LECTURE 1:
NORMAL CELLS OF CNS

- **Objectives:**

At the end of this lecture, you should describe the microscopic structure and the function of:

1. **Neurons:**
   - *Cell body (perikaryon).*
   - *Processes: An axon and dendrites.*
2. **Neuroglia:**
   - *Astrocytes.*
   - *Oligodendrocytes.*
   - *Microglia.*
   - *Ependymal cells.*

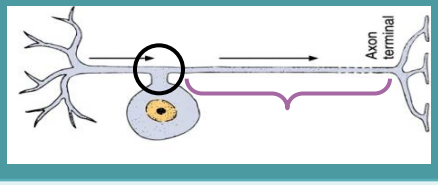
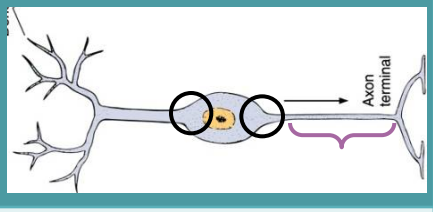
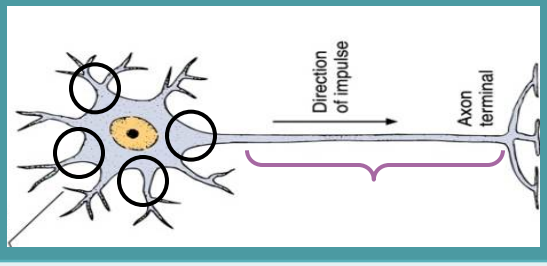
Neuron

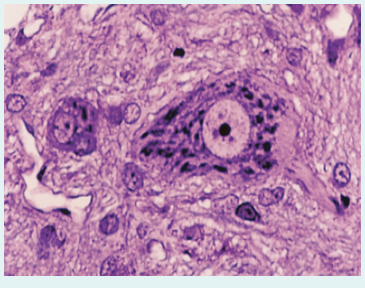
Notes:
- Neurons out of the CNS are called ganglia
- Processes are extensions of cytoplasm so they are able to branch

❖ Components:

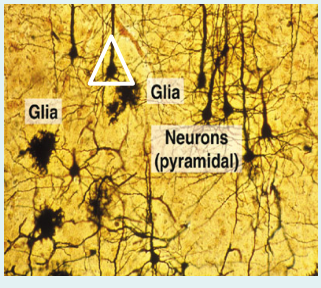
1) **Cell body** *(Perikaryon)*
2) **Processes**: *Only ONE axon & one or more dendrites.*

❖ Types of neurons based on: Number of processes

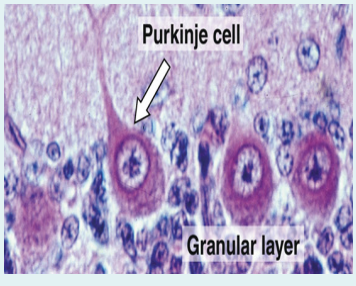
Unipolar (Pseudounipolar) neuron *(rounded neuron)*	**Bipolar** Neuron *(spindle-shaped neuron)*	**Multipolar** neuron
		
ONE process, divides into → TWO branches: •One acts as a Dendrite. •ONE acts as a Axon.	TWO processes, one arising from each pole: •One dentdrite. •ONE axon	Has ONE axon & MULTIPUL dendrites. ❖Types of Multipolar neurons: a) Stellate Neuron •The commonest type •Distributed in most areas of CNS (example: Anterior horn cells of the spinal cord) b) Pyramidal Neuron •Distributed in motor area 4 of the cerebral cortex. c) Pyriform Neuron •Pear-shaped (example: Purkinje cells of cerebellar cortex)
Example: •Mesencephalic nucleus of trigeminal nerve *[the 5th cranial nerve]* •dorsal root (spinal) ganglion.	Example: •retina •Olfactory epithelium. *•10% of the neurons found outside CNS like: ganglia and olfactory.*	



a) Stellate "Star" Neuron



b) Pyramidal Neuron



c) Pyriform "Pear" Neuron

CELL BODY (Perikaryon)

❖ **It contains**: Nucleus & cytoplasm

Nucleus

- Single (never divided) *[processes can heal, but soma cannot]*
- Large and central *[due to active secretion (Ach)]*
- Vesicular "Open-face" & rounded: full of loose active chromatin "Euchromatin"
- prominent nucleolus.

Cytoplasm

1) ***Nissl bodies***: Are basophilic patches of rER and free ribosomes in the cell body and bases of wide dendrites. *[never found in axon]*

2) ***Neurofilaments***: Are intermediate filaments which are bundled together to form neurofibrils. Are found in the cell body, axon and dendrites.

3) ***Microtubules***: Are found in the cell body, axon and dendrites

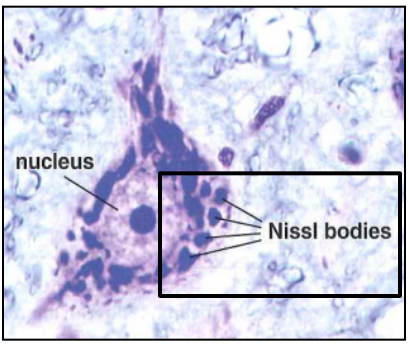
4) ***Golgi apparatus***: Surrounds the nucleus all around

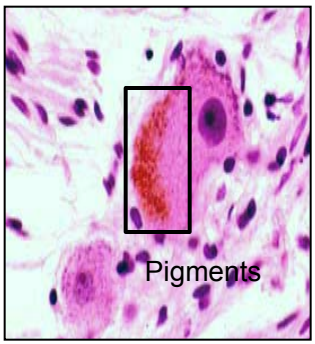
5) ***Mitochondria***

6) ***Centriole***: Most adult neurons have only one rudimentary *(not fully developed)* centriole, so they cannot divide. *[can divide in childhood]*

7) ***Some fat and glycogen granules***

8) ***Pigments***
   - Lipofuscin pigments (in old age).
   - Melanin pigments (in neurons of substantia nigra (black) of the midbrain).





TYPES OF NERVE FIBERS IN CNS

Unmyelinated **without** neurilemmal sheath
(in grey matter)

Myelinated **without** neurilemmal sheath
(in white matter)

[Neurilemmal sheath is derived from the Schwan cells in the PNS for protection (there are no Schwan cells in the CNS)]

NEUROGLIA

Definition: are group of cells that act as the **supportive tissue of CNS** (specific supportive tissue)
Has 4 types: 1) Astrocytes 2) Oligodendrocytes
3) Microglia 4) Ependyma

Notes:
- In the CNS we do not have CT, we have neuroglia.
- Neuroglia can be renewed.
- After injury, we do not have fibrosis, we have gliosis.

1) Astrocytes

- The **commonest type** of neuroglia cells
- Found in **both the grey and white matter**.
- **Star-shaped cells** with numerous long processes.

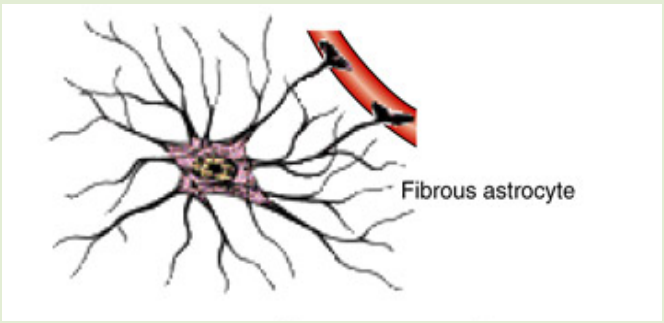
Types of astrocytes

a) Protoplasmic astrocytes

- in the **grey** matter of CNS.
- Their processes branch extensively.

b) Fibrous astrocytes

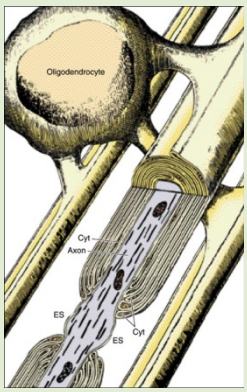
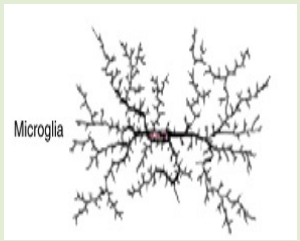
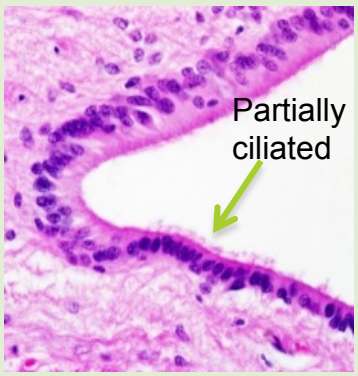
- found in **white** matter of CNS.
- Their processes have fewer but longer branches.



Functions of Astrocytes

1. Repair of injury of CNS tissue (gliosis).
2. **Supportive** and **nutritive** functions to the neurons.
3. Participate in the formation of **blood-brain barrier**.

Continuation of the Neuroglia:

Neuroglia cells	2)Oligodendrocytes	3) Microglia	4) Ependyma
Features	- Are branching cells with few, short processes.	-spindle-shaped cells with branching processes rising from each pole.	-simple columnar epithelial cells (partially ciliated)
Location	found in **grey** and **white** matter of CNS.	Found in the **grey** and **white** matter of CNS.	lining the brain ventricles and the central canal of spinal cord.
Functions	-Formation of myelin sheath in the CNS. -Insulation of nerve fibers.	Their main function is **phagocytosis** because they rich in lysosomes - derived from monocyte like macrophages	* You find it in the place where CSF is present
Notes	• Oligodendrocytes' function in the CNS is like the Schwan cell's function in the PNS: Myelination of CNS	It's function is similar to macrophages	CSF moves here
Slide			

Neuroglia is 10 times neurons in number , because it can regenerate.

Summary

- **Neurons:**

  Types of neurons::

  pseudounipolar

  bipolar

  multipolar: stellate, Pyramidal, Pyriform.

  Components:

  Cell body

  Processes: Axon and dendrites.

  Types of nerve fibers in CNS: Unmyelinated, Myelinated.

- **Neuroglia:**

1) Astrocytes.
2) Oligodendrocytes.
3) Microglia.
4) Ependyma.

MCQs

Q1- A Neuron contains:

a) Cell Body
b) An Axon and dendrites
c) Astrocytes
d) a & b

Q2- Which of these statements is true about a Neuron?

a) Has only one axon
b) One or more dendrites
c) a cell body
d) All of the above

Q3- Which of the following is an example of a Unipolar Neuron ?

a) Mesencephalic nucleus of Trigeminal nerve
b) Dorsal Root Ganglion
c) Olfactory Epithelium
d) A & B

Q4- A Stellate Neuron:

a) is the most common type of multipolar neurons
b) is in the Dorsal Root Ganglion
c) has two axons and multiple dendrites
d) All of the above

Q5- Where are the Pyriform Neuron located ?

a) Distributed in motor area 4 of cerebral cortex
b) Purkinje cells of cerebellar cortex
c) Distributed in most areas of CNS
d) All of the above

Q6- Where are the Pyramidal Neurons located?

a) Distributed in motor area 4 of cerebral cortex
b) Purkinje cells of cerebellar cortex
c) Distributed in most areas of CNS
d) All of the above

Q7- Nissl Bodies are found in the:

a) Axon
b) Cell body
c) Bases of wide dendrites
d) b & c

Q8- Microtubules are found in the:

a) Axon
b) Cell body
c) Dendrites
d) All of the above

1-d 2-d 3-d 4-a
5-b 6-a 7-d 8-d

MCQs

Q9- Most adult neurons have …… rudimentary centriole. Fill in the blank:

a) only one
b) two
c) three
d) four

Q10- Lipofuscin pigments are found in:

a) Old people
b) Children
c) Adults
d) All of the above

Q11- Melanin pigments are found in neurons of …… of the midbrain. Fill in the blank.

a) Substantia Nigra
b) Dorsal part (Tectum)
c) Ventral part (Tegmentum)
d) All of the above

Q12- The Grey Matter of the CNS is:

a) Myelinated without neurilemmal sheath
b) Myelinated with neurilemmal sheath
c) Unmyelinated with neurilemmal sheath
d) Unmyelinated without neurilemmal sheath

Q13- The White Matter of the CNS is:

a) Myelinated without neurilemmal sheath
b) Myelinated with neurilemmal sheath
c) Unmyelinated with neurilemmal sheath
d) Unmyelinated without neurilemmal sheath

Q14- Astrocytes are:

a) The most common type of neuroglia cells
b) The most common type of neuron cells
c) Found in white matter only
d) a & b

Q15- Protoplasmic Astrocytes:

a) Are found in the grey matter of CNS.
b) Are found in white matter of CNS
c) Their processes have fewer branches but longer.
d) Both a&c

Q16- Fibrous Astrocytes:

a) Are found in the grey matter of CNS.
b) Are found in white matter of CNS
c) Their processes have fewer branches but longer.
d) Both b&c

9-a 10-a 11-a 12-d
13-a 14-a 15-a 16-d

MCQs

Q17- Which of the following is a function of Astrocytes?

a) They repair injuries of CNS tissue (Gliosis)
b) They form myelin sheaths in the CNS
c) Phagocytosis
d) All of the above

Q18- The main function of Microglia is:

a) They repair injuries of CNS tissue (Gliosis)
b) They form myelin sheaths in the CNS
c) Phagocytosis
d) All of the above

Q19- Which of the following is a function of Oligodendrites ?

a) They repair injuries of CNS tissue (Gliosis)
b) They form myelin sheaths in the CNS
c) Phagocytosis
d) All of the above

Q20- Ependymal cells are:

a) Simple Columnar Epithelial Cells
b) Partially Ciliated
c) Lining the brain ventricles and the central canal of spinal cord
d) All of the above

Q21- A Unipolar neuron has:

a) One process that branches into two
b) Two processes that combine as one
c) Three processes

Q22- An example of a Bipolar neuron is:

a) Mesencephalic nucleus of Trigeminal nerve
b) Dorsal Root Ganglion
c) Olfactory Epithelium
d) All of the above

Q23- You can find Neurofilaments in the:

a) Cell body & Dendrites
b) Axon & Dendrites
c) Cell body, Axon,& Dendrites

17-a 18-c 19-b 20-d
21-a 22-c 23-c