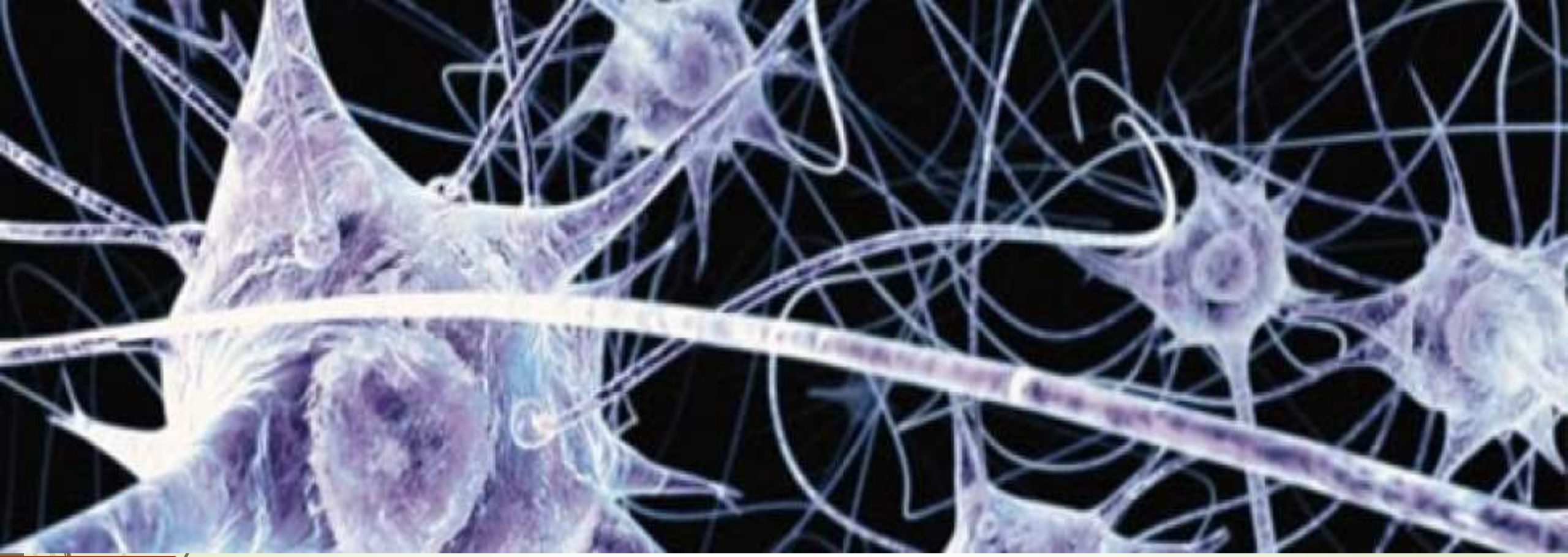

Neurologie

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Université Des Frères Mentouri – Constantine 1

Promotion A2 Docteur Vétérinaire

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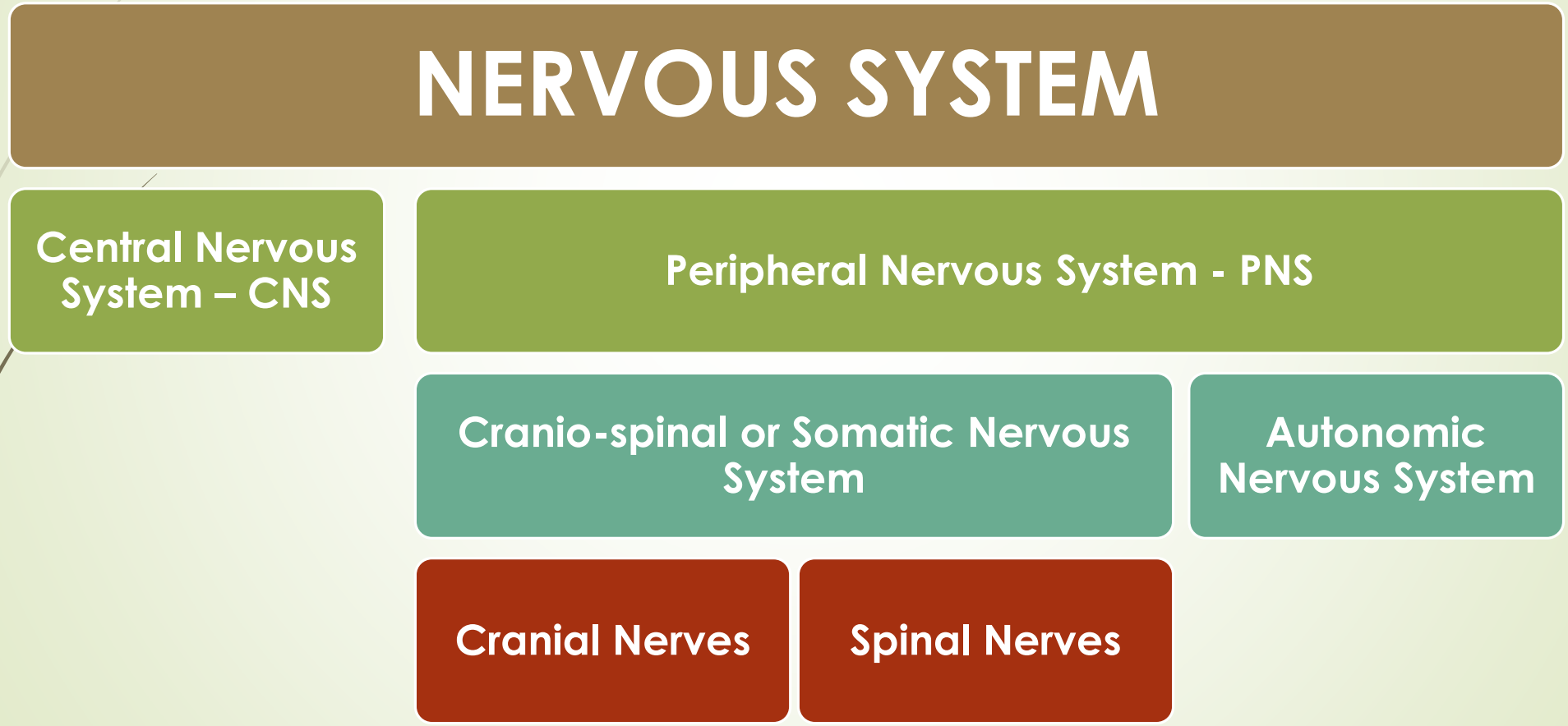
Fig.1: Organization of the Nervous System



The Peripheral Nervous System (PNS)

- The **peripheral nervous system** consists of all the nervous structures located outside the **central nervous system** (CNS). **Nerves** constitute its most characteristic and extensive part; they are pearly white or grayish cords that connect the central nervous system to all other parts of the body.
- They are formed by the assembly of **nerve fibers**, which are the **axons** of **neurocytes** (neurons). The cell bodies of these neurons are located either within the central nervous system or inside **ganglia**, which act as small secondary centers. These ganglia are positioned at specific points along the path of certain nerves, where they appear as more or less voluminous swellings.

Classification of Nerves

- Based on their connections and functions, two orders of nerves are recognized, each having its own specific type of ganglia:
- **Cranio-spinal Nerves:**
  - **Cranial nerves** (connected to the brain/brainstem)
  - **Spinal nerves** (connected to the spinal cord)
- **Autonomic Nervous System Nerves** (involved in involuntary functions)

Anatomical Classification of Cranial Nerves

Proencephalic Nerves

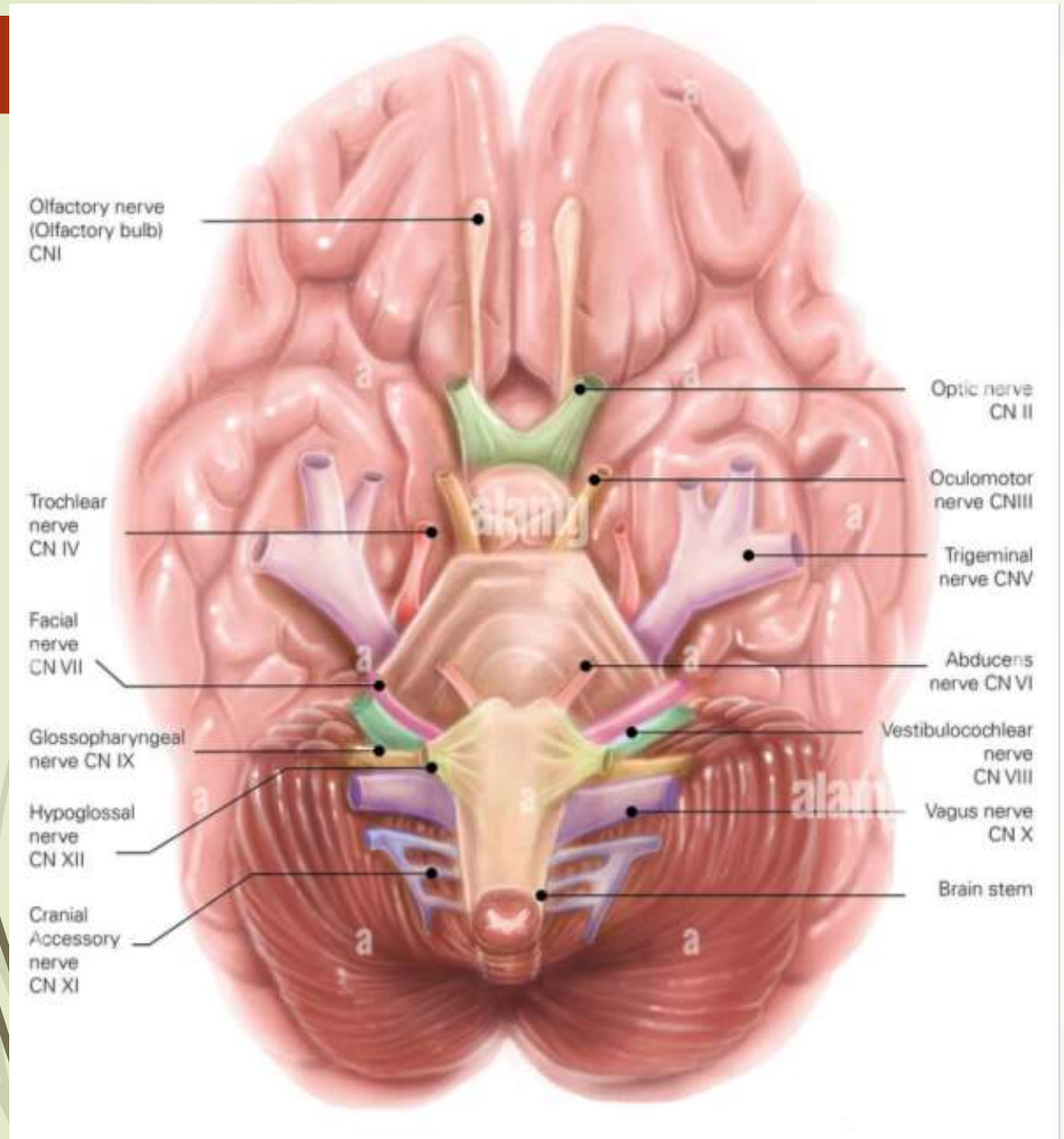
- Olfactory Nerve (I)
- Optic Nerve (II)

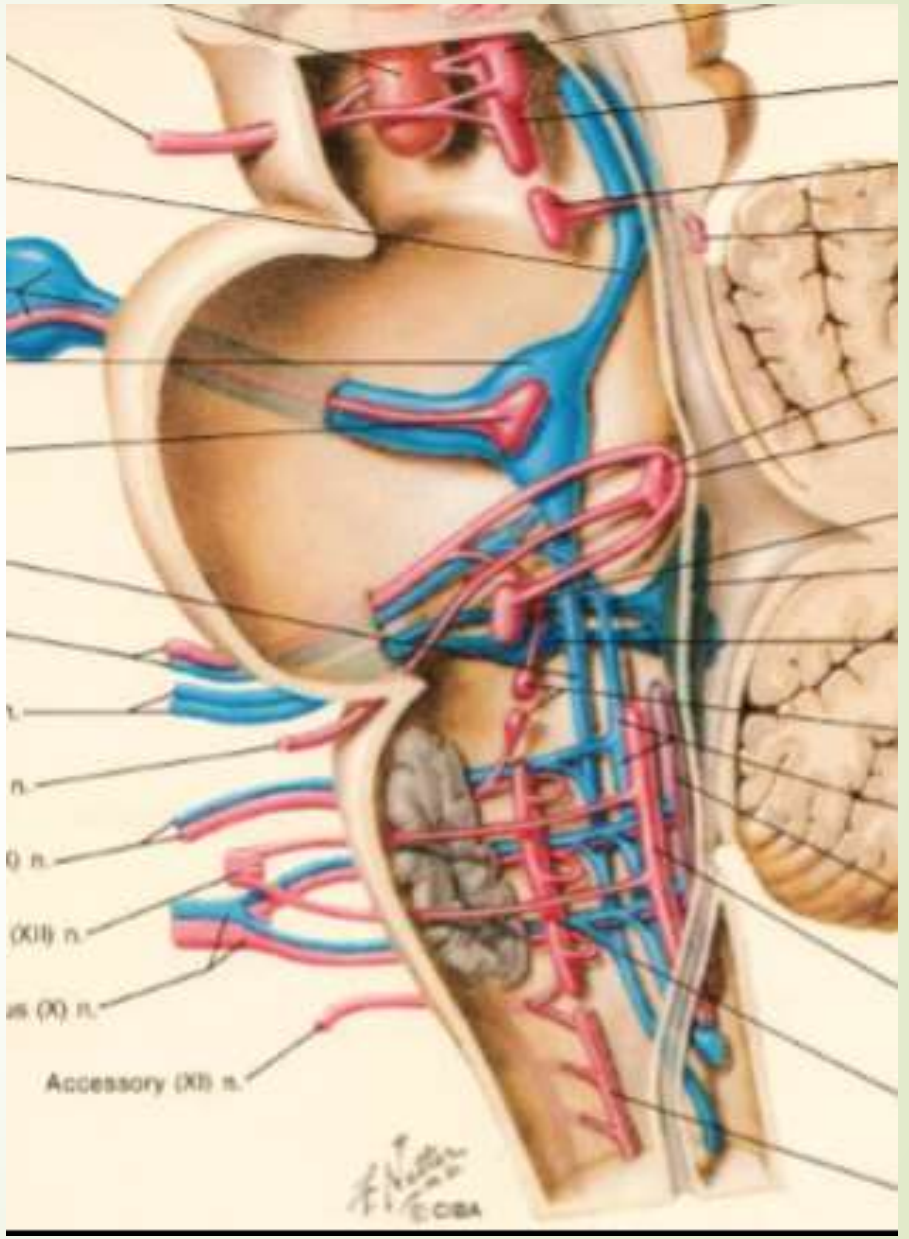
Mesencephalic Nerves

- Oculomotor Nerve (III)
- Trochlear Nerve (IV)

Rhombencephalic Nerves

- Trigeminal Nerve (V)
- Abducens Nerve (VI)
- Intermedio-facial Nerve (VII)
- Vestibulocochlear Nerve (VIII)
- Glossopharyngeal Nerve (IX)
- Vagus Nerve (X)
- Accessory Nerve (XI)
- Hypoglossal Nerve (XII)


Olfactory nerve
(Olfactory bulb)
CNI
Optic nerve
CN II
Trochlear
nerve
CN IV
Oculomotor
nerve CNIII
Trigeminal
nerve CNV
Facial
nerve
CN VII
Abducens
nerve CN VI
Glossopharyngeal
nerve CN IX
Vestibulocochlear
nerve
CN VIII
Hypoglossal
nerve
CN XII
Vagus nerve
CN X
Cranial
Accessory
nerve
CN XI
Brain stem


Accessory (XI) n.

Physiological Classification of the Nervous System

Sensory Nerves

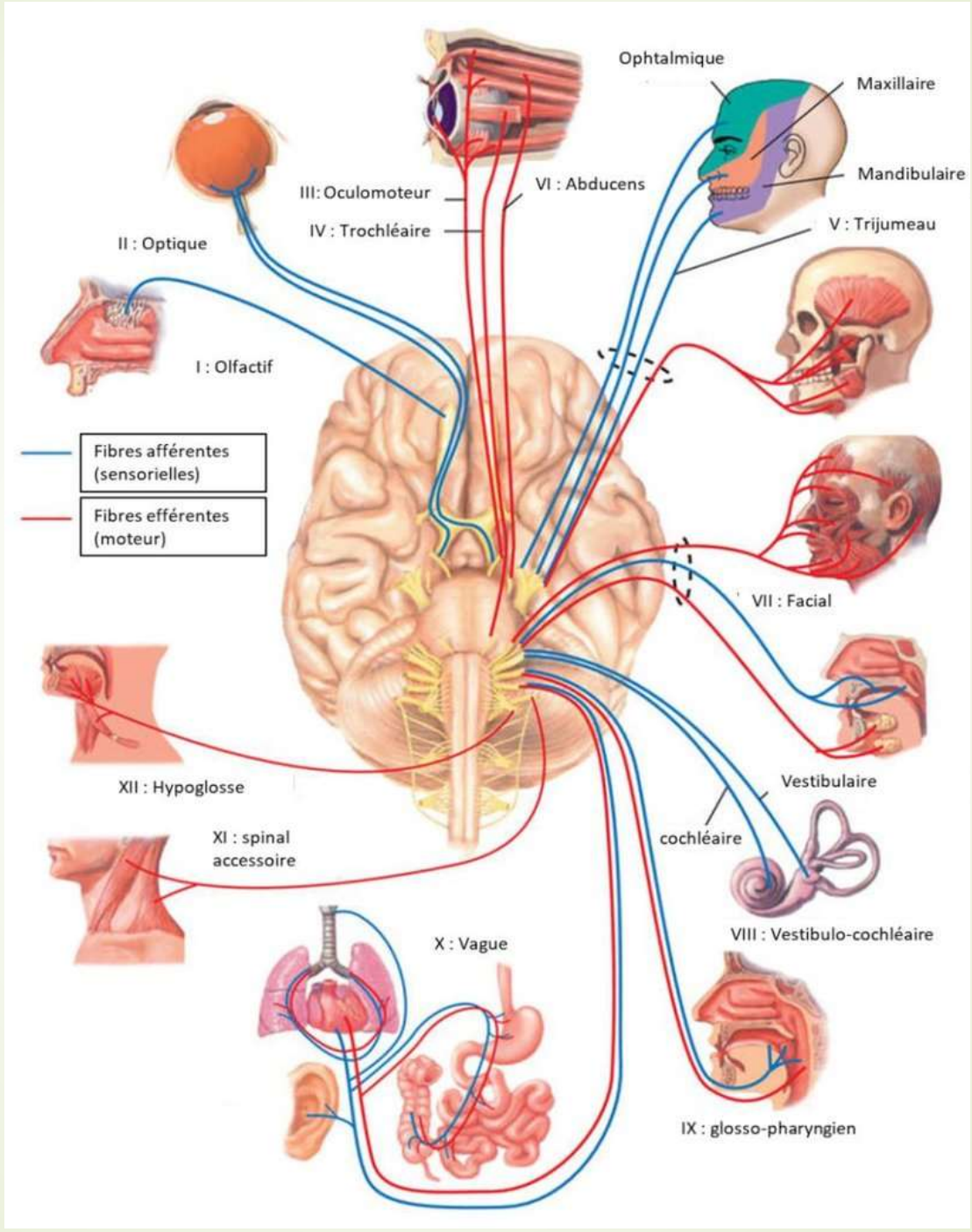
- Olfactory Nerve (I)
- Optic Nerve (II)
- Vestibulocochlear Nerve (VIII)

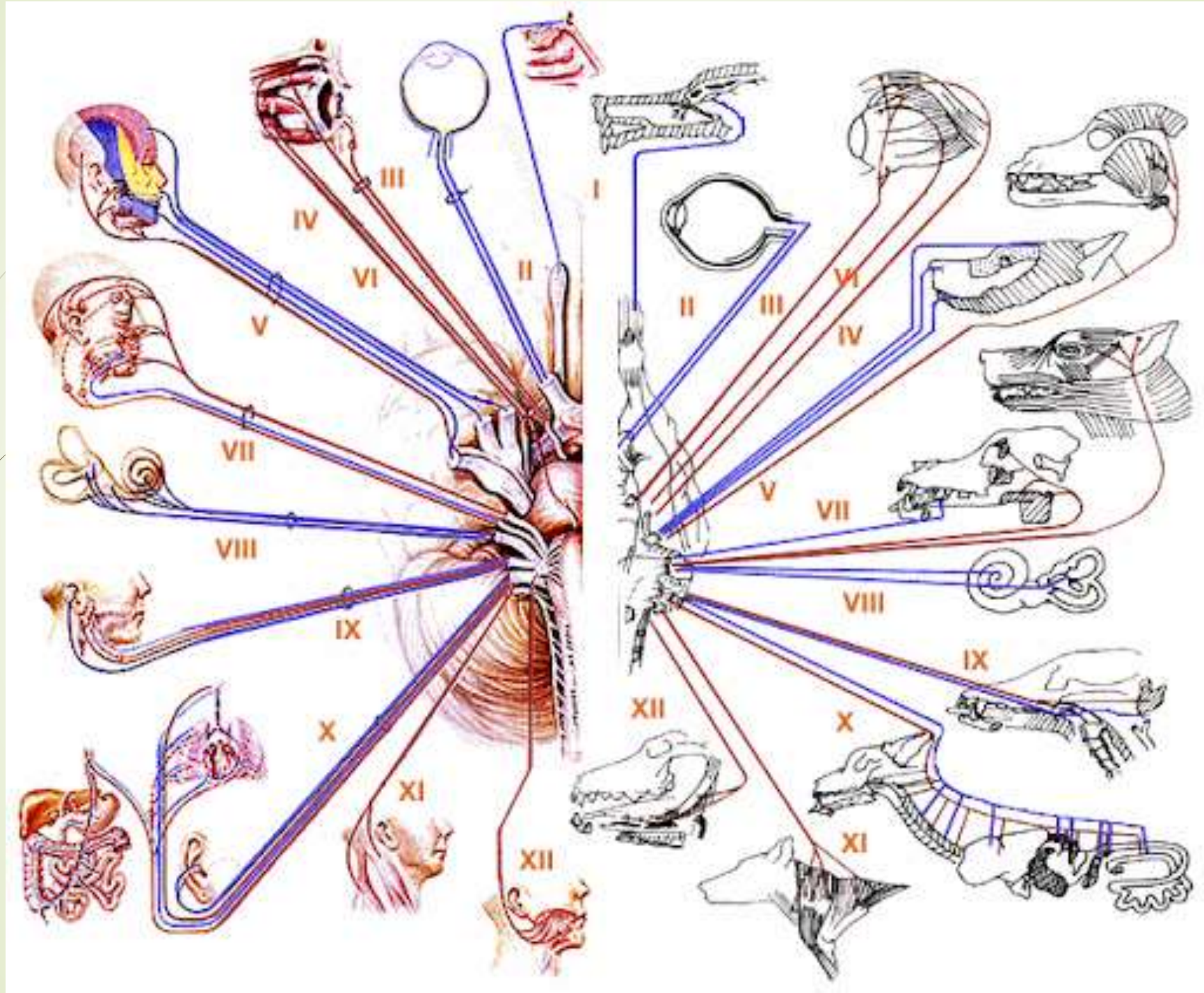
Motor Nerves

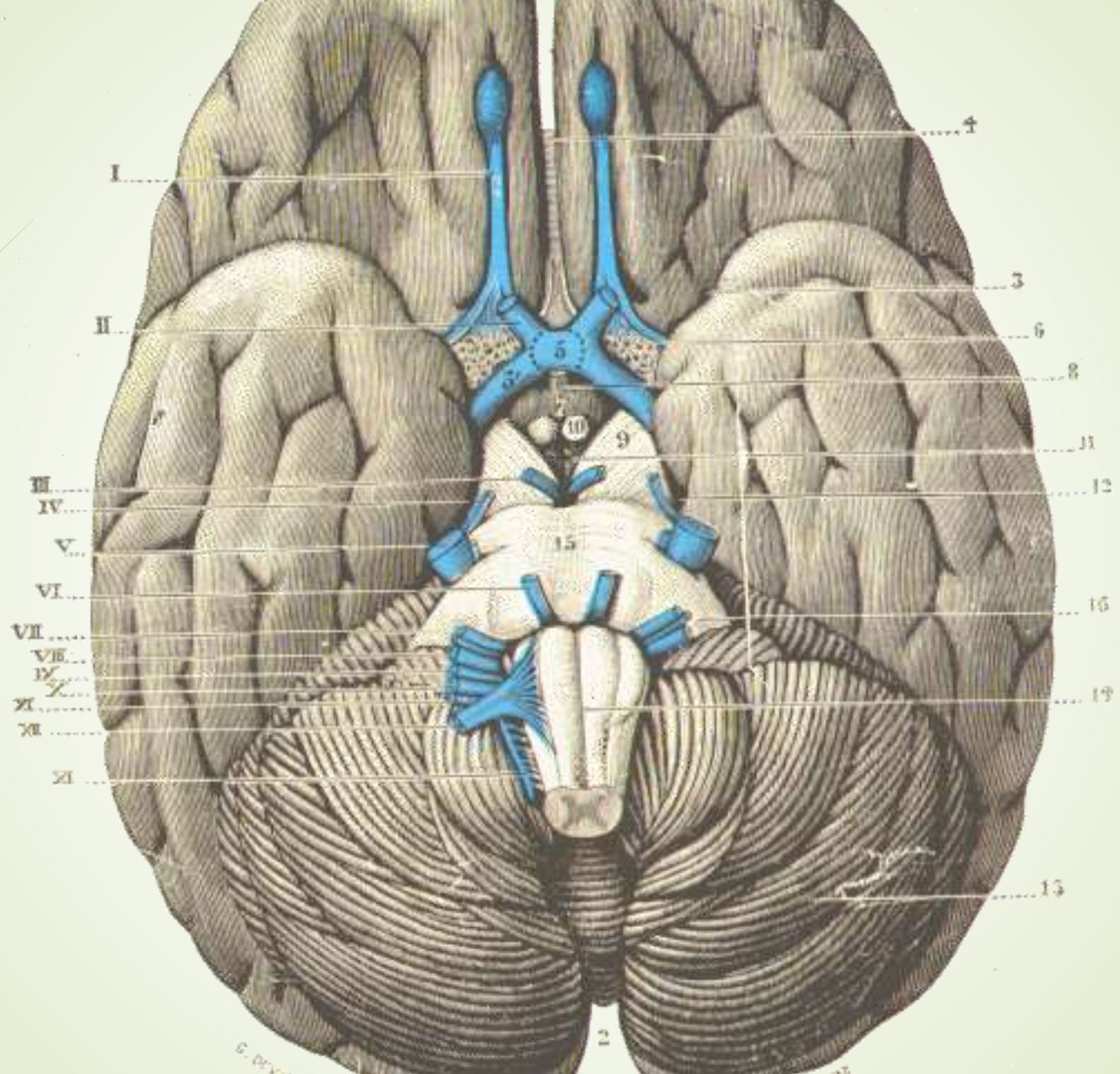
- Oculomotor Nerve (III)
- Trochlear Nerve (IV)
- Abducens Nerve (VII)
- Hypoglossal Nerve (XII)
- Accessory Nerve (XI)

Mixed Nerves

- Trigeminal Nerve (V)
- Facial Nerve (VII)
- Glossopharyngeal Nerve (IX)
- Vagus Nerve (X)
- Accessory Nerve (XI)


Ophtalmique
Maxillaire
Mandibulaire
III: Oculomoteur
VI : Abducens
IV : Trochléaire
V : Trijumeau
II : Optique
I : Olfactif
Fibres afférentes (sensorielles)
Fibres efférentes (moteur)
VII : Facial
XII : Hypoglosse
Vestibulaire
cochléaire
XI : spinal accessoire
VIII : Vestibulo-cochléaire
X : Vague
IX : glosso-pharyngien

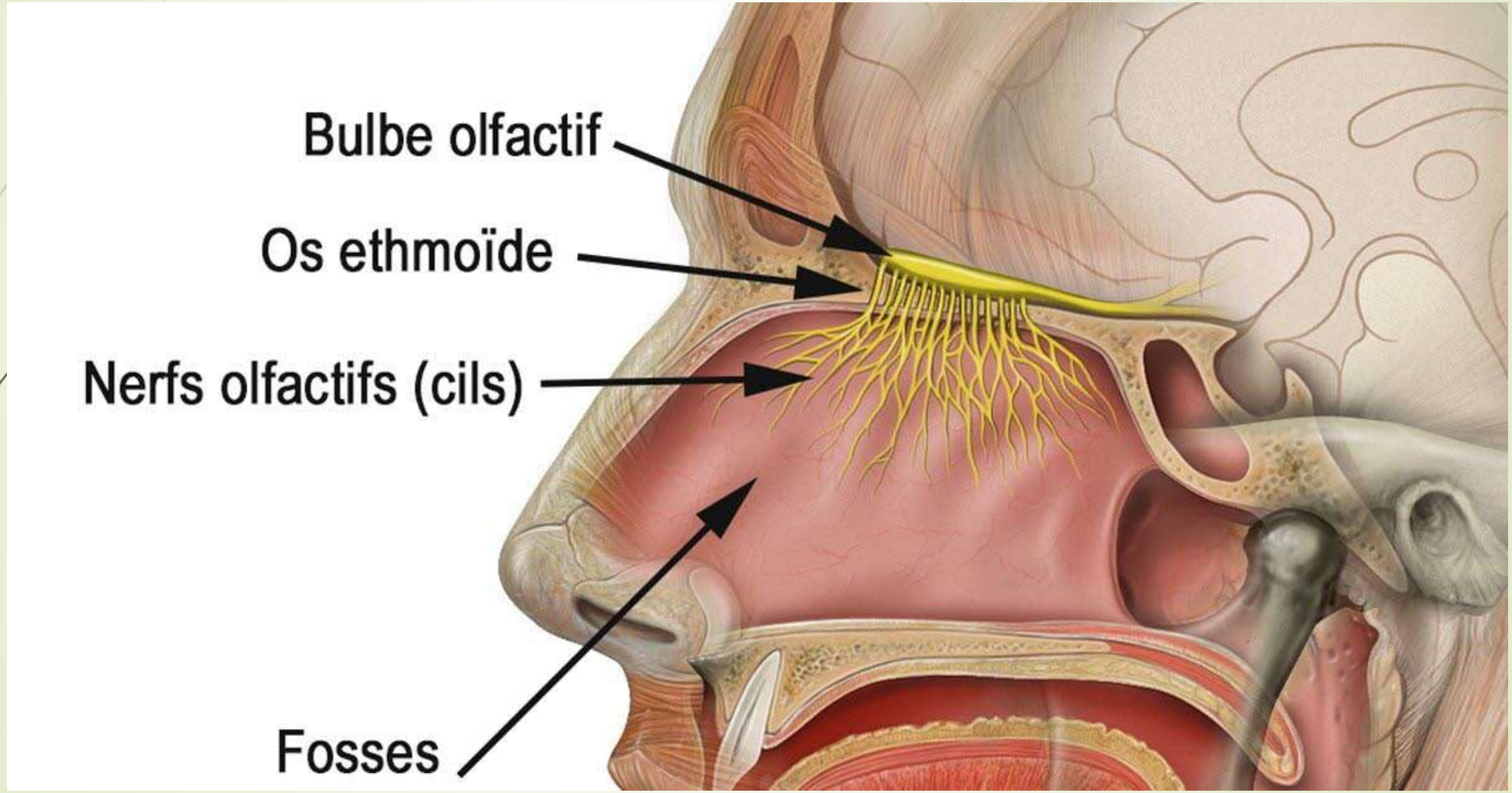

III
IV
VI
II
V
VII
VIII
IX
X
XI
XII
I
II
III
VI
IV
V
VII
VIII
IX
XII
X
XI

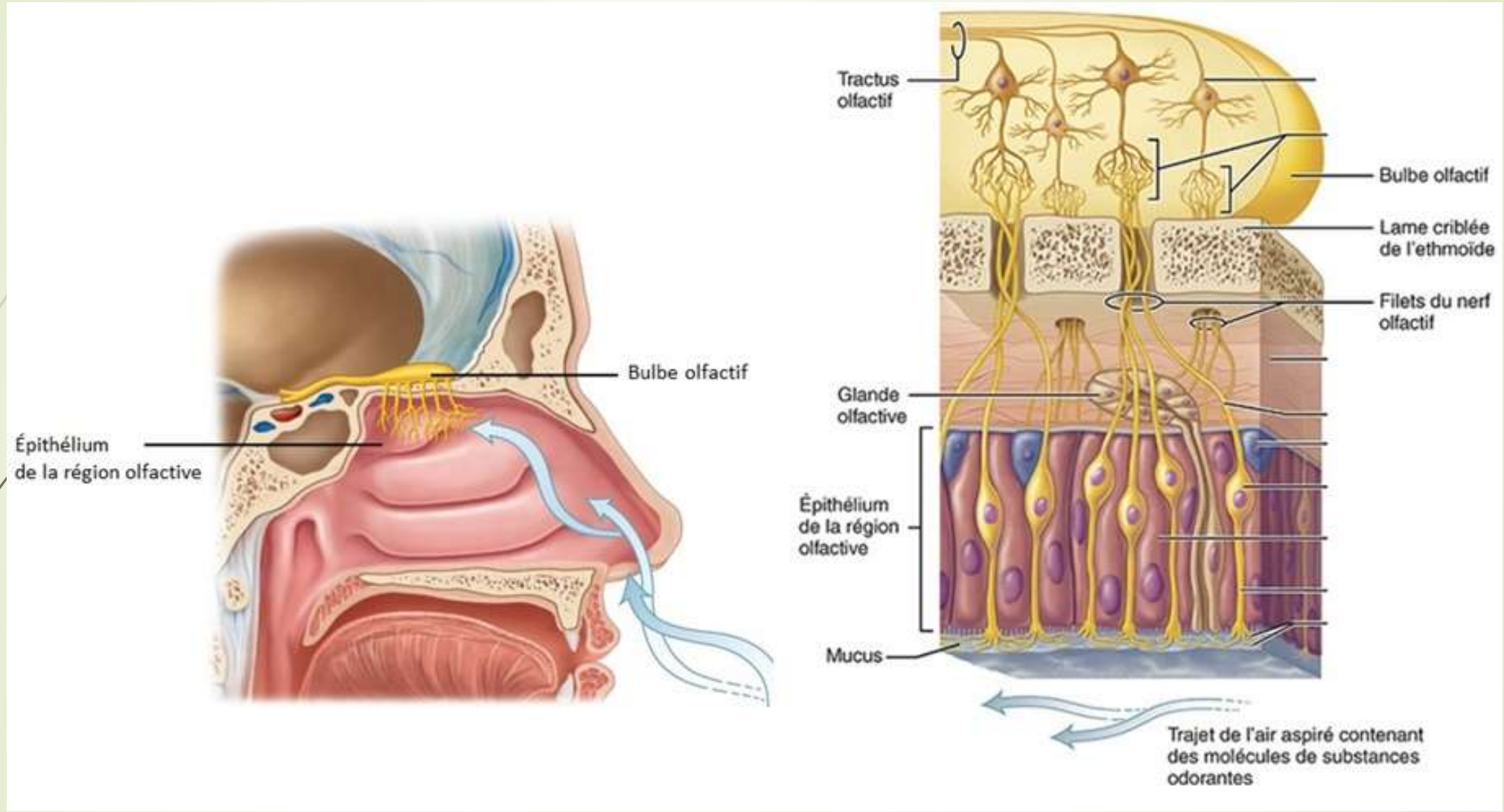

I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XI
4
3
6
8
11
12
16
18
13
2
5
9
10
15

The Olfactory Nerves (CN I)

- The olfactory nerves originate in the pituitary mucosa (olfactory epithelium). This mucosa is composed of olfactory neurosensory epithelial cells, which are a specific type of bipolar neurocytes (neurons). Their axons gather into small bundles to form the nerves, which pass through the foramina of the cribriform plate and reach the olfactory bulbs.

The Olfactory Nerves (CN I)

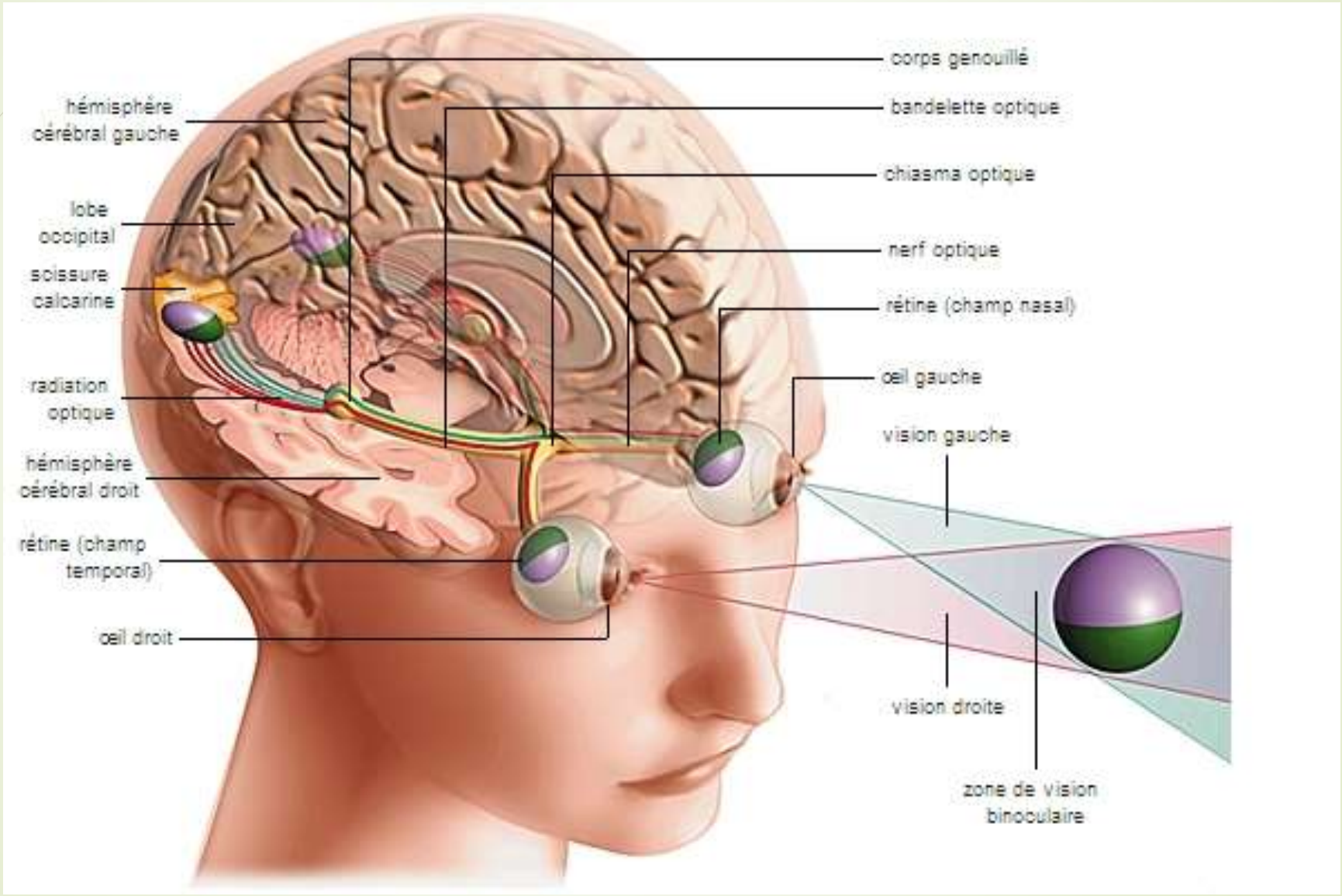


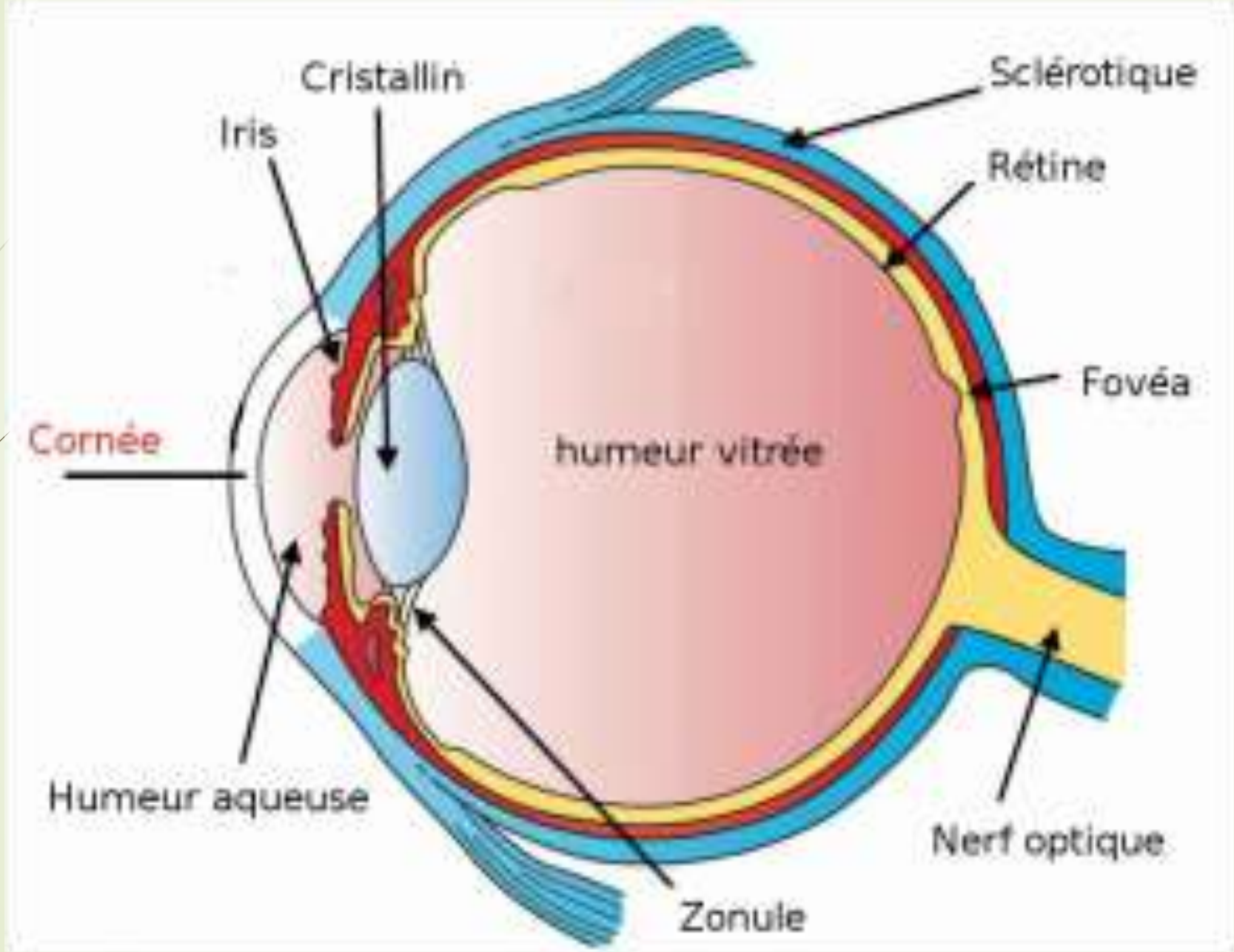

Bulbe olfactif
Épithélium
de la région olfactive
Tractus
olfactif
Bulbe olfactif
Lame criblée
de l'ethmoïde
Filets du nerf
olfactif
Glande
olfactive
Épithélium
de la région
olfactive
Mucus
Trajet de l'air aspiré contenant
des molécules de substances
odorantes

The Optic Nerve (CN II)

- The optic nerve appears to originate from the optic chiasm, which is its apparent origin. However, almost all of its fibers come from the multipolar neurocytes (ganglion cells) of the ganglionic layer of the retina, which constitutes its real origin.
- The nerve passes through the optic canal to enter the cranial cavity, where it has only a short path before reaching the optic chiasm.

The Optic Nerve (CN II)




Cristallin
Iris
Sclérotique
Rétine
Fovéa
Cornée
humeur vitrée
Humeur aqueuse
Nerf optique
Zonule

Oculomotor Nerve (CN III)

- The oculomotor nerve is distributed to all the striated muscles of the eye, with the exception of the dorsal oblique, the lateral rectus, and (in domestic mammals) the retractor bulbi.
- **Origin**: It emerges from the medial sulcus of the cerebral peduncle.
- **Exit**: It leaves the cranial cavity via the orbital fissure or the foramen orbito-rotundum, depending on the species.

Trochlear Nerve (CN IV)

- It is the smallest of the cranial nerves and is the motor nerve for a single muscle: the dorsal oblique muscle of the eye.
- Unique feature: It is the only nerve to emerge from the dorsal surface of the brainstem (specifically the caudal mesencephalic border).

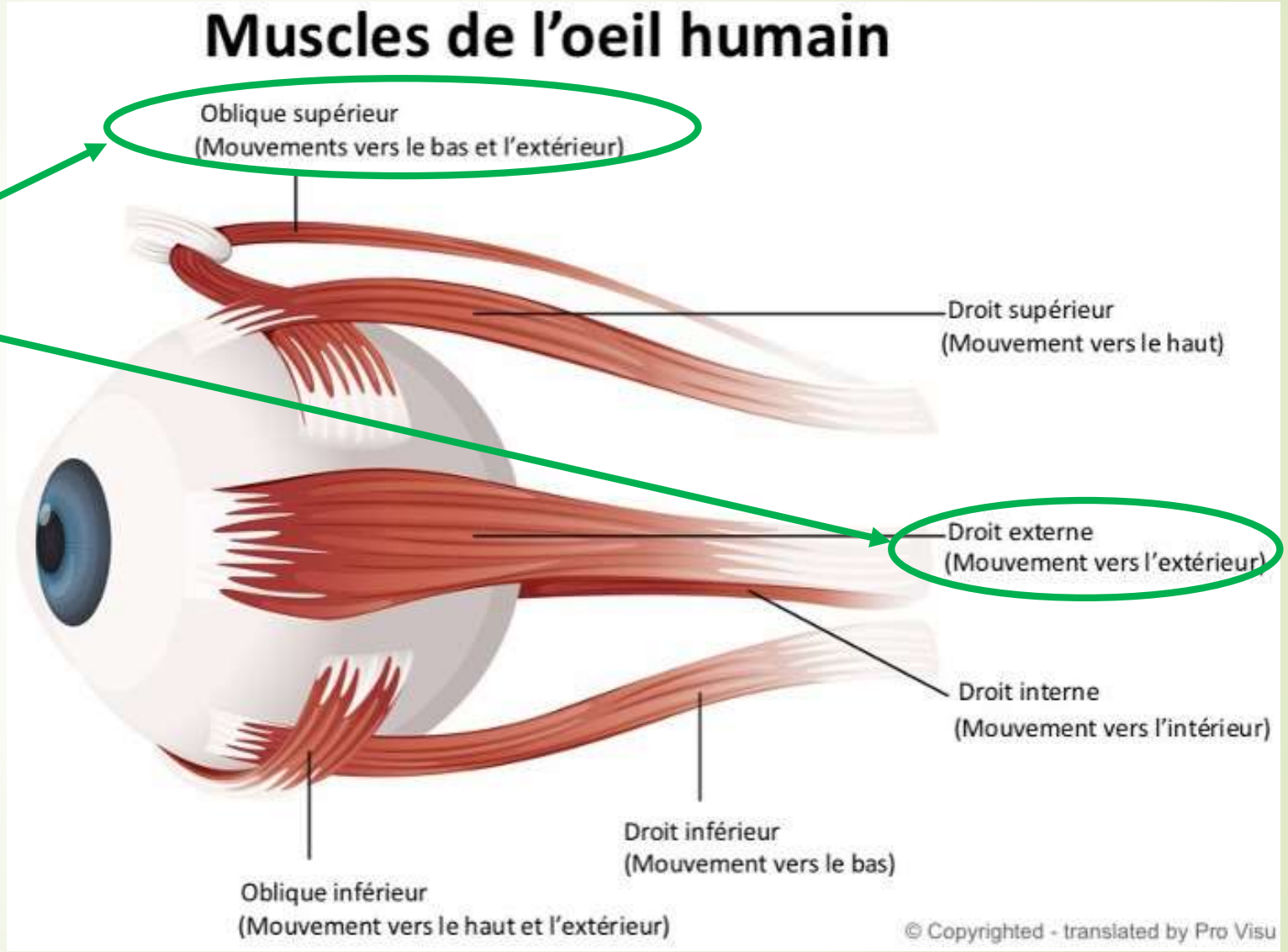
Abducens Nerve (CN VI)

- This nerve has the longest intracranial path. It emerges at the rostral end of the ventrolateral sulcus of the medulla oblongata. It enters the orbital fissure (or foramen orbito-rotundum) along with the other oculomotor nerves.
- Function: It innervates the lateral rectus muscle of the eye and the retractor bulbi muscle (which is absent in humans).

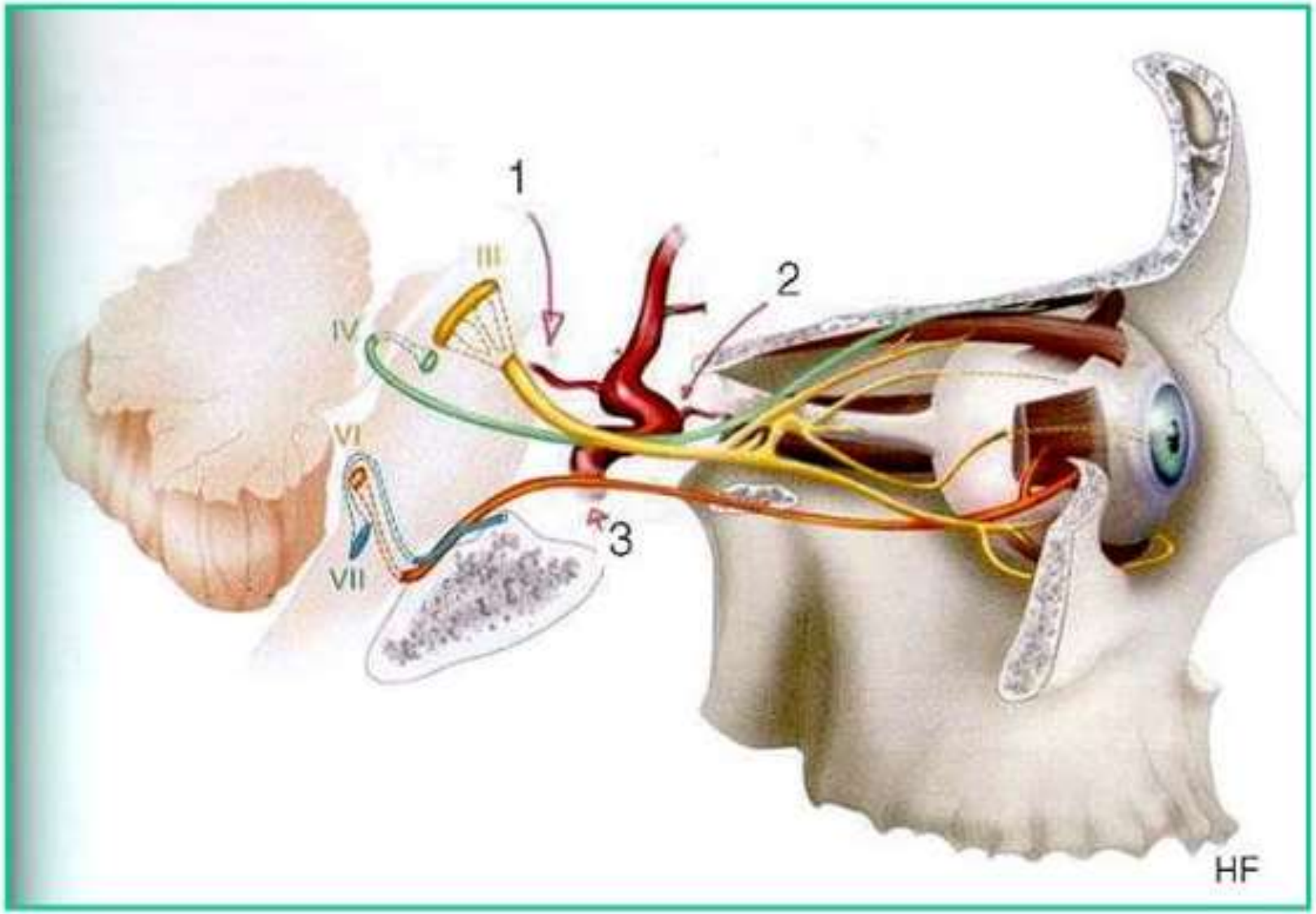
Oculomotor Nerve (III)

Trochlear Nerve (IV)

Abducens Nerve (VII)



Nerfs oculomoteurs: trajet



Trigeminal Nerve (CN V)

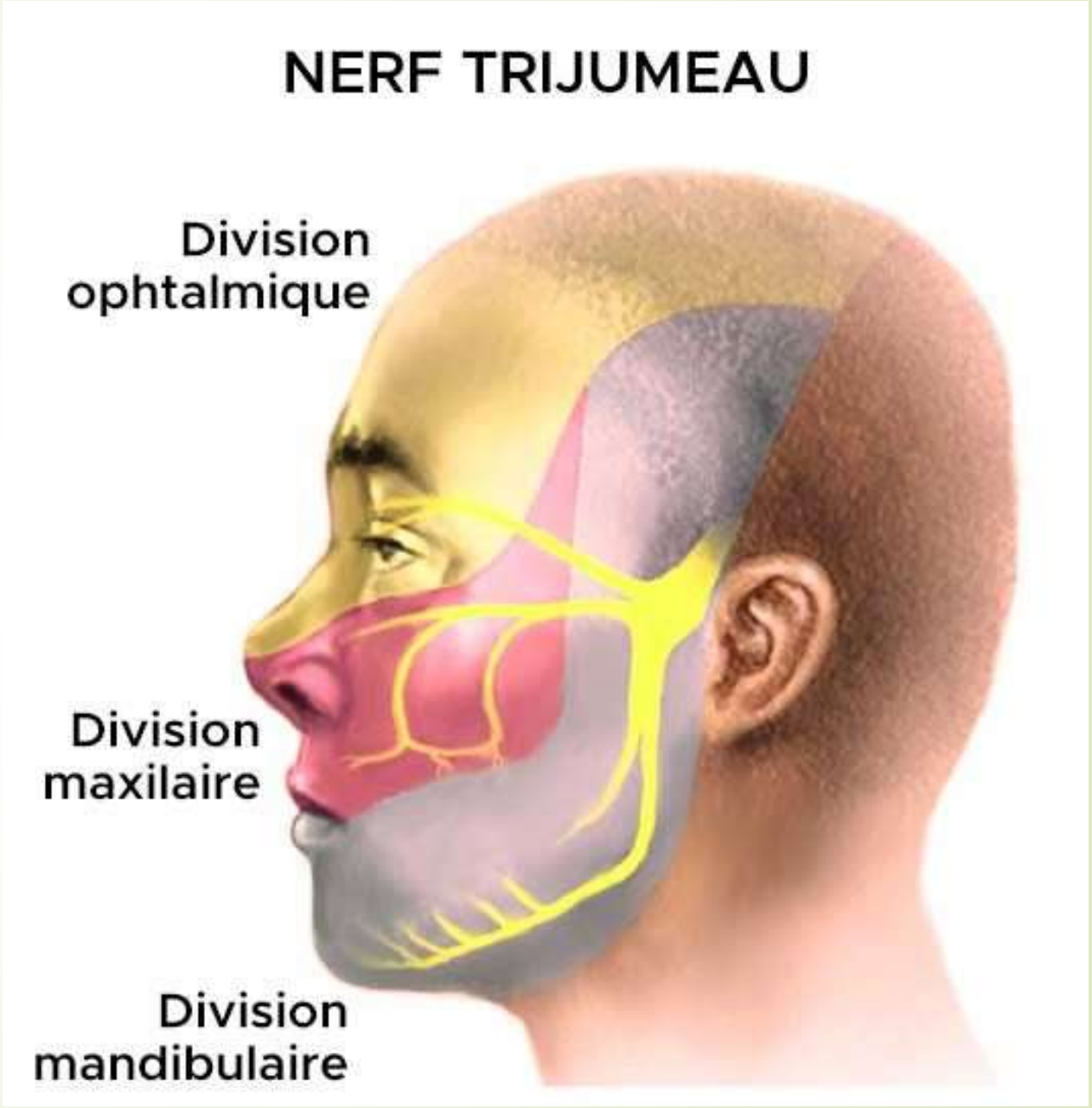
- This is the most voluminous (largest) of the cranial nerves. Its apparent origin is located on the side of the pons (cerebellopontine angle). It is a mixed nerve, formed by two closely joined but very unequal roots:

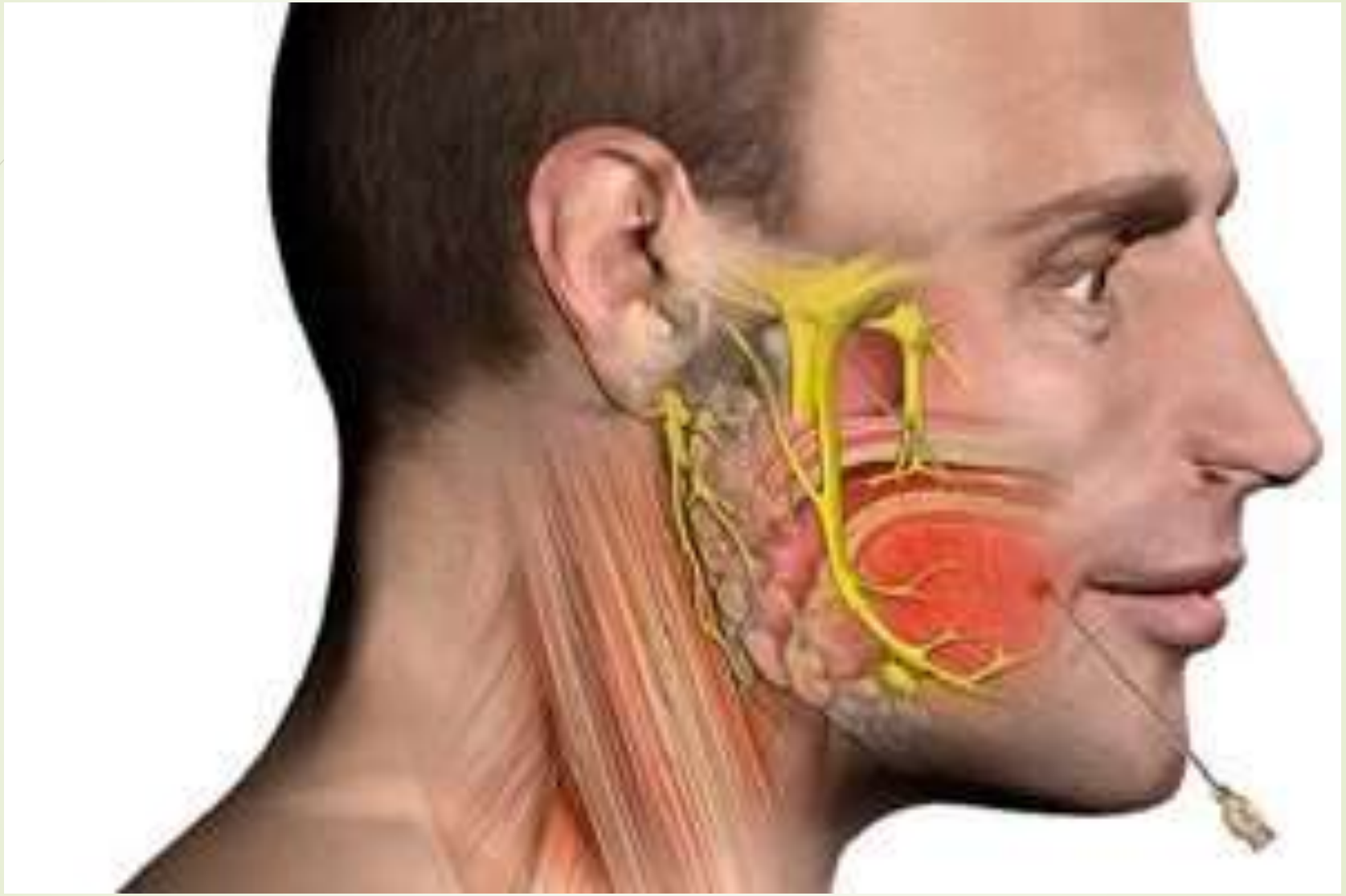
  Major Root (Sensory): The thick, dorsal part. It serves almost the entire corresponding half of the head and features a trigeminal ganglion formed by three nuclei.

  Minor Root (Motor): The ventro-medial part. It is distributed only to the muscles of mastication (chewing muscles) that bring the jaws together.

- The trigeminal nerve is so named because its sensory part divides into three primary levels of the face:
  - **Ophthalmic Nerve (V1)**
  - **Maxillary Nerve (V2)**
  - **Mandibular Nerve (V3)**

- **Sensory Root**
  - **Ophthalmic Nerve** (V1)
  - **Maxillary Nerve** (V2)
  - **Mandibular Nerve** (V3)
- **Motor Root**





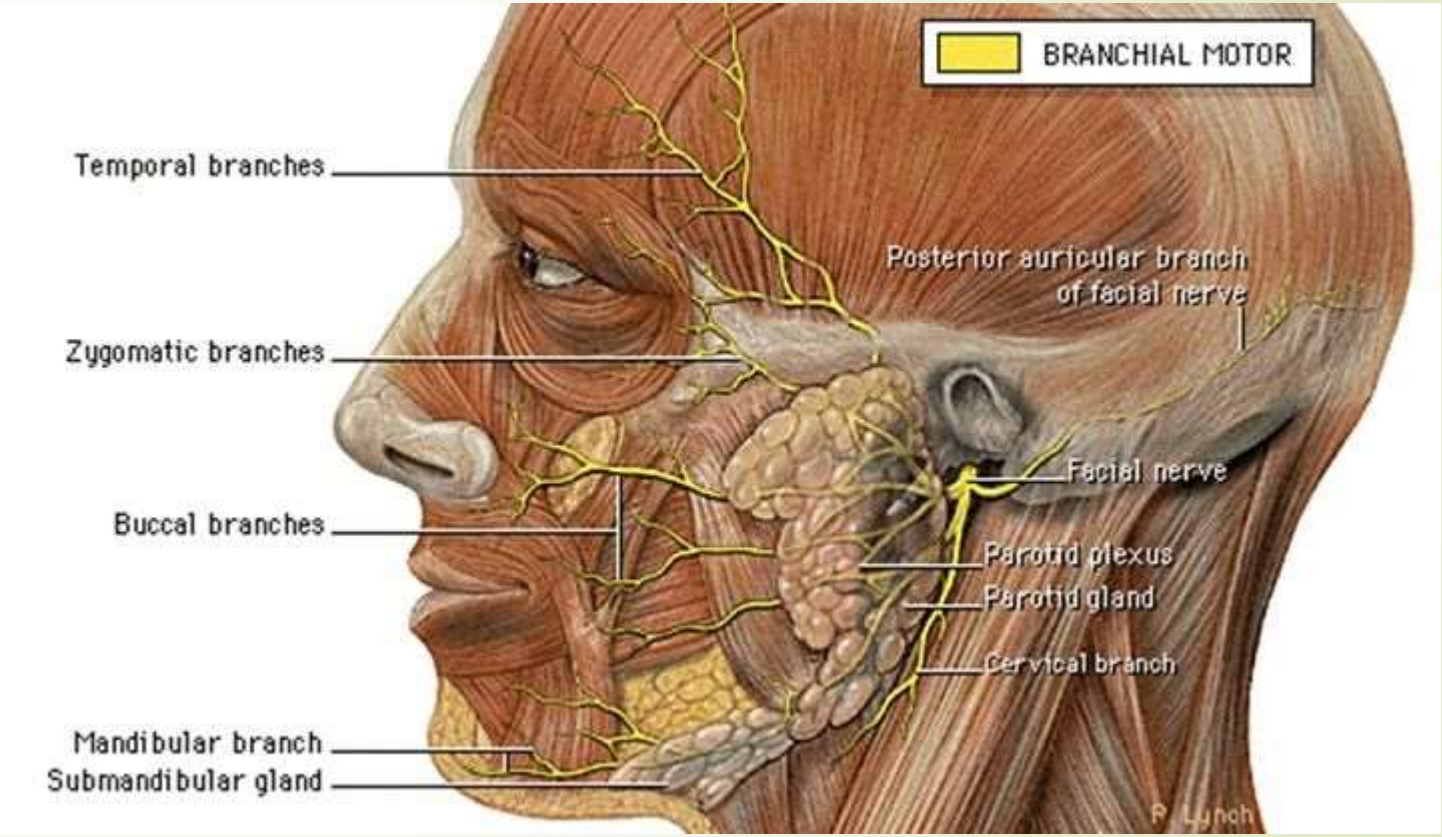
Intermedio-facial Nerve (CN VII)

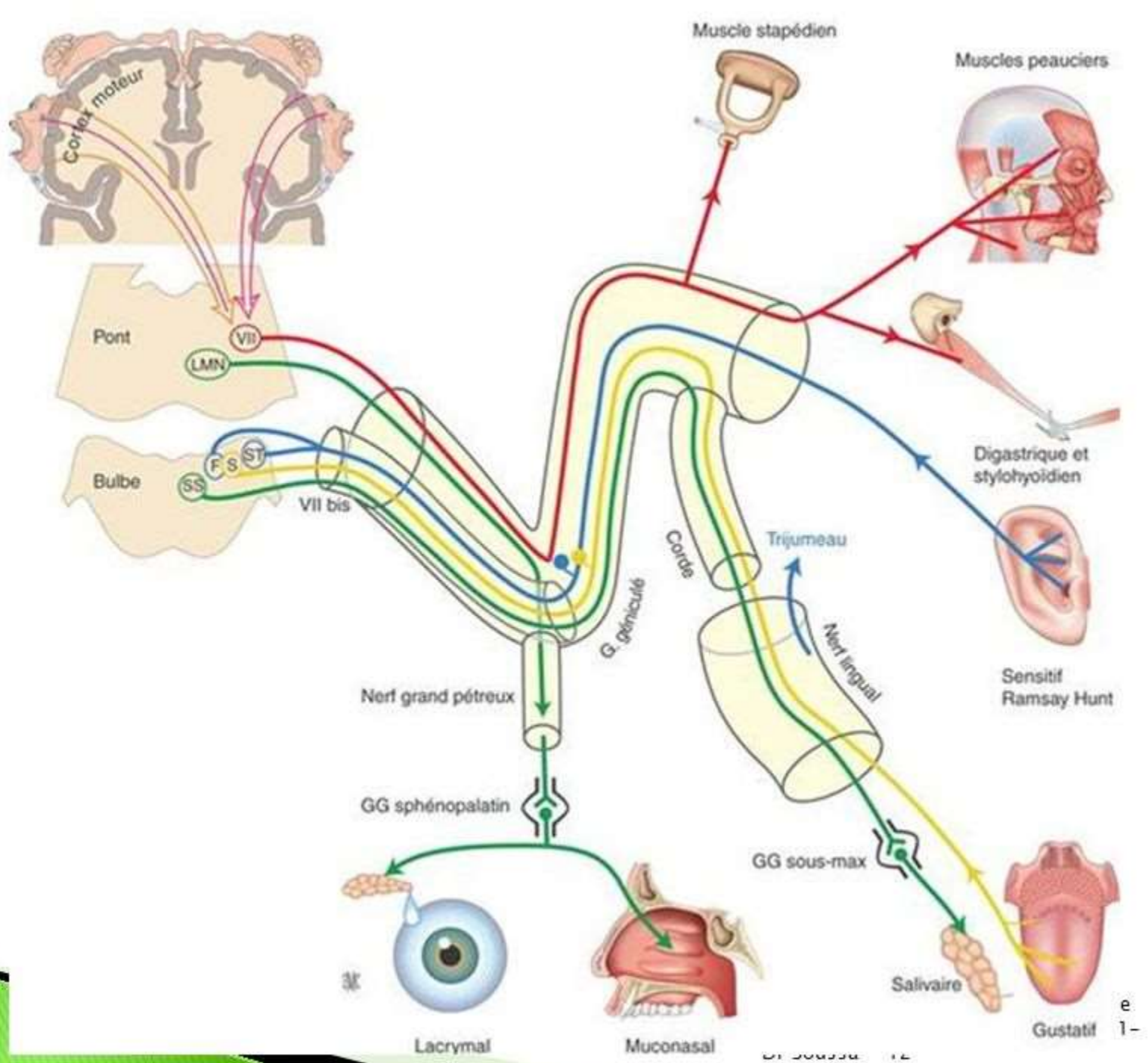
- The intermedio-facial nerve is a mixed nerve composed of two functionally distinct parts:
- Facial Nerve (proper): The larger motor component, responsible for the muscles of facial expression.
- Intermediate Nerve (Nervus intermedius): A much thinner sensory part, primarily dedicated to gustation (taste).
- Both components carry parasympathetic fibers.

- **Functions**:
  - The intermediate nerve provides cutaneous sensitivity to part of the external ear and gustatory (taste) sensation to the anterior two-thirds of the tongue.
  - The facial nerve fibers innervate the superficial cutaneous muscles of the face and the auricular (ear) muscles.
- **Apparent Origin**: Located at the lateral extremity of the trapezoid body.

Intermedio-facial Nerve (CN VII)

- **Motor root : the facial nerve**
- **Sonsory root : the intermediate nerve**

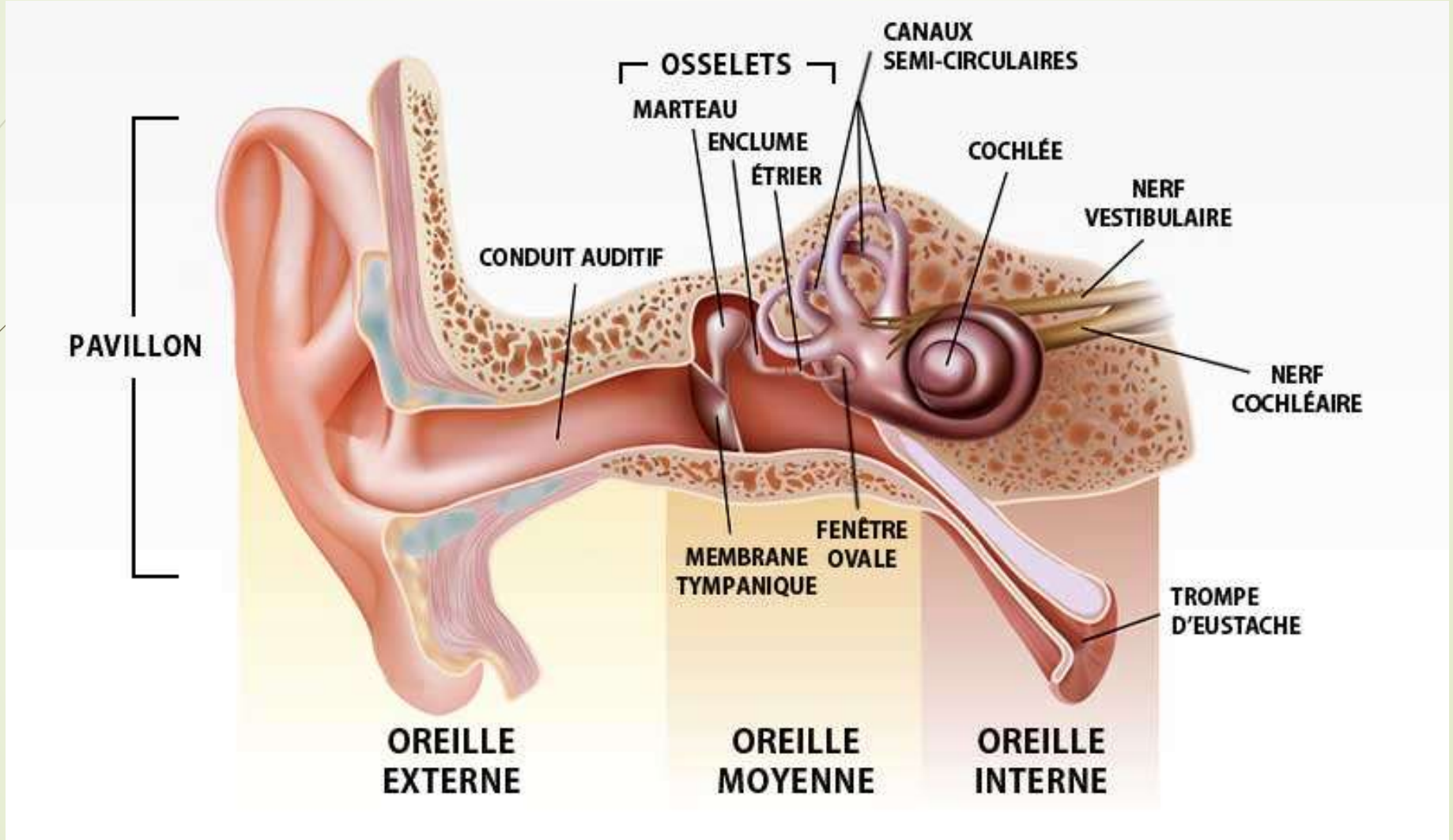


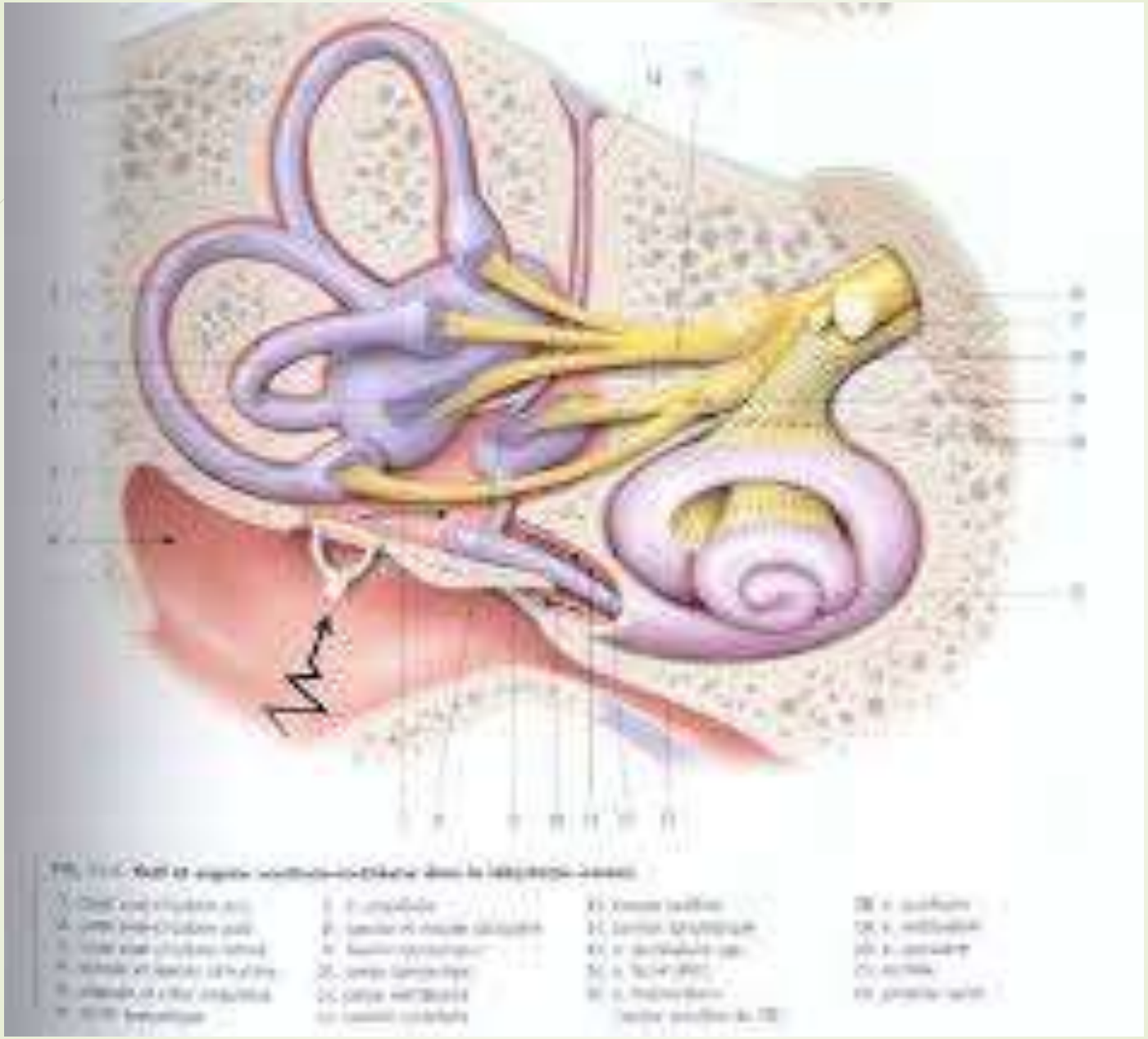

Muscle stapédien
Muscles peauciers
Cortex moteur
Pont
VII
LMN
Bulbe
SS
F
S
ST
VII bis
Digastrique et stylohyoïdien
Trijumeau
Corde
G. géniculé
Nerf lingual
Sensitif
Ramsay Hunt
Nerf grand pétreux
GG sphénopalatin
GG sous-max
Salivaire
Gustatif
Lacrymal
Muconasal

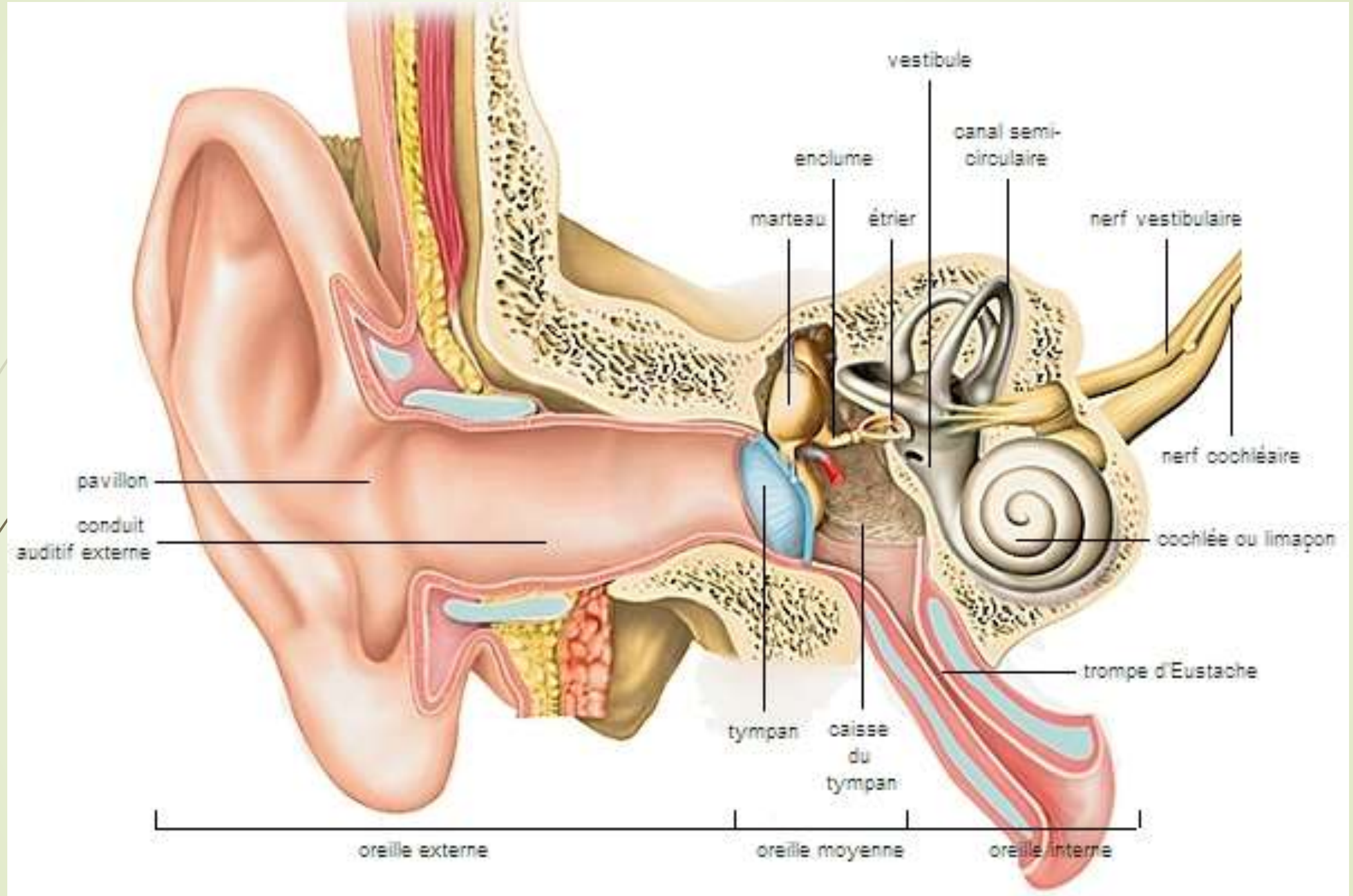
Vestibulocochlear Nerve (CN VIII)

- It is a purely sensory nerve that serves the inner ear. It consists of two distinct parts associated only by their topography:
  - **Cochlear Nerve:** Dedicated to hearing; it originates in the cochlea.
  - **Vestibular Nerve**: Dedicated to balance (equilibrium).
- **Path**: It emerges at the lateral extremity of the trapezoid body and enters the internal acoustic meatus, dividing within the membranous labyrinth.
- **Real Origin**: The cochlear nerve originates in the spiral ganglion of the cochlea, while the vestibular nerve originates in the vestibular ganglion (located within the nerve itself).

Vestibulocochlear Nerve (CN VIII)



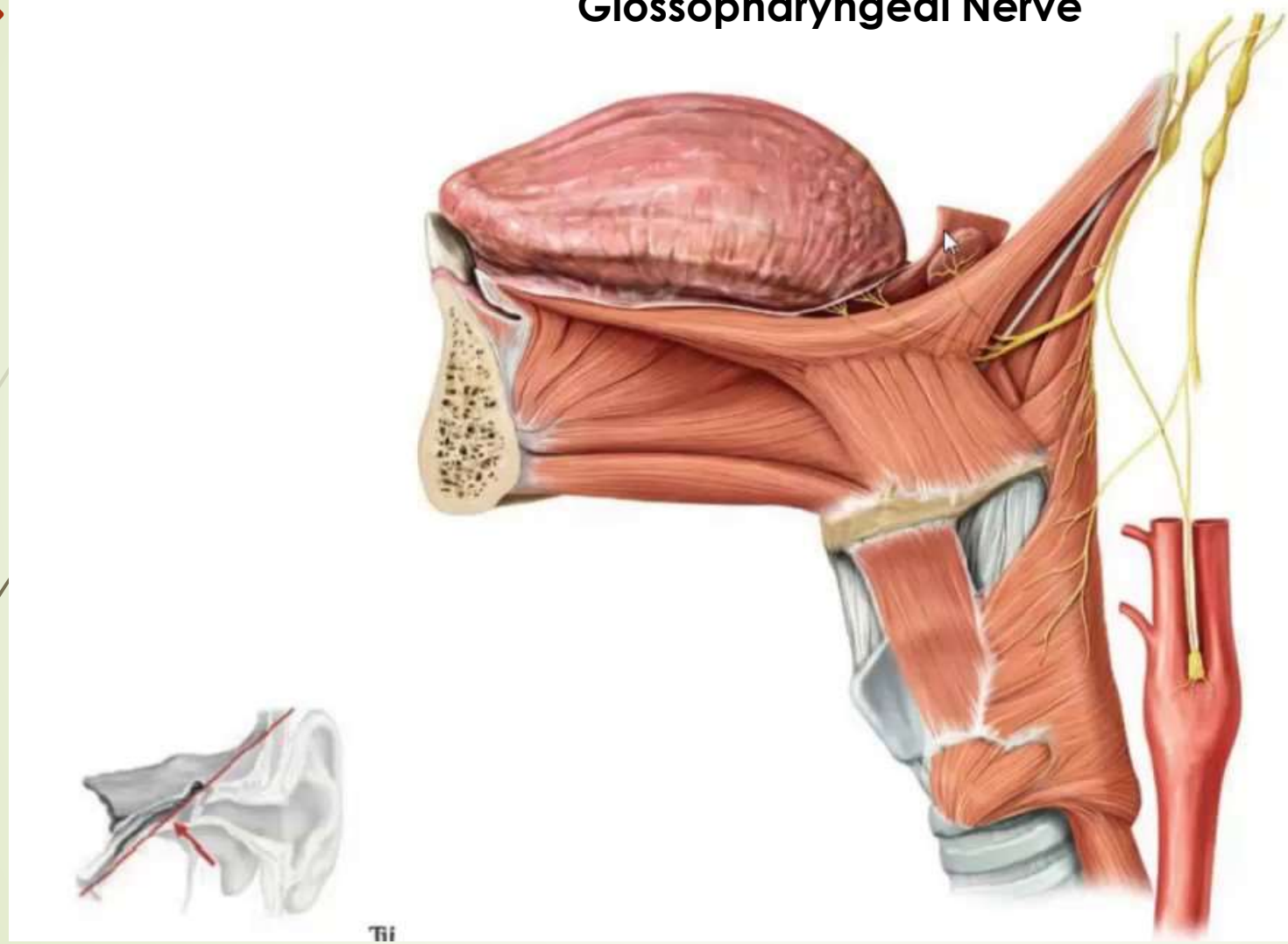


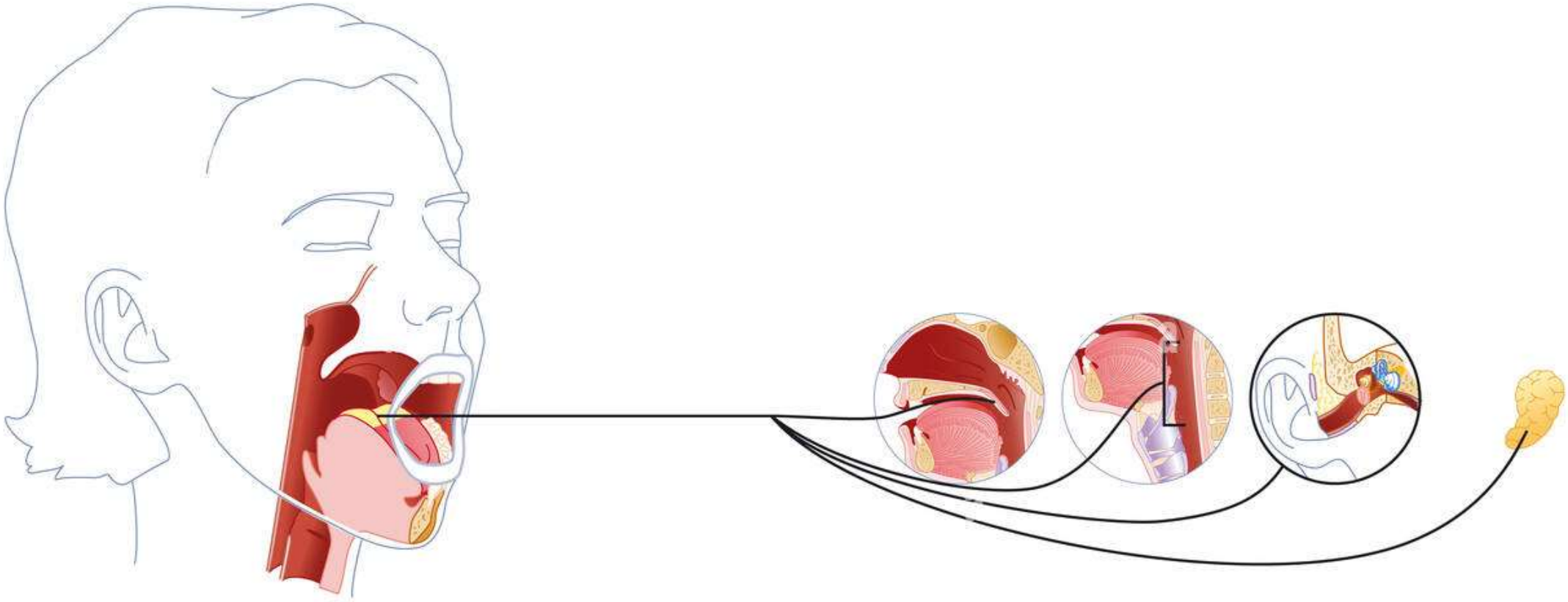

vestibule
canal semi-circulaire
enclume
marteau
étrier
nerf vestibulaire
nerf cochléaire
pavillon
conduit auditif externe
cochlée ou limaçon
trompe d'Eustache
tympan
caisse du tympan
oreille externe
oreille moyenne
oreille interne

Glossopharyngeal Nerve (CN IX)

- A mixed nerve containing three fiber types: sensory, motor, and parasympathetic. It serves the junction of the head and neck (extending from the root of the tongue and soft palate to the caudal pharynx) and the middle ear.
- **Origin & Exit**: It emerges from the rostral part of the dorsolateral sulcus of the medulla oblongata. It exits the skull through the jugular foramen alongside the vagus group.

Glossopharyngeal Nerve

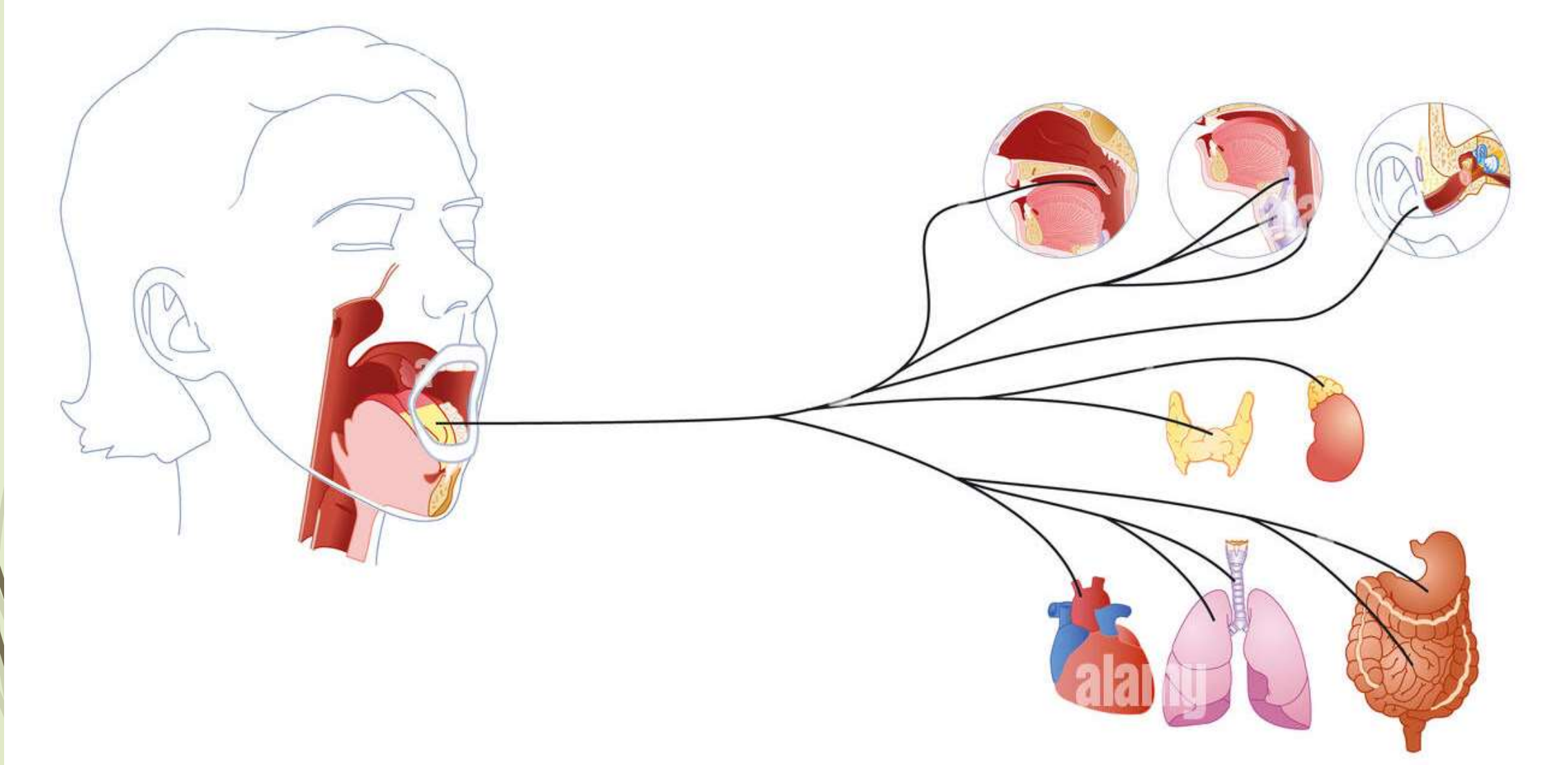


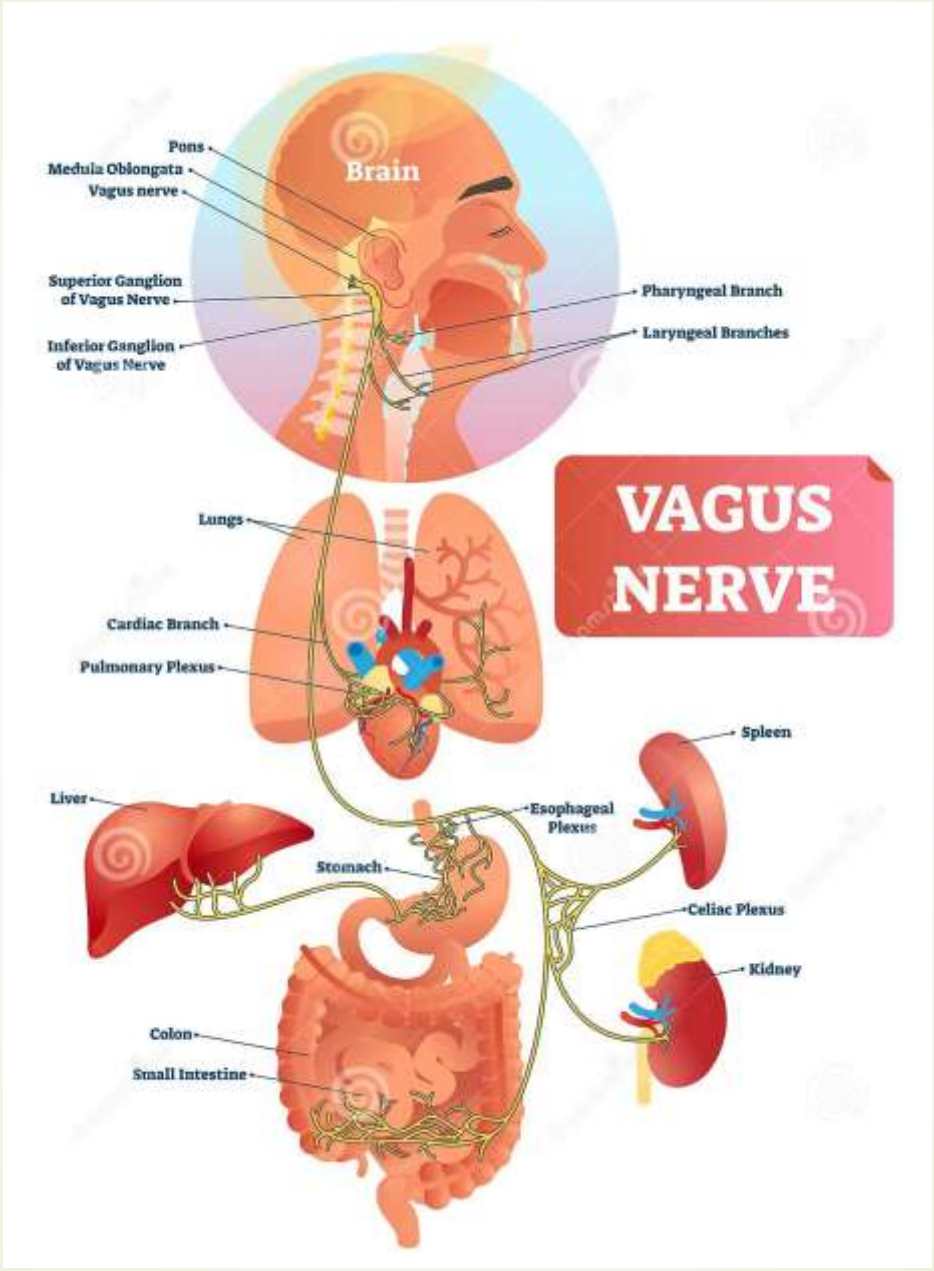


The Glossopharyngeal Nerves -IX

Vagus Nerve (CN X)

- Formerly known as the "pneumogastric nerve," it is mixed, but its autonomic (vegetative) component is predominant. It innervates most viscera and constitutes the most extensive part of the cranial parasympathetic system (cervico-thoraco-abdomino-pelvic).
- **Origin**: It appears as a series of rootlets in the dorsolateral sulcus of the medulla oblongata.
- **Distribution**: Motor and sensory fibers provide innervation to the muscles of the pharynx, larynx, and external acoustic meatus. The parasympathetic fibers are destined for most visceral organs.



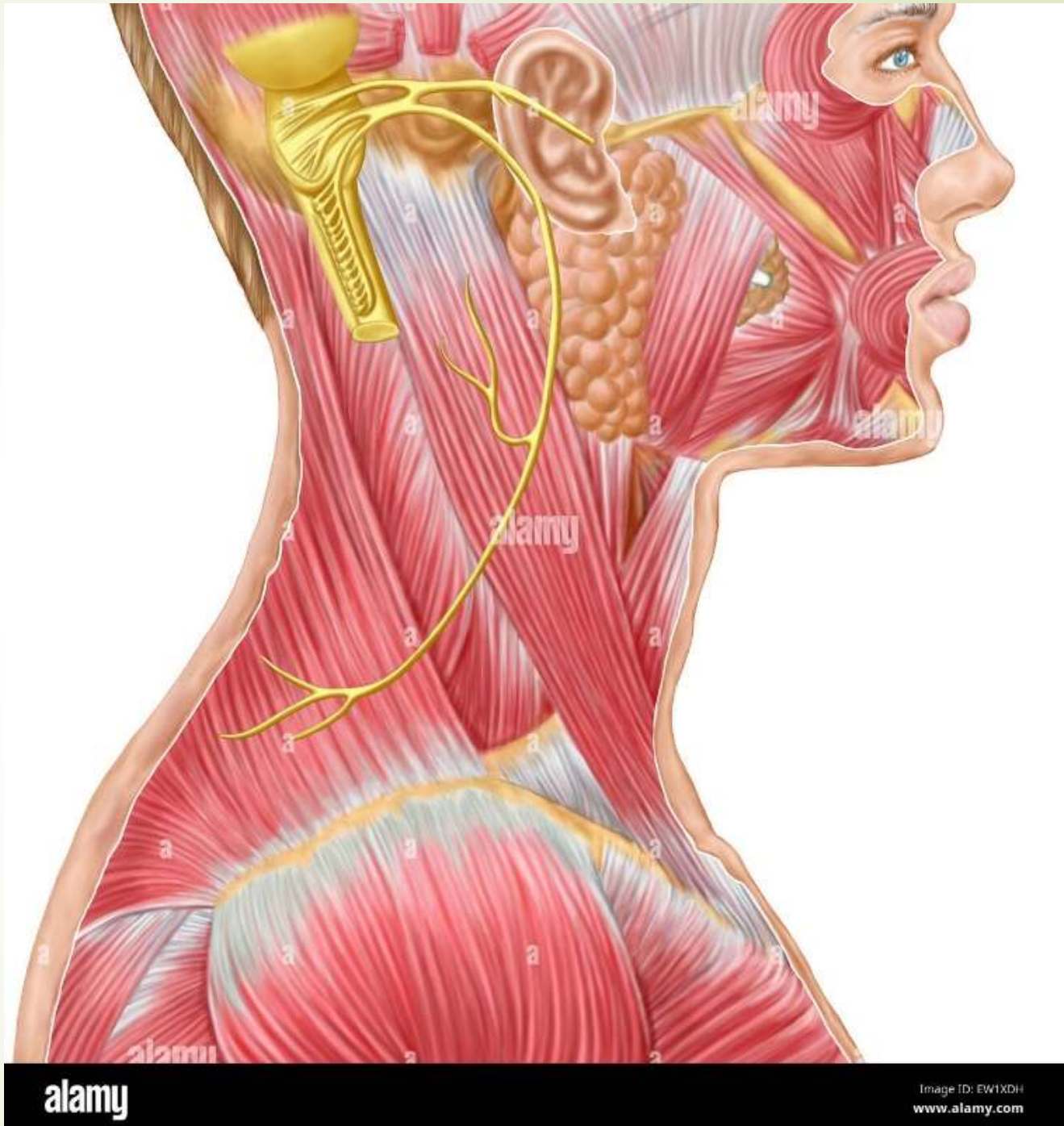

Brain
Pons
Medula Oblongata
Vagus nerve
Superior Ganglion of Vagus Nerve
Inferior Ganglion of Vagus Nerve
Pharyngeal Branch
Laryngeal Branches
VAGUS NERVE
Lungs
Cardiac Branch
Pulmonary Plexus
Spleen
Liver
Esophageal Plexus
Stomach
Celiac Plexus
Kidney
Colon
Small Intestine

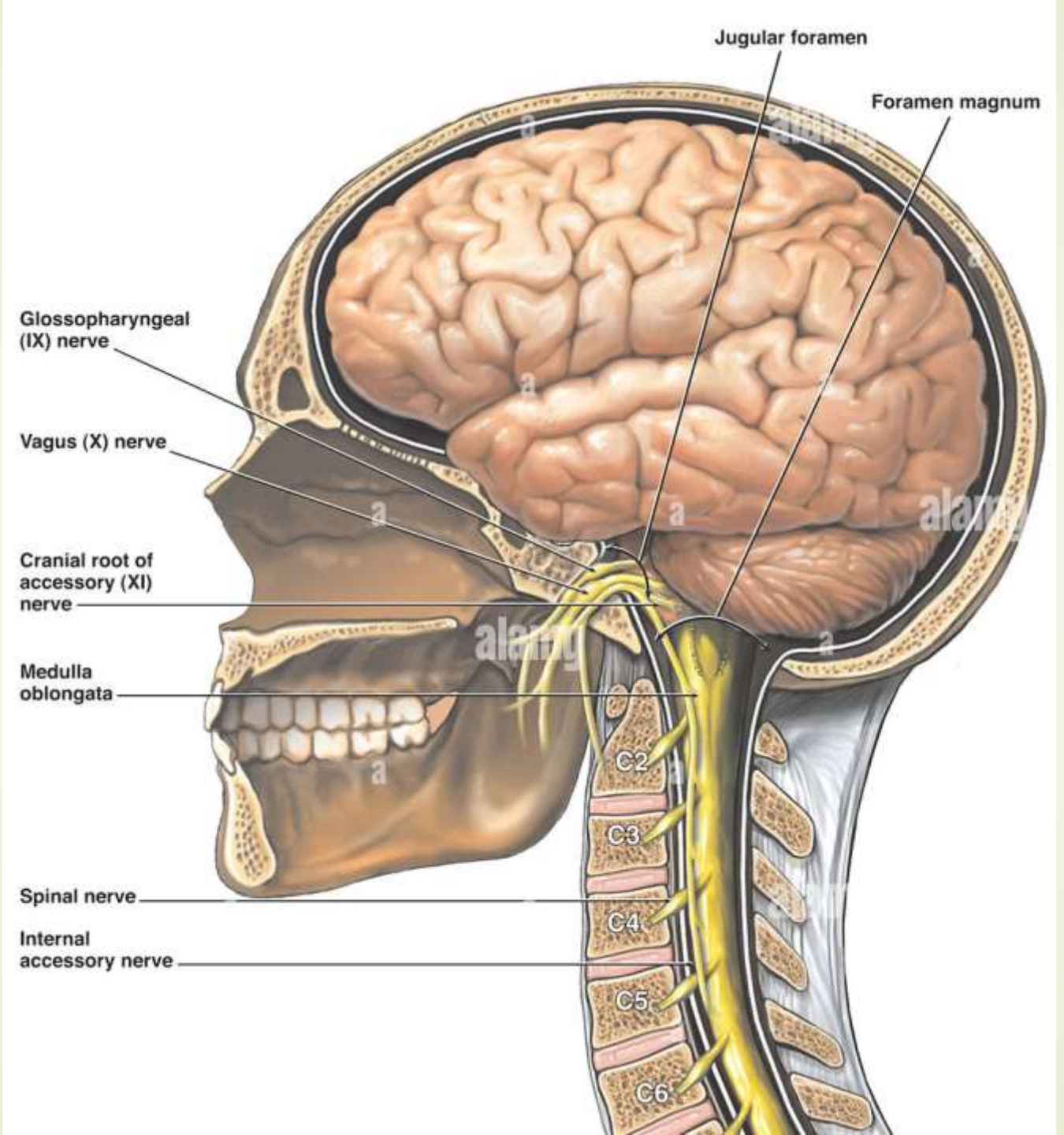
Accessory Nerve (CN XI)

- Formerly called the "spinal nerve" due to its primary root's arrangement, it is purely motor. It is a "hybrid" formed by two roots:
  - **Cranial (Medullary) Root**: Emerges from the dorsolateral sulcus.
  - **Spinal Root**: Longer, collecting fibers from almost all cervical segments of the spinal cord.

- After a short path together, they exit the jugular foramen and divide into two branches:
  - **Internal Branch:** Joins the vagus nerve (hence the name "accessory" to the vagus).
  - **External Branch**: Formed by the spinal portion, it continues toward the muscles of the neck (encolure in veterinary anatomy).

Accessory Nerve

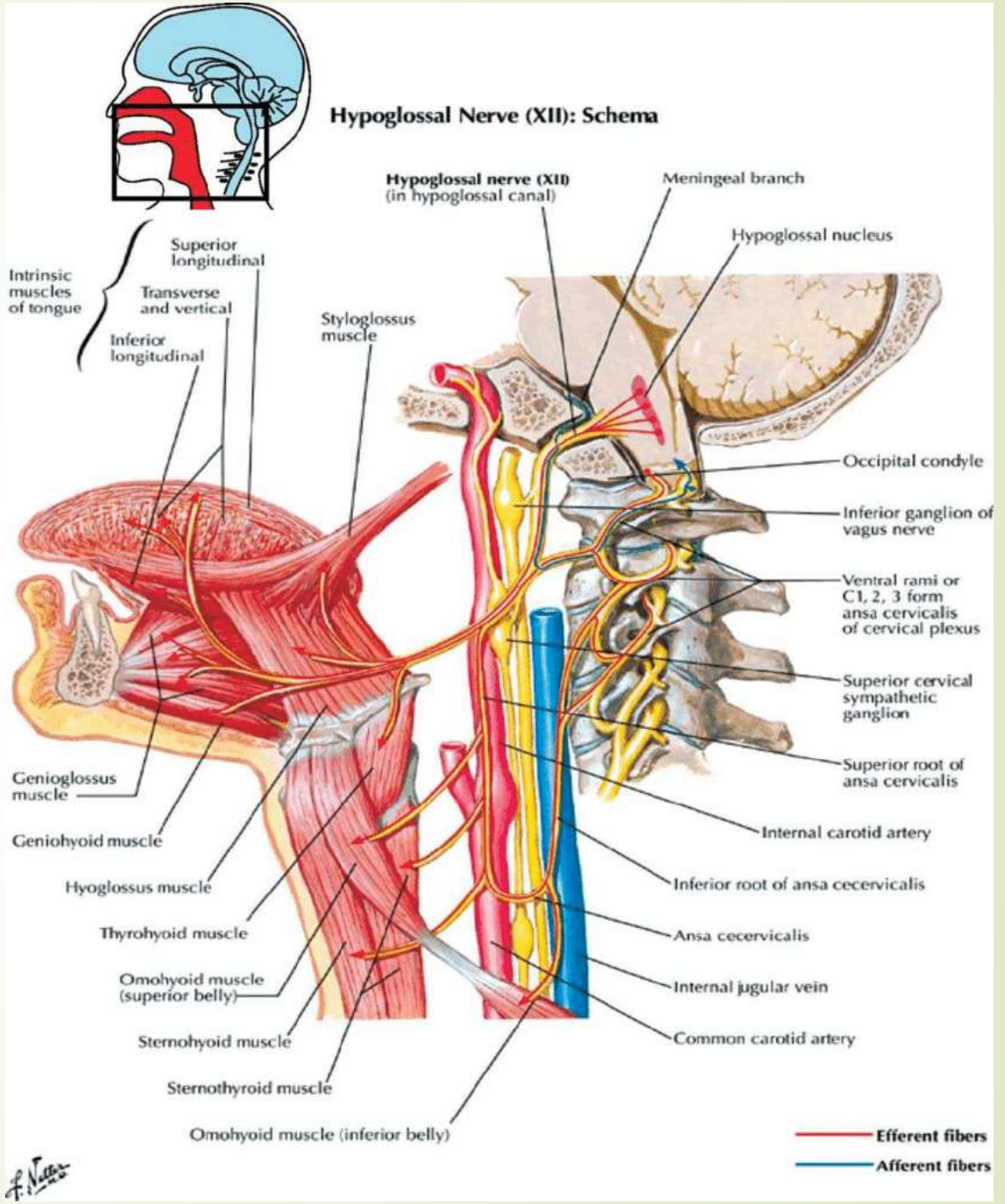


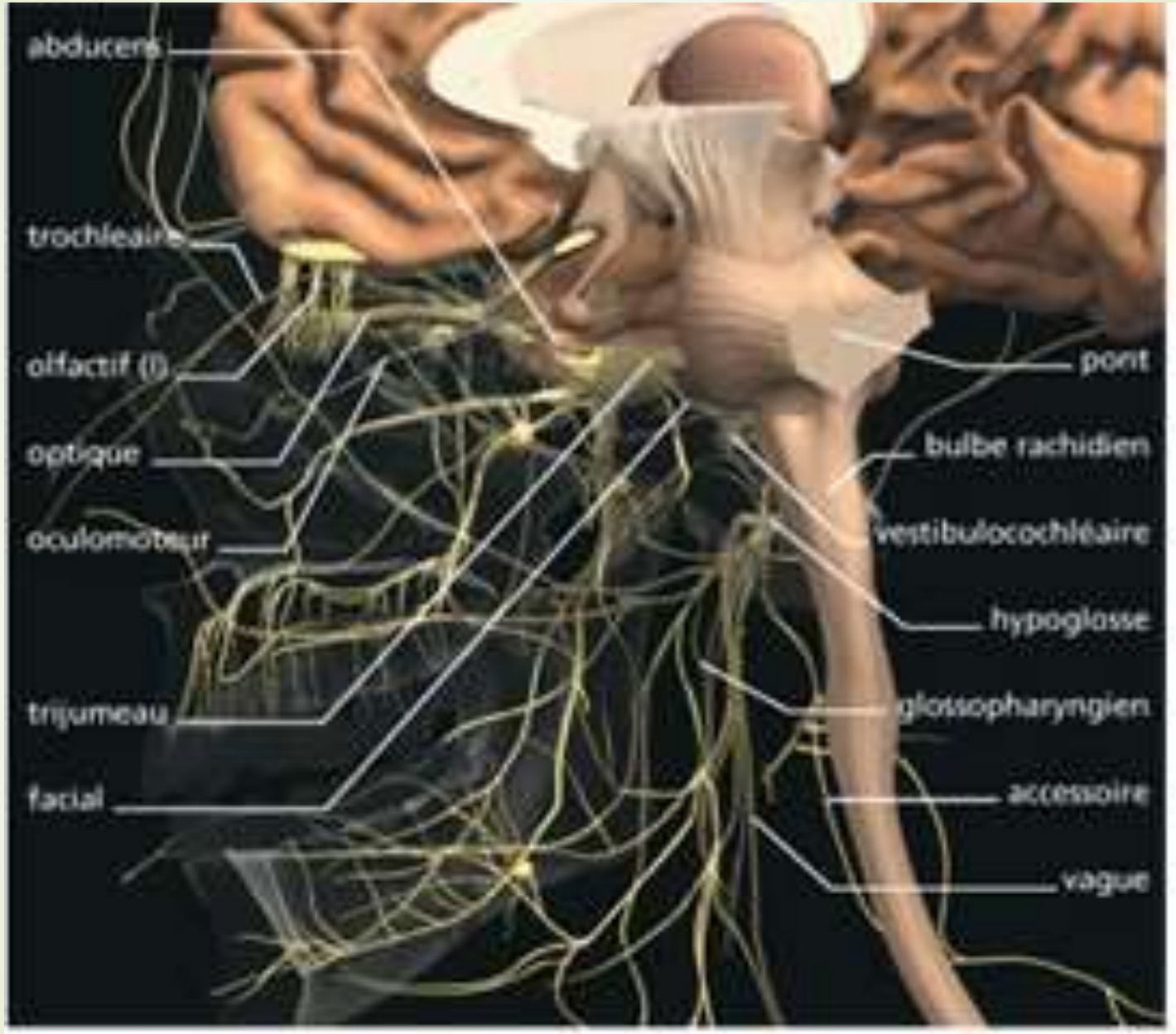

Jugular foramen
Foramen magnum
Glossopharyngeal (IX) nerve
Vagus (X) nerve
Cranial root of accessory (XI) nerve
Medulla oblongata
C2
C3
Spinal nerve
C4
Internal accessory nerve
C5
C6

Hypoglossal Nerve (CN XII)

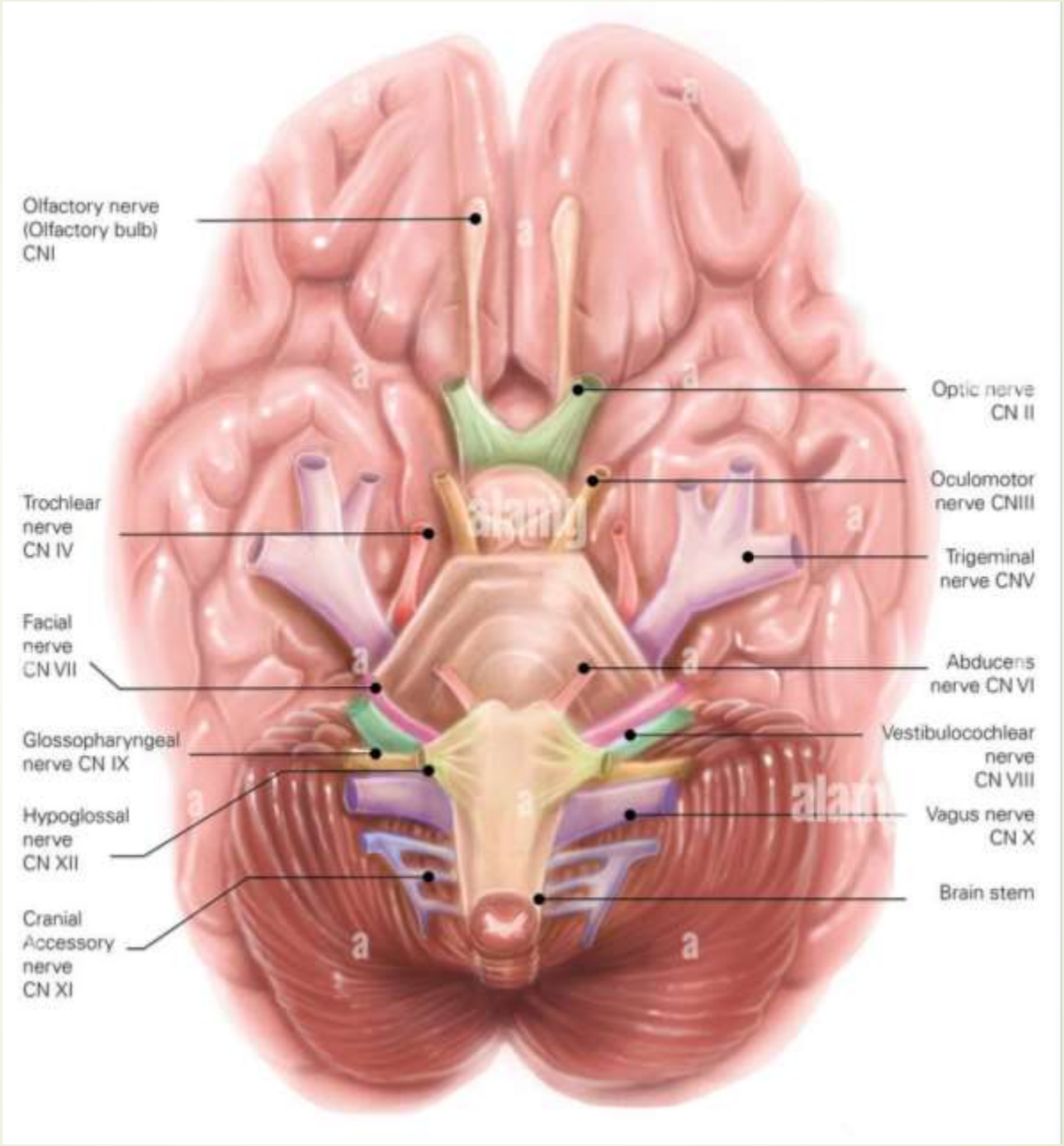
- This is the motor nerve for the muscles of the tongue, as well as the geniohyoid and thyrohyoid muscles.
- **Origin & Exit**: Its apparent origin is in the caudal part of the ventrolateral sulcus, and it exits the skull via the hypoglossal canal.

Hypoglossal Nerve





Les nerfs crâniens, vue postérieure de la tête


Olfactory nerve
(Olfactory bulb)
CNI
Optic nerve
CN II
Oculomotor
nerve CNIII
Trochlear
nerve
CN IV
Trigeminal
nerve CNV
Facial
nerve
CN VII
Abducens
nerve CN VI
Glossopharyngeal
nerve CN IX
Vestibulocochlear
nerve
CN VIII
Hypoglossal
nerve
CN XII
Vagus nerve
CN X
Cranial
Accessory
nerve
CN XI
Brain stem

Cranial Exit Foramina

Single Nerve, Dedicated Exit

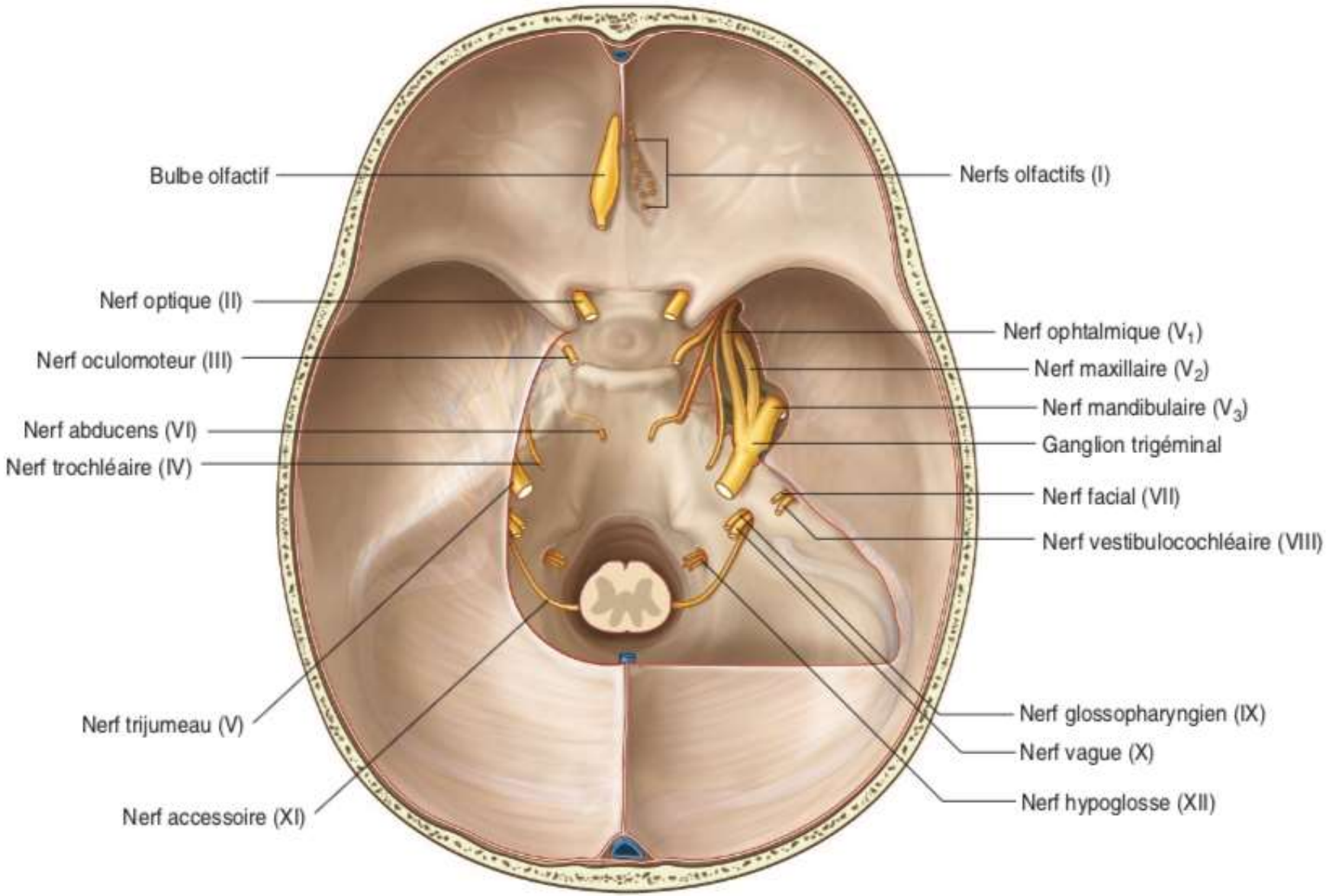
- Optic Nerve (II): Optic canal.
- Trochlear Nerve (IV): Trochlear canal.
- Facial Nerve (VII): Facial canal.
- Hypoglossal Nerve (XII): Hypoglossal canal.

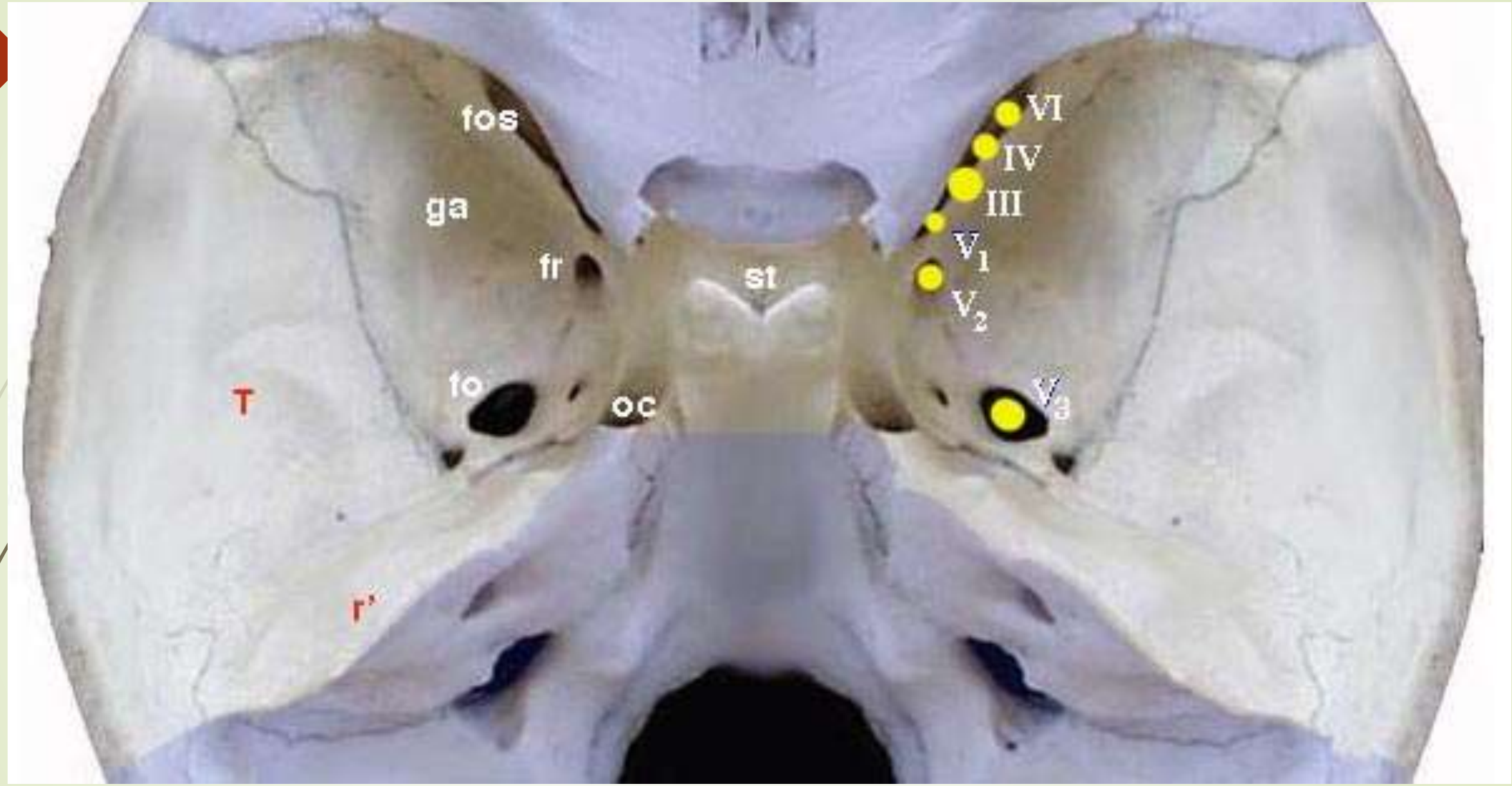
Single Nerve, Multiple Exit Points

- **Olfactory Nerve (I): Foramina of the cribriform plate.**
- **Trigeminal Nerve (V):**
  - **Ophthalmic Nerve (V1): Orbital fissure.**
  - **Maxillary Nerve (V2): Foramen rotundum.**
  - **Mandibular Nerve (V3): Foramen ovale. nerfs, même orifice de sortie**

Multiple Nerves, Shared Exit

- **Orbital Fissure :** Houses **CN III**, **CN IV**, **CN VI**, and the **Ophthalmic nerve** (V1).
- **Internal Acoustic Meatus :** Houses **CN VII** and **CN VIII**.
- **Jugular Foramen :** Houses **CN IX**, **CN X**, and **CN XI**.


Bulbe olfactif
Nerfs olfactifs (I)
Nerf optique (II)
Nerf ophtalmique (V_1)
Nerf oculomoteur (III)
Nerf maxillaire (V_2)
Nerf mandibulaire (V_3)
Nerf abducens (VI)
Ganglion trigéminal
Nerf trochléaire (IV)
Nerf facial (VII)
Nerf vestibulocochléaire (VIII)
Nerf trijumeau (V)
Nerf glossopharyngien (IX)
Nerf vague (X)
Nerf accessoire (XI)
Nerf hypoglosse (XII)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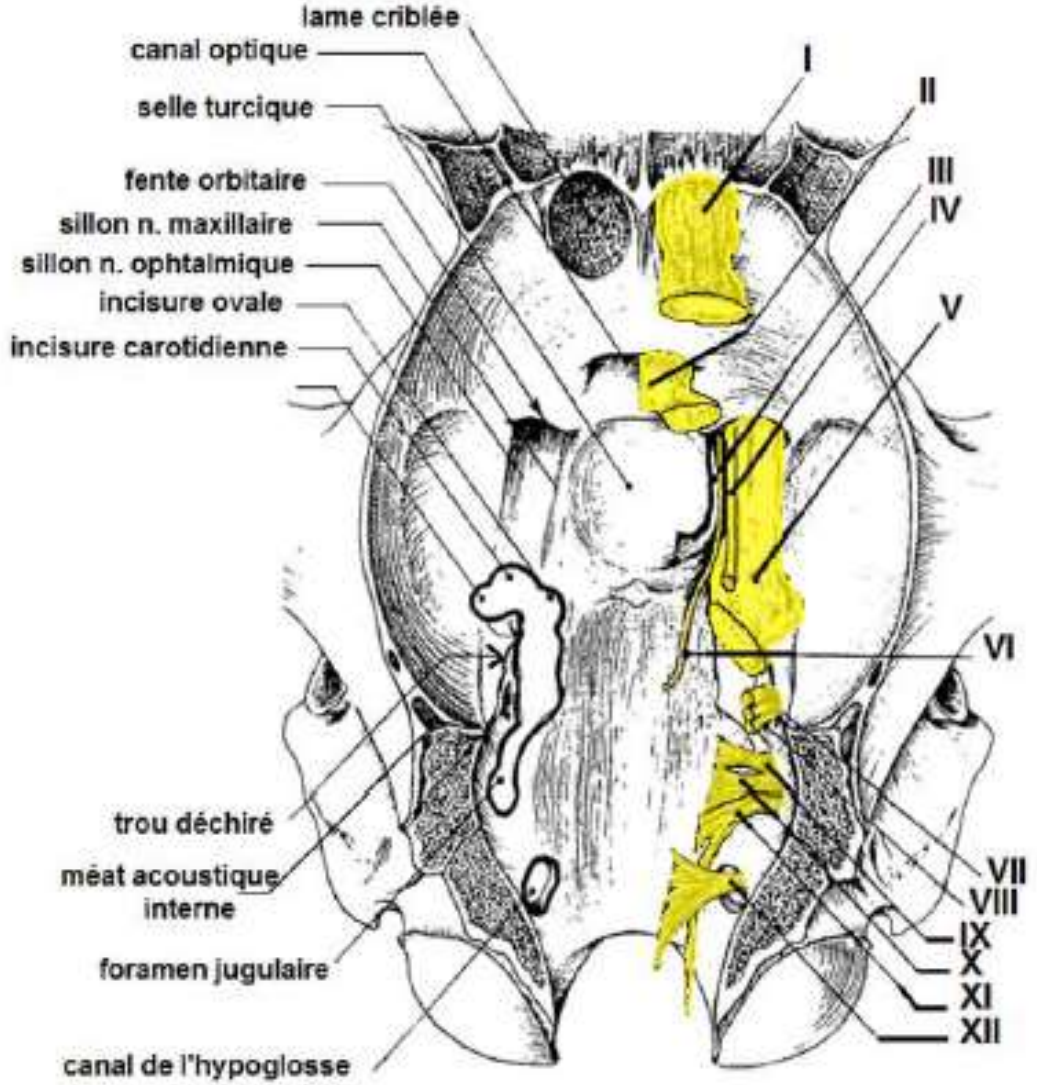
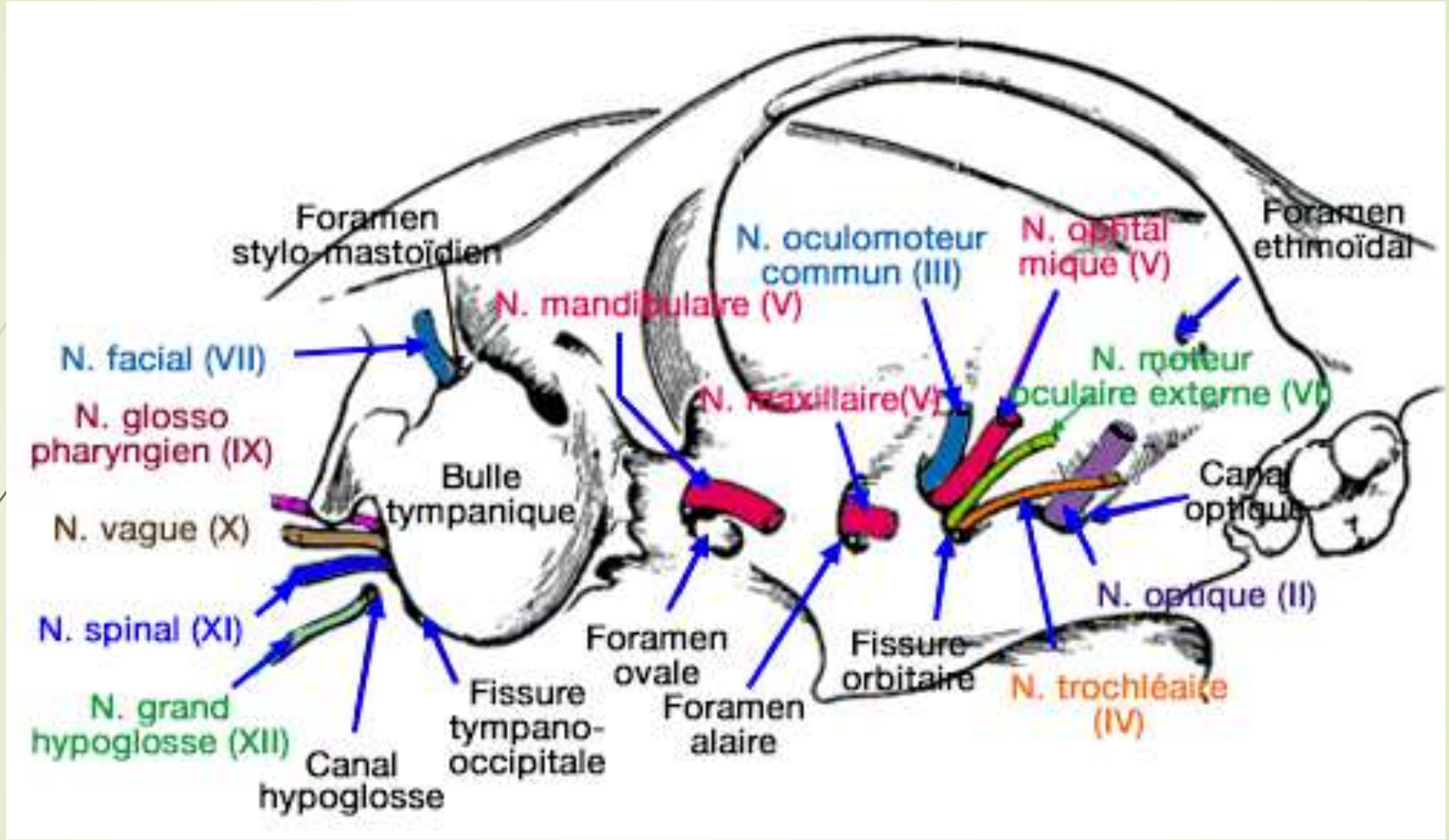


Origines apparentes et foramens de sortie des nerfs crâniens


Foramen stylo-mastoïdien
N. facial (VII)
N. glosso pharyngien (IX)
N. vague (X)
N. spinal (XI)
N. grand hypoglosse (XII)
Canal hypoglosse
Fissure tympano-occipitale
Bulle tympanique
N. mandibulaire (V)
N. maxillaire(V)
Foramen ovale
Foramen alaire
N. oculomoteur commun (III)
Fissure orbitaire
N. ophtalmique (V)
N. moteur oculaire externe (VI)
N. trochléaire (IV)
Foramen ethmoïdal
Canal optique
N. optique (II)