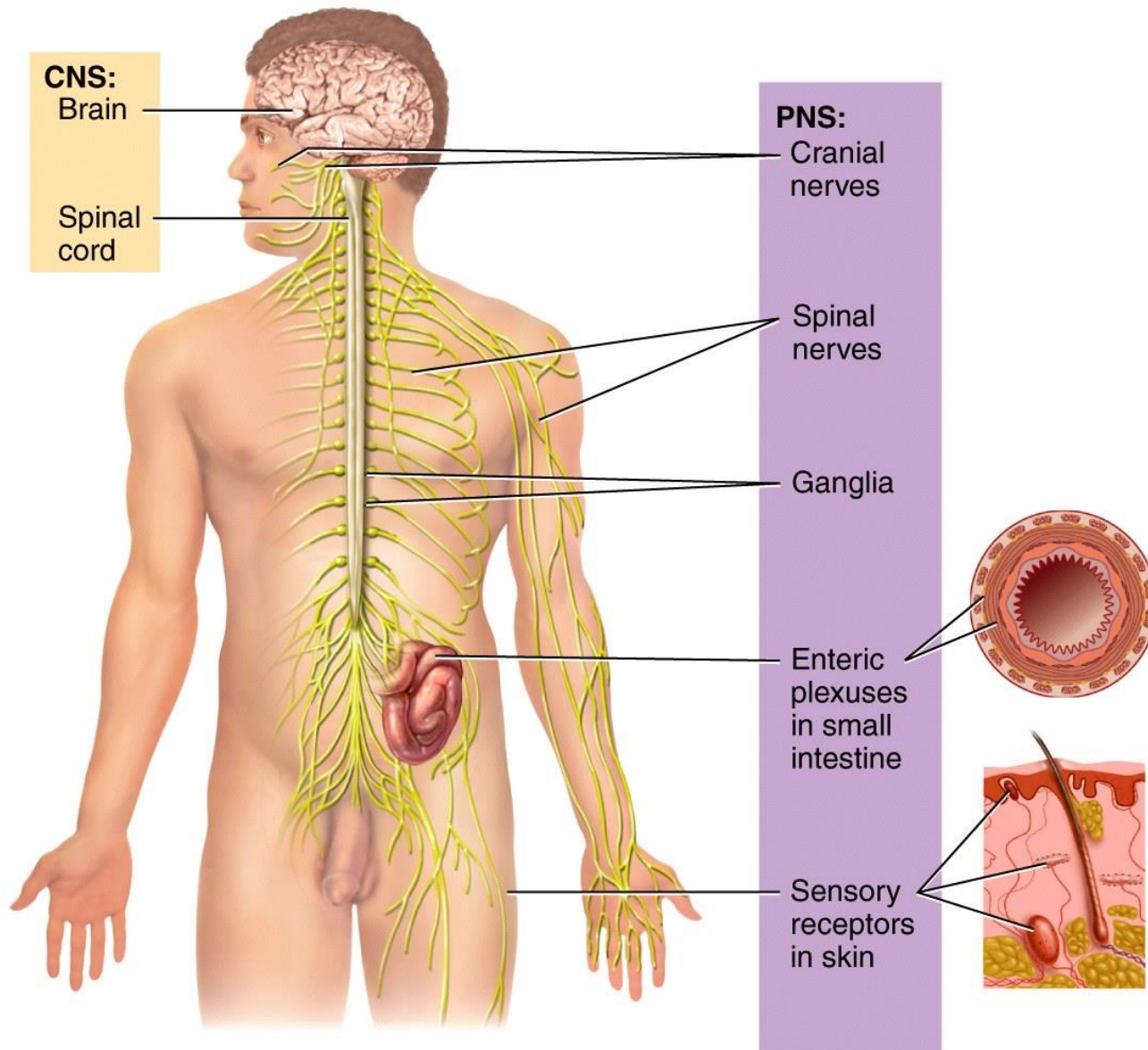


Nervous System (I)

Chien, 2025

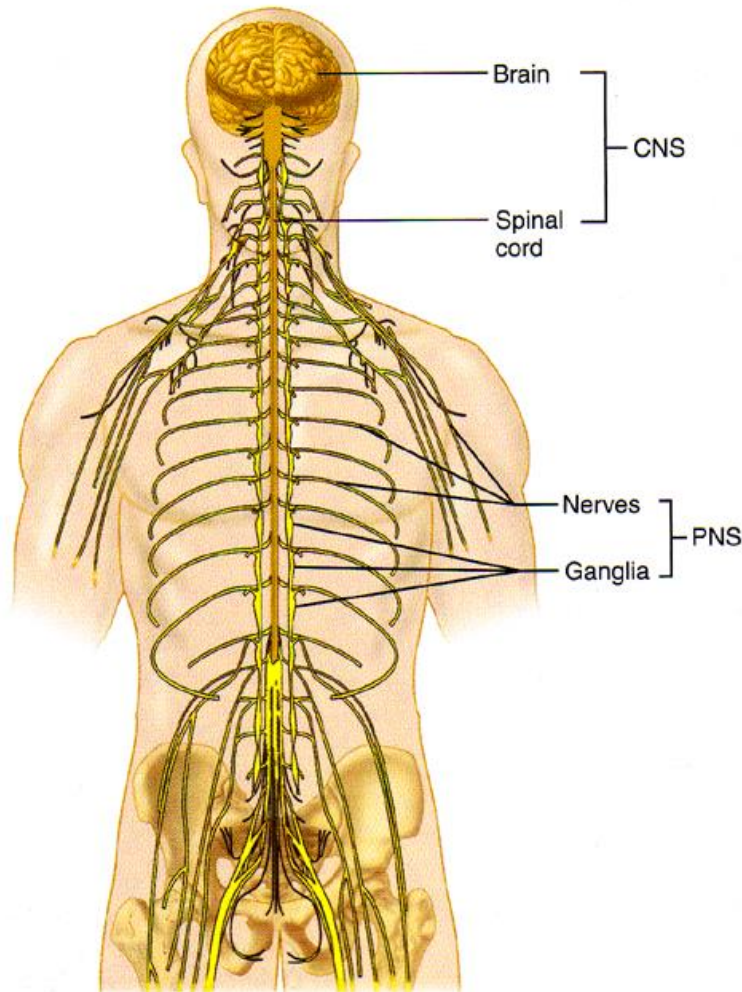


Nervous System (I)

- **Histology of nervous tissue**
- **Development of the nervous system**
- **Spinal cord**
- **Spinal nerves**

Nervous System (I) --- Histology of nervous tissue

Divisions of the nervous system



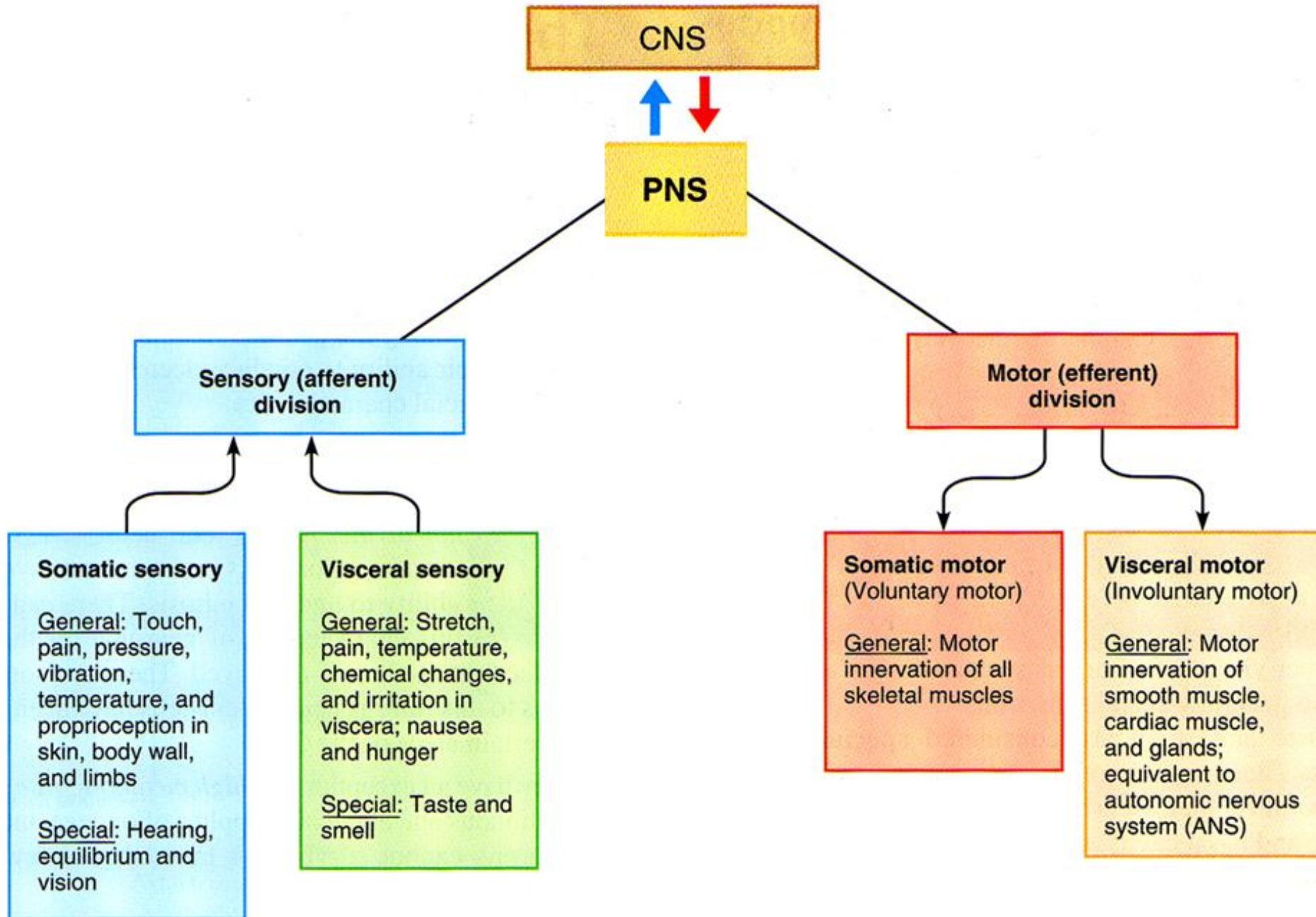
- **C**entral **N**ervous **S**ystem

- brain and spinal cord

- **P**eripheral **N**ervous **S**ystem

- cranial and spinal nerves that contain both sensory and motor fibers
- connects sensory receptors to CNS and CNS to muscles & glands ...

Nervous System (I) --- Histology of nervous tissue



Nervous System (I) --- Histology of nervous tissue

Subdivisions of the PNS

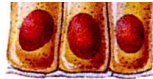
- **Somatic nervous system (SNS)** 體神經系統
 - from cutaneous and special sensory receptors to CNS
 - motor neurons to skeletal muscle tissue
- **Autonomic nervous systems (ANS)** 自主神經系統
 - sensory neurons from visceral organs to CNS
 - motor neurons to smooth & cardiac muscle and glands
 - **sympathetic division**
 - **parasympathetic division**
- **Enteric nervous system (ENS)** 腸神經系統
 - involuntary sensory & motor neurons control GI tract
 - neurons function independently of ANS & CNS

Histology of the Nervous System

I. Nervous tissue proper 神經組織 Neurons in CNS and PNS Neuroglia in CNS

Schwann cells, satellite cells 衛星細胞 in PNS (peripheral glia)

in shape from cuboidal to columnar; many are ciliated.

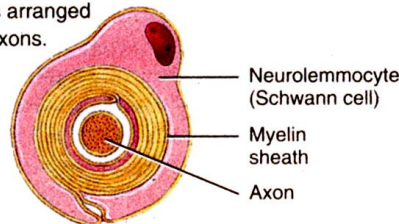


cell

spinal cord; form cere assist in its circulation

PERIPHERAL NERVOUS SYSTEM

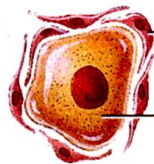
Type	Appearance	Function
Neurolemmocytes (Schwann Cells)	Flattened cells arranged around PNS axons.	Each cell produces p around a single axon



Neurolemmocyte (Schwann cell)
Myelin sheath
Axon

Satellite cells

Flattened cells arranged around the cell bodies of neurons in ganglia (collections of neuronal cell bodies in the PNS).



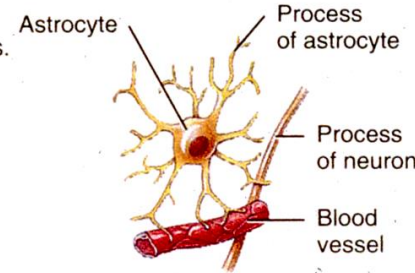
Satellite cell
Neuron cell body of a ganglion cell

Support neurons in P

Table 16.1 Neuroglia.

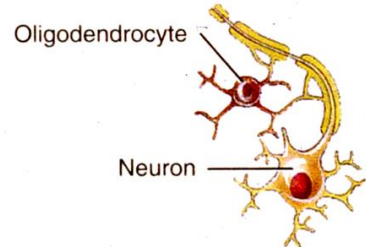
CENTRAL NERVOUS SYSTEM

Type	Appearance
Astrocytes	Star-shaped cells with many processes.



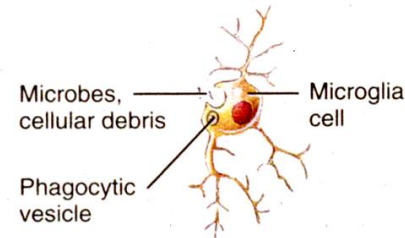
Oligodendrocytes

Smaller than astrocytes; with fewer processes; round or oval cell body.



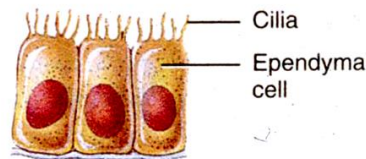
Microglia

Small cells with few processes.



Ependymal cells

Epithelial cells arranged in a single layer; range in shape from cuboidal to columnar; many are ciliated.

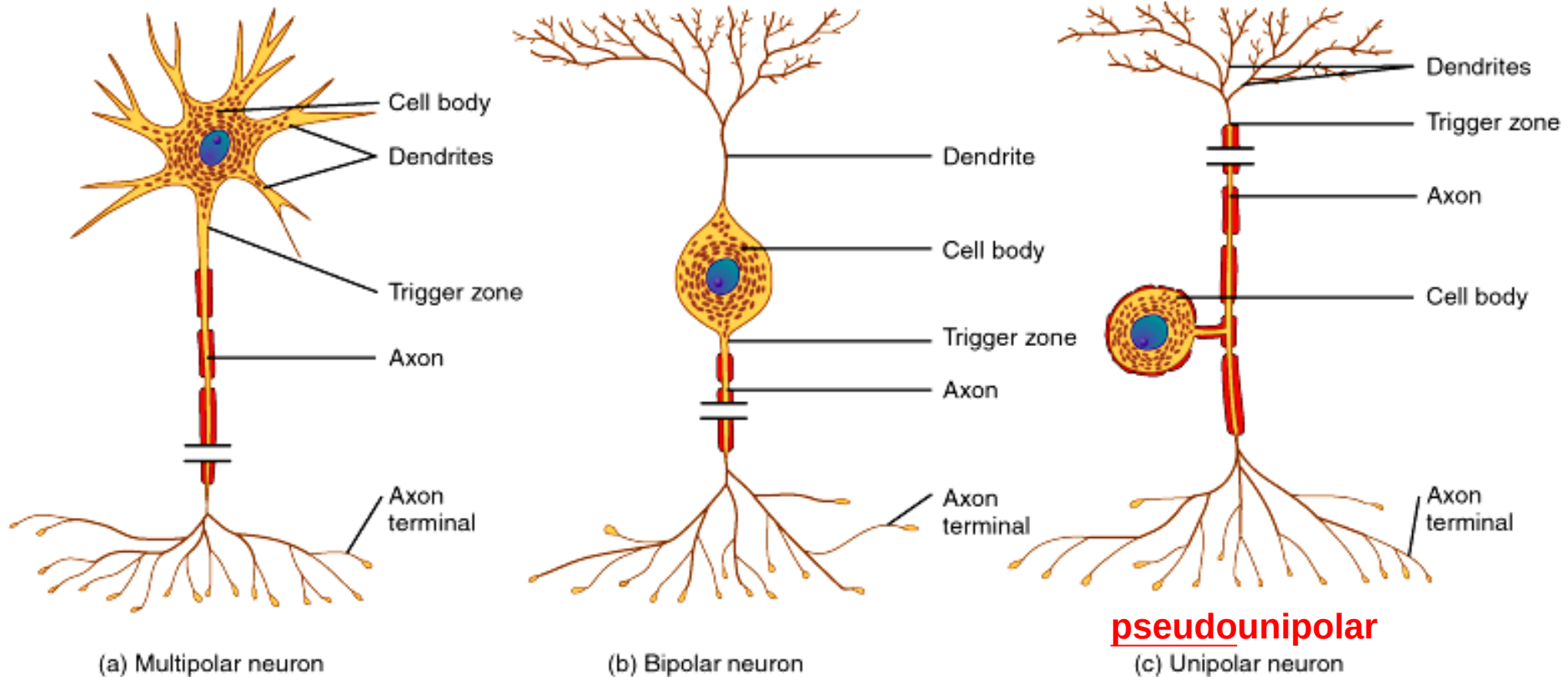


PERIPHERAL NERVOUS SYSTEM

Neurons

Classification by numbers of cytoplasmic processes:

1. **unipolar**: embryonic neurons 單一
2. **bipolar**: in **retina, olfactory epithelium**, etc. 雙極
3. **pseudounipolar**: **cranial and spinal ganglia** 偽單極
4. **multipolar**: most common, in brain, spinal cord, autonomic ganglia 多極



Cell body (perikaryon)

rough ER

(Nissl bodies or basophil substance)

嗜鹼性

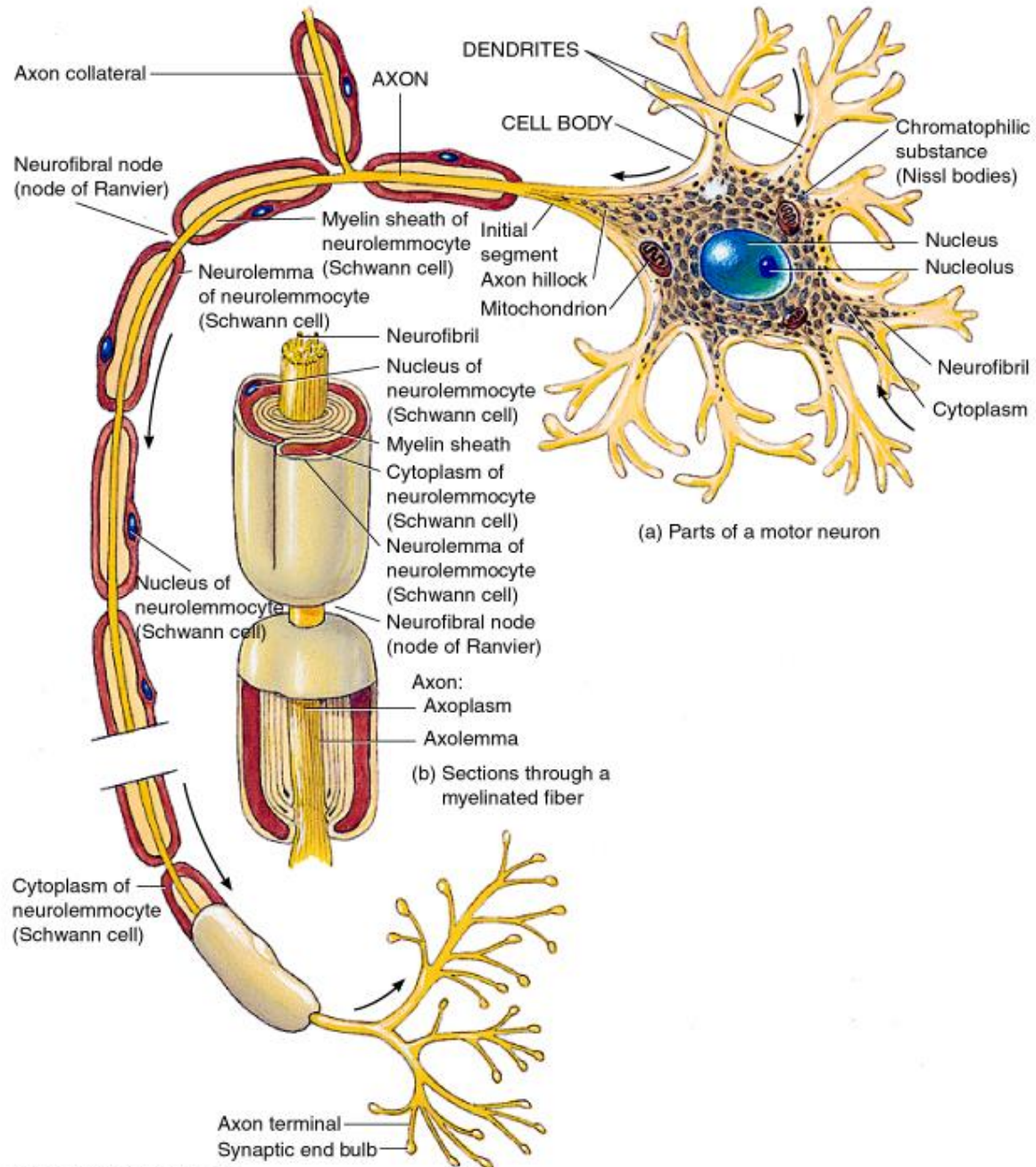
Cytoplasmic processes:

a. **dendrites** 樹突

usually shorter than axons,
several processes per cell
contain microtubules,
filaments, mitochondria,
rough ER, ribosomes

b. **axon** 軸突

only one per cell, axon
hillock: origin of axon
lacks Nissl substance,
contain microtubules,
filaments, mitochondria,
sER



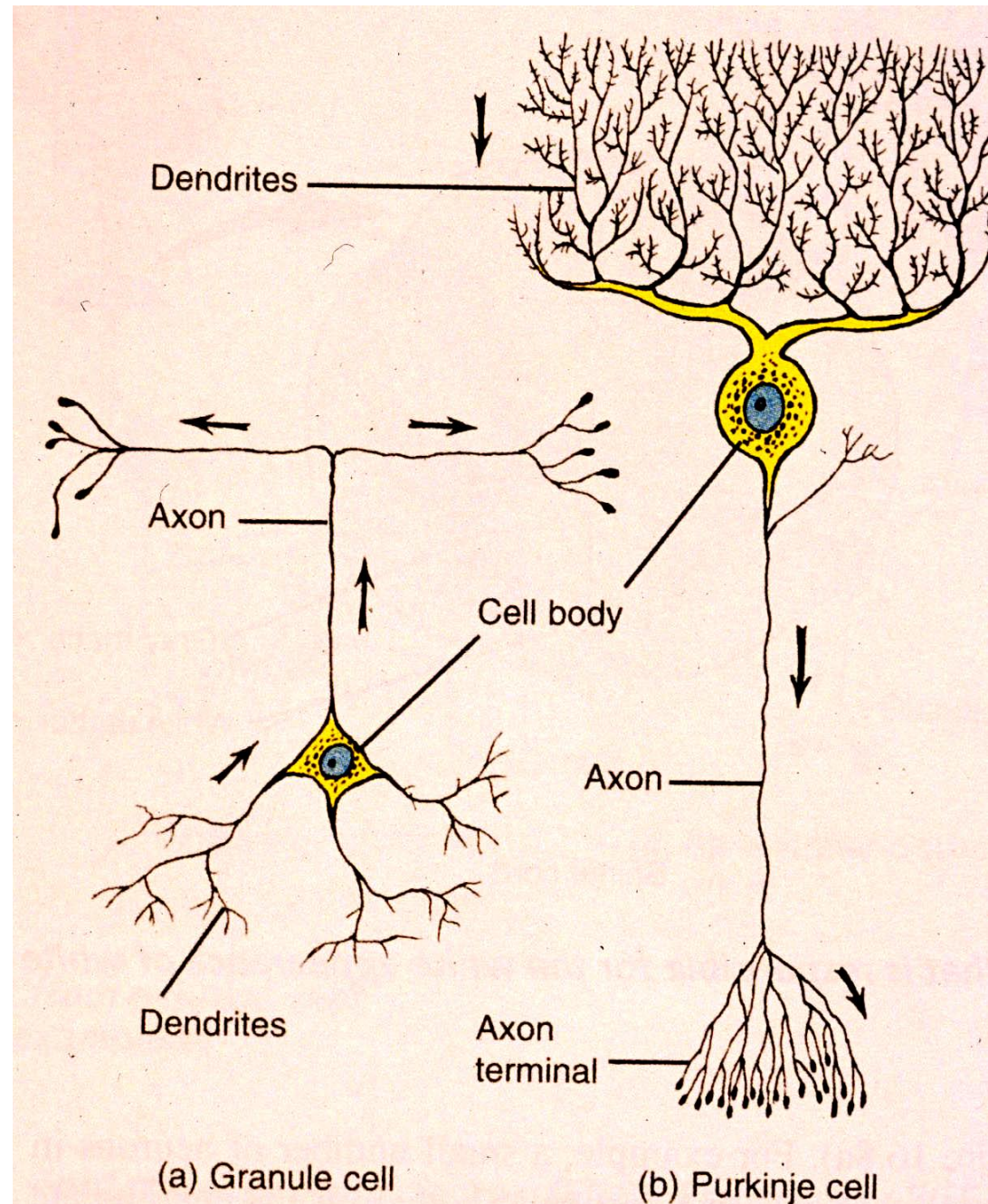
cytoplasmic processes:

a. dendrites 樹突

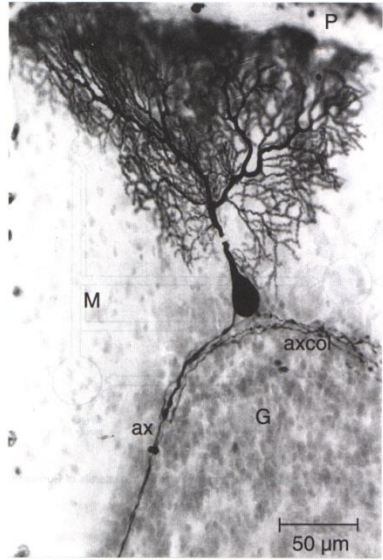
usually shorter than axons,
several processes per cell
contain microtubules, filaments,
mitochondria, rough ER,
ribosomes

b. axon 軸突

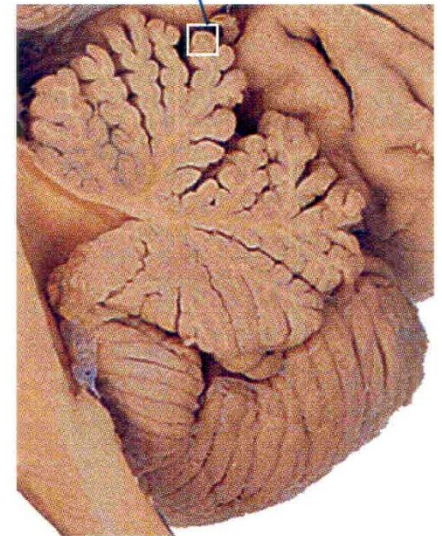
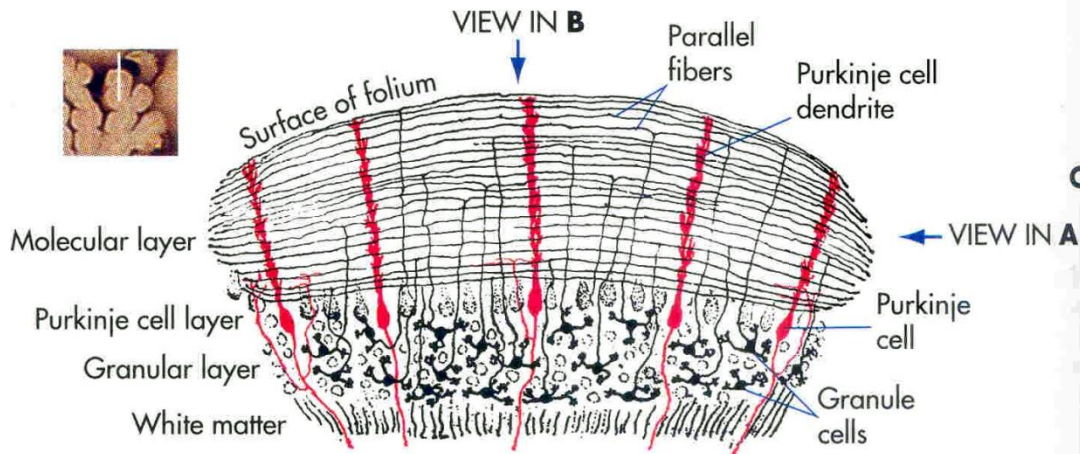
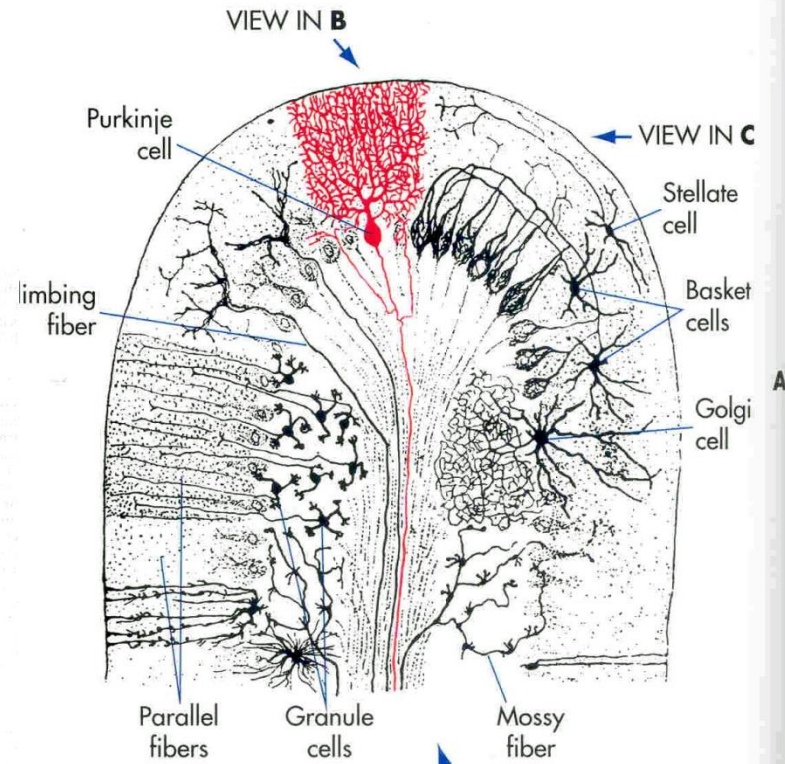
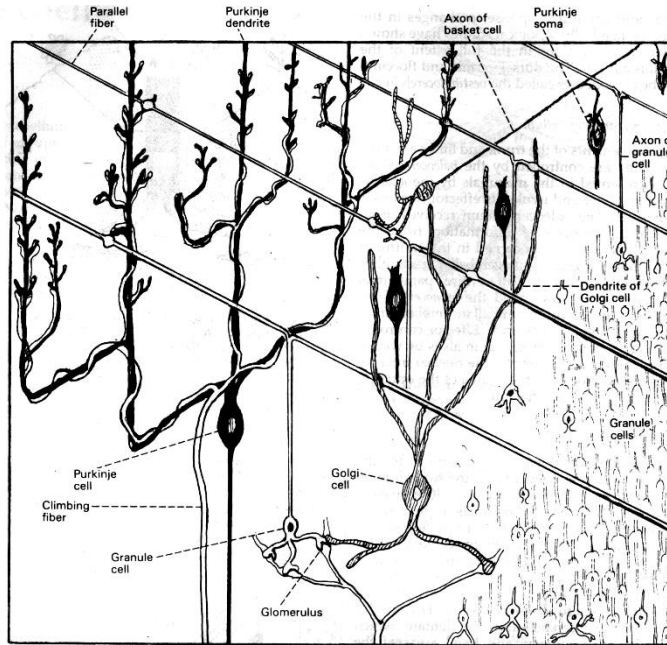
only one per cell, axon hillock:
origin of axon
lacks rER, contain microtubules,
filaments, mitochondria, sER



Granule cell (axonal parallel fibers) vs. Purkinje cell (dendrite tree)

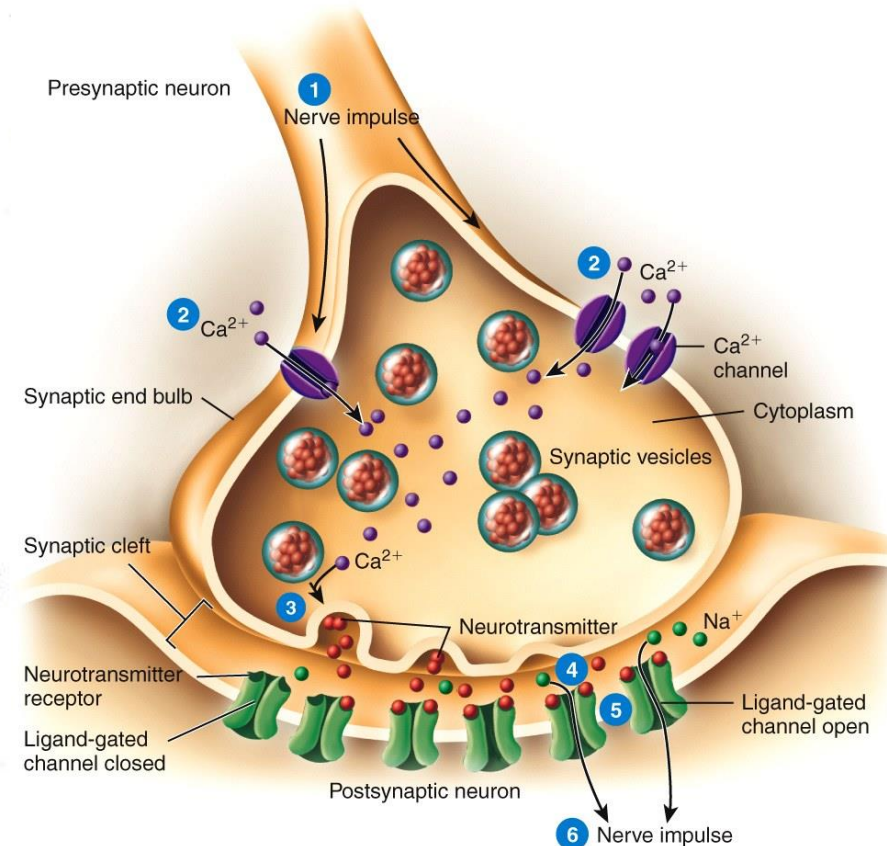
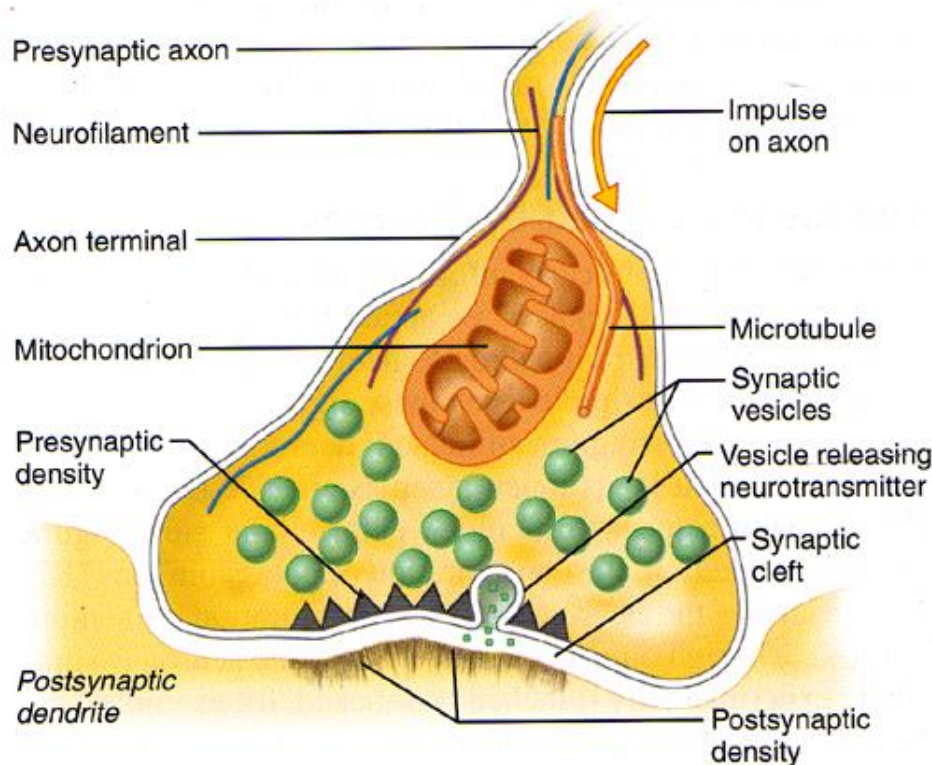
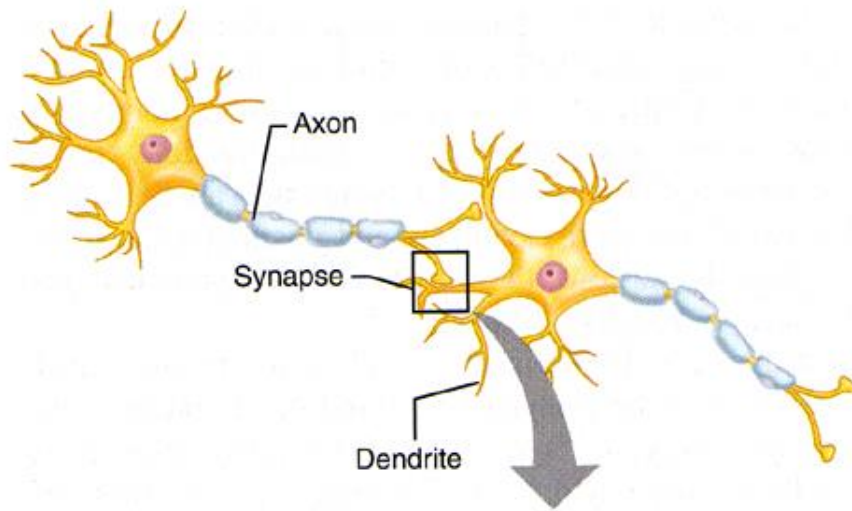


8.163 Photograph of an intracellularly labelled Purkinje cell of rat cerebellum. The plexus of Purkinje cell axon collaterals (axcol) is located in the superficial granular layer. ax = axon, axcol = axon collaterals, G = granular layer, M = molecular layer, p = pia mater. (Courtesy of Dr T.J. H. Ruigrok.)



Axonal Terminals:

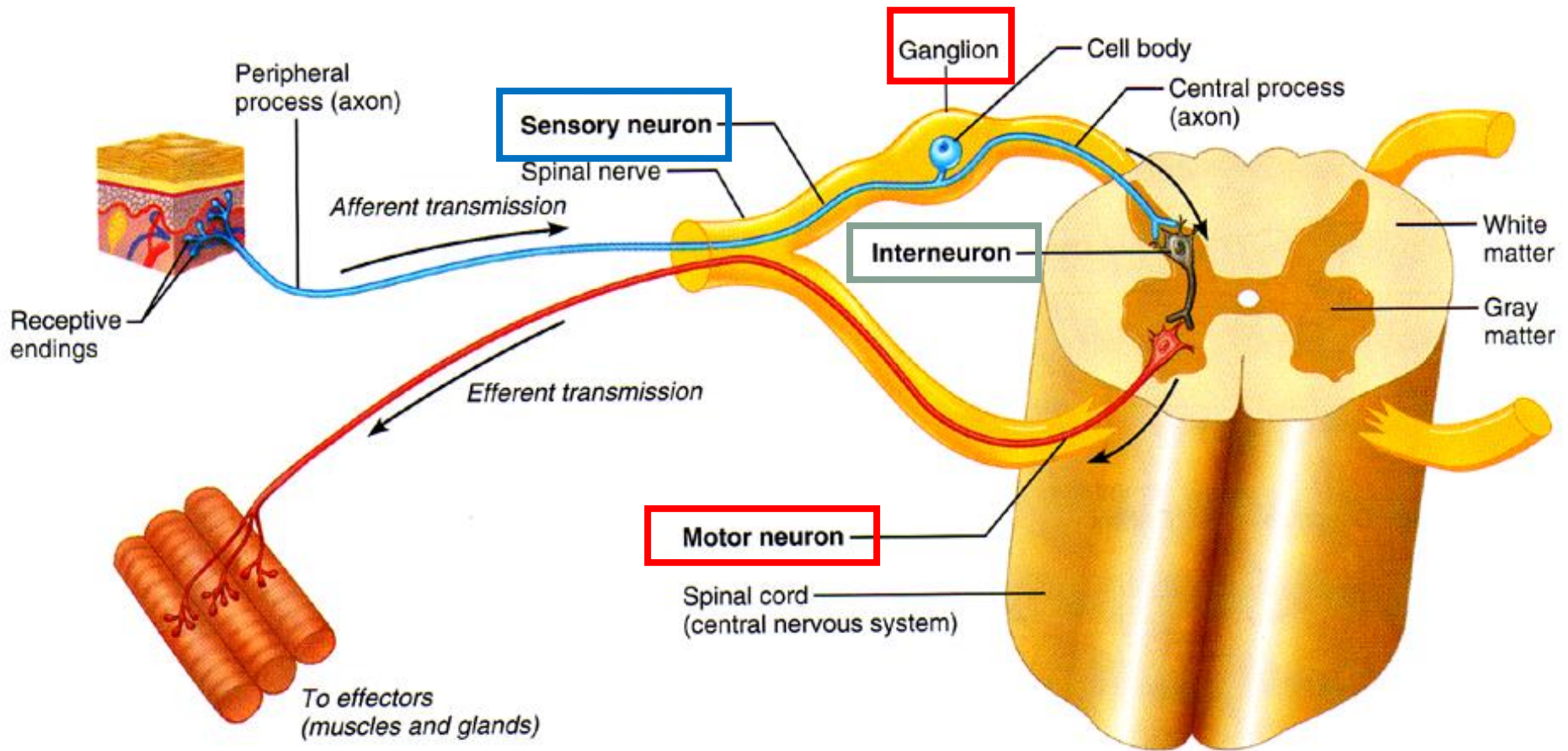
Swollen tips called synaptic end bulbs contain vesicles filled with neurotransmitters



(c) Synapse between neurons

Functional Classification of Neurons

Pseudounipolar Neuron



Neuroglial Cells

- Half of the volume of the CNS
- Smaller cells than neurons
- 50 X more numerous
- Cells can divide
 - Rapid mitosis in tumor formation (gliomas 神經膠細胞瘤)
- 4 cell types in CNS
 - 1. astrocytes (astroglia): 星狀細胞
 - 2. oligodendrocytes 寡樹突細胞
 - 3. microglia 微膠細胞
 - 4. ependymal cells 室管膜細胞
- 2 cell types in PNS
 - Schwann cells 許旺氏細胞 and satellite cells 衛星細胞

CNS

Neuroglia 神經膠細胞

non-nervous elements, protective, supportive, nutritive

1. astrocytes (astroglia): 星狀細胞
2. oligodendrocytes 寡樹突細胞
3. microglia 微膠細胞
4. ependymal cells 室管膜細胞

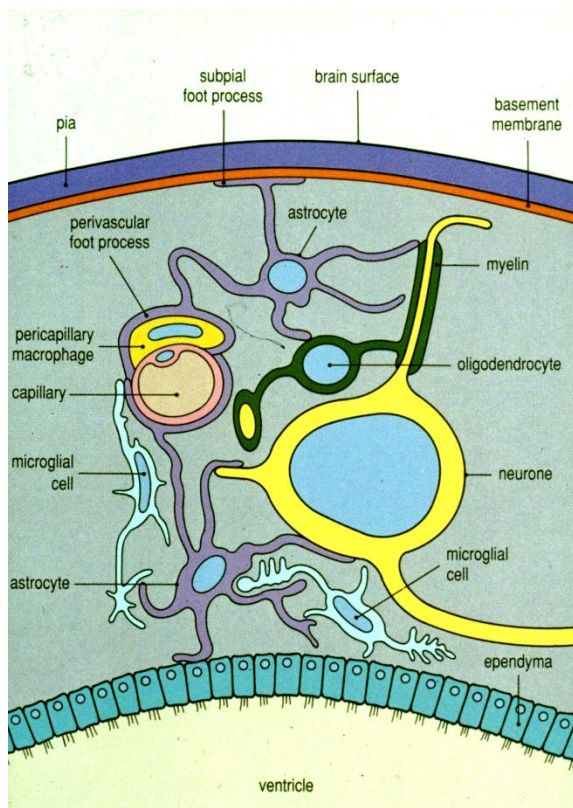
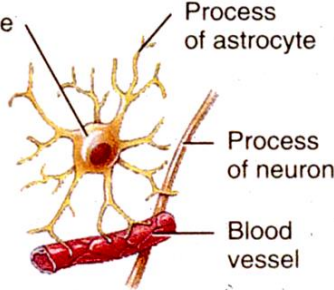
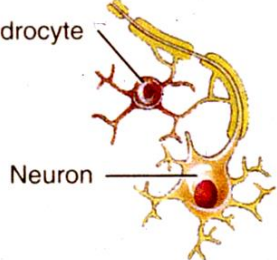
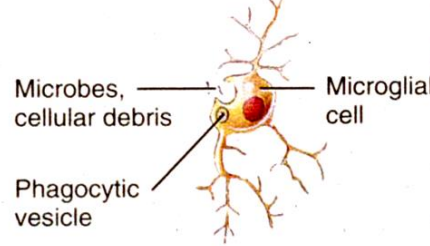
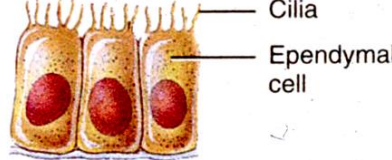


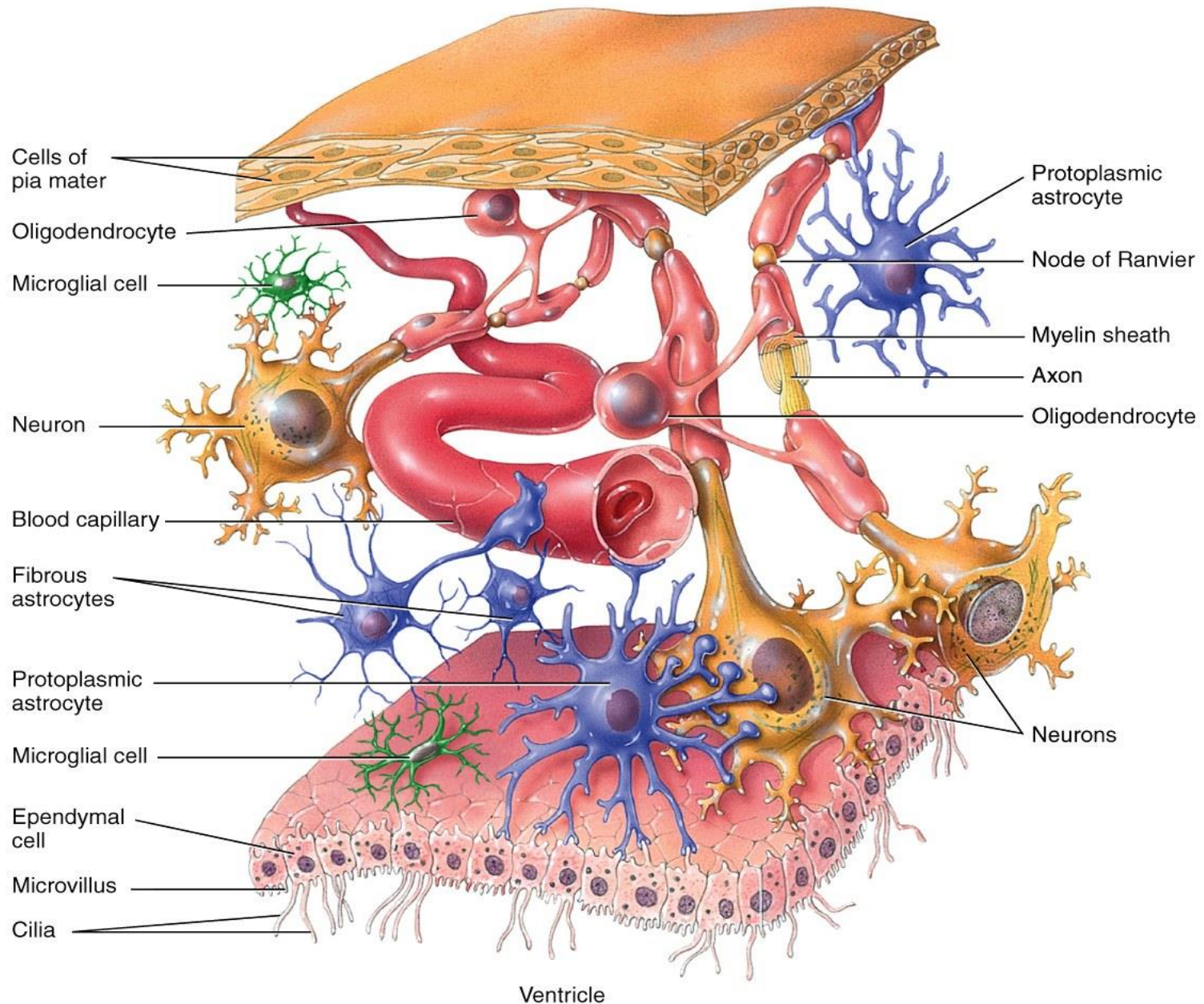
Table 16.1 Neuroglia.

CENTRAL NERVOUS SYSTEM

Type	Appearance
Astrocytes	Star-shaped cells with many processes. 
Oligodendrocytes	Smaller than astrocytes; with fewer processes; round or oval cell body. 
Microglia	Small cells with few processes. 
Ependymal cells	Epithelial cells arranged in a single layer; range in shape from cuboidal to columnar; many are ciliated. 

PERIPHERAL NERVOUS SYSTEM

Major cell types in nervous tissue



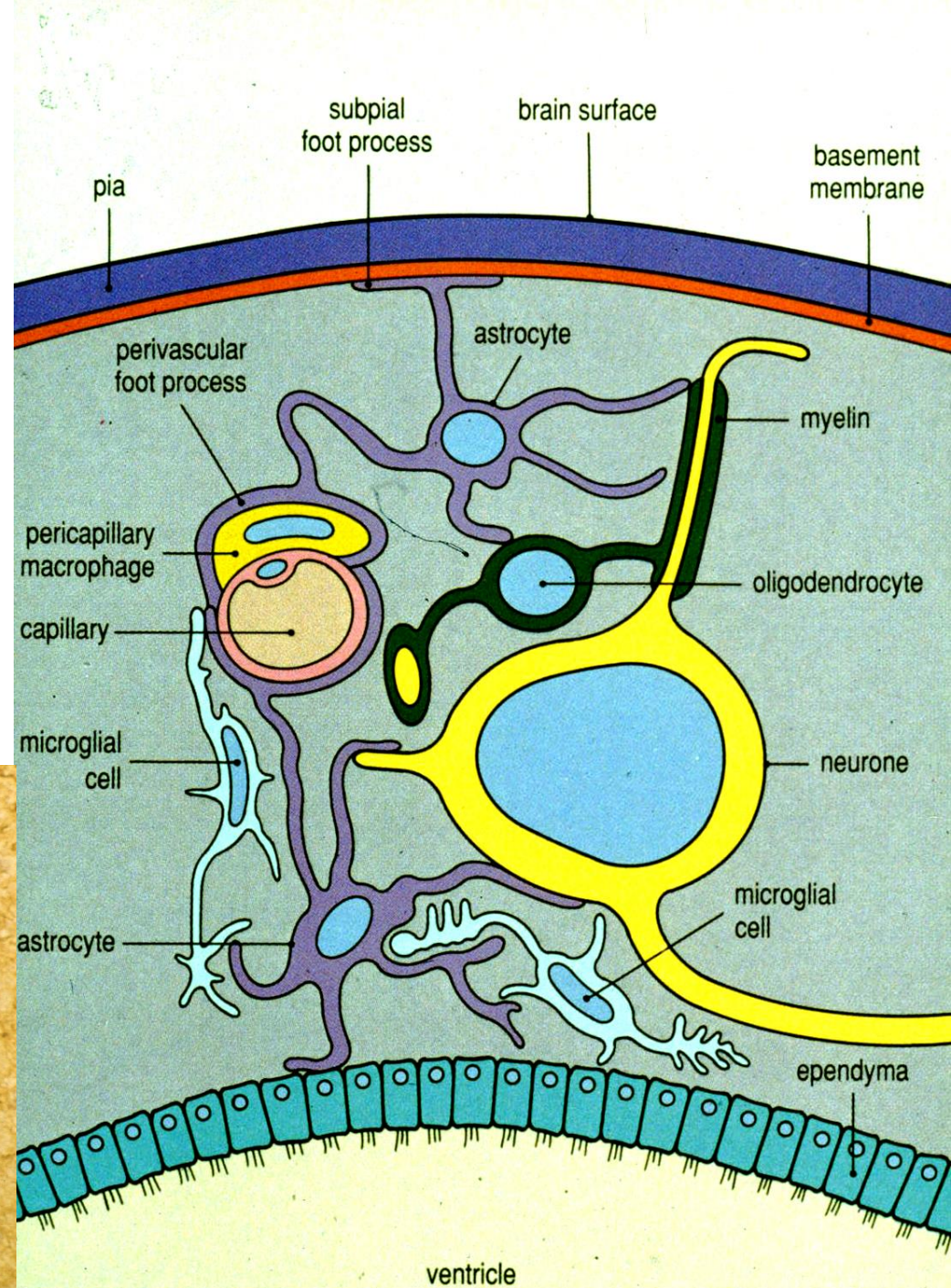
astrocytes (astroglia):

星狀細胞

1. protoplasmic astrocytes
(in gray matter) 原漿性
2. fibrous astrocytes
(in white matter) 纖維性

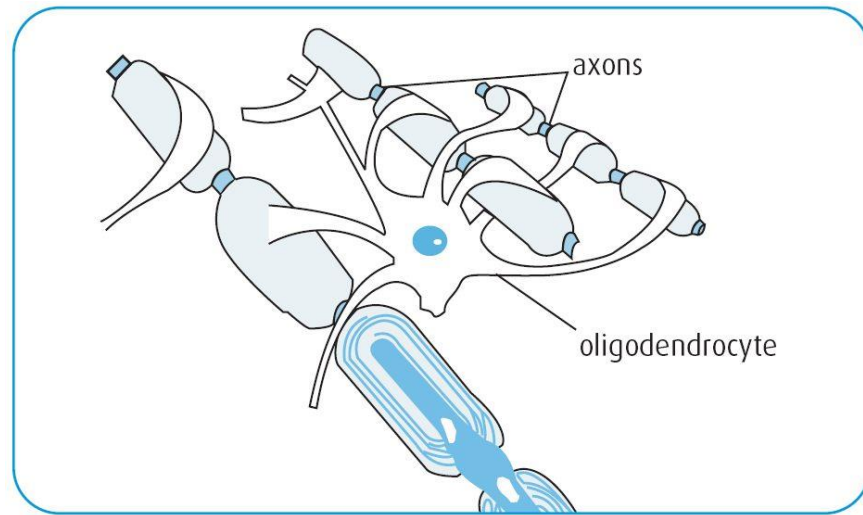
processes form perivascular feet
(foot plates) 環血管足板

BBB: Brain-Blood Barrier



oligodendrocytes (oligodendroglia) 寡樹 突細胞

form myelin sheath in
CNS. medium-sized, rounded,
regularly shaped dense
nucleus

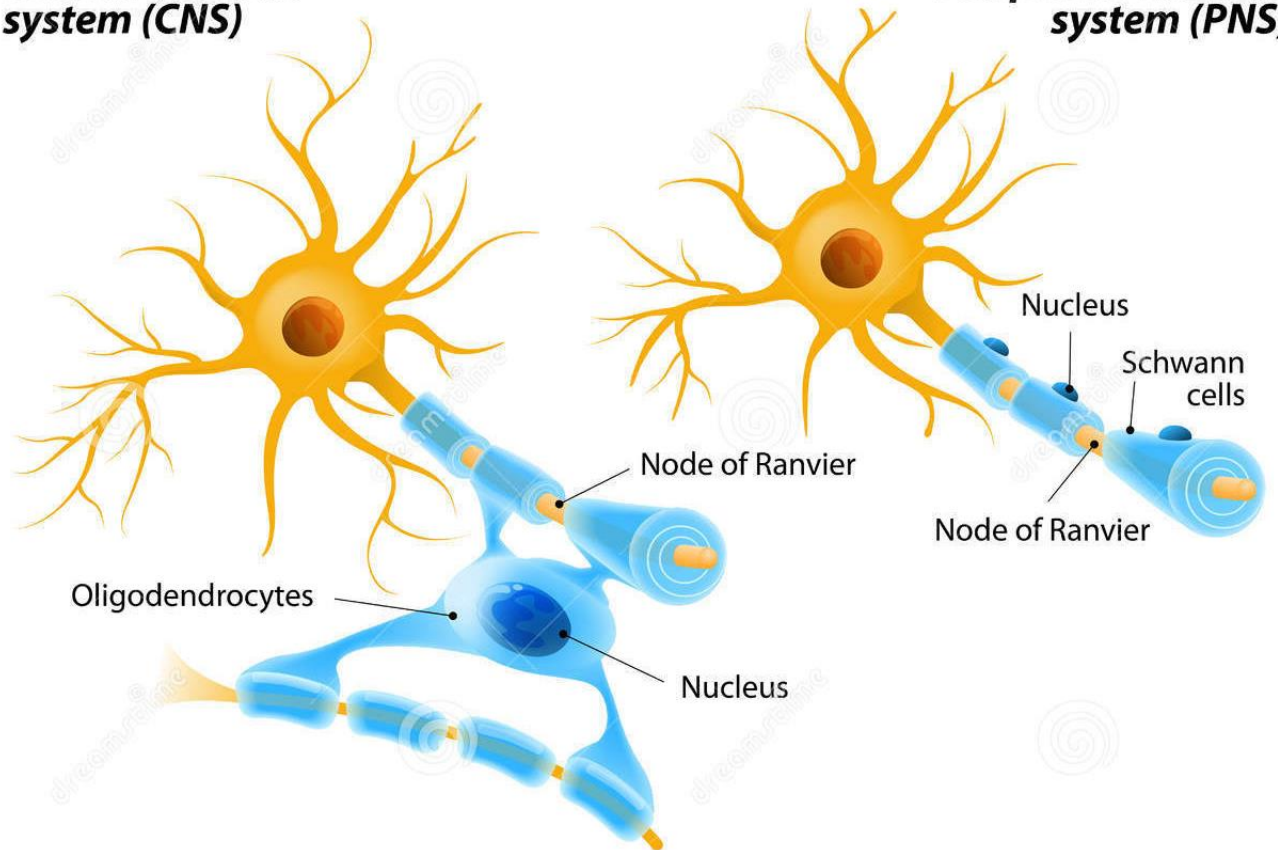


Central nervous system (CNS)

Peripheral nervous system (PNS)

Oligodendrocytes:
一個細胞對多條**Axons**

Schwann Cells:
多個細胞對一條**Axon**



Microglia 微膠質細胞

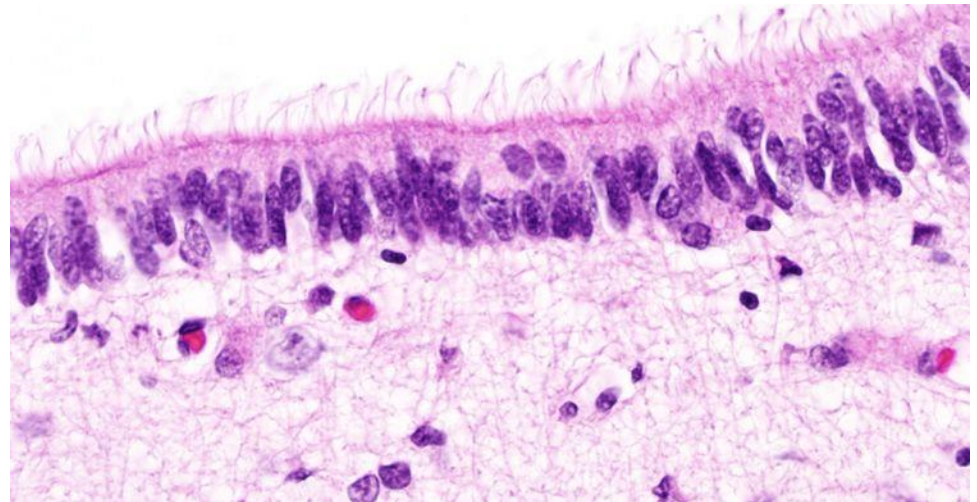
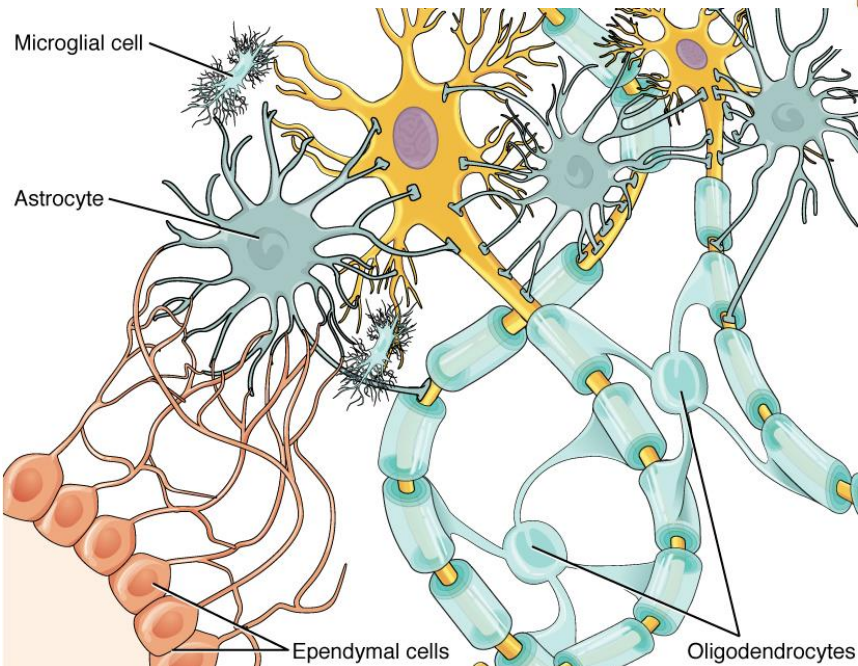
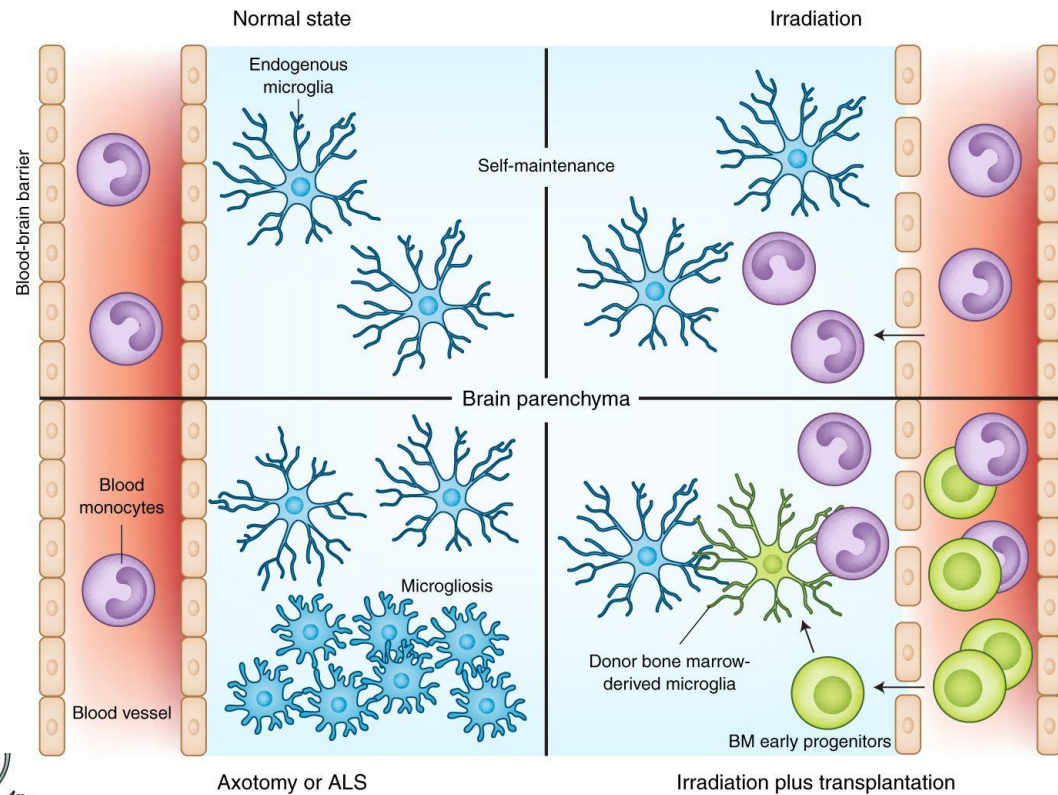
macrophage of CNS

small size, small irregularly shaped deeply staining nucleus

ependymal cells

室管膜細胞

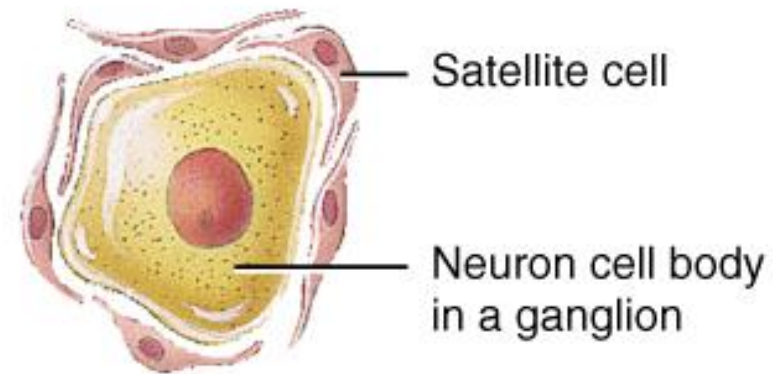
lining ventricles, aqueduct and central canal



2 types of neuroglia cells in the PNS

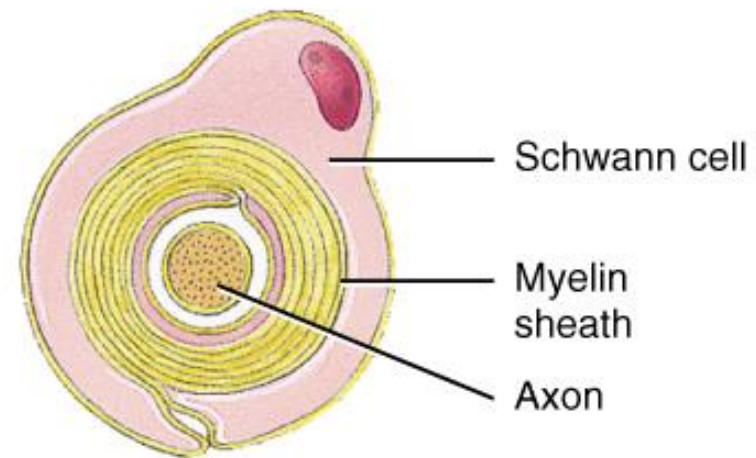
Satellite Cells 衛星細胞

- Flat cells surrounding neuronal cell bodies in peripheral ganglia
- Support neurons in the PNS ganglia

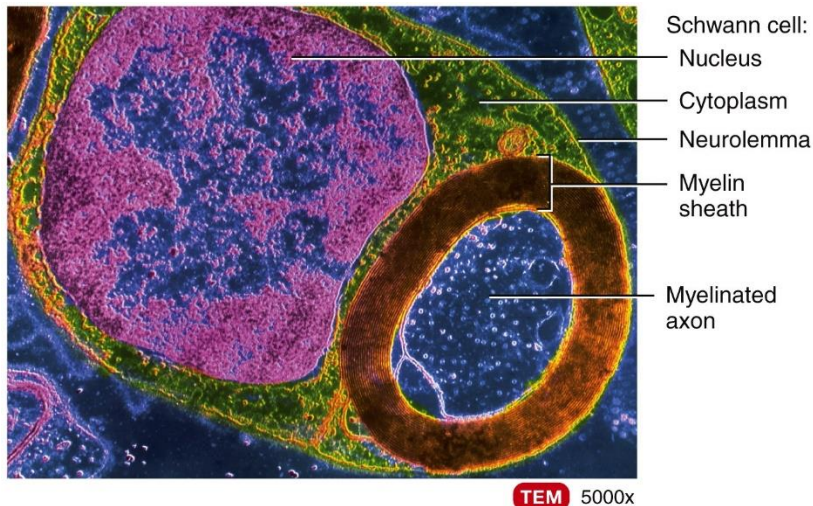
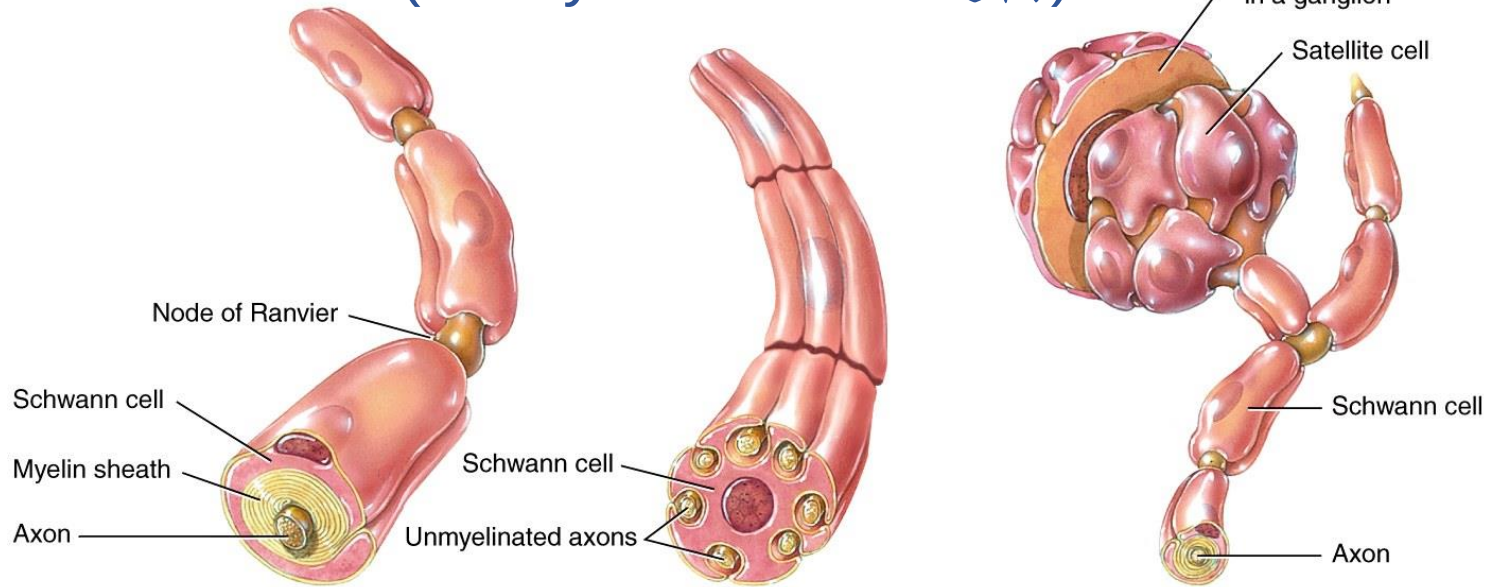


Schwann Cells 許旺氏細胞

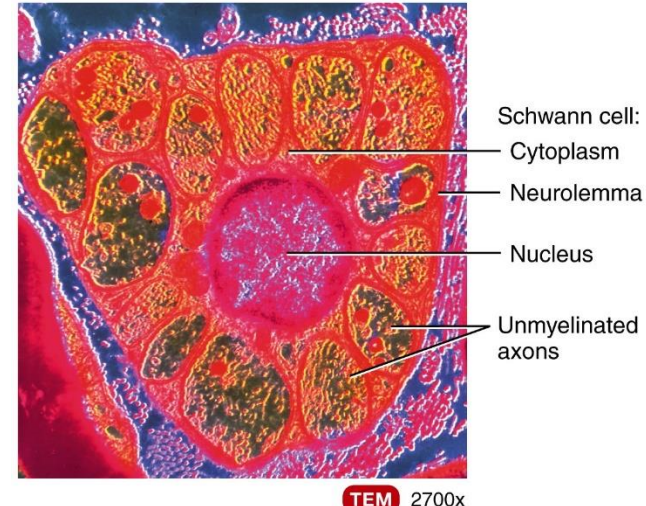
- Cells encircling PNS axons
- **Each cell produces part of the myelin sheath surrounding an axon in the PNS**



PNS nerve fibers : myelinated nerve fibers: myelin sheath formed by **Schwann cell** node of Ranvier (no myelin sheath 髓鞘)



(c) Transverse section of myelinated axon

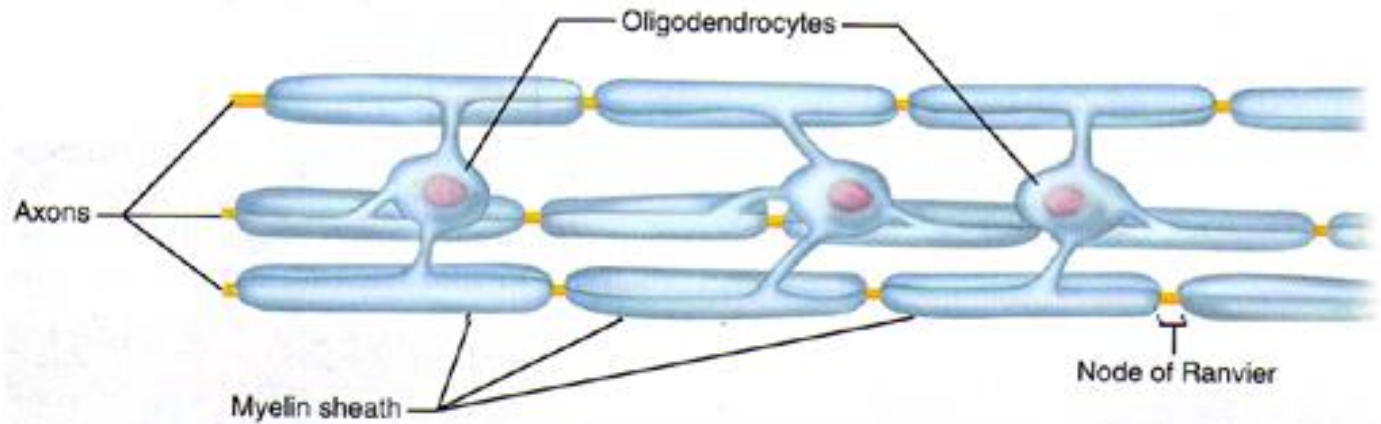


(d) Transverse section of unmyelinated axons

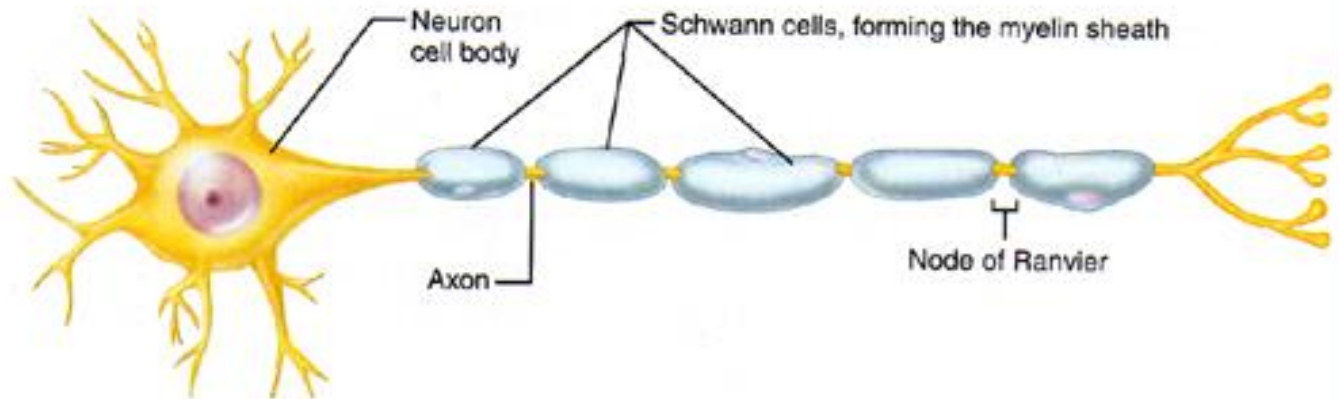
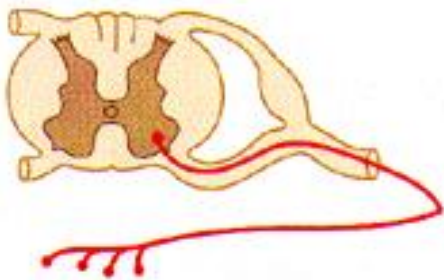
Axon Covering

CNS, Oligodendrocytes: 一個細胞對多條Axons
PNS, Schwann Cells: 多個細胞對一條Axon

CNS



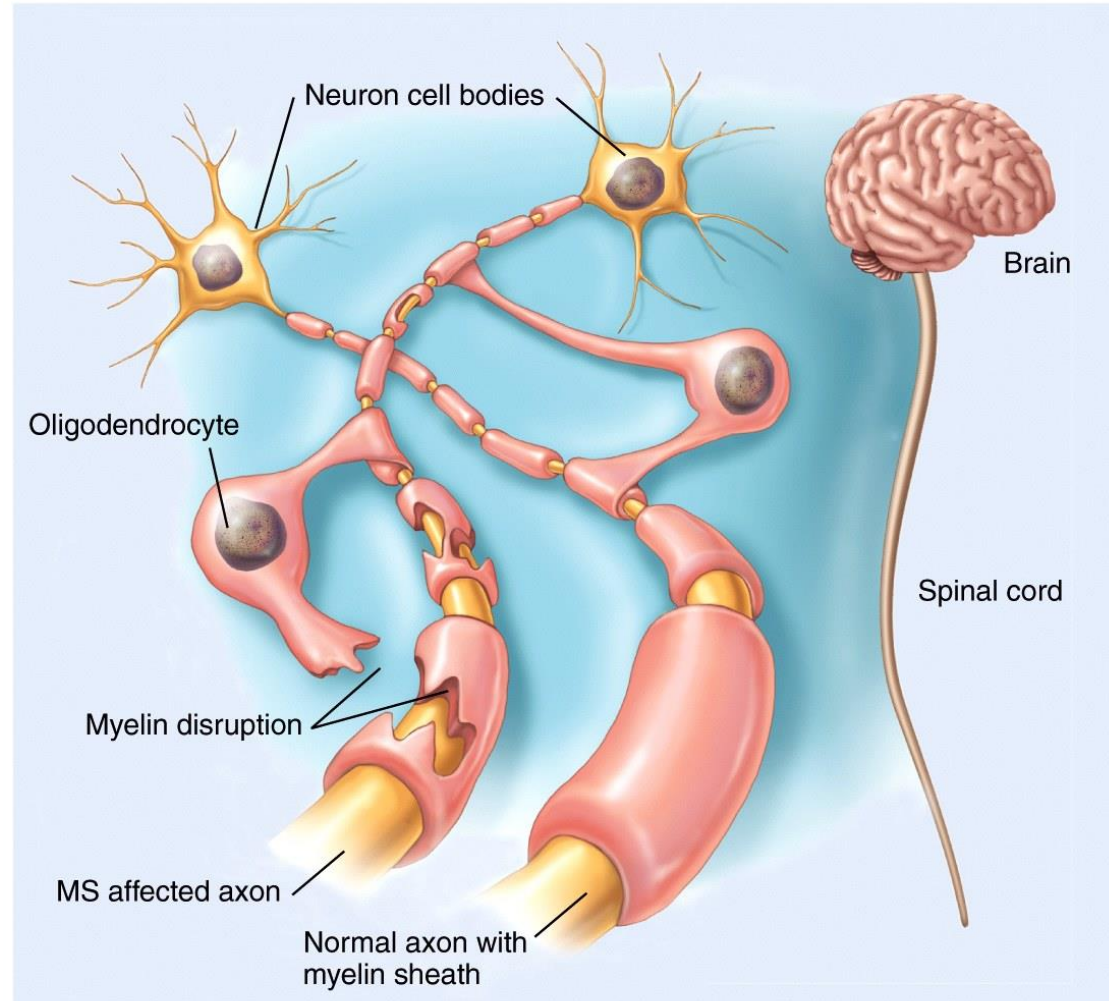
PNS



Multiple Sclerosis (MS) 多發性硬化症

Autoimmune disorder causing destruction of myelin sheaths in CNS

- sheaths become scars or plaques
- 1/2 million people in the United States
- appears between ages 20 and 40
- females twice as often as males
- Symptoms include muscular weakness, abnormal sensations or double vision
- Remissions & relapses result in progressive, cumulative loss of function



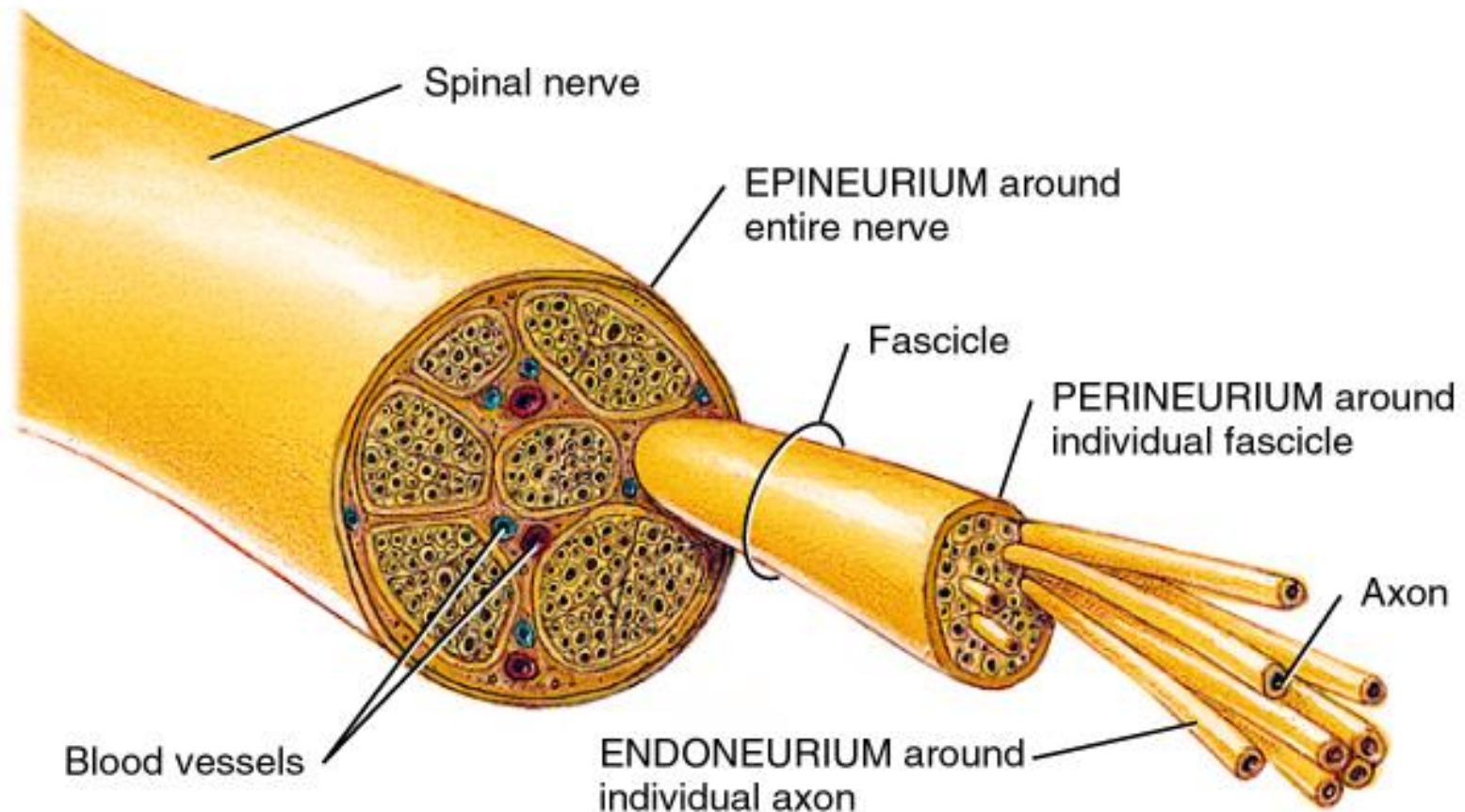
Peripheral Nervous System (PNS) Nerves (nerve trunks) in PNS

ensheathment (irregular c.t.):

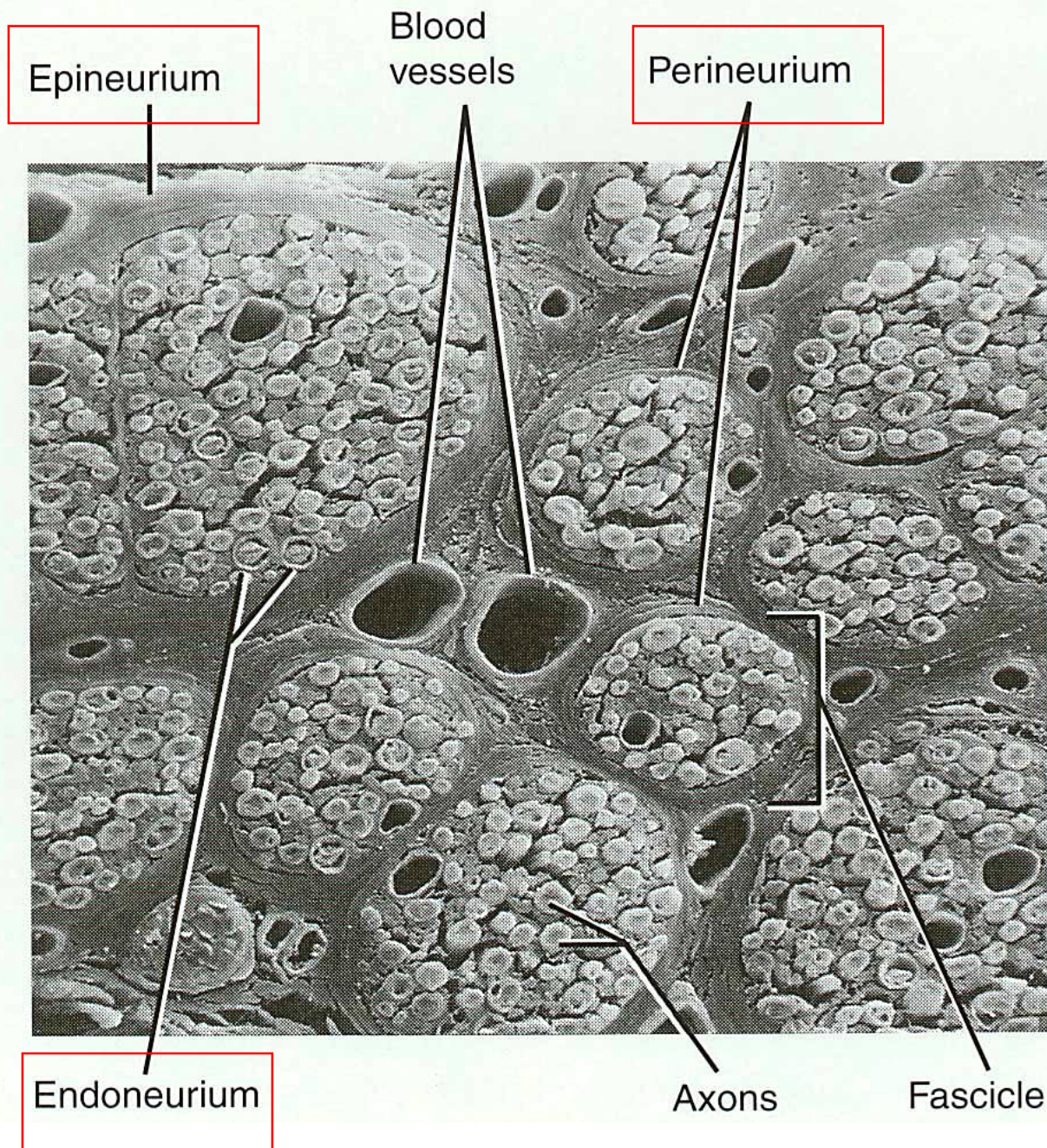
epineurium 神經束外膜

perineurium 神經束衣

endoneurium 神經內膜

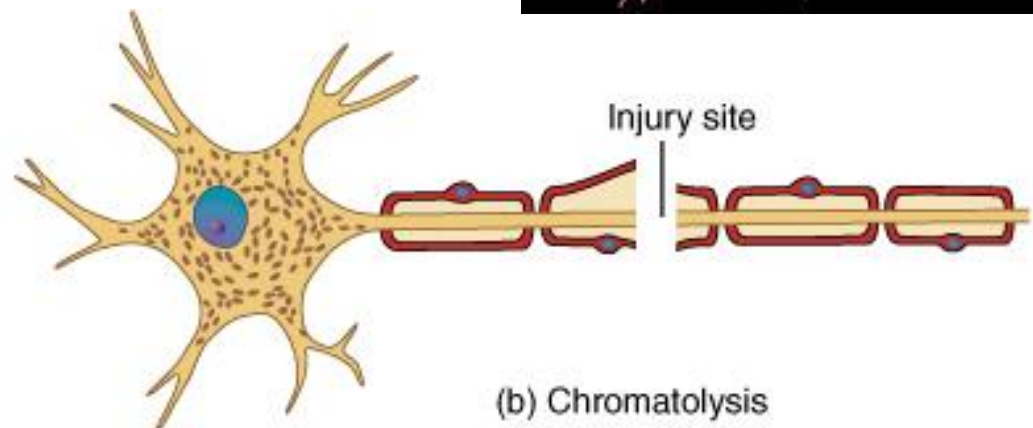
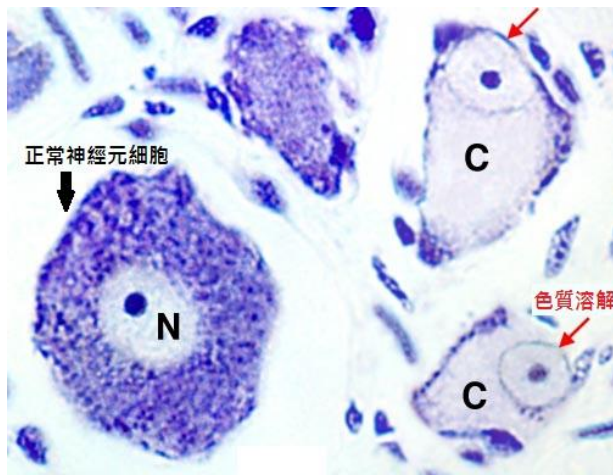
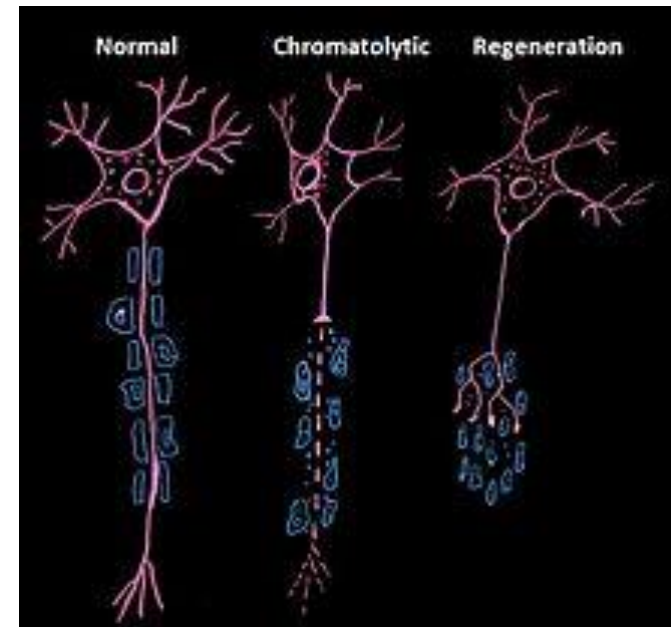


Transverse sections showing the coverings of a spinal nerve



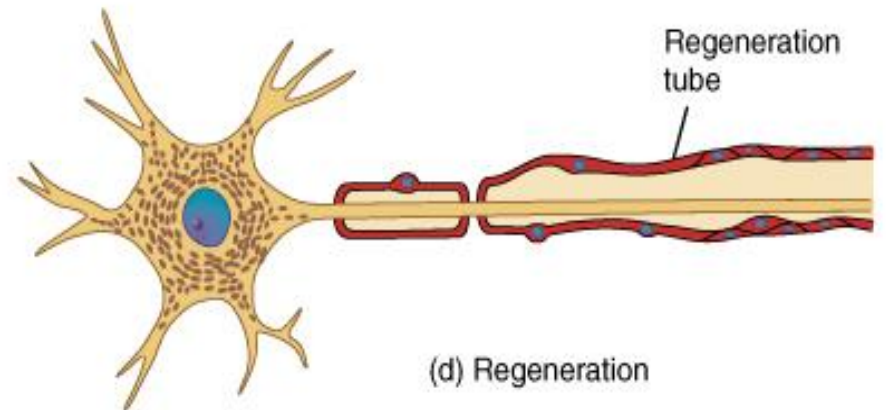
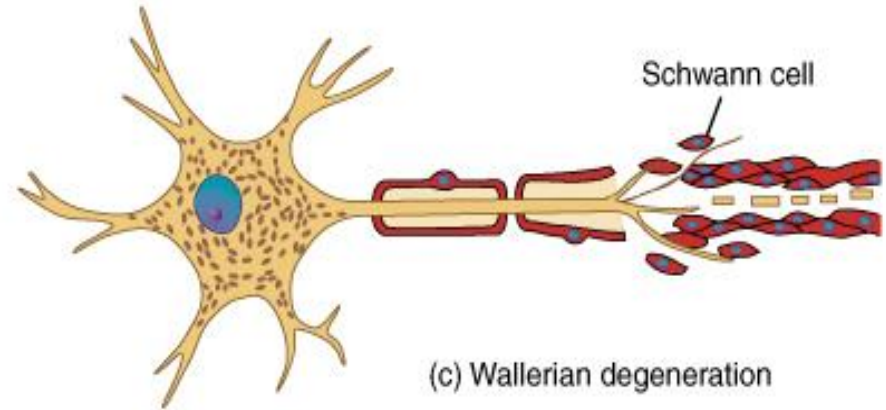
Repair within the PNS

- Axons & dendrites may be repaired if
 - Neuron cell body remains intact
 - Schwann cells remain active and form a tube
 - Scar tissue does not form too rapidly
- Chromatolysis 色質溶解
 - 24-48 hours after injury, Nissl bodies break up into fine granular masses

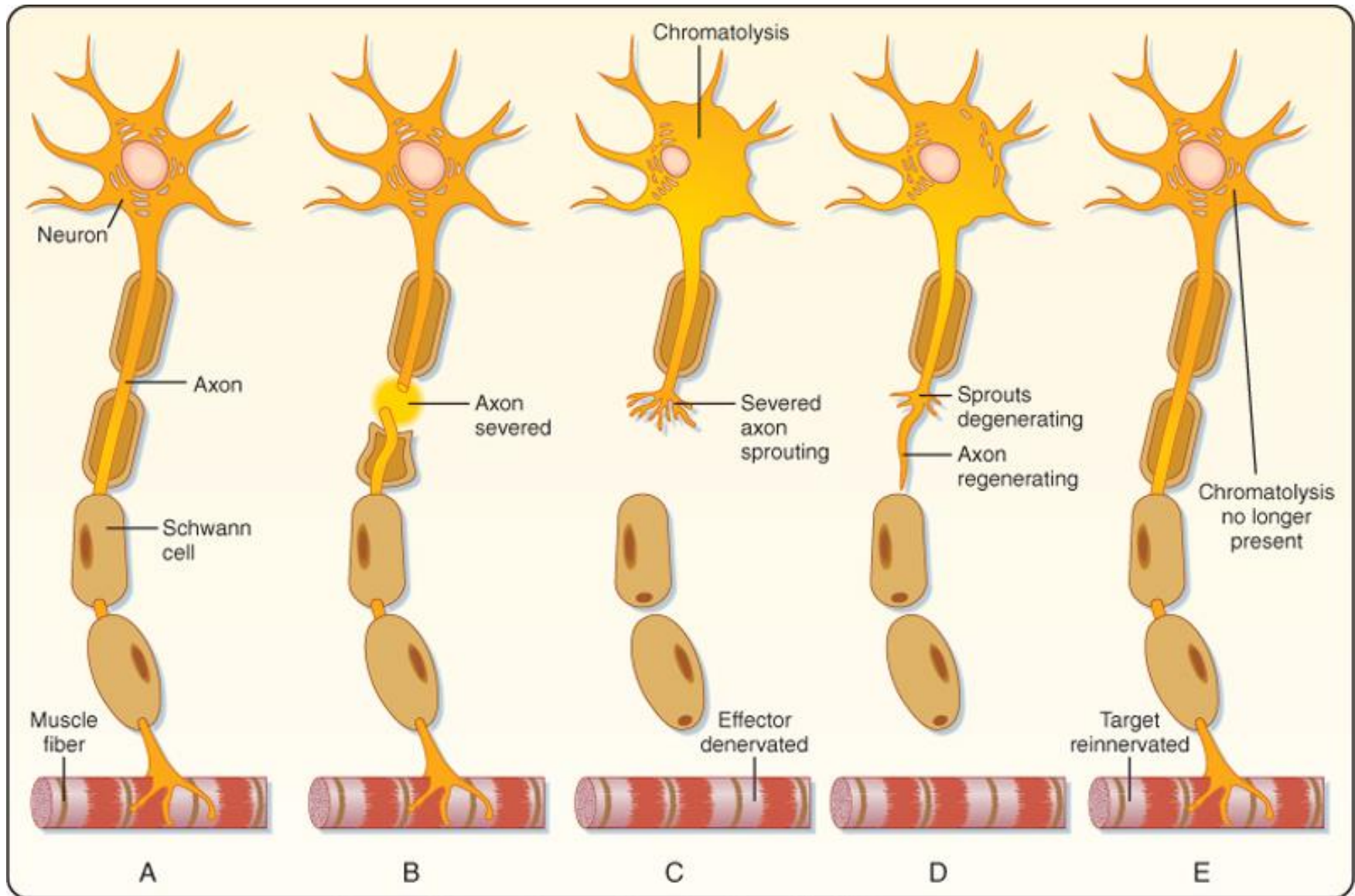


Repair within the PNS

- By 3-5 days,
 - Wallerian degeneration occurs (breakdown of axon & myelin sheath distal to injury)
 - retrograde degeneration occurs back one node
- Within several months, regeneration occurs
 - neurilemma on each side of injury repairs tube (schwann cell mitosis)
 - axonal buds grow down the tube to reconnect (1.5 mm per day)

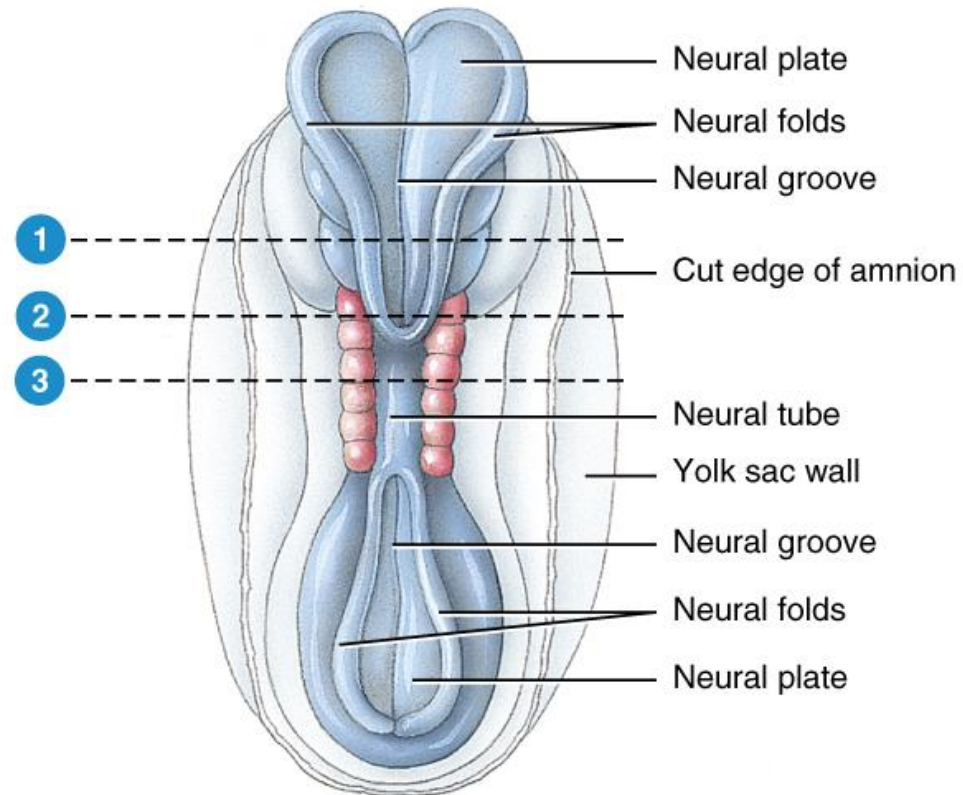
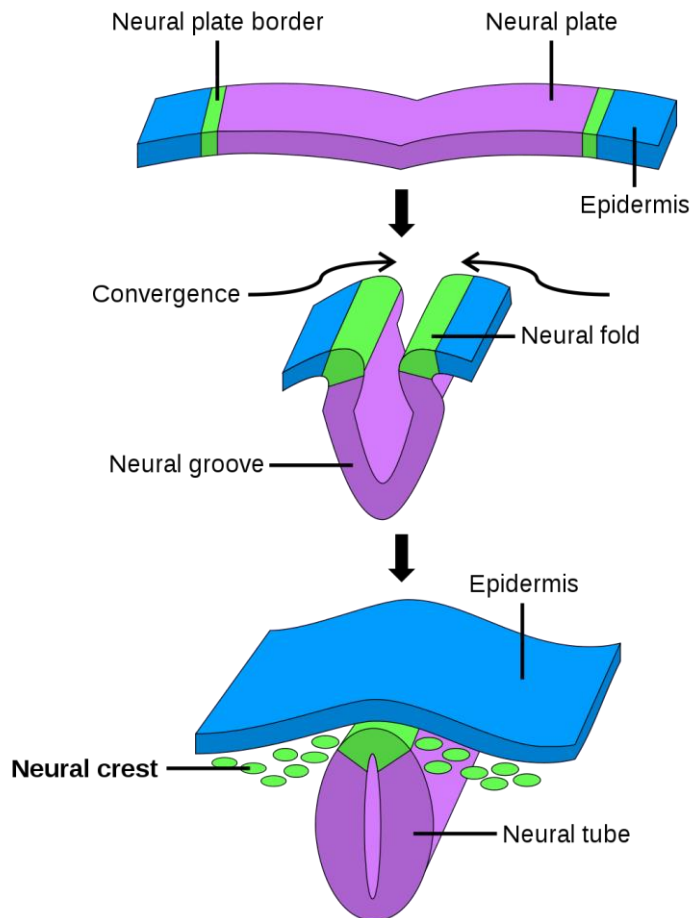


Repair within the PNS



Development of nervous system

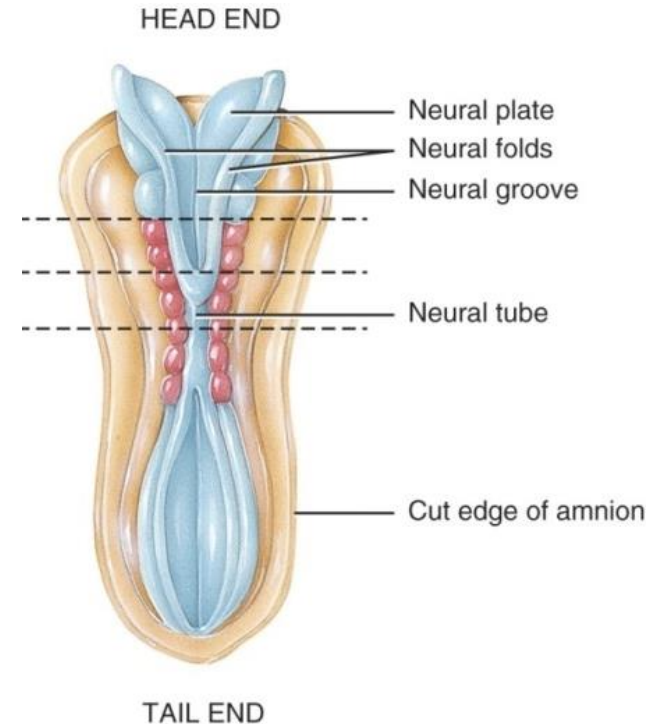
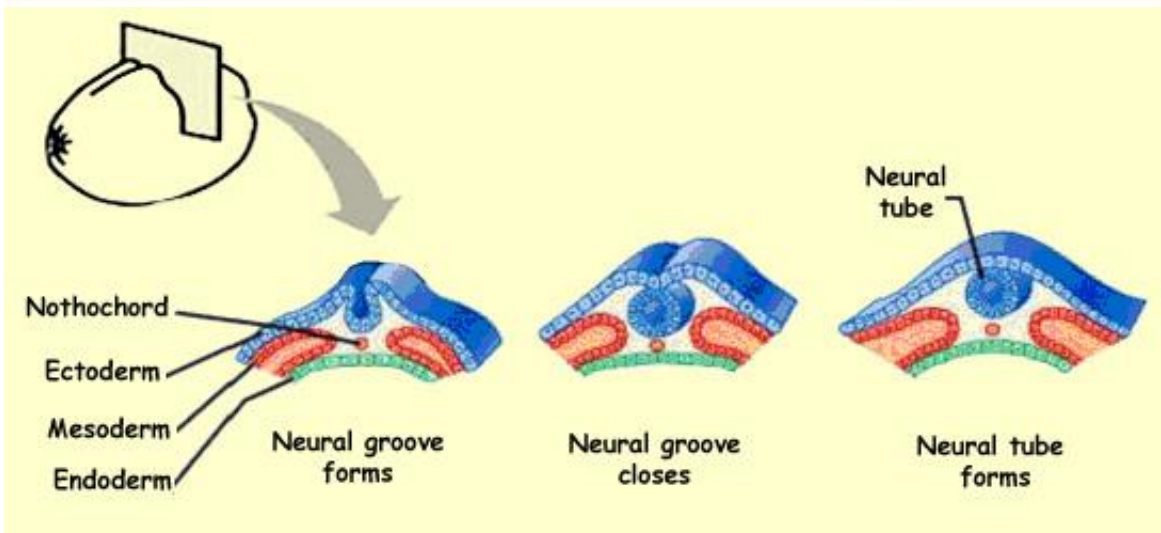
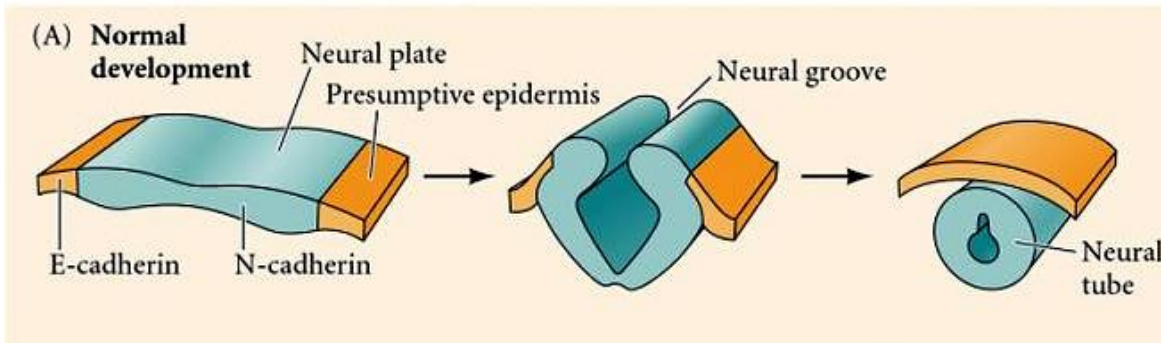
- Neural plate, neural groove, and neural tube
- Neural crest
- Brain formation



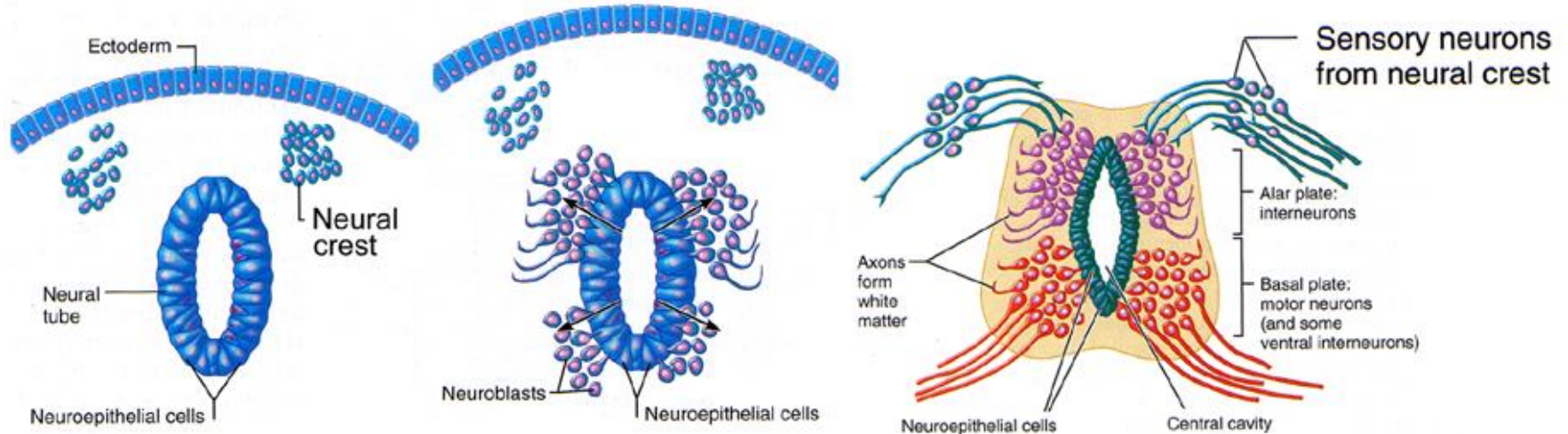
Development of the CNS

Neural plate, neural groove, & neural tube

- Begins in the 3rd week
 - ▢ ectoderm forms thickening (neural plate)
 - ▢ plate folds inward to form neural groove
 - ▢ edges of folds join to form neural tube

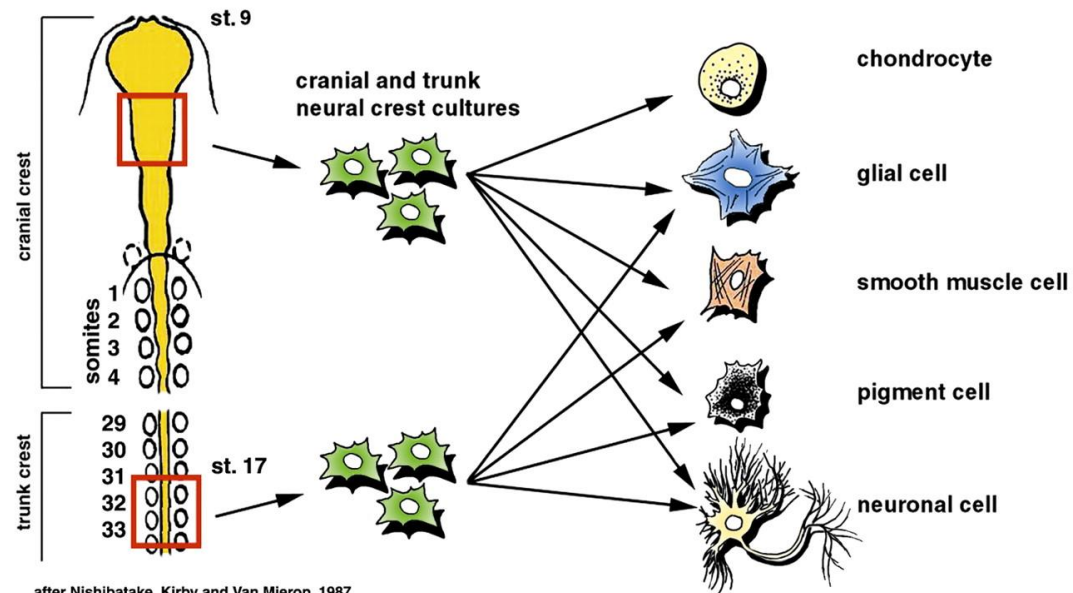


Neural crest 神經嵴



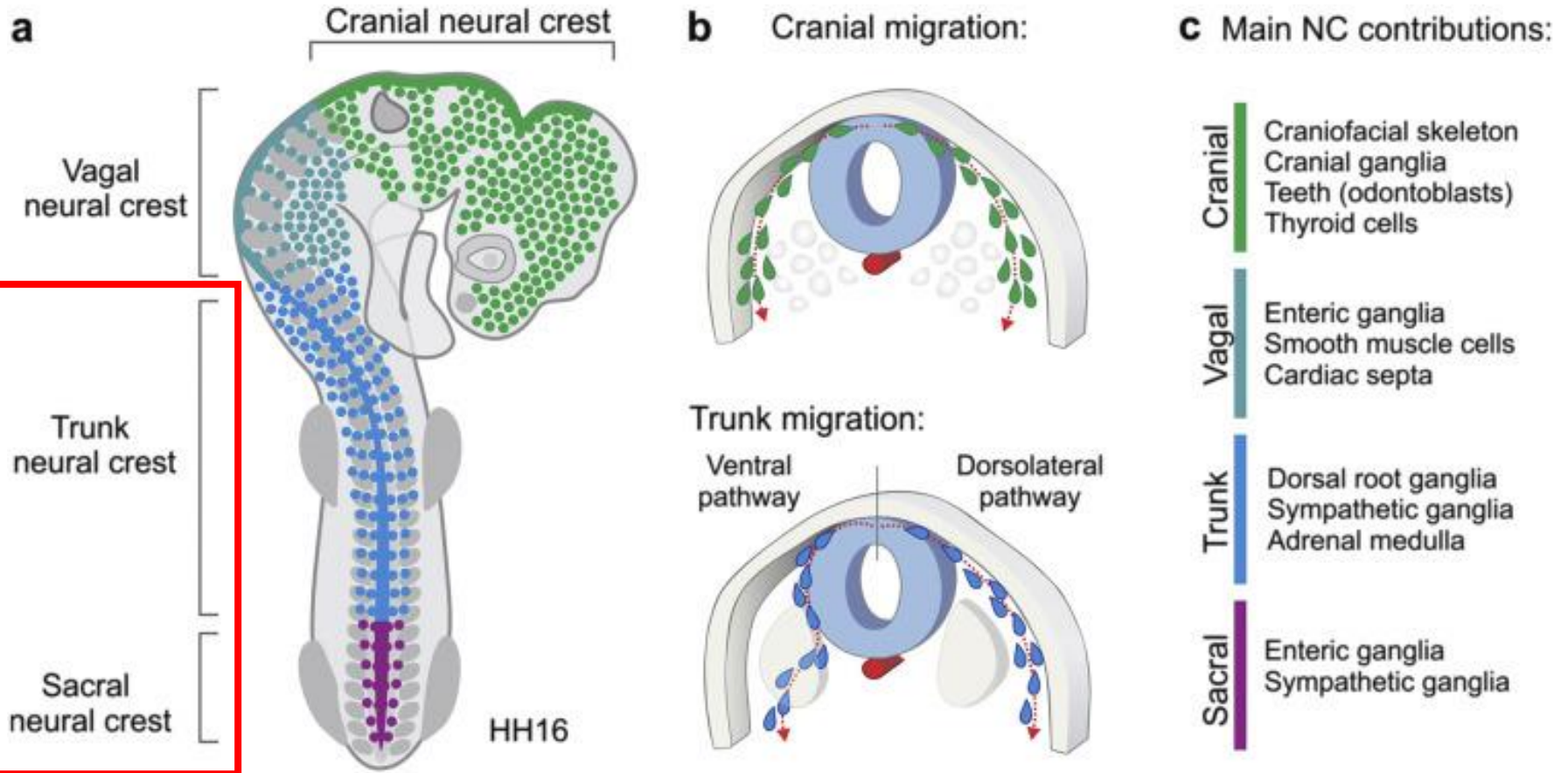
Neural crest tissue forms:

- ✓ **Spinal & cranial nerves**
- ✓ **Dorsal root & cranial nerve ganglia**
- ✓ **Sympathetic ganglia**
- ✓ **Adrenal gland medulla**
- ✓ **Pigment cells**



after Nishibatake, Kirby and Van Mierop, 1987

Neural crest derivatives

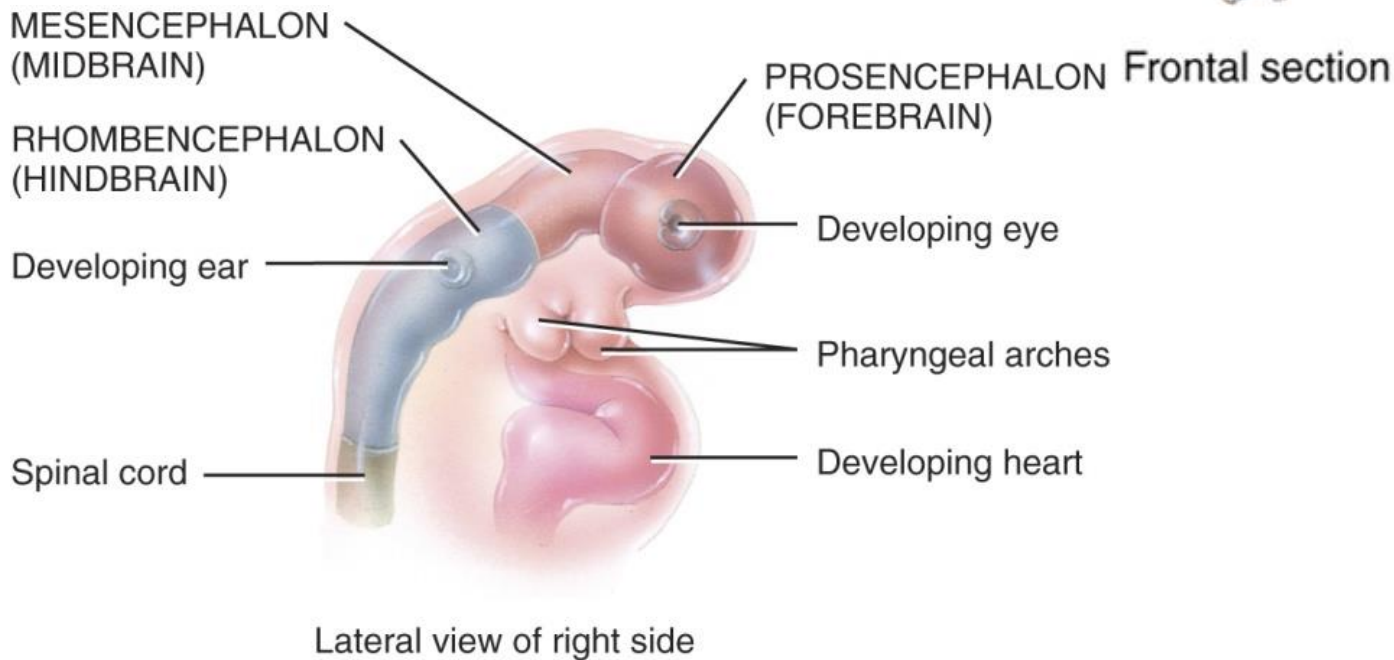
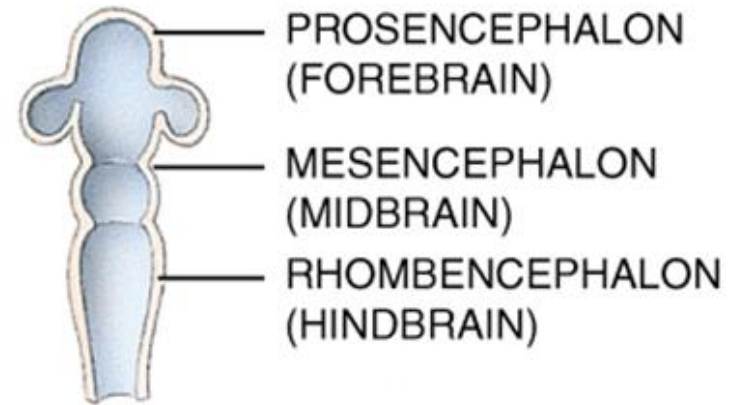


- ✓ Spinal & cranial nerves
- ✓ Dorsal root ganglia
- ✓ Sympathetic ganglia
- ✓ Adrenal gland medulla
- ✓ Pigment cells

Development of the CNS: Brain formation

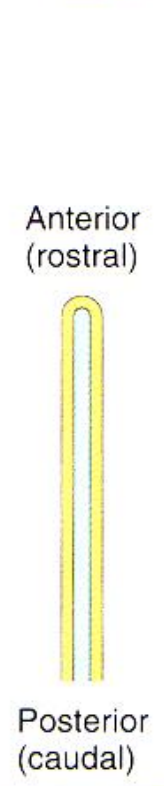
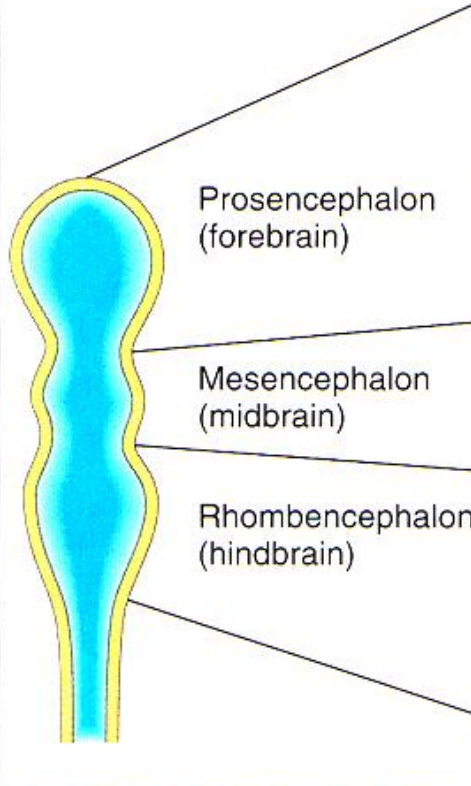
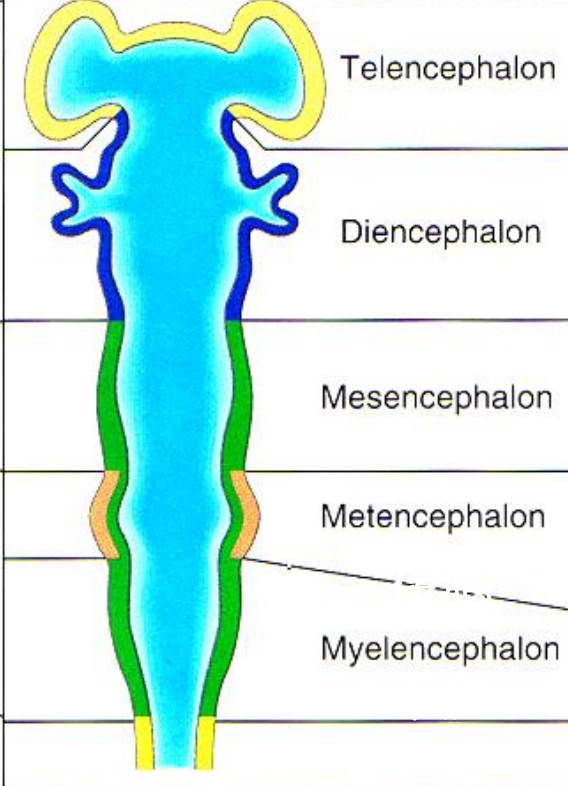
- By end of 4th week, 3 anterior enlargements occur

- **Prosencephalon** 前腦
- **Mesencephalon** 中腦
- **Rhombencephalon** 菱腦 (後腦)



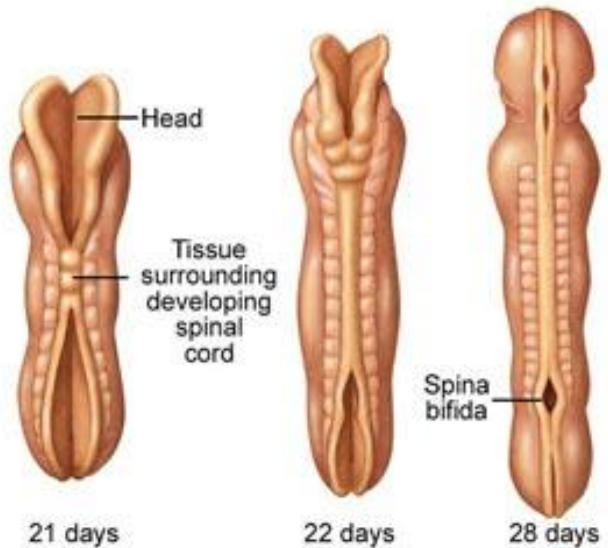
(a) Three-four week embryo showing primary brain vesicles

Development of the CNS

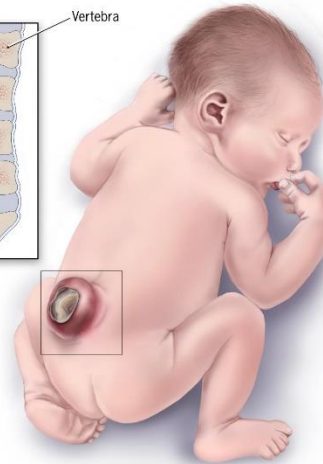
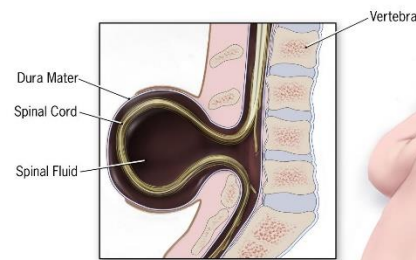
(a) Neural tube	(b) Primary brain vesicles	(c) Secondary brain vesicles	(d) Adult brain structures	(e) Adult neural canal regions
 Anterior (rostral) Posterior (caudal)	 Prosencephalon (forebrain) Mesencephalon (midbrain) Rhombencephalon (hindbrain)	 Telencephalon Diencephalon Mesencephalon Metencephalon Myelencephalon	Cerebrum: Cerebral hemispheres (cortex, basal ganglia)	Lateral ventricles
			Diencephalon (thalamus, hypothalamus)	Third ventricle
			Brain stem: midbrain	Cerebral aqueduct
			Brain stem: pons	Fourth ventricle
			Cerebellum	
			Brain stem: medulla oblongata	Central canal
			Spinal cord	

■ Neural tube defects

- associated with low levels of folic acid (B vitamins)
- spina bifida (脊柱分裂) is failure to close of vertebrae (1/1000)
- anencephaly (無腦畸形) is absence of skull & cerebral hemispheres



Spina Bifida (Open Defect)

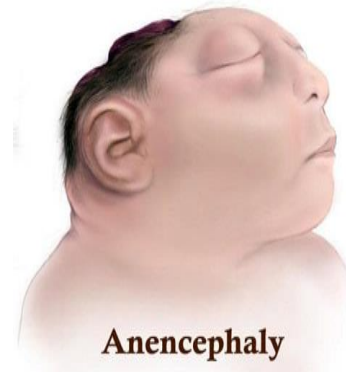


Anencephaly (無腦畸形)

Normal



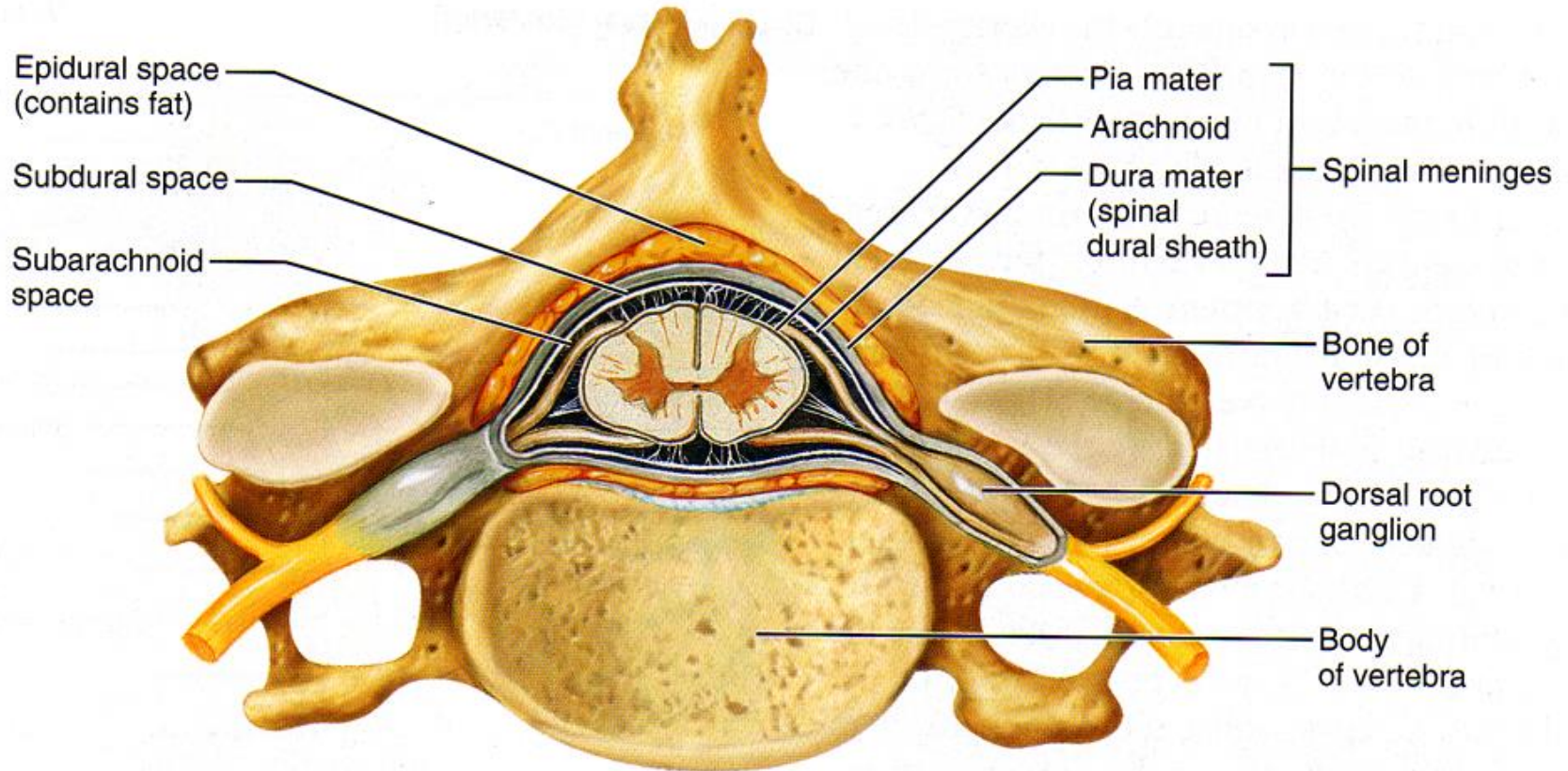
Anencephaly



Spinal cord

- Functions of the spinal cord
- Structures protecting the spinal cord
- Morphology of the spinal cord
- Tracts of the spinal cord
- Spinal reflexes

Structures protecting spinal cord



Spinal cord is protected by the vertebral column, meninges, cerebrospinal fluid, and vertebral ligaments.

Meninges

Dura mater 硬膜

Pia-arachnoid

軟膜-蜘蛛膜

Arachnoid mater

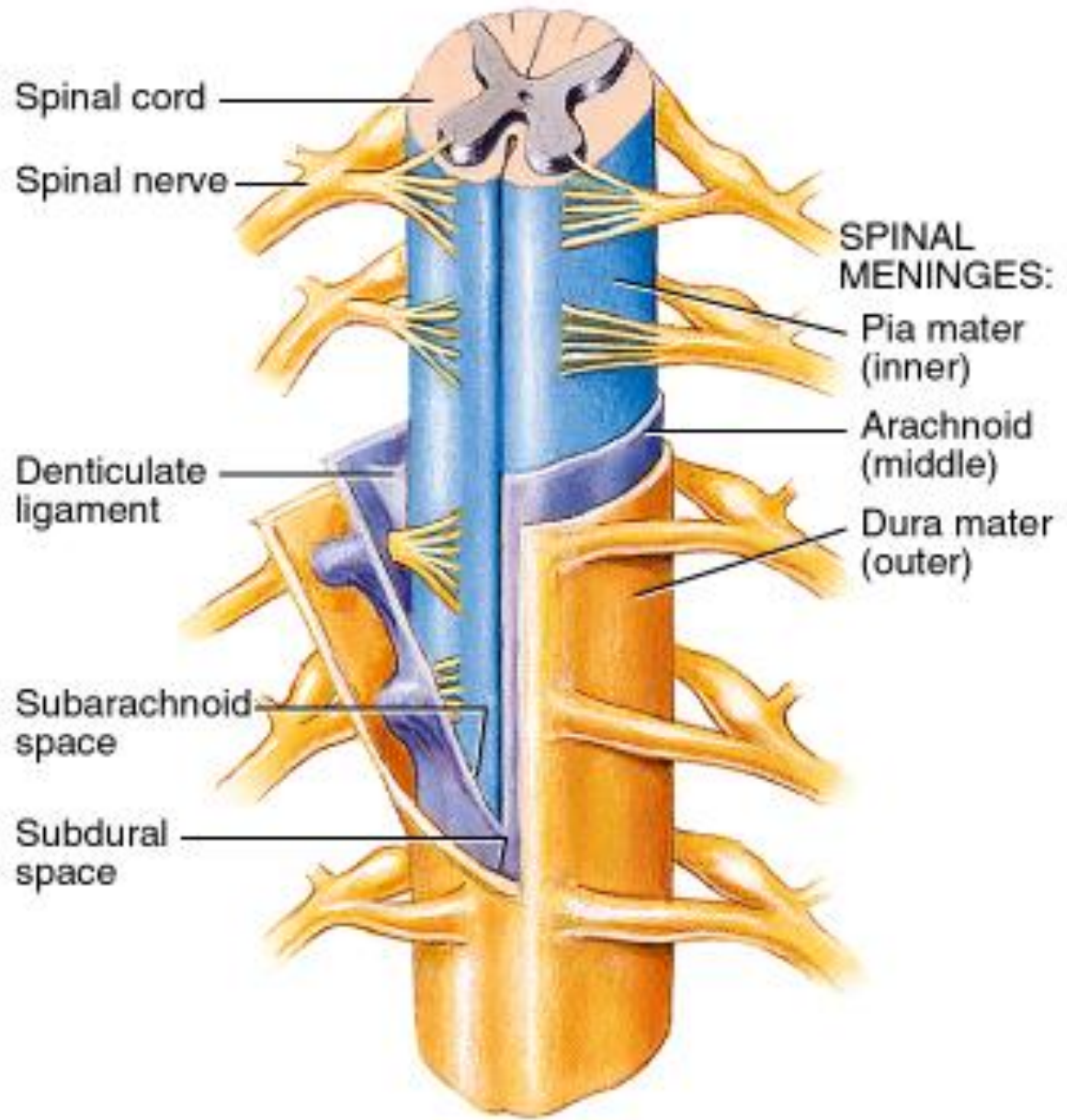
蜘蛛膜

Sub-arachnoid space:

蜘蛛膜下腔

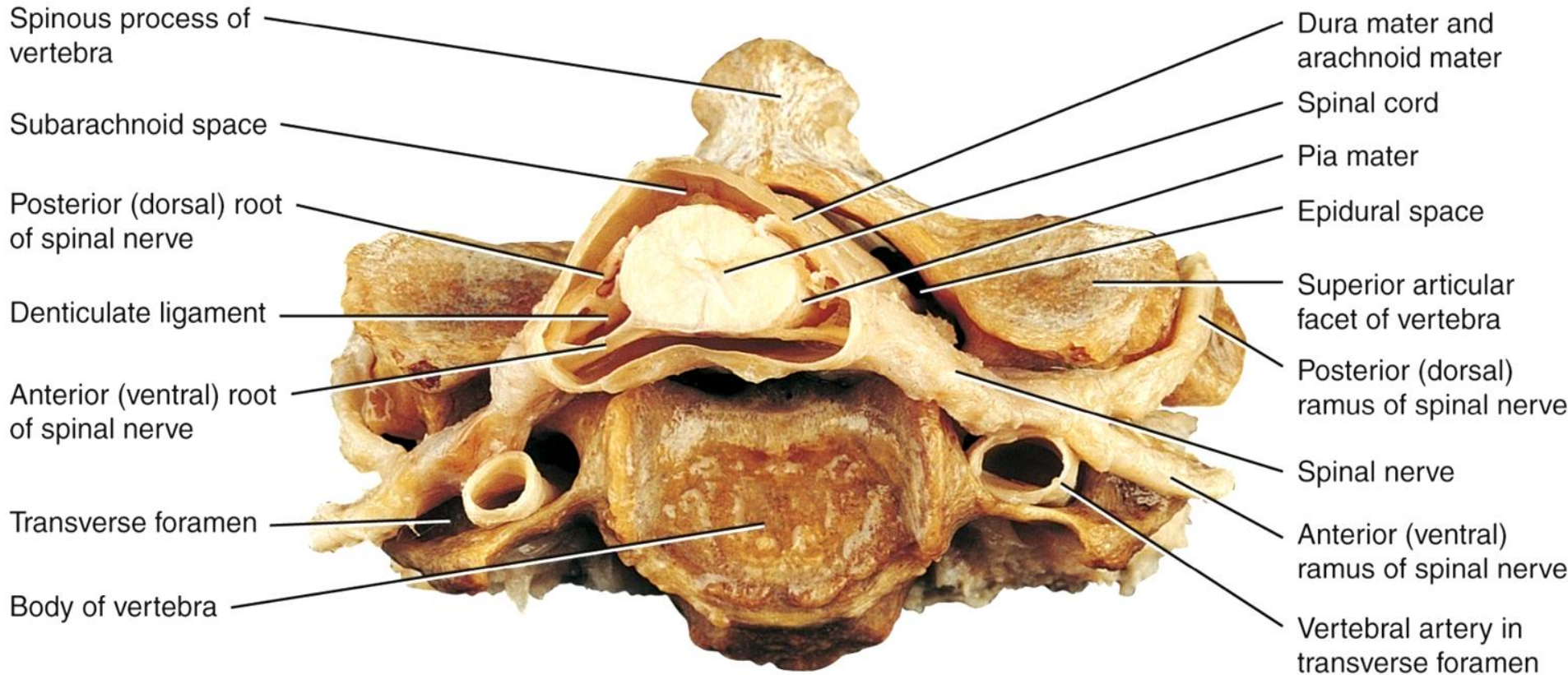
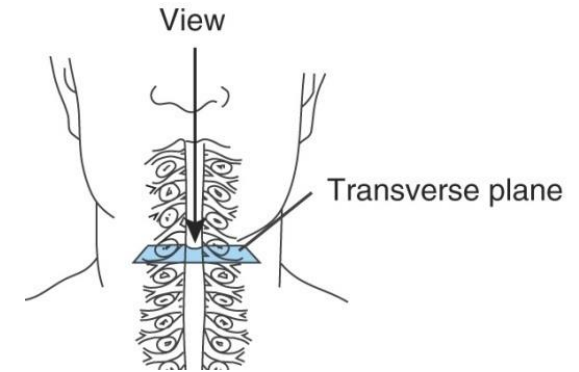
腦脊髓液 (CSF)

Pia mater 軟膜



(a) Diagram of sections through spinal cord

Morphology of the spinal cord



ANTERIOR

Spinal Cord 脊髓

In vertebral canal 脊椎管

From foramen magnum 枕骨大孔 to L2 (vertebra) 第二腰椎, 42 to 45 cm

Cervical enlargement 頸膨大部:

Brachial plexus 臂神經叢

Lumbar enlargement 腰膨大部:

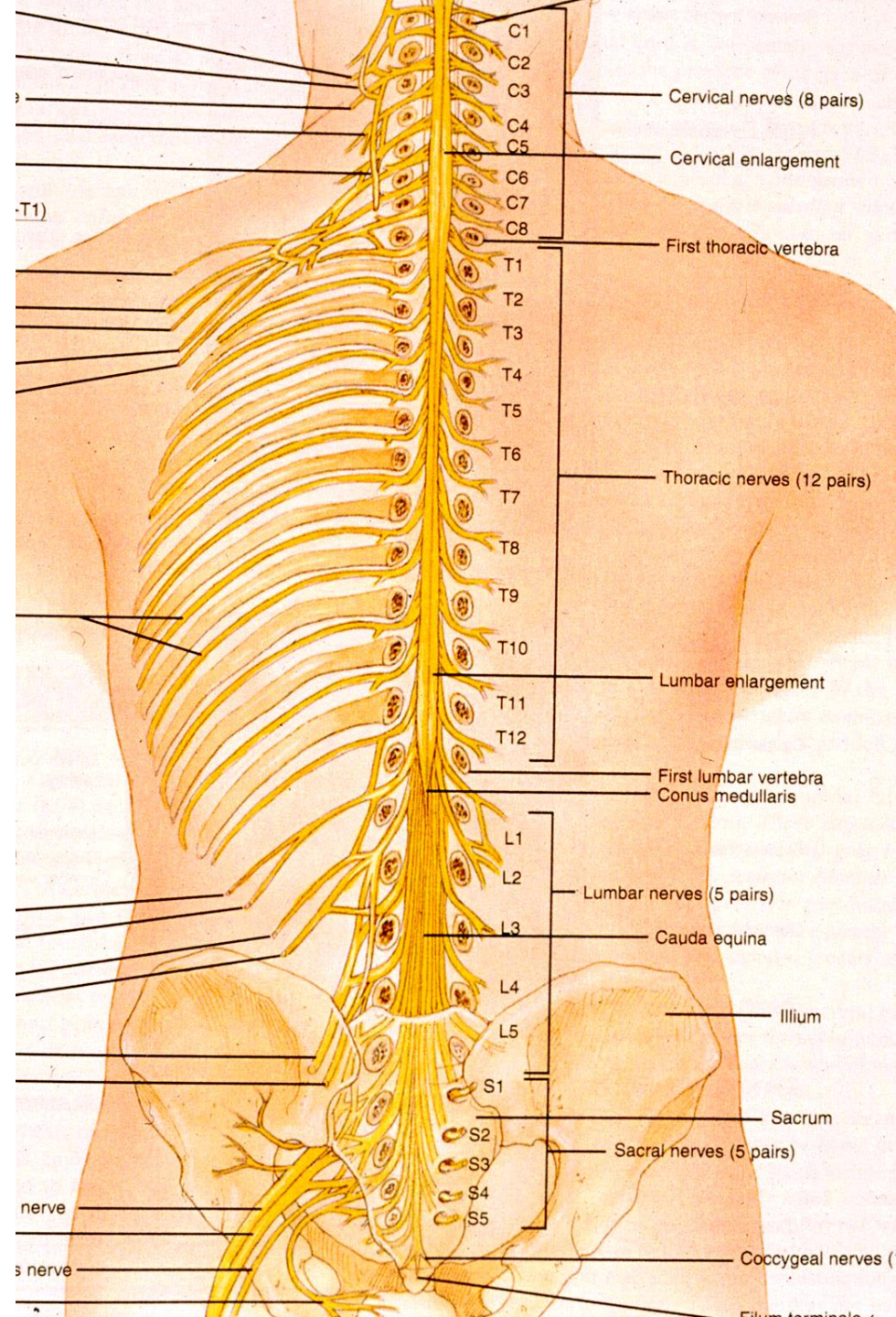
Lumbar plexus 腰神經叢;

Sacral plexus 薦神經叢

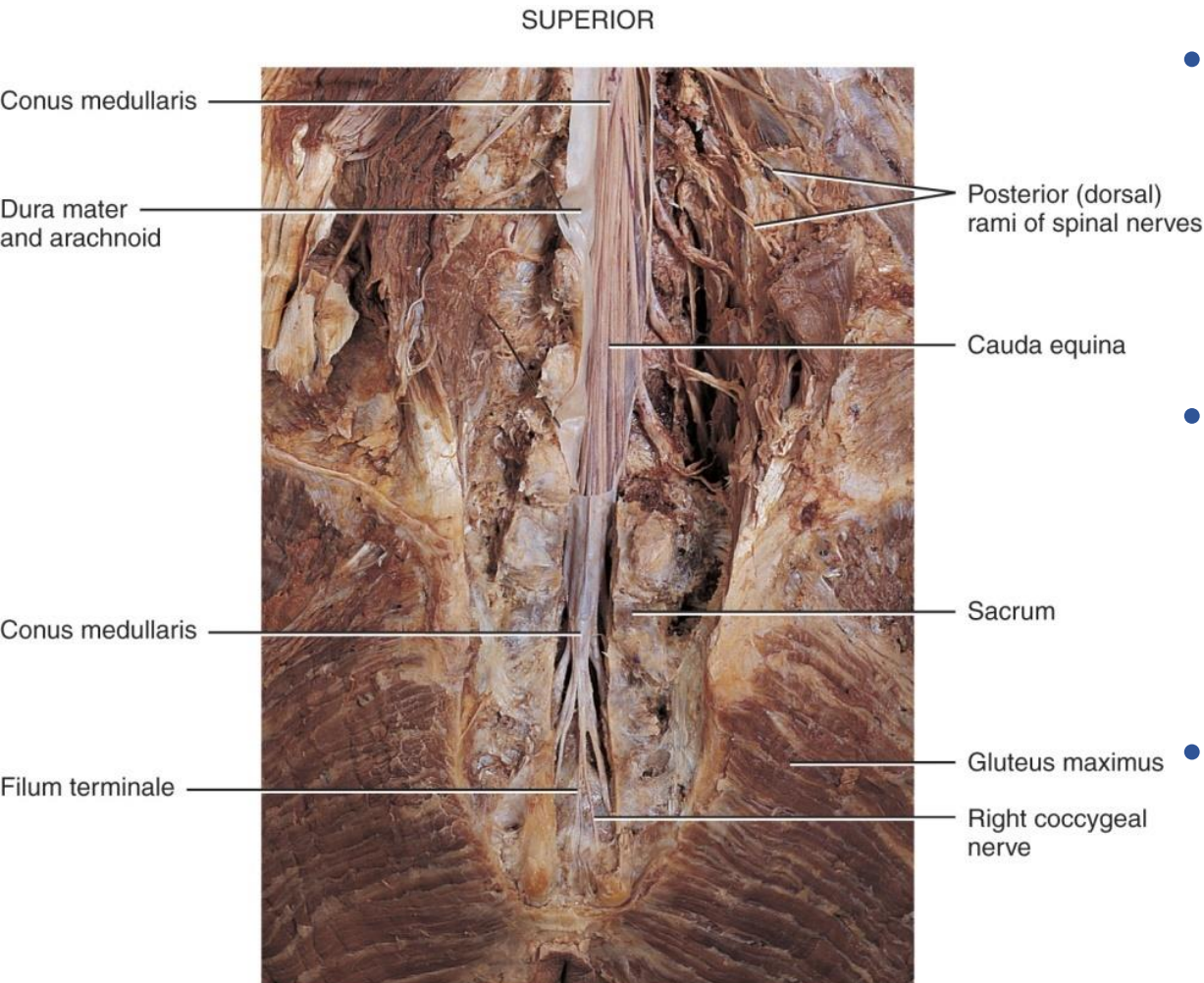
In adult ends at L 2

In newborn ends at L 4

Growth of spinal cord stops at age 5



Caudal End of Spinal Cord



- Conus medullaris

脊髓圓椎

- end of spinal cord
- cone-shaped end of spinal cord

- Filum terminale 終絲

- thread-like extension of pia mater
- stabilizes spinal cord in canal

- Caudae equinae (horse's tail) 馬尾

- dorsal & ventral roots of lowest spinal nerves

Spinal tap or Lumbar Puncture

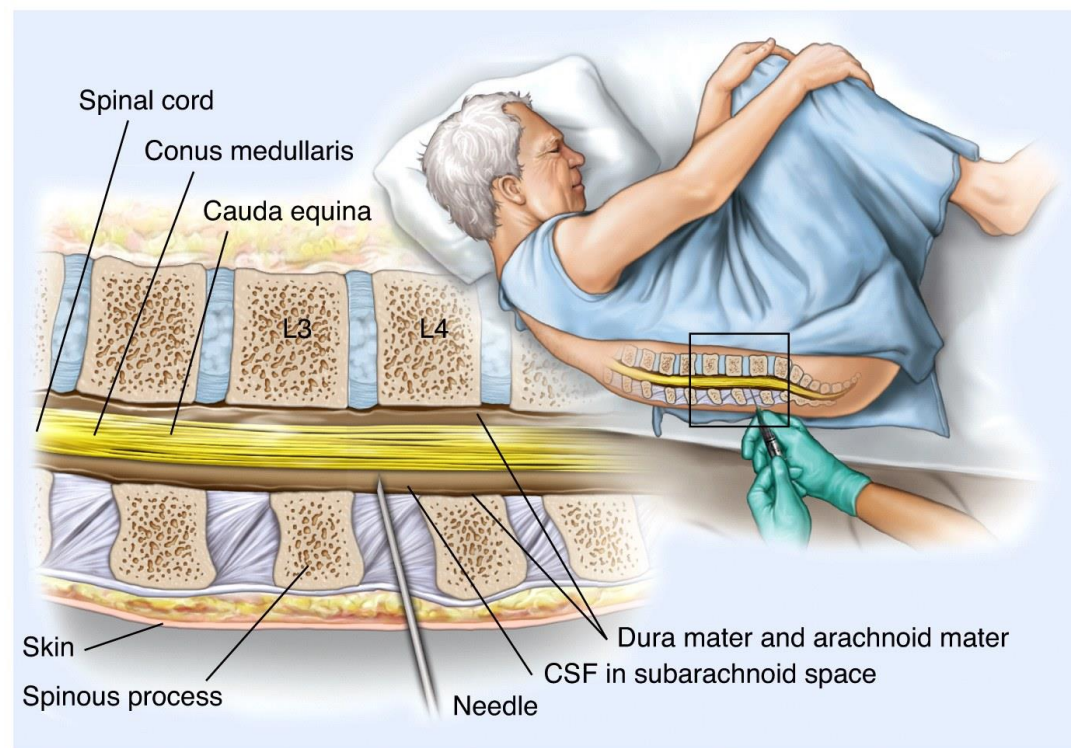
腰椎穿刺

• Technique

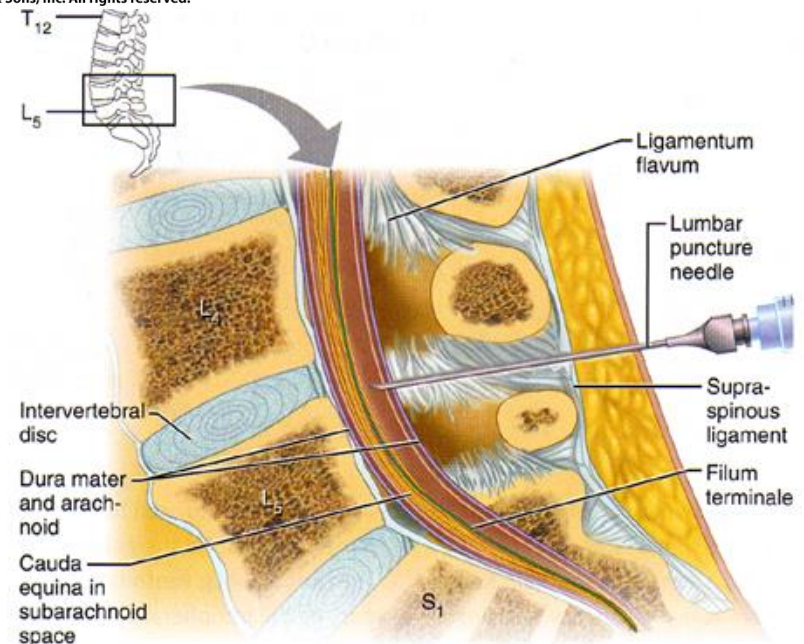
- long needle into subarachnoid space
- safe from L3 to L5

• Purpose

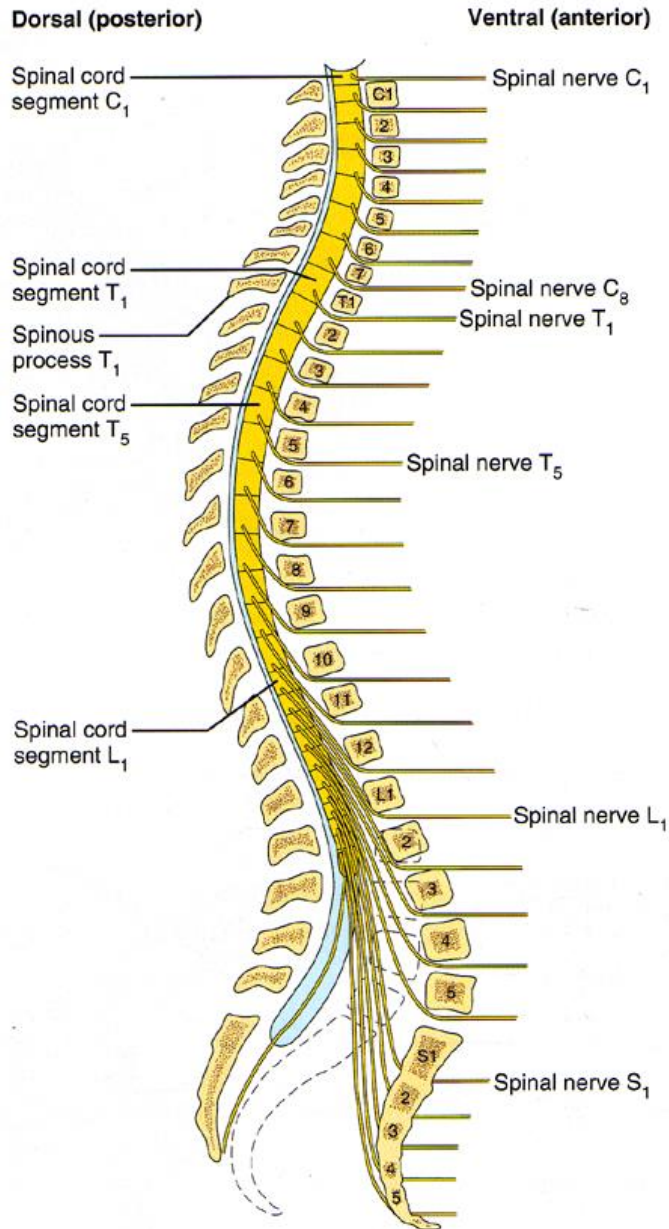
- sampling **CSF** 腦脊髓液
- injection of antibiotics, anesthetics or chemotherapy
- measurement of CSF pressure



Copyright © John Wiley & Sons, Inc. All rights reserved.



Spinal cord



Cervical



(Segment C1)



(Segment C8)

Thoracic



(Segment T2)

Lumbar



(Segment L4)

Sacral



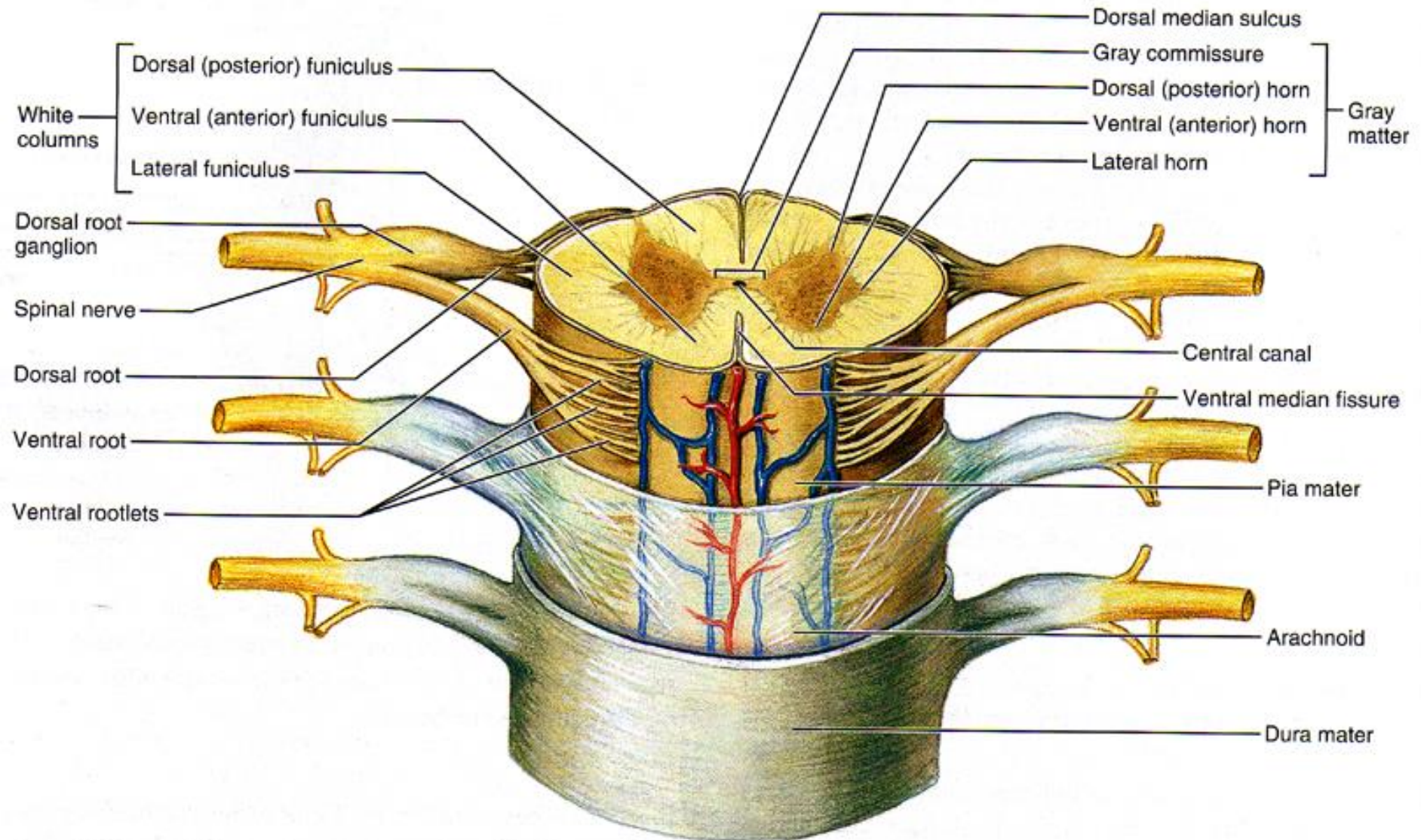
(Segment S3)

Spinal segment :
area of cord
from which each
pair of spinal
nerves arises

Gray Matter
(H or butterfly)
灰質: Neurons and
neuroglia

White Matter 白質:
bundles of
myelinated
axons

Internal Anatomy of the Spinal Cord



Internal anatomy of the spinal cord

Gray Matter (H or butterfly) 灰質: Neurons and neuroglia

Anterior (ventral) horn 前角: Motor neurons for skeletal muscles

Lateral horn 側角: Motor neurons for smooth muscle, cardiac muscle, or a gland (Autonomic nervous system)

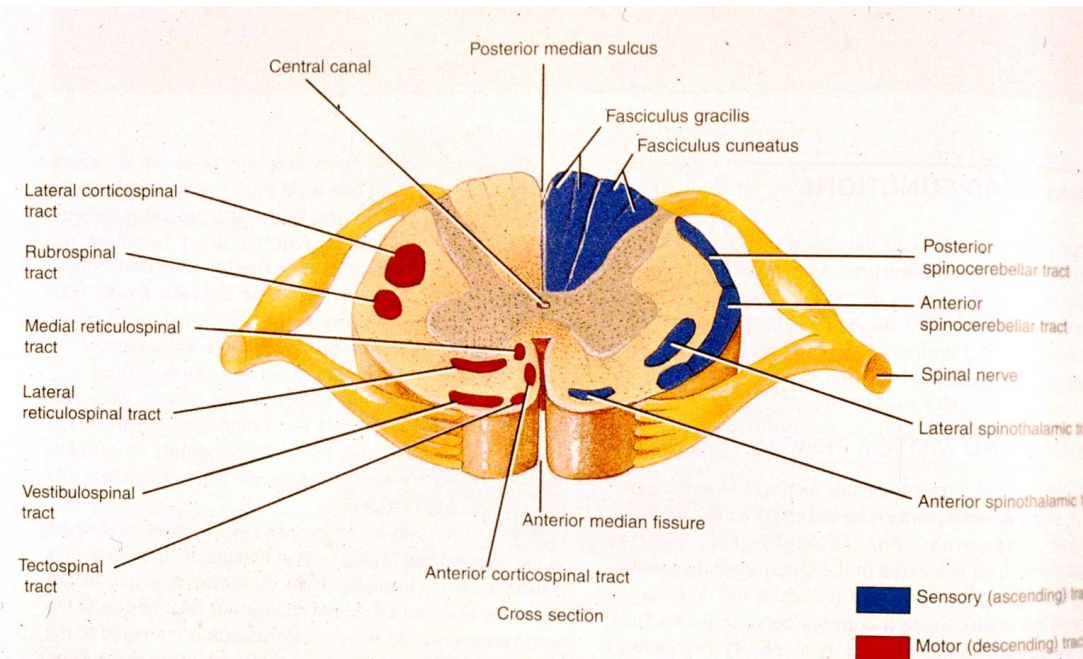
Posterior (dorsal) horn 後角

White Matter 白質: bundles of myelinated axons

Anterior (ventral) white columns 前柱(索)

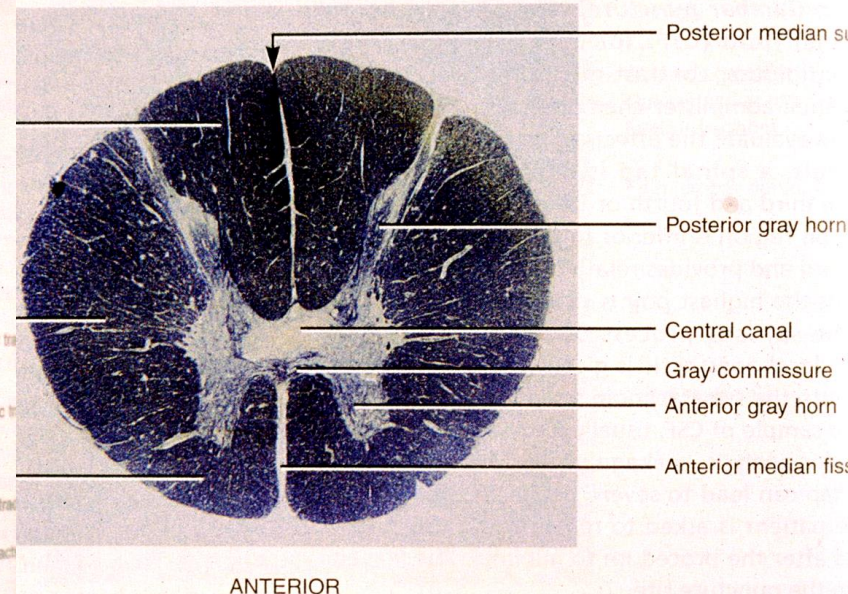
Posterior (dorsal) white columns 後柱(索)

Lateral white column 側柱(索)



► Based on its name, what is the origin, destination, and position in the cord of the anterior corticospinal tract? Is this a sensory or a motor tract?

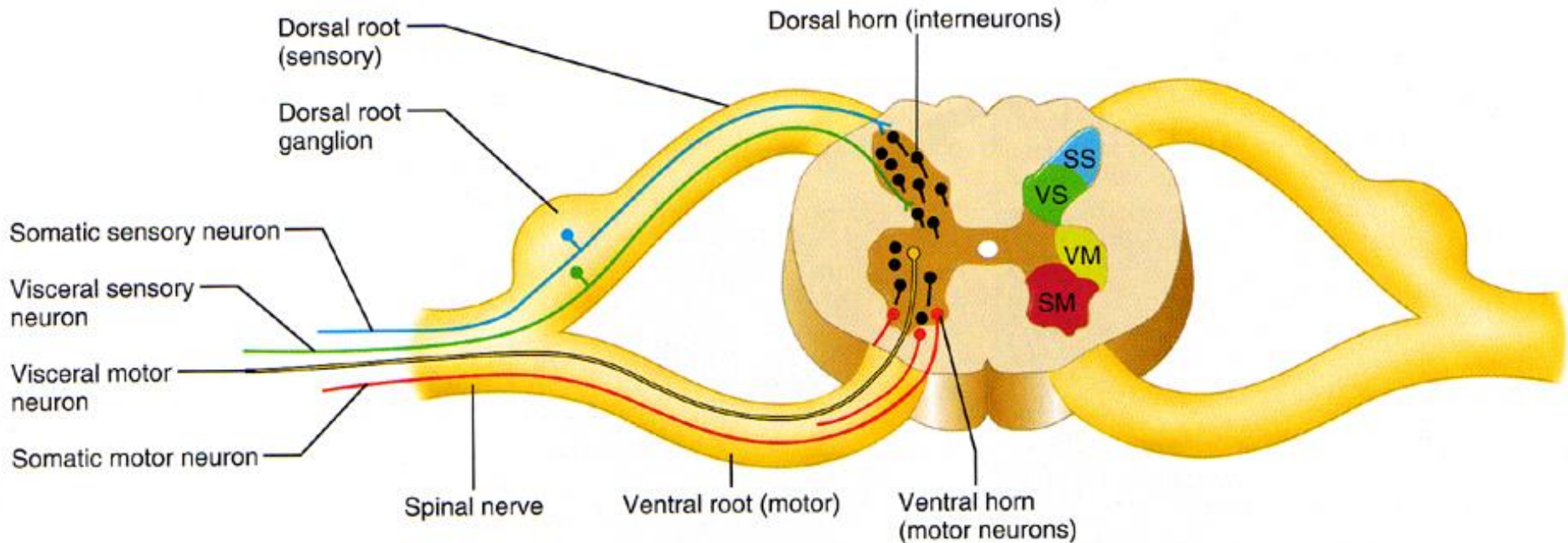
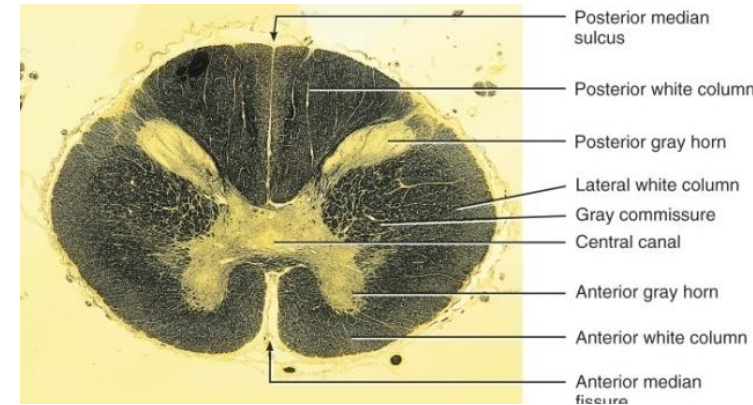
(a) Diagram of a cross section of the thoracic spinal cord



(b) Photograph of a cross section of the

Organization of gray matter of the Spinal Cord

- Somatic sensory 體感覺 (SS)
- Visceral sensory 臟腑感覺 (VS)
- Visceral motor 臟腑運動 (VM)
- Somatic motor 體運動 (SM)



Tracts of the spinal cord

- Function of tracts

- highway for sensory & motor information
- sensory tracts ascend (to brain)
- motor tracts descend (to body)

- Naming of tracts

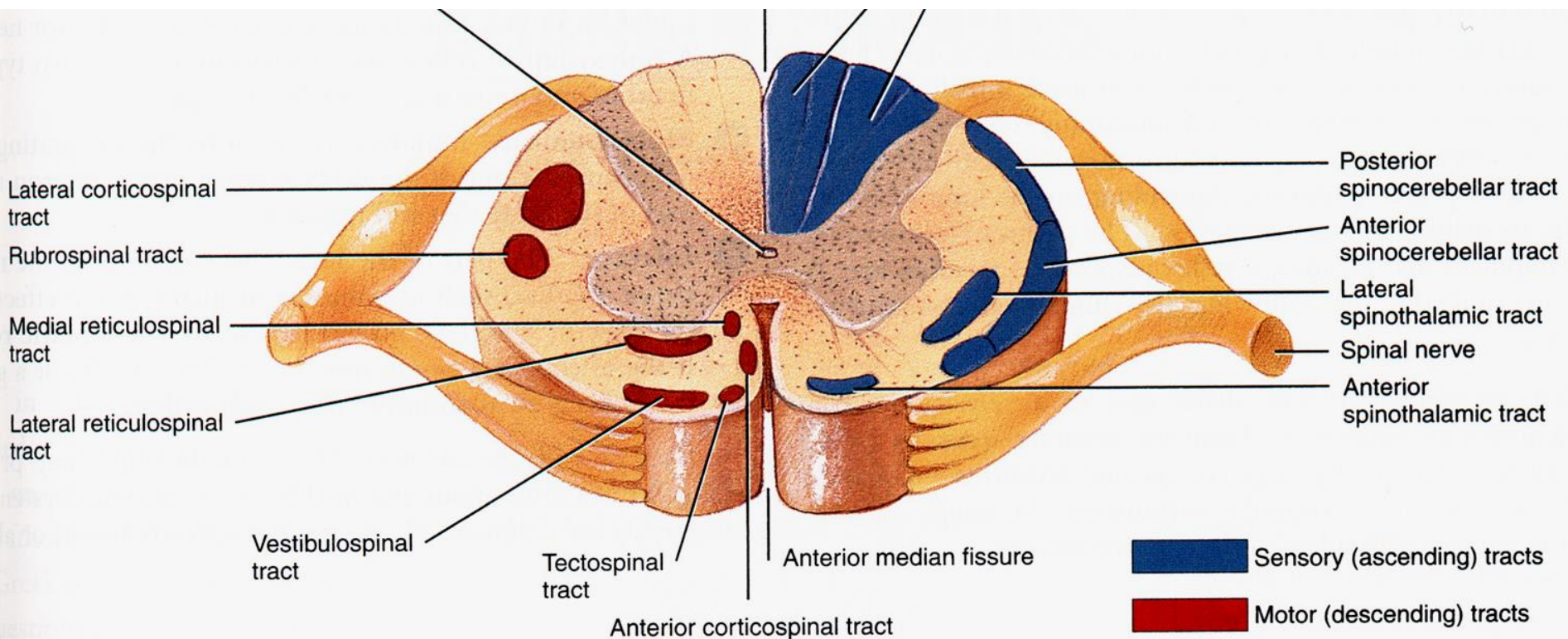
- indicates position & direction of signal
- example : **anterior spinothalamic tract** 前脊髓丘腦徑
 - impulses travel from spinal cord towards brain (thalamus 丘腦)
 - found in anterior part of spinal cord

Sensory (ascending) Tracts 感覺神經徑

Anterior spinothalamic tract 前脊髓視丘徑: **Crude touch and deep pressure**

Lateral spinothalamic tract 側脊髓視丘徑: **Pain and temperature**

Fasciculus gracilis 薄束 and Fasciculus cuneatus 楔狀束:
proprioception, discriminative touch, two-point discrimination, pressure, and vibrations



Sensory (ascending) Tracts

感覺神經徑（在脊髓處交叉到對側）

Anterior spinothalamic tract

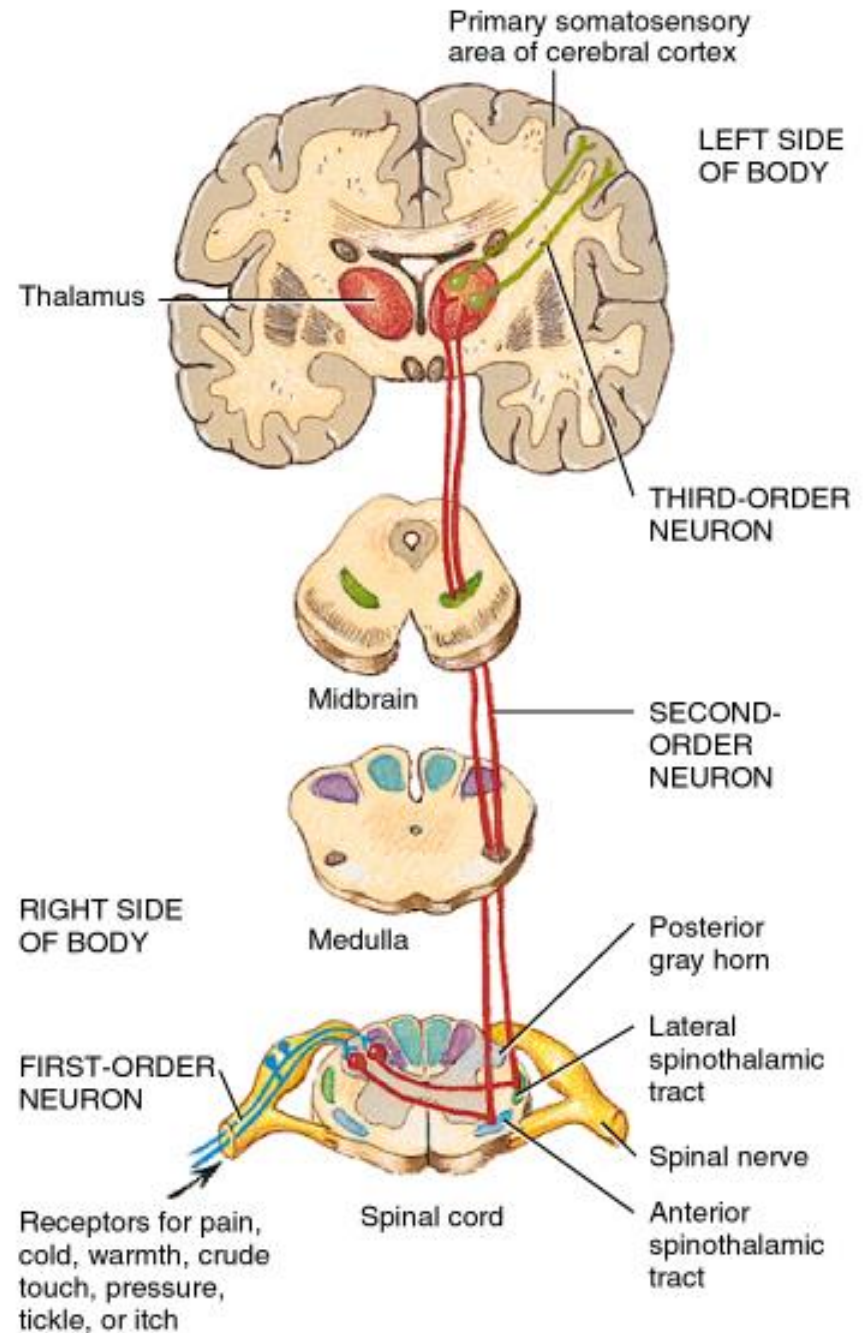
前脊髓丘腦徑：

Crude touch and deep pressure

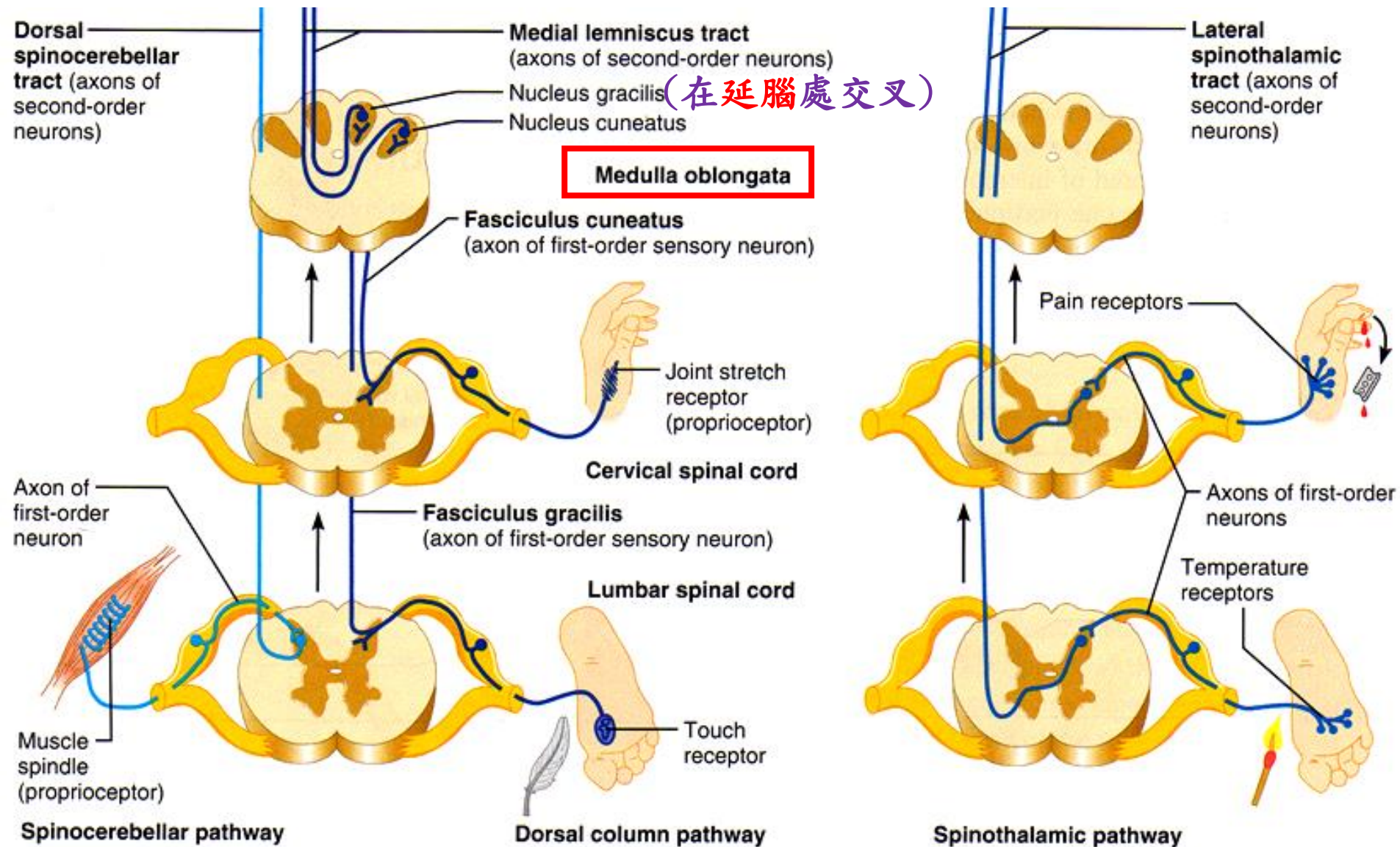
Lateral spinothalamic tract

側脊髓丘腦徑：

Pain and temperature



Tracts of the Spinal cord



Proprioception

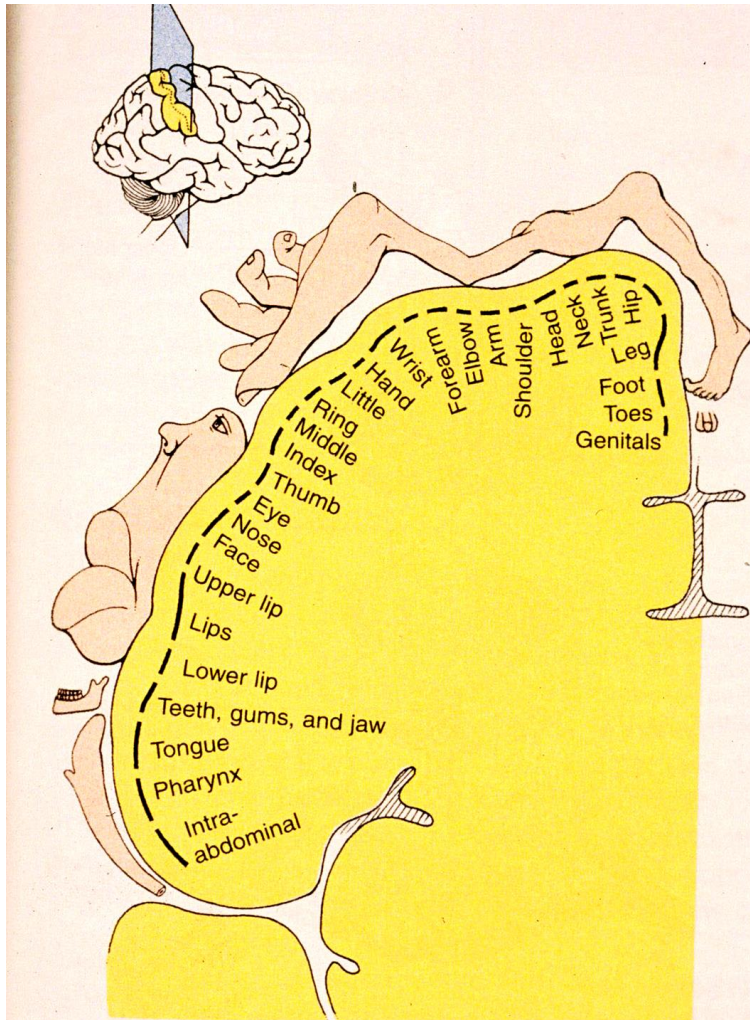
Touch, pressure ...

Pain, temperature

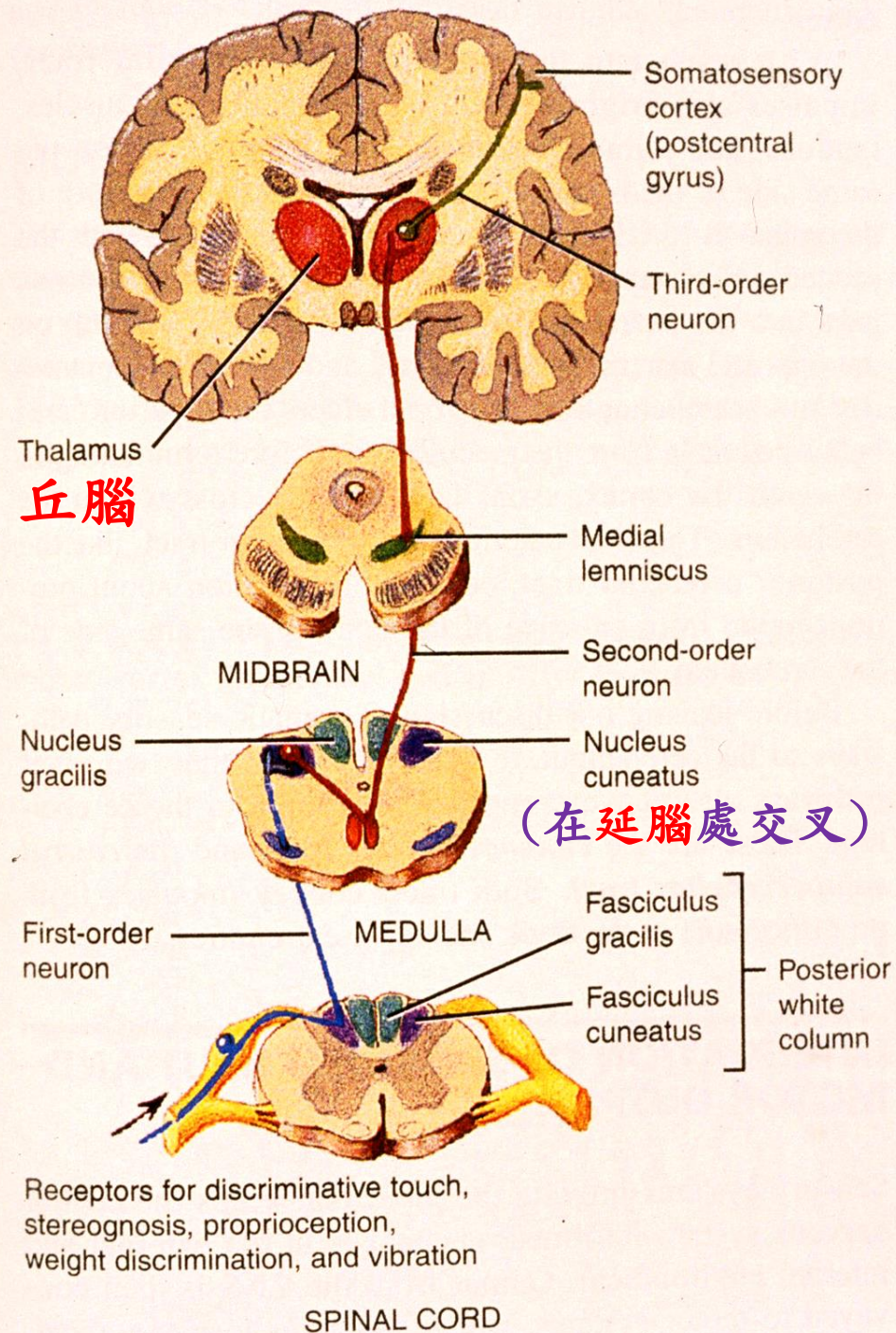
Fasciculus gracilis 薄束

Fasciculus cuneatus 楔狀束:

proprioception, discriminative touch, two-point discrimination, and vibrations



(a) Somatosensory cortex in right cerebral hemisphere



Motor (descending) Tracts

運動神經徑

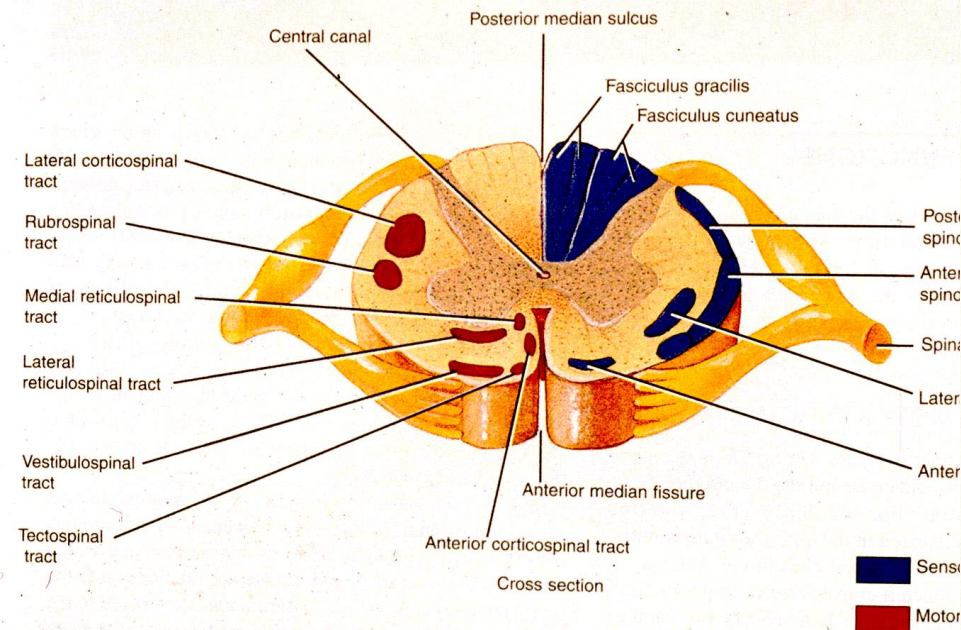
Direct (pyramidal) pathways 錐體途徑
(voluntary movements)

Lateral corticospinal tract 側皮質脊髓徑

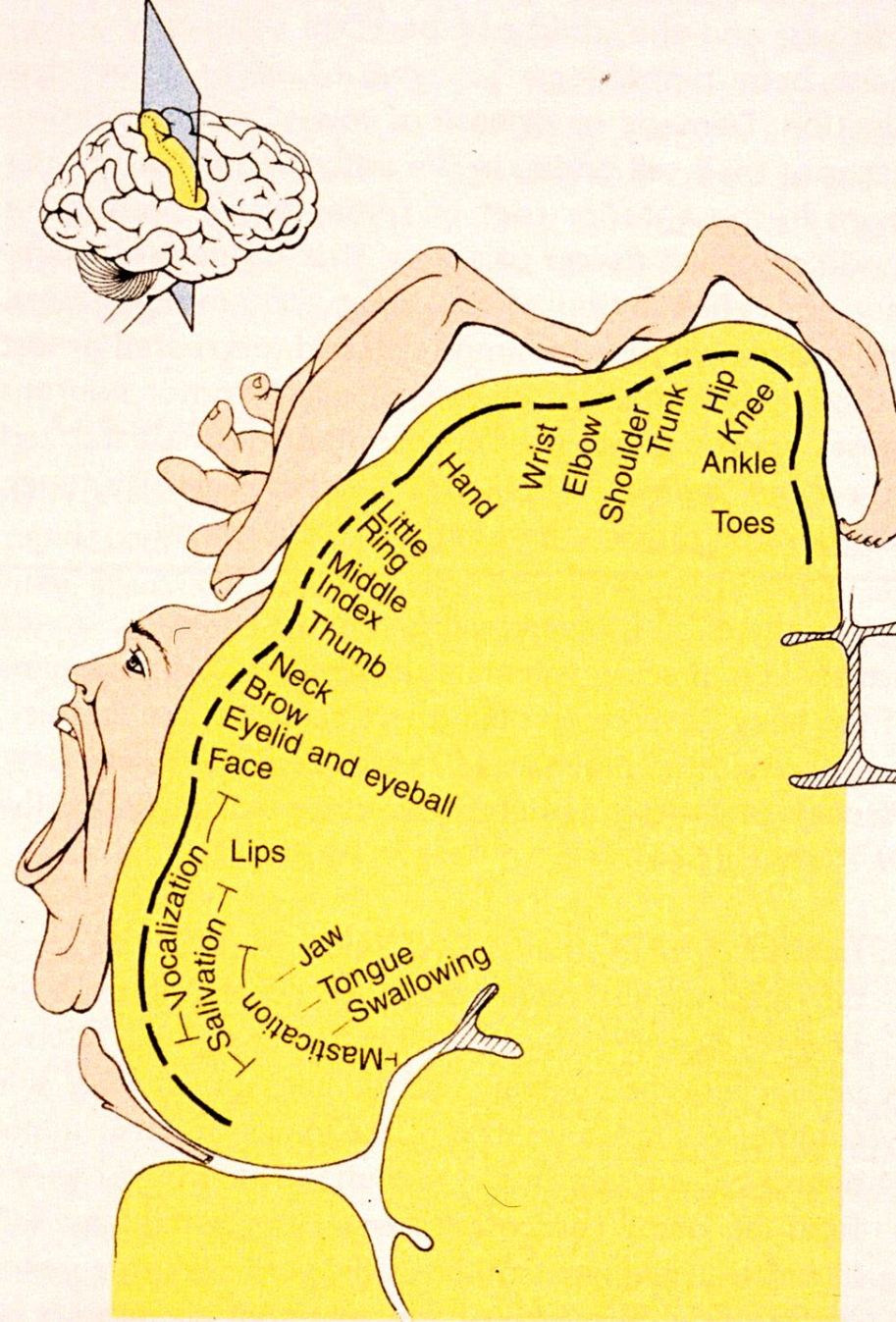
Anterior corticospinal tract 前皮質脊髓徑

Corticobulbar tract 皮質延腦徑

Indirect pathways: (Head and neck
automatic movements)



► Based on its name, what is the origin, destination, and position in the cord of the anterior corticospinal tract? Is this a sensory or a motor tract?

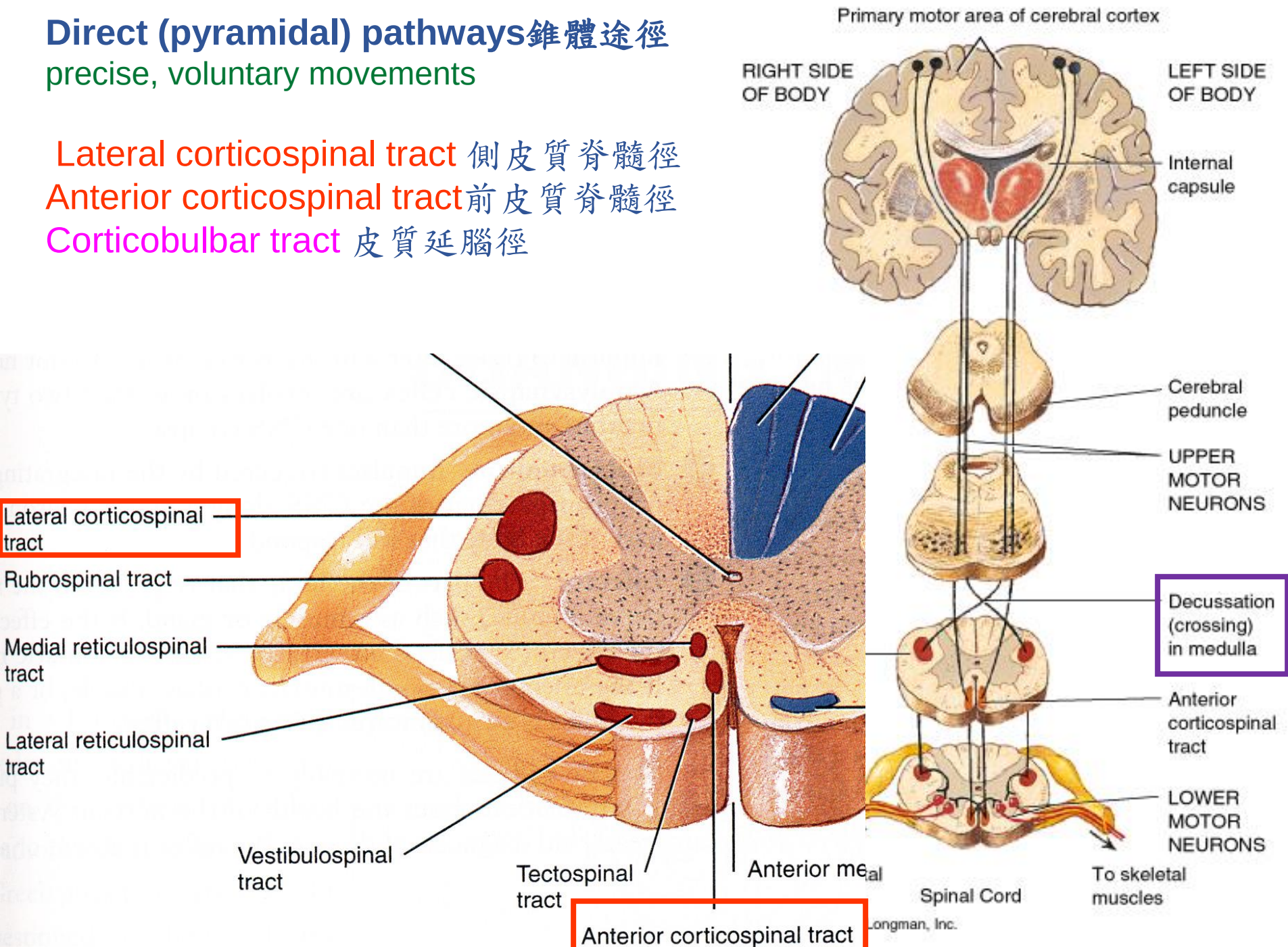


(b) Motor cortex in right cerebral hemisphere

Direct (pyramidal) pathways 錐體途徑

precise, voluntary movements

Lateral corticospinal tract 側皮質脊髓徑
Anterior corticospinal tract 前皮質脊髓徑
Corticobulbar tract 皮質延腦徑

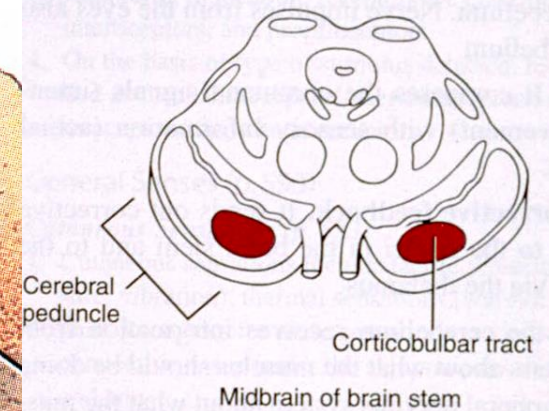
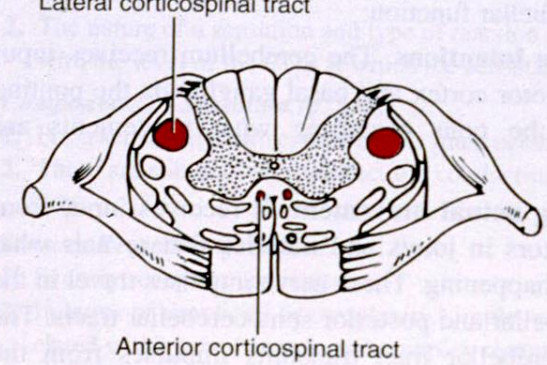
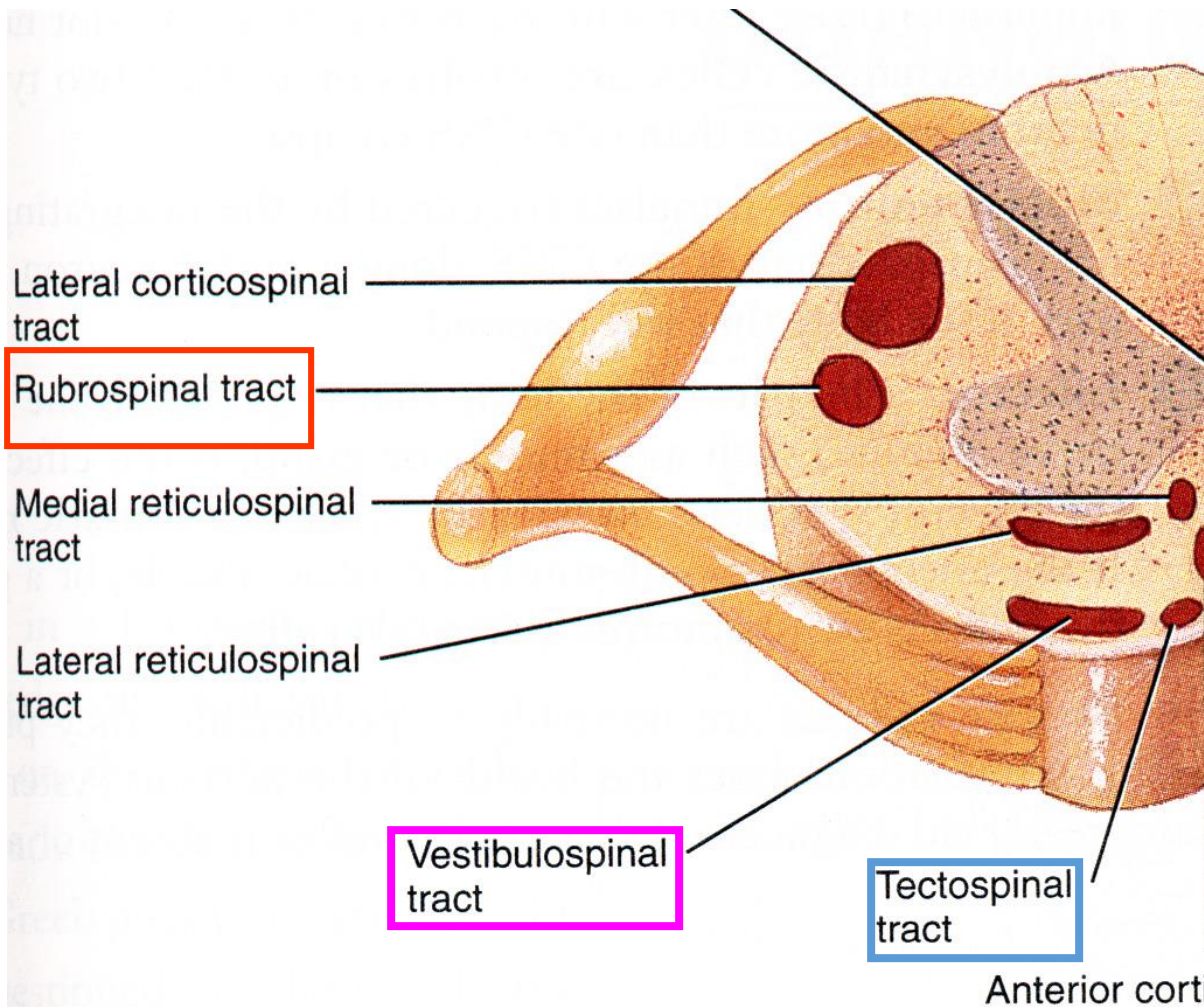


Indirect pathways: Head and neck automatic movements: programming automatic movements, posture & muscle tone, equilibrium & coordination of visual reflexes

Rubospinal tract 紅核脊髓徑

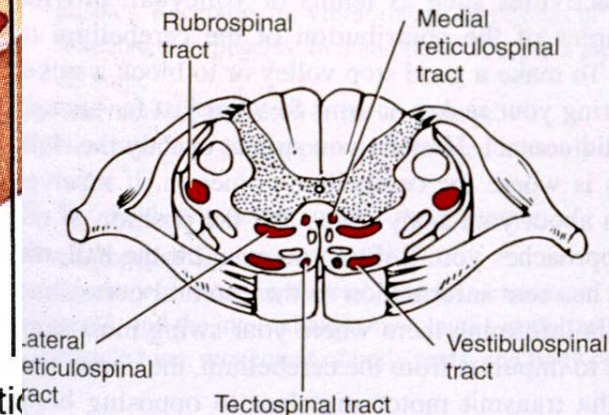
Tectospinal tract 四疊板(頂蓋)脊髓徑

Vestibulospinal tracts 前庭脊髓徑



Indirect Pathways

TRACT AND LOCATION

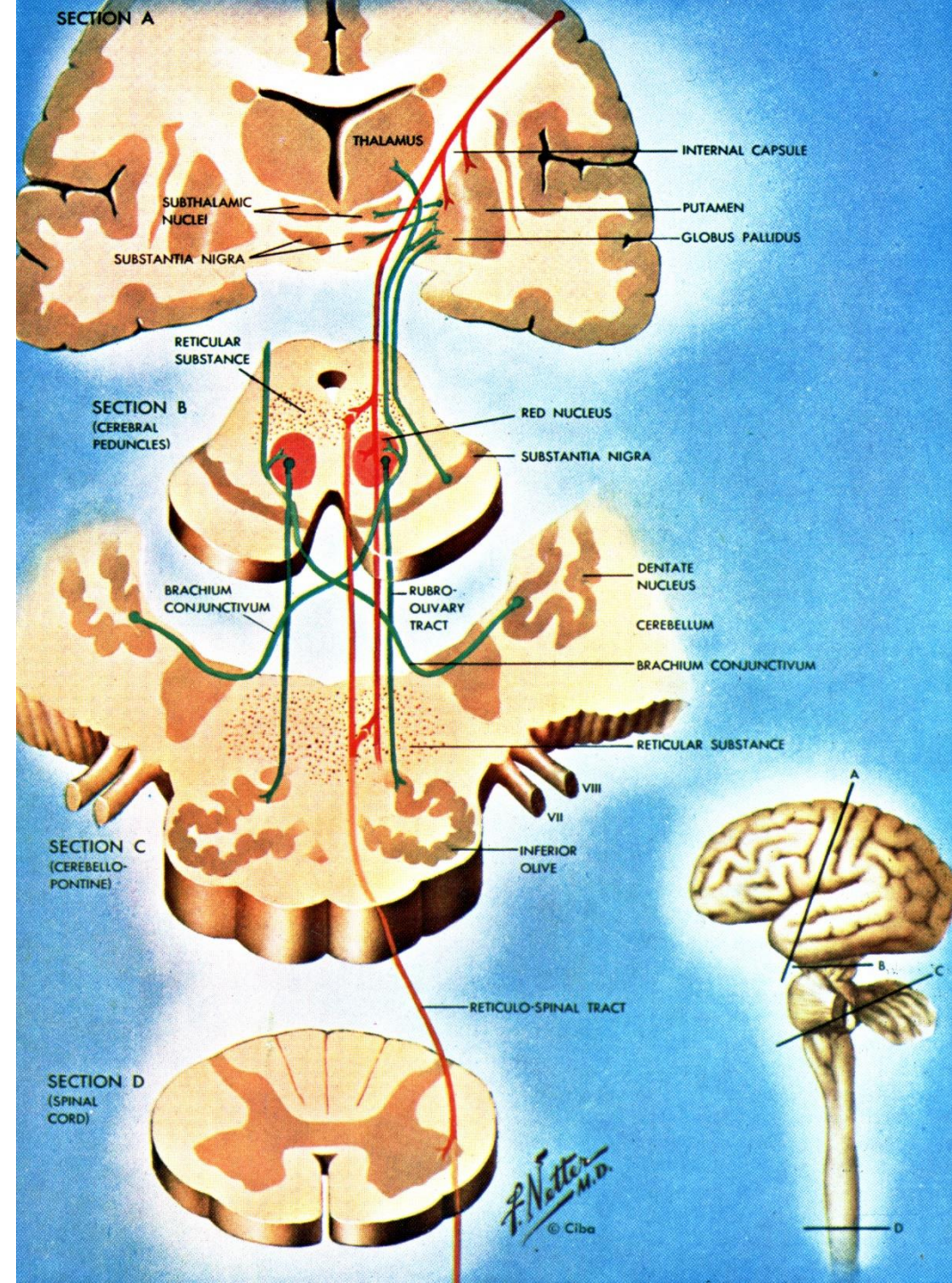


Indirect pathways: (Head and neck automatic movements)

Rubrospinal tract 紅核脊髓徑

Tectospinal tract 四疊板脊髓徑

Vestibulospinal tracts 前庭脊髓徑



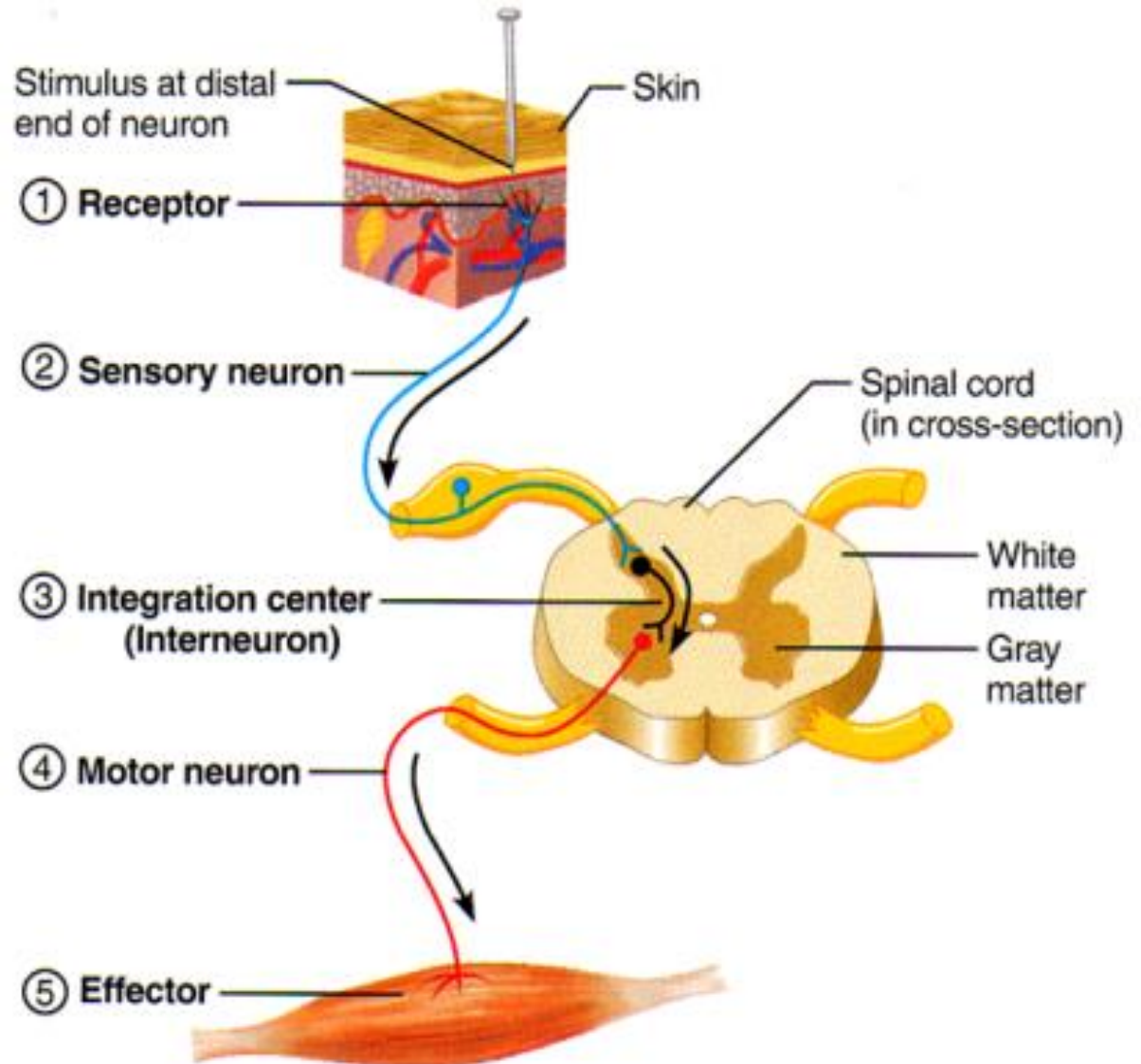
Spinal reflexes

- Automatic response to change in environment
- Integration center for spinal reflexes is gray matter of spinal cord
- Examples
 - somatic reflexes result in skeletal muscle contraction
 - autonomic (visceral) reflexes involve smooth & cardiac muscle and glands.
 - heart rate, respiration, digestion, urination, etc.
- Note: cranial reflexes involve cranial nerves

Spinal reflexes: Reflex Arc

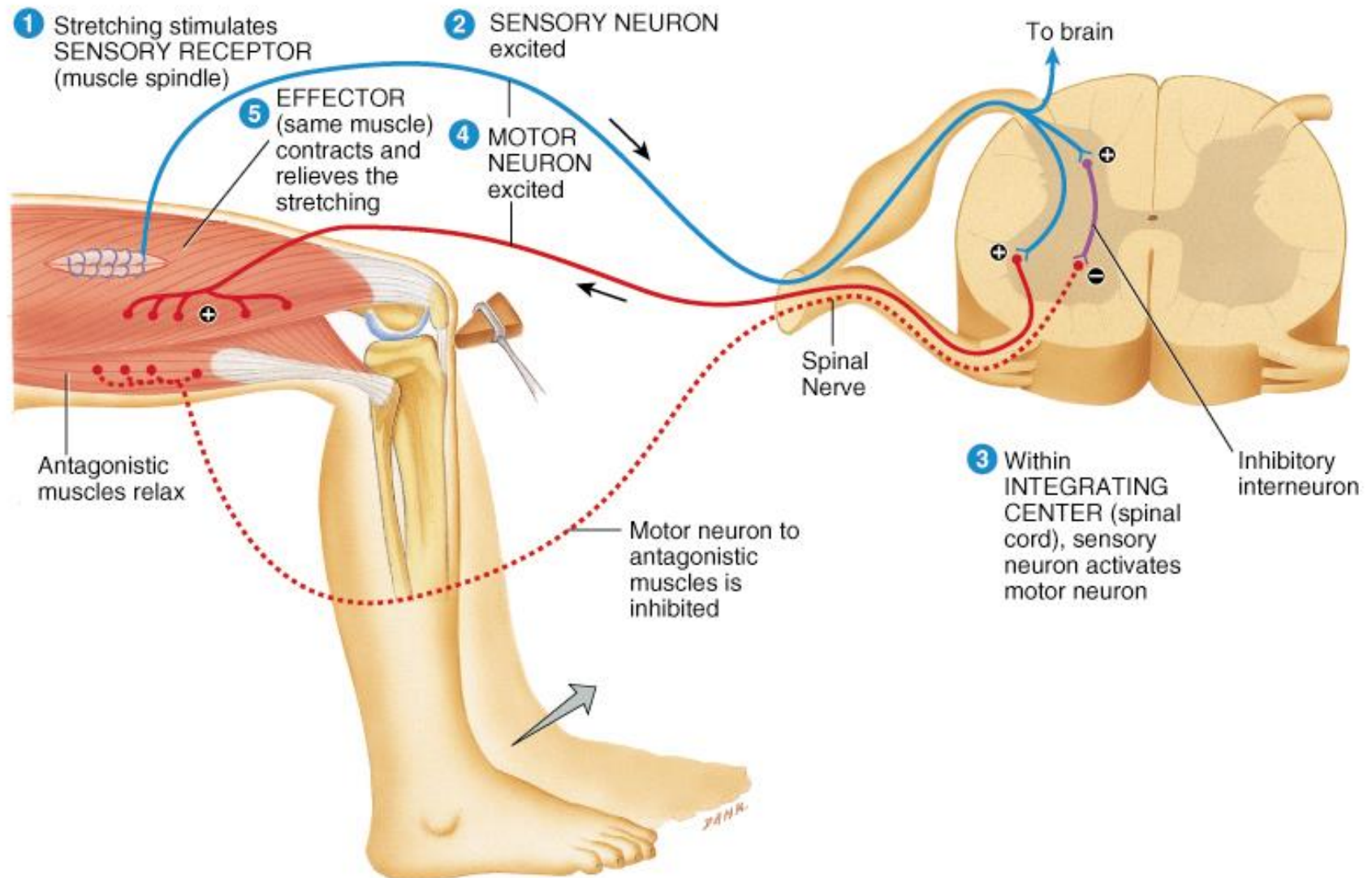
5 components of reflex arc

- **receptor**
- **sensory neuron**
- **integrating center**
- **motor neuron**
- **effector**



Spinal cord

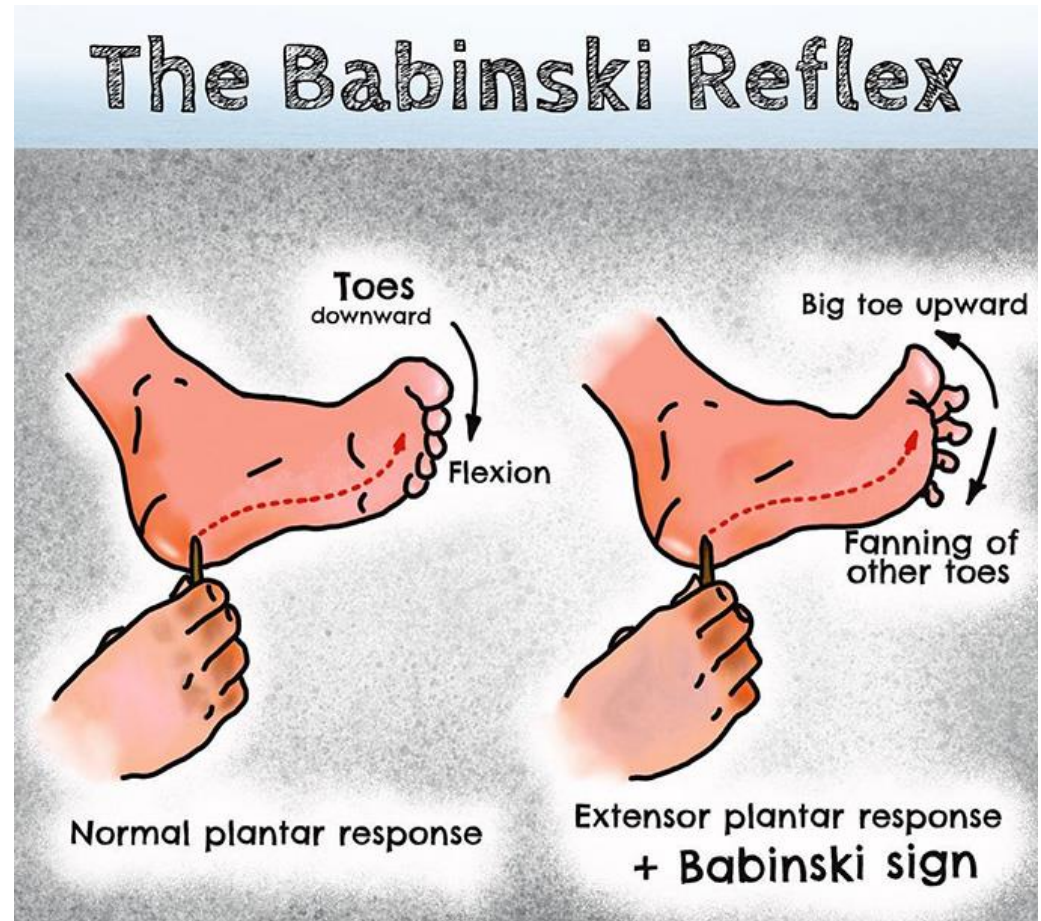
Illustration of the Stretch Reflex



Clinical Considerations : Checking a patient's reflexes may help to detect disorders/injury

Plantar flexion reflex –

- normal response is curling under the toes
- abnormal response or response of children under 18 months is called **Babinski sign** (upward fanning of toes due to incomplete myelination in child)

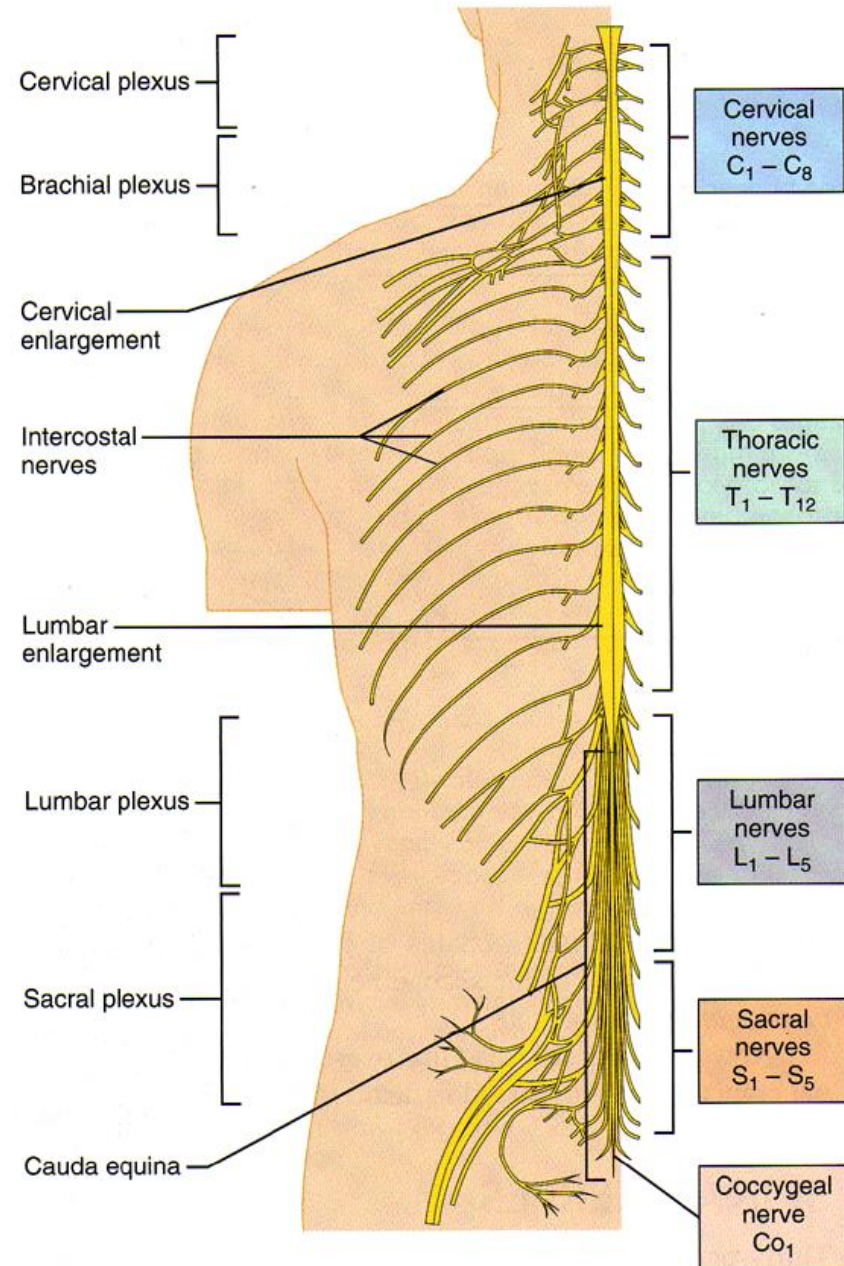


Spinal nerves

- Name and number of the spinal nerve
- Branching of the spinal nerve
- Nerve plexuses
 - Cervical plexus 頸神經叢
 - Brachial plexus 臂神經叢
 - Lumbar plexus 腰神經叢
 - Sacral plexus 薦神經叢

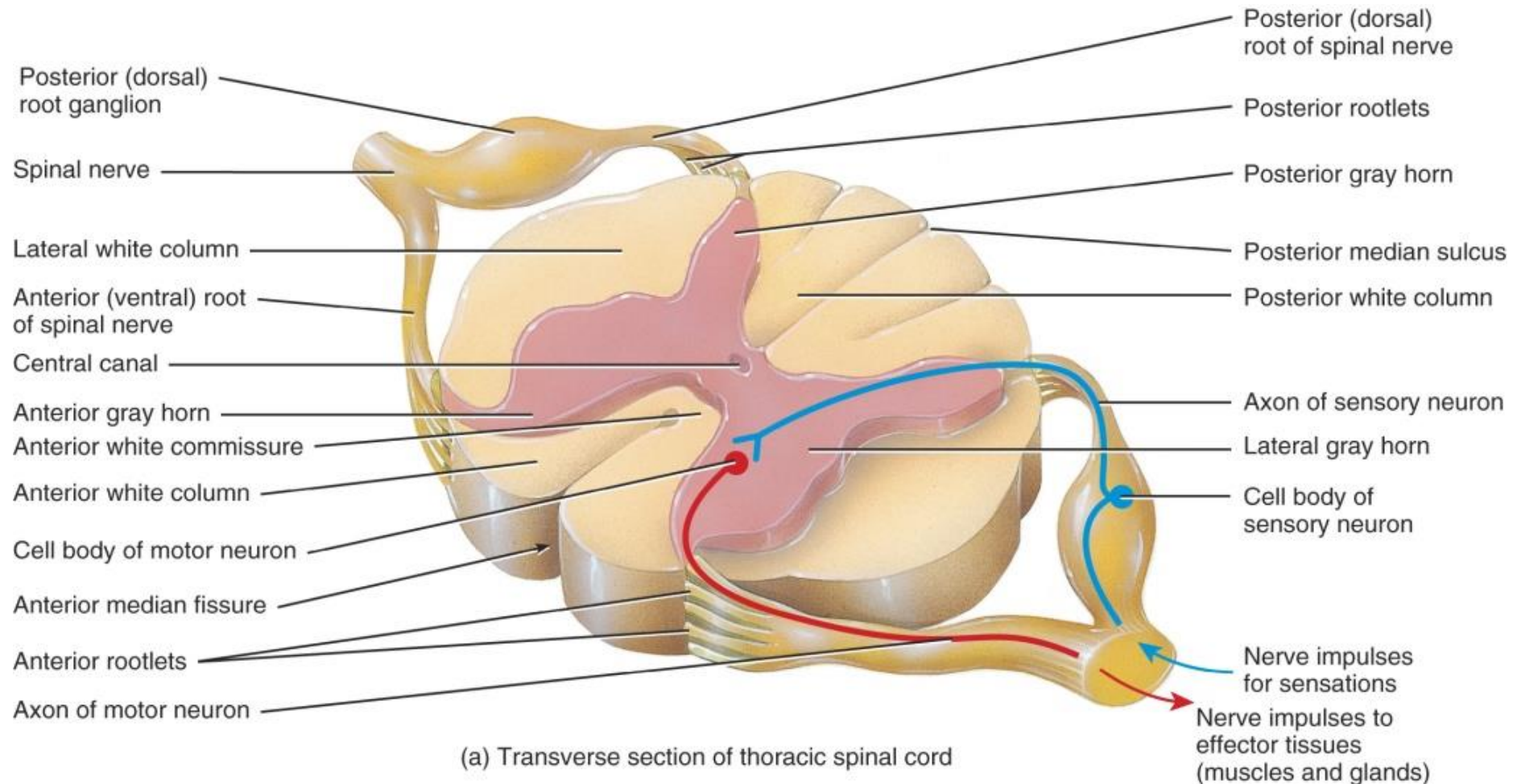
Name and number of the spinal nerve

- 31 Pairs of spinal nerves
- Named & numbered by the cord level of their origin
 - 8 pairs of cervical nerves (C1 to C8)
 - 12 pairs of thoracic nerves (T1 to T12)
 - 5 pairs of lumbar nerves (L1 to L5)
 - 5 pairs of sacral nerves (S1 to S5)
 - 1 pair of coccygeal nerves
- Mixed sensory & motor nerves



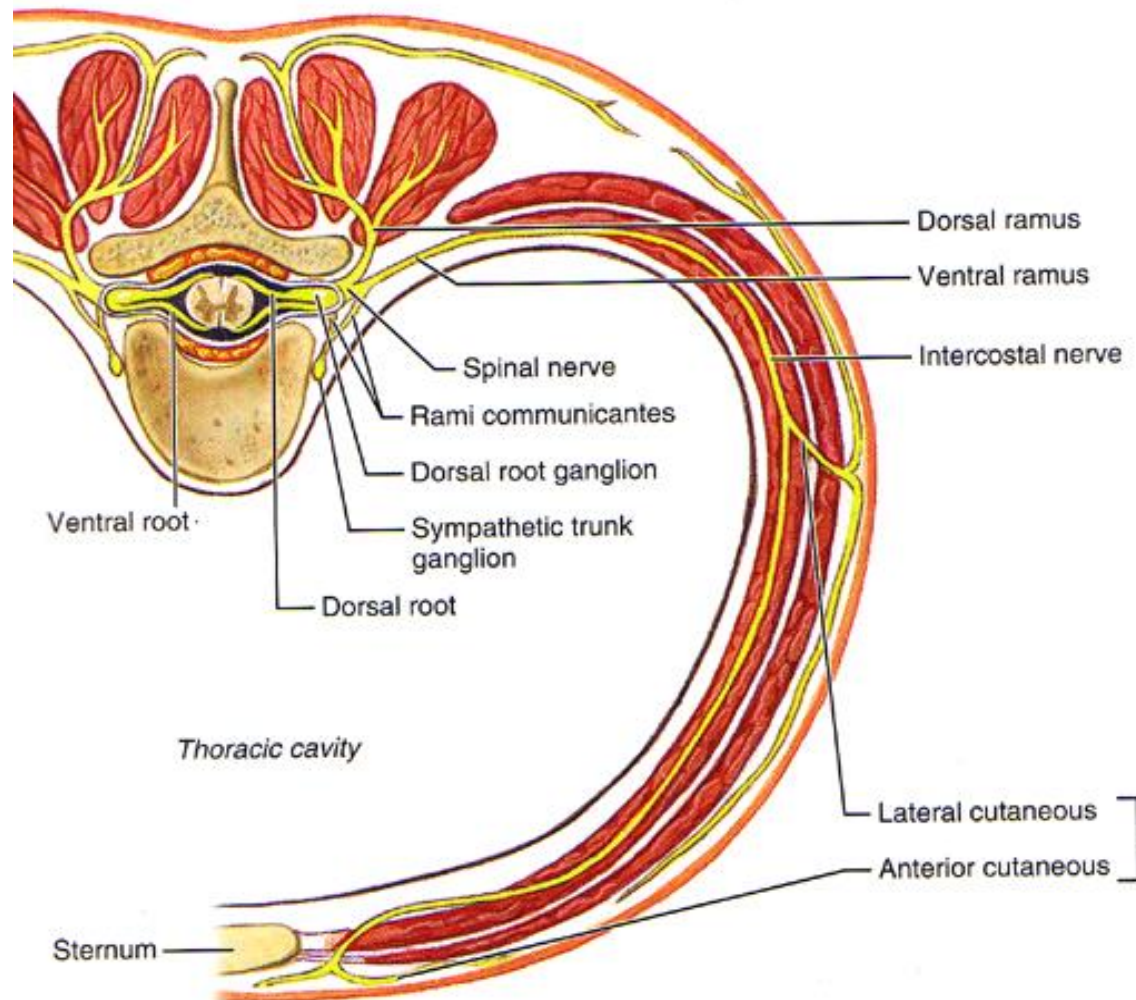
Spinal nerve

- Spinal nerves begin as roots
- Dorsal or posterior root is incoming sensory fibers
 - dorsal root ganglion (swelling) = cell bodies of sensory nerves
- Ventral or anterior root is outgoing motor fibers



Branching of the spinal nerve

- Spinal nerves branch into dorsal & ventral rami
 - dorsal rami supply skin & muscles of back
 - ventral rami form plexus supply anterior trunk & limbs
 - meningeal branches supply meninges, vertebrae & BV

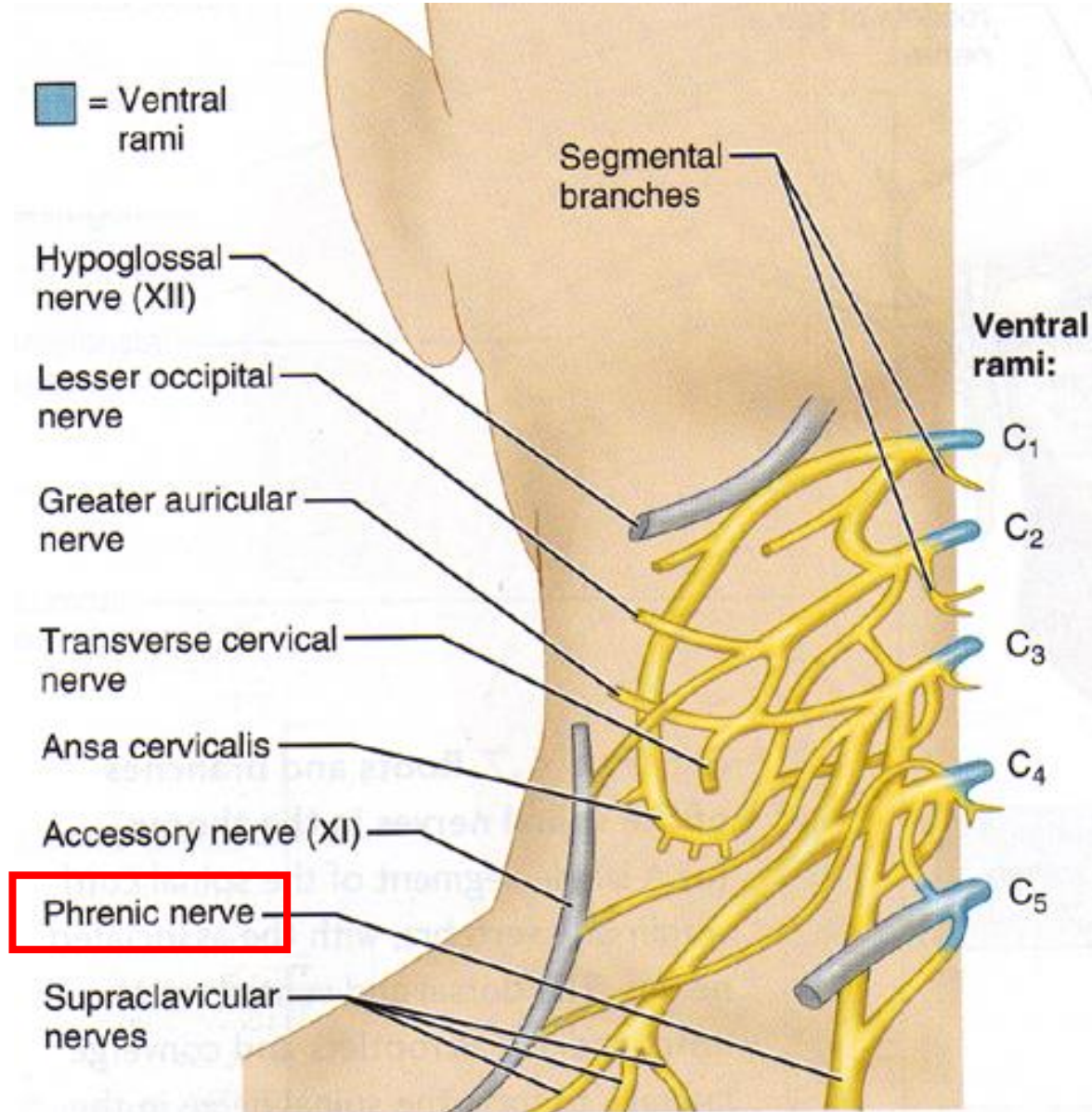


Nerve plexuses 神經叢

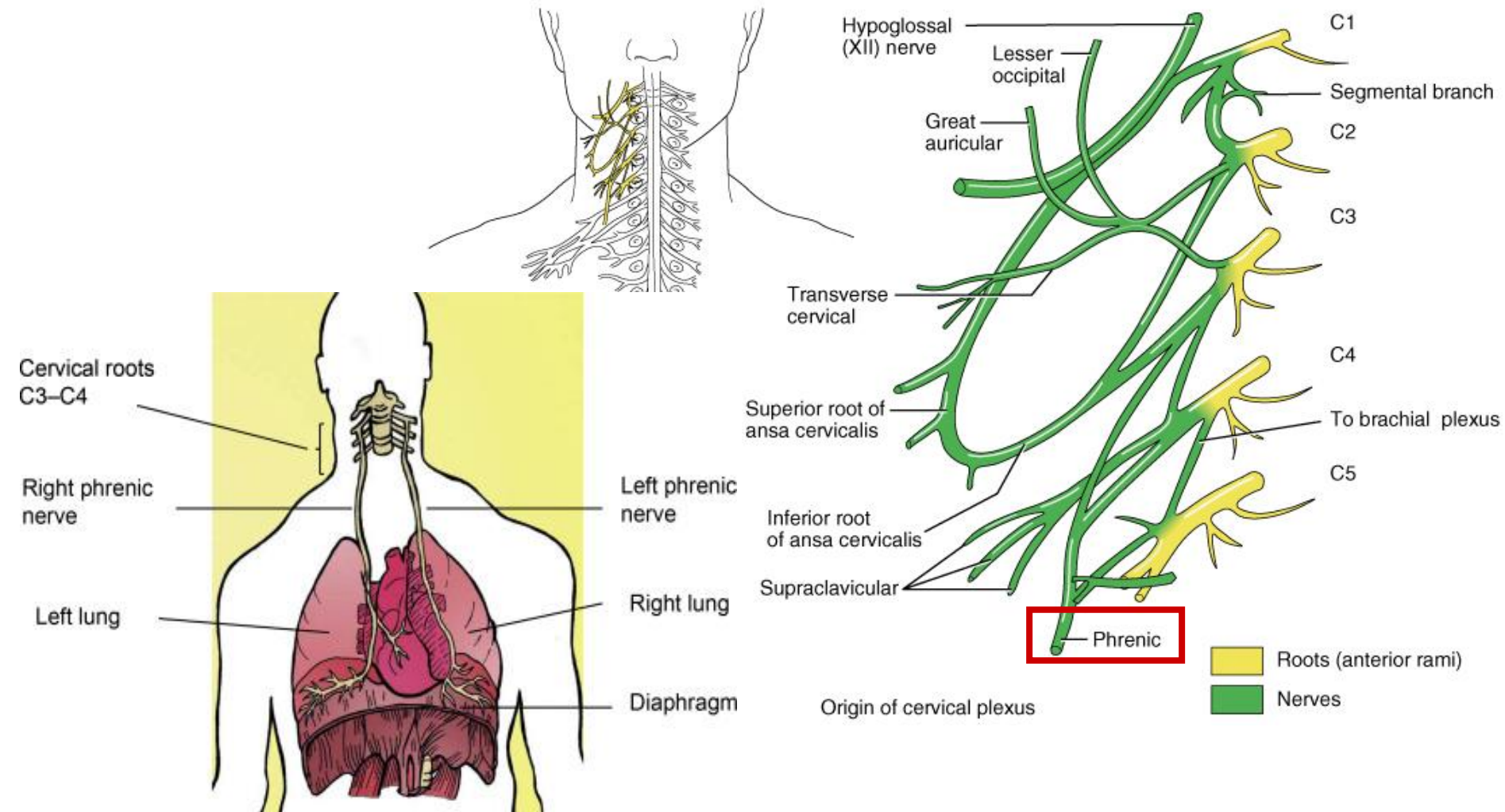
- Joining of ventral rami of spinal nerves to form nerve networks or plexuses
- Found in neck, arm, low back & sacral regions
 - **Cervical plexus** 頸神經叢
 - **Brachial plexus** 臂神經叢
 - **Lumbar plexus** 腰神經叢
 - **Sacral plexus** 薦神經叢
- No plexus in thoracic region
 - intercostal nerves innervate intercostal spaces
 - T7 to T12 also supply abdominal wall

Cervical plexus

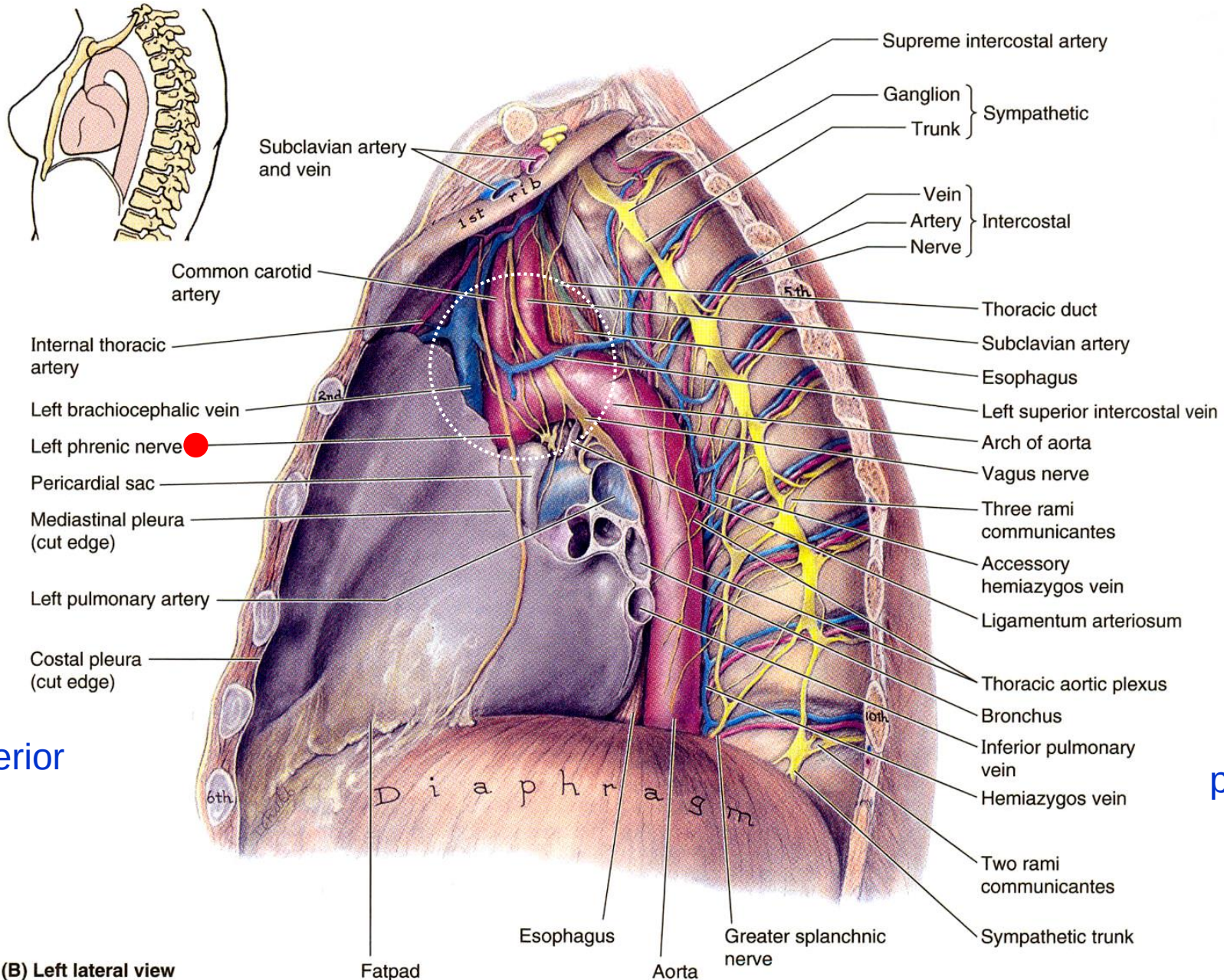
- Ventral rami of spinal nerves (C1 to C5)
- Supplies parts of head, neck & shoulders
- **Phrenic nerve** 膈神經 (C3-C5) keeps diaphragm alive
- Damage to cord above C3 causes respiratory arrest



Phrenic Nerve 膈神經



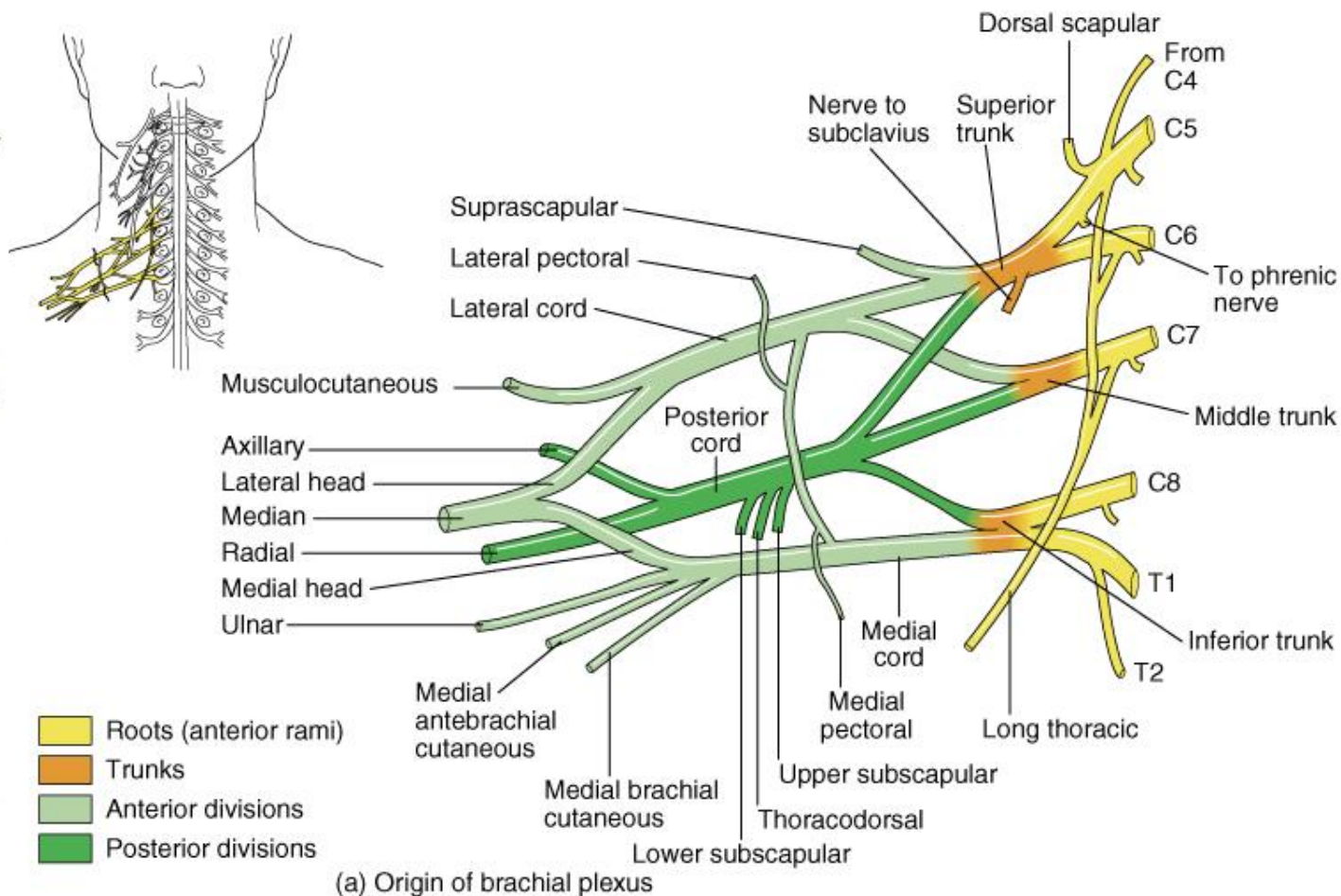
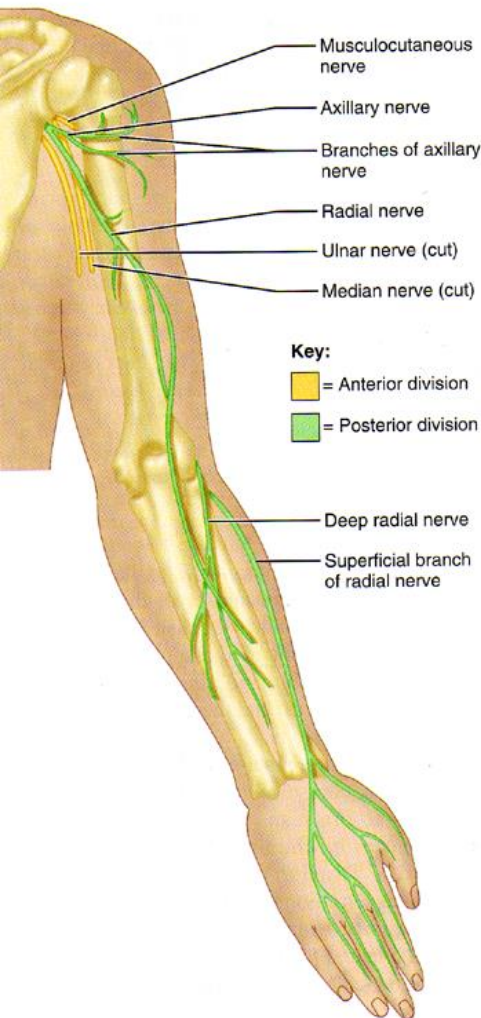
Left phrenic nerves



(B) Left lateral view

Brachial plexus

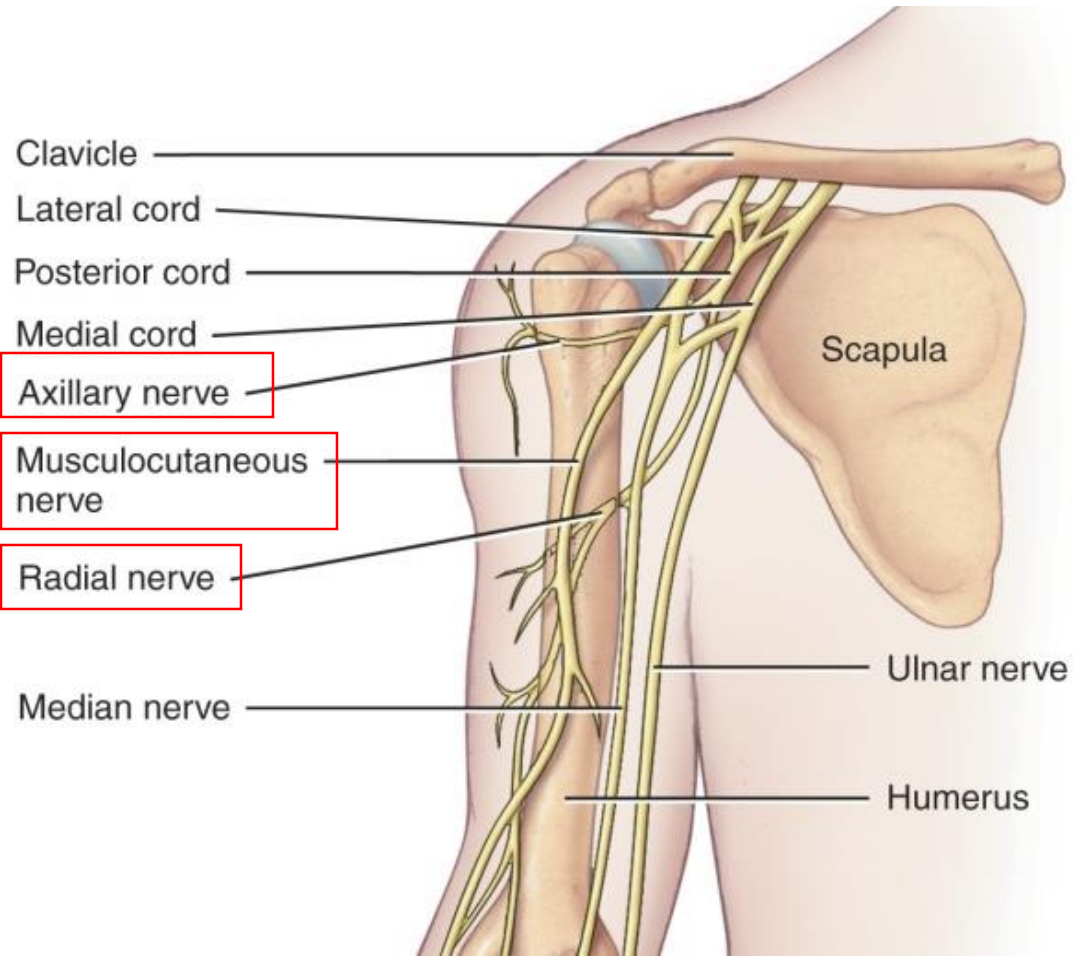
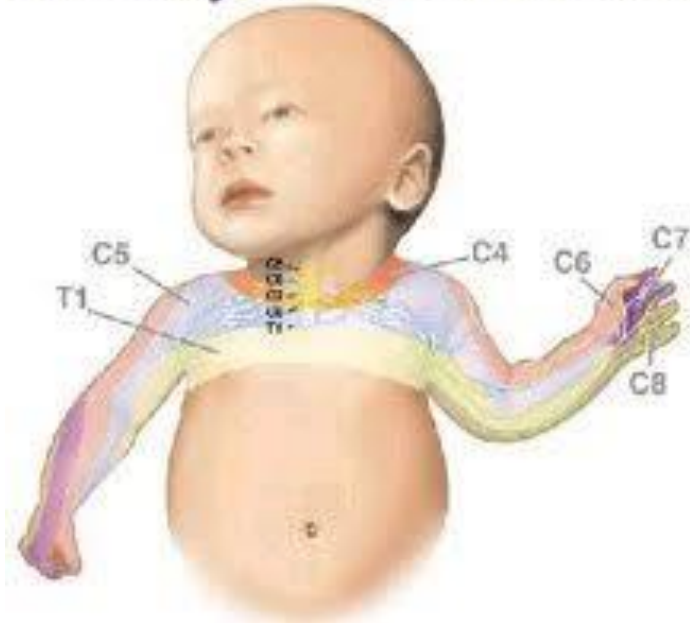
Ventral rami from C5 to T1
Supplies shoulder & upper limb



Brachial plexus: Passes superior to 1st rib & under clavicle

- Axillary nerve: deltoid & teres m.
- Musculocutaneous nerve: elbow flexors
- Radial nerve: shoulder, elbow extensors & extensor muscles of hand

Anatomy of Brachial Plexus



Brachial plexus 臂神經叢

Median nerve 正中神經 C5-T1:

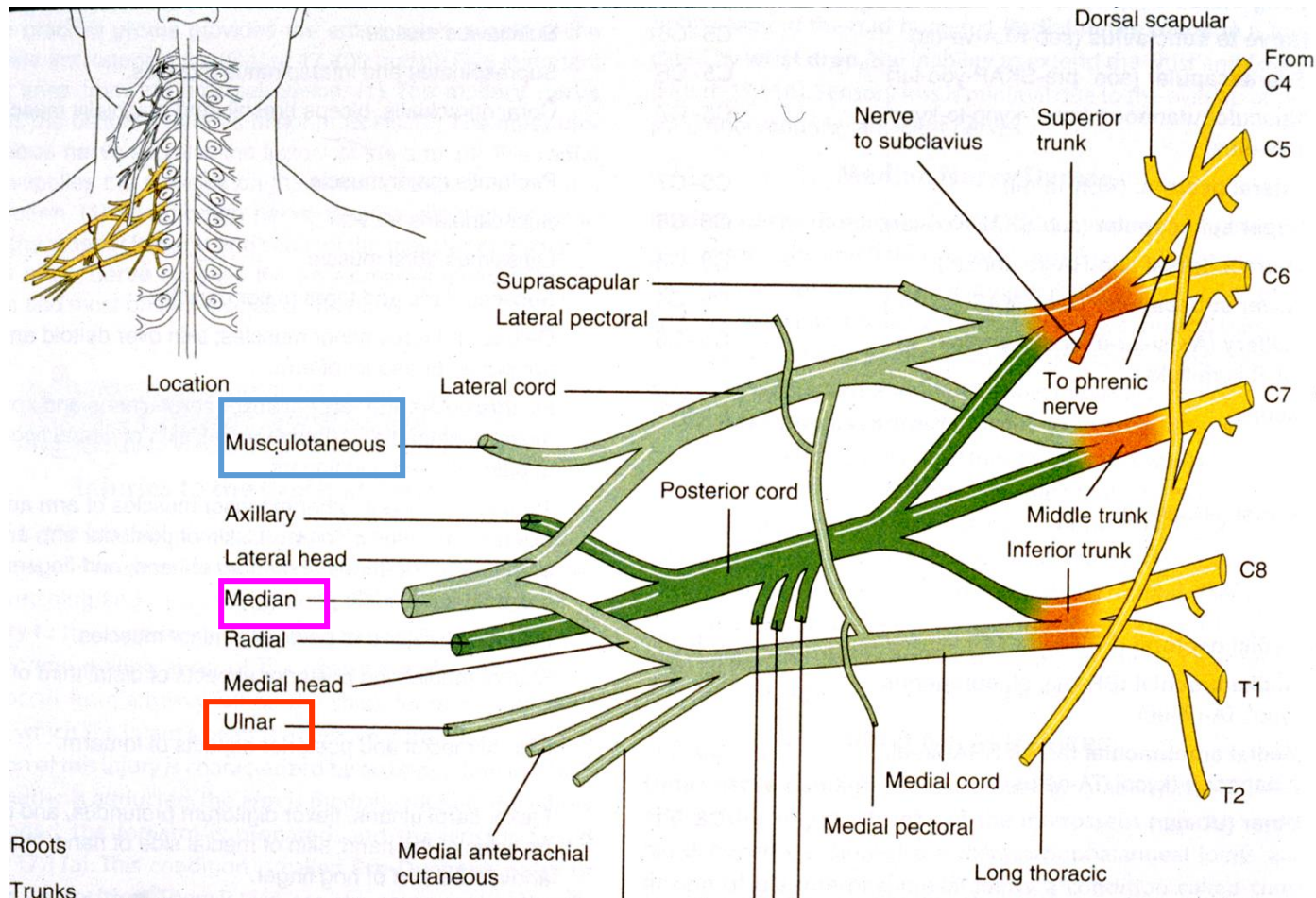
Flexors of forearm; skin of lateral 2/3 of palm of hand

Ulnar nerve 尺神經 C8- T1:

muscles of the hand; skin of little finger and 1/2 ring finger

Musculocutaneous nerve 肌皮神經 C5-C7:

Biceps brachii & brachialis muscles



Brachial plexus 臂神經叢

Median nerve 正中神經 C5-T1:

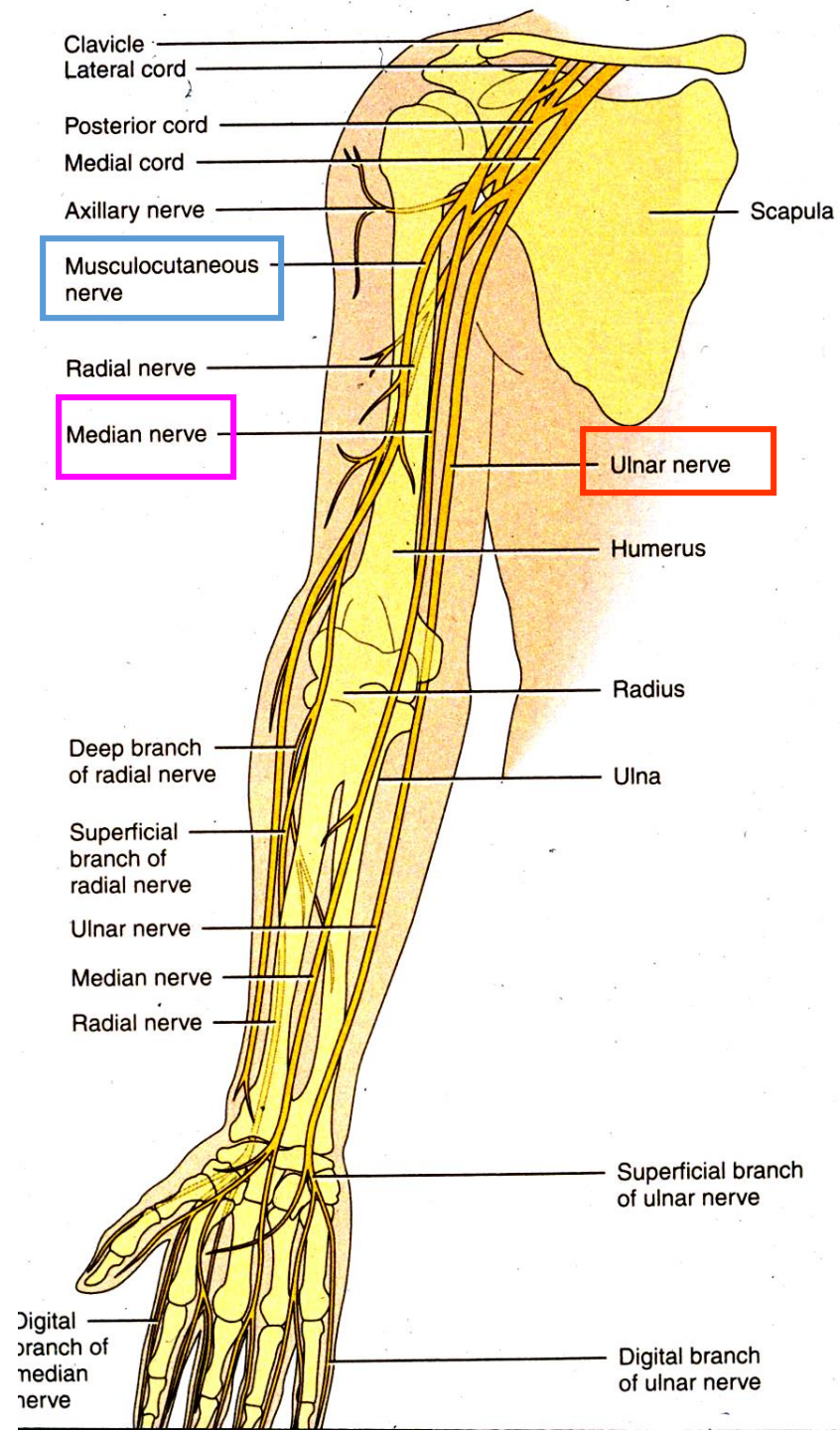
Flexors of forearm; skin of lateral 2/3 of palm of hand

Ulnar nerve 尺神經 C8- T1:

muscles of the hand; skin of little finger and 1/2 ring finger

Musculocutaneous nerve 肌皮神經 C5-C7:

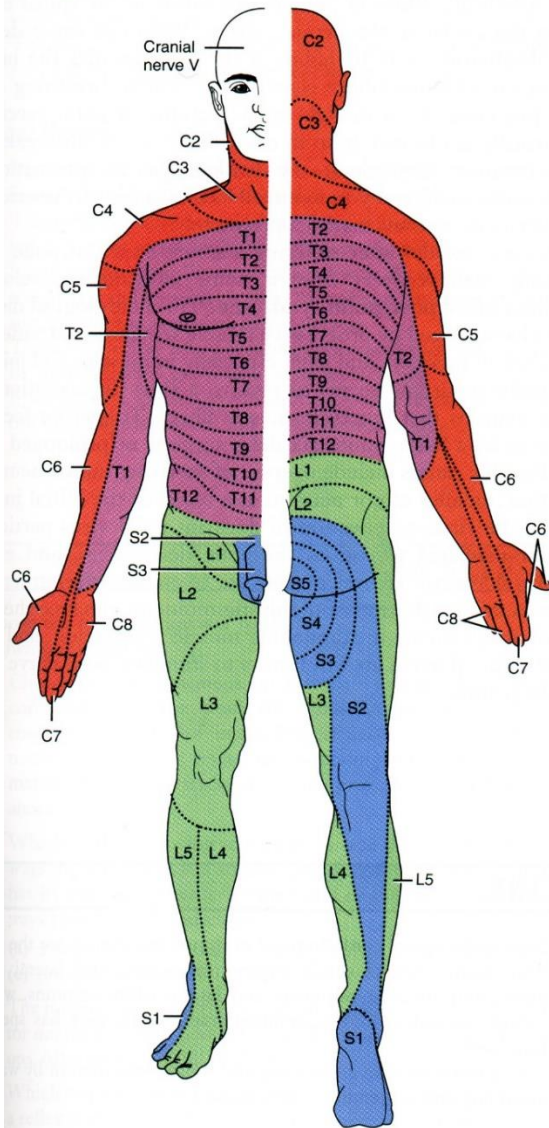
Biceps brachii & brachialis muscles



Intercostal nerves

T1-T11 肋間神經

T12 Subcostal nerve



(a) Anterior view

(b) Posterior view

CERVICAL PLEXUS (C1-C5):

Lesser occipital nerve
Ansa cervicalis
Transverse cervical nerve
Supraclavicular nerve
Phrenic nerve

BRACHIAL PLEXUS (C5-T1):

Musculocutaneous nerve
Axillary nerve
Median nerve
Radial nerve
Ulnar nerve

Intercostal (thoracic) nerves

Subcostal nerve
(intercostal nerve 12)

LUMBAR PLEXUS (L1-L4):

Iliohypogastric nerve
Ilioinguinal nerve
Genitofemoral nerve
Lateral femoral cutaneous nerve
Femoral nerve
Obturator nerve

SACRAL PLEXUS (L4-S4):

Superior gluteal nerve
Inferior gluteal nerve
Sciatic nerve:
Common peroneal nerve
Tibial nerve
Posterior femoral cutaneous nerve
Pudendal nerve

Medulla oblongata

Atlas (first cervical vertebra)

CERVICAL NERVES (8 pairs)

Cervical enlargement

First thoracic vertebra

THORACIC NERVES (12 pairs)

Lumbar enlargement

First lumbar vertebra

Conus medullaris

LUMBAR NERVES (5 pairs)

Cauda equina

Ilium

Sacrum

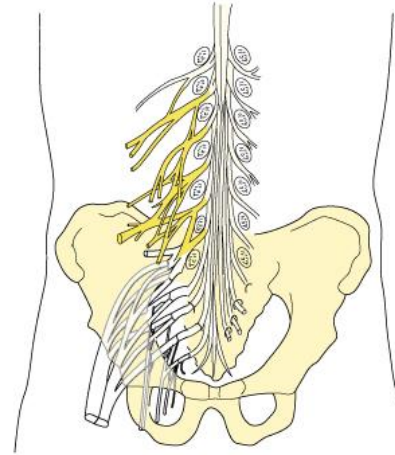
SACRAL NERVES (5 pairs)

COCCYGEAL NERVES (1 pair)

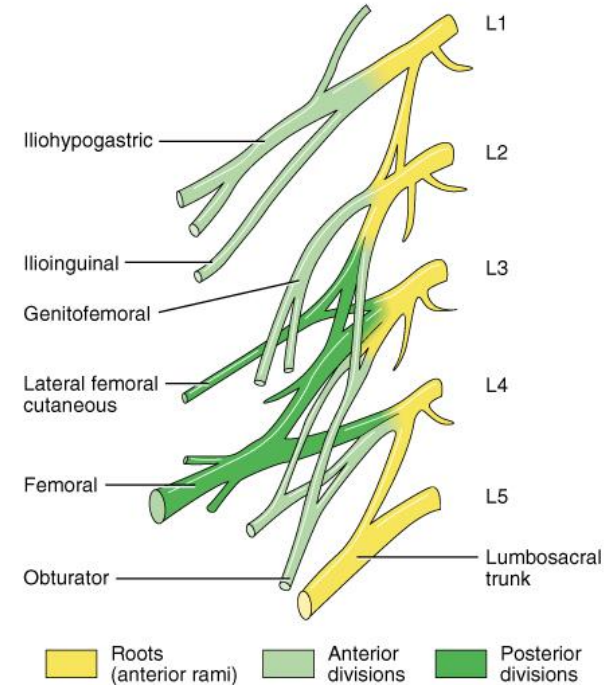
Filum terminale

Lumbar plexus 腰神經叢

- Ventral rami of L1 - L4
- Supplies abdominal wall, external genitals & anterior/medial thigh



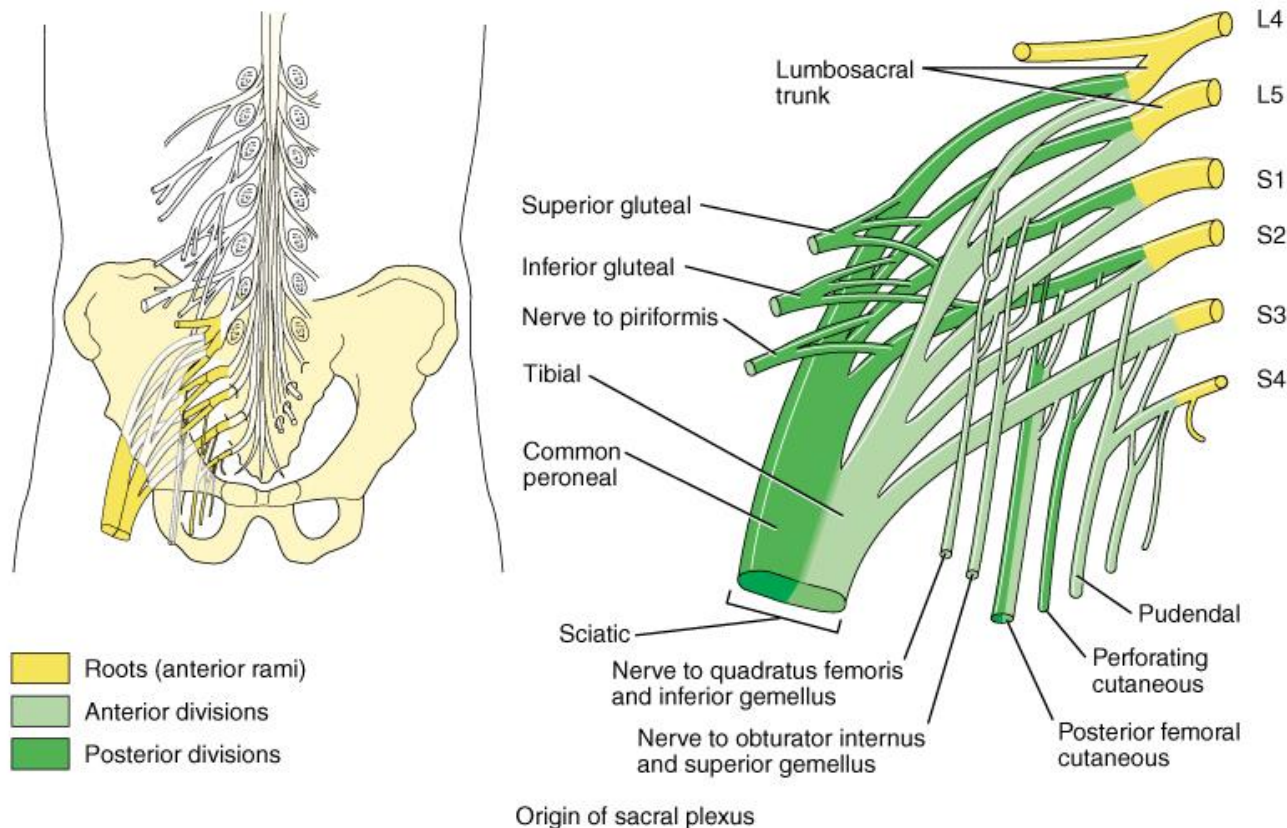
(a) Origin of lumbar plexus



- Injury to **femoral nerve (L2-L4)** causes inability to extend leg & loss of sensation in thigh
- Injury to **obturator nerve (L2-L4)** causes paralysis of thigh adductors

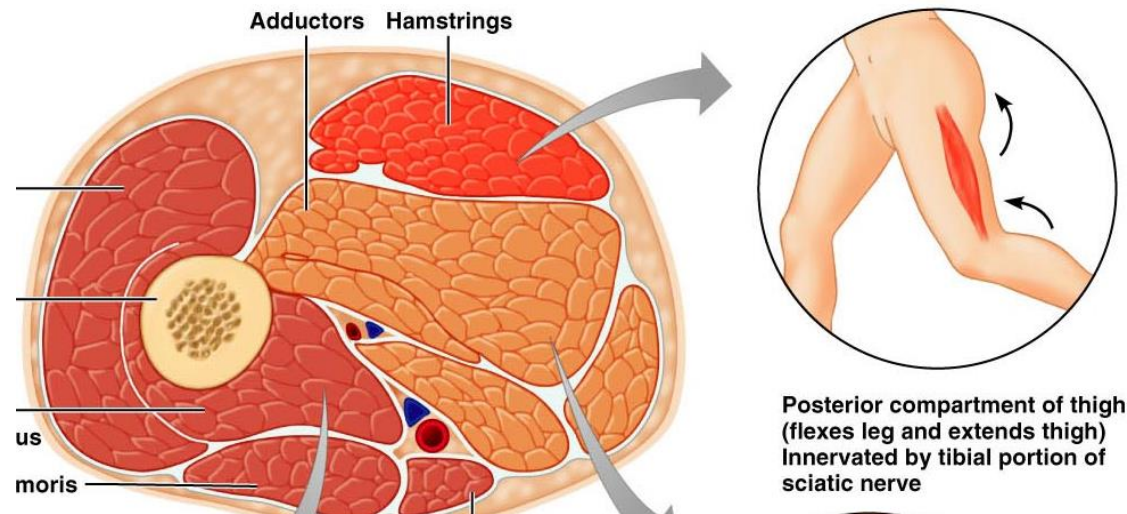
Sacral plexus 薦神經叢

- Ventral rami of L4-L5 & S1-S4
- Anterior to the sacrum
- Supplies buttocks, perineum & part of lower limb

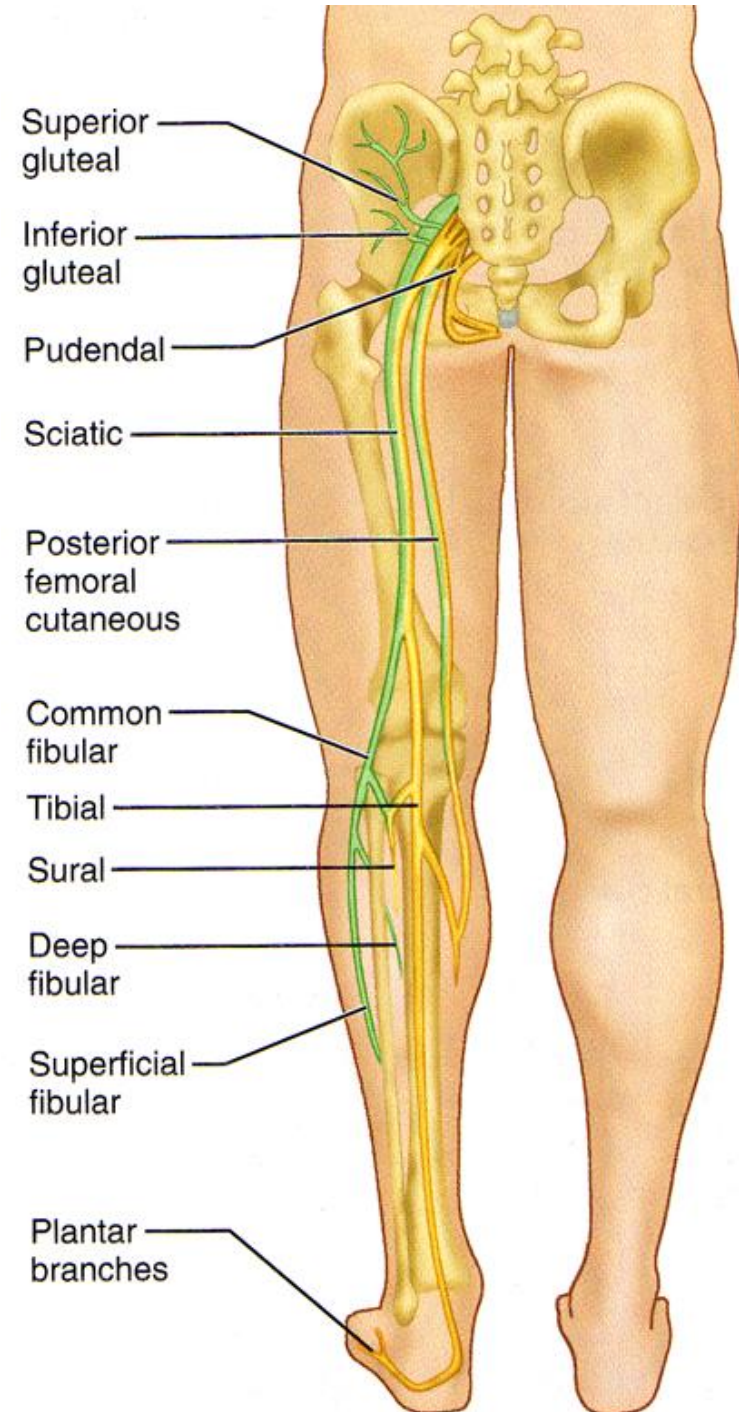


Sciatic Nerve Branches

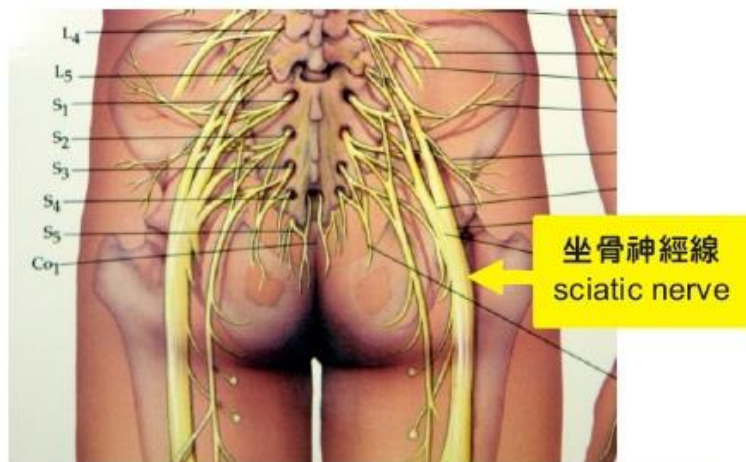
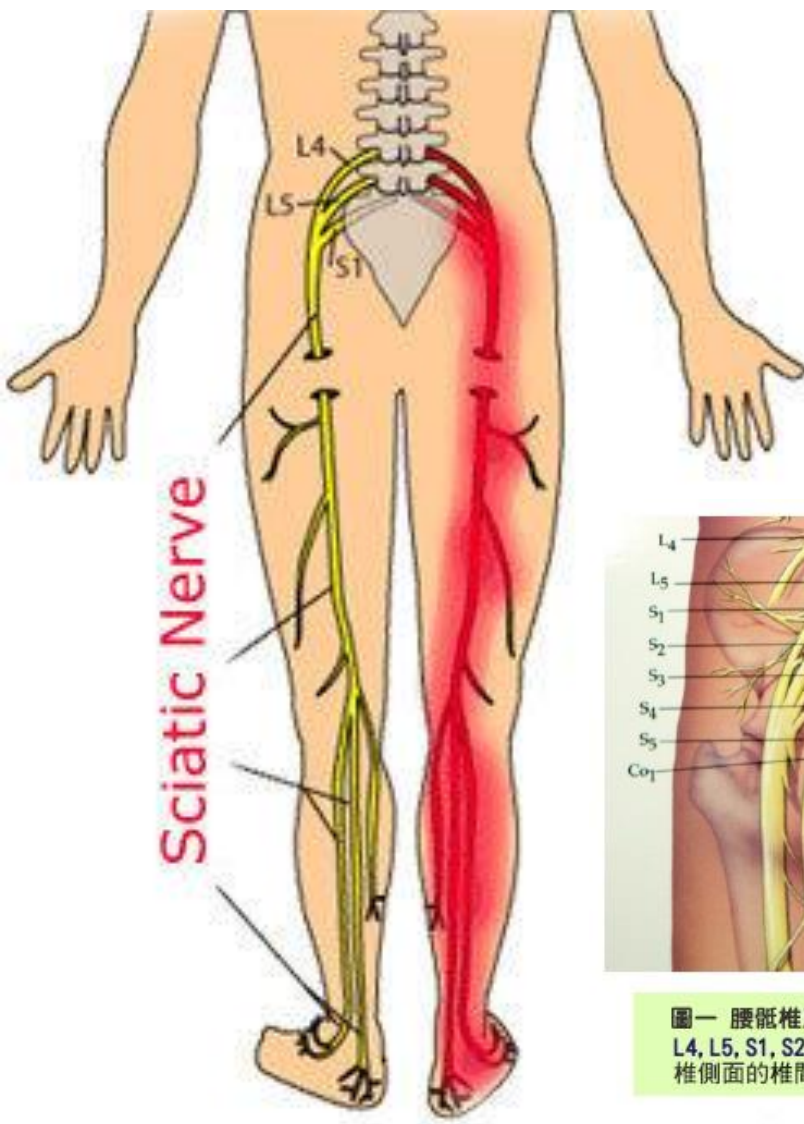
- **Sciatic nerve** = L4 to S3 supplies post thigh



- Behind the knee
 - **Tibial nerve**. 脛神經
 - **Common Peroneal (Fibular) nerve** 腓總神經



坐骨神經痛 指的就是一種順著坐骨神經走向傳導而下的痛，通常由臀部沿大腿後部而下，有時會傳到小腿。坐骨神經痛只是一種症狀，而可能引起坐骨神經痛的原因也有許多種，唯有找出病因才能對症下藥。

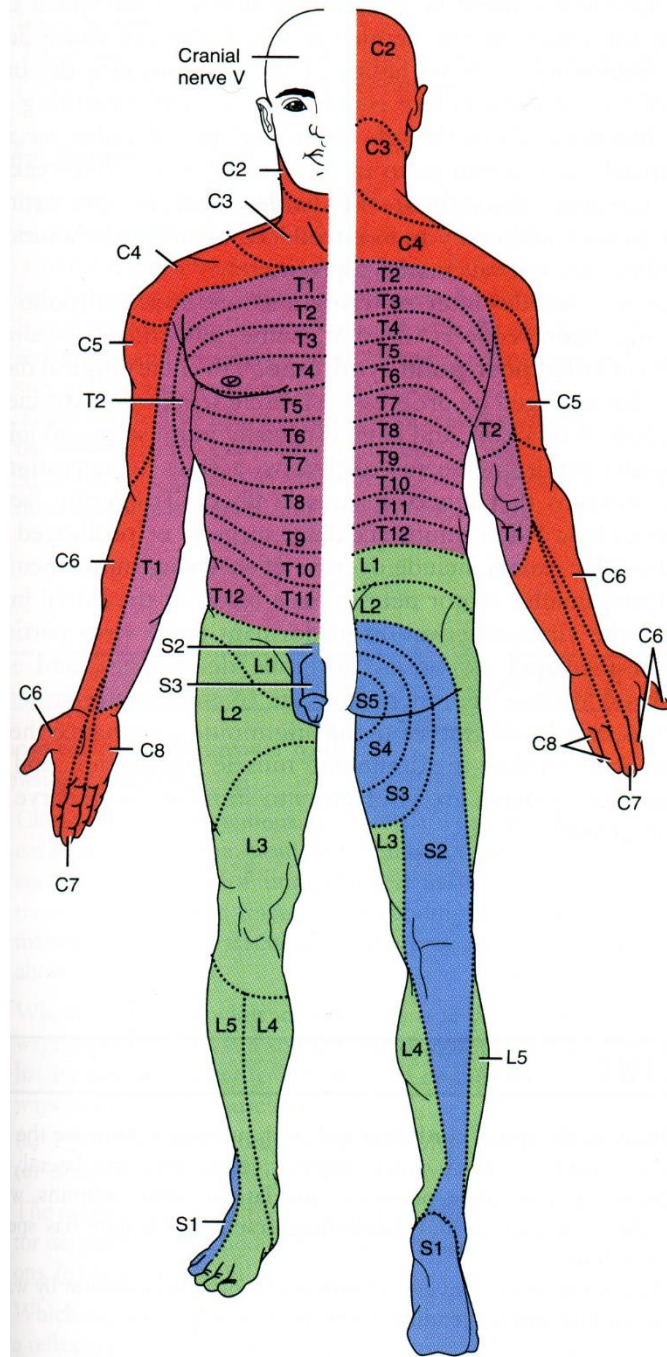
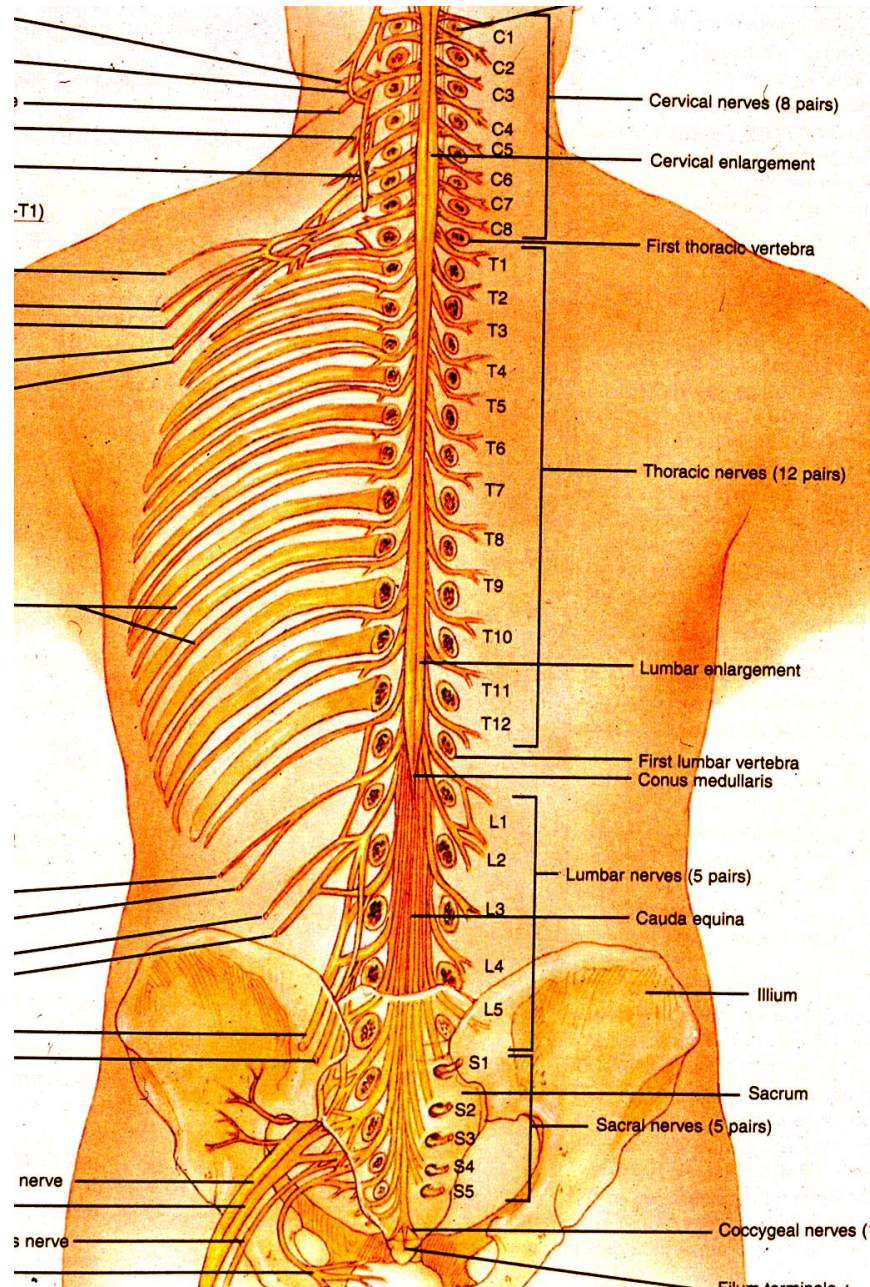


圖一 腰骶椎及坐骨神經線結構簡圖：

L4, L5, S1, S2, S3 神經根從脊髓(spinal cord)從腰椎及骶椎側面的椎間孔走出，匯合成坐骨神經線，延伸是至下肢



Dermatomes 皮節



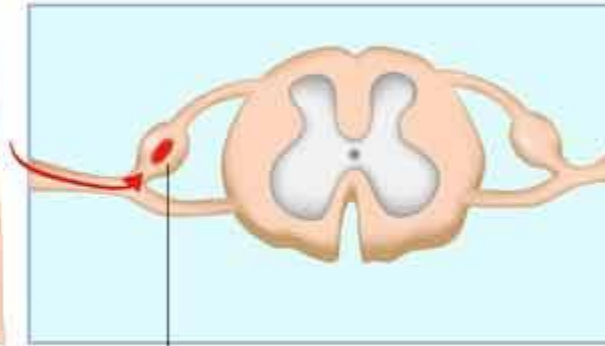
(a) Anterior view

(b) Posterior view

Herpesvirus varicella-zoster

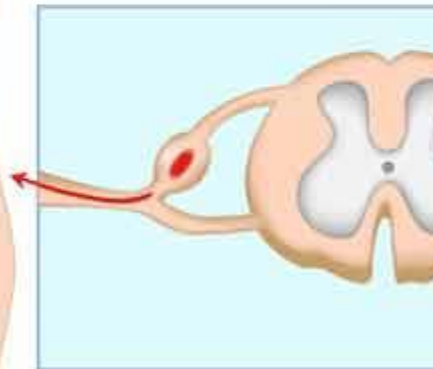
帶狀疱疹

Initial infection with the virus, usually during childhood, causes **chickenpox**. The virus then moves to a dorsal root ganglion, where it remains latent indefinitely

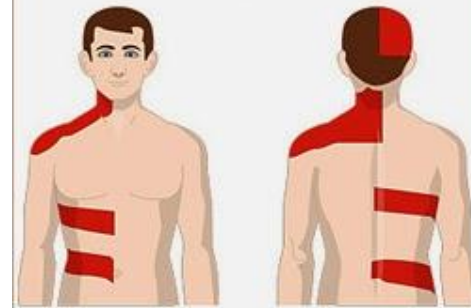


Dorsal root ganglion

Later, usually in adulthood, immune system depression or stress can trigger a reactivation of the virus, causing **shingles**.



Common sites of shingles



Front

Back



Zoster

ADAM

