Plan du Cours

- Lundi 14 Novembre

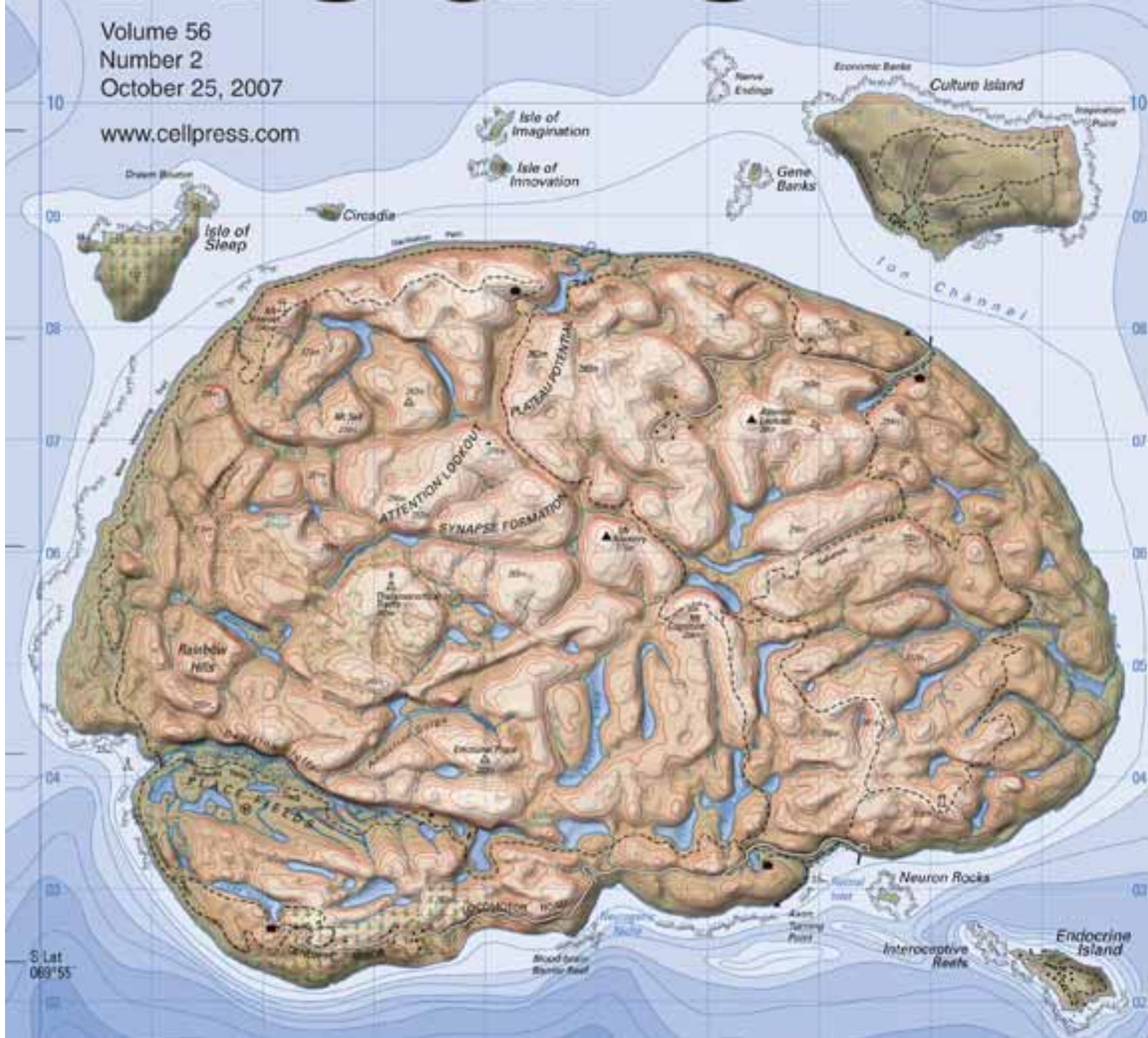
Cellules du système nerveux

- Jeudi 17 Novembre

Neurotransmission

- Mercredi 23 Novembre

Organisation et développement du système nerveux



Cours No3 Anatomie et Développement

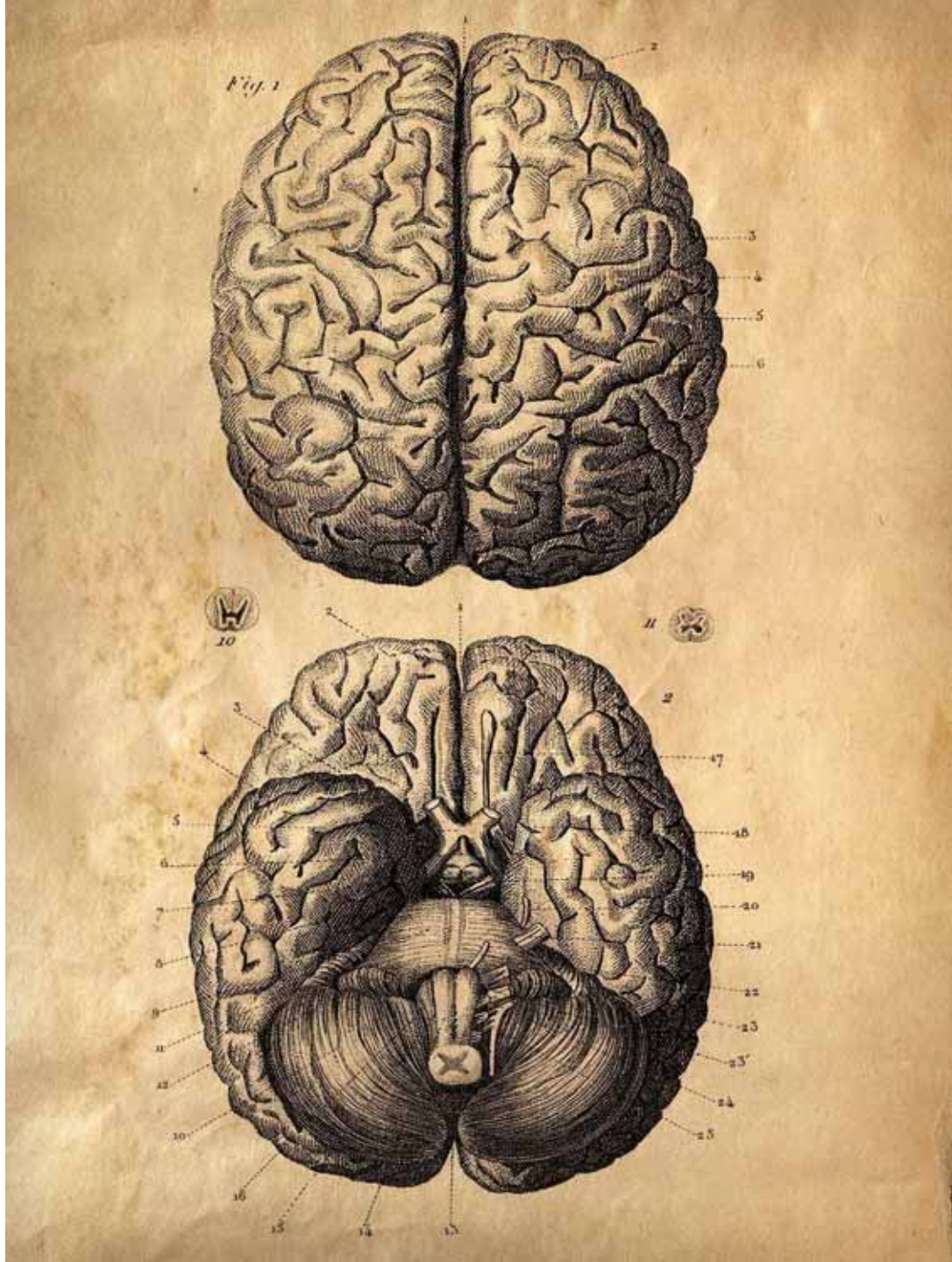
7. Principes d’organisation du SNC

8. Anatomie du cerveau et de la moelle épinière

9. Organisation du cortex cérébral

10. Méninges et LCR

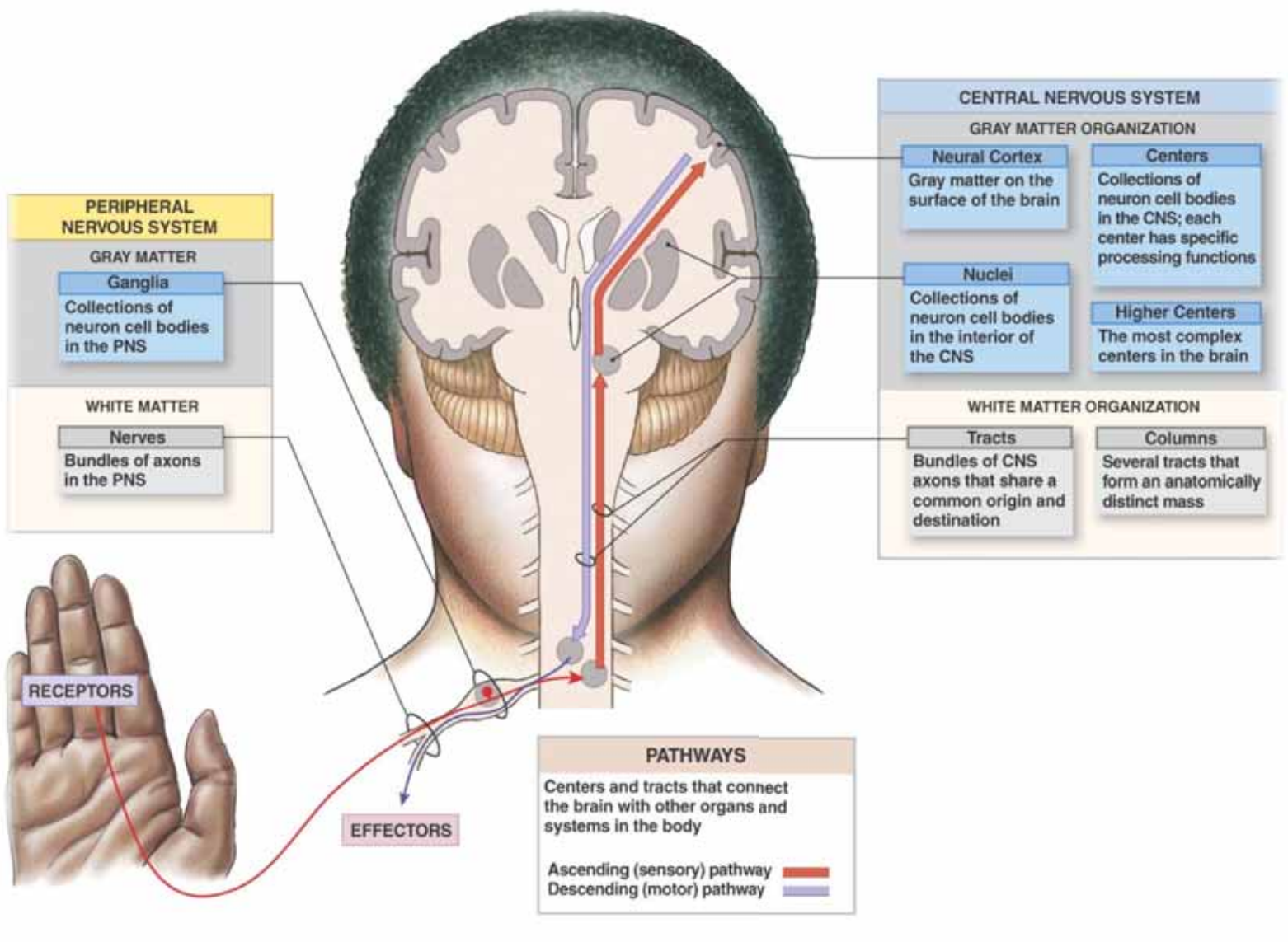
11. Développement du SNC



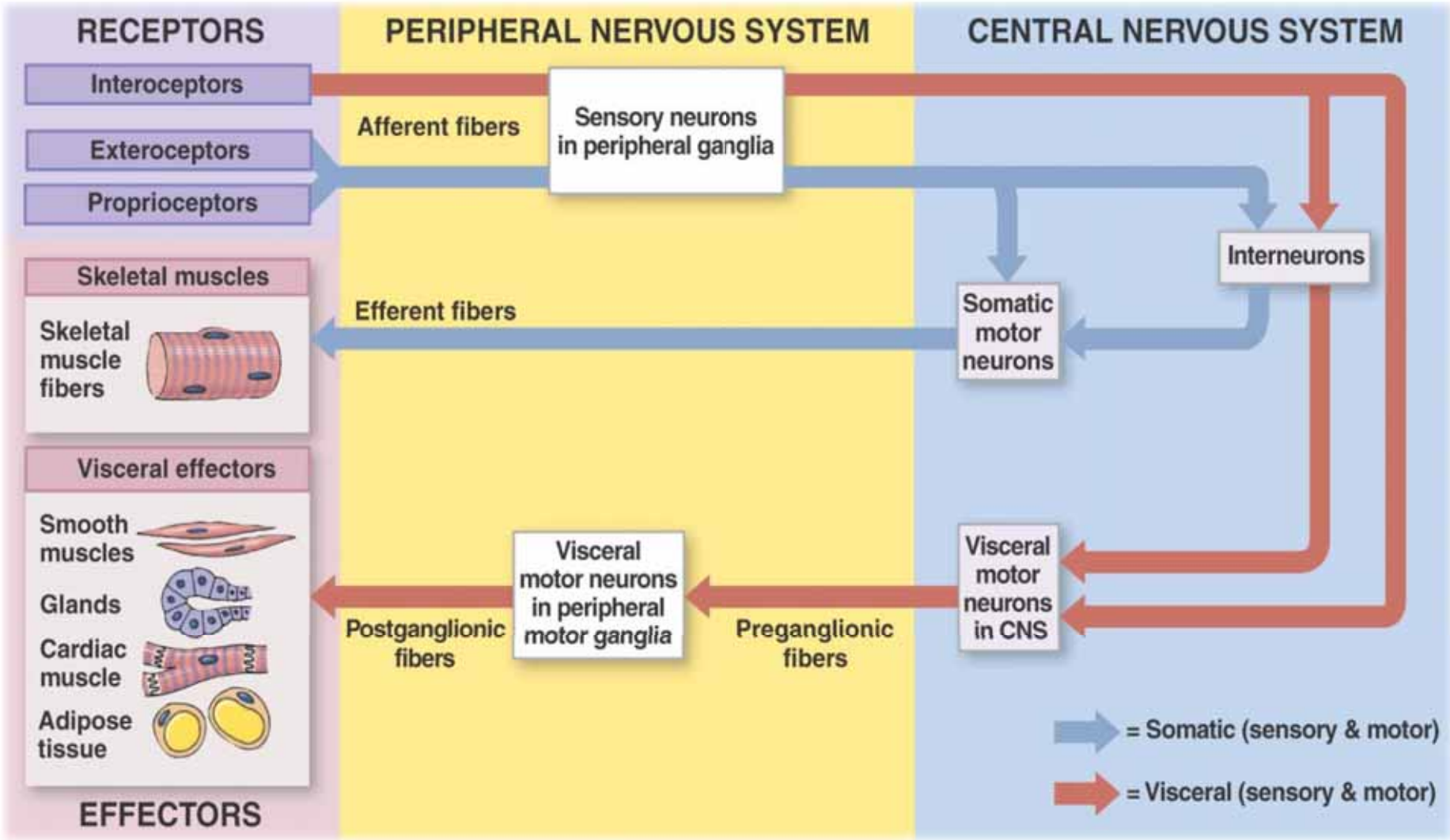
Echelles de Grandeur

Cerveau entier	15 cm AP homme
Cortex cérébral	3 mm épaisseur homme
Neurones	Soma gros neurone: 100 um
Parties de neurones	Gros axone: 10 um de diamètre
Synapse	Bouton terminal: 1 um de diamètre
Fente synaptique	20 nm
Membrane neuronale	5 nm d'épaisseur
Canal ionique	0.5 nm de diamètre

Organisation anatomique du SN



Organisation fonctionnelle du SN



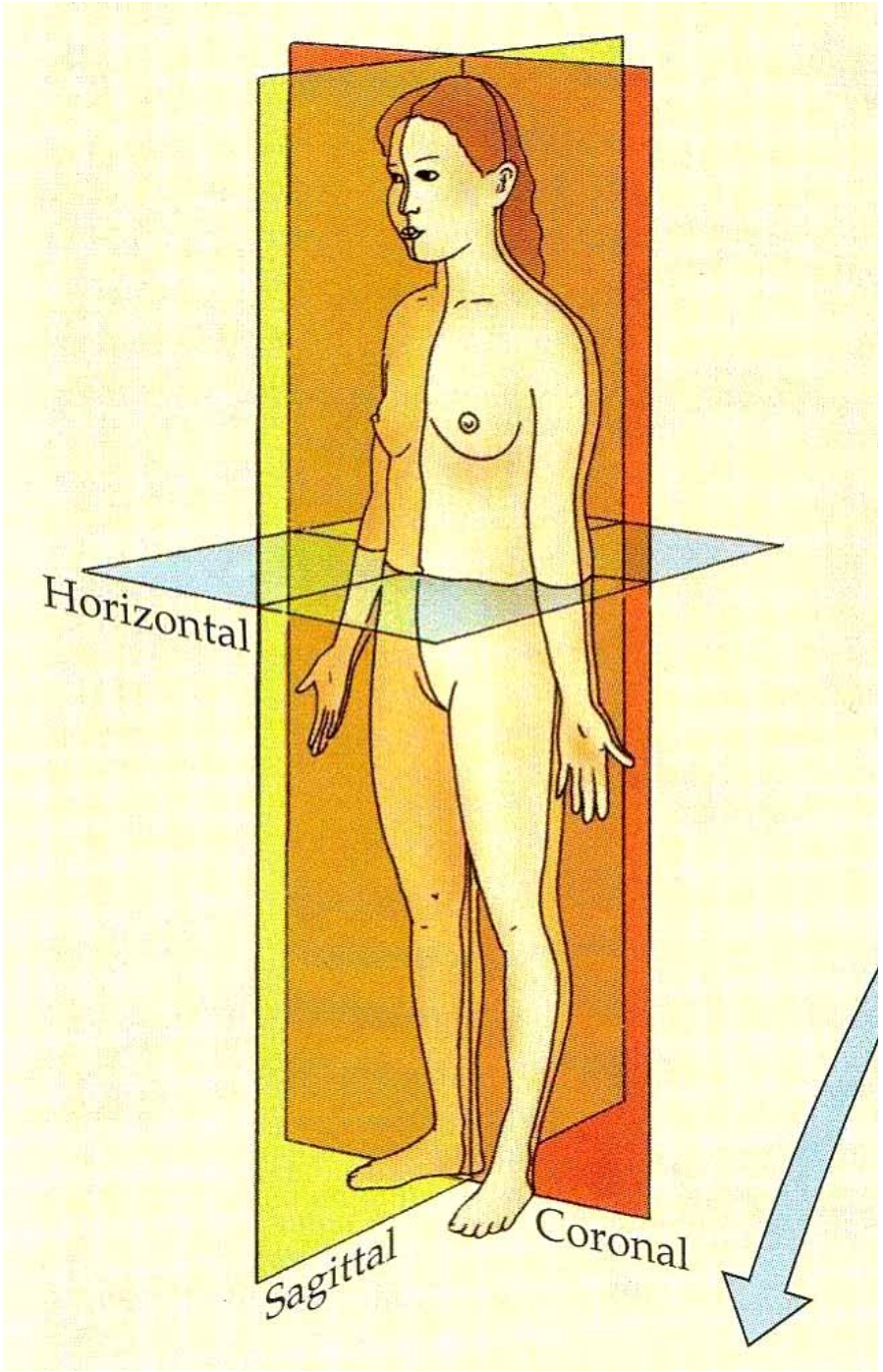
Tissu nerveux: quelques termes

- Les corps cellulaires dans le SNC sont groupés en noyaux et en couches corticales.
- Les corps cellulaires dans le SNP sont groupés en ganglions.
- Les fibres nerveuses dans le SNC forment des tractus, ou faisceaux.
- Les fibres nerveuses dans le SNP forment des nerfs.
- Les axones naviguant côte à côte sont dits “fasciculés”.

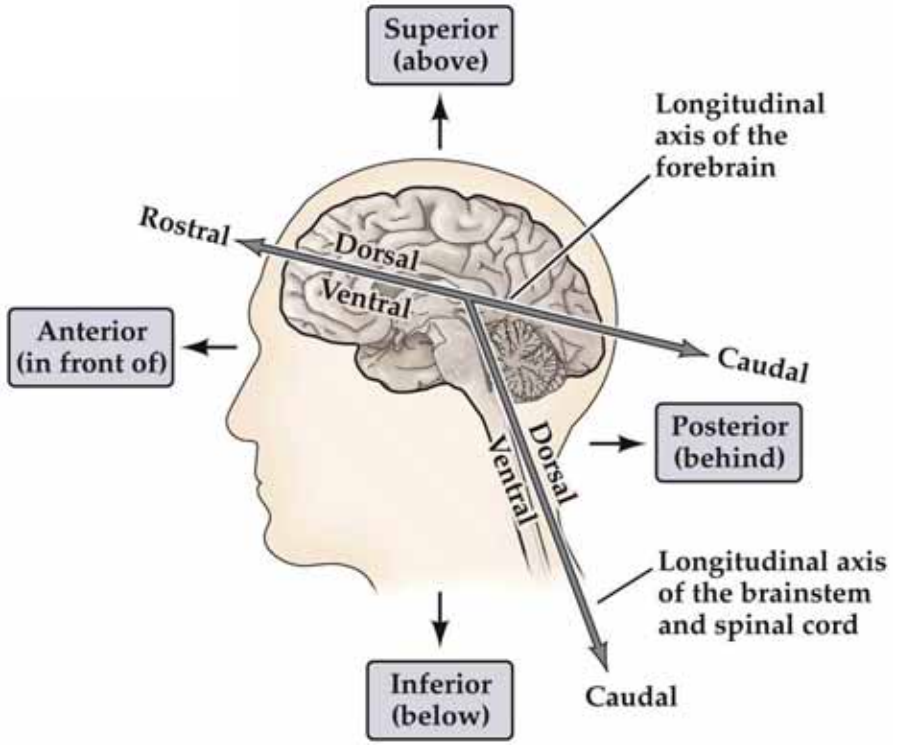
- Matière grise = corps cellulaires, dendrites, et synapses; “neuropile”.
  - Forme le cortex à la surface du cerveau et du cervelet.
  - Forme les noyaux en profondeur du cerveau.
- Matière blanche = faisceaux axonaux reliant les différentes parties du SNC entre elles.
- Nerf: axones des neurones du SNP.

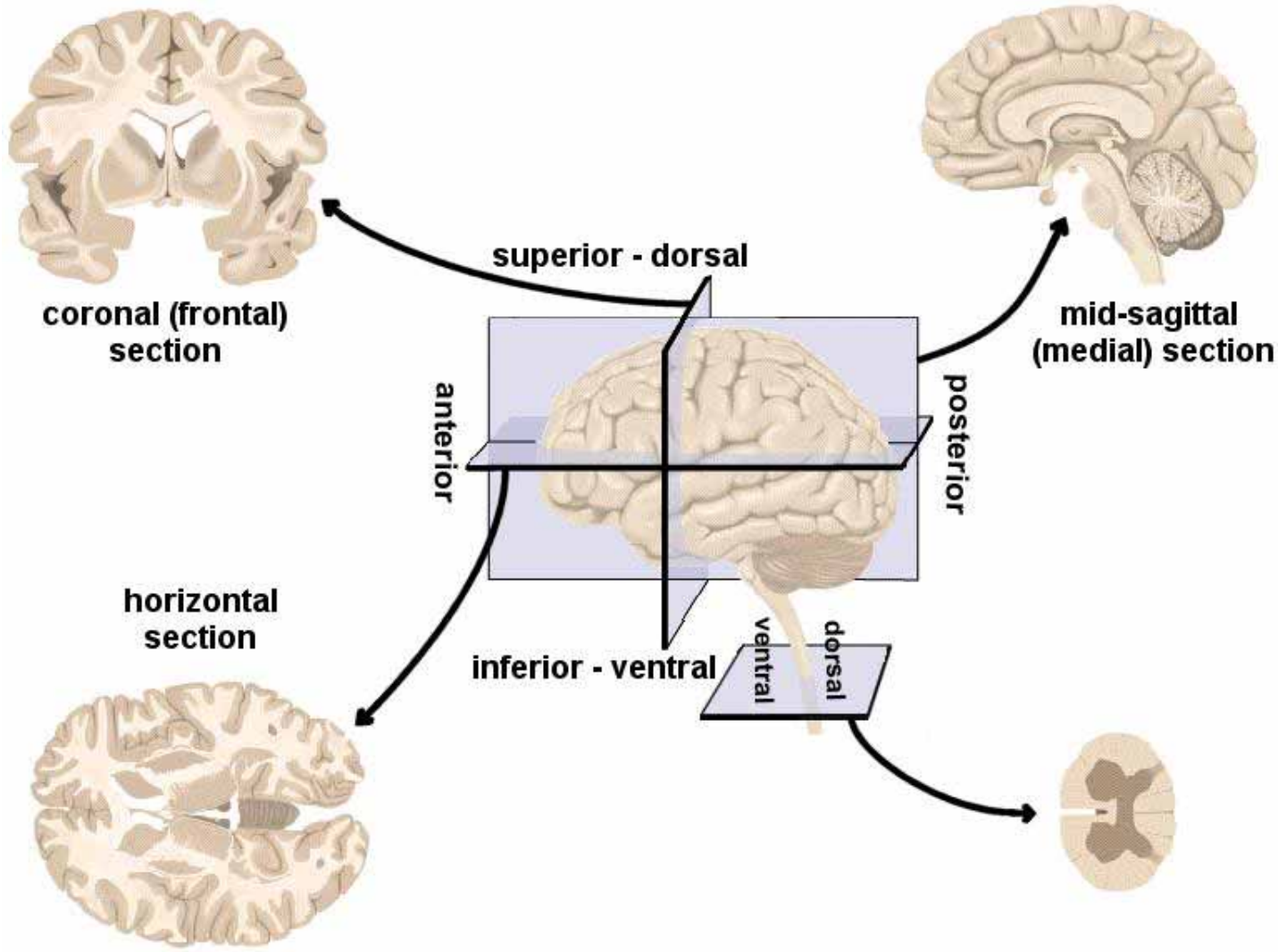
S’orienter dans le corps

- 3 plans de section
  - Sagittal: division g/d
  - Coronal (Frontal, Transverse): division a/p
  - Horizontal (Axial): division s/i
- Médial = vers le milieu
- Latéral = vers l’extérieur
- Proximal = vers le centre
- Distal = vers la périphérie



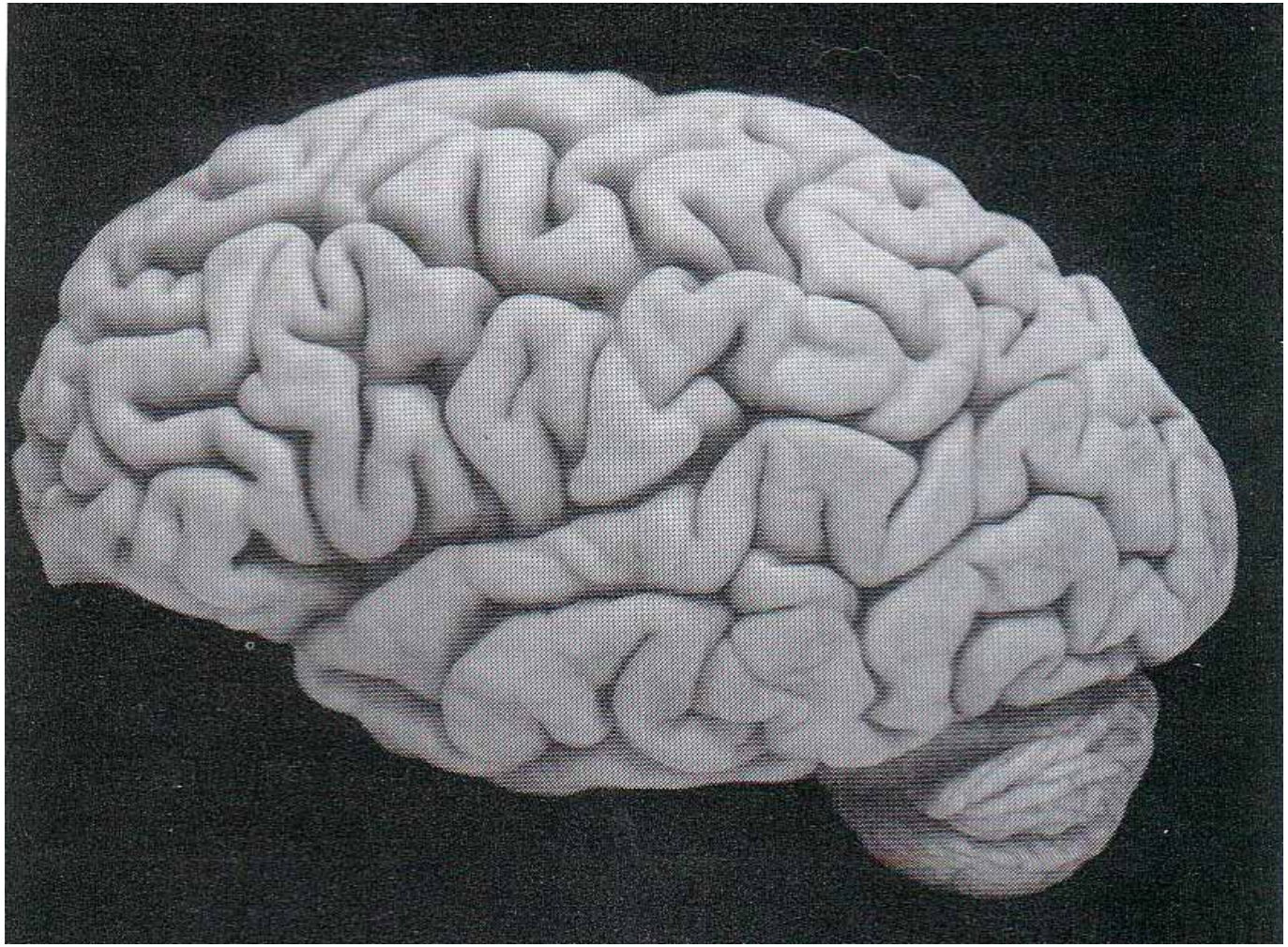
S’orienter dans le névraxe (= SNC)

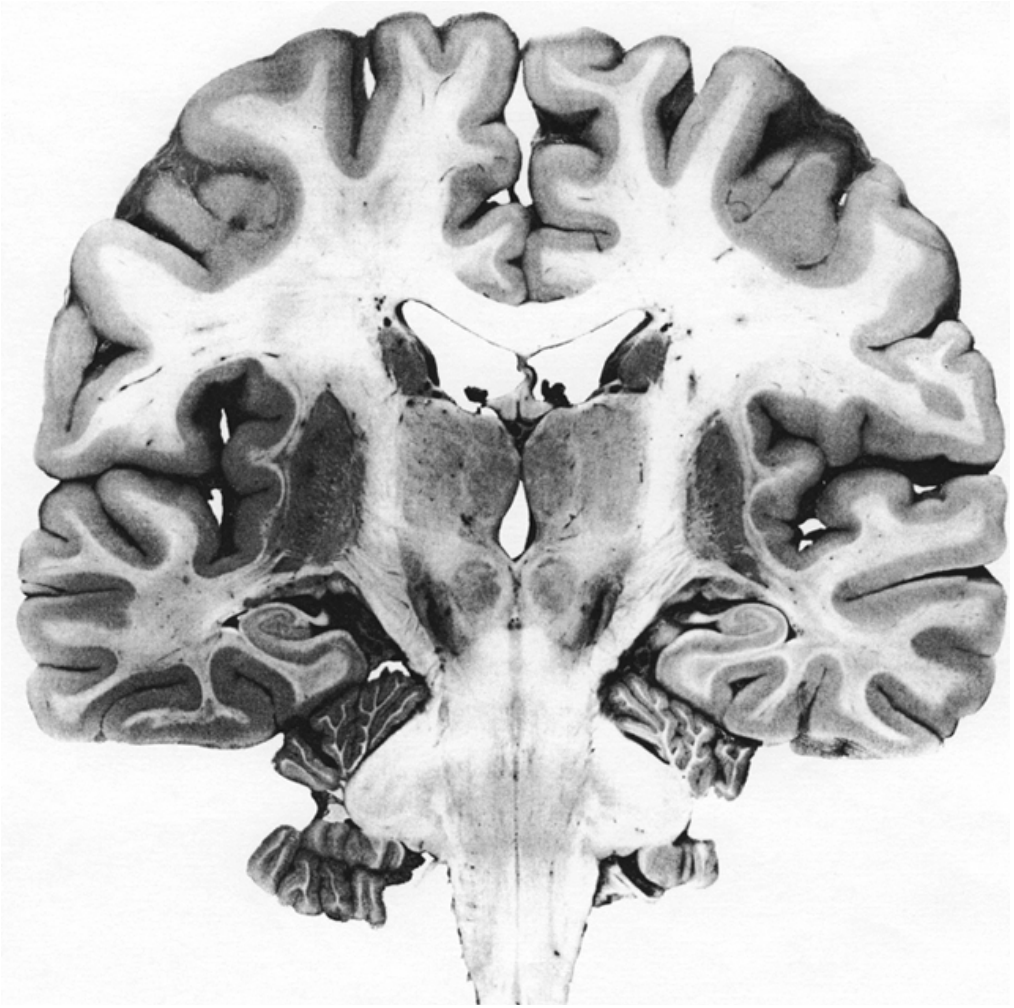




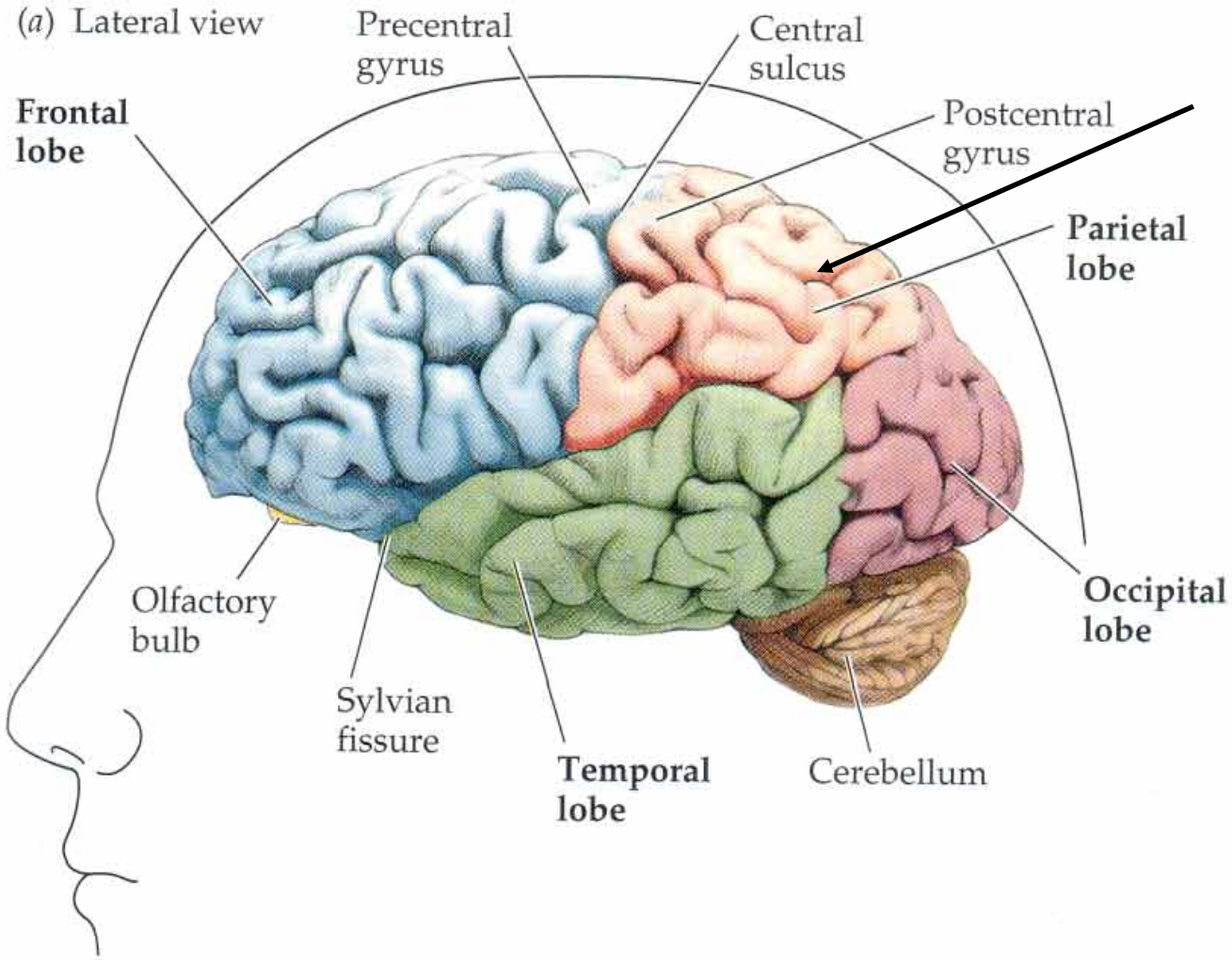
Le cerveau a une anatomie tridimensionnelle complexe

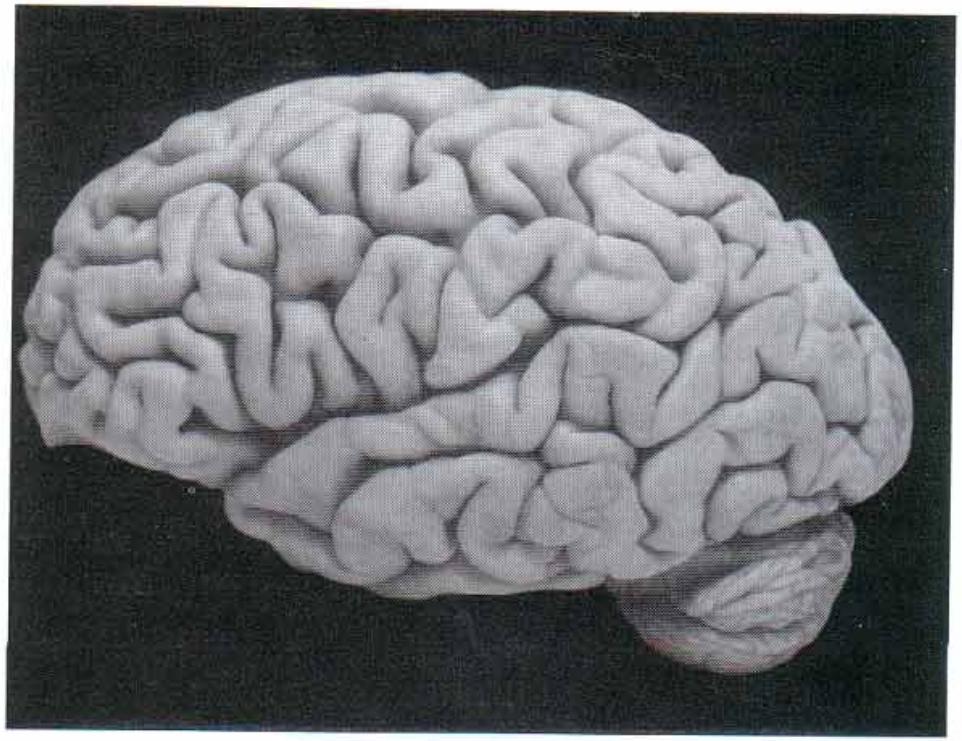
Le cerveau



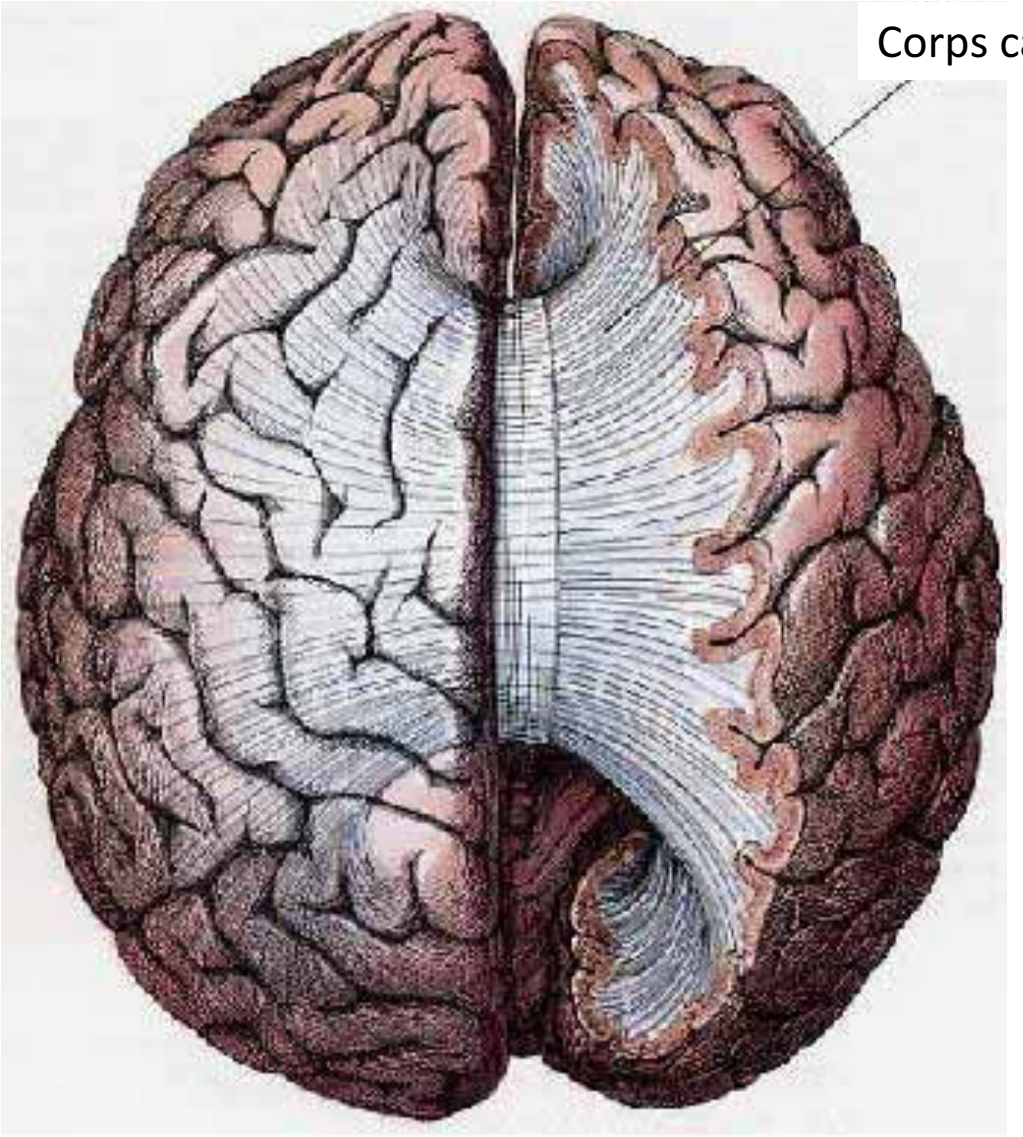


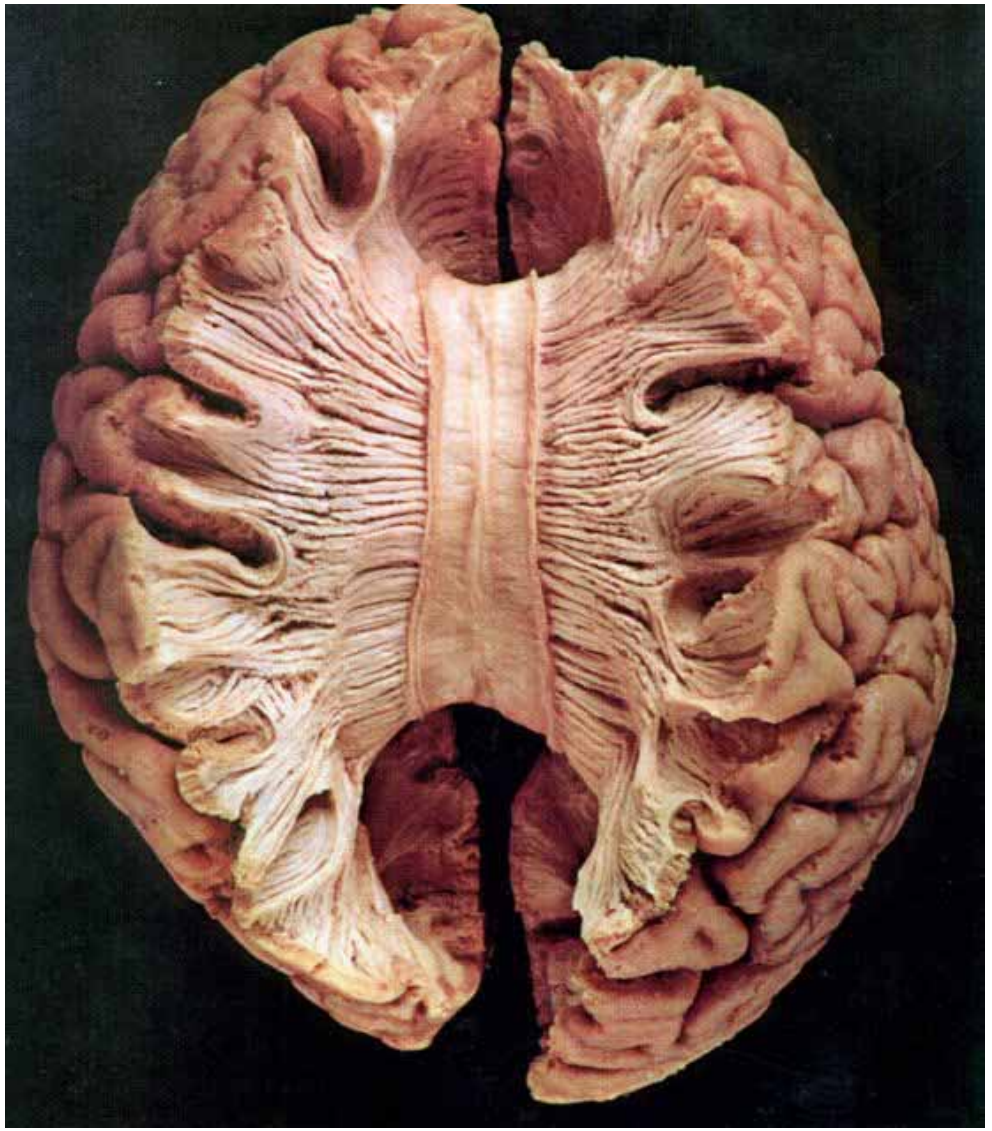
Le cerveau (vue latérale)



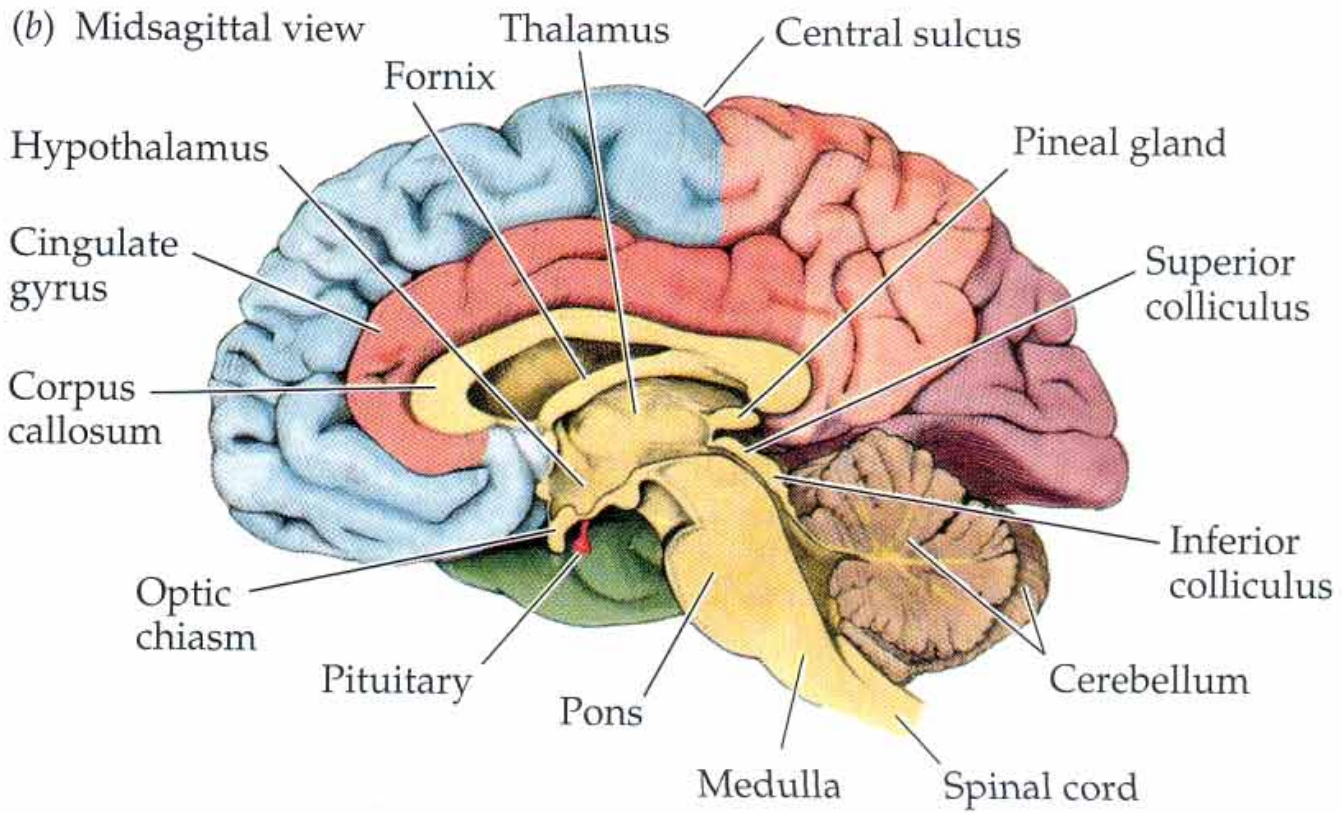


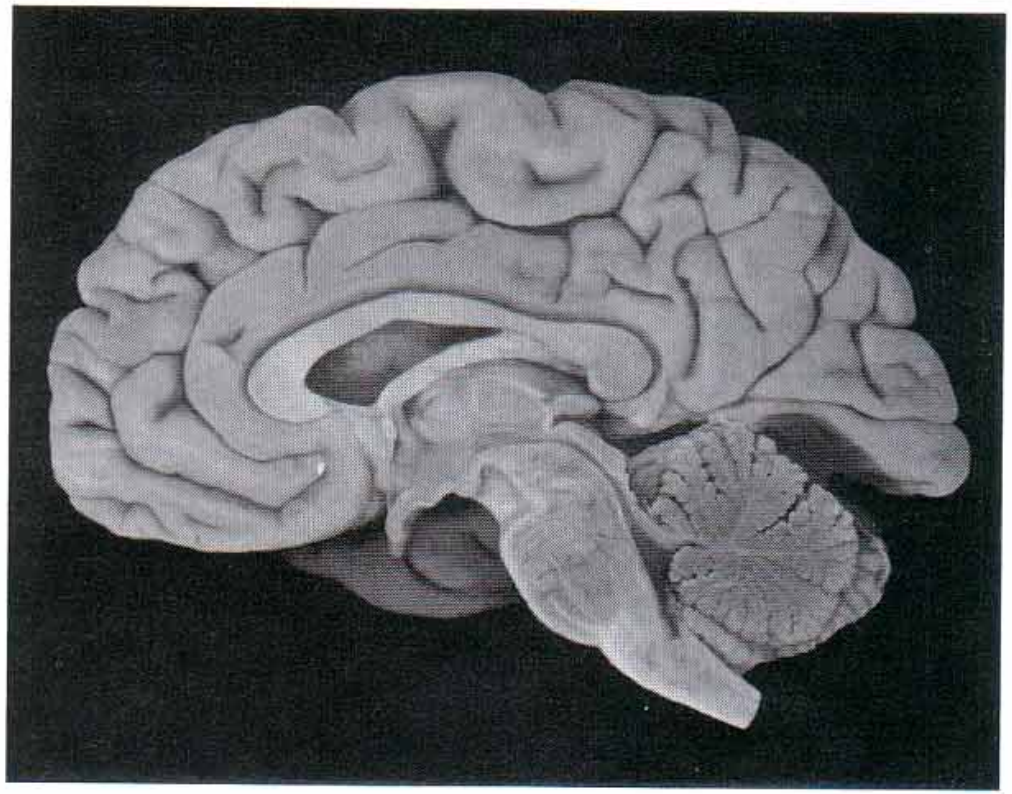
Le cerveau (vue dorsale)



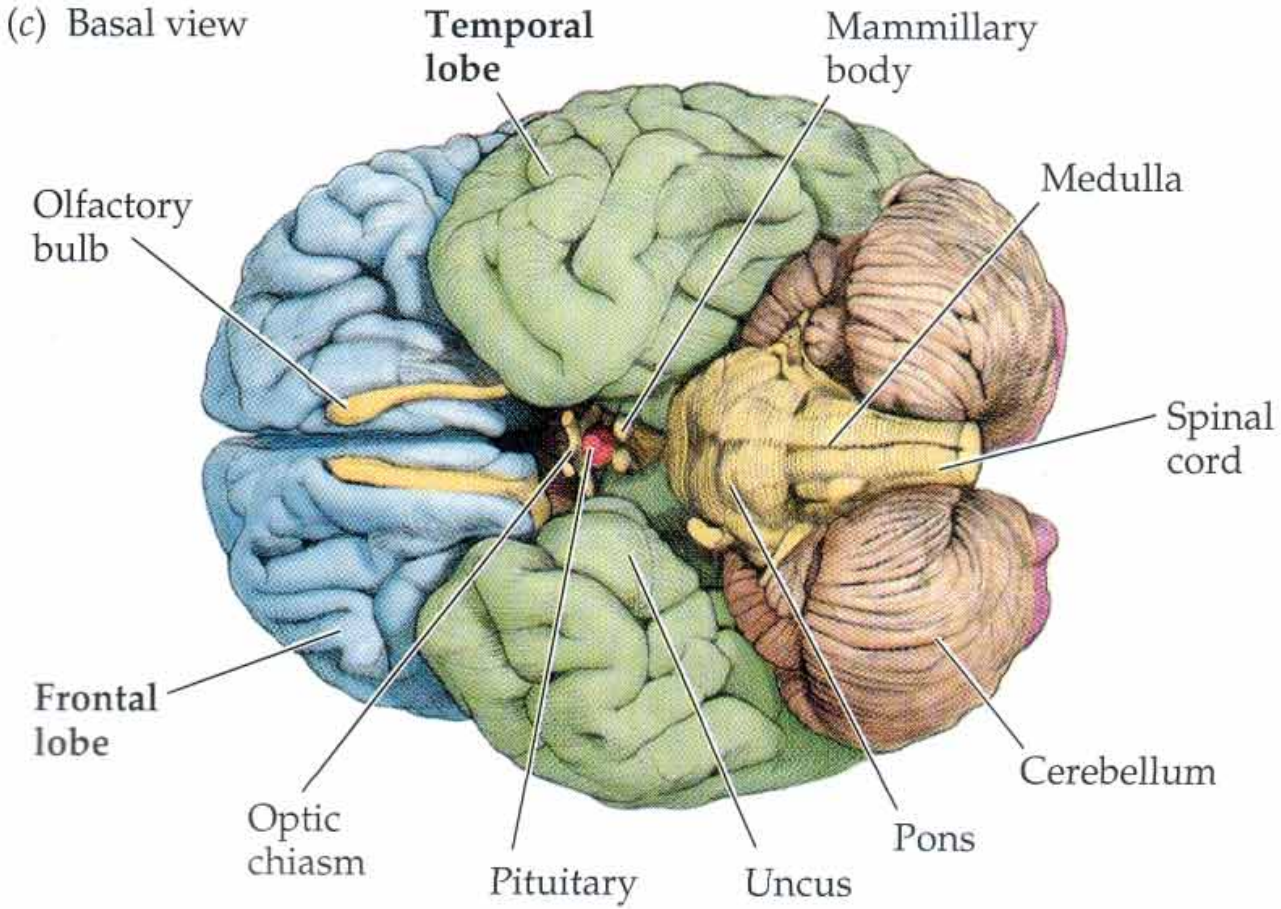


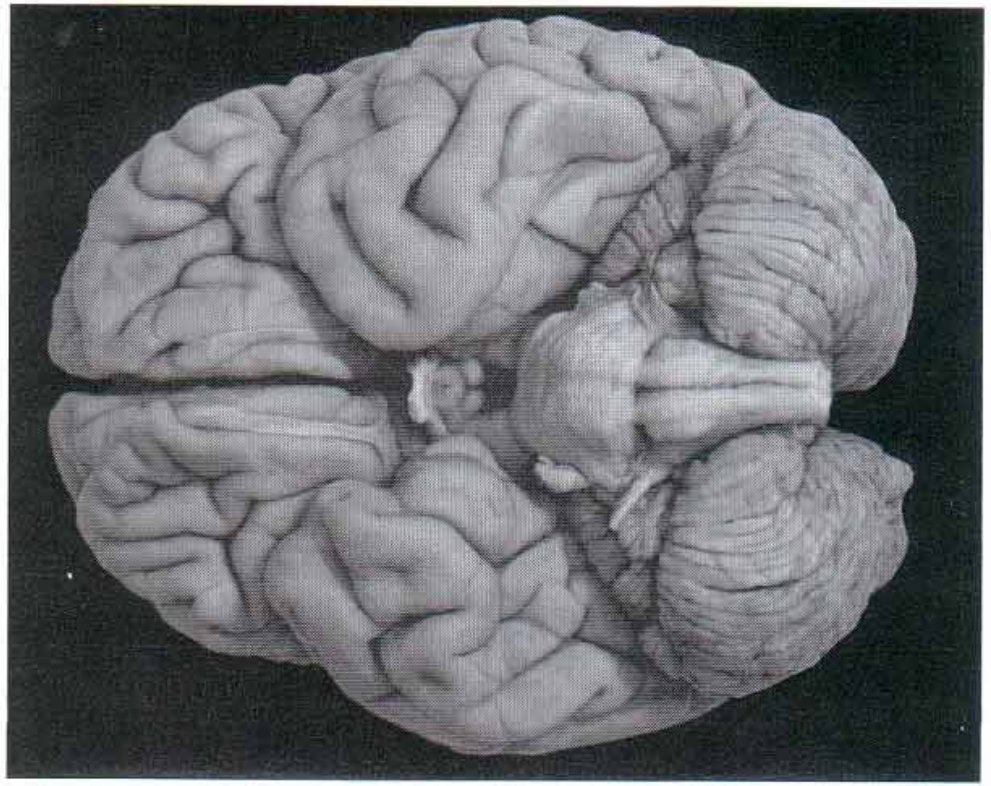
Le cerveau (vue médiale)





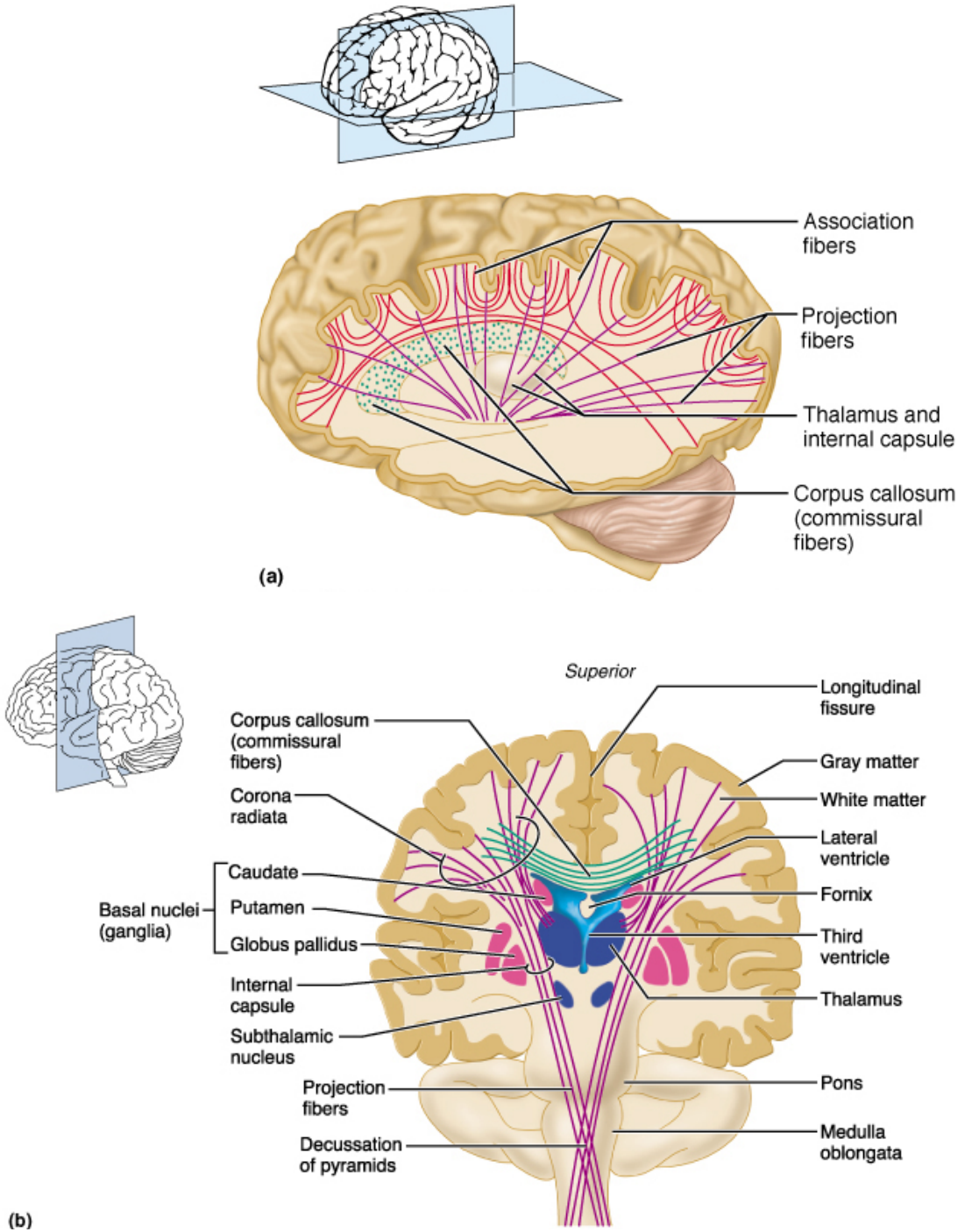
Le cerveau (vue ventrale)



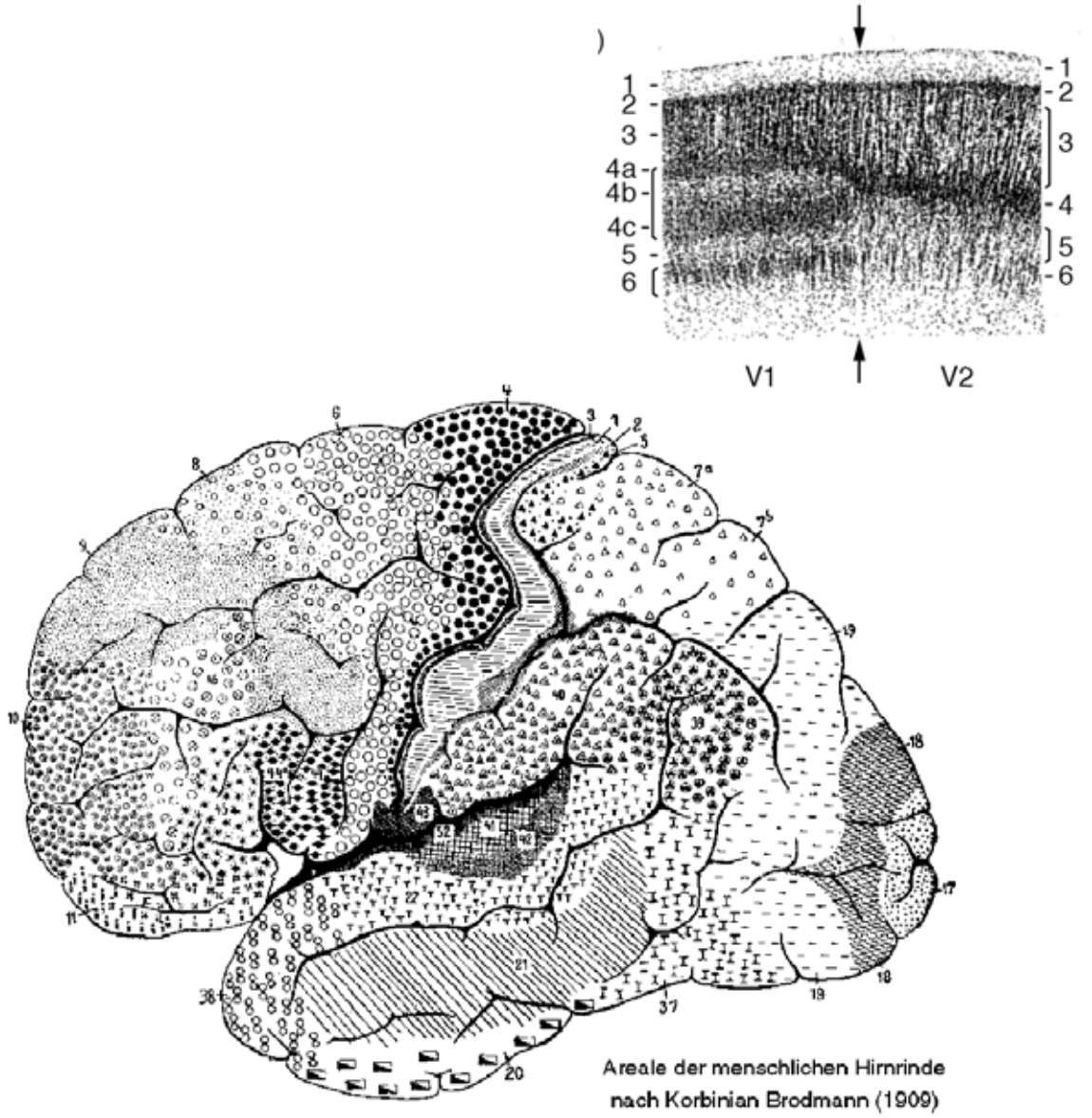


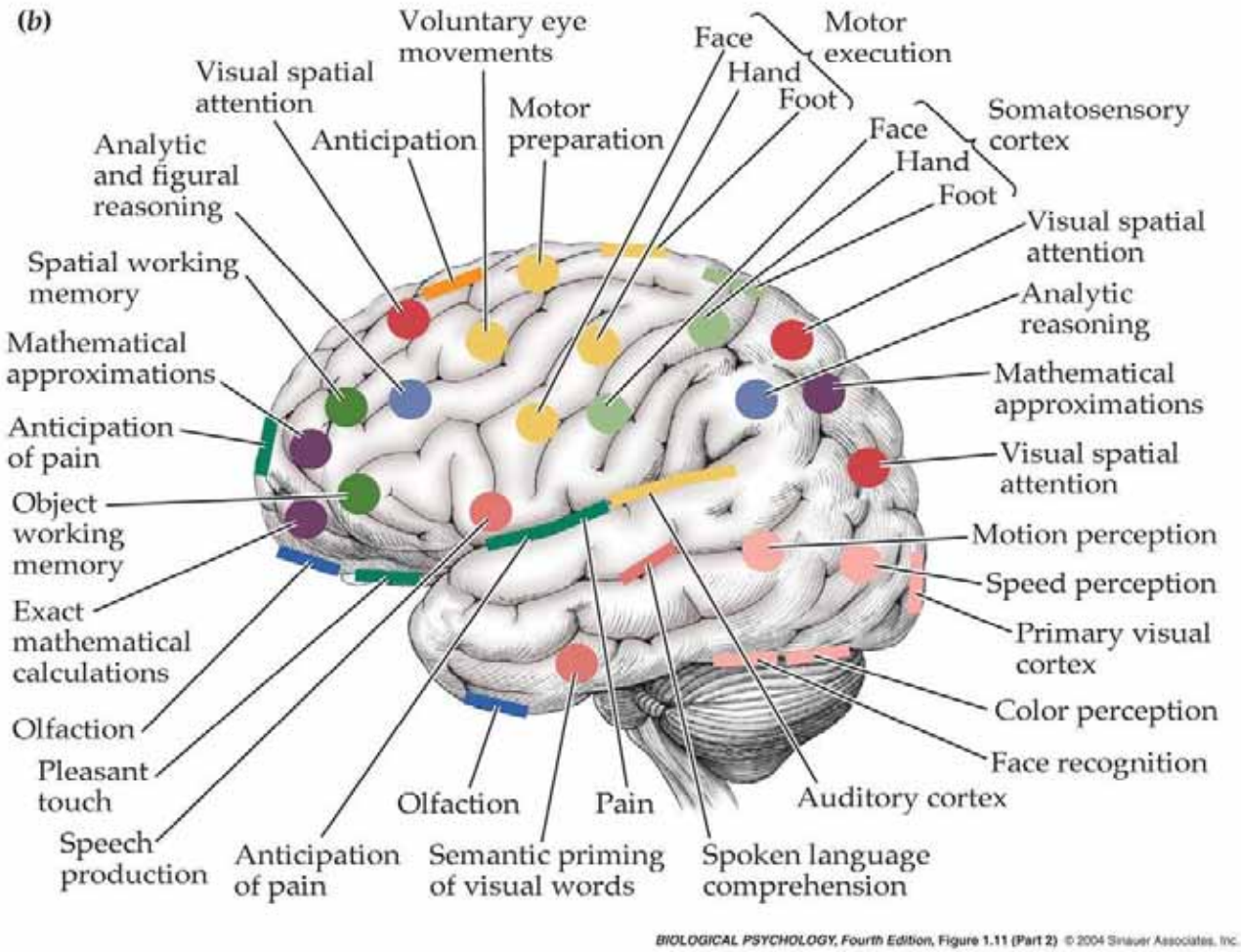
Le cortex cérébral

- Recouvre chacune des hémisphères
  - Epaisseur de 2 à 4 mm
  - Surface de 1300 cm^2
  - Subdivisé en 6 couches
- Scissures et circonvolutions.
- Commissures: Les fibres commissurales relient la substance grise des deux hémisphères. Le corps calleux est une commissure.
- Fibres d'associations : fibres horizontales ou en U qui relient différentes aires au sein d'une hémisphère.
- Fibres de projection : fibres verticales qui relient le cortex avec d'autres structures profondes.



Aires de Brodmann et spécialisation corticale





Somatotopie corticale

Somatosensoriel

Moteur

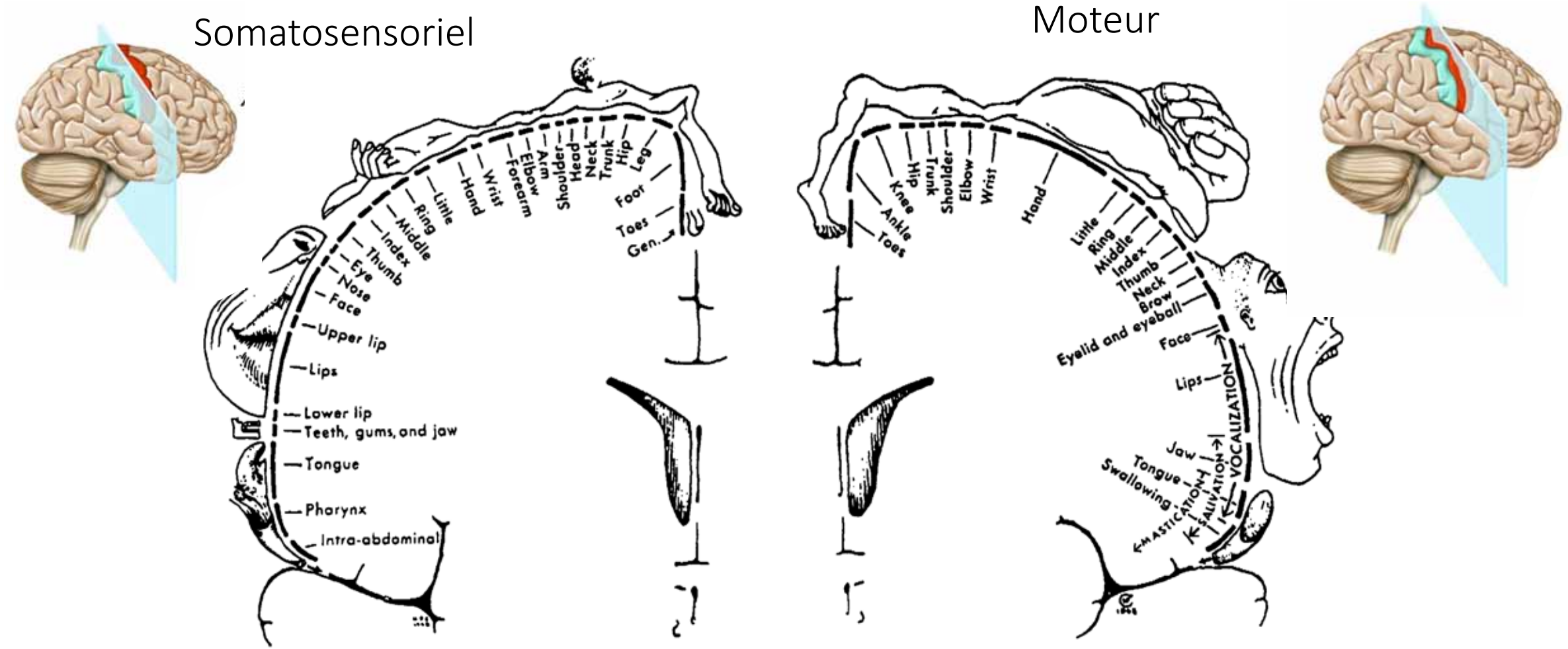
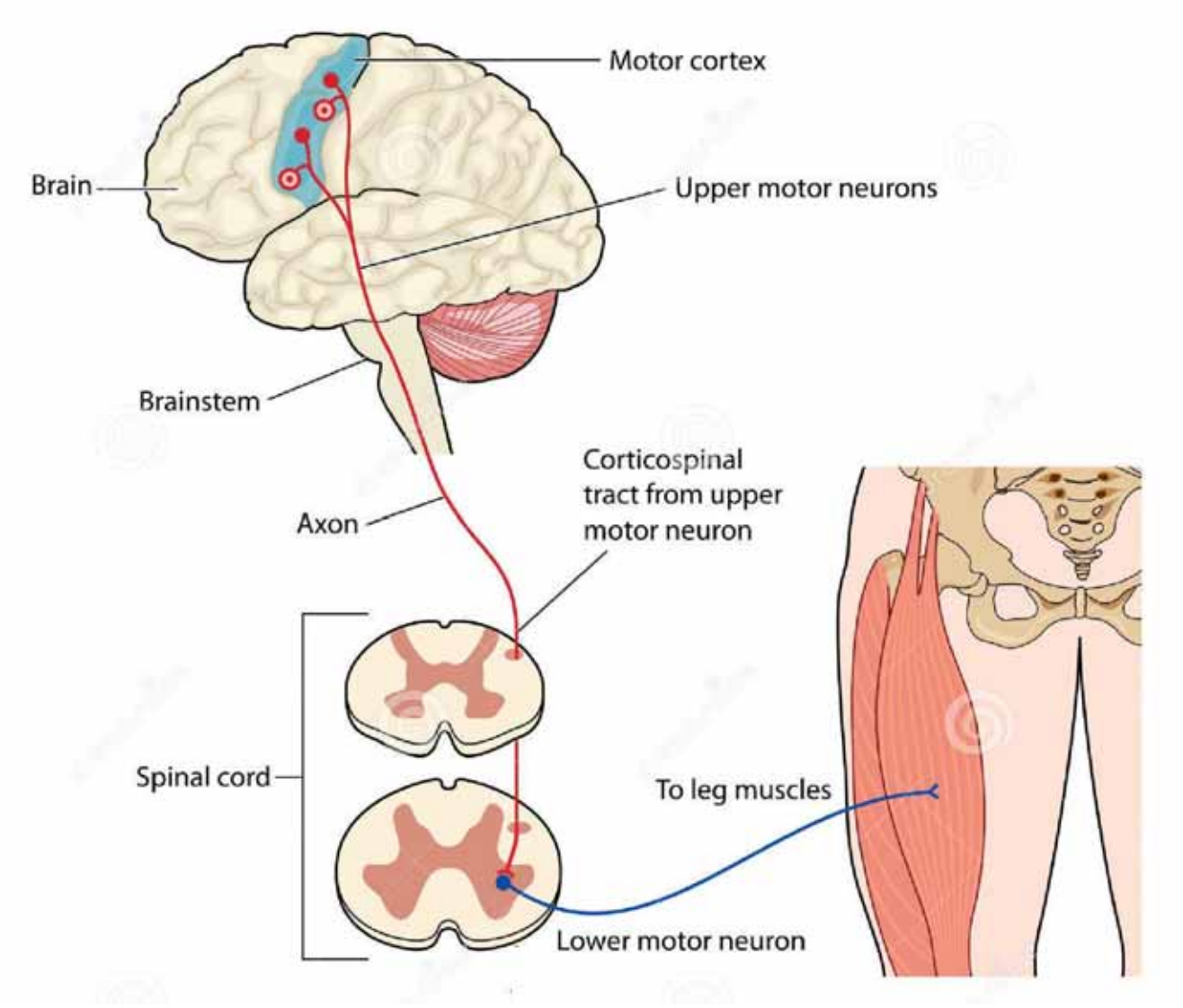
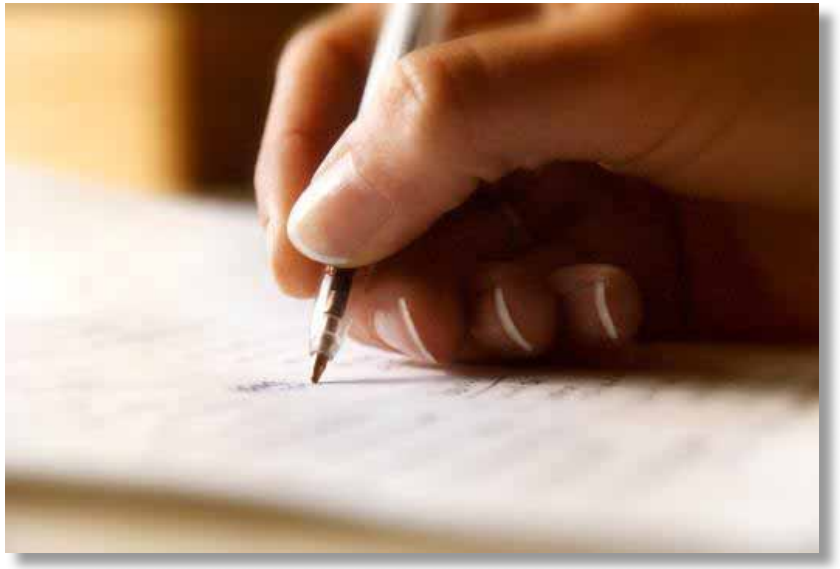


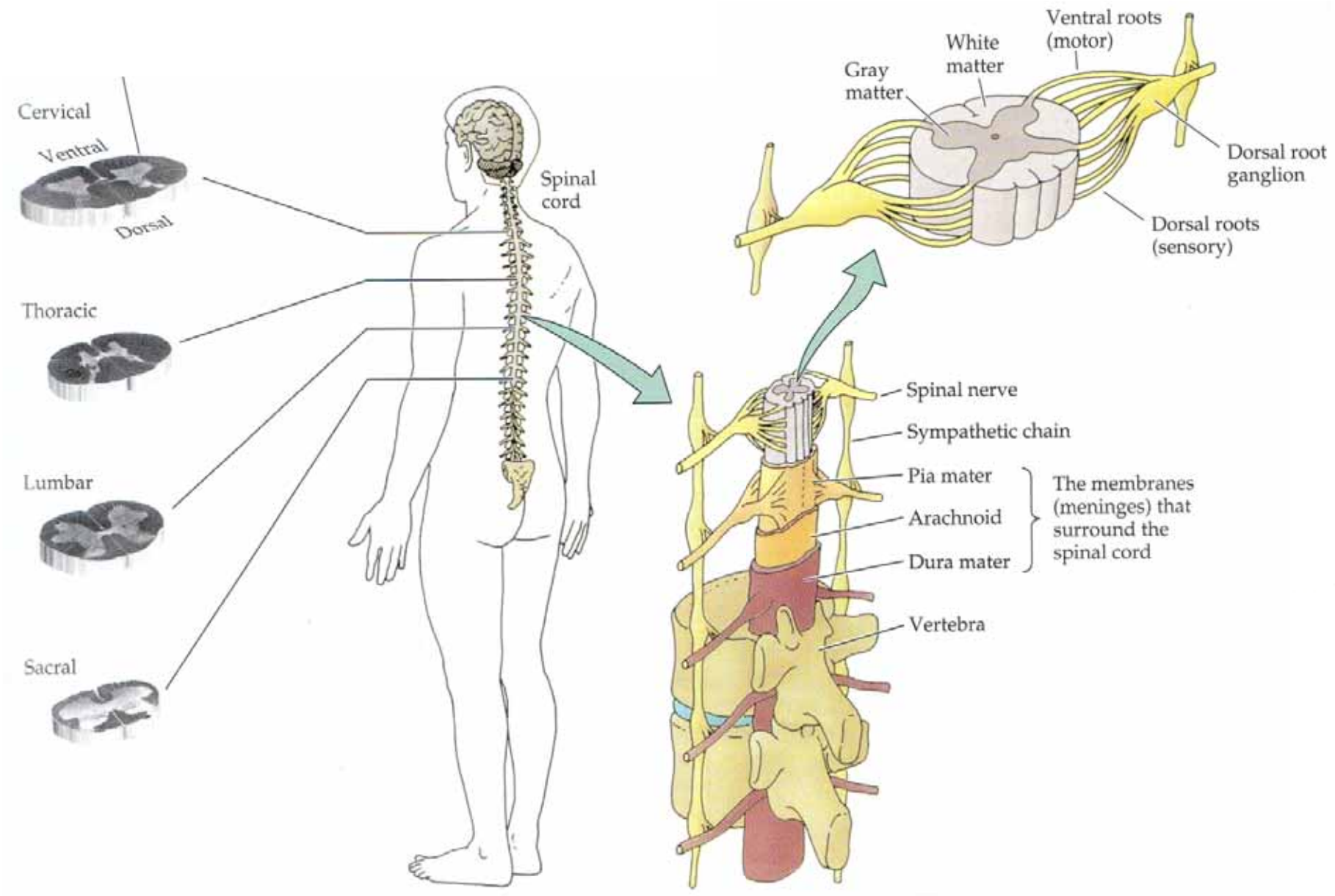
Figure 15-3. Homunculi of the primary somatosensory area (**left**) and primary motor area (**right**). Wilder Penfield

Le tractus corticospinal

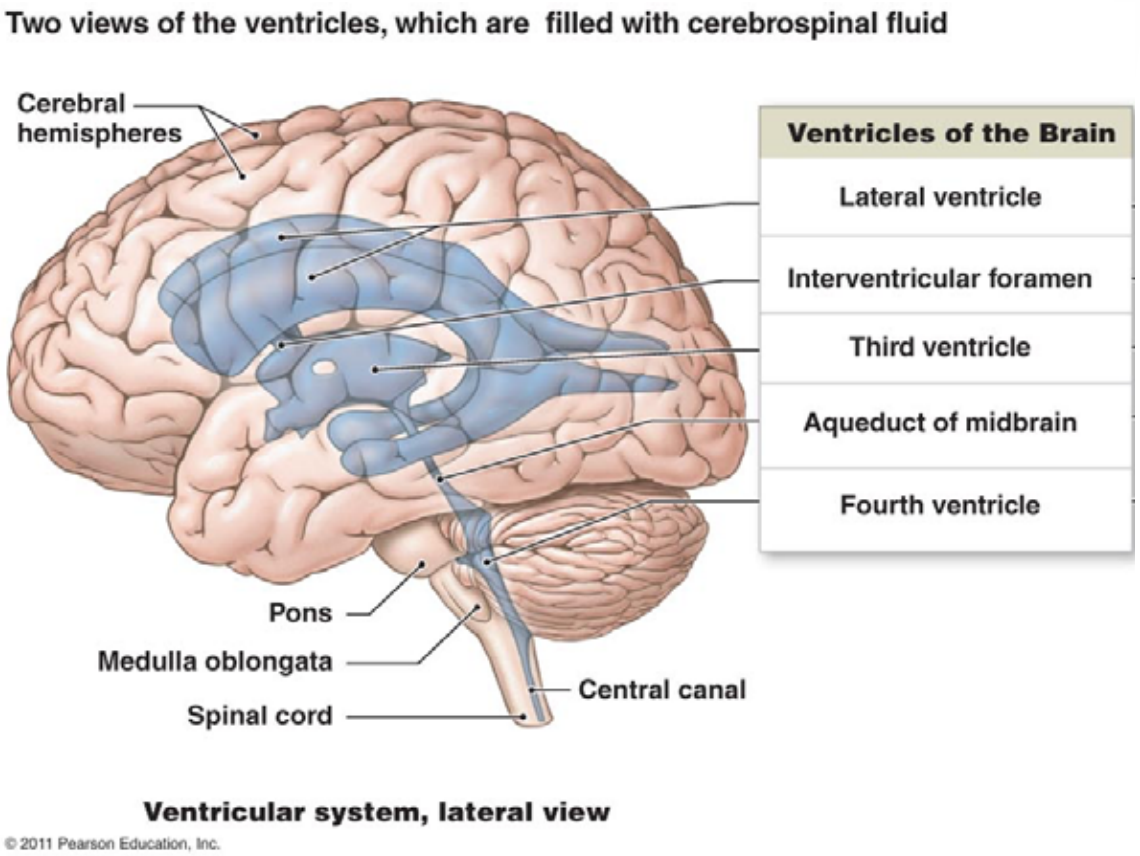


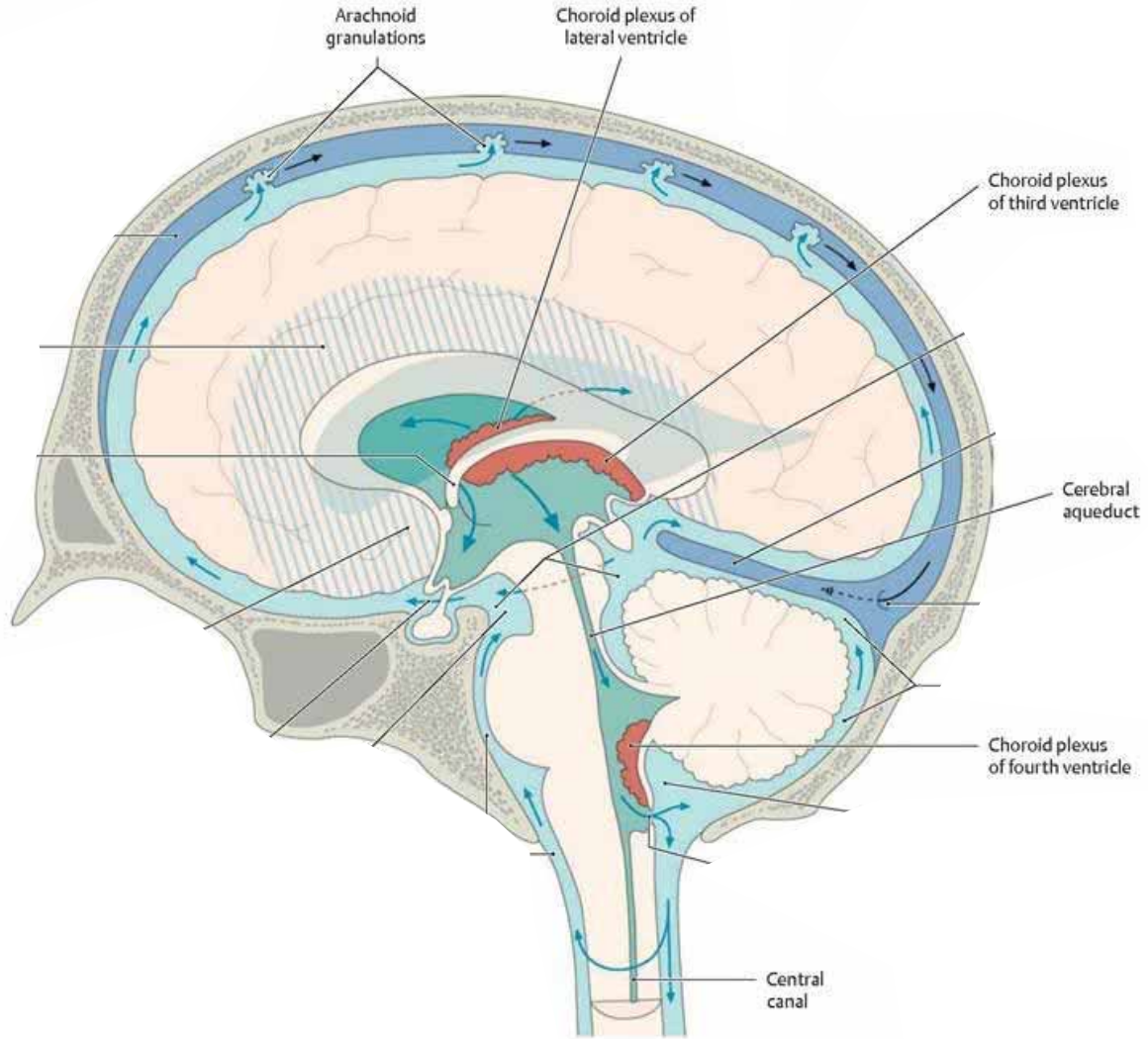


La moelle épinière



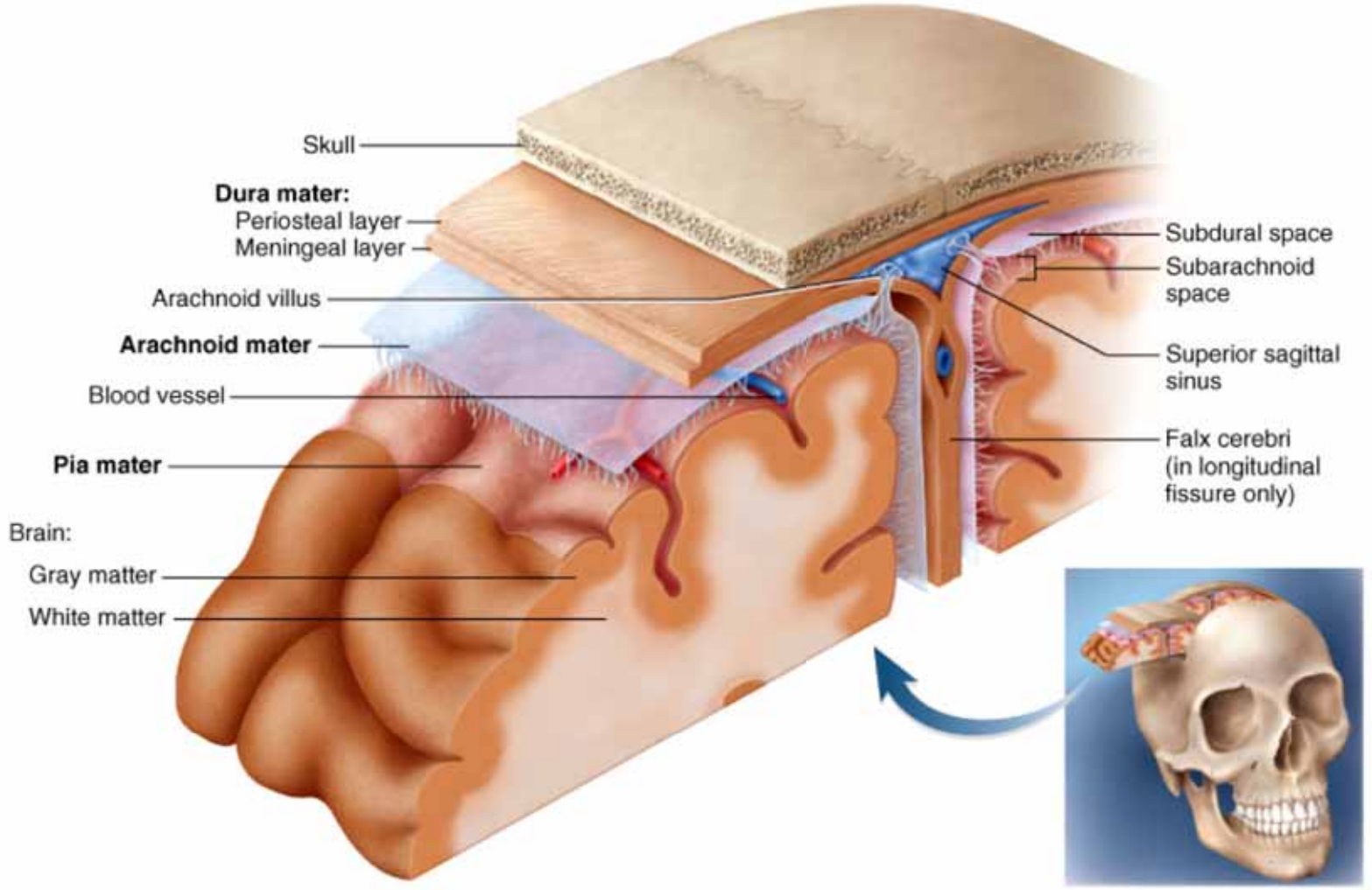
Le liquide céphalo-rachidien





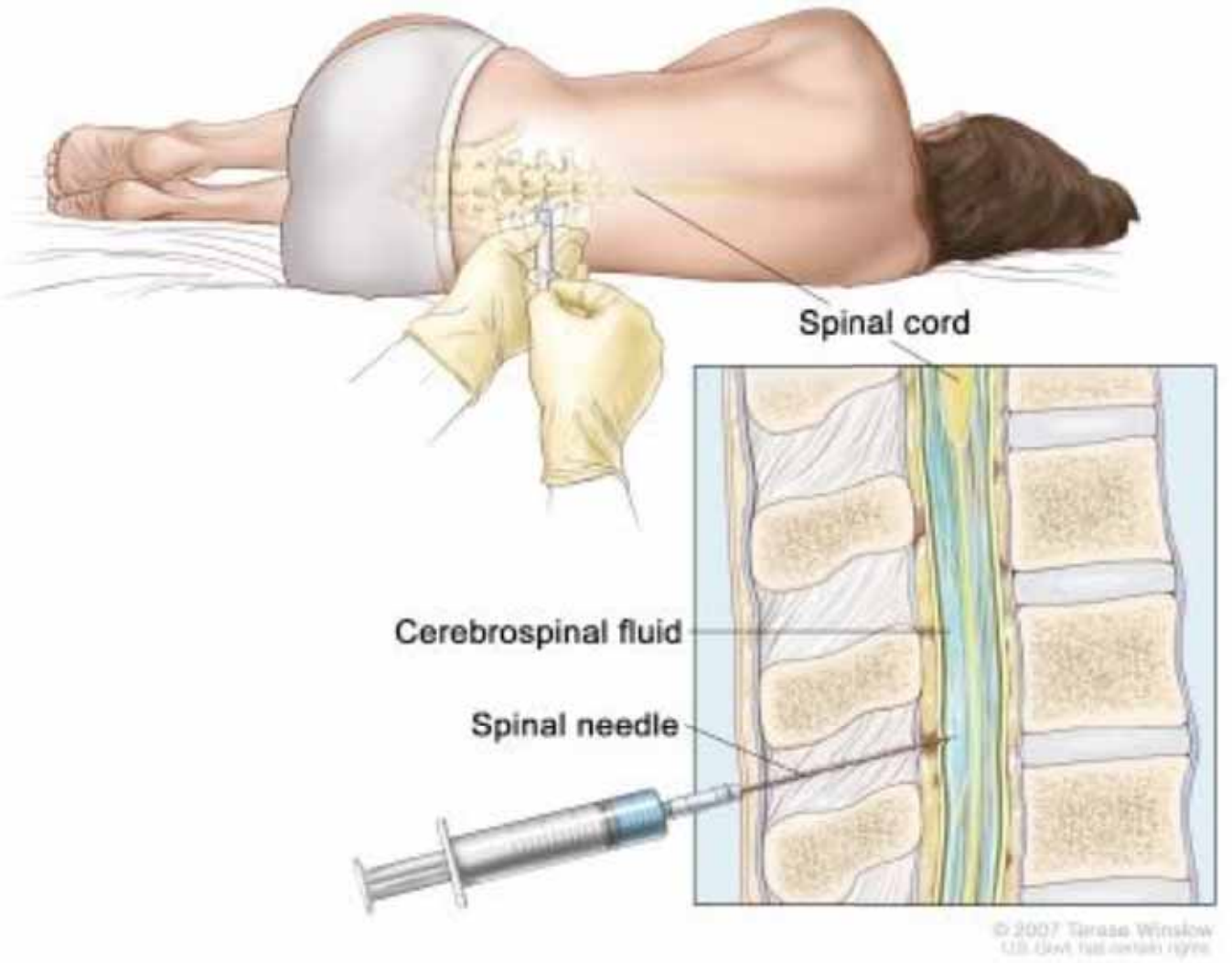
Les méninges

- Dure mère: membrane externe, la plus résistante
  - Entoure les sinus veineux duraux (retour veineux du cerveau)
  - Forme des structures de soutien: faux du cerveau, faux du cervelet, tente du cervelet.
- Arachnoïde: tapisse l'espace subarachnoïde où circule le LCR.
  - Granulations (villosités) arachnoïdiennes: invagination de l'arachnoïde dans les veines, lieu de résorption du LCR.
- Pie mère: la plus fine, tapisse la surface du cerveau.



Méningite

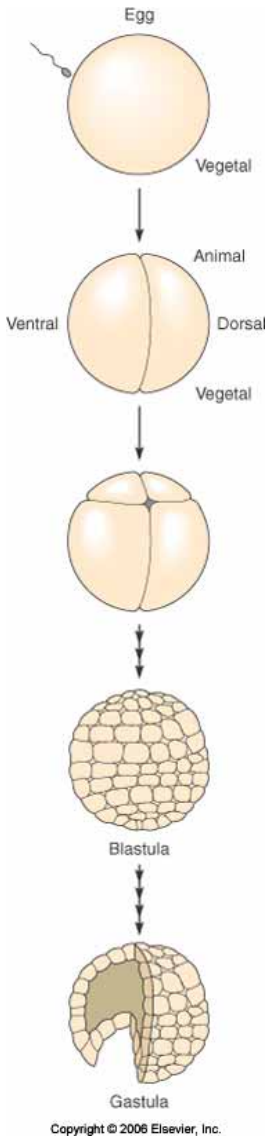
- Inflammation des méninges.
- Invasion bactérienne ou virale du LCR par voie ORL.
- Symptômes: fièvre, raideur de nuque, céphalées, somnolence, nausées et vomissements.
- Diagnostic par examen du LCR (ponction lombaire).

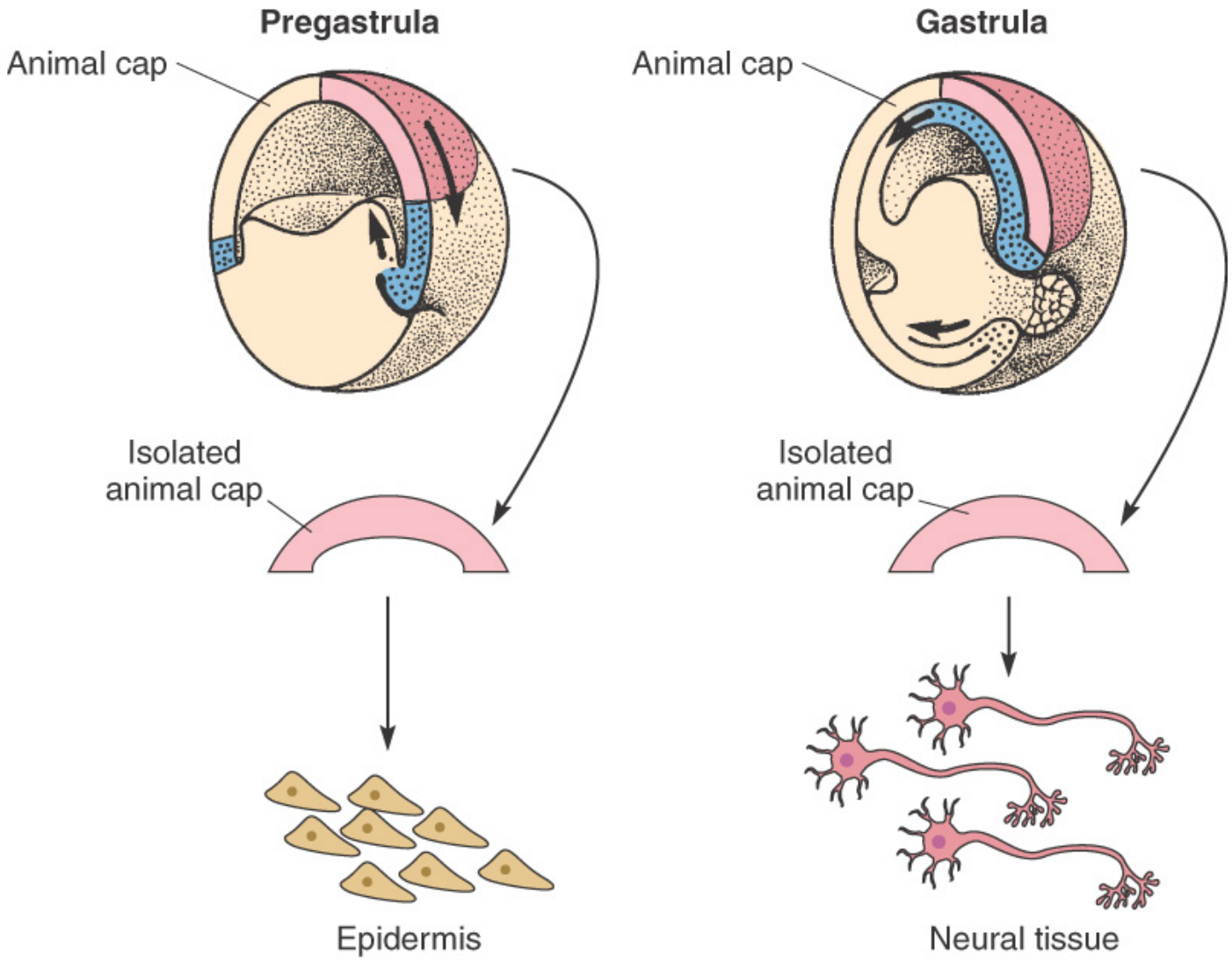


Développement du système nerveux

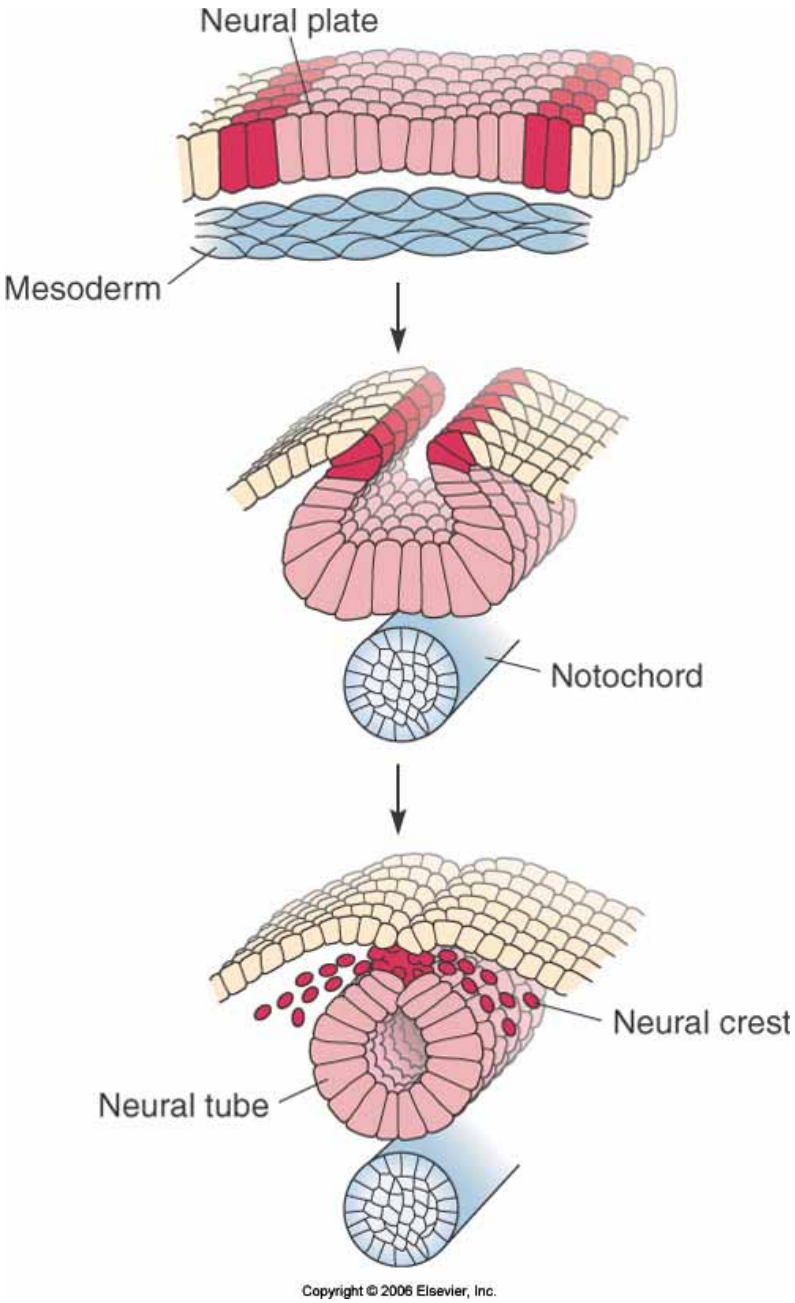
1. Formation du tissu nerveux
2. Neurogénèse et migration
3. Informations de position
4. Croissance axonale

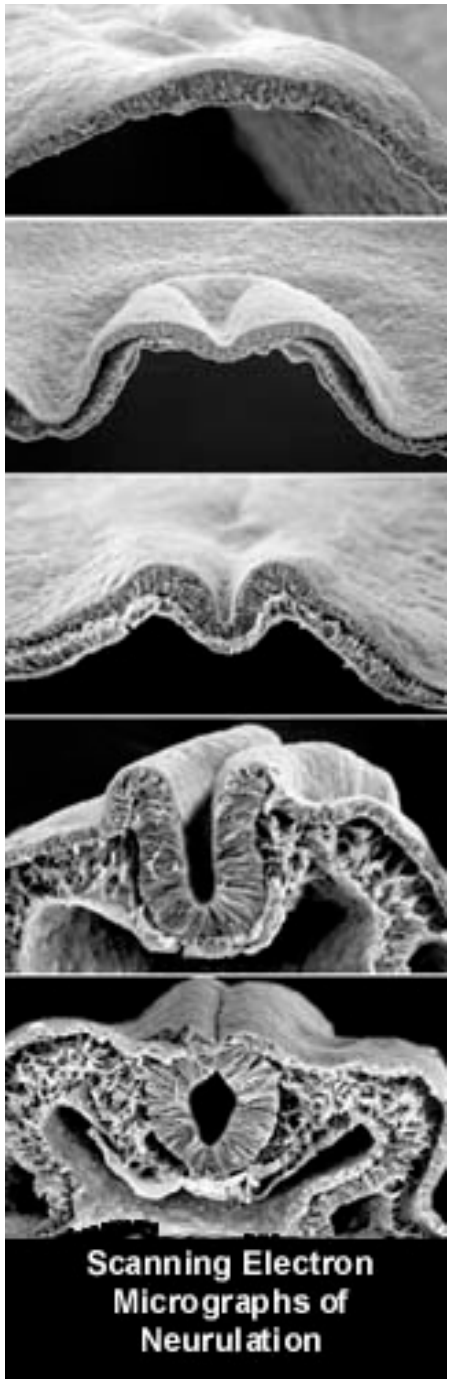
Le neurectoderme



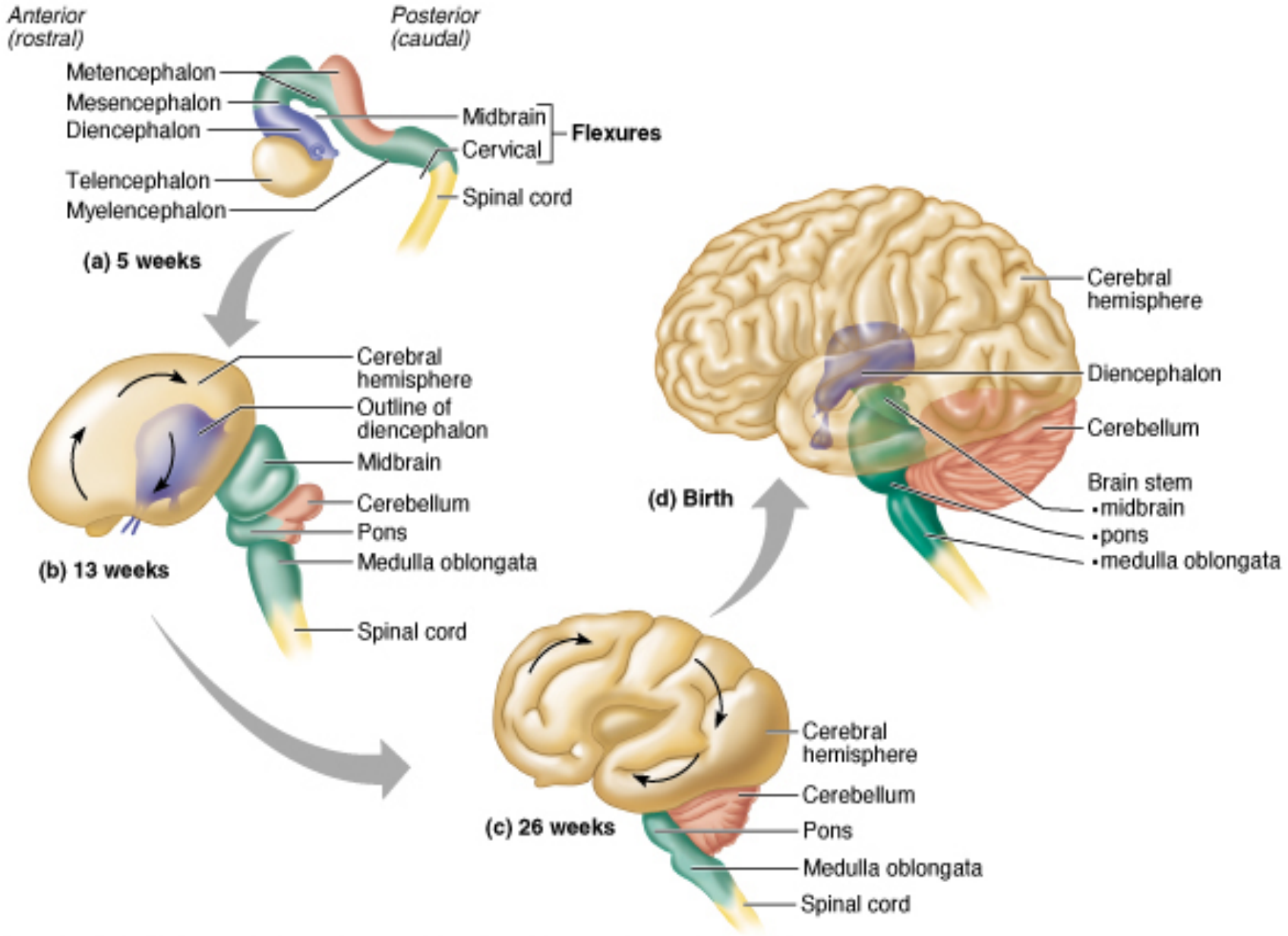


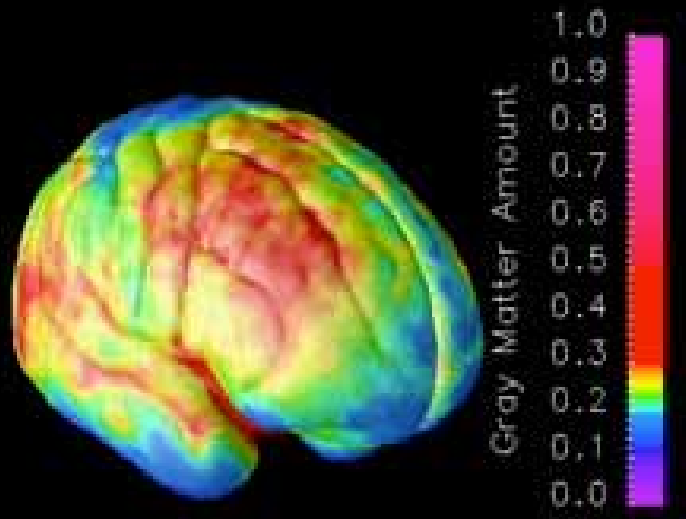
Neurulation





Tube neural et encéphale

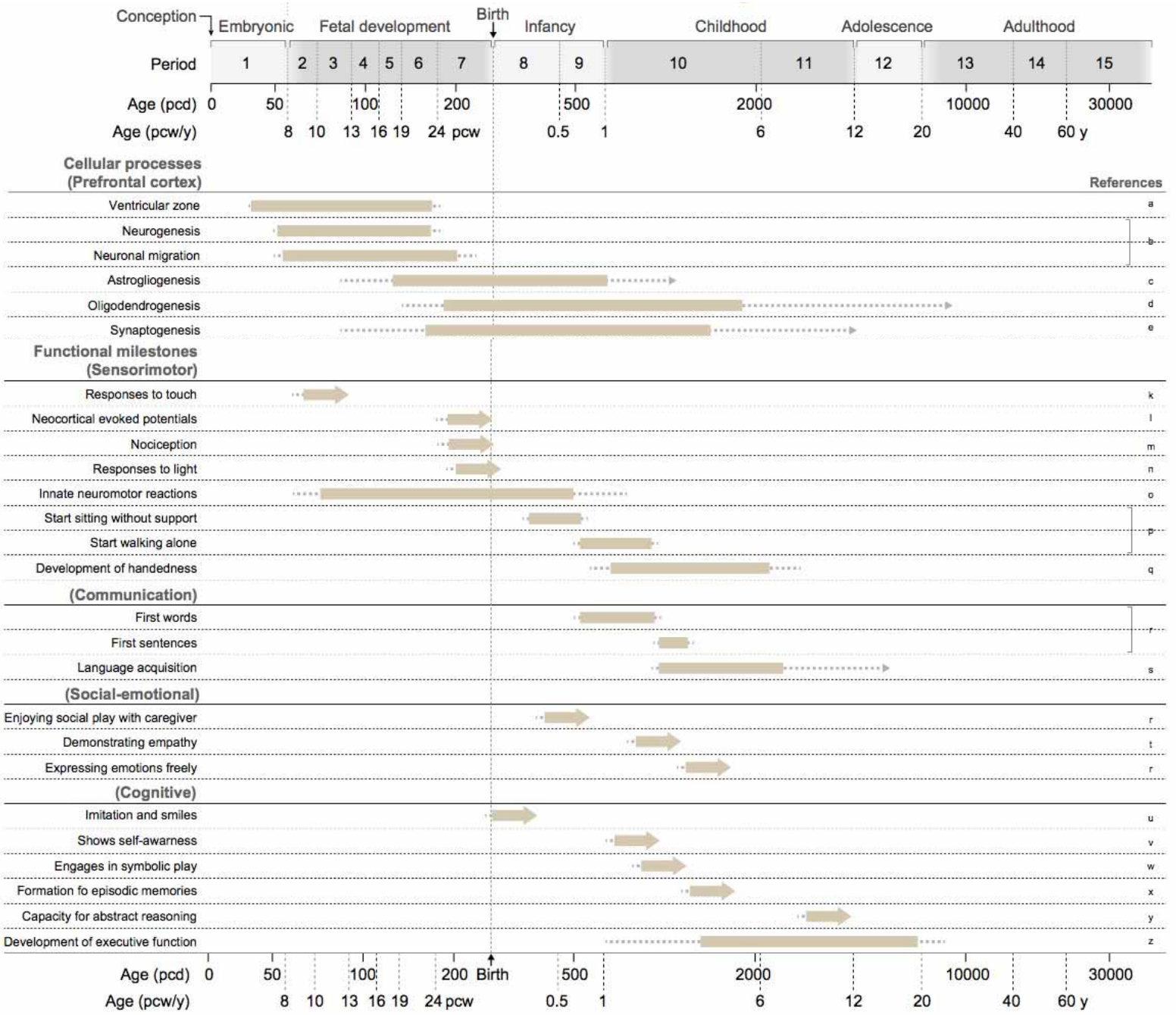




- 86 milliards de neurones.

Cortex cérébral:

- 16 milliards de neurones.
- 164’000 milliards de synapses.
- 7’000- 80’000 synapses par neurone
  80% 3.8 millions de neurones générés par heure pendant corticogénèse.



Développement du système nerveux

1. Formation du tissu nerveux
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3. Informations de position
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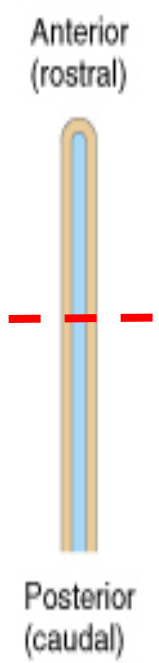
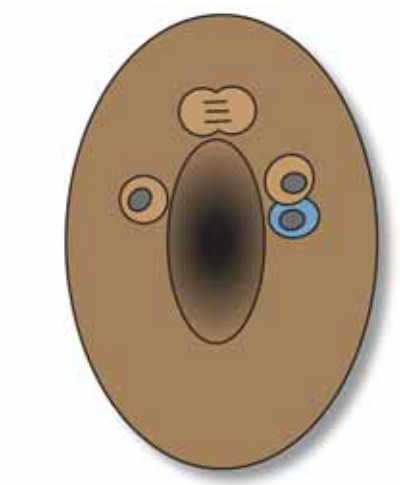
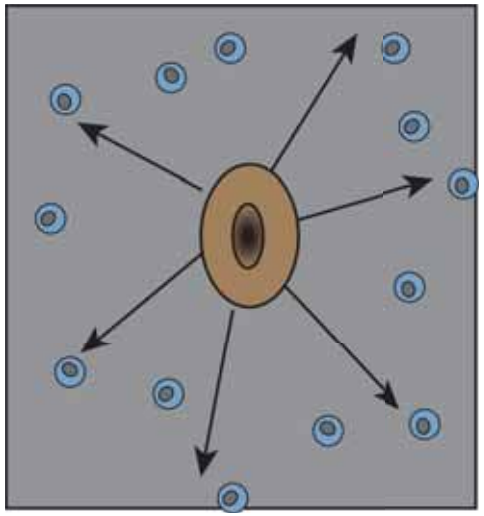
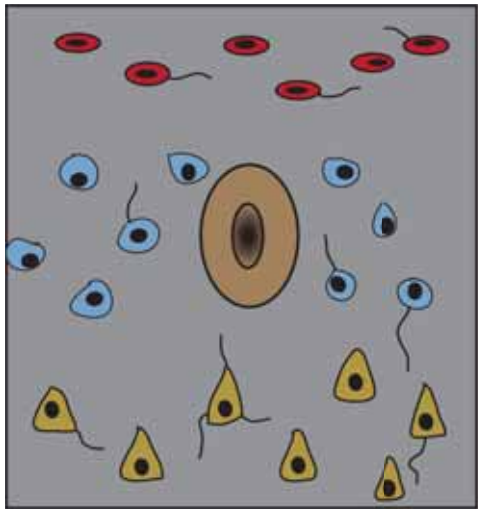
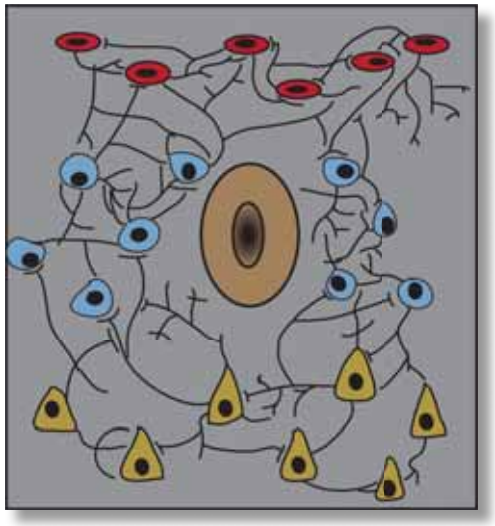
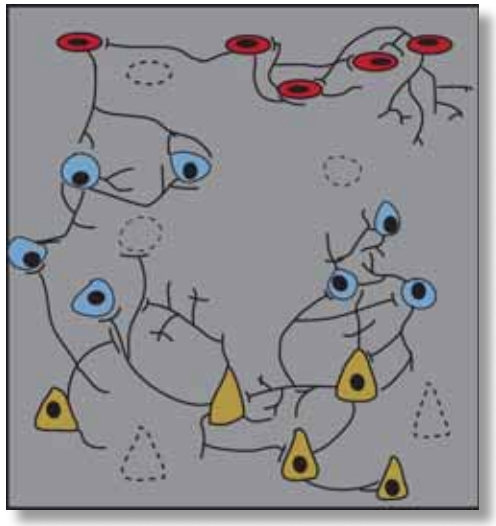

Anterior
(rostral)
Posterior
(caudal)

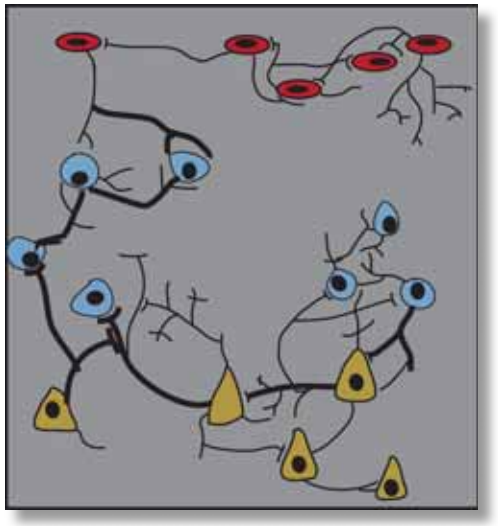










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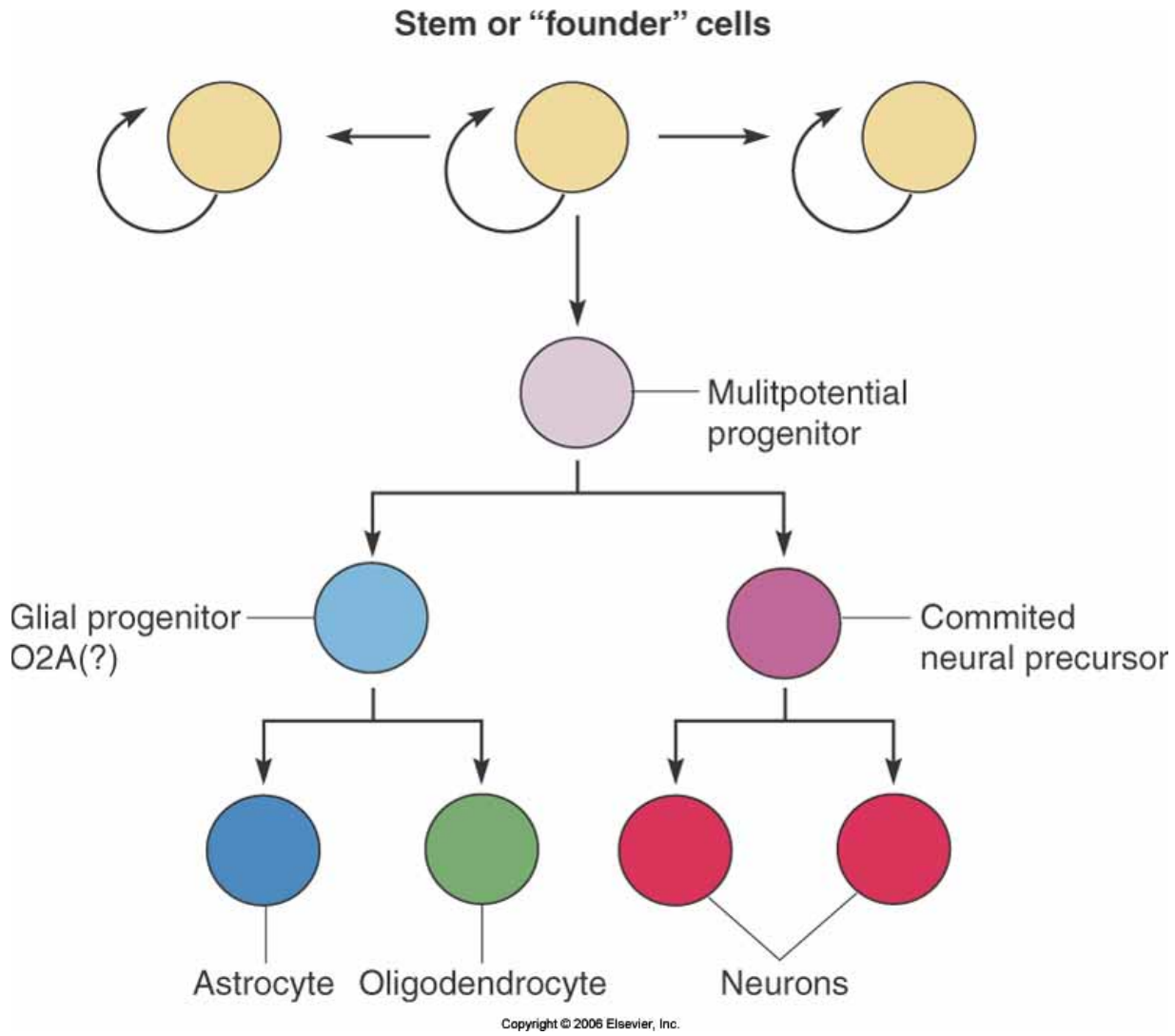
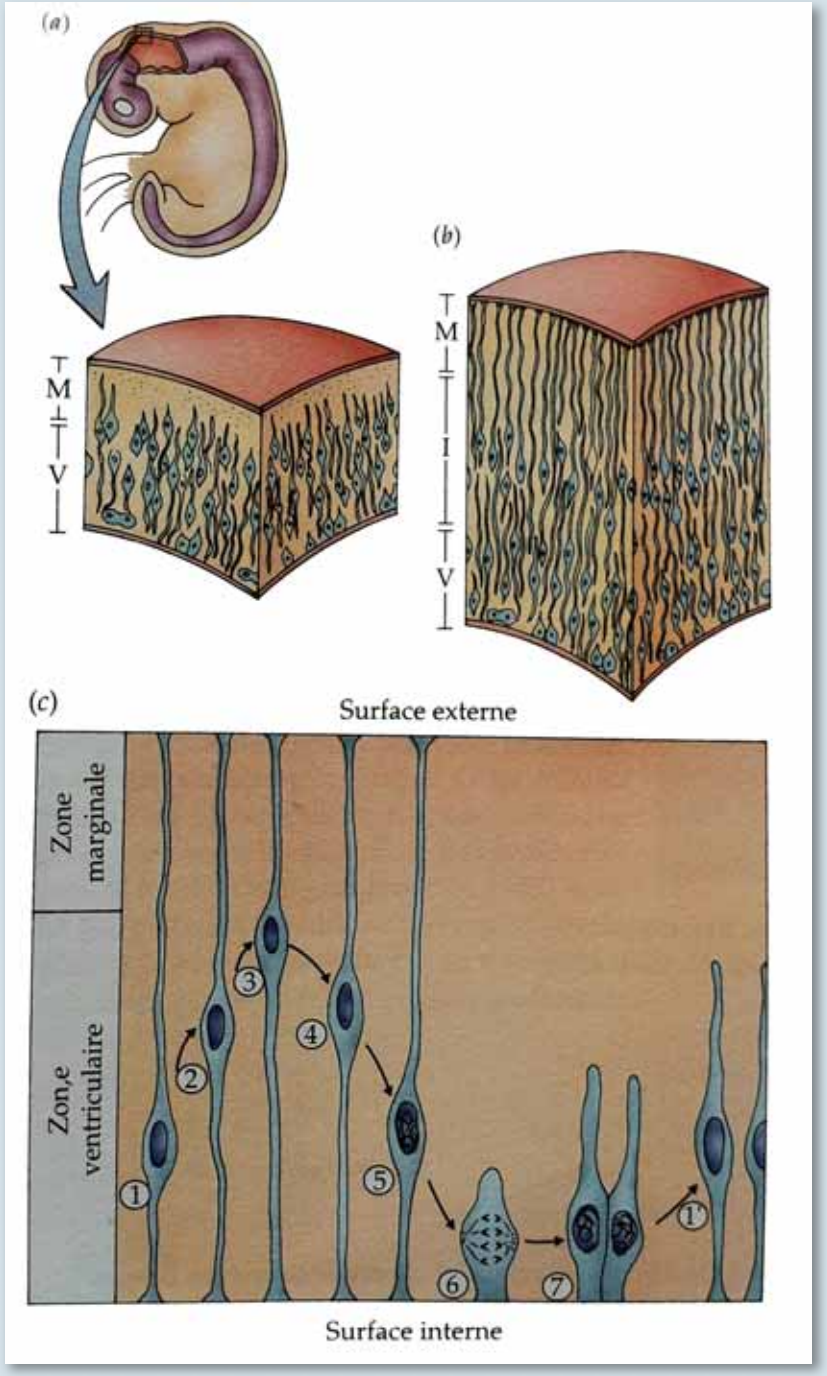
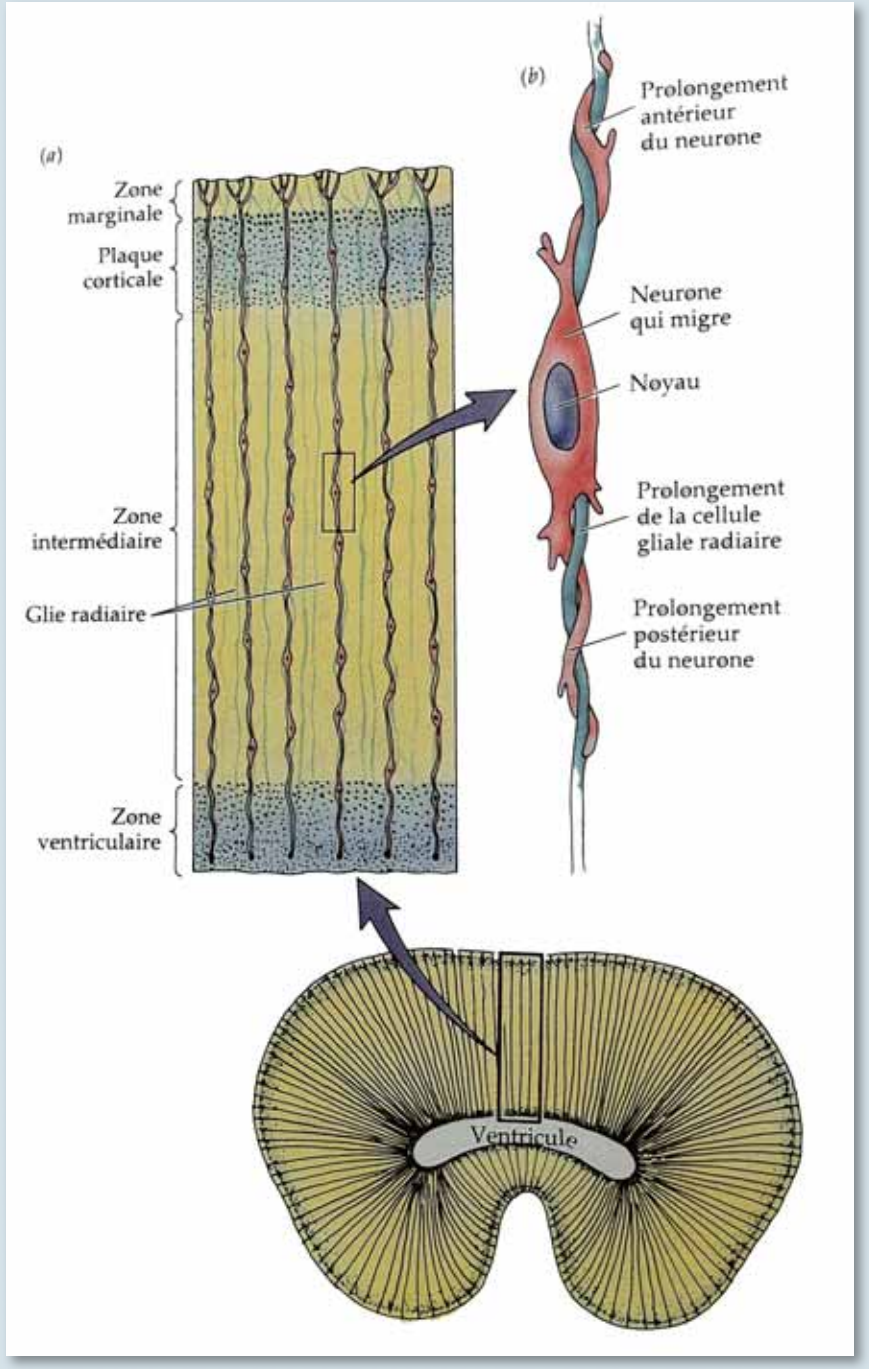
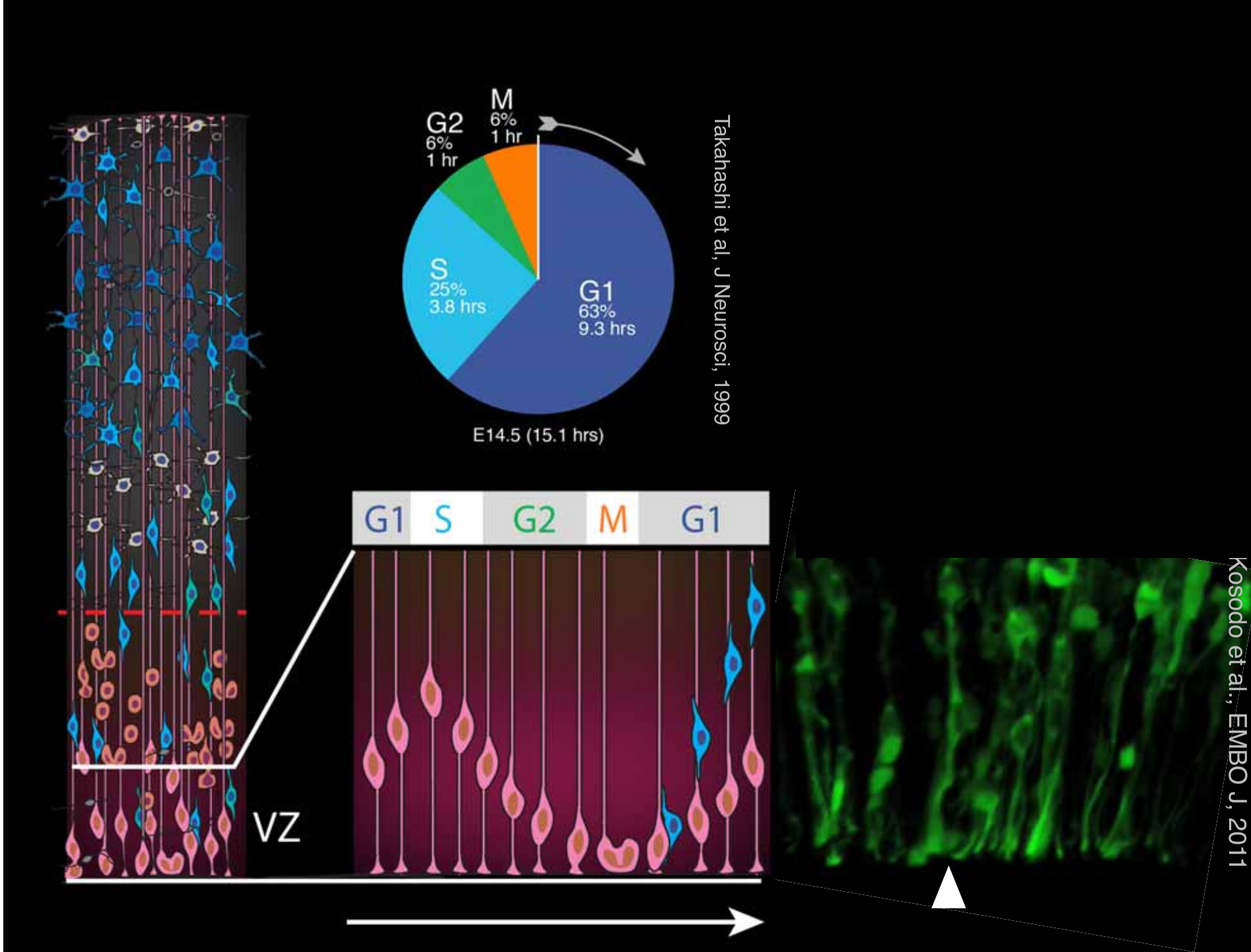
Précurseurs neuraux et neuronaux



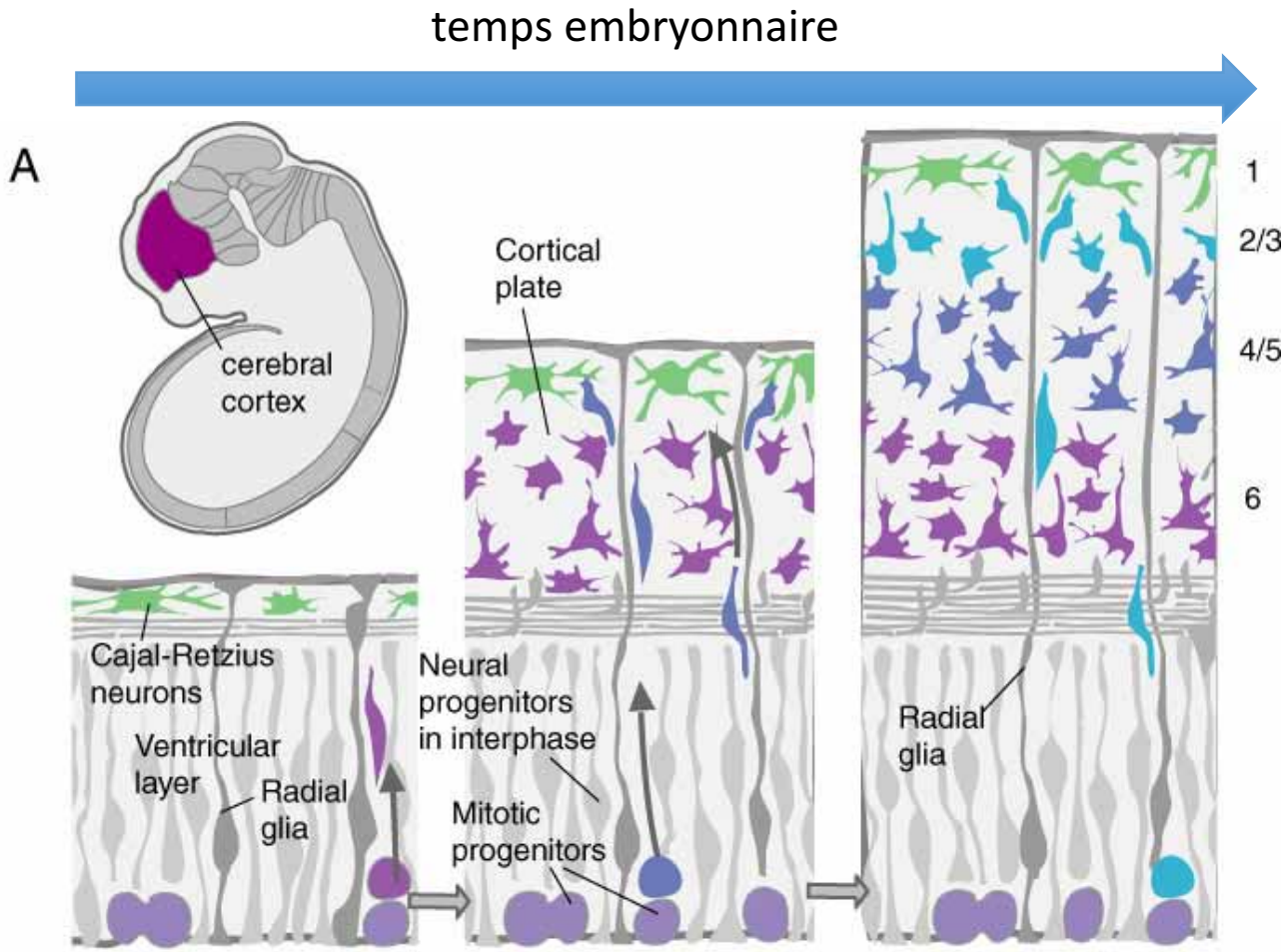

(a)
M
V
(b)
M
I
V
(c)
Surface externe
Zone marginale
Zone ventriculaire
1
2
3
4
5
6
7
Surface interne

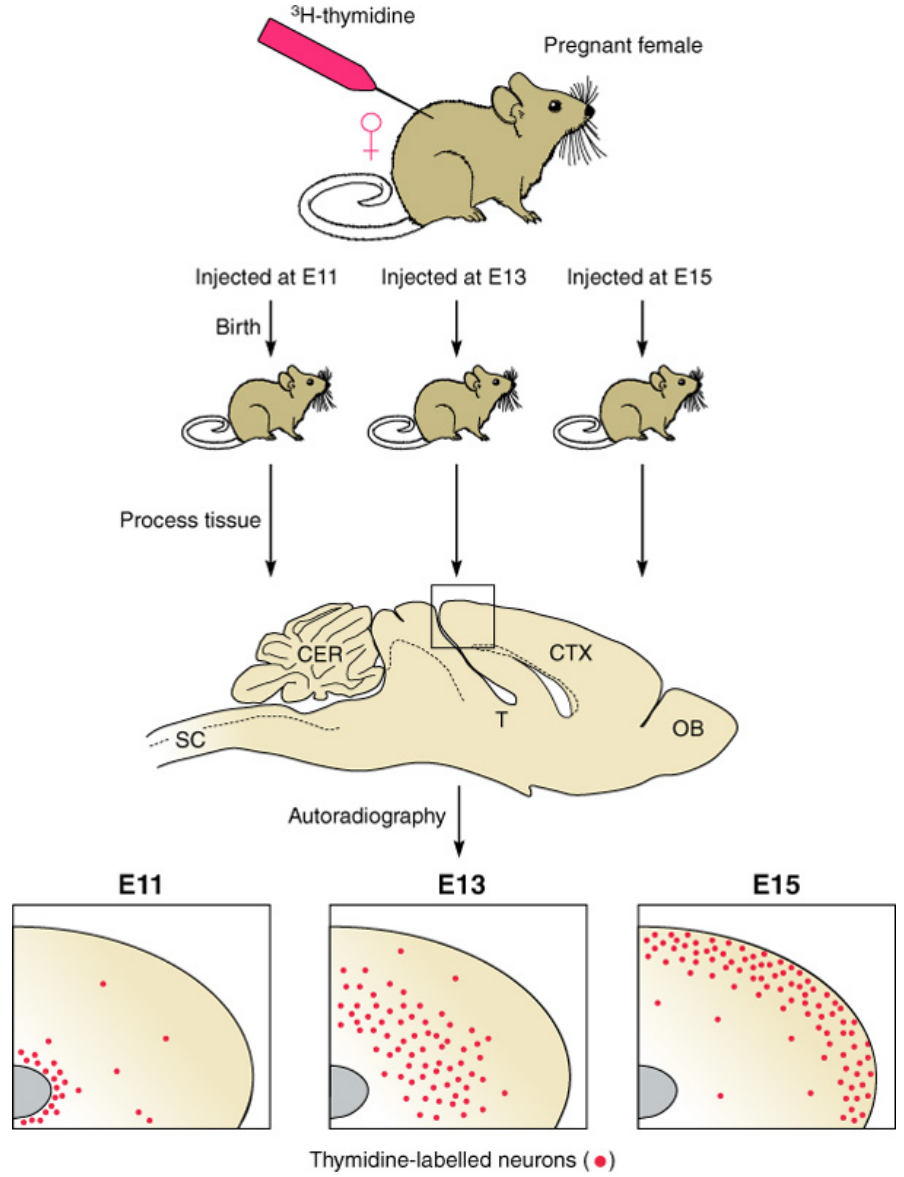

(a)
Zone marginale
Plaque corticale
Zone intermédiaire
Glie radiaire
Zone ventriculaire
(b)
Prolongement antérieur du neurone
Neurone qui migre
Noyau
Prolongement de la cellule gliale radiaire
Prolongement postérieur du neurone
Ventricule

Migration interkinétique

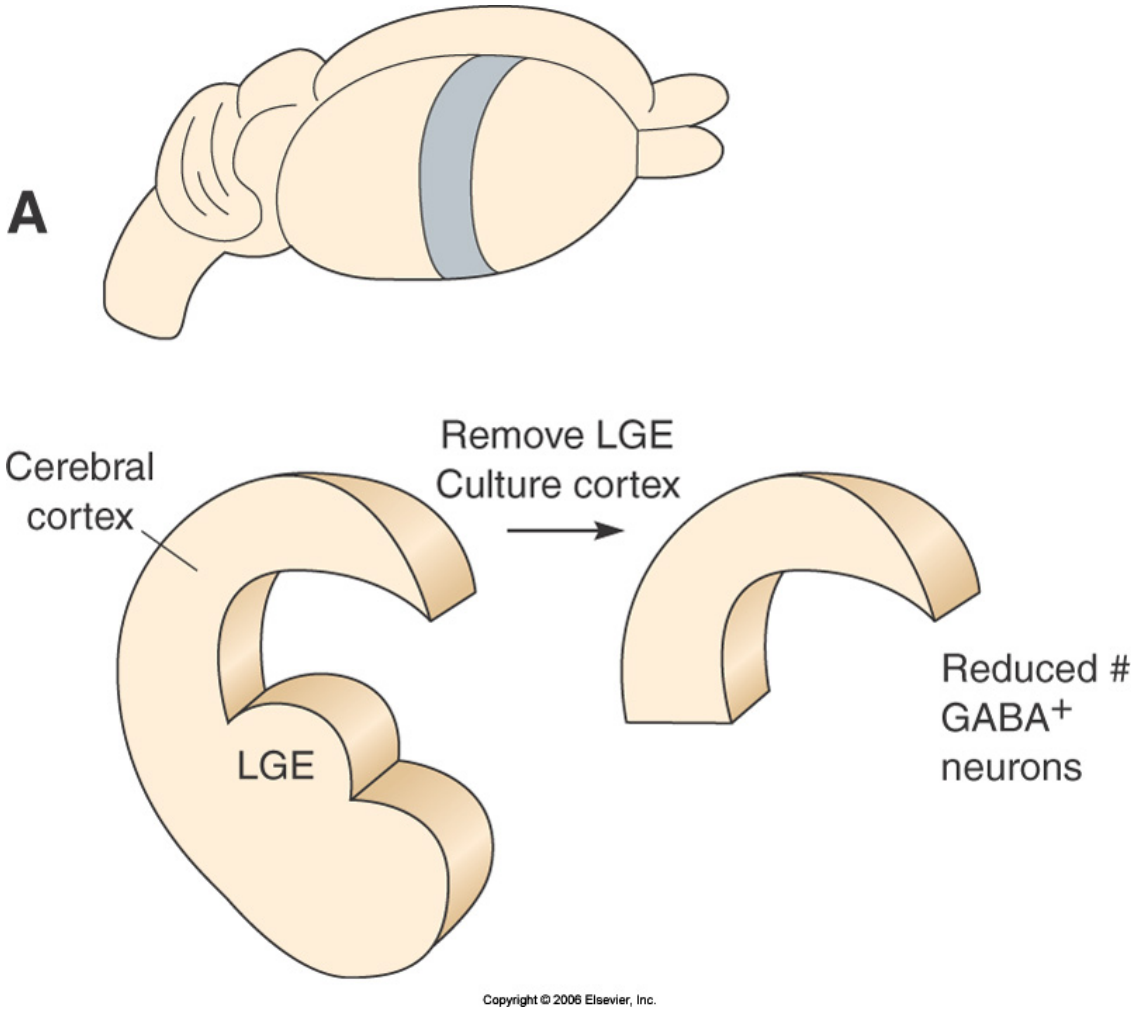


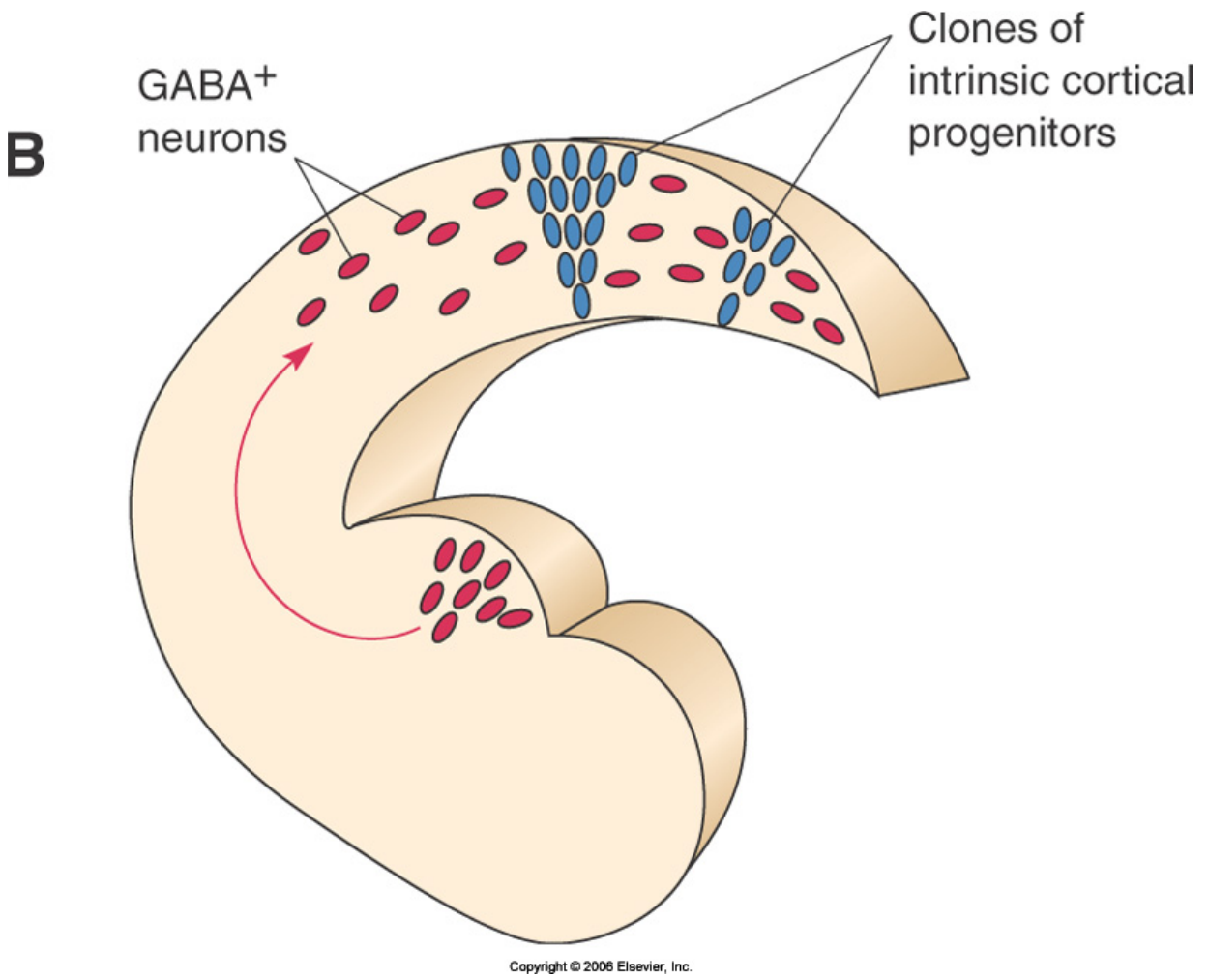
Développement du cortex cérébral

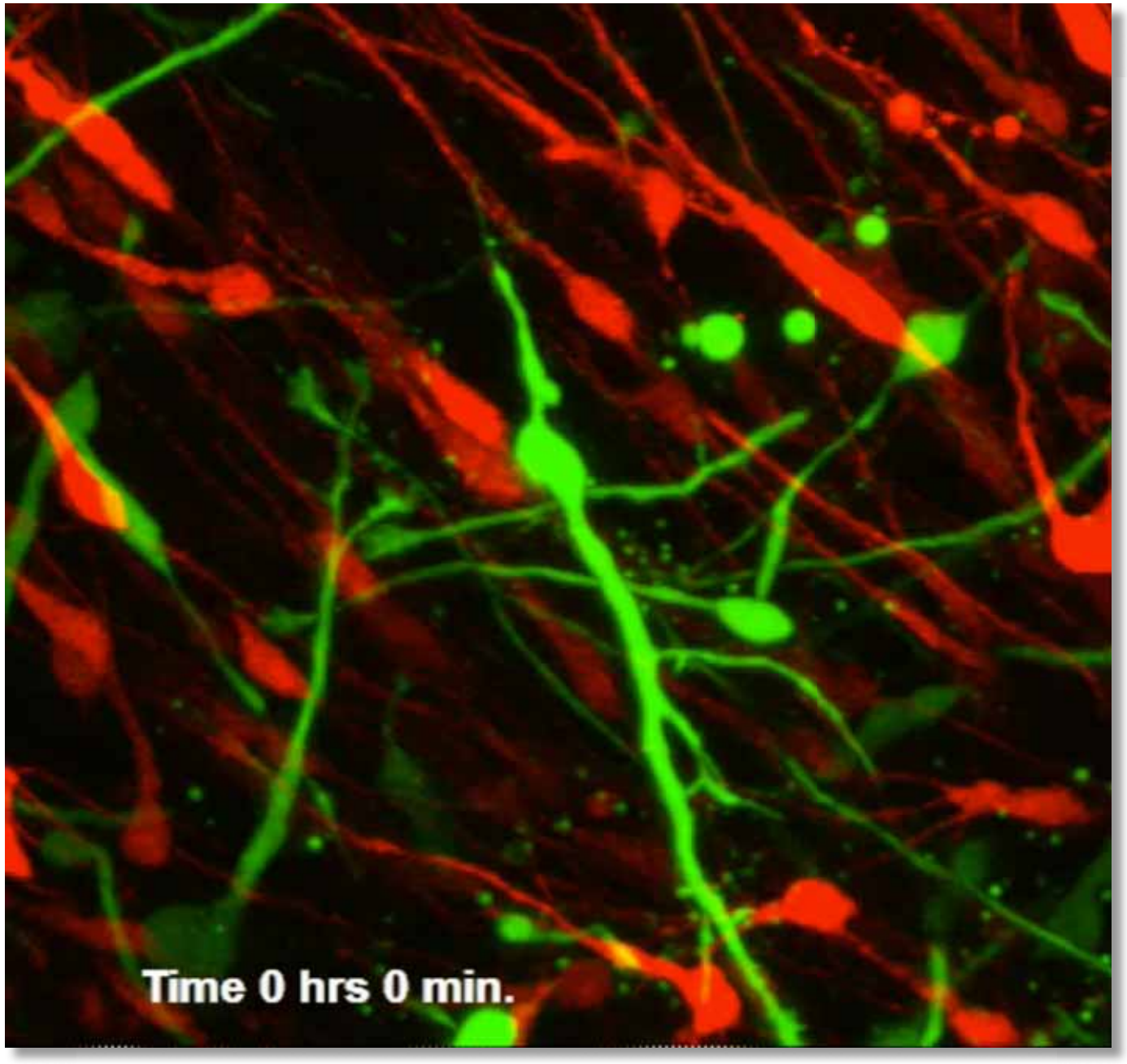




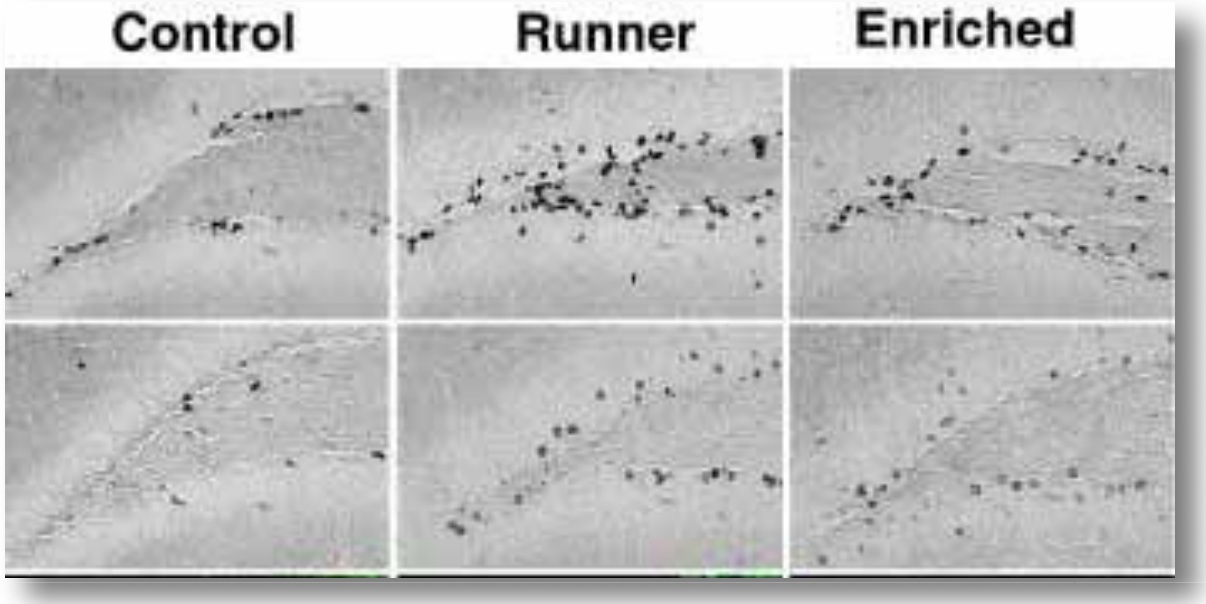
Migration radiale et tangentielle

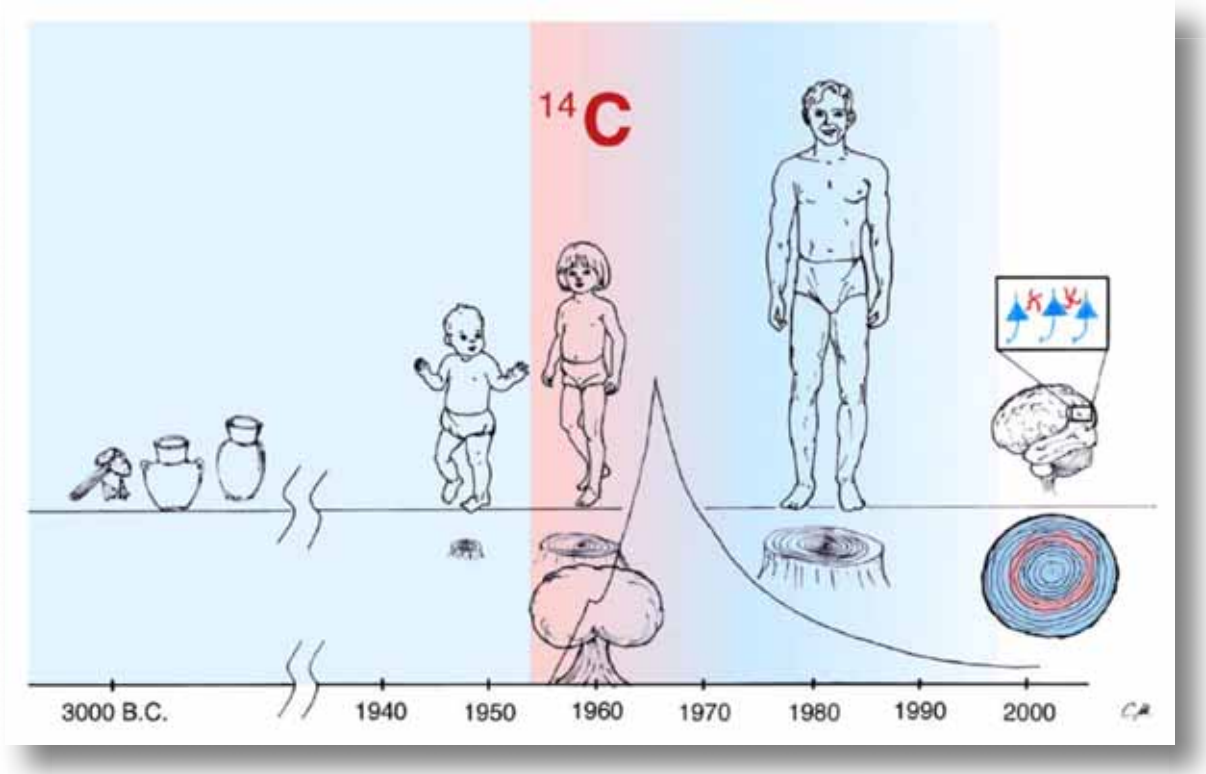





Time 0 hrs 0 min.

Neurogénèse adulte





Développement du système nerveux

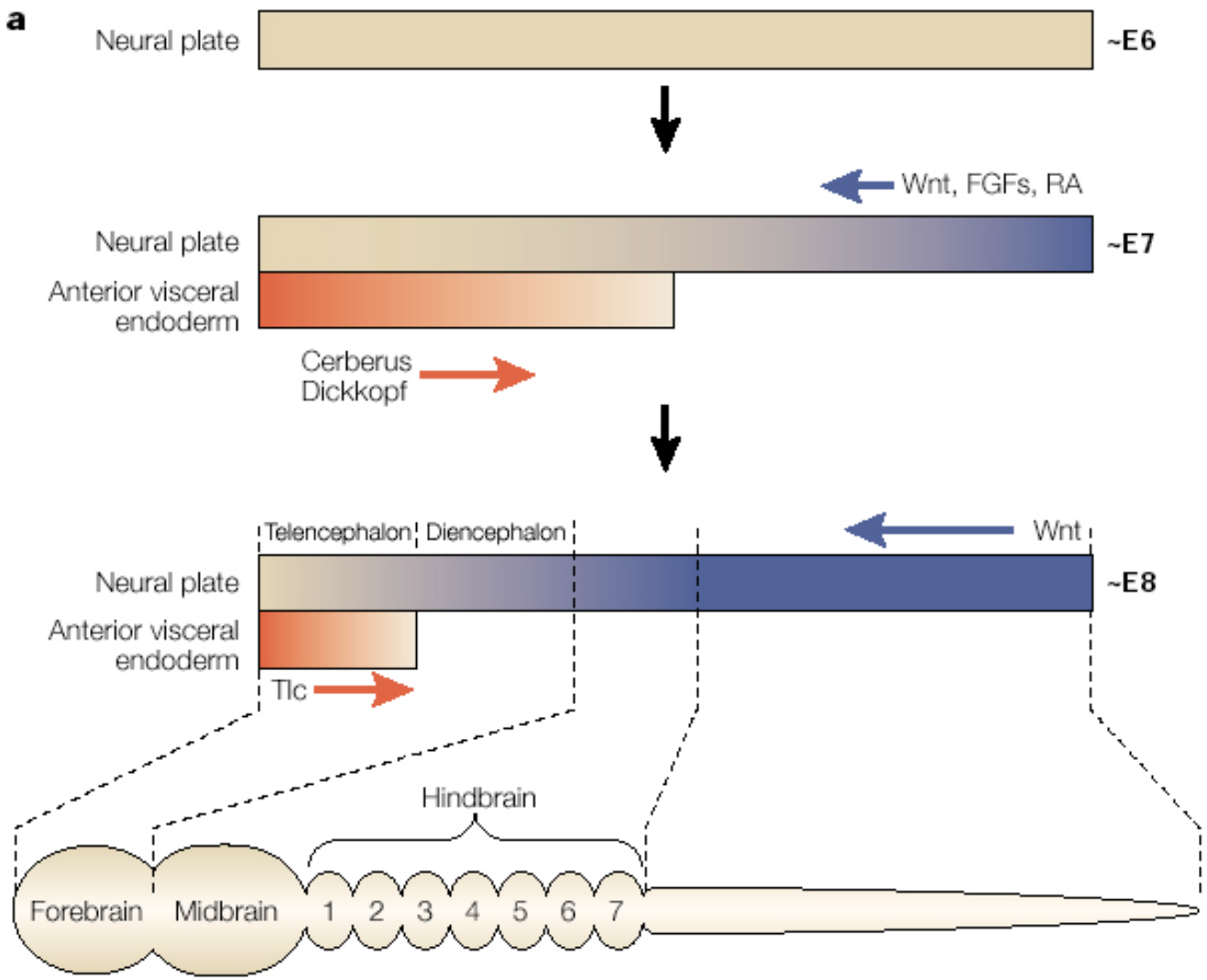
1. Formation du tissu nerveux
2. Neurogénèse et migration
3. Informations de position
4. Croissance axonale

Polarisation du névraxe: indicateurs de position rostro-caudale

Organisateur Céphalique

Inhibiteurs de BMP: Cordin & Noggin

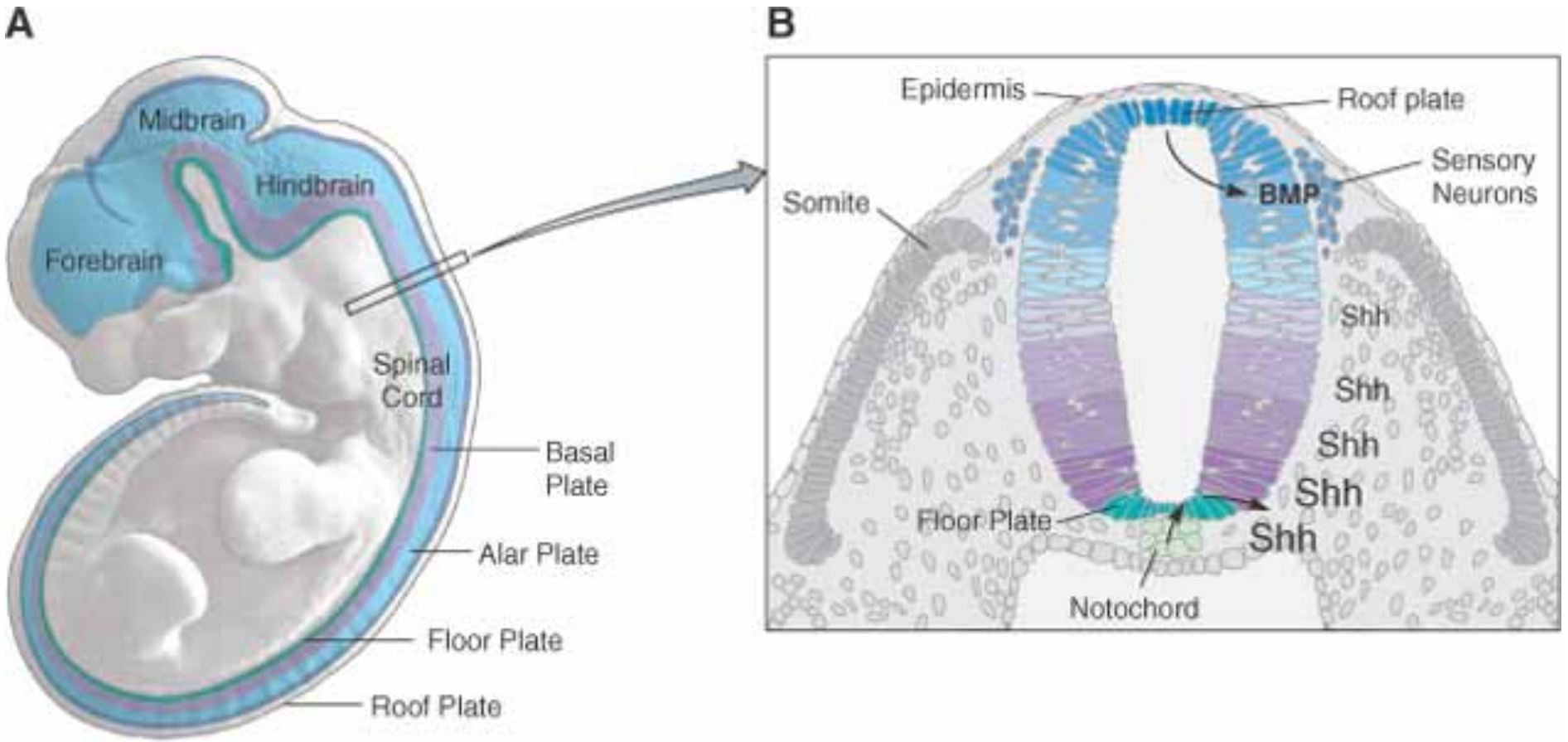
Inhibiteurs de Wnt: Cerberus, Dickkopf & frzb1



Organisateur caudal:

FGF, WNT, RA

Polarisation du névraxe: indicateurs de position dorso-ventrale



Développement du système nerveux

1. Formation du tissu nerveux
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3. Informations de position
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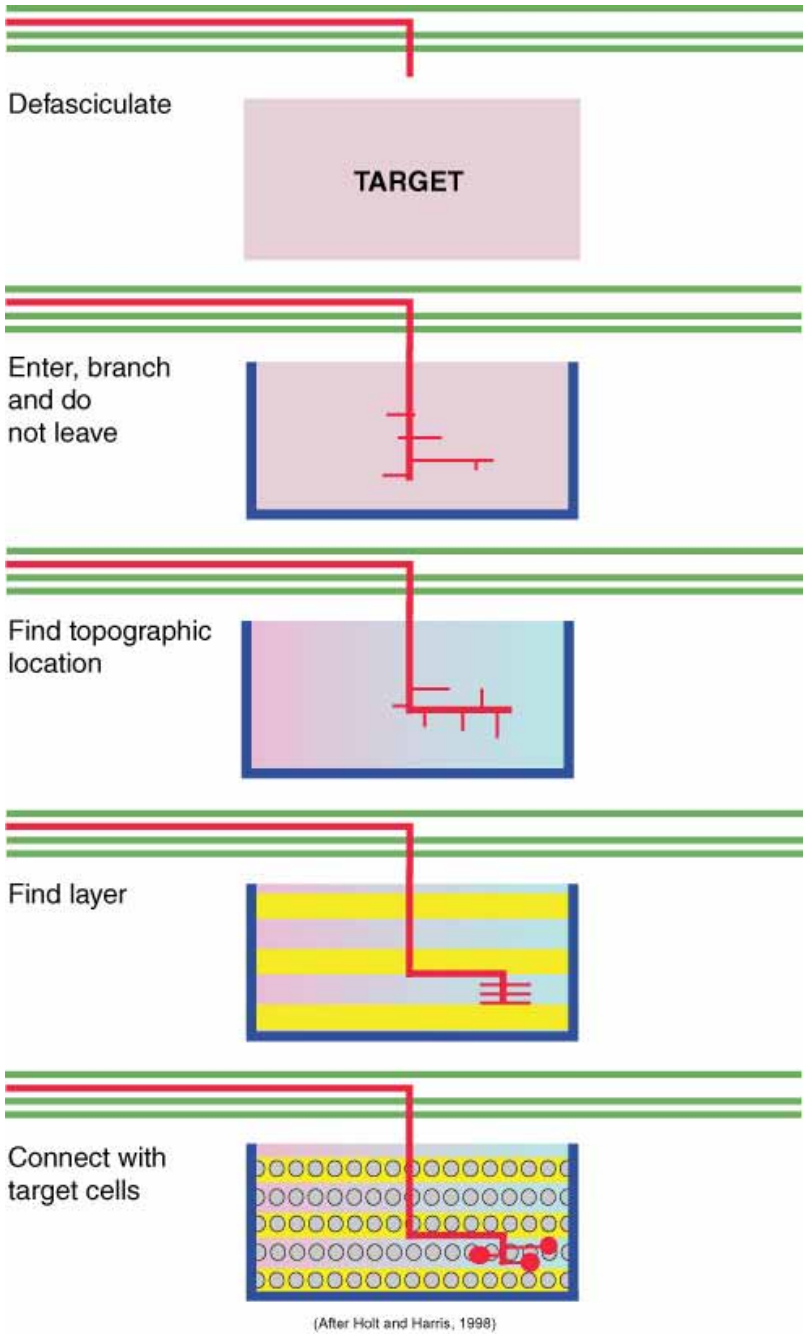
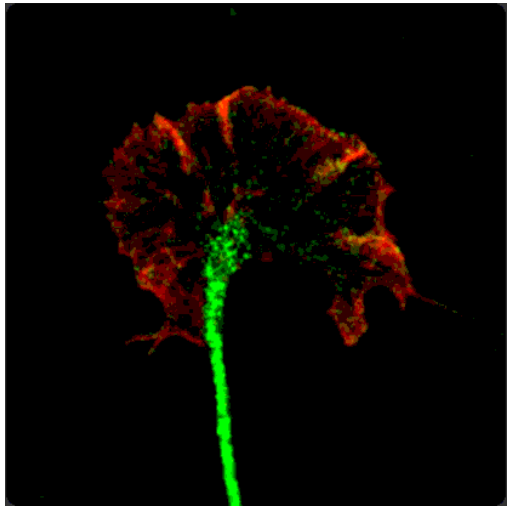
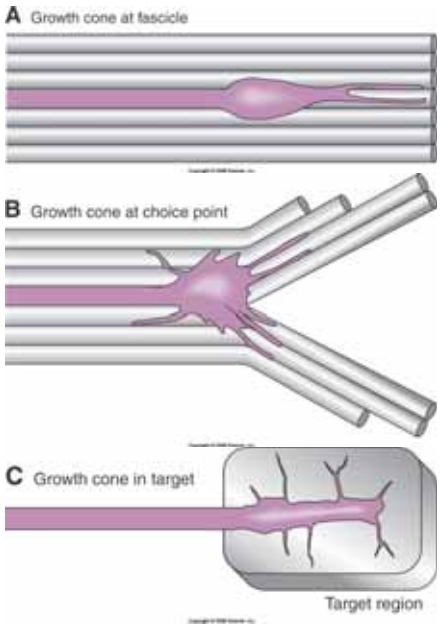
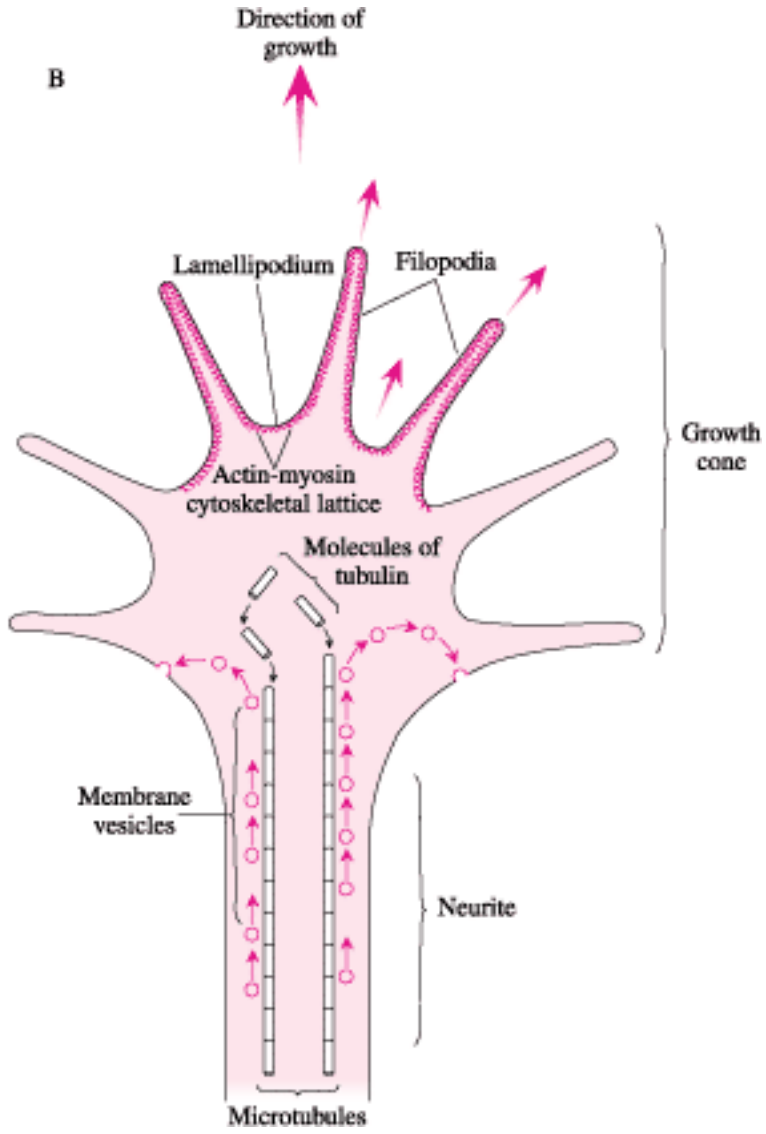
Etapes pour atteindre une cible

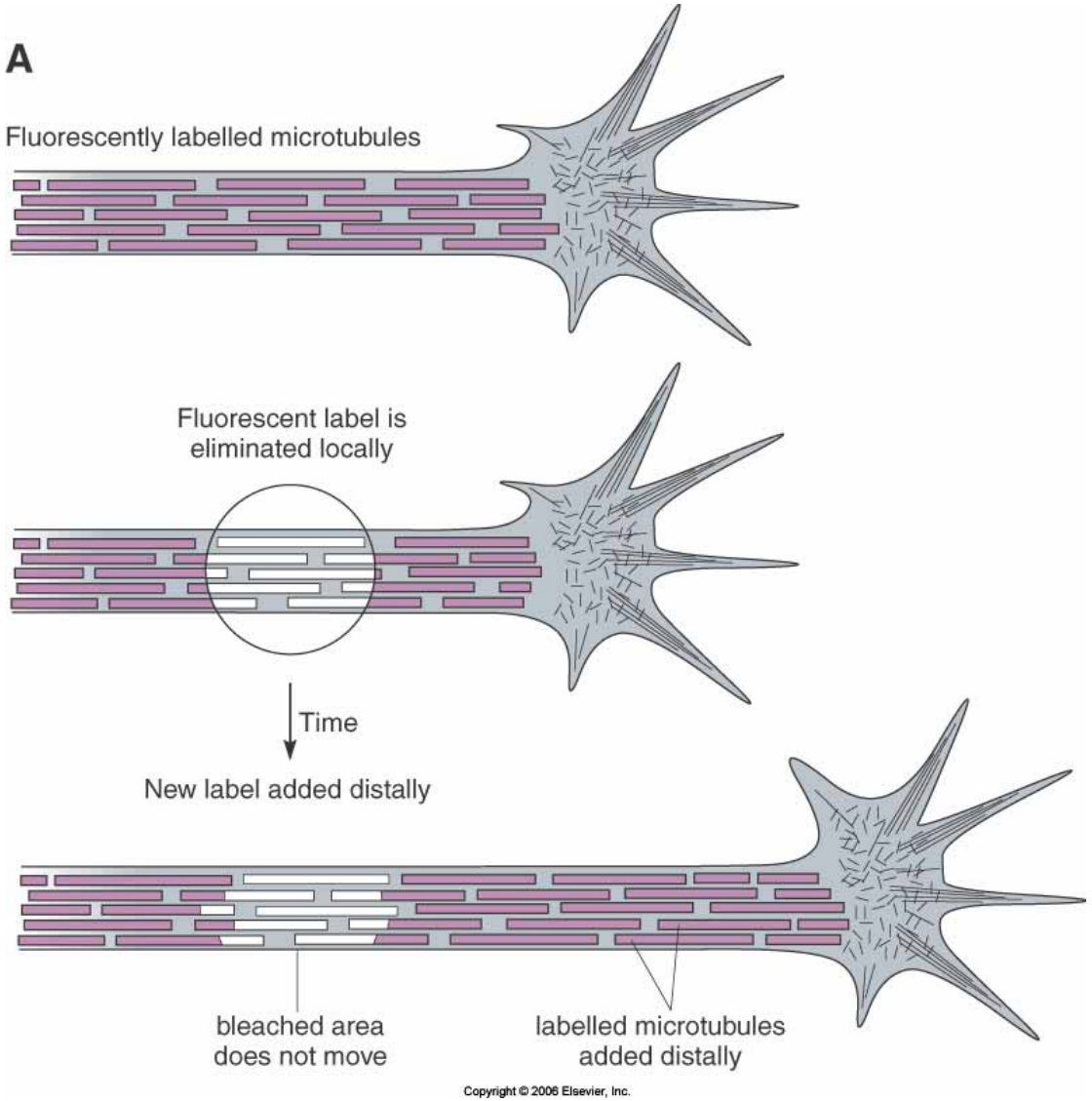


Cône de croissance axonal

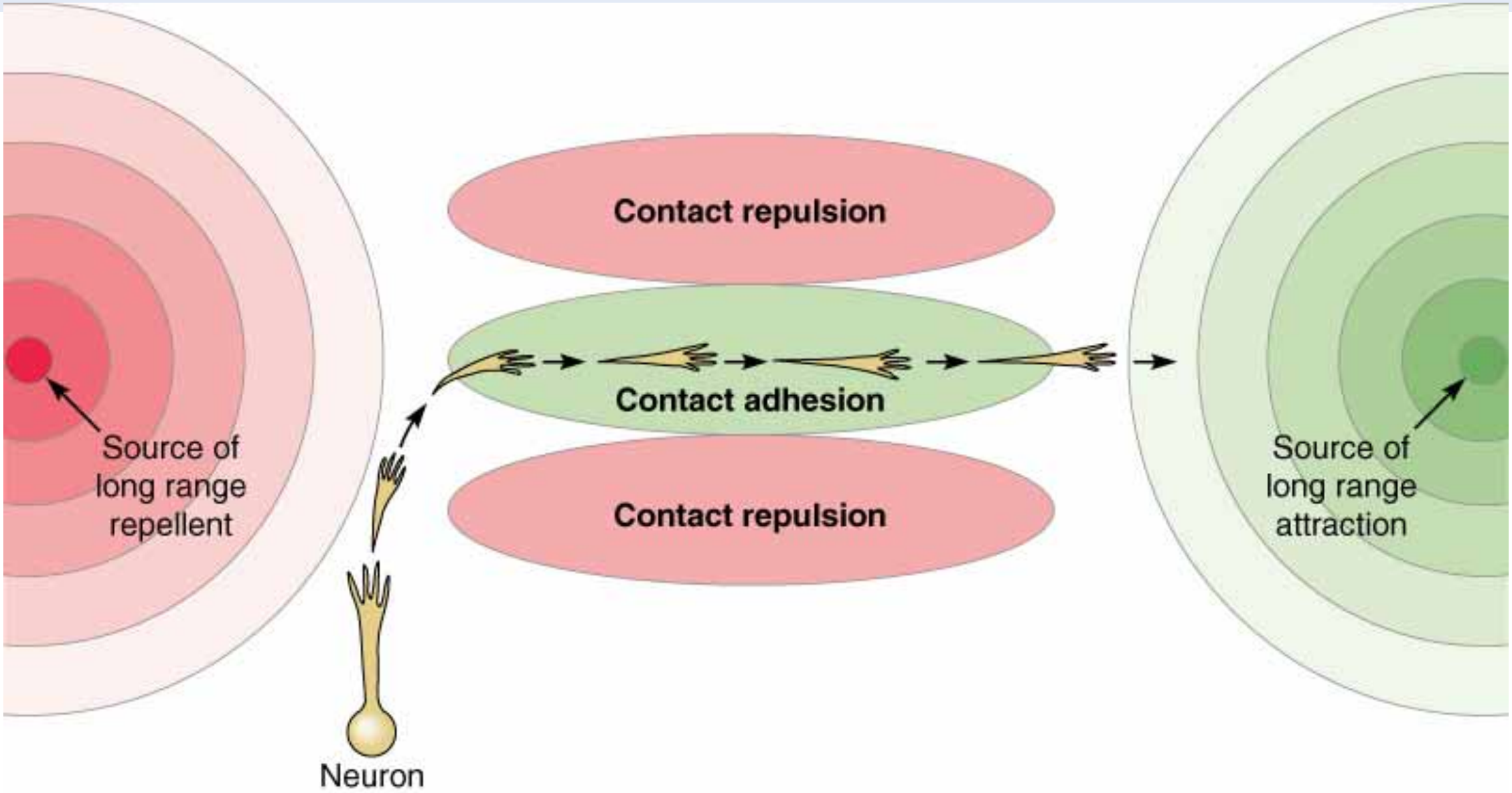








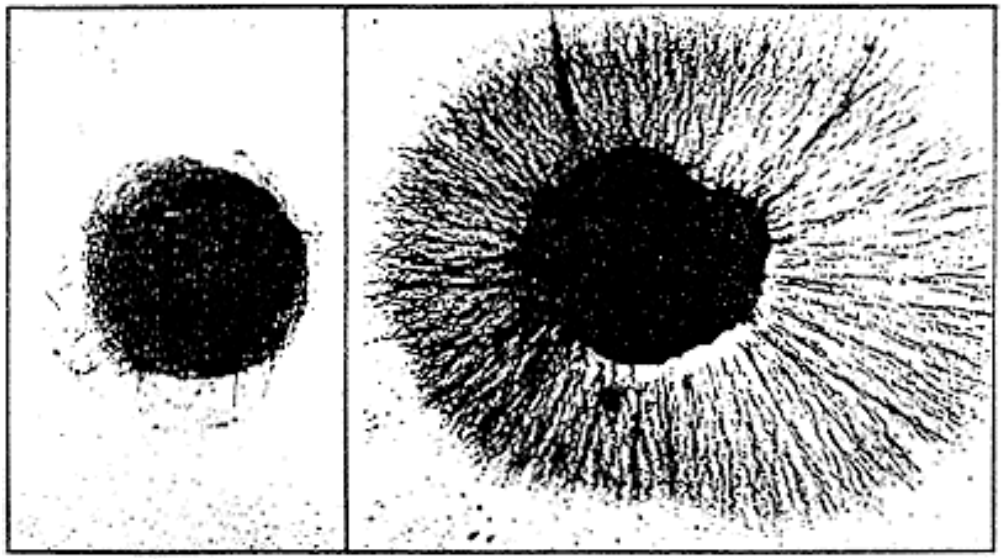
Guidage axonal: chemoattractants et chemorepellents

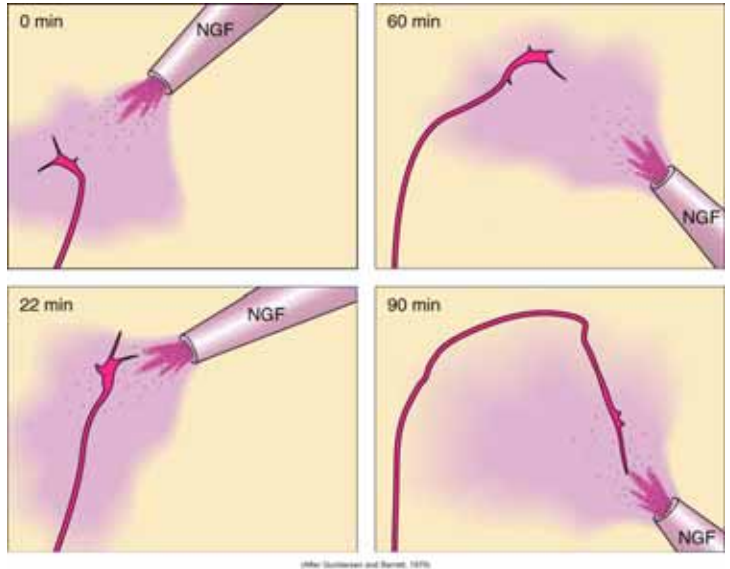


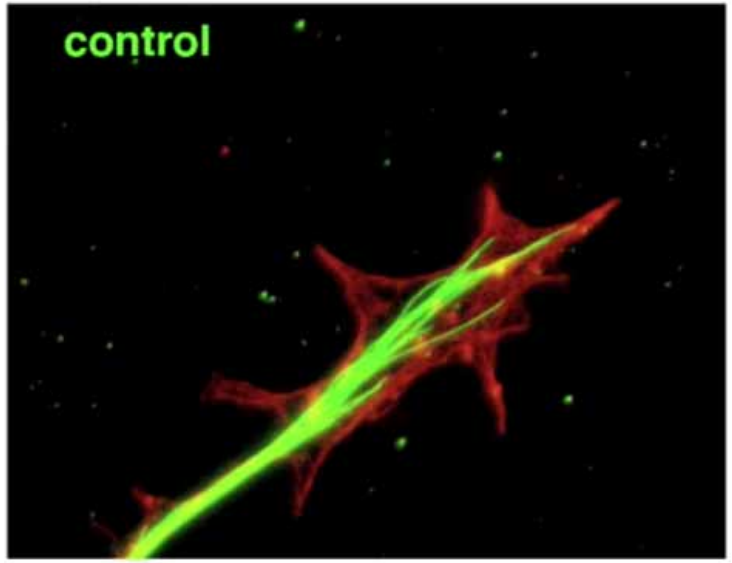
(After Tessier-Lavigne and Goodman, 1996)

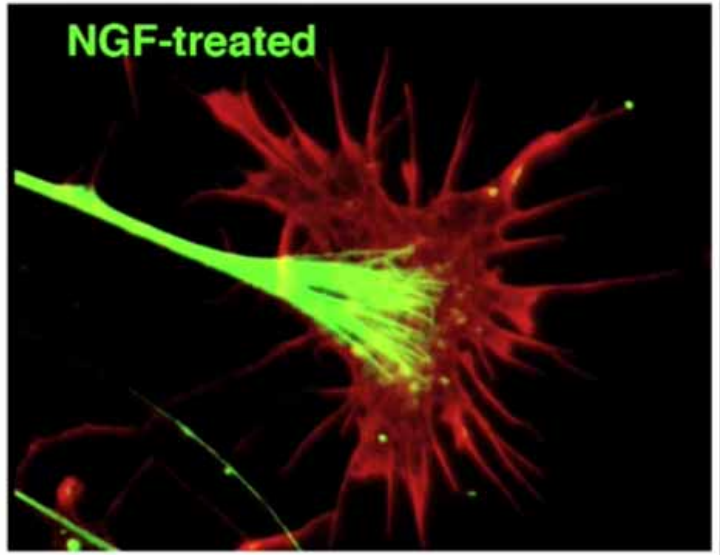
Nerve Growth Factor (NGF)

- Protéine sécrétée par les glandes et les muscles
- Capturée par les axones des neurones moteurs, prévient l'apoptose.



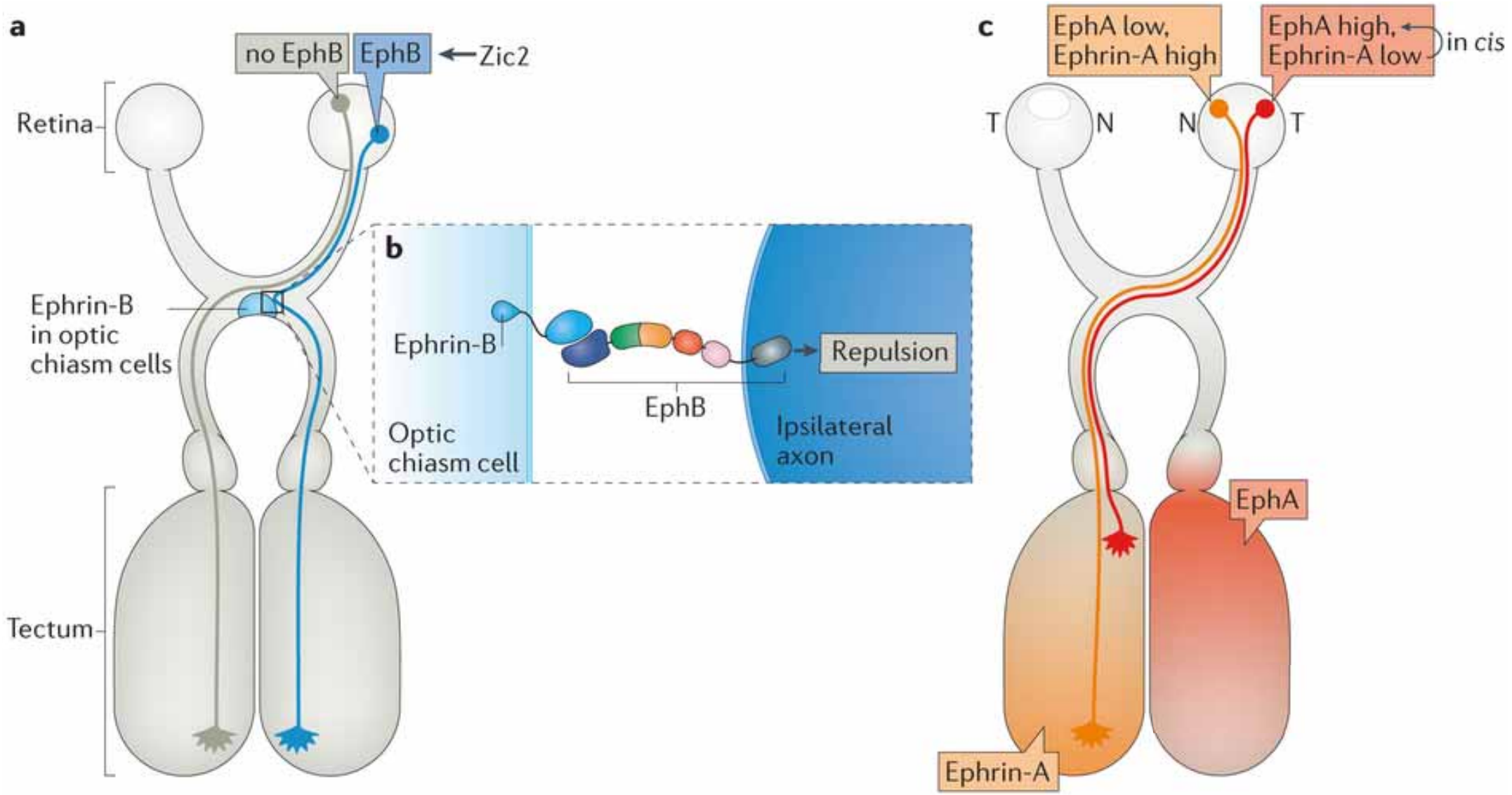


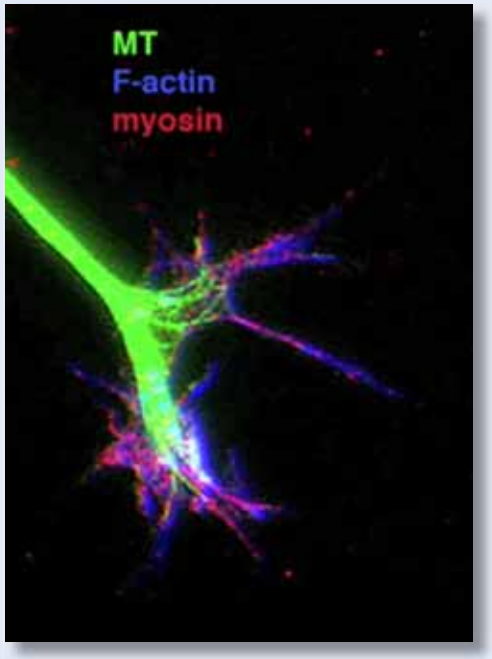


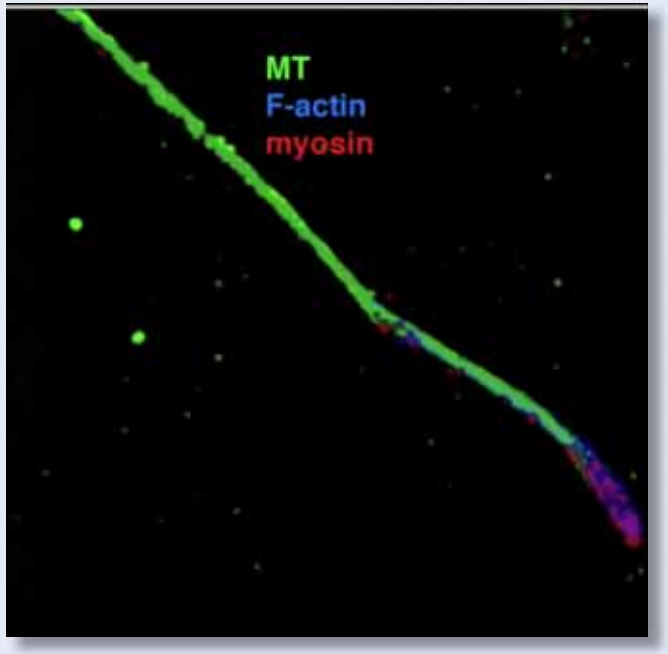


Le NGF est un chemoattractant

Guidage axonal des neurones de la rétine

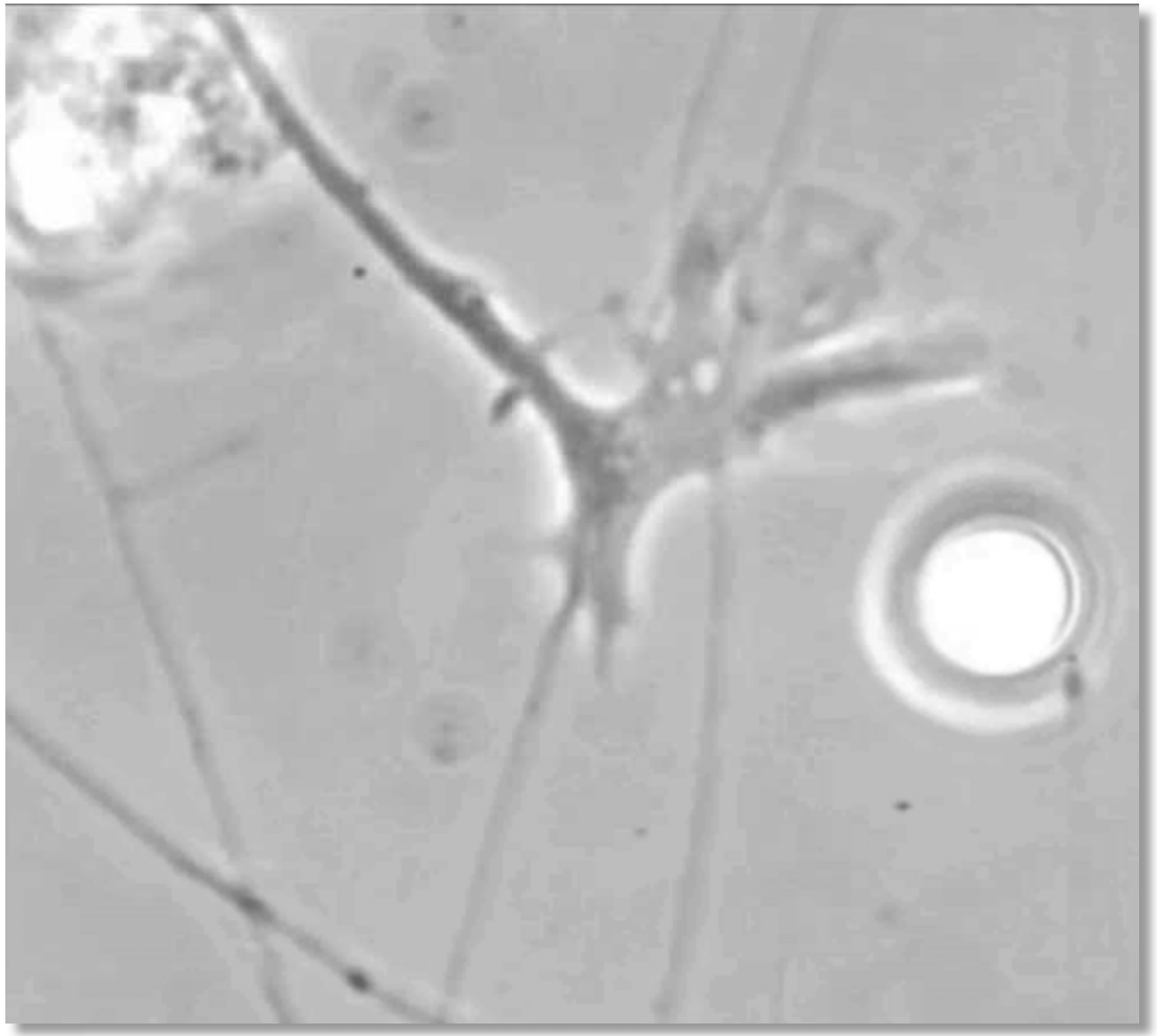



MT
F-actin
myosin

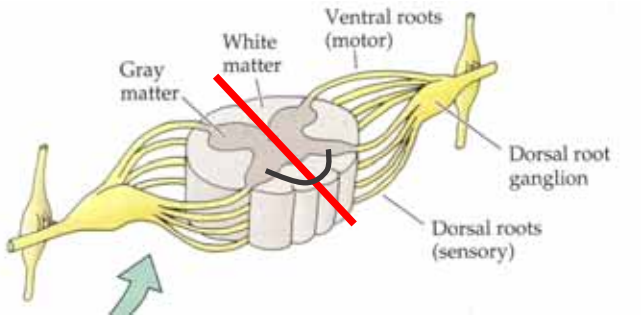

MT
F-actin
myosin

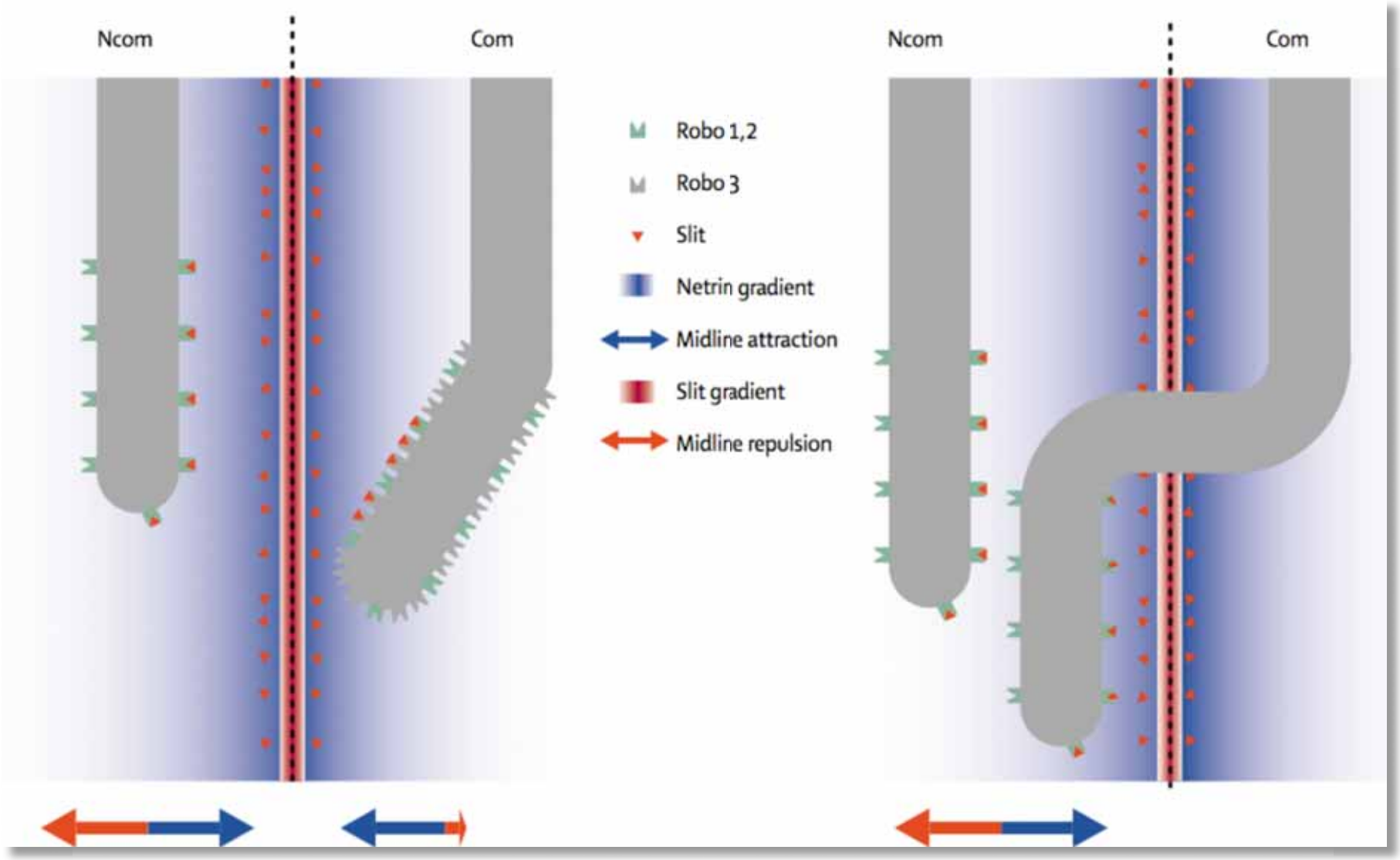

Growth cone guidance by
a repellent surface (ephrinA)

La directionalité dépend de gradients de chemoattractants/repellants



Guidage des fibres commissurales de la moelle épinière





Plan du Cours

- Lundi 14 Novembre

Cellules du système nerveux

- Jeudi 17 Novembre

Neurotransmission

- Mercredi 23 Novembre

Organisation et développement du système nerveux