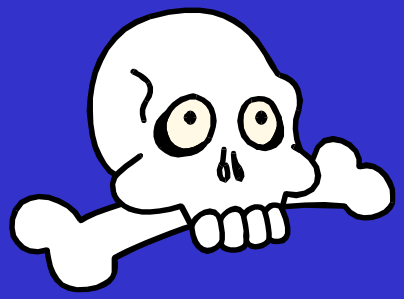
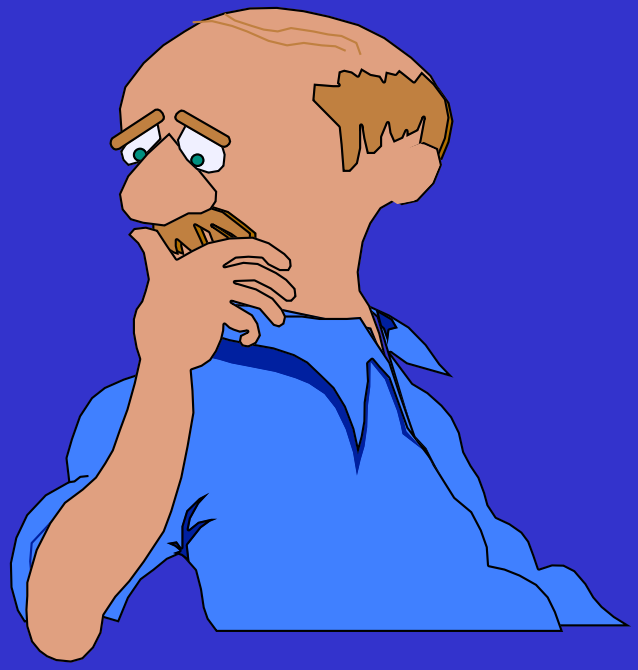
神經系統介紹





林宙晴
國立成功大學附設醫院　神經科

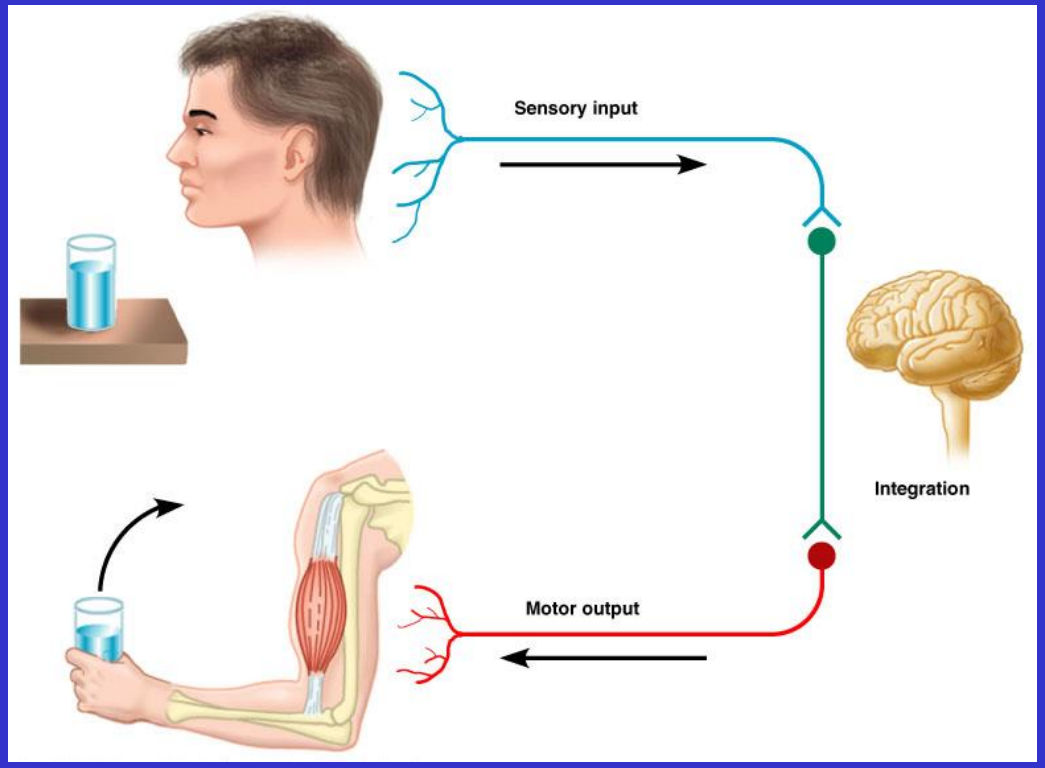
大綱

- 發生學角度
- 由內而外
- 功能性組成

神經系統之主要組成

神經系統

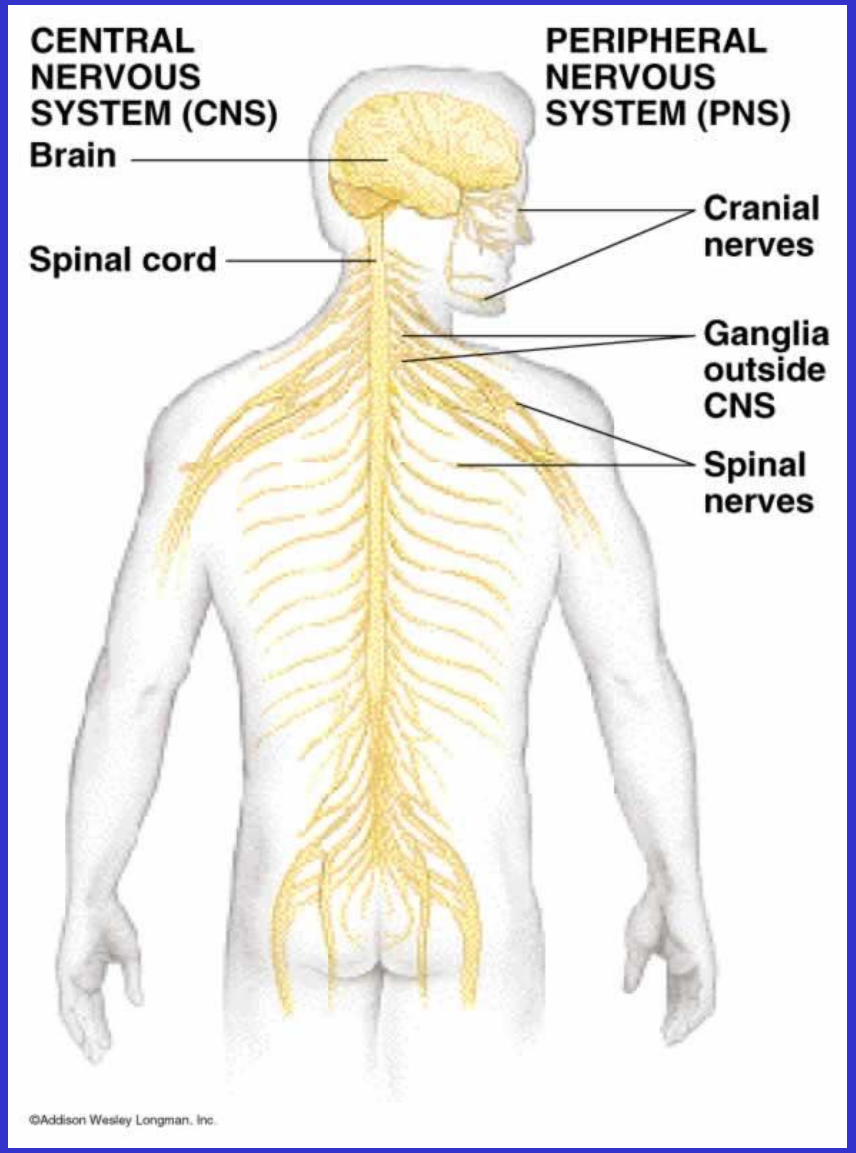
- Sensory input – monitoring stimuli occurring inside & outside the body
- Integration – interpretation of sensory input
- Motor output – response to stimuli by activating effector organs



The most sophisticated system in the body.

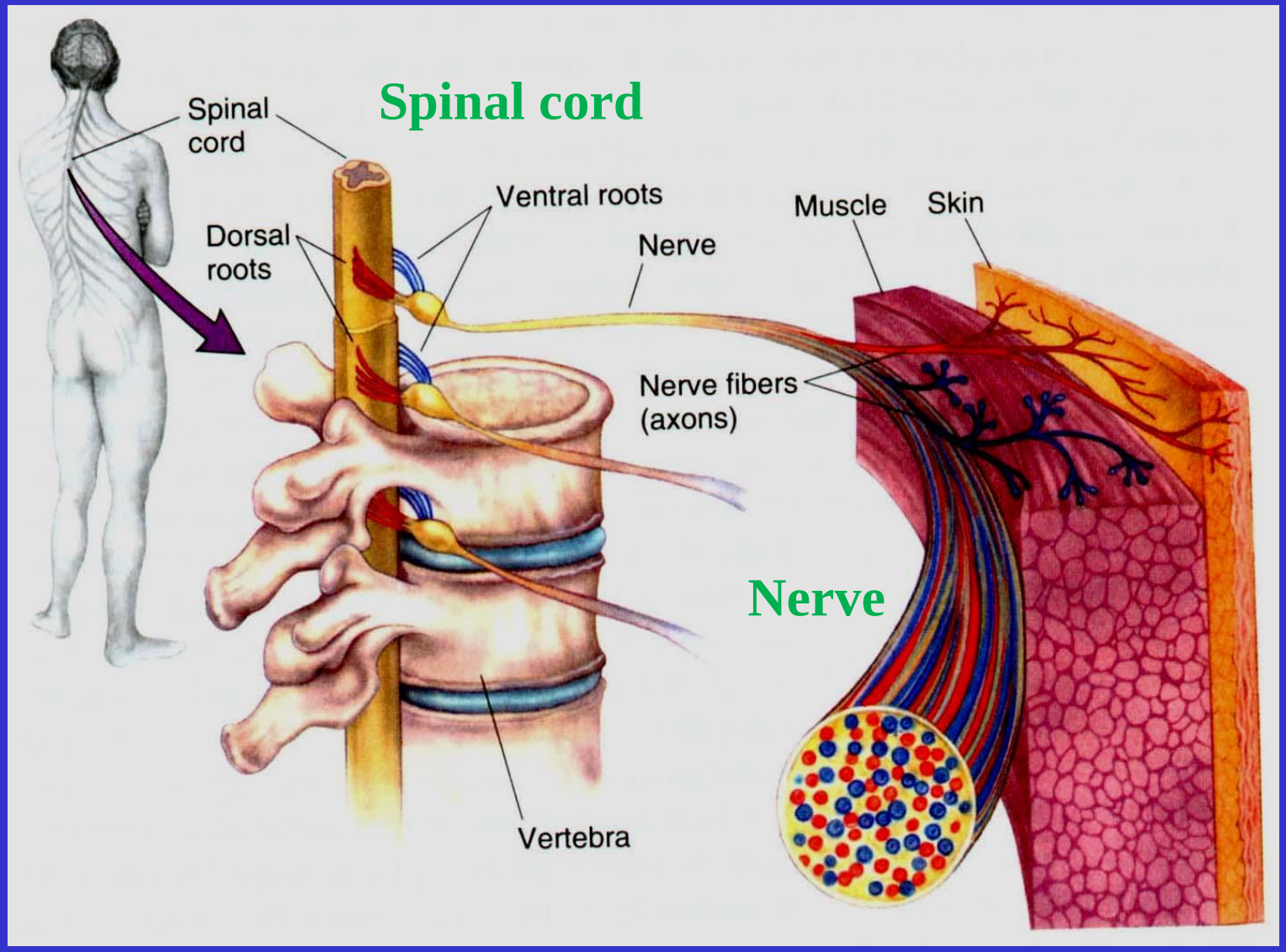
神經系統的組織

- **Central nervous system (CNS)**
  - Brain
  - Spinal cord
- **Peripheral nervous system (PNS)**
  - Cranial nerves
  - Spinal nerves



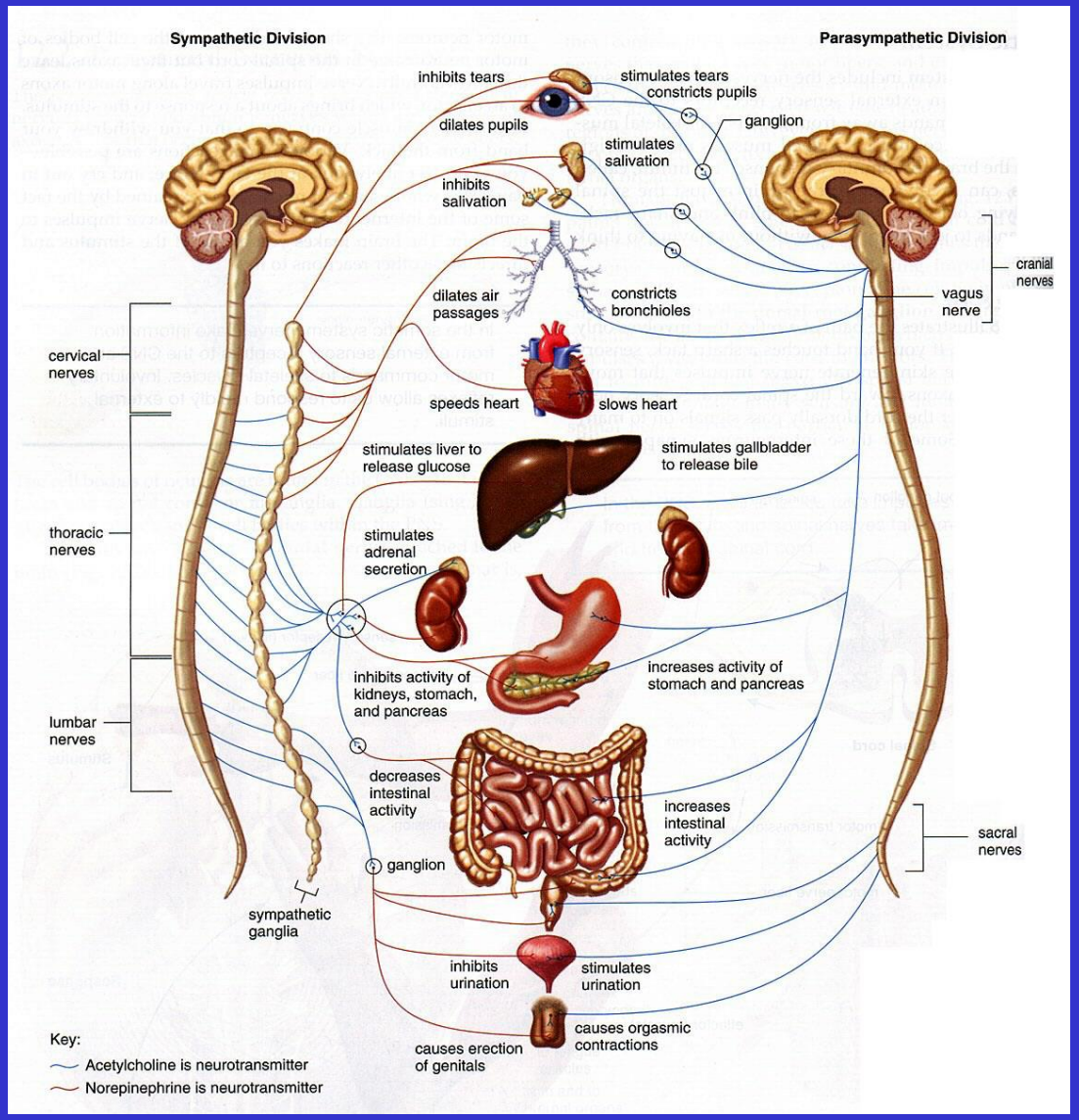
神經路徑

Brain


Spinal cord
Spinal cord
Ventral roots
Dorsal roots
Nerve
Muscle
Skin
Nerve fibers (axons)
Nerve
Vertebra

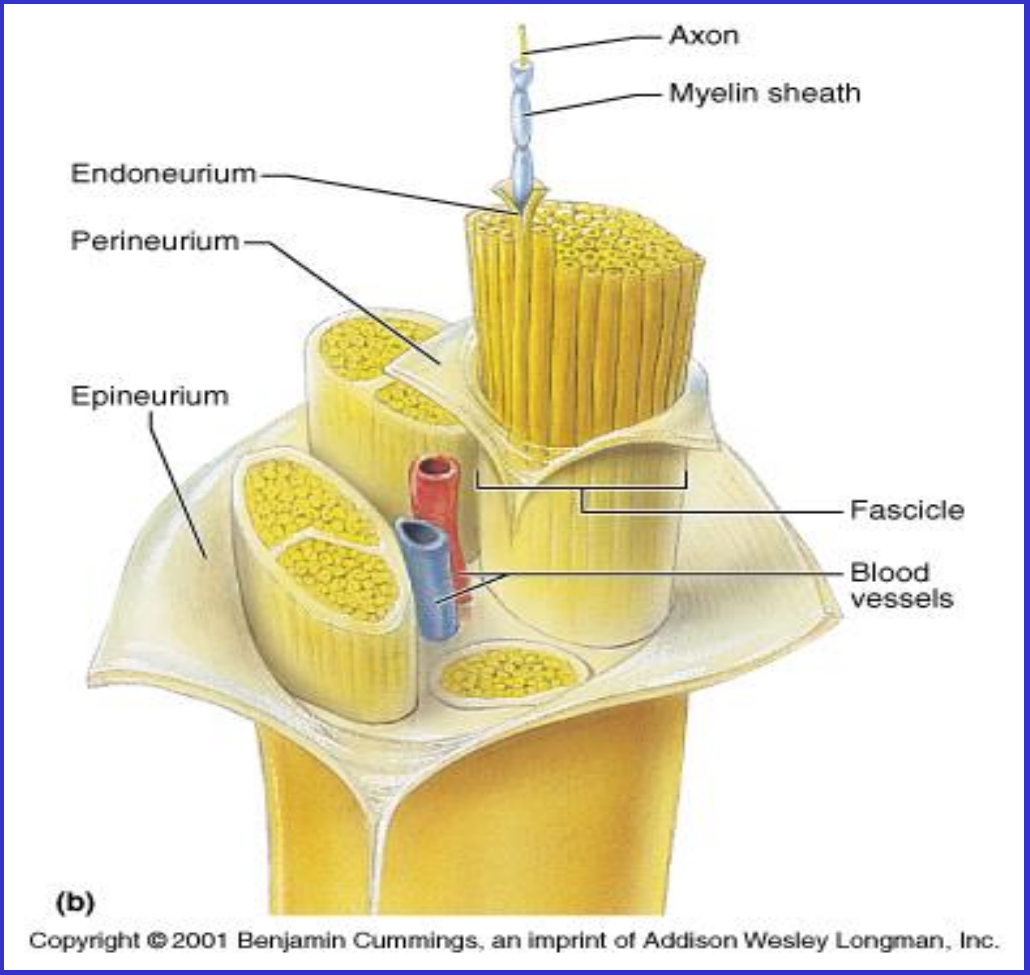
周邊神經系統

- 運動神經
- 感覺神經
- 自主神經



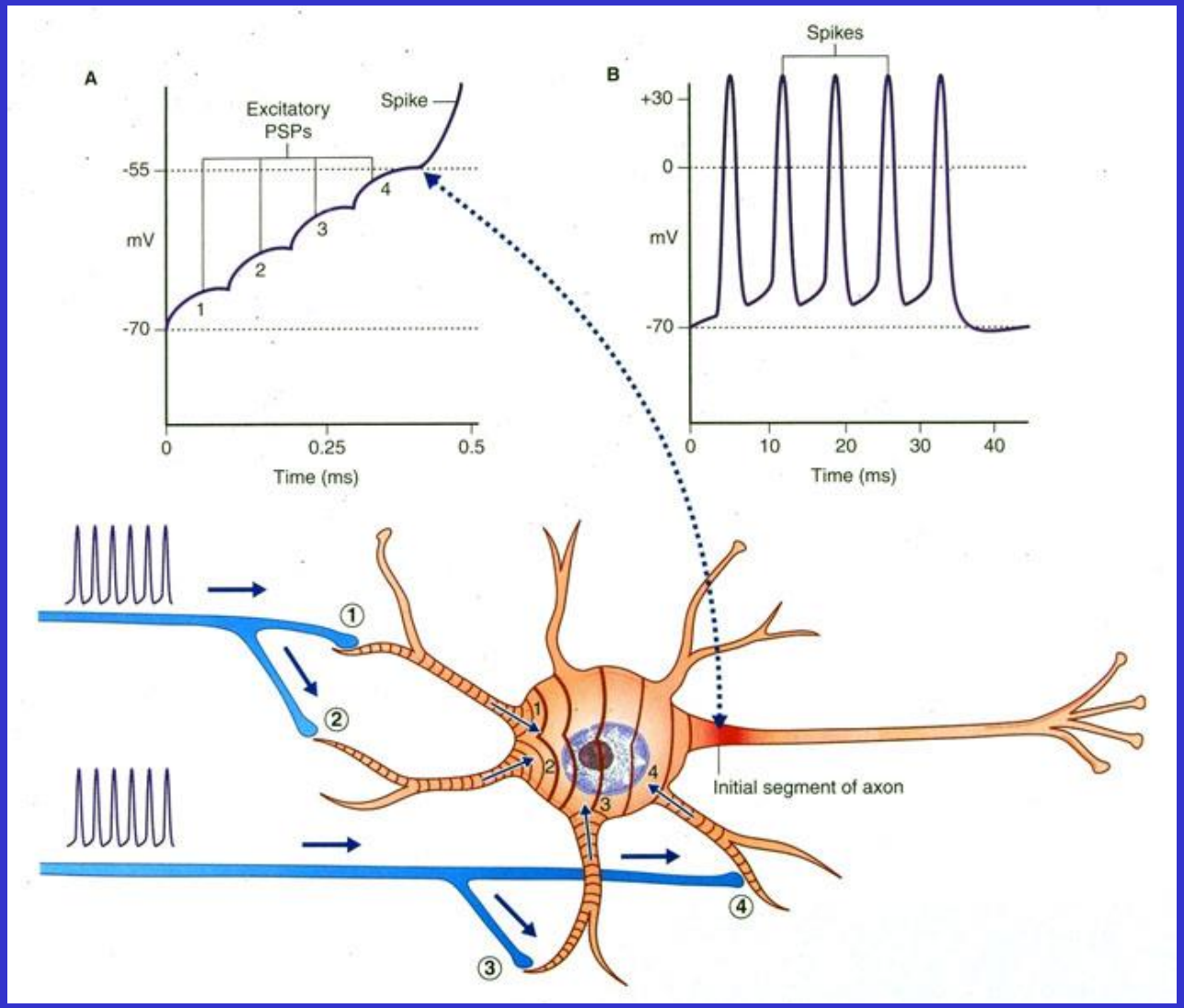
週邊神經之構造

- 外膜
  - Areolar connective tissue
  - 30 – 75% of area
- 束膜
  - Diffusion barrier
  - Mechanical support
- 內膜
- 神經內血管 (Nervi Nervorum)



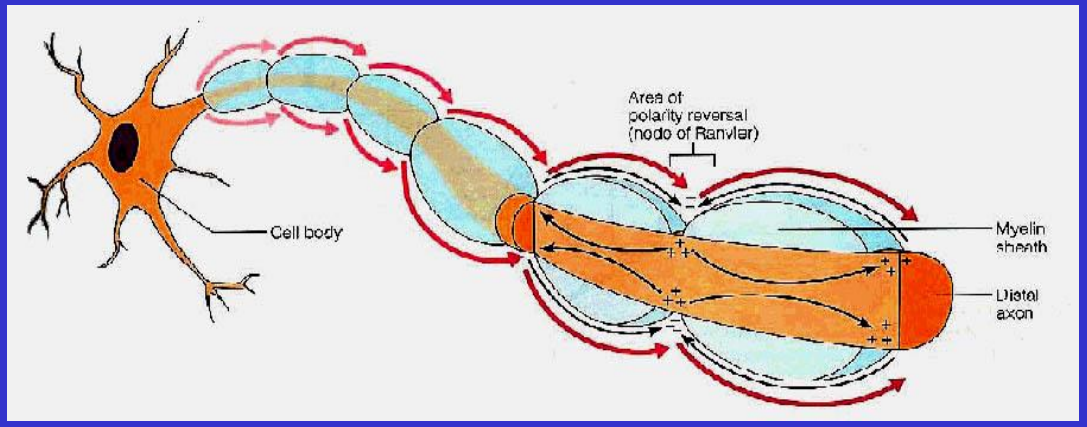
神經細胞用動作電位傳導訊息

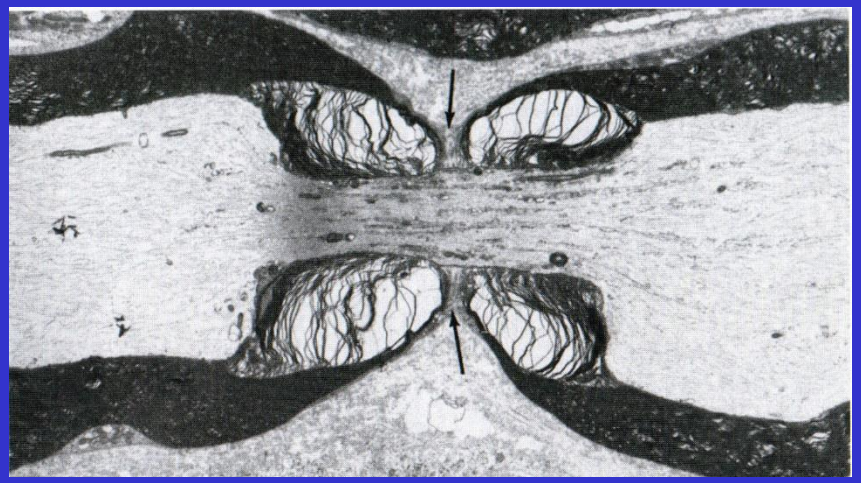
- 其實動作電位如何在神經上傳導也是需要很多解釋

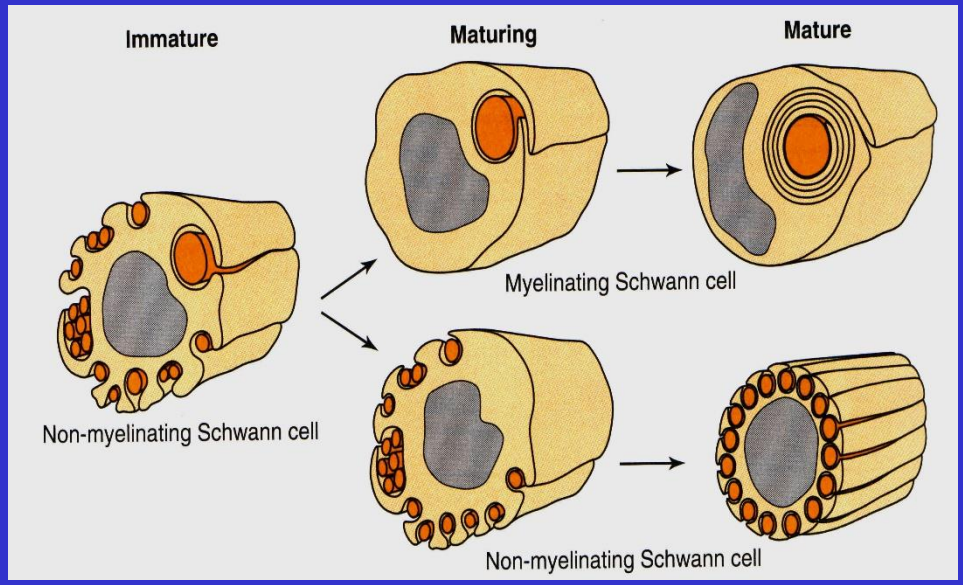


許旺細胞 (Schwann Cell)

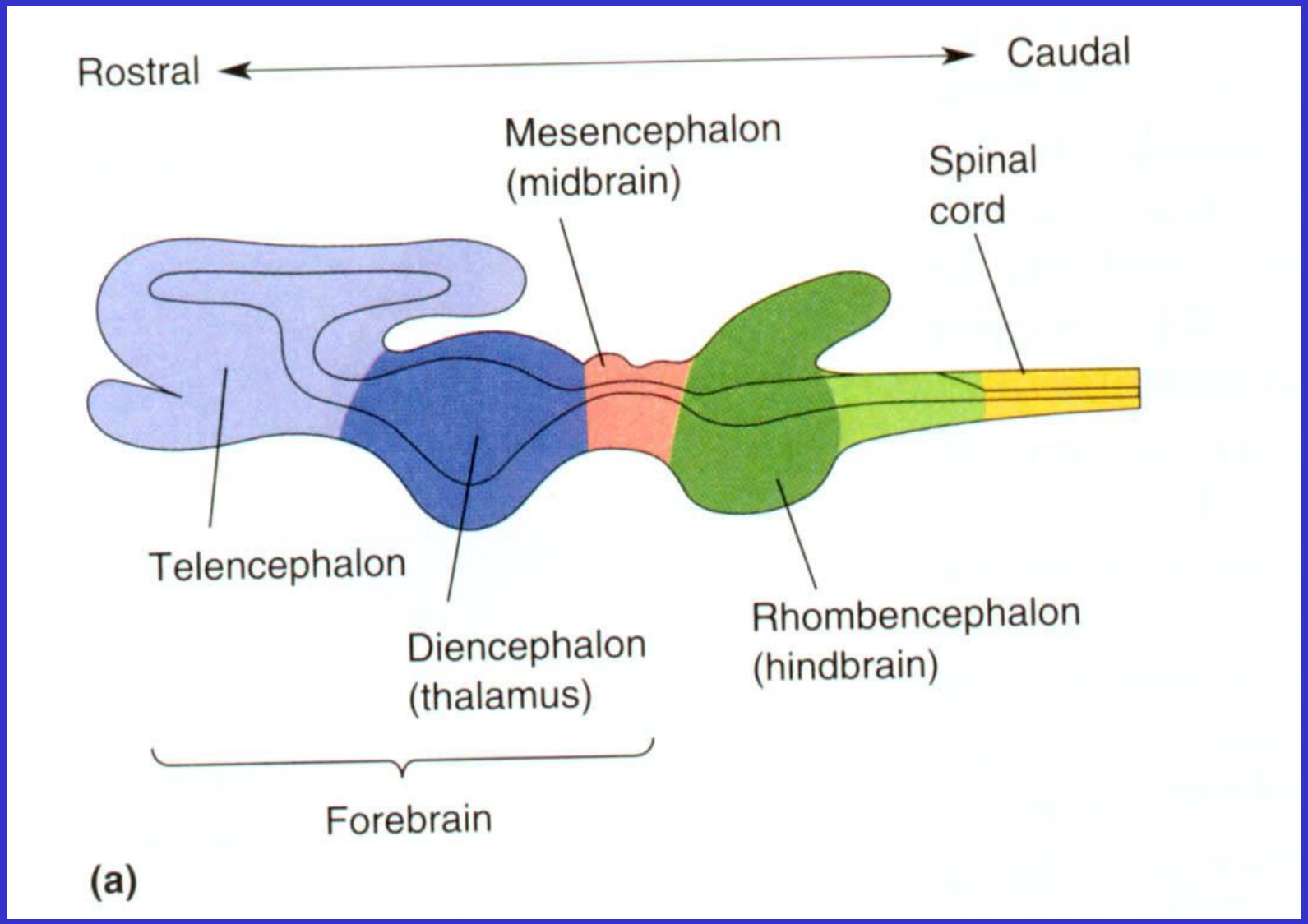
- 多重功能
  - 結構骨架和障壁
  - 提供養分
  - 增加速度

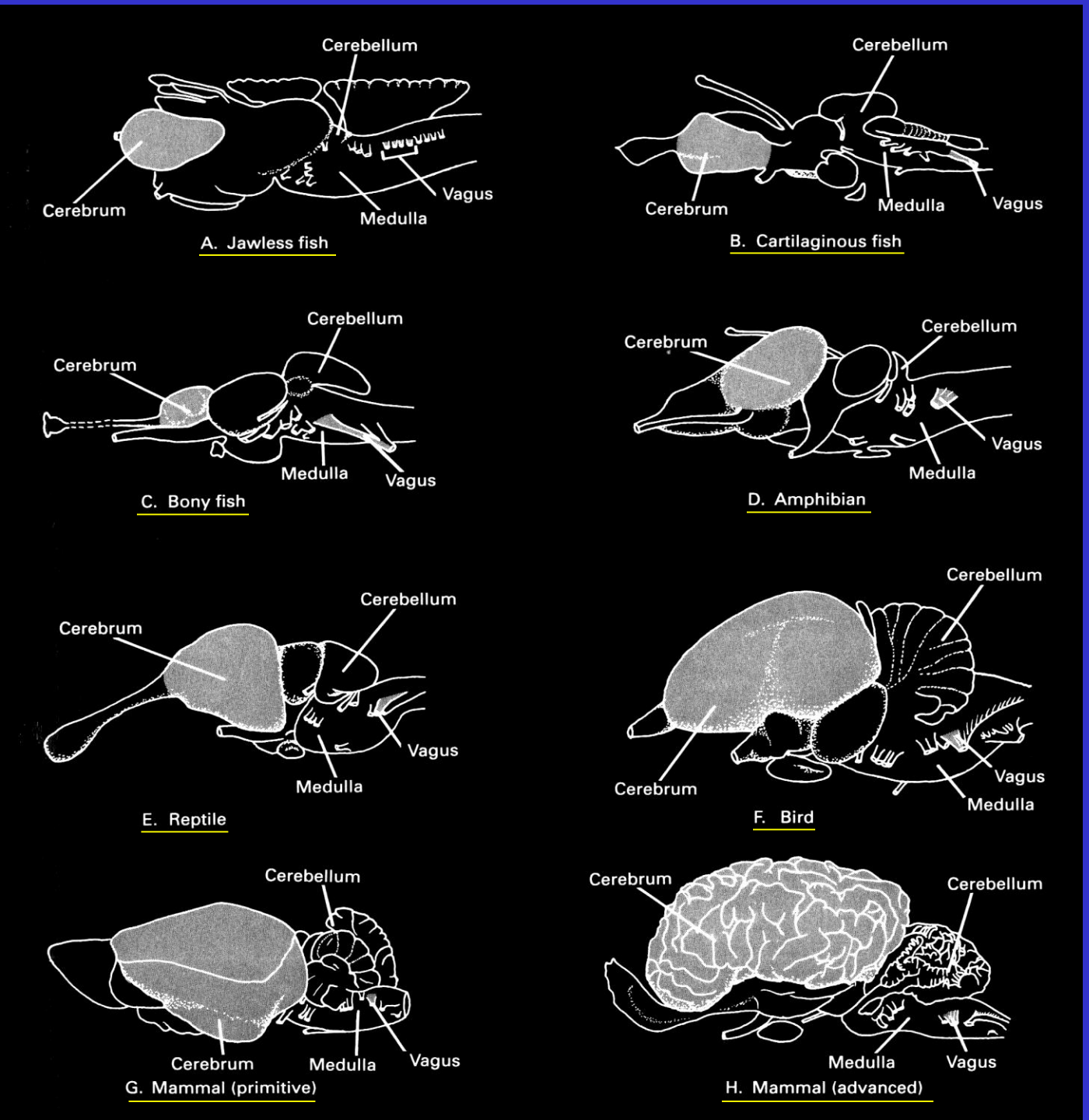






腦部的原始架構


Rostral
Caudal
Mesencephalon
(midbrain)
Spinal
cord
Telencephalon
Diencephalon
(thalamus)
Rhombencephalon
(hindbrain)
Forebrain
(a)



Medulla =
Medulla + Pons

Functional Chordate Anatomy, RG Wolff, 1991

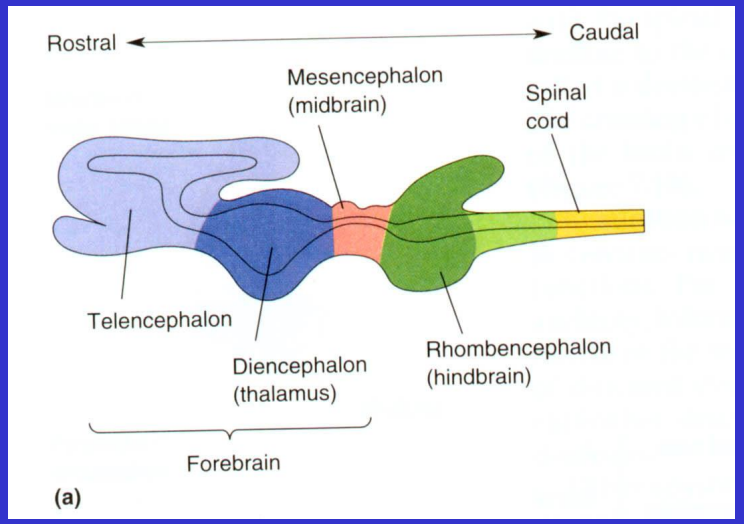
腦部

Forebrain

- cerebrum
- diencephalon

Brainstem

- midbrain
- cerebellum + pons
- medulla oblongata



大腦

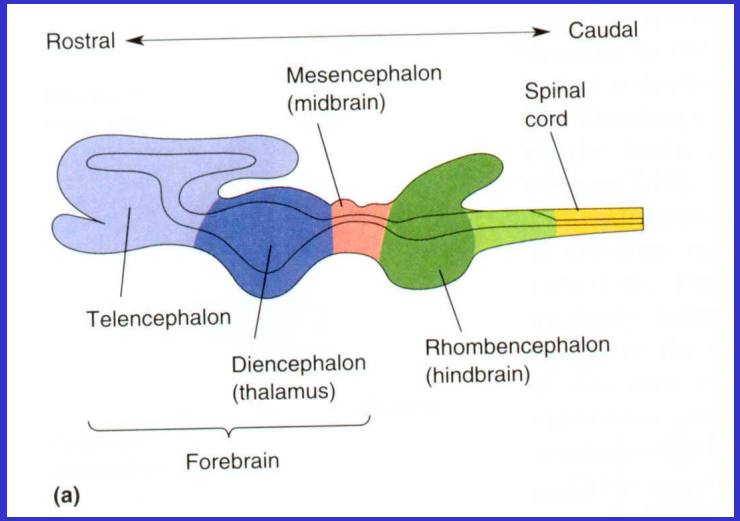
Paired cerebral hemispheres:

gray matter: cerebral cortex / lobes

white matter: fiber tracts …

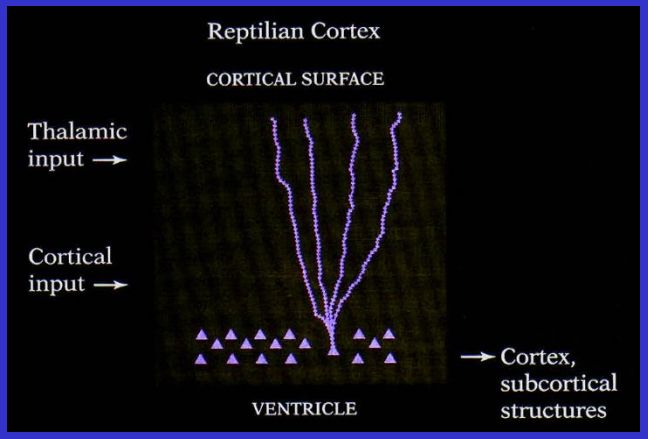
limbic system

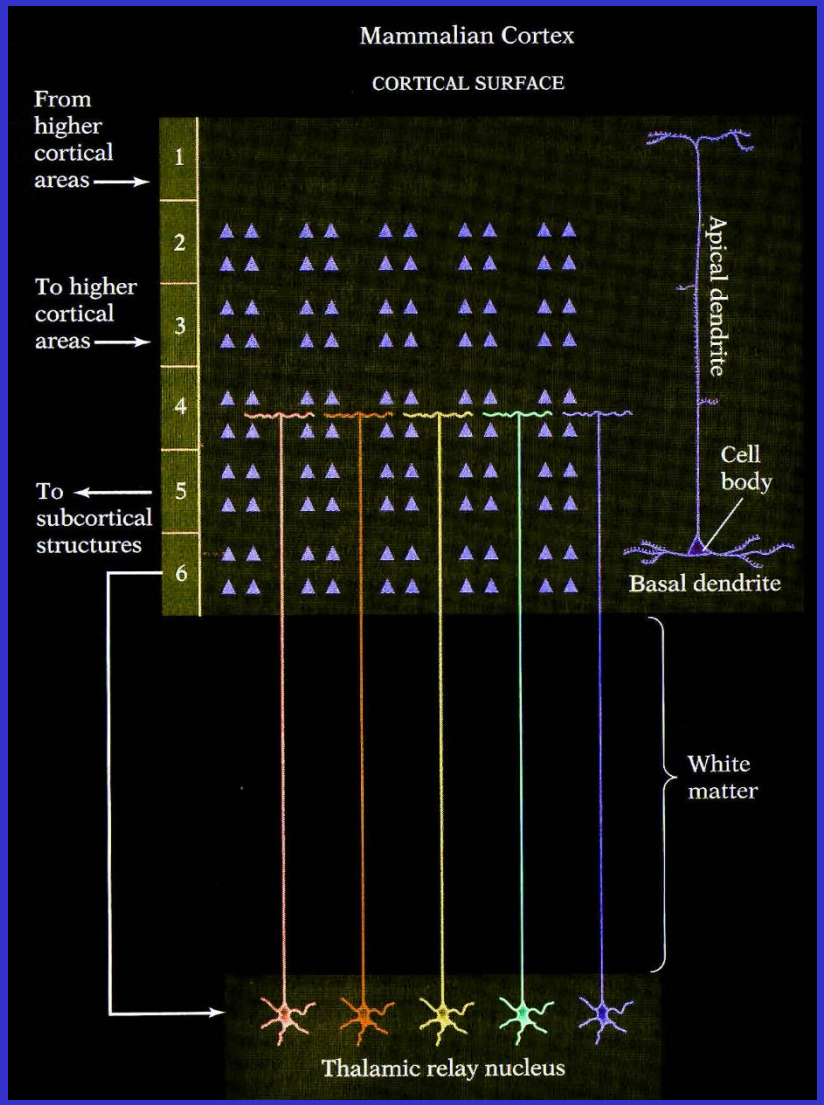
(邊緣系統 - complicated structure)…



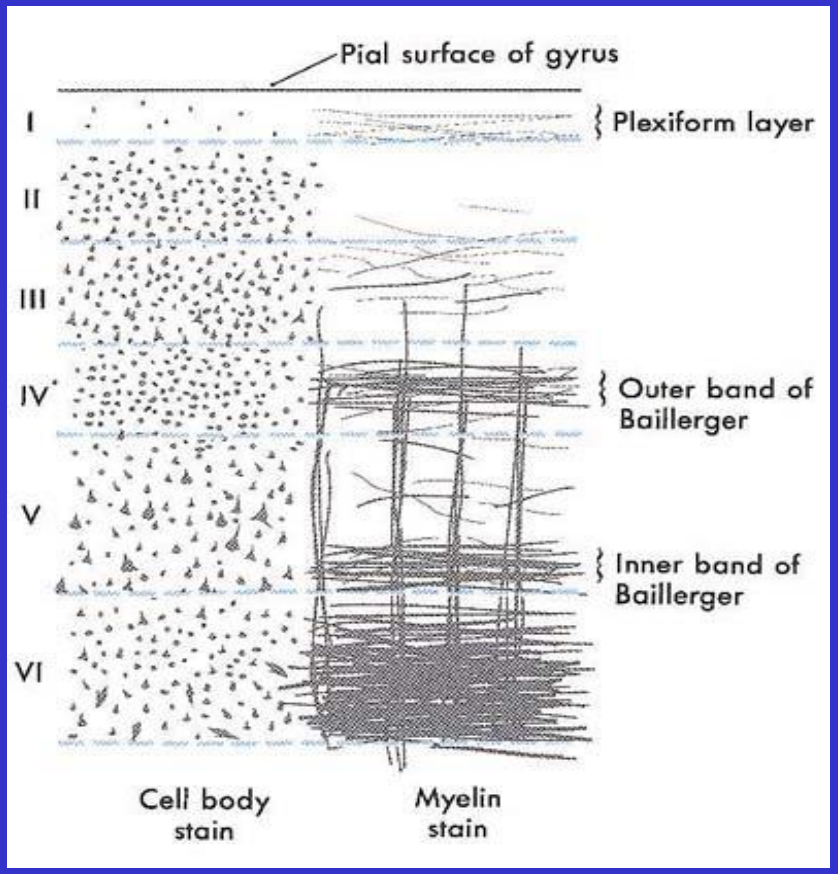
皮質之微觀構造

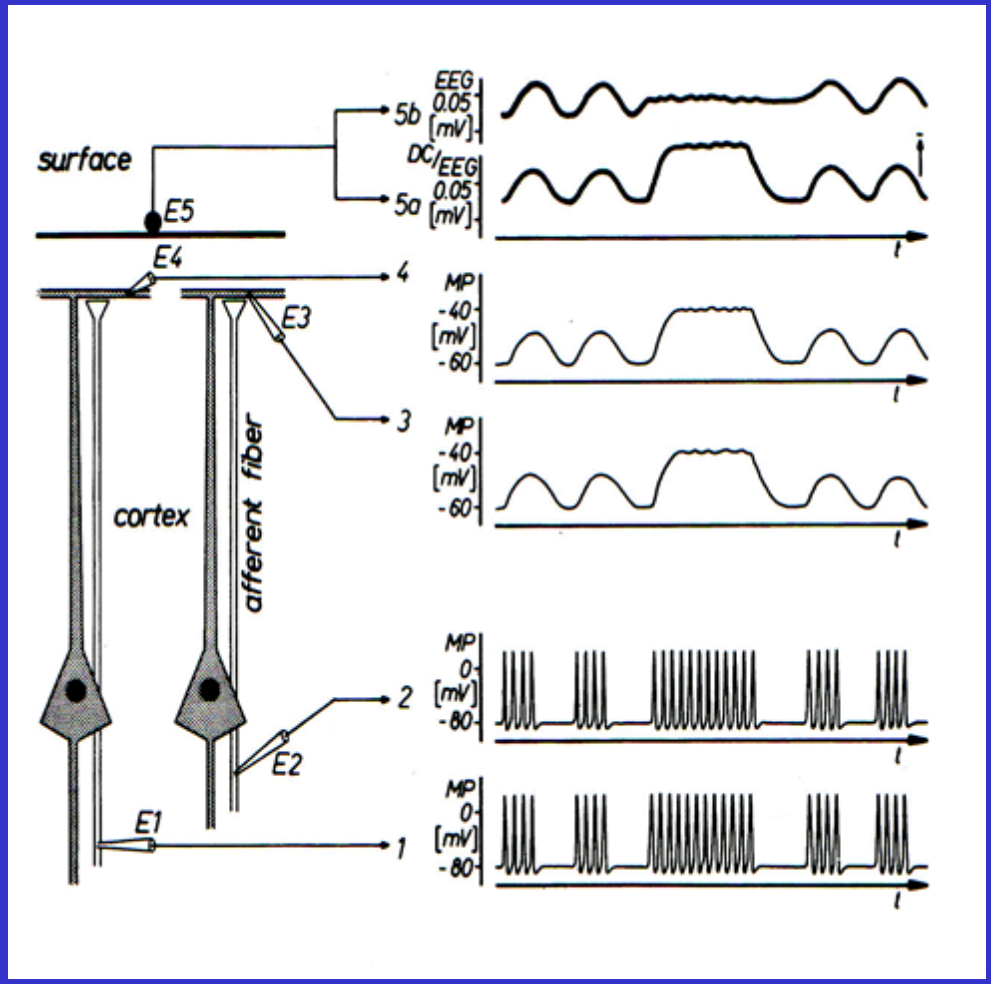
- Amphibian – no cortex
- Reptile – 3-layered cortex
- Mammal – 6-layered cortex
- Bird – different kind of cortex





腦波的產生


Pial surface of gyrus
I
II
III
IV
V
VI
Plexiform layer
Outer band of Baillerger
Inner band of Baillerger
Cell body stain
Myelin stain


surface
E5
E4
E3
E2
E1
cortex
afferent fiber
5b
5a
4
3
2
1
EEG 0.05 [mV]
DC/EEG 0.05 [mV]
MP -40 [mV] -60
MP 0 [mV] -80
t

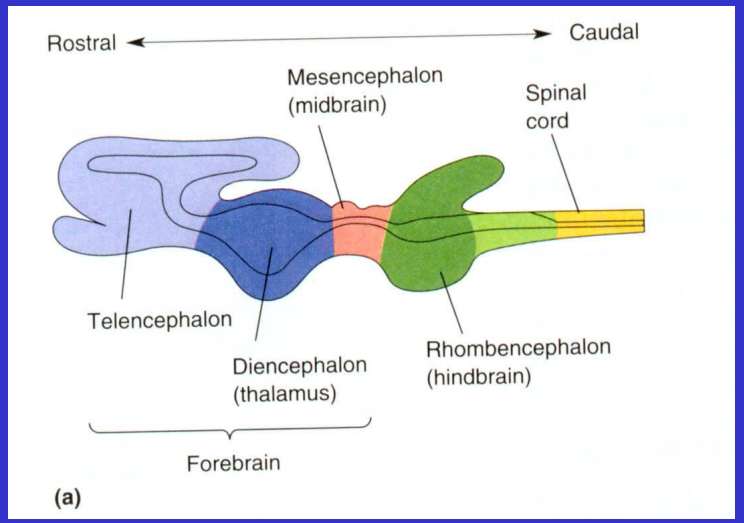
間腦 (Diencephalon)

Thalamus:

‘secretary’ to the ‘boss’ (cortex)

Hypothalamus:

‘head ganglion’ of ANS



腦幹

Midbrain:

reflex center for special senses (eye and ear)

Cerebellum + pons:

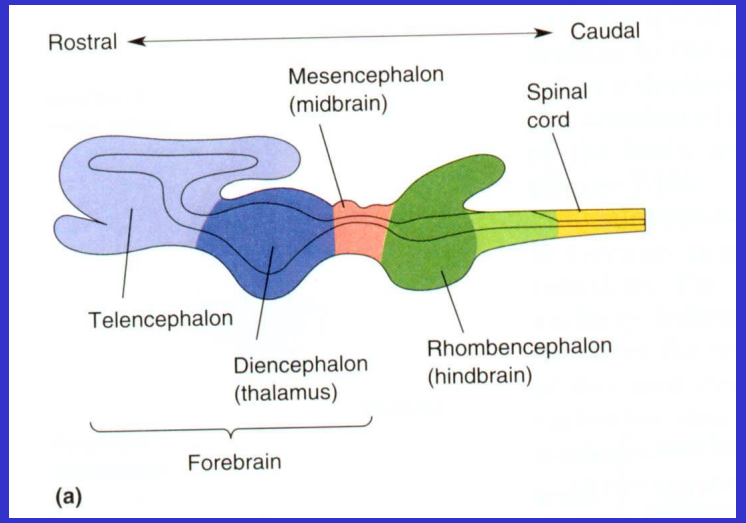
movement control center

Medulla oblongata (reticular formation):

ANS control centers

consciousness control center

cranial nerve control center

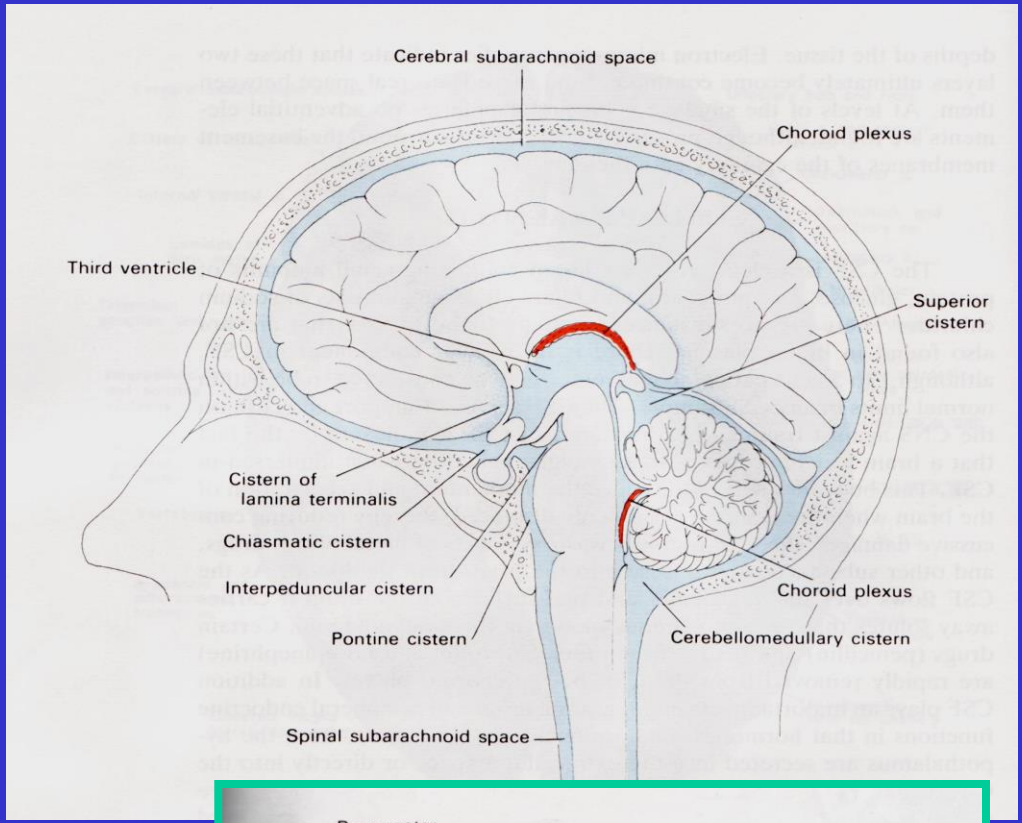


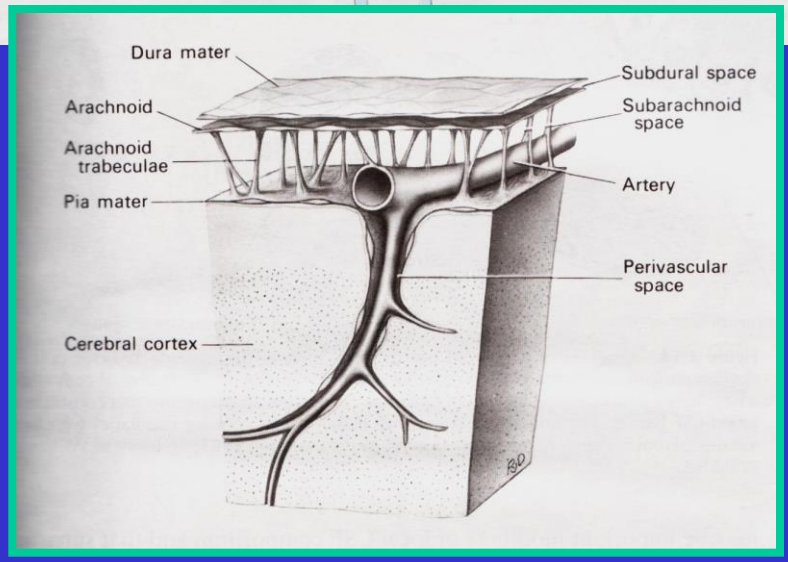
大腦由外而內

I. 腦外構造

- 顱外肌
- 頭骨
- 腦膜
  - 硬腦膜 (dura)
  - 軟腦膜 (pia)
  - 蜘蛛網膜 (arachnoid)

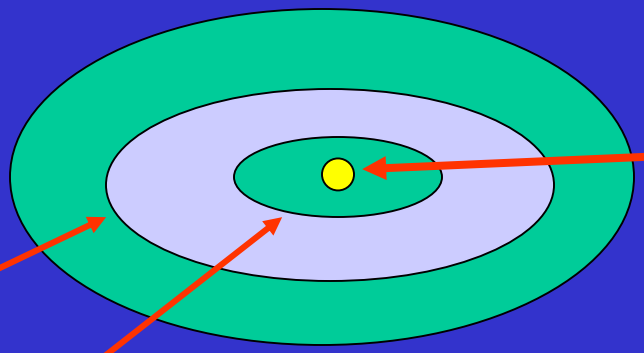
- 蜘蛛網膜下腔 (subarachnoid space)





II. 大體結構

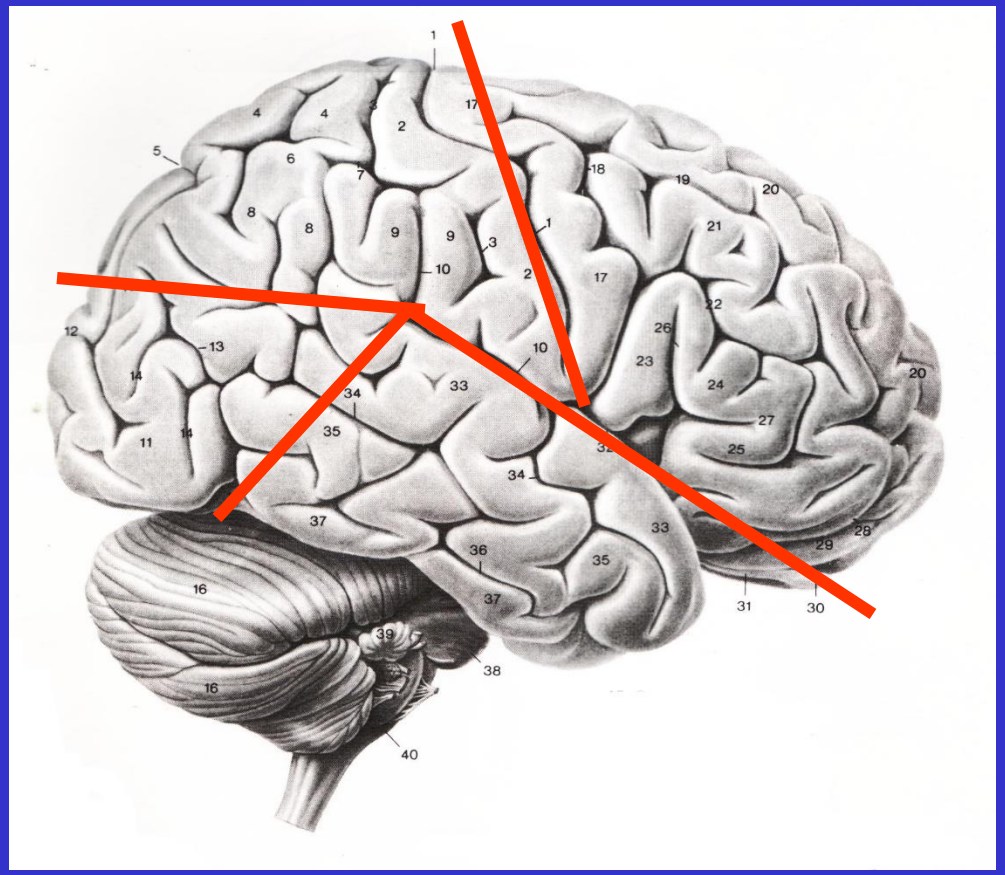
- 大腦
  - 皮質 (cortex)
  - 白質 (white matter)
  - 中心核群
- 腦幹
  - 中腦 (midbrain)
  - 橋腦 (pons)
  - 延腦 (medulla)
- 小腦



III. 大腦

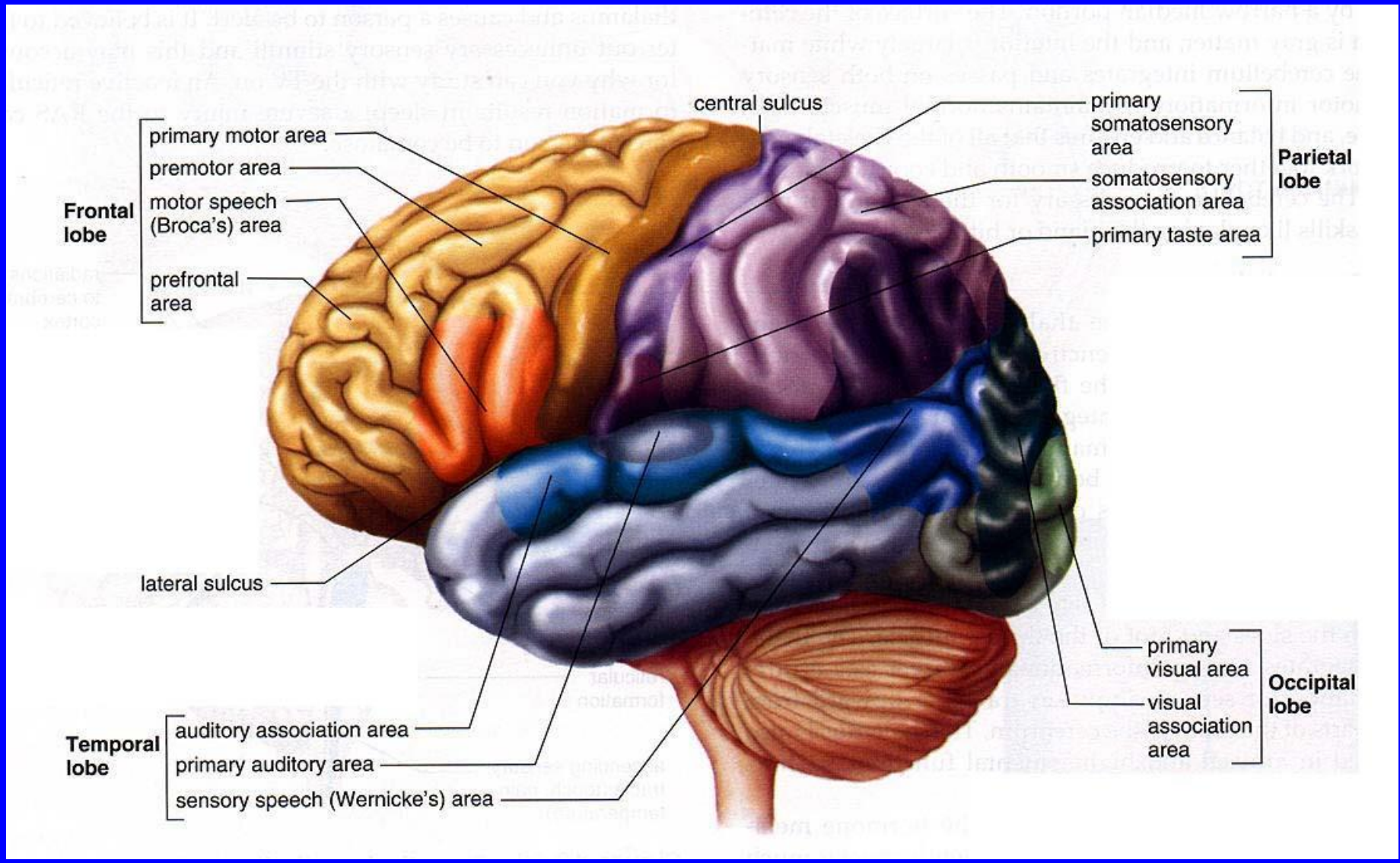
- 皮質
  - 前葉 (frontal)
  - 頂葉 (parietal)
  - 顳葉 (temporal)
  - 枕葉 (occipital)
- 白質
  - optic radiation
  - corpus callosum
  - 內囊 (internal capsule)
  - 冠狀幅射 (corona radiata)

Central sulcus



大腦

細胞體都在表面上 --> 皺折越多細胞越多



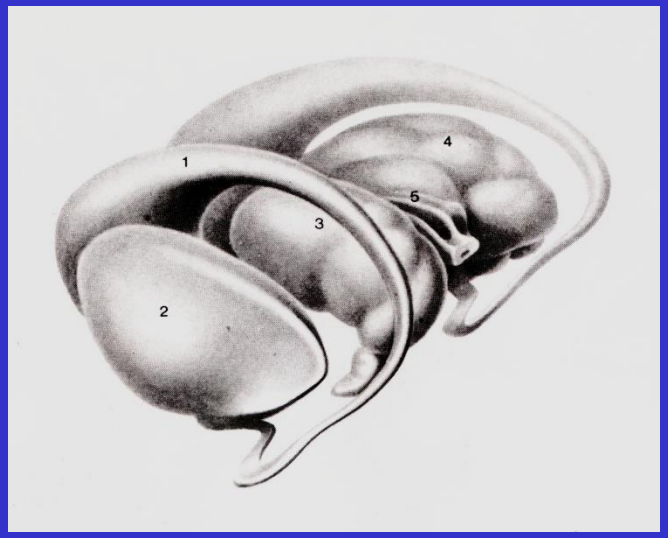
VI. 大腦 --- 大原則

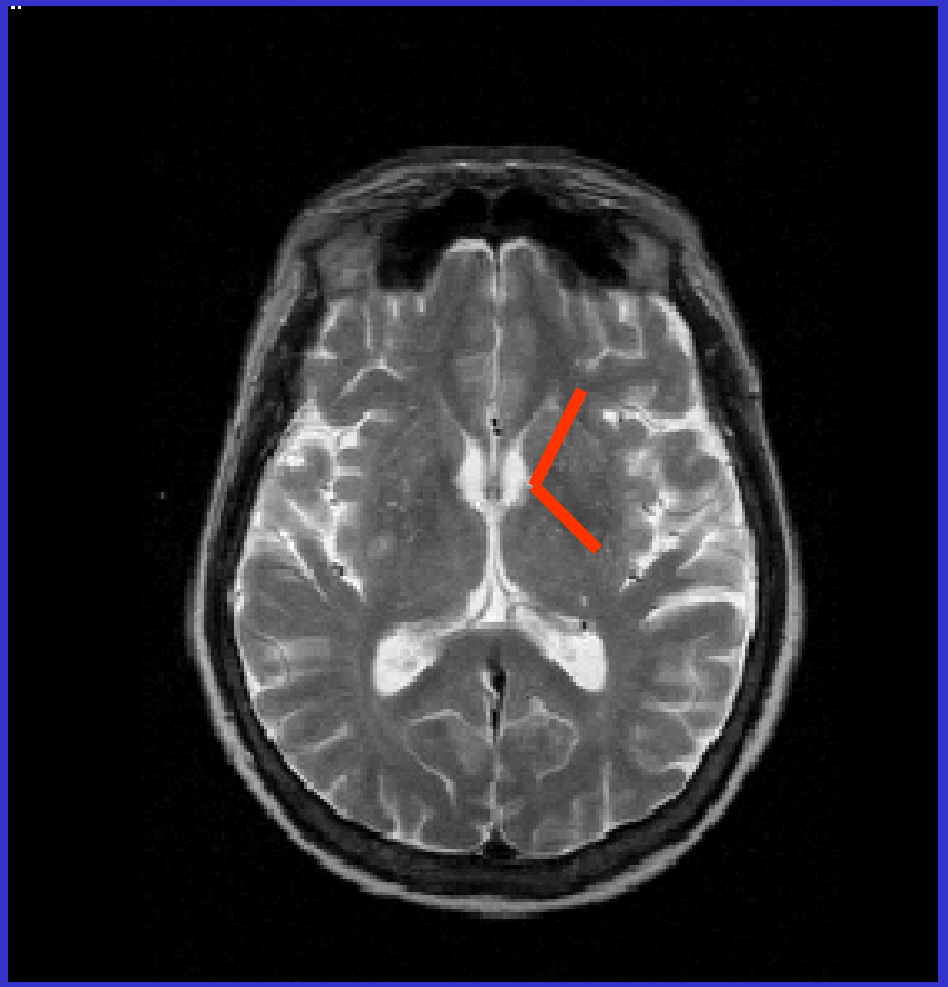
- 前 運動　後 感覺
- 外 自發　內 自主
- 左右交叉支配
- 上 腳　下 手
- 左 語言　右 空間音樂

- 血管: 前 大腦　後 腦幹 + 枕葉
- 脊髓液由內而外

III. 大腦 --- 中心核群

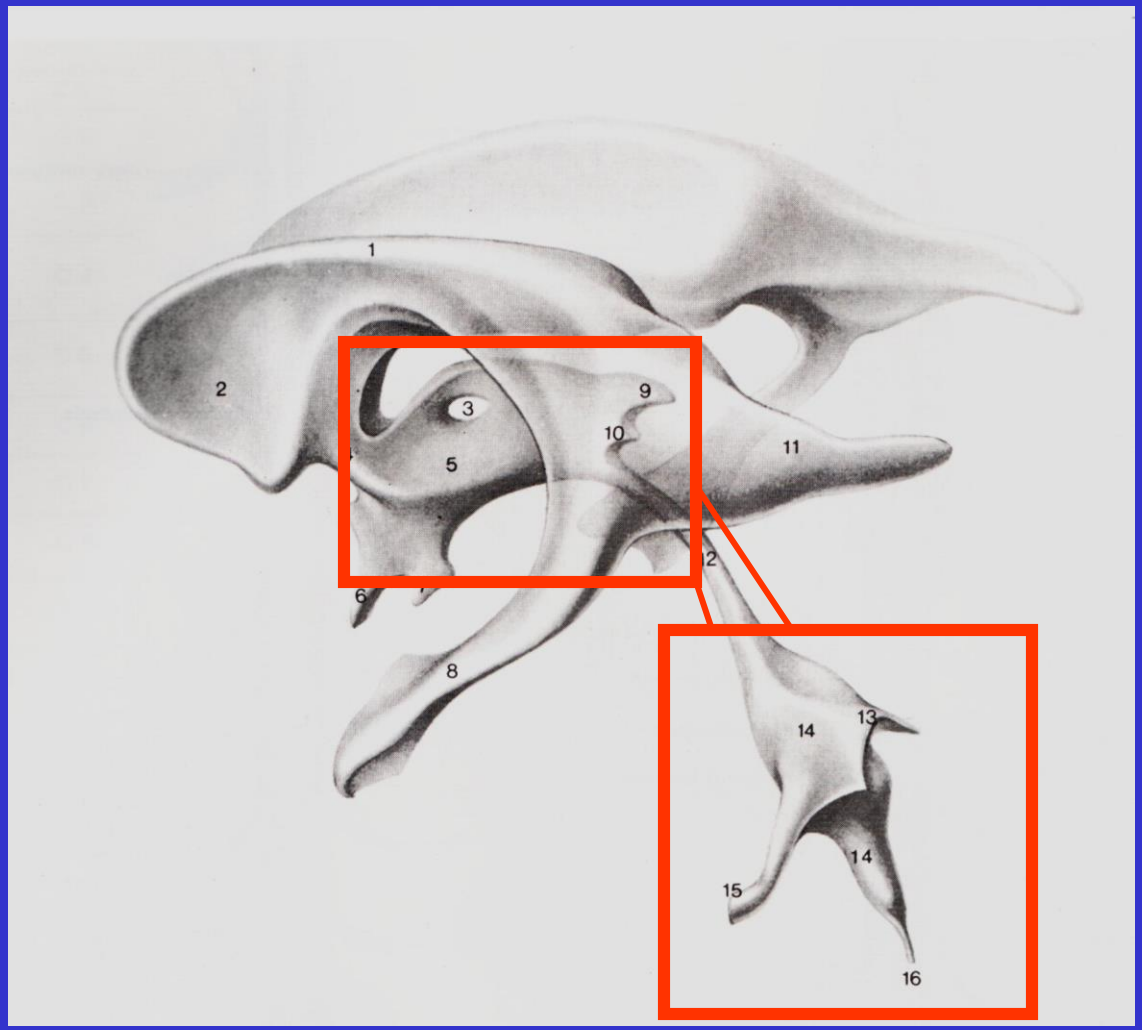
- 基底核 (basal ganglia)
  - putamen
  - globus pallidus
  - caudate nucleus
- 視丘 (thalamus)





IV. 腦室

- 側腦室
- 第三腦室
- aqueduct
- 第四腦室



Hydrocephalus

V. 腦幹 --- 腦幹反射

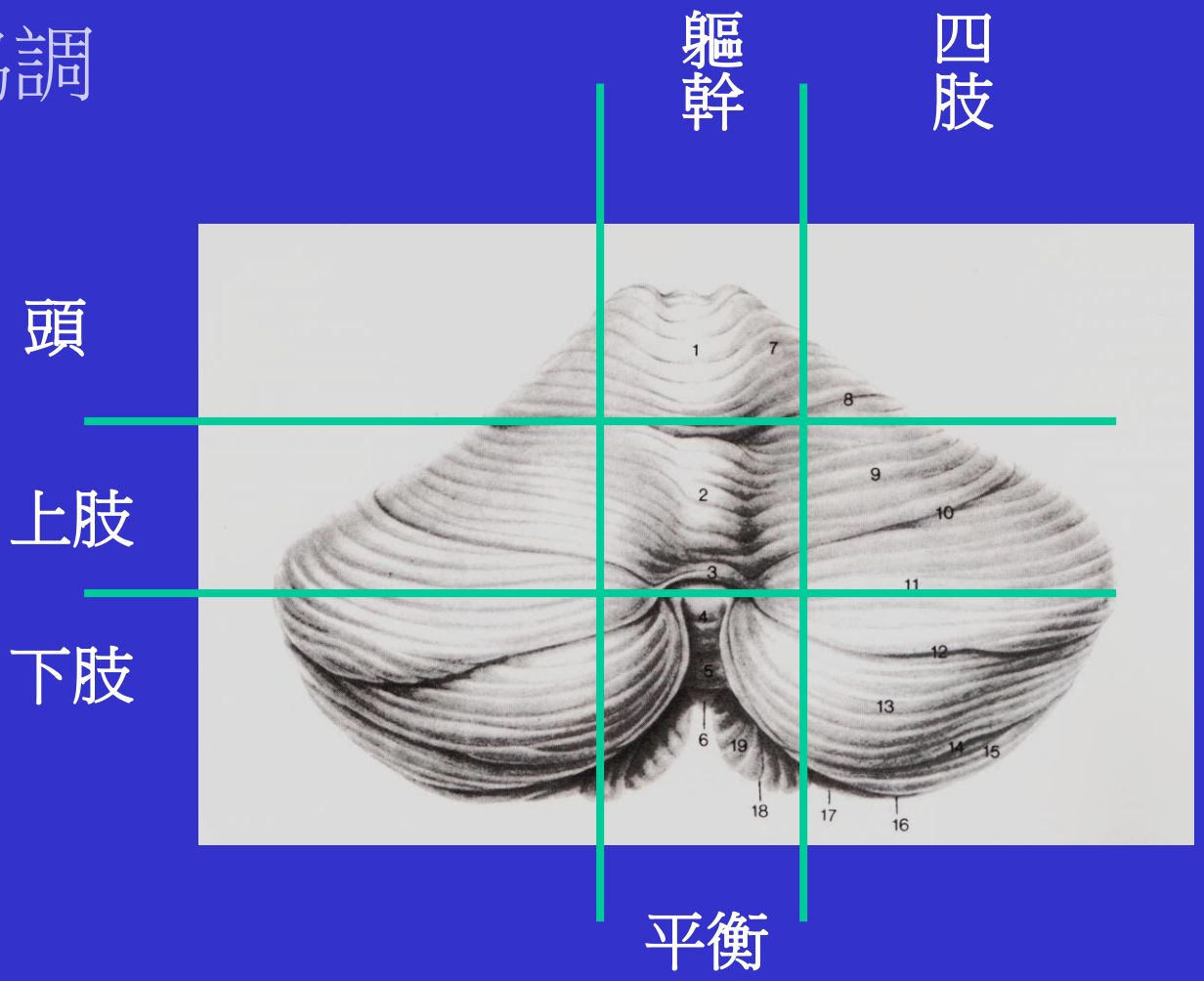
- 中腦
  - Pupil size, Light reflex
- 橋腦
  - Doll's eye sign
  - Blink reflex
- 延腦
  - Breathing
  - Cardiovascular center

Tentorium

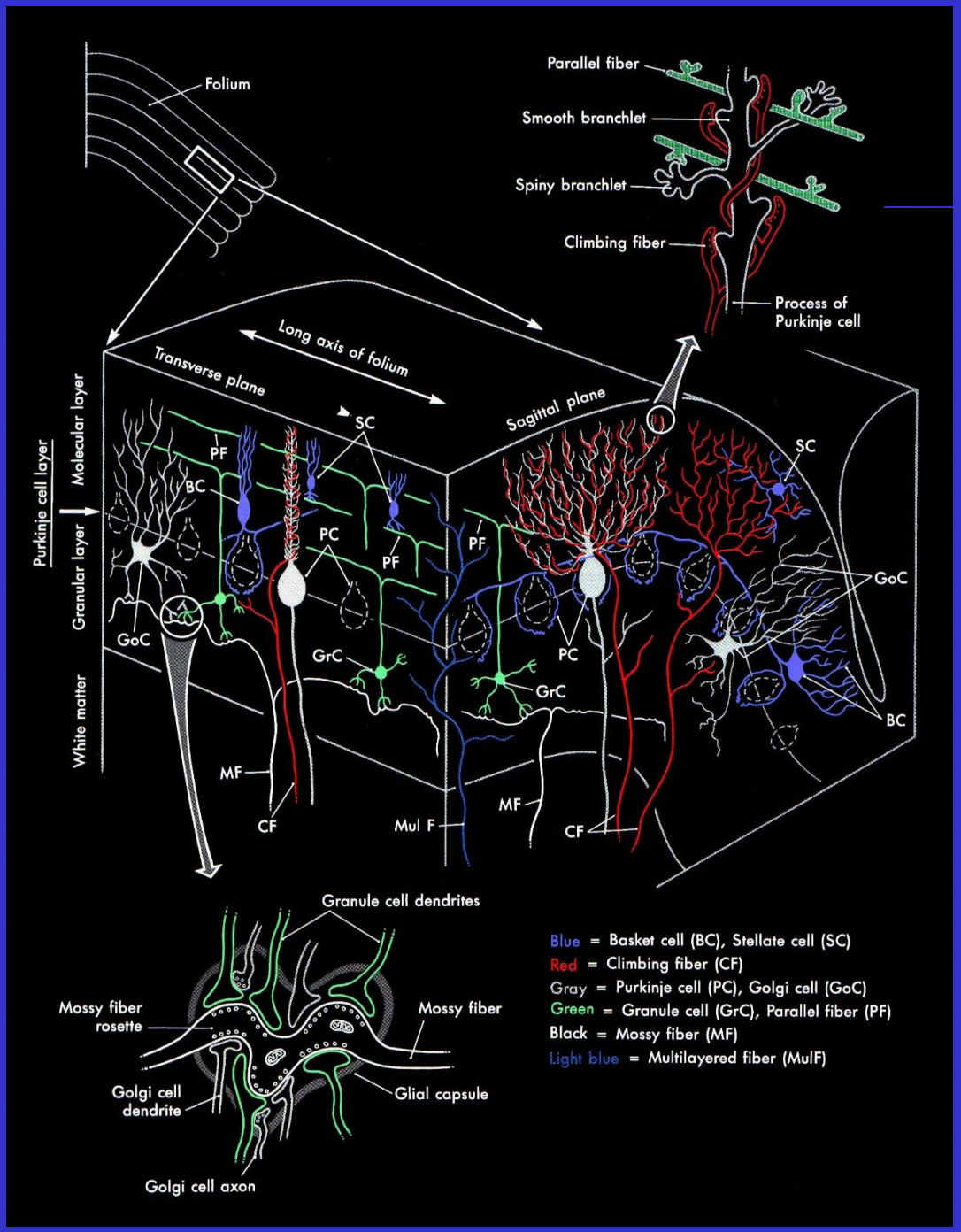
Uncal herniation

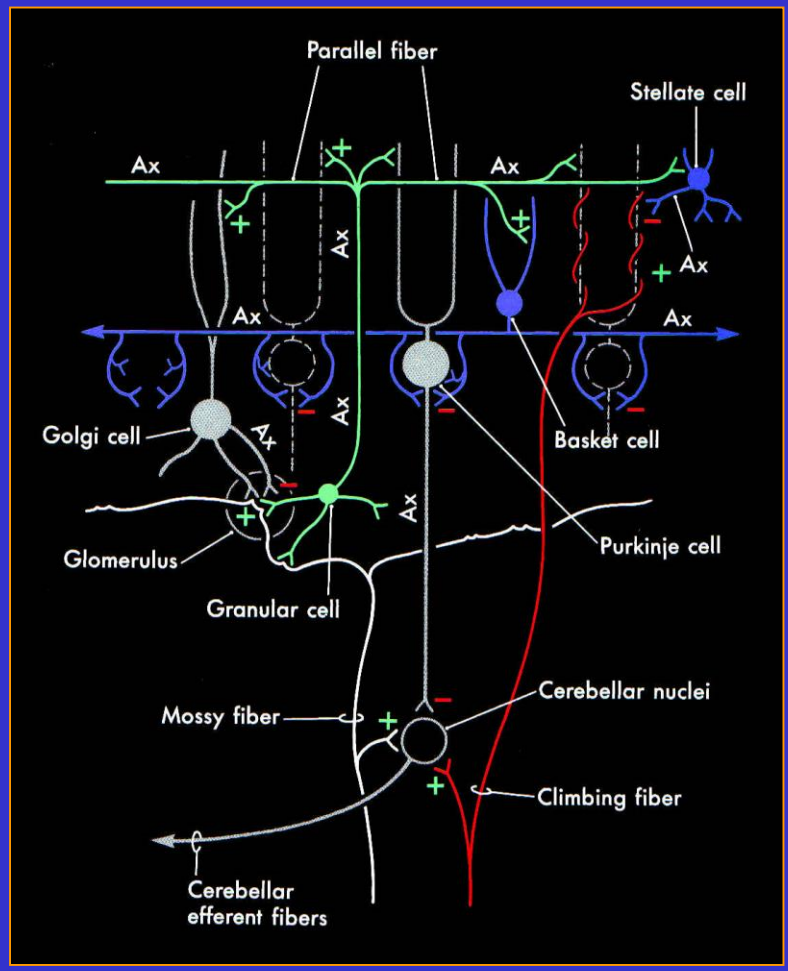
VI. 小腦

- 管平衡與協調
- 管同側



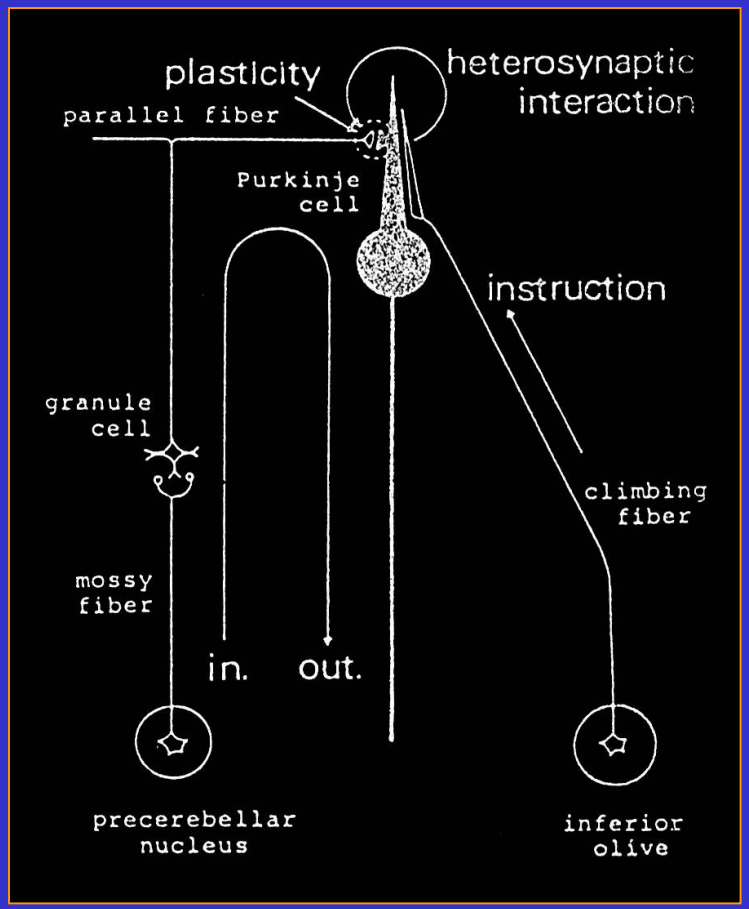
小腦微結構

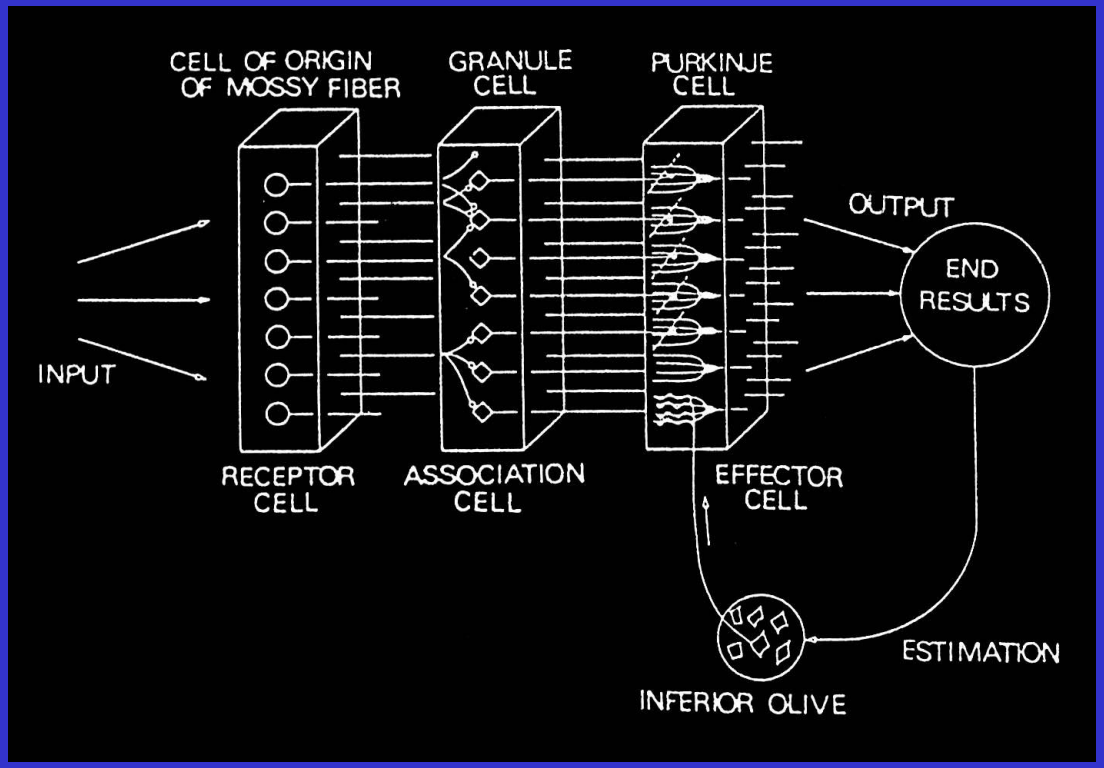

Folium
Parallel fiber
Smooth branchlet
Spiny branchlet
Climbing fiber
Process of Purkinje cell
Long axis of folium
Transverse plane
Sagittal plane
Purkinje cell layer
Molecular layer
Granular layer
White matter
SC
PF
BC
PC
GoC
GrC
MF
CF
Mul F
Granule cell dendrites
Mossy fiber rosette
Mossy fiber
Golgi cell dendrite
Glial capsule
Golgi cell axon
Blue = Basket cell (BC), Stellate cell (SC)
Red = Climbing fiber (CF)
Gray = Purkinje cell (PC), Golgi cell (GoC)
Green = Granule cell (GrC), Parallel fiber (PF)
Black = Mossy fiber (MF)
Light blue = Multilayered fiber (MulF)

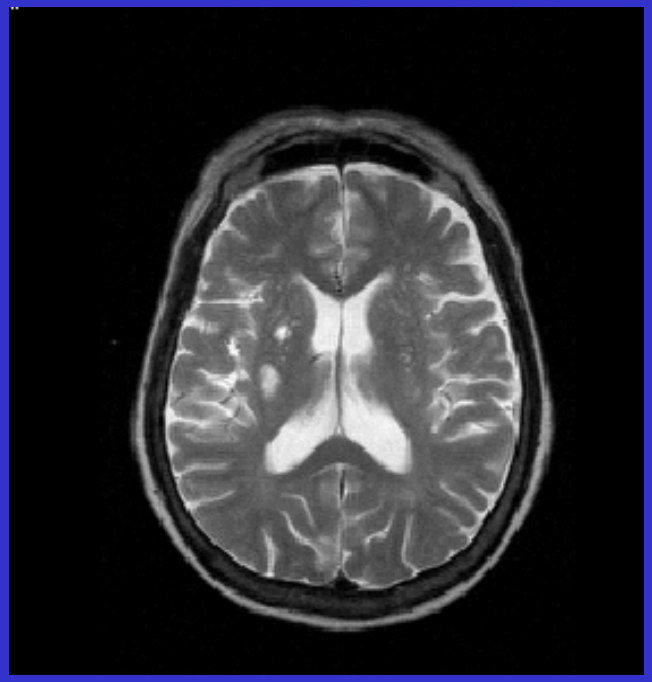

Parallel fiber
Stellate cell
Ax
Golgi cell
Basket cell
Glomerulus
Purkinje cell
Granular cell
Mossy fiber
Cerebellar nuclei
Climbing fiber
Cerebellar efferent fibers

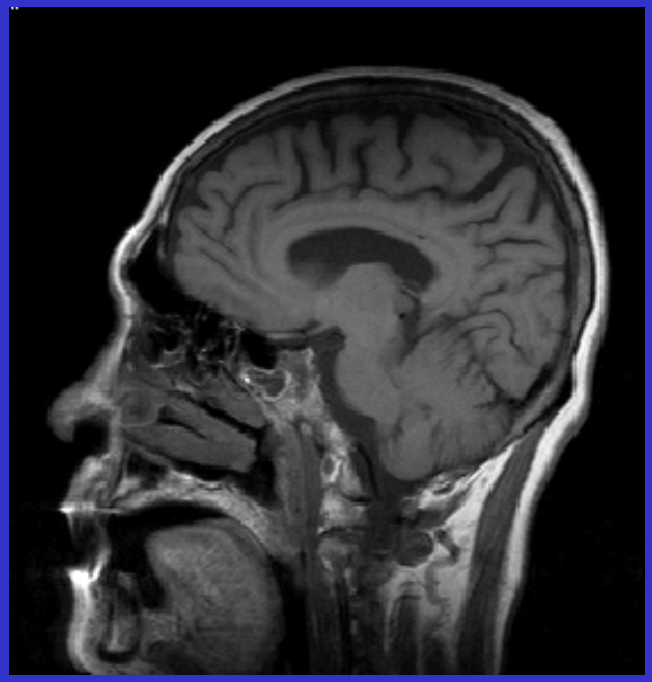
小腦模型

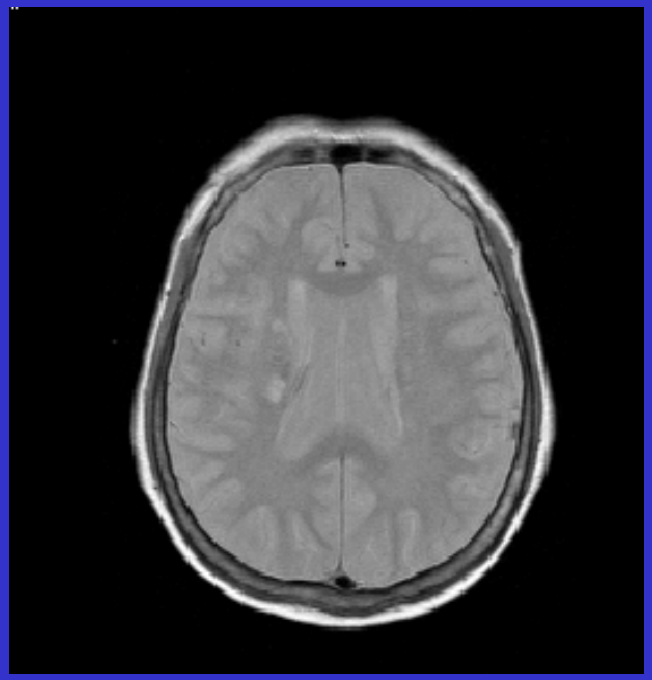
- Mossy fiber: raw data ?
- Climbing fiber: teaching data ?







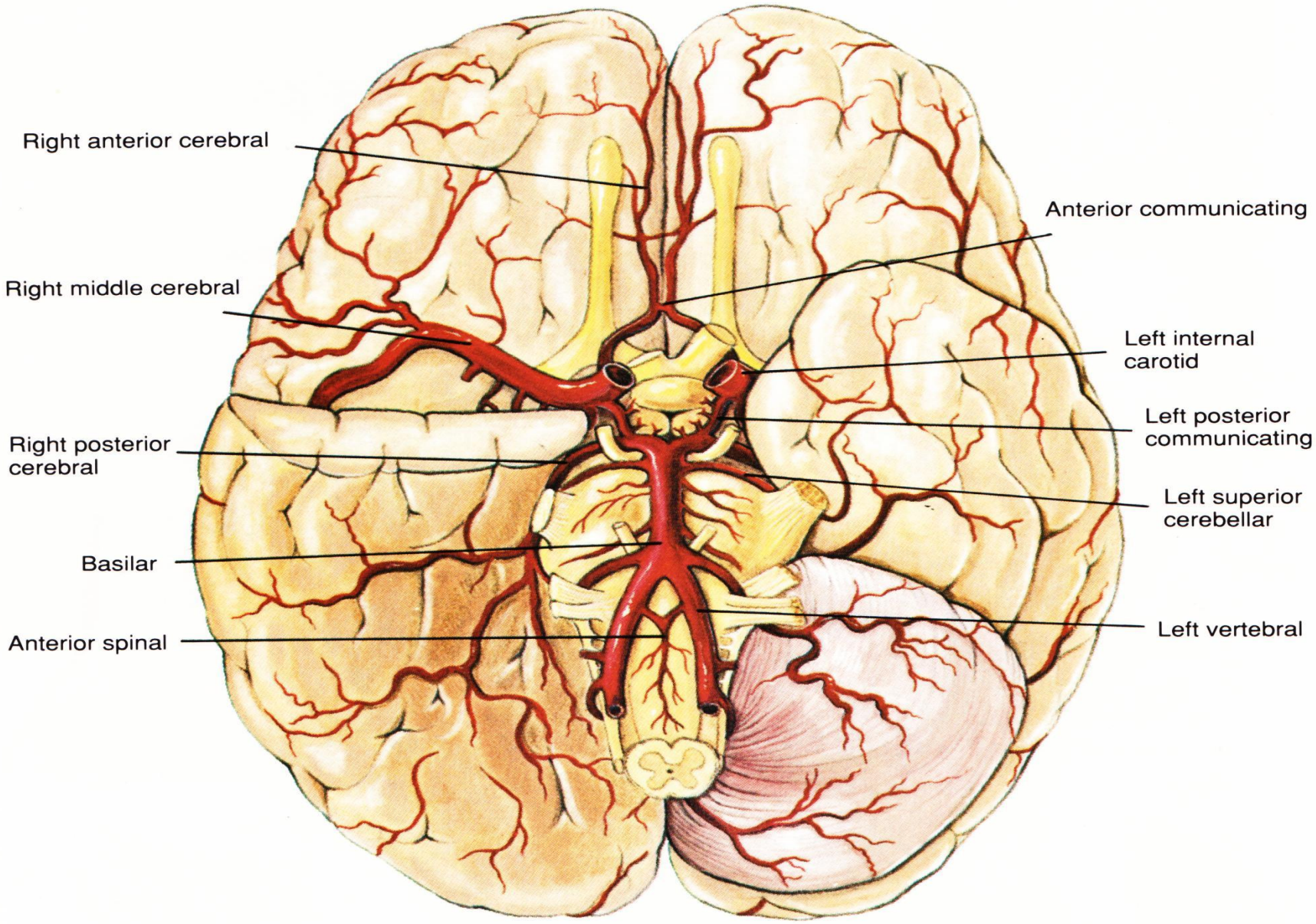




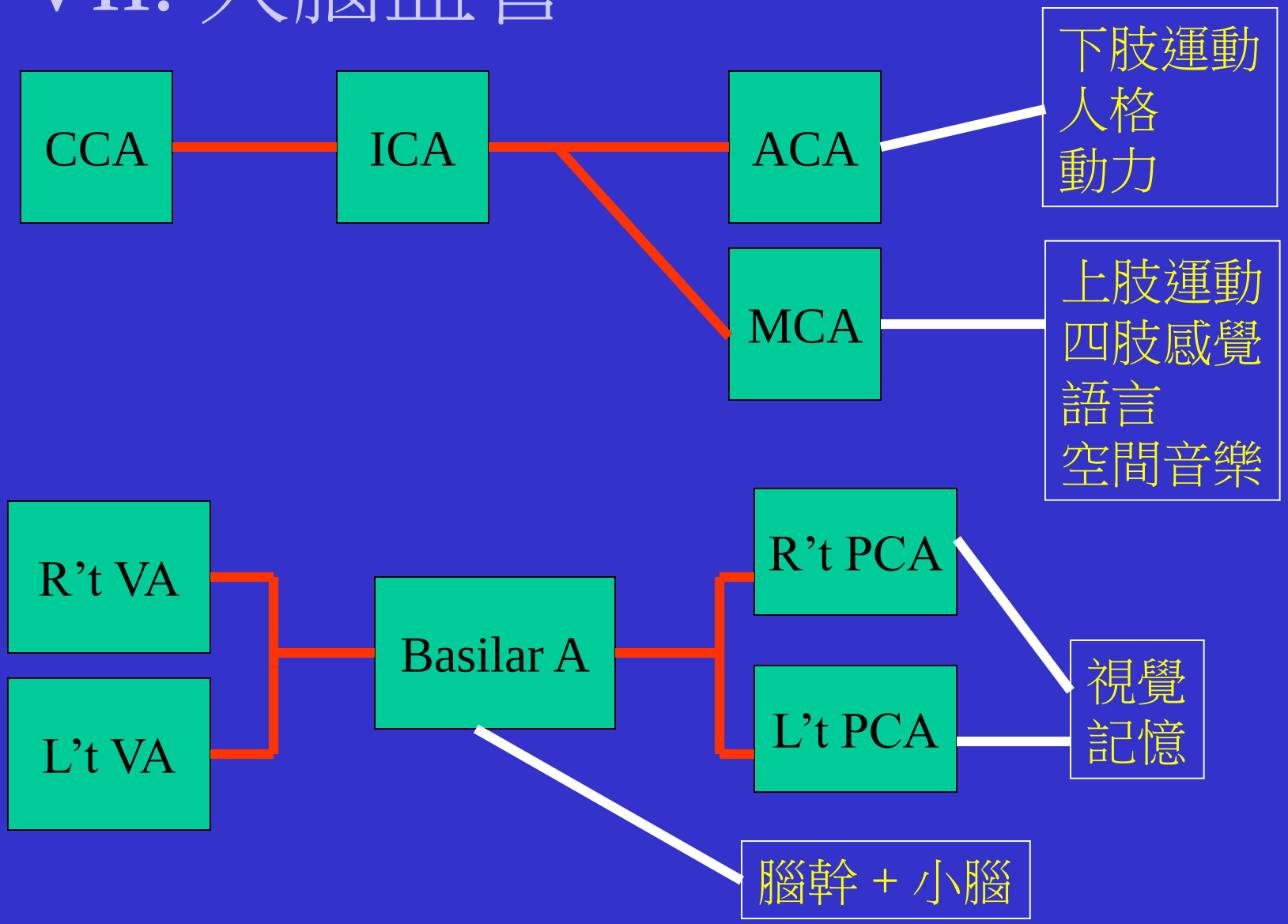
T1

T2

Proton

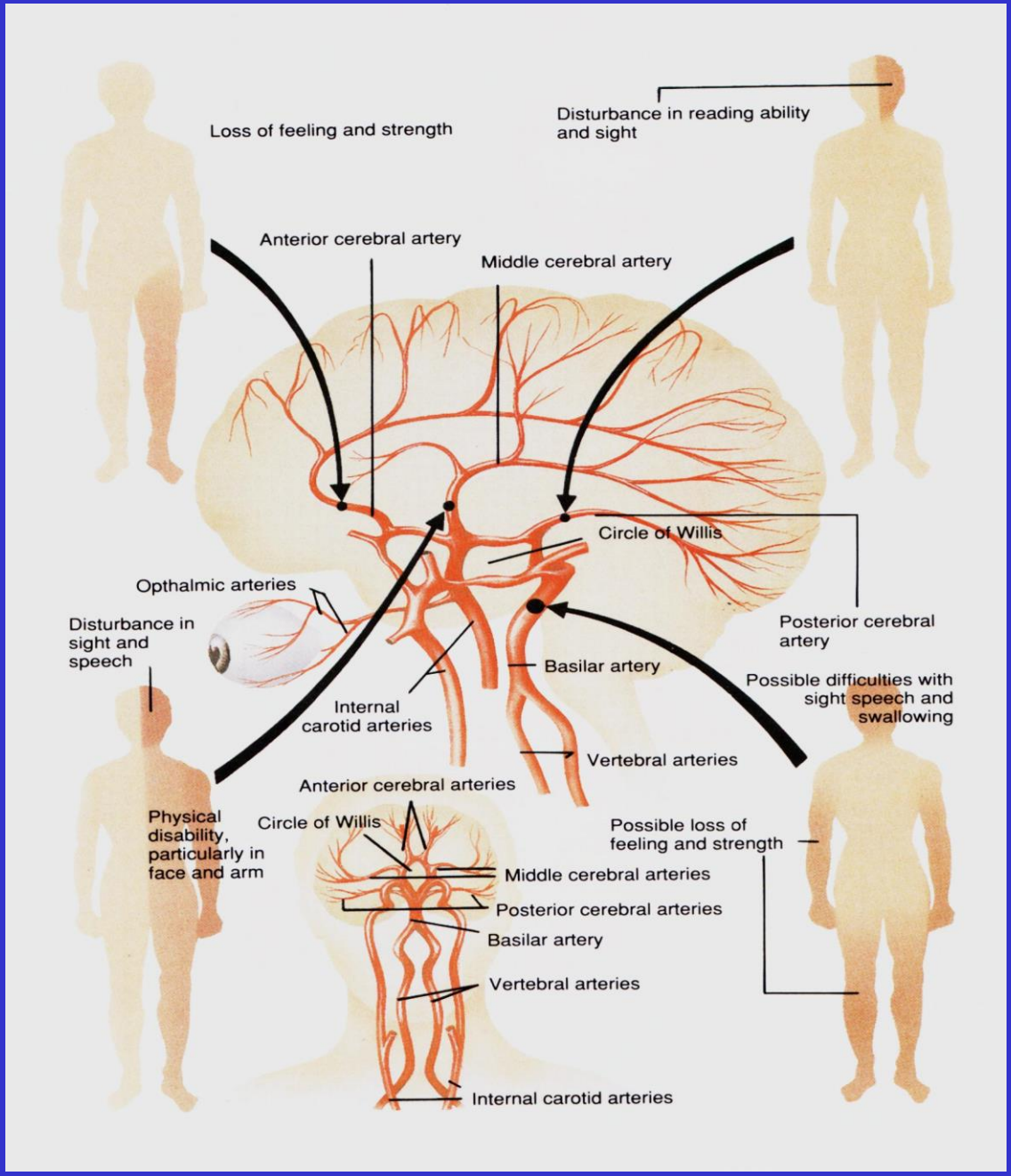

Right anterior cerebral
Anterior communicating
Right middle cerebral
Left internal carotid
Left posterior communicating
Right posterior cerebral
Left superior cerebellar
Basilar
Left vertebral
Anterior spinal

VII. 大腦血管


CCA
ICA
ACA
MCA
下肢運動
人格
動力
上肢運動
四肢感覺
語言
空間音樂
R't VA
L't VA
Basilar A
R't PCA
L't PCA
視覺
記憶
腦幹 + 小腦

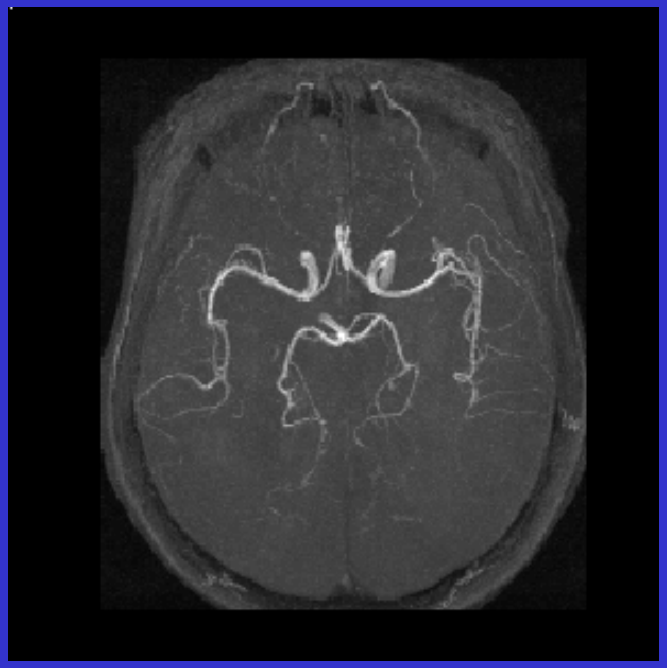
ACA

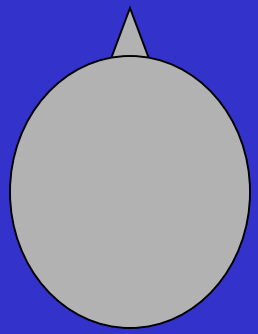
PCA

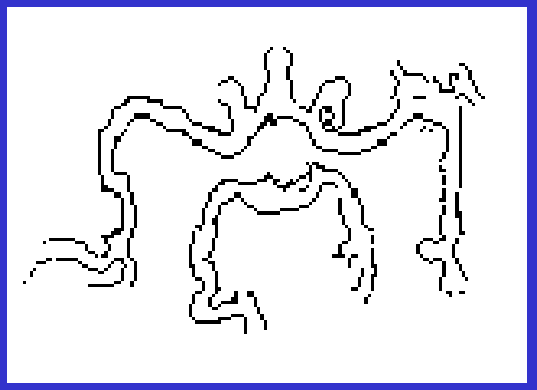


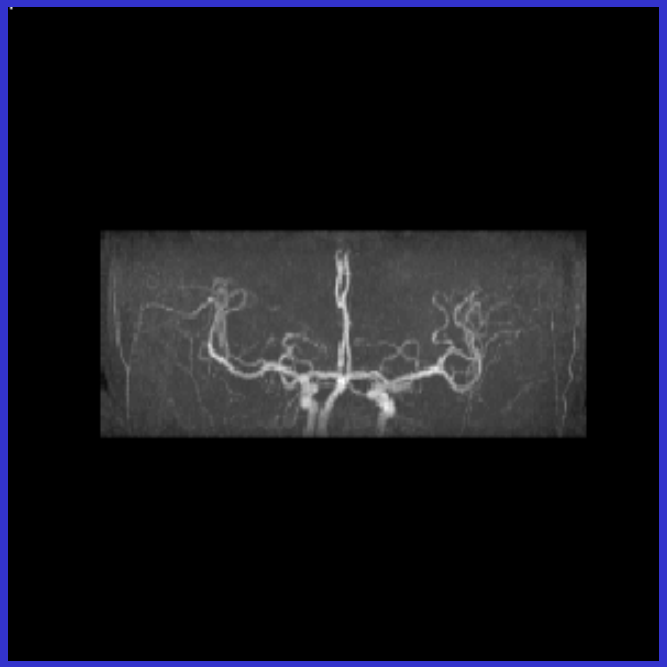
MCA

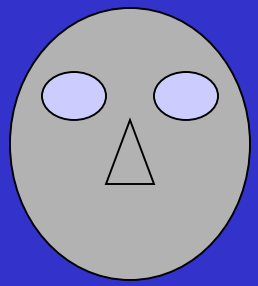
VBA

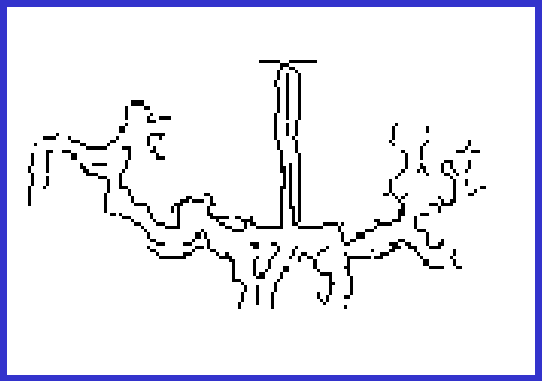


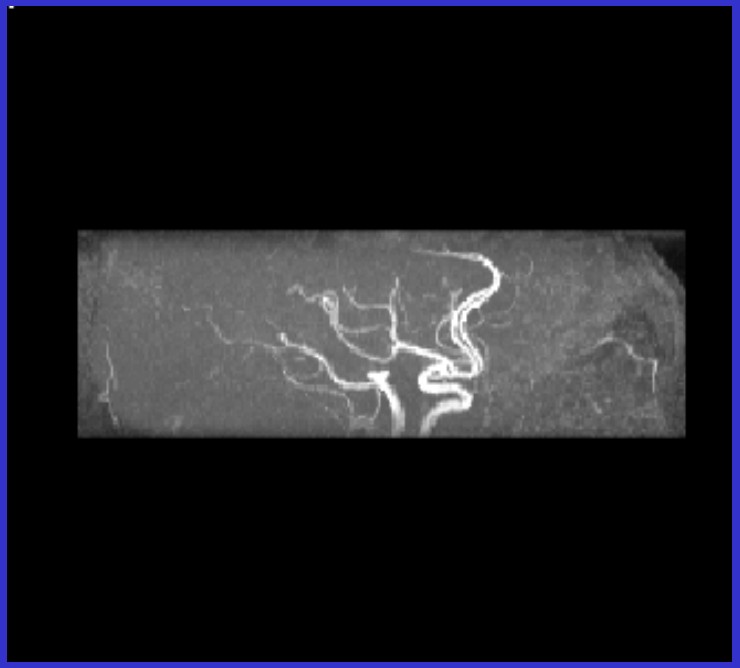


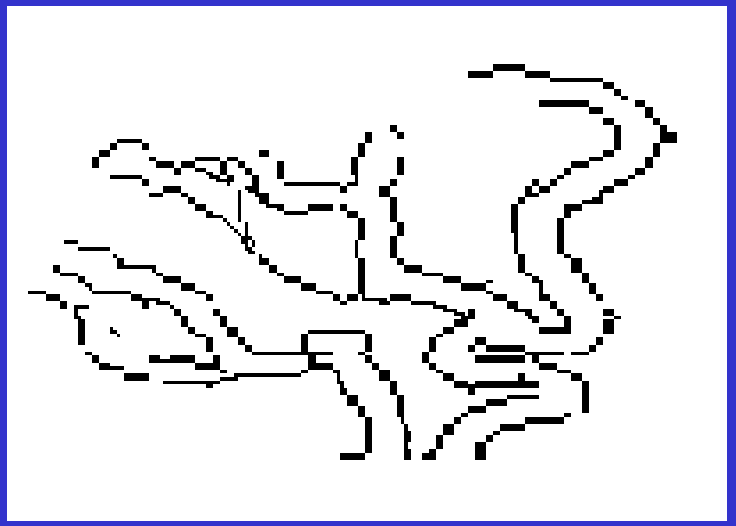


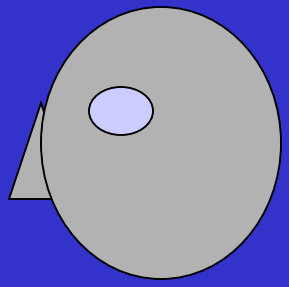












大腦之功能性組成

皮質區域

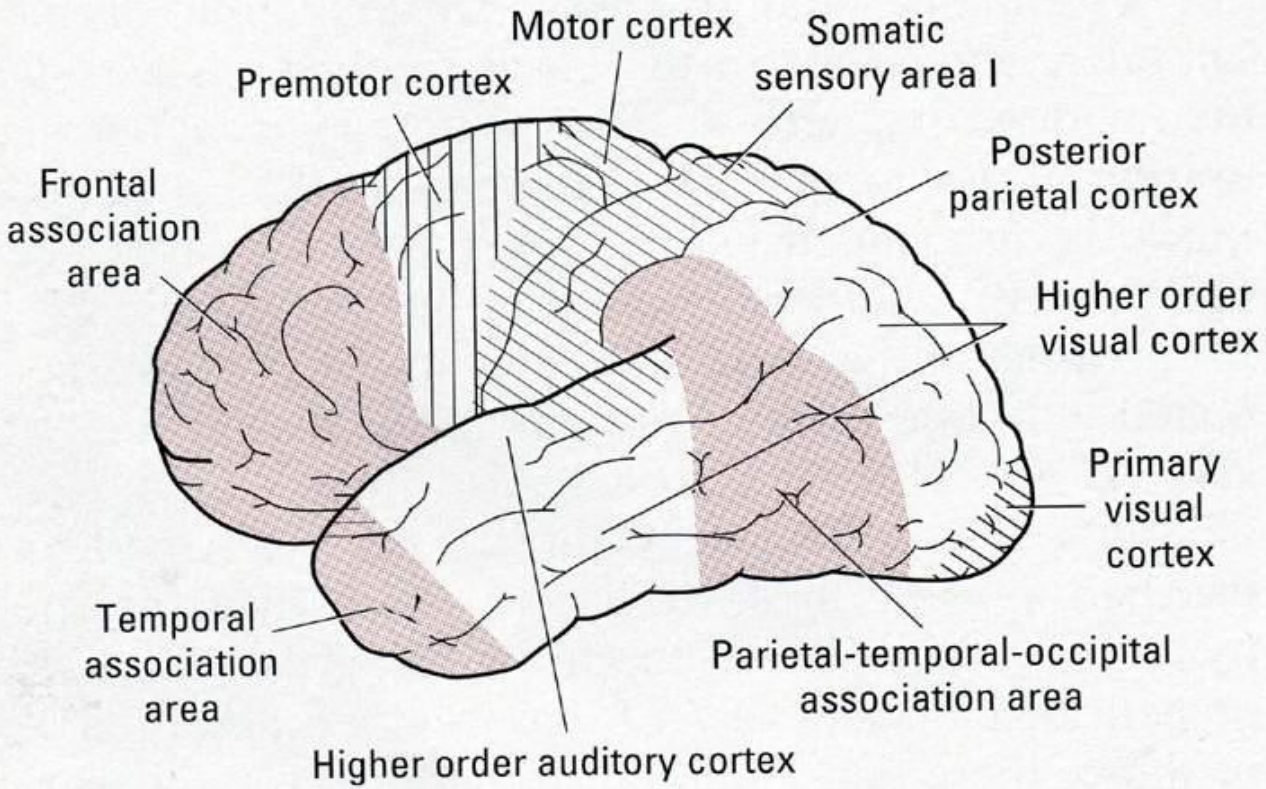
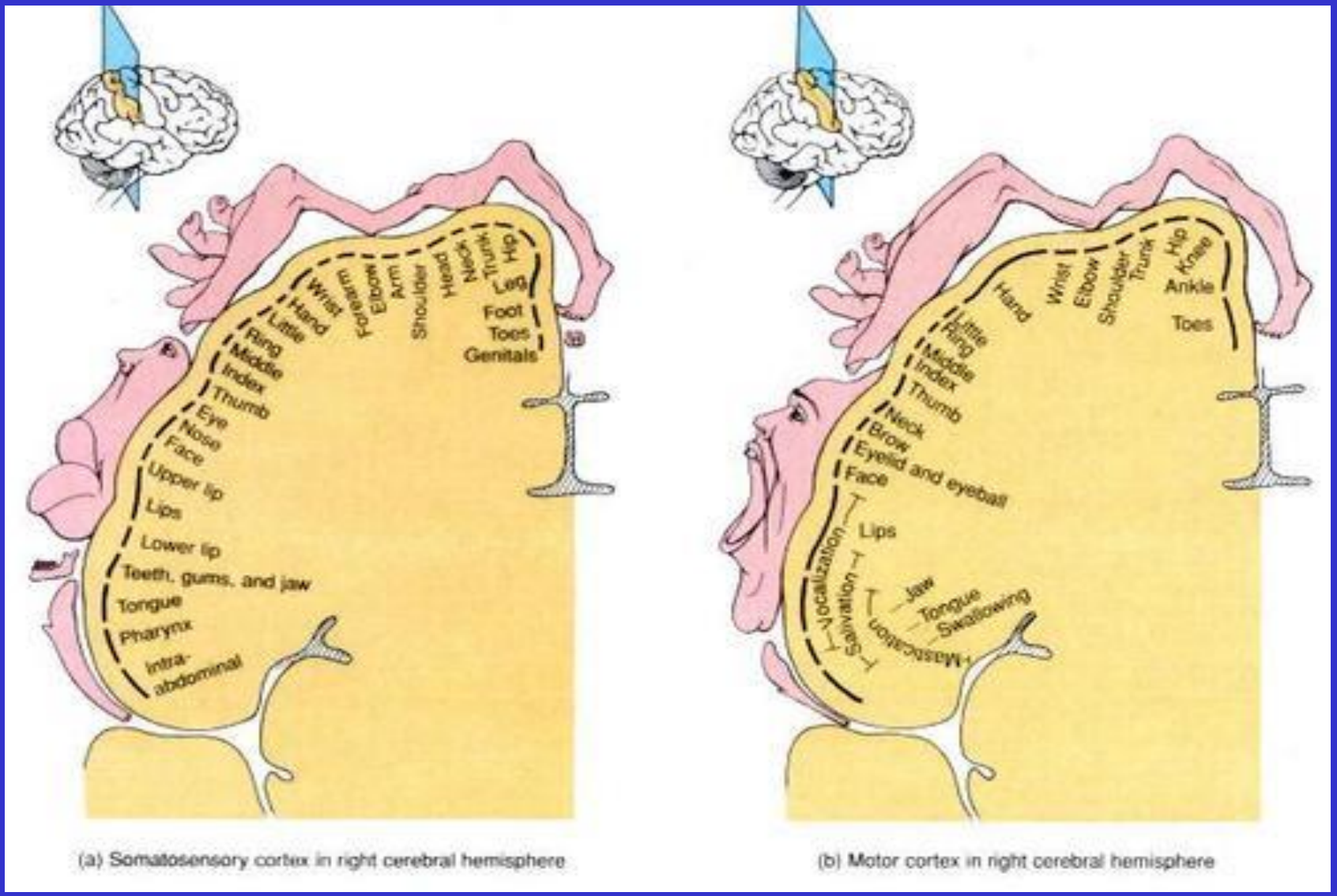


Figure 16–5. Lateral view of the human cerebral cortex, showing the primary sensory and motor areas and the association areas.

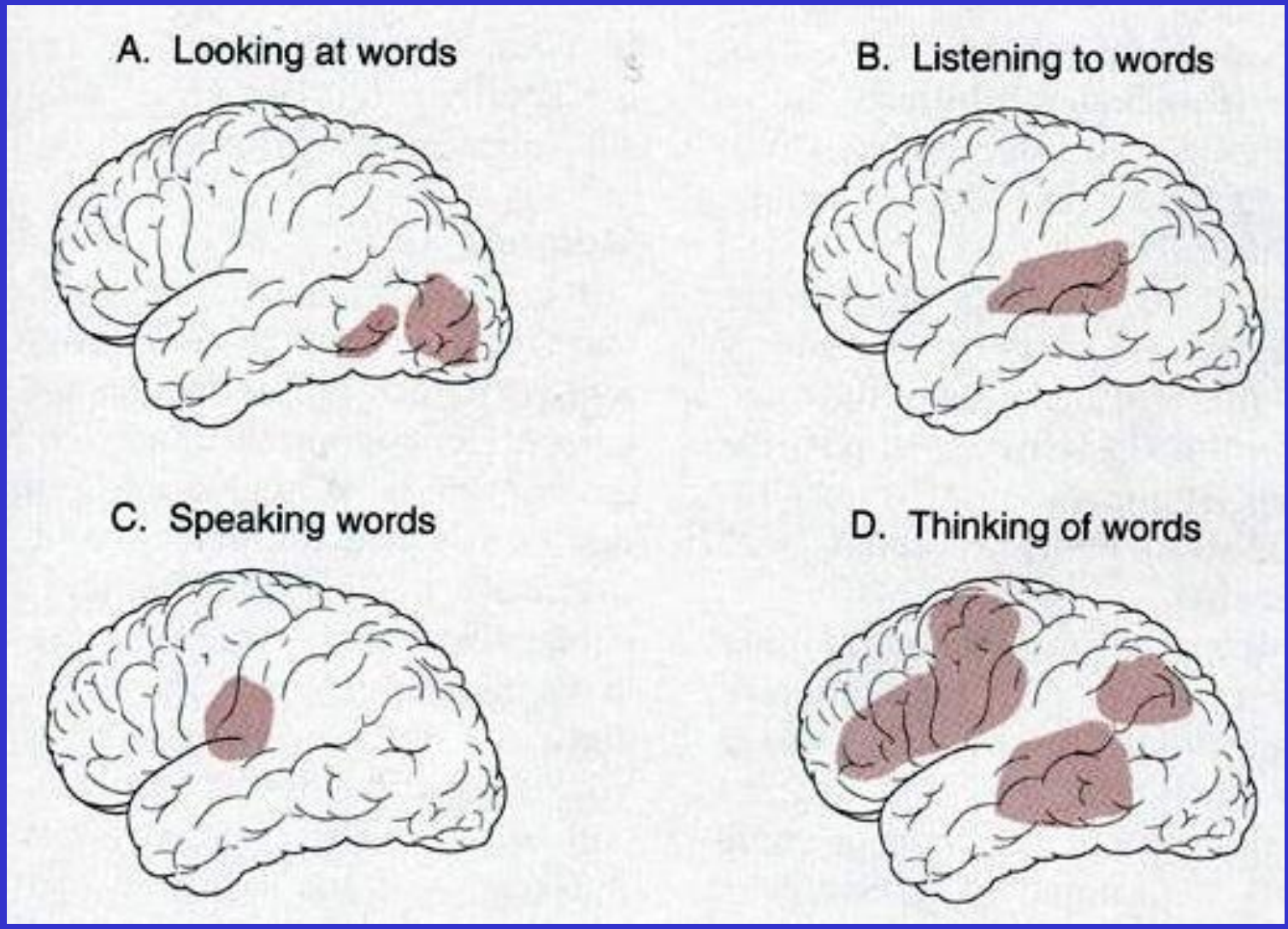
Homunculus



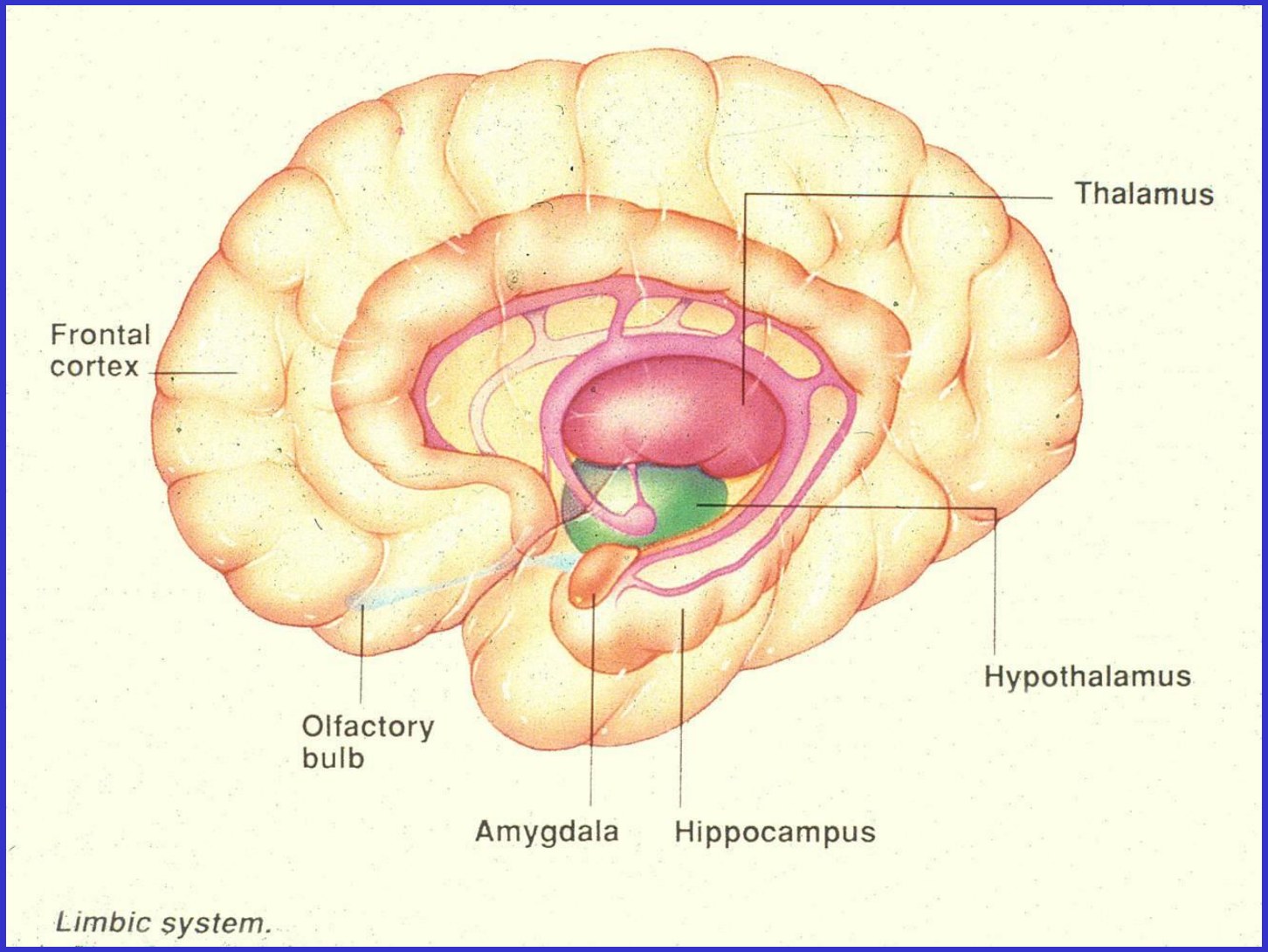
(a) Somatosensory cortex in right cerebral hemisphere

(b) Motor cortex in right cerebral hemisphere

語言功能


A. Looking at words
B. Listening to words
C. Speaking words
D. Thinking of words

邊緣系統 (Limbic system)



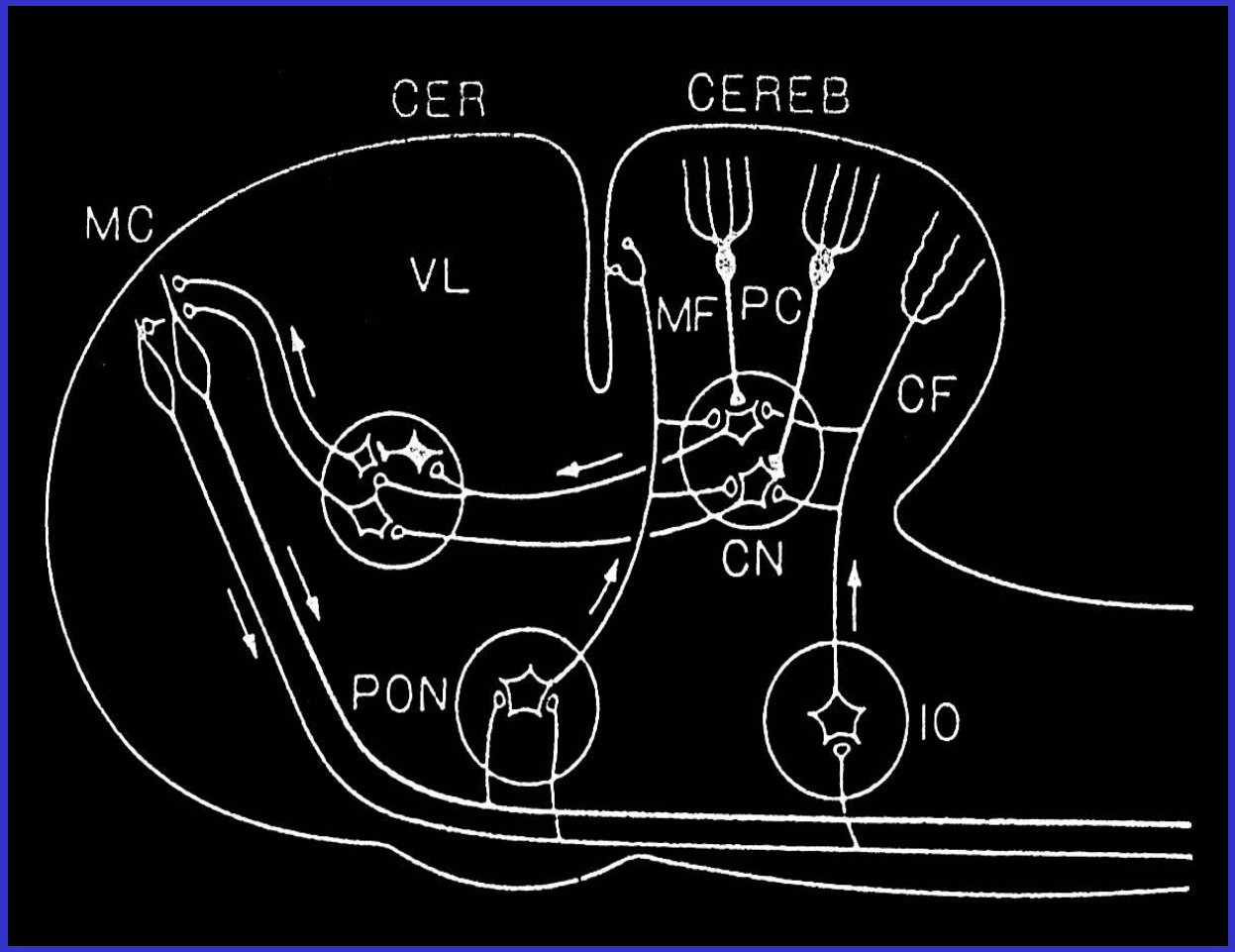
Limbic system.

Limbic system之功能

- The limbic system supports a variety of functions including emotion, behavior, motivation, long-term memory, and olfaction.
- Emotional life is largely housed in the limbic system, and it has a great deal to do with the formation of memories.

運動系統

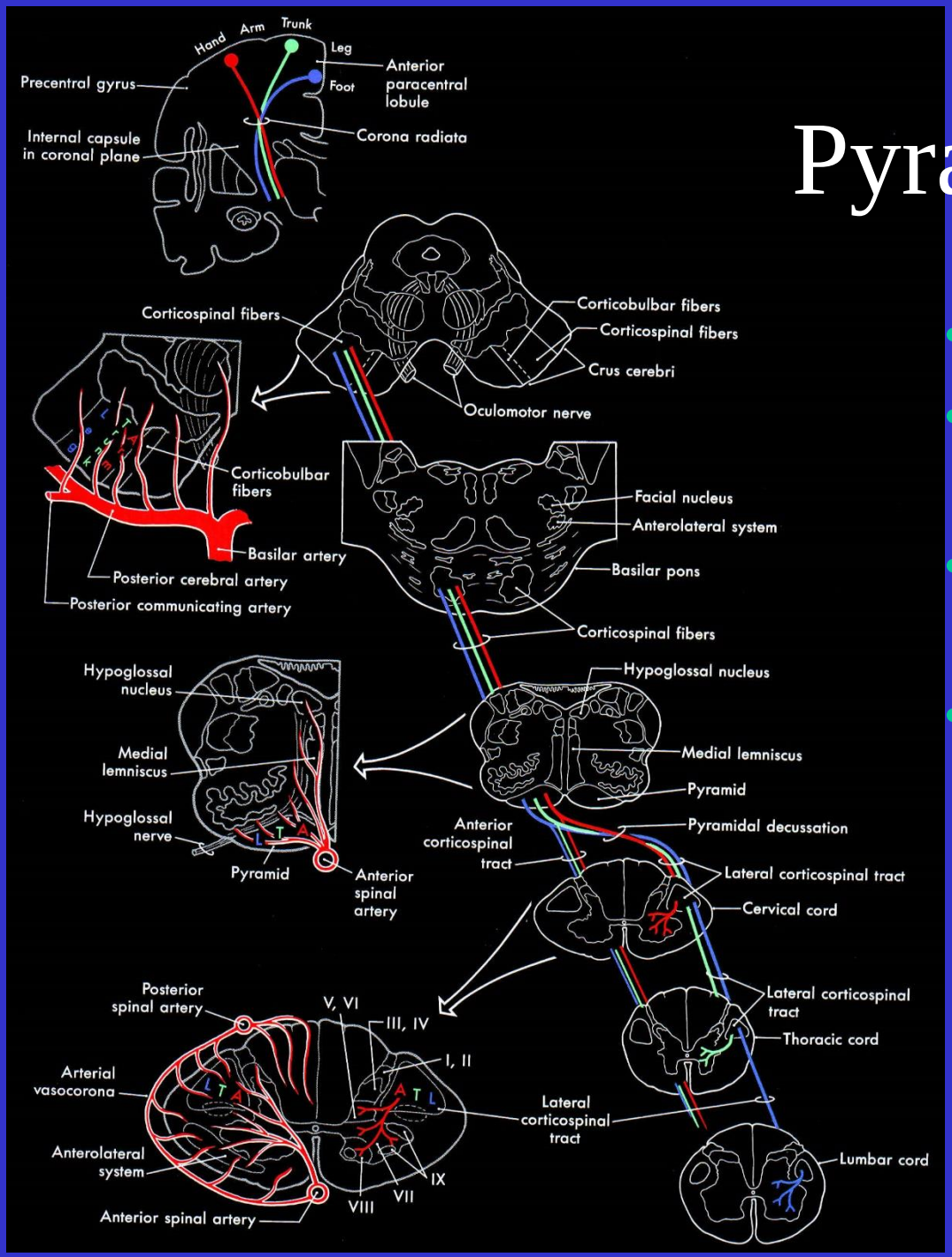
Also extrapyramidal system



MC: motor cortex
CER: cerebrum
VL: ventro-lateral nu. of thalamus
CEREB: cerebellum
MF: mossy fiber
PC: Purkinje cell
CF: climbing fiber
CN: central nu.
IO: inferior olivary nu.

Adaptive control

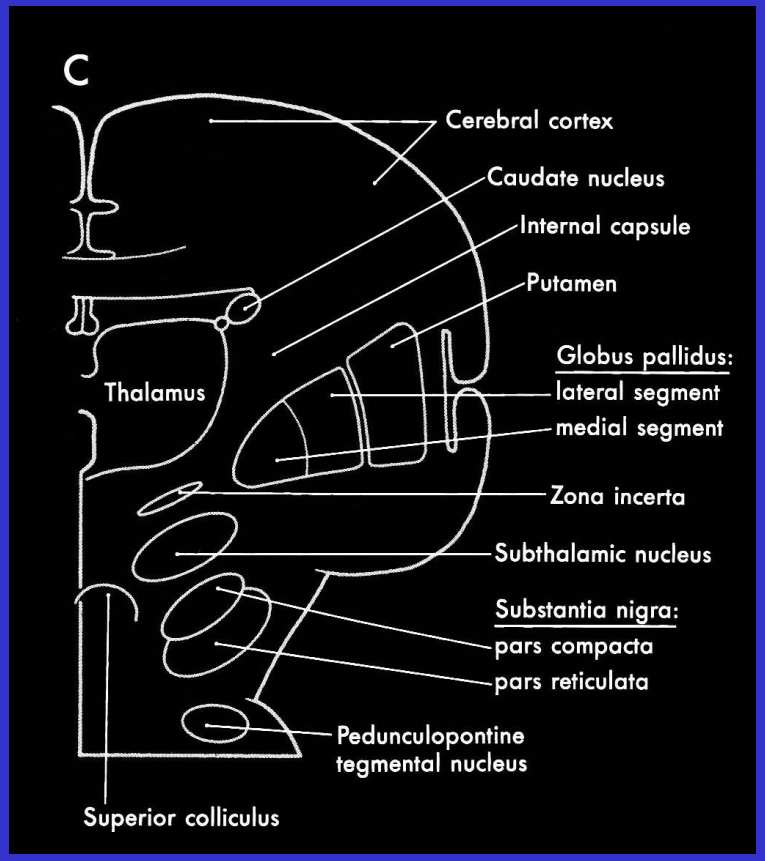
Pyramidal Tract

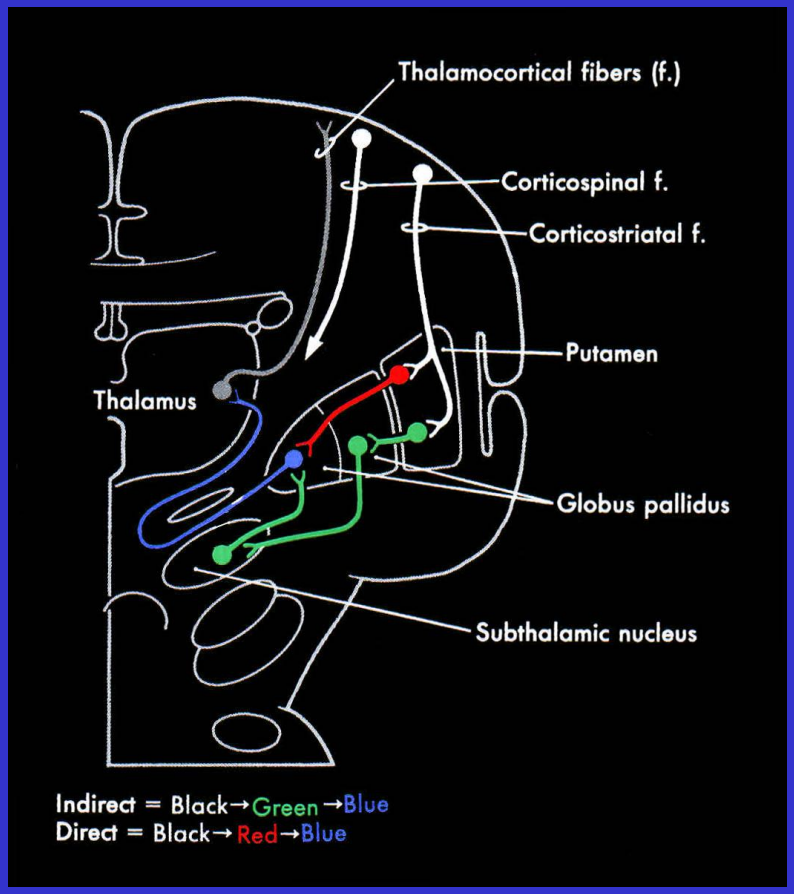


- Main motor pathway
- Decussate at junction of brain stem and spinal cord
- Run at lateral part of spinal cord
- Synapse with the lower motor neuron at ventral horn

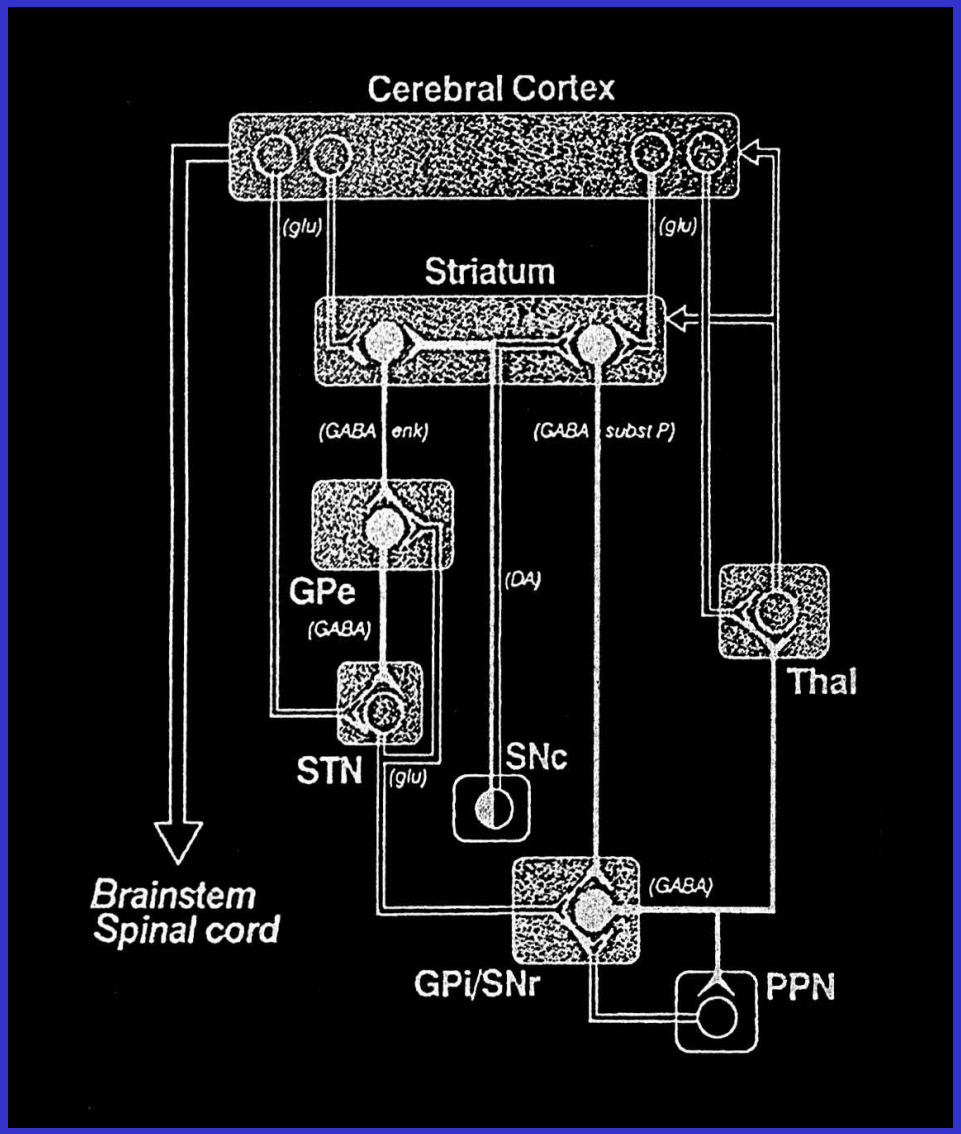
Extra-Pyramidal System (EPS)

- As the name suggests, consist of pathways out of pyramidal system





Circuits of Basal Ganglia



- Direct pathway
  - excitatory
- Indirect pathway
  - Inhibitory
- Has a focus function ?

Level of movement construction I

- Level of tone: A
  - Structure: rubrospinal
  - Involuntary of trunk
  - Animal: fish
- Level of synergies: B
  - Structure: pallidum - thalamus
  - Animal: reptile
  - Function: provide the internal consistency of a movement

Level of movement construction II

- Level of spatial field: C
  - Structure: pyramido-striatal
  - Animal: mammal and bird
  - Function: to make the space field spacious, stationary, and homogeneous

- Level of action: D
  - Structure: parietal-premotor
  - Animal: human
  - Function: forming a sequence of movements that solves a motor problem