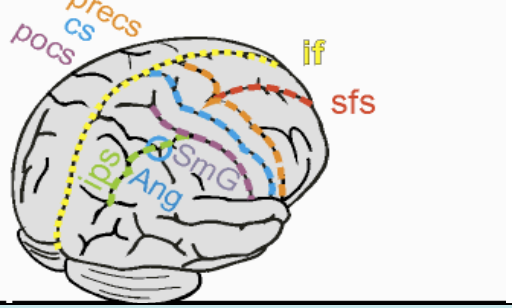
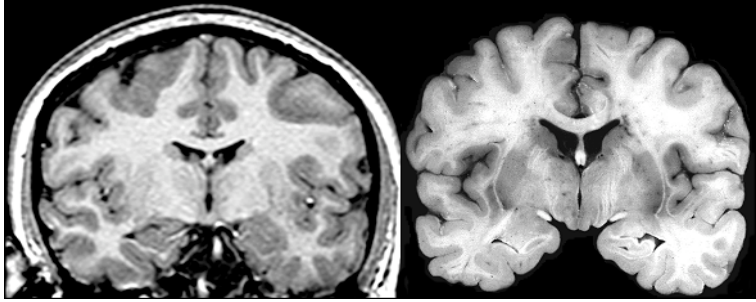
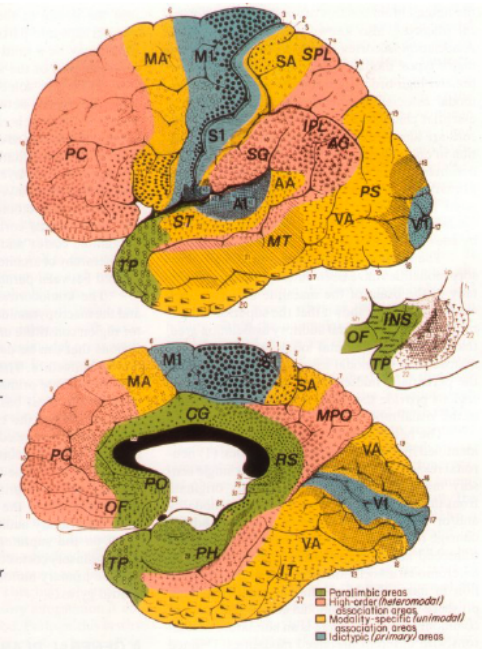


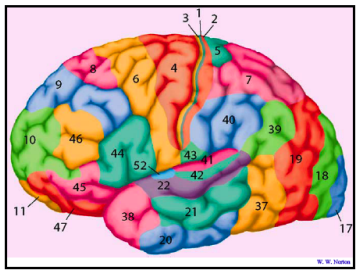


Principes d'organisation topographique du cerveau humain



Un guide pour mieux comprendre à quoi sert le cerveau et où se situent ses différentes parties

michel.habib@resodys.org
http://resodys.org



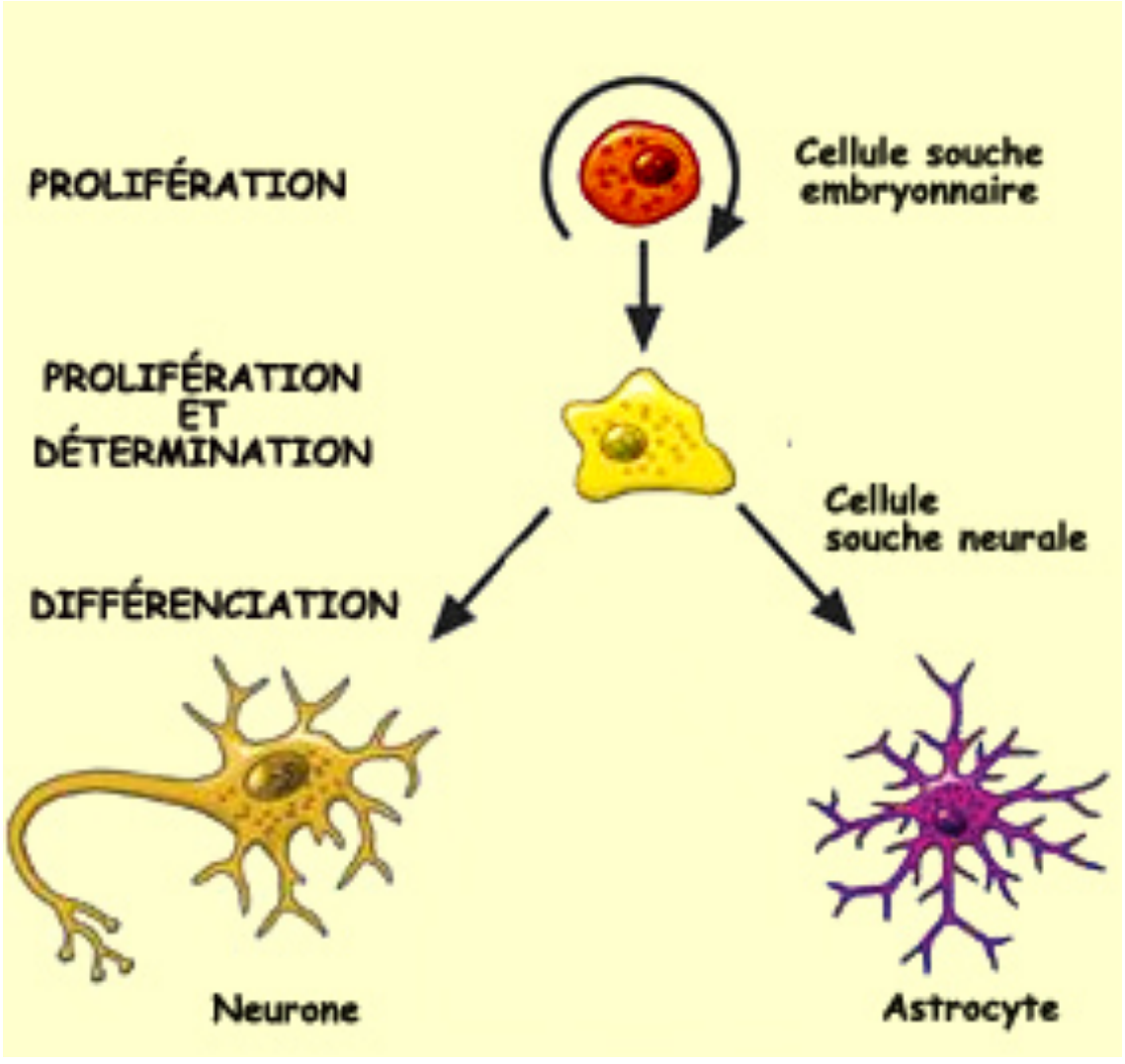
Généralités : Architecture et connexions

Quelques définitions et chiffres

- Le cerveau est composé
  - de 100 milliards de neurones qui communiquent entre eux par des messagers chimiques, des médiateurs;
  - des centaines de milliards de cellules gliales qui jouent un rôle crucial dans la connectique du cerveau;
  - dix à cent mille milliards de connexions synaptiques.
- Le corps du neurone mesure de 5 à 120 μm. La taille d'un neurone (ou plutôt d'un axone) varie d'une fraction de micron à deux mètres (du cerveau à l'orteil).
- La tige du neurone est l'axone et les ramifications en épi qui en émergent sont les dendrites. Il y en a 7000 en moyenne par neurone.
- Les synapses sont les zones de contact entre neurones ou neurones cellule.
  Une synapse peut être chimique – le signal est transmis via une action chimique – ou électrique. Intervalle de contact de 10 à 40 nm pour les chimiques et environ 2 nm pour les électriques. Il y en a de 1 000 à 10 000 par neurones.

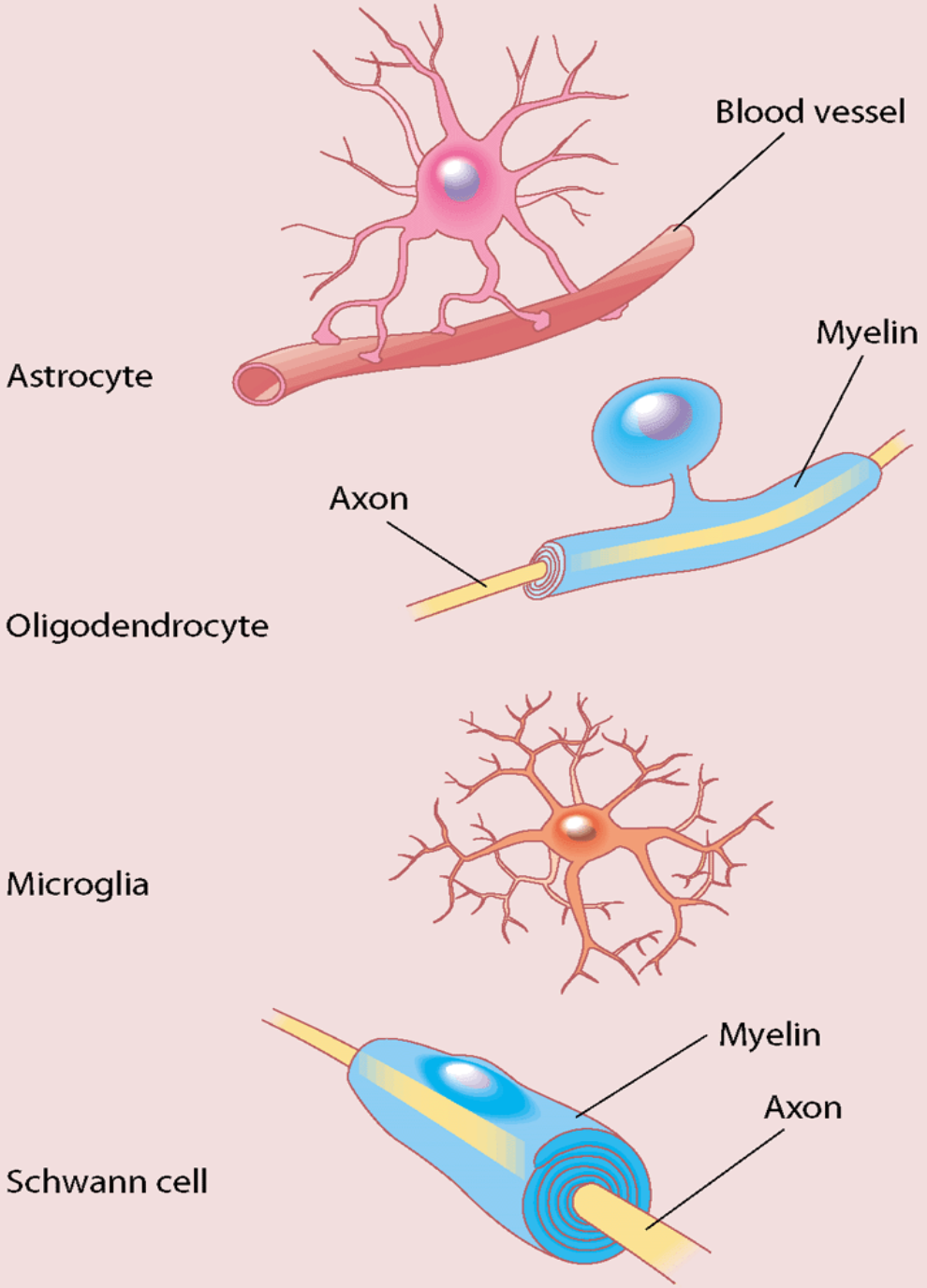
Organisation Cellulaire

- Glie
- Neurones



Glie

- Gaine de myéline.
- Barrière hémato-encéphalique
- Débarrasse des débris et des substances chimiques en excès
- Support structural pour les neurones
- Role critique dans le développement du cerveau

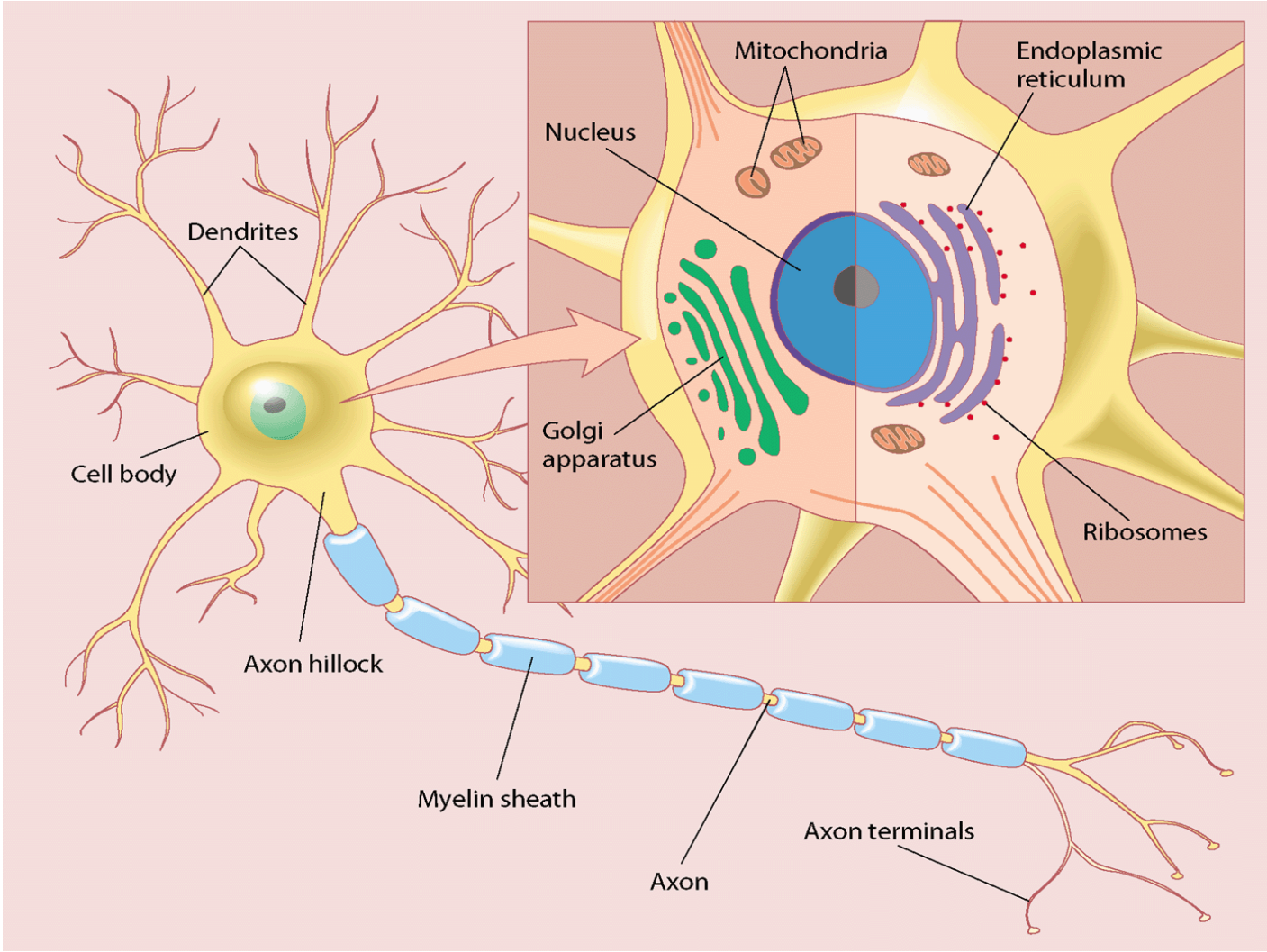


Neurones

- Anatomie
- Physiologie

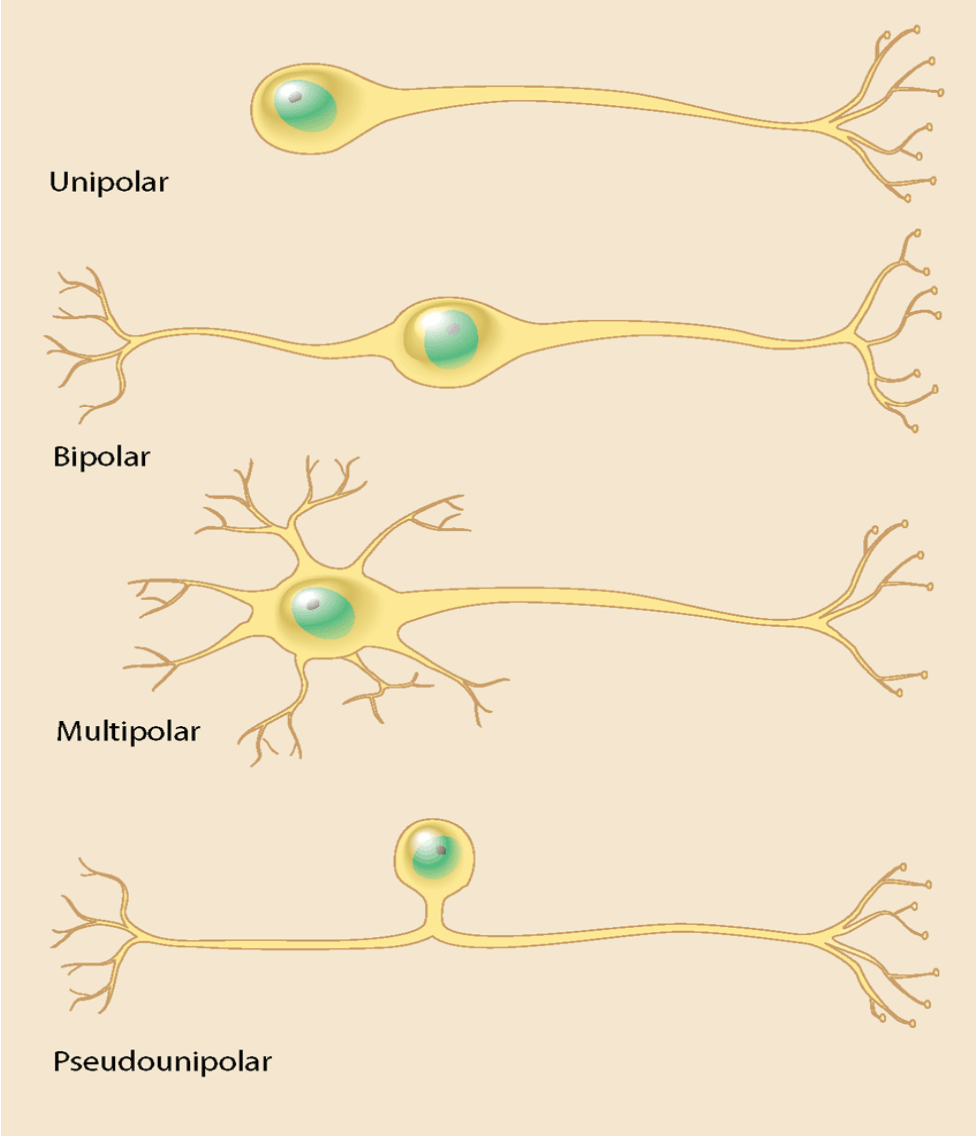
L'Anatomie d'un Neurone

– Corps cellulaire (ou soma),
– dendrites,
– axone



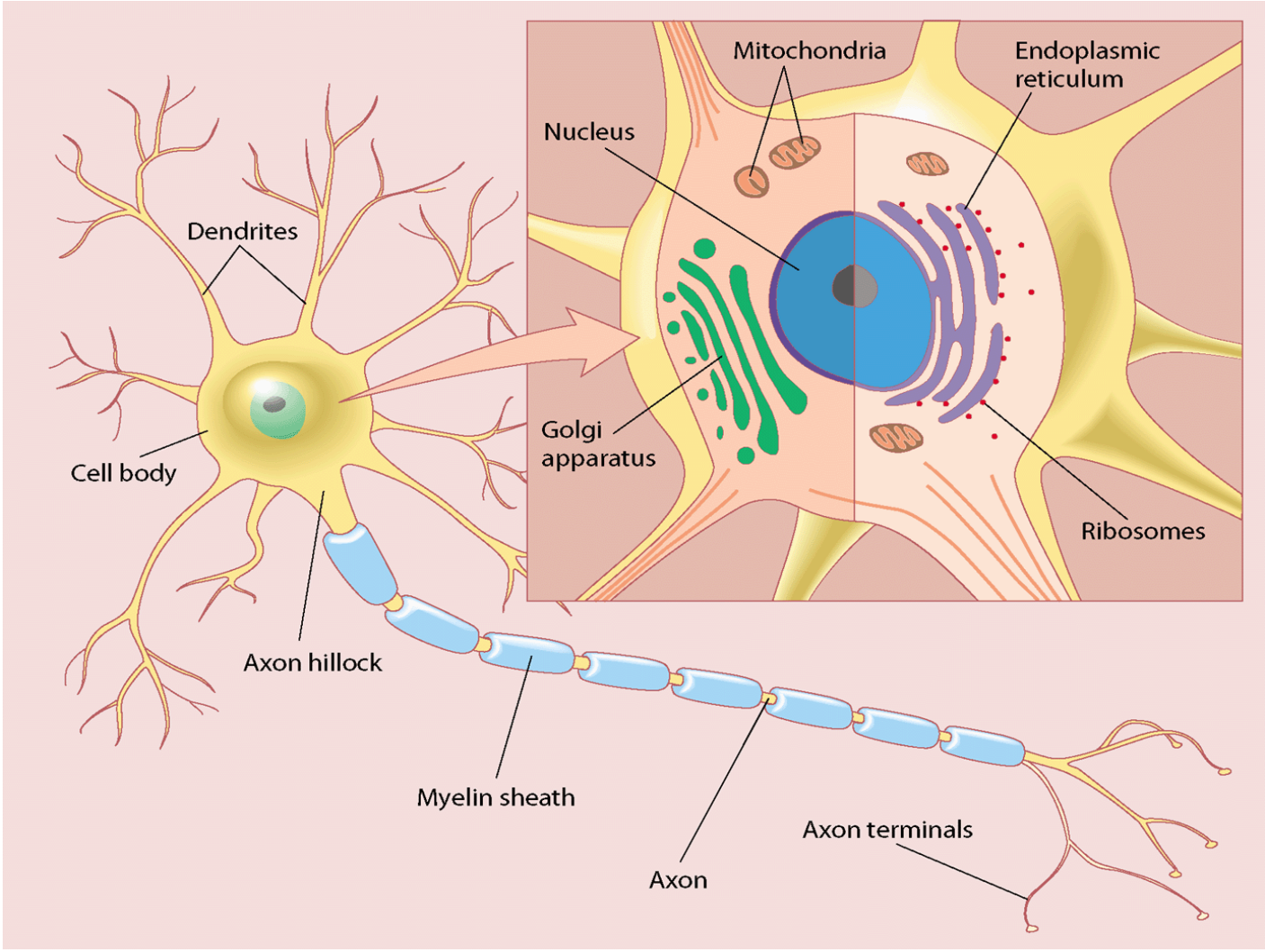
L'anatomie d'un Neurone

Diverses formes de neurones

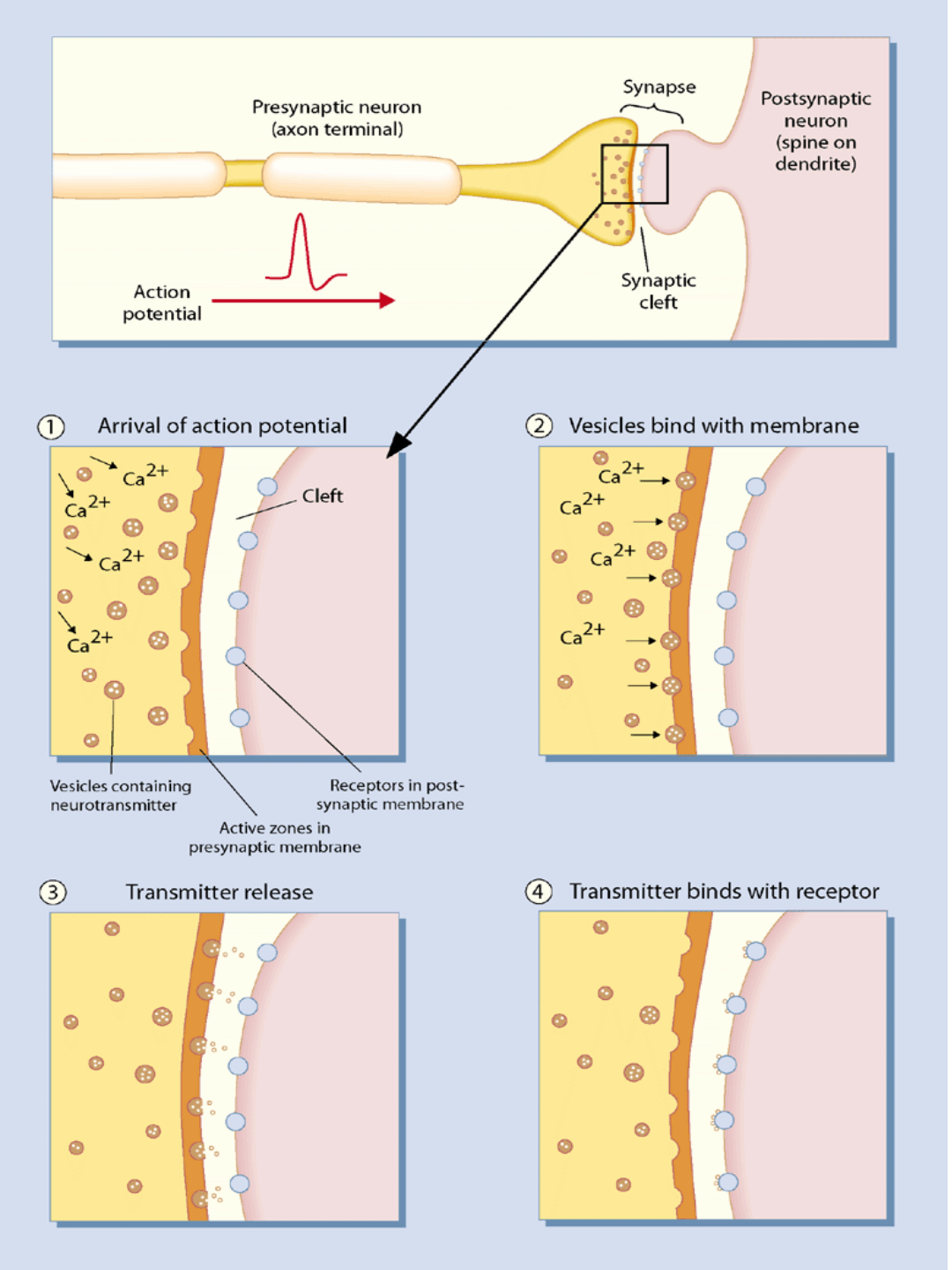


Axone

- Cône d'implantation de l'axone
- myeline (ou gaine de myelie)
- Noeuds de Ranvier
- Terminaisons axonales
- synapse
- Fente synaptique.



- Cône d'implantation de l'axone
- myelin (or myelin sheath
- Nodes of Ranvier
- axon terminals
- synapse
- synaptic cleft.



Physiologie du Neurone

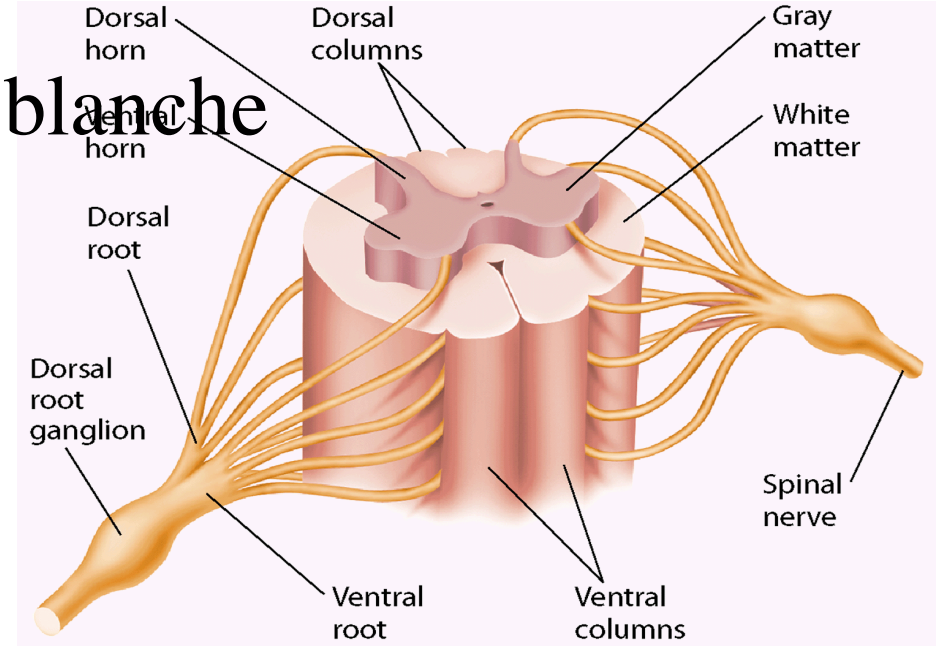
- Neurones réalisent des computations, ils transforment l'information.
- Les composants fonctionnels d'un neurone.
  - Une composante d'entrée (input: les dendrites)
  - une composante d'integration (Cône d'implantation)
  - une composante de transmission (axone)
  - Une composante de sortie (synapse)
- Conductance passive vs active
- Transmission électrique vs chimique

SNC

- Encéphale
- Moelle épinière

Moelle épinière

- Deux principales classes de fibres nerveuse
  - Fibres motrices descendantes (portion ventrale)
  - Fibres sensorielles ascendantes (portion dorsale)
- réflexes spinaux
- Substance grise vs substance blanche

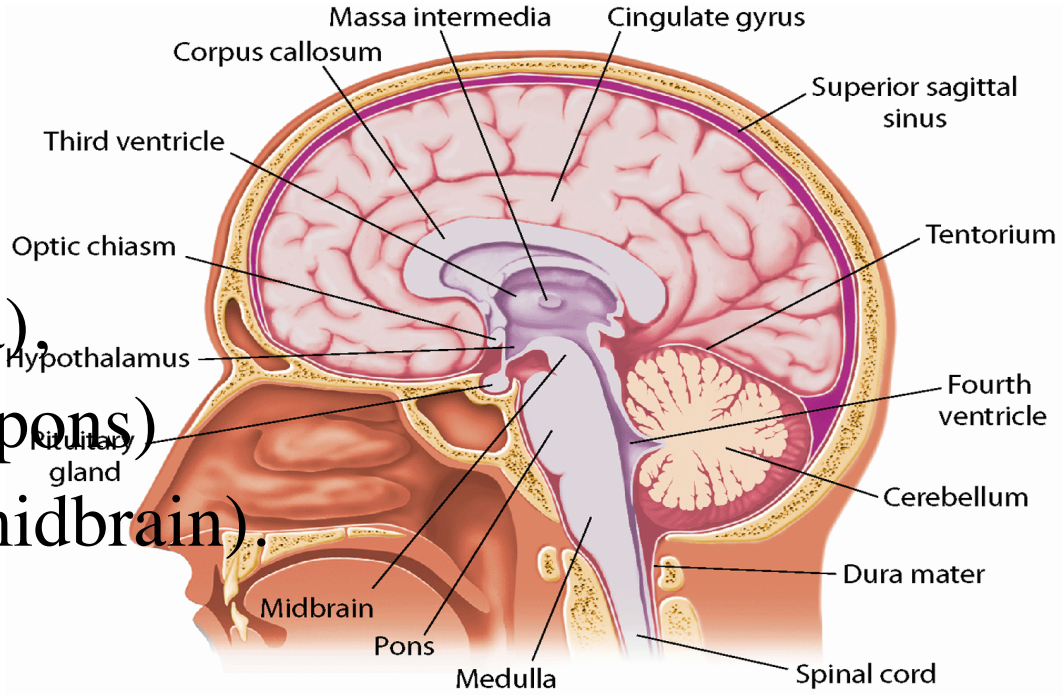


Encéphale

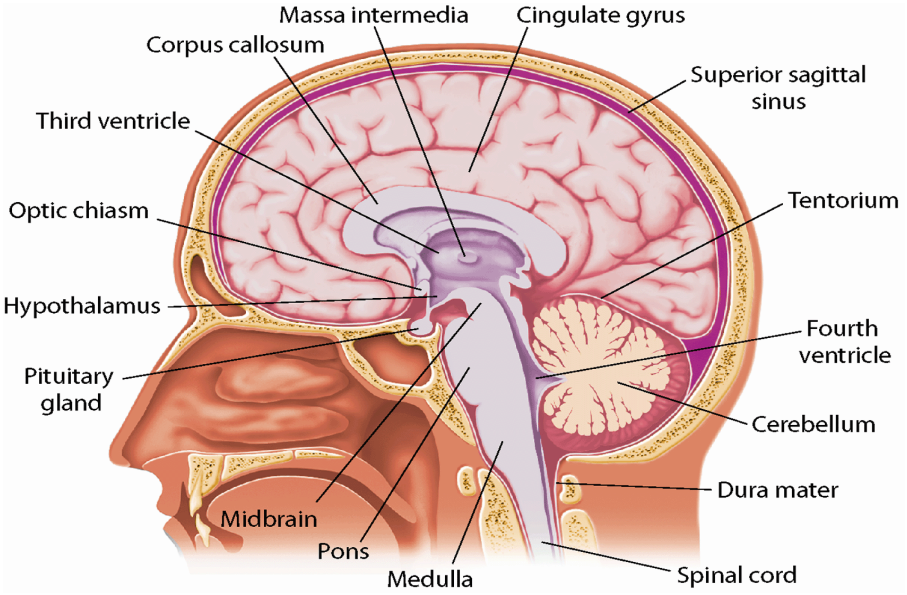
- Tronc cérébral,
- cervelet,
- diencéphale
- cerveau.

Tronc cérébral

- Trois principales parties
  - bulbe rachidien (medulla),
  - Protubérance annulaire (pons)
  - Pédoncules cérébraux (midbrain).
- Nerfs crâniens
- Respiration, rythme cardiaque , cycles veille-sommeil, éveil
- Substance noire (locus niger) et noyau rouge



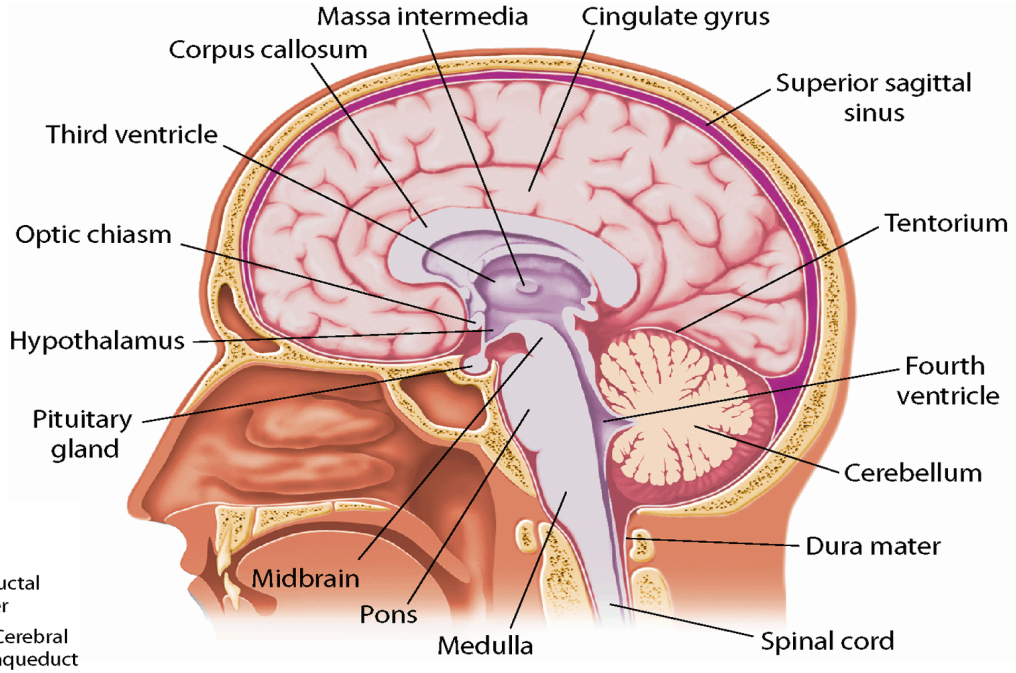
Cervelet

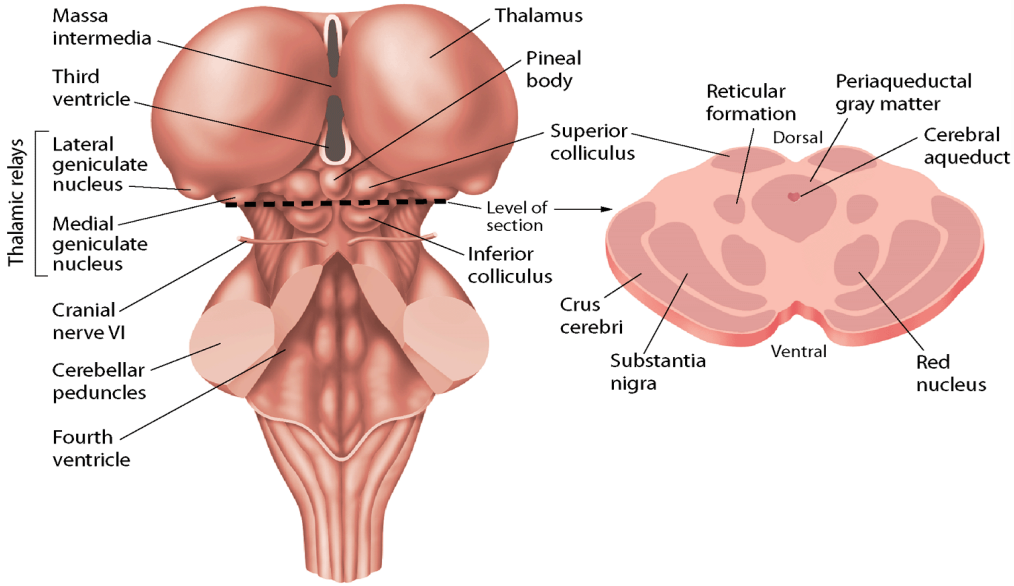


- 2 hemisphères
- cortex.
- Contrôle moteur, particulièrement en effectuant les ajustements posturaux et les mouvements fins
- Participe aux fonctions mentales supérieures, dont le langage

Diencéphale

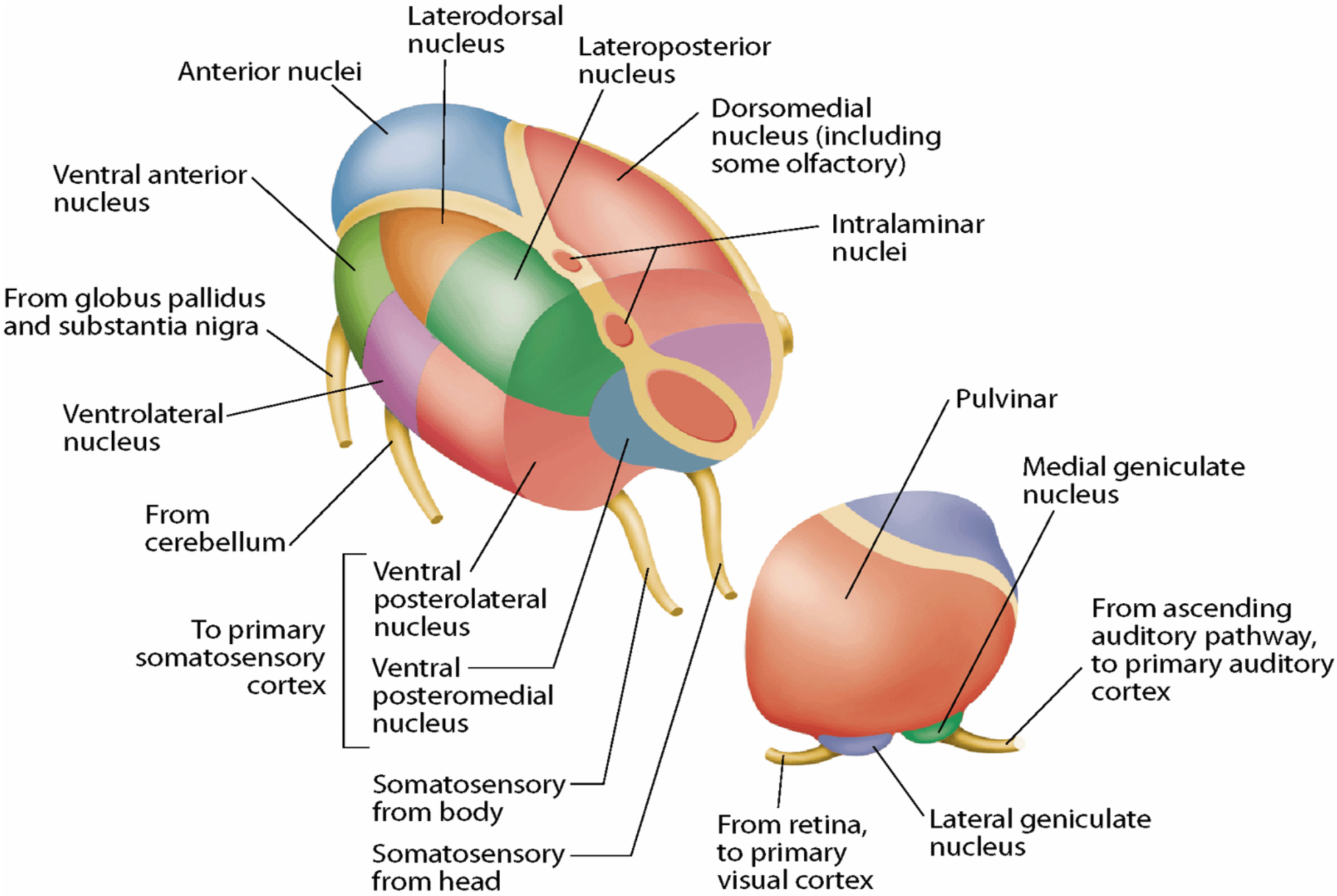
- 3 structures
  - L'hypothalamus
  - le subthalamus
  - the thalamus





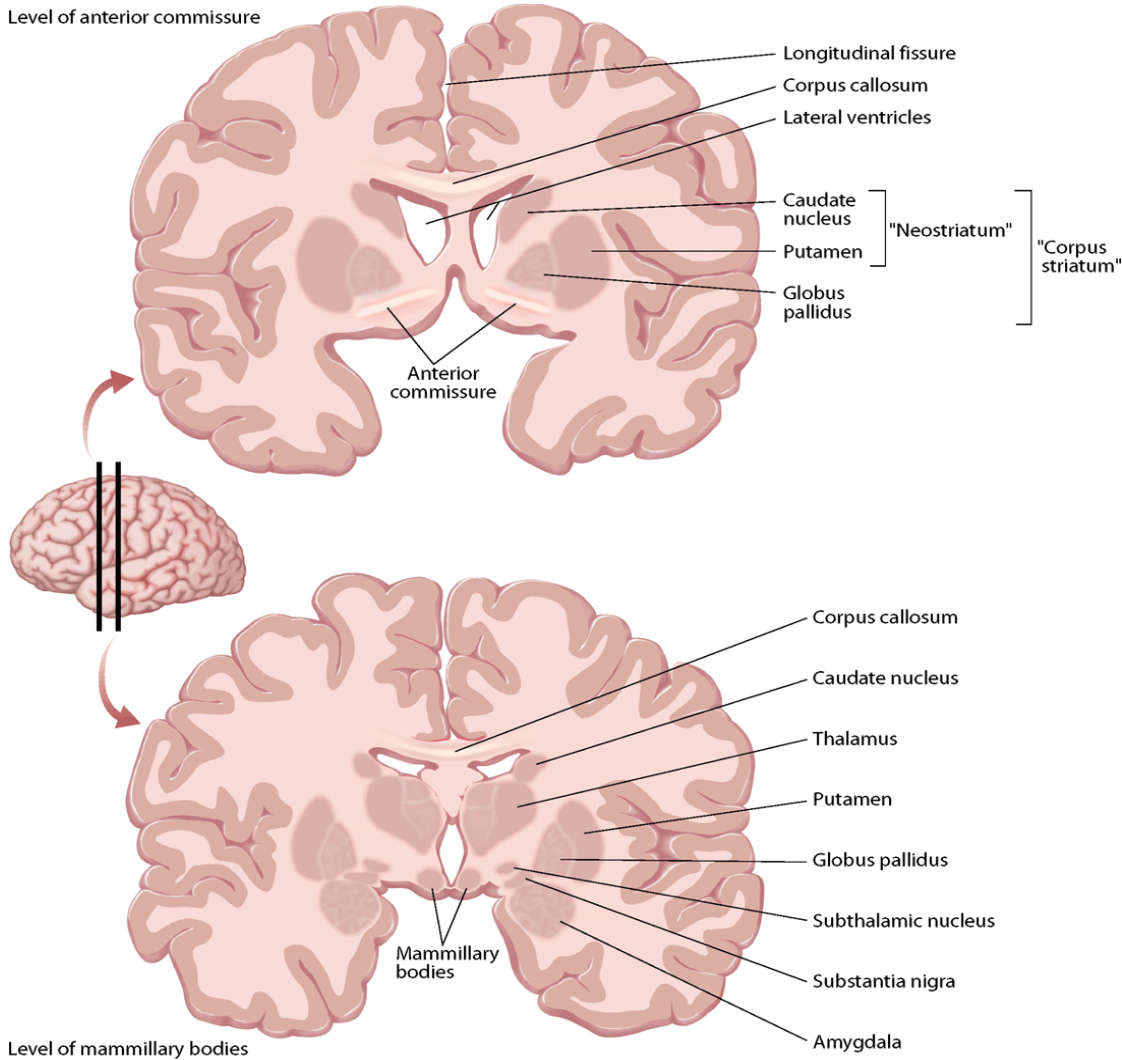
Le thalamus

- paire de structures ovoïdes.
- Toutes les informations sensorielles entrantes font relais dans le thalamus avant d'entrer dans le cortex cérébral
- Participe à de nombreuses fonctions motrices, sensorielles et cognitives
- Connexions avec cortex hautement organisées
- Connexions en grande partie réciproques


Laterodorsal nucleus
Lateroposterior nucleus
Anterior nuclei
Dorsomedial nucleus (including some olfactory)
Ventral anterior nucleus
Intralaminar nuclei
From globus pallidus and substantia nigra
Ventrolateral nucleus
From cerebellum
Pulvinar
Medial geniculate nucleus
From ascending auditory pathway, to primary auditory cortex
To primary somatosensory cortex
Ventral posterolateral nucleus
Ventral posteromedial nucleus
Somatosensory from body
Somatosensory from head
From retina, to primary visual cortex
Lateral geniculate nucleus

Sous-cortex

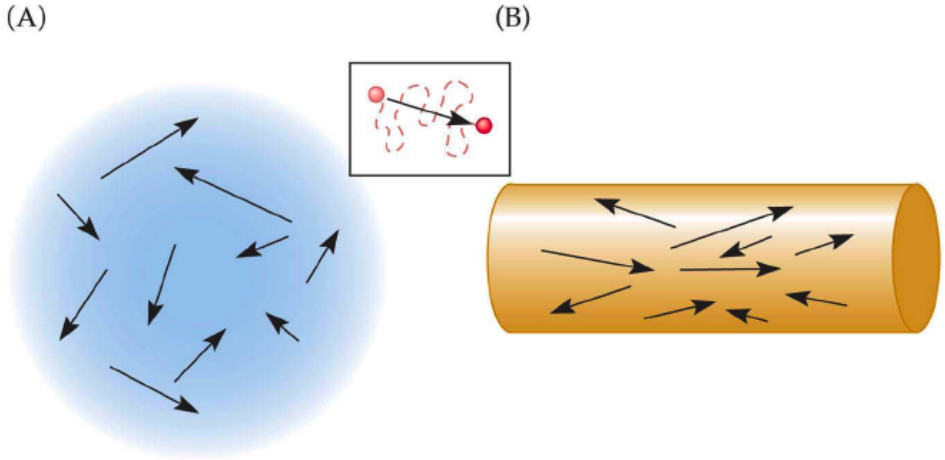
- Substance blanche
- Noyaux sous-corticaux
- ventricules.

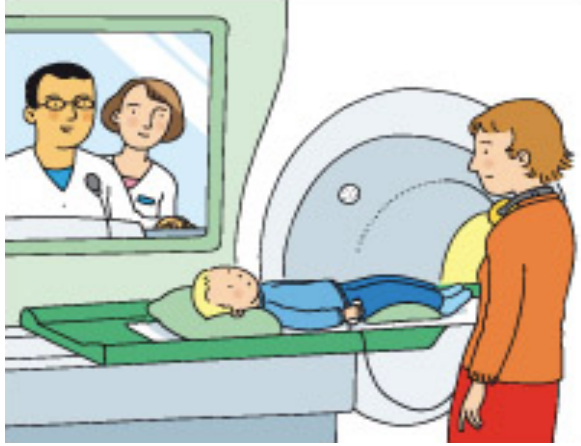


Substnce blanche

- Trois classes de voies de substance blanche:
  - Voies descendantes
  - Voies ascendantes
  - Connexions cortico-corticales

5.18 Isotropic and anisotropic diffusion.

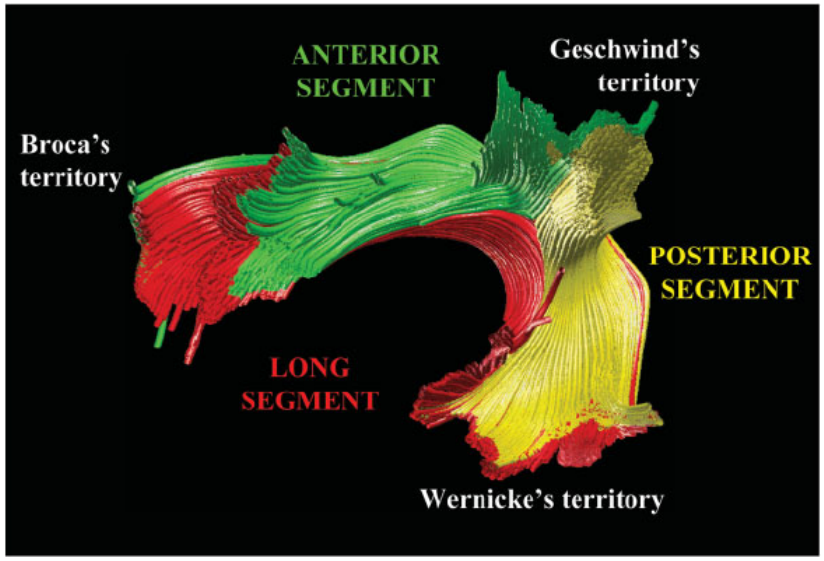




Diffusion tensor imaging (D.T.I.)

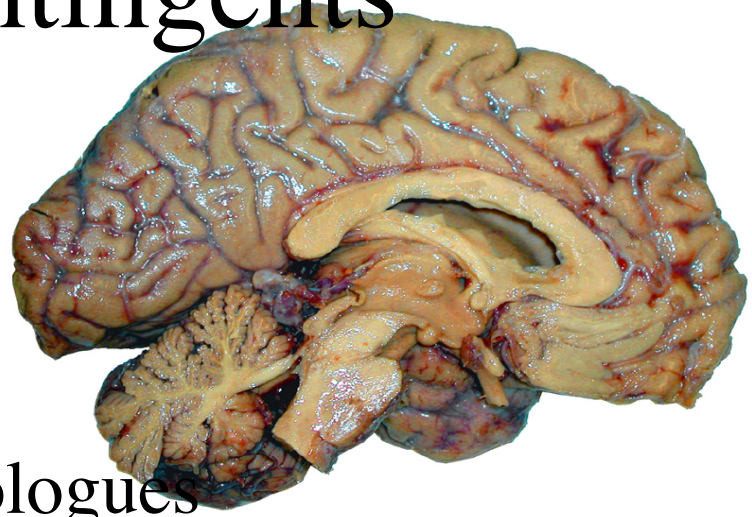
FUNCTIONAL MAGNETIC RESONANCE IMAGING, Figure 5.18 © 2004 Sinauer Associates, Inc.

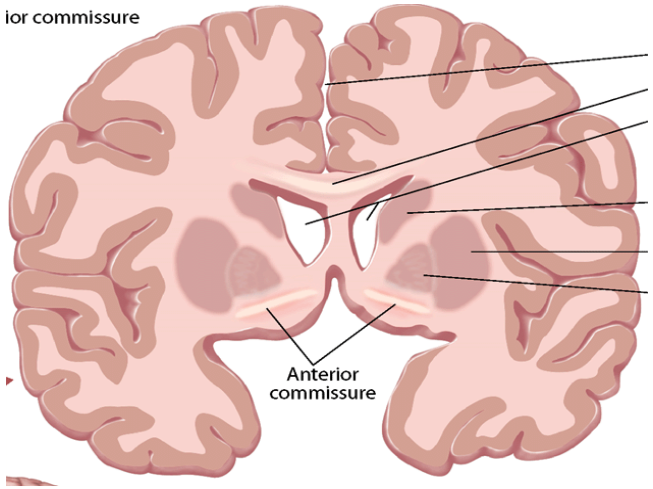
Le faisceau arqué : principal marqueur anatomique de la dyslexie



Connexions cortico-corticales séparées en deux contingents

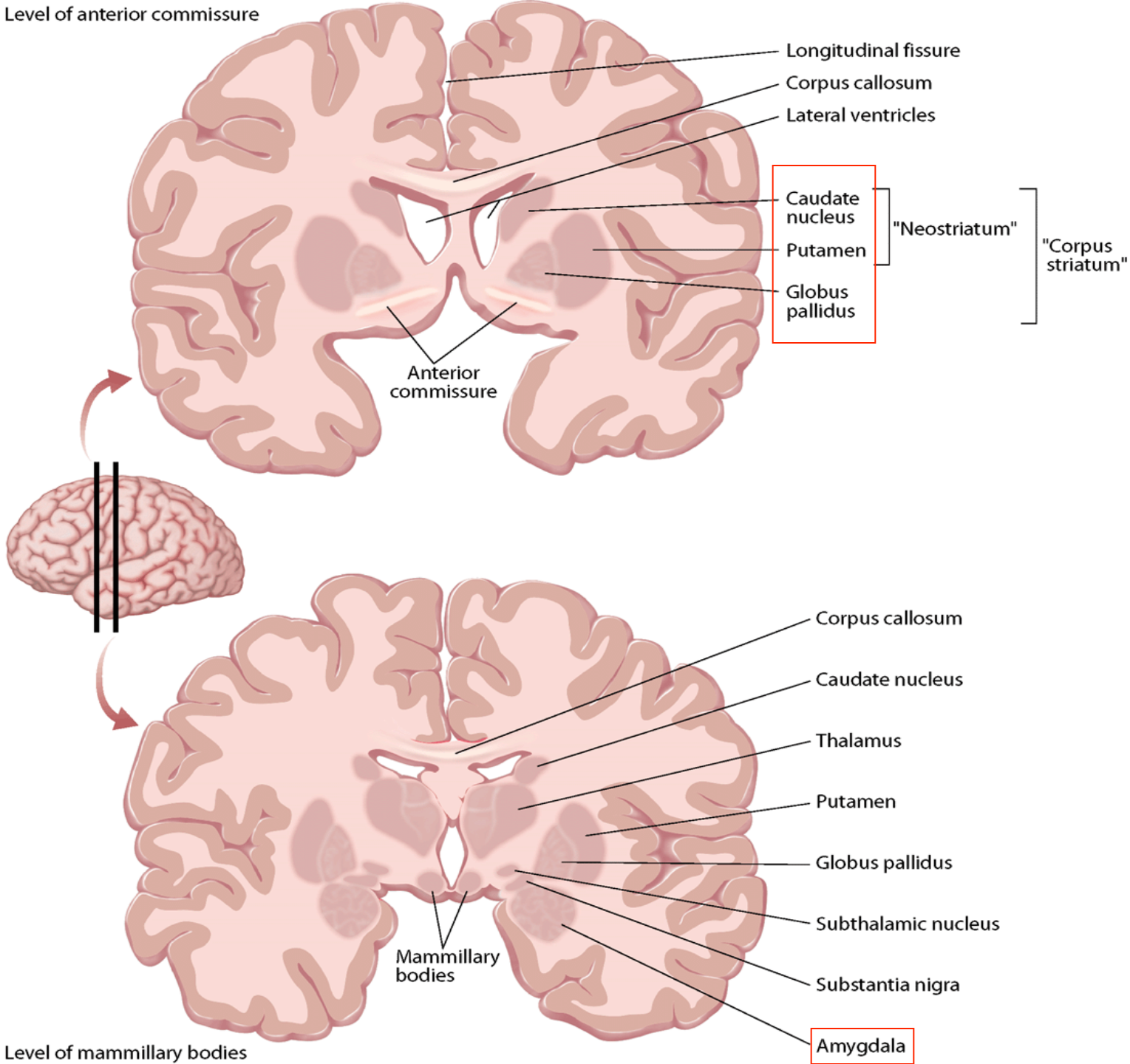
- À l'intérieur d'un hémisphère
  - Courts vs longs (**faisceaux**)
- Entre les hémisphères
  - Principalement connexions homologues
  - **Les commissures**
  - **Le corps calleux**





Les noyaux sous-corticaux

- Ganglions de la base
  - Noyau caudé
  - putamen
  - globus pallidus
  - Noyau sous-thalamique (diencéphale)
  - Substance noire (tronc cérébral)
- claustrum
  - Fine couche de substance grise située latéralement aux ganglions de la base et connectée réciproquement avec pratiquement toutes les autres strucutres. Ses fonctions sont largement inconnues…
- amygdale
  - Système limbique (voir ci-après) jour un rôle dans les émotions et la mémoire chargée émotionnellement

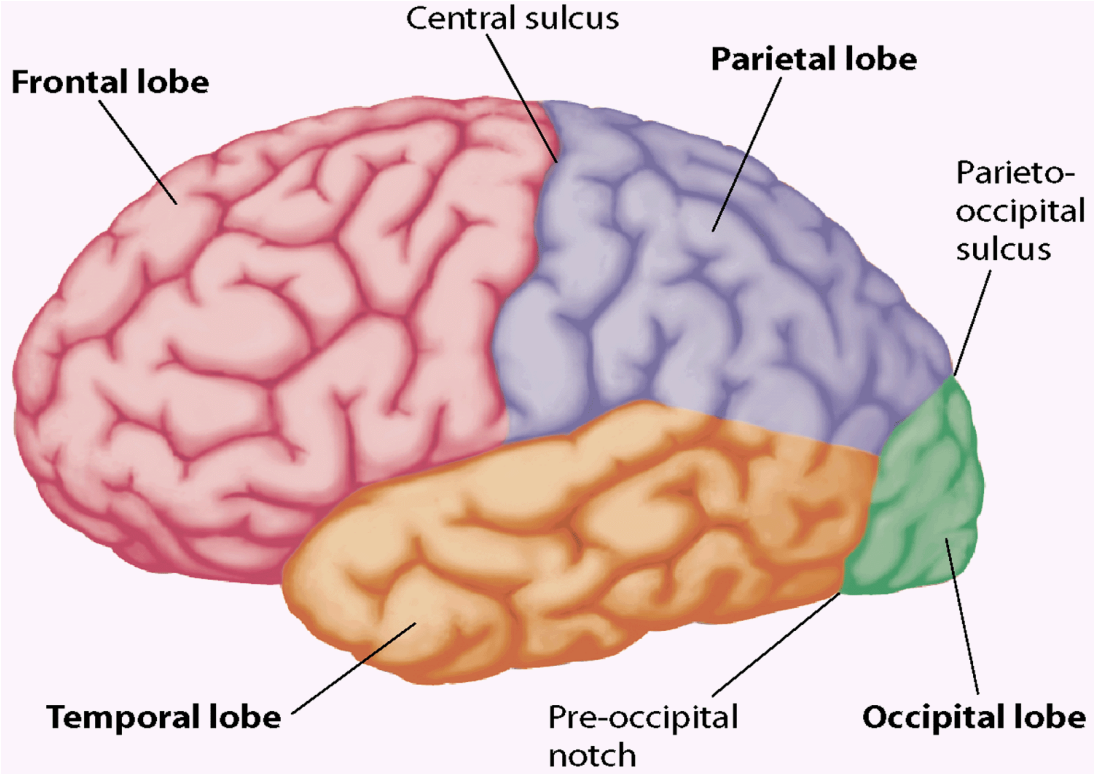

Level of anterior commissure
Longitudinal fissure
Corpus callosum
Lateral ventricles
Caudate nucleus
Putamen
Globus pallidus
"Neostriatum"
"Corpus striatum"
Anterior commissure
Corpus callosum
Caudate nucleus
Thalamus
Putamen
Globus pallidus
Subthalamic nucleus
Substantia nigra
Amygdala
Mammillary bodies
Level of mammillary bodies

ventricules

- Sont un système de cavités liquidiennes interconnectées à l'intérieur du système nerveux central
- **Liquide céphalo-rachidien** (LCR),

Le Cortex Cerebral

- Sillons et circonvolutions (fissures)
- Anatomie lobaire
  - frontal
  - parietal
  - temporal
  - occipital
  - limbic
  - insulaire



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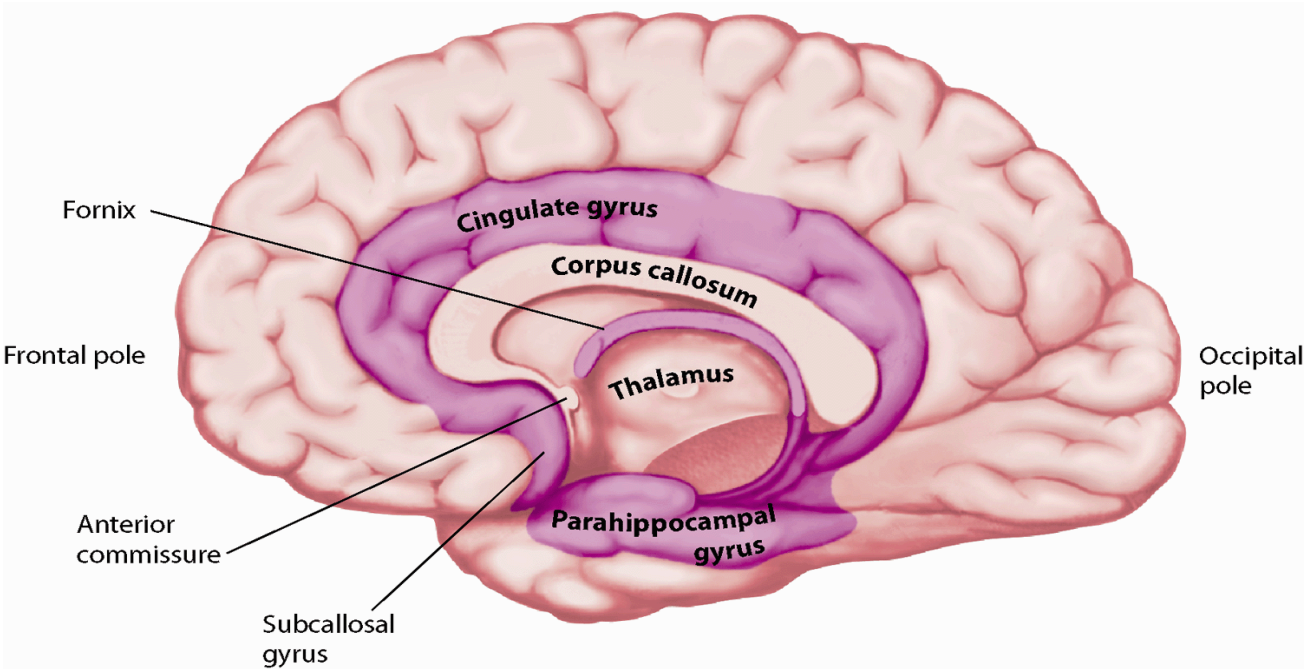
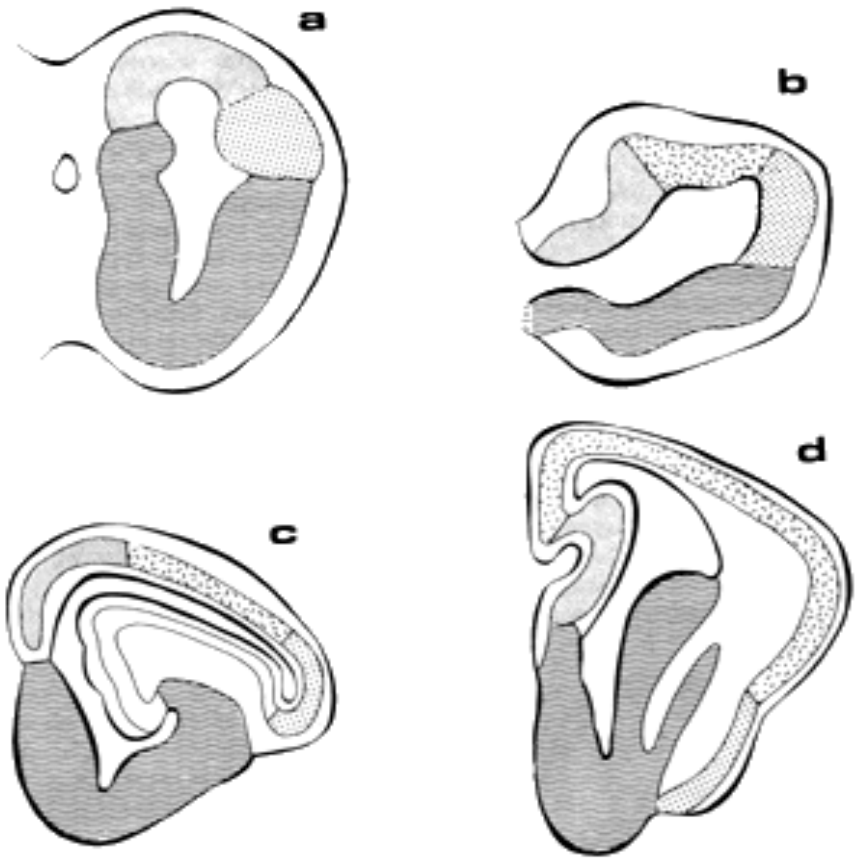
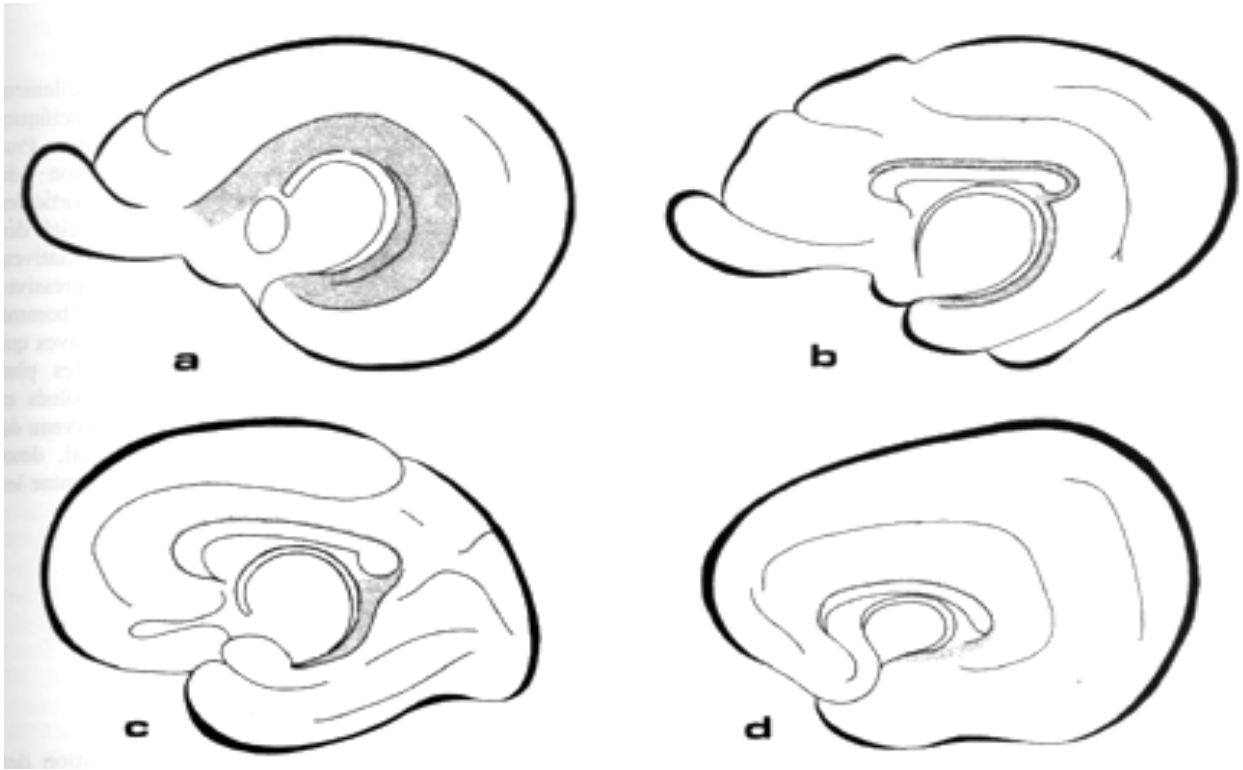




Evolution phylogénétique du télencéphale

mammifère aplacentaire

carnivore

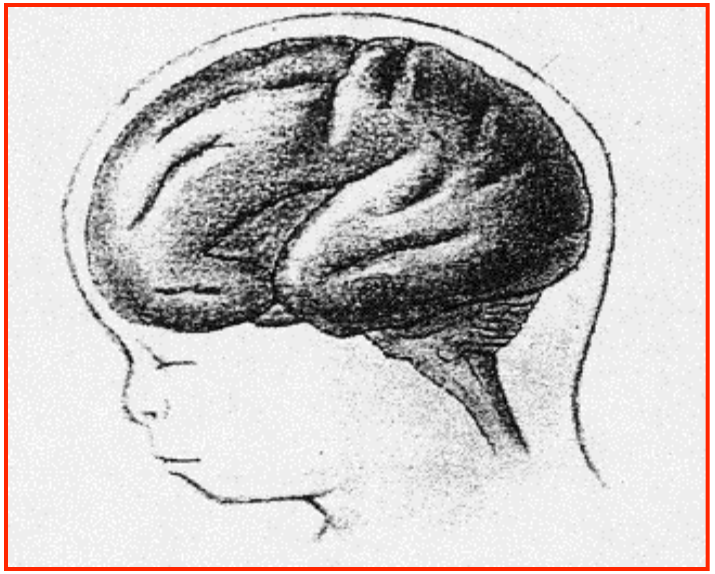


primate

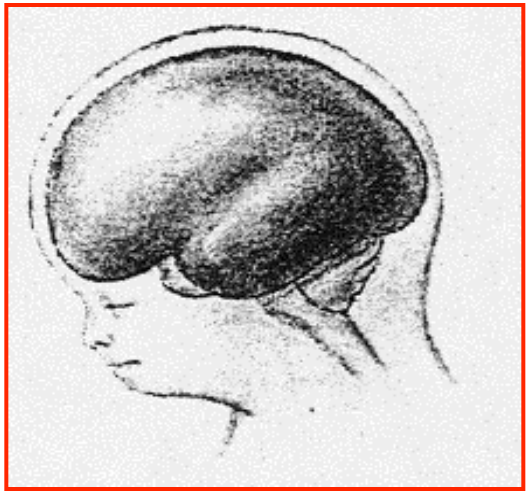
dauphin

évolution de la formation hippocampique

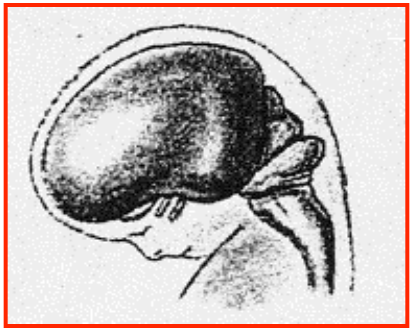
Telencephalon: C-shaped growth
Cortex: Folding



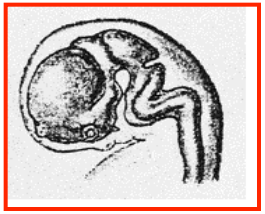
9 Months



5 Months

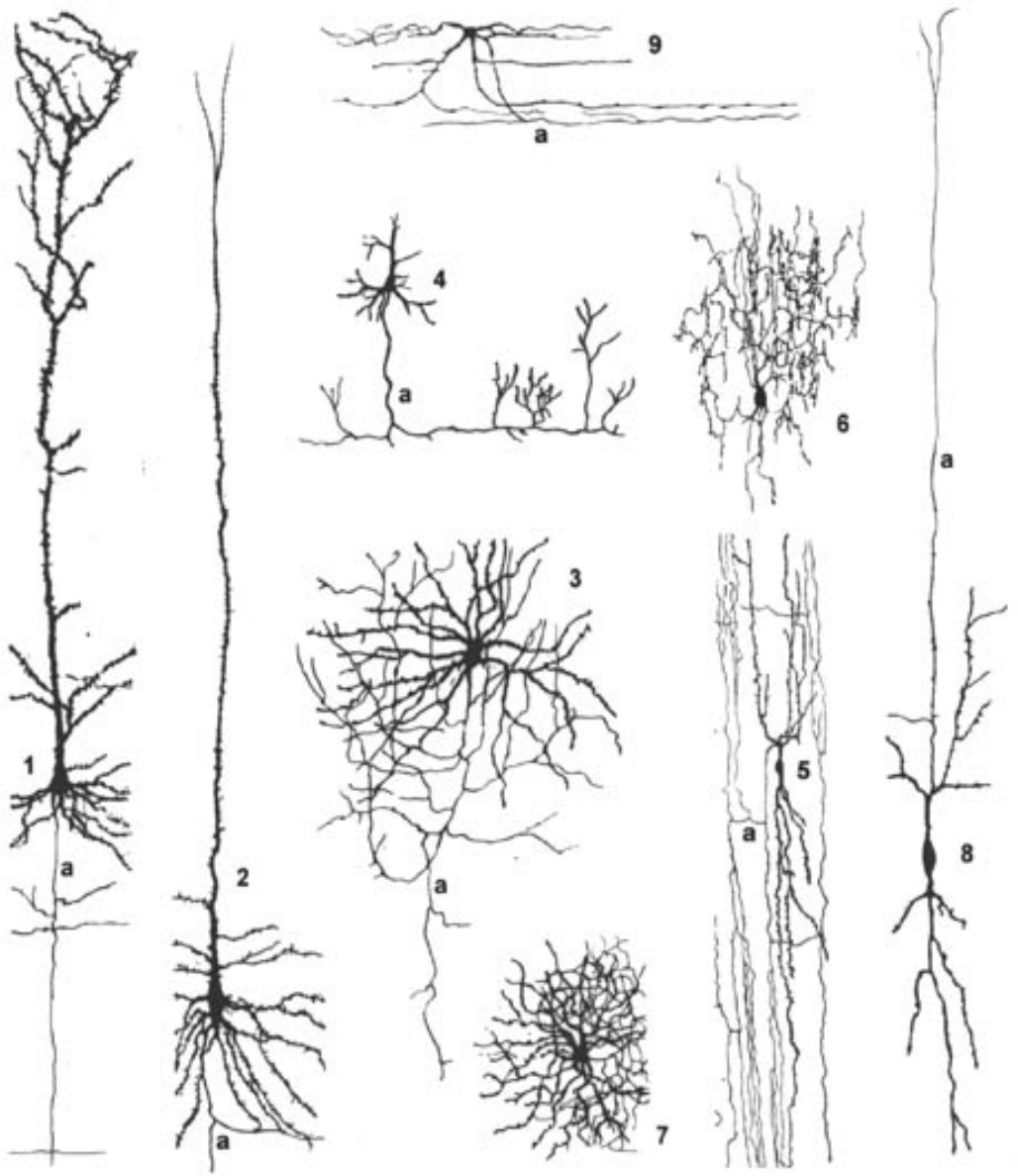


14 Weeks



7 Weeks

Cerebral Cortex



1. Pyramidal Cell

2. Fusiform Cell

3. Granular (Stellate) Cell

4. basket cell

5. double bouquet cell

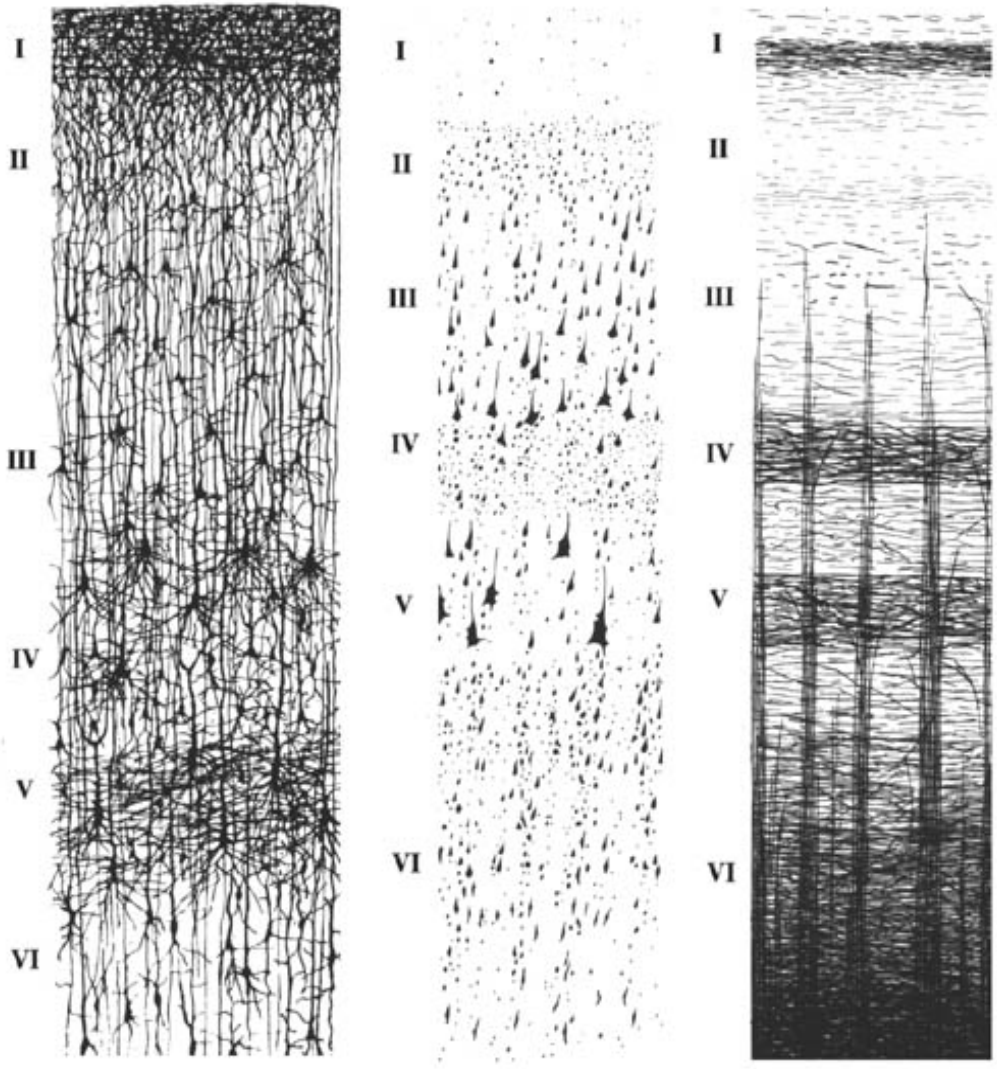
6. chandlier cell

7. neurogliform cell

8. Horizontal Cell of Cajal

9. Cells of Martinotti

a: axon



Golgi *Nissl* *Weigert*

I. Molecular Layer

II. External Granular Layer

III. External Pyramidal Layer

Line of Kaes-Bechterew

IV. Internal Granular Layer

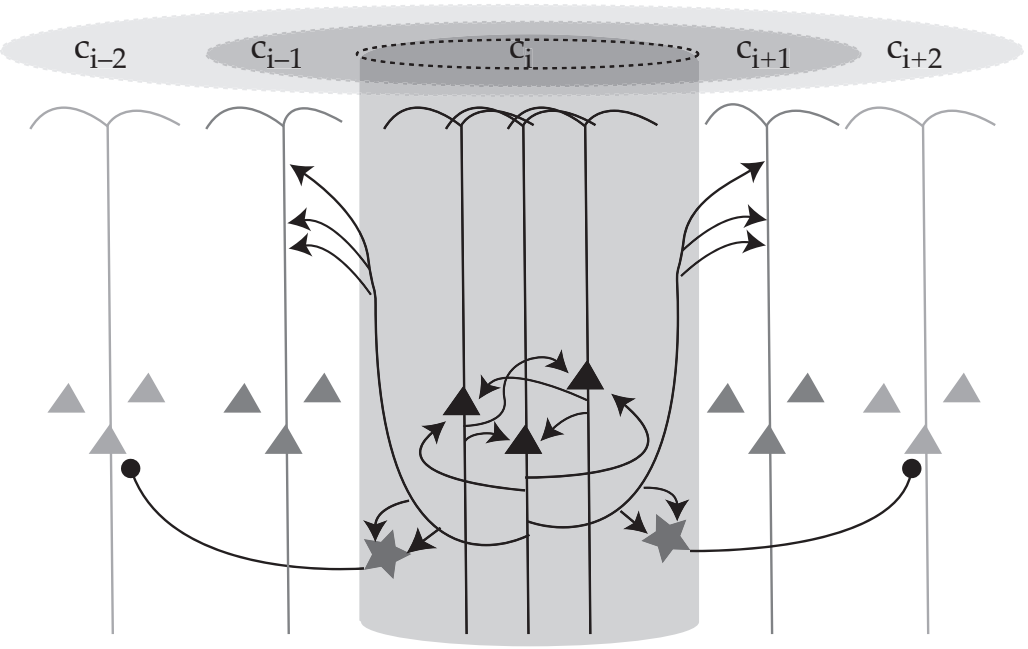
Outer band of Baillarger
- Line of Gennari in area 17

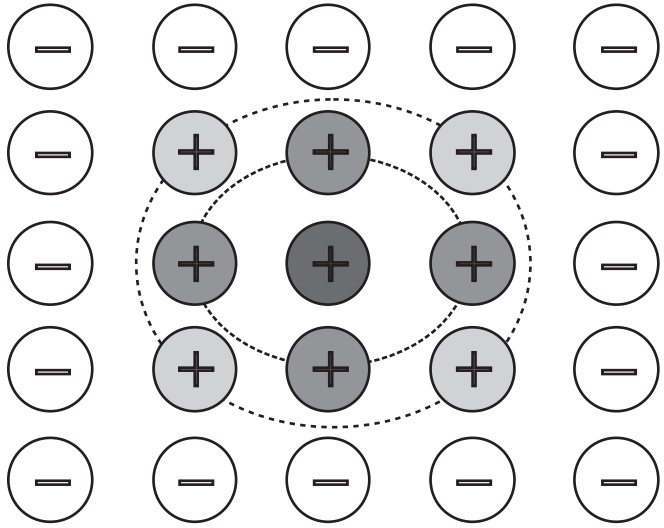
V. Internal Pyramidal Layer

Giant pyramidal cell of Betz
Inner Band of Baillarger

VI. Polymorphic Layer

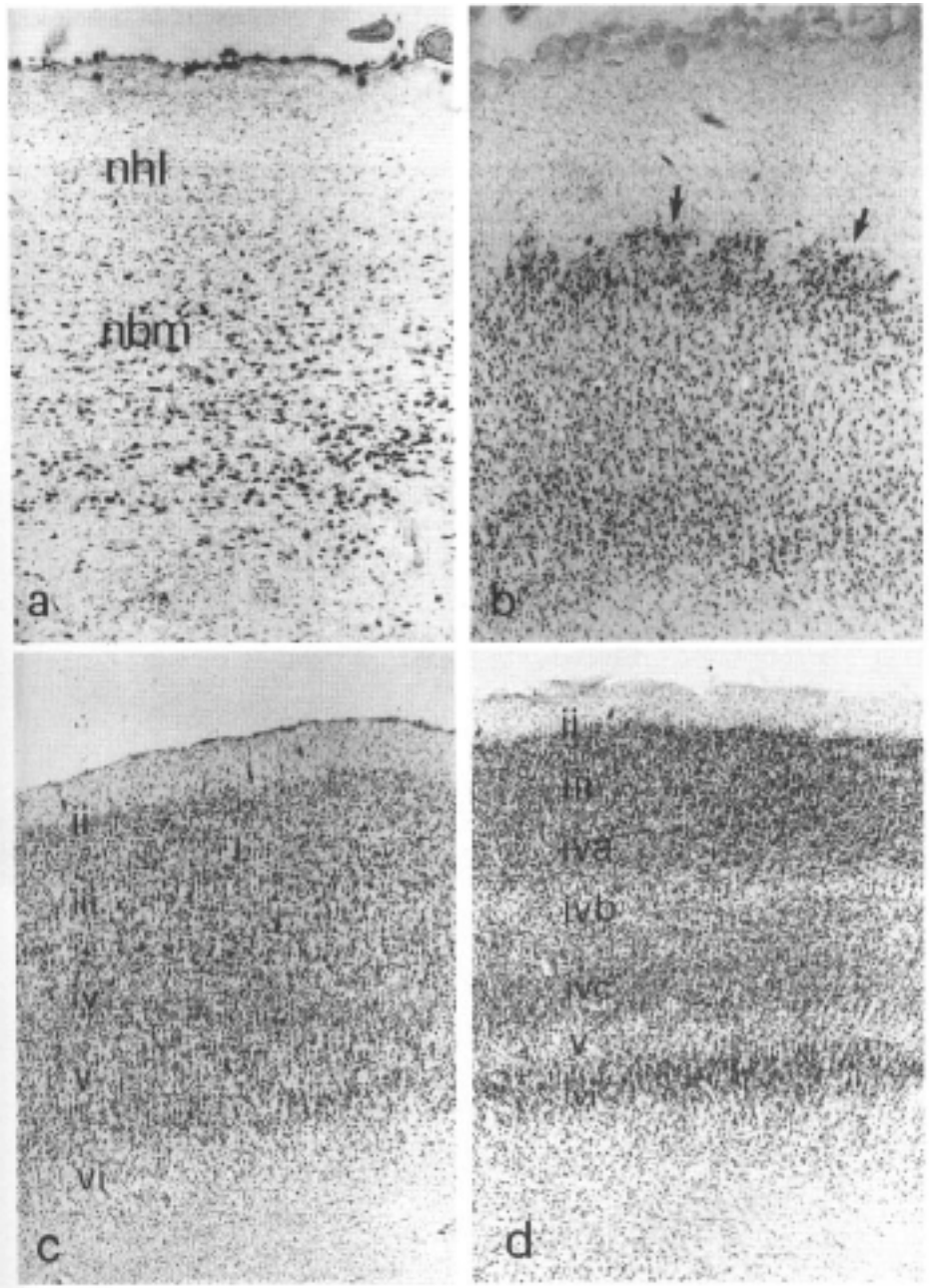
Minicolonne





(Vue de dessus)

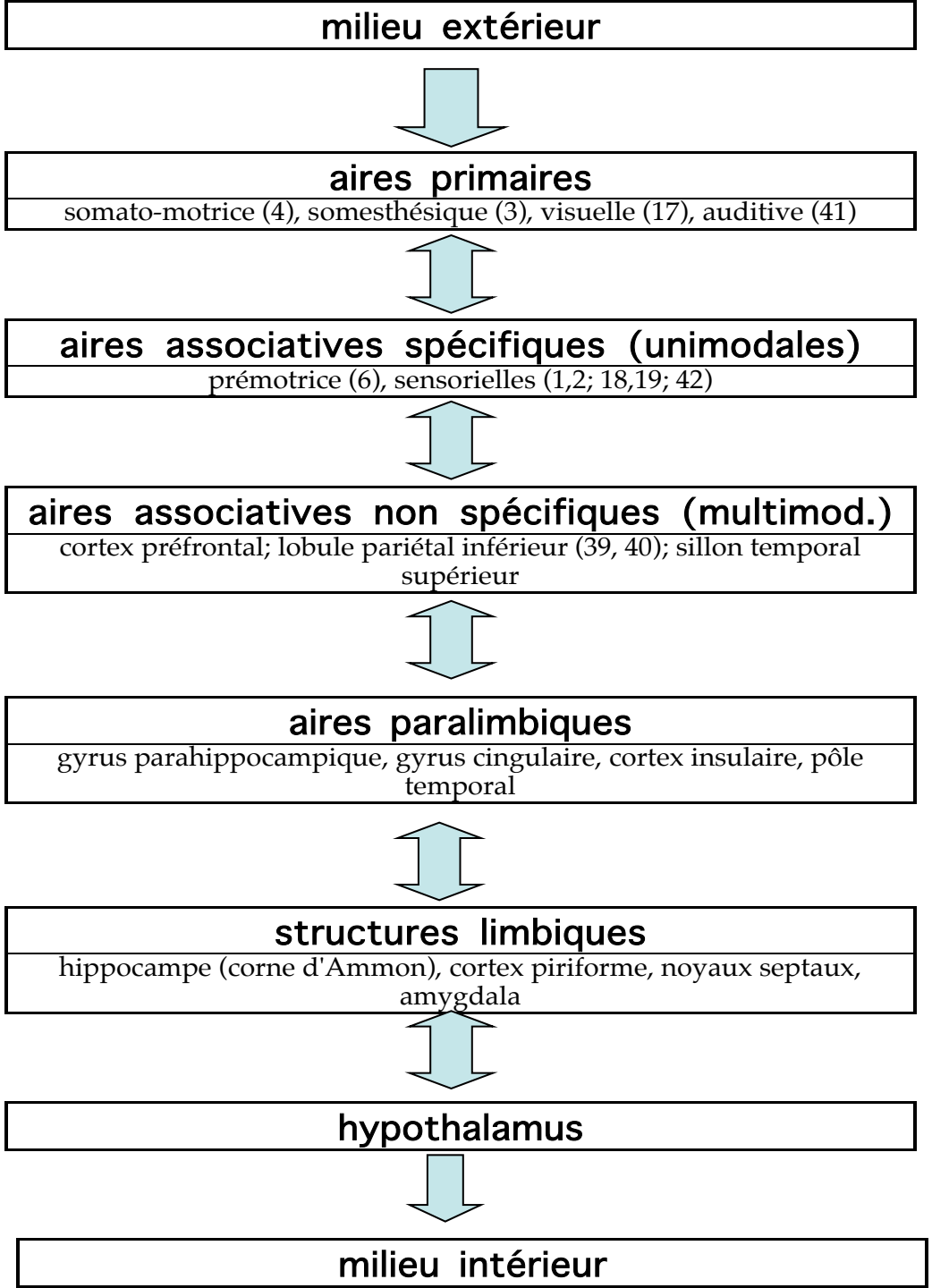
Structure corticoïde
(ny basal de Meynert)

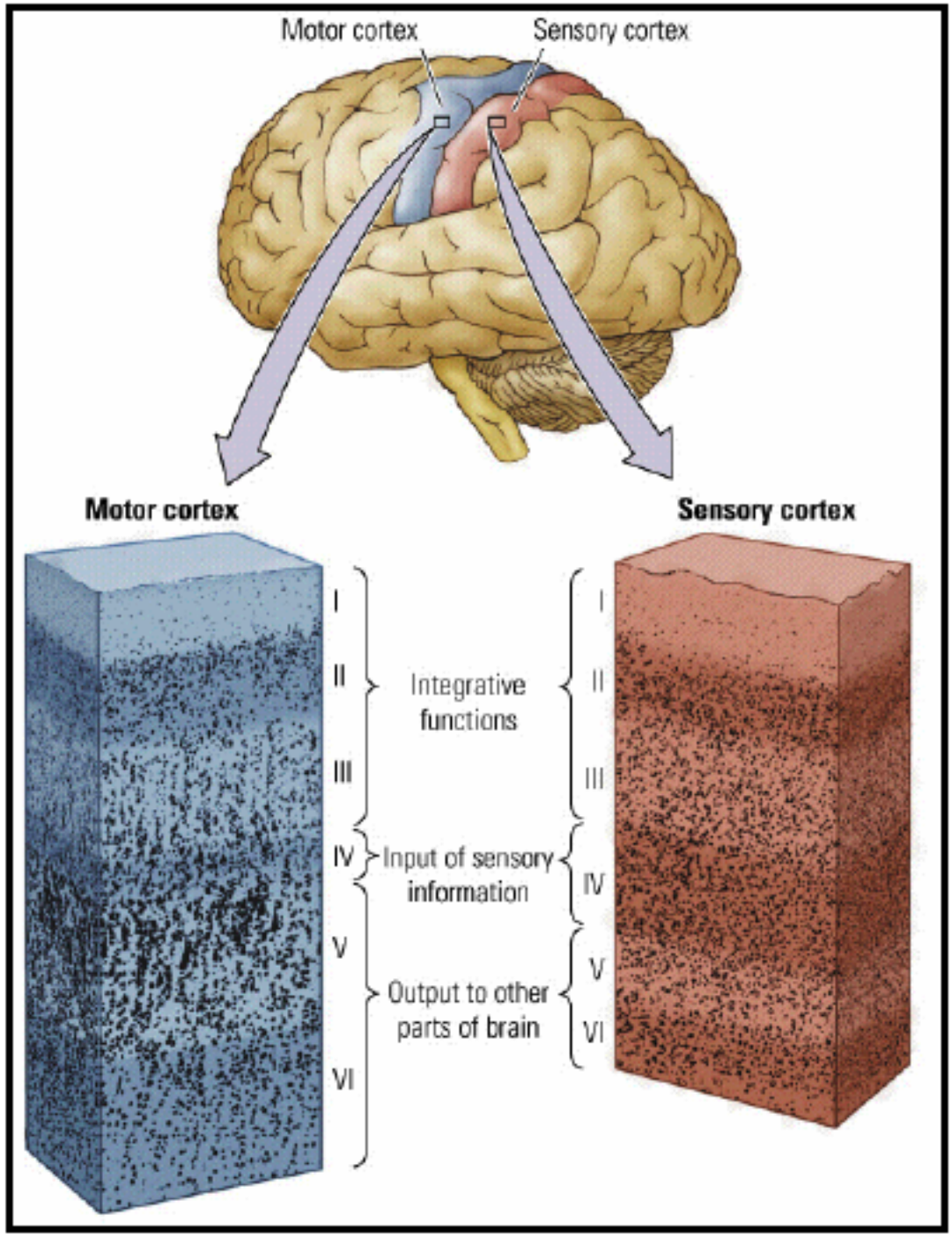


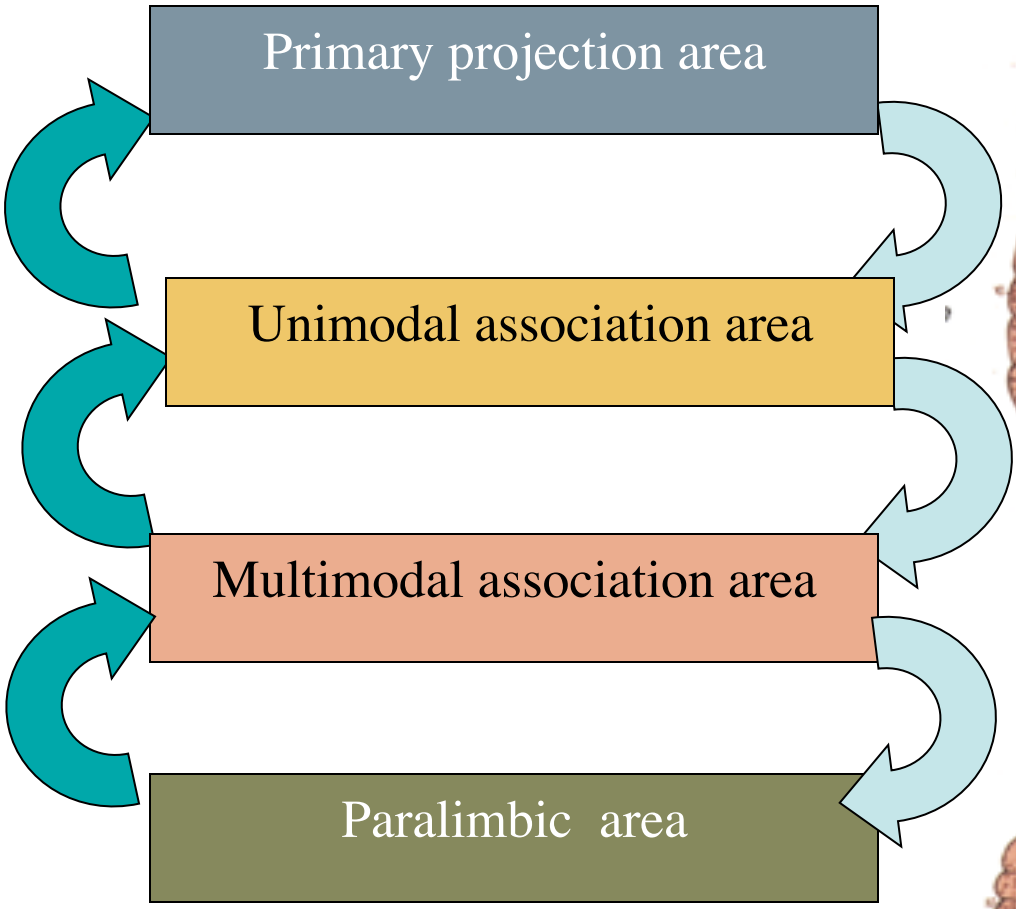
Allocortex
(hippocampe)

Isocortex homotypique
(cortex préfrontal)

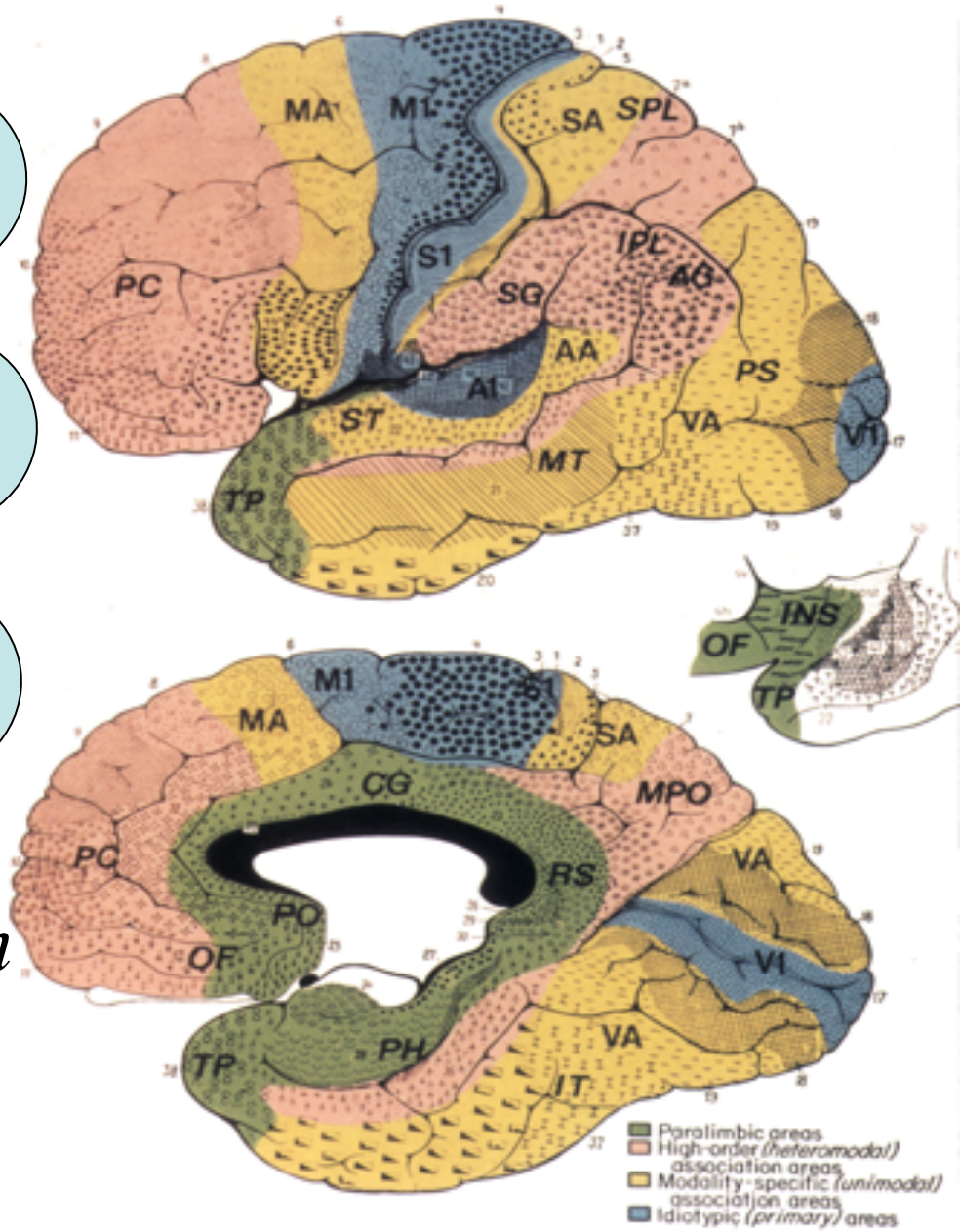
Cortex idiotypique
(strié : aire 17)


milieu extérieur
aires primaires
somato-motrice (4), somesthésique (3), visuelle (17), auditive (41)
aires associatives spécifiques (unimodales)
prémotrice (6), sensorielles (1,2; 18,19; 42)
aires associatives non spécifiques (multimod.)
cortex préfrontal; lobule pariétal inférieur (39, 40); sillon temporal supérieur
aires paralimbiques
gyrus parahippocampique, gyrus cingulaire, cortex insulaire, pôle temporal
structures limbiques
hippocampe (corne d'Ammon), cortex piriforme, noyaux septaux, amygdala
hypothalamus
milieu intérieur


Motor cortex
Sensory cortex
Motor cortex
Sensory cortex
I
II
III
IV
V
VI
Integrative functions
Input of sensory information
Output to other parts of brain
I
II
III
IV
V
VI



Bottom-up *Top-down*

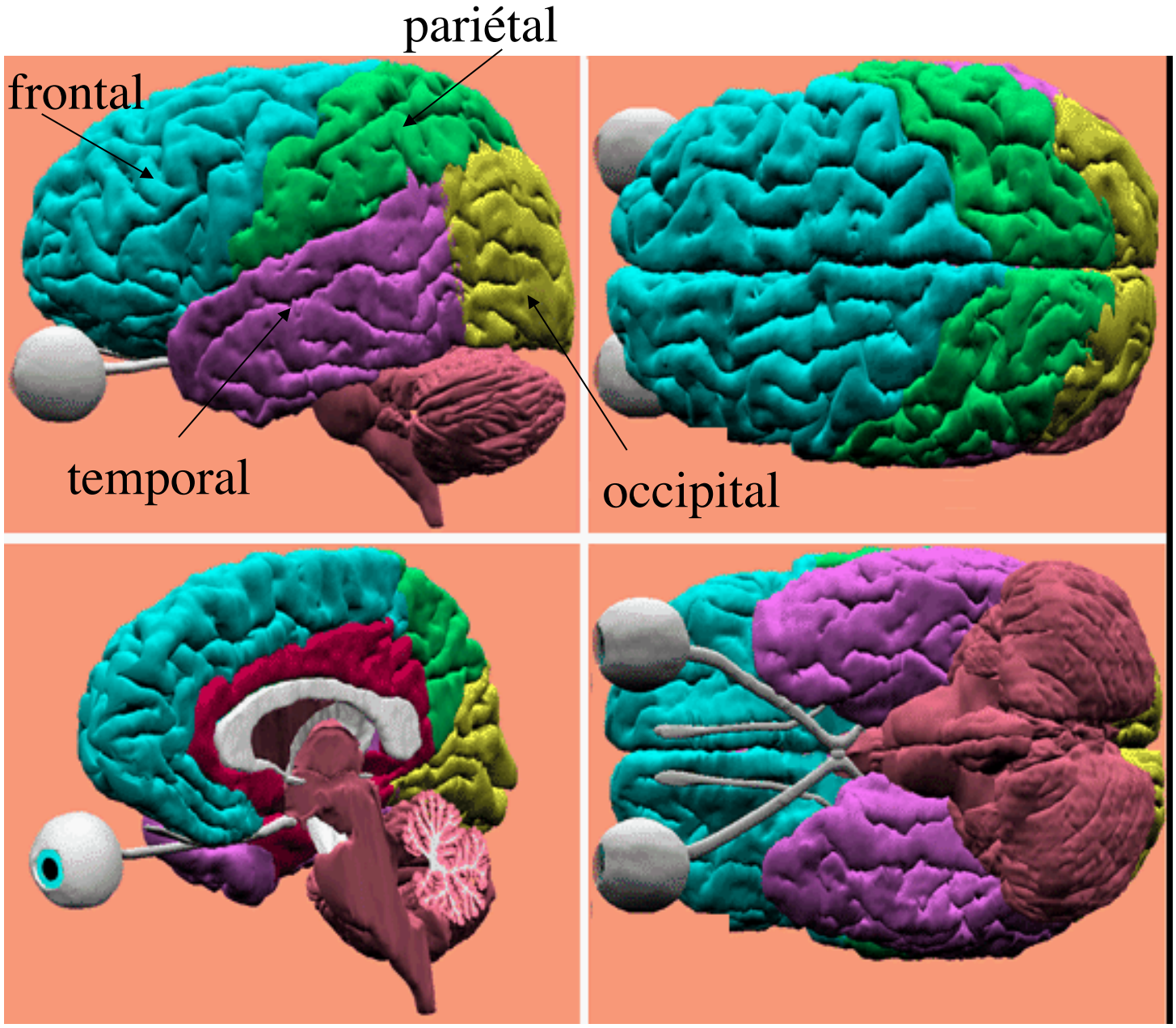


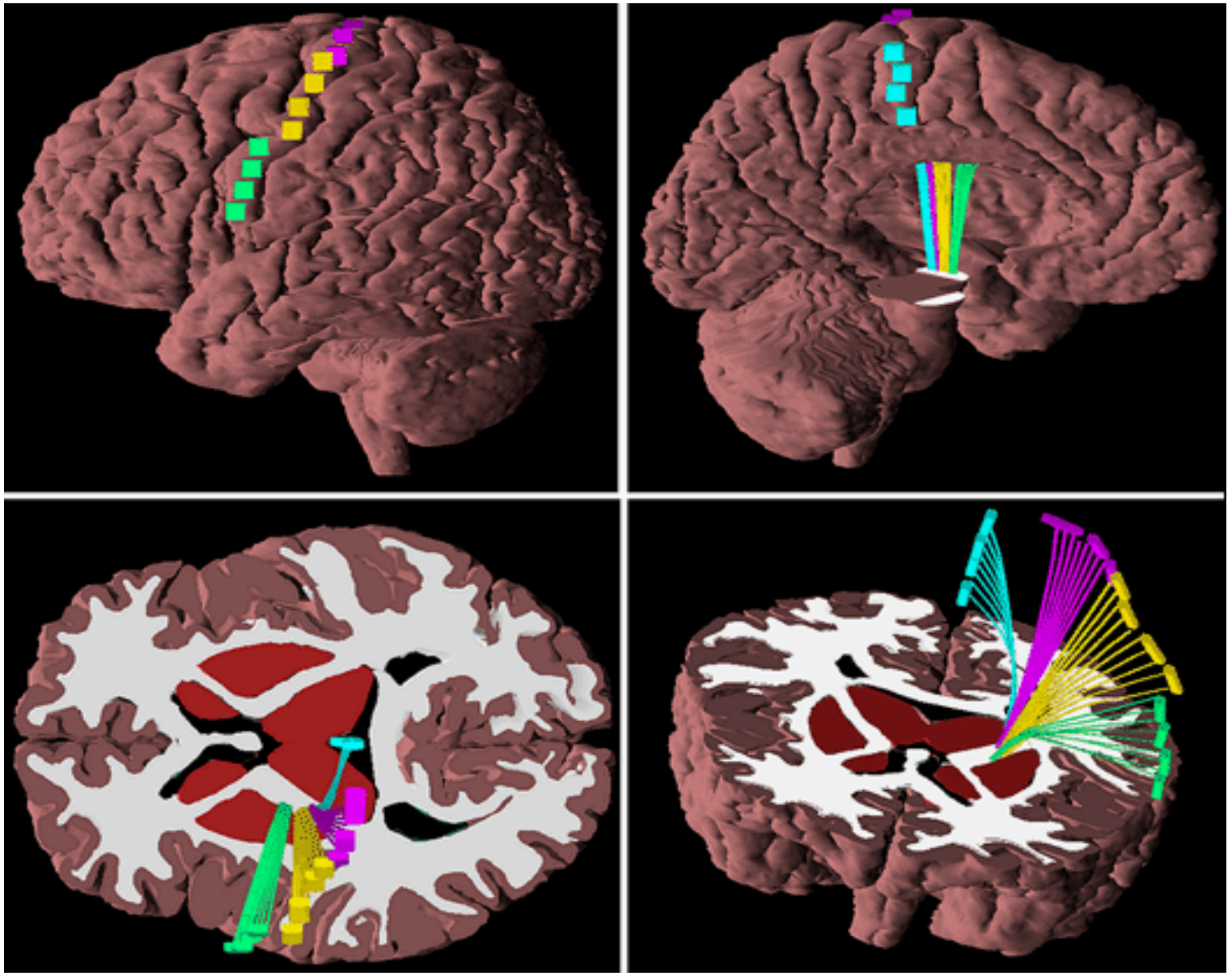
Les différents types de cortex (d'après Mesulam, 1985)

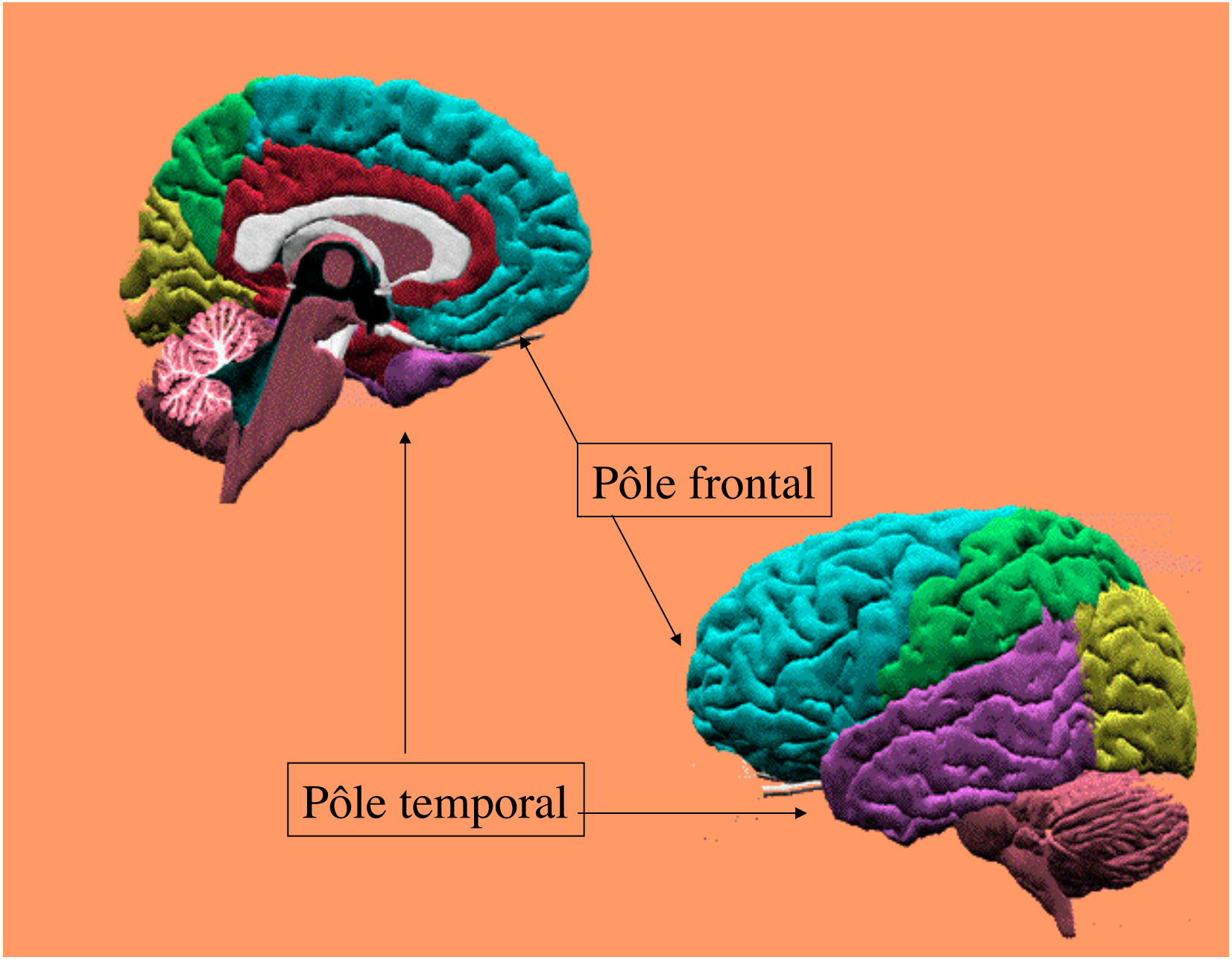
Les grands repères en macroanatomie

Une référence de base
Interactive Atlases
Digital Anatomist Project

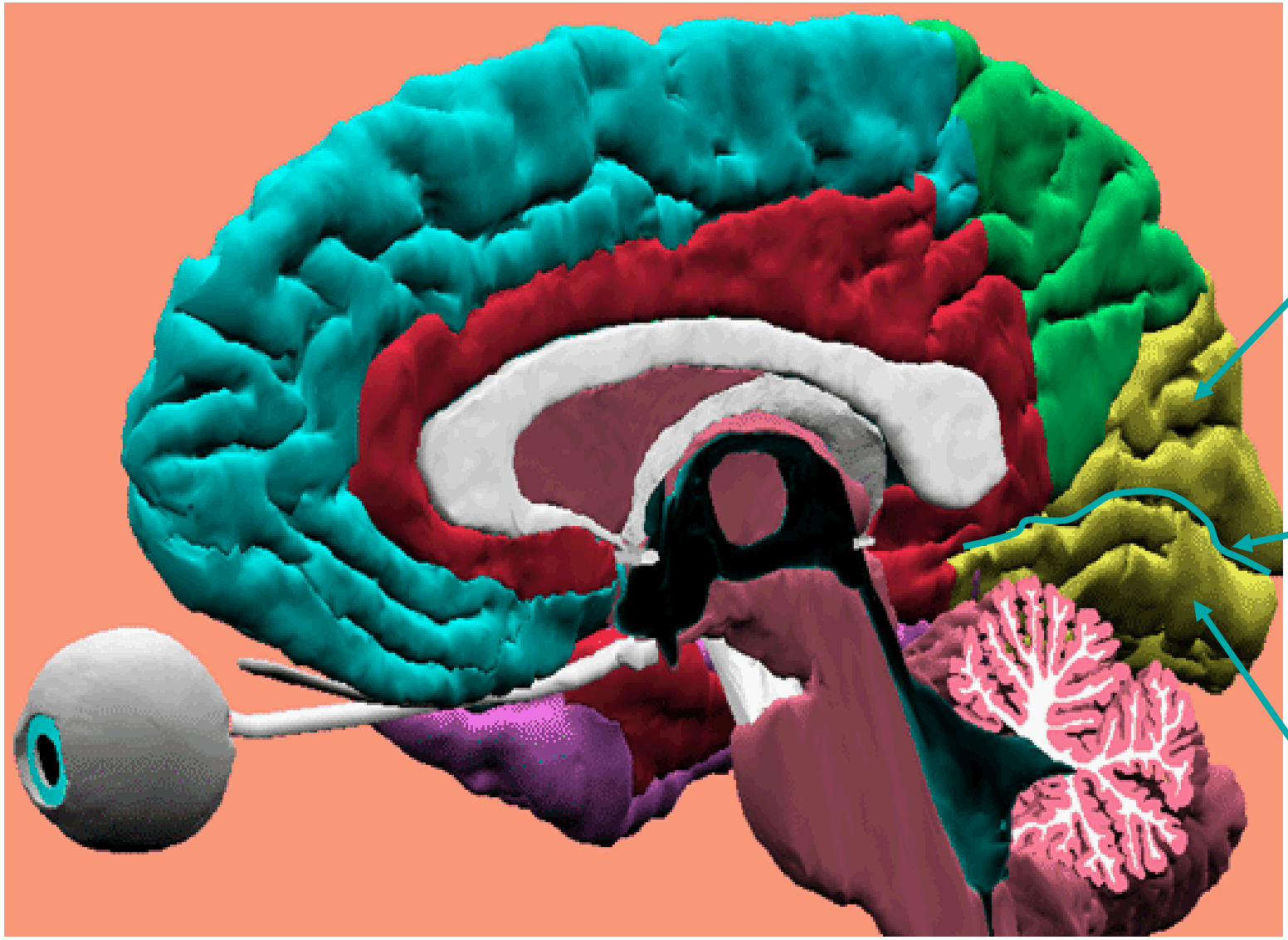
http://www9.biostr.washington.edu/da.html


pariétal
frontal
temporal
occipital

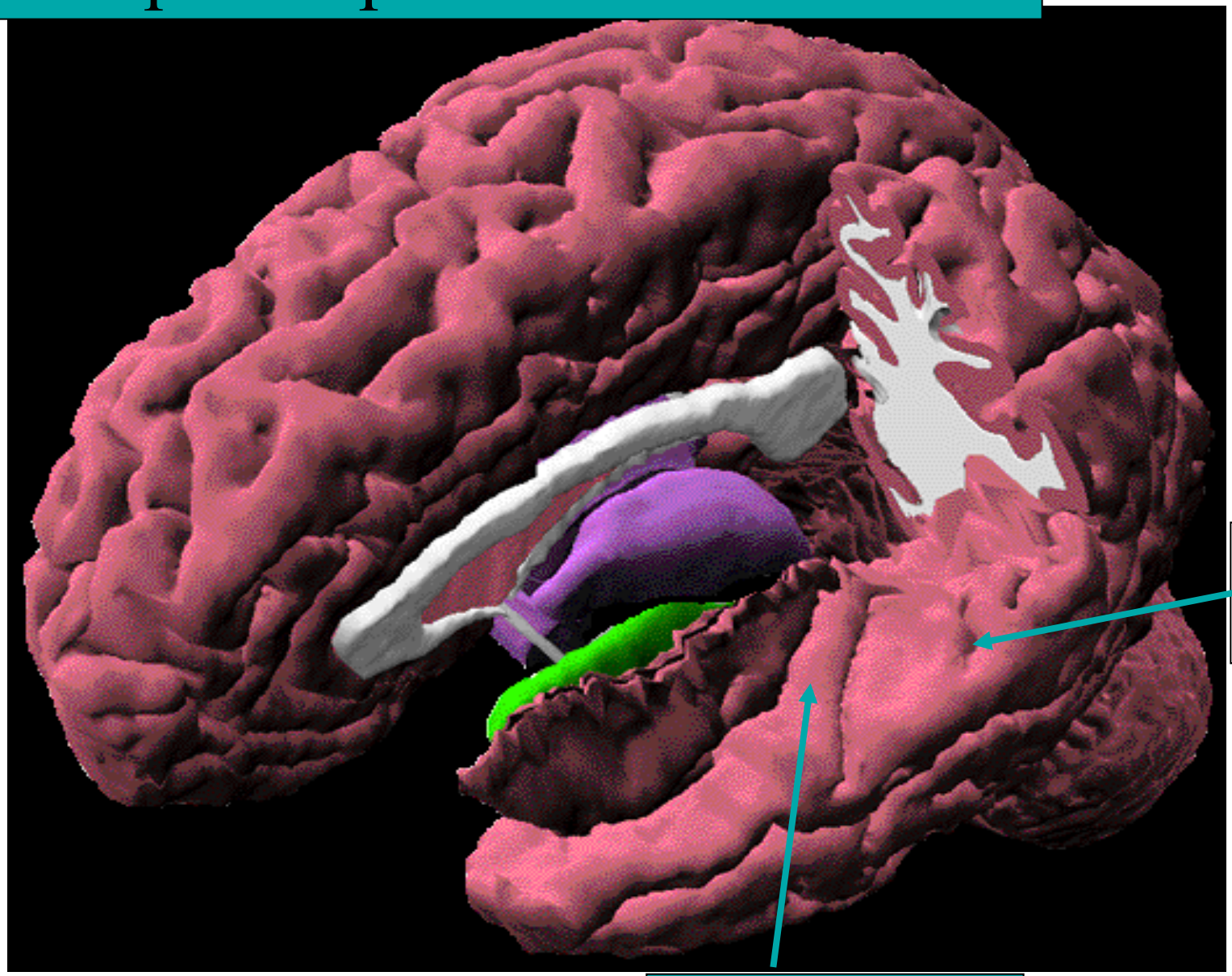



Pôle frontal
Pôle temporal

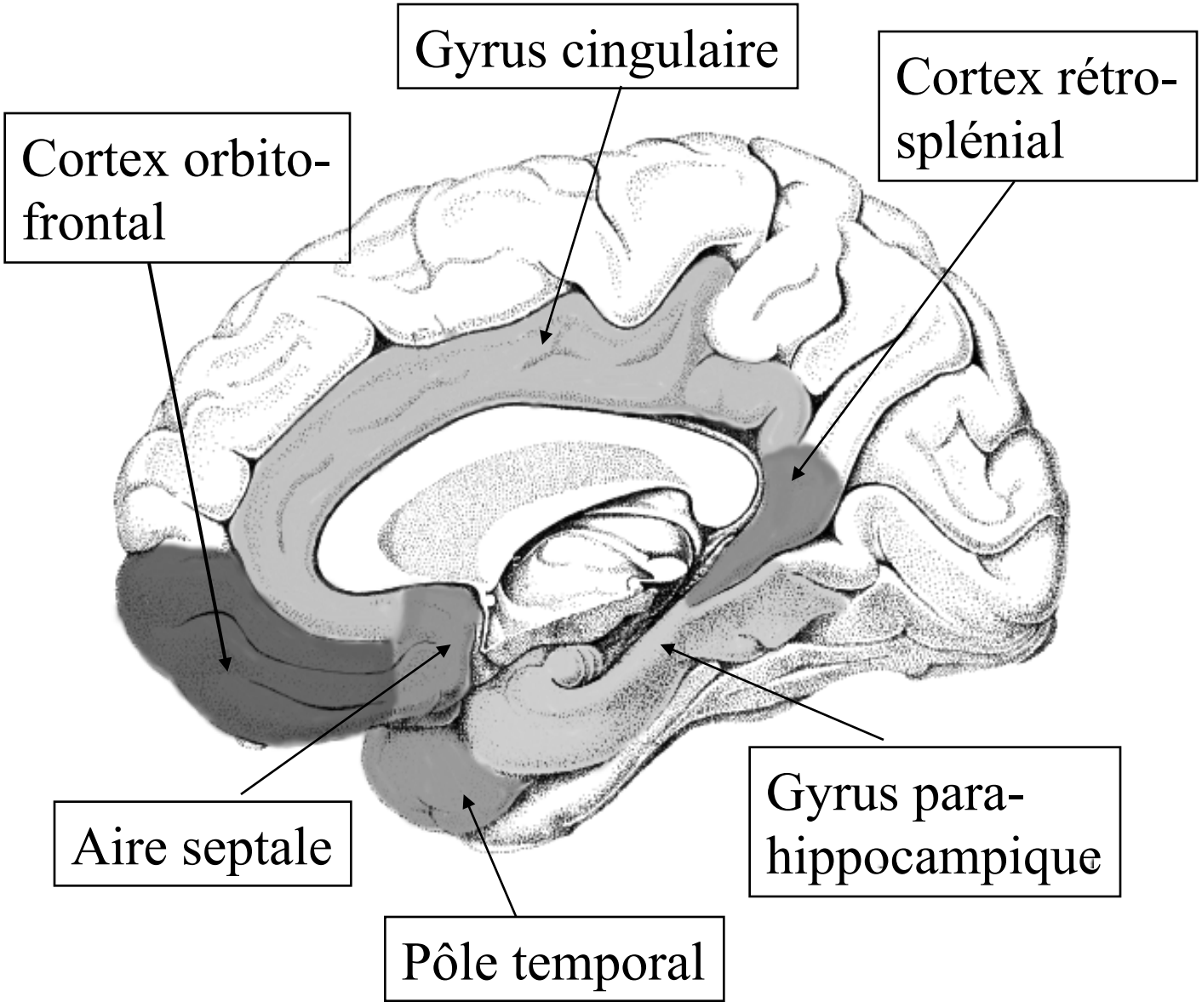
Lobe occipital : le cortex visuel primaire

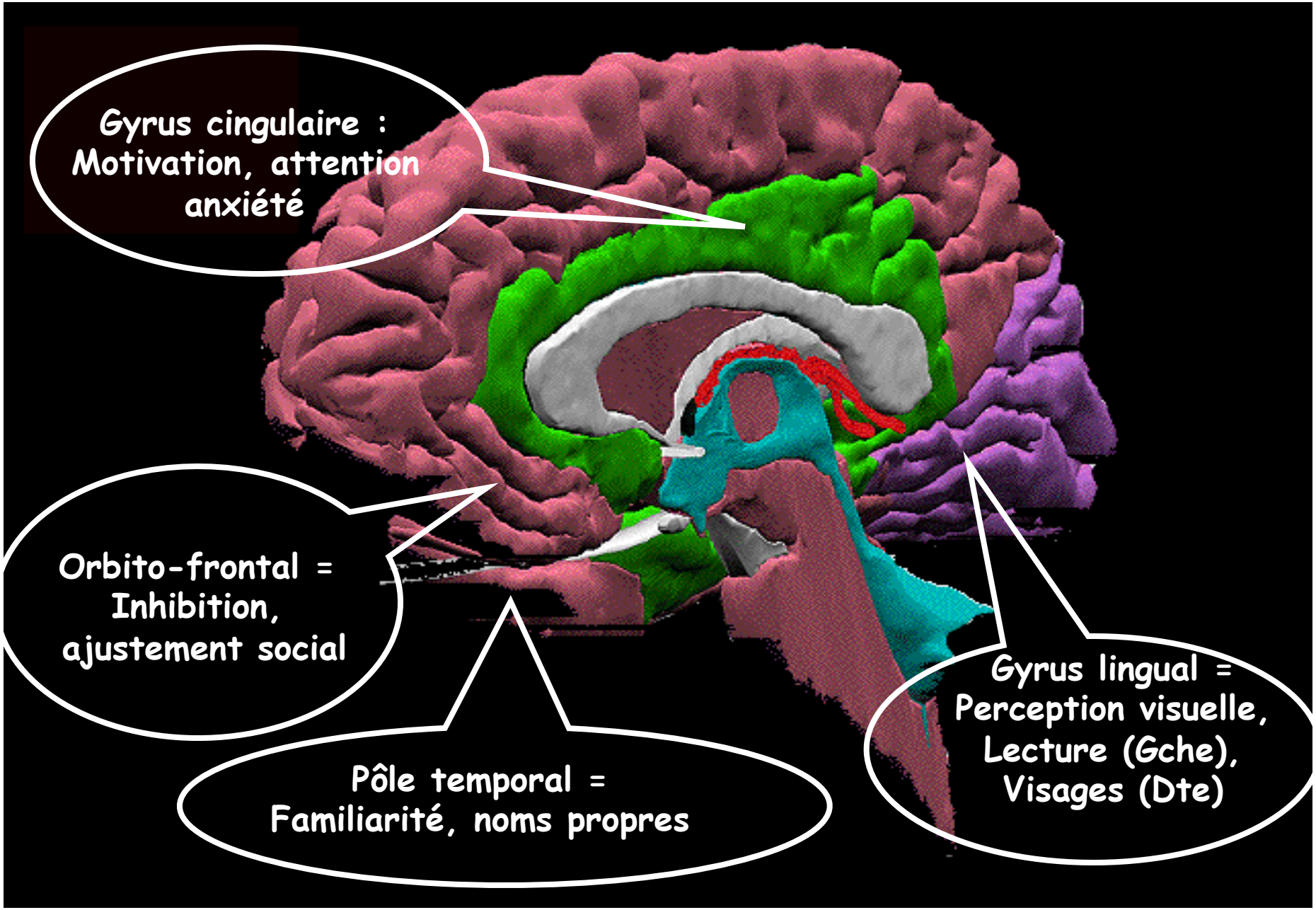


Cortex supratemporal : aires auditives



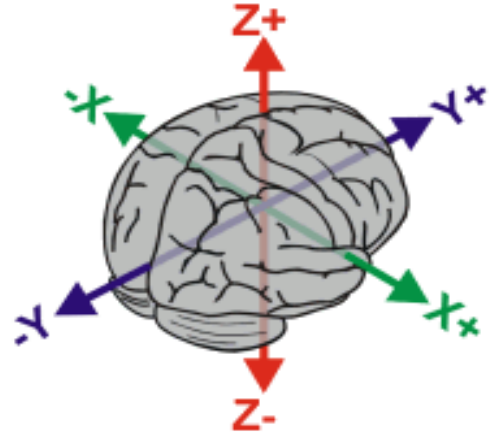
Les structures paralimbiques

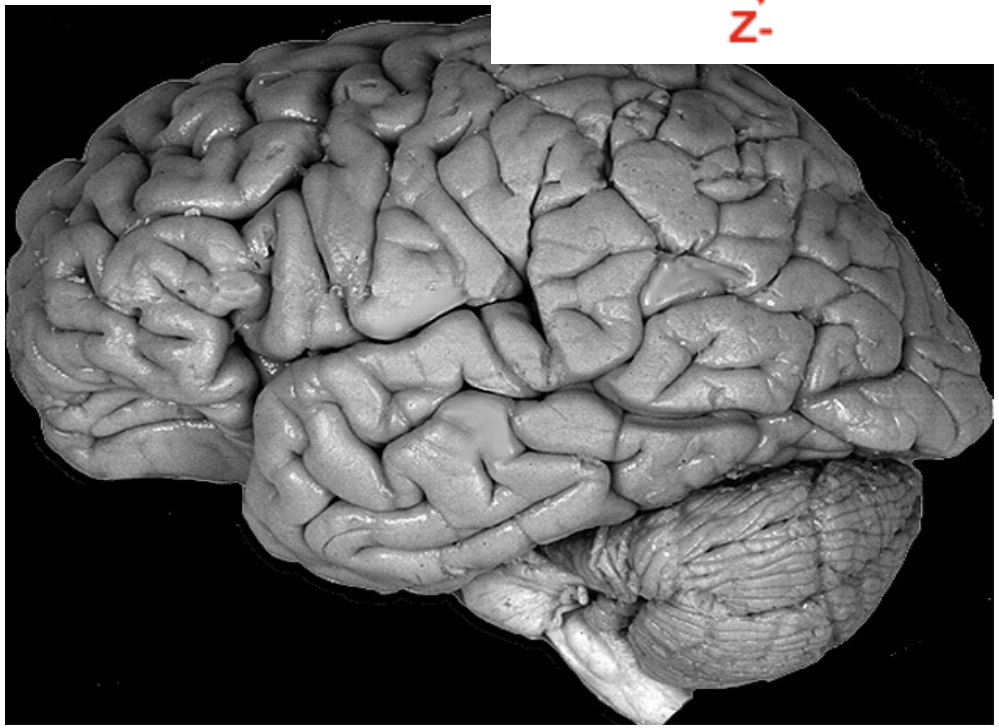



Gyrus cingulaire :
Motivation, attention
anxiété
Orbito-frontal =
Inhibition,
ajustement social
Pôle temporal =
Familiarité, noms propres
Gyrus lingual =
Perception visuelle,
Lecture (Gche),
Visages (Dte)

Orientation Terminology

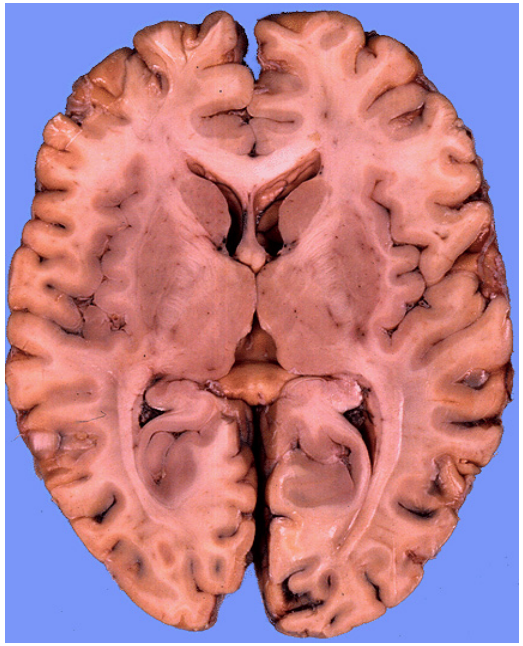
- Superior/Middle/Inferior and Dorsal/Ventral
  - Brain vs Spinal Cord
- Anterior/Posterior and Rostral/Caudal
- Medial/Lateral



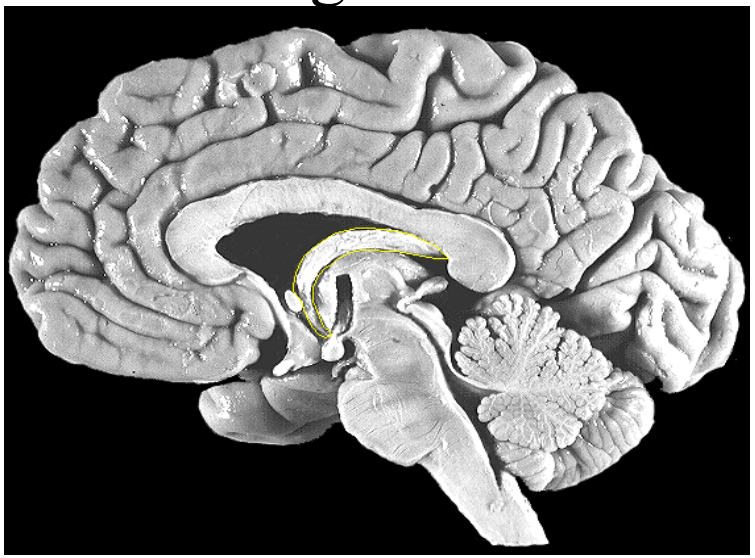


Slice orientation Terminology

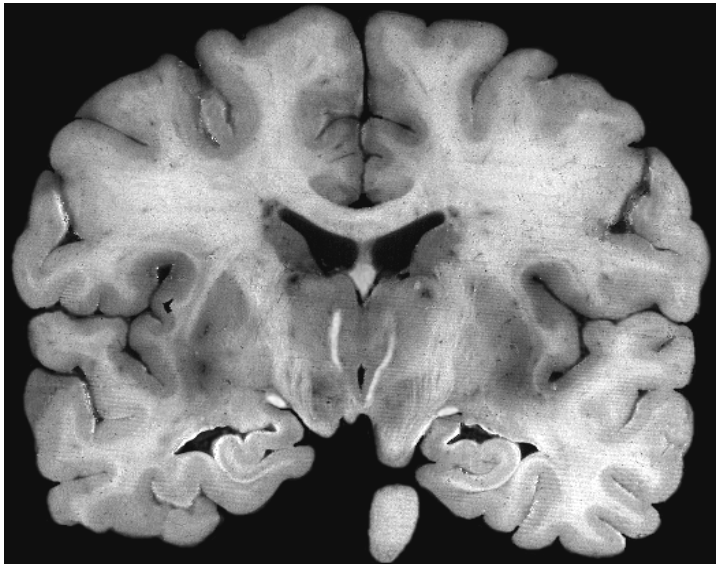
- Axial (or Horizontal)



•Sagittal



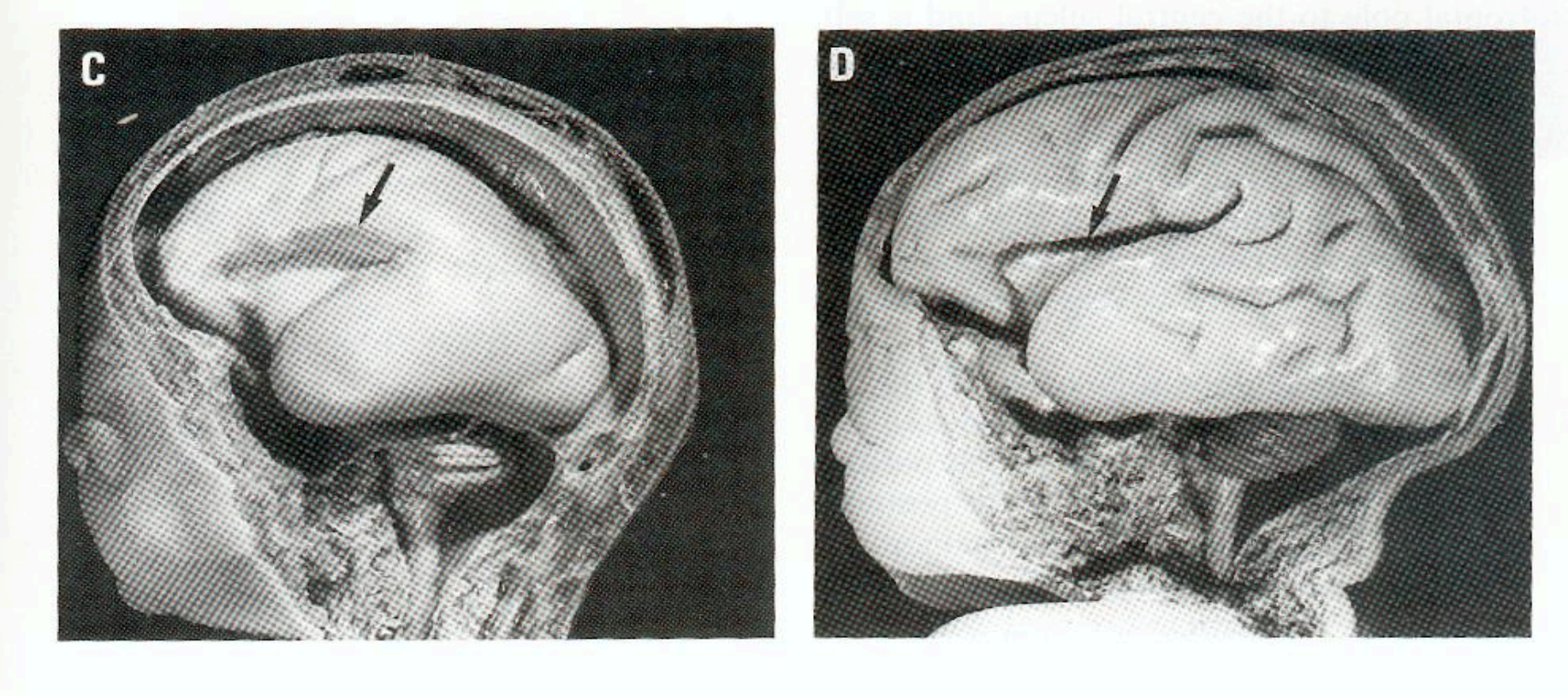
Coronal



L'anatomie des sillons et scissures

http://defiant.ssc.uwo.ca/Jody_web/fMRI4Dummies/cortical_sulci.htm

Development of Sulci

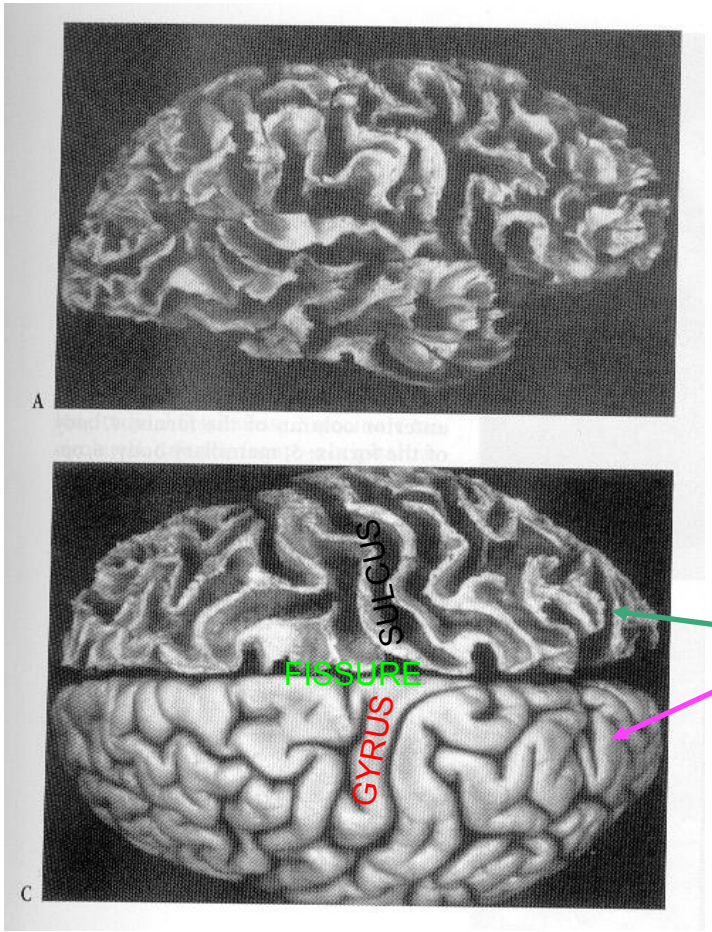


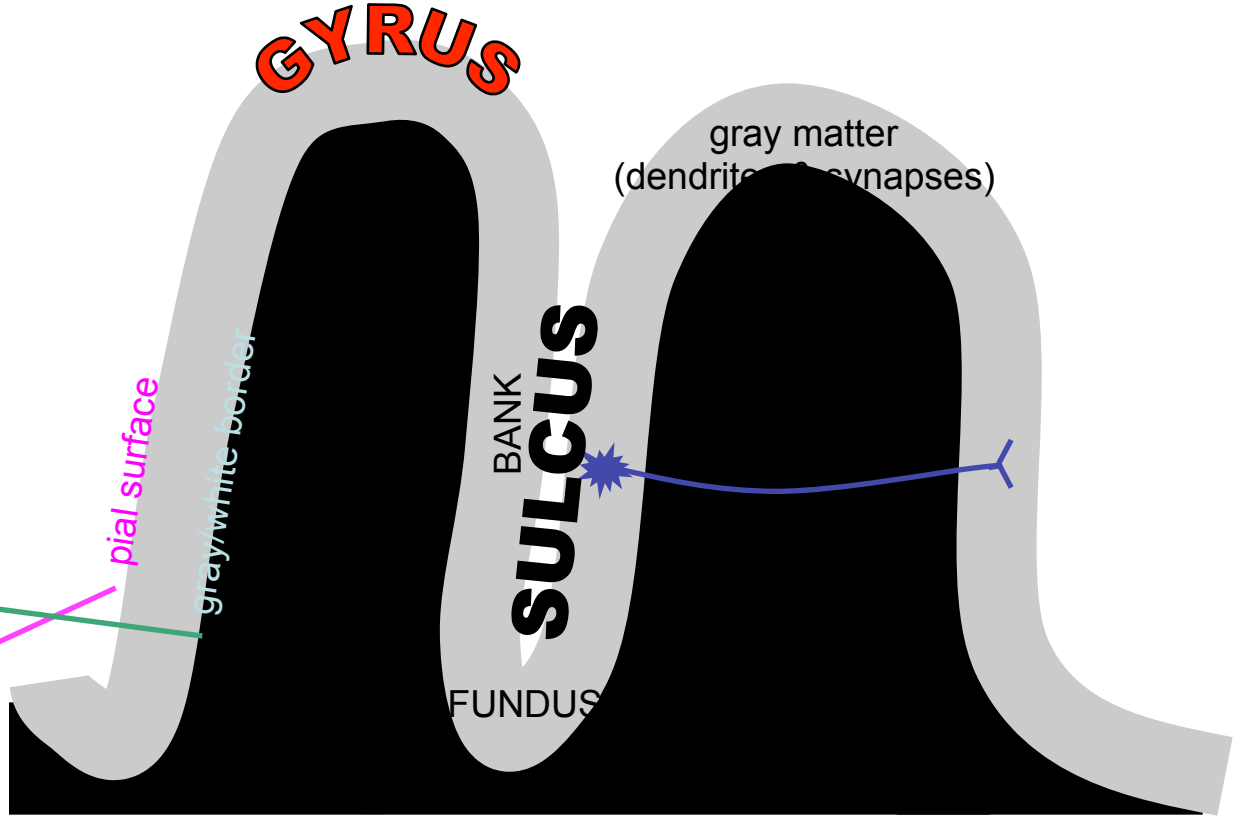
Sulci appear at predictable points in fetal development with the most prominent sulci (e.g., Sylvian fissure) appearing first.

Source: Ono, 1990

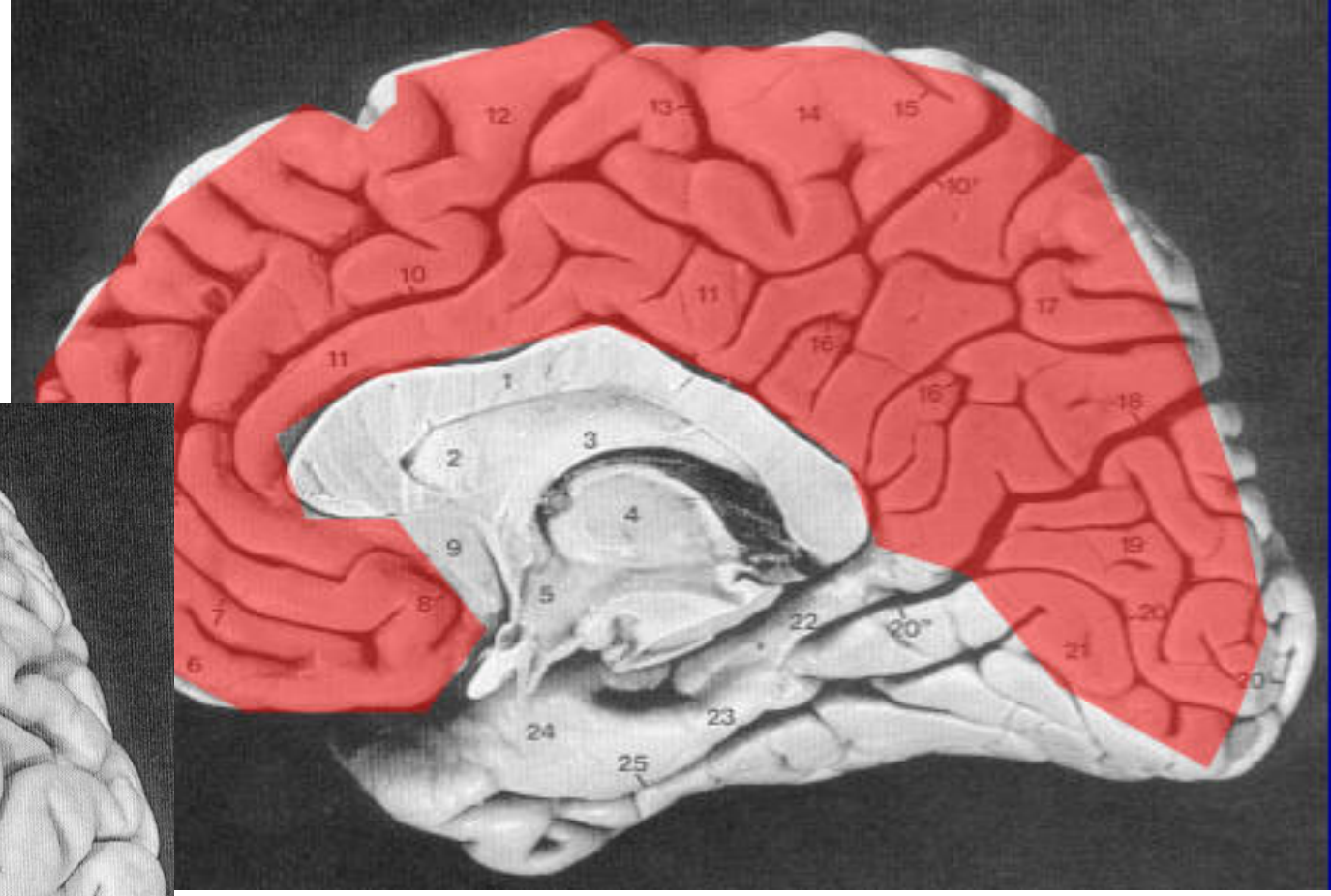
Anatomical Localization

Sulci and Gyri

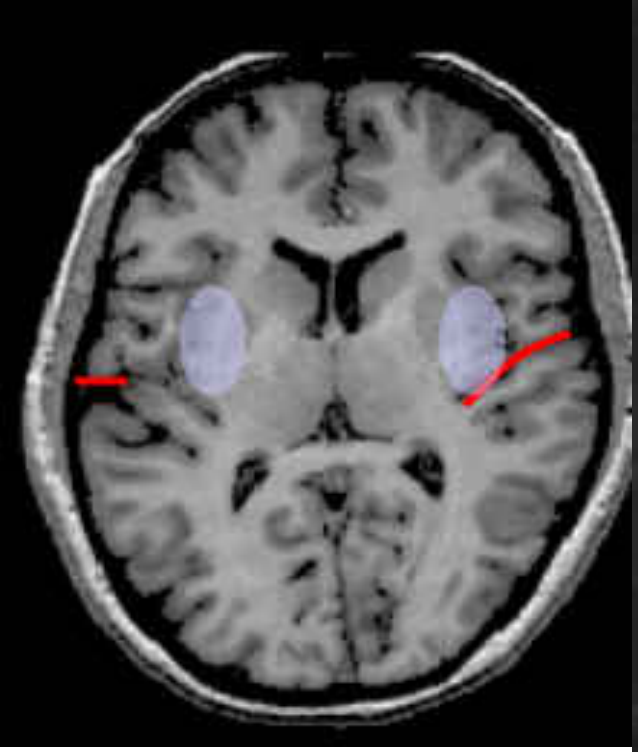


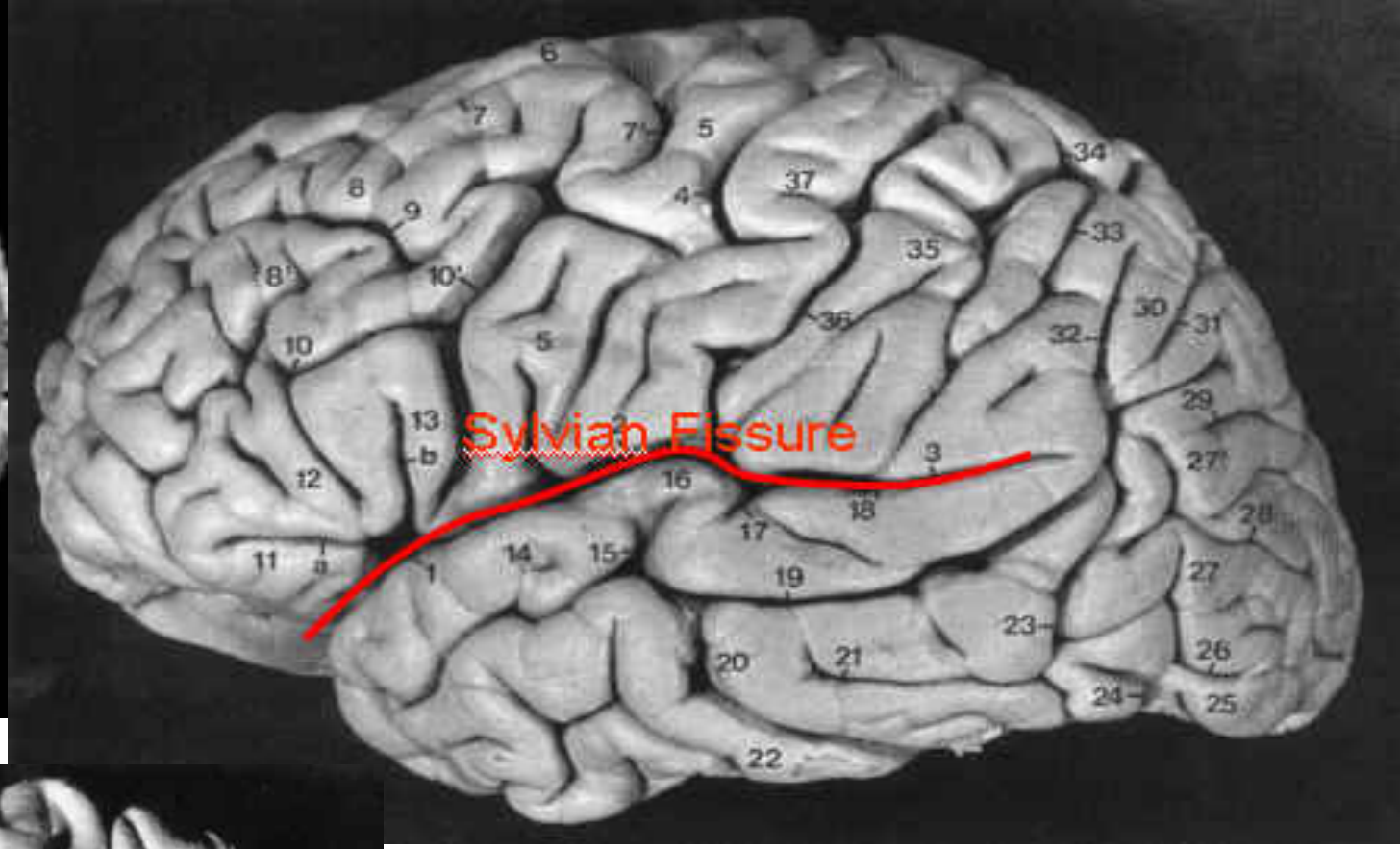


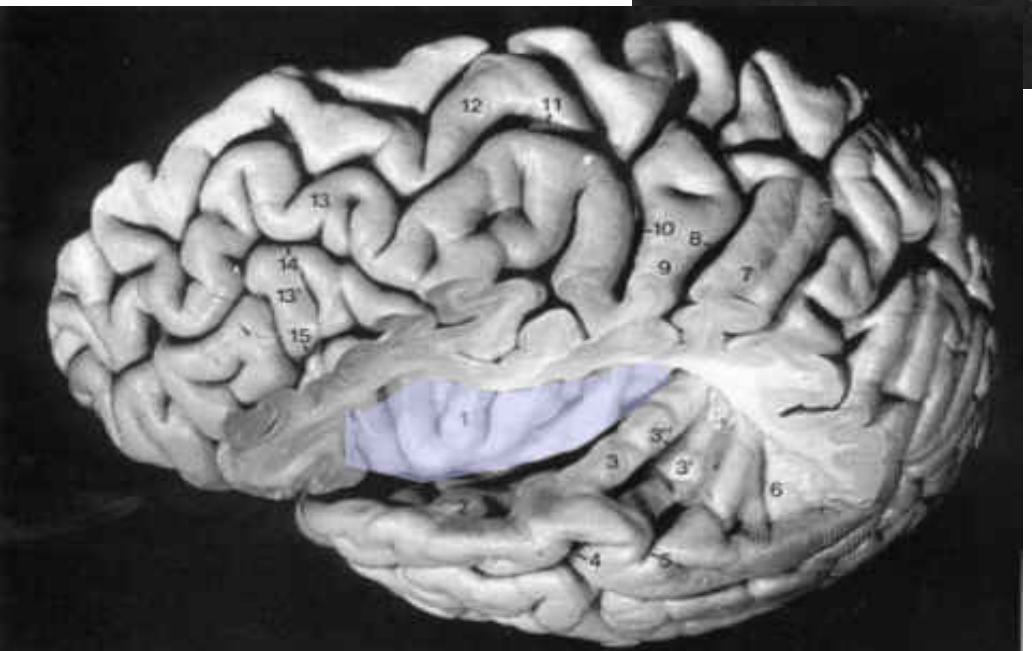
Source: Ludwig & Klingler, 1956 in Tamraz & Comair, 2000



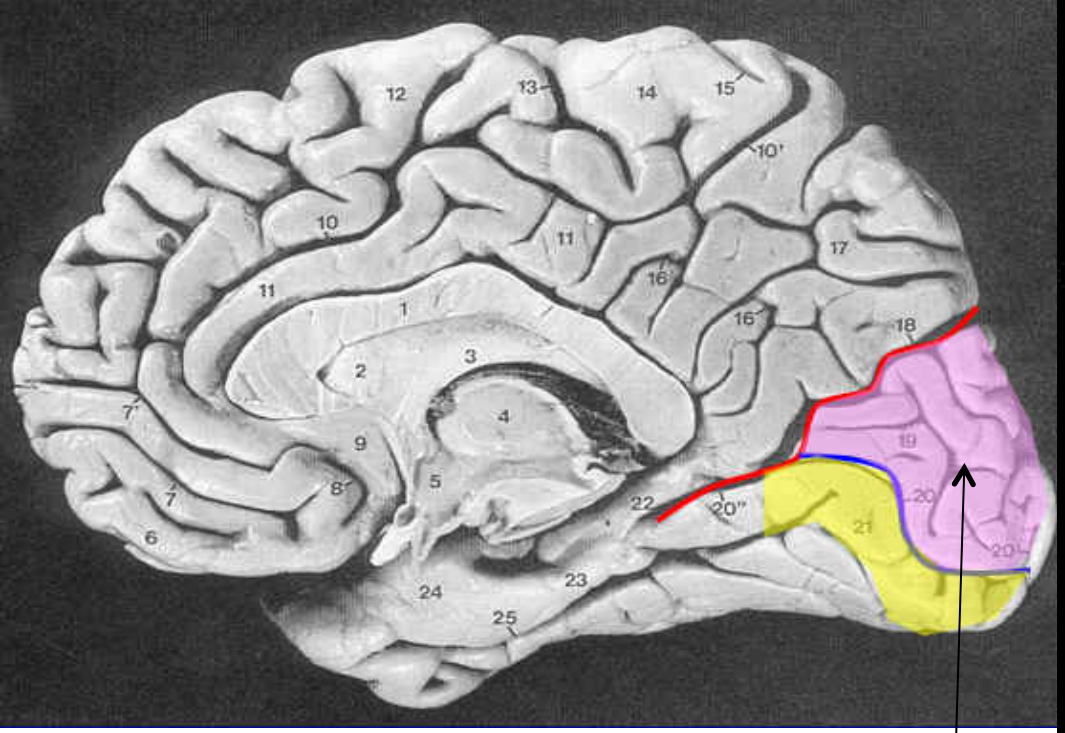
Scissure inter-hémisphérique







Insula et Cortex supra-temporal


12
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14
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10'
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16'
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7'
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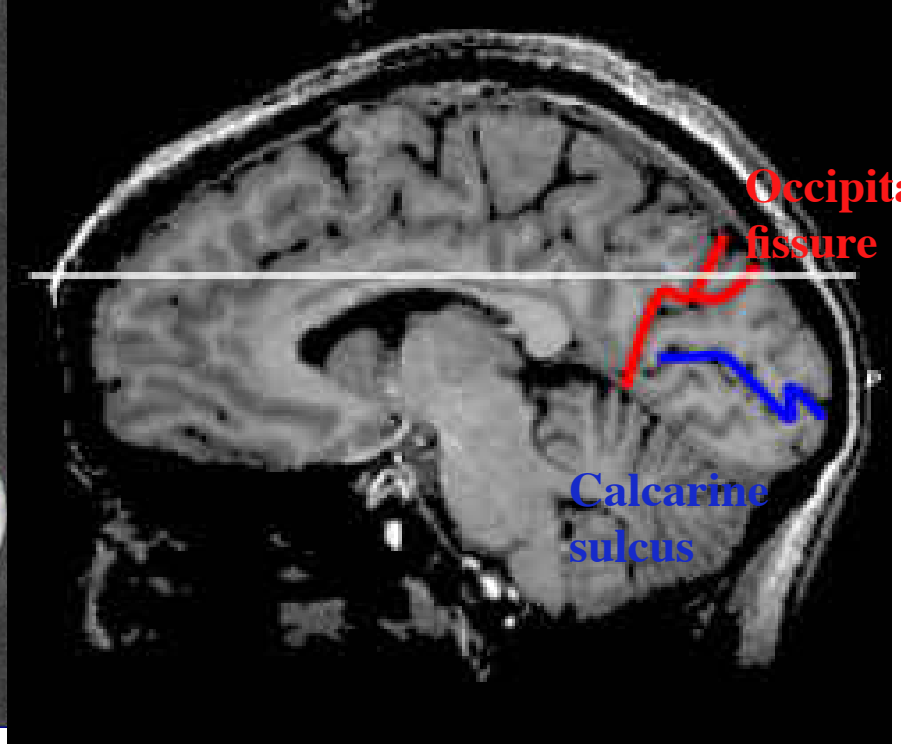
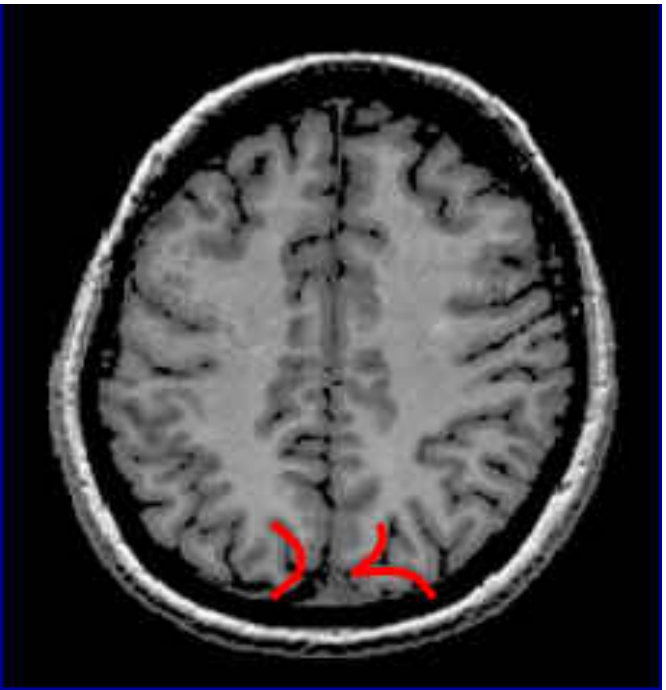
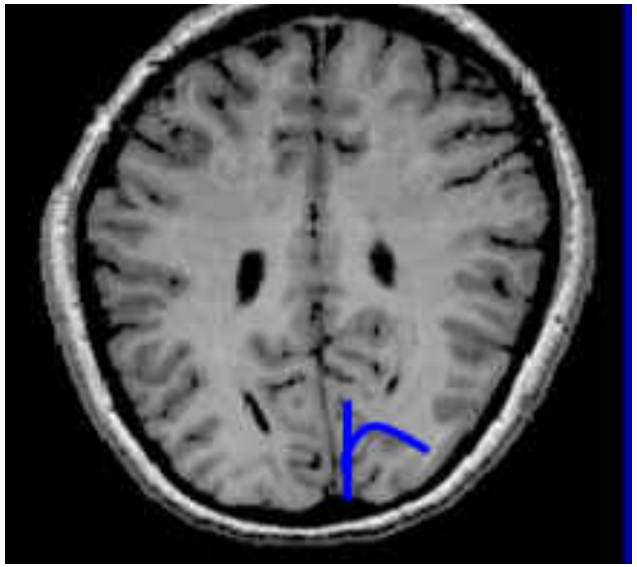
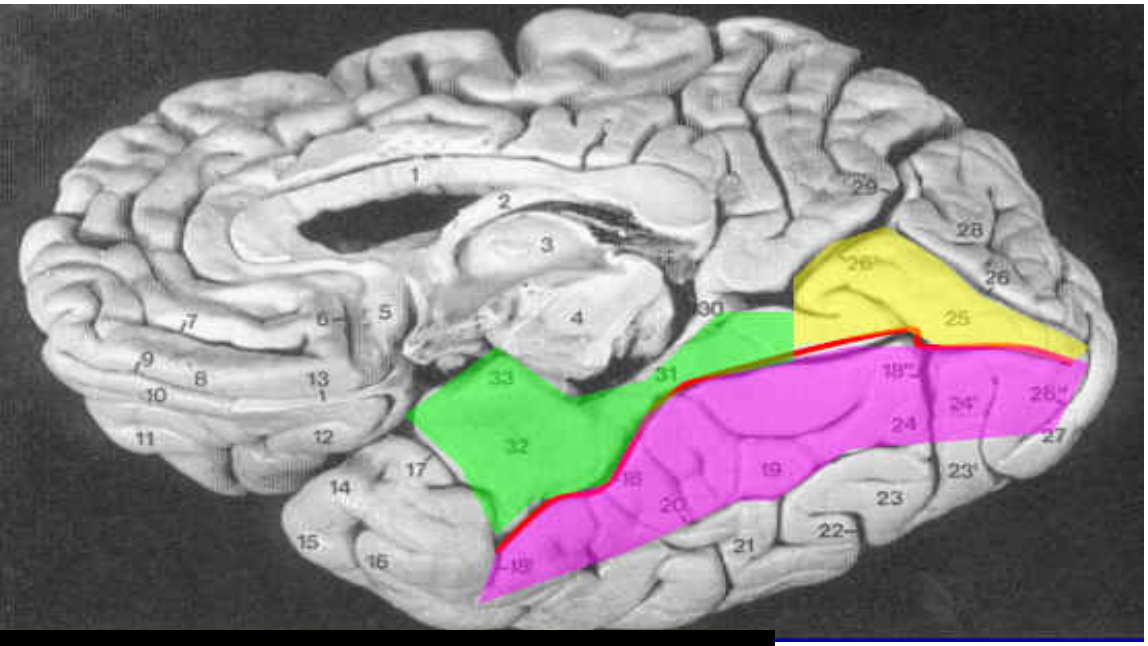
23
25

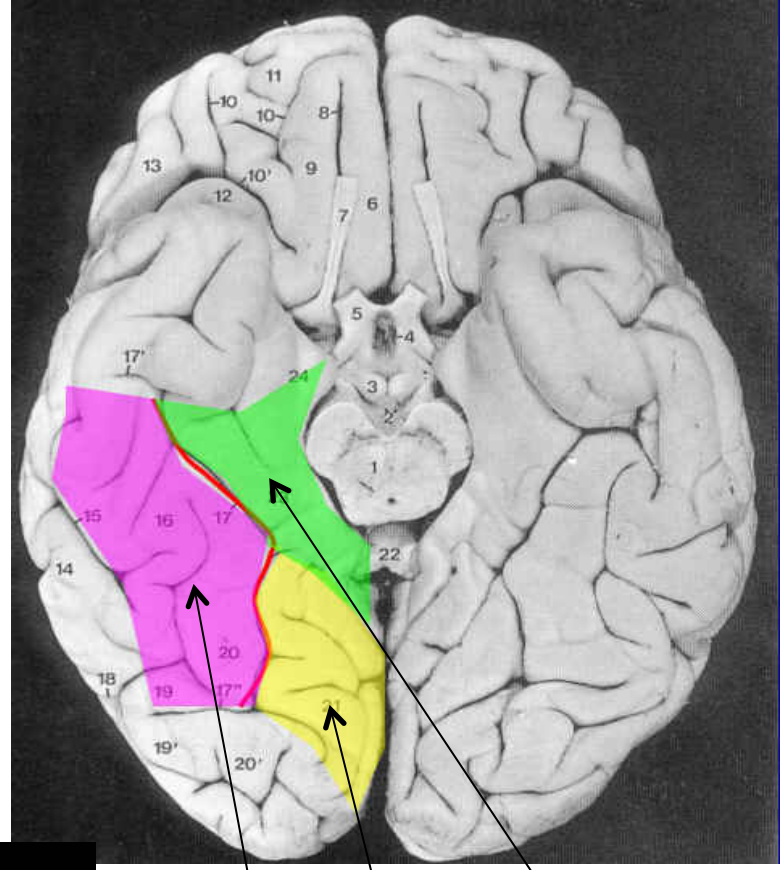

Occipital fissure
Calcarine sulcus

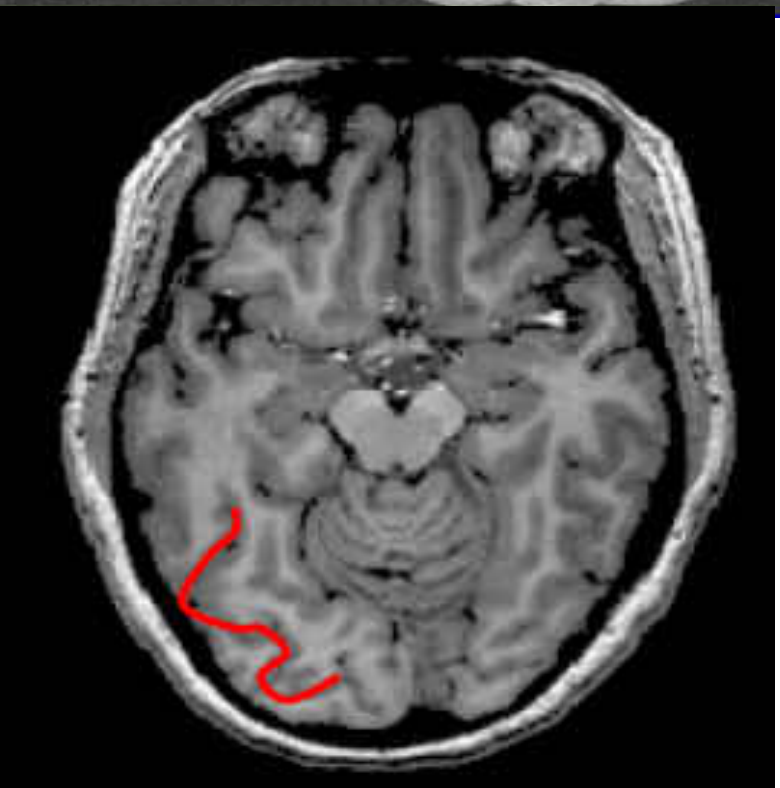


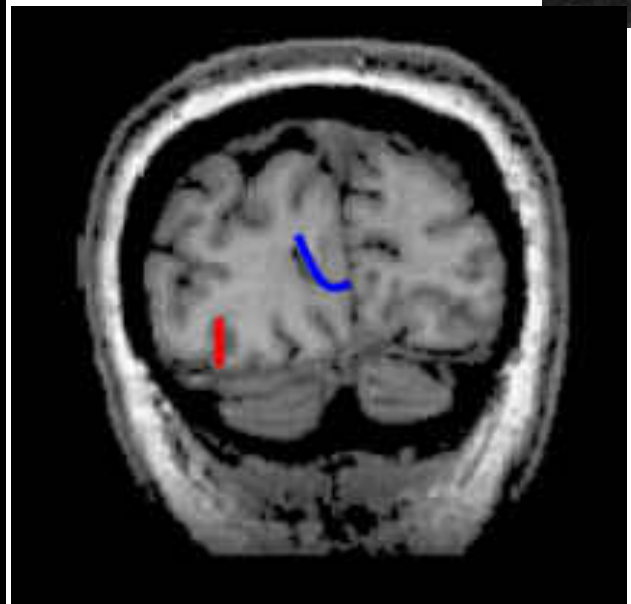
cuneus









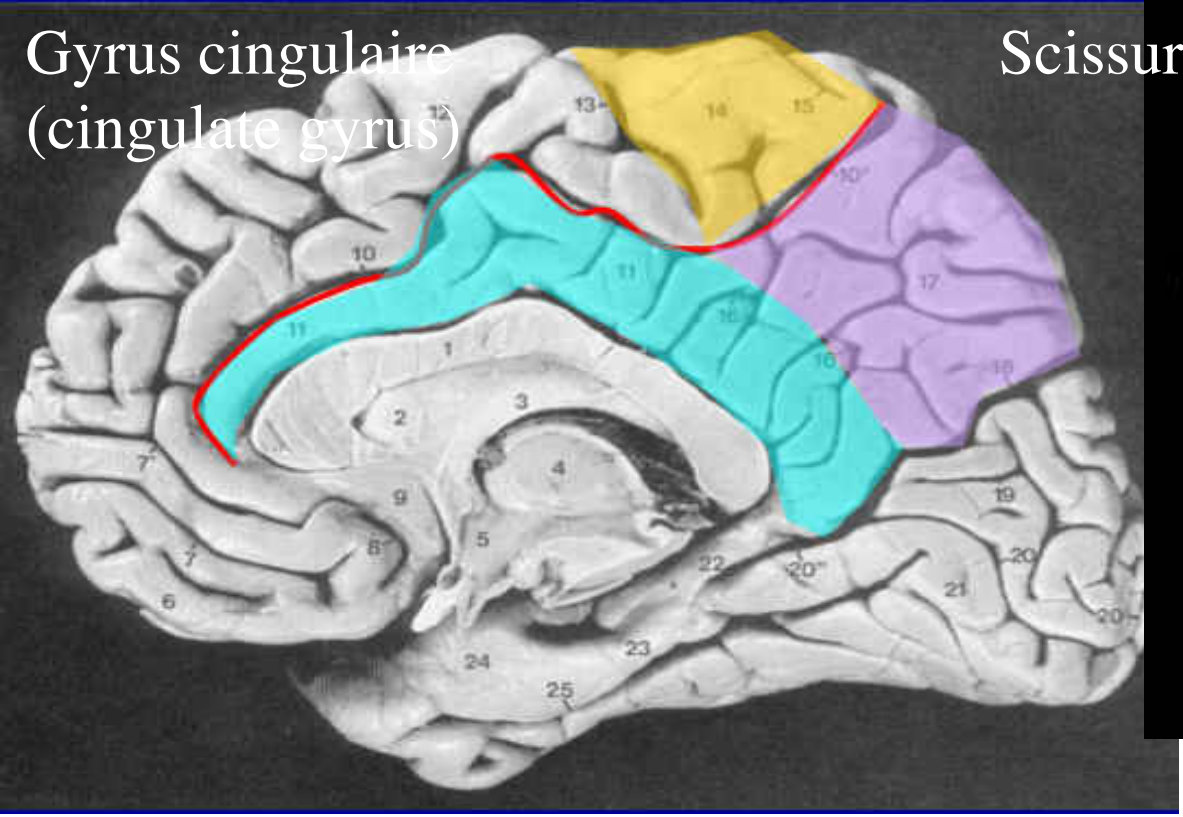


fusiforme

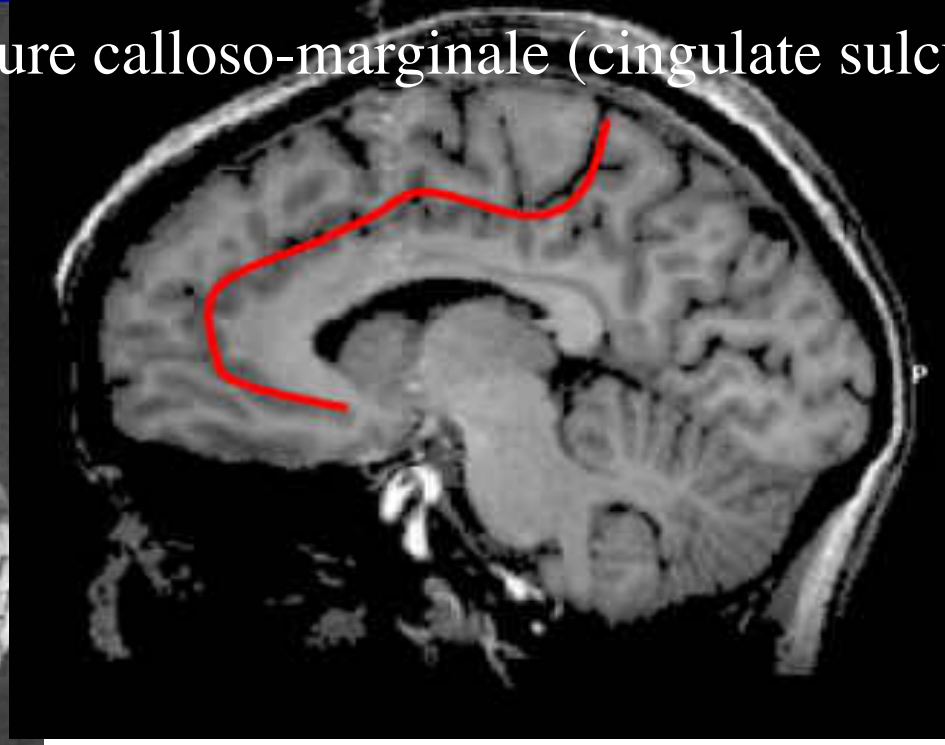
lingual

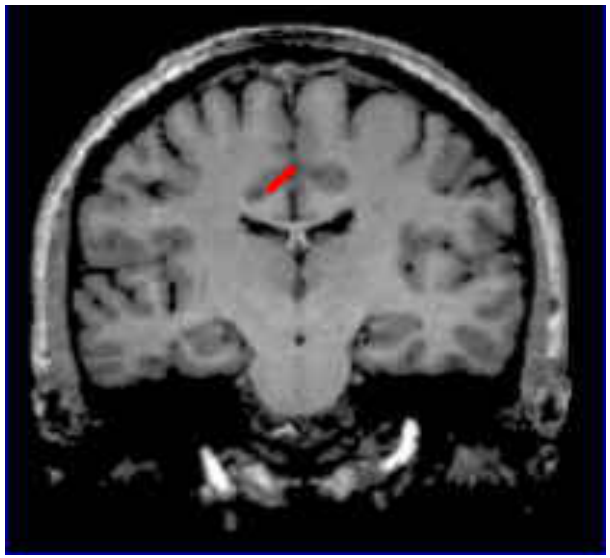
Para-
hipp

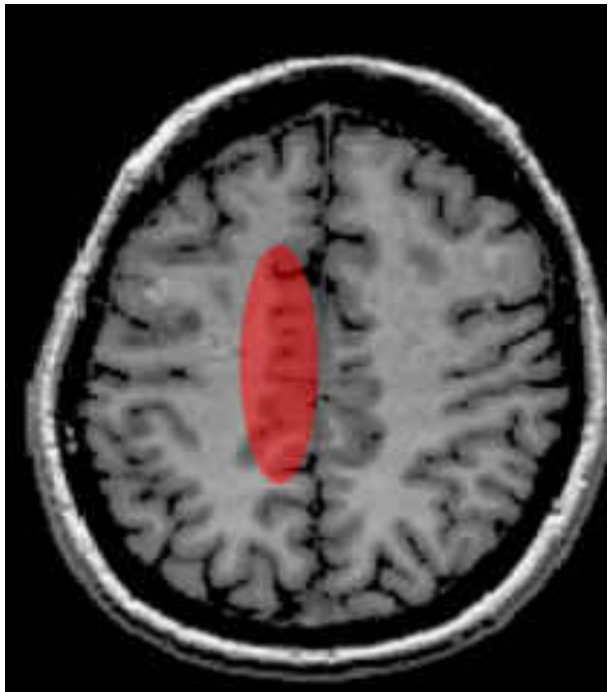
Gyrus cingulaire
(cingulate gyrus)

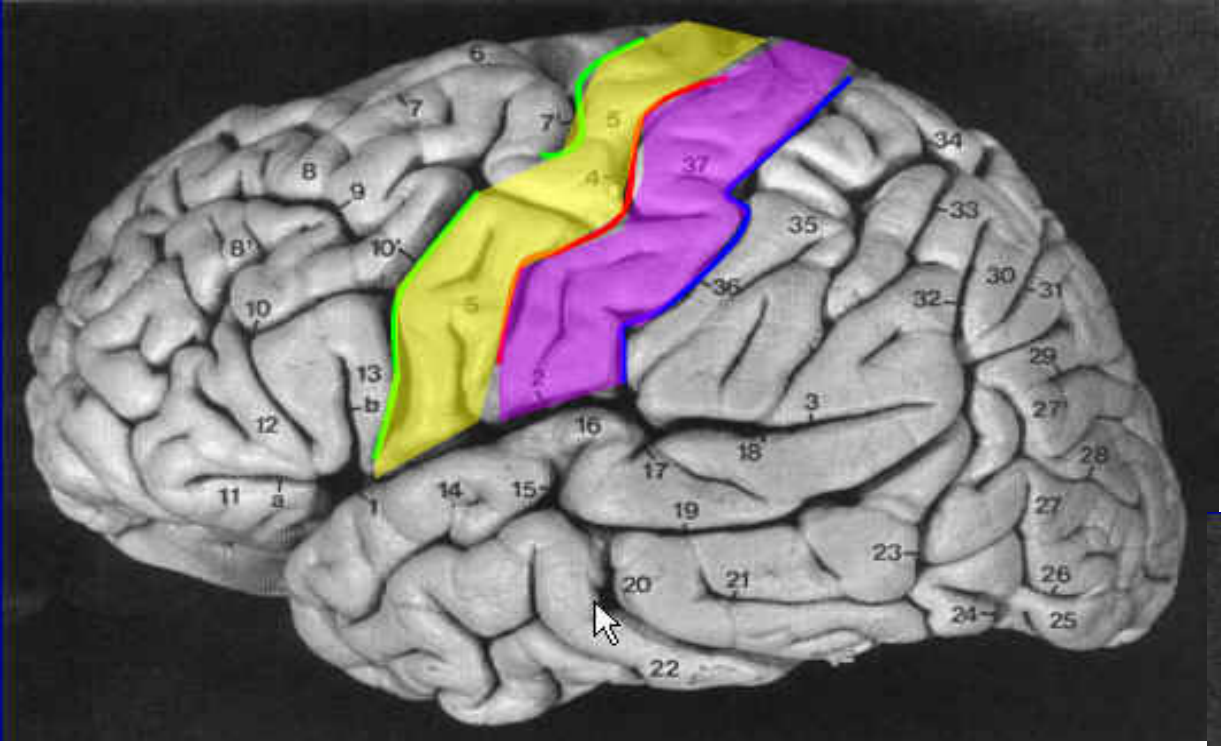


Scissure calloso-marginale (cingulate sulc








6
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36
32
30
31
29
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b
12
3
27'
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a
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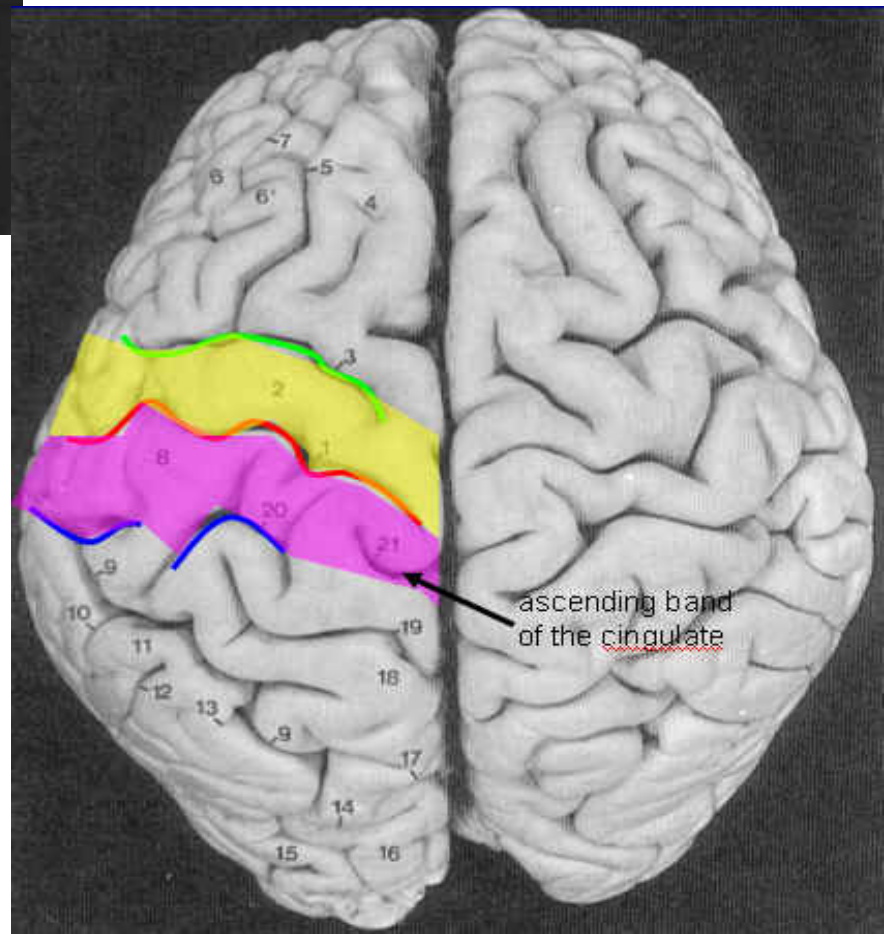
22


7
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6'
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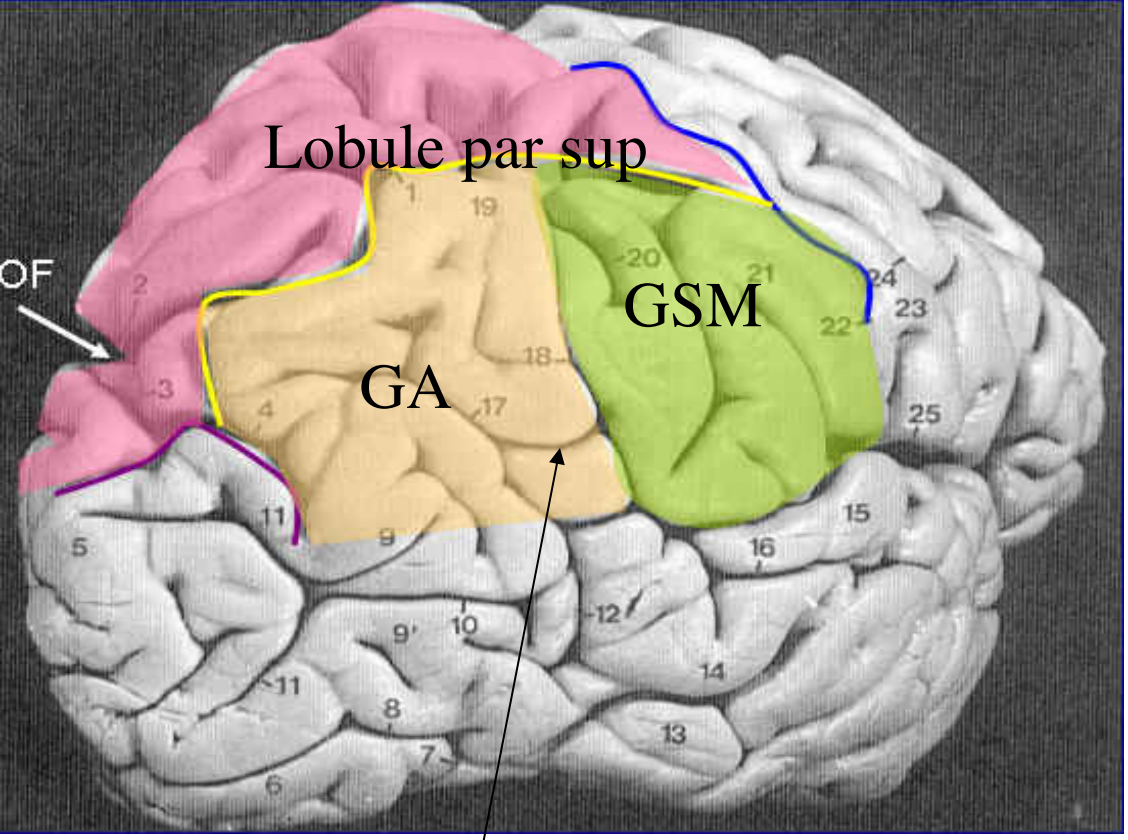
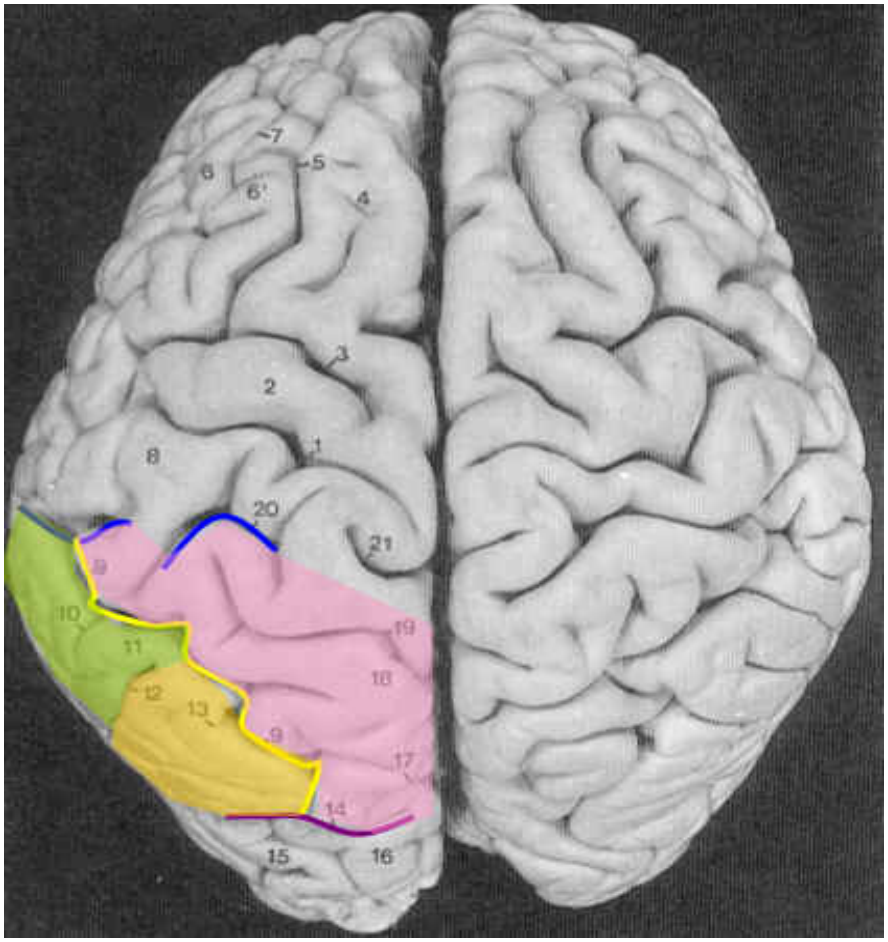
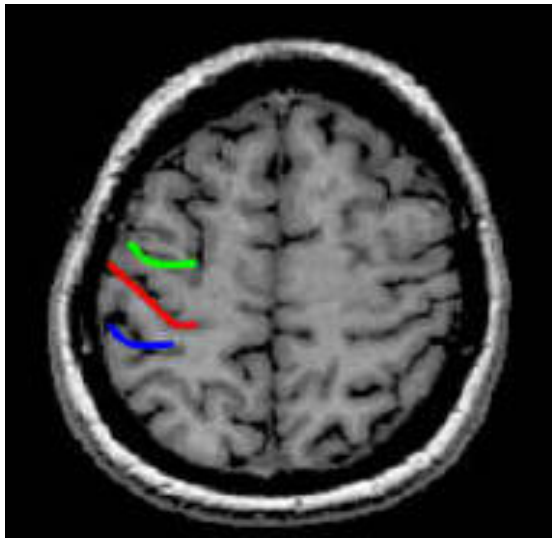
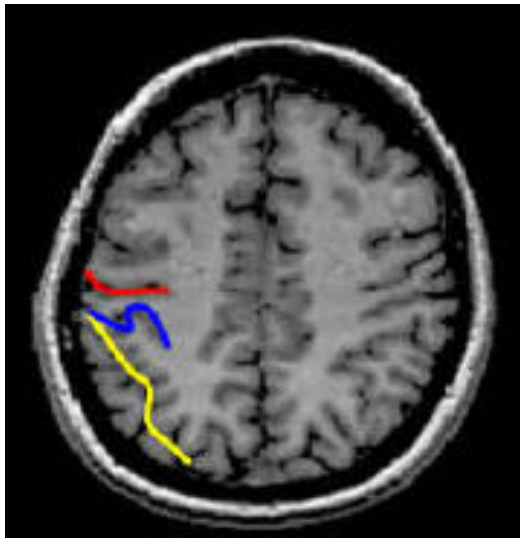
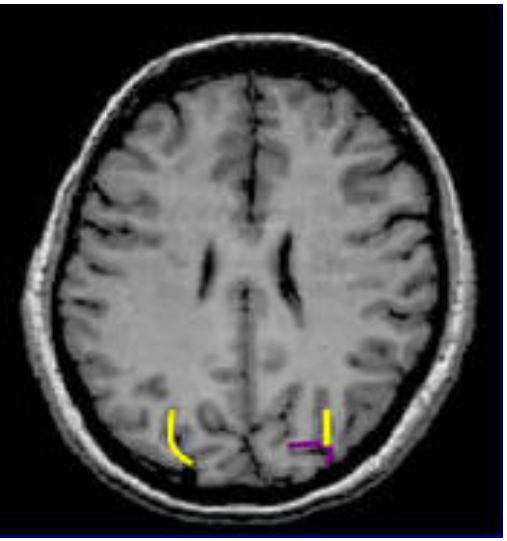
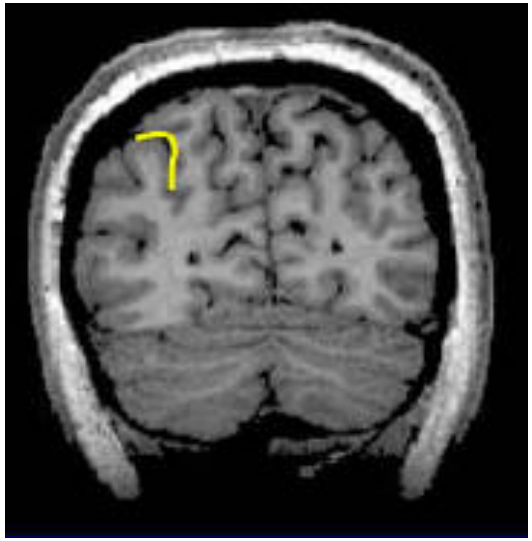
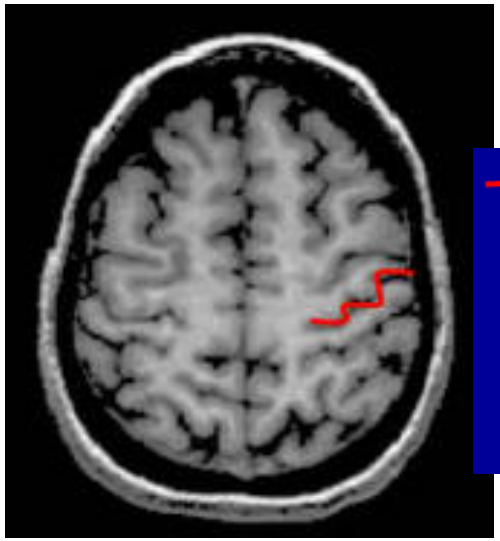
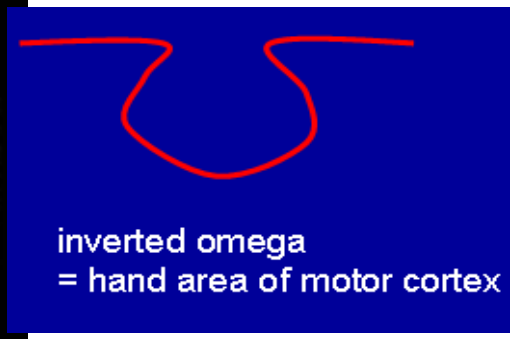
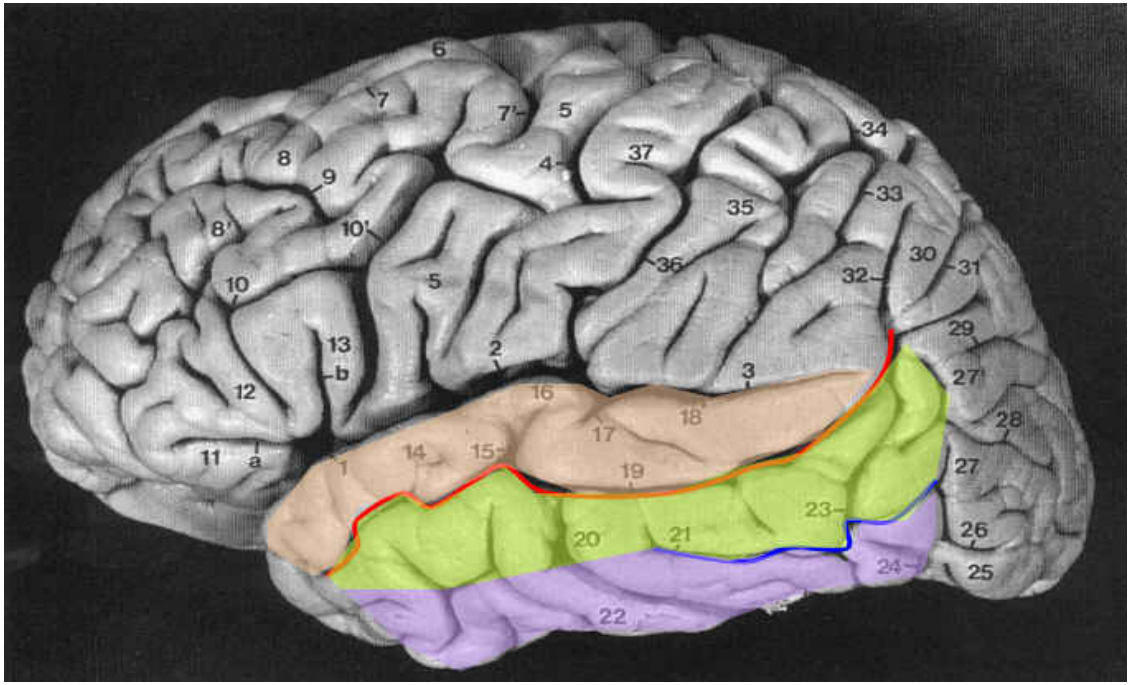
16
ascending band
of the cingulate



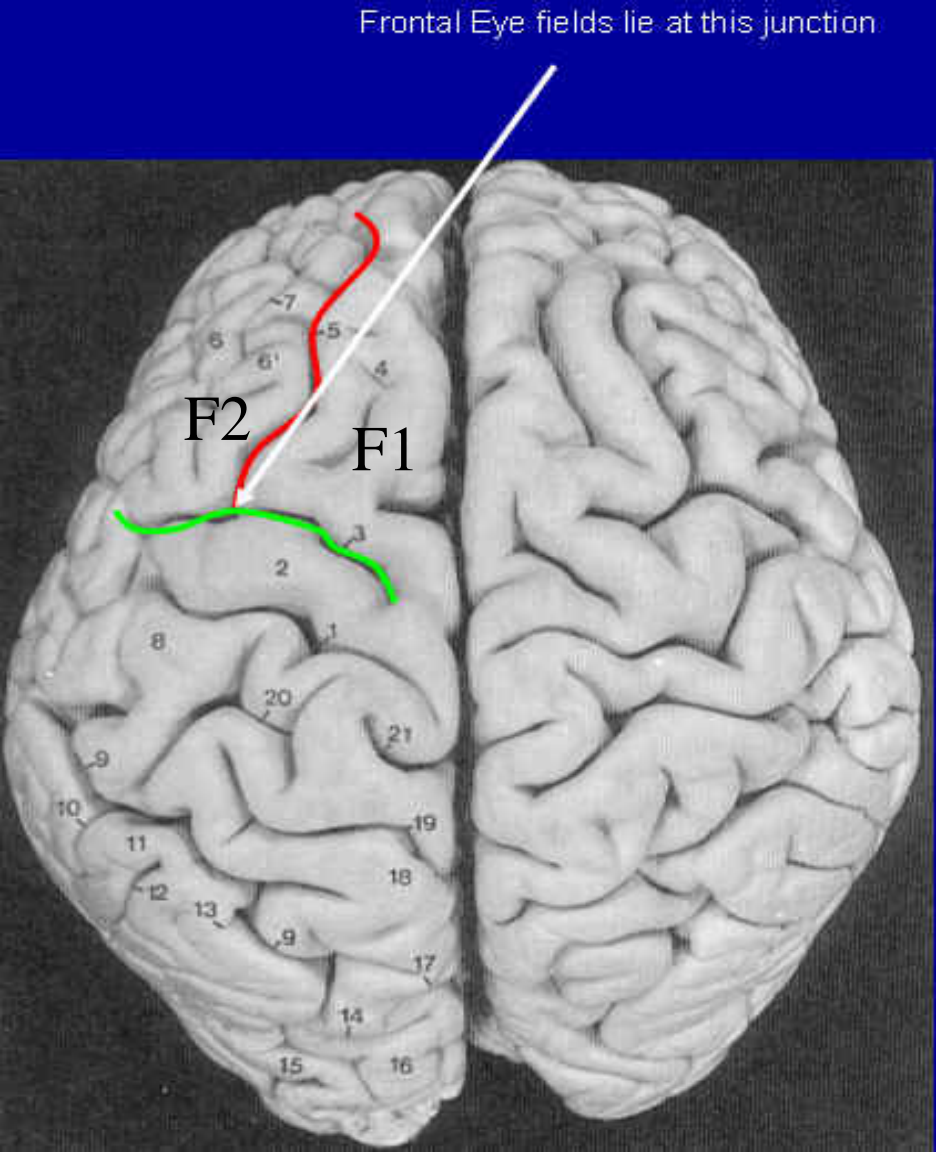


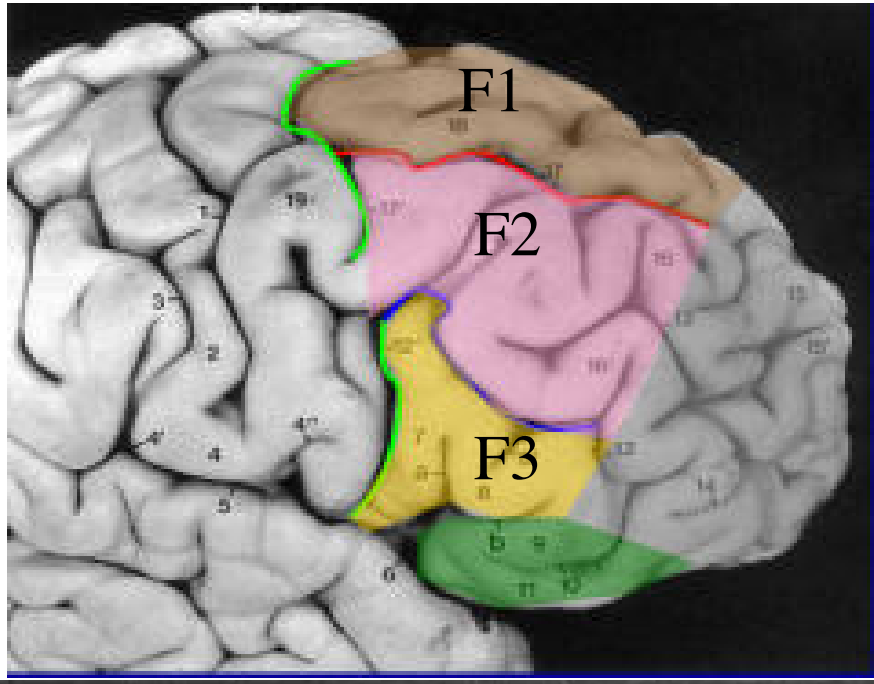
Lobule par inf

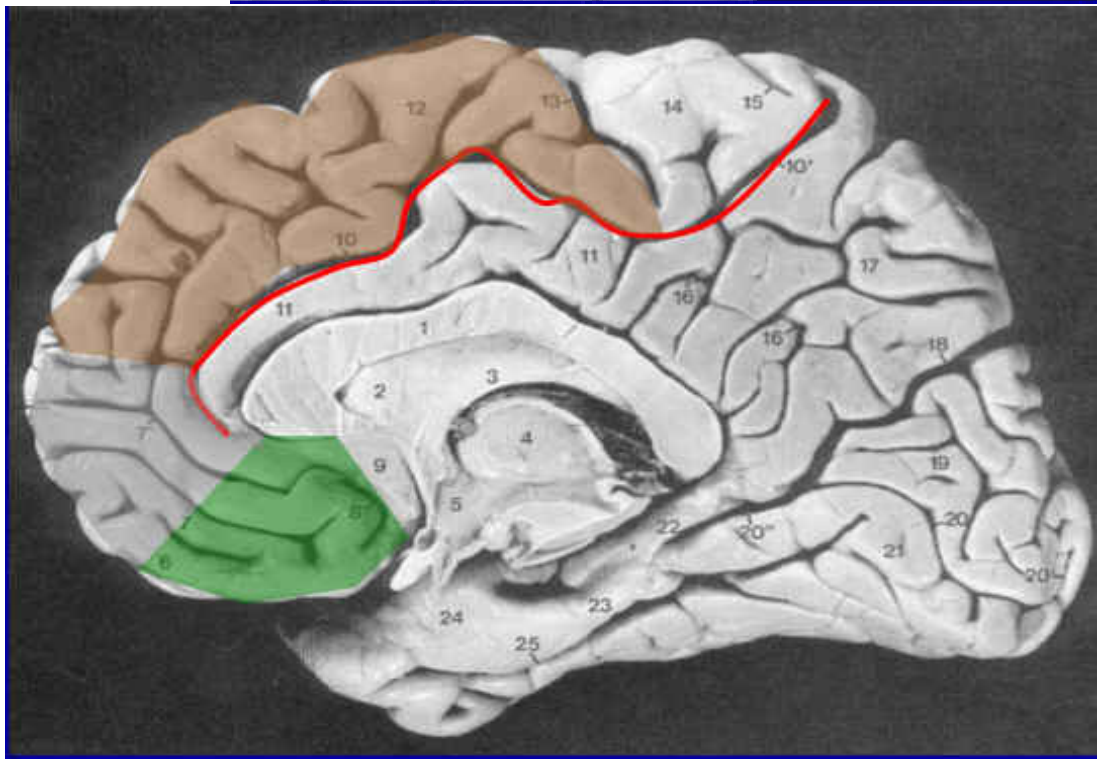







inverted omega
= hand area of motor cortex



Superior temporal sulcus (STS)


Frontal Eye fields lie at this junction
F2
F1


F1
F2
F3



Ventromedial frontal cortex

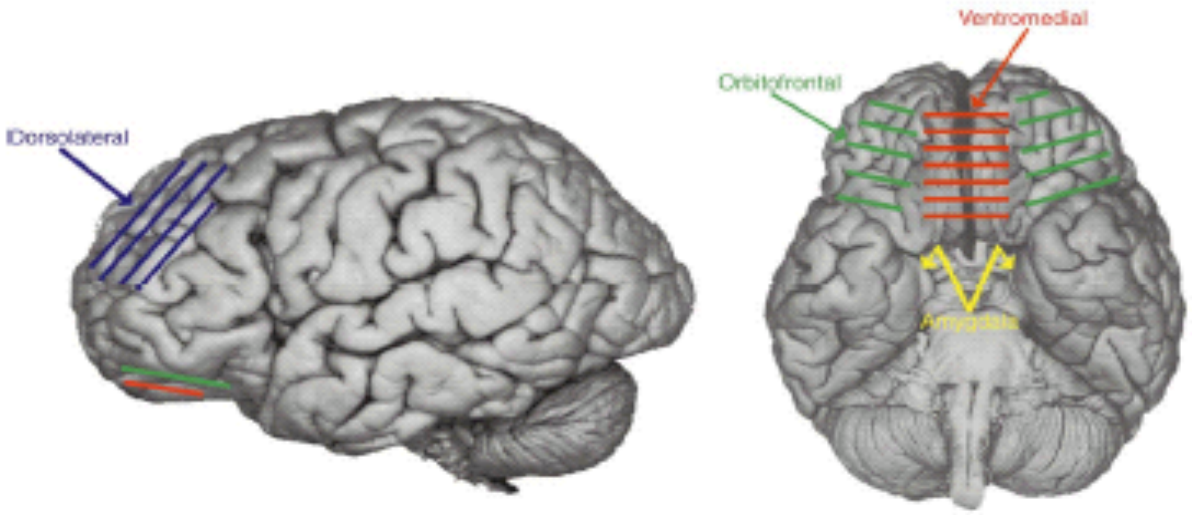
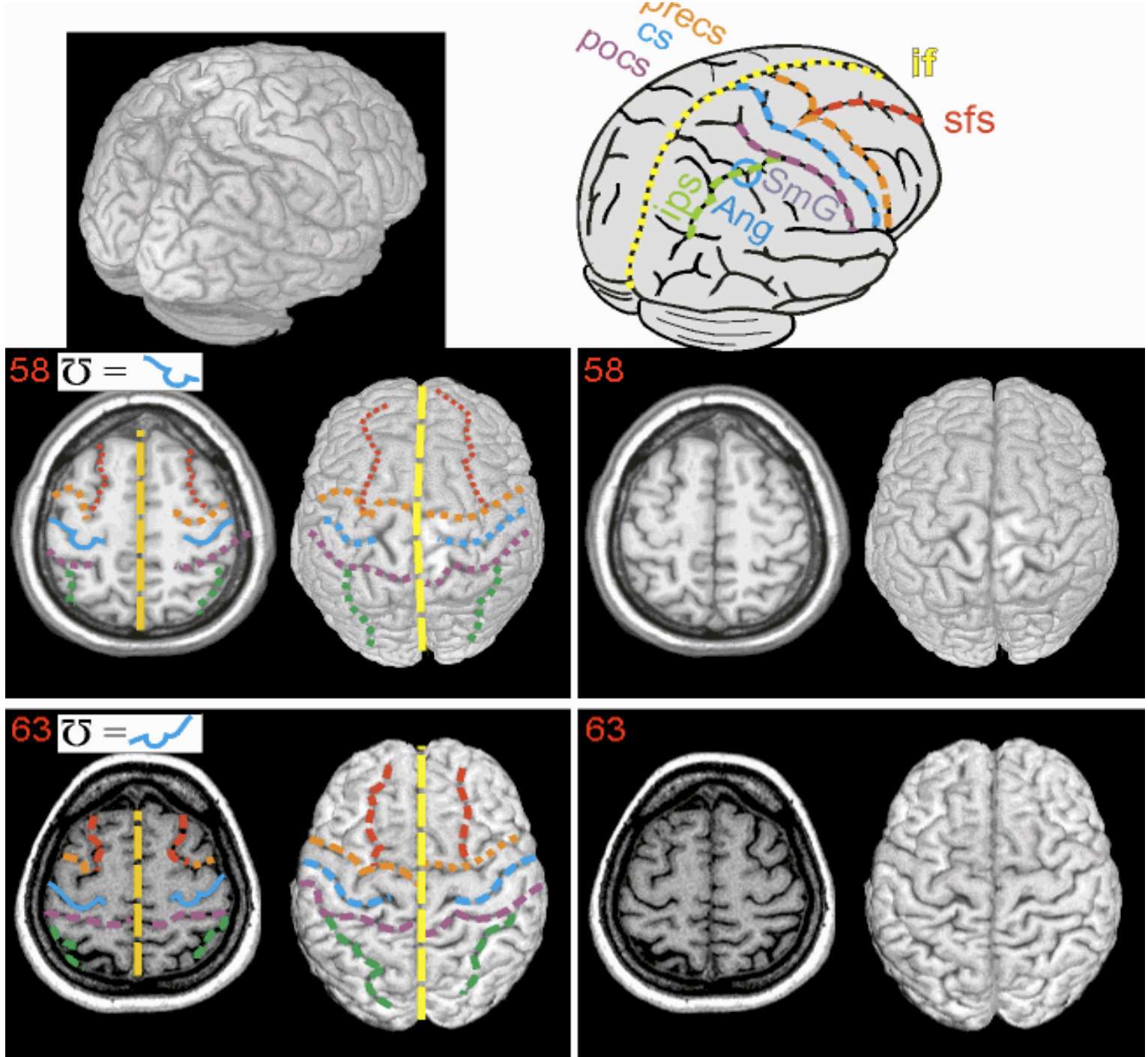
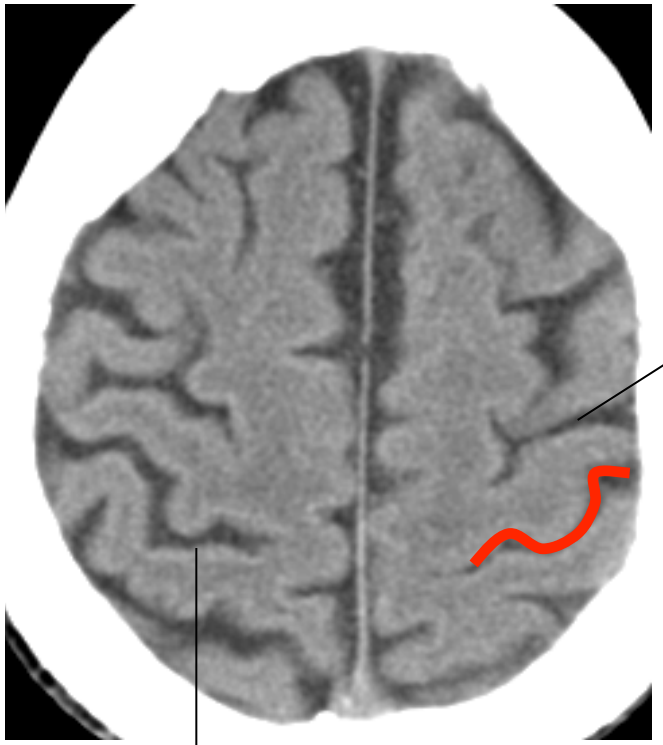


Fig. 1. Sectors of human prefrontal cortex. Left: lateral view indicating dorsolateral (blue), ventromedial (red) and orbitofrontal (green) cortical territories. Right: ventral view indicating ventromedial (red) and orbitofrontal (green) cortical territories. Also indicated are the amygdalae located on the medial margin of the temporal lobes, just dorsal to the uncl which are identified by the tips of the arrowhead (yellow; see Fig. 2). (Adapted from Ref. 93.)


precs
cs
pocs
if
sfs
ips
SmG
Ang
58
63

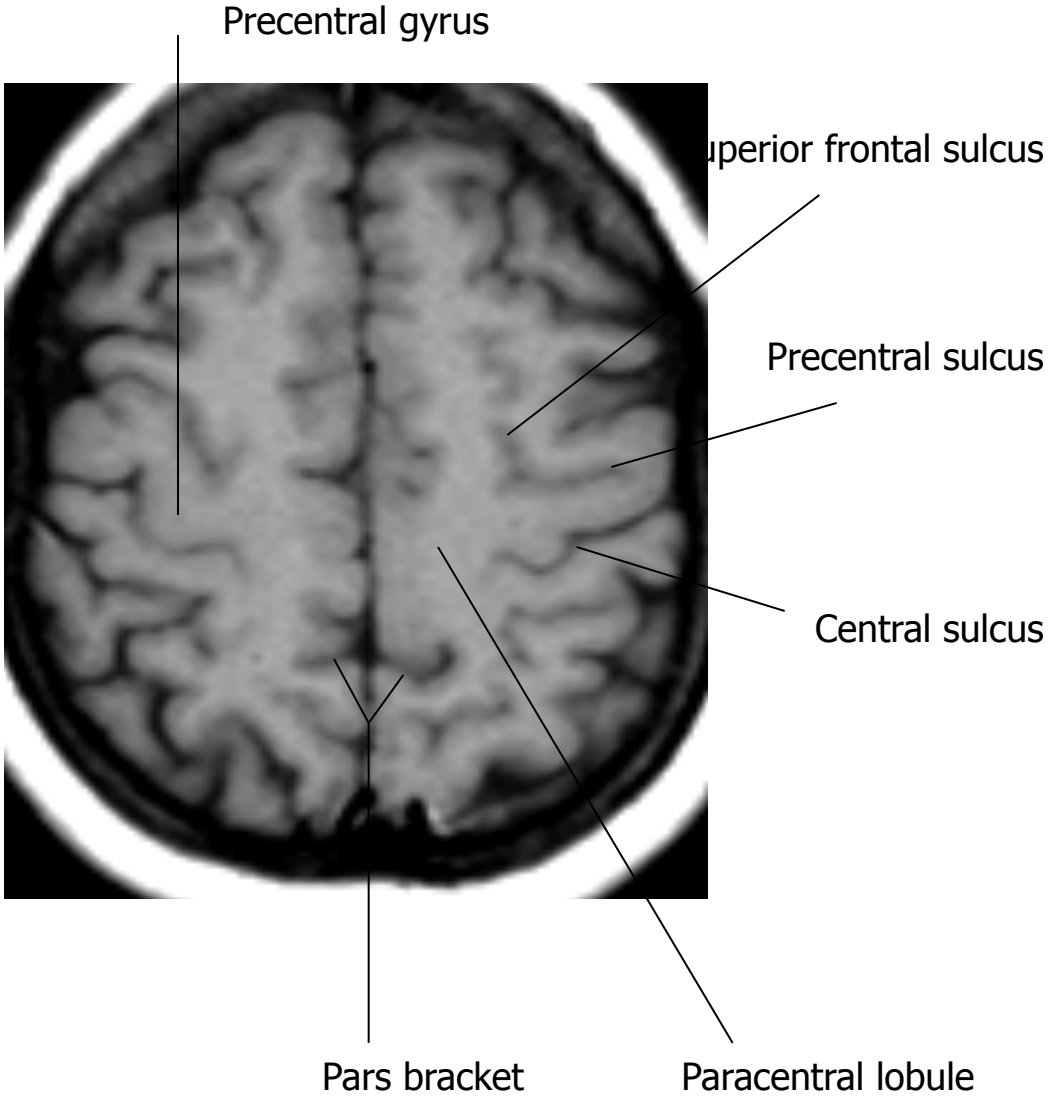
The Central Sulcus (CS)

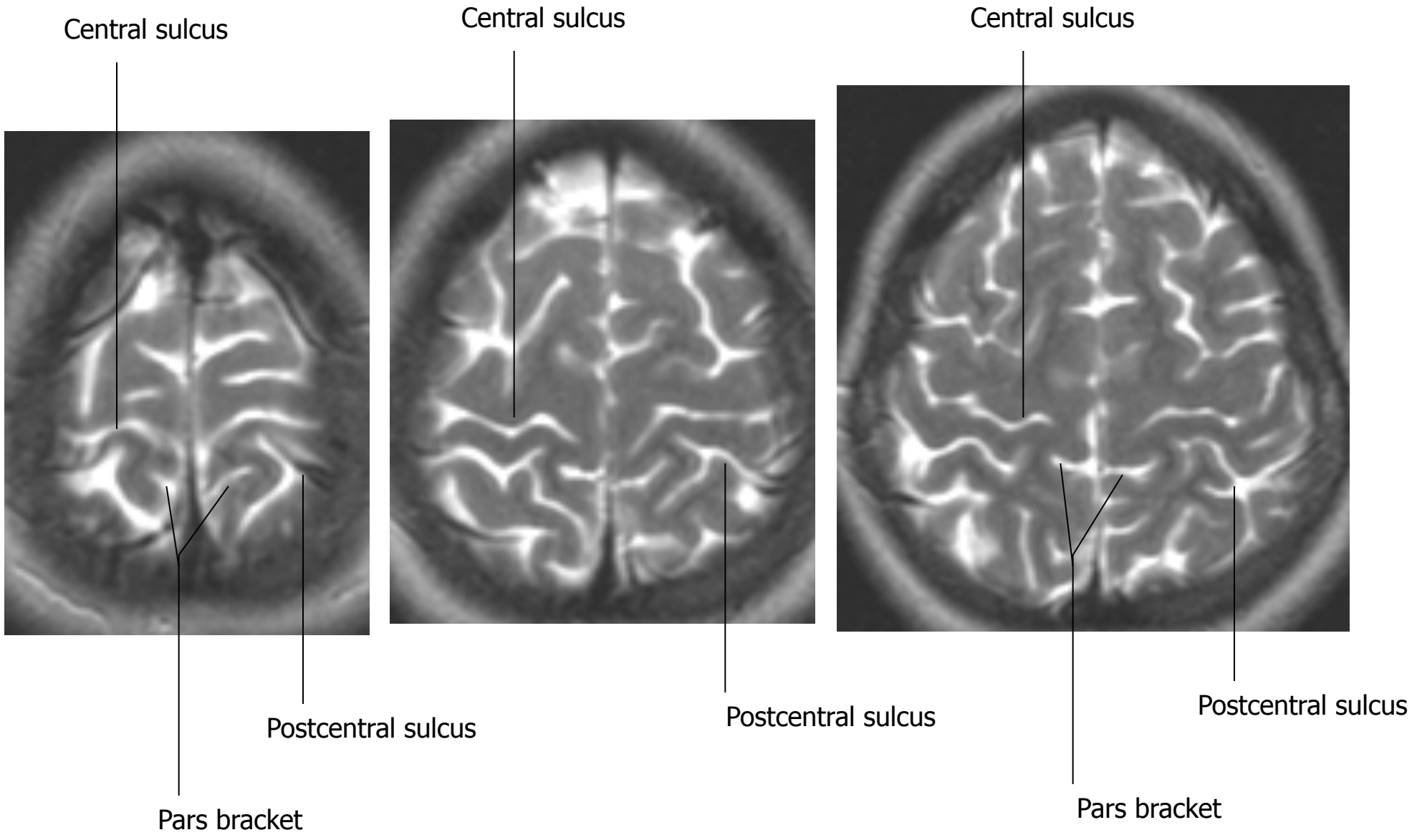
- Sigmoid "Hook"
  - hooklike configuration of the posterior surface of the precentral gyrus
  - the "hook" corresponds to the motor hand area.
  - The "hook" is well seen on CT (89%) and MRI (98%).



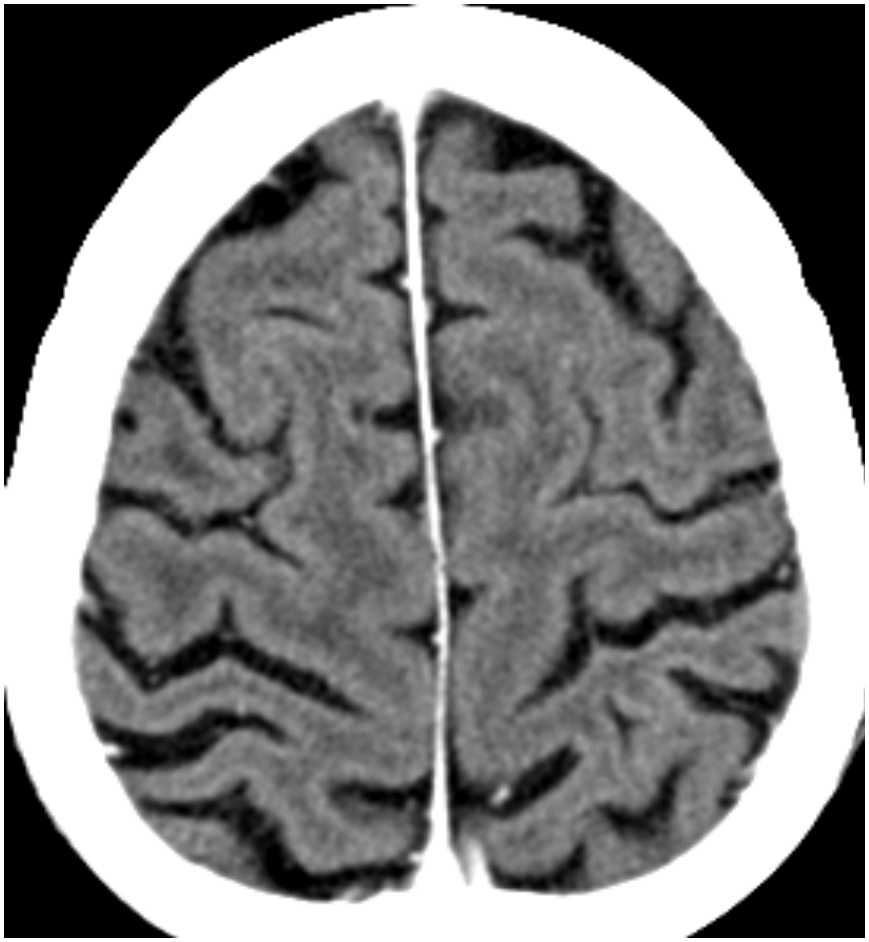
The Central Sulcus (CS)

- pars bracket sign
  - The paired pars marginalis form a "bracket" to each side of the interhemispheric fissure at or behind the central sulcus (96%).

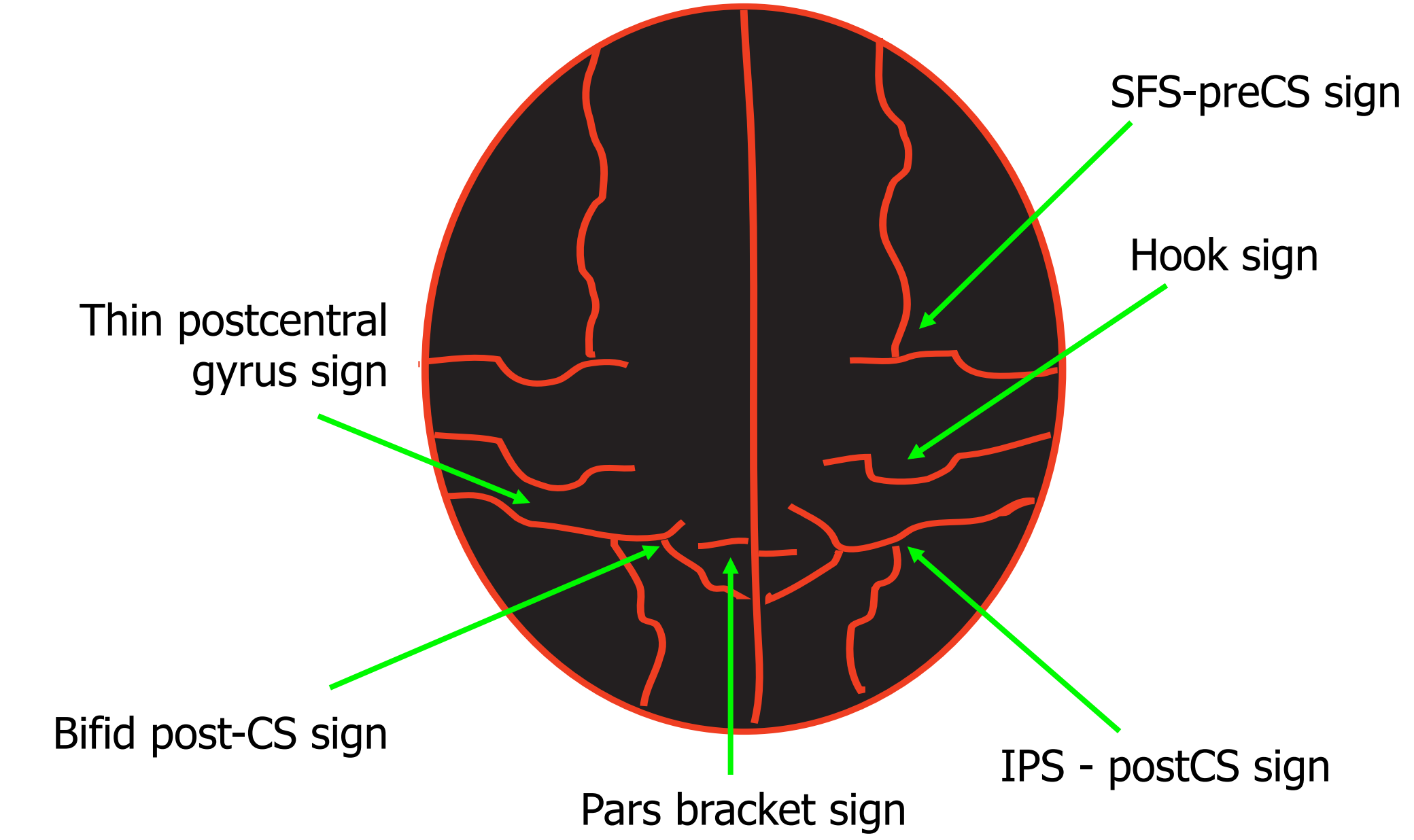



Central sulcus
Central sulcus
Central sulcus
Postcentral sulcus
Postcentral sulcus
Postcentral sulcus
Pars bracket
Pars bracket

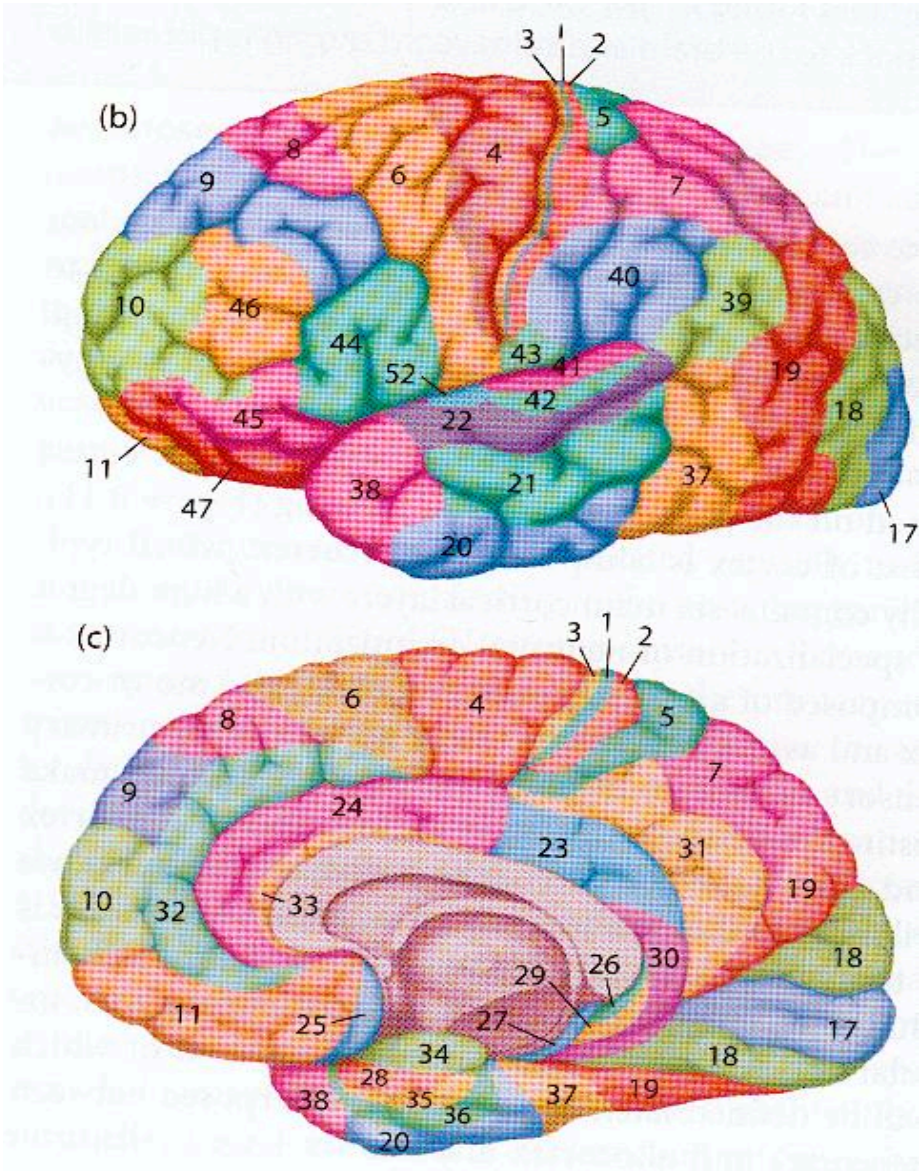
The Central Sulcus (CS)

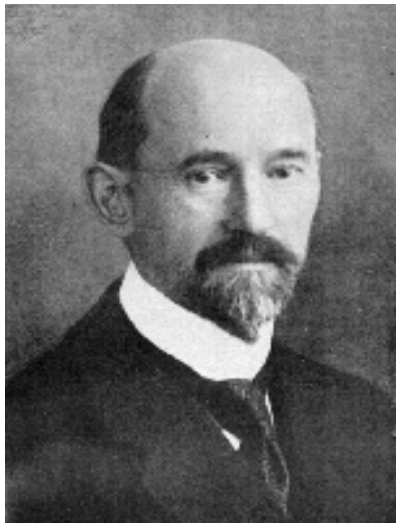


The Central Sulcus (CS)

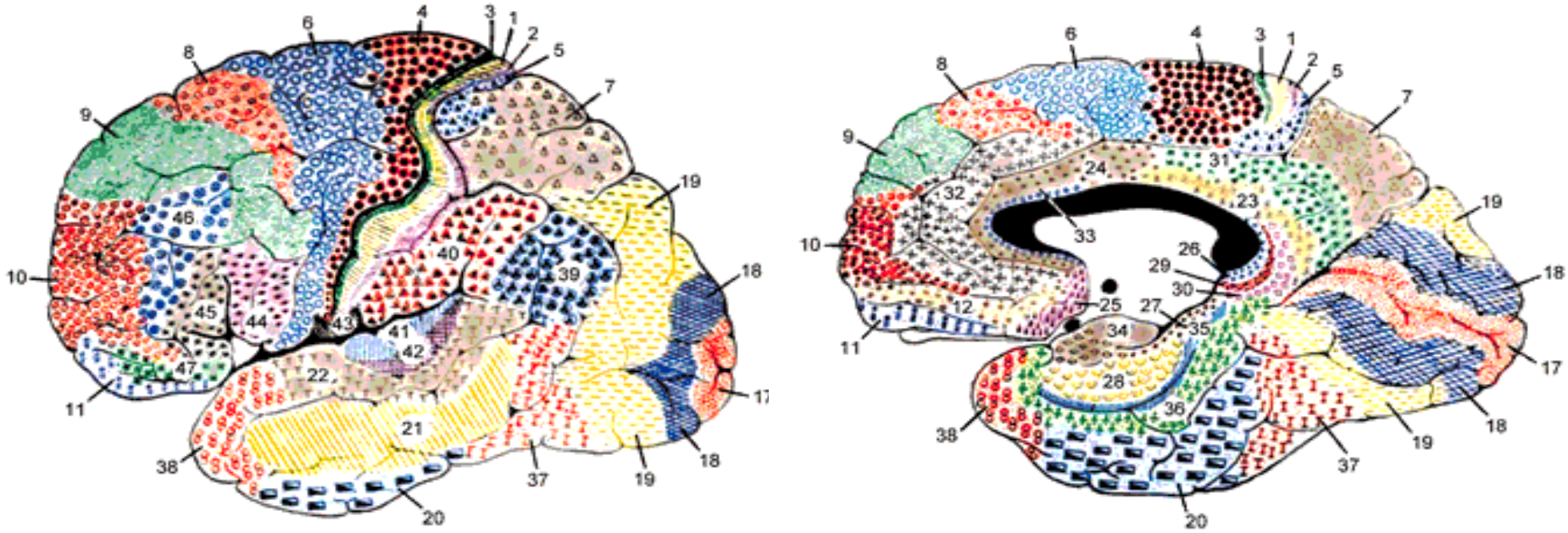


Brodmann's Areas





Brodmann (1905):
Based on cytoarchitectonics: study of differences in cortical layers between areas
Most common delineation of cortical areas
More recent schemes subdivide Brodmann's areas into many smaller regions
Monkey and human Brodmann's areas not necessarily homologous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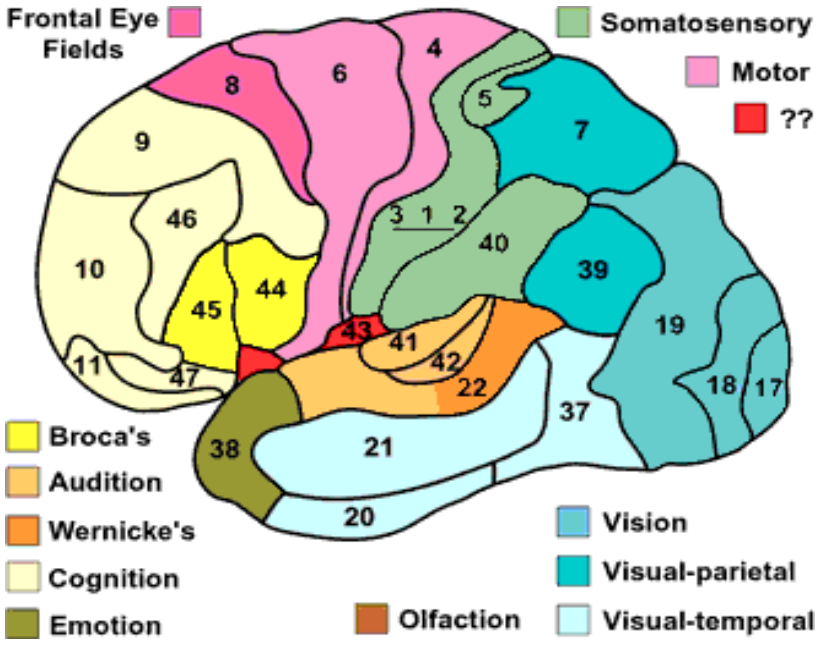
Frontal Eye Fields
Somatosensory
Motor
??
Broca's
Audition
Wernicke's
Cognition
Emotion
Olfaction
Vision
Visual-parietal
Visual-temporal
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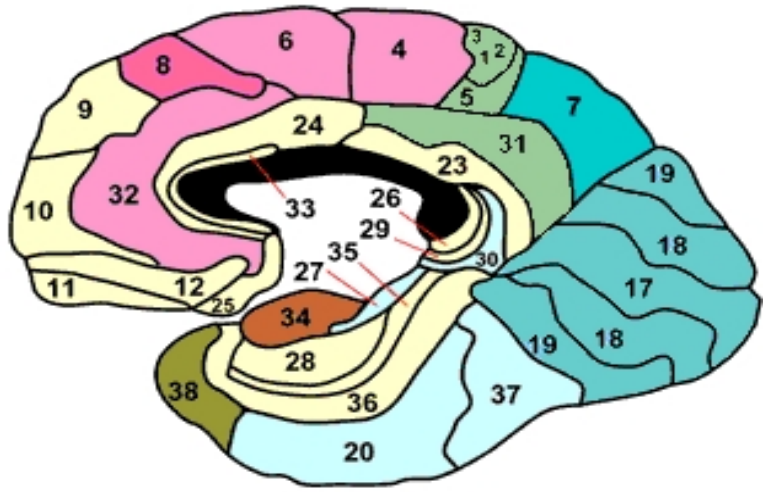
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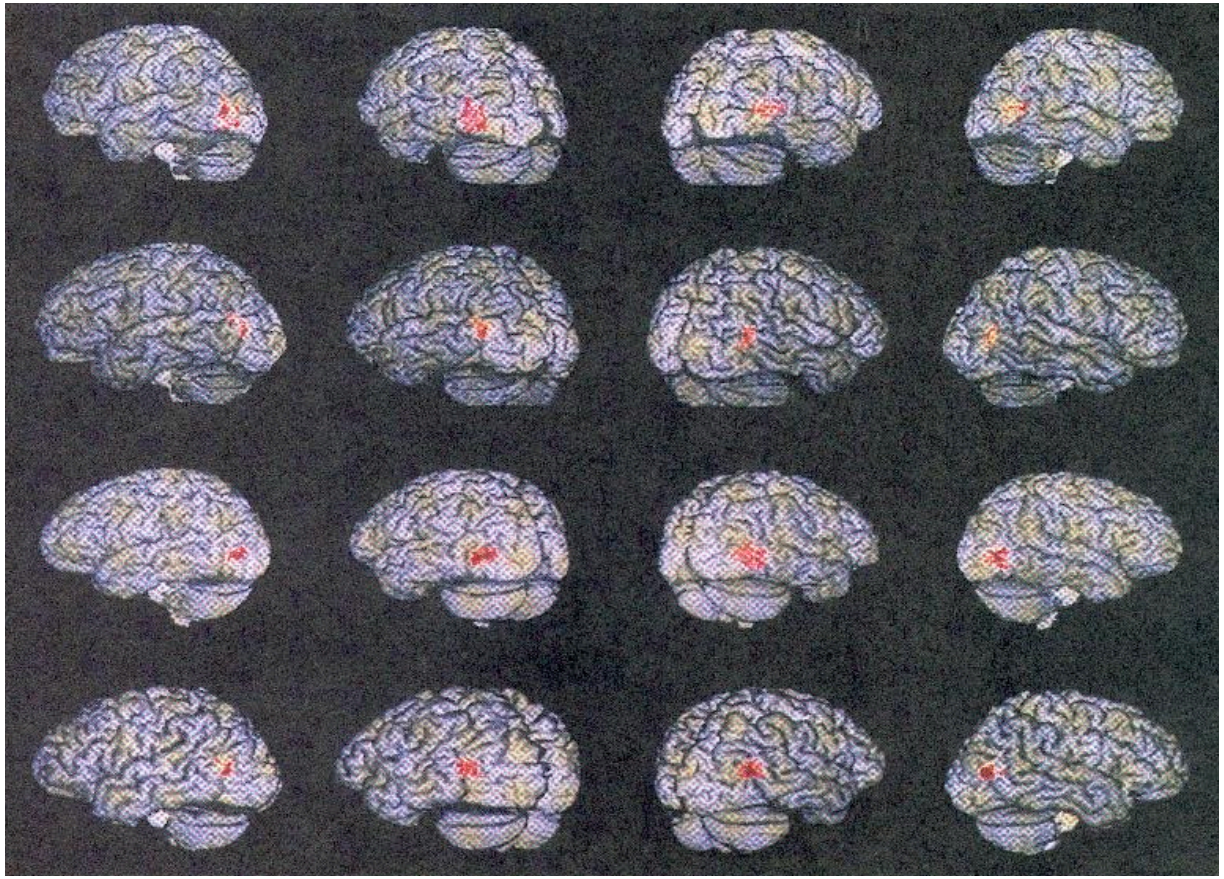
Variability of Functional Areas



Watson et al., 1995
-functional areas (e.g., MT) vary between subjects in their Talairach locations
-the location relative to sulci is more consistent


MRI
SAGITTAL
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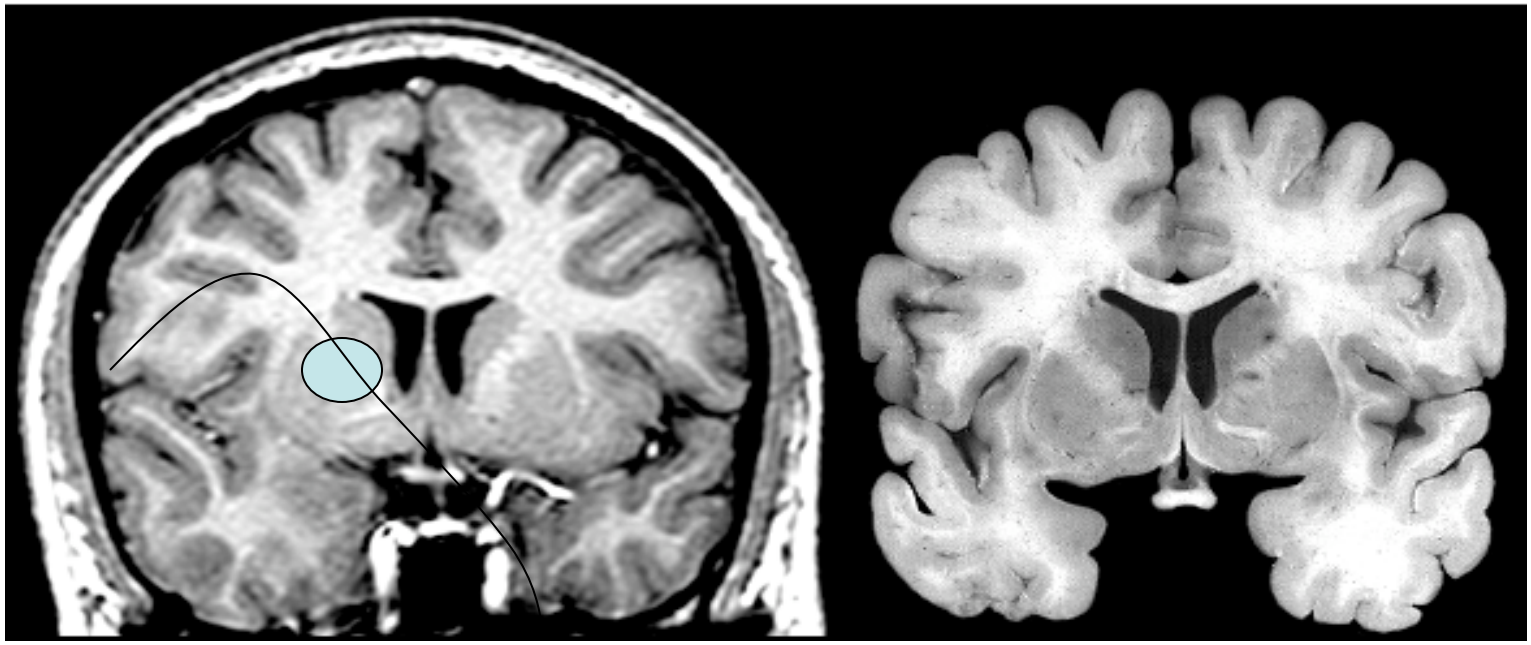
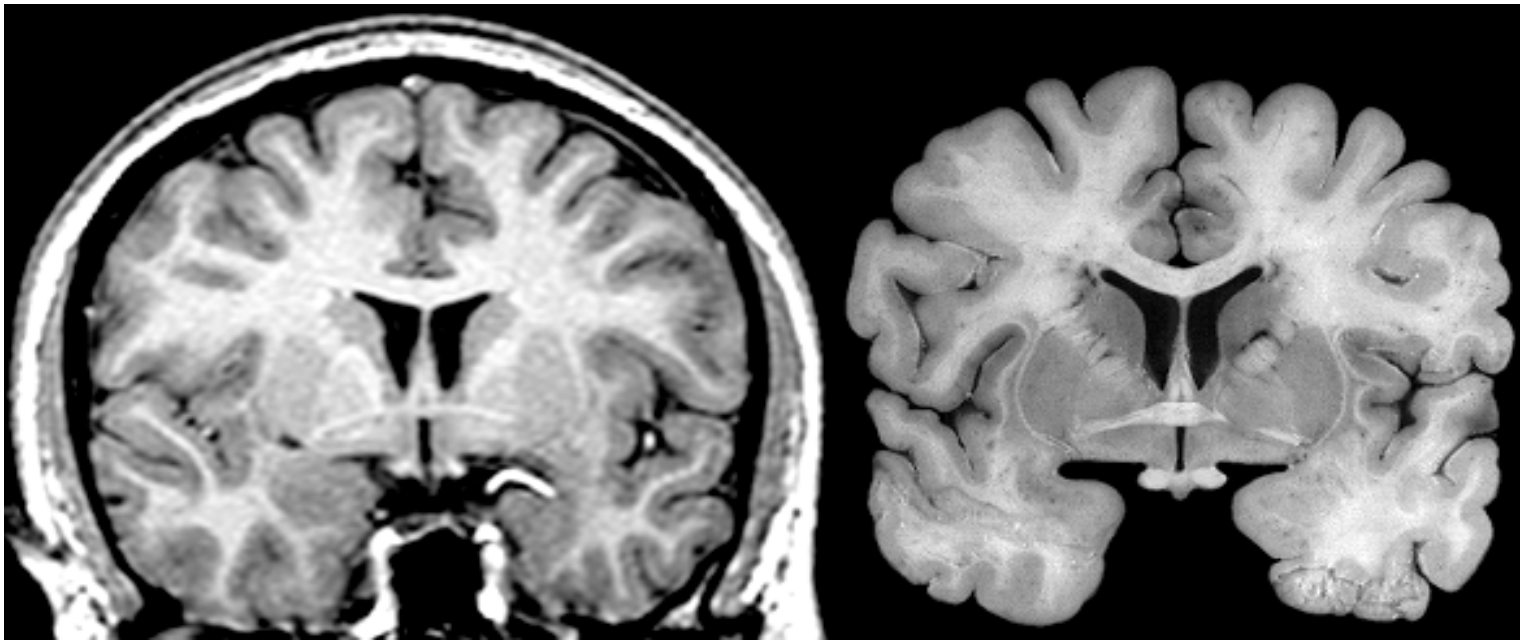
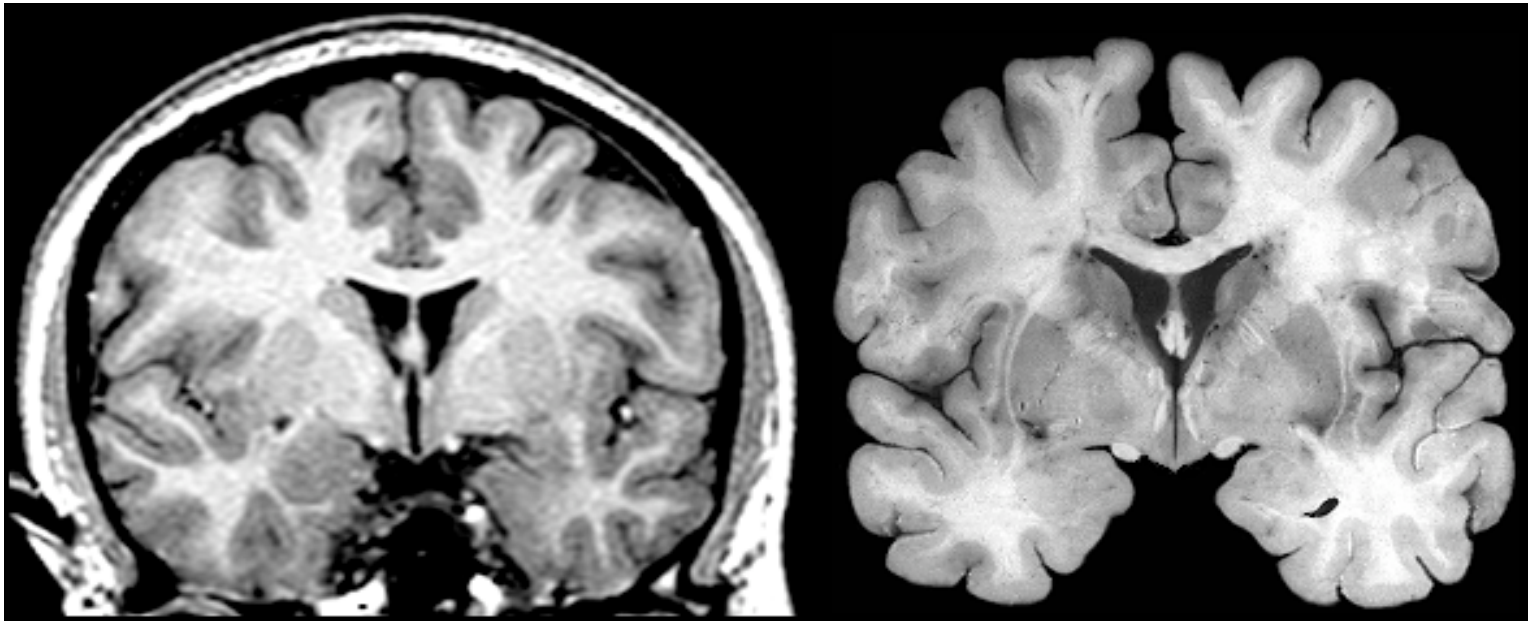
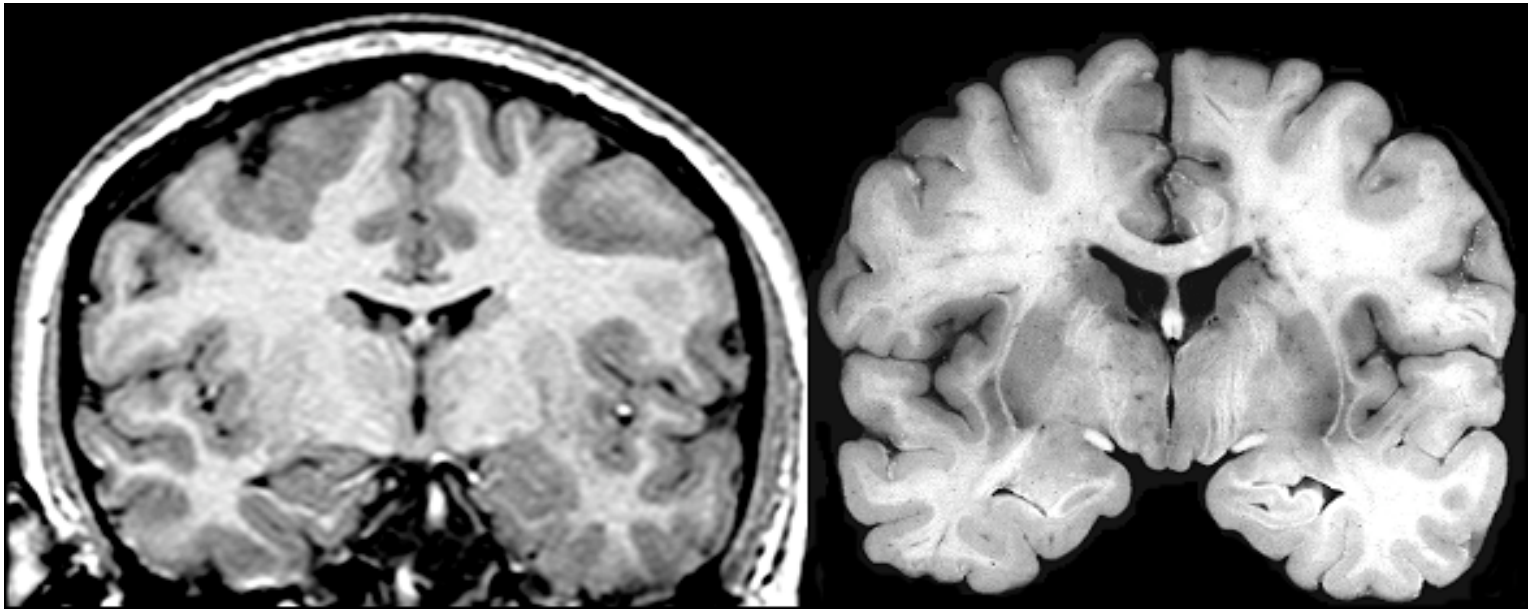
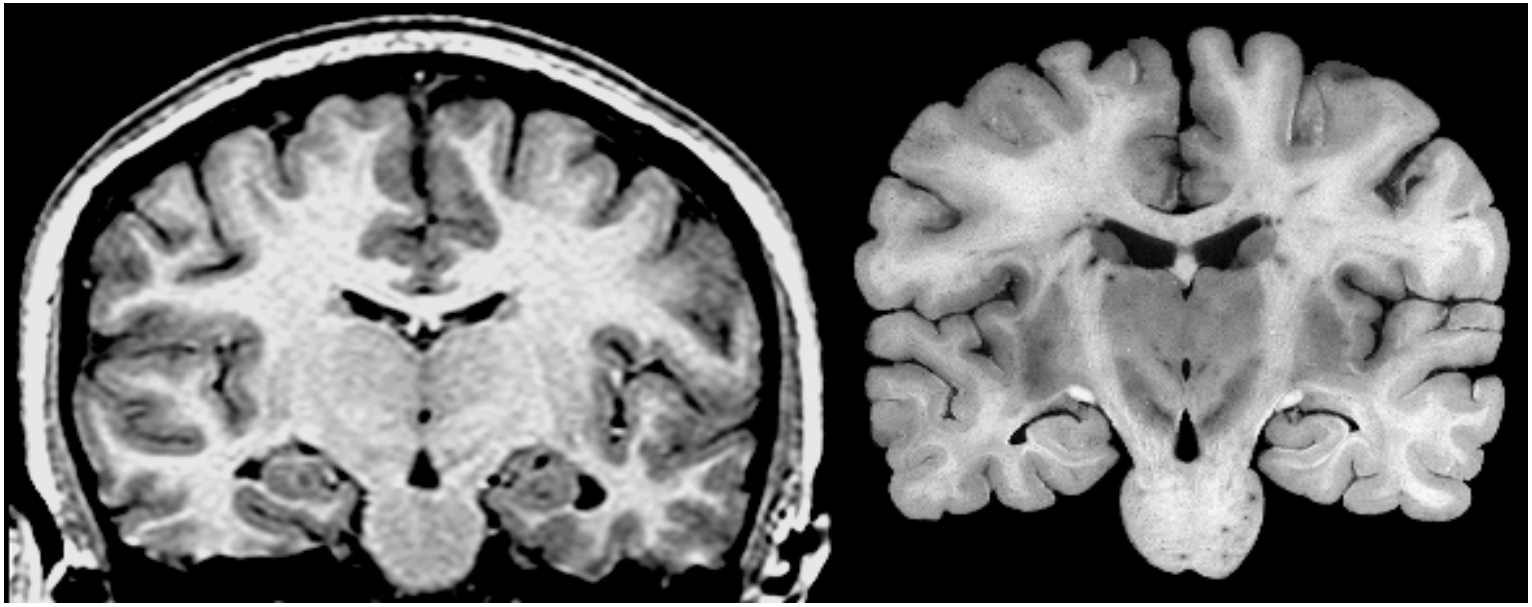
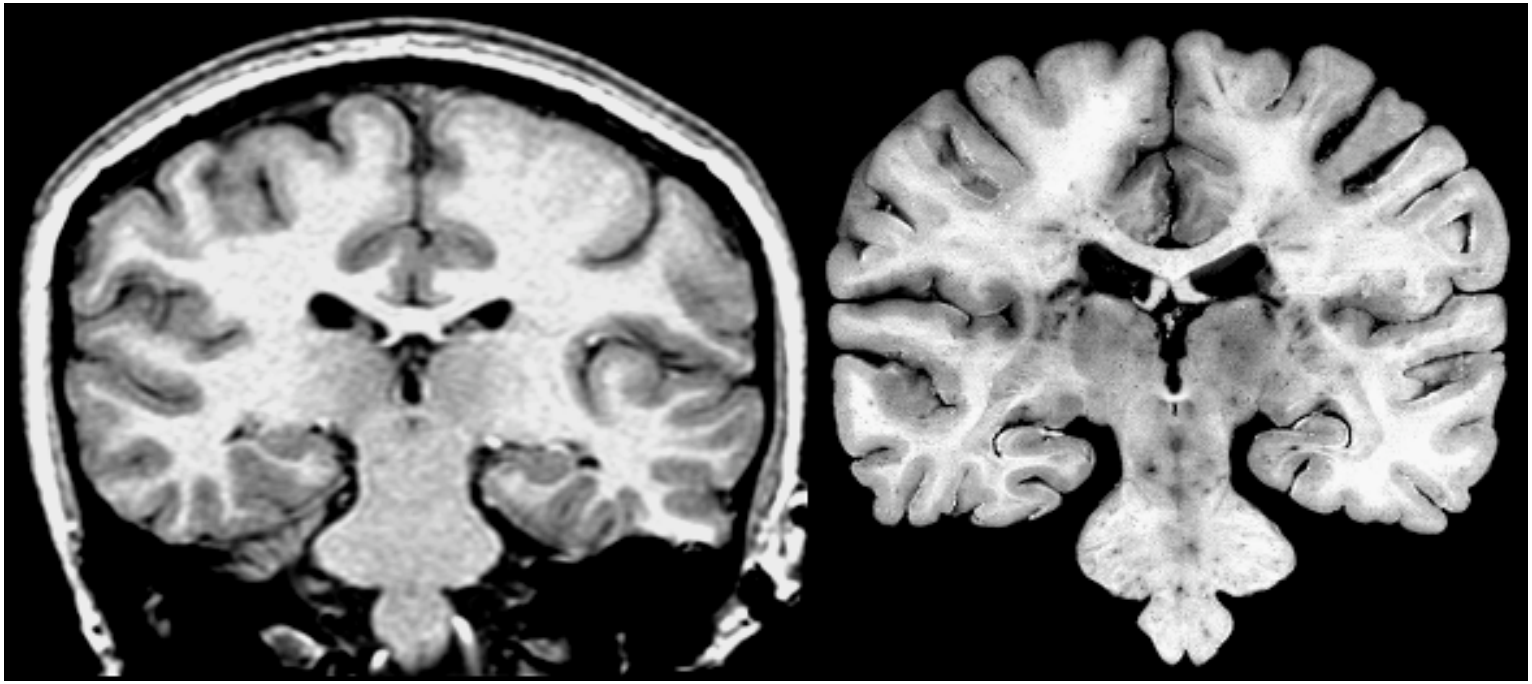


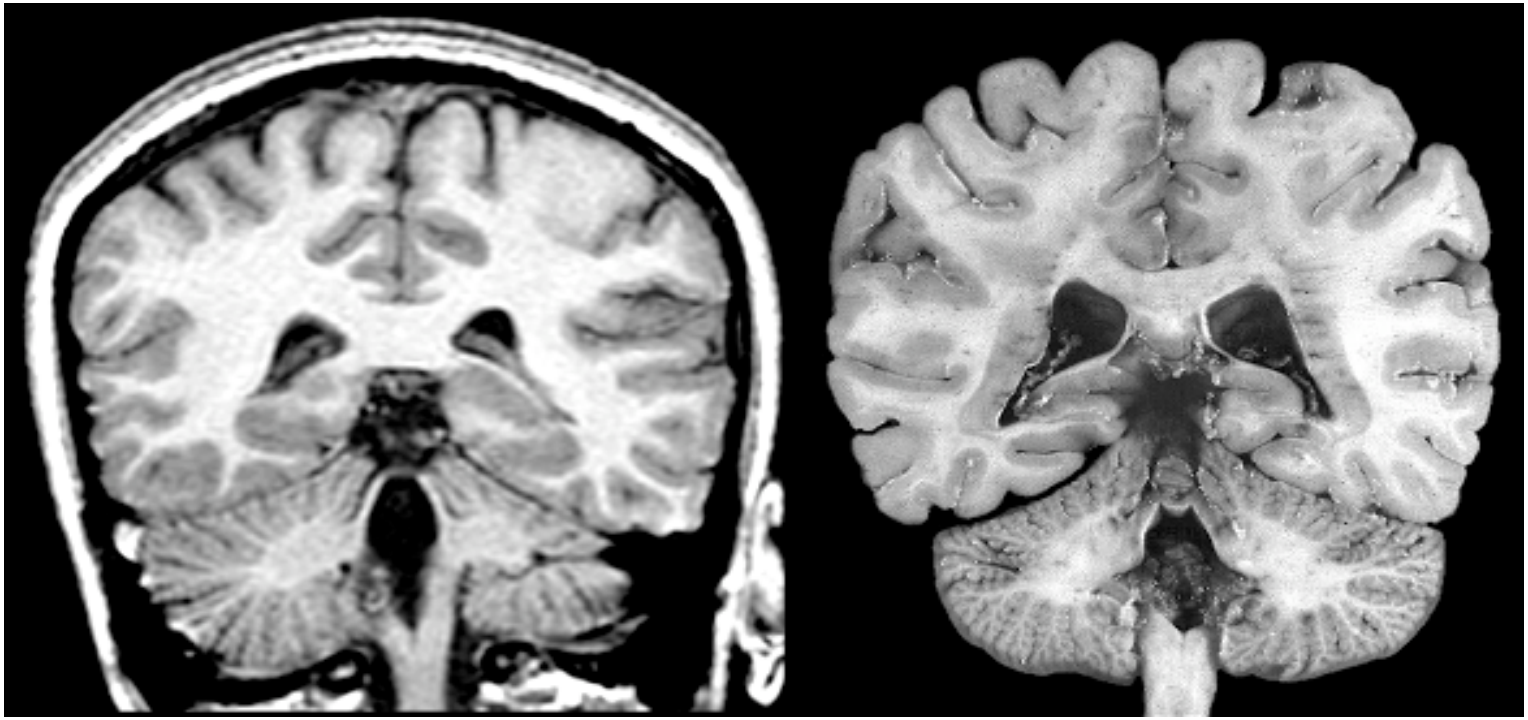




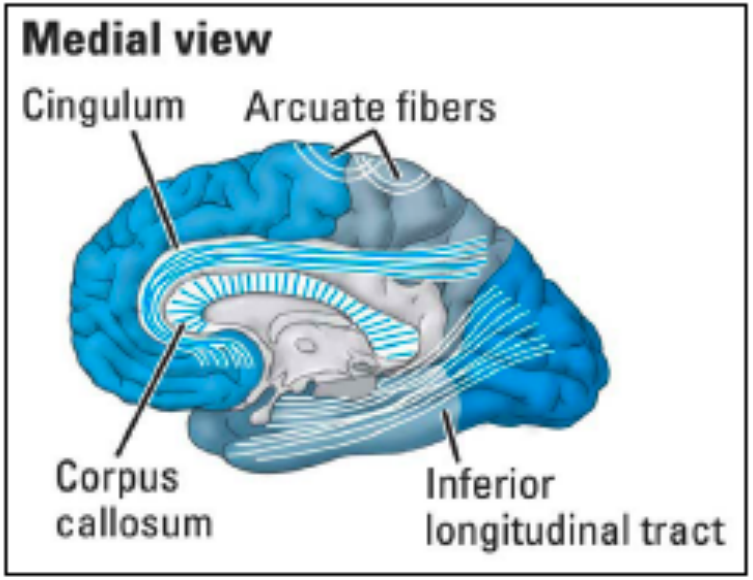


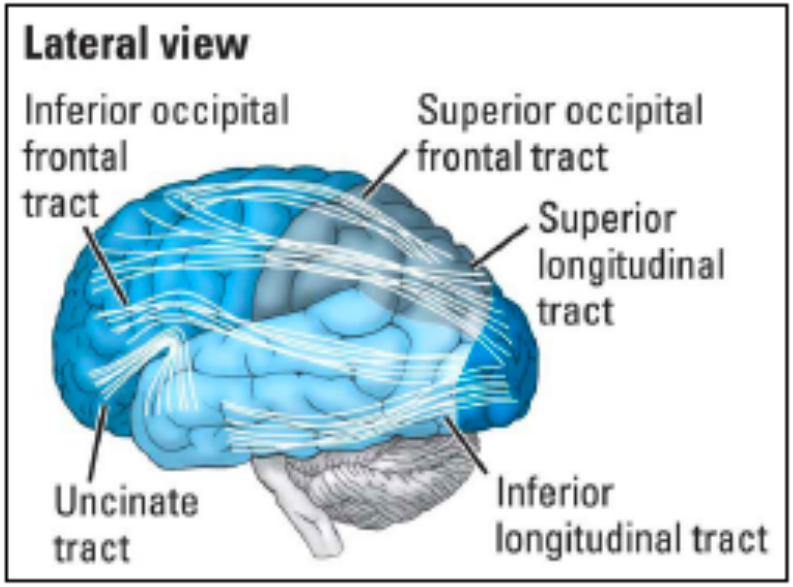


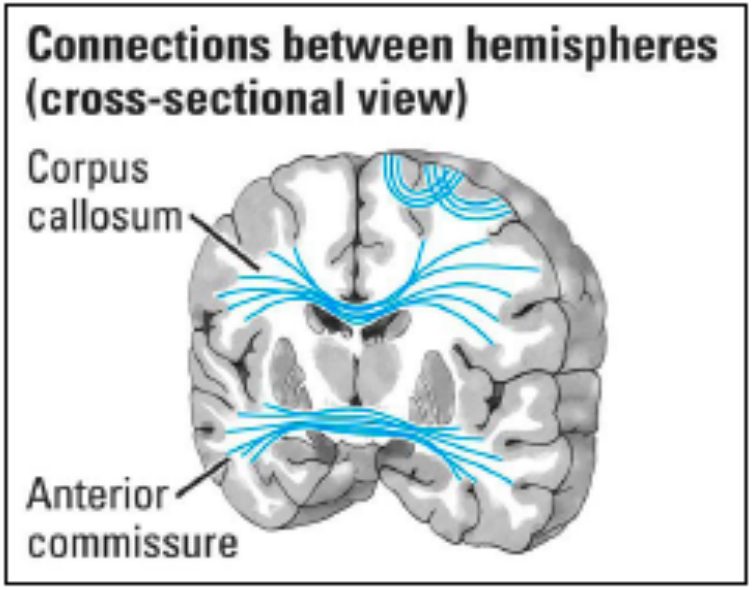




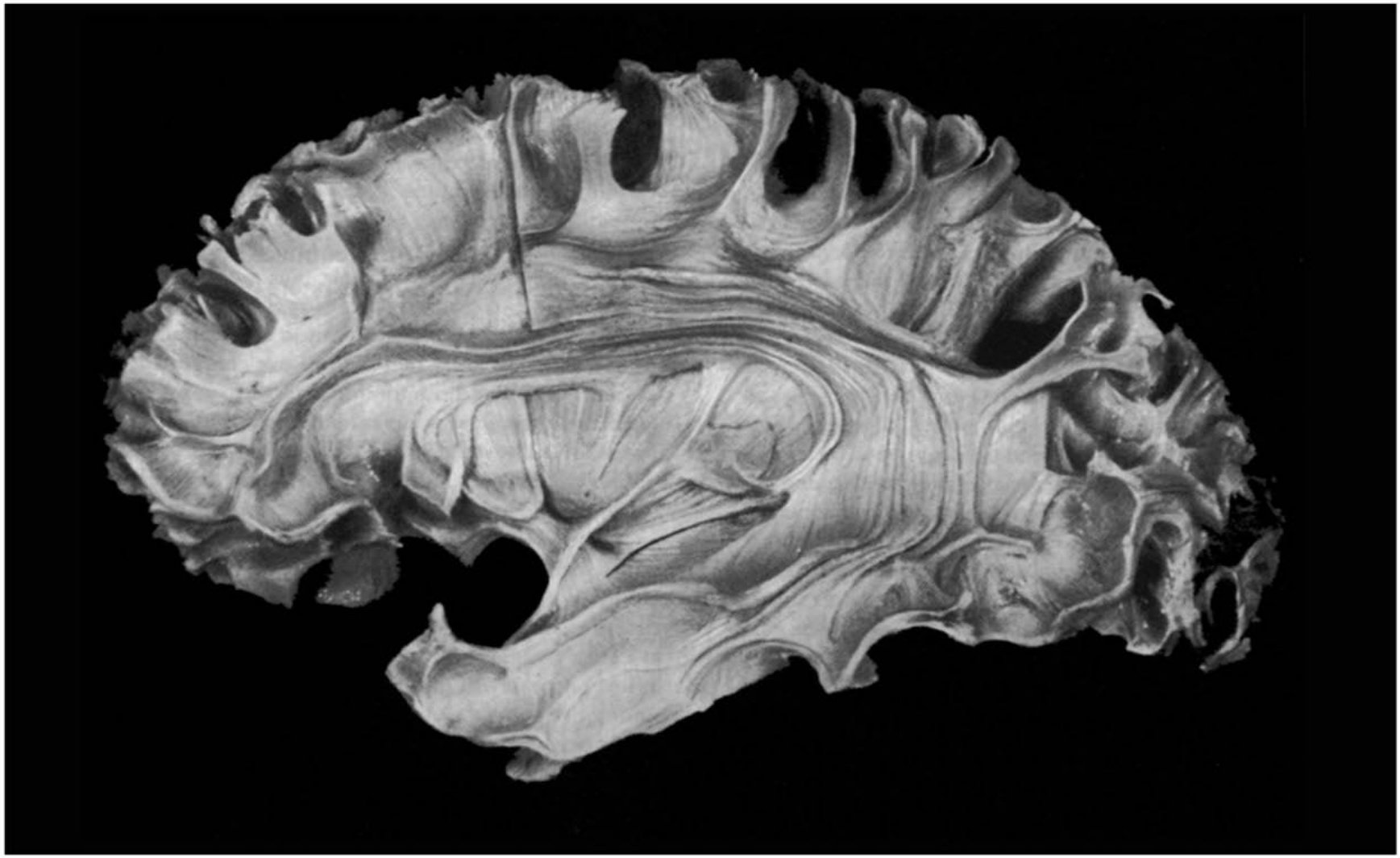
Brain Tour: Cortical Connections

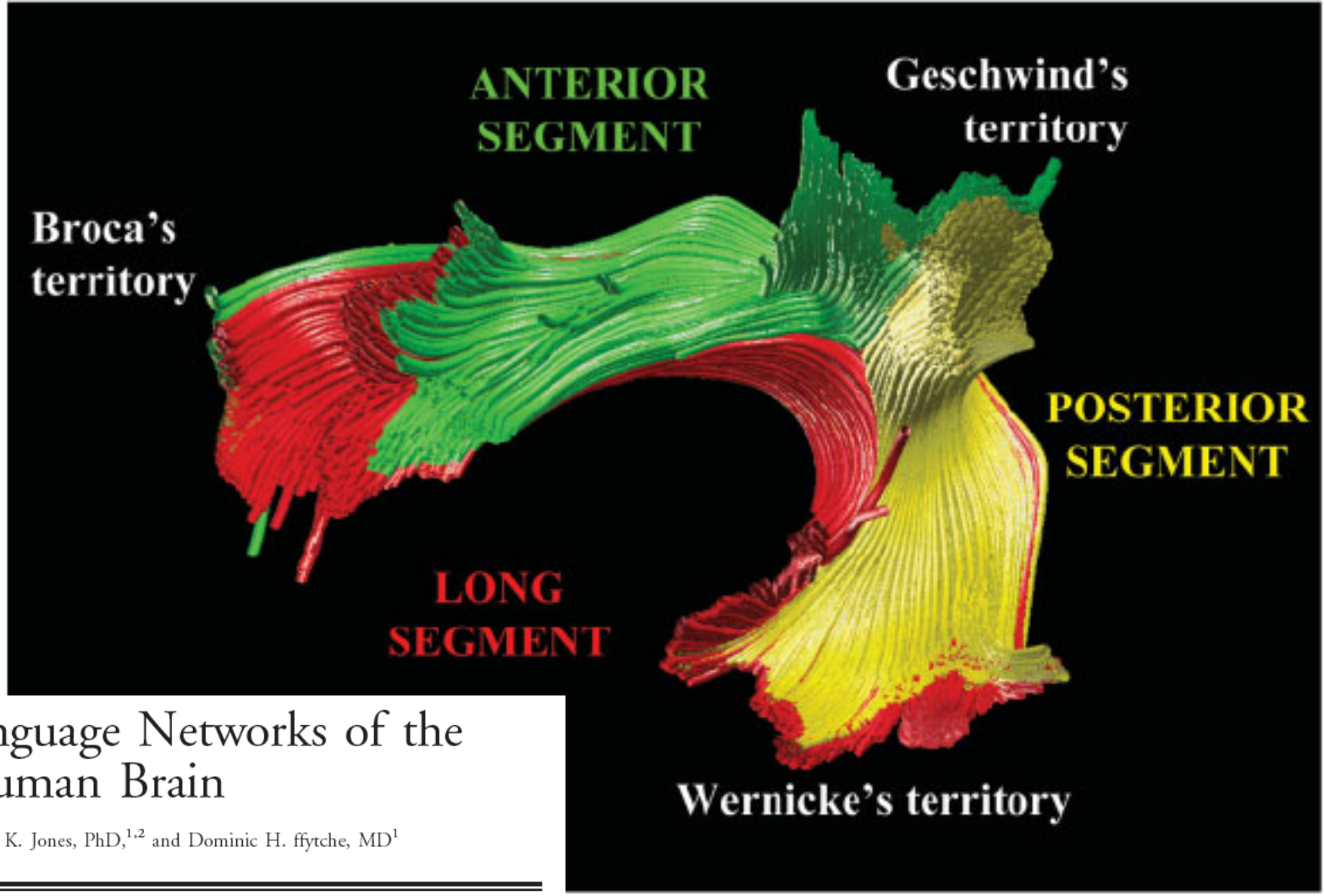






6.20 A sagittal drawing of the white-matter tracts of the human cerebral cortex.





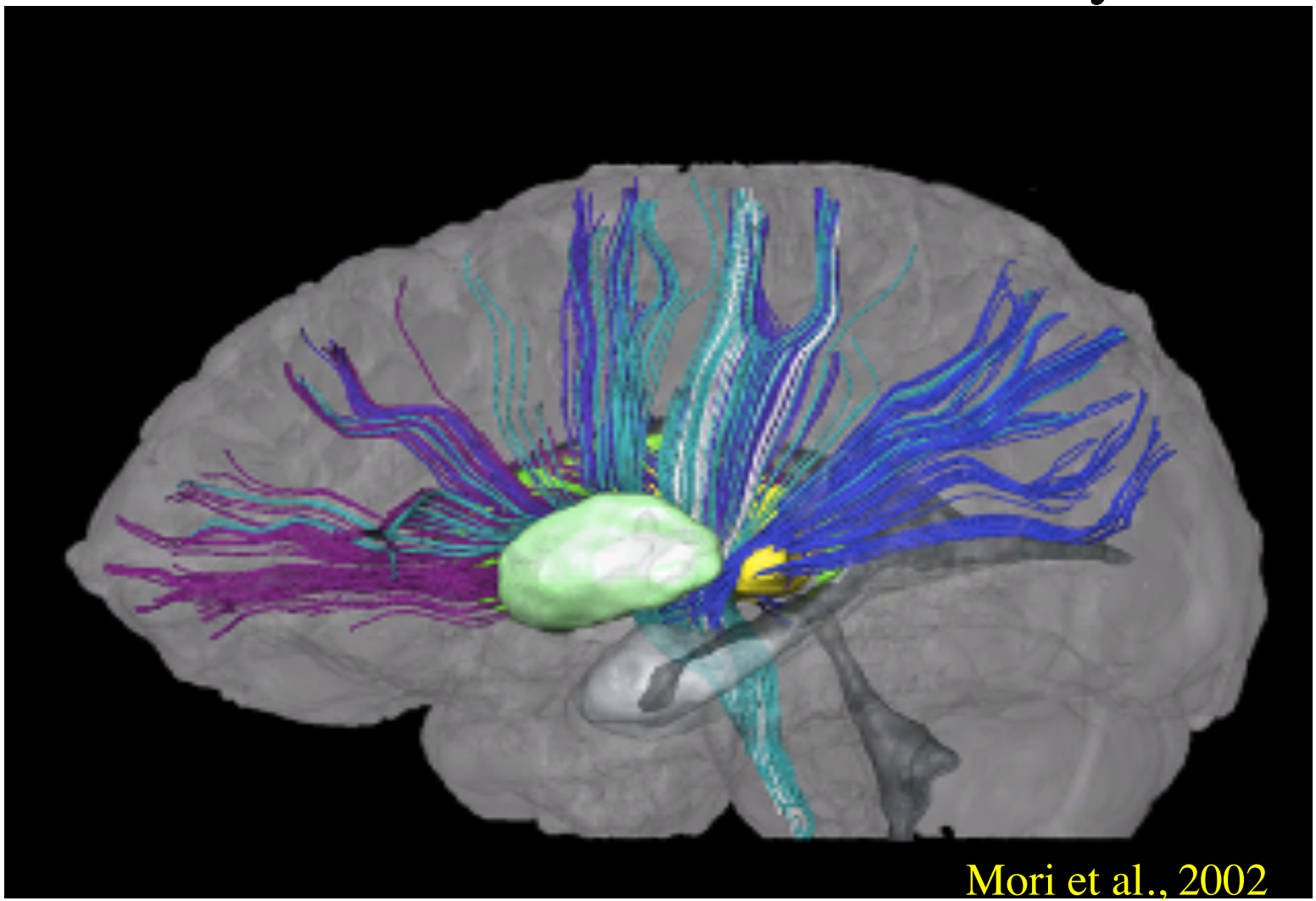
Perisylvian Language Networks of the Human Brain

Marco Catani, MD,[1] Derek K. Jones, PhD,[1,2] and Dominic H. ffytche, MD[1]

Early anatomically based models of language consisted of an arcuate tract connecting Broca's speech and Wernicke's comprehension centers; a lesion of the tract resulted in conduction aphasia. However, the heterogeneous clinical presentations of conduction aphasia suggest a greater complexity of perisylvian anatomical connections than allowed for in the classical anatomical model. This article re-explores perisylvian language connectivity using in vivo diffusion tensor magnetic resonance imaging tractography. Diffusion tensor magnetic resonance imaging data from 11 right-handed healthy male subjects were averaged, and the arcuate fasciculus of the left hemisphere reconstructed from this data using an interactive dissection technique. Beyond the classical arcuate pathway connecting Broca's and Wernicke's areas directly, we show a previously undescribed, indirect pathway passing through inferior parietal cortex. The indirect pathway runs parallel and lateral to the classical arcuate fasciculus and is composed of an anterior segment connecting Broca's territory with the inferior parietal lobe and a posterior segment connecting the inferior parietal lobe to Wernicke's territory. This model of two parallel pathways helps explain the diverse clinical presentations of conduction aphasia. The anatomical findings are also relevant to the evolution of language, provide a framework for Lichtheim's symptom-based neurological model of aphasia, and constrain, anatomically, contemporary connectionist accounts of language.

Ann Neurol 2005;57:8–16

Diffusion Tensor Imaging (DTI) measures white matter anatomy



Cortico-Thalamic projections and connections from motor cortex to the pyramidal tracts in the pons

Quelques notions sur le développement du cerveau

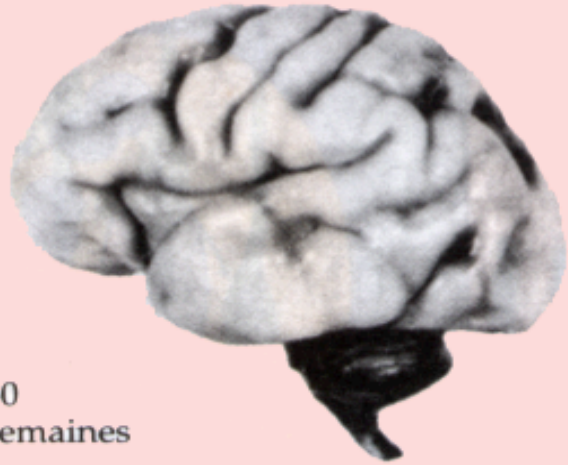
(e)

10
semaines

15
semaines

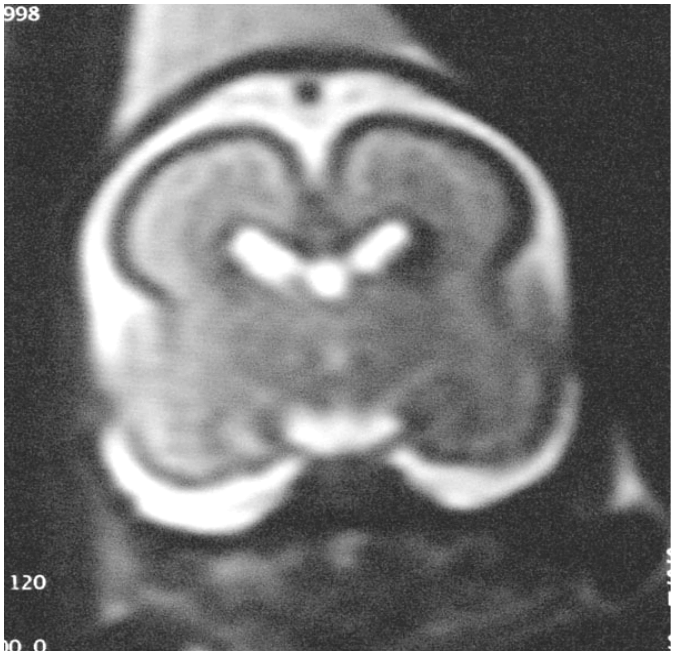
24
semaines

Gyrification
Flexion télencéphalique
opercularisation



30
semaines

41
semaines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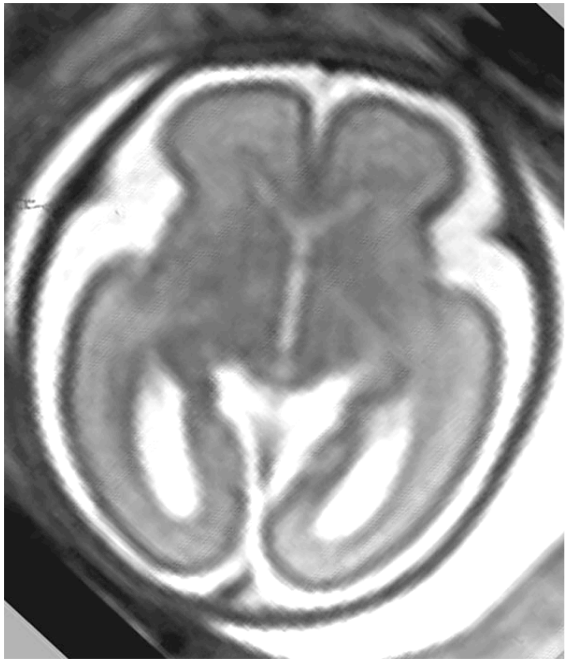
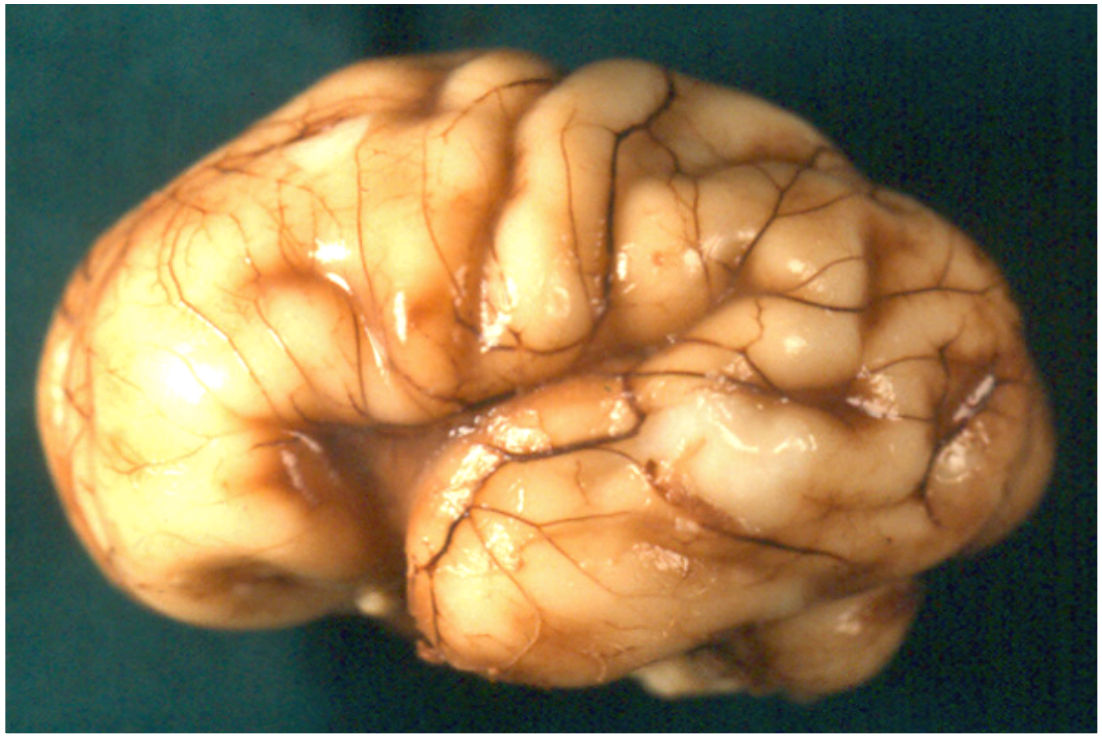
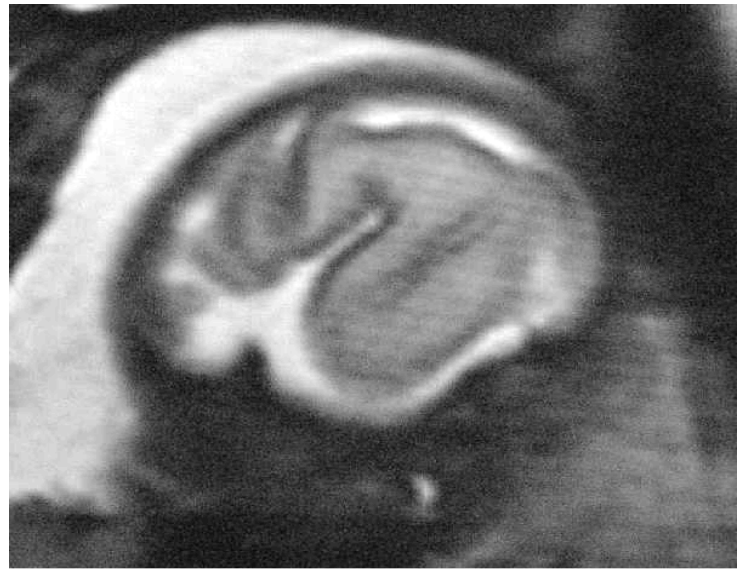
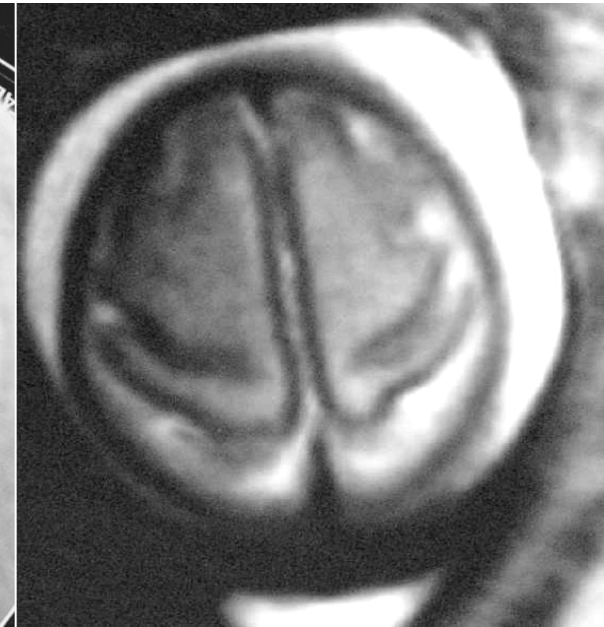
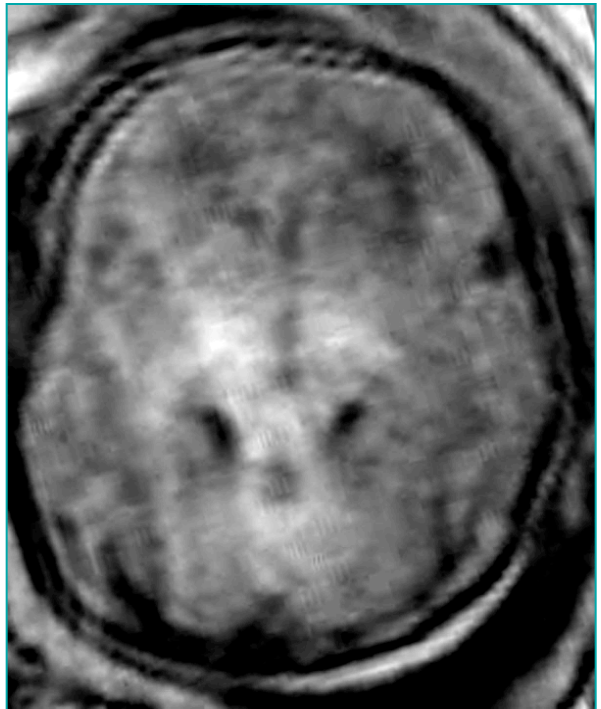
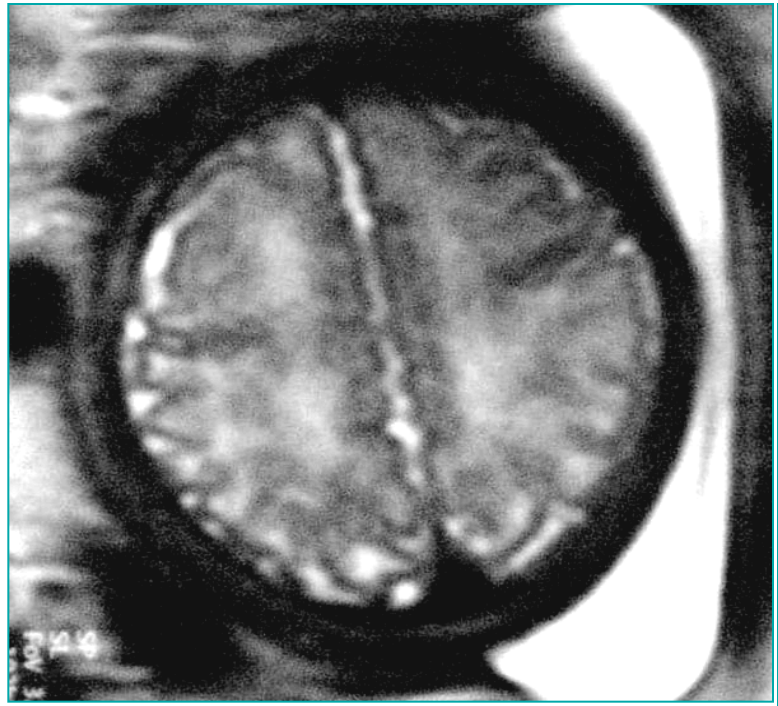


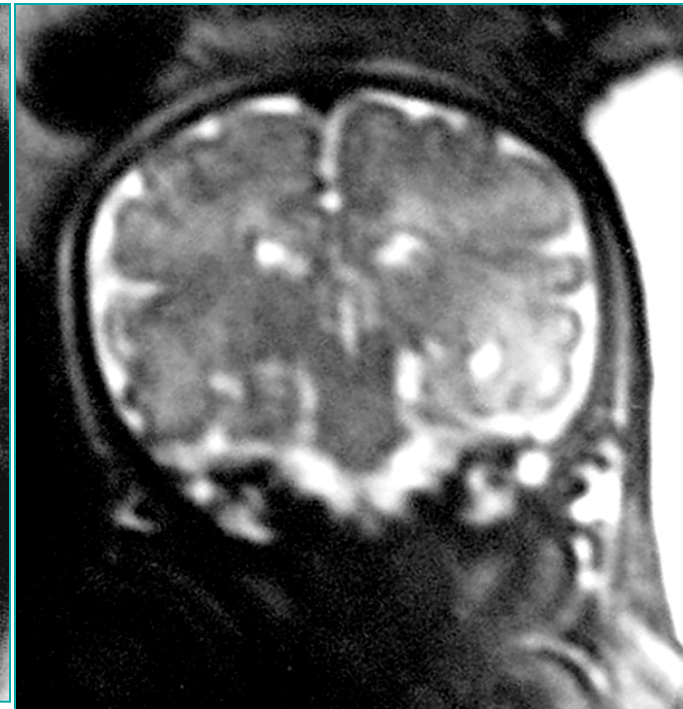


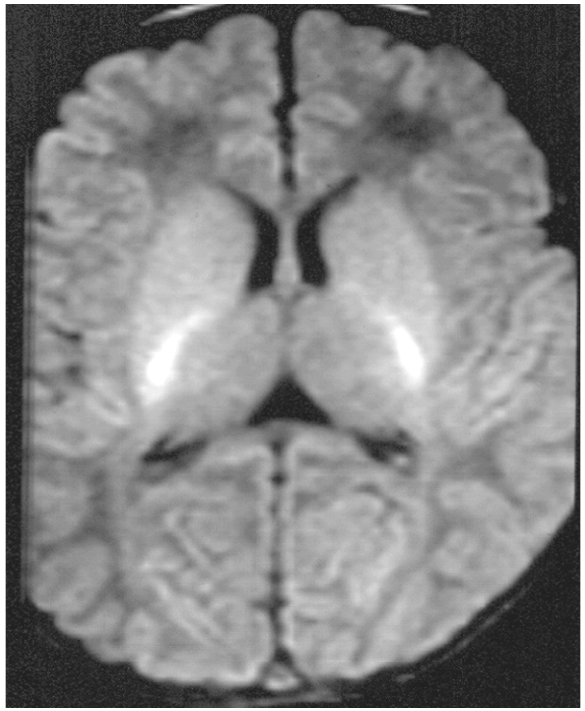




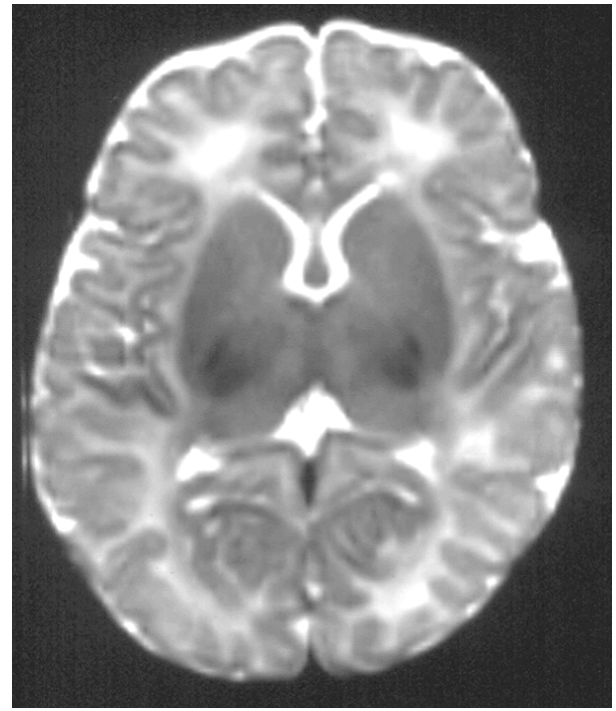


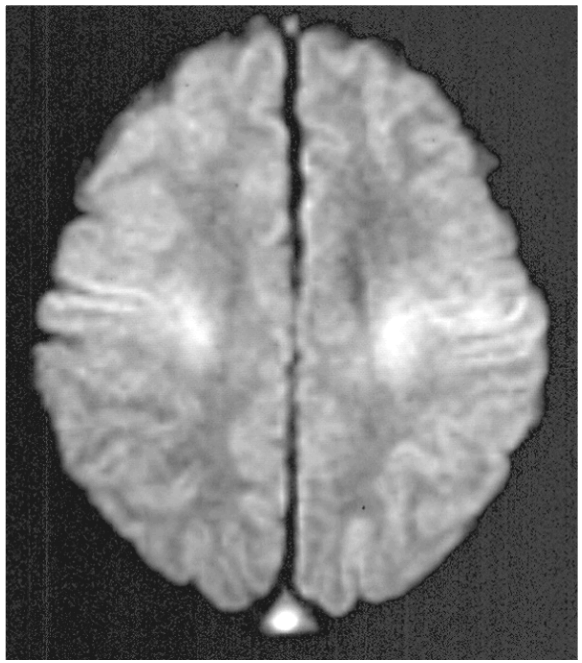


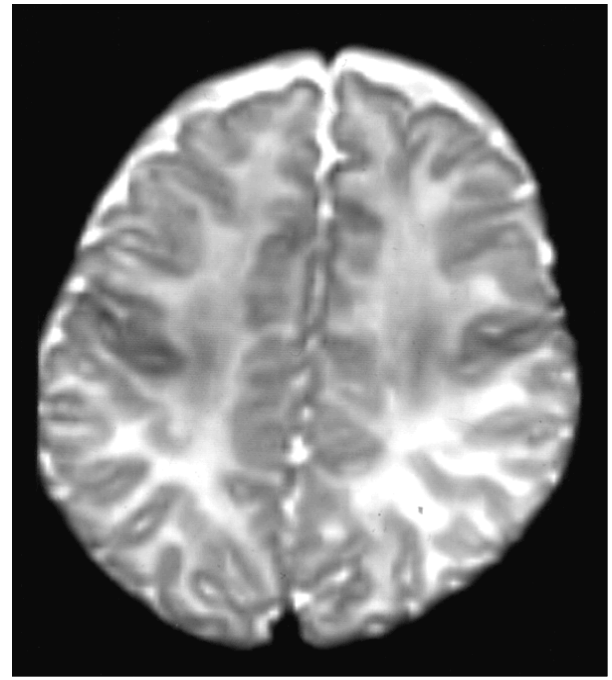


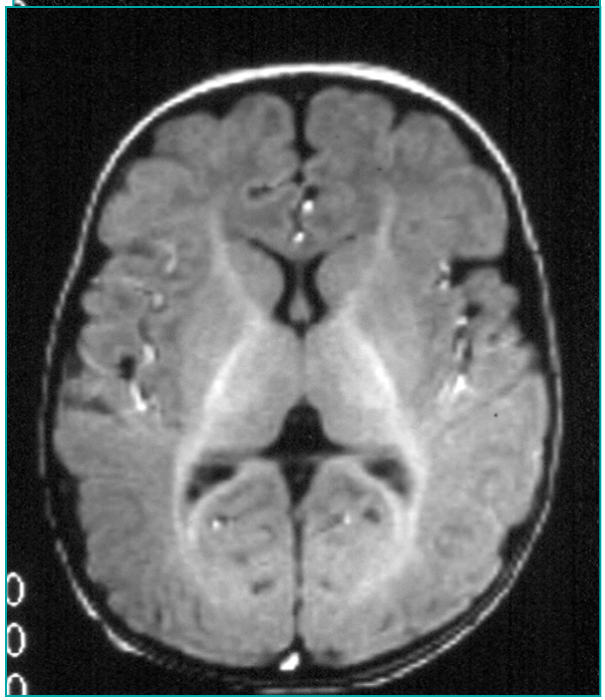


Naissance à terme

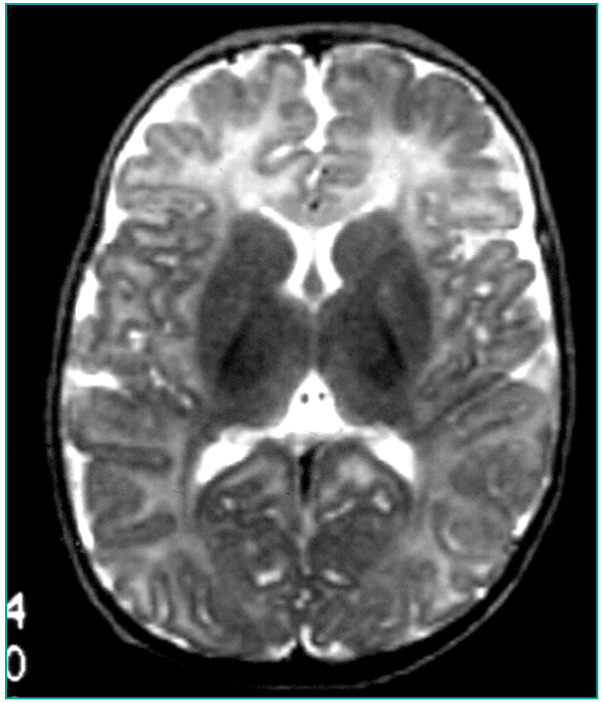


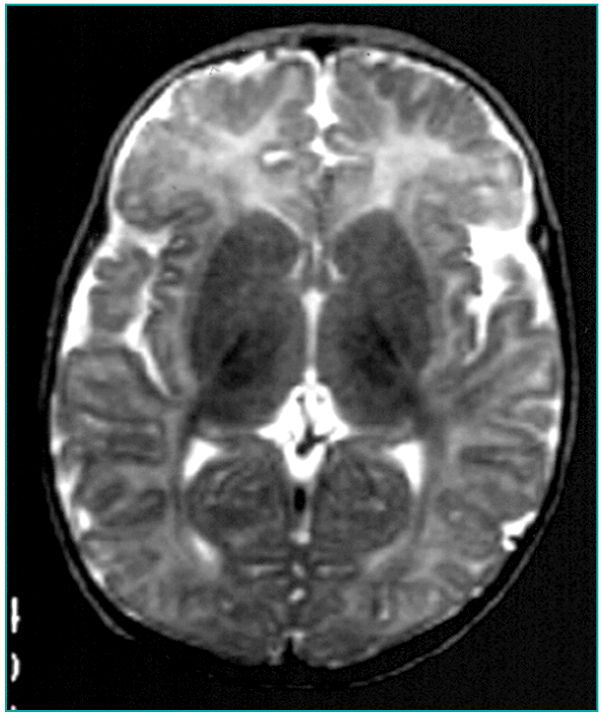


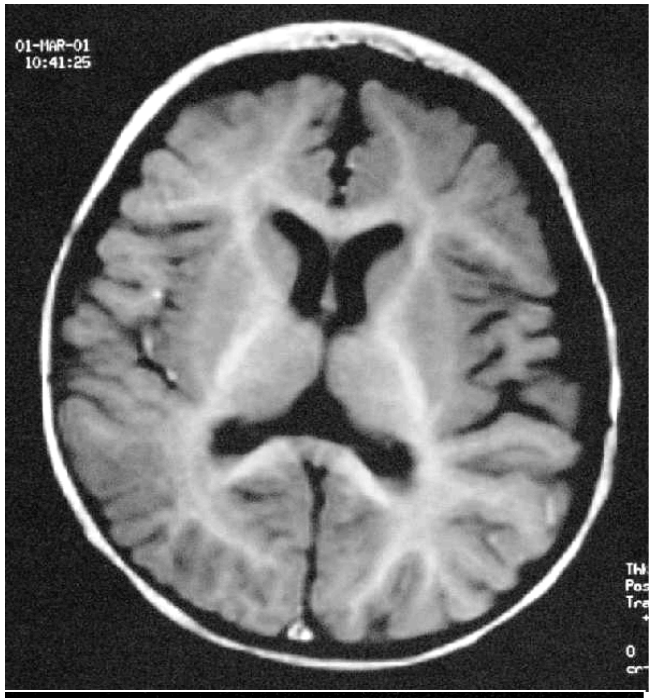




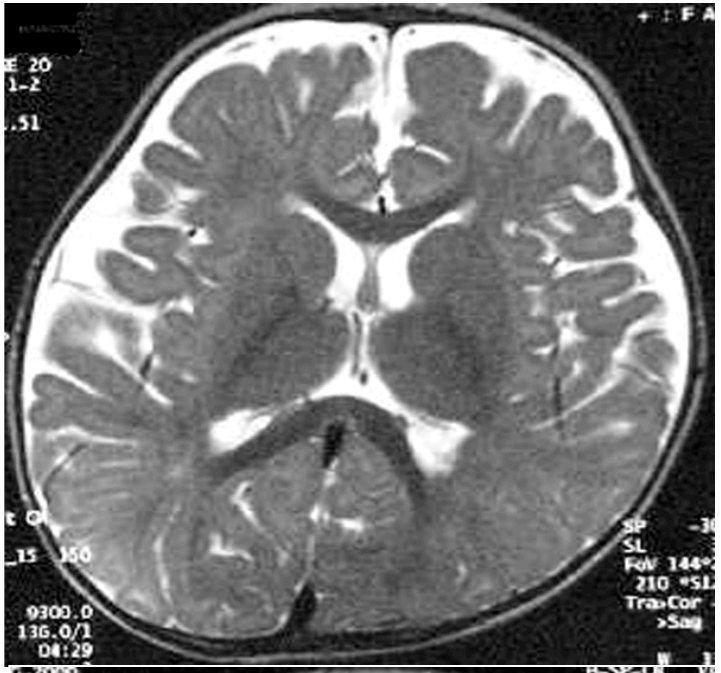
4 mois

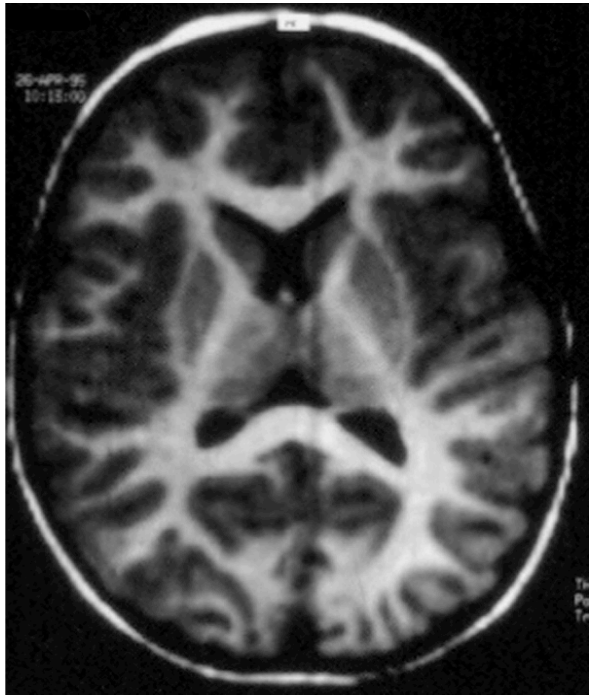




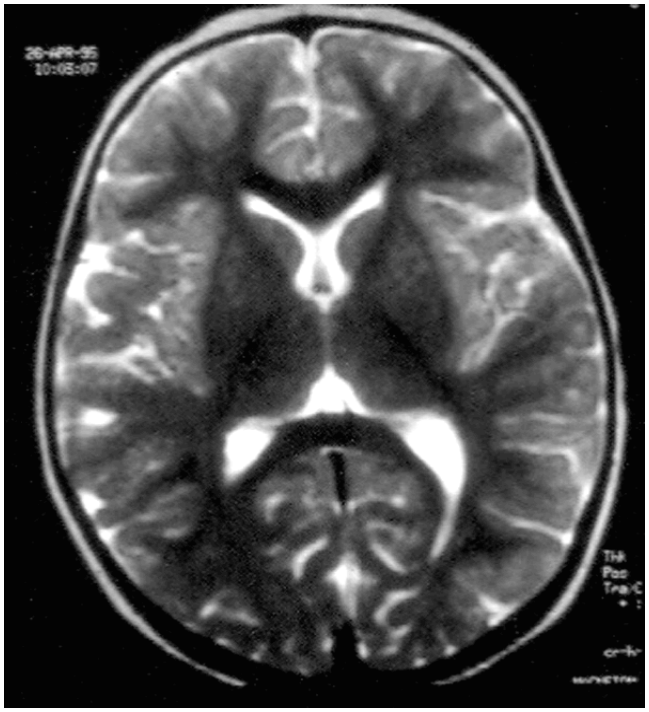


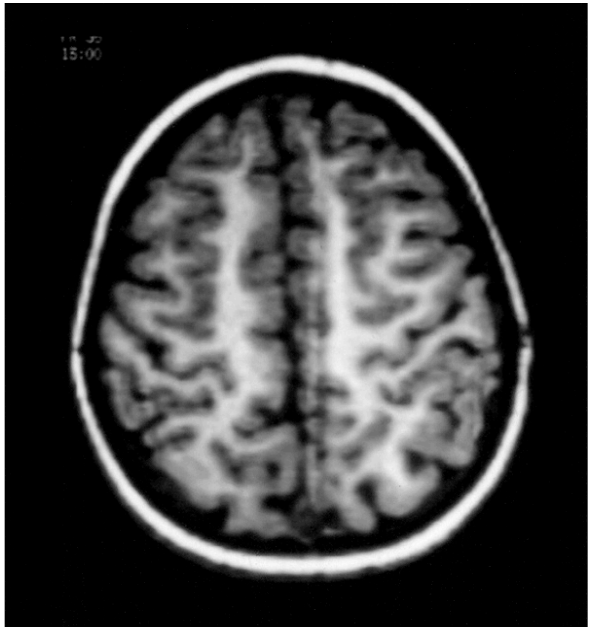
8 mois

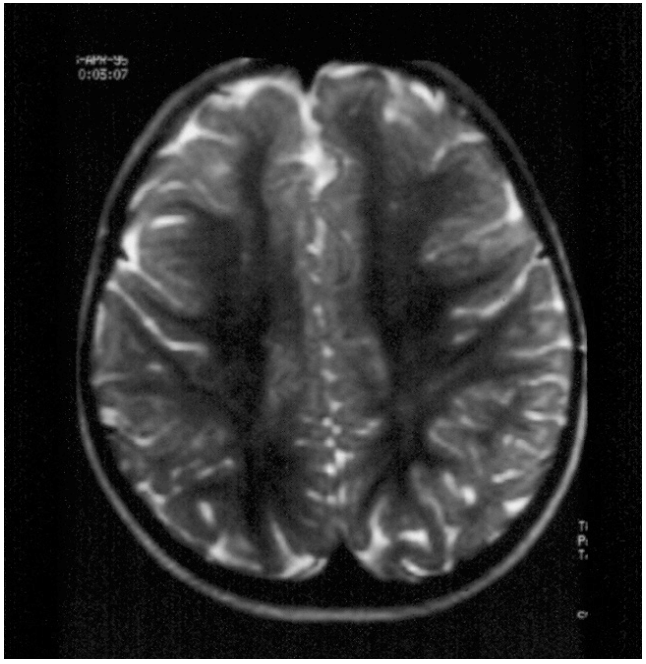


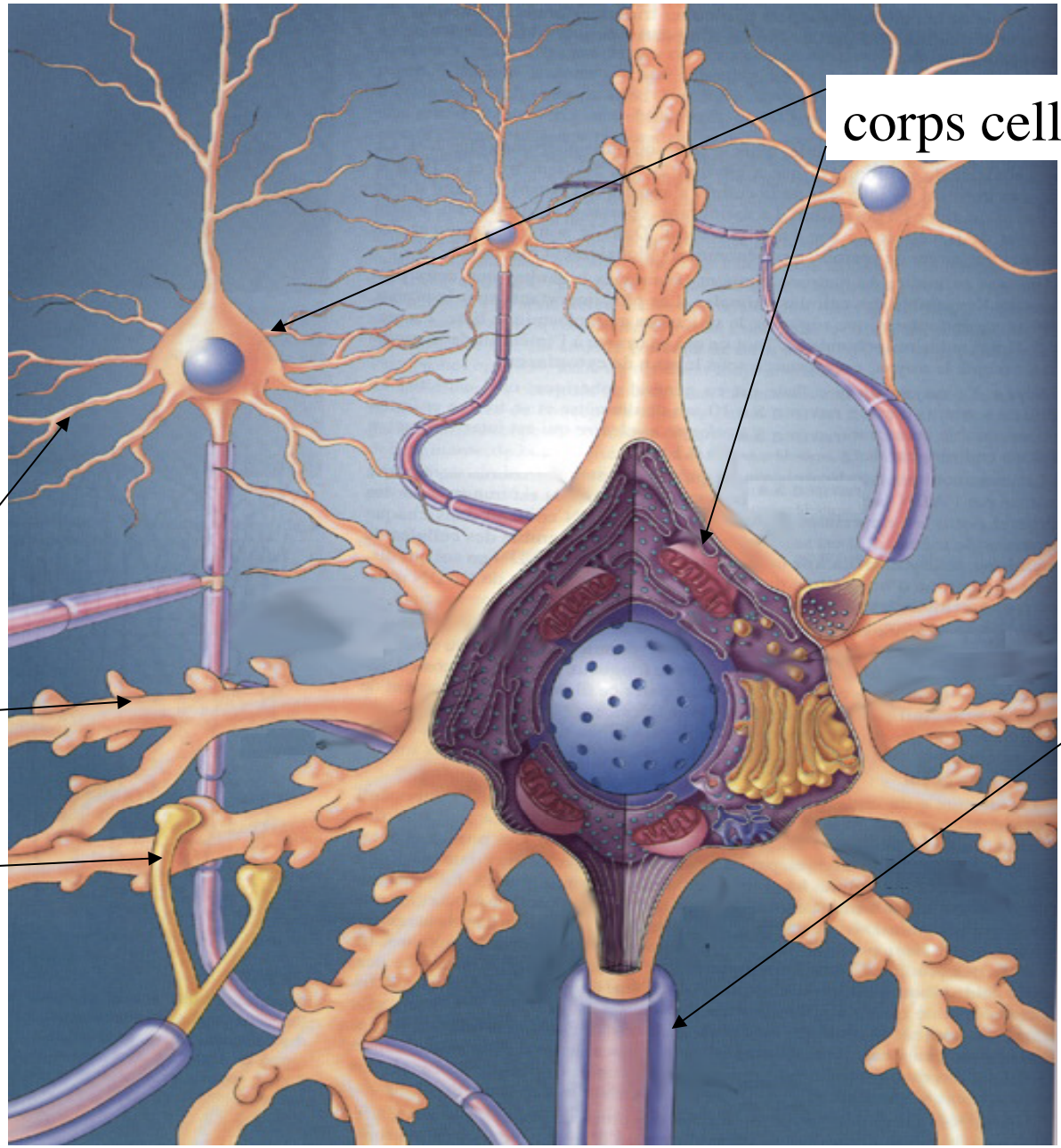


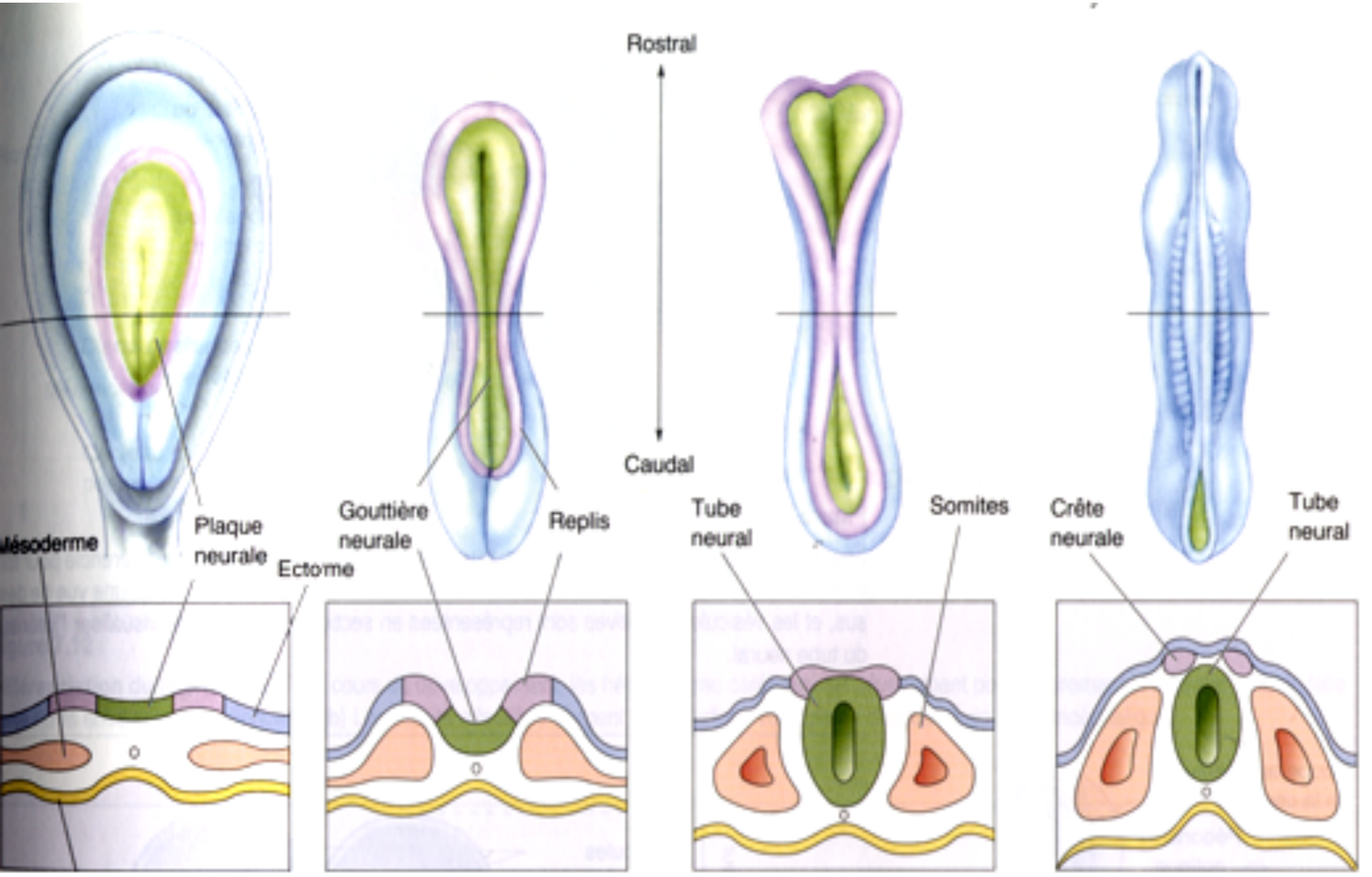
18 mois

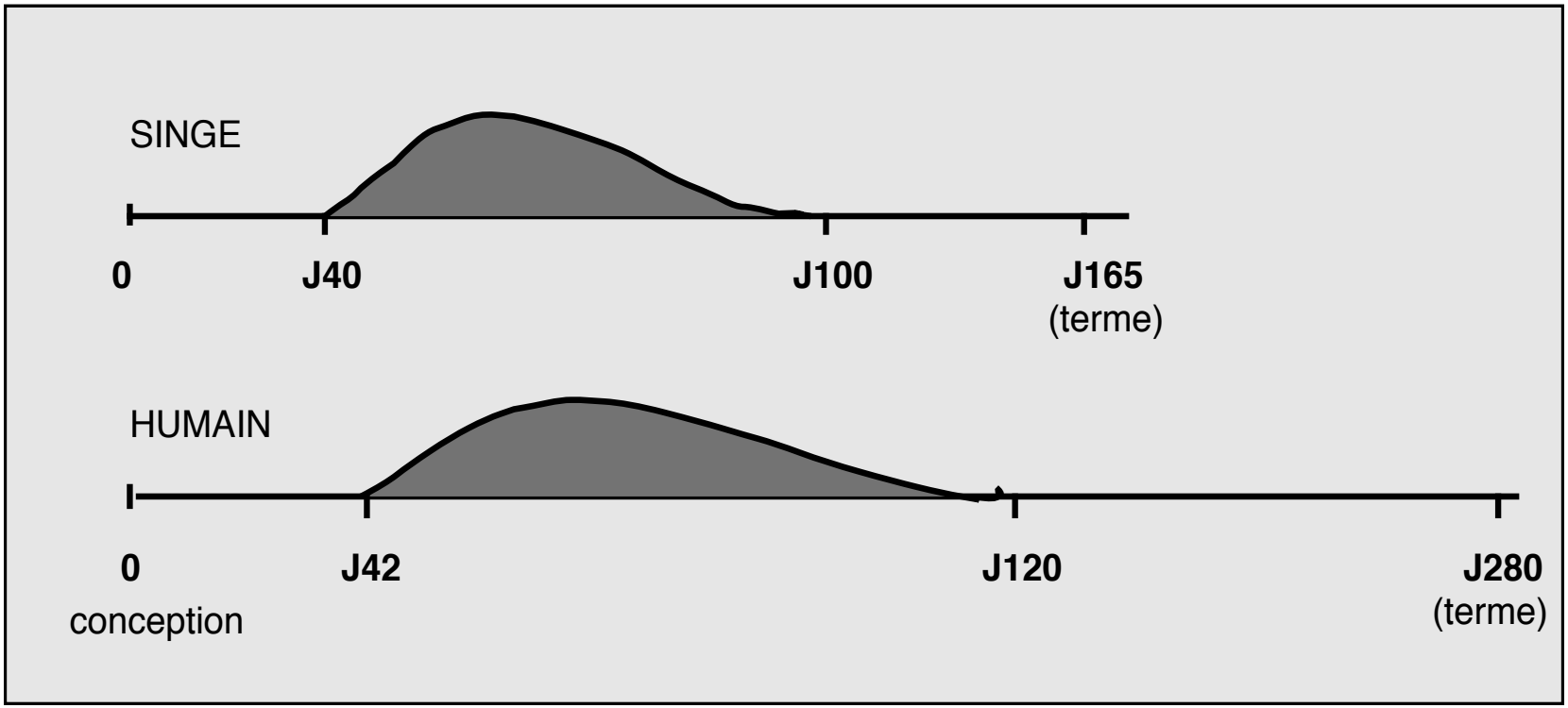







corps cellulaire
dendrites
axone
synapse

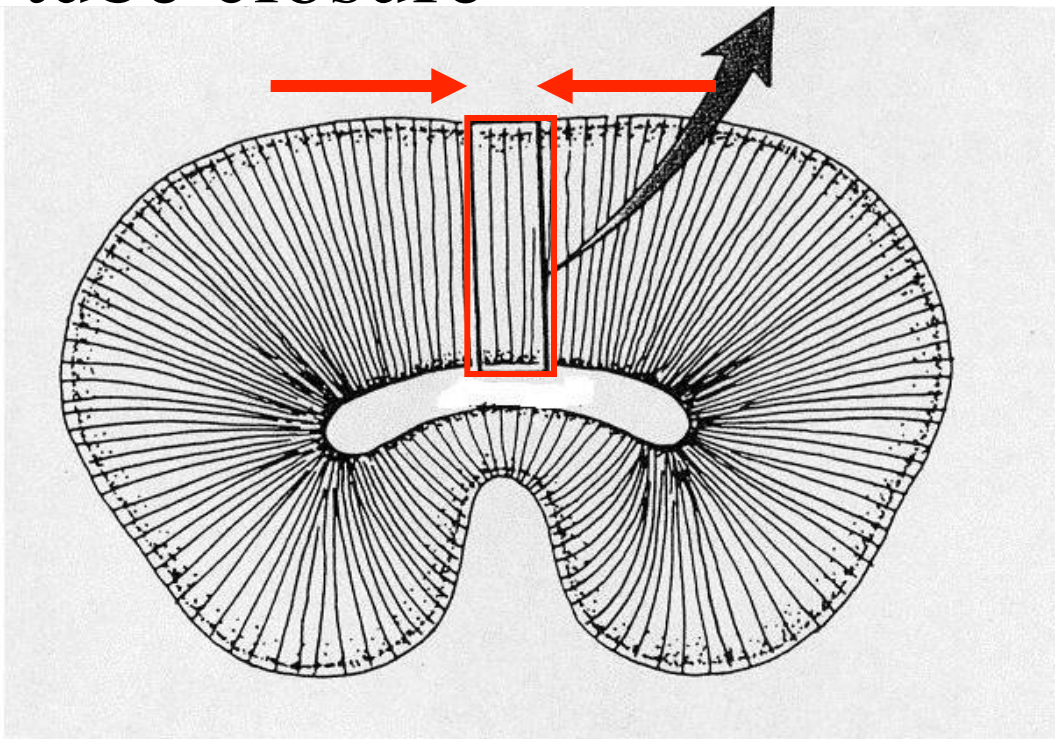

Rostral
Caudal
Mésoderme
Plaque neurale
Ectome
Gouttière neurale
Replis
Tube neural
Somites
Crête neurale
Tube neural



phase de prolifération neuronale

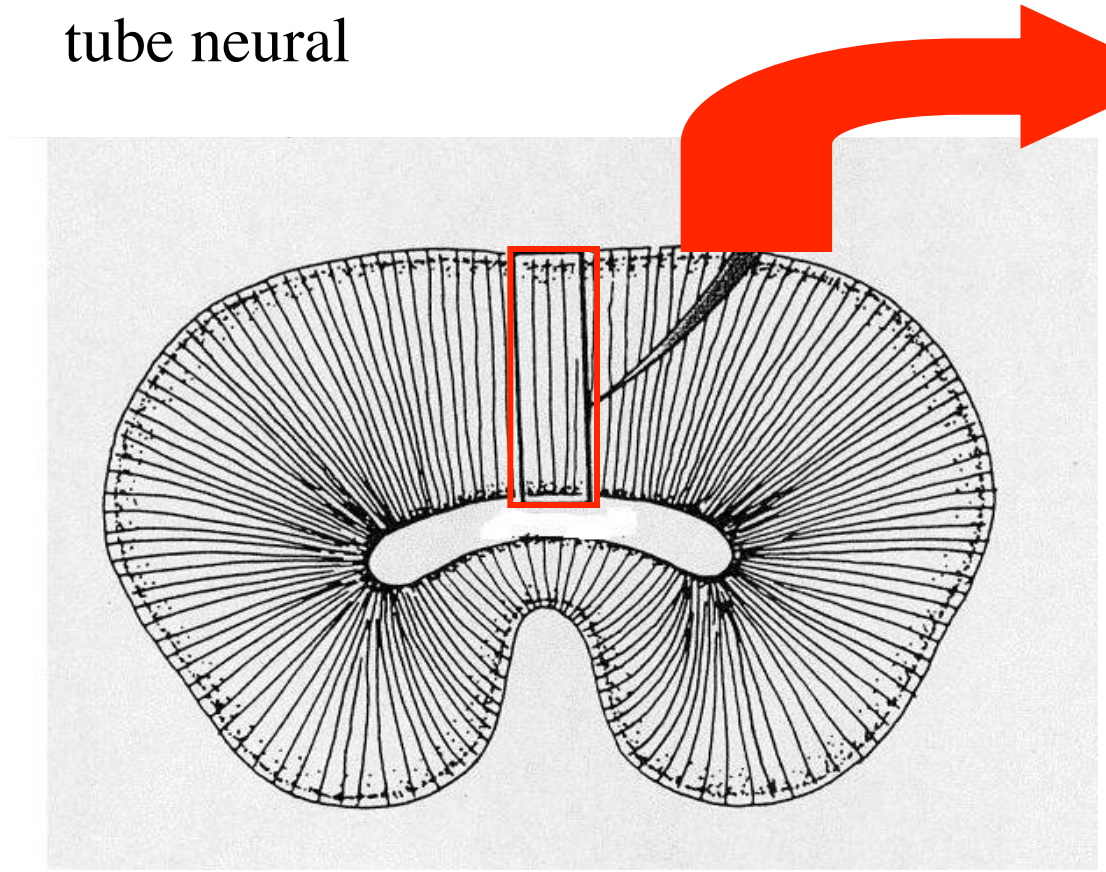
1. Neural proliferation

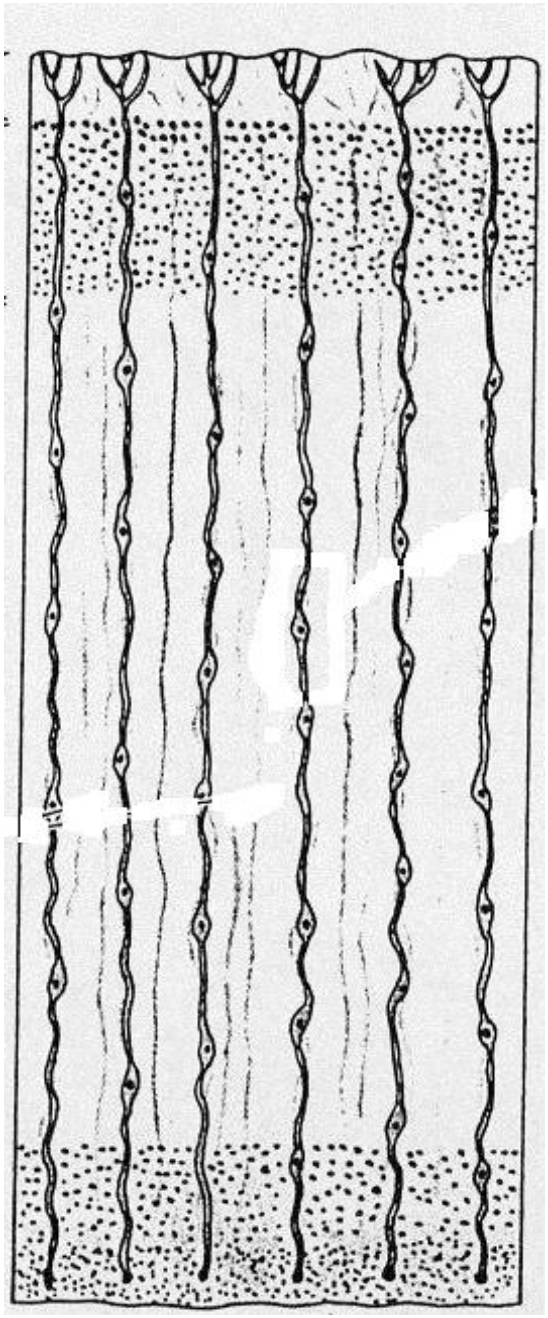
- Begins with neural tube closure



1. Prolifération neuronale

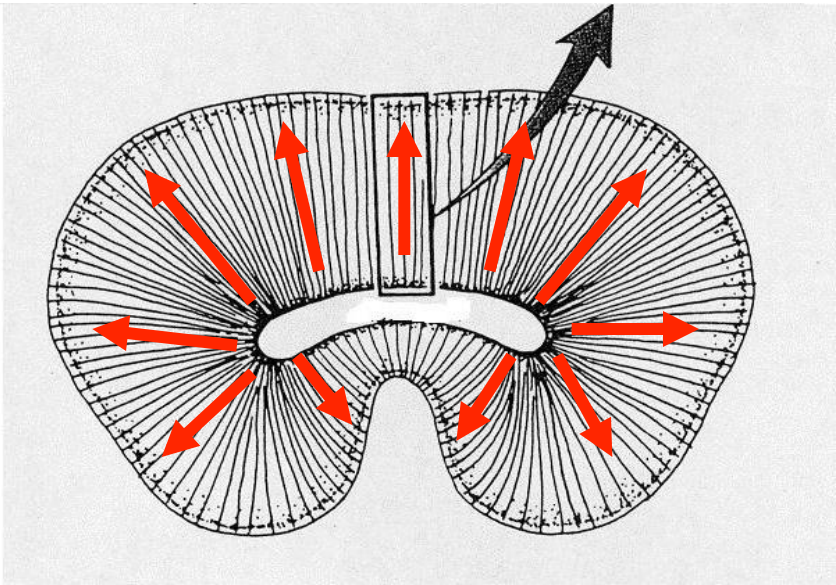
- Commence avec la fermeture du tube neural

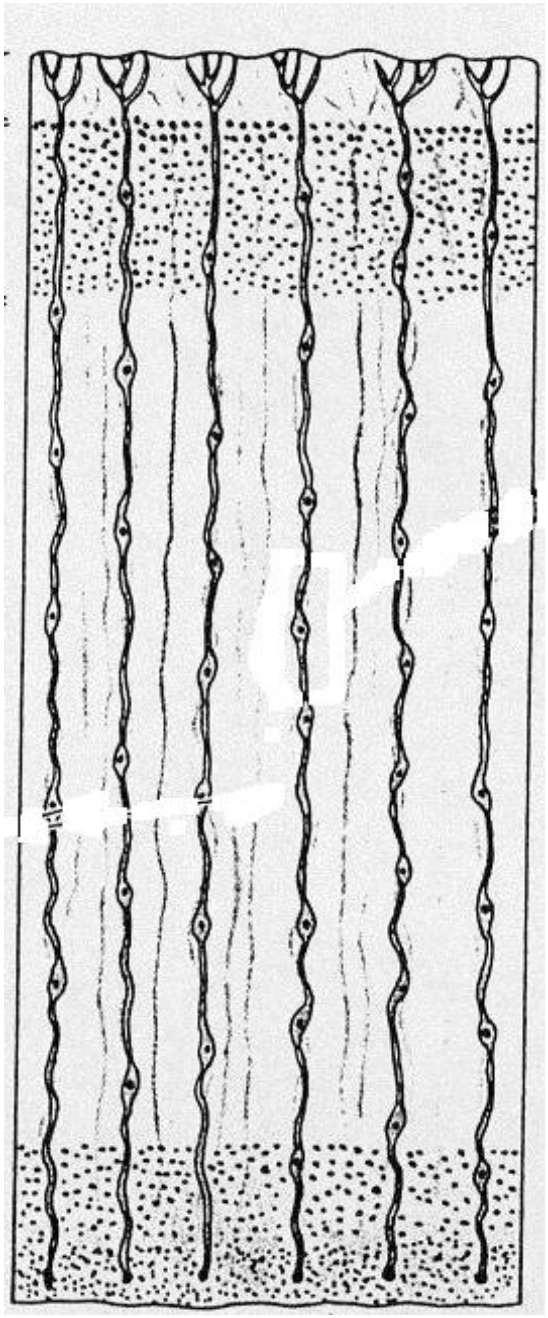


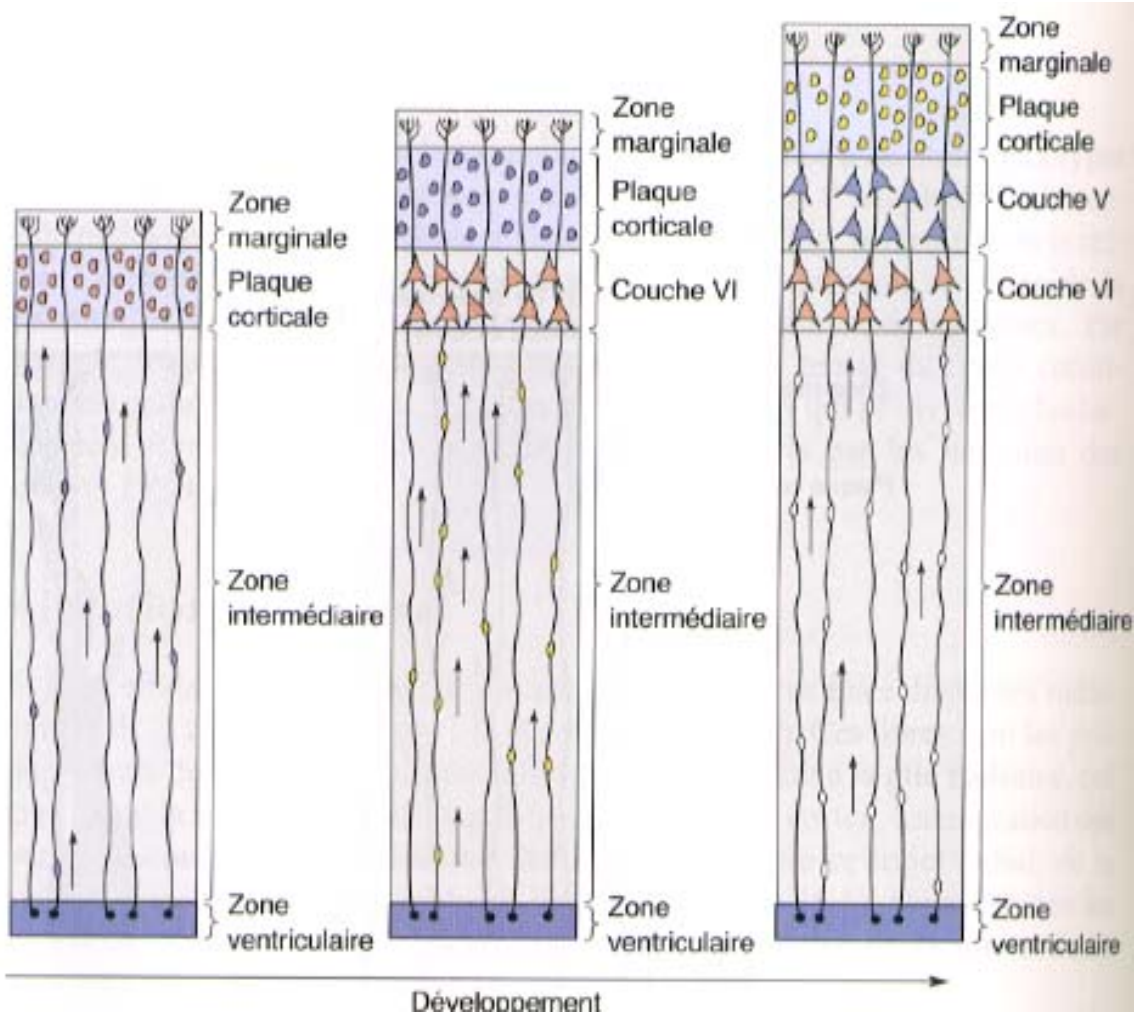


2: Migration cellulaire

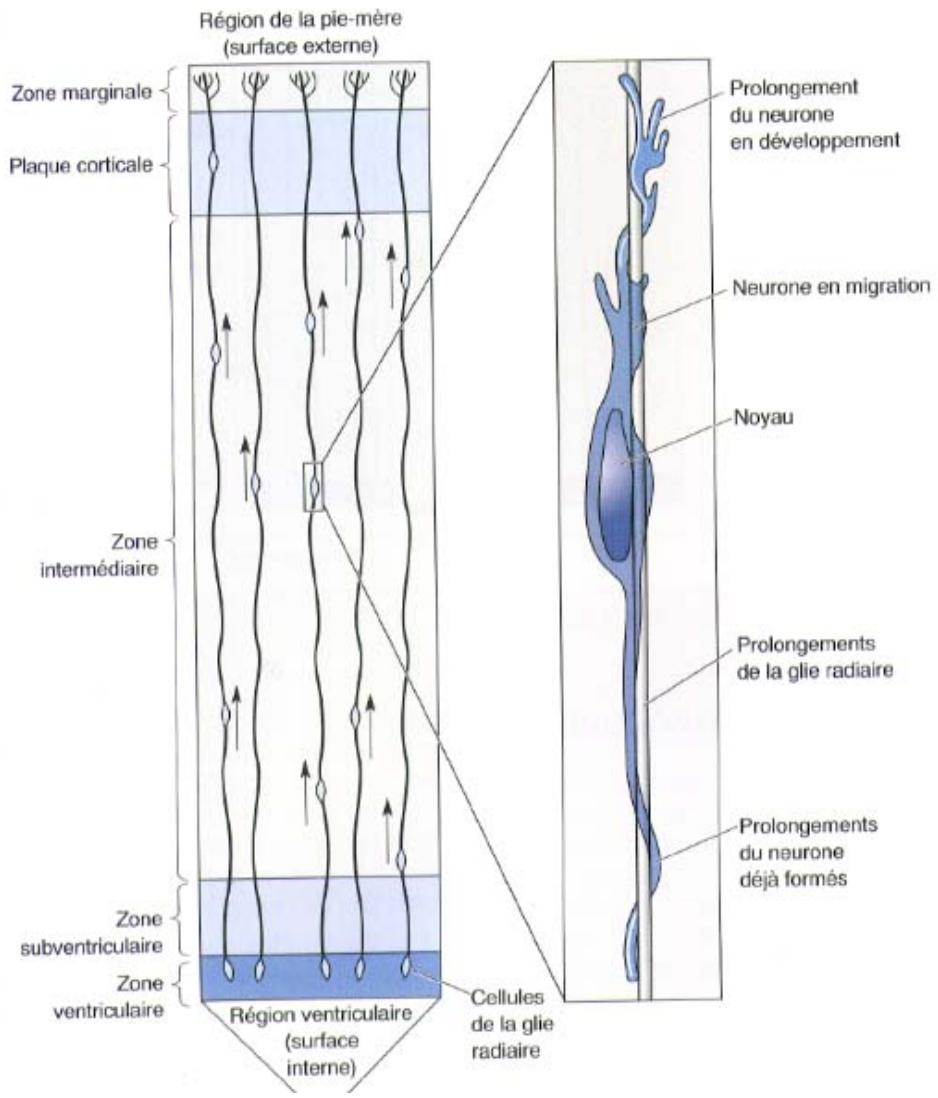
- Les cellules non en cours de division migrent à partir de la couche ventriculaire
- Crée un développement radiaire de l'intérieur à l'extérieur





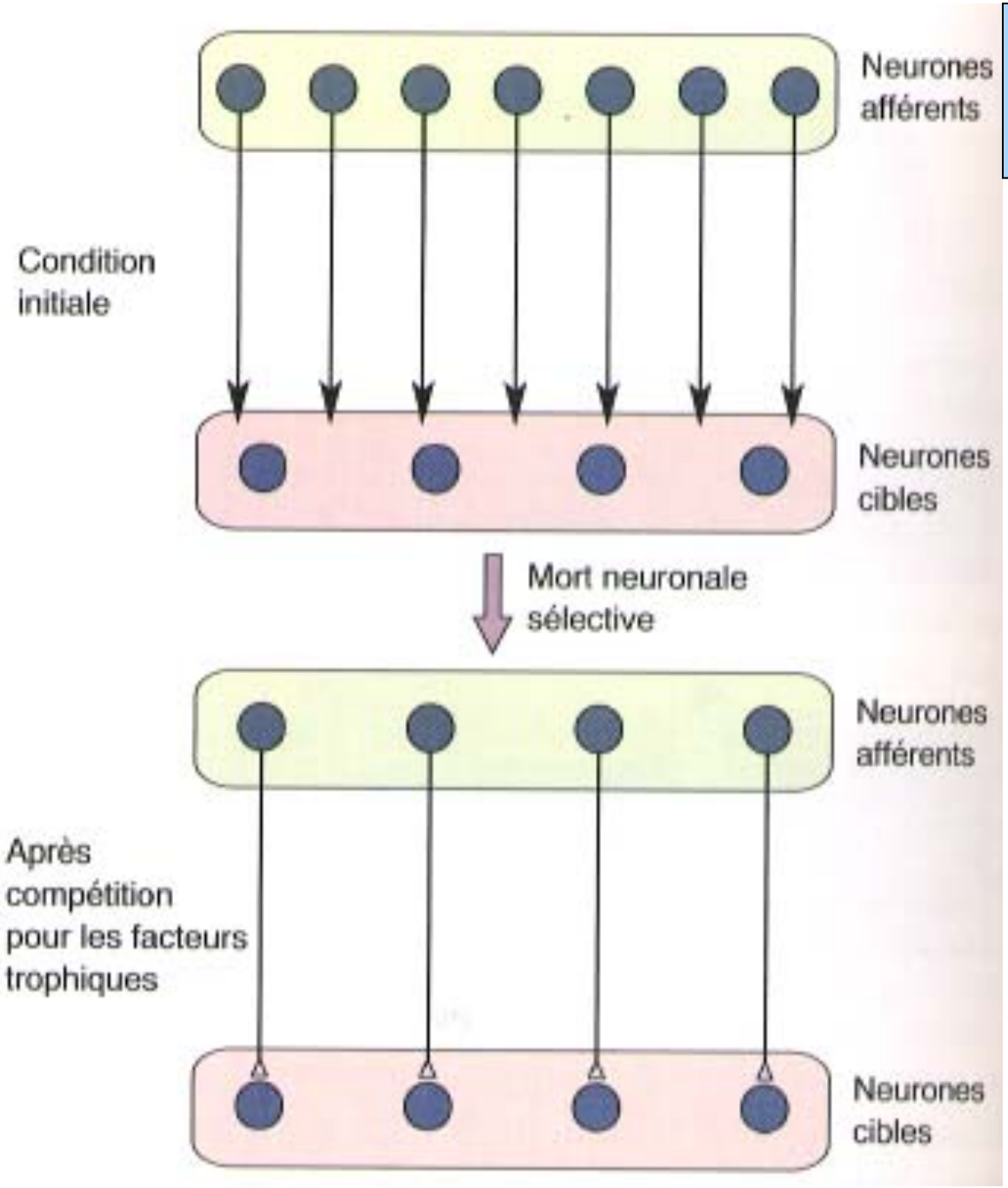


Tout laisse à penser que les règles d'organisation de cette phase migratoire sont incluses dans le programme génétique de l'individu, c'est-à-dire que la position qu'adoptera chaque cellule dans le cortex est déjà prévue dès sa production initiale



chaque neurone semble "choisir" son rail glial en fonction de la présence à la surface de ce dernier de certaines molécules, dites molécules d'adhésion

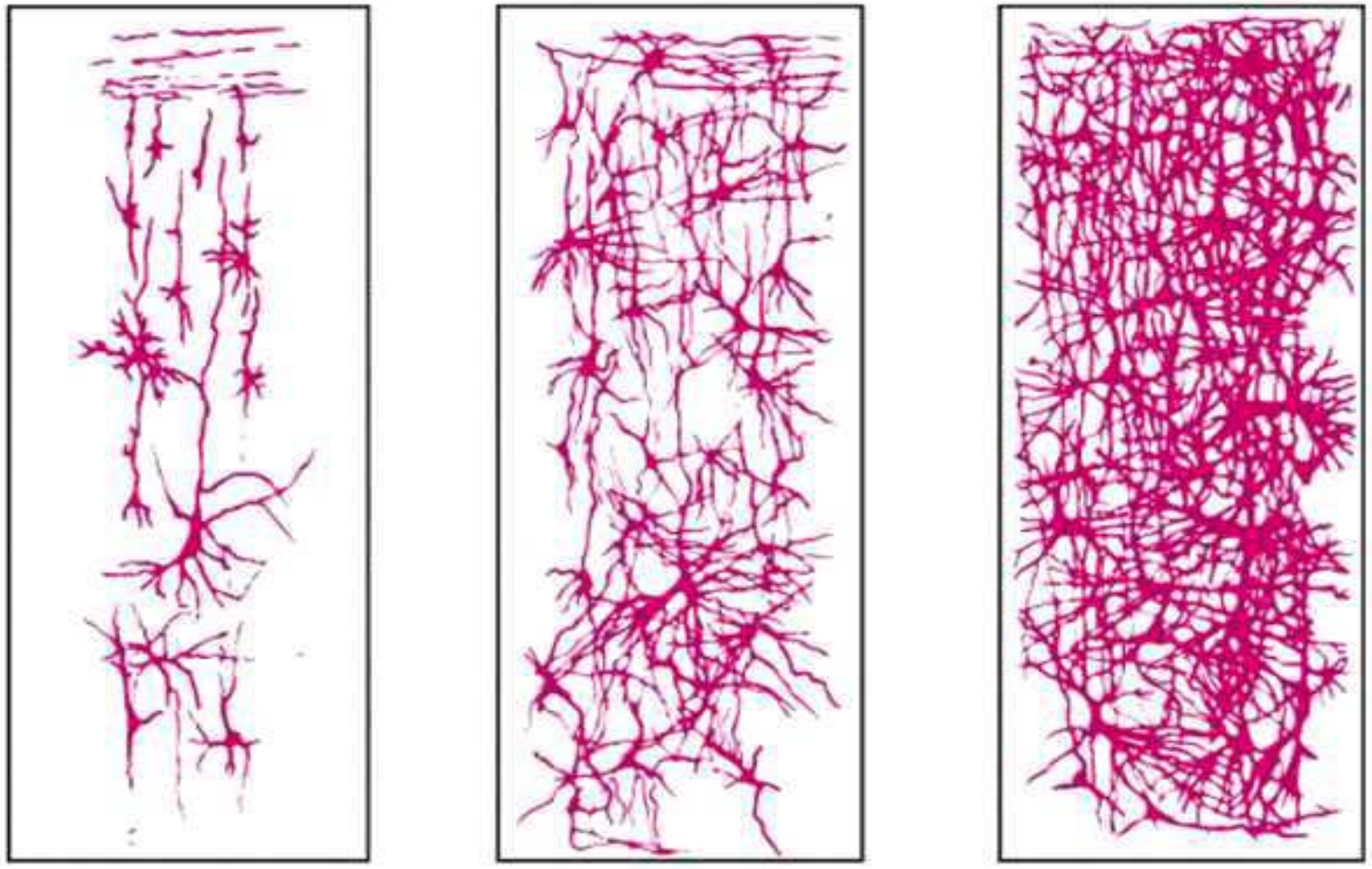
Perte neuronale physiologique des neurones



1- compétition pour l'établissement de synapses

2- des facteurs trophiques déterminent, par leur concentration au niveau des terminaisons synaptiques, la survivance ou l'élimination des neurones

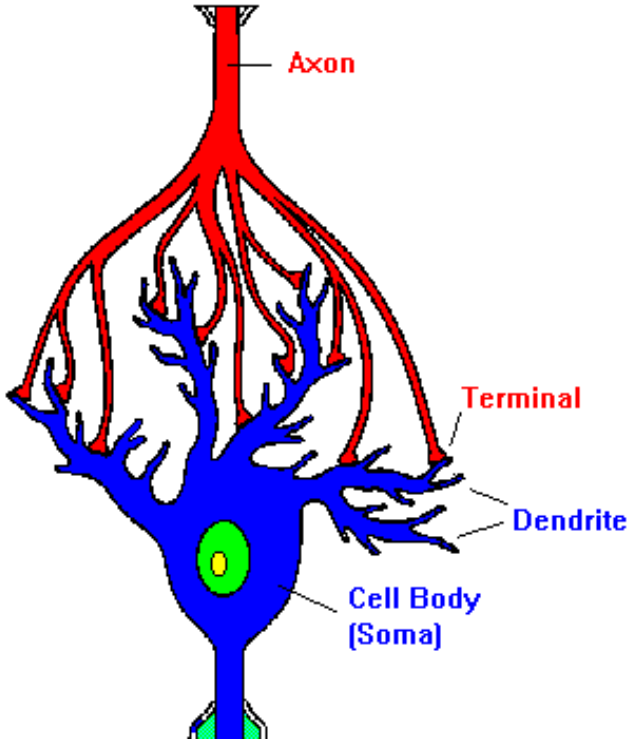
Une fois arrivé à destination, le neurone commence à développer ses prolongements ("sprouting")
Cette phase connaît son maximum d'intensité jusqu'à 18 mois

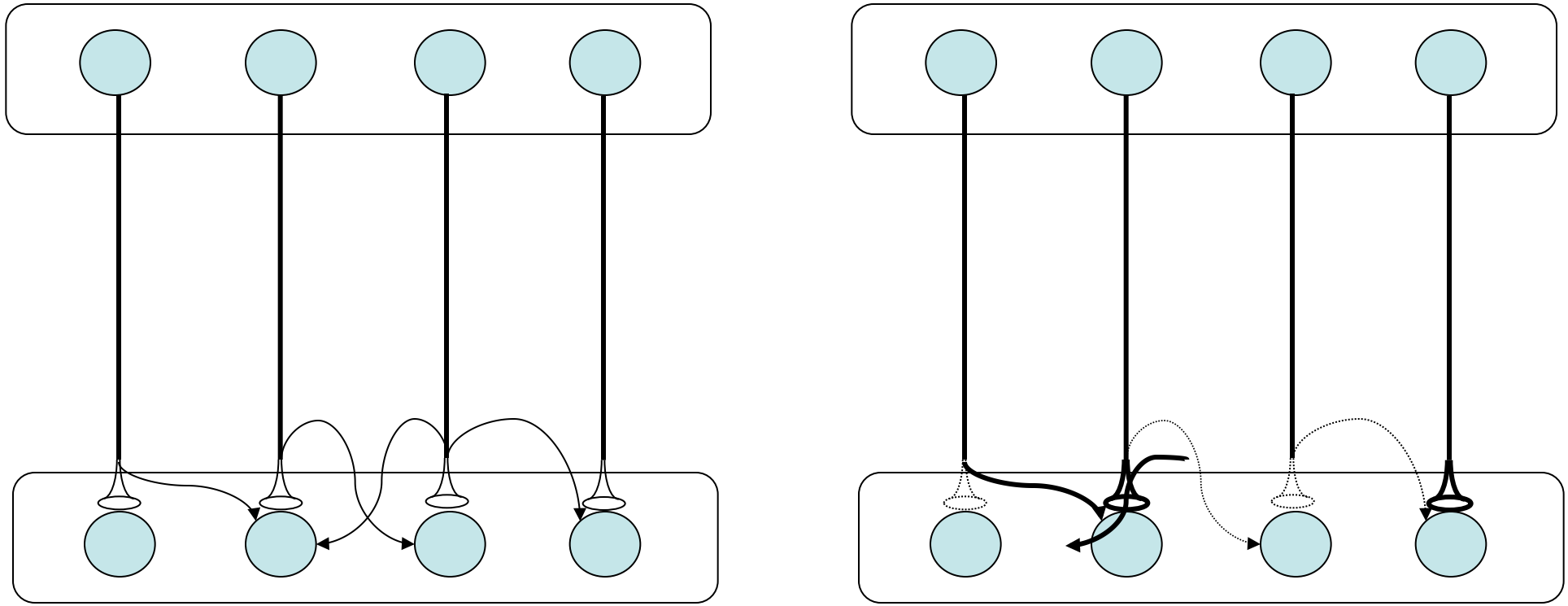


Prolifération dendritique : atteint son maximum vers 2 ans : ensuite, perte de milliers de connexions ("pruning"). Vers 16 ans, seulement la moitié des synapses persistent

Synaptogenèse

- A lieu au fur et à mesure de la création des arborisations dendritiques
- Les synapses se forment à un rythme différent selon les régions
    - lobe occipital : début pré-natal, niveau proche de la densité adulte entre 2 et 4 ans
    - cortex pré-frontal : n'atteint pas son niveau définitif avant le début de l'âge adulte

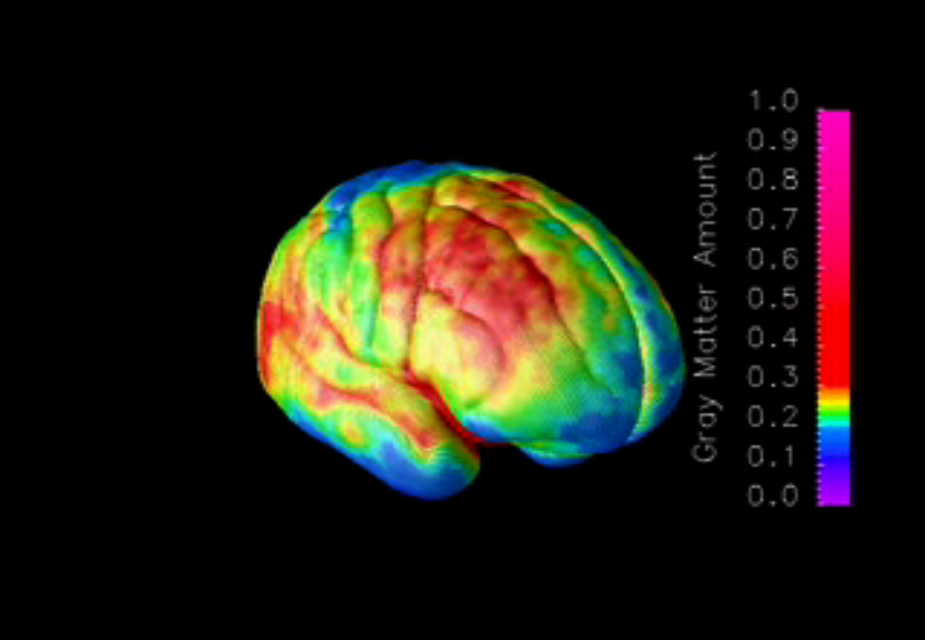


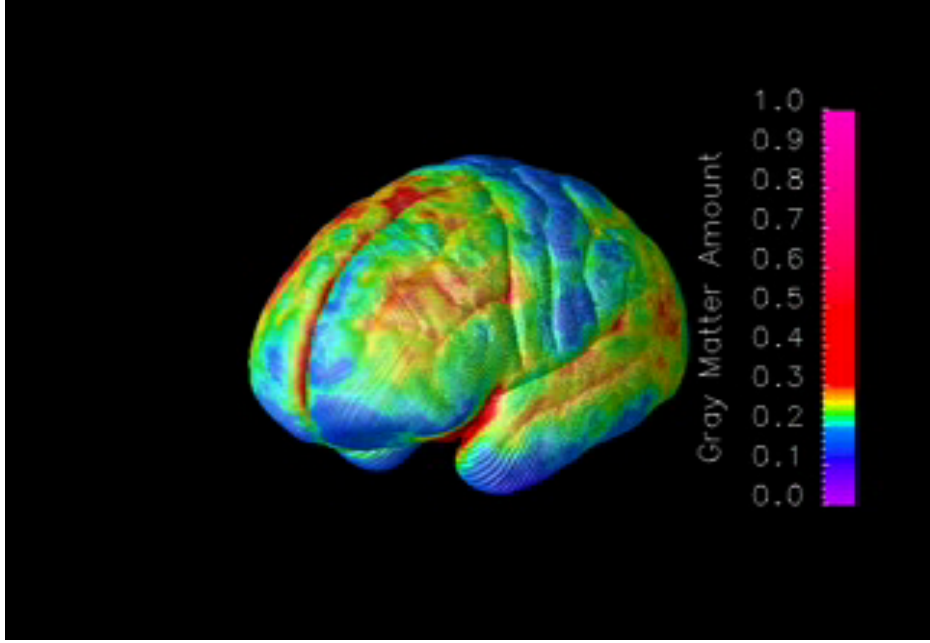


Synaptogénèse et perte sélective des synapses : une base possible de l'apprentissage

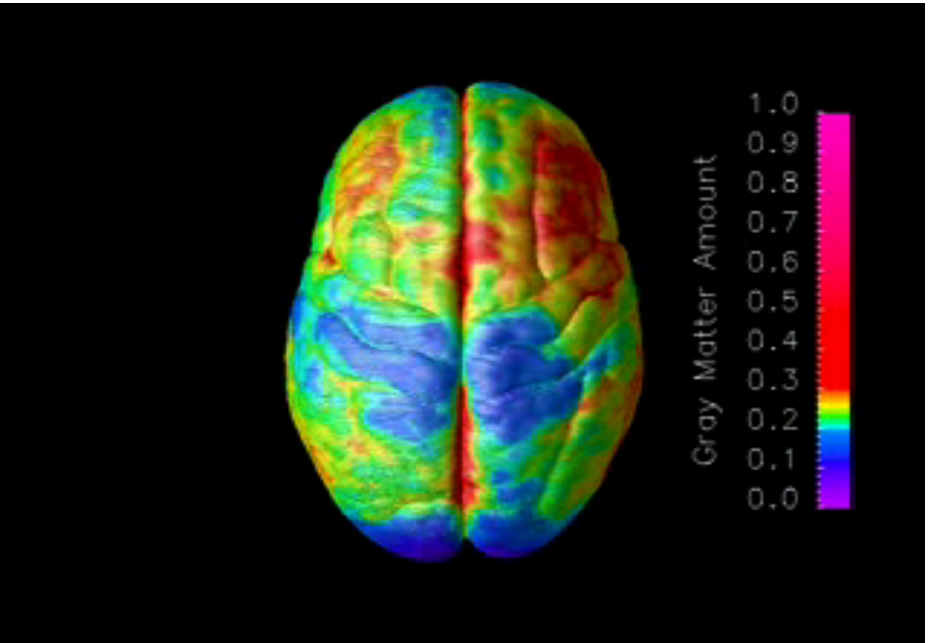
Developpement post-natal

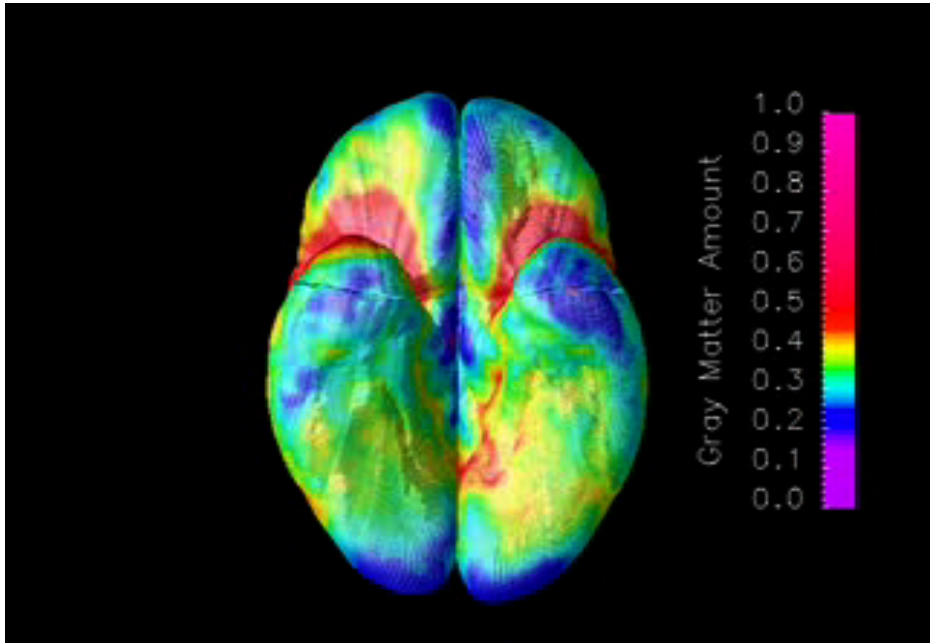
- A la naissance, le cerveau pèse un quart de son poids final chez l'adulte (1300-1500g)
- Vers deux ans, il a atteint la moitié de son poids final
- Pendant les deux premières années de vie, le cortex double et atteint les dimensions adultes
- Durant cette période, les synapses, dendrites, et la myéline se forment.





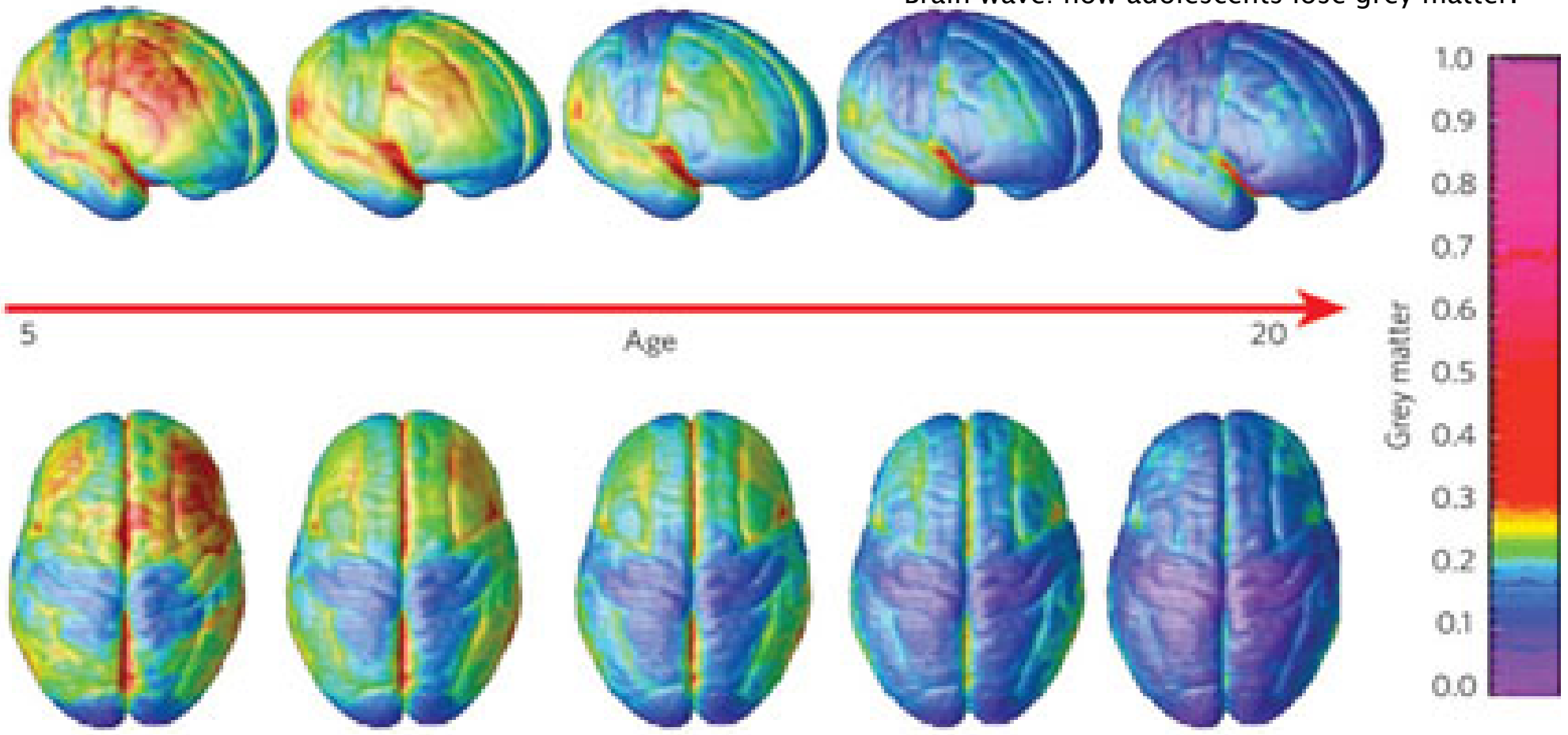
gray matter maturation over the cortical surface between ages 4 and 21 (Gogtay et al. /pnas, 2004)





J. GIEDD

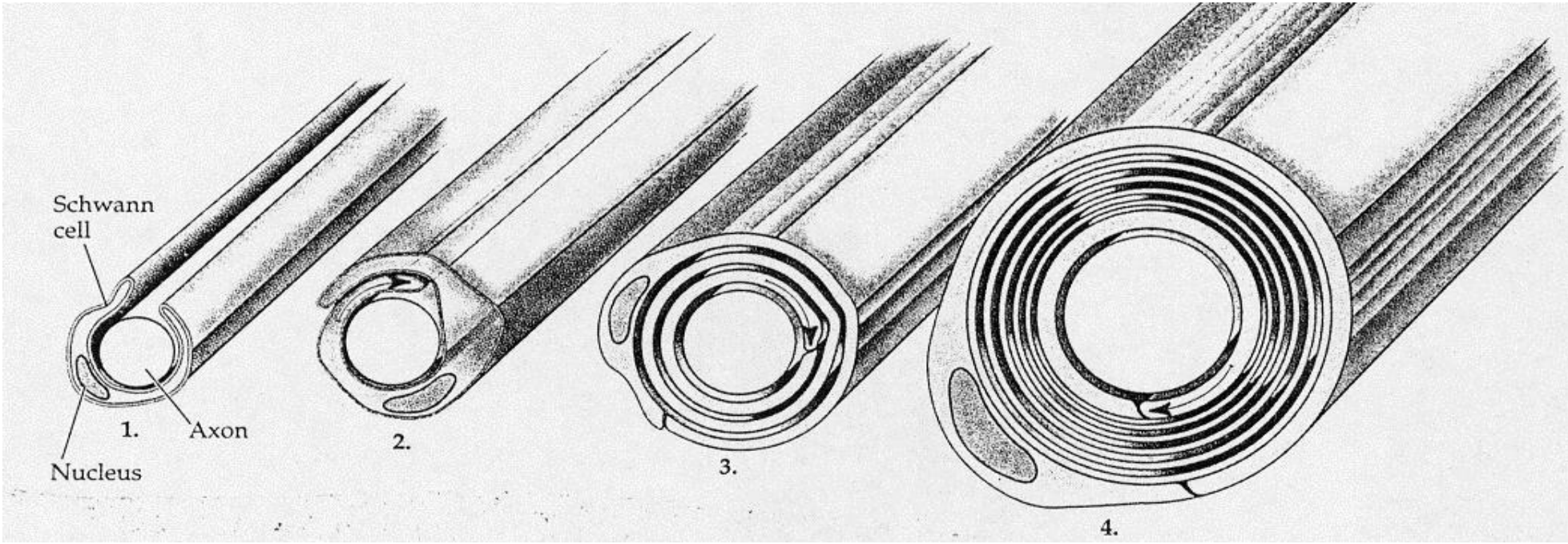
Brain wave: how adolescents lose grey matter.



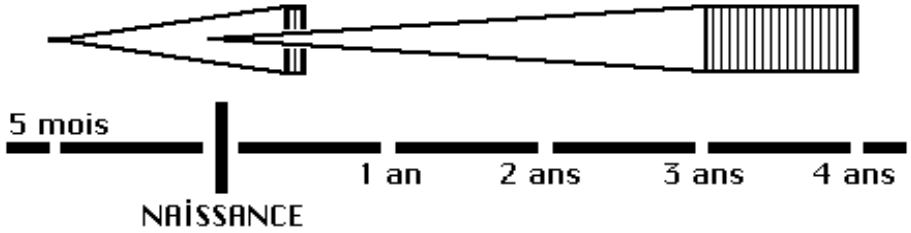
Giedd and many other neuroscientists think the grey-matter thinning seen during adolescence is probably due to 'synaptic pruning' — the process of eliminating overabundant, unnecessary nerve cell connections. If synaptic pruning is accelerated during adolescence, says Giedd, it follows that this is a time of 'use it or lose it' in the brain. The more environmental input there is to guide that pruning, he says, the better. On the same basis he argues that less guidance could result in a brain less able to react to complex situations, as could uncontrolled pruning: preliminary studies show that childhood schizophrenics have an exaggerated loss of grey matter during adolescence

Myélinisation : le processus par lequel les axones s'entourent d'une gaine de myéline

- Augmente la vitesse de conduction
- Commence avant la naissance dans les aires motrices et sensorielles
- Continue jusqu'à l'adolescence dans certaines régions (e.g. lobes frontaux).



VOIE AUDITIVE

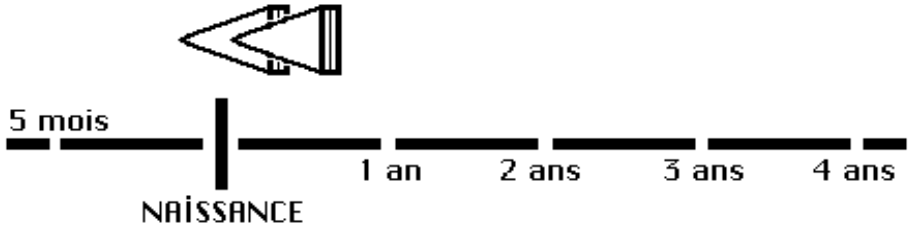


DE LA COCHLÉE AU THALAMUS
COURT ET LARGEMENT PRÉNATAL

•

DU THALAMUS AU CORTEX AUDITIF PRIMAIRE
LONG (4 ANS)

VOIE VISUELLE



DE LA RÉTINE AU THALAMUS
COURT ET PÉRINATAL

•

DU THALAMUS AU CORTEX VISUEL PRIMAIRE
COURT (4 MOIS)

Maturation comparée des voies visuelle et auditive d'après l'étude myélinogénétique (Yokovlev et Lecours)

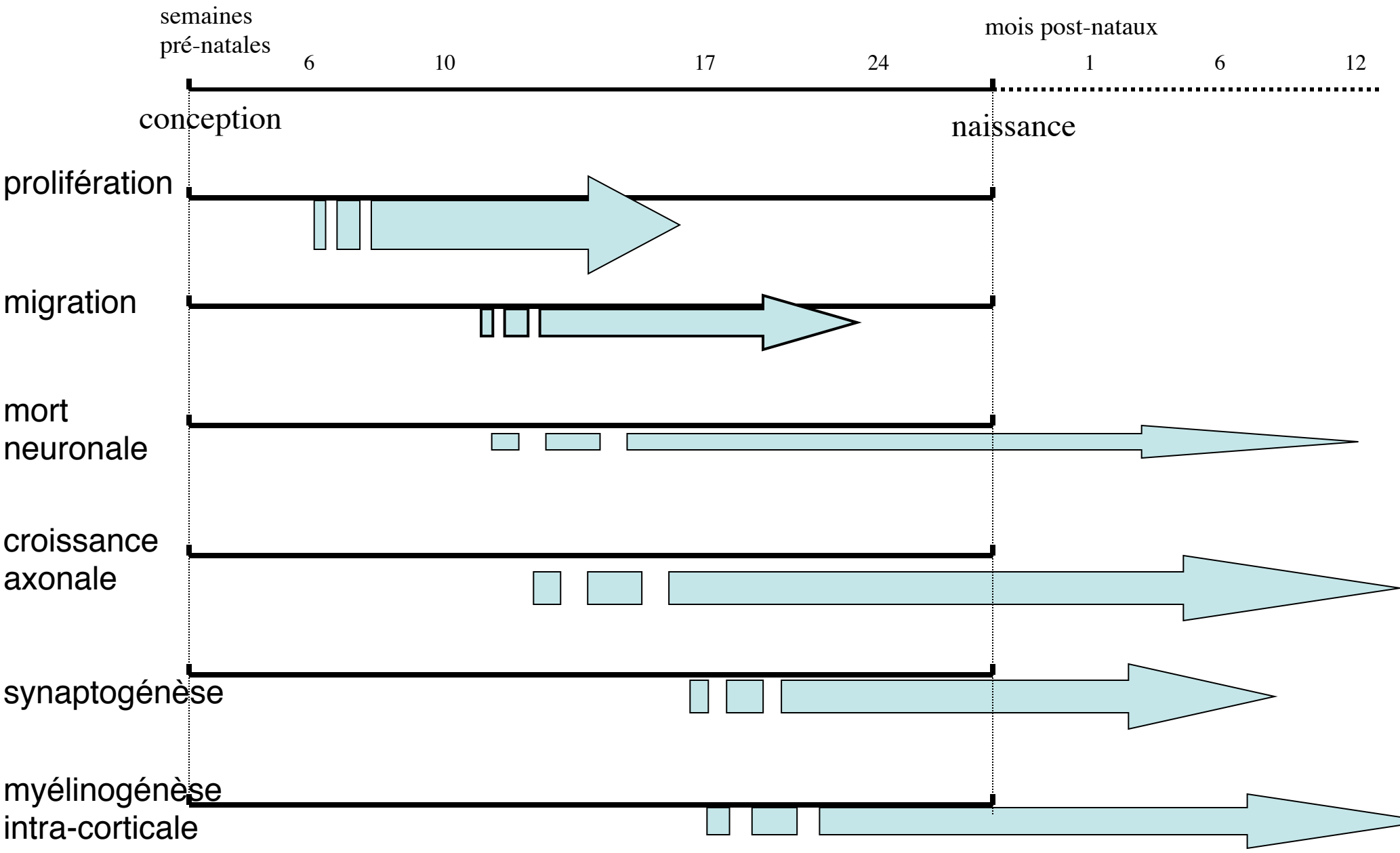
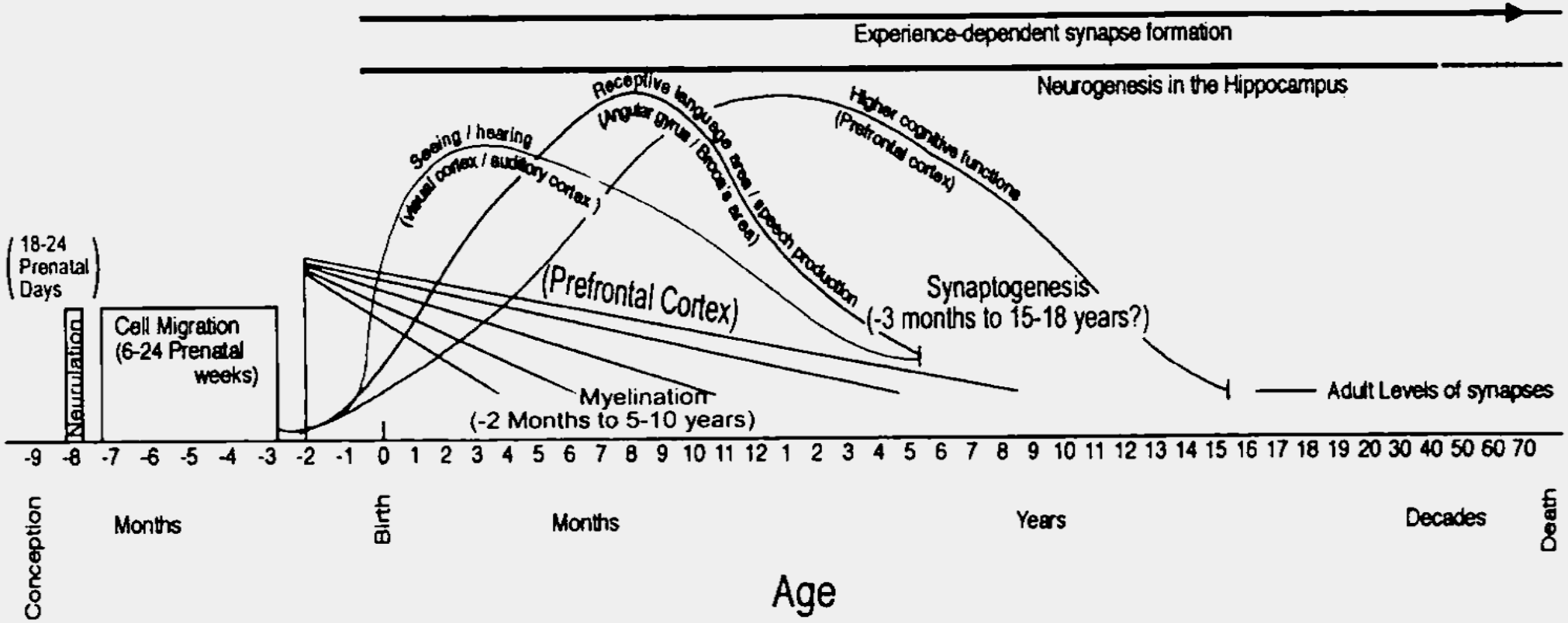
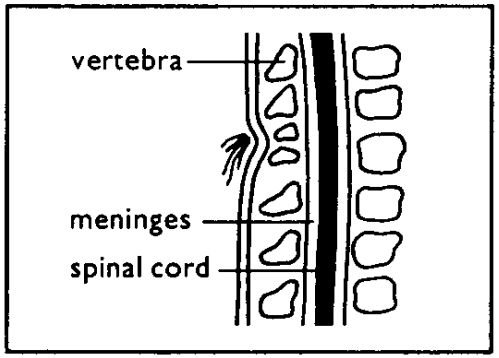

semaines
pré-natales
6
10
17
24
mois post-nataux
1
6
12
conception
naissance
prolifération
migration
mort
neuronale
croissance
axonale
synaptogénèse
myélinogénèse
intra-corticale

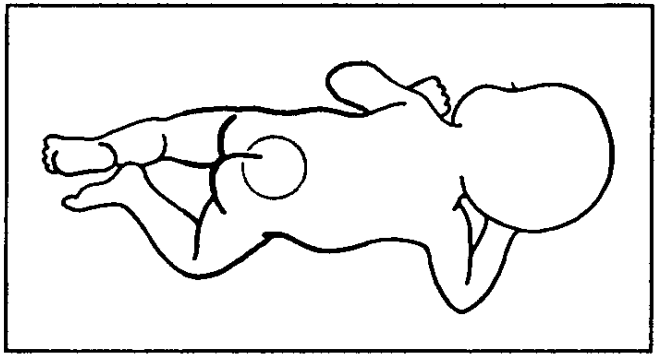
Figure 1
The Developmental Course of Human Brain Development

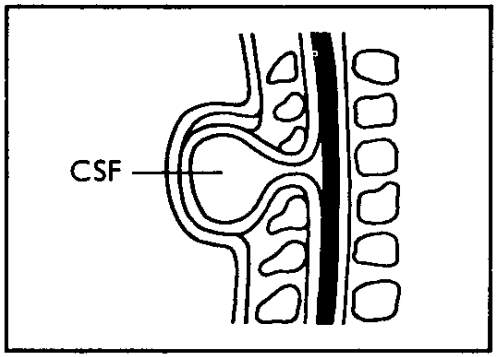


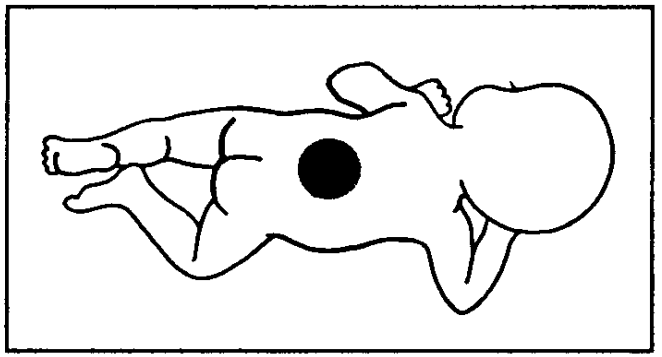
Note. This graph illustrates the importance of prenatal events, such as the formation of the neural tube (neurulation) and cell migration; critical aspects of synapse formation and myelination beyond age three; and the formation of synapses based on experience, as well as neurogenesis in a key region of the hippocampus (the dentate gyrus), throughout much of life.

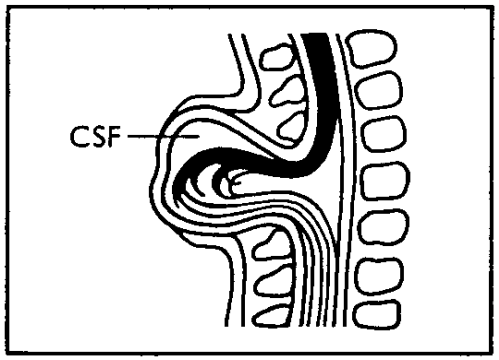
TYPES OF SPINA BIFIDA

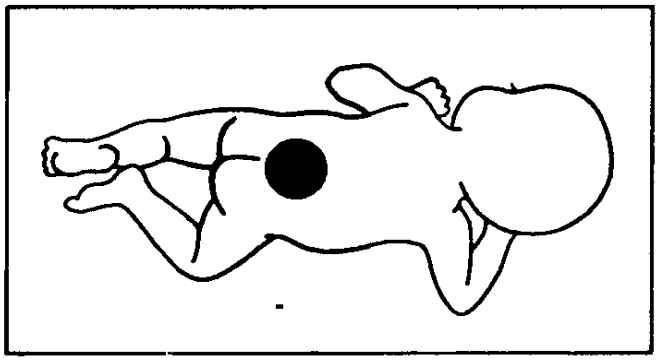










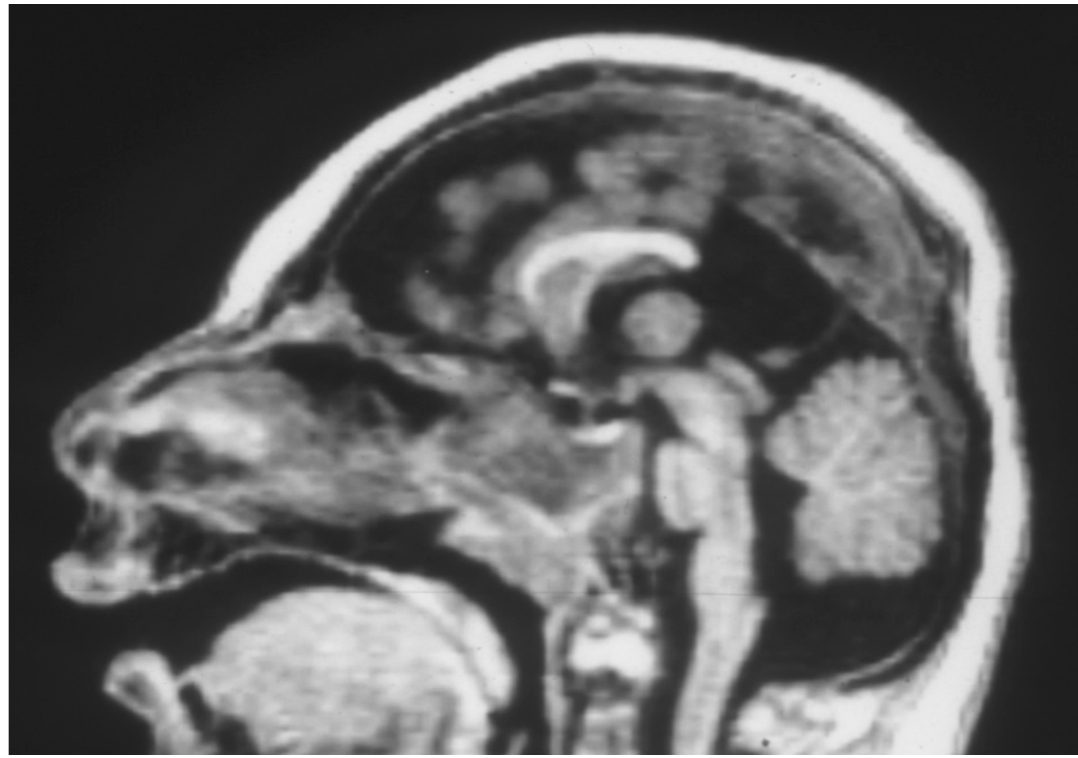


Occulta
Outer part of vertebrae not completely joined. Spinal cord and covering (meninges) usually undamaged. Hair often at site of defect.

Meningocele
Outer part of vertebrae split. Spinal cord usually normal. Meninges damaged and displaced through opening.

Myelomeningocele
Outer part of vertebrae split. Spinal cord and meninges damaged and displaced through opening. Usually hydrocephalus.

Proliferation: Microlissencephalie

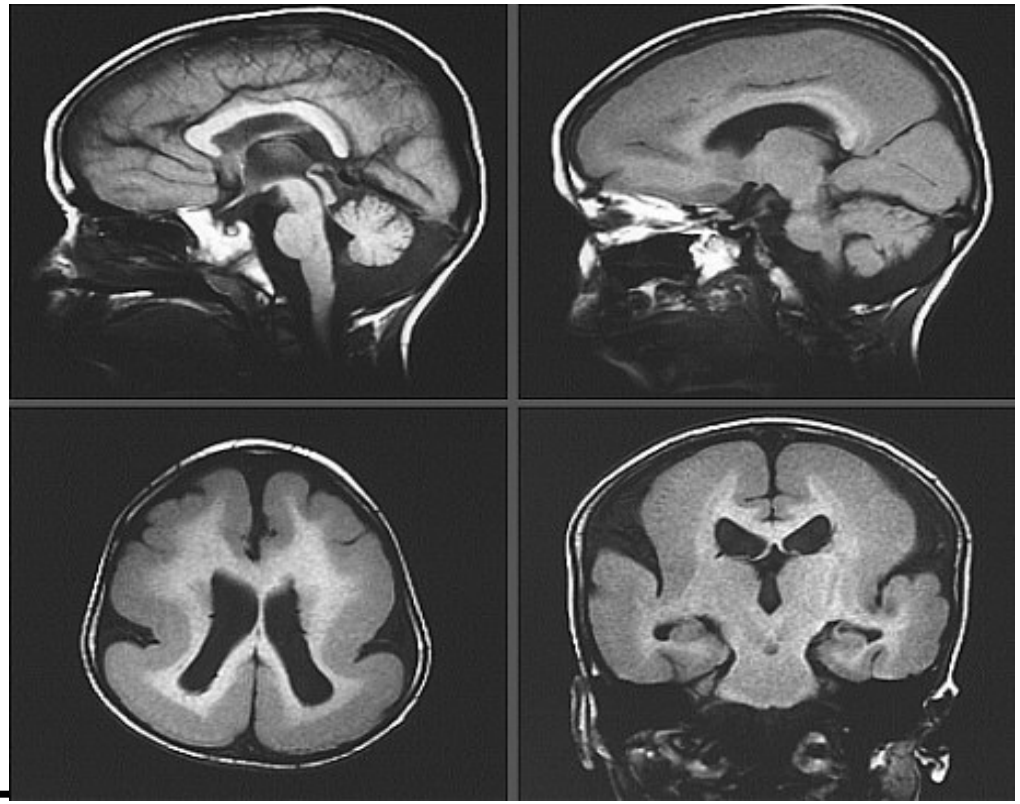


Neurogenesis & Cellular Migration (cont.)

- Disrupted migration
  - *Agyria (lissencephaly)*
    - 1st trimester
    - Underdeveloped cortical gyri
  - Corpus callosum or other subcortical structures also may be affected as a result of migrational problems.

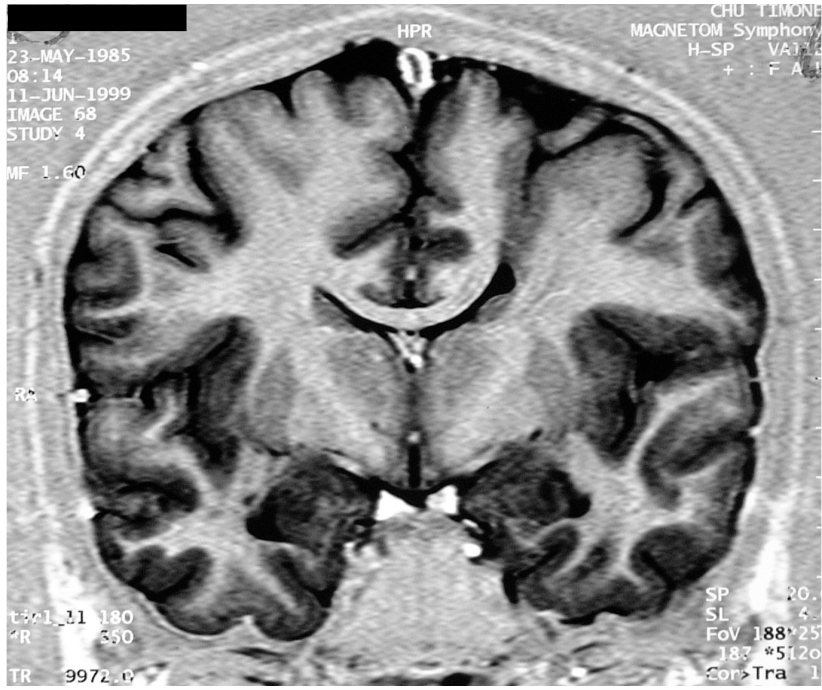
6-month old infant

AGYRIA



From the American College of Radiology

Dysplasie corticale focale



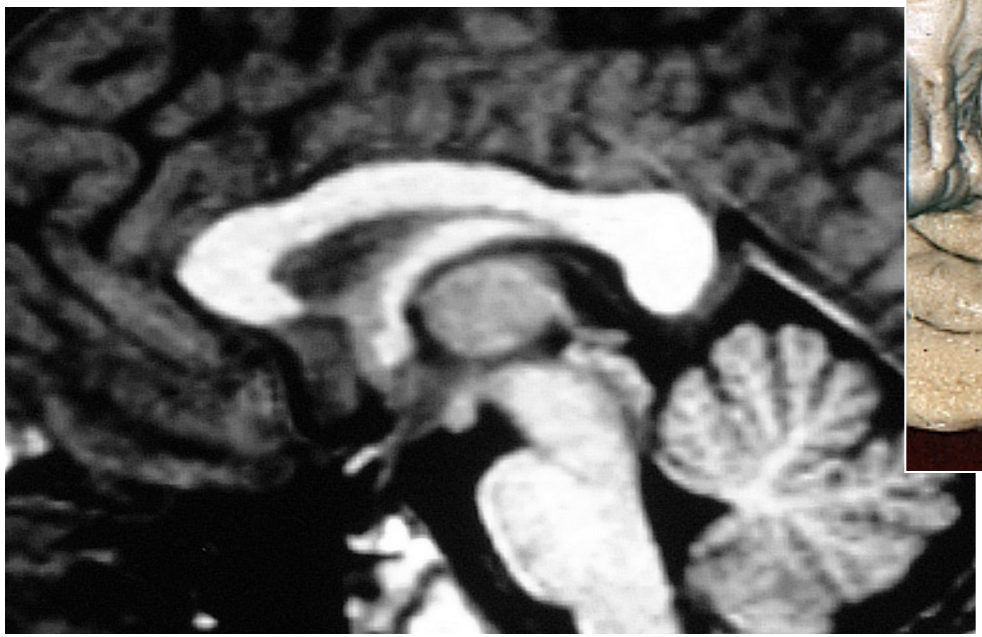
- **Les cellules ne se différencient pas**

bien en neurones ou astrocytes.

- **Il s'ensuit une migration anormale, une organisation anormale du cortex**
- **Mauvaise ségrégation entre le cortex et la substance blanche**
- **Anomalies étendues sur tout le trajet de migration.**
- **Sporadique, très épileptogène, pas de déficit mental ou neurologique si limité.**

Le corps calleux

Relie l'essentiel du néocortex des deux hémisphères (mammifères placentaires)



Agénésie du corps calleux

totale

partielle