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Nervous system : Syllabus for foreign students

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NERVOUS SYSTEM

1. Central nervous system – brain, spinal cord

2. Peripheral nervous system – ganglia, peripheral nerves, peripheral nerve endings

Central nervous system (CNS)

gray matter – substantia grisea: nerve cells and neuroglial cells- protoplasmic astrocytes, microglia; neuropil - axons, dendrites, synapses, neuroglial processes; capillaries

white matter – substantia alba: myelinated axons and neuroglia – oligodendrocytes, fibrillar astrocytes, microglia; capillaries

gray matter - on the surface of the brain and cerebellum- **cortex**

white matter – on the surface of the spinal cord

Within the CNS, specific terms are used to describe arrangement of nerve cells and their connections:

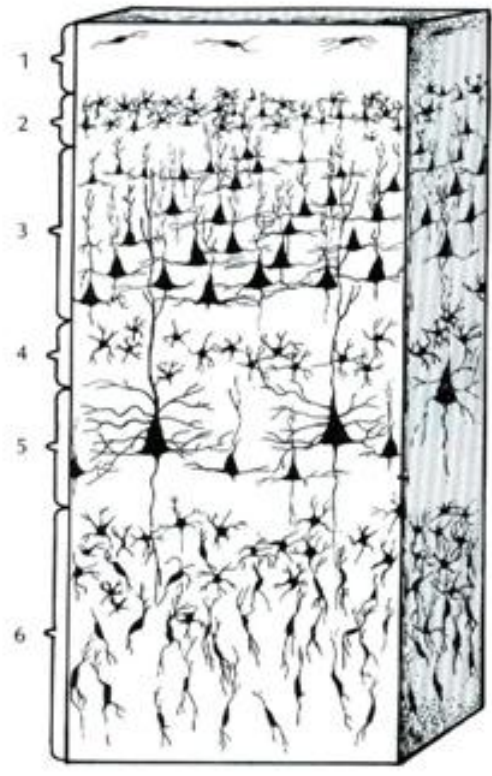
- **cortex** - arrangement of neurons over the surface of the brain and cerebellum
- **nuclei** - clusters of neuron bodies forming islands of gray matter embedded in white matter
- **column or horn** - arrangement of neurons within the spinal cord
- **funiculus or fascicle** - bundle of axons running in white matter

On the basis of **phylogenetic development** and microscopic structure, the following two types of cerebral cortices are recognized – **Allocortex** and **Neocortex**.

Neocortex or isocortex

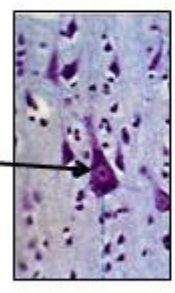
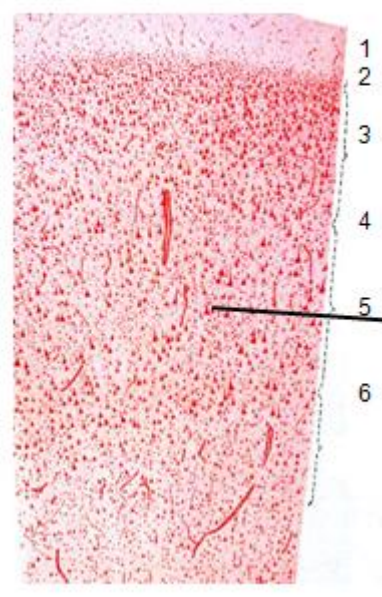
This cortex is **six layered** and comprises 95% of the cerebral cortex on the surface of hemispheres in humans. Isocortex in which six layers are clearly evident (primary sensory cortex) is termed **homotypical cortex**. Isocortex in which some of the six layers are obscured (motor or visual cortex) is termed **heterotypical cortex**.

- 1 Lamina molecularis
- 2 Lamina granularis externa
- 3 Lamina pyramidalis externa
- 4 Lamina granularis interna
- 5 Lamina pyramidalis interna – seu ganglionaris
- 6 Lamina multiformis



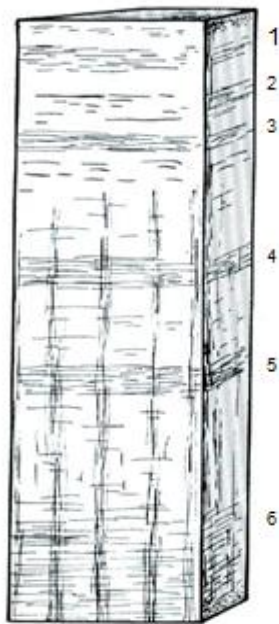
Isocortex

Cerebral cortex



Betz pyramidal cell





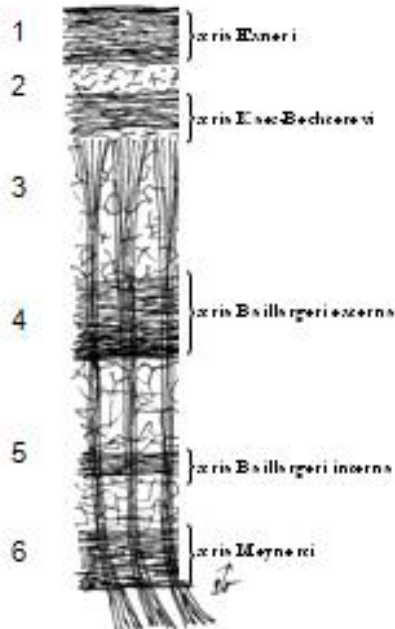
HORIZONTAL FIBERS -striae

- | | |
|----------------------|--------------------------|
| 1. MOLECULAR L. | - STRIA EXNERI |
| 2. OUTER GRANULAR L. | - 0 |
| 3. PYRAMIDAL L. | - STRIA BECHTEREVI |
| 4. INNER GRANULAR L. | - STRIA BAILLARGERI EXT. |
| 5. GANGLIONAR L. | - STRIA BAILLARGERI INT. |
| 6. MULTIFORM L. | - STRIA MEYNERTI |

Myeloarchitecture

arrangement of myelinated nerve fibers in nerve system, Weigert method

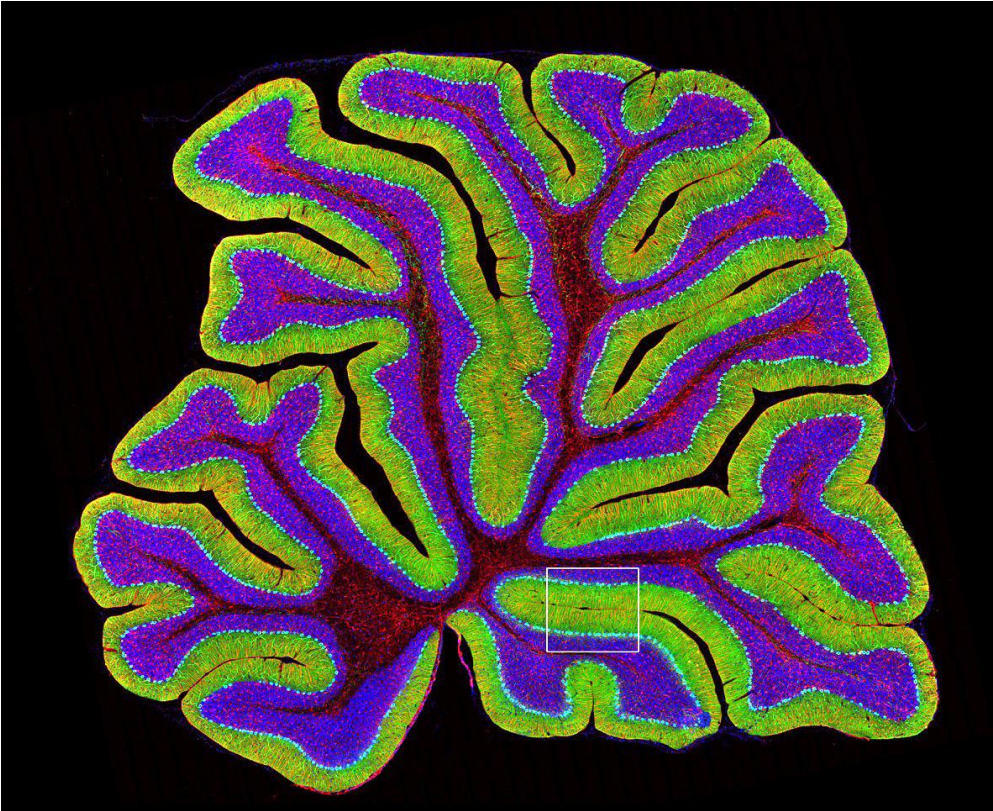
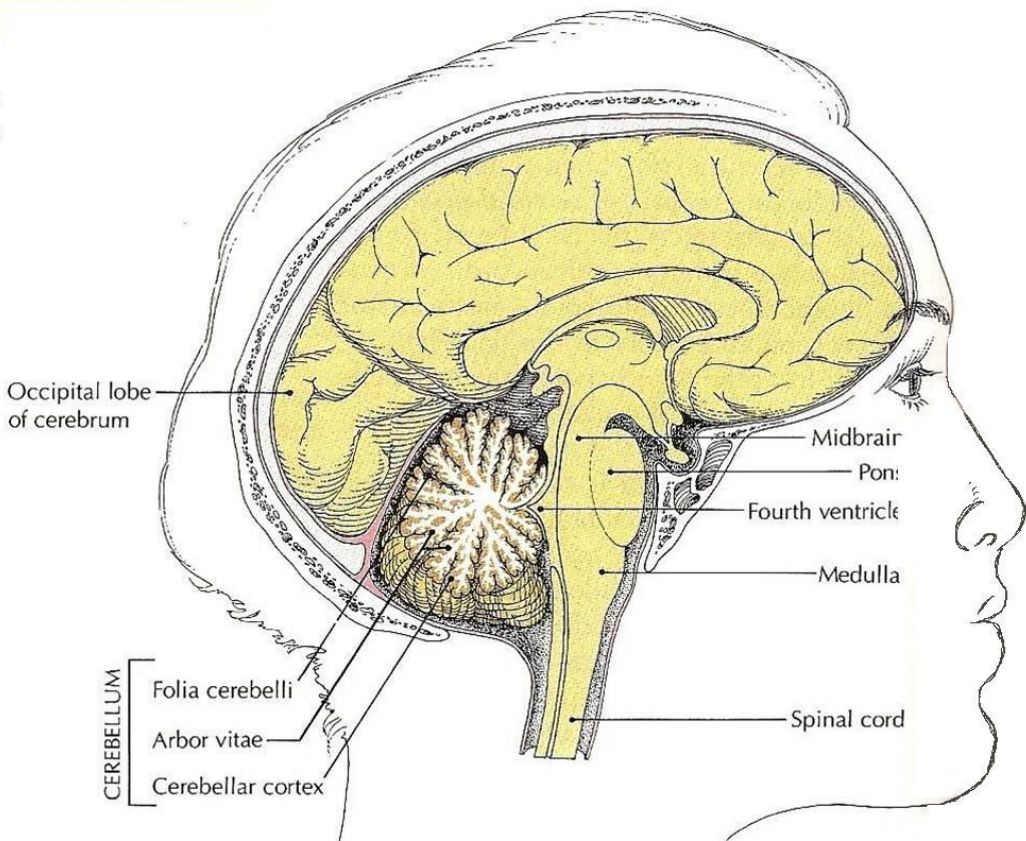
Horizontal fibers - striae



Vertical fibers - radii

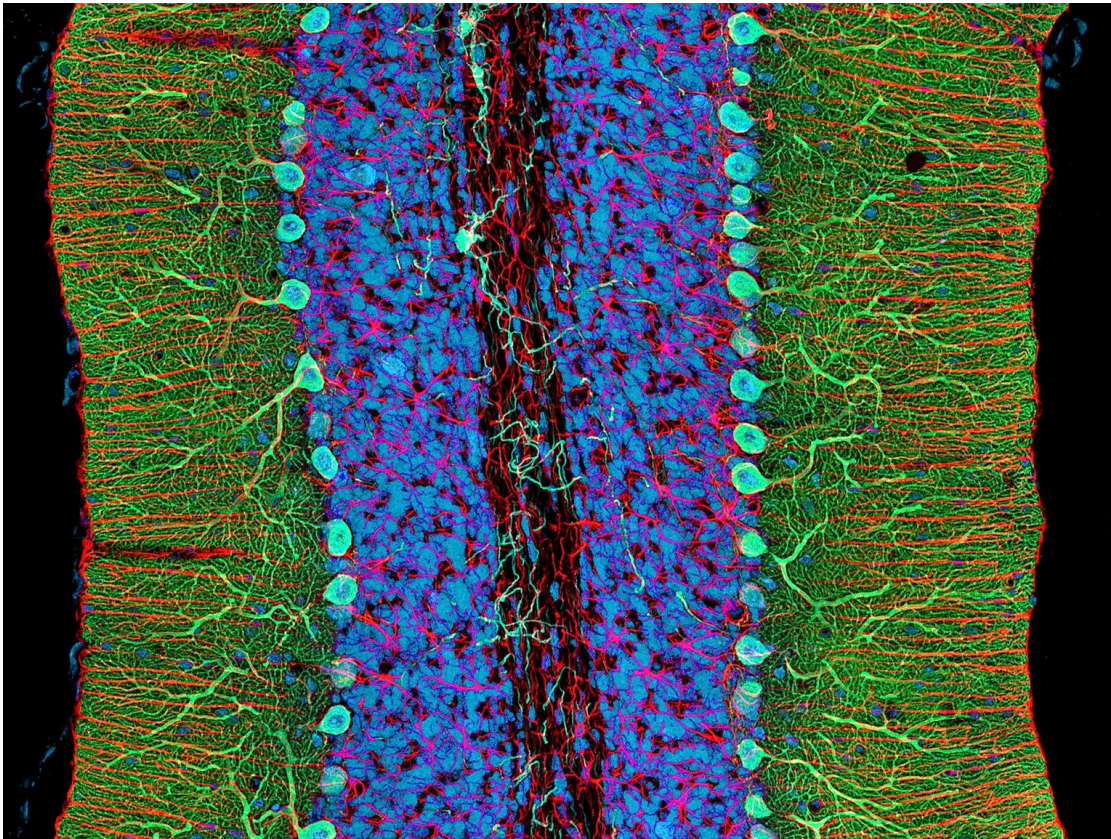
1. Typus supraradiatus
2. Typus euradiatus
3. Typus infraradiatus

CEREBELLUM



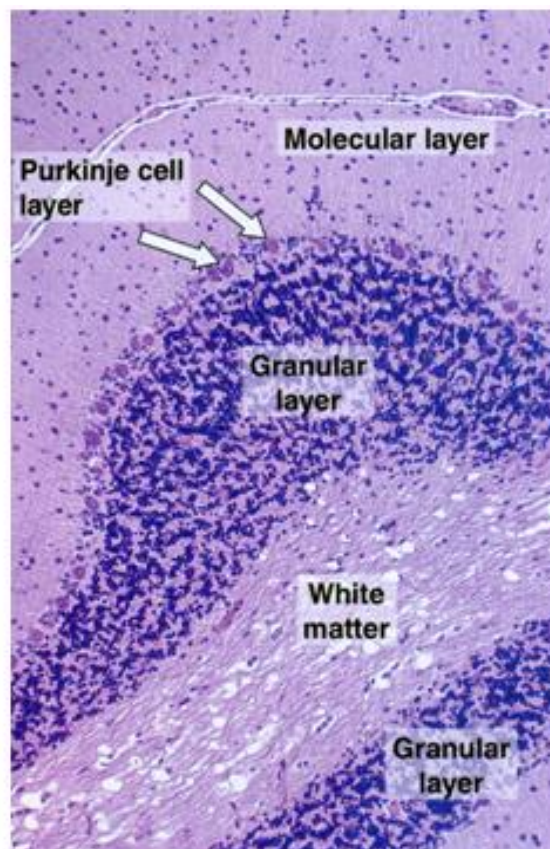
ARBOR VITAE

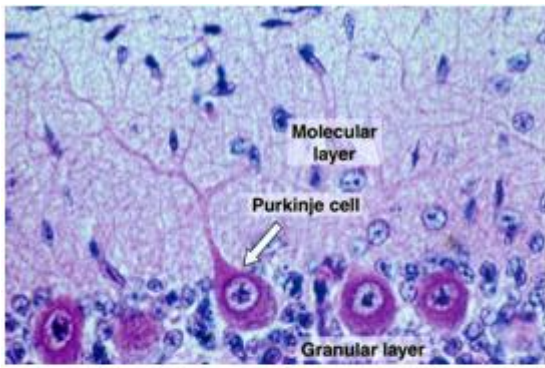
Cytoarchitecture of the cerebellar cortex



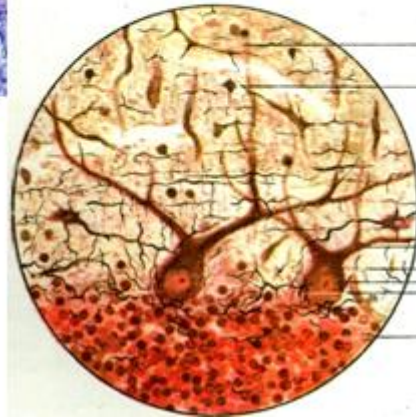
Cerebellar cortex

1. Molecular layer
2. Purkinje cell layer
3. Granular layer



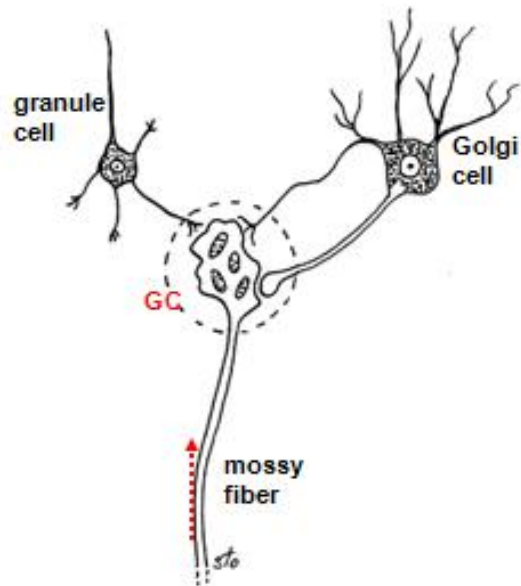
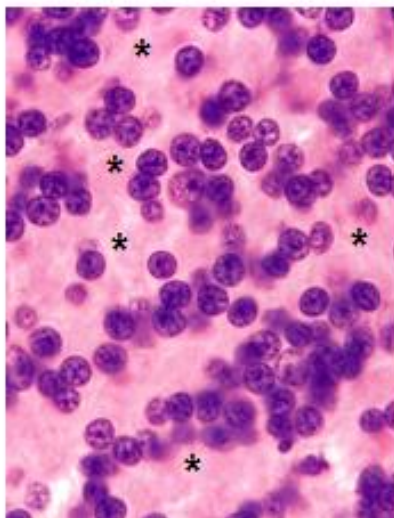


Purkinje cells



Glomerulus cerebellaris

- light eosinophilic intercellular space within the *stratum granulosum* – synaptic contacts between the dendrites of granular cells and mossy fibers (afferent fibers)

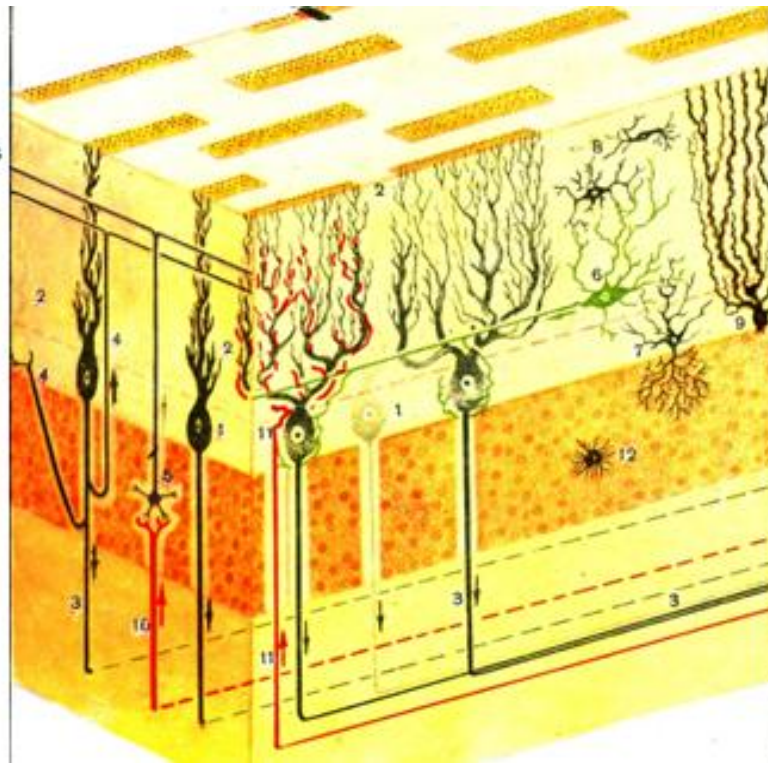


Afferent fibers:

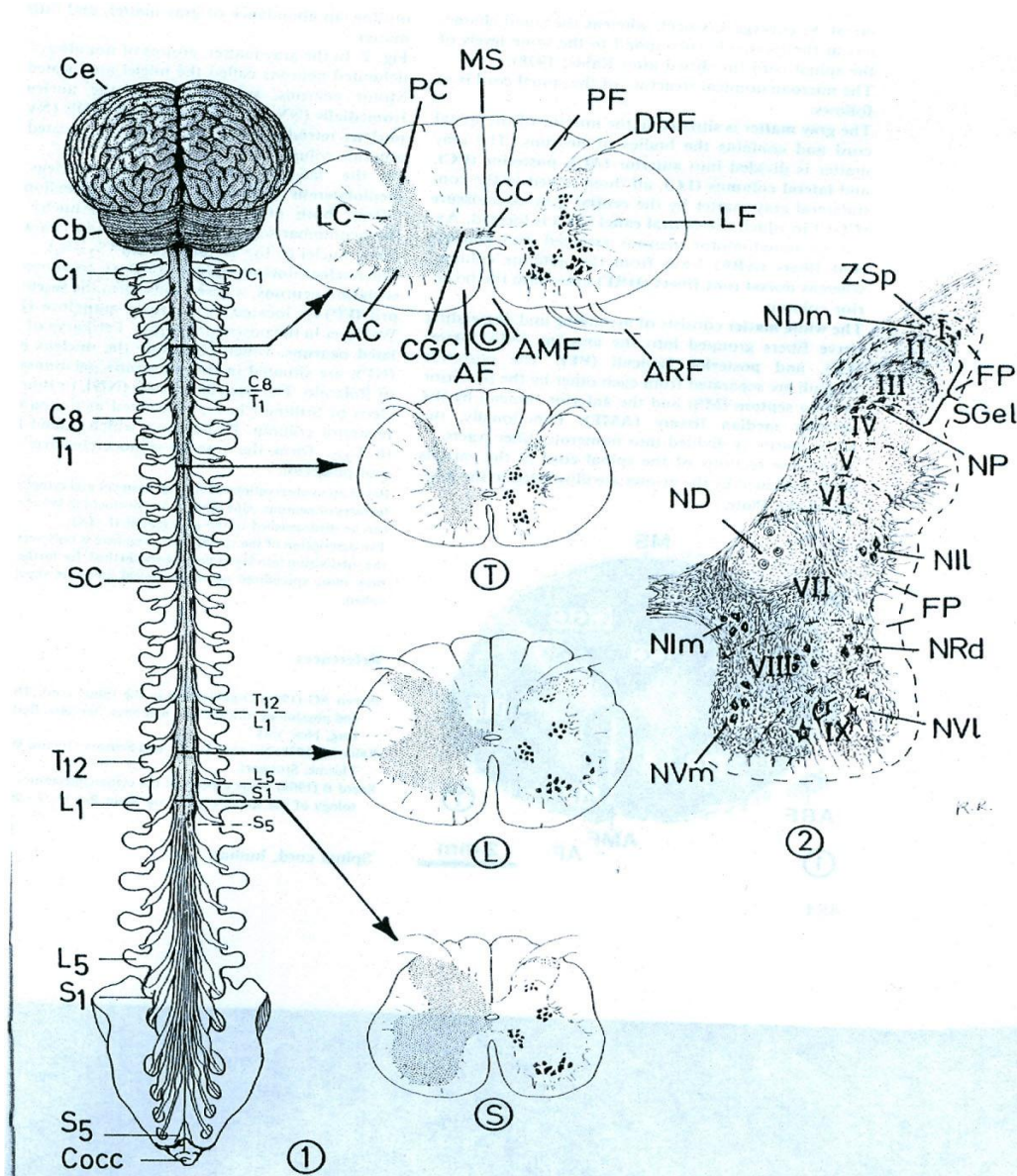
1. Mossy fibers
2. Climbing fibers

Efferent fibers:

axons of
Purkinje cells



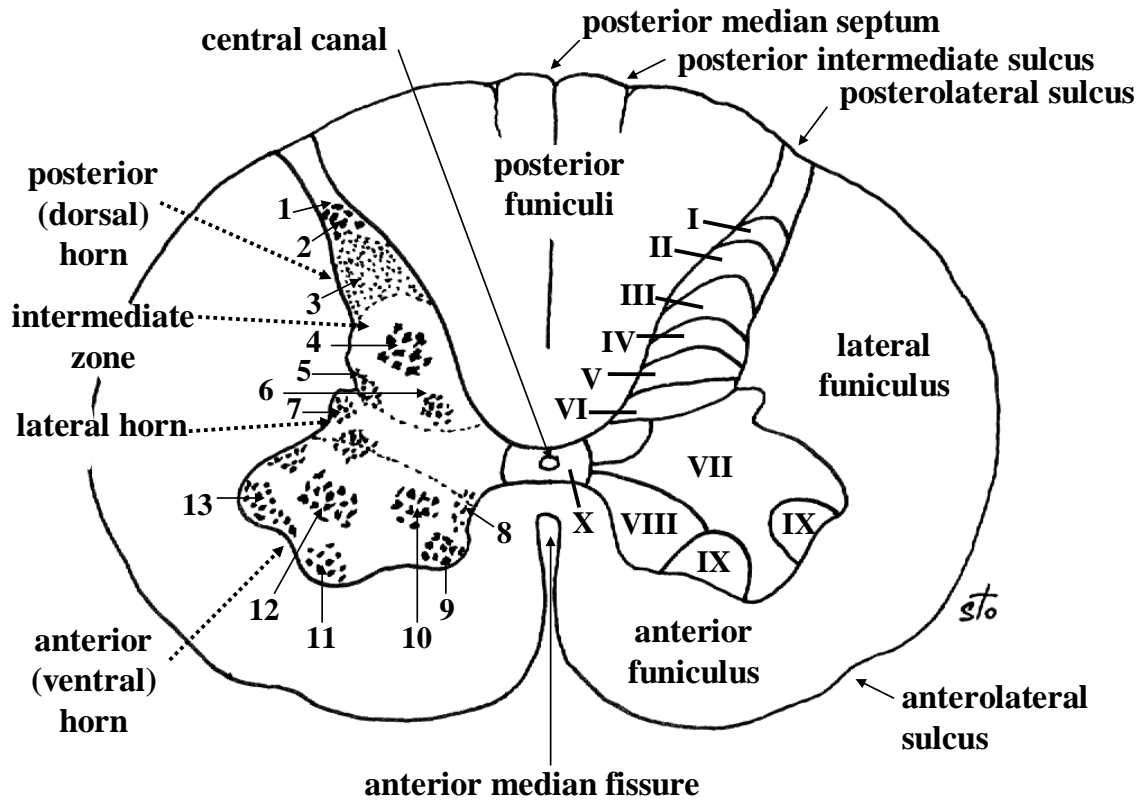
Medulla spinalis - spinal cord



1. Cervical – 8 segments
2. Thoracic – 12 segments
3. Lumbar – 5 segments
4. Sacral – 5 segments
5. Coccygeal – 1 segment

nuclei

Rexed's laminae – I – X



Nuclei of gray matter

- nc. apicalis (posteromarginalis)
- substantia gelatinosa
- nc. proprius columnae dorsalis
- nc. thoracicus - (C₂-L₂) (Stilling-Clarkovo)
- zona intermedia
- nc. dorsolateralis
- nc. dorsomedialis
- nc. centralis
- nc. ventrolateralis
- nc. ventromedialis

Rexed laminae



Neurons of the spinal cord

Nerve cells of the spinal cord can be divided into **tree main groups**:

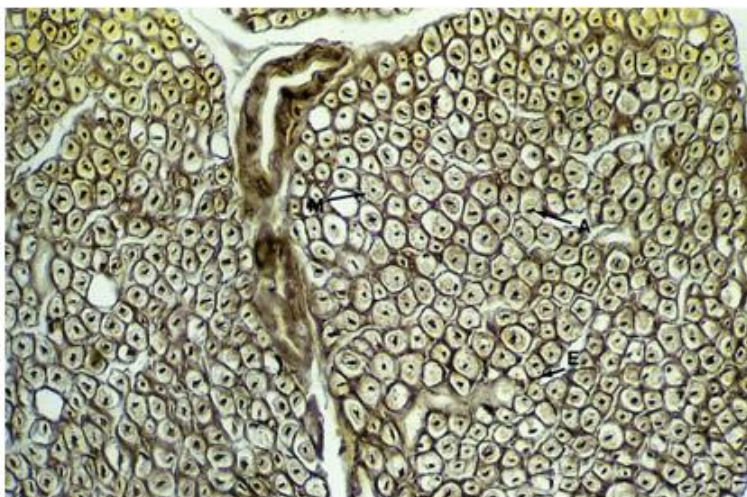
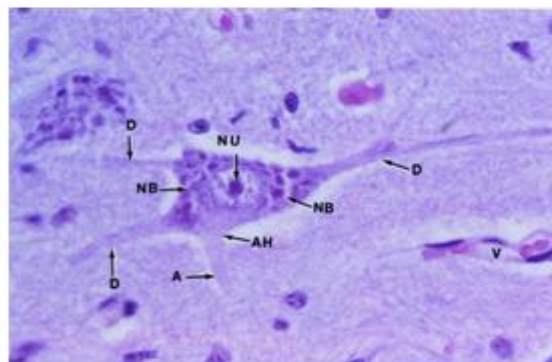
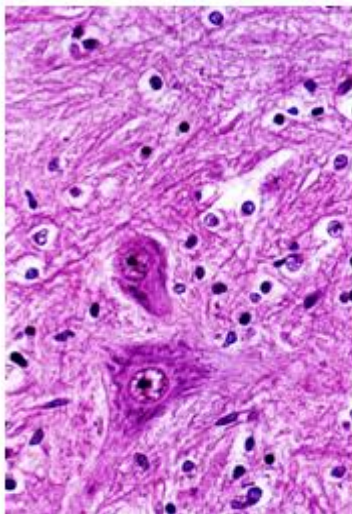
a) **Radicular neurons – (motor neurons)**

b) **Interneurons – (connecting)**

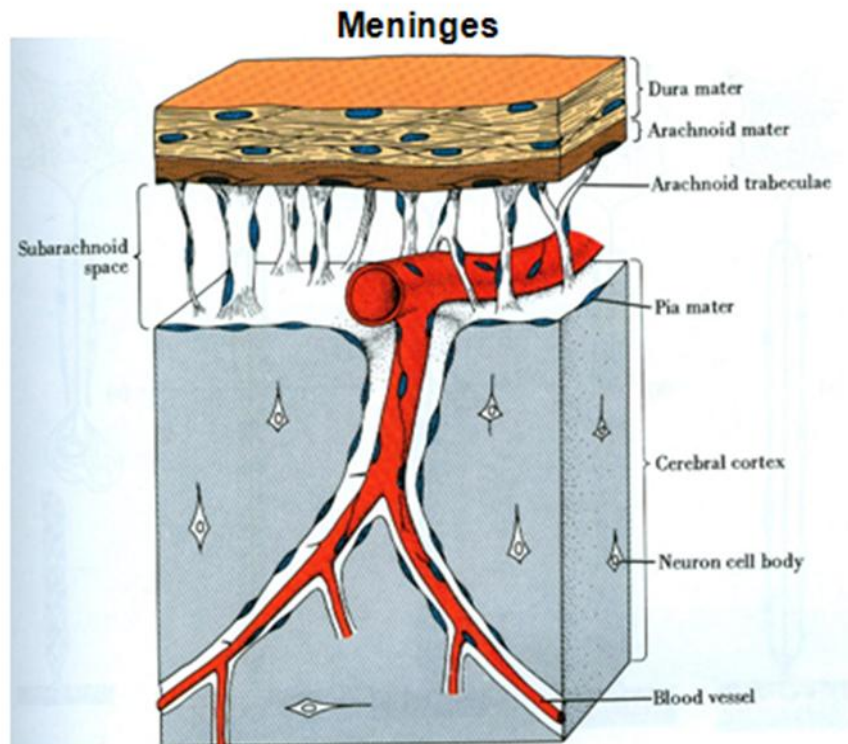
c) **Funicular neurons**

- a) **Radicular neurons (Golgi type I)** are **efferent neurons** whose long axons leave the spinal cord and form the anterior root of a peripheral nerve.
- b) **Interneurons** are neurons whose axons remain in the spinal cord. They include **intercalated, commissural, and association interneurons**. They are also called as **connecting interneurons** with short axons (**Golgi type II**).
- c) The last types of neurons are **funicular neurons**. They are sensitive, afferent neurons with long axon (**Golgi type I**) which create the ascending tracts of spinal cord. Funicular neurons of the dorsal horn whose axons join the tracts of funiculi, thus forming most of the white matter of spinal cord (**tractus spinobulbaris**).

Motor neurons



White mater



Meninges

The skull and the vertebral column protect the organs of CNS. Between the bone and nerve tissue are membranes of connective tissue called the meninges. Three **meningial layers** are distinguished – dura mater, arachnoid and pia mater

1. Dura mater

The dura mater is a thick external layer, consisting of dense irregular connective tissue with blood vessels. There is a tight junction between the dura mater and periosteum of the skull. The dura mater that envelops the spinal cord is separated from the periosteum of the vertebrae by the epidural space filled by adipose and loose connective tissue with thin veins.

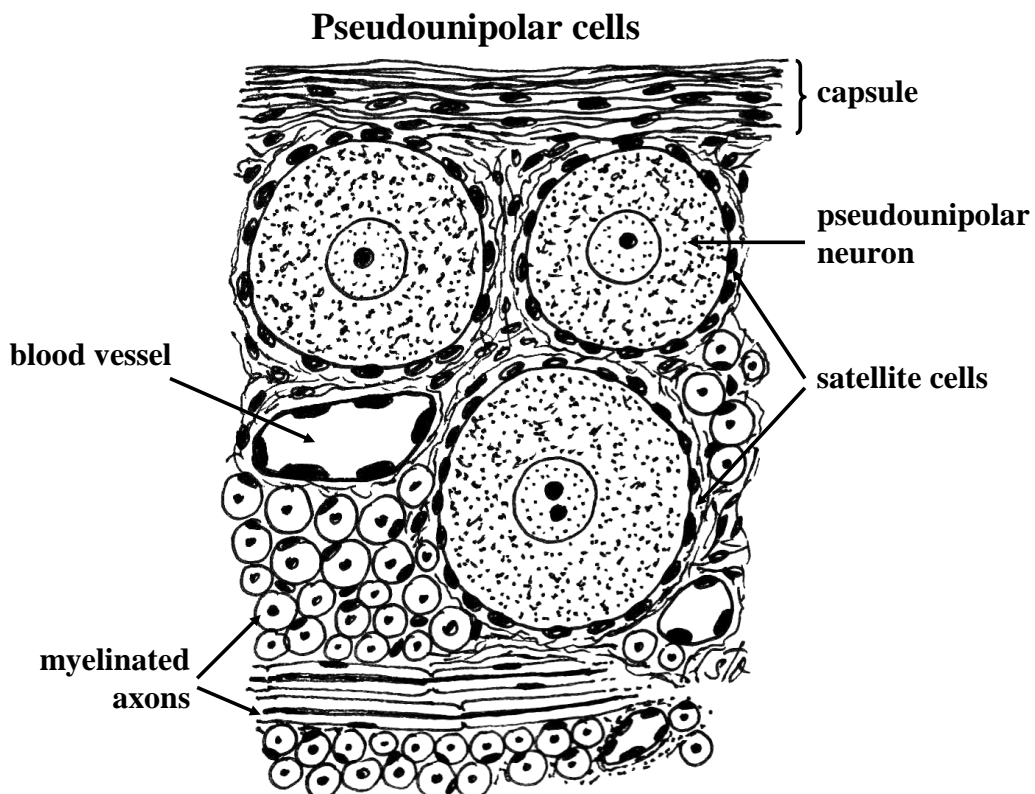
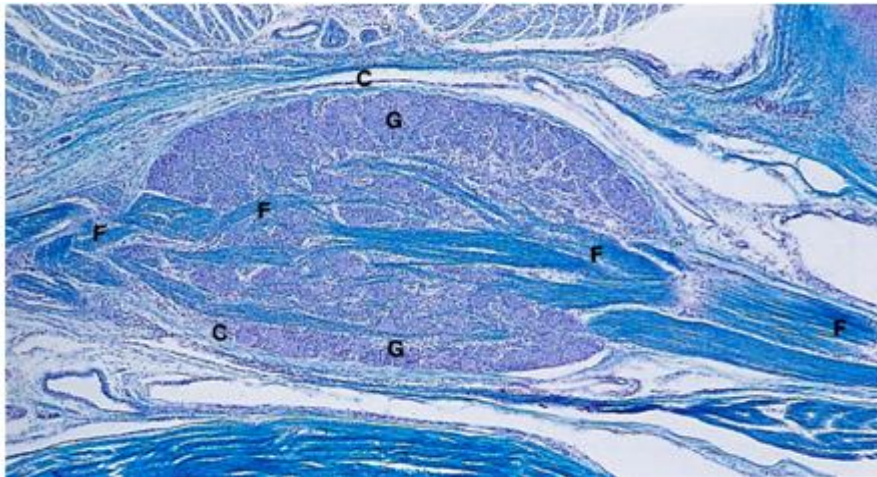
2. Arachnoid

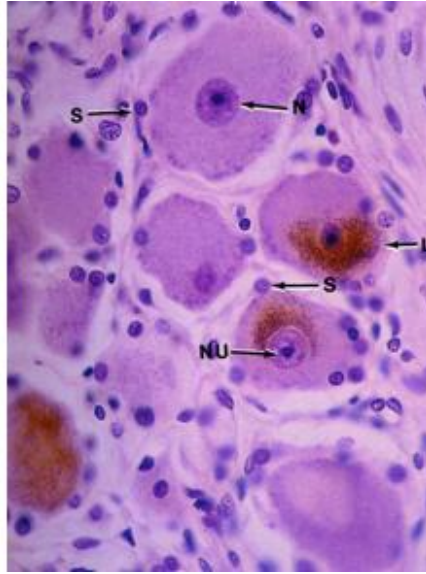
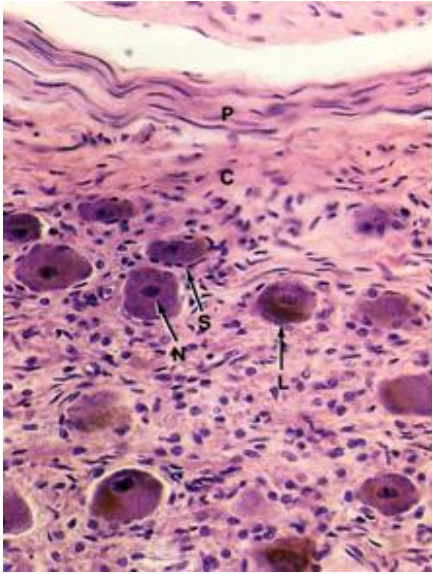
The arachnoid has two components: (a) a sheet of connective tissue in contact with the dura mater, and (b) a system of loosely arranged **arachnoid trabeculae** containing connective tissue with fibroblasts and collagen fibers. This trabecular system is continuous with deeper pia mater. The connective tissue of arachnoid is said to be avascular because it lacks nutritive capillaries, but larger blood vessels run through it.

3. Pia mater

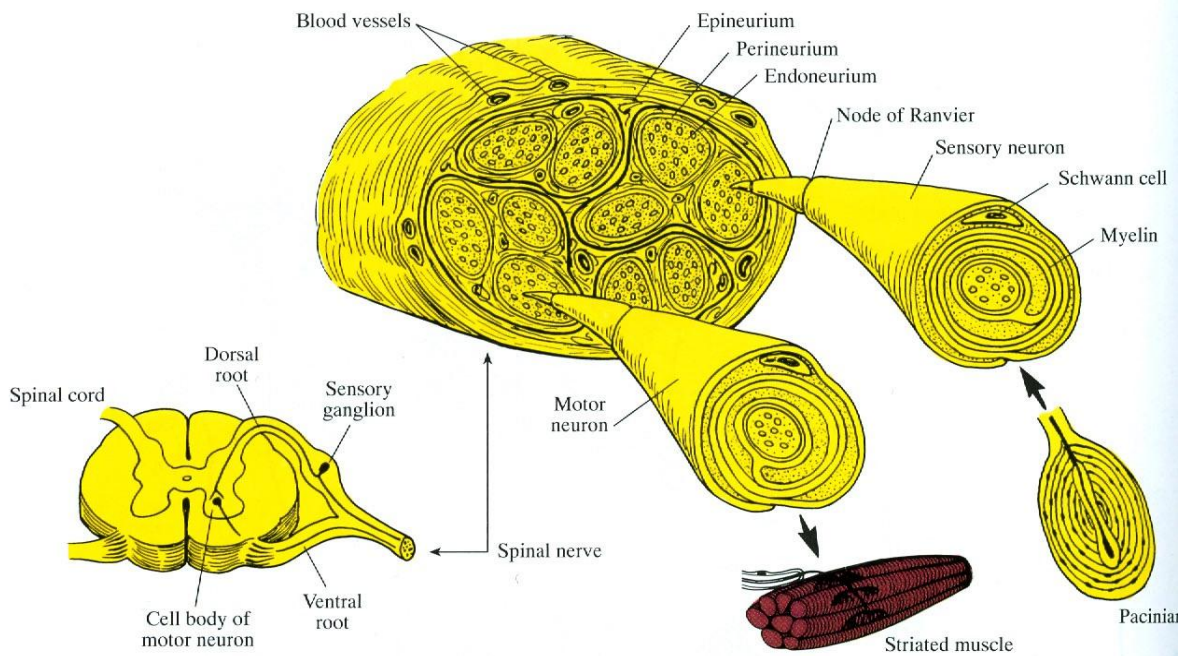
The innermost pia mater is a thin vascular connective tissue membrane adherent to the neuroglial membrane – **limiting membrane of superficial glia**, delimiting the underlying nerve tissue

Spinal ganglion- peripheral nervous system

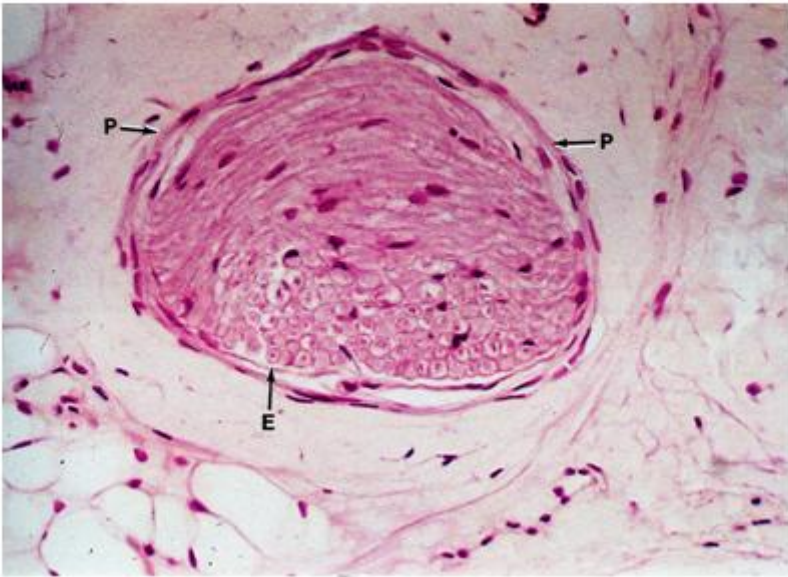




Peripheral nerve



Longitudinal and cross sectioned nerve fibers



Nerve fibers

