BASIC ANATOMY
OF THE NERVOUS SYSTEM

Recommended textbooks:

Dubový, Petr. **Gross Anatomy and Structure of the Human Nervous System** - Part I. Surface Anatomy and Structural Arrangement of the Central Nervous System. 3rd ed. Brno : Masarykova univerzita, 2012. 91 s. ISBN 978-80-210--6125-5.

Drake, Richard L. **Gray s anatomy for students**. ISBN 9780443069529.

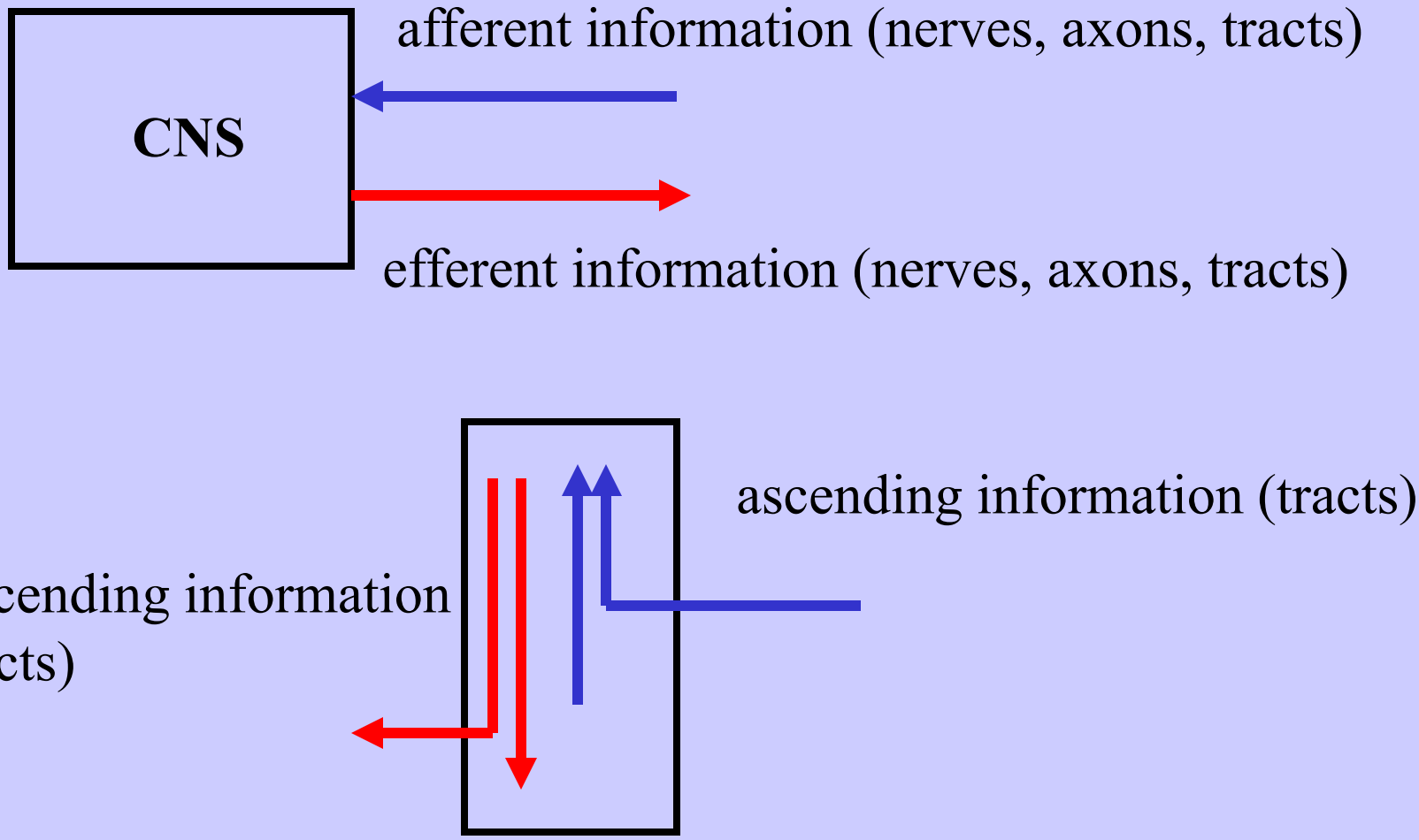
Stingl, Grim, Druga: **Regional anatomy**. Galén 2012, ISBN 978-80-7262-879-7.

Dubový, Petr. **Instructions for Anatomical Dissection Course.** 1. dotisk 2. vyd. Brno: Masarykova univerzita, 2010. 71 s. ISBN 978-80-210-4229-2.

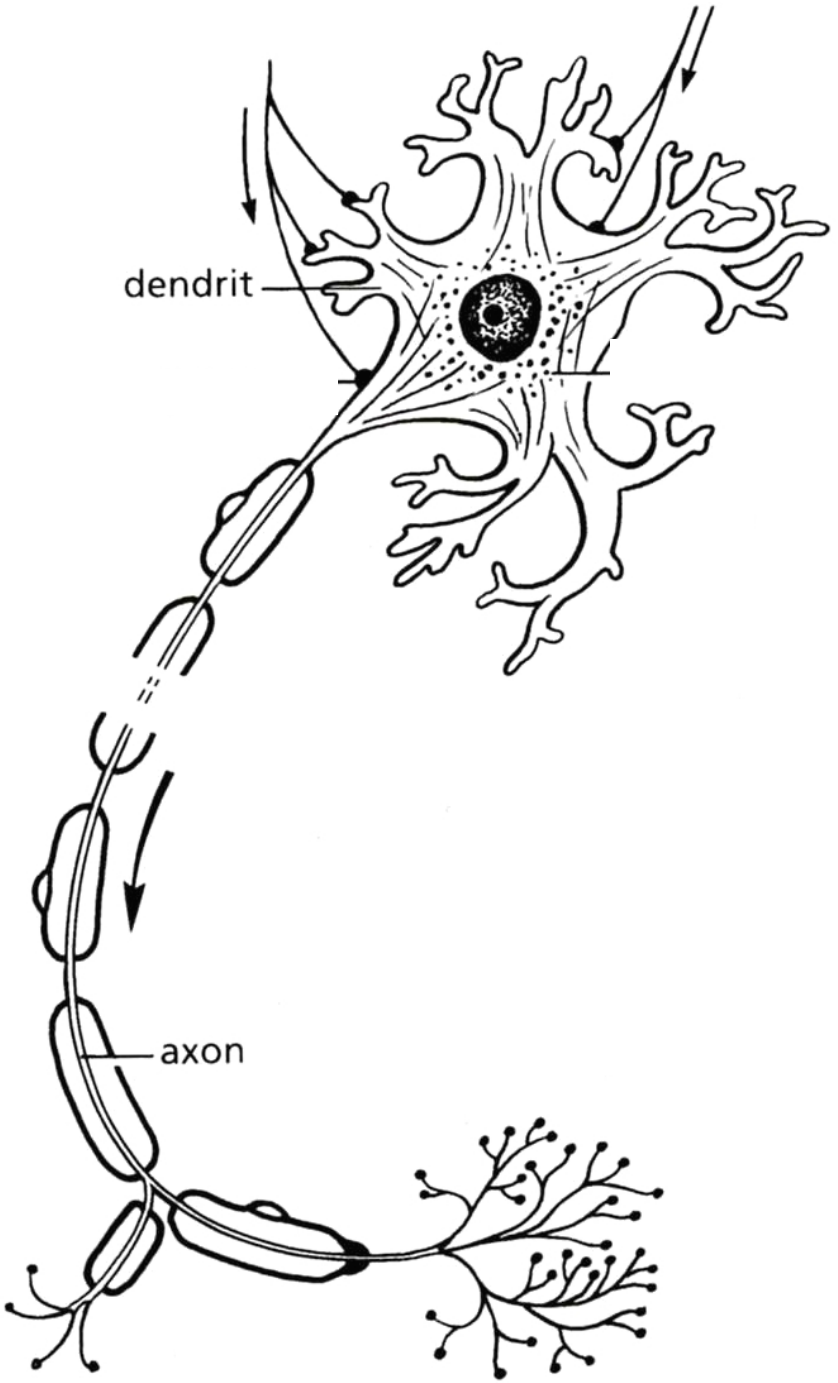
Netter, Frank H. **Atlas of Human Anatomy**, 3rd. ed. 2003. ISBN: 1929007116

Atlas of anatomy: Latin nomenclature. Edited by Anne M. Gilroy - Brian R. MacPherson - Lawrence M. Ross - Michael Schu. New York: Thieme Medical, 2009. xv, 656 p. ISBN 978-1-60406-099-7.

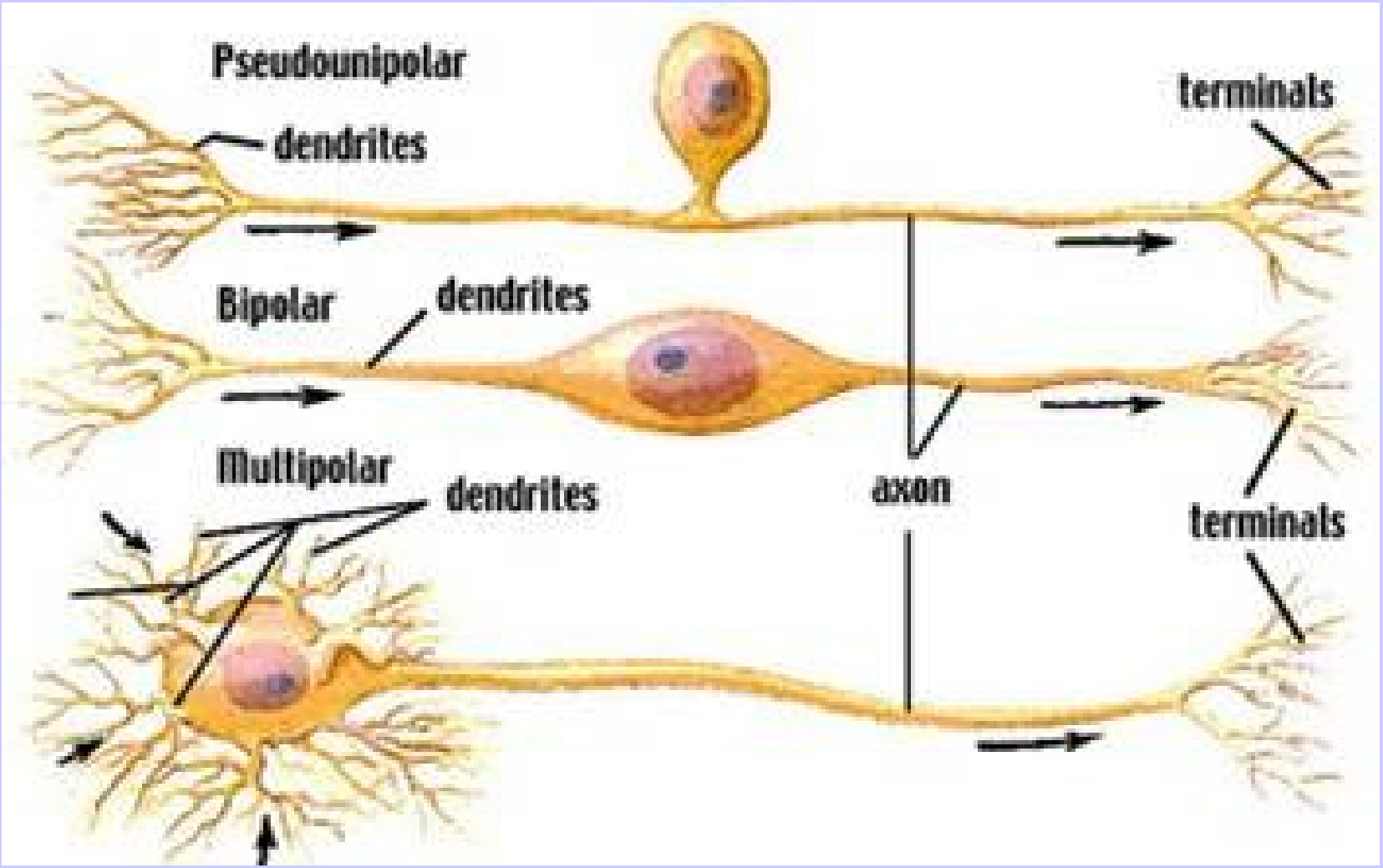
Basic conception



NERVE CELL = NEURON



TYPES OF NEURONS

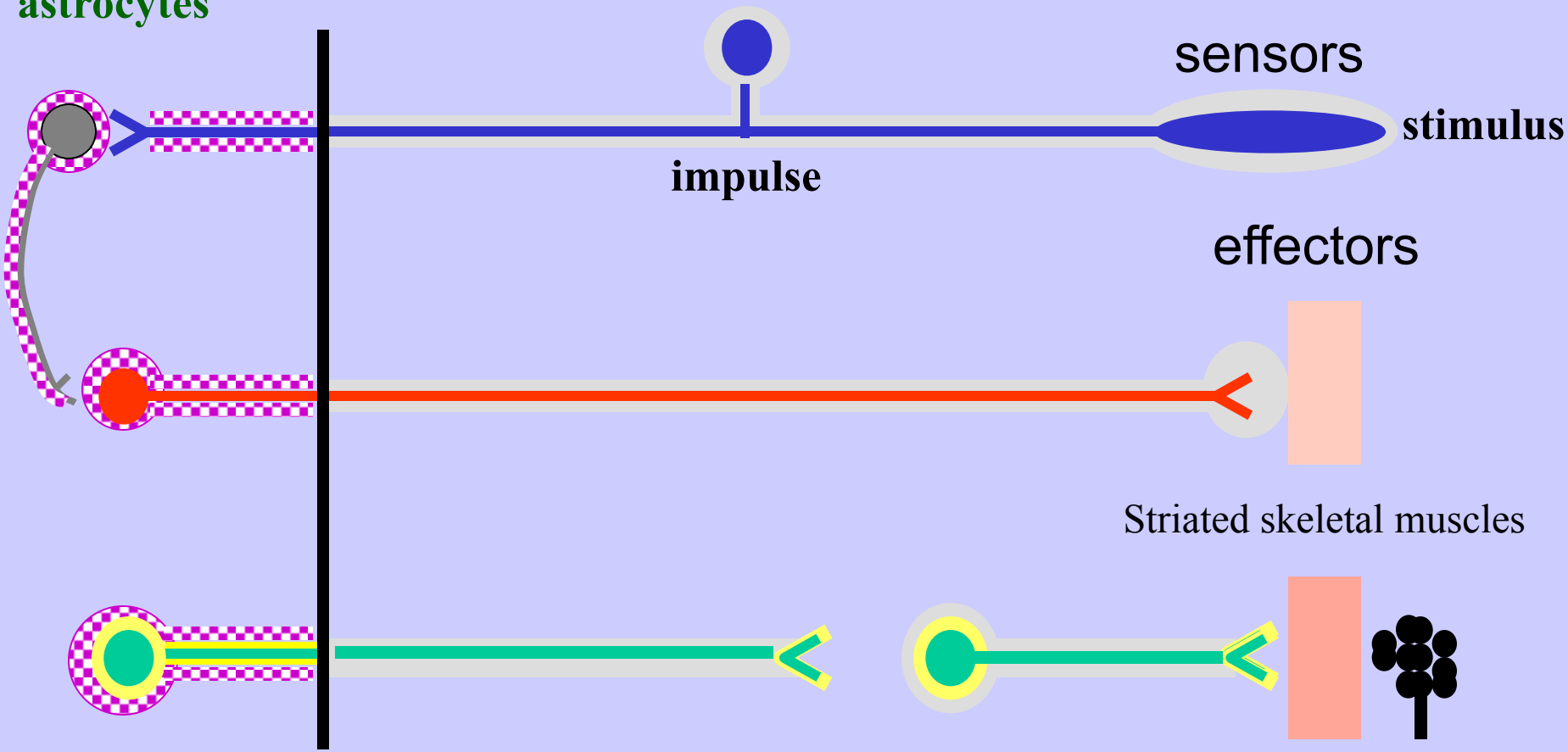


DIVISION OF THE NERVOUS SYSTEM

CNS **PNS**

oligodendrocytes
astrocytes

Schwann cells and their derivatives



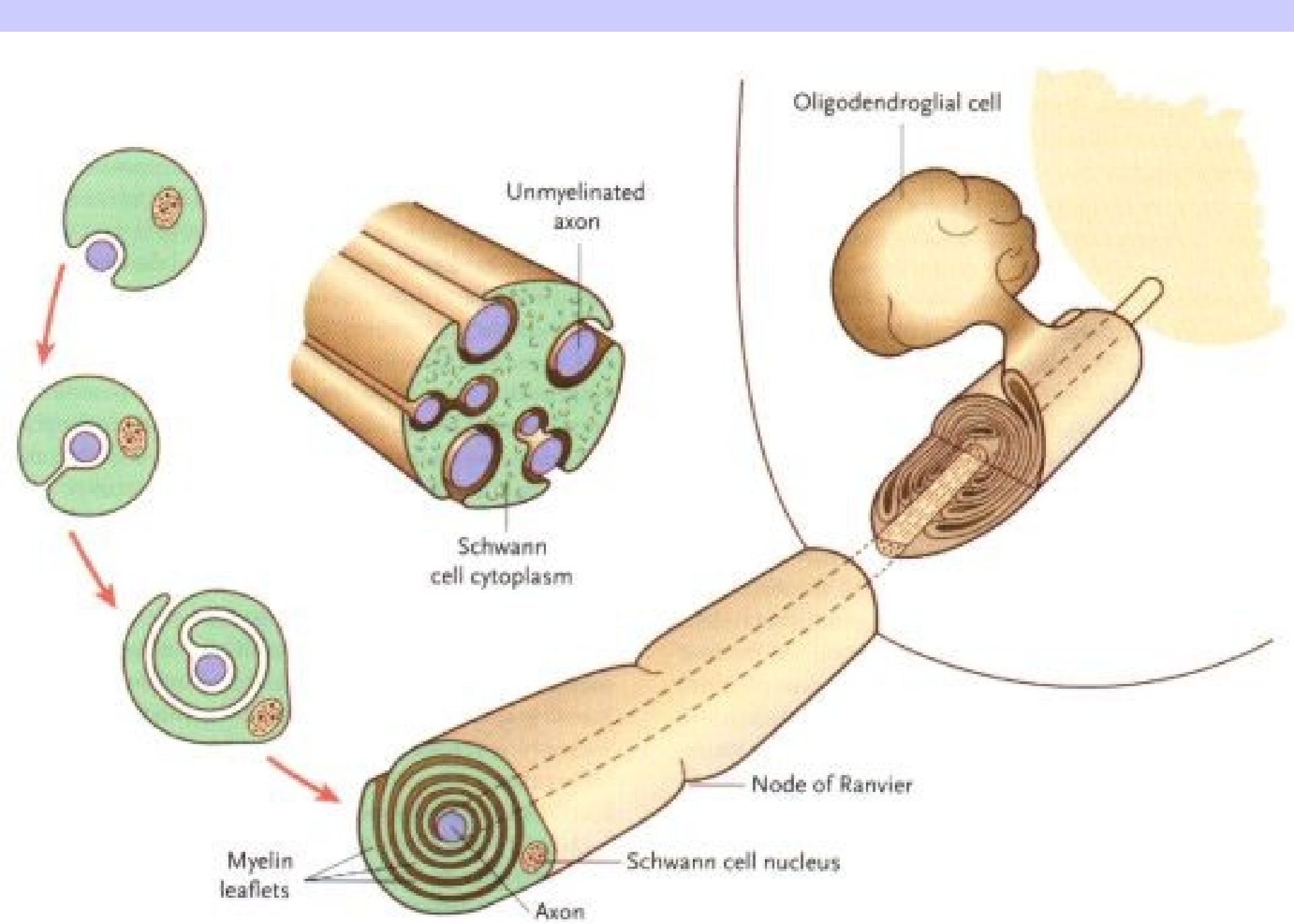
DIVISION OF THE PNS

Cranial nerves I.- XII.

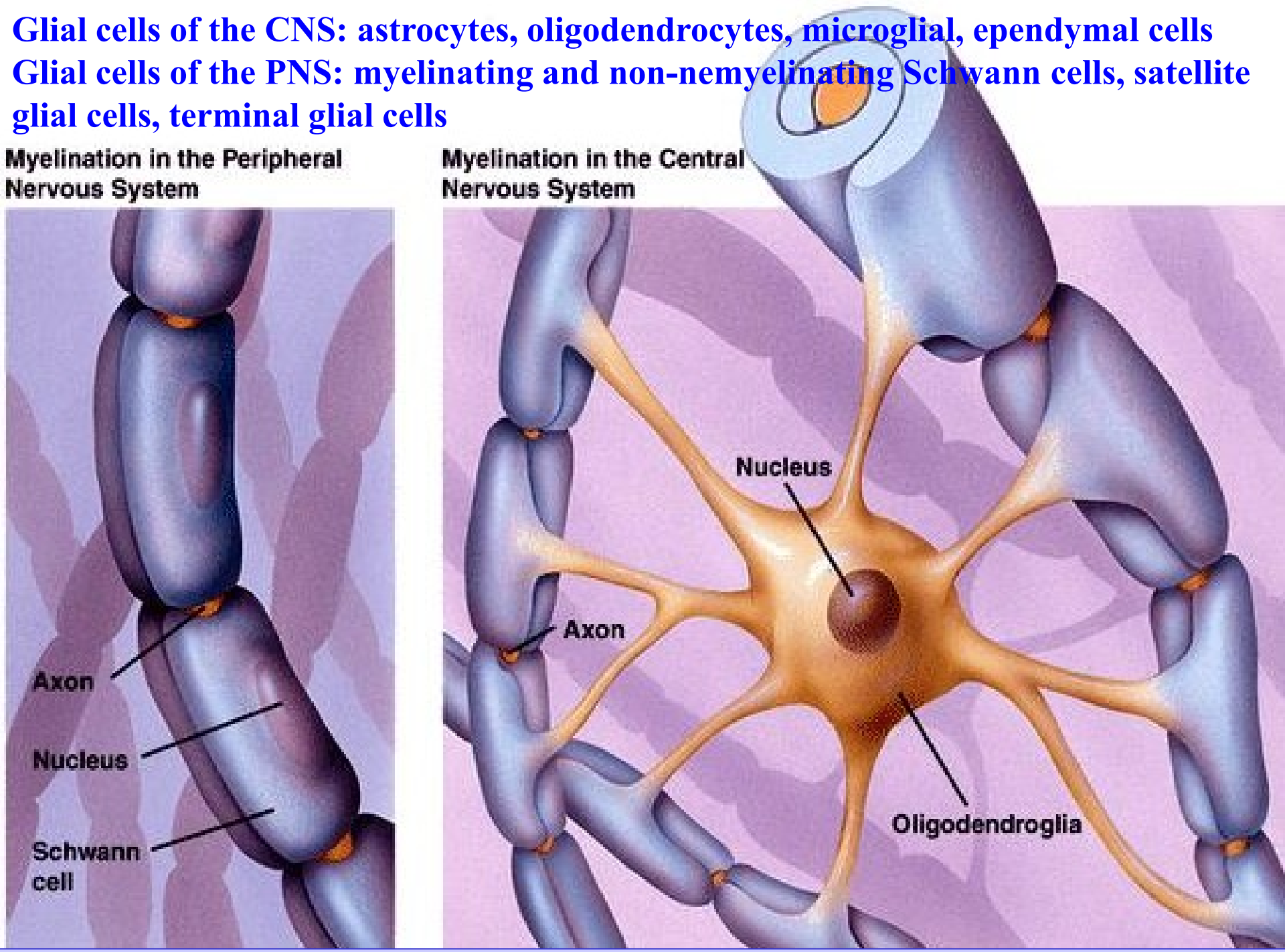
- **run through the skull base**

Spinal nerves – 31 pairs

- **run through foramina intervertebralia**

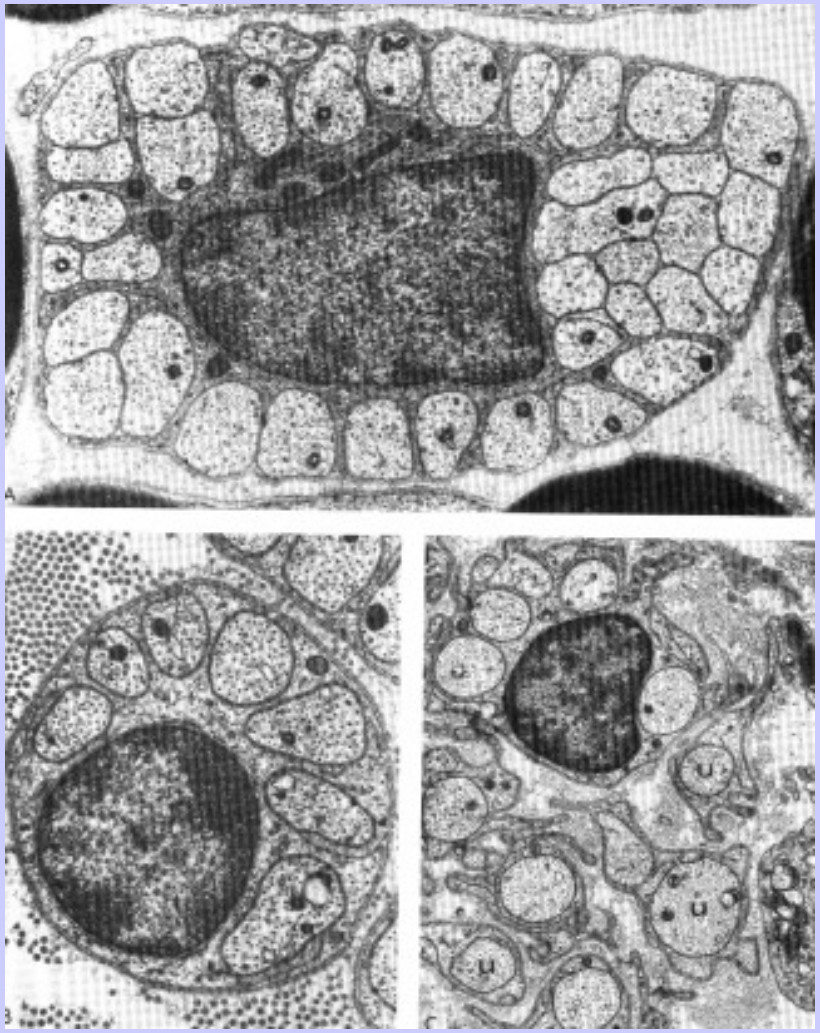

Oligodendroglial cell
Unmyelinated axon
Schwann cell cytoplasm
Node of Ranvier
Myelin leaflets
Schwann cell nucleus
Axon

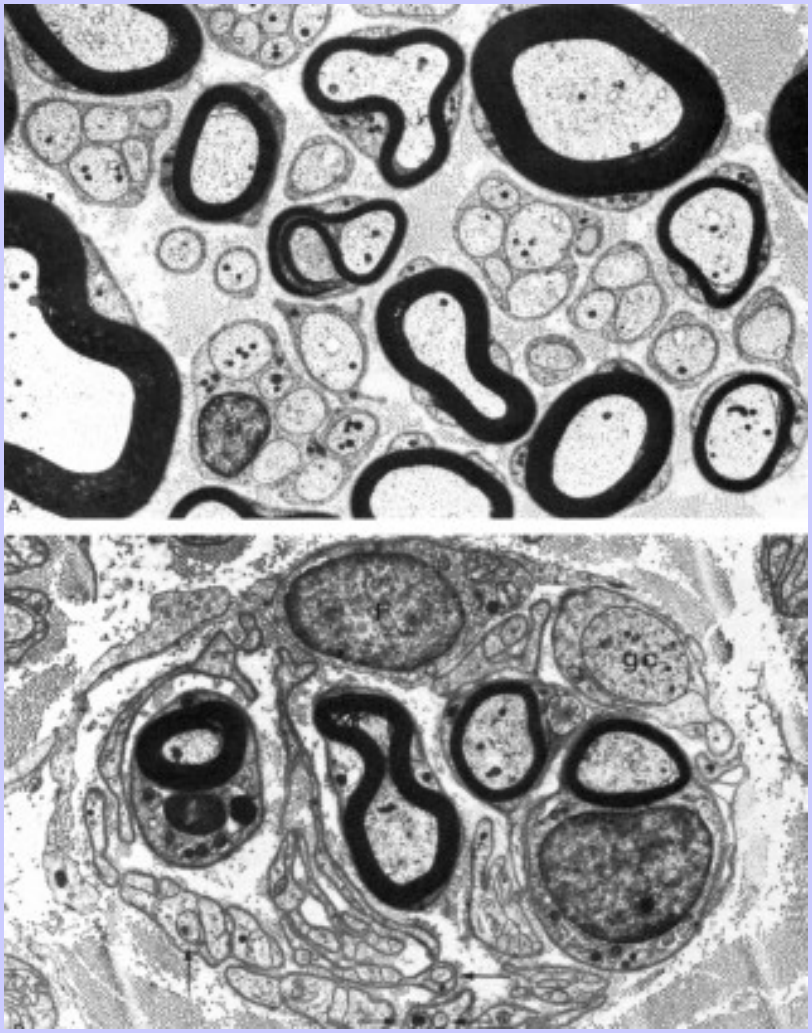
Glial cells of the CNS: astrocytes, oligodendrocytes, microglial, ependymal cells
Glial cells of the PNS: myelinating and non-nemyelinating Schwann cells, satellite glial cells, terminal glial cells



unmyelinated axons (< 1μm)

myelinated axons





FUNCTIONAL TYPES OF AXONS IN PNS

Afferent

somatosensory ← touch, proprioception, pain

viscerosensory ← mechanoception, pain

sensory ← relay impulses for taste, hearing and balance

Efferent

somatomotor → striated muscles

branchiomotor → striated muscles

visceromotor → non-striated muscles

sympathetic → myocardium

parasympathetic → glands

DIVISION OF THE CNS

Brain (Encephalon)

Spinal cord (Medulla spinalis)

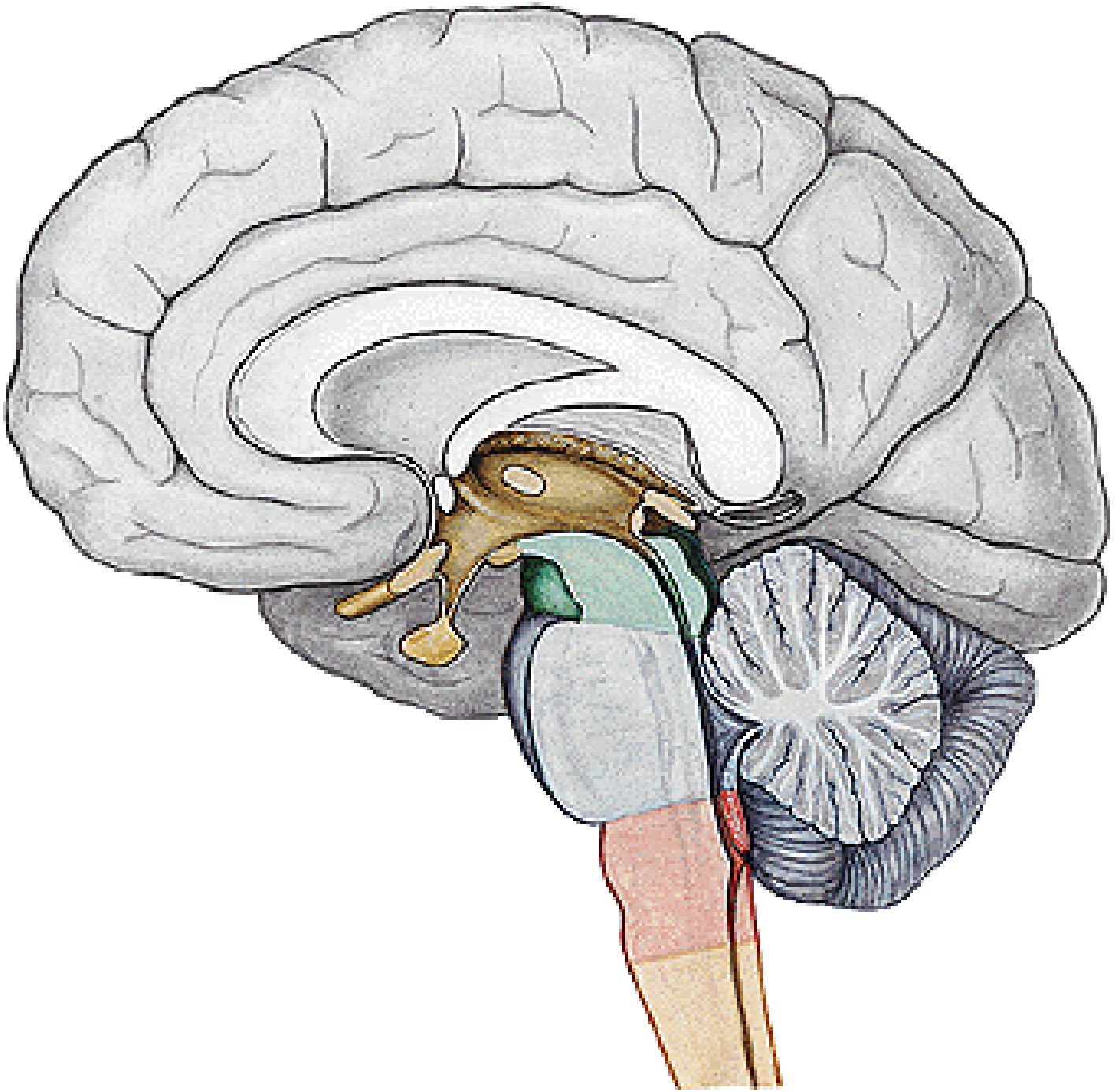
Brainstem (Truncus encephali)

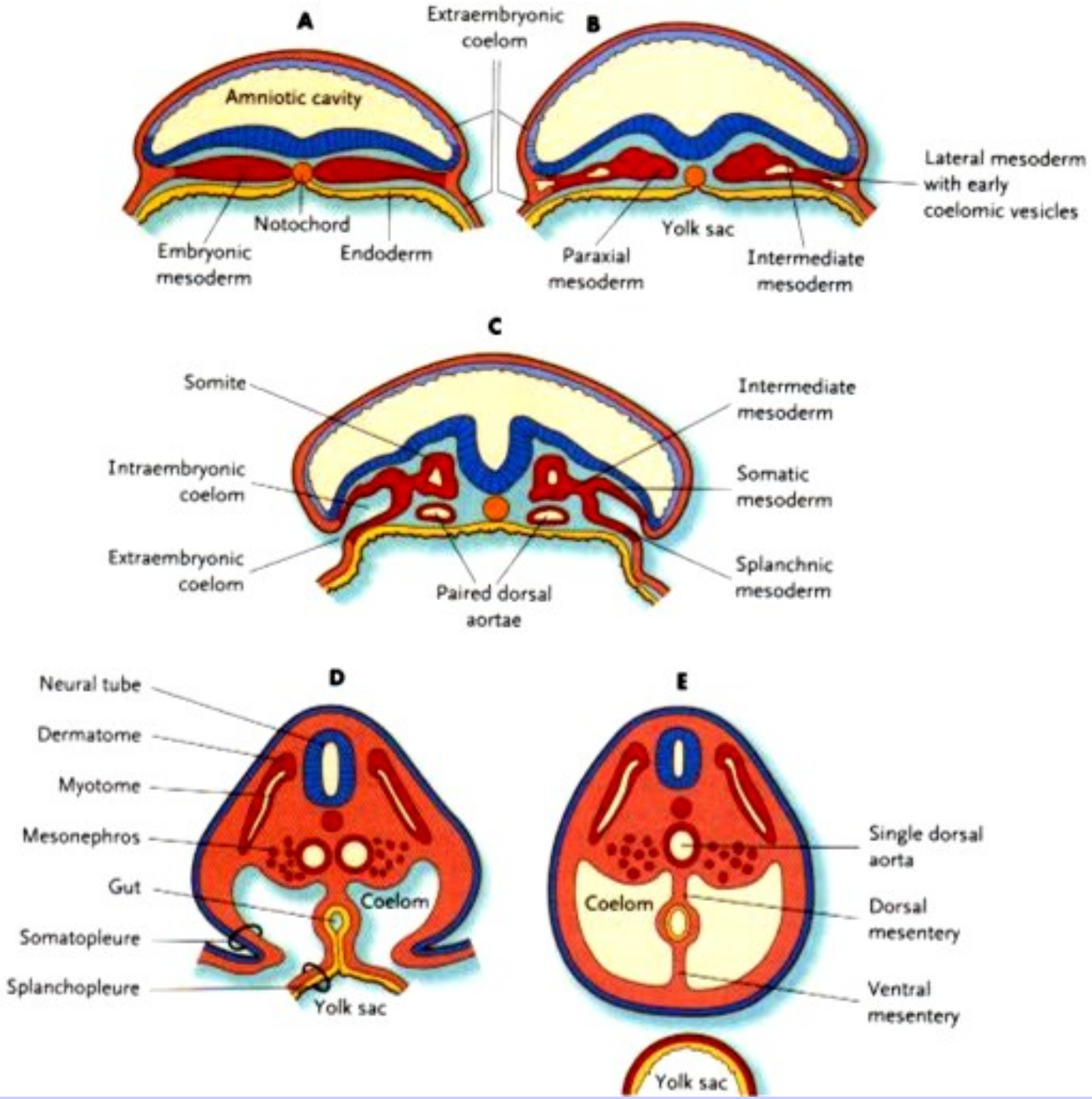
- **Medulla oblongata**
- **Pons**
- **Mesencephalon**

Cerebellum

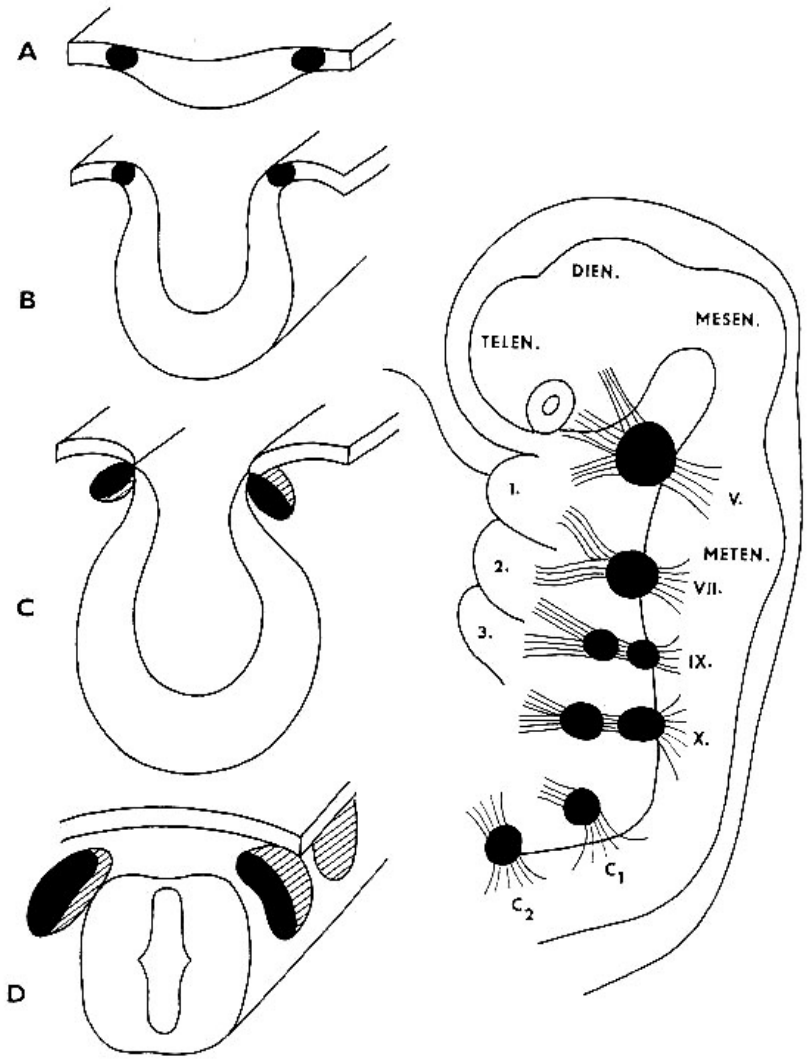
Diencephalon

Telencephalon




A
Extraembryonic coelom
B
Amniotic cavity
Lateral mesoderm with early coelomic vesicles
Notochord
Embryonic mesoderm
Endoderm
Paraxial mesoderm
Yolk sac
Intermediate mesoderm
C
Somite
Intermediate mesoderm
Intraembryonic coelom
Somatic mesoderm
Extraembryonic coelom
Splanchnic mesoderm
Paired dorsal aortae
D
E
Neural tube
Dermatome
Myotome
Mesonephros
Gut
Somatopleure
Splanchopleure
Coelom
Yolk sac
Single dorsal aorta
Coelom
Dorsal mesentery
Ventral mesentery
Yolk sac

Neural crest

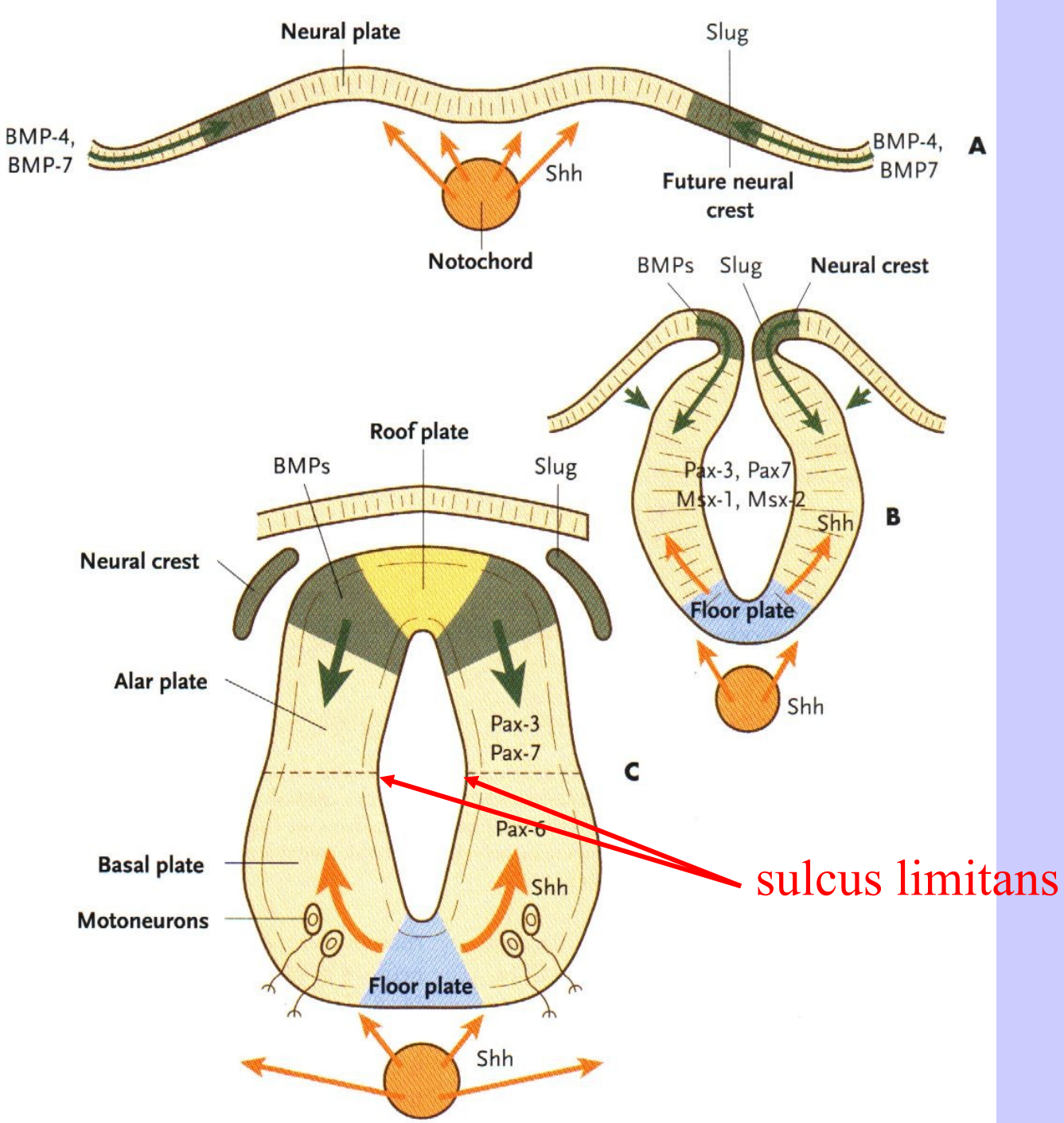


r. 1.: Schema vývoje nervové trubice a gangliové lišty v příčných řezech (vlevo) a poloha spinálních ganglií (C_1, C_2) a ganglií hlavových nervů (římské číslice (vpravo)

A - vznik medulární ploténky, B - prohloubení v medulární rýhu, C - odštěpování gangliové lišty, D - vznik nervové trubice.

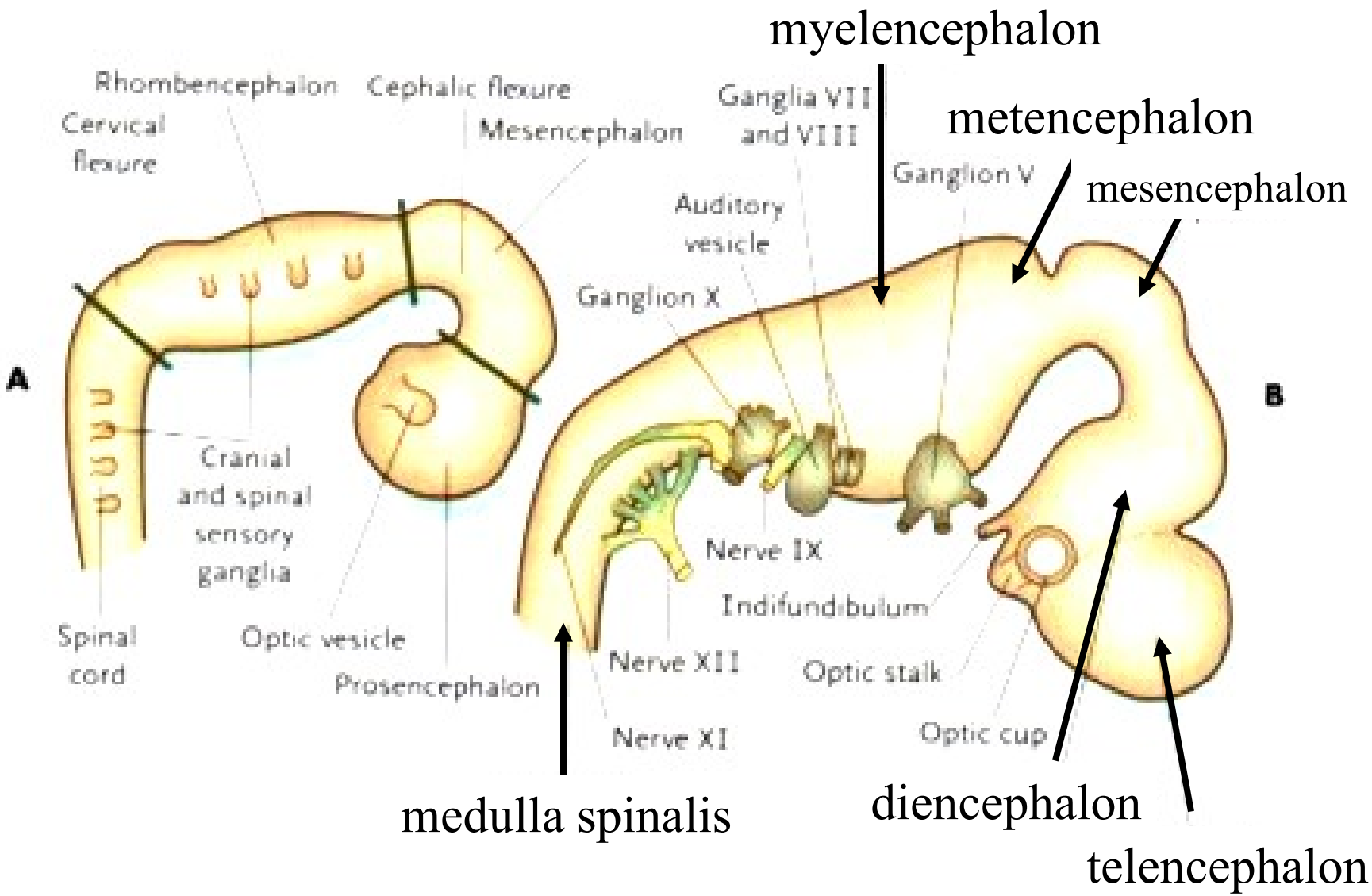
DIEN. - mezimozek, MESEN. - střední mozek, METEN. - zadní mozek, TELEN. - koncový mozek, 1.-3. - žaberní oblouky.

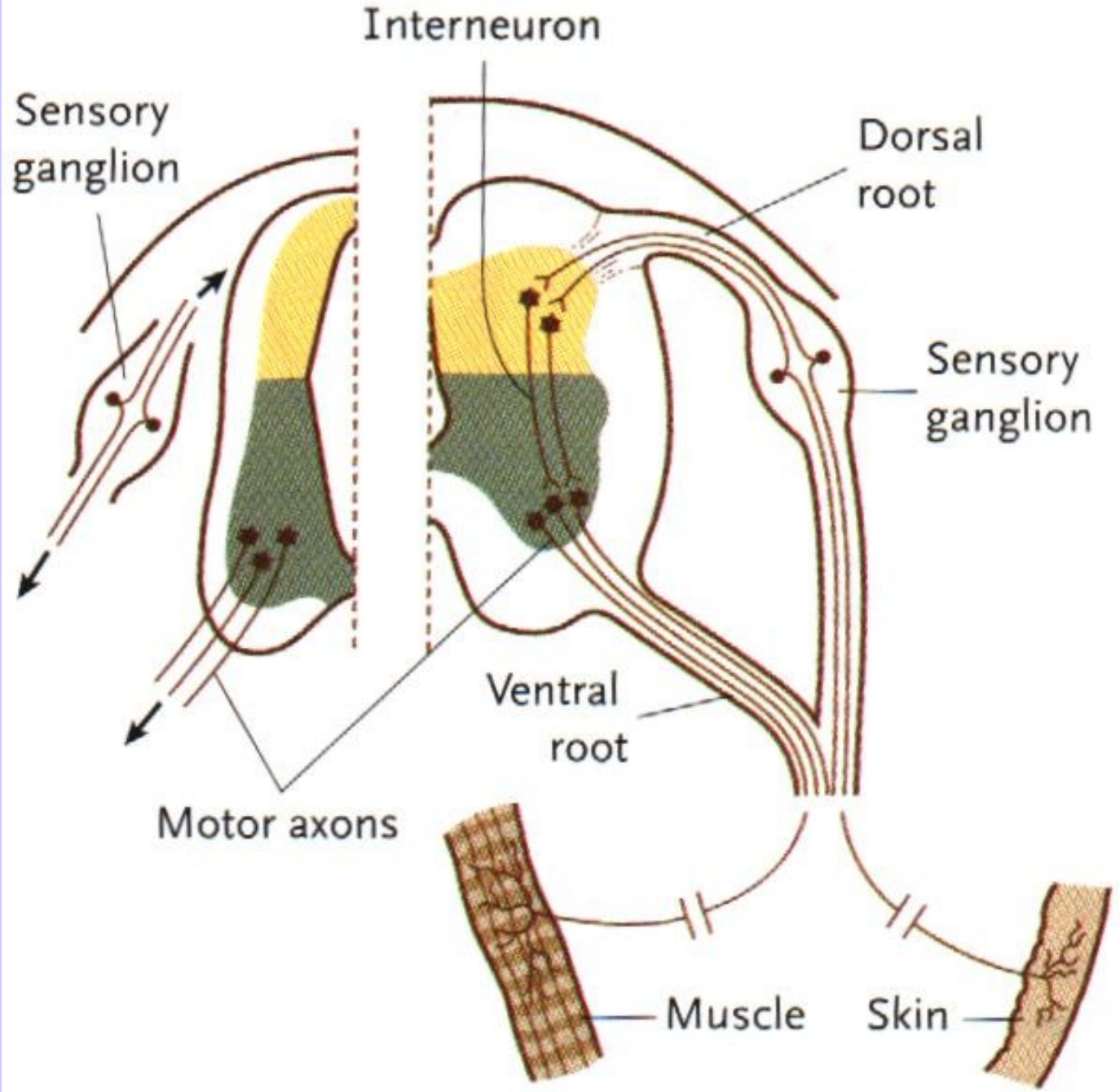
Buněčný materiál gangliové lišty i jednotlivá ganglia jsou zakresleny černě.


Neural plate
Slug
BMP-4,
BMP-7
Shh
BMP-4,
BMP7
A
Future neural
crest
Notochord
BMPs
Slug
Neural crest
Pax-3, Pax7
Msx-1, Msx-2
Shh
B
Floor plate
Shh
Roof plate
BMPs
Slug
Neural crest
Alar plate
Pax-3
Pax-7
C
Pax-6
Basal plate
Shh
Motoneurons
Floor plate
Shh
sulcus limitans

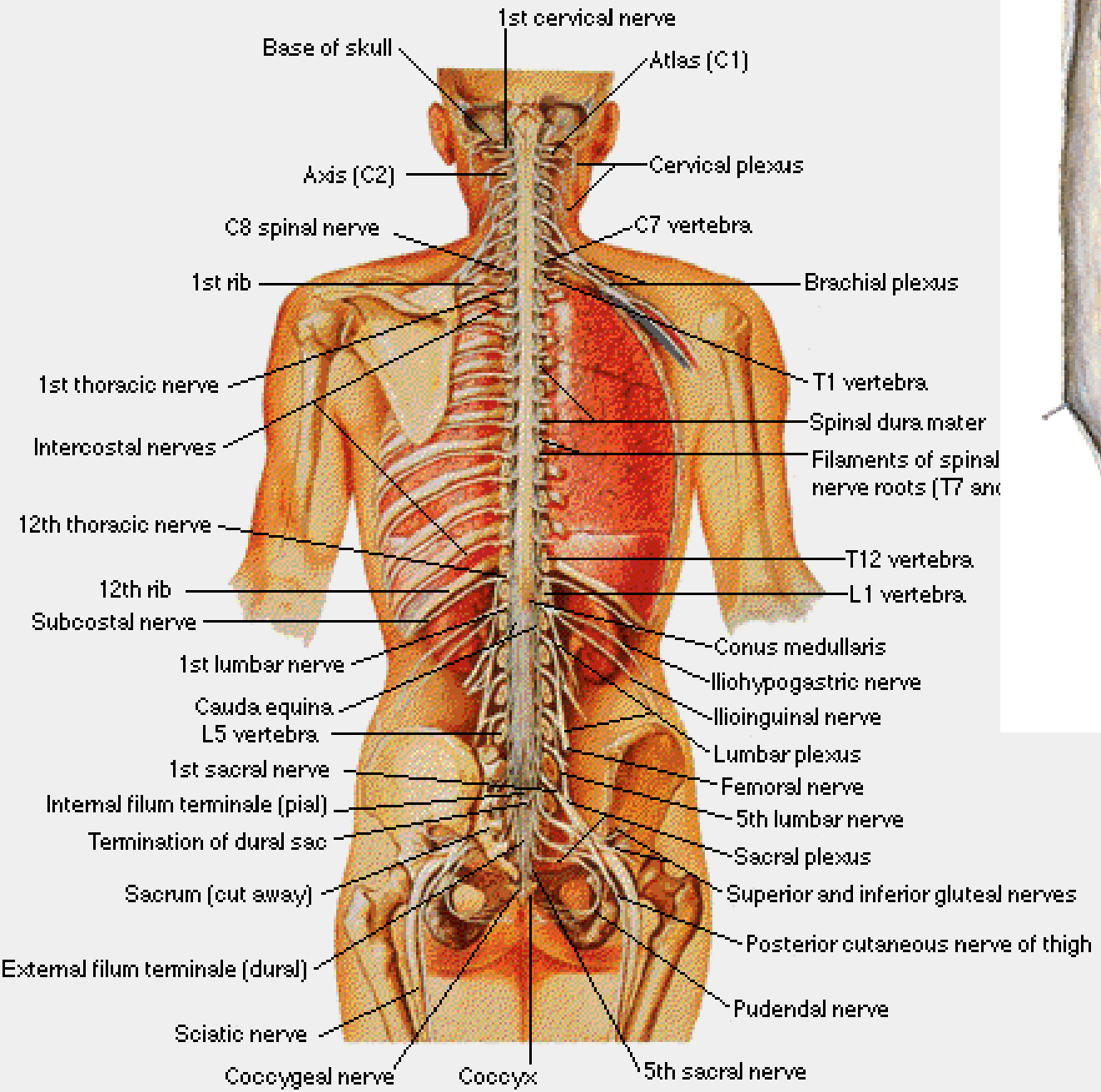
Primary subdivisions: prosencephalon, mesencephalon, rhombencephalon

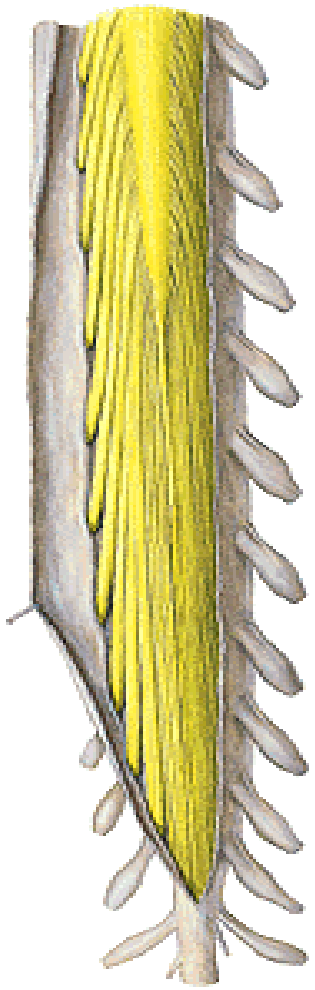
Secondary subdivision: telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon



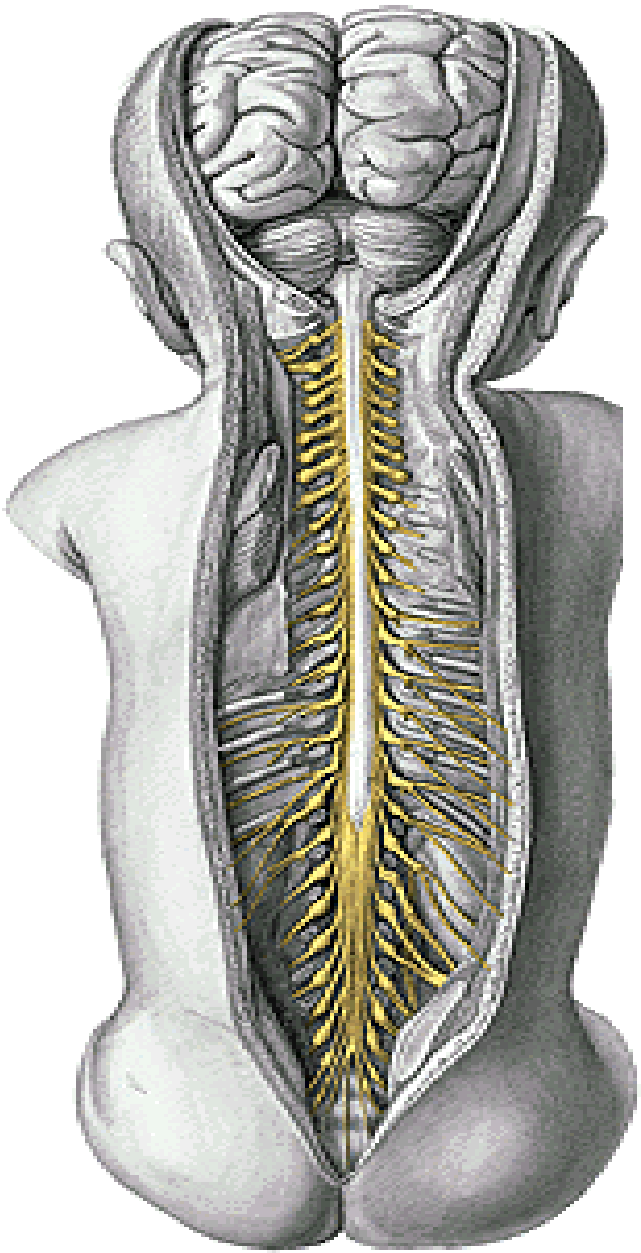

Interneuron
Sensory ganglion
Dorsal root
Sensory ganglion
Ventral root
Motor axons
Muscle
Skin

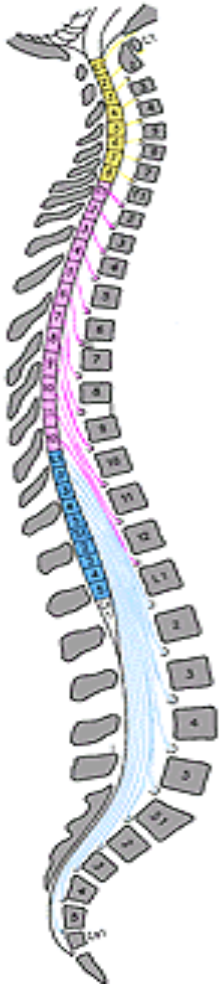
Spinal Cord in Situ





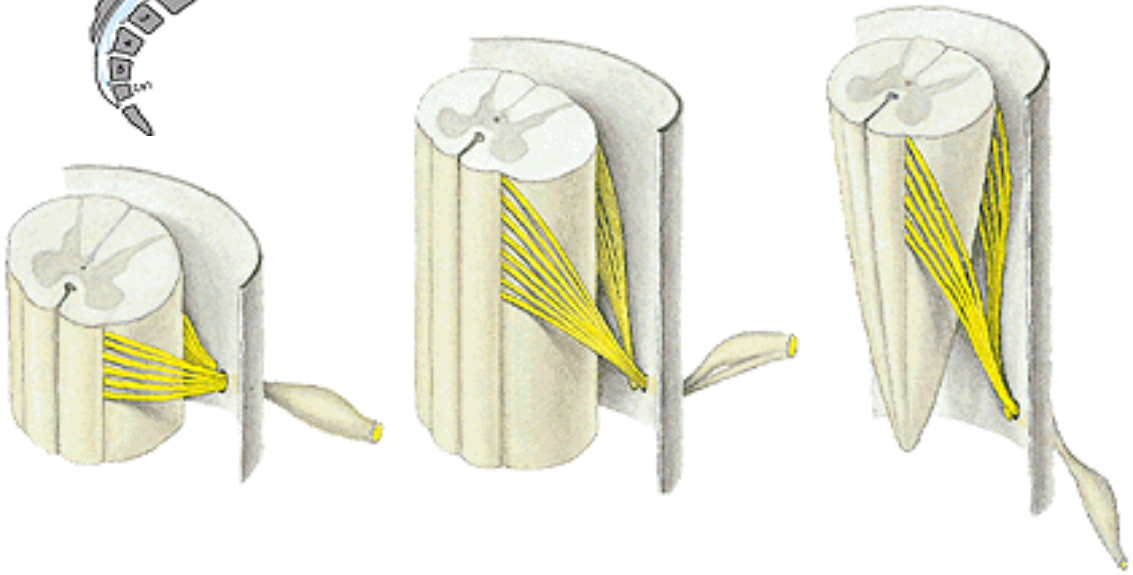
Conus medullaris
Filum terminale
Cauda equina

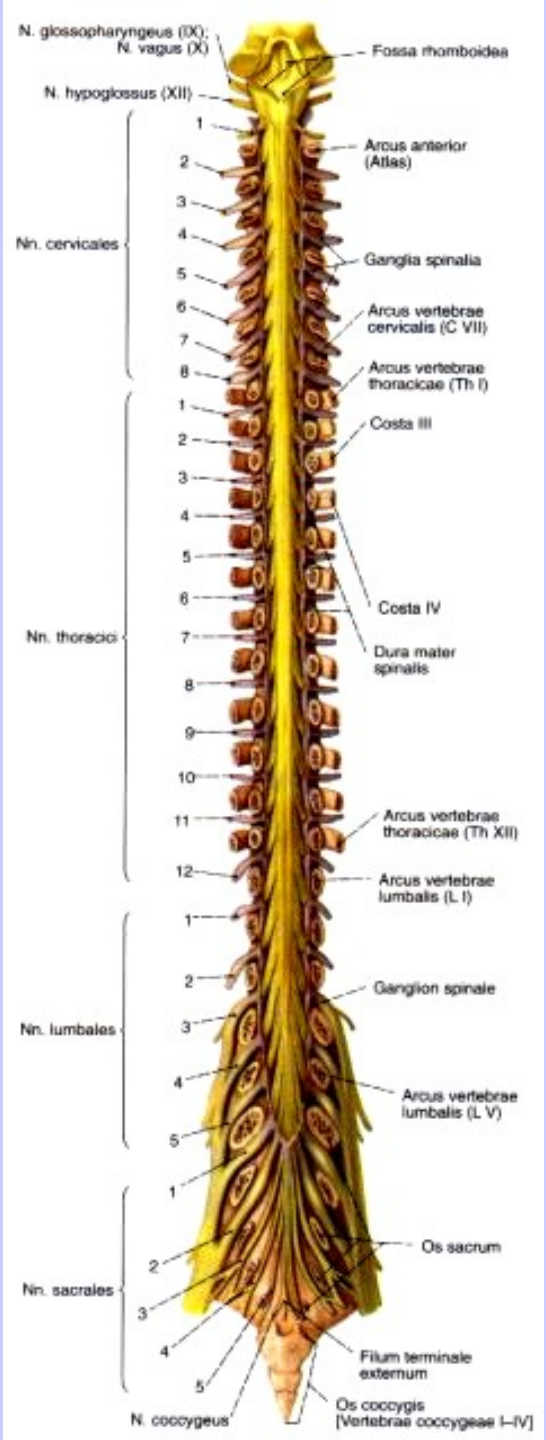




Spinal segment

Fila radicularia



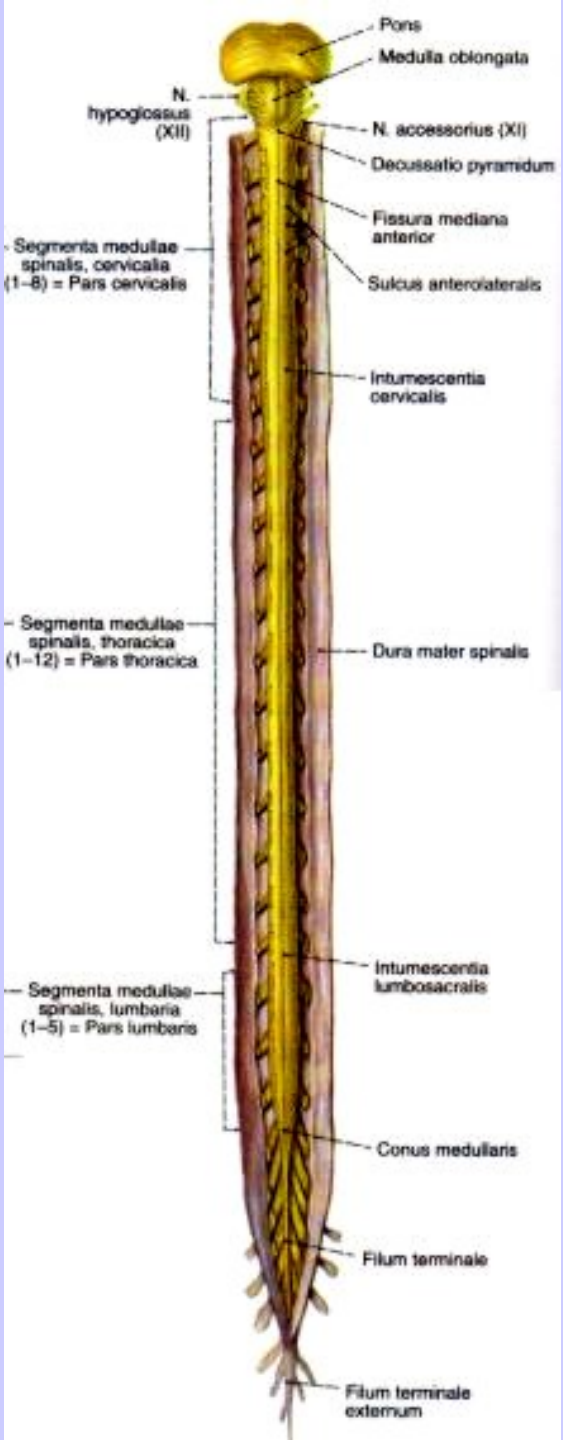


Intumescentia cervicalis

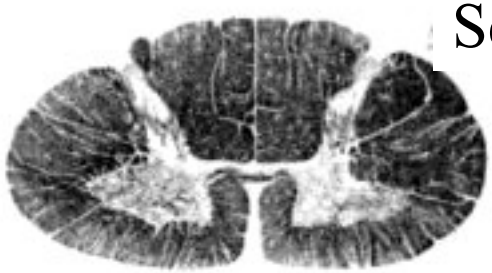
C3 – T2

Intumescentia lumbalis

T9 – T12



Segment C5



Segment C8

Segment Th2

Segment L4

Segment S4

Segment C1

Segment C5

Segment C8

Segment Th2

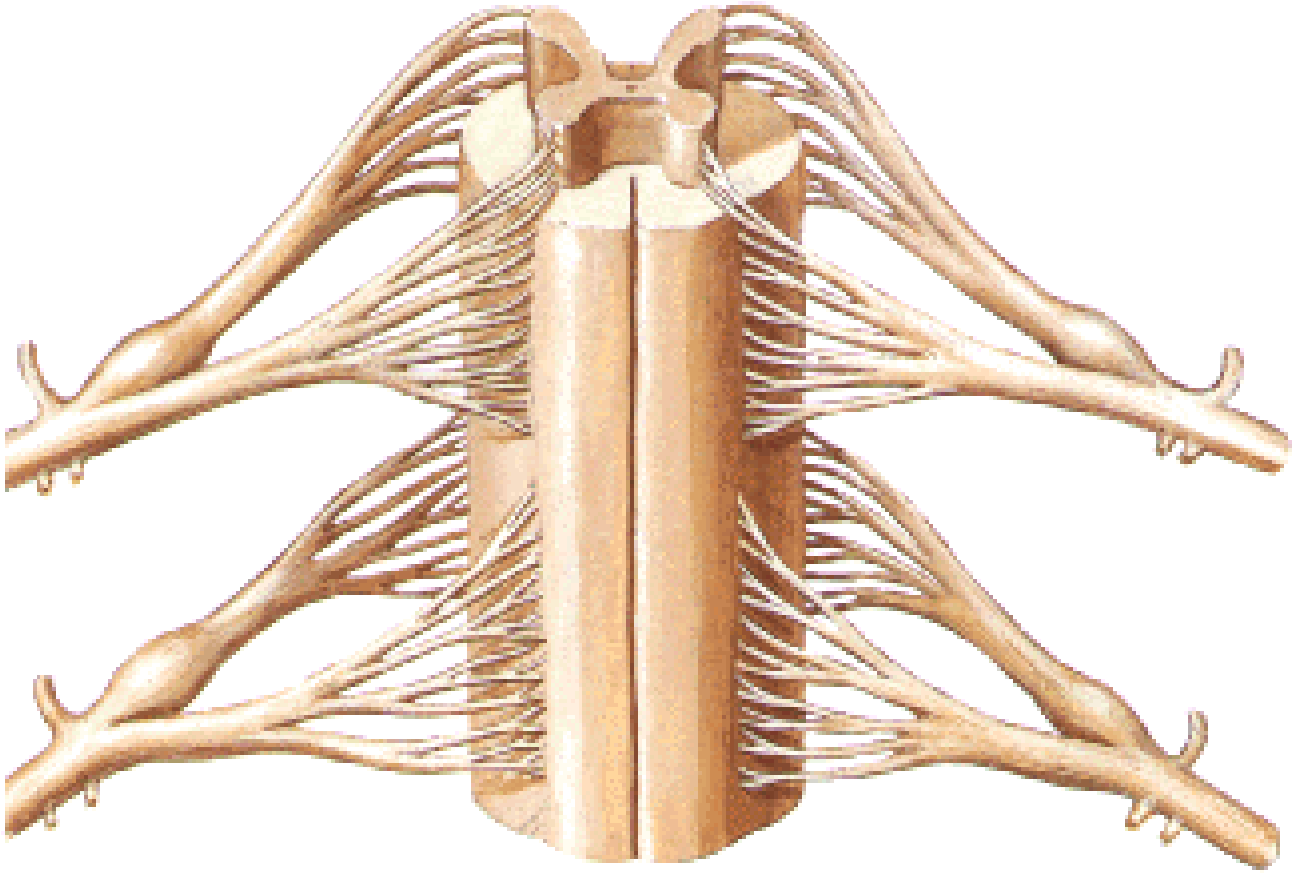
Segment Th10

Segment L1

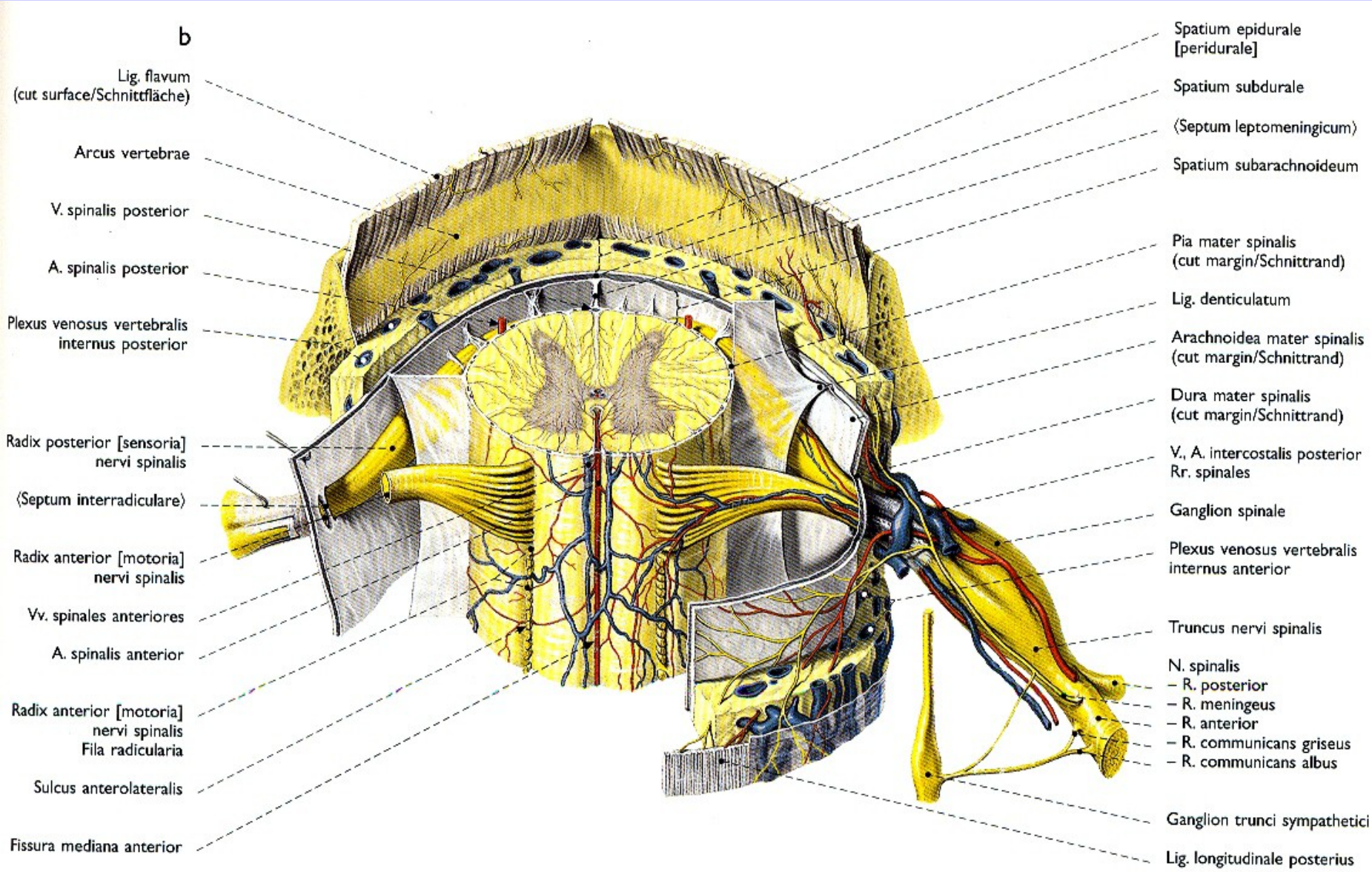
Segment L4

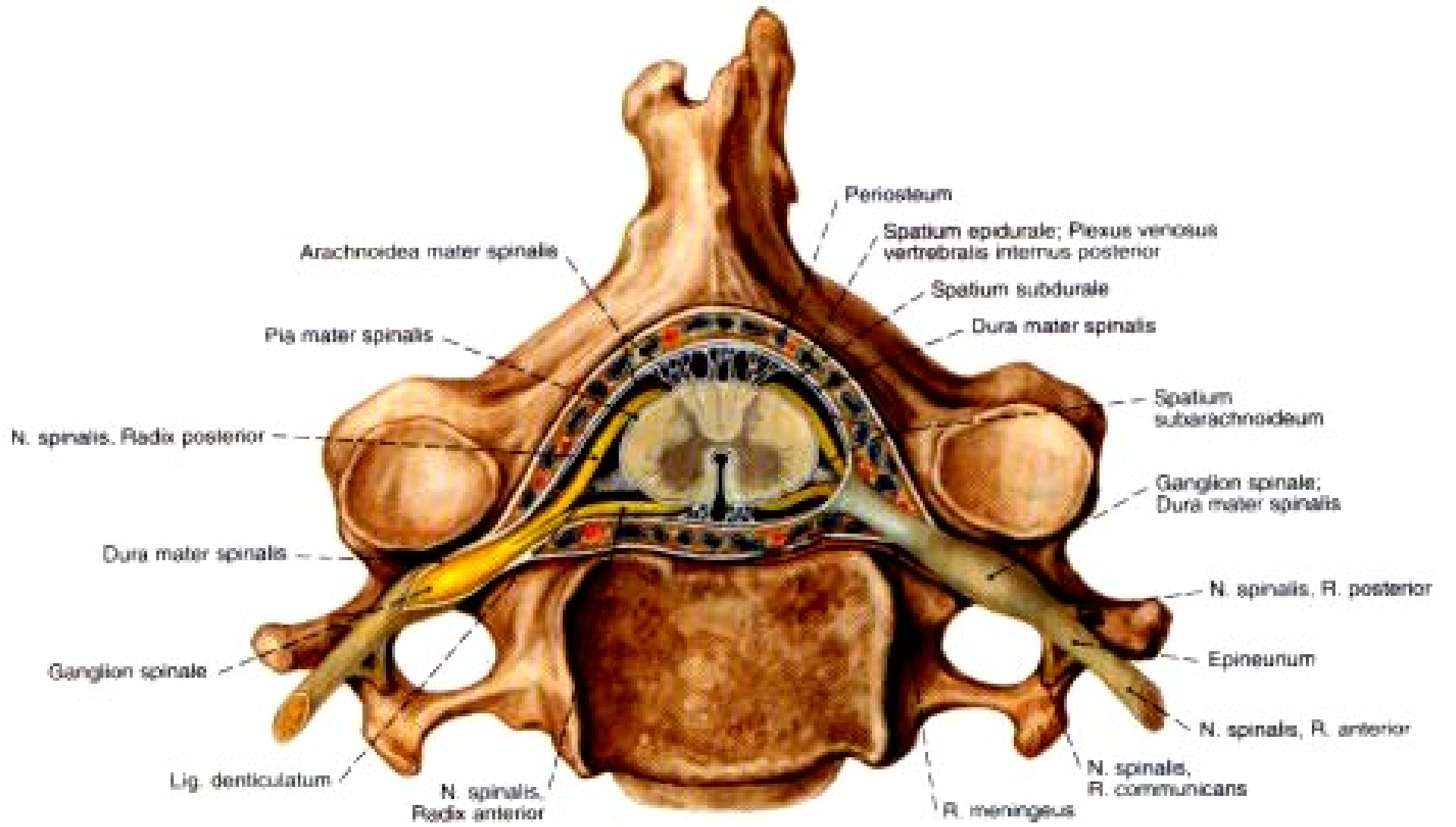
Segment S4

SUBSTANTIA GRISEA – cornu anterius (columna anterior), cornu posterius (columna posterior), cornu laterale (columna lateralis), substantia intermedia, canalis centralis

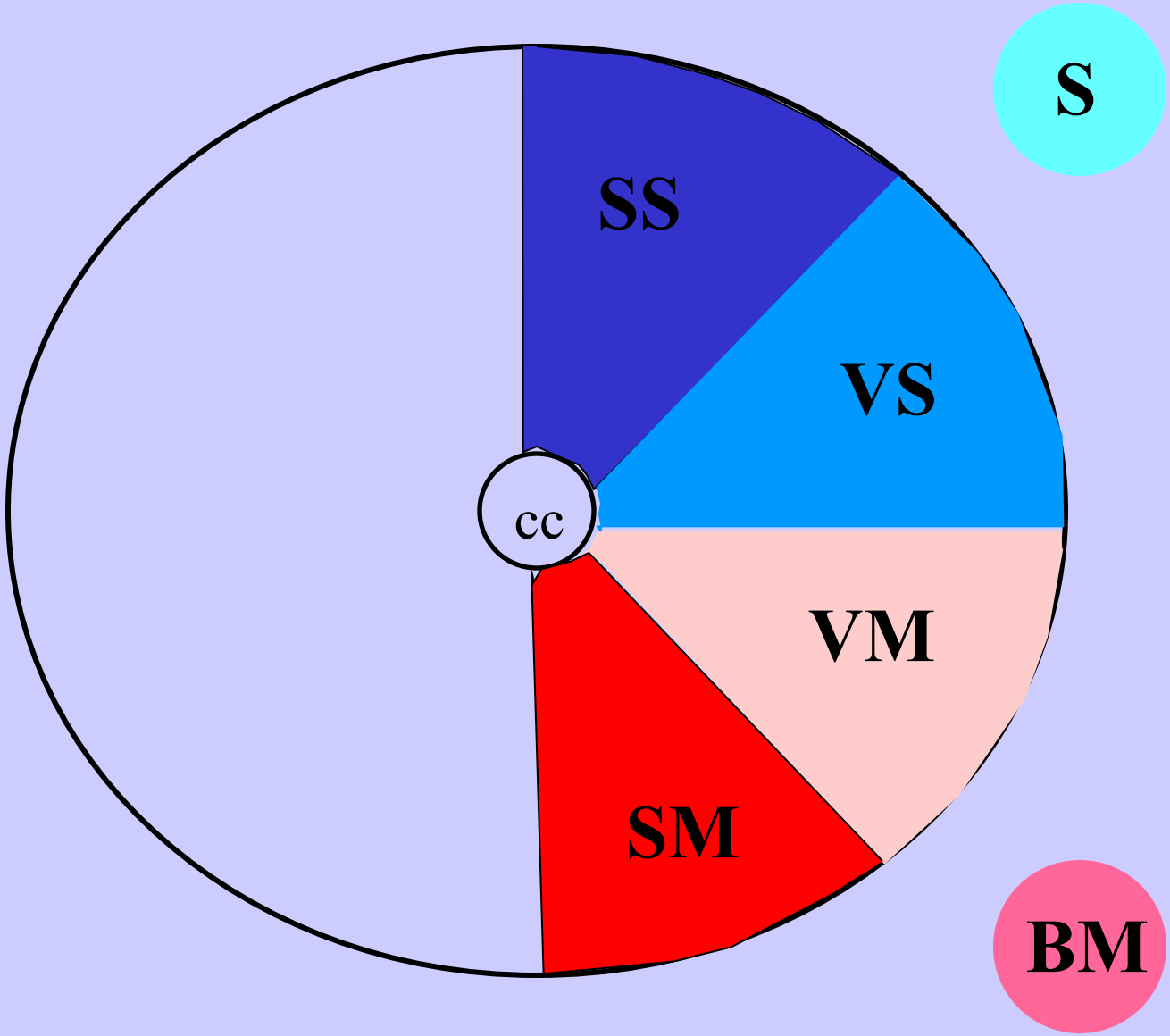


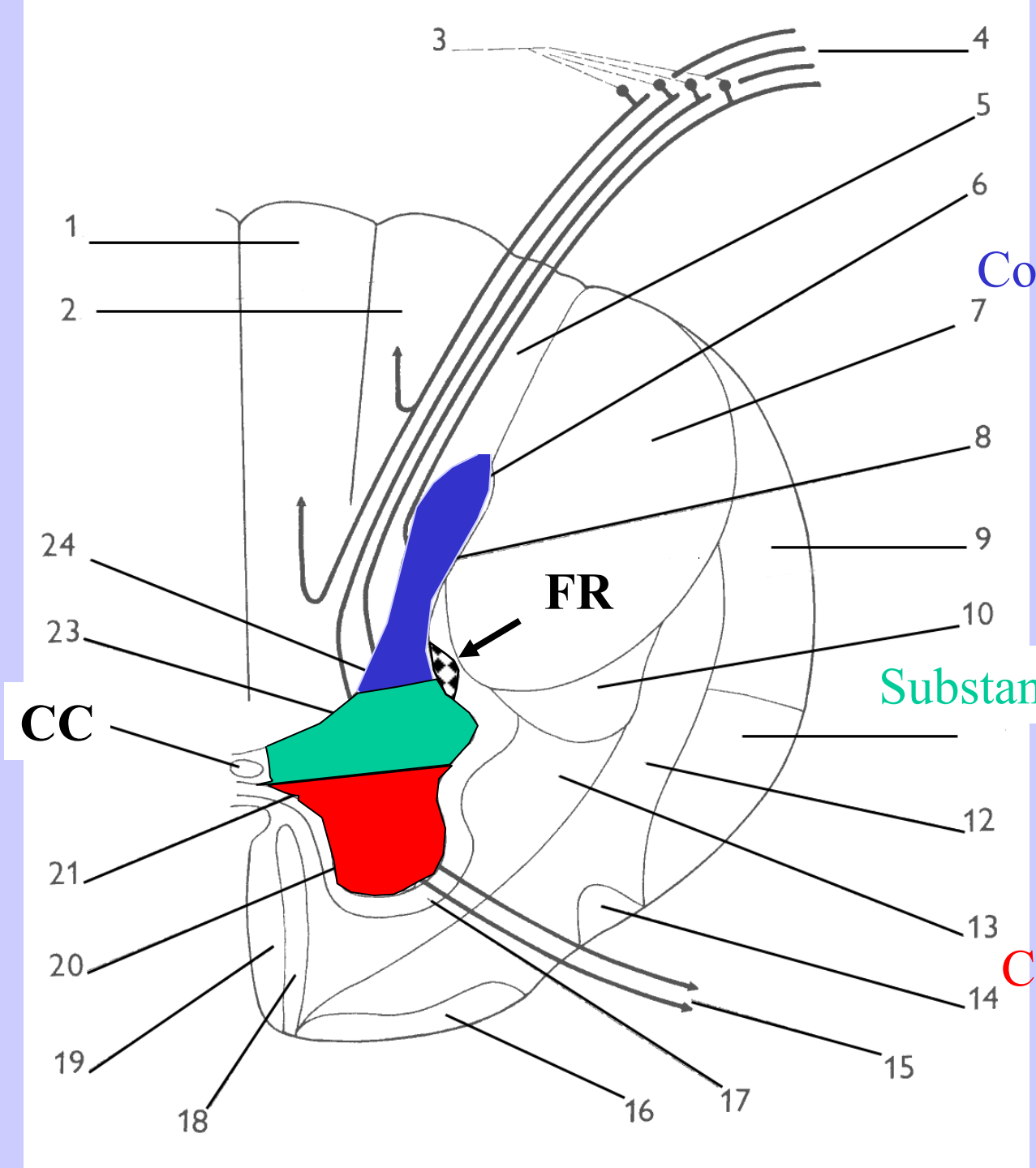
SUBSTANTIA ALBA – funiculus anterior, lateralis, posterior fissura mediana ant., sulcus medianus post., septum medianum posterius, sulcus anterolateralis, posterolateralis




Periosteum
Spatium epidurale; Plexus venosus vertebralis internus posterior
Arachnoidea mater spinalis
Spatium subdurale
Pia mater spinalis
Dura mater spinalis
Spatium subarachnoideum
N. spinalis, Radix posterior
Ganglion spinale; Dura mater spinalis
Dura mater spinalis
N. spinalis, R. posterior
Epineurium
Ganglion spinale
N. spinalis, R. anterior
N. spinalis, R. communicans
Lig. denticulatum
N. spinalis, Radix anterior
R. meningeus

FUNCTIONAL ZONES IN THE NEURAL TUBE

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1
2
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9
24
FR
23
10
CC
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21
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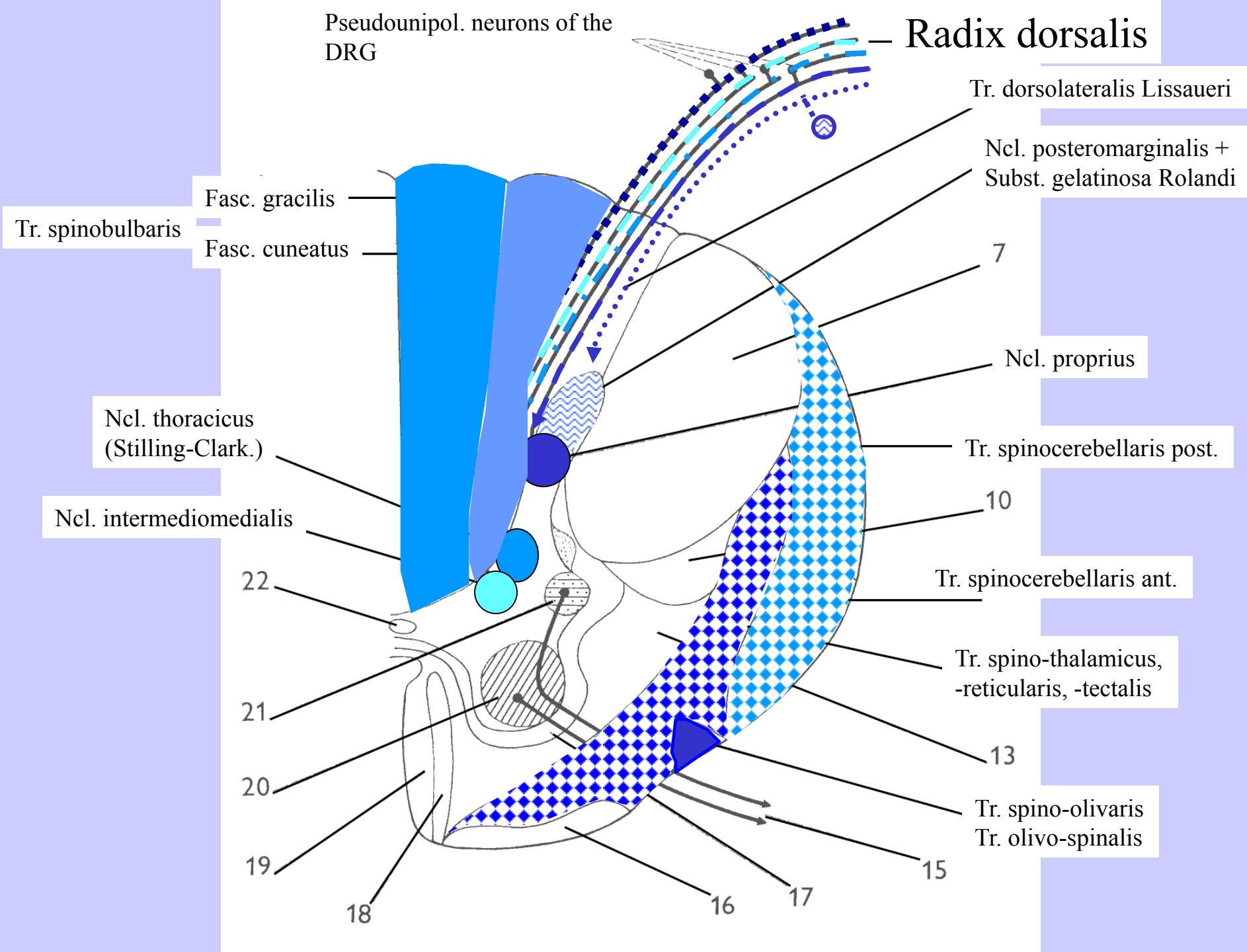
14
19
15
18
16
17
Cornu posterius
Substantia intermedia
Cornu anterius


Pseudounipol. neurons of the DRG
Radix dorsalis
Tr. dorsolateralis Lissaueri
Ncl. posteromarginalis +
Subst. gelatinosa Rolandi
Fasc. gracilis
Tr. spinobulbaris
Fasc. cuneatus
7
Ncl. proprius
Ncl. thoracicus
(Stilling-Clark.)
Tr. spinocerebellaris post.
Ncl. intermediomedialis
10
22
Tr. spinocerebellaris ant.
Tr. spino-thalamicus,
-reticularis, -tectalis
21
13
20
Tr. spino-olivaris
Tr. olivo-spinalis
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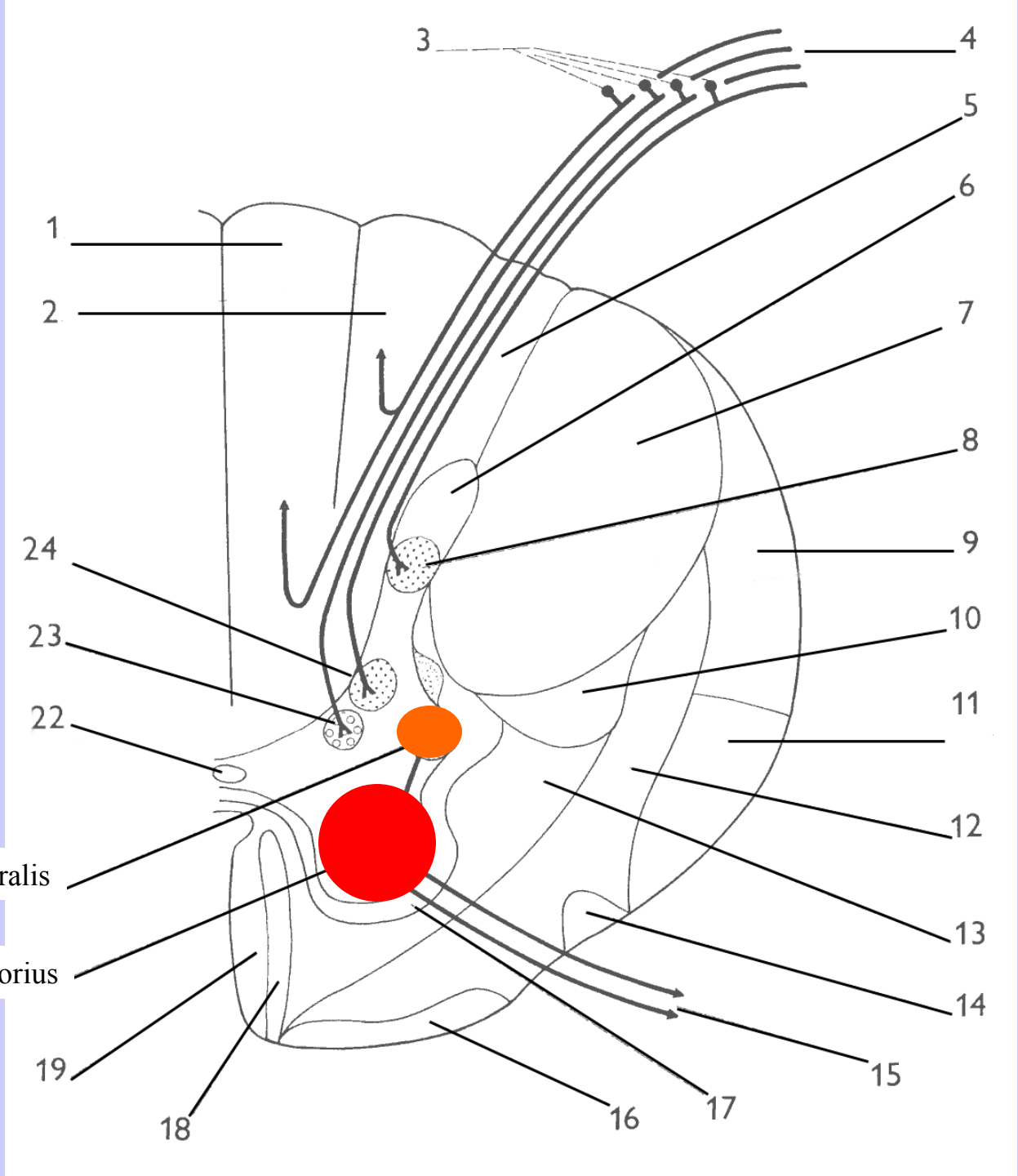
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Ncl. intermediolateralis
13
Ncl.motorius
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18
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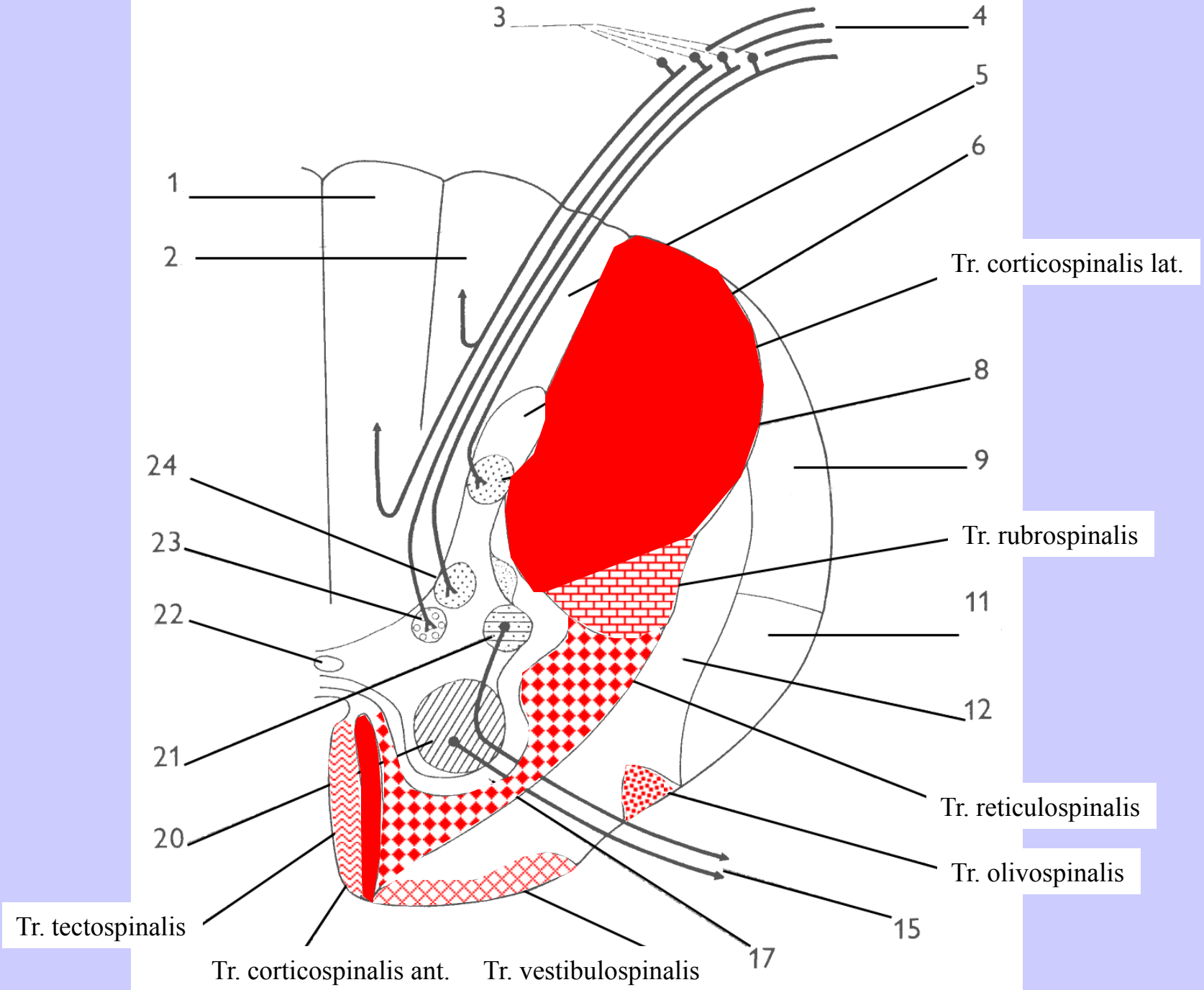
17


3
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Tr. corticospinalis lat.
8
9
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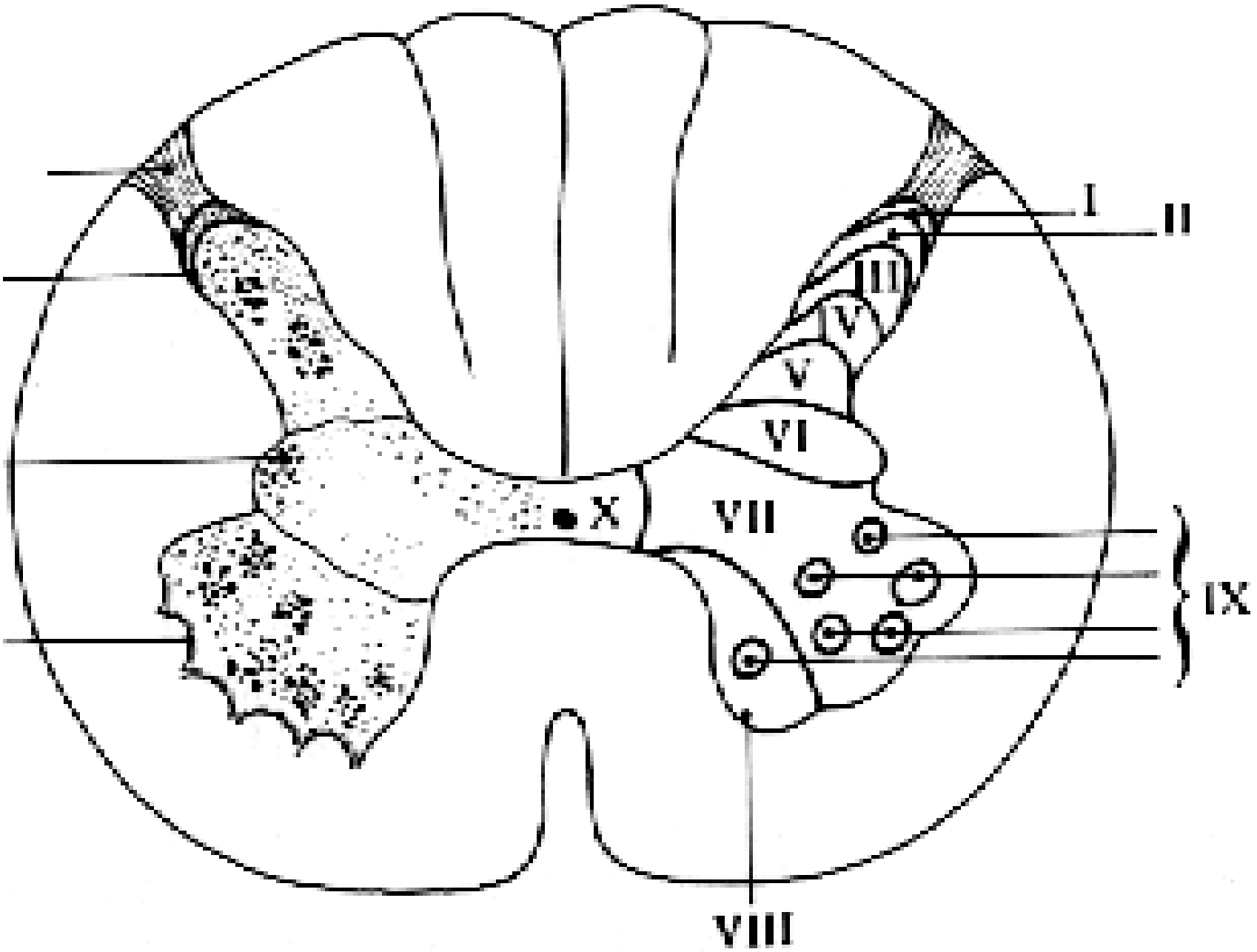
23
Tr. rubrospinalis
22
11
12
21
Tr. reticulospinalis
20
Tr. olivospinalis
15
Tr. tectospinalis
17
Tr. corticospinalis ant.
Tr. vestibulospinalis

Lames de Rexed



laminae (Rexed 1952)	nuclei
I	ncl. apicalis (ncl. posteromarginalis)
II + III	substantia gelatinosa Rolandi
IV + V	ncl. proprius
VI	ncl. thoracicus (Stilling - Clark) C8-L3
VII	group of interneurons in the anterior horn
VIII	medial group of motoneurons
IX	lateral group of motoneurons
X	zona centralis, gray matter around the central canal