Central Nervous System (CNS MODULE 2022) HISTOLOGY

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TOPICS TO BE DISCUSSED

- HISTOLOGY & NEUROBIOLOGY OF THE NEURON & NEUROGLIA
- Histology of spinal cord, tracts, & lamina of REXED
- ANATOMY/Histology of Descending tracts
- ANATOMY/Histology of Ascending tracts
- Histology of Brain stem
- Histology of cerebrum & cerebellum
- LAB: TYPE OF NEURONS, SPINAL CORDS, CEREBRUM & CEREBULLUM HISTORY

Anatomic TERMS:

- In four legged animals the UPPER (BACK) surface is called DORSAL and the lower (belly) surface ventral.
- The terms *anterior*, *cranial*, *cephalic*, and *rostral* refer to the head end of the body,
- *posterior* and *caudal* to the tail end.
- In humans,
- ✓ DORSAL becomes equivalent to POSTERIOR
- ✓ VENTRAL is the same as ANTERIOR
- ✓ CRANIAL is often called SUPERIOR
- ✓ CAUDAL is for INFERIOR.
- ✓ Objects near the middle plane of the body are medial and those farther away are lateral.
- ✓ ***Proximal*** refers to structures **nearest** the central bulk of a structure and ***distal*** to ones **away** from it.
- ✓ In referring to another structure, if it is located on the **same side of the body,** it is known as **ipsilateral;** if it is on the **opposite side**, it is contralateral.

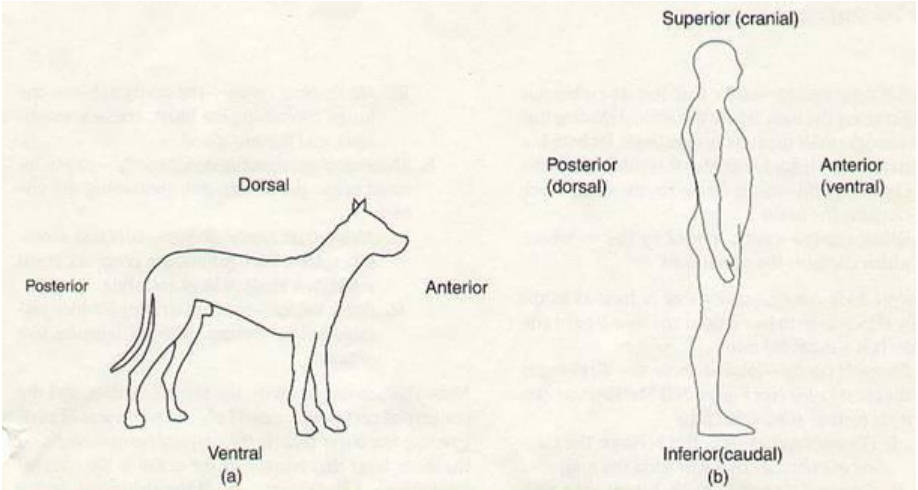
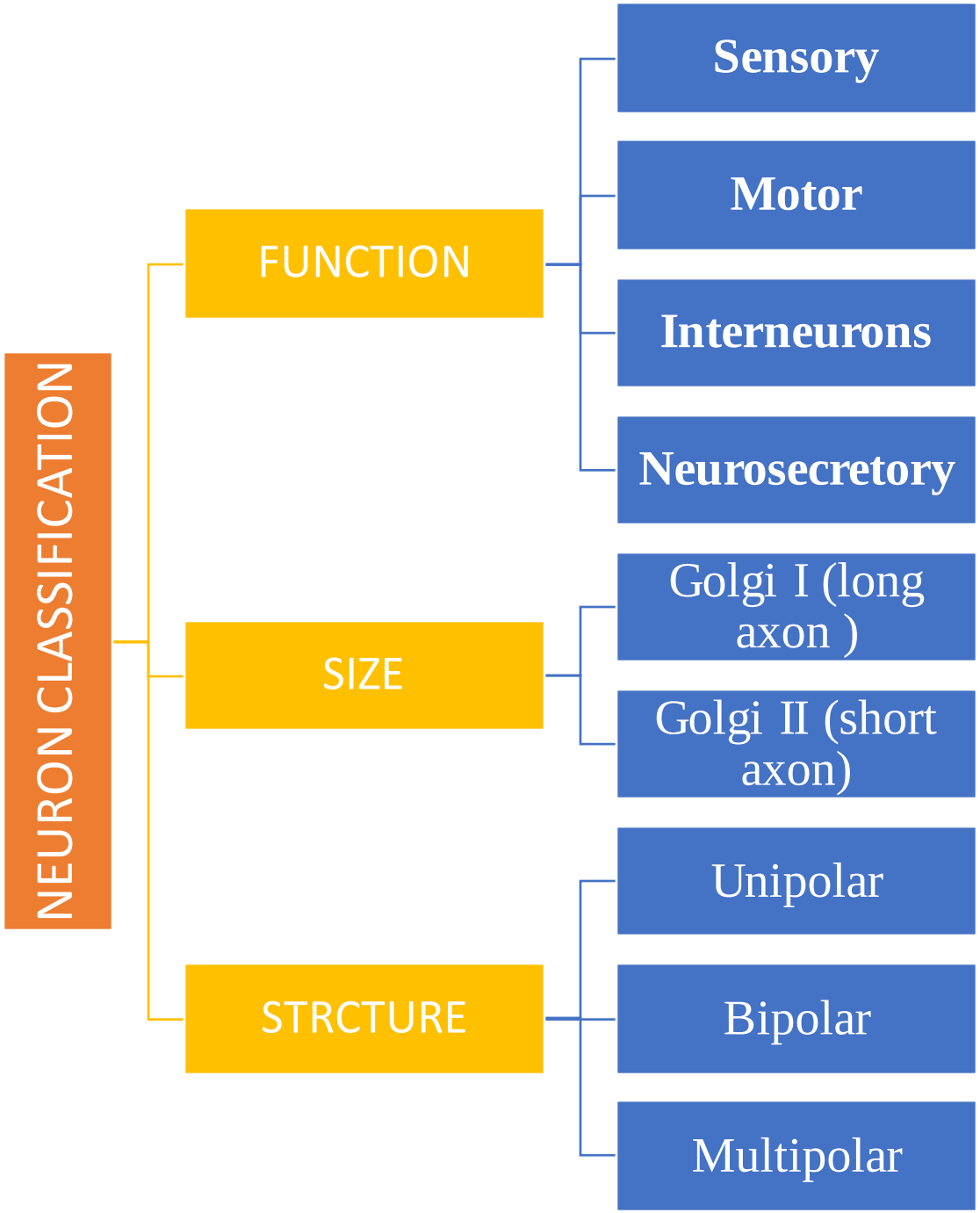


Figure 7-2 Lateral view of (a) four-legged animal and (b) two-legged form. Please note how the terms for top, bottom, back, and front are used.


Unilateral: One Side
Bilateral: Two Sides
Ipsilateral: Same Side of Body
Contralateral: Opposite Side of Body

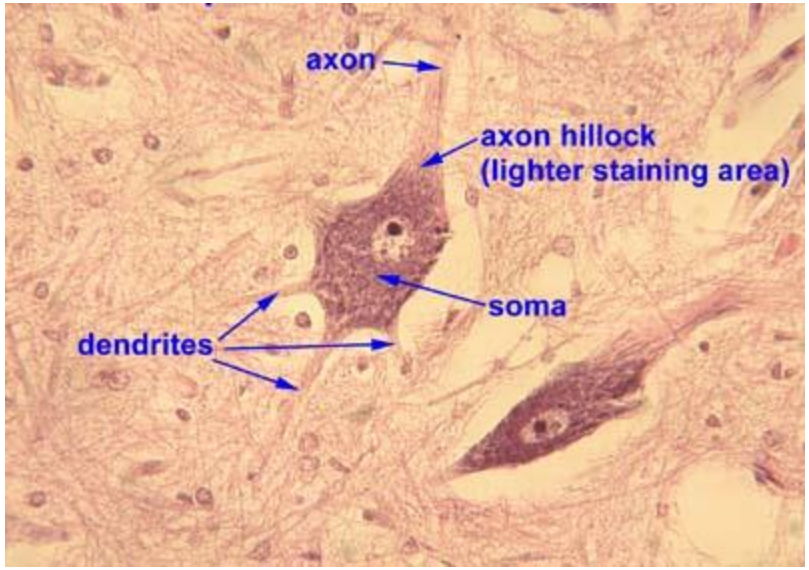

NEURON CLASSIFICATION
FUNCTION
Sensory
Motor
Interneurons
Neurosecretory
SIZE
Golgi I (long axon)
Golgi II (short axon)
STRCTURE
Unipolar
Bipolar
Multipolar

Morphology of a Typical Neuron

Neurons:
The structural and functional cells of the nervous tissue are the

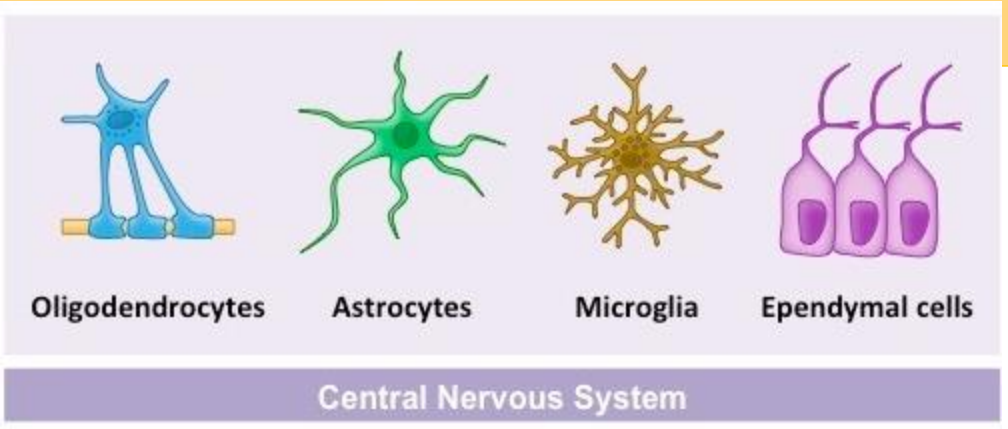
Each neuron consists of:

- ❖ soma or cell body
- ➢ The cell body or soma contains the nucleus, nucleolus, numerous different organelles, and the surrounding cytoplasm or perikaryon.
- ❖ numerous dendrites
- ➢ Projecting from the cell body are numerous cytoplasmic extensions called dendrites that form a dendritic tree.
- ❖ a single axon.



NONNEURAL COMPONENTS OF THE CNS

- Surrounding the neurons are the smaller and more numerous supportive cells collectively called **NEUROGLIA**. These cells form the nonneural components of the CNS.
- There are no Schwann cells in the CNS.
- Instead, neuroglial cells called oligodendrocytes myelinate the axons in the CNS.
- The four types of neuroglia cells are astrocytes, oligodendrocytes, microglia, and ependymal cells.
- Oligodendrocytes differ from Schwann cells in that the cytoplasmic extensions of one oligodendrocyte envelopes and myelinates numerous axons.

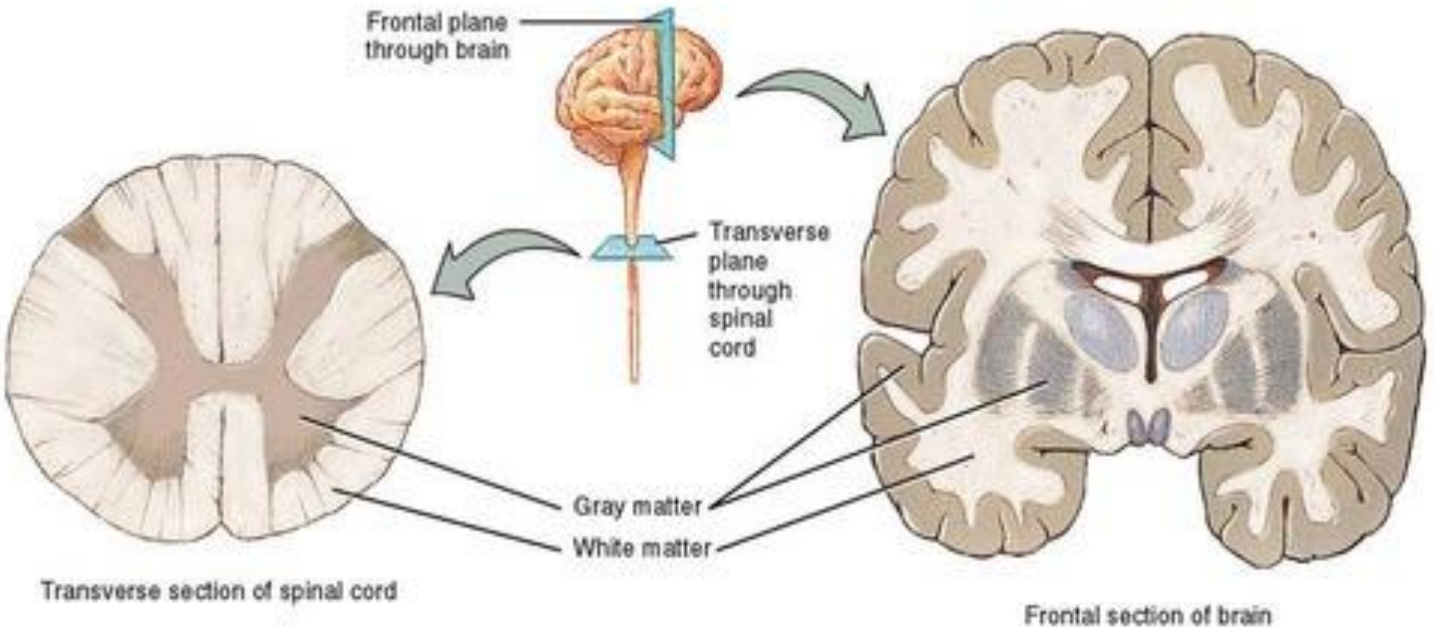


TYPES OF NEUROGLIA

Name of the cell	Location	Function
❖ Astrocytes	Grey & white matter	Regulate microenvironment Blood Brain Barrier
❖ Oligodendrocytes	White & grey matter	Myelination of axon in CNS
❖ Microglia	Grey & white matter Mesodermal in origin	Phagocytic
❖ Ependymal cell	Ventricle & central canal of spinal cord------with a ciliated simple columnar shape	Assist in producing & controlling composition of CSF

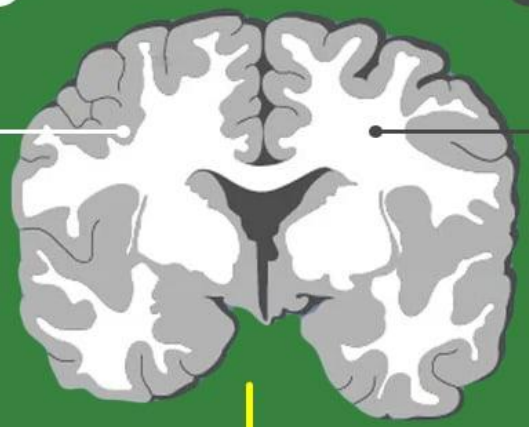
White and Gray Matter

The brain and the spinal cord contain gray matter and white matter.



GRAY MATTER

WHITE MATTER



40%
OF THE BRAIN

60%
OF THE BRAIN

- CONTAINS MOST OF THE BRAINS NEURONAL CELL BODIES
- FULLY DEVELOPS ONCE A PERSON REACHES HIS/HER 20'S
- CONDUCTS, PROCESSES, AND SENDS INFORMATION TO VARIOUS PARTS OF THE BODY.

- MADE UP OF BUNDLES WHICH CONNECT VARIOUSGRAY MATTER AREAS
- DEVELOPS THROUGHOUT THE 20'S AND PEAKS IN MIDDLE AGE
- INTERPRETS SENSORY INFORMATION FROM VARIOUS PARTS OF THE BODY.

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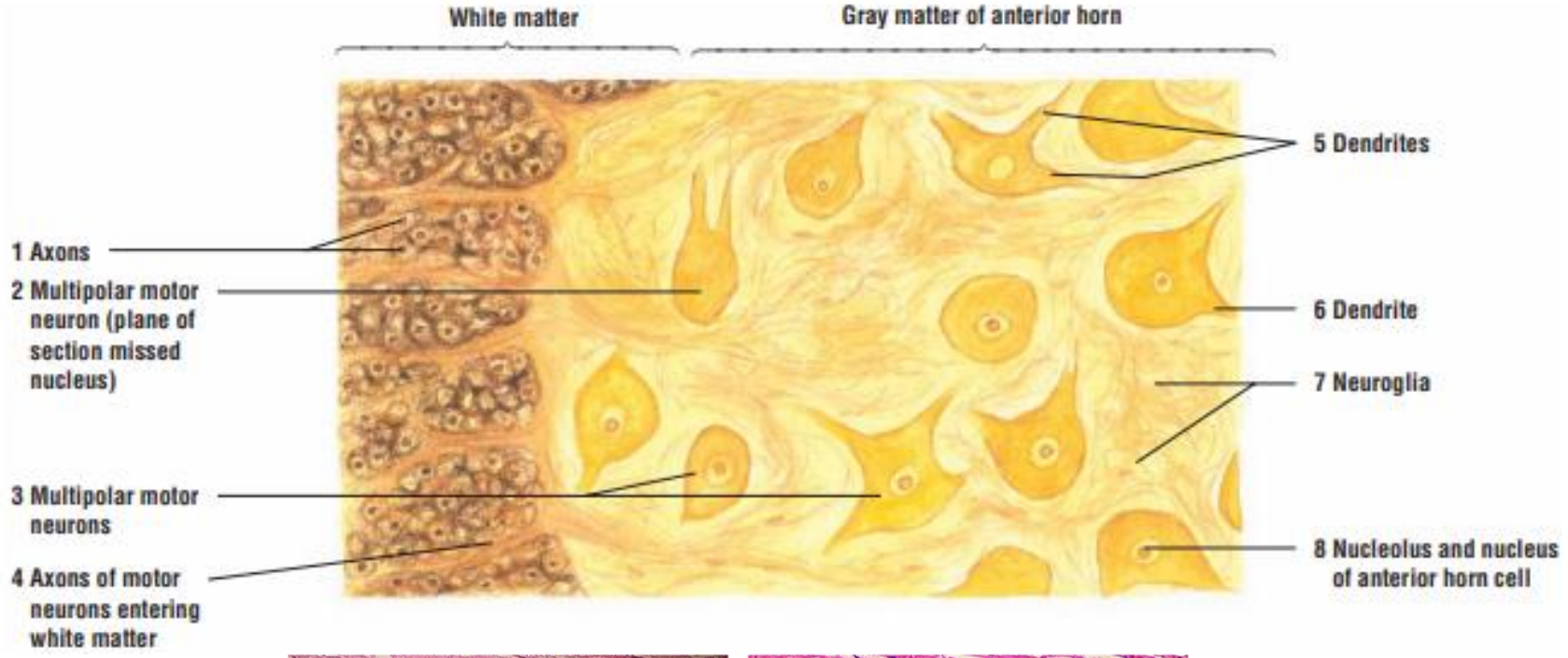
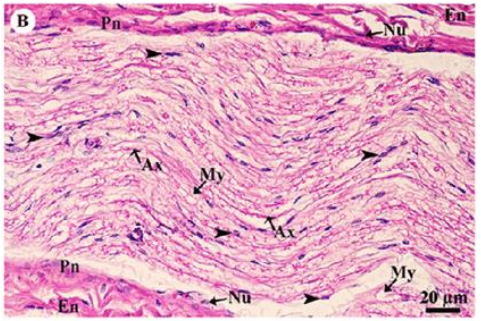
TYPE	WHITE MATTER	GRAY/GREY MATTER
CONTENT	is devoid of neuronal cell bodies and consists primarily of myelinated axons, some unmyelinated axons, and the supportive neuroglial oligodendrocytes. {is composed of bundles of axons}	neurons, their dendrites, and the supportive cells called neuroglia
SITE	BRAIN: found in the deeper tissues of the brain (subcortical) SPINAL CORD: is sometimes called superficial tissue because it is located in the outer regions of the brain and spinal cord	BRAIN: Gray matter covers the surface of the brain (cerebrum) and cerebellum, and midbrain Spinal cord:The grey matter creates a hornlike structure throughout the inside of the spinal cord while the white matter makes up the surrounding sections of the spinal cord


White matter
Gray matter of anterior horn
1 Axons
2 Multipolar motor neuron (plane of section missed nucleus)
3 Multipolar motor neurons
4 Axons of motor neurons entering white matter
5 Dendrites
6 Dendrite
7 Neuroglia
8 Nucleolus and nucleus of anterior horn cell


A
F
Pn
V
Ad
En
200 µm


B
Pn
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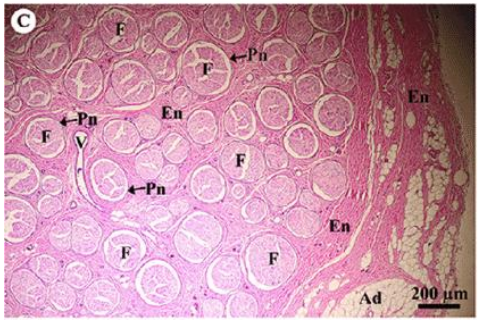
20 µm


C
F
Pn
En
V
Ad
200 µm


D
Va
F
Ma
Na
Pn
V
20 µm

Internal Anatomy of the Spinal Cord

❖ The cord is made up of:

✓ an **outer** layer of **white** matter

➢ The white matter consists of [1]longitudinally oriented nerve fibres (axons), [2]glial cells ,

[3] blood vessels

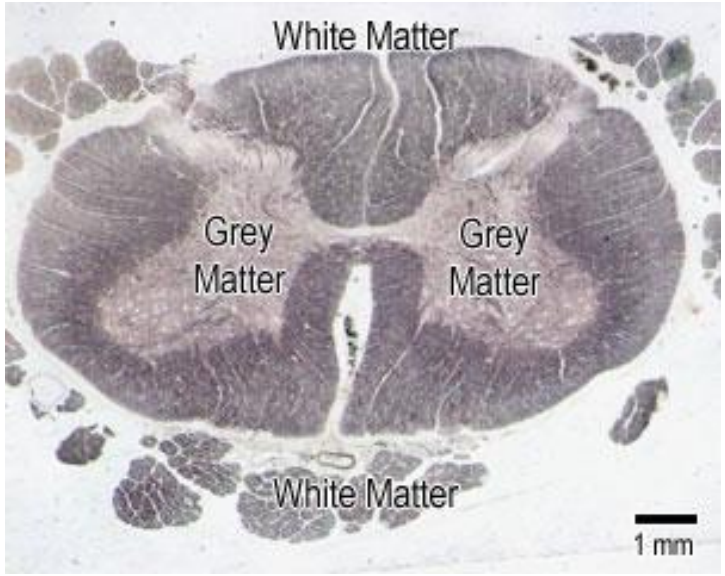
AND

✓ an **inner,** 'H' or butterfly shaped core of **grey** matter.

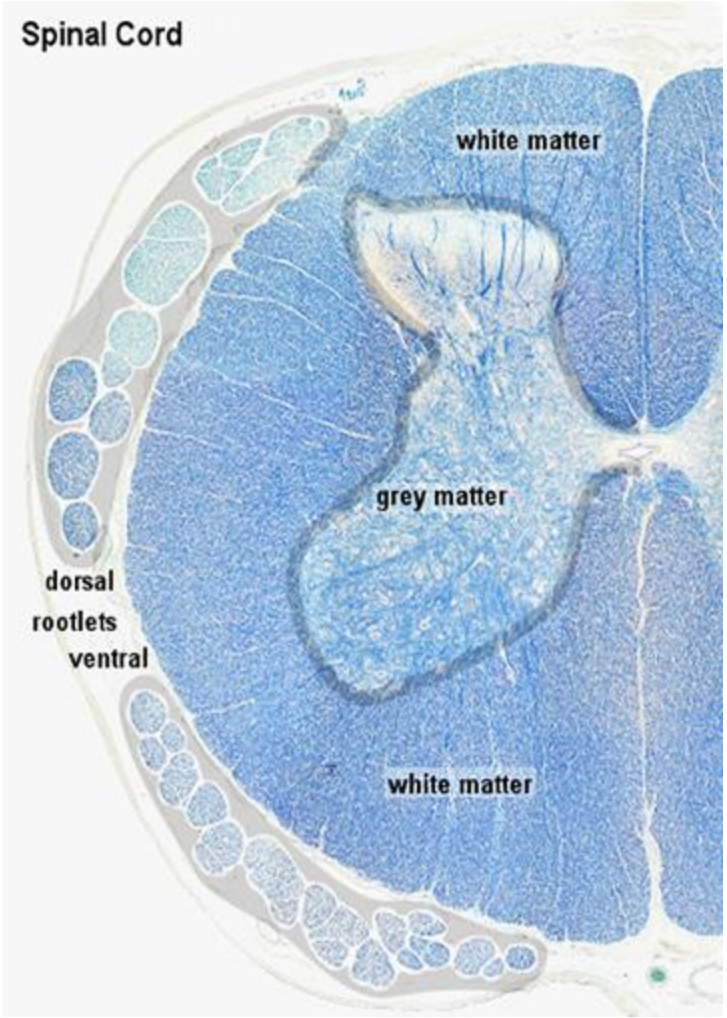
➢ The grey matter contains

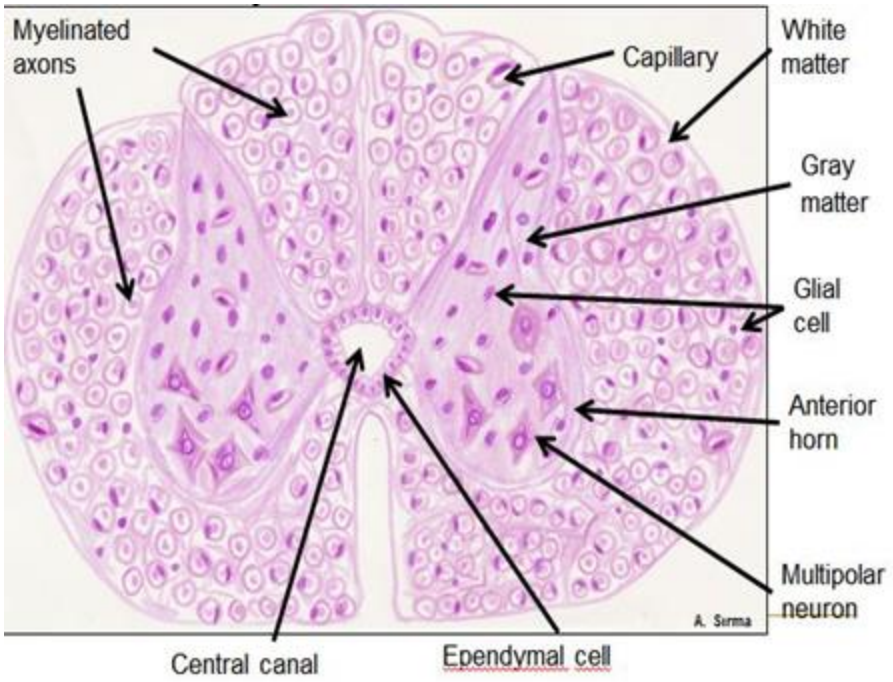
[1] neuronal soma [**cell bodies** (perikarya)], [2] cell processes,[3] synapses, [4]glia and

[5] blood vessels.



NOTE: The picture shows a section of spinal cord, stained by a method that colours myelin blue-black. This is a good way of distinguishing white matter from grey but it can be confusing since it stains white matter black

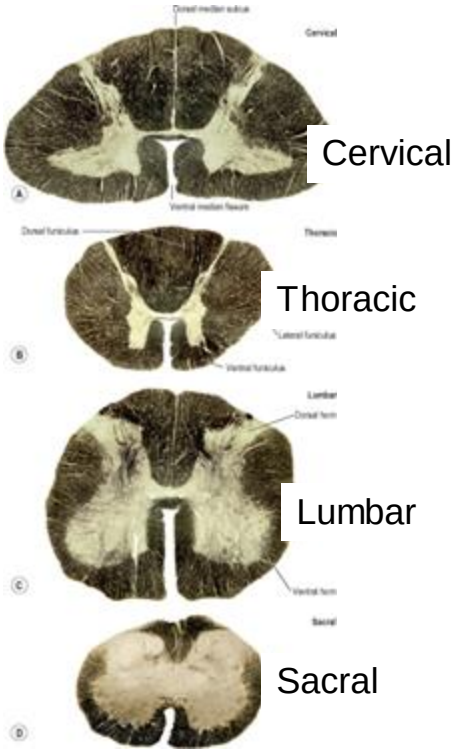


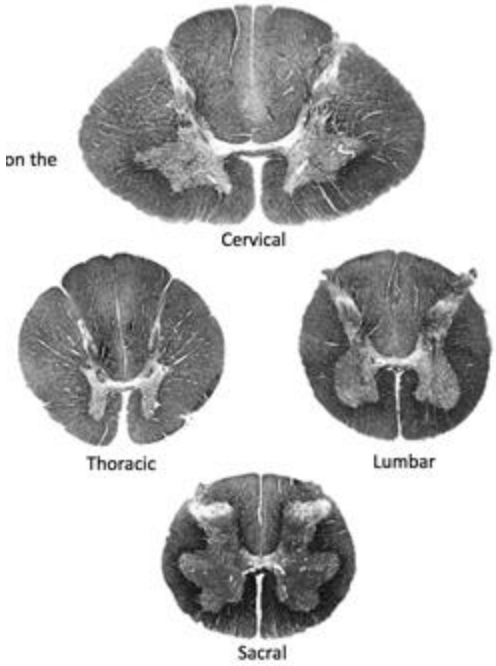


The central canal (also known as ependymal canal) is the cerebrospinal fluid-filled space that runs through the spinal cord. The central canal lies below and is connected to the ventricular system of the brain, from which it receives cerebrospinal fluid, and shares the same ependymal lining.

Internal Histology of the Spinal Cord

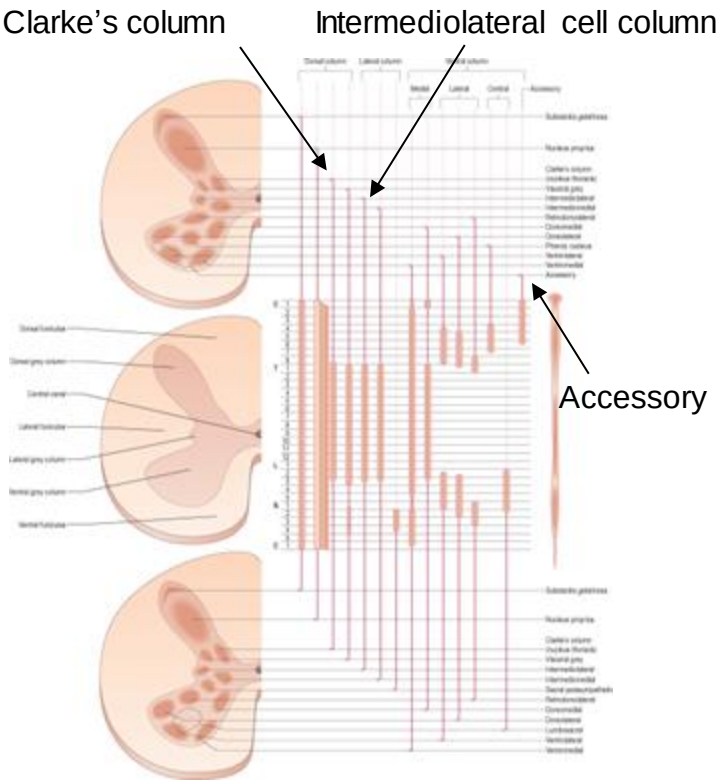
- The relative sizes and proportions of grey and white matter vary significantly in different regions.
- **Grey matter** is greatest at cervical and lumbar enlargements.
- **White matter** **is** greatest at cervical levels and is **progressively less** at more caudal levels.





Internal Histology of the Spinal Cord

It is important to realize that while there are many relatively organized regions of cells within the grey matter, typically organized as **LONGITUDINAL COLUMNS OF CELLS**, in most cases these are *NOT* all found at all levels.



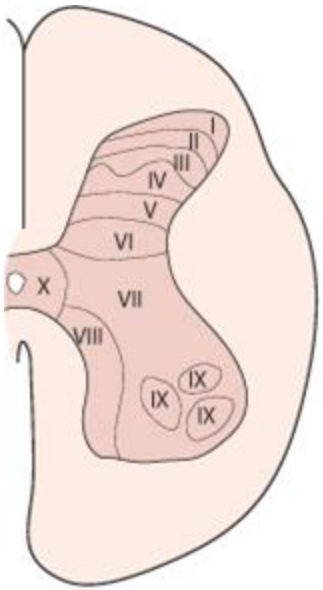
Internal Histology of the Spinal Cord

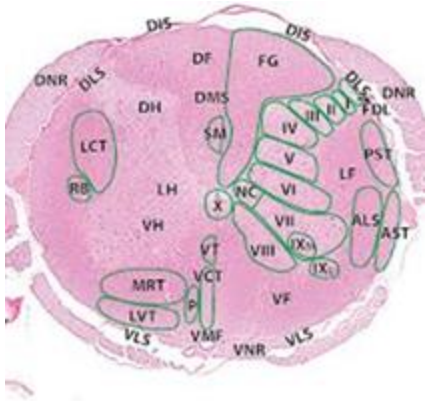
LAMINAE OF REXED

COLLECTION OF NUCLEI

Rexed Laminae:

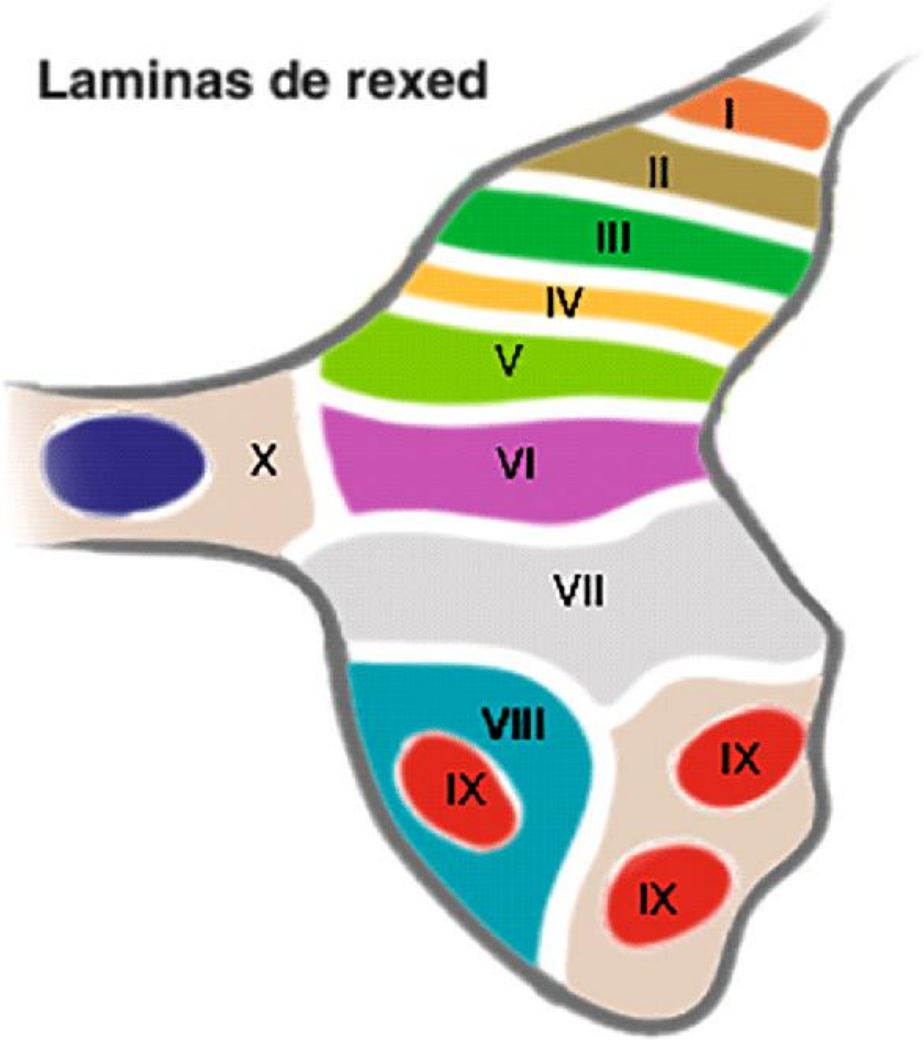
- A series of **ten cell** lamina in the grey matter of the spinal cord,
- Numbered in a dorso-ventral series using Roman numerals. Each lamina is defined on the basis of [1]cell size, [2] shape, [3] density and [4]other cytological features.
- and with the aim of bringing cells with similar functions together.





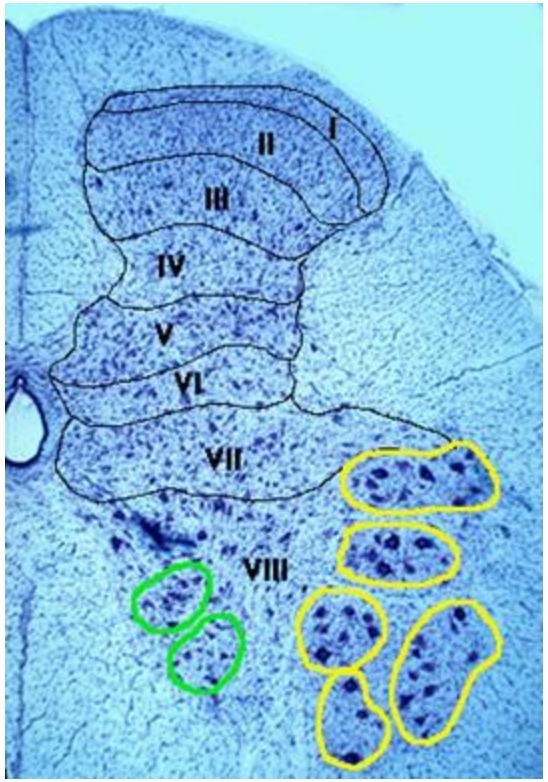
Named after Bror Rexed who described them in the 1950's.

SPINAL CORD: LAMINA OF REXED AND TRACTS



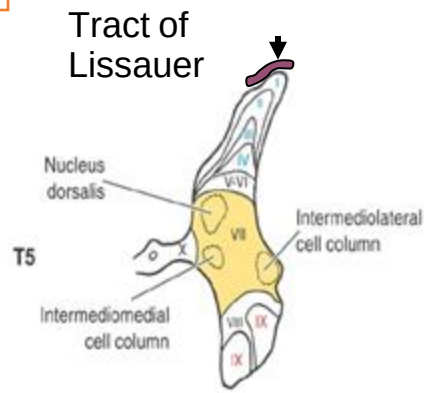
Internal Histology of the Spinal Cord

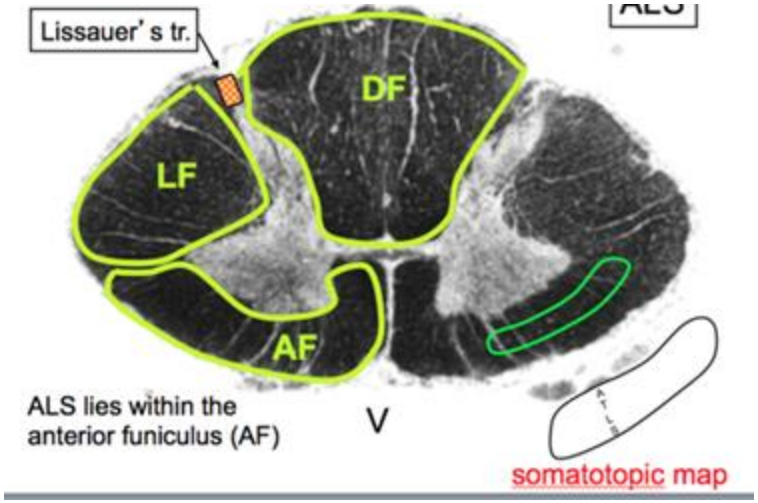
- **LAMINA I**: Lamina Marginalis (some large diameter afferents synapse here).
- **LAMINA II**: Substantia Gelatinosa (many pain fibers synapse here).
- **LAMIN III**: part of Substantia Gelatinosa, and part of Nucleus Proprius (receives a variety of afferents).
- **LAMIN IV**: part of Nucleus Proprius.



Internal Histology of the Spinal Cord

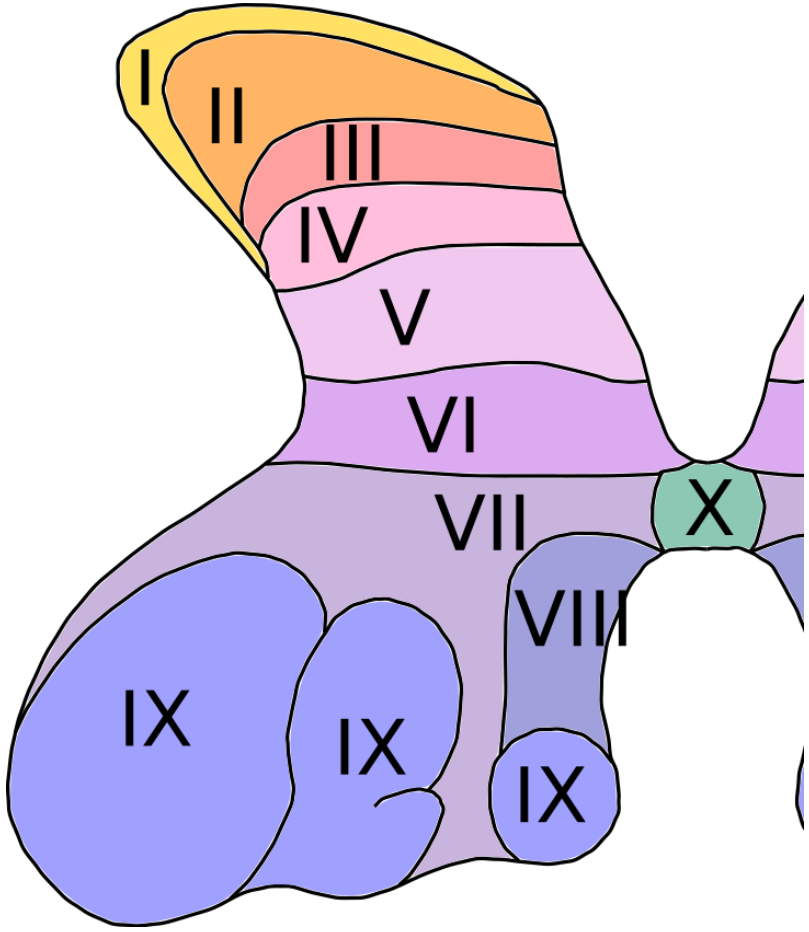
Overlying lamina I is the Tract of Lissauer, a thin layer of white matter. Afferents entering the cord typically divide into ascending and descending branches that travel in this tract for a distance before penetrating the grey matter.





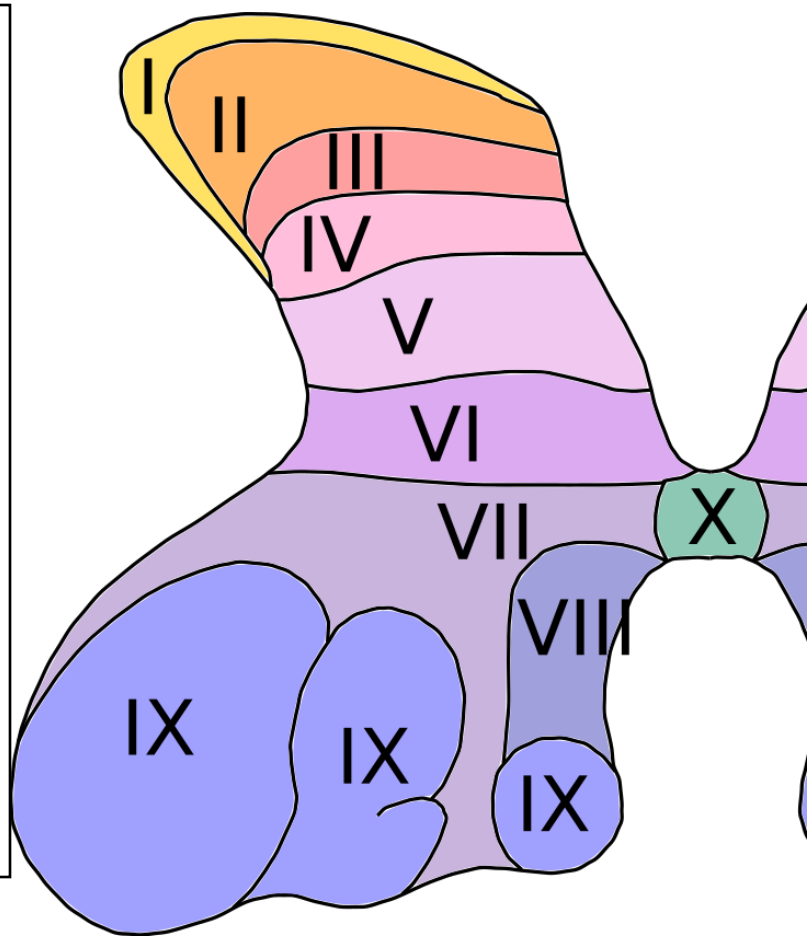
Internal Histology of the Spinal Cord

Lamina V and VI: found at the base of the dorsal horn, cells here receive most of the proprioceptive afferents, as well as many inputs from both motor and sensory higher centres, suggesting that these layers are important in movement. Also contains *tract cells* that give rise to the spinothalamic tract.



Internal Histology of the Spinal Cord

Lamina VII: comprises most of the intermediate horn and includes Clarke's column (T1-L2) (also known as dorsal nucleus, nucleus dorsalis, thoracic nucleus or nucleus thoracis) many proprioceptive fibres synapse here. Also includes the intermediolateral column (T1-L2) that contains the sympathetic preganglionic neurons.

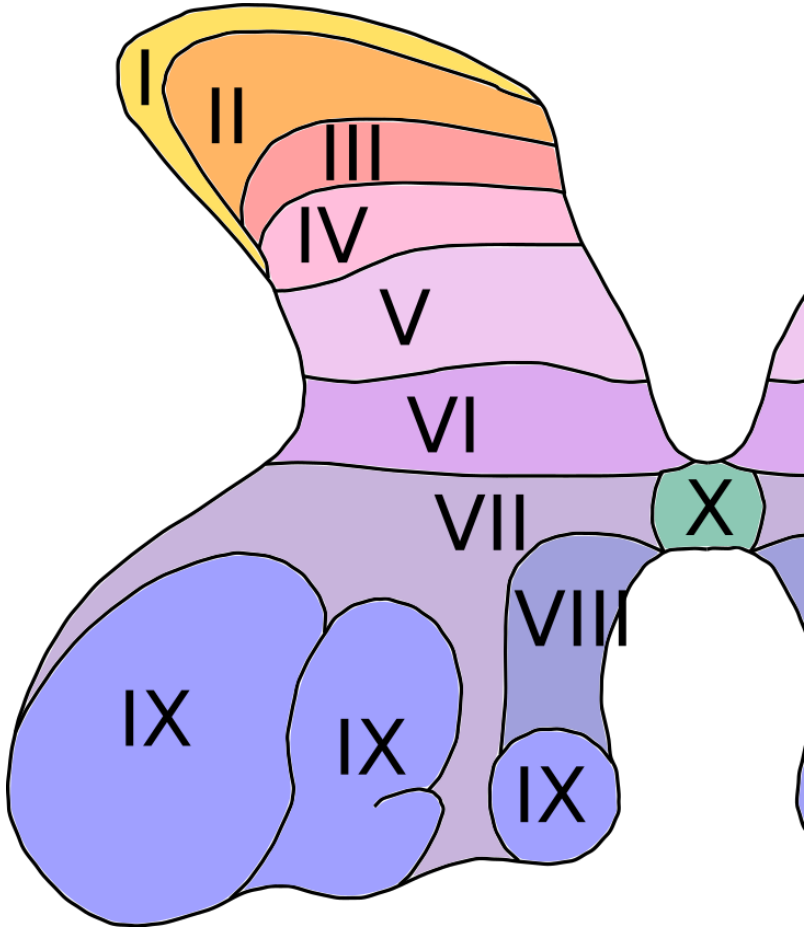


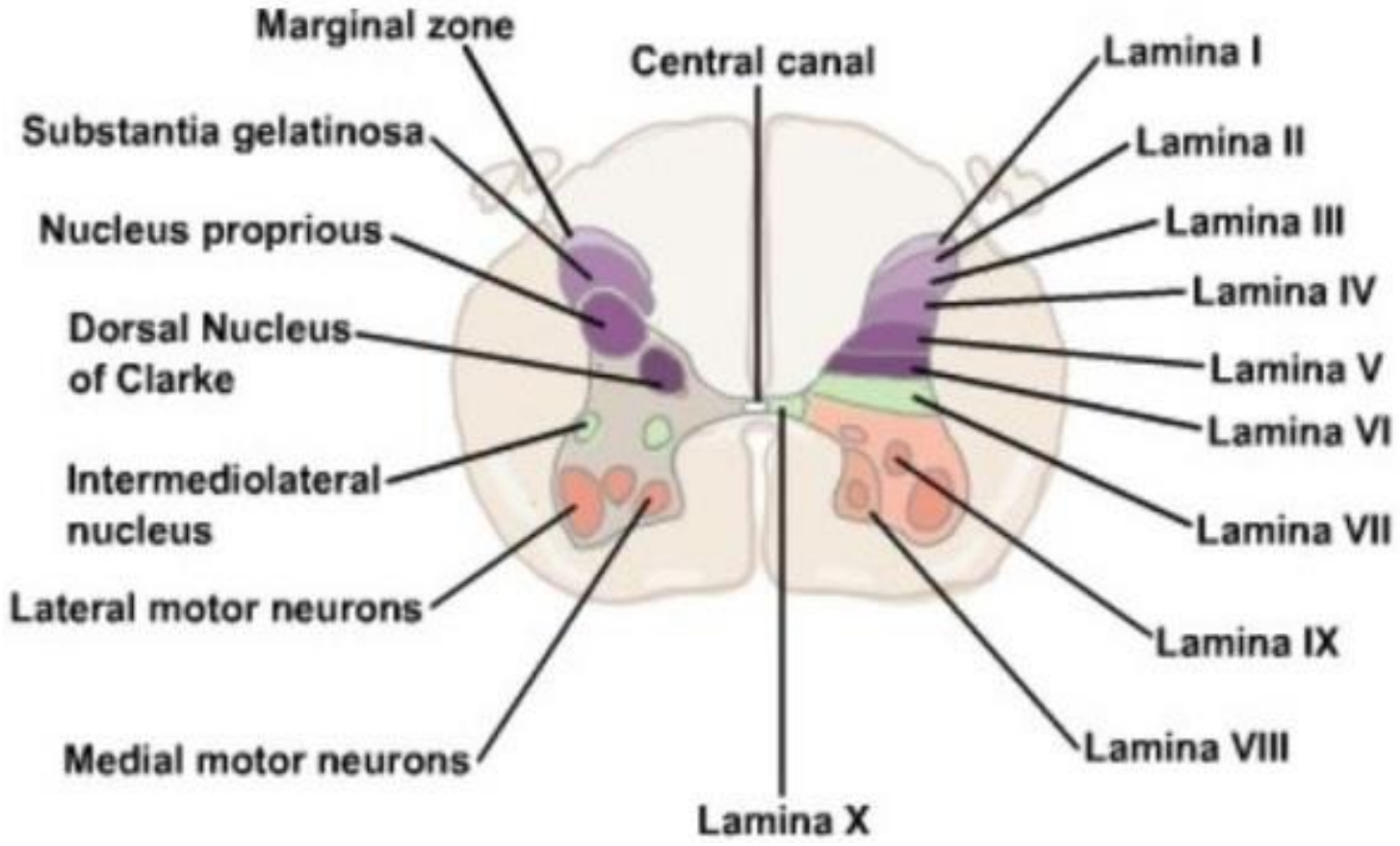
Internal Histology of the Spinal Cord

Lamina VIII: contains proprioceptive interneurons.

Lamina IX: layer of alpha and gamma motoneurons.

Lamina X: consists of the dorsal and ventral grey commissures.




Marginal zone
Central canal
Lamina I
Substantia gelatinosa
Lamina II
Nucleus proprious
Lamina III
Lamina IV
Dorsal Nucleus
of Clarke
Lamina V
Lamina VI
Intermediolateral
nucleus
Lamina VII
Lateral motor neurons
Lamina IX
Lamina VIII
Medial motor neurons
Lamina X

DIVISIONS IN WHITE MATTER

Anterior white column (or funiculus)

Lateral white column (or funiculi)

Posterior white column (or funiculus)

Anterior white commissure.