V.I.Vernadsky Federal University Medical Academy named after S.I. Georgievsky
Human Anatomy Department (Head of the Dpt. Prof. S.A. Kutia)

BRAINSTEM. CEREBELLUM. RETICULAR FORMATION.

II semester
Lecturer: Associate Professor,
Lilia R. Shaymardanova, M.D., Ph.D.

Germany, Max Planck Institute for Brain Research

The Institute of neurophysiology, Russian Academy of Sciences

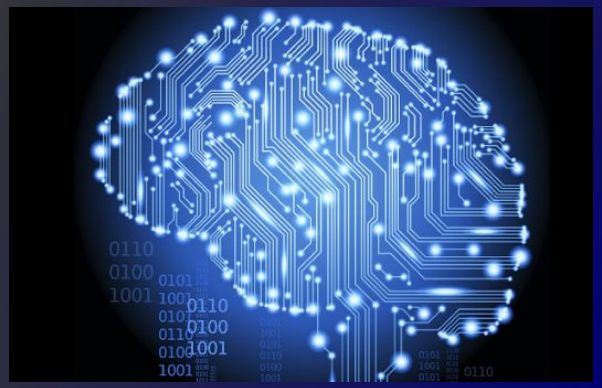
The Paul-Flechsig-Institute for Brain Research , institute of Leipzig University

The Zanvyl Krieger Mind/Brain Institute, The Johns Hopkins University

The European Brain Research Institute in Rome

Hertie Institute for Clinical Brain Research

A mistery between your ears…

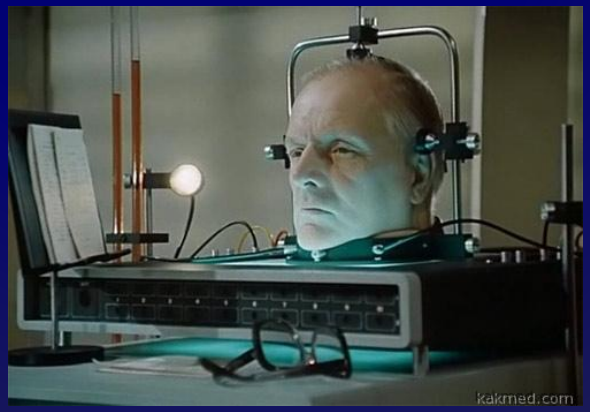


11 bln neurons,
100 trn synapses

Speed =274 km/ hr

Awaking-10-23
Wt

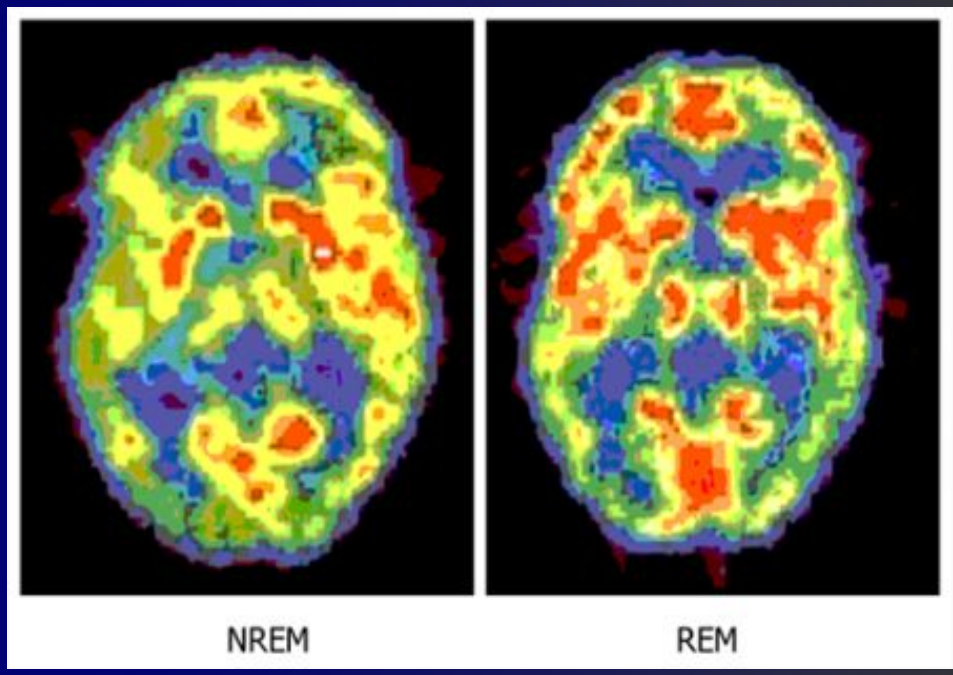
telekinesis



1000 terabites of info

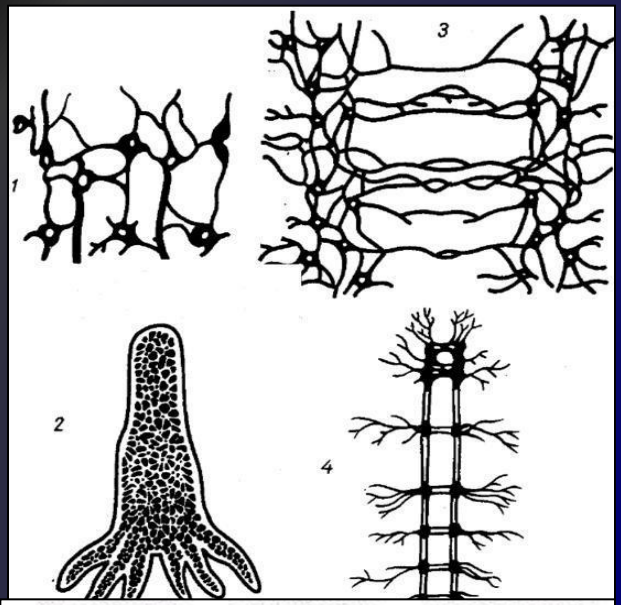
teleparhy

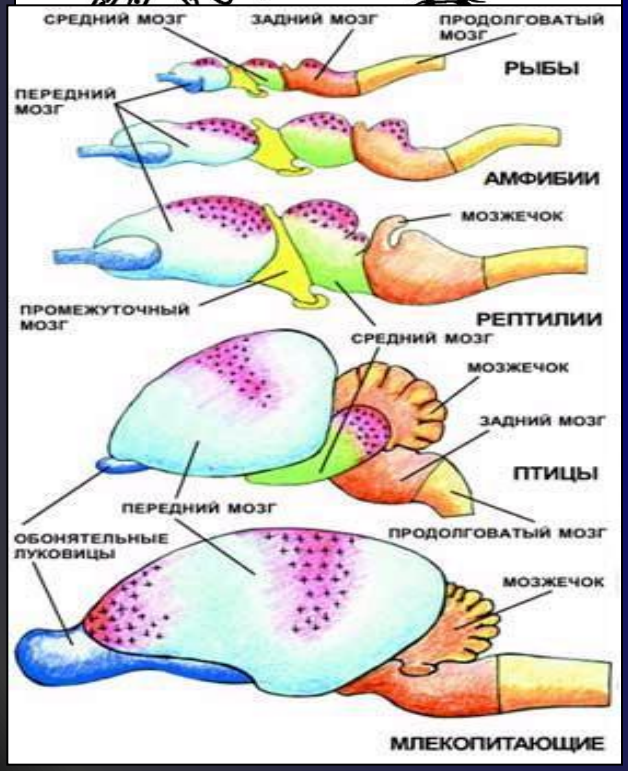
BRAIN: female versus male

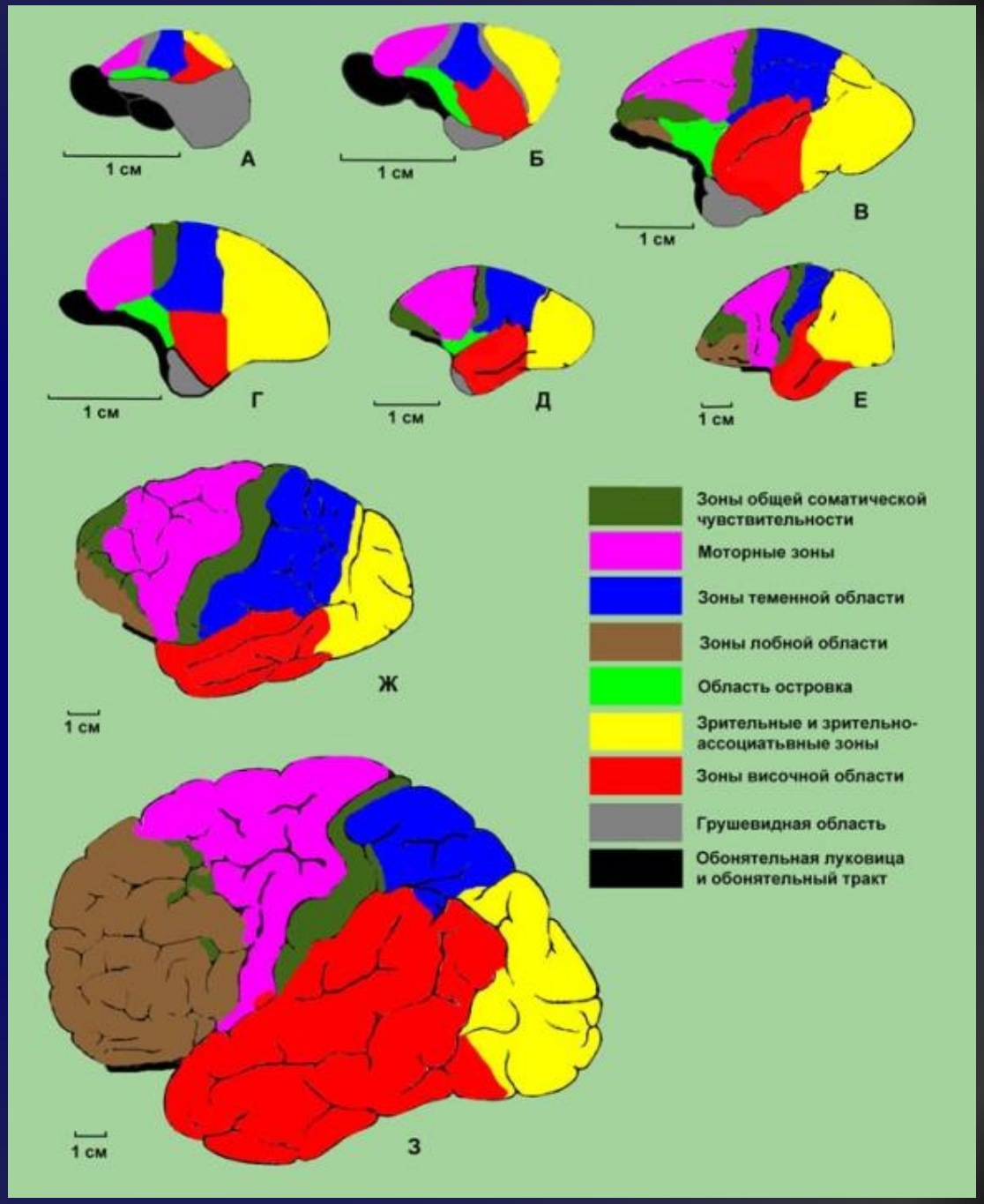


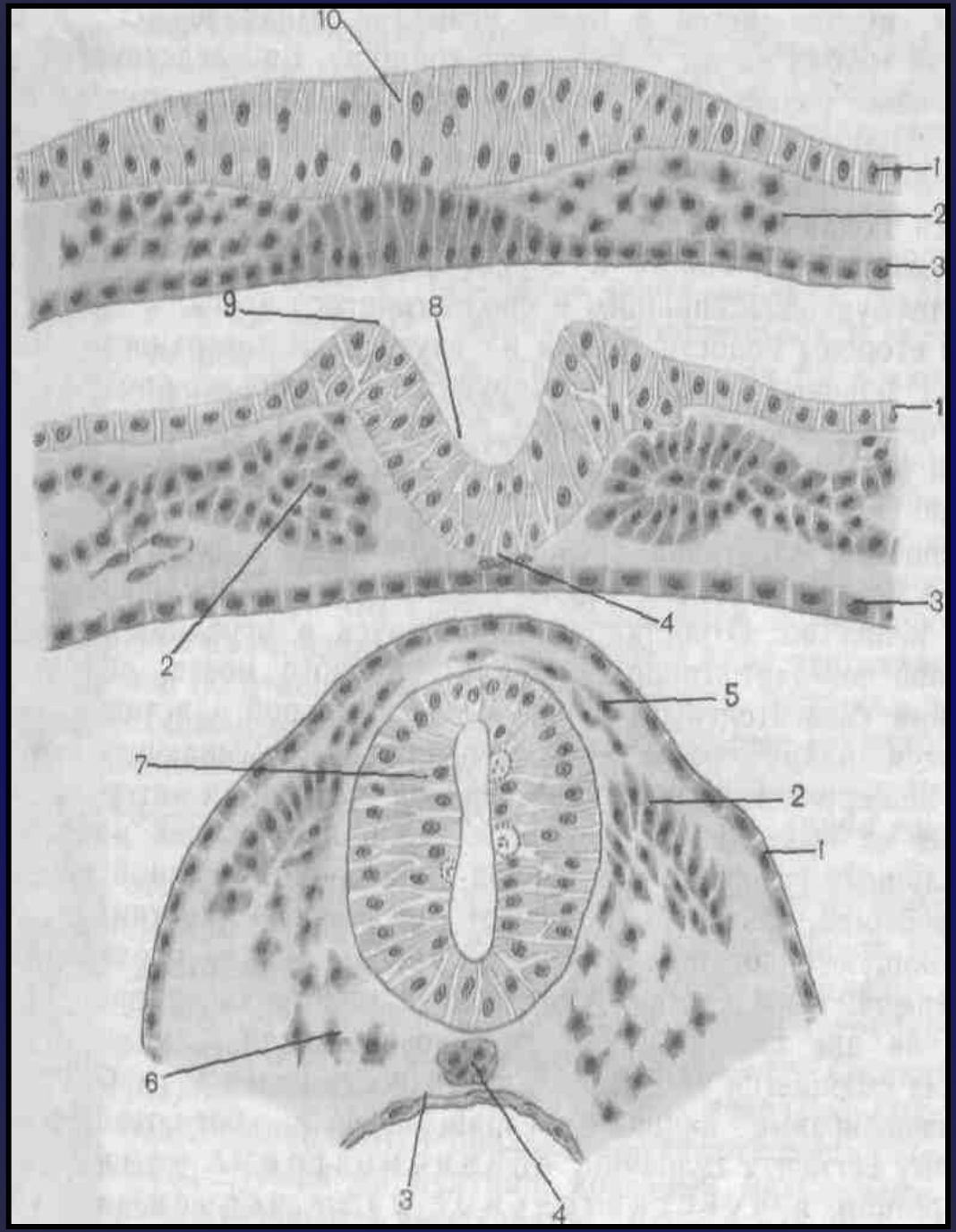
Weight difference 10%

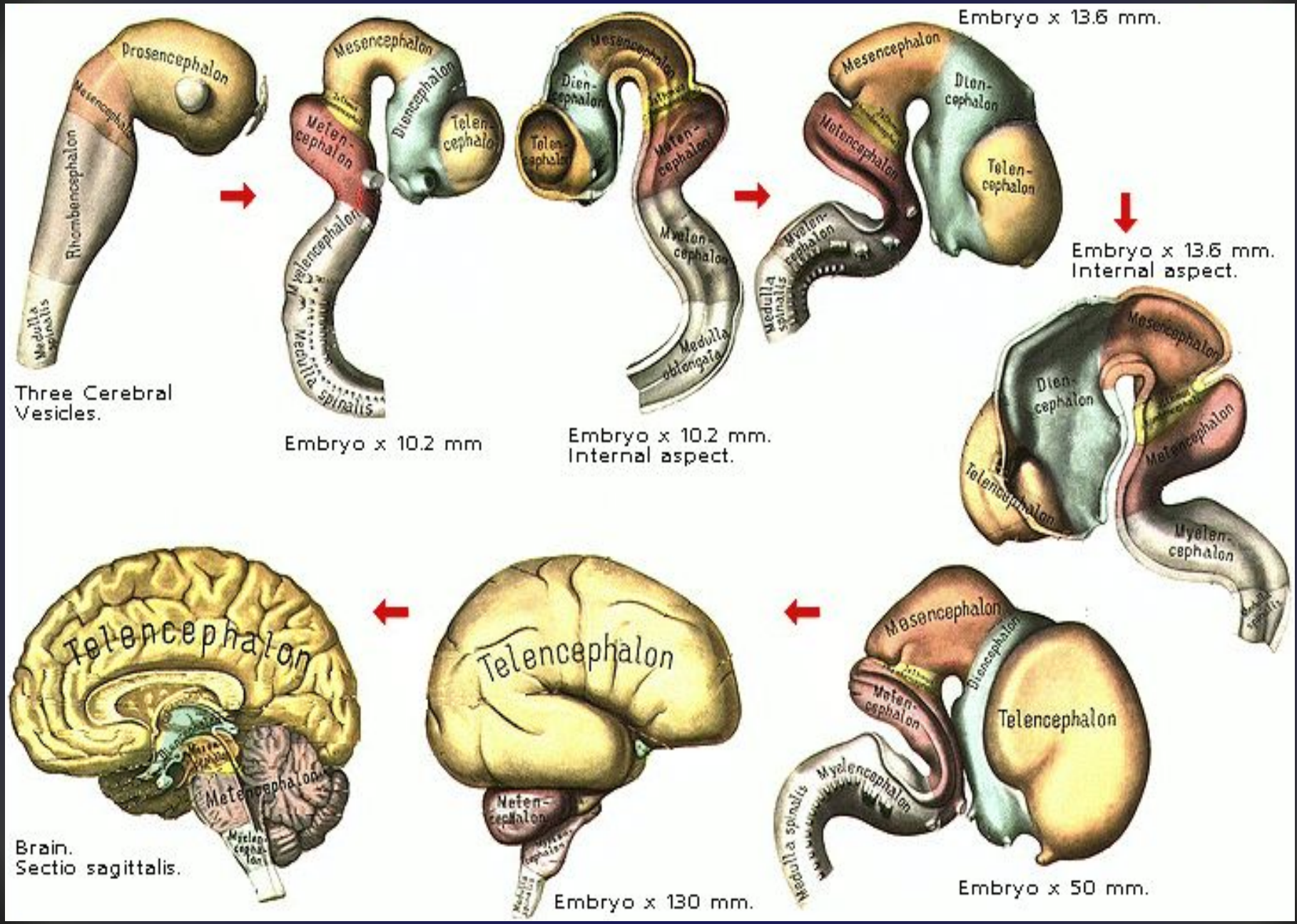
Centers involved

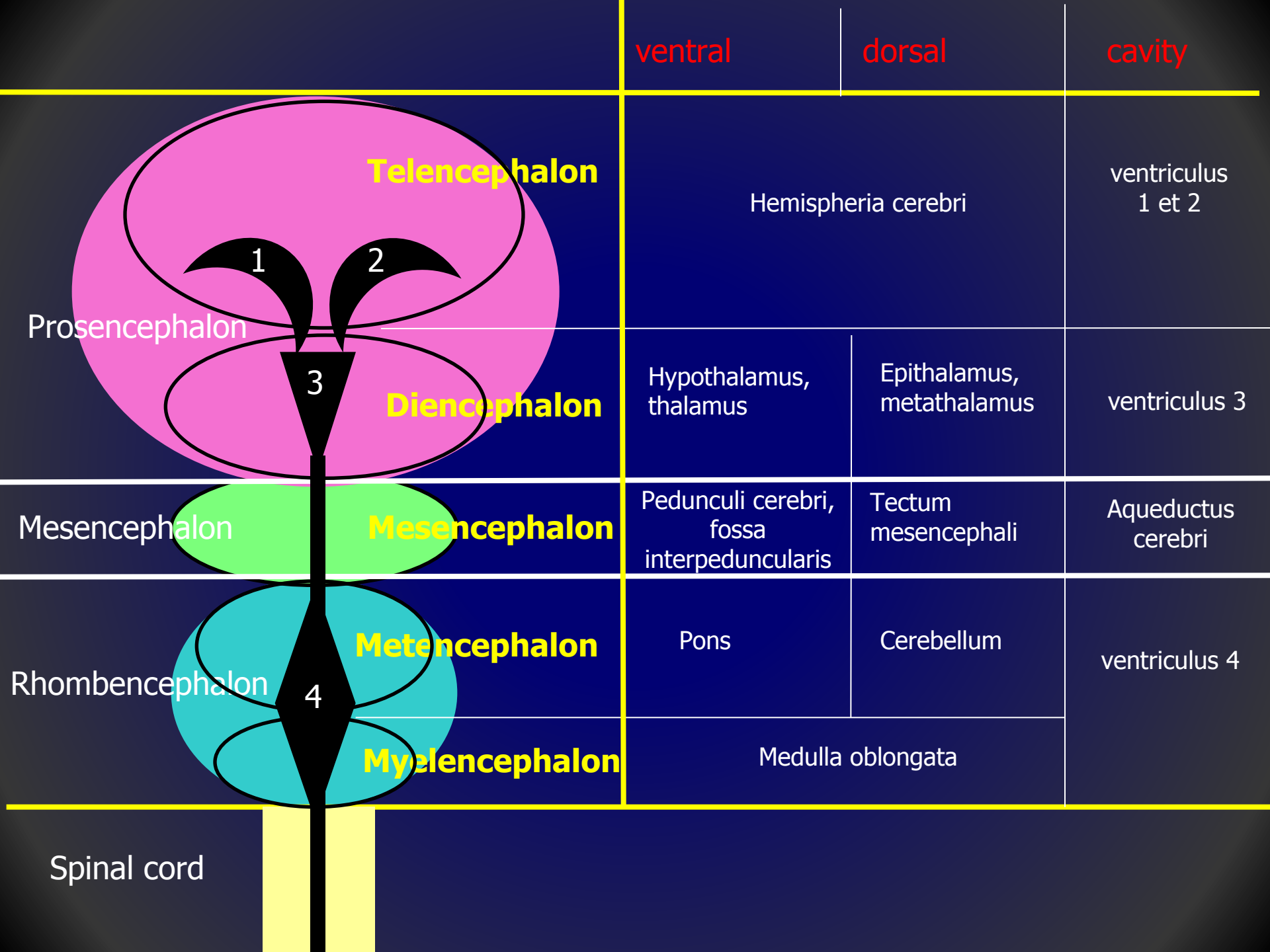

1
2
3
4


СРЕДНИЙ МОЗГ
ЗАДНИЙ МОЗГ
ПРОДОЛГОВАТЫЙ МОЗГ
РЫБЫ
ПЕРЕДНИЙ МОЗГ
АМФИБИИ
МОЗЖЕЧОК
ПРОМЕЖУТОЧНЫЙ МОЗГ
РЕПТИЛИИ
СРЕДНИЙ МОЗГ
МОЗЖЕЧОК
ЗАДНИЙ МОЗГ
ПТИЦЫ
ПЕРЕДНИЙ МОЗГ
ПРОДОЛГОВАТЫЙ МОЗГ
ОБОНЯТЕЛЬНЫЕ ЛУКОВИЦЫ
МОЗЖЕЧОК
МЛЕКОПИТАЮЩИЕ

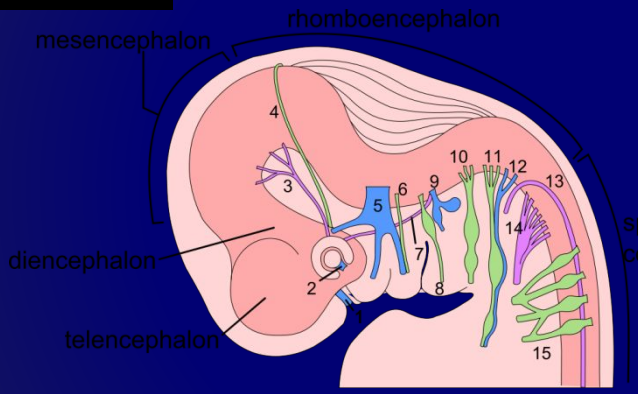

1 см
А
1 см
Б
1 см
В
1 см
Г
1 см
Д
1 см
Е
1 см
Ж
1 см
З
Зоны общей соматической чувствительности
Моторные зоны
Зоны теменной области
Зоны лобной области
Область островка
Зрительные и зрительно-ассоциатьвные зоны
Зоны височной области
Грушевидная область
Обонятельная луковица и обонятельный тракт


10
1
2
3
9
8
1
2
4
3
5
7
2
1
6
3
4


Prosencephalon
Mesencephalon
Rhombencephalon
Medulla spinalis
Three Cerebral Vesicles.
Mesencephalon
Dien-cephalon
Meten-cephalon
Myelencephalon
Medulla spinalis
Telen-cephalon
Embryo x 10.2 mm
Mesencephalon
Dien-cephalon
Telen-cephalon
Meten-cephalon
Myelen-cephalon
Medulla oblongata
Embryo x 10.2 mm.
Internal aspect.
Embryo x 13.6 mm.
Mesencephalon
Dien-cephalon
Meten-cephalon
Telen-cephalon
Myelen-cephalon
Medulla spinalis
Embryo x 13.6 mm.
Internal aspect.
Mesencephalon
Dien-cephalon
Meten-cephalon
Telencephalon
Myelen-cephalon
Mesencephalon
Dien-cephalon
Meten-cephalon
Telencephalon
Myelencephalon
Medulla spinalis
Embryo x 50 mm.
Telencephalon
Meten-cephalon
Embryo x 130 mm.
Telencephalon
Meten-cephalon
Brain.
Sectio sagittalis.


ventral
dorsal
cavity
Telencephalon
Hemispheria cerebri
ventriculus 1 et 2
1
2
Prosencephalon
3
Diencephalon
Hypothalamus, thalamus
Epithalamus, metathalamus
ventriculus 3
Mesencephalon
Mesencephalon
Pedunculi cerebri, fossa interpeduncularis
Tectum mesencephali
Aqueductus cerebri
Metencephalon
Pons
Cerebellum
ventriculus 4
Rhombencephalon
4
Myelencephalon
Medulla oblongata
Spinal cord

DEVELOPMENT



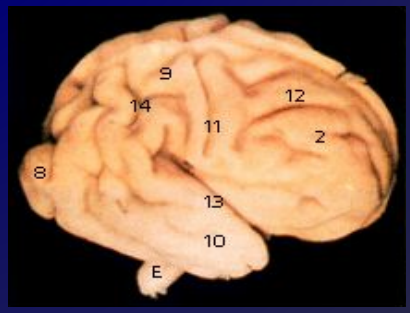
8 week

1. cerebellum
2. cerebral hemispheres (telencephalon)
3. frontal lobe
4. insula
5. lateral sulcus
6. medulla
7. mesencephalon
8. occipital lobe
9. parietal lobe
10. temporal lobe
11. central sulcus
12. gyri
13. lateral fissure
14. sulci

13 week

1. cerebellum
2. cerebral hemispheres (telencephalon)
3. frontal lobe
4. insula
5. lateral sulcus
6. medulla
7. mesencephalon
8. occipital lobe
9. parietal lobe
10. temporal lobe
11. central sulcus
12. gyri
13. lateral fissure
14. sulci

28 week



1. cerebellum
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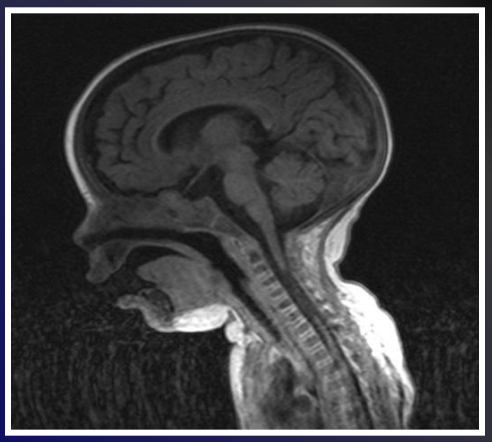
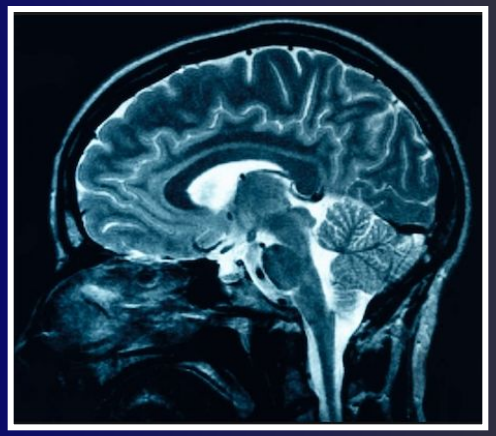
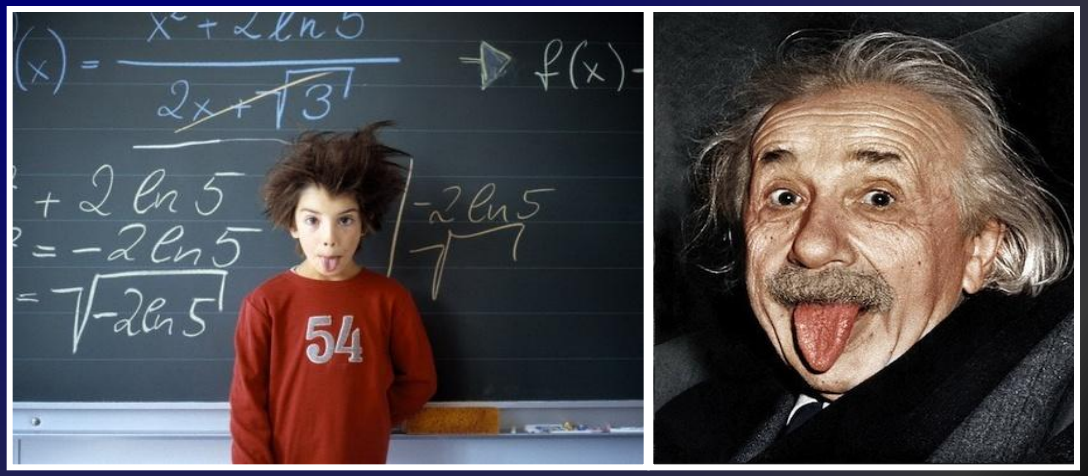
9. parietal lobe
10. temporal lobe
11. central sulcus
12. gyri
13. lateral fissure
14. sulci

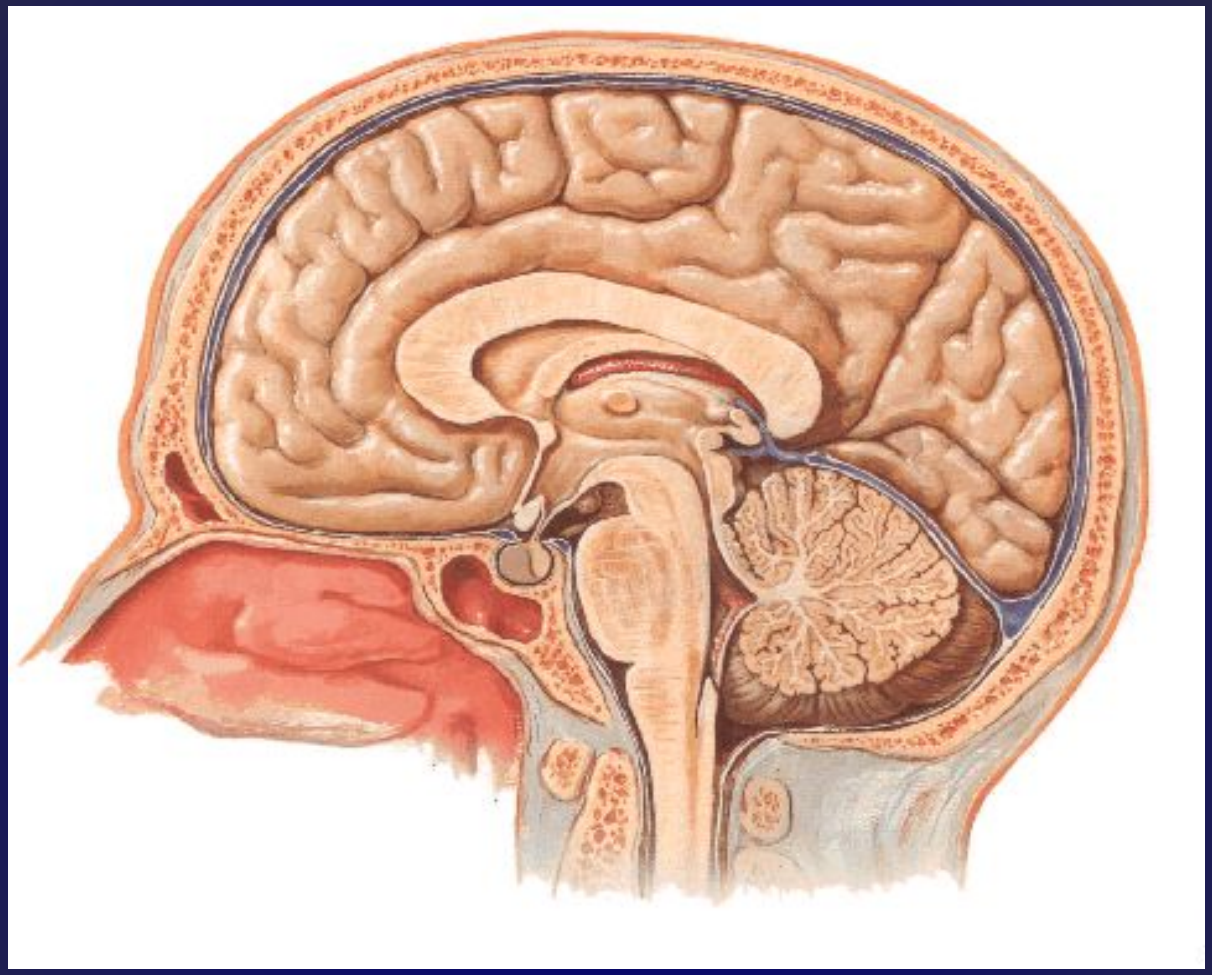
DEVELOPMENT







Anatomical parts of brain

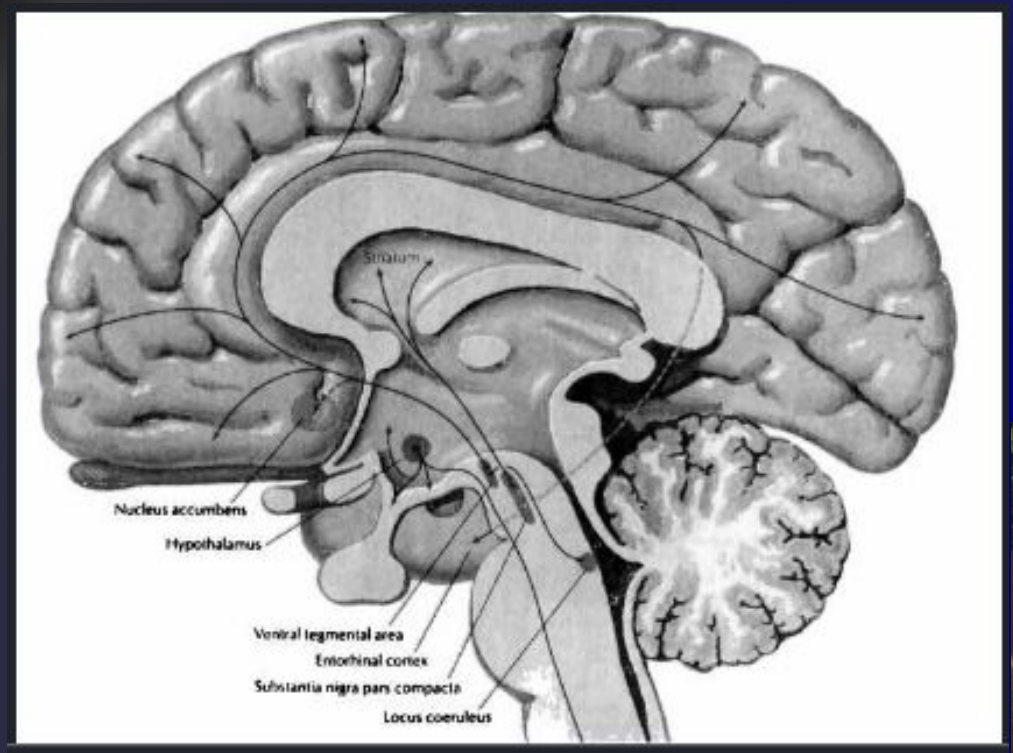


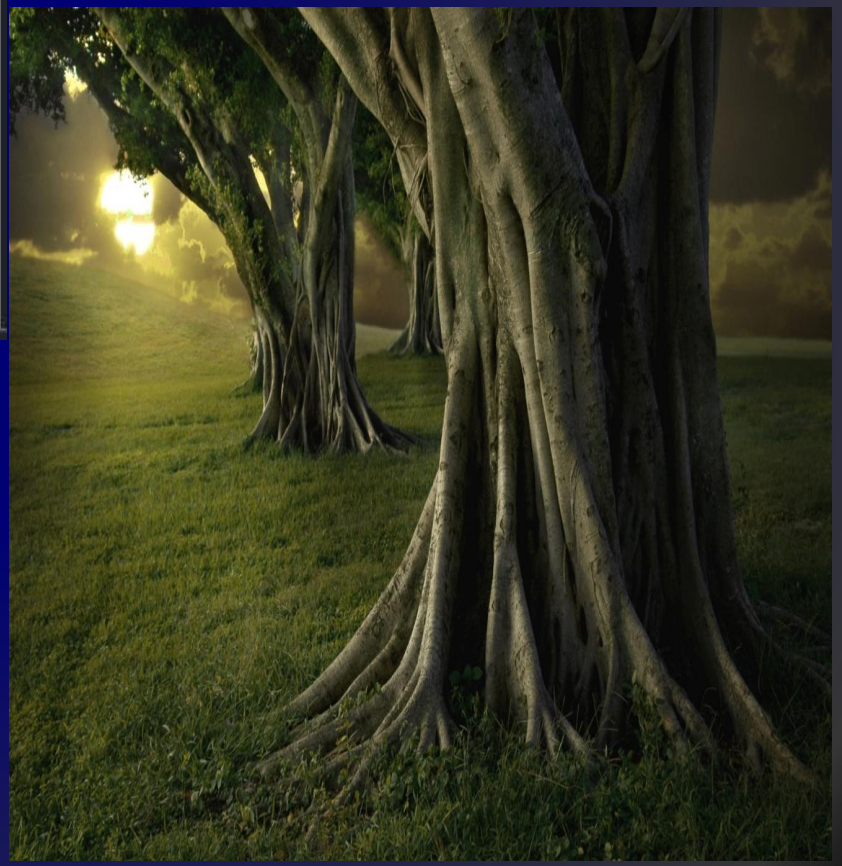
Brain = brainstem+ cerebellum +forebrain

Plan of description of brain parts

1. The name
2. Development
3. Boundaries
4. External view
   - ventral view
   - dorsal view
5. Internal structure
   - gray matter
   - white matter

Brainstem


Striatum
Nucleus accumbens
Hypothalamus
Ventral tegmental area
Entorhinal cortex
Substantia nigra pars compacta
Locus coeruleus



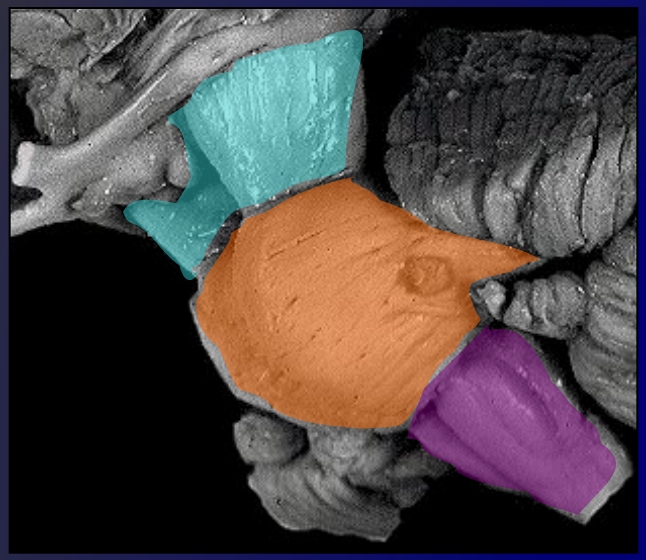
(MESENCEPHALON)

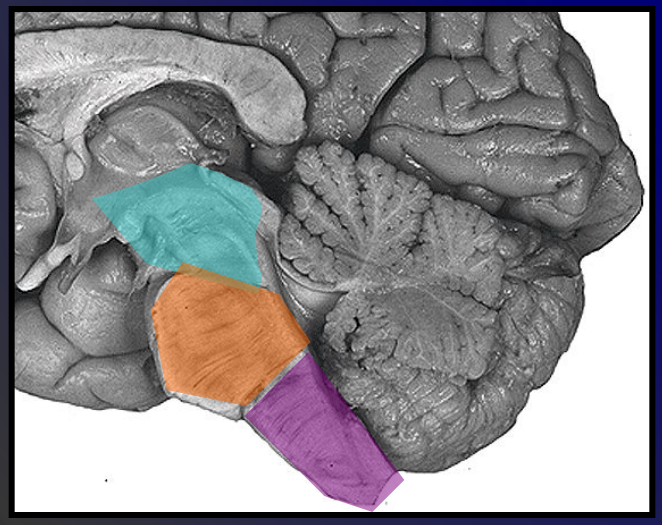
(PONS)

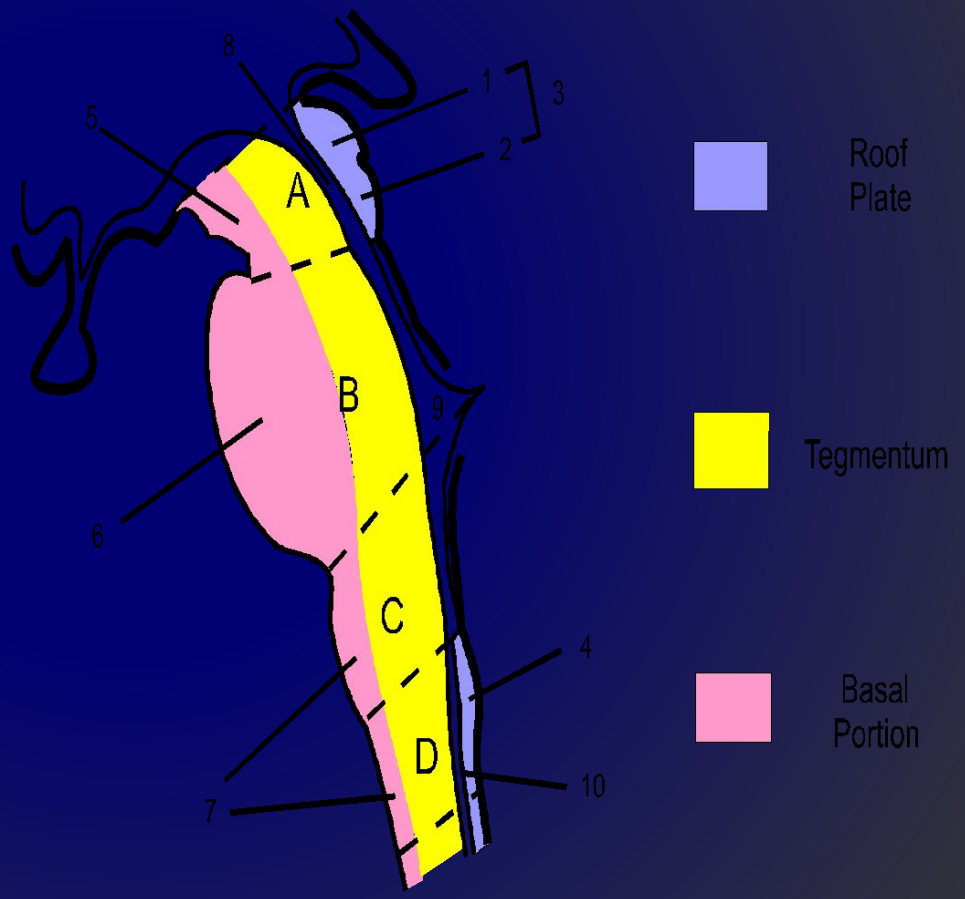
(MEDULLA OBLONGATA) =
BULBUS CEREBRI

Brainstem

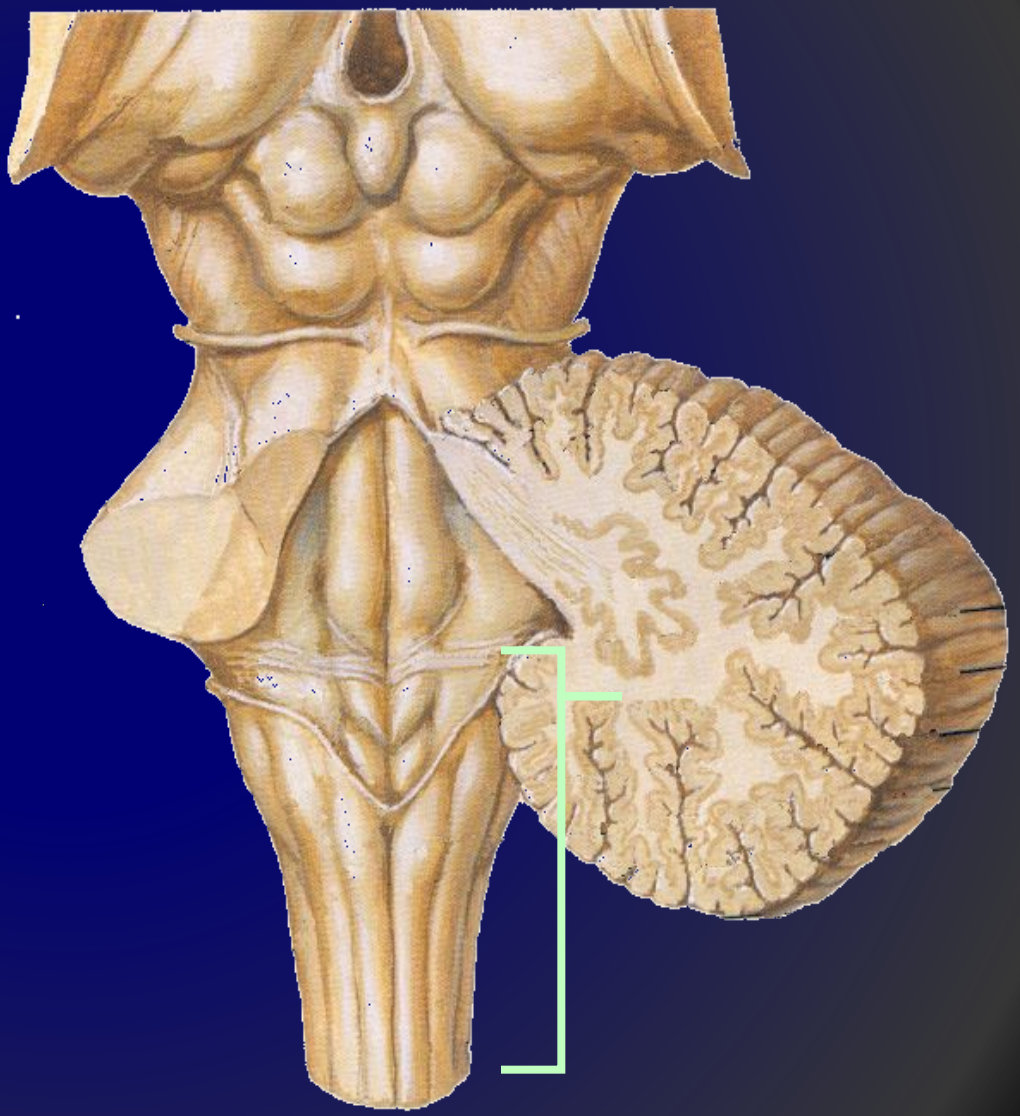
- midbrain
- pons
- Medulla oblongata



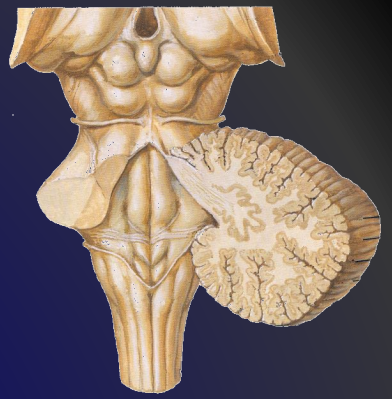


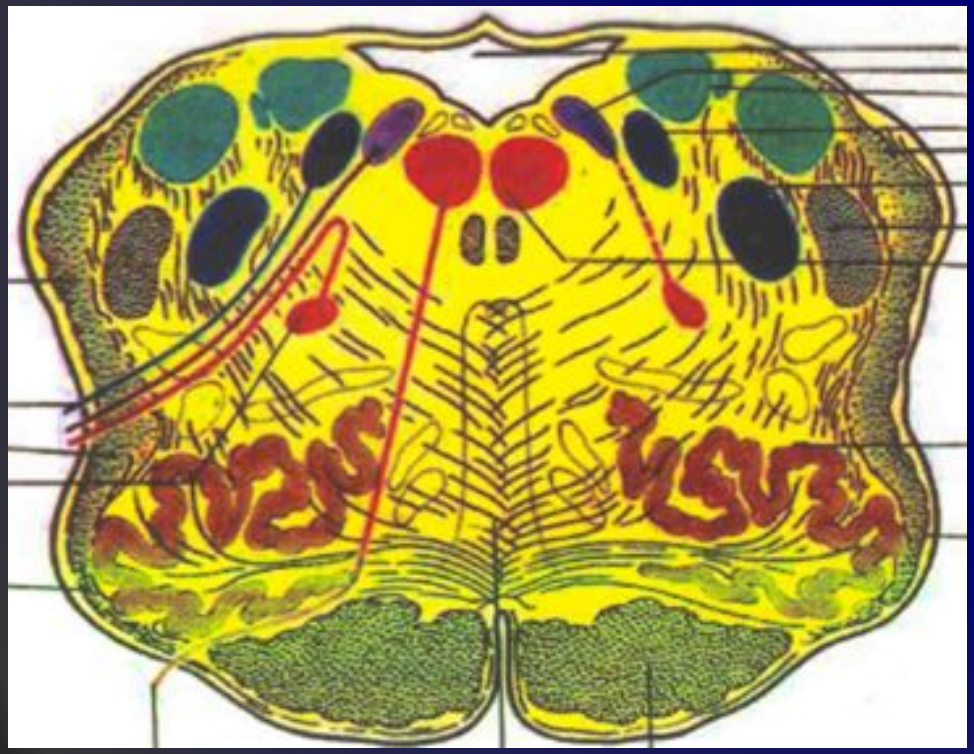


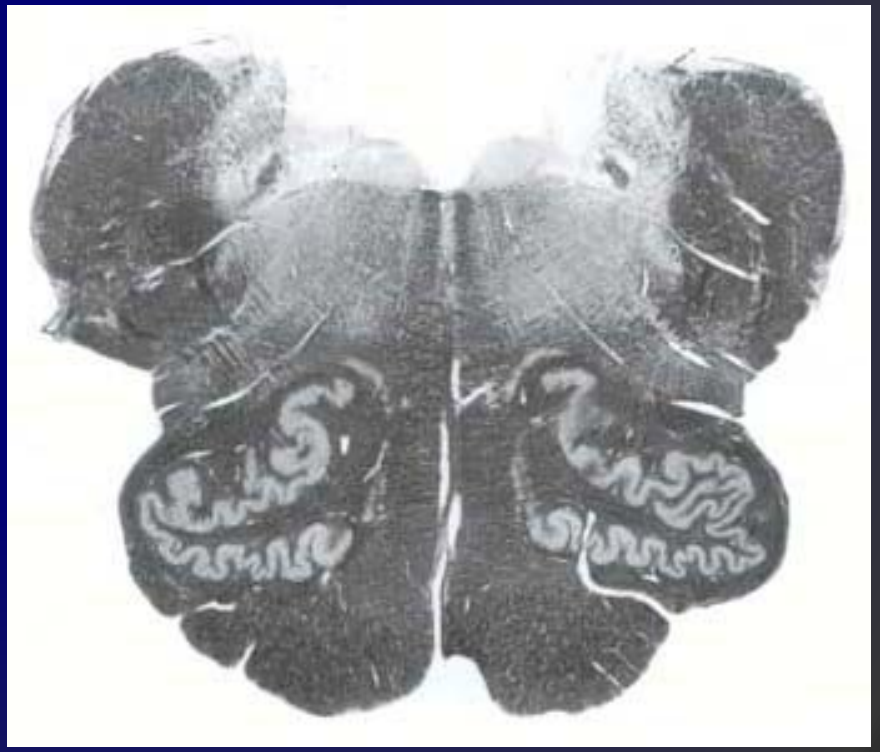
External structure of MO



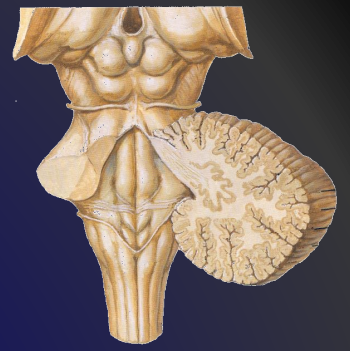
Grey matter of MO

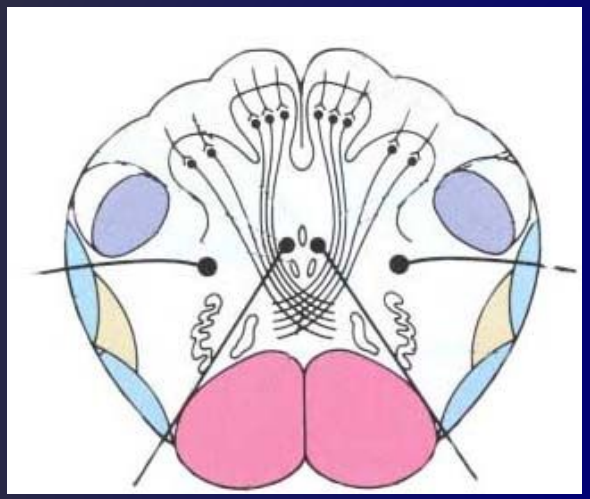


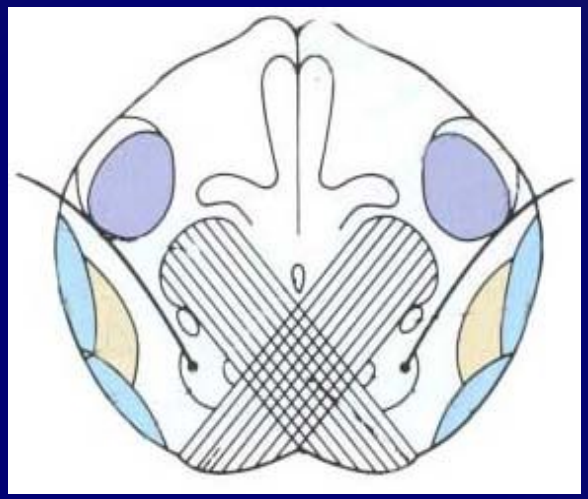


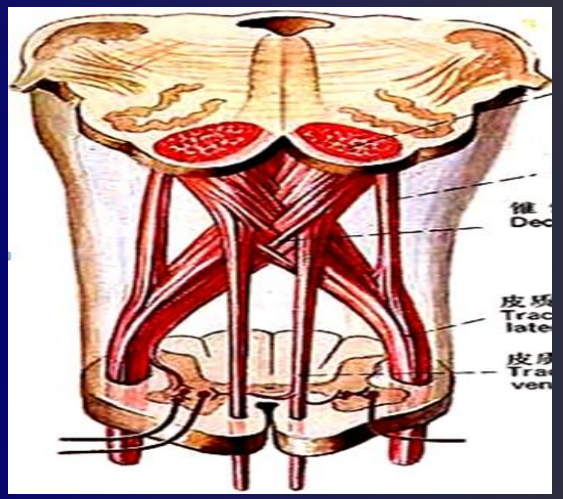


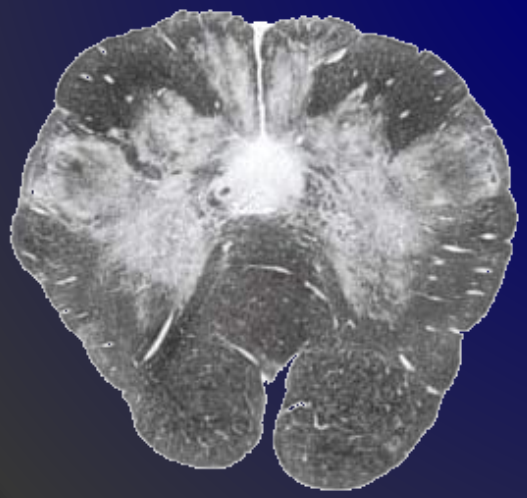
White matter of MO

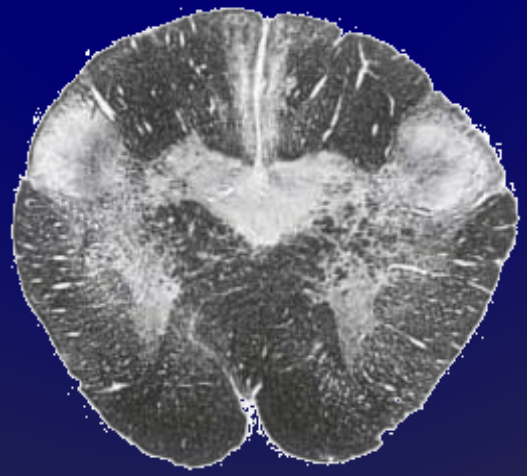








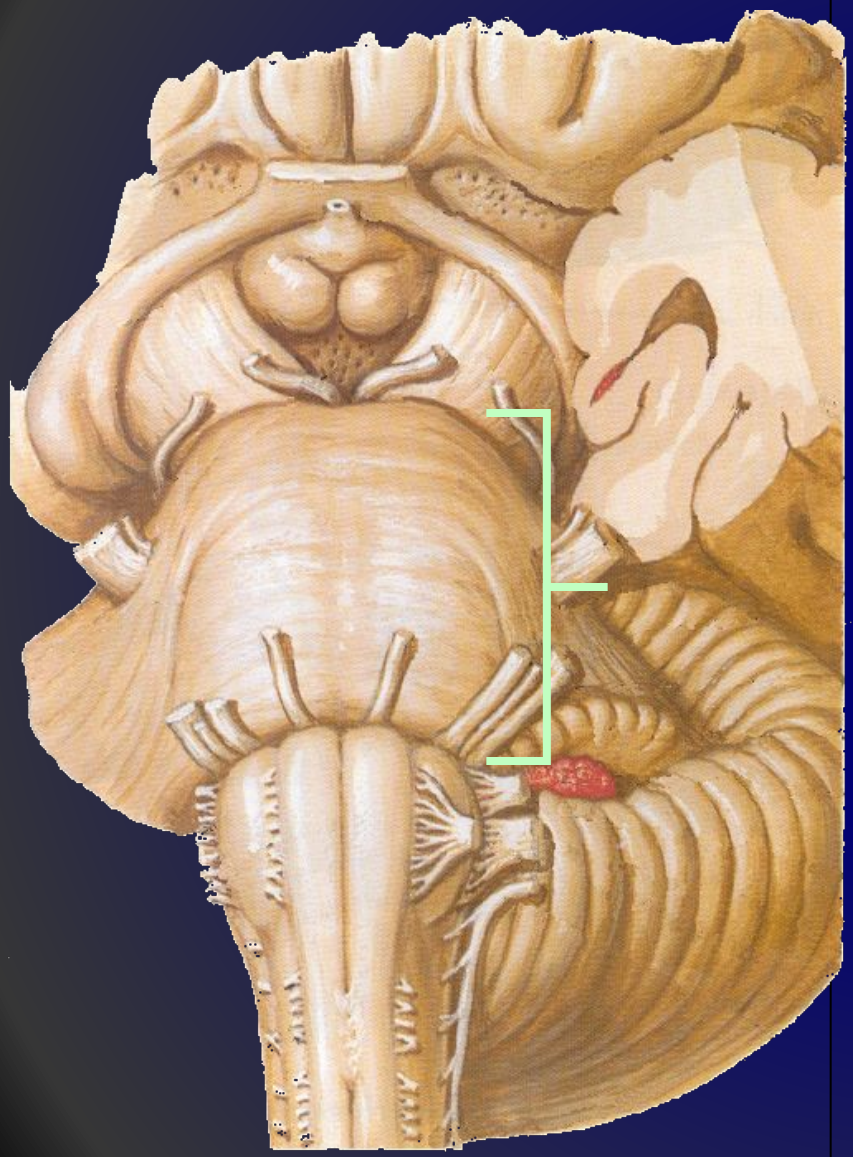


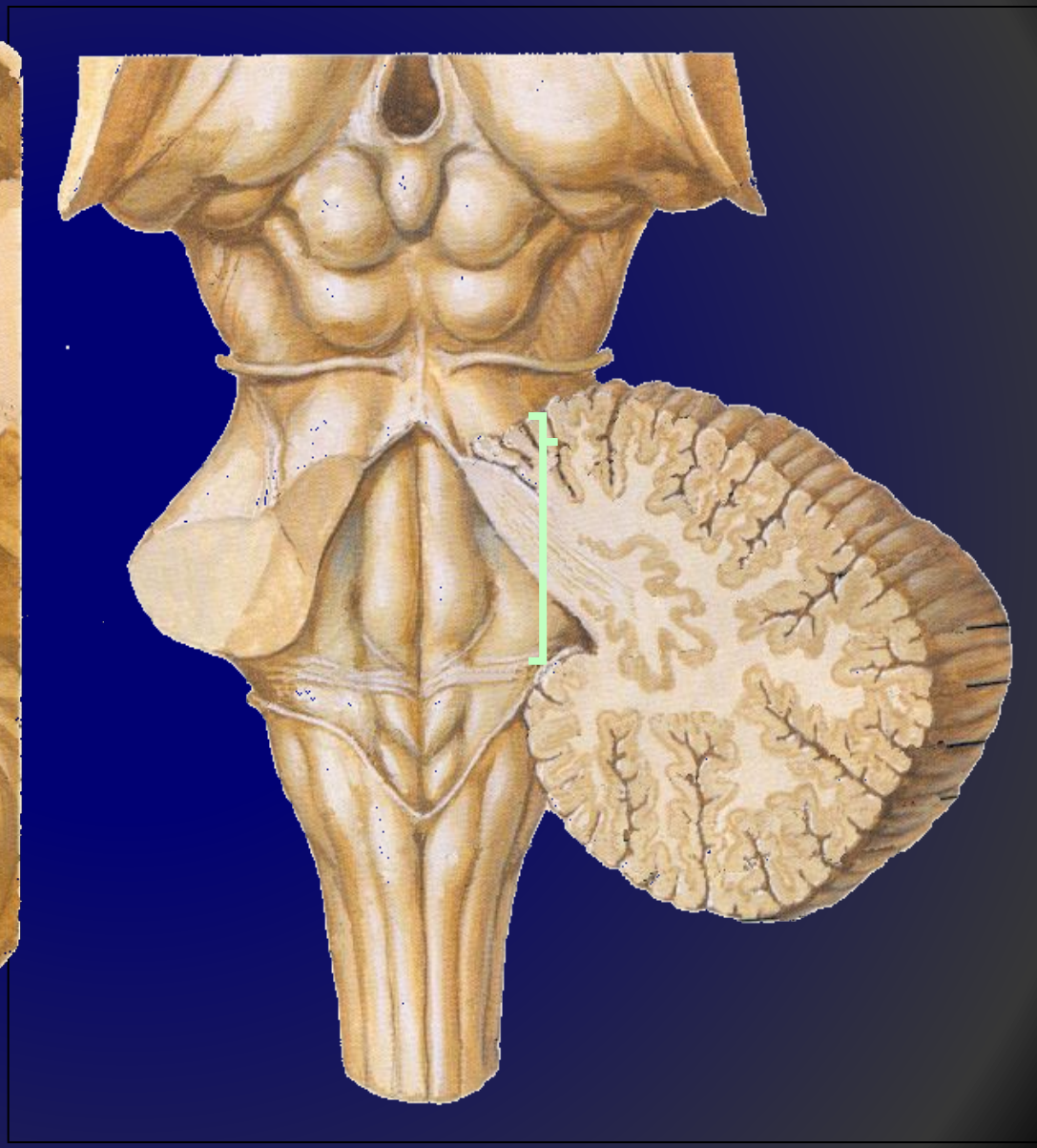


<u>2 decussations</u>

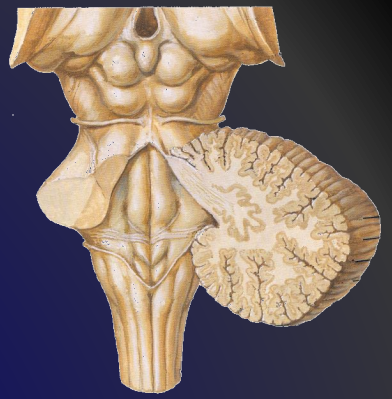
- Decussatio lemniscorum
- Decussatio pyramidalis

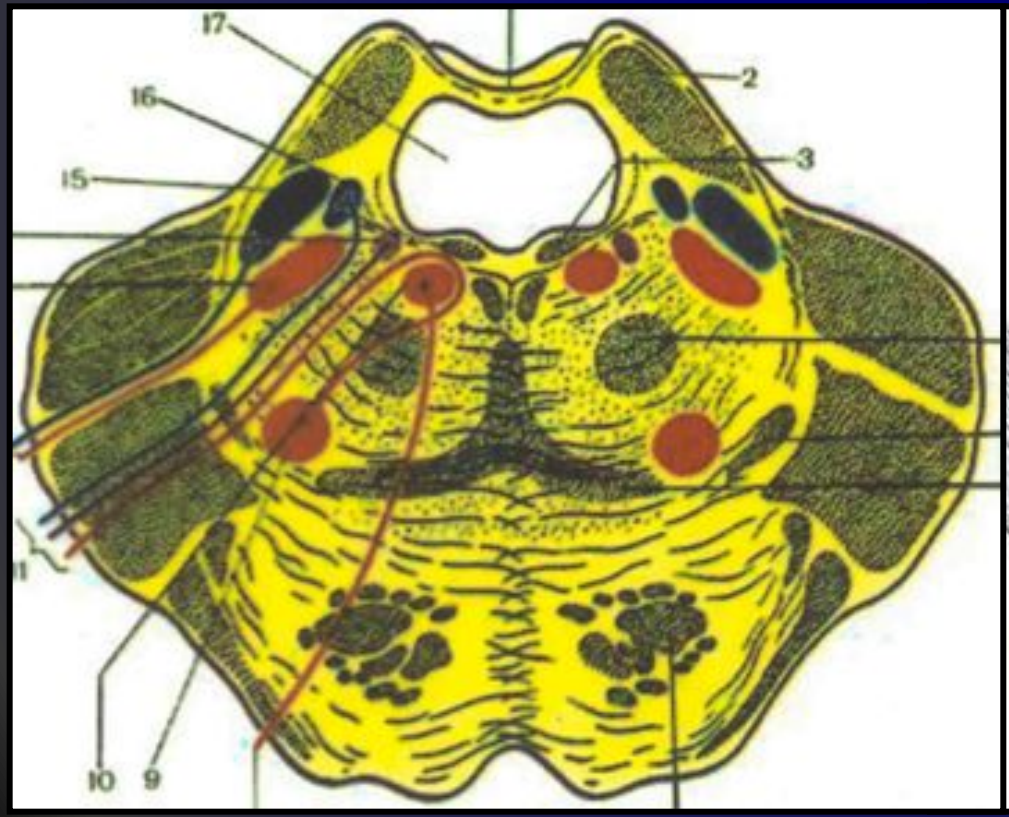
External structure of pons

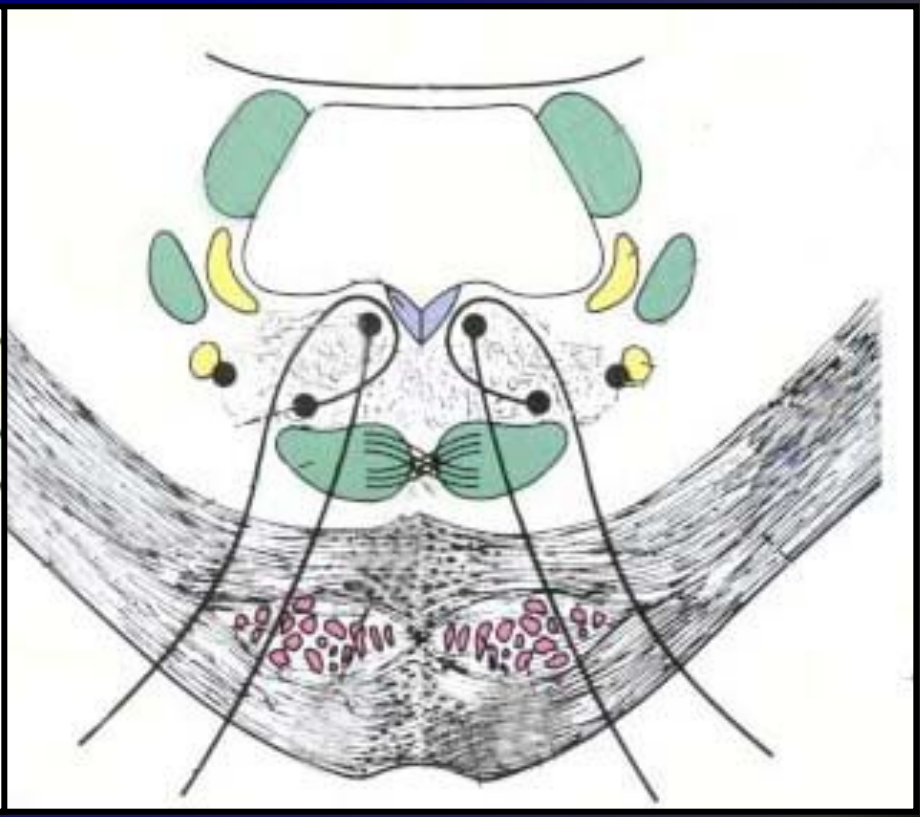




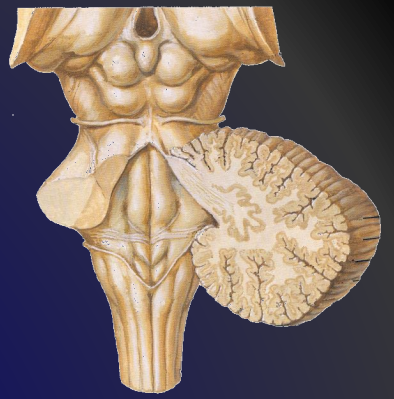
Grey matter of pons

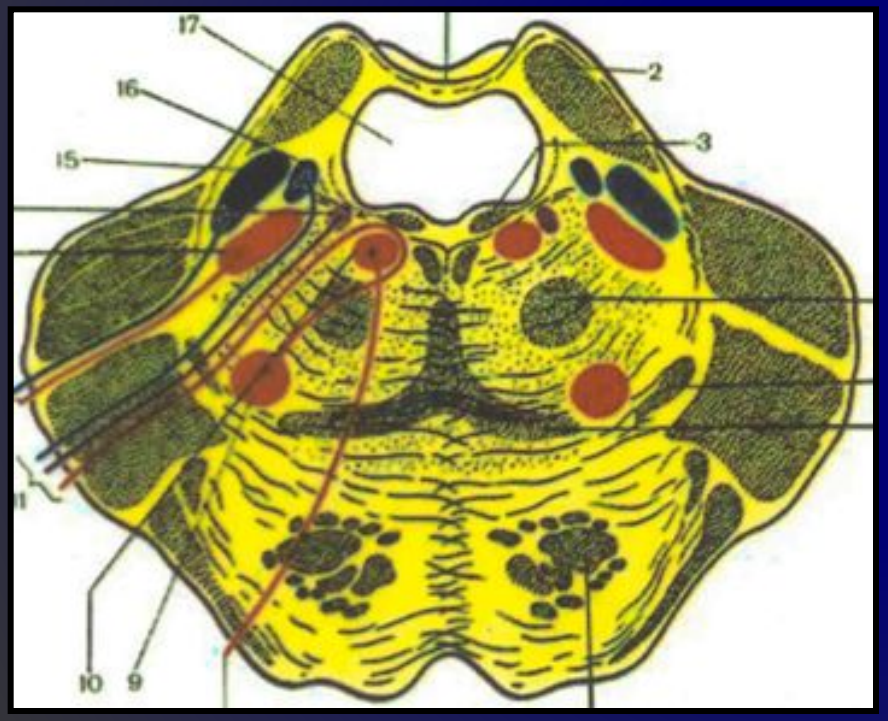


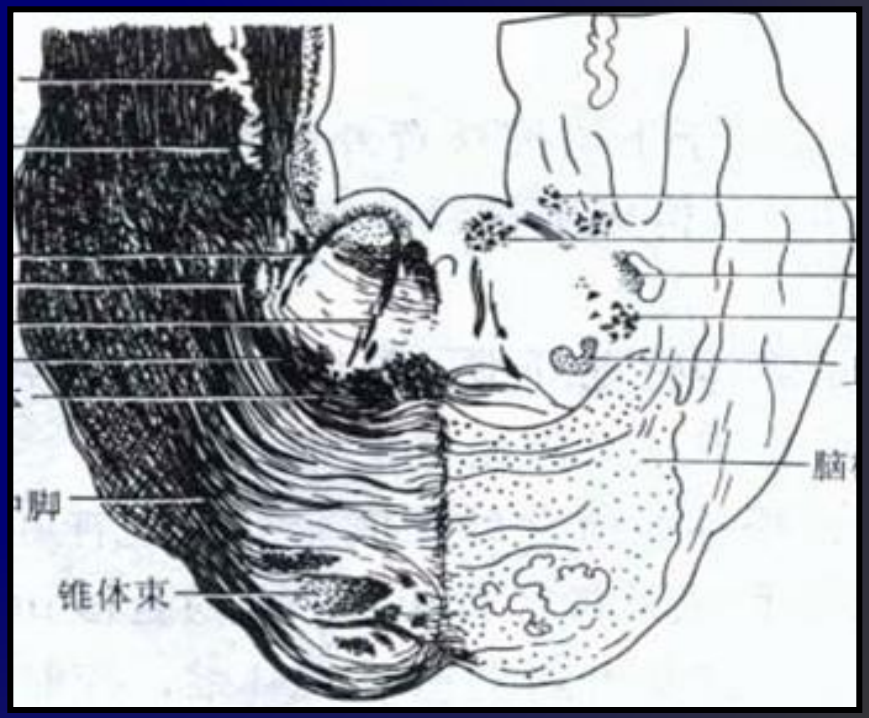




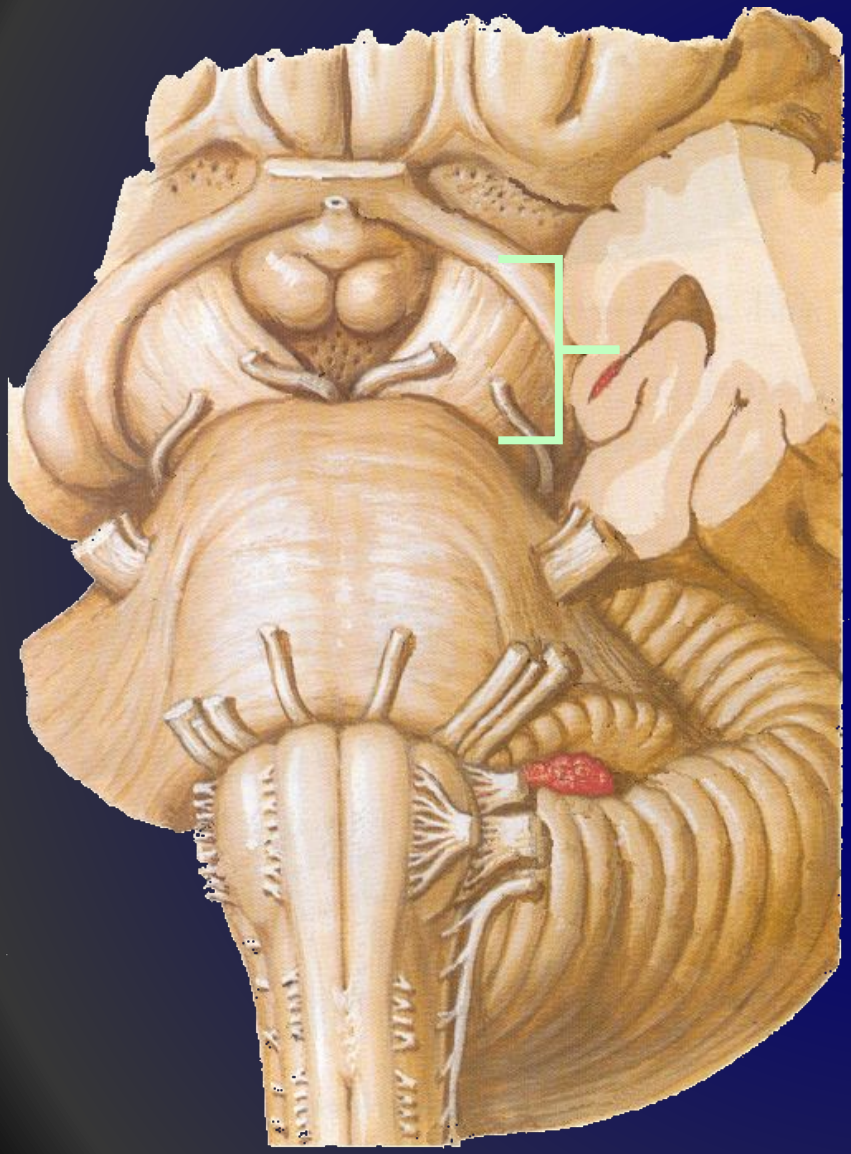
White matter of pons

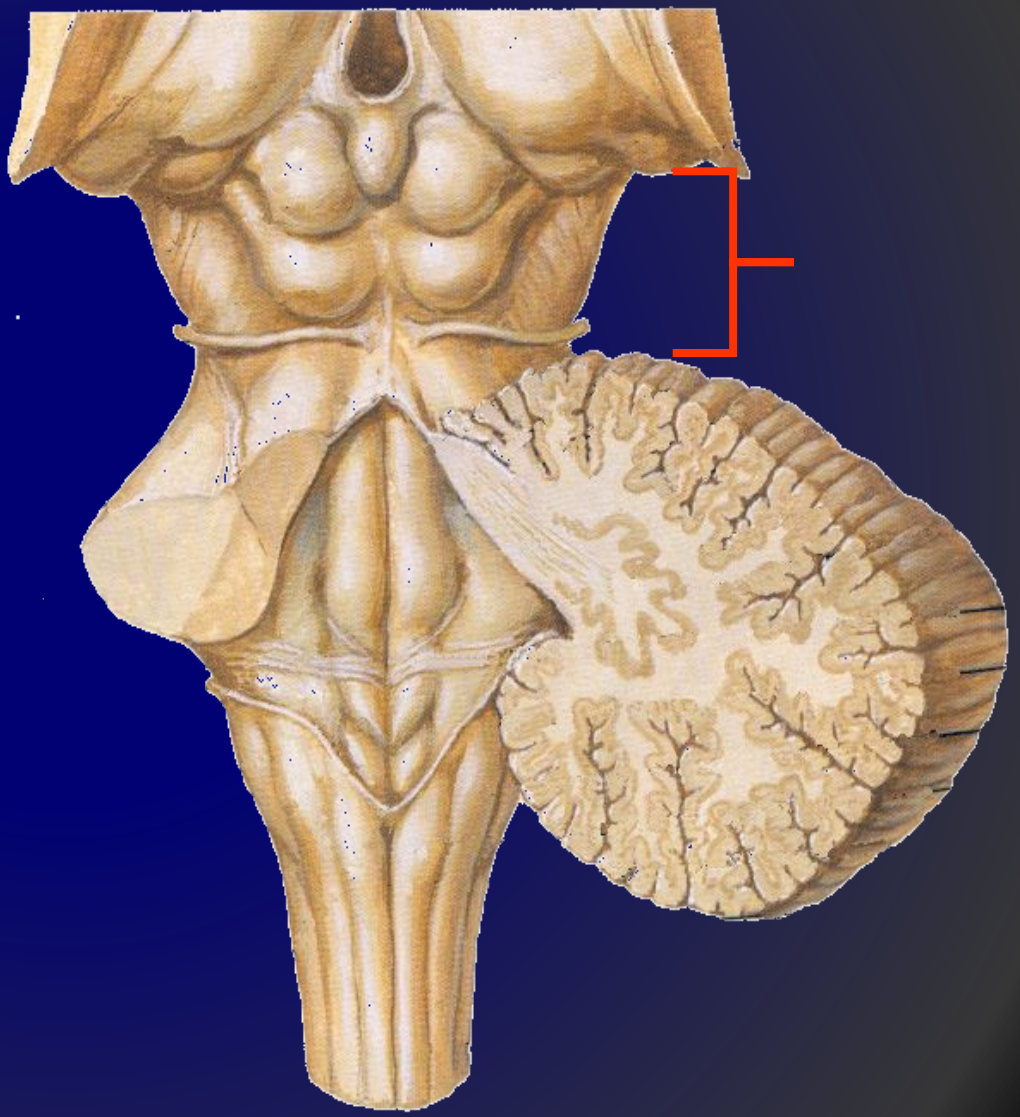




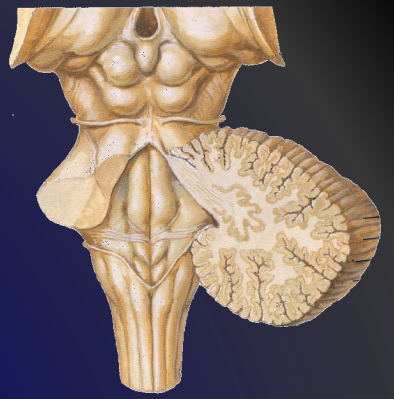


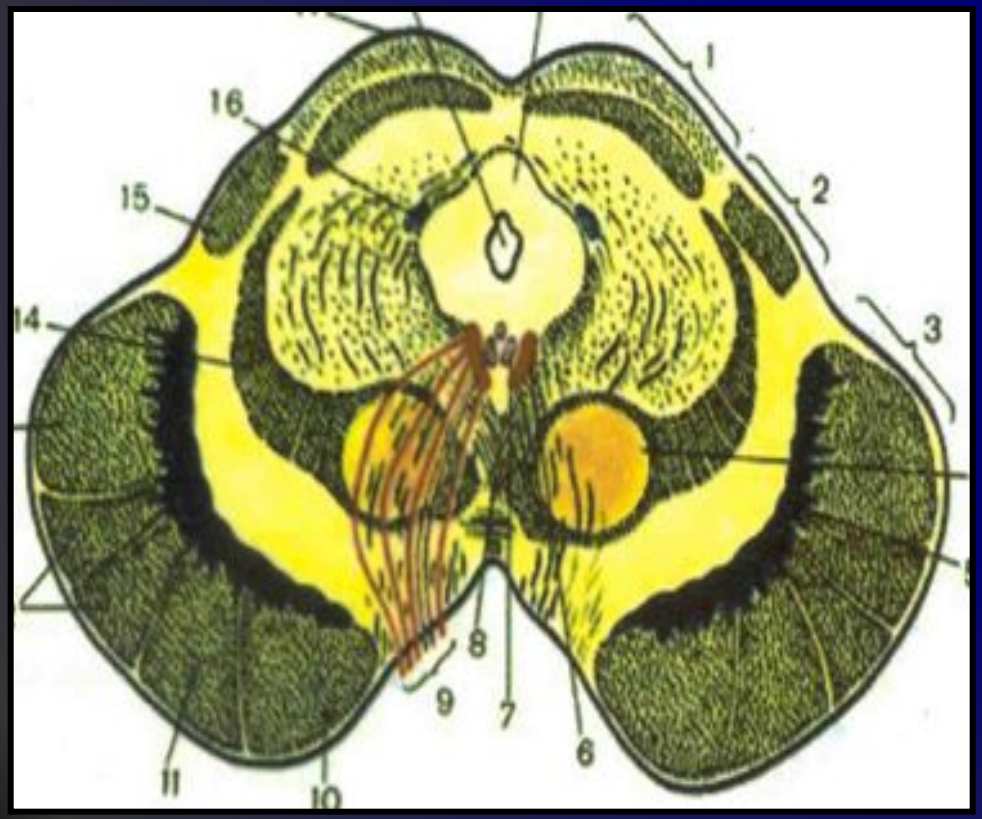
External structure of midbrain



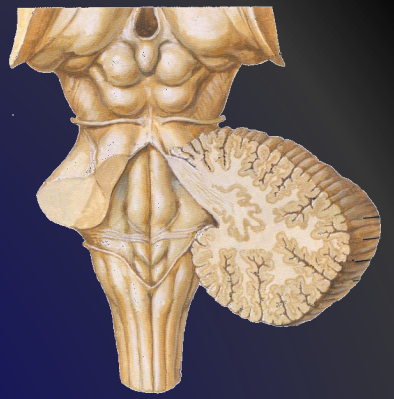


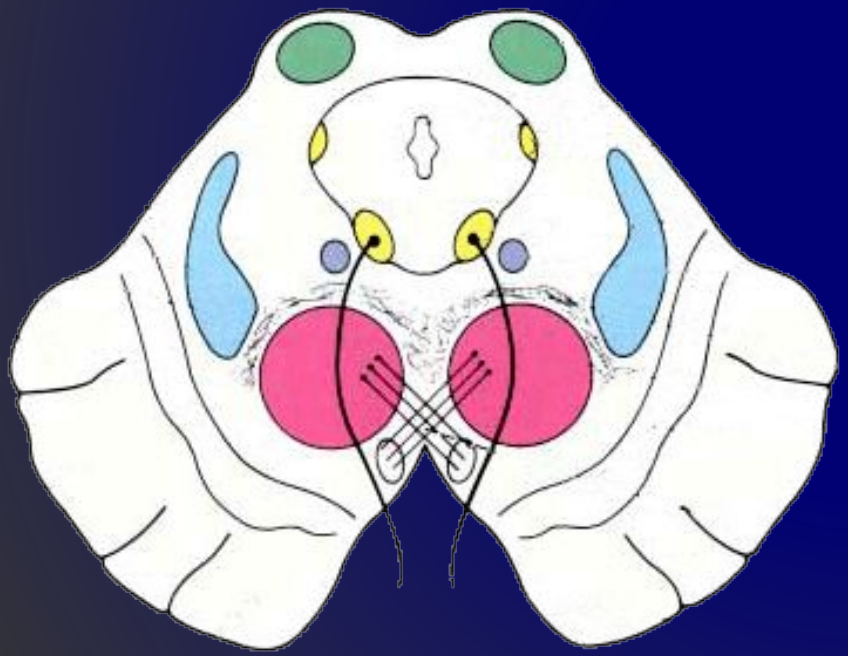
Grey matter of midbrain

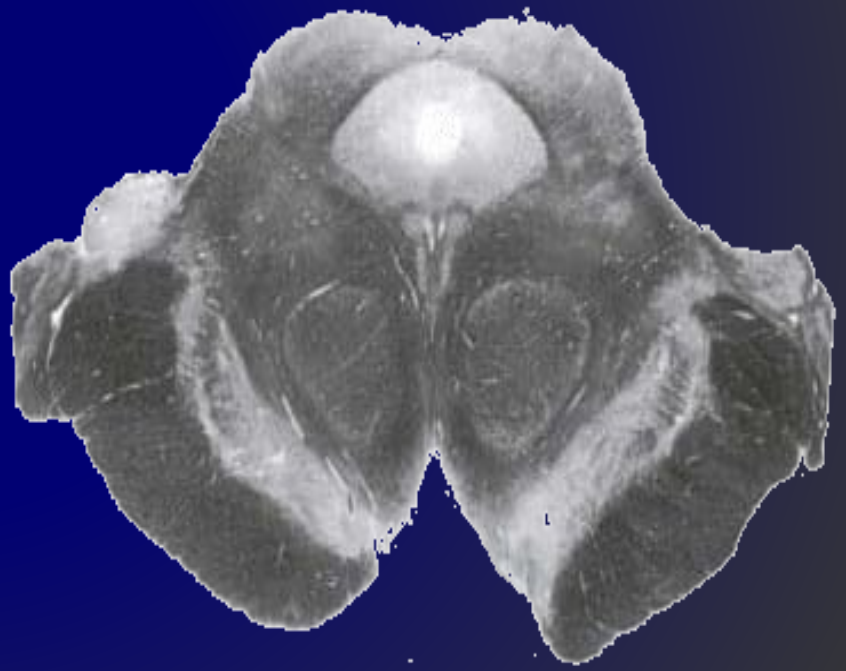




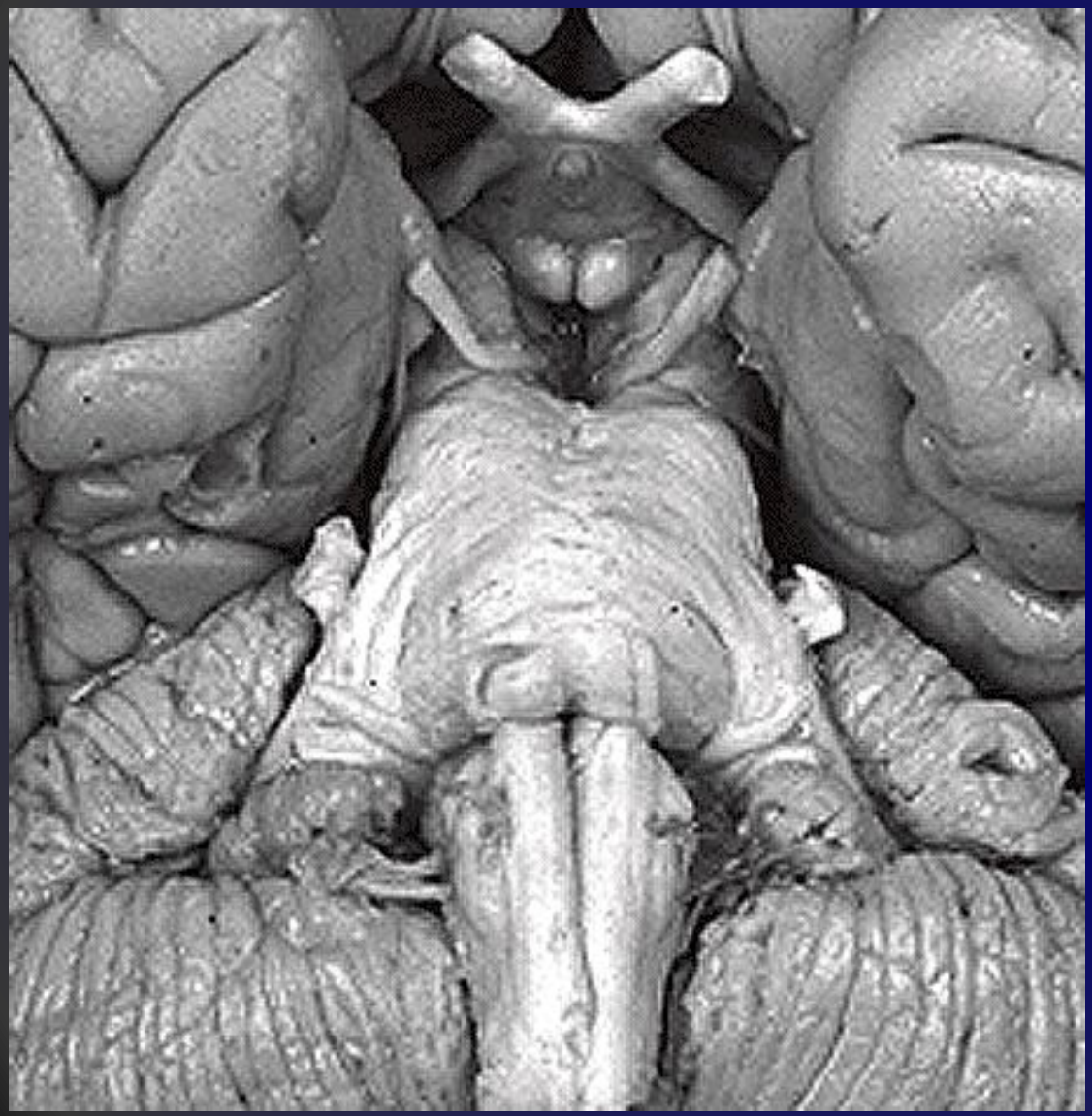
White matter of midbrain







Natural sample of brainstem



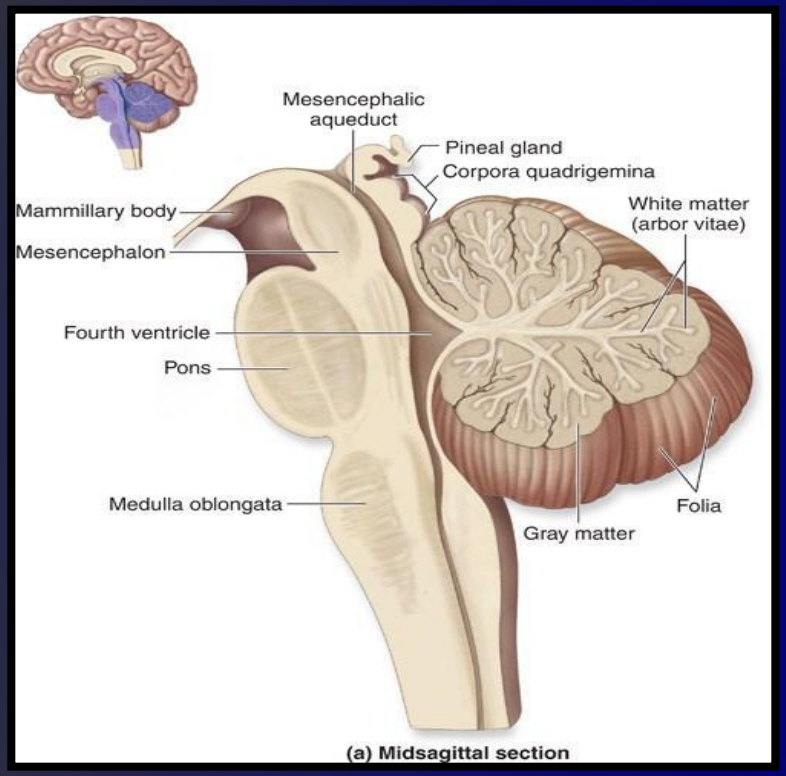
General regularities

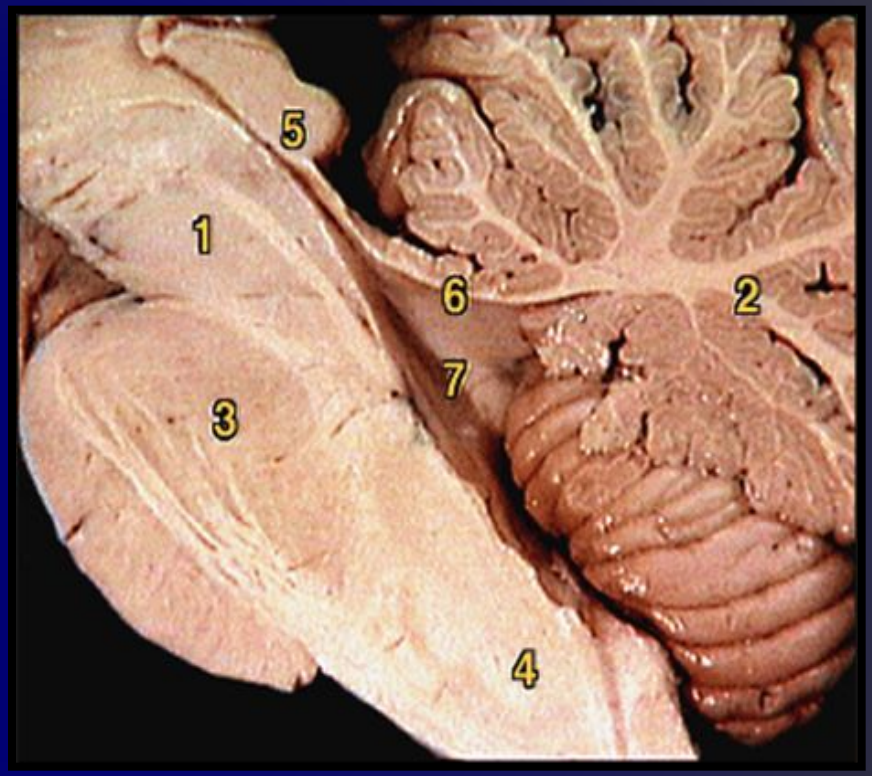
General reguliarities of internal structure in brainstem parts

	Grey matter	White matter
mesence phalon	1. Nuclei of CN 3-4, sensory of CN 5 2. Nuclei of RF 3. Specific nuclei (nuclei of associative nurons of conductive tracts) - substancia grizea -substancia nigra -nuclei rubra	1. Asceending tracts 2. Descending tracts - Decussations - Lemniscus
Pons	1. Nuclei of CN 5-8 2. Nuclei of RF 3. Specific nuclei - nuclei proprii pontinae - nuclei dorsales corpus trapezoideum	
MO	1. Nuclei of CN 9-12, sensory of CN 5 2. Nuclei of RF 3. Specific nuclei - nuclei gracilis et cuneatus -nuclei olivares inferiores	

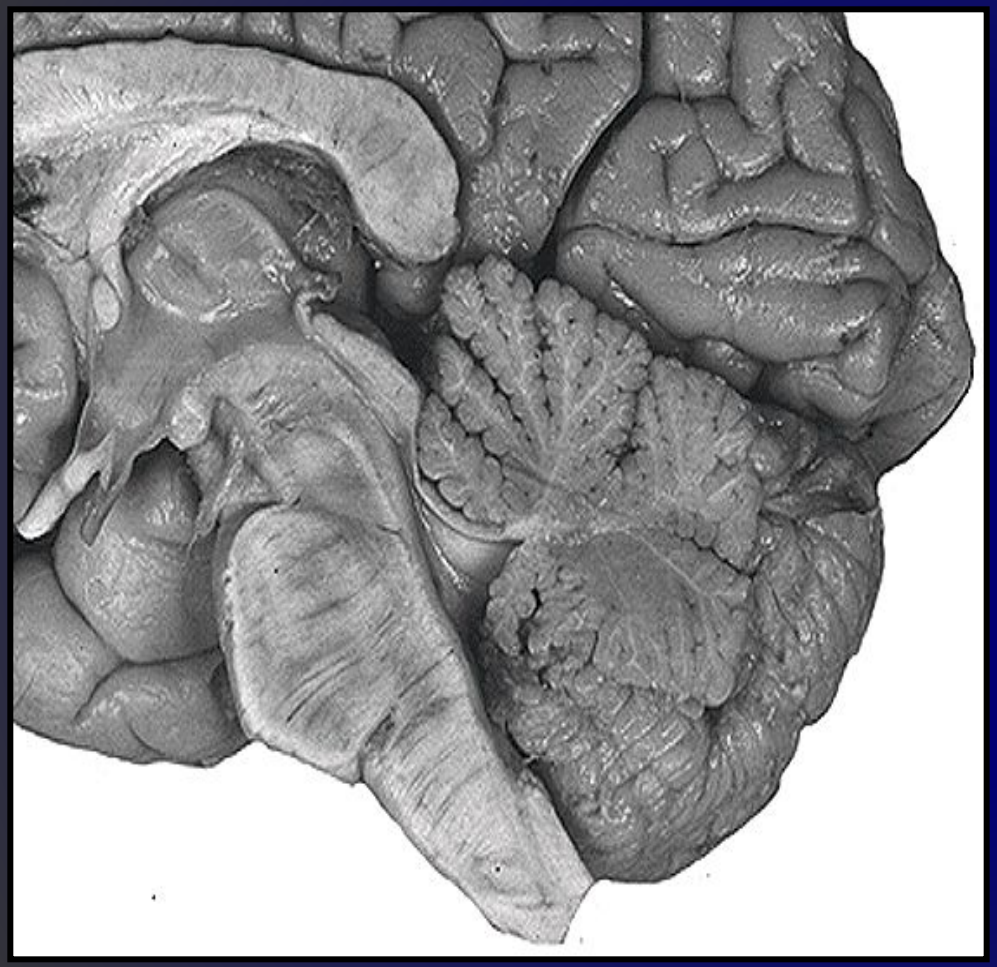
4-th ventricle

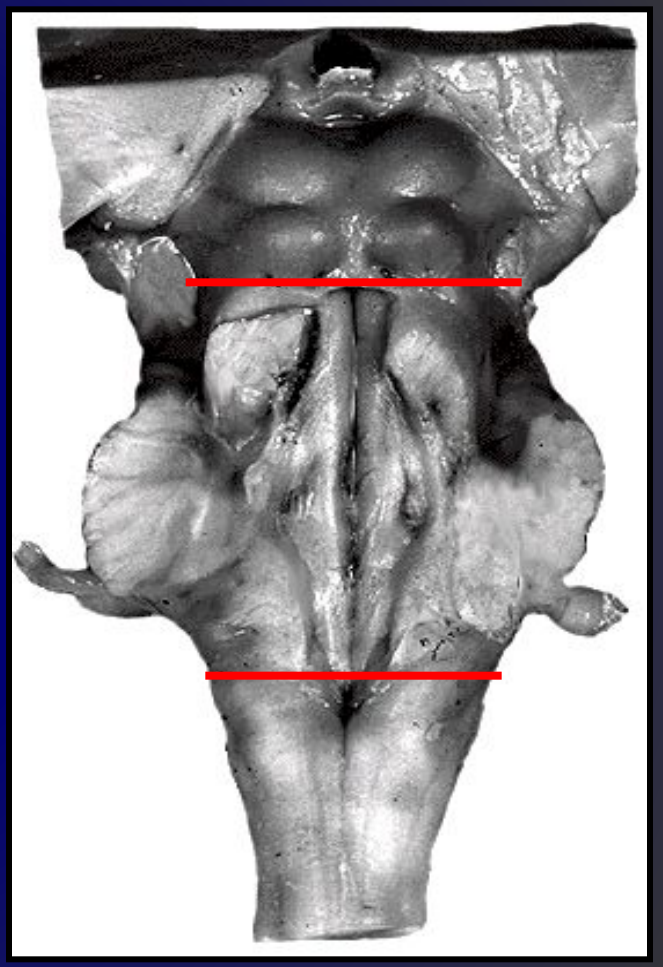
4-th ventricle



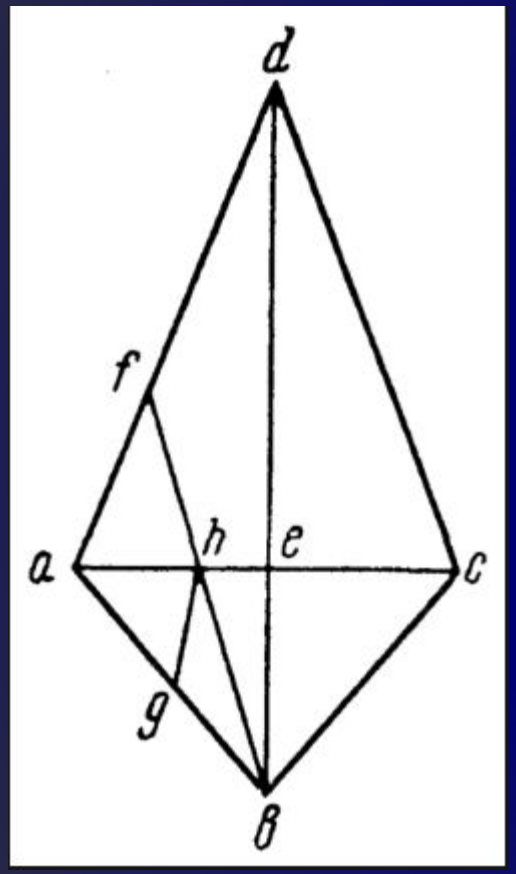


Rhomboid fossa





Blumenau scheme of rhombois fossa



abed — rhomboid fossa;

abc — inferior triangle, belongs to MO;

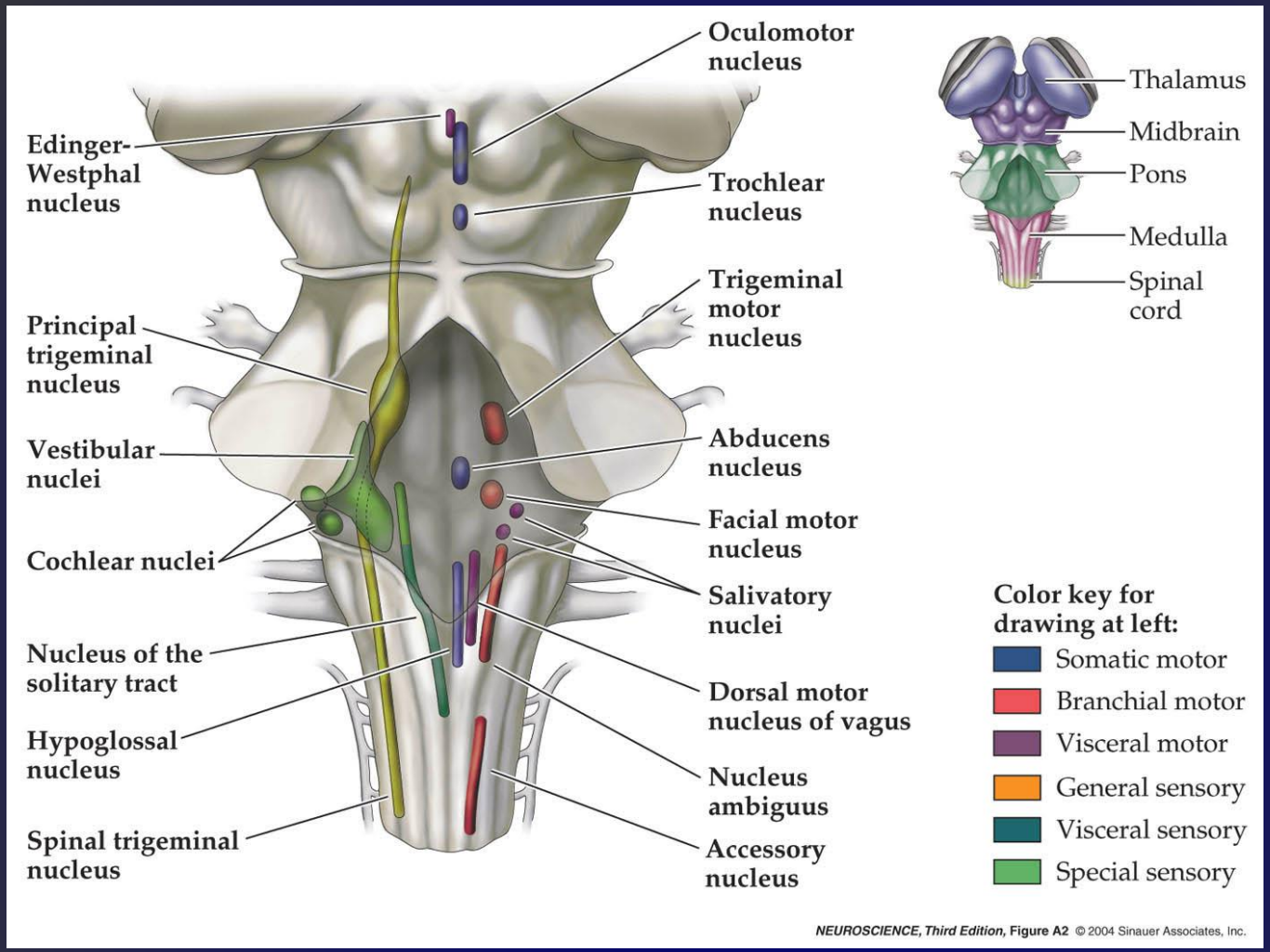
ba, bc — inferior cerebellar peduncles;

ae, ec — striae medullares;

beh — trigonum hypoglossi;

bhg — trigonum vagi;

aghf — area acustica



III, IV, VI, XII

V, VII, N. ambiguus, XII

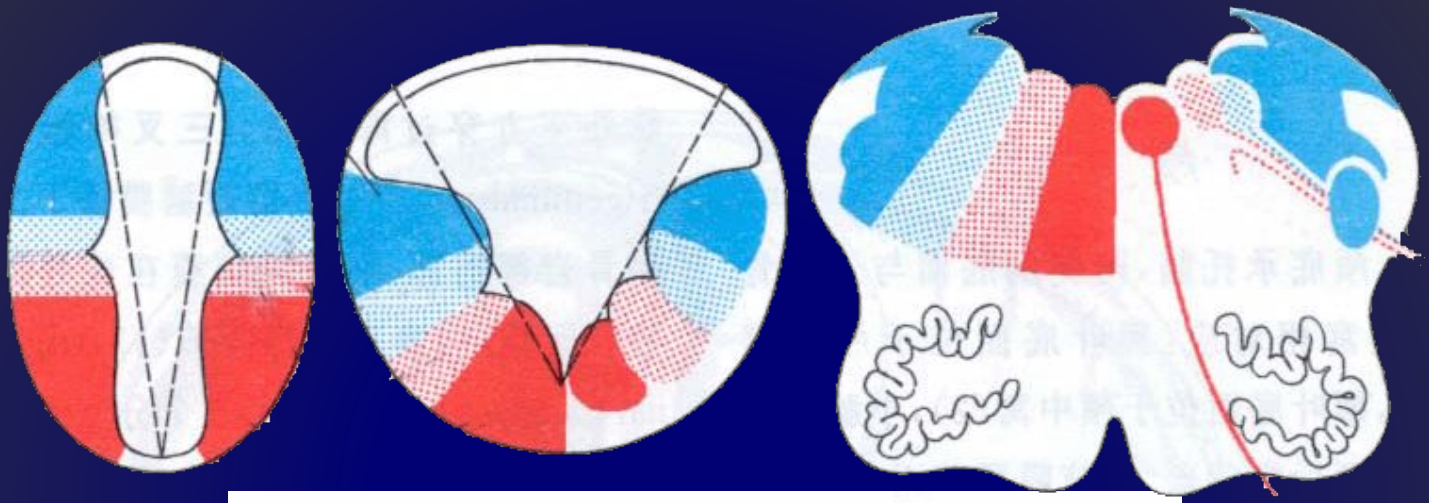
EW, Salivatory, DMN X

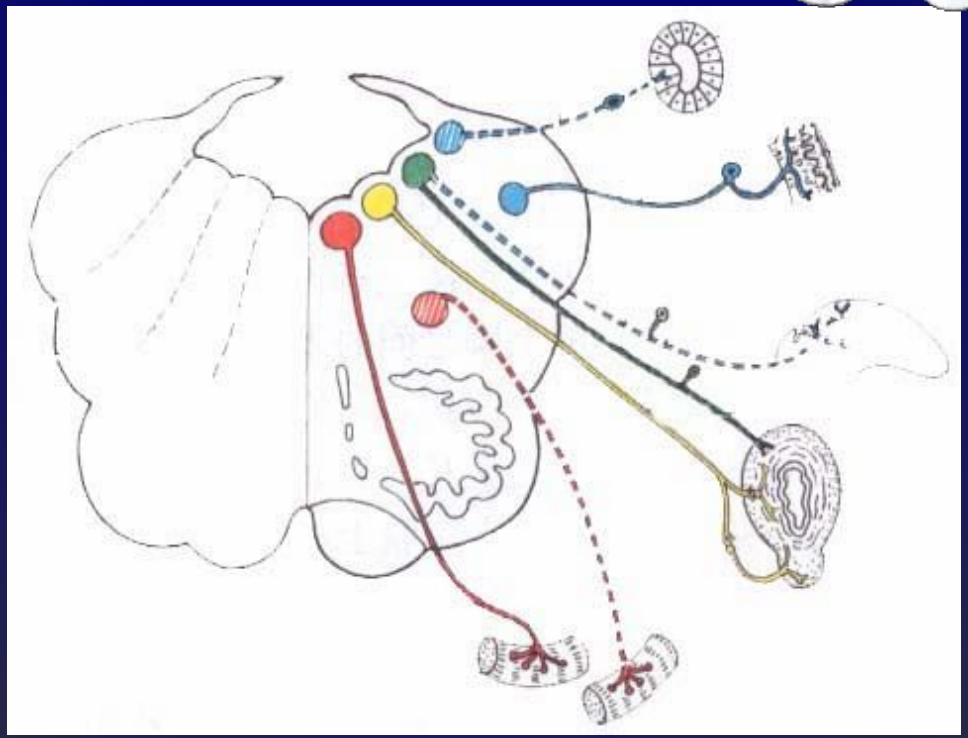
V, VII, IX, X

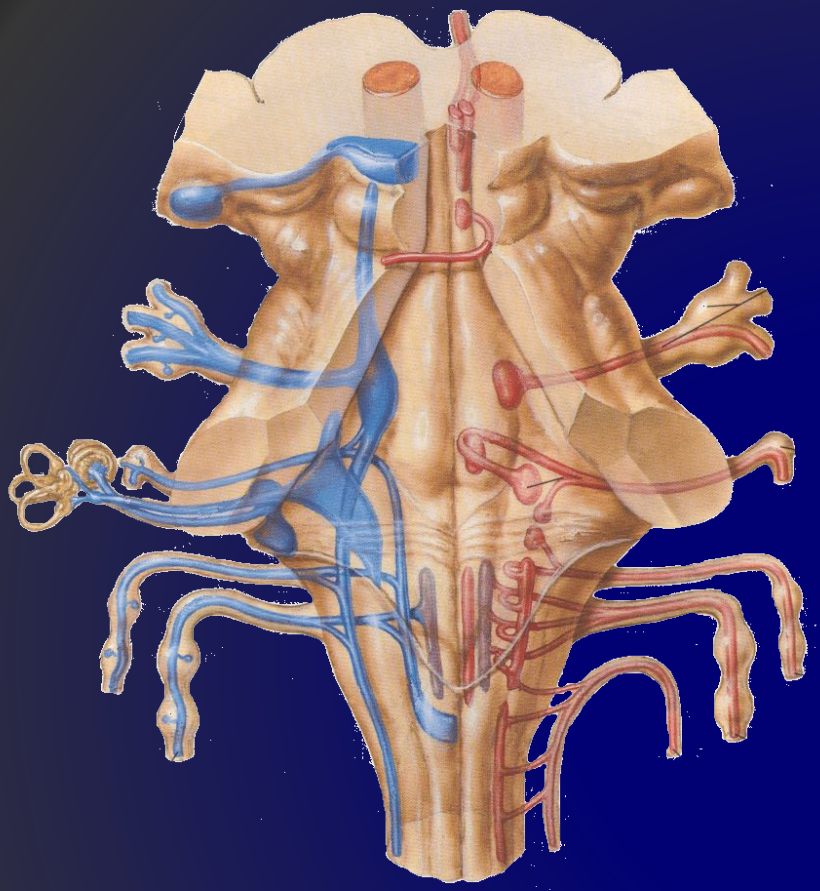
N. Solitary tract

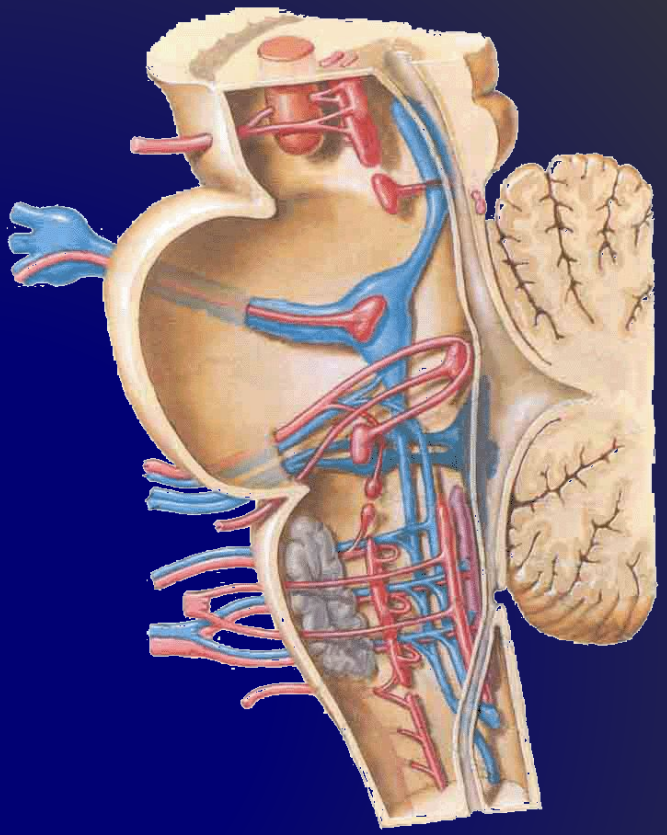
VIII

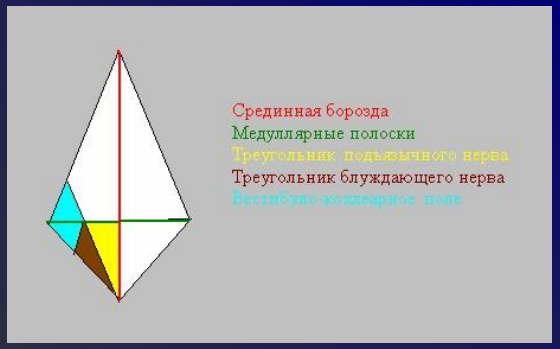
Regularities of nuclei projection in rhomboid fossa



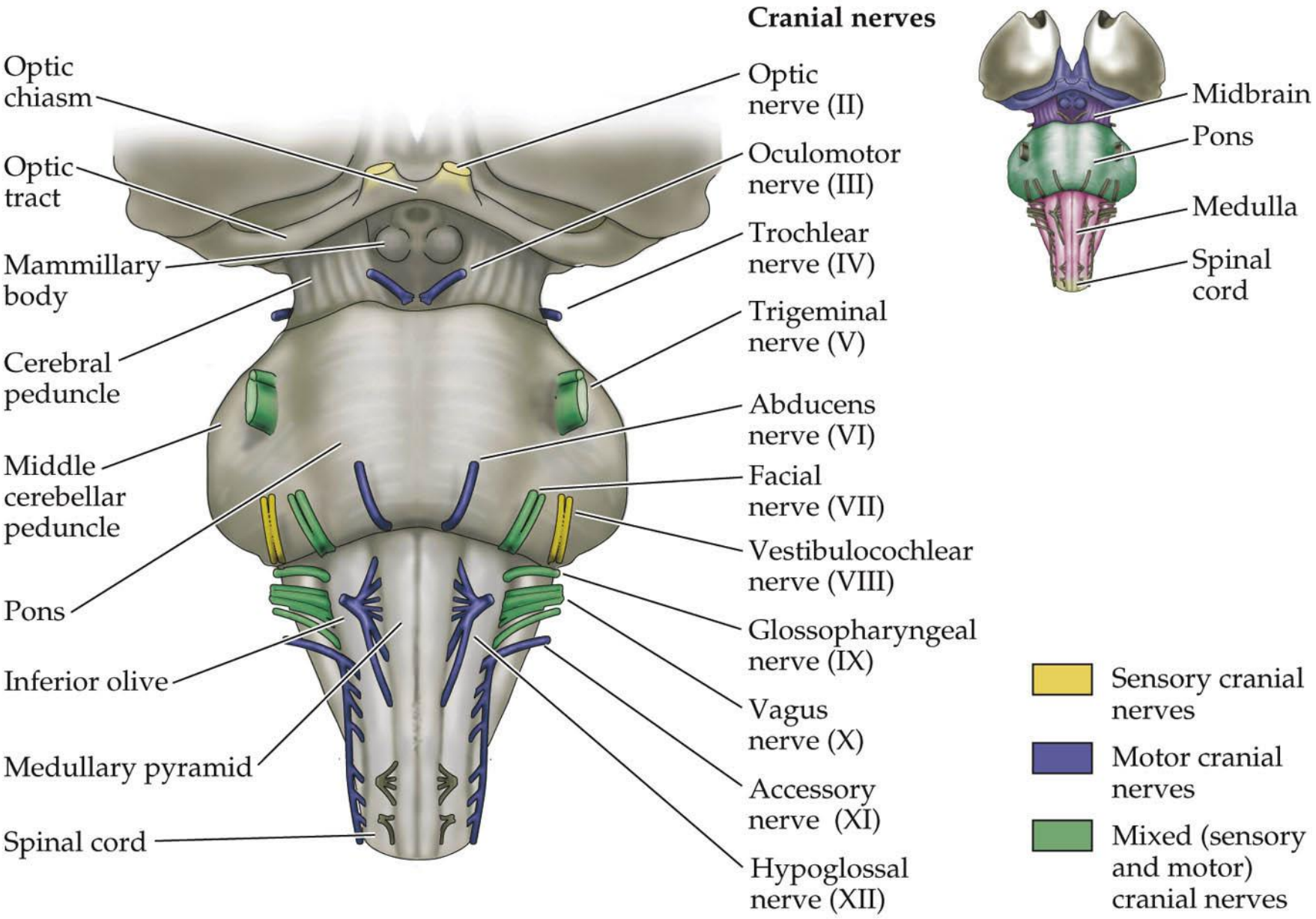






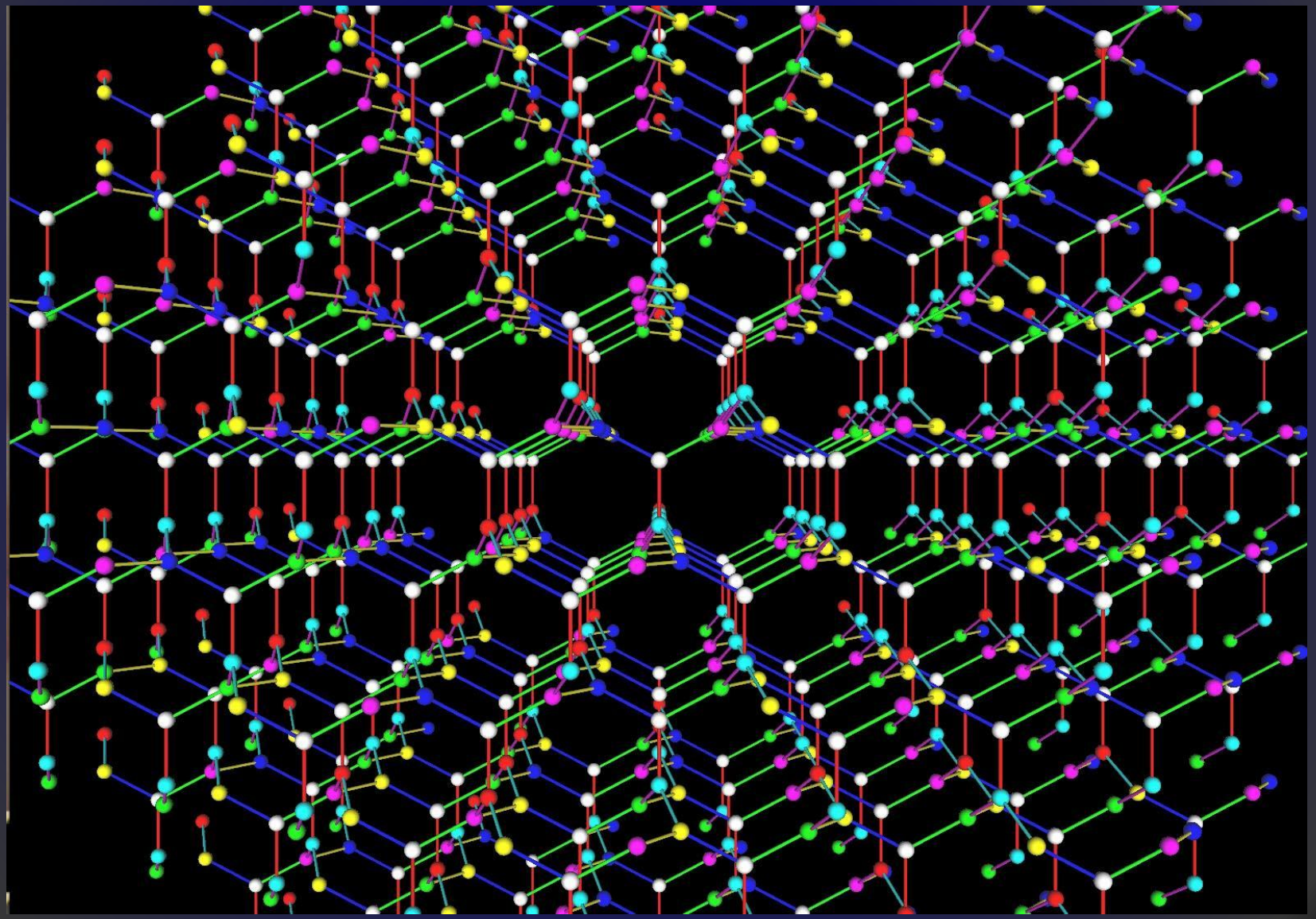


- Sensory nuclei lateral to sulcus limitans
- Motor nuclei medial to sulcus limitans
- Visceral nuclei are on either side of sulcus
- Innervation of skeletal muscle (GSE & SVE) most medial
- General and special visceral afferent nuclei in same column

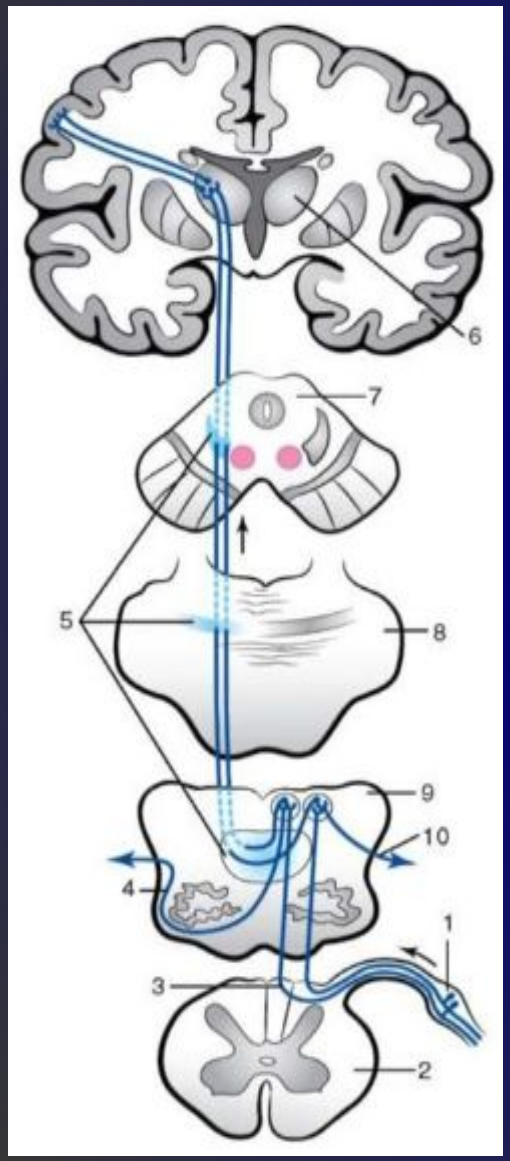


NEUROSCIENCE, Third Edition, **Figure A1**

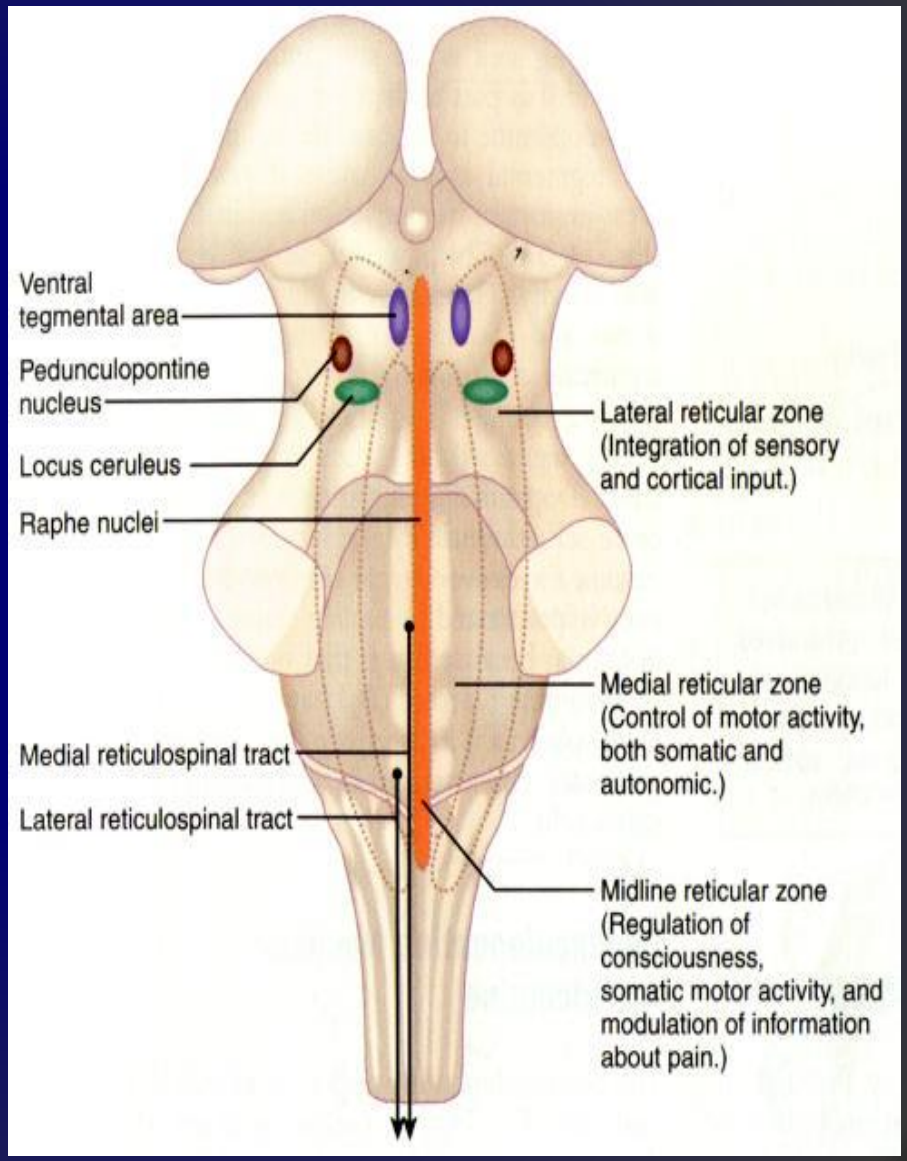
Reticular formation



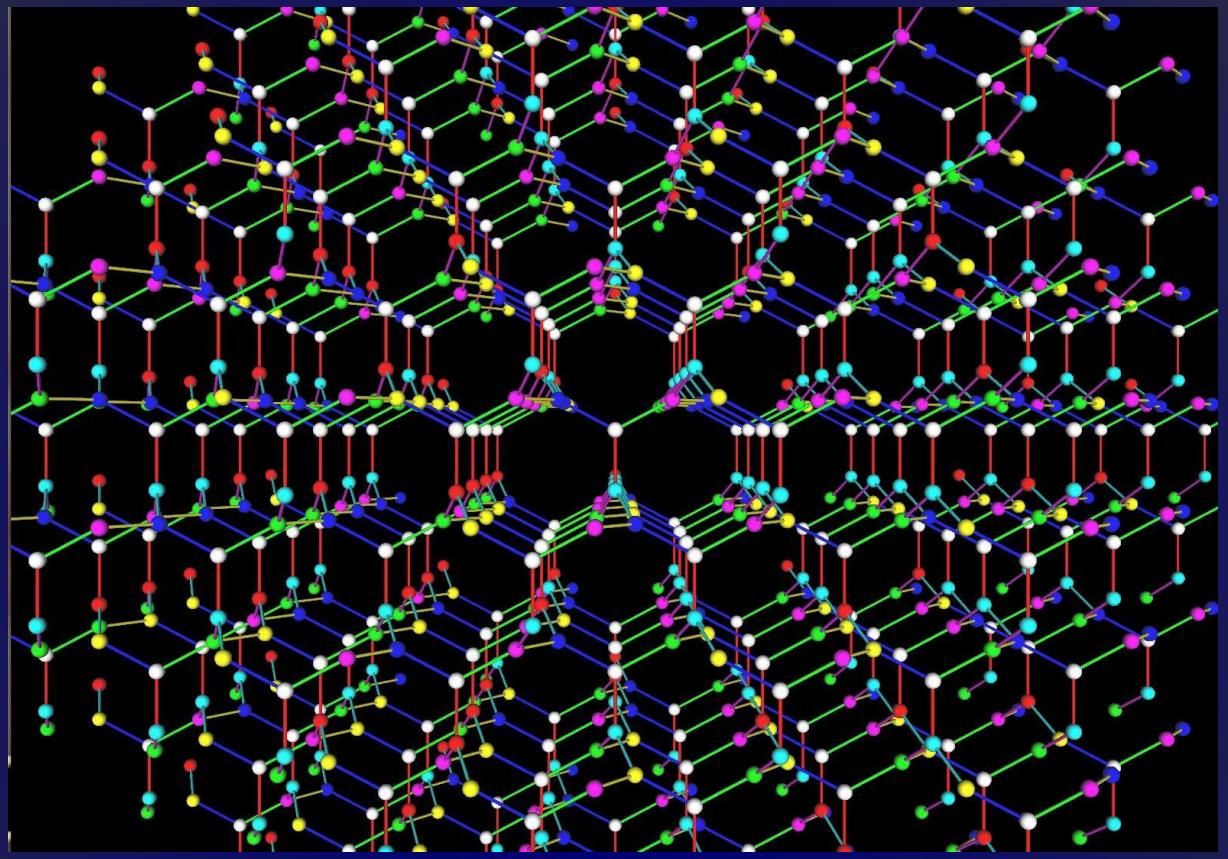
1-st activating system -
Conductive tracts



2-nd activating system-
Reticular activating system (RAS)



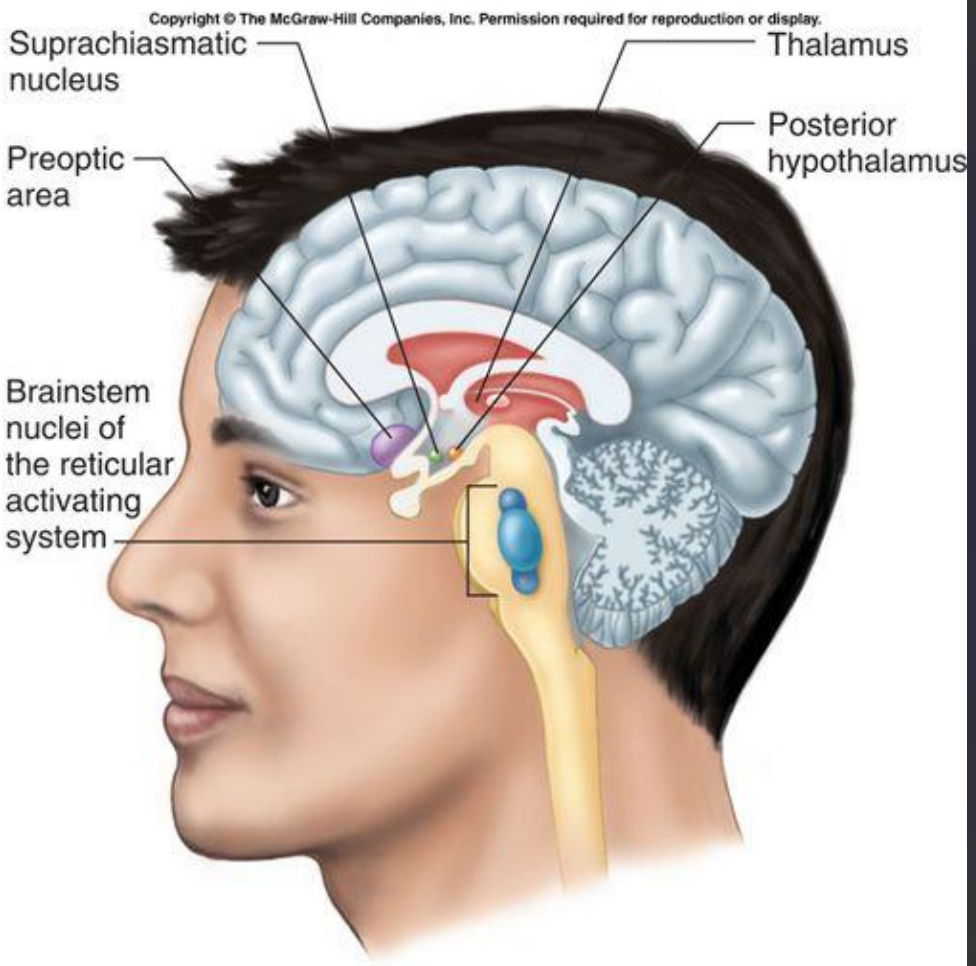
Effects of RAS

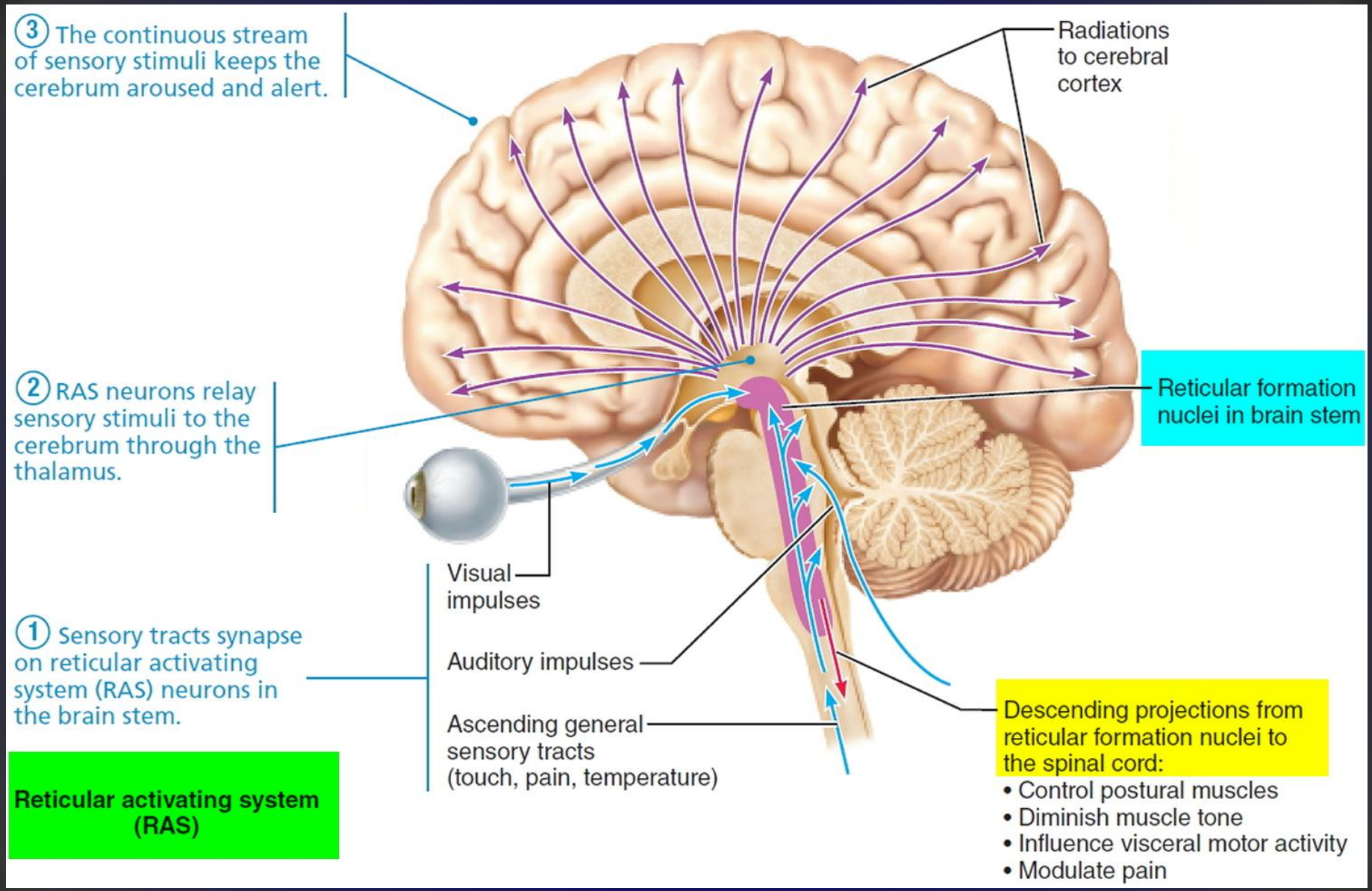


1. Multiplication of stimuli
2. Amplification of stimuli
3. More generalized answer

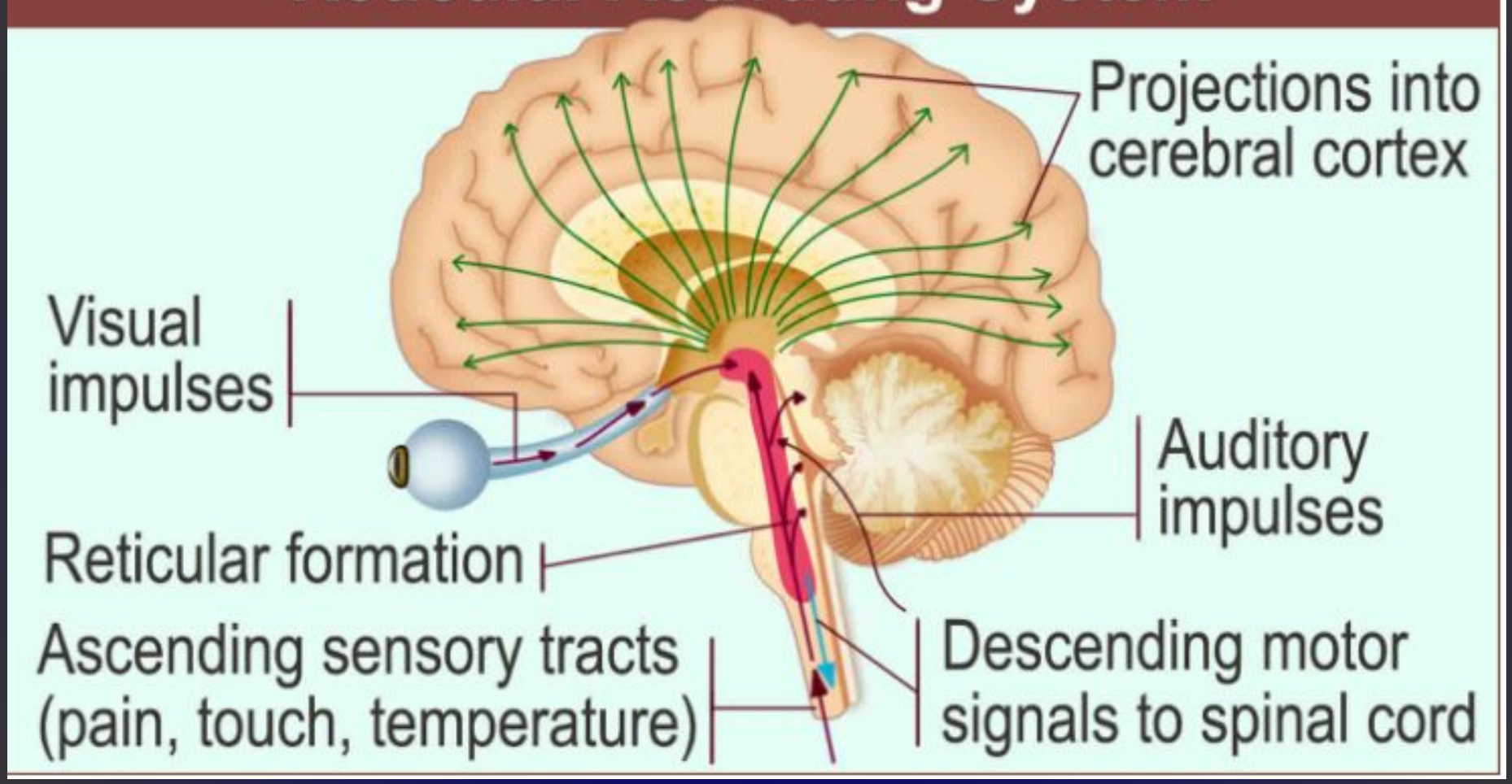
RAS (Reticular Activating System)

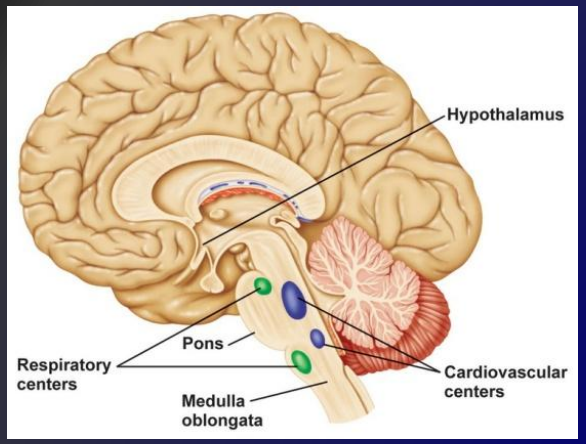
- Brainstem nuclei intermingled with bundles of axons
- Receives and integrates input from all regions of CNS
- Involved in motor function, cardiac and respiratory control, attention, vasomotor control, sleep/wakefulness
- Extends along length of brain stem; used in maintaining alertness while awake

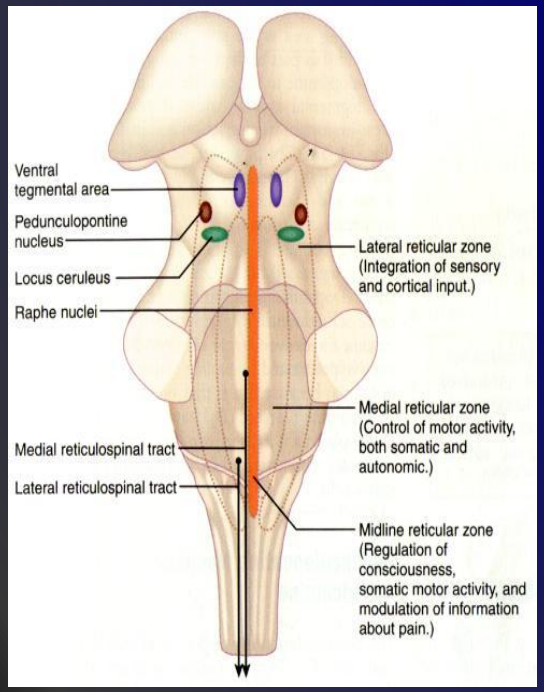


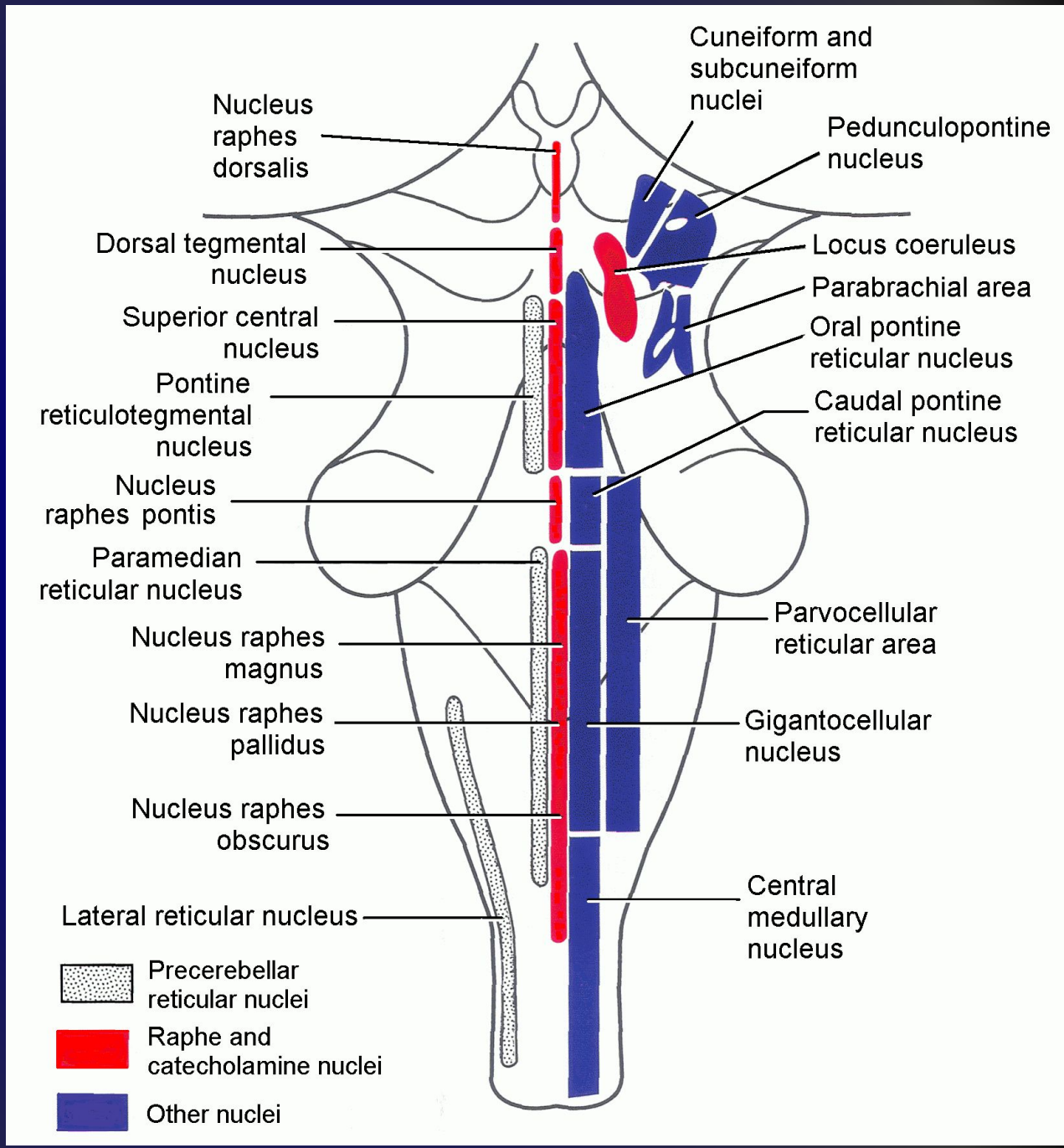

3 The continuous stream of sensory stimuli keeps the cerebrum aroused and alert.
Radiations to cerebral cortex
2 RAS neurons relay sensory stimuli to the cerebrum through the thalamus.
Reticular formation nuclei in brain stem
Visual impulses
1 Sensory tracts synapse on reticular activating system (RAS) neurons in the brain stem.
Auditory impulses
Ascending general sensory tracts (touch, pain, temperature)
Descending projections from reticular formation nuclei to the spinal cord:
• Control postural muscles
• Diminish muscle tone
• Influence visceral motor activity
• Modulate pain
Reticular activating system (RAS)

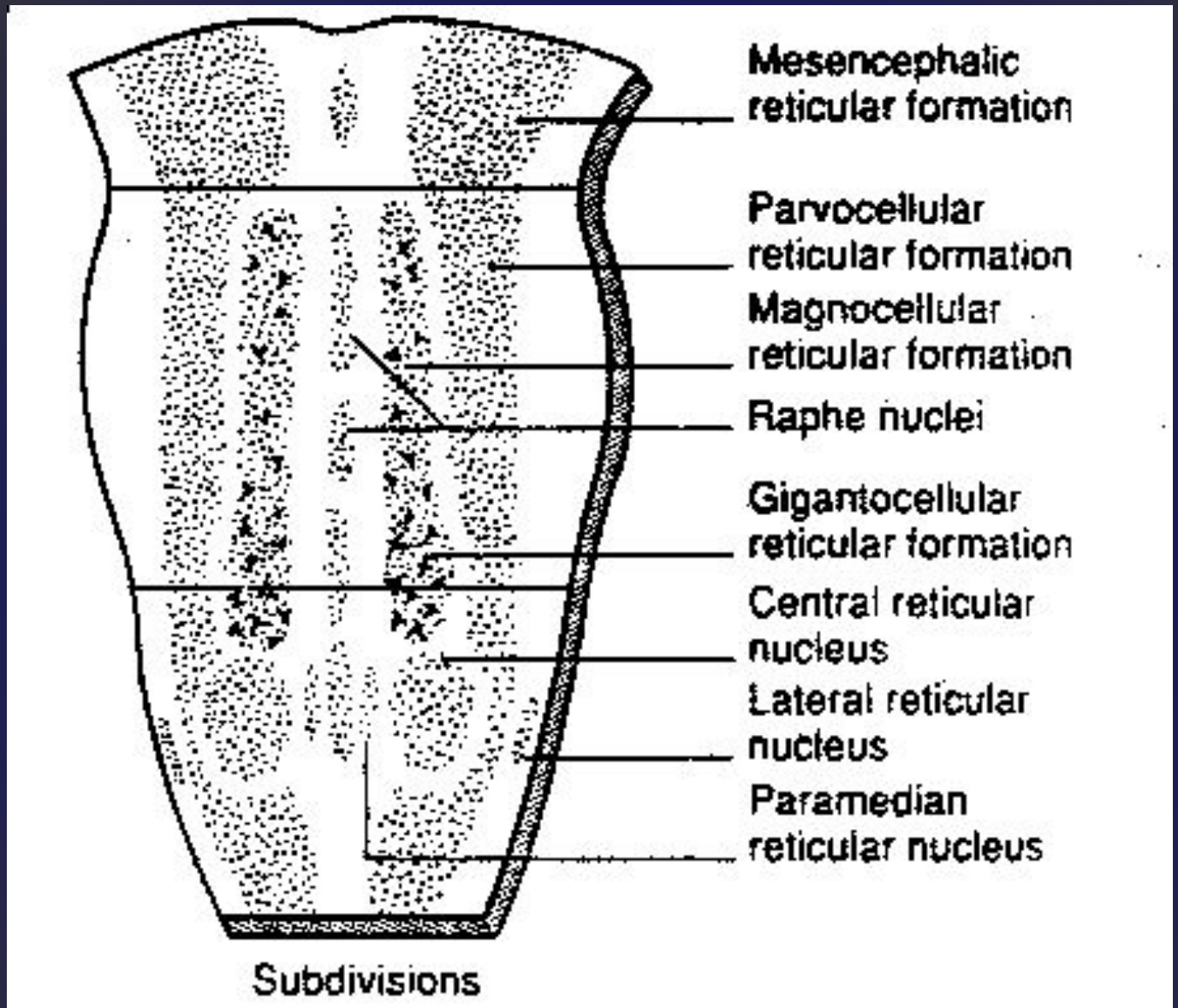
Reticular Activating System




Hypothalamus
Pons
Respiratory centers
Cardiovascular centers
Medulla oblongata


Ventral tegmental area
Pedunculopontine nucleus
Locus ceruleus
Raphe nuclei
Lateral reticular zone (Integration of sensory and cortical input.)
Medial reticular zone (Control of motor activity, both somatic and autonomic.)
Medial reticulospinal tract
Lateral reticulospinal tract
Midline reticular zone (Regulation of consciousness, somatic motor activity, and modulation of information about pain.)

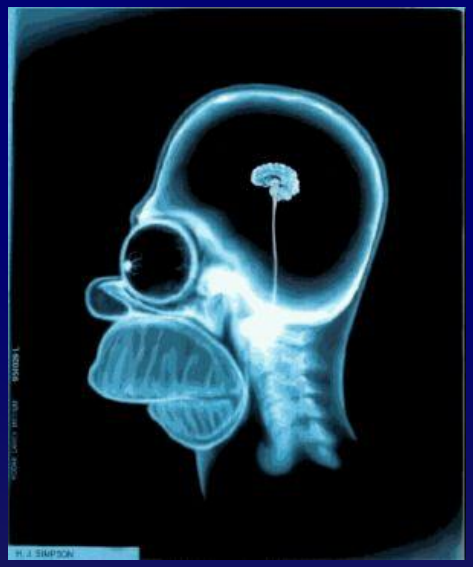

Cuneiform and subcuneiform nuclei
Nucleus raphes dorsalis
Pedunculopontine nucleus
Dorsal tegmental nucleus
Locus coeruleus
Parabrachial area
Superior central nucleus
Oral pontine reticular nucleus
Pontine reticulotegmental nucleus
Caudal pontine reticular nucleus
Nucleus raphes pontis
Paramedian reticular nucleus
Parvocellular reticular area
Nucleus raphes magnus
Nucleus raphes pallidus
Gigantocellular nucleus
Nucleus raphes obscurus
Central medullary nucleus
Lateral reticular nucleus
Precerebellar reticular nuclei
Raphe and catecholamine nuclei
Other nuclei



Subdivisions

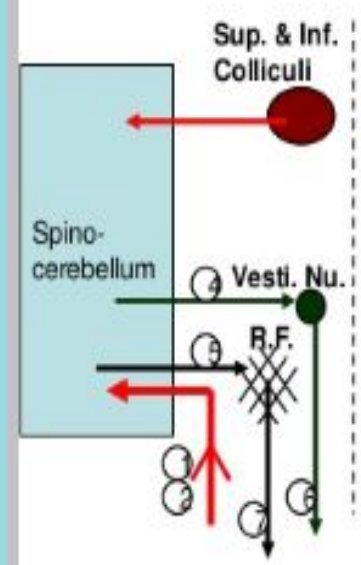
(pons between horizontal lines)

cerebellum



Functions Of Cerebellum

(1) CONTROL OF TONE & POSTURE:



o Mainly function of Spinocerebellum.

CHANGE IN BODY POSTURE

Proprioceptive from Body

↓

1.Spino-cerebellar (dor. & Vent.)
2.Cuneo-cerebellar
3.Tecto-cerebellar (Visual & Auditory)

↓

REFLEX CORRECTION OF MUSCLE TONE

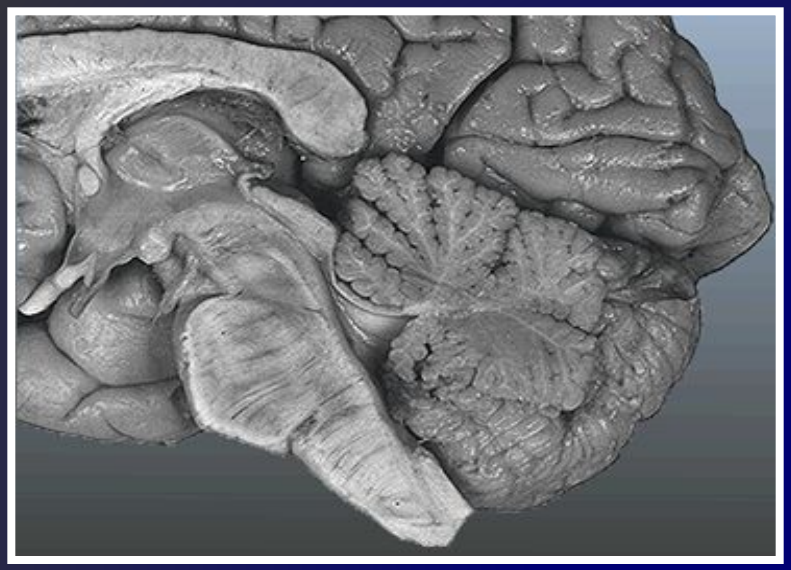
4.Cereb.-vestibular
5.Cereb.-reticular
6.Vestibulo-spinal
7.Reticulo-spinal

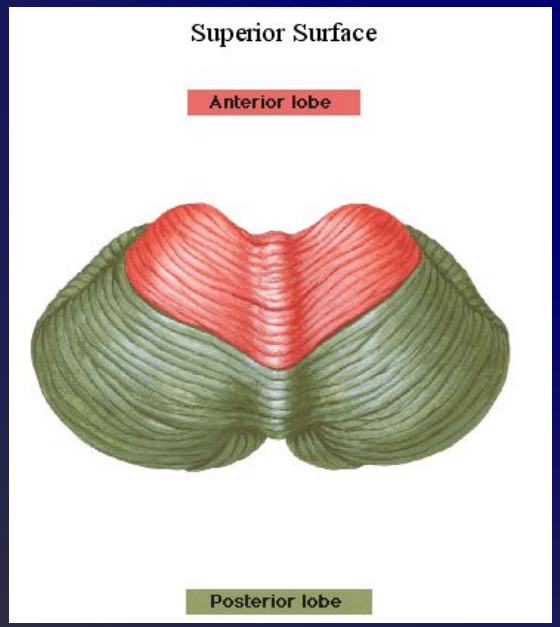
↓

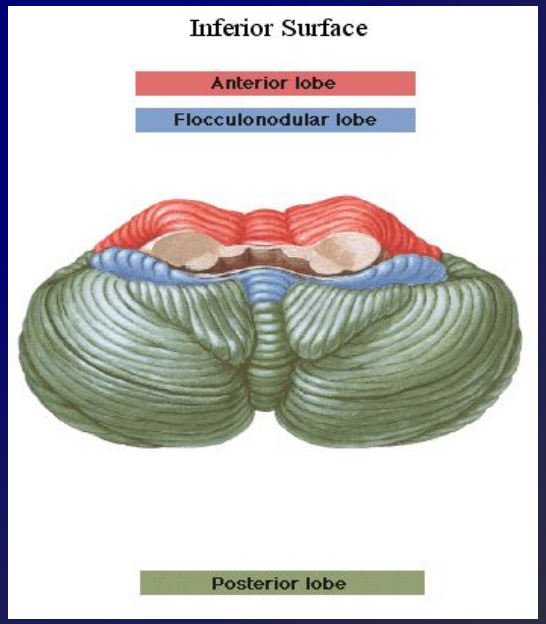
A.H.C.

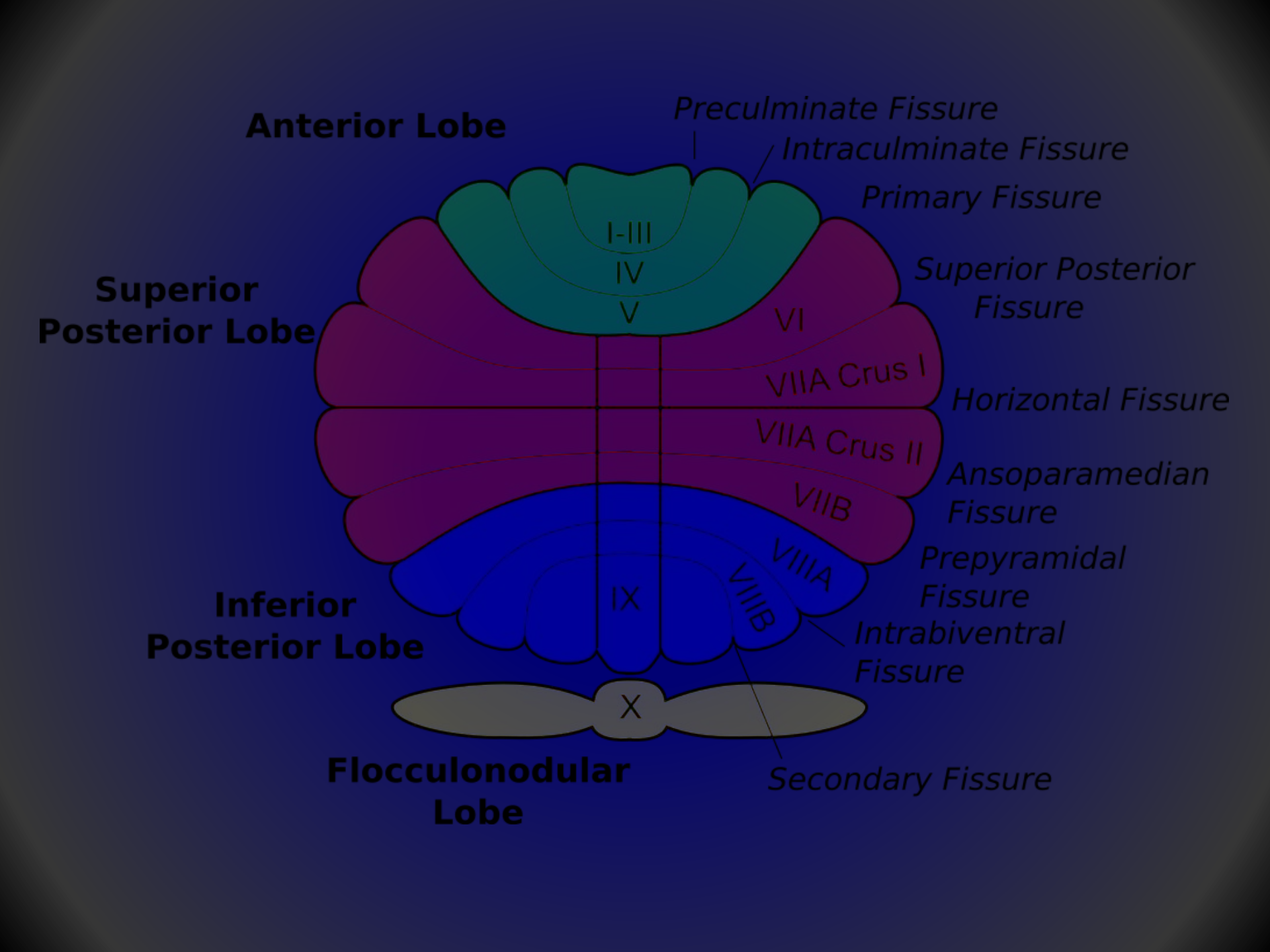
EASY MAINTANENCE OF NEW POSTURE

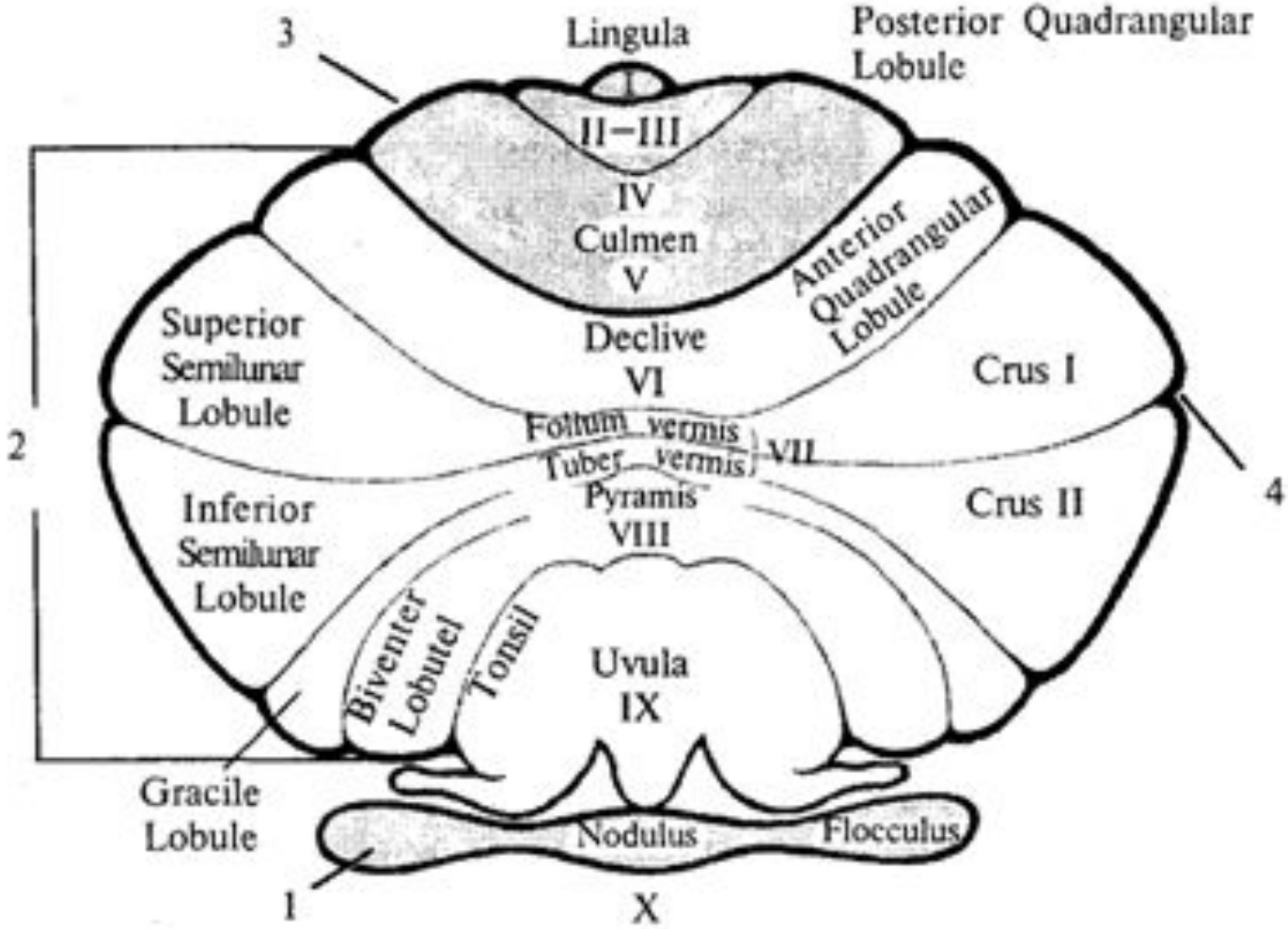
External structure of cerebellum





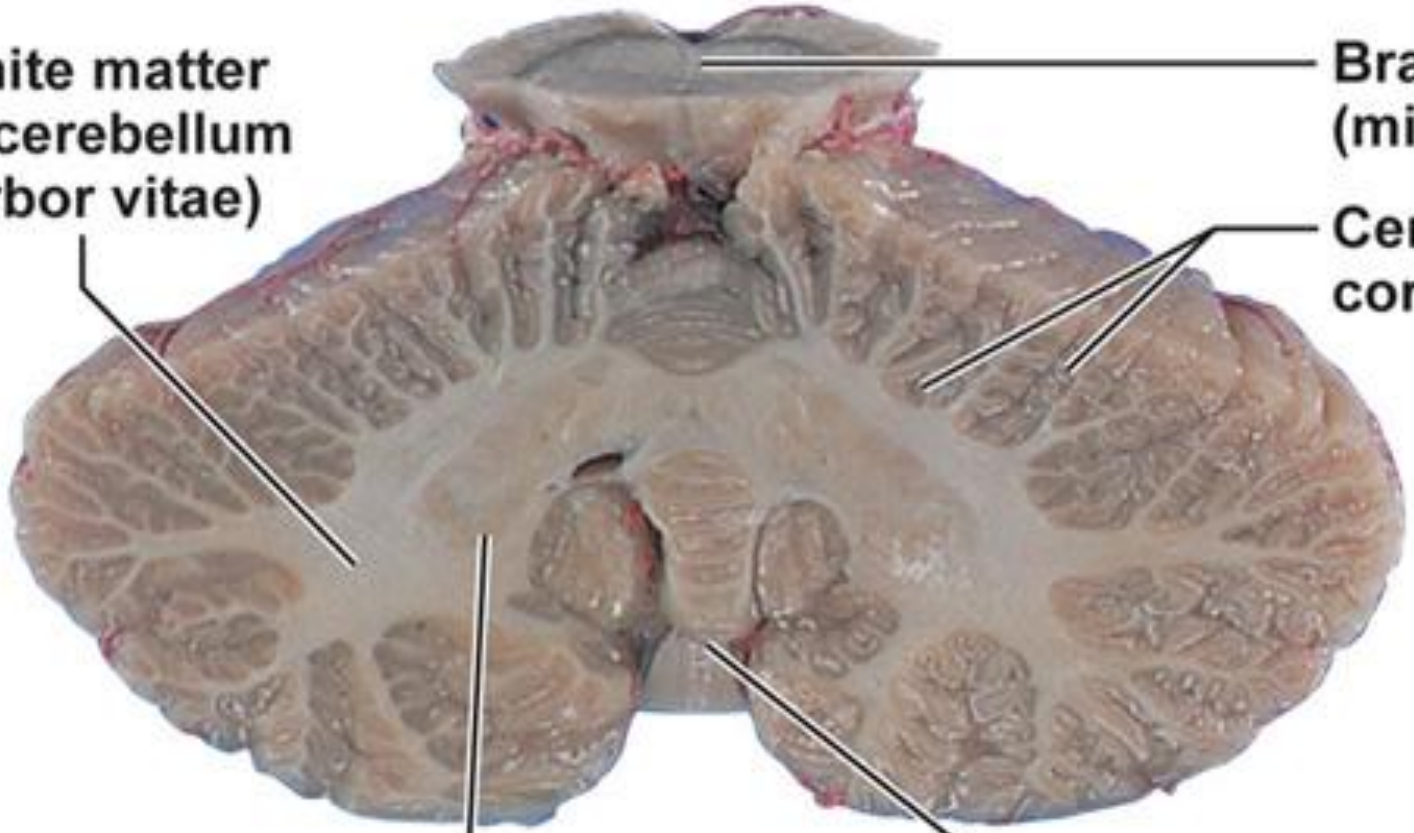



Anterior Lobe
Preculminate Fissure
Intraculminate Fissure
Primary Fissure
I-III
IV
V
Superior Posterior Lobe
Superior Posterior Fissure
VI
VIIA Crus I
Horizontal Fissure
VIIA Crus II
Ansoparamedian Fissure
VIIB
VIIIA
Prepyramidal Fissure
VIIIB
IX
Inferior Posterior Lobe
Intrabiventral Fissure
X
Flocculonodular Lobe
Secondary Fissure



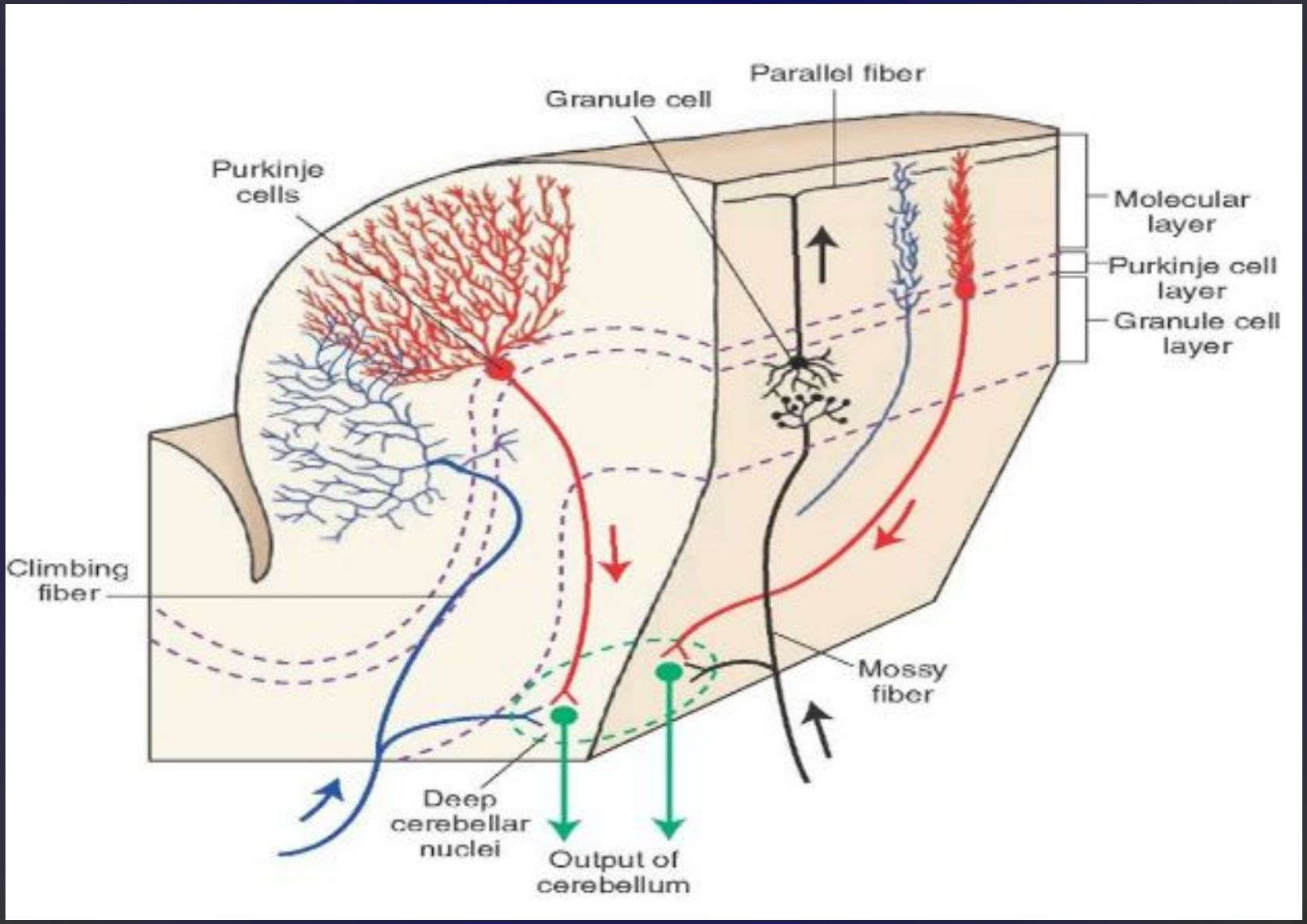
Lobules of cerebellum

The Cerebellum – White and Gray Matter

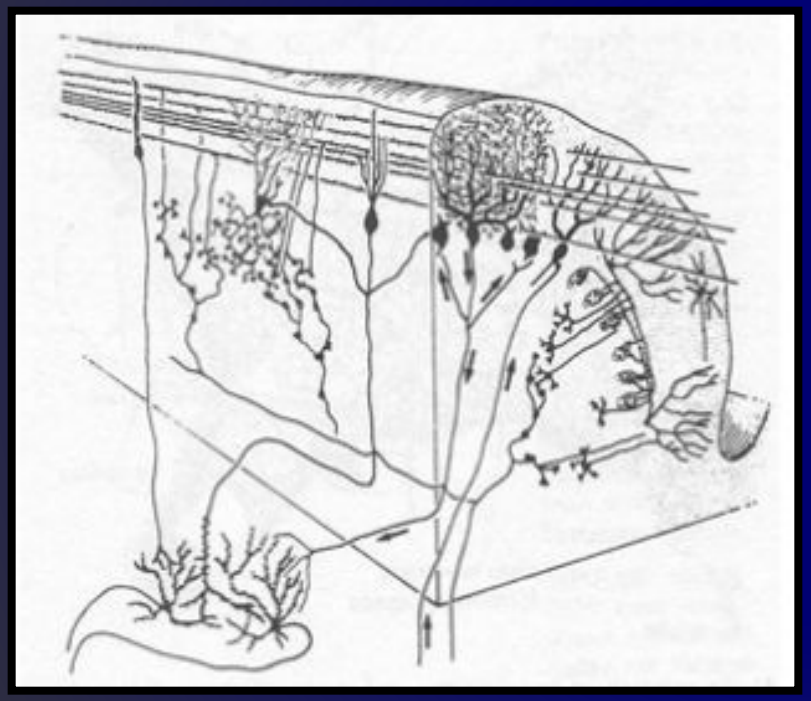


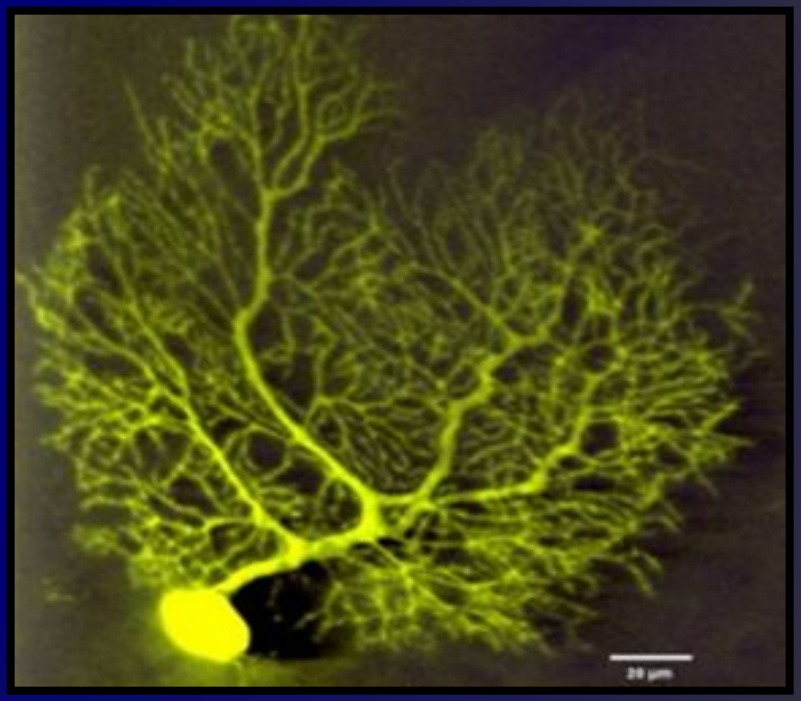
(d) Coronal section, posterior view

Layers of cortex in cerebellum

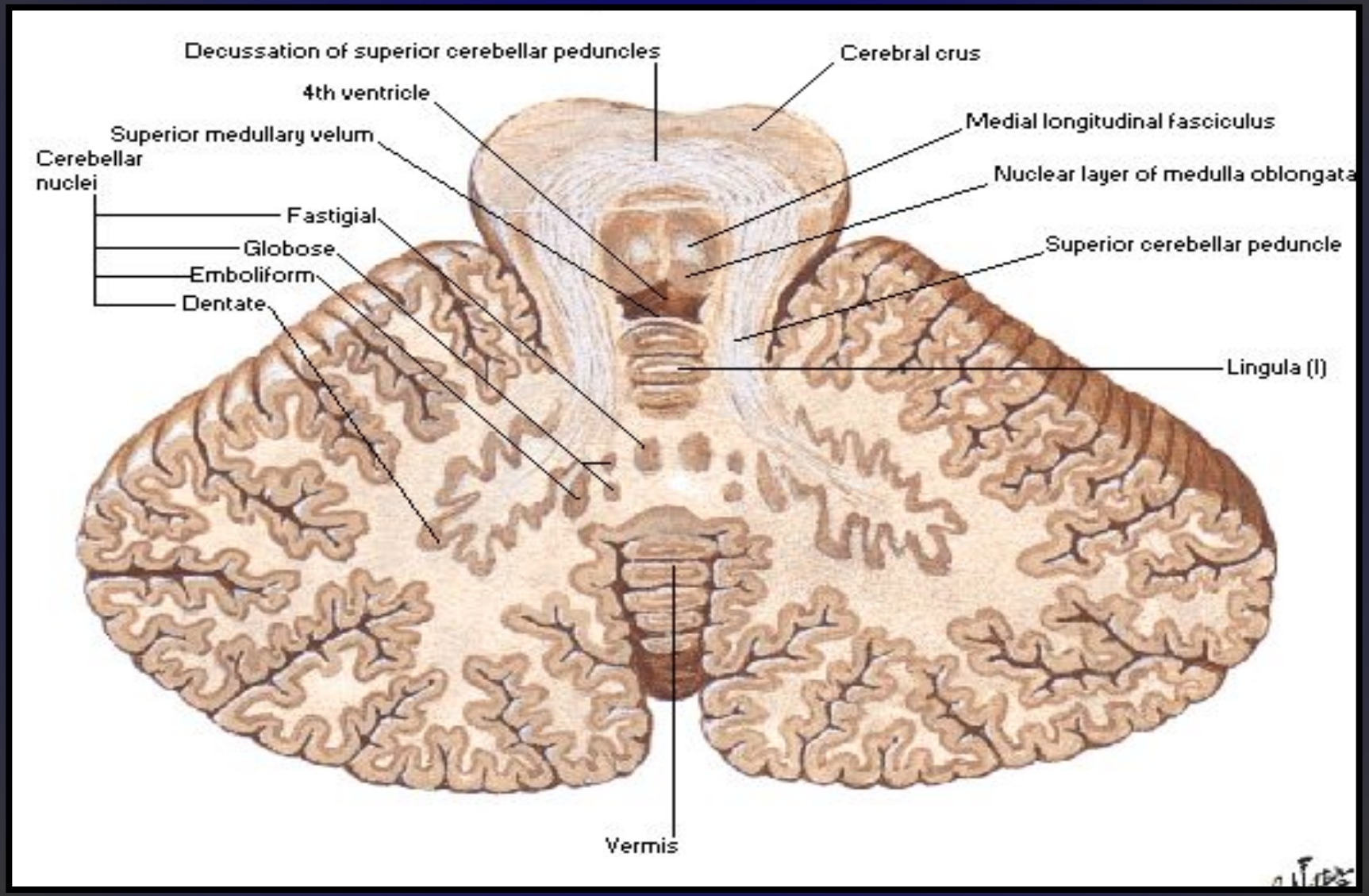


Purkinje fibers with 2D dendritic tree

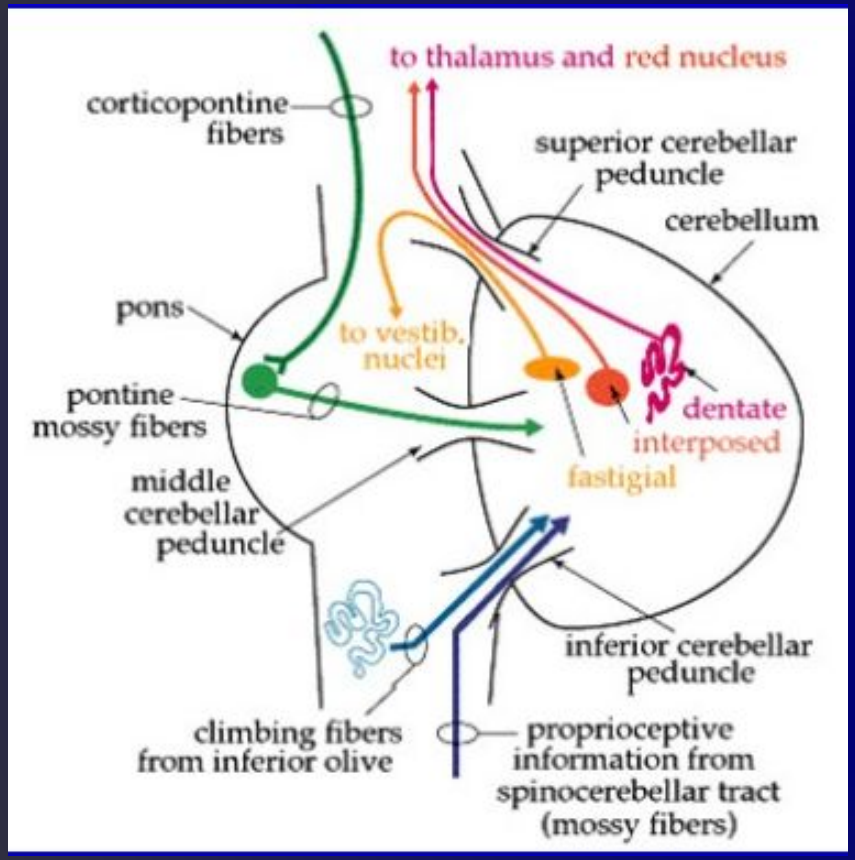


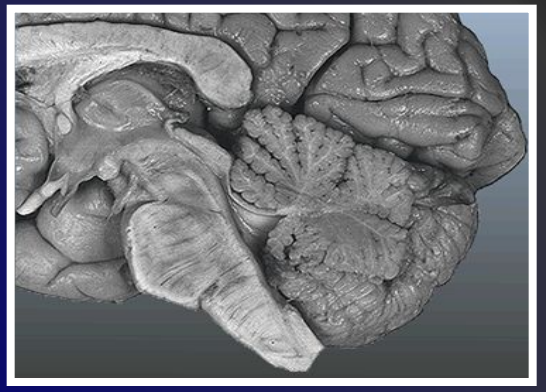


Internal structure of cerebellum (grey and white matter)

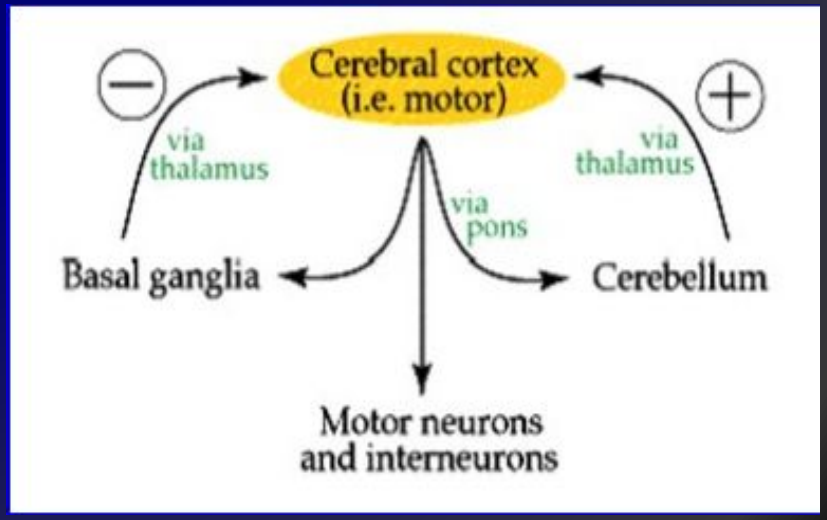


Afferent and efferent pathways of cerebellum





Cerebellum participates in movements regulation



Methods of study


Thank you
for attention!