this type is spinal cord in reflex arc .



Neuroglia:

- Neuroglia or glial cells are protective and support structure of the nervous tissue.

- They are found in bunches surrounding the neurons and have the ability to regenerate in case of injury .

-They are located in both peripheral ad central nervous system .

* Neruroglia of peripheral nervous system (PNS) include:

1.schwann cell

2. satellite cell

*** Neruroglia of central nervous system (CNS)**

1.Astrocytes

- Two types of astrocytes

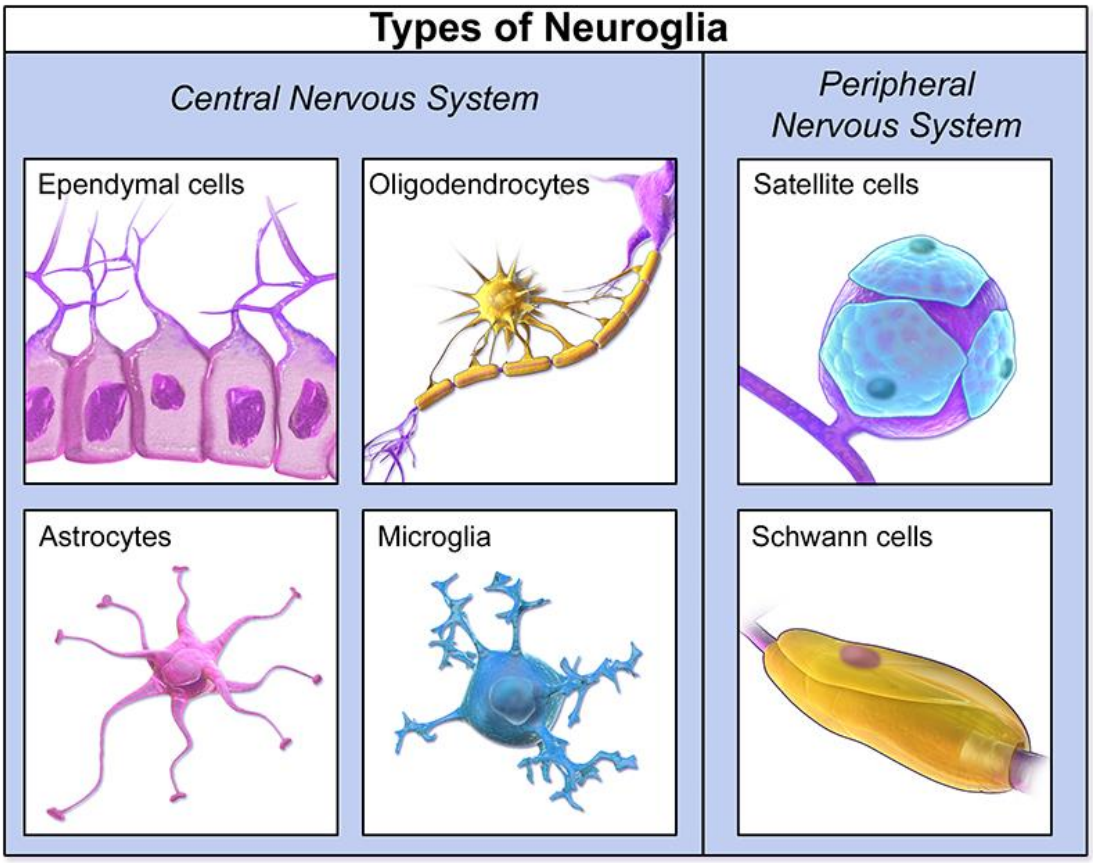
a. fibrous astrocytes.

b. protoplasmic astrocytes.

2. Oligodendroglia

3. Microglia

4. Ependymal cells.



Synapse

- Any two neurons are connected together at the site called synapse.

-Information from one neuron flows to another neuron across a synapse.

- according to the site , synapse are classified into;

1.Axo-dendritic between axon and dendrite .

2.Axo-axonic between axon cell body (soma)

3. Axo-axonic between axon and another axon.

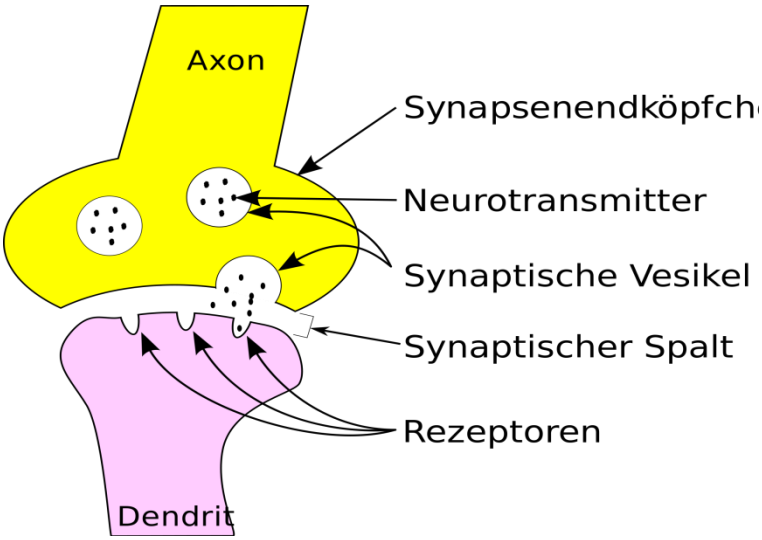
Synapses have 4 main functions

a- They transmit information between neurons .

b- They filter out low frequency impulses .

c. They act as valves to ensure that impulses pass across then in one direction only.

d. they also act as junctions allowing impulses to be divided up along many neuron or merge into one.



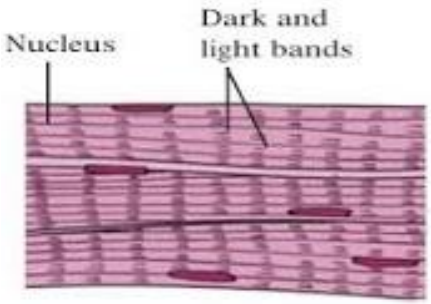
Nerve fibers:

- A nerve fiber is an axon and its sheath.
- Long , peripheral axons are surrounded by a multi-layered white . Phospholipid , segmented covering called myelin sheath .
- Axons with the covering are known as myelinated fibers and those without are unmyelinated fibers.
- The functions of the myelin sheath is to increase the speed of nerve impulse conduction.
- Myelin sheaths in the PNS are formed by multiple layers of wrapped Schwann cells.
- The outer surface of the Schwann cells is the neurilemma or sheath of Schwann and is located just beneath the plasma membrane of the cell.

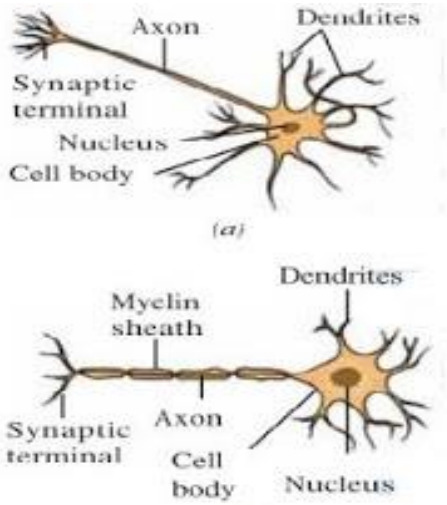
- Between Schwann cells in an unmyelinated gap called the node of **Ranvier**.

- Unmyelinated fibers are also enclosed by Schwann cells, but without multiple wrappings.

-CNS myelin sheaths also lack a neurilemma.



A strained muscle fibre



(a) Non-myelinated nerve fibre
(b) Myelinated nerve fibre