لجان الدُّفعات

ANATOMY

MORPHINE ACADEMY

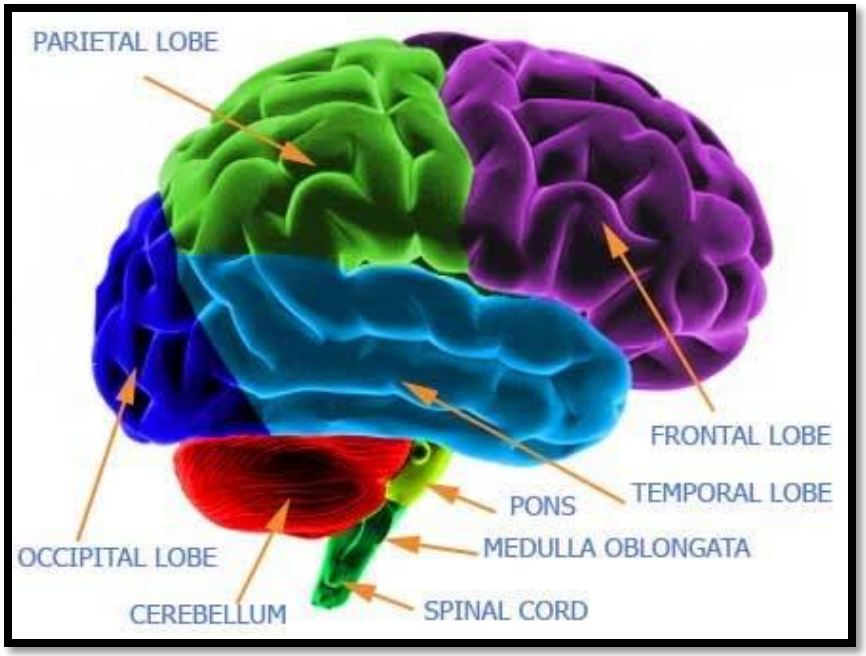
MORPHINE
ACADEMY

The Nervous System

السلام عليكم ورحمة الله وبركاته

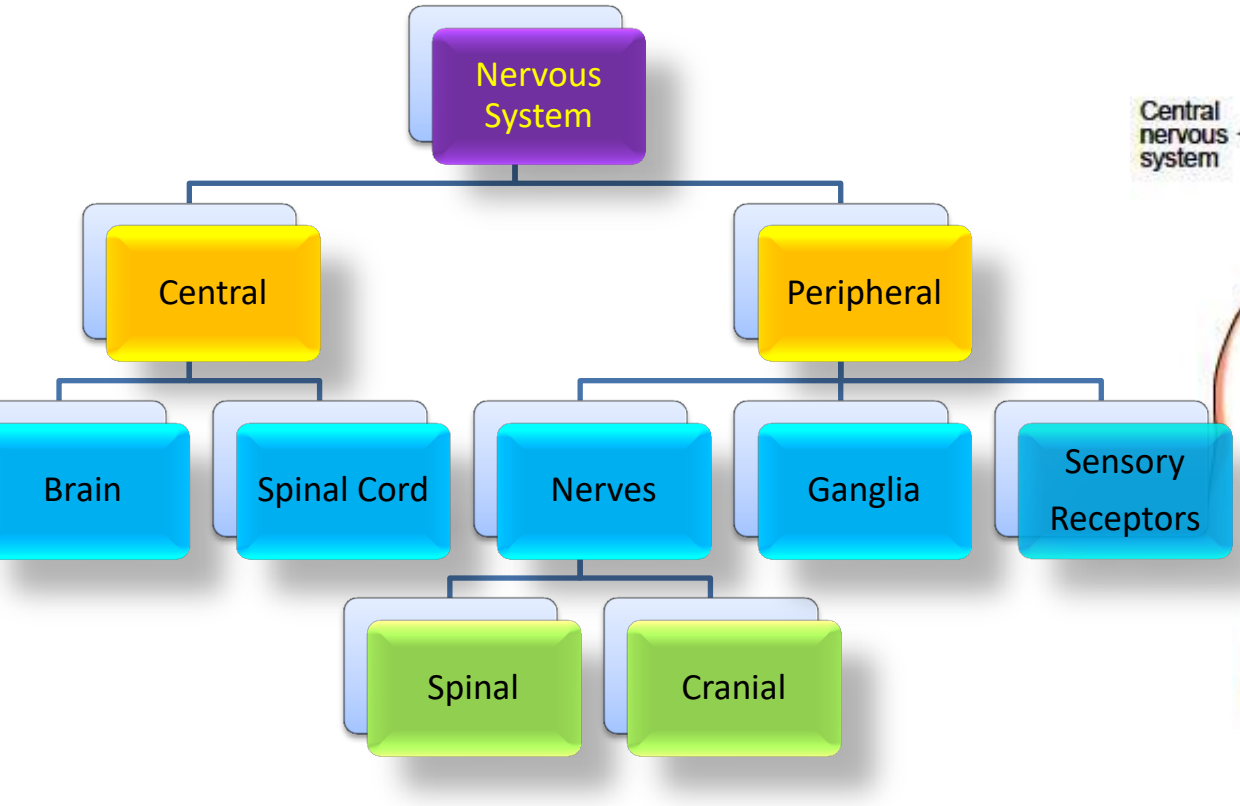
عشان تكونوا فاهمين هاد اللكتشر كويس،نصيحة روحوا بلشوا بالفسيو وارجعوا هون عشان المادة تكون متكاملة

وبس والله،بالتوفيق💚



Overview

- *The nervous system is the system that **controls** the various functions of the body by the means of **electrical impulses.***



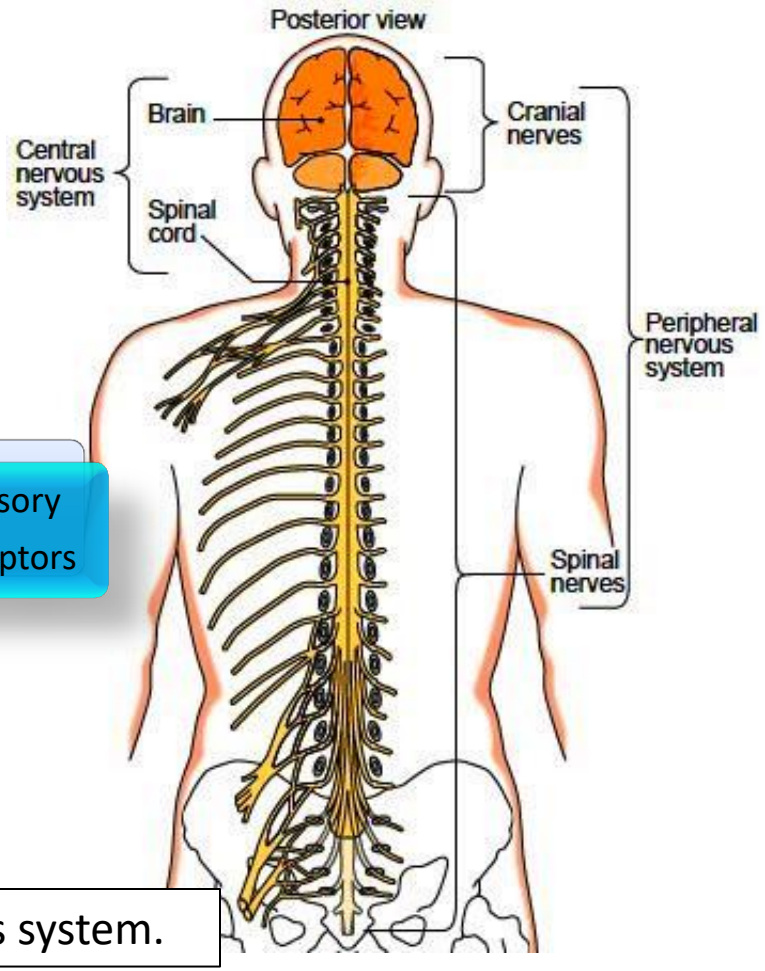


Fig.1: Divisions of the nervous system.

The Central Nervous System (CNS)

- Formed of the brain and spinal cord
- Formed of millions of nerve cells (neurons) and supporting cells (glia cells).
- Well protected within the skull and vertebral column.

- **Functions:**

1. **Initiates motor commands (movement and secretions).**
2. **Receives and perceives sensory information.**
3. **Responsible for our emotions, personality, behavior, memory and others.**

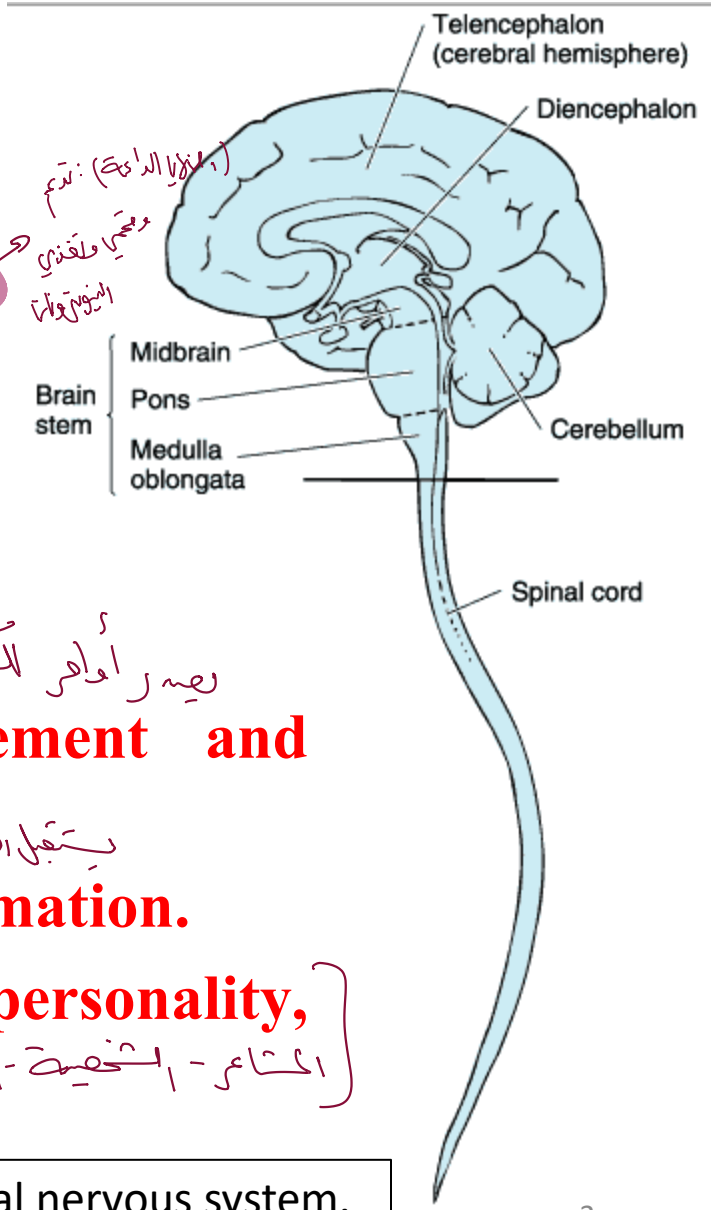


Fig.2: The central nervous system.

The Peripheral Nervous System (PNS)

- Formed of the peripheral nerves (cranial and spinal), the ganglia, and the sensory receptors.
- The nerves may be sensory (carry information to CNS) or motor (carry orders from the CNS)
- **Ganglia** are collection of neurons outside the central nervous system.
- **Sensory receptors** are parts of neurons or specialized structures that can detect changes in the internal or external environment. The skin, for example, contains several types of receptors that detect pain, touch and heat.

- Functionally, the PNS can be divided into:

- **Somatic part**: connected to skin, muscles, joints and the special senses. We are fully conscious of this part. Our voluntary movements and our sensation of pain and touch are controlled by this part.

- **Autonomic Nervous System**: this part usually operates without conscious control, as it controls all of our involuntary actions, like our heart rate, respiratory rate and blood pressure.

- **Enteric part**: controls the secretions and movements of the various parts of the digestive system unconsciously.

Histology Of The Nervous System

- The nervous tissue is formed of two types of cells:

1. The nerve cell – Neurons
2. Supporting cells –Neuroglia or Glia cells

- In the nervous tissue, there is ***a very small amount of extracellular matrix*** found around the blood vessels.
- The space between the cells is filled with **neuropil** which is formed of the processes of both neurons and glia cells and some fluid.

(Dendrites + Axons + Glia)

Neurons

- Functional unit of nervous system.
- Have capacity to produce action potentials.
- ***Cell body:*** (soma)
  - Single nucleus with prominent nucleolus
  - *Nissl bodies* formed of rough endoplasmic reticulum & free ribosomes for protein synthesis.
  - Neurofilaments give cell shape and support
- ***Cell processes*** = dendrites & axons

- ***Mature neurons cannot divide. A damaged neuron cannot be repaired and is replaced by fibrous tissue.***

(fibrous tissue) ما بتنقسم بعد النضج ← الخلايا المتالفة تستبدل بنسيج ليفي

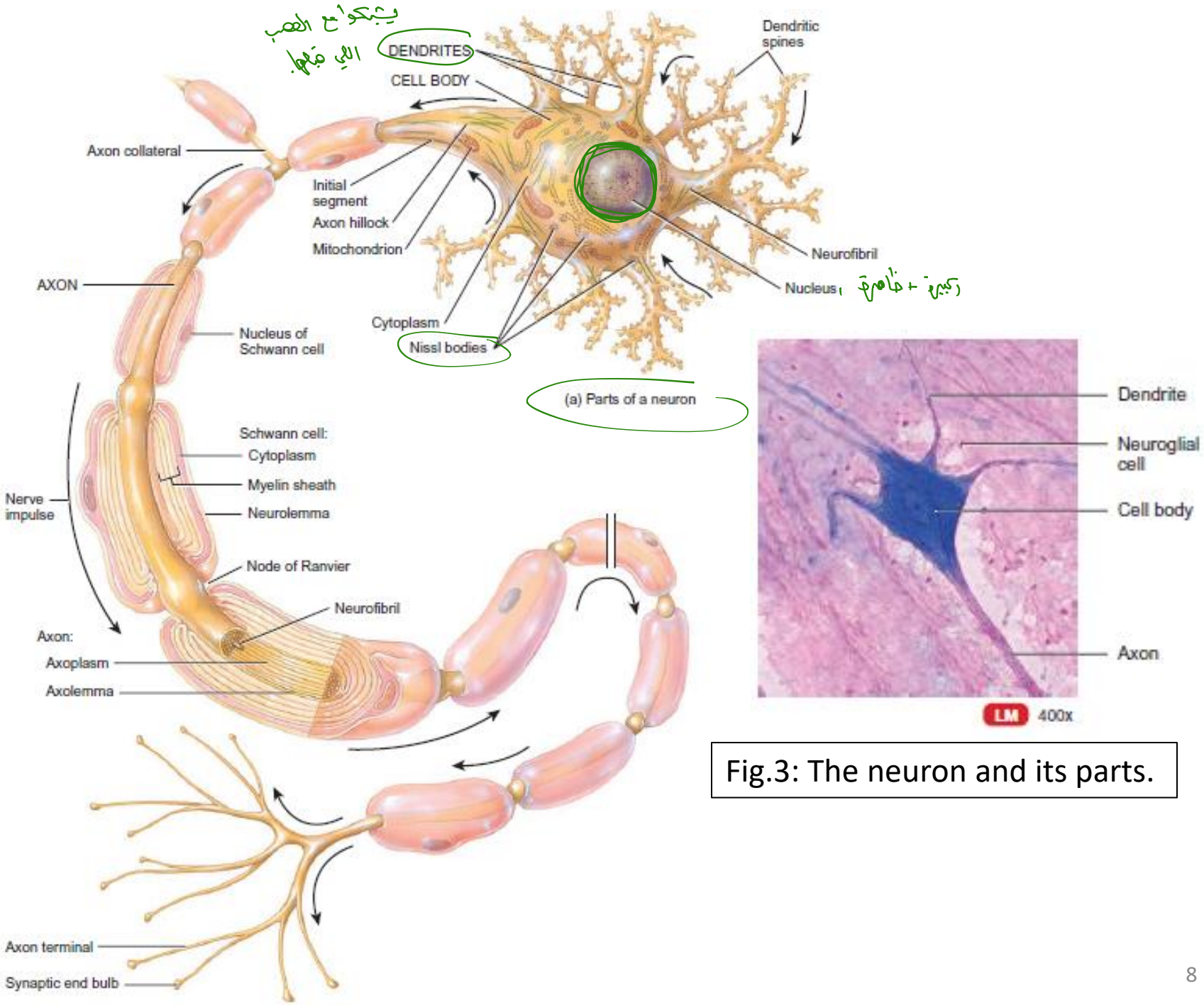


Fig.3: The neuron and its parts.

	Dendrites	Axon
1	Mostly multiple branches	A Single branch
2	Usually short	Usually the longest branch and is called ***nerve fiber***
3	Taper as they extend away from cell body	Has a fixed diameter
4	Branch profusely	▪ No branches near cell body ▪ Collateral branches along course ▪ Terminal branches
5	Not covered by a myelin sheath	Some are covered by a myelin sheath
6	Conduct impulse towards cell body	Conducts impulse away from cell body

ملاحظة مهمة: النيورون هايبر يعني اذا الخلية العصبية تلفت ما راح تتعوض

الجسم بعوضها بـ fibrous tissue يعني الخلايا الباقية بتتكاثر وبتملأ محل المنطقة المتضررة.

neuroglia= Glial cells

Glia cells

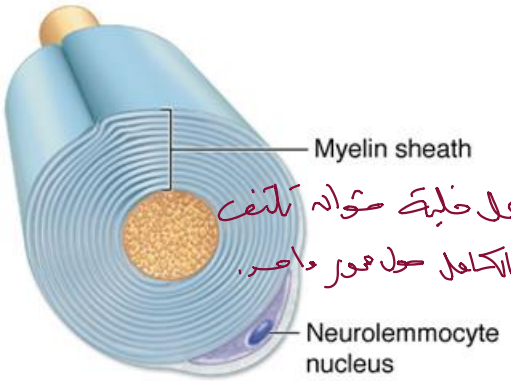
تنقسم حسب مكانها وجودها

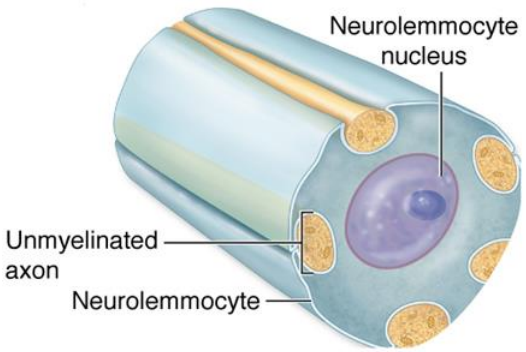
Location	Cell	Function
CNS	Astrocytes	• Part of blood-brain barrier (BBB) • Provide nutrients for neurons • Form scar tissue after injury
	Oligodendrocytes	Form myelin sheath
	Microglia cells	Defense (by phagocytosis)
	Ependymal cells	Line cavities
PNS	Schwann cells (Neurolemmocytes)	Form myelin sheath
	Satellite cells	Support neurons in dorsal root ganglia

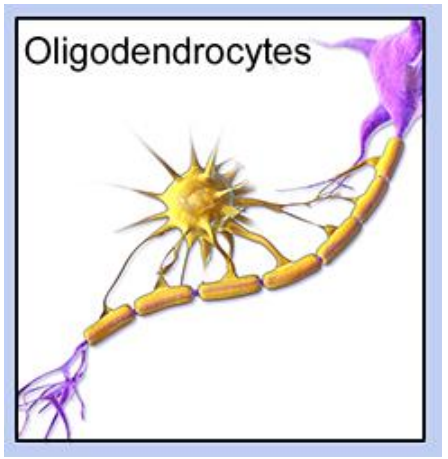
Myelination

- The process by which a nerve fiber (axon) is surrounded by multiple layer of cell membrane (myelin sheath)

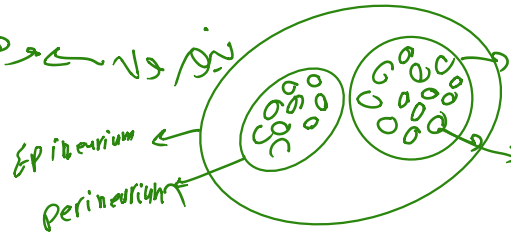
	PNS	CNS
	Done by Schwann cells	Done by oligodendrocyte
	The entire cell wraps around the axon	The process of the cell wraps around the axon
	Unmyelinated axons are also surrounded by cell membrane of Schwann cell	Unmyelinated fibers are not surrounded by anything







Histology of a nerve



- **Nerve**: a group of bundles of nerve fibers and their covering connective tissue layers.

- The whole nerve is surrounded by the **epineurium.**
- Each bundle is surrounded by the **perineurium,** which forms a blood-nerve barrier.
- Each nerve fiber (axon) is surrounded by myelin sheath and an areolar connective tissue **endoneurium.**

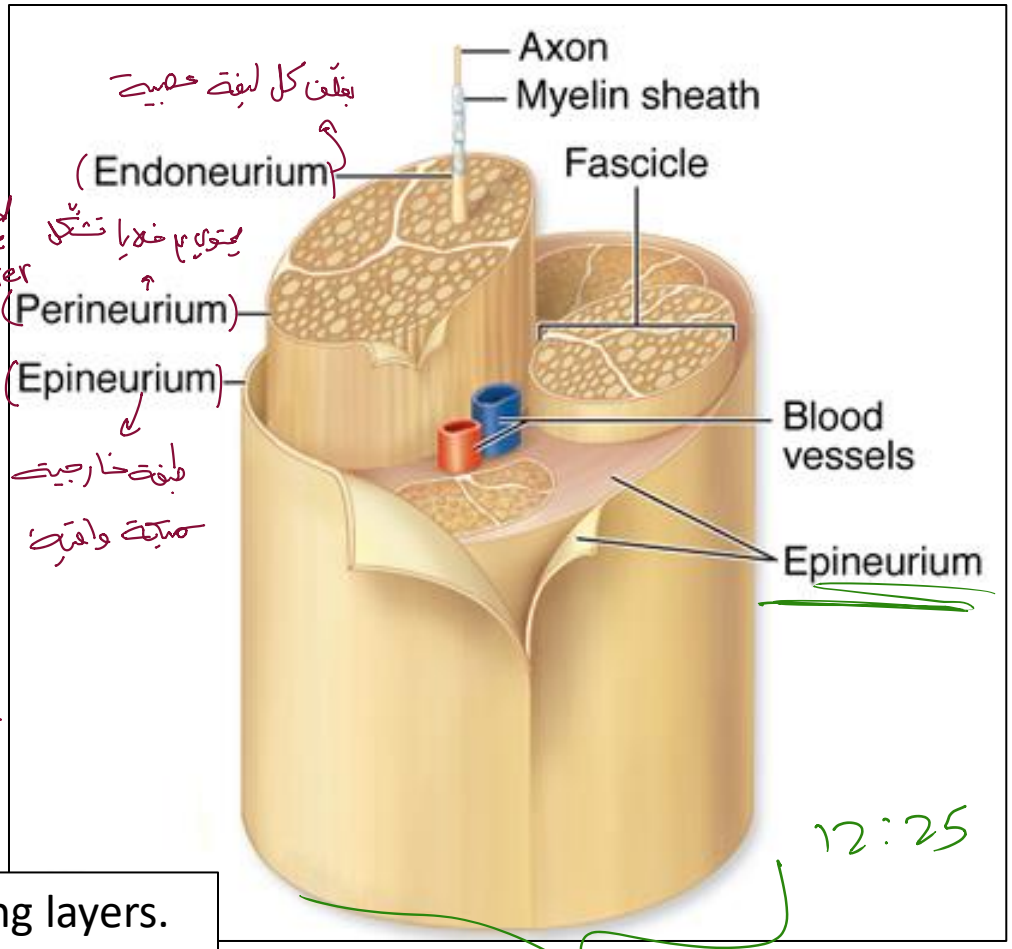


Fig.4: Peripheral nerve and its covering layers.

The Central Nervous System - The Brain

- The brain is the part of the nervous system present within the skull. It's covered by protective layers called the meninges.

- The brain is formed of:

1) The Cerebrum
2) The Diencephalon
3) The Cerebellum
4) The Brainstem

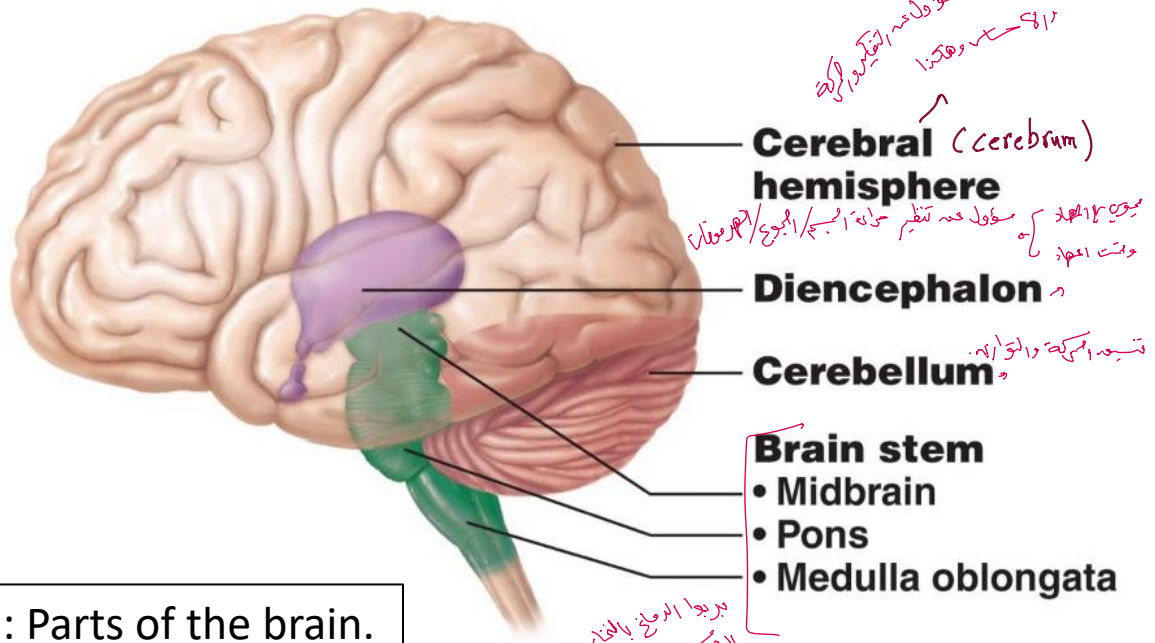


Fig.5: Parts of the brain.

Ventricular system

- Within the different parts of the brain, there are several cavities lined by ependymal cells and filled with cerebrospinal fluid.

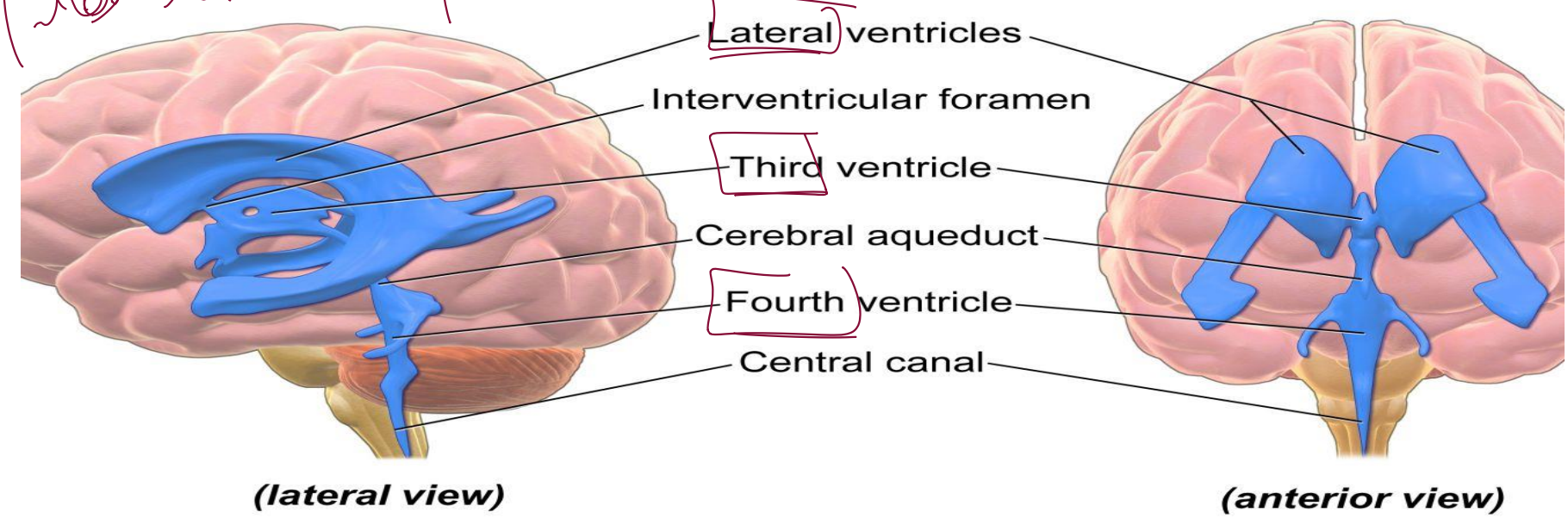


Fig.6: Ventricles of the brain.

المكان	الخلية	الوظيفة
CNS	Astrocytes	جزء من الحاجز الدموي الدماغي، تغذية النيورونات، تكوين نسيج ندبي بعد الإصابة
	Oligodendrocytes	تكوين الميالين في الـCNS
	Microglia	دفاعية (بلعمة خلايا تالفة وجراثيم)
	Ependymal cells	تبطين تجاويف الدماغ والنخاع، إنتاج وتحريك الـCSF
PNS	Schwann cells	تكوين الميالين في الأعصاب الطرفية
	Satellite cells	دعم وتغذية الخلايا العصبية في العقد العصبية

⚡ مقارنة الميالين في الـCNS والـPNS:

الخاصية	PNS	CNS
الخلية المسؤولة	Schwann cell	Oligodendrocyte
طريقة الالتفاف	الخلية كلها تلتف حول المحور	زوائد الخلية تلتف حول عدة محاور
الألياف غير المغلّفة	محاطة بغشاء شوّان	غير محاطة بشيء
عدد المحاور المغطاة	محور واحد فقط لكل خلية	عدة محاور لكل خلية

🧵 طبقات الأعصاب المحيطية:

الطبقة	ما تغلفه	الملاحظات
Epineurium	العصب بالكامل	طبقة حماية قوية خارجية
Perineurium	كل حزمة ألياف (fascicle)	يشكل Blood-Nerve Barrier
Endoneurium	كل ليفة عصبية منفردة	يحتوي شعيرات دموية صغيرة

Cranial meninges

1. **Dura mater**: the hard outermost layer. Separated from the skull bones by the epidural space. The venous sinuses of the brain are located within the dura mater.
2. **Arachnoid mater** : the thin middle layer. Separated from the dura by the subdural space. Beneath the arachnoid, we have the large subarachnoid space.
3. **Pia mater**: thin innermost layer. Directly covers the brain.

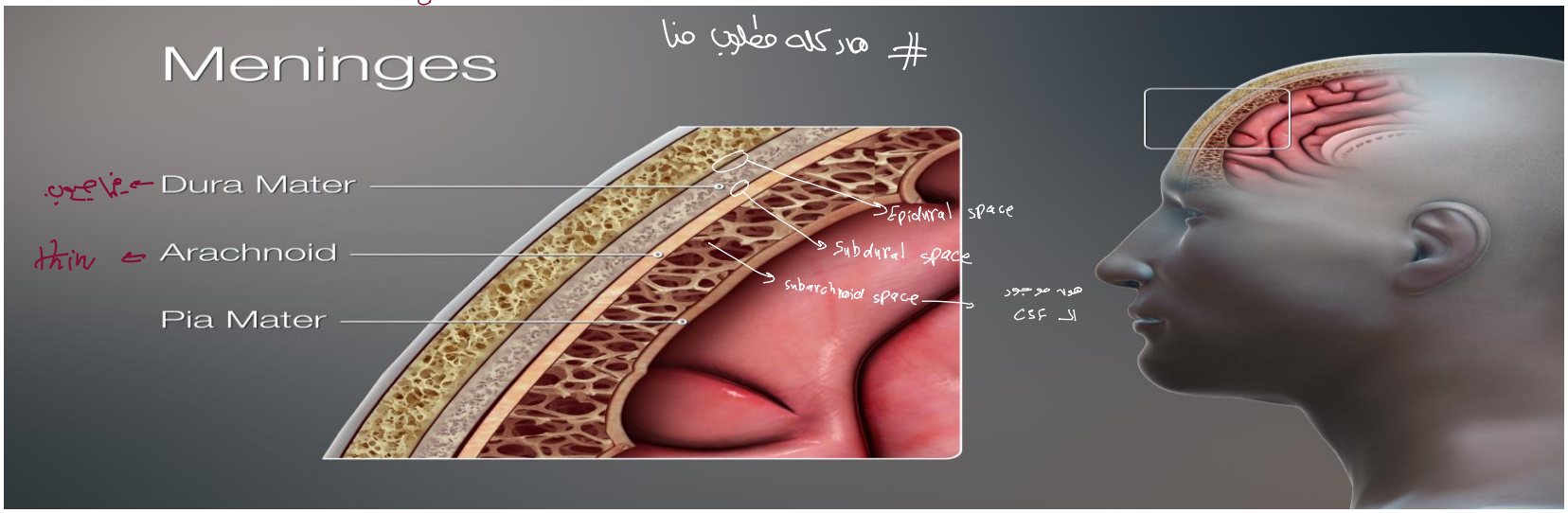
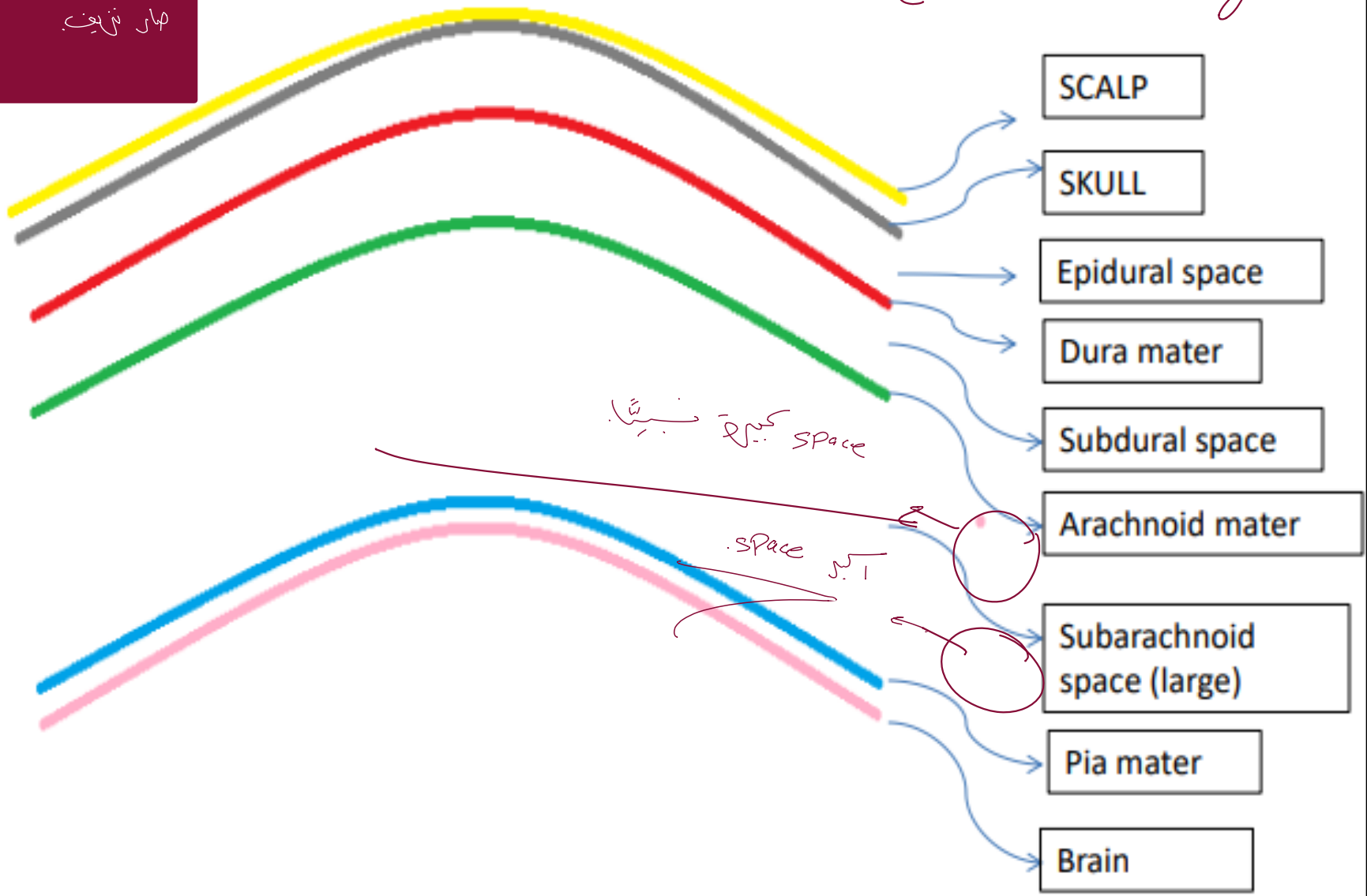


Fig.7: The cranial meninges.

هاي الطبقات بتهمني اذا
جاء تزيف

CT-Scal => Radiographic



السائل الدماغي الشوكي:::

The Cerebrospinal Fluid (CSF)

هاد السائل (بدور) داخل تجاويف الدماغ والقناة المركزية بالنخاع الشوكي

- Clear fluid.
- Circulates through cavities in the brain (ventricles) and the spinal cord (central canal) and also in the subarachnoid space.

- ***Functions:***

1. ***Absorbs shock and protects the brain and the spinal cord.***
2. ***Helps transport nutrients and wastes between the blood and the nervous tissue.*** نقل المغذيات والفضلات بين الدم وبقية نسج الجسم

The Blood-Brain Barrier

- This include a number of structures that control the passage of substances from blood to the nervous tissue to protect it against harmful agents.

- It's formed of:

1) Endothelium of capillaries
2) Pericytes: cells present around the capillaries beneath its basal lamina
3) Basal lamina
4) Processes of astrocytes

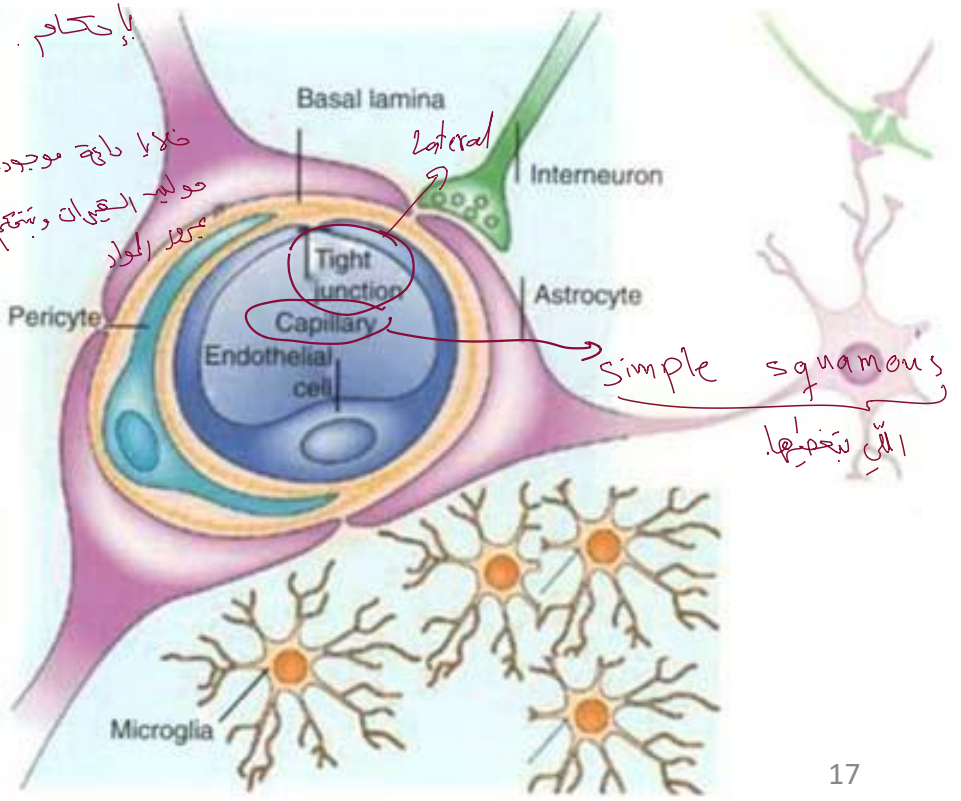
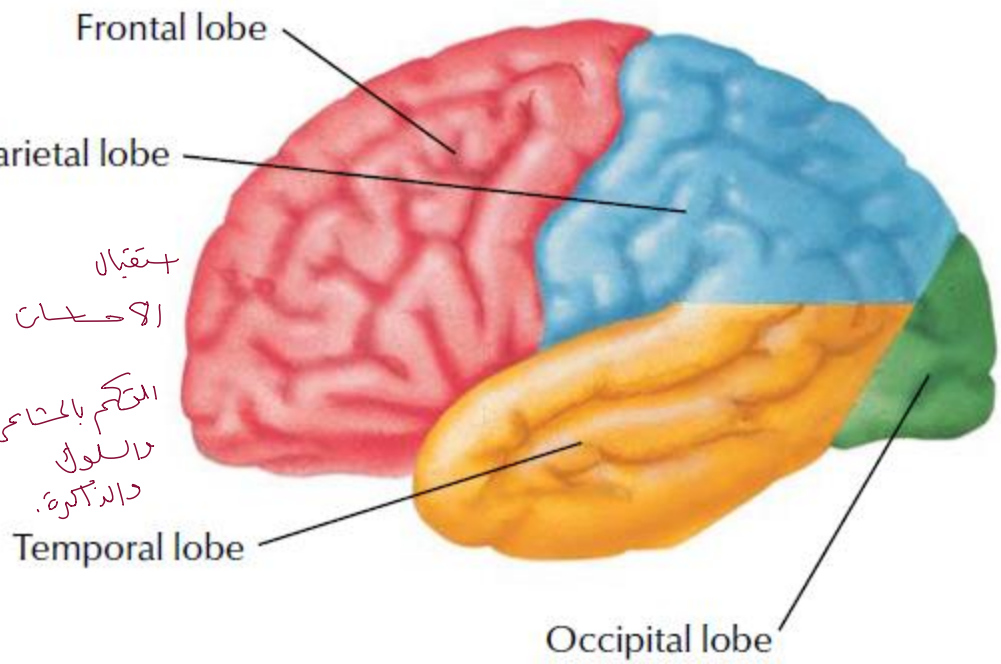


Fig.8: The blood-brain barrier.

The Cerebrum

Fig.9: The Cerebrum (lateral view).



- All motor commands issue from the cerebrum. All sensations are perceived here. In addition, this part is responsible for emotions, behavior and memory.

- The cerebrum is the largest part of the brain. It's formed of two parts (called hemispheres) each of which is formed of four lobes: frontal lobe, parietal lobe, temporal lobe, and occipital lobe.

- It's characterized by the presence of fissures called sulci and protrusions called gyri (Fig.11). The cavity within it is the lateral ventricle.

- The outer layer of the cerebrum is called the **cerebral cortex**. It's formed mainly of the body of neurons and therefore it's called the **gray matter**. Deep to it, we have the **white matter,** formed mainly of nerve fibers.
- In the spinal cord, the arrangement is reversed.

العنصر	Gray Matter	White Matter
المكونات	أجسام خلايا عصبية	ألياف عصبية (محاطة بالمايلين)
اللون	رمادي	أبيض
الموقع في الدماغ	الطبقة الخارجية	الداخلية
الموقع في النخاع الشوكي	الداخلية	الخارجية

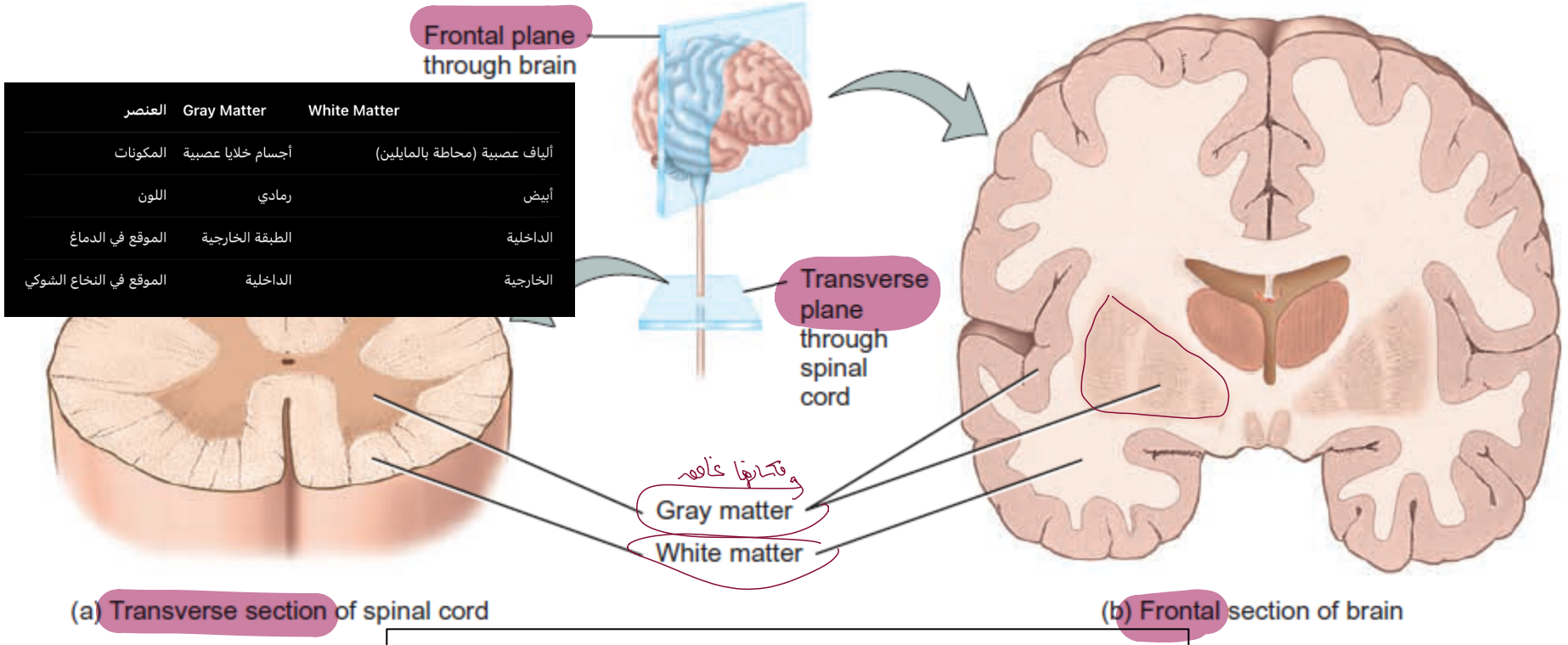
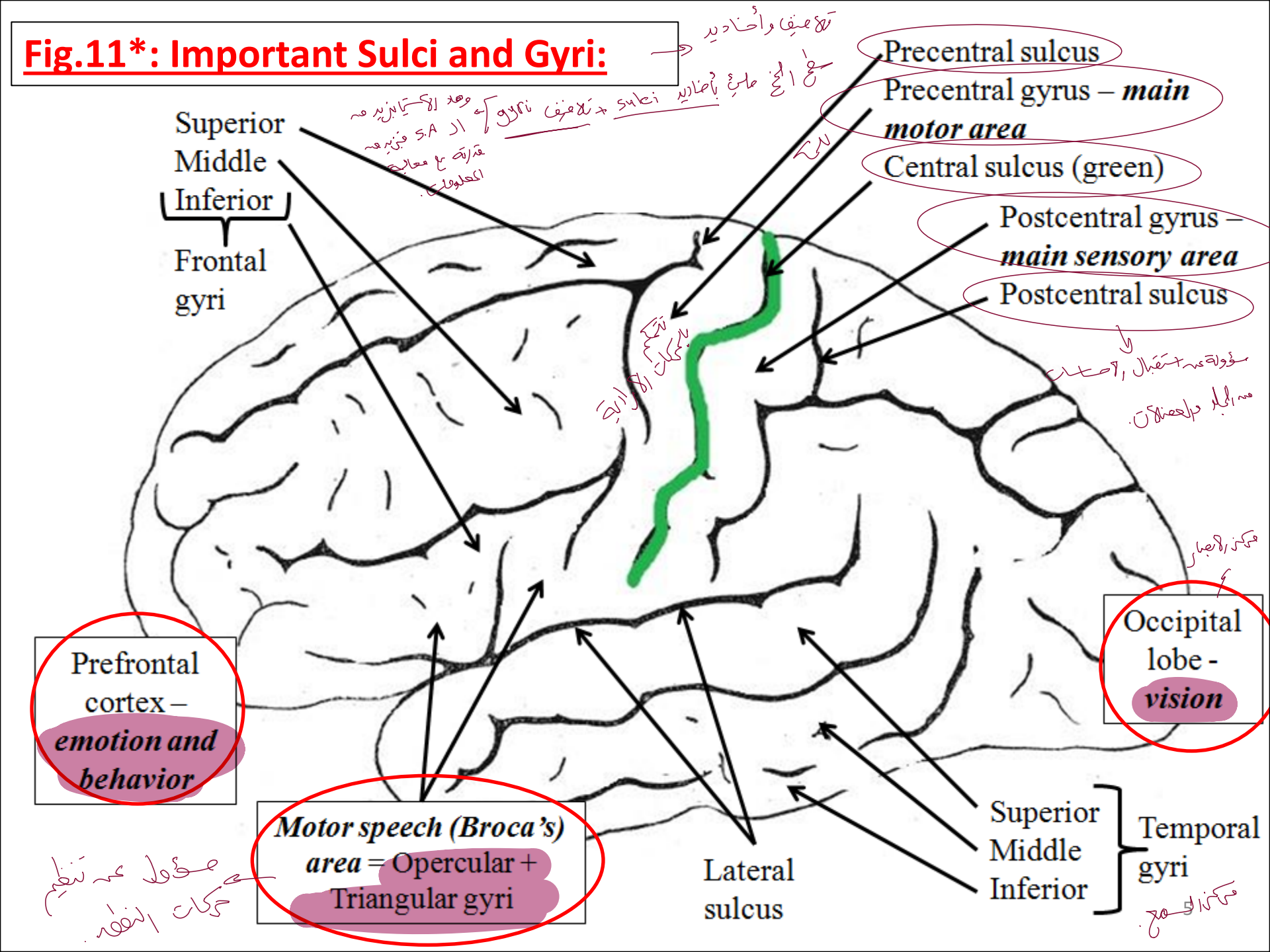


Fig.10: The arrangement of the gray and white matter in the cerebrum and spinal cord.

Fig.11*: Important Sulci and Gyri:



The Diencephalon

- This part of the brain is located on the medial aspect of the cerebrum. The cavity here is the 3rd ventricle.

- It's formed of the:

1. Thalamus
2. Hypothalamus
3. Epithalamus

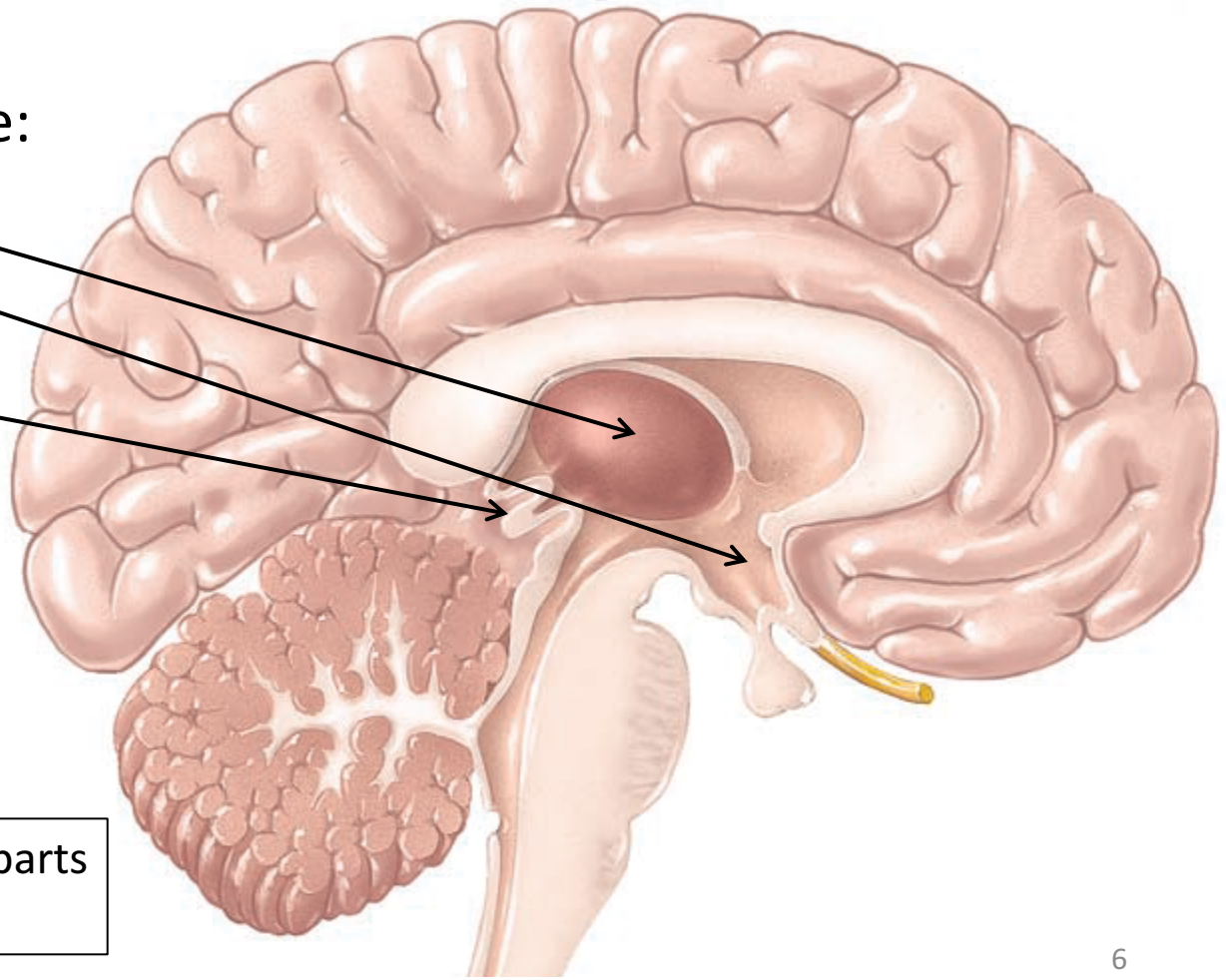


Fig.12: The location and parts of the diencephalon.

Part	Main Function
Thalamus	Relay station for most sensation
Hypothalamus	1. Controls hormone secretions of all endocrine glands in the body 2. Control body temperature 3. Control eating and drinking
Pineal gland of the epithalamus	Secrete melatonin hormone which regulates diurnal (day-night) cycles

الجزء	الوظيفة الرئيسية	ملاحظات
Thalamus	محطة ترحيل الإحساسات	يرسل المعلومات إلى القشرة المخية
Hypothalamus	تحكم هرموني وتنظيمي	يتحكم بالأكل، الشرب، والحرارة
Epithalamus	إفراز الميلاتونين	ينظم دورة النوم واليقظة

The Cerebellum

- Second largest part of the brain.
- The central constricted area is the **vermis**. On each side of the vermis, we have the expanded **cerebellar hemispheres.**
- The cerebellum is located inferior to the occipital lobe and posterior to the brainstem. It's separated from the brainstem by the 4th ventricle.

The function of the cerebellum is the coordination of movement and the maintaining of balance.

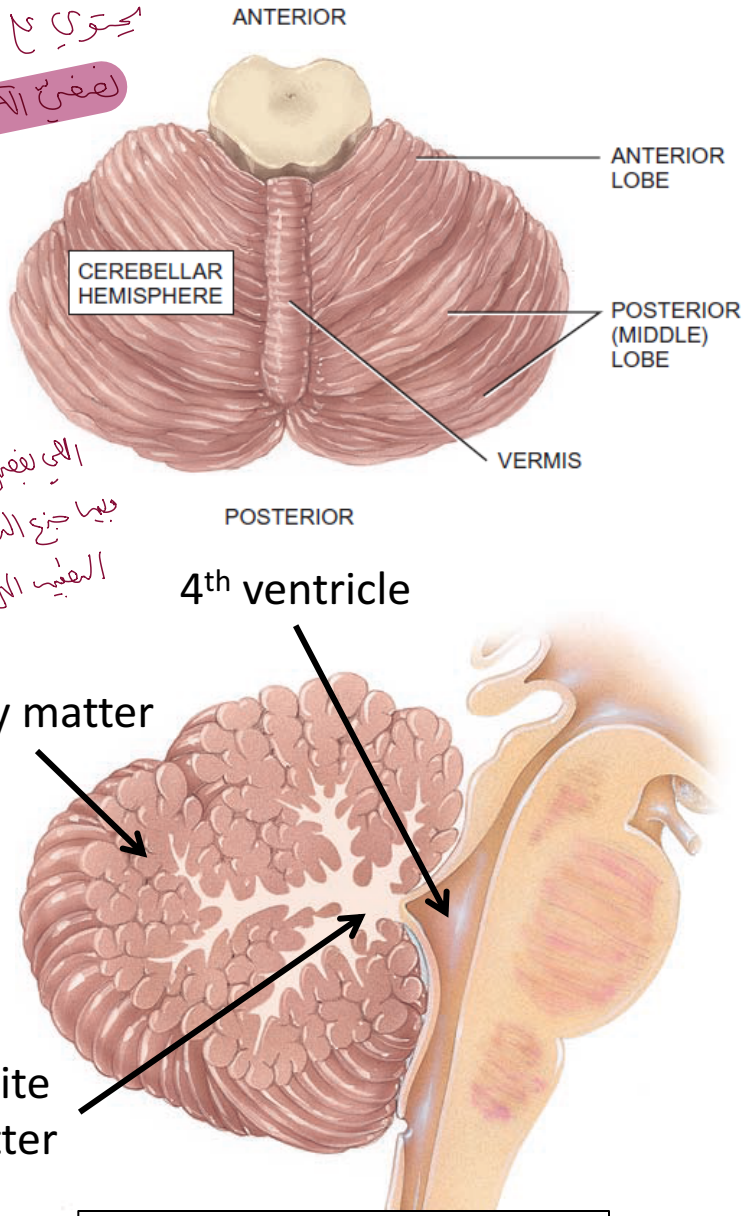


Fig.13: The cerebellum.

The Brainstem

جذع الدماغ:

- The part of the brain that connects the diencephalon with the spinal cord.
- Formed of 3 parts:
  - Midbrain (MB)
  - Pons – connect several parts of the CNS together. Contains respiratory centers.
  - Medulla oblongata
- The brainstem contains several important control centers and the attachment of several cranial nerves.
- Also in the brainstem is the ***Reticular Formation*** which is related to consciousness and muscle tone.

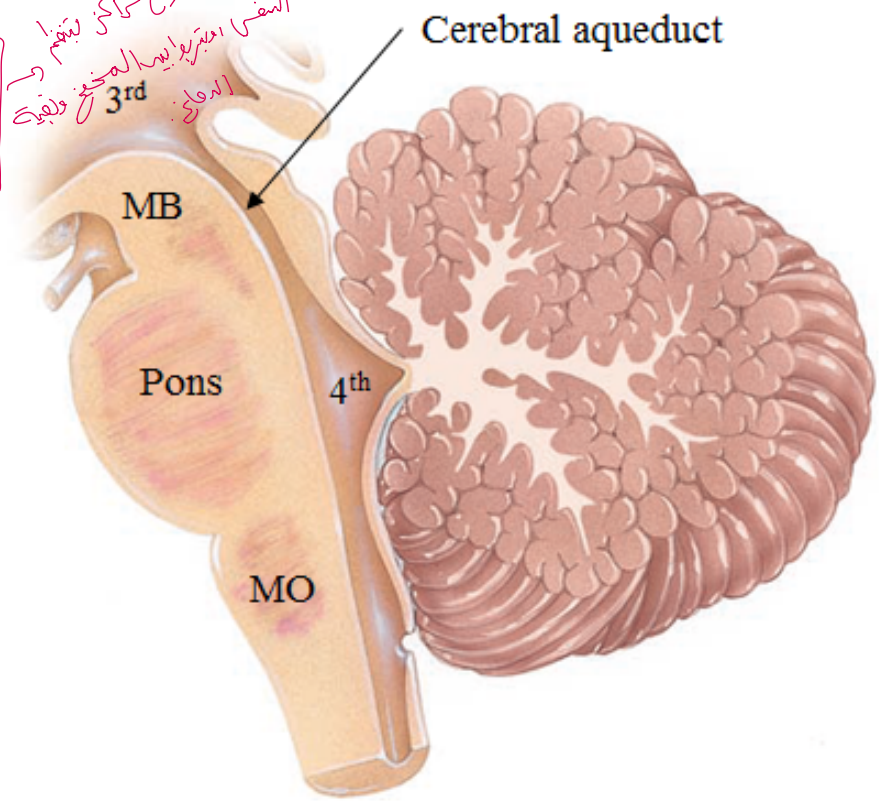
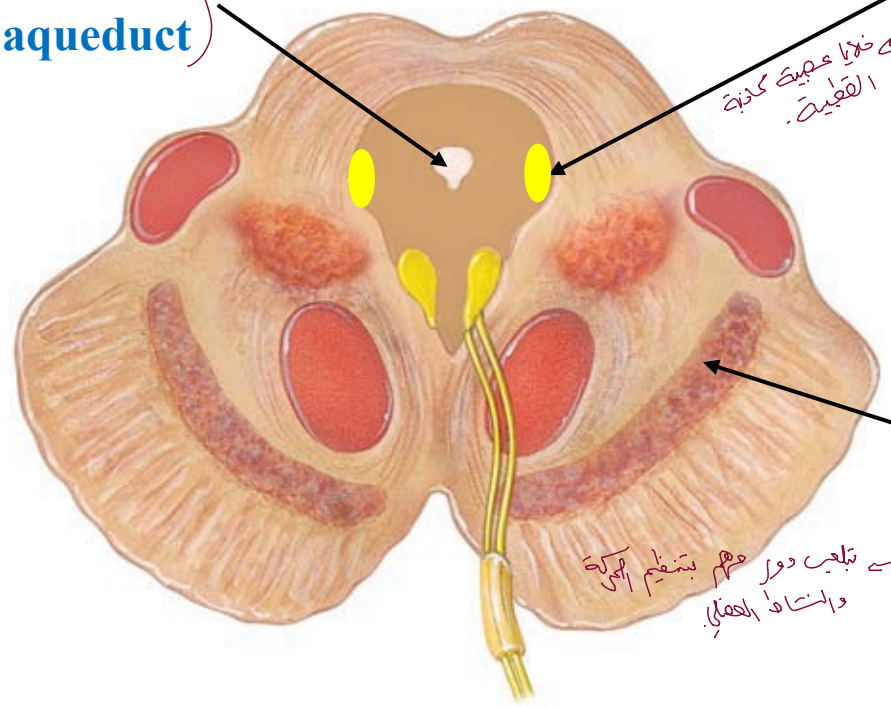


Fig.14: Location and parts of the brainstem.

The Midbrain



Cerebral aqueduct

Mesencephalic nucleus – contains pseudounipolar neurons that carry sensations from the face. The only place in the CNS with such neurons; all other pseudounipolar neurons are located in peripheral ganglia.

Substantia nigra – neurons here release Dopmaine and is involved in muscular activity. Lesion in this area is associated with Parkinson's disease.

Fig.15: Section through the midbrain.

The Medulla Oblongata

- Contains important control centers:
  - Cardiovascular center
  - Respiratory center
- Anteriorly, near the midline, are ***the pyramids*** which are formed by the descending motor tracts (group of nerve fibers in the CNS).
- At a certain point in the medulla, the majority of the fibers in these tracts will cross to the opposite side forming the ***decussation of the pyramid***.
- This is why each half of the brain controls the opposite side of the body.

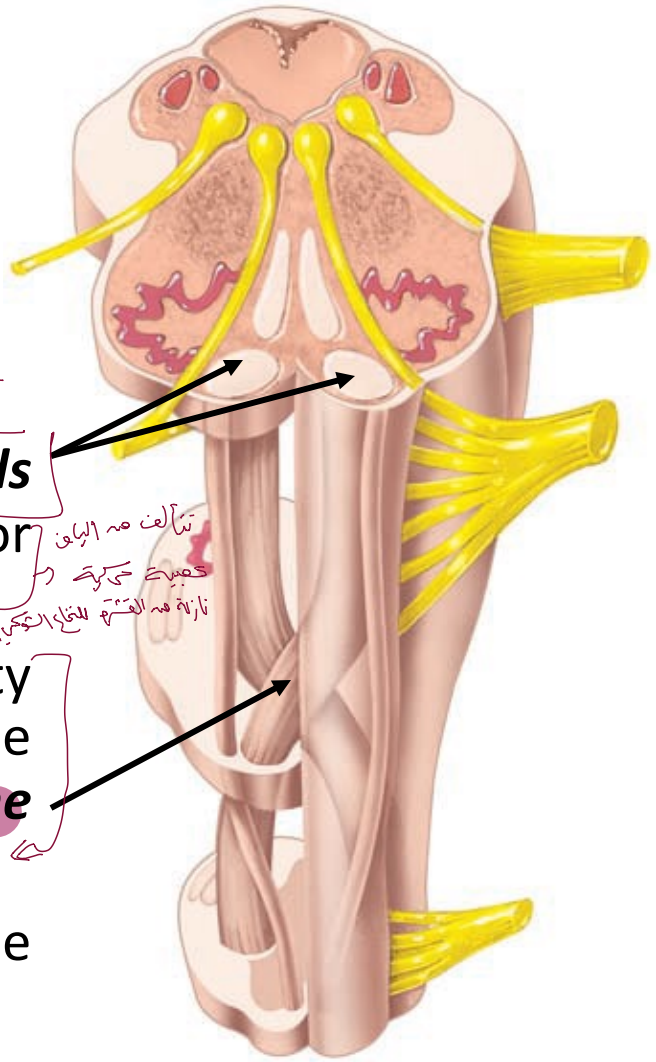


Fig.16: The medulla oblongata.

The Central Nervous System - The Spinal Cord

- A grayish-white cylindrical structure.

- Starts at the foramen magnum and ends at lower border of L1 in adults. In children, it ends at L3.

- Protected by the vertebral column and the three layers of meninges.

- The pia matter will continue after the termination of the spinal cord as a thin thread called the filum terminale.

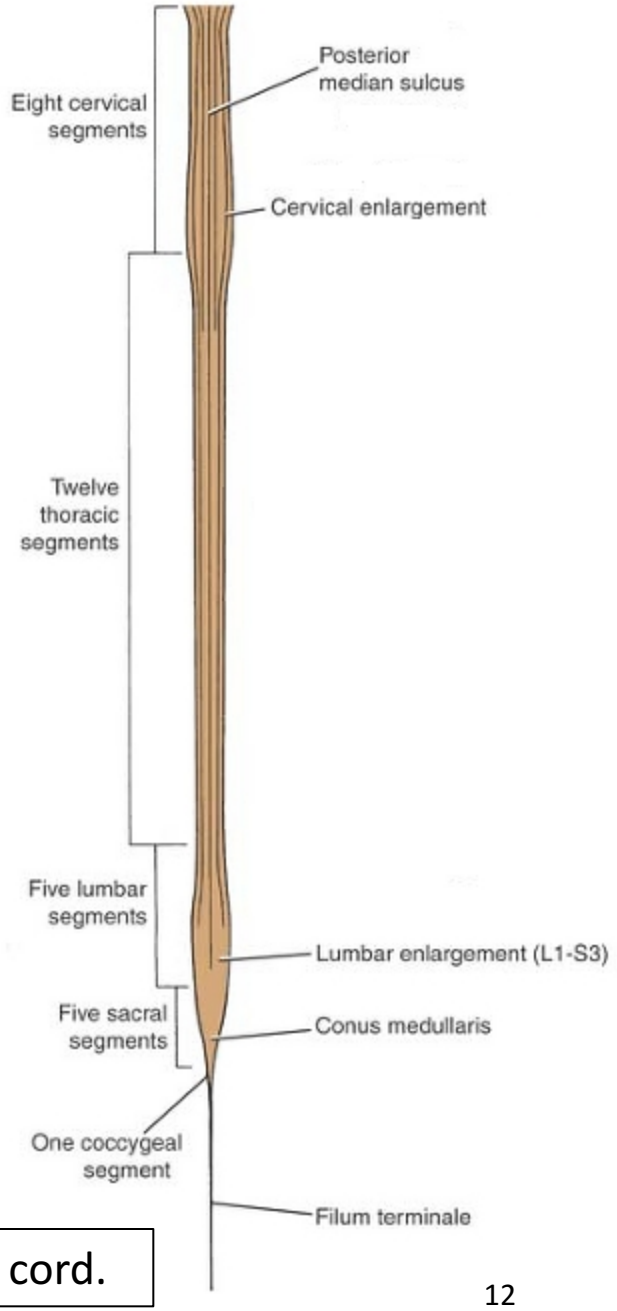


Fig.17: The spinal cord.

External features of the spinal cord

- It has two enlargements: cervical and lumbar. The cervical enlargement is the origin of the cervical and brachial plexuses. The lumbar enlargement is the origin of the lumbar and sacral plexuses.

- The terminal part of the spinal cord is cone shaped and called the **Conus medullaris.**

Fig.18: The conus medullaris.

- The spinal cord is divided into segments: 8 Cervical, 12 Thoracic, 5 Lumbar, 5 Sacral and 1 Coccygeal. From each segment arises a pair of spinal nerves. Thus, we have a total of 31 pairs of spinal nerves.

- The nerves pass laterally to exit the vertebral column. The spinal cord is shorter than the spine. Therefore the lower nerves must pass down for a distance before exiting. These will form a structure like a wisp of hair around the filum terminale called the **Cauda Equina.**

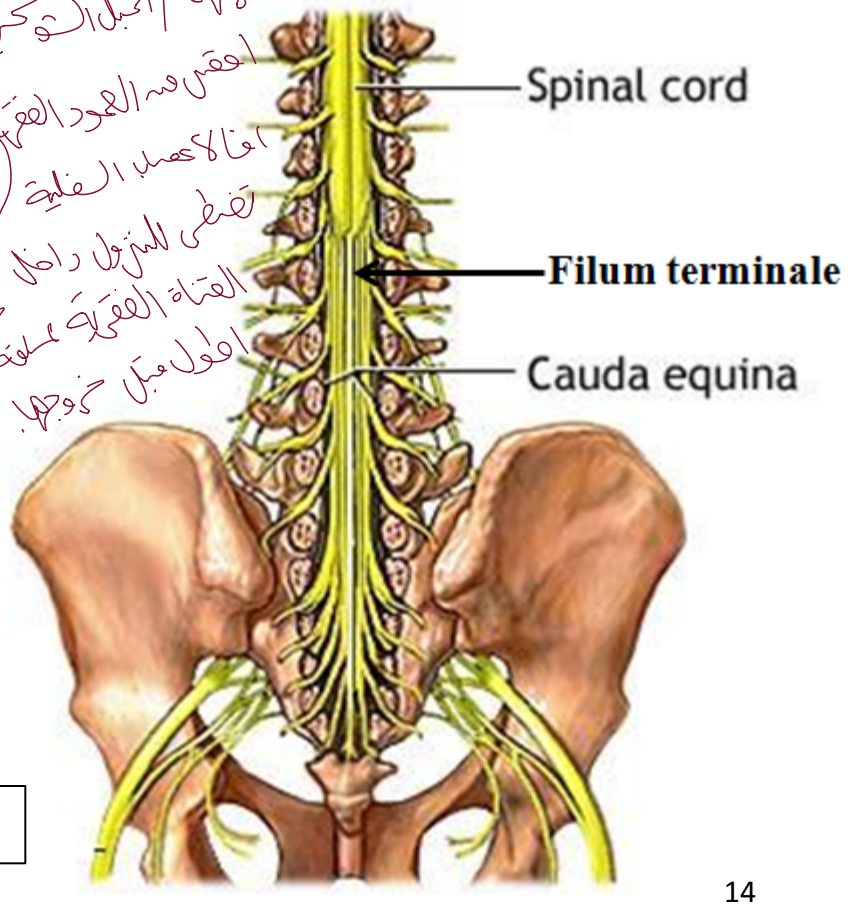


Fig.19: The cauda equina.

Internal features of the spinal cord

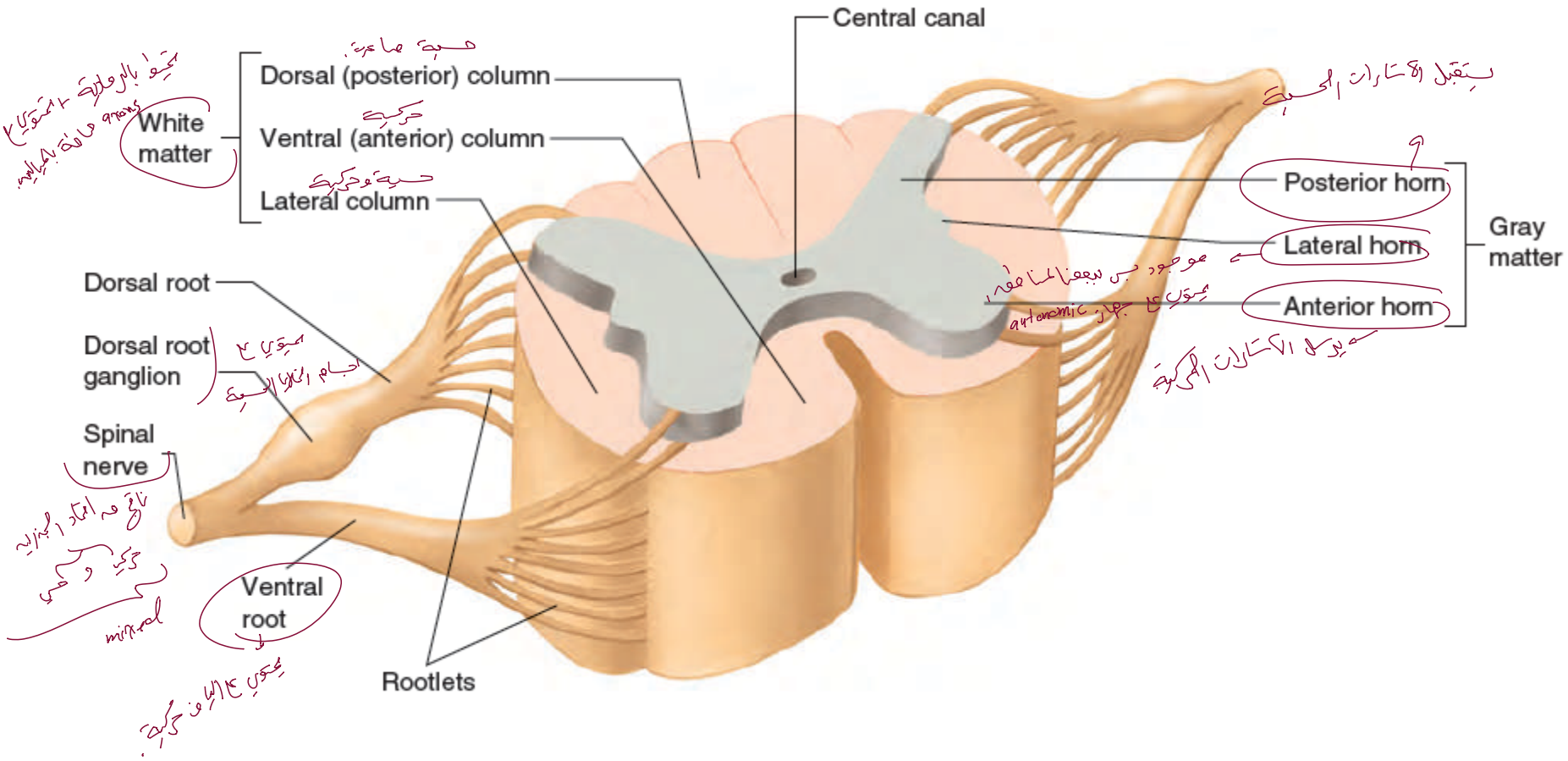


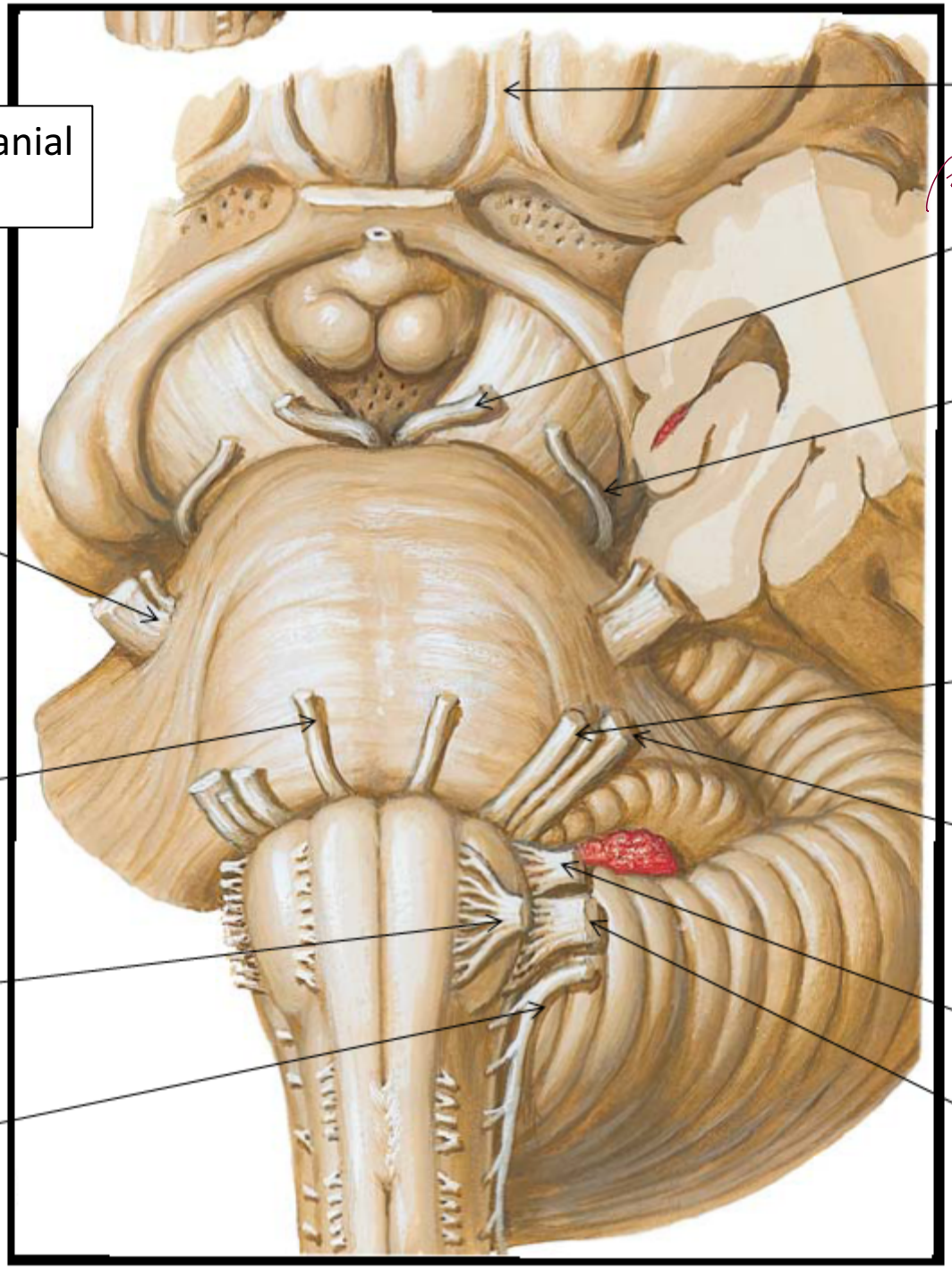
Fig.20*: Cross section through the spinal cord showing important internal features.

The Peripheral Nervous System - The Cranial Nerves

Cranial Nerve	Main Functions
I – Olfactory	Olfaction (Smelling)
II – Optic	Vision
III – Oculomotor	Supplies extrinsic muscles of eye
IV - Trochlear	
V – Trigeminal	1. Carries sensation from face 2. Supplies muscles of mastication
VI – Abducent	Supplies extrinsic muscles of eye

Cranial Nerve	Main Functions
VII – Facial	1. Supplies muscles of facial expression 2. Carries taste sensations from anterior 2/3 of tongue
VIII - Vestibulocochlear	Hearing and equilibrium
IX - Glossopharyngeal	1. Supplies some muscles 2. Carries taste sensation from posterior 1/3 of tongue
X – Vagus	1. Supplies various muscles 2. Carries various sensation 3. Supplies internal organs
XI – Accessory	Supplies the sternocleidomastoid and trapezius muscles
XII – Hypoglossal	Supplies all muscles of the tongue (except palatoglossus)

Fig.21: The cranial nerves.



Olfactory

Oculomotor

Trochlear

Trigeminal

Abducent

Facial

Vestibulocochlear

Glossopharyngeal

Vagus

Accessory

Hypoglossal

The Peripheral Nervous System - The Spinal Nerves

- 31 pairs of mixed nerves (sensory and motor): Cervical (C1-C8), thoracic (T1-T12), lumbar (L1-L5), sacral (S1-S5) and coccygeal (Co).
- A spinal nerve gives off two main branches: anterior ramus and posteior ramus. Anterior rami of spinal nerves are usually arranged in groups called plexuses.

Plexus	Main Branches
Cervical	Phrenic
Brachial	Axillary, Musculocutaneous, Radial, Median, Ulnar
Lumbar	Obturator, Femoral
Sacral	Sciatic (Largest nerve in the body)

* في شغلة الدكتور بيقل بيعطيها بالمحاضرات ، الصور المعروضة بالسلايدات لدواعي الشرح بواخد فيهم أسئلة تابعة لـ Lecture 1

لـ فالي عليكم نقسموا المتويان : ① inferior بالنسبة لـ / ② superior بالنسبة لـ

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بسأل عن الصورة شو نوع التقويم بتعتها ، بس التدريب يعني ولا صيتاط ، لأنه اجزاء الدماغ مجربطها!

بالتوفيق إن شاء الله