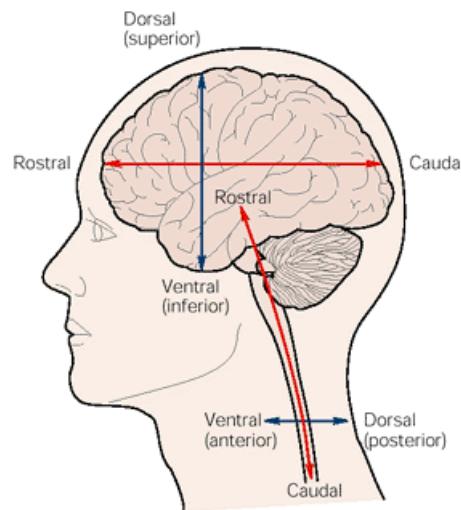
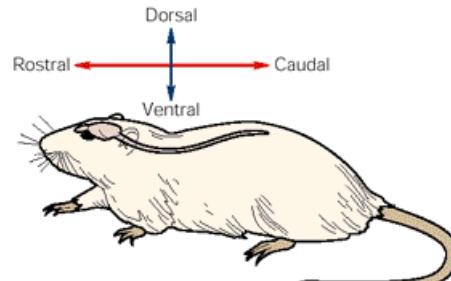
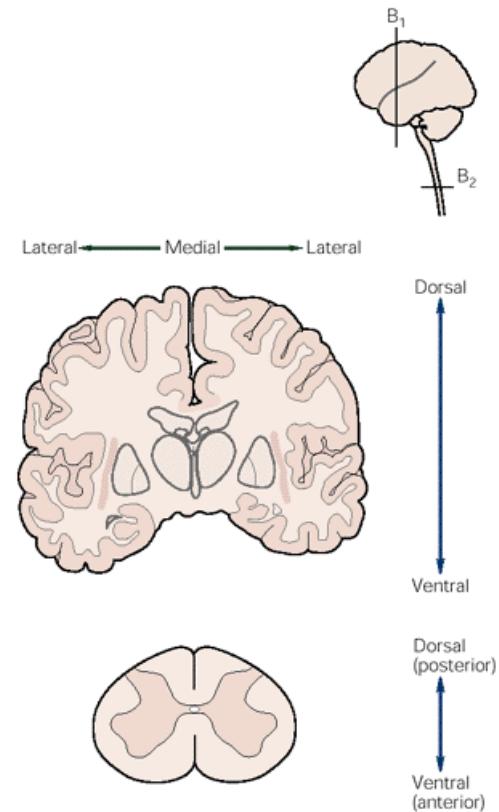


# Direcciones y planos anatómicos

A Rostral-caudal and dorsal-ventral axes

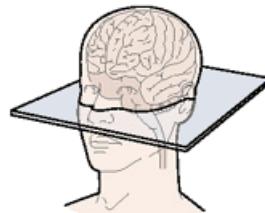


B Medial-lateral axis

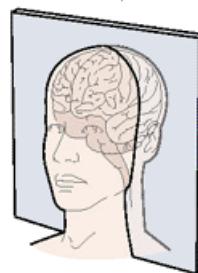


C Section planes

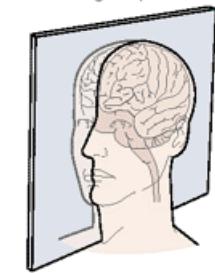
Horizontal plane



Coronal plane

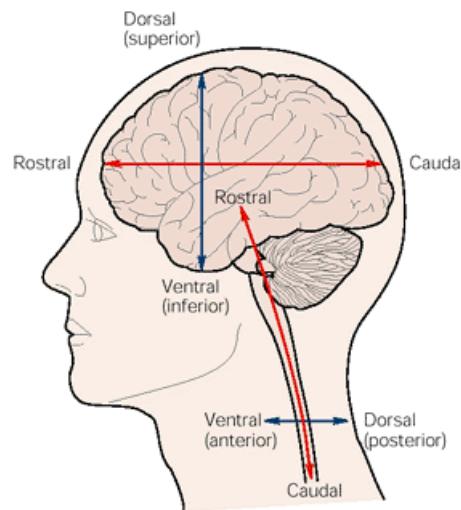
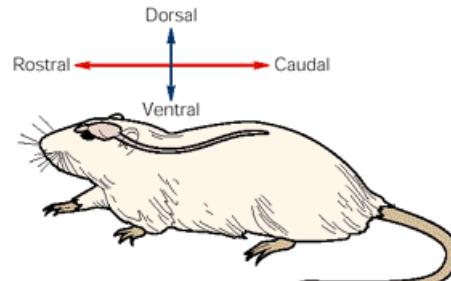


Sagittal plane

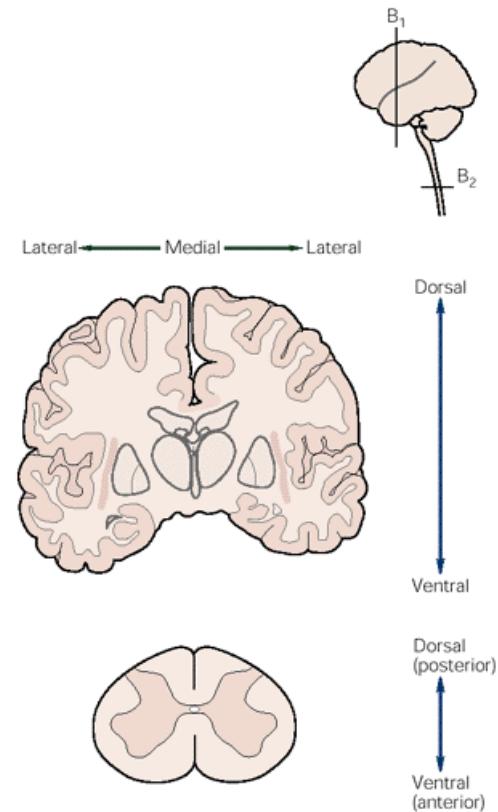


# Direcciones y planos anatómicos

A Rostral-caudal and dorsal-ventral axes

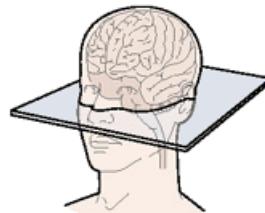


B Medial-lateral axis

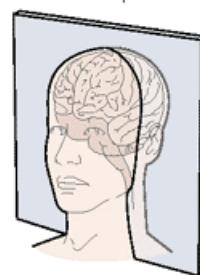


C Section planes

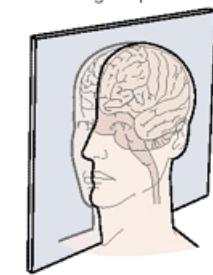
Horizontal plane



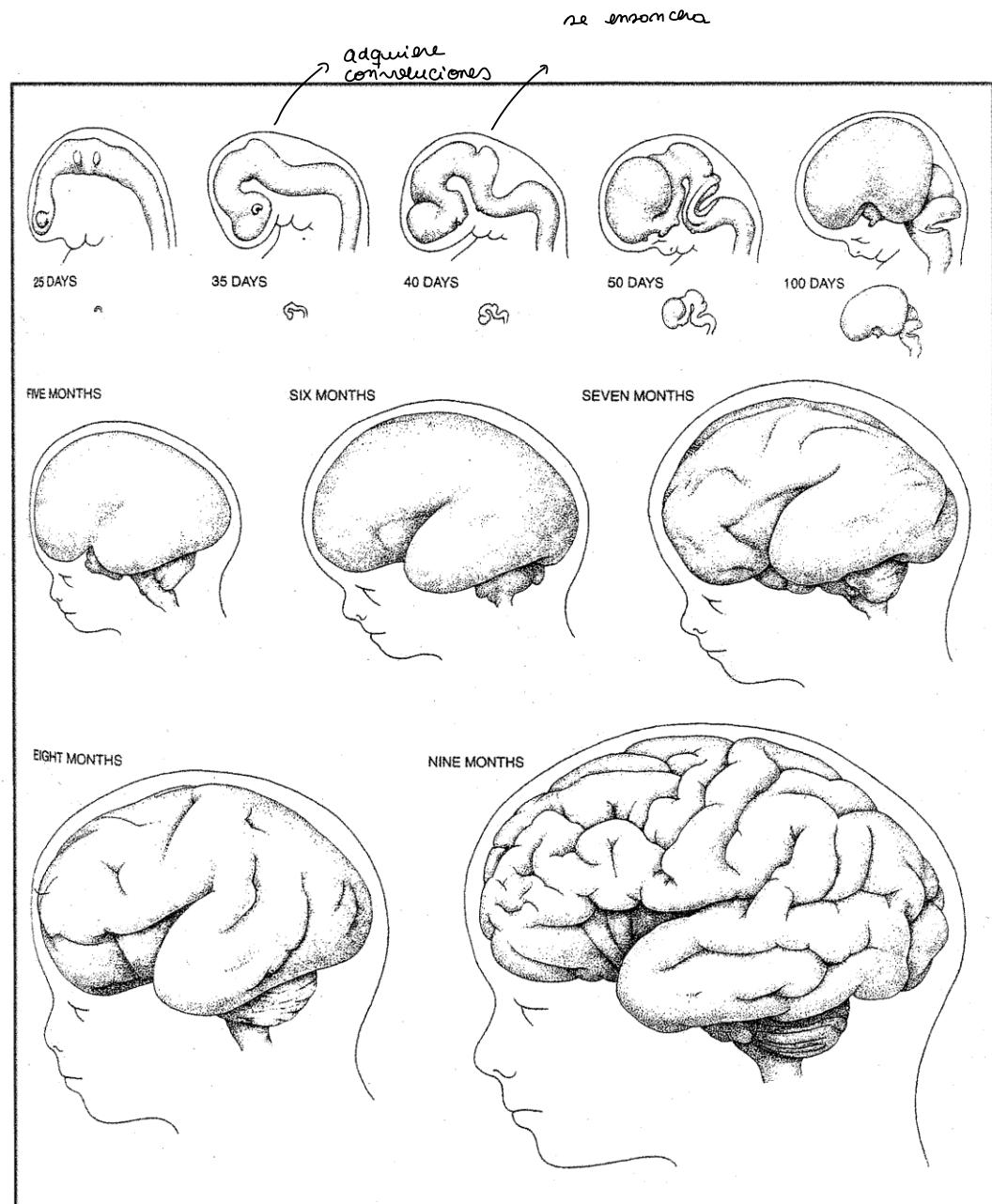
Coronal plane



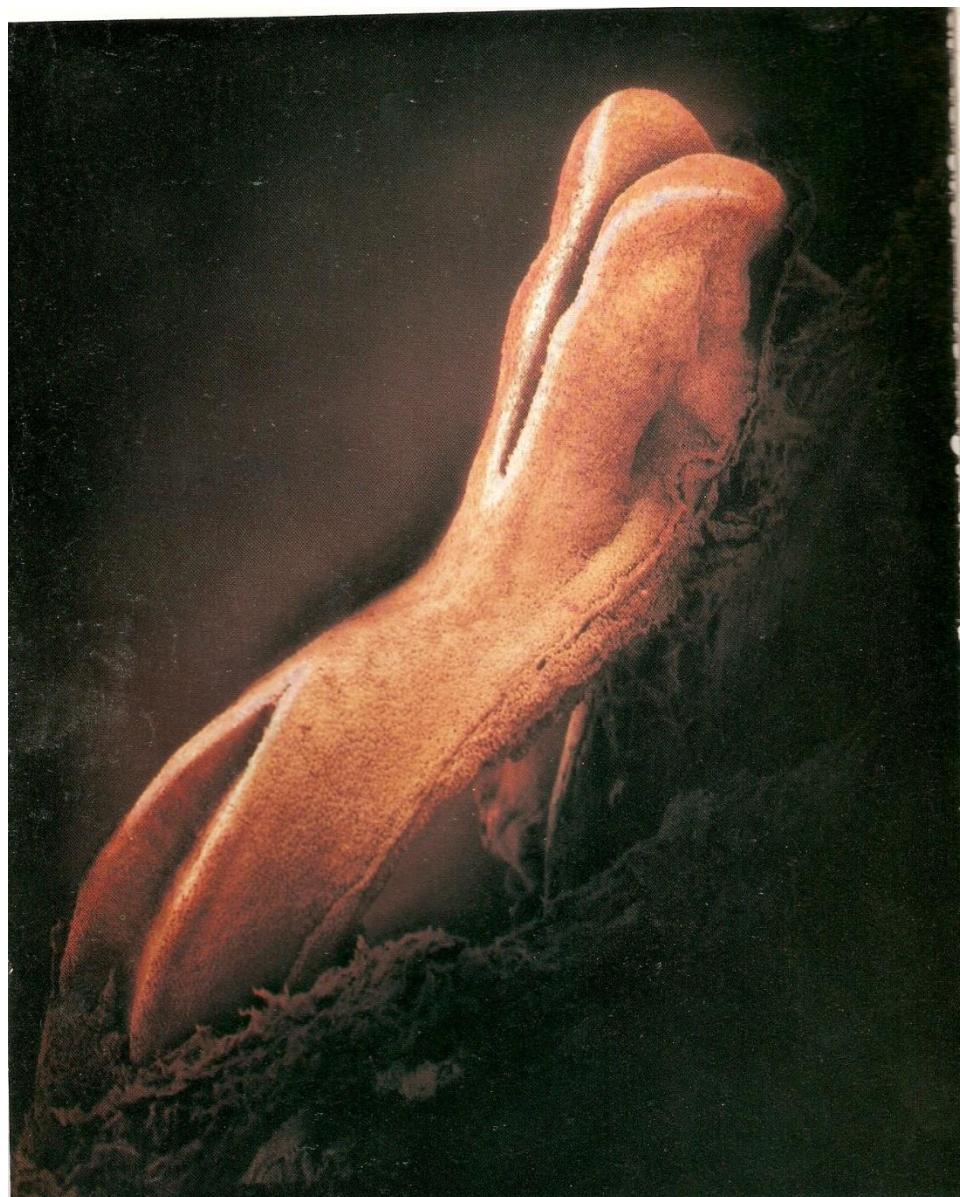
Sagittal plane



# Desarrollo intrauterino del cerebro humano

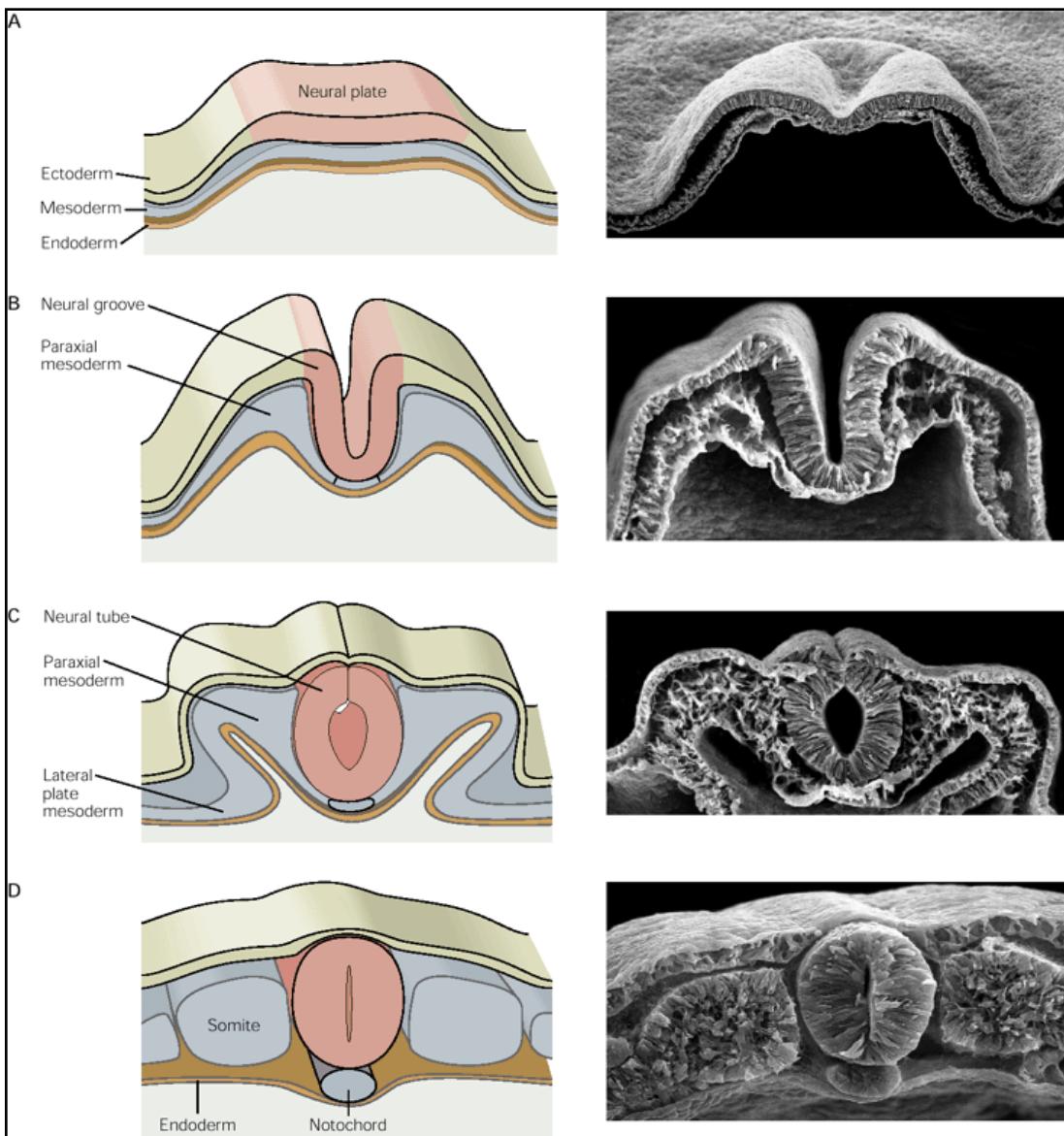
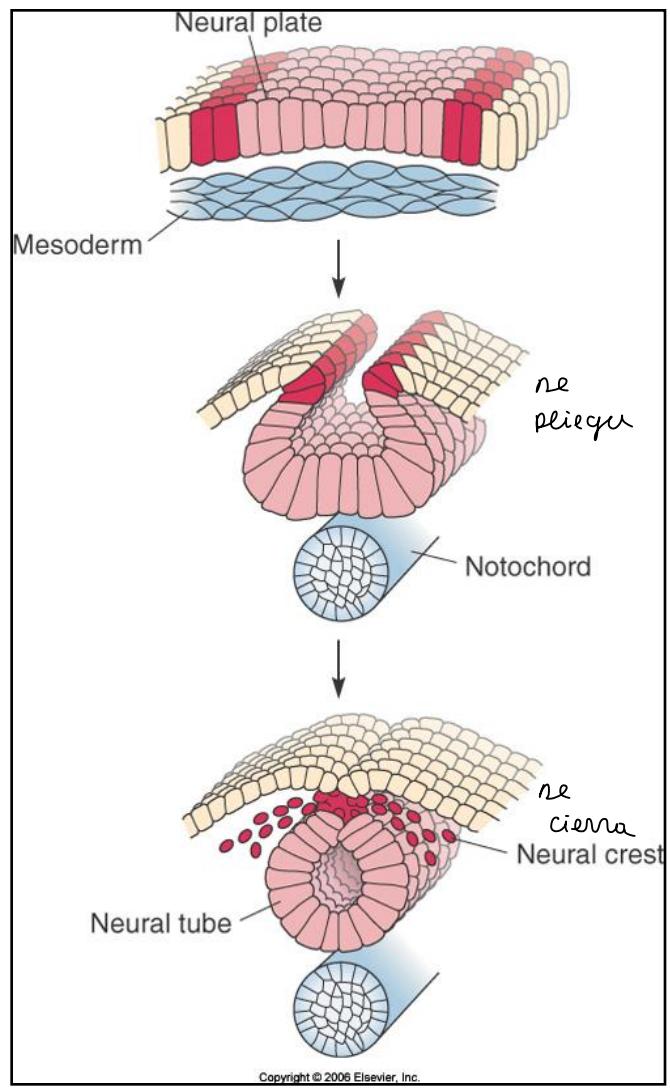


Embrión humano de  
3 semanas (2 mm)



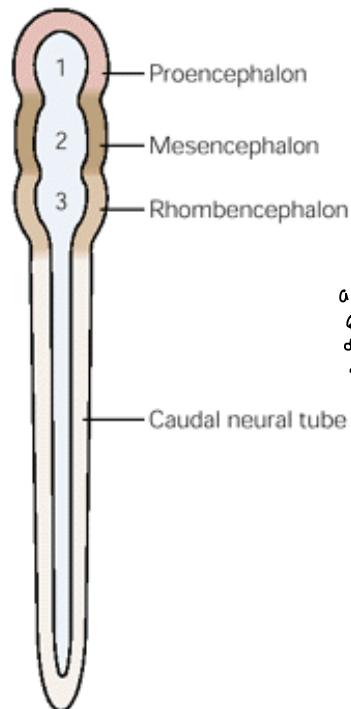
el tejido meníngeo surge de un tejido del tipo epitelial  
(como el que luego forma la piel)

## Formación del tubo neural

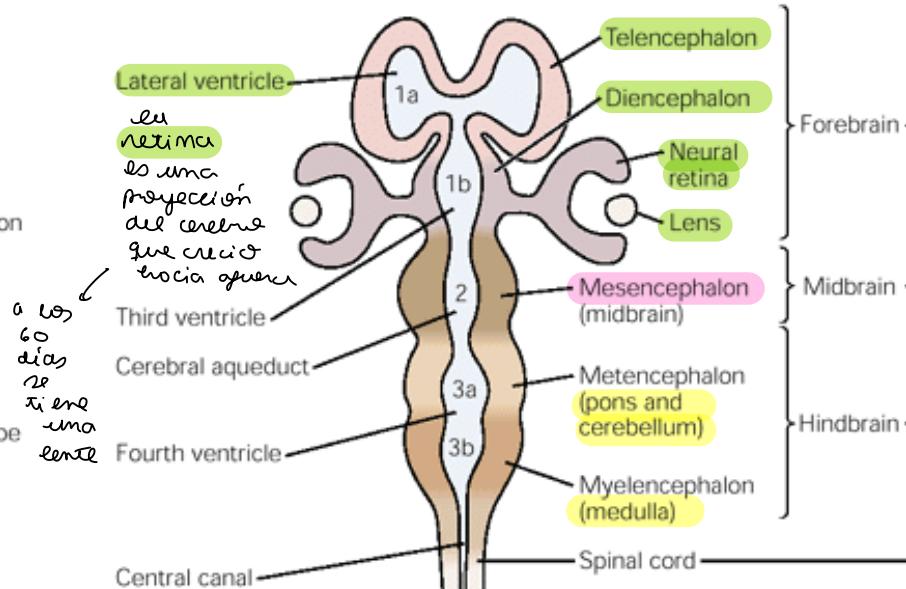


# Etapas del desarrollo

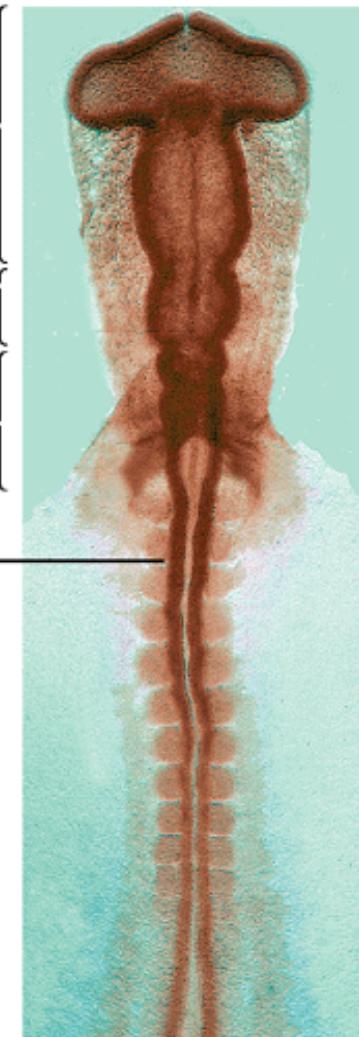
A Three-vesicle stage



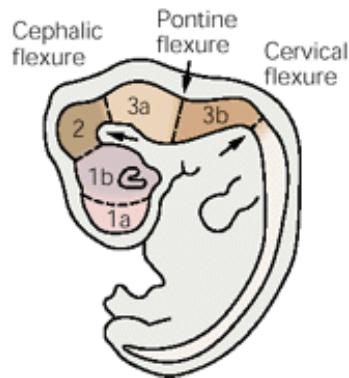
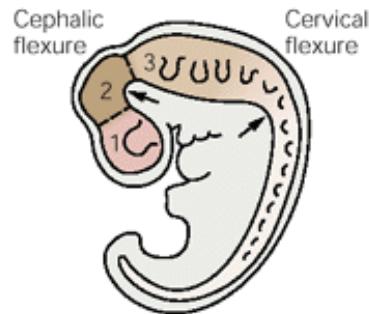
B Five-vesicle stage



C



Al principio mente se tiene un tubo como  
un sistema nervioso



Embrión humano de 4  
semanas (6 mm)



Embrión humano  
de 5 semanas  
1 cm



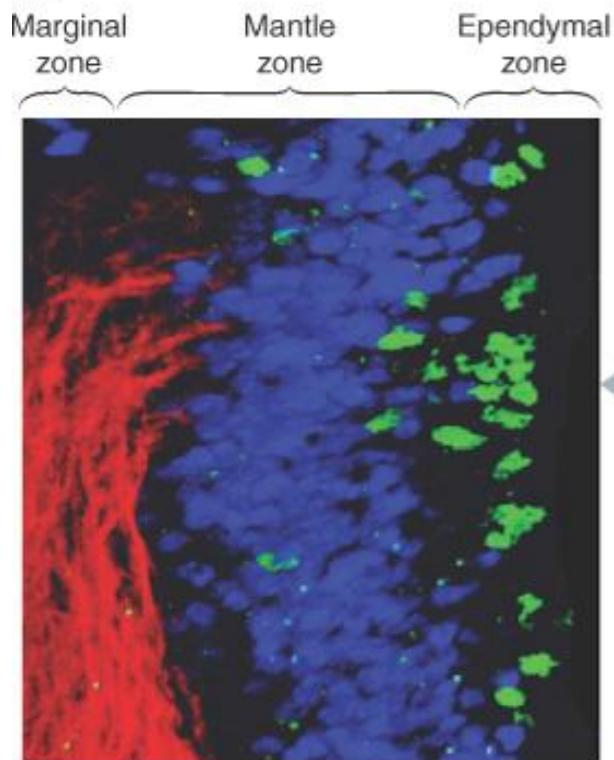
Embrión humano de  
6 semanas – 15 mm



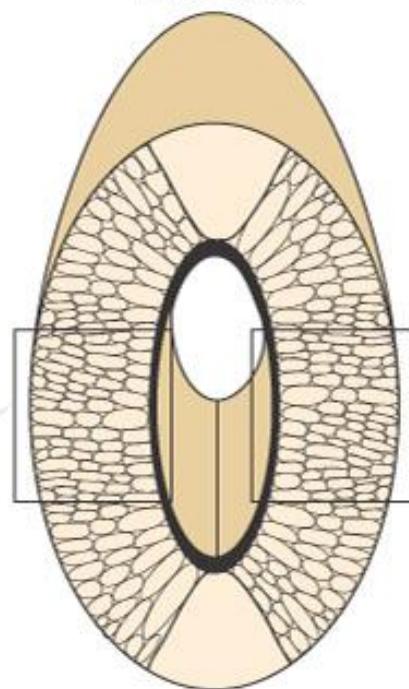
# Los ventrículos en el desarrollo del sistema nervioso

Se tiene una reción interna  
y otra externa con dist  
funcionamientos.

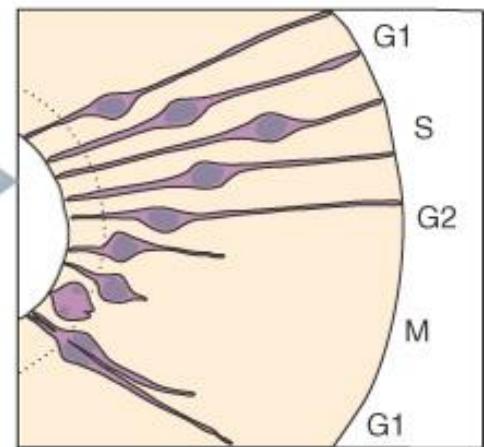
A



Neural tube

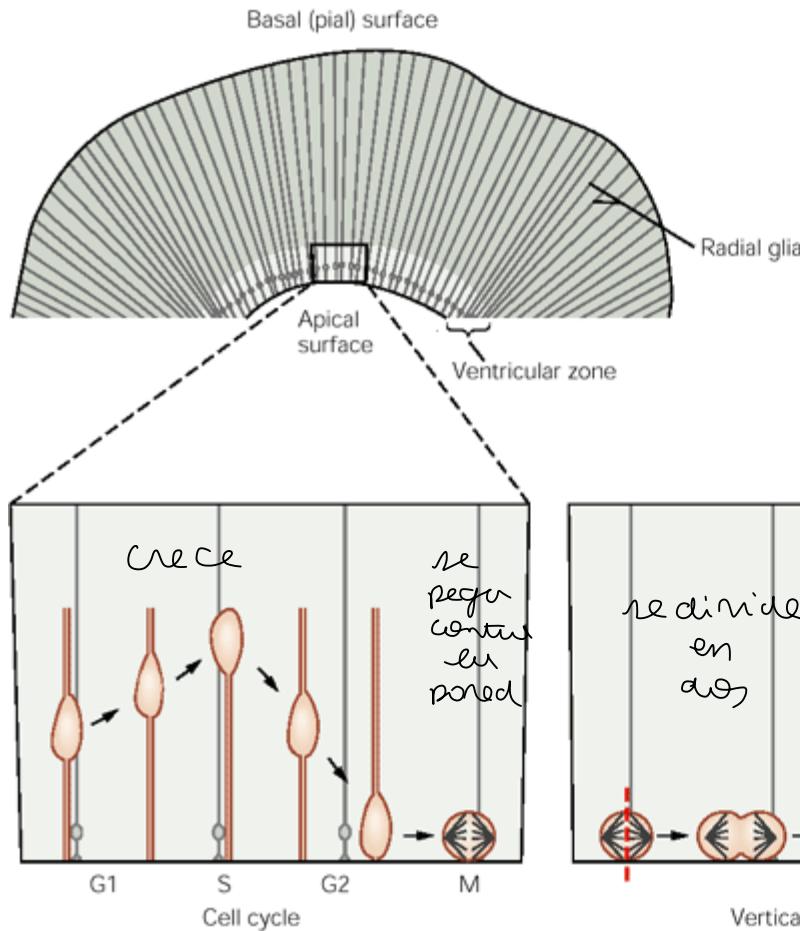


B



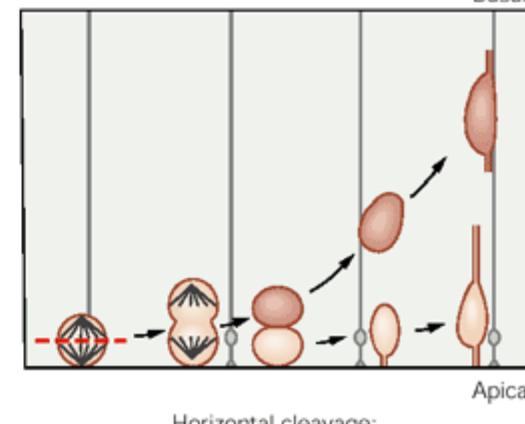
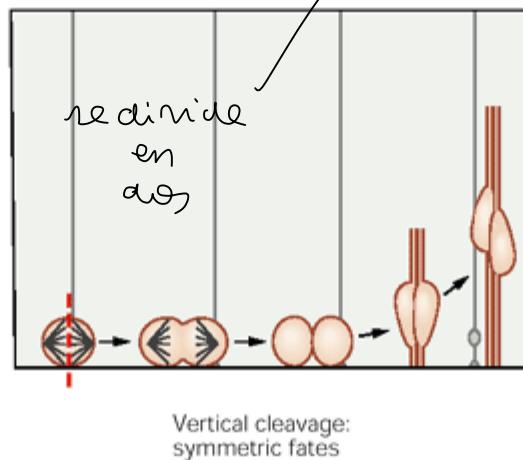
# Ciclos de reproducción celular

Ciclo de crecimiento de las células en el cerebro

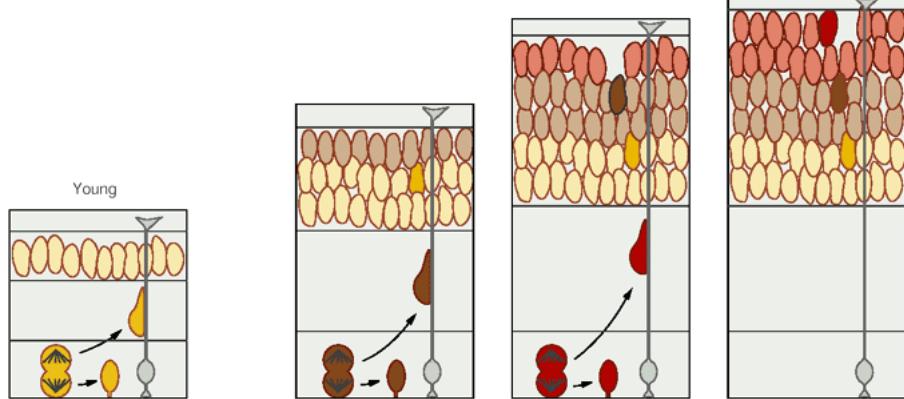


los dos celulos:

se regeneran simétricamente (juntas) o asiméticamente (se separan). Cada uno tiene una nueva pegada en la superficie inferior; se vuelve a dividir



se regeneran en la superficie inferior; se vuelve a dividir



# Formación de la corteza cerebral

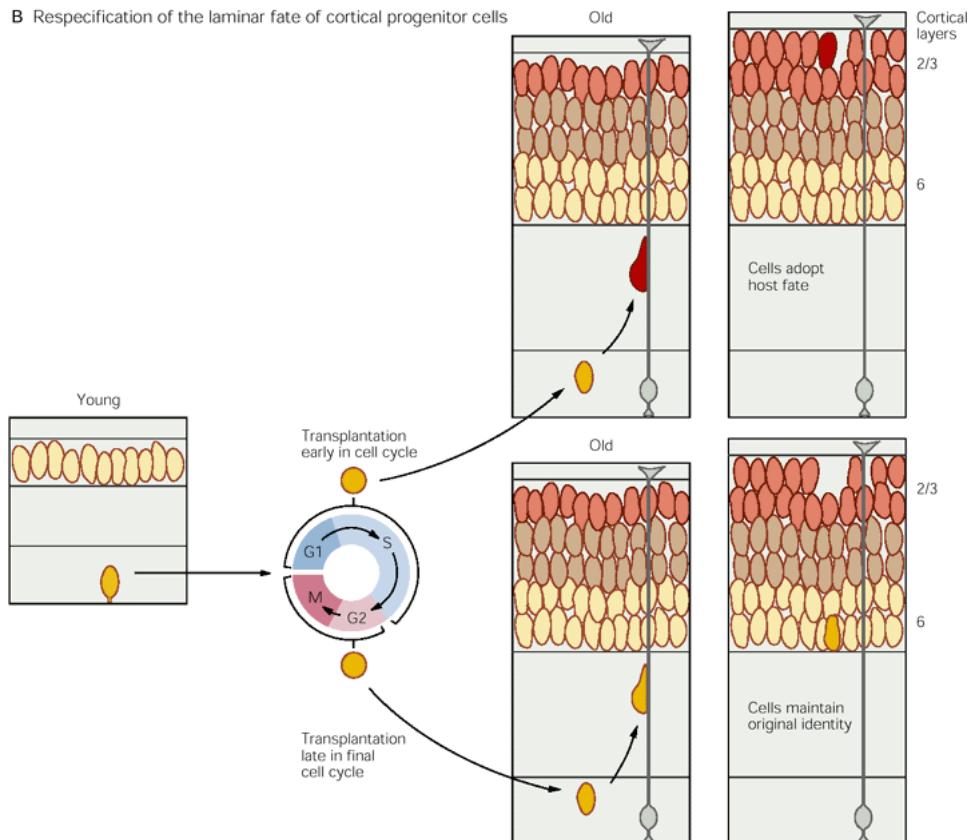
los celulos se organizan en capas

↳ diferentes capas se generan en  
dij momentos del crecimiento y  
tienen distintas funcionalidades

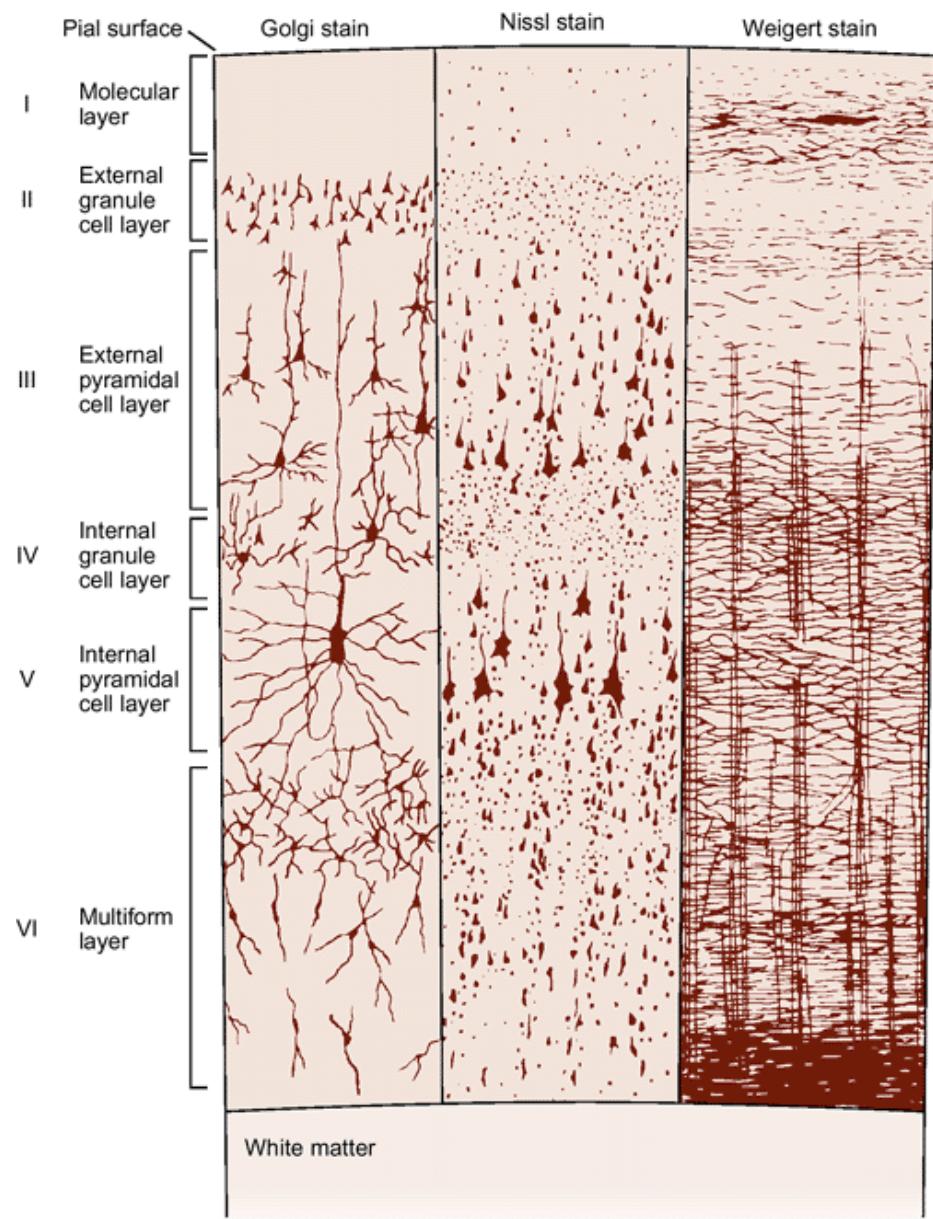
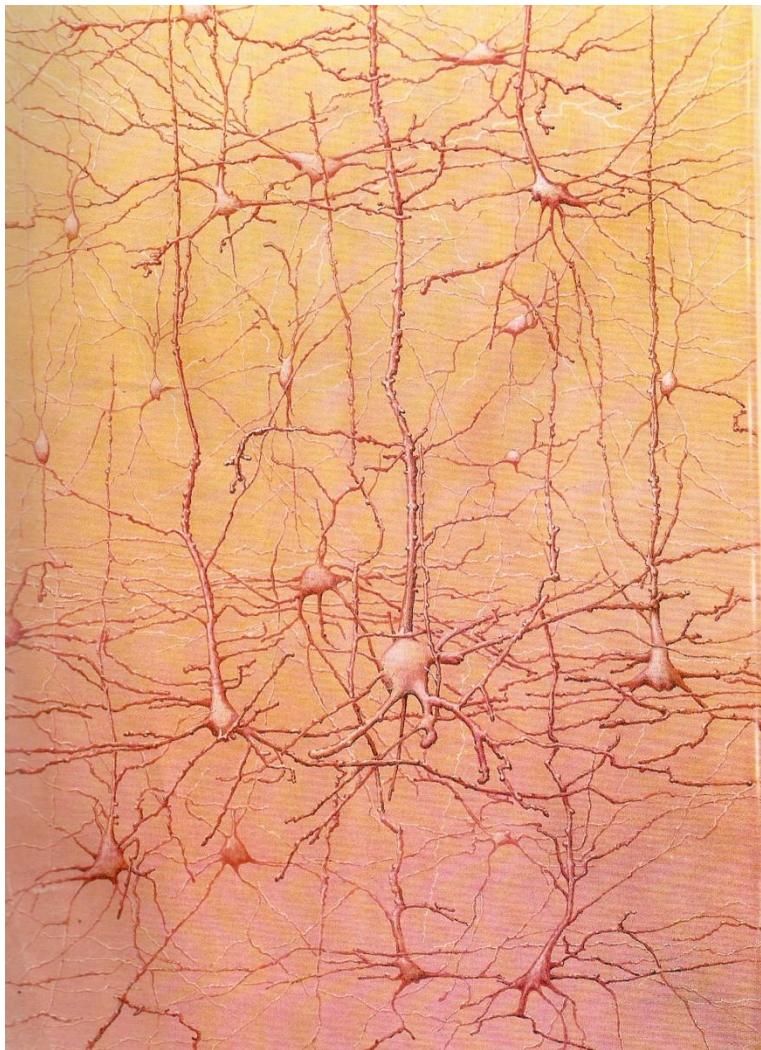
J

cada zona del cerebro tiene las  
misma estructura de capas pero  
con dist. gruesos

B Respecification of the laminar fate of cortical progenitor cells

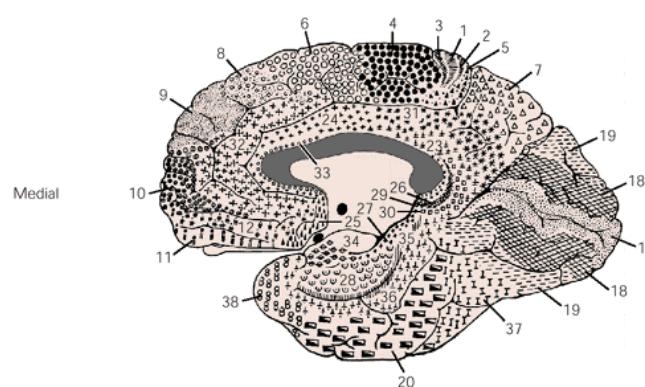
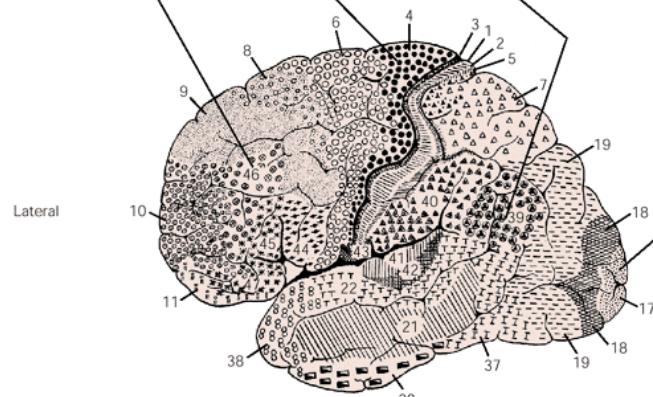
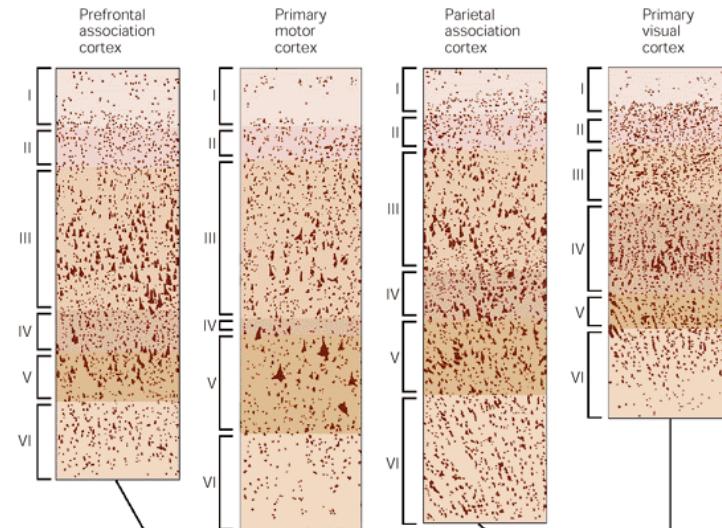


# Estructura de la corteza cerebral



## Variación inter-área

Mi uno mina dig árees: la estructura geolig es la misma, pero no son iguales. Los dist cpos en los dist zonas tienen distintos gruesos



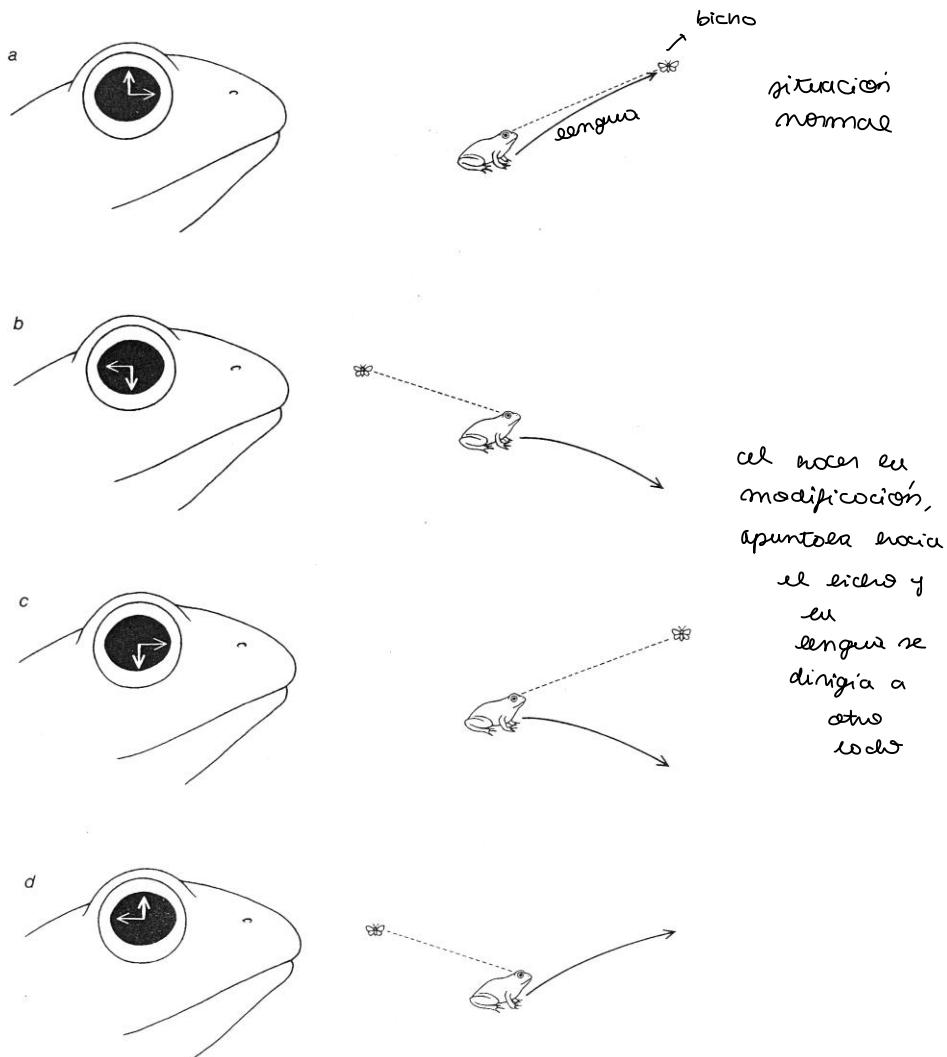
Existen claves químicas que guían a los axones en su desarrollo

lo que importa es la conexión neuronal

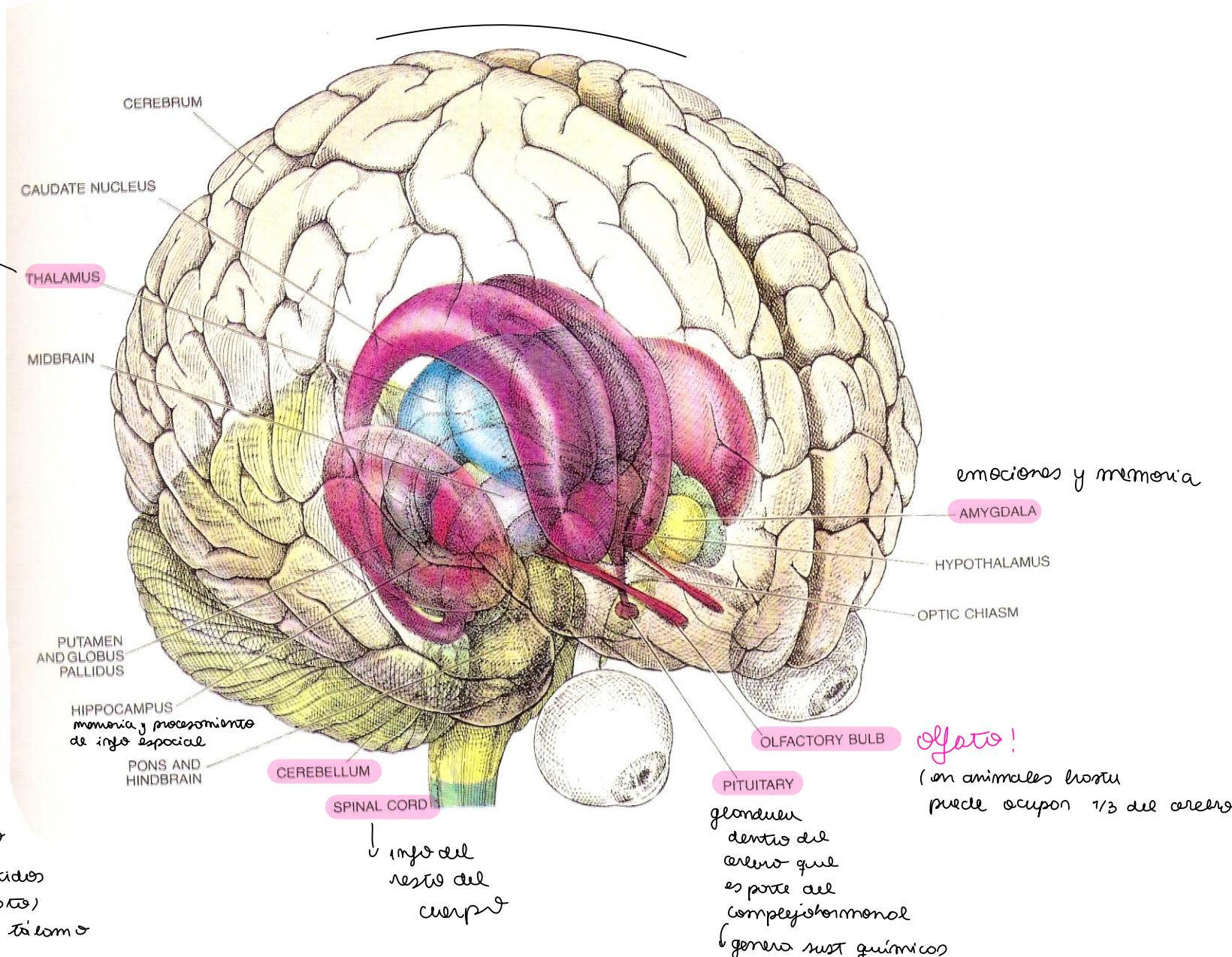
Se sabe que las conexiones entre los neuronas están rodeadas en gradientes en concentraciones químicas.

El axón es guiado por este gradiente

modificaron químicamente las conexiones



# Un tour por la anatomía del cerebro humano



# El cerebro humano, vista medial

corte sagital

corteza cerebral

cuerpo calloso

tálamo

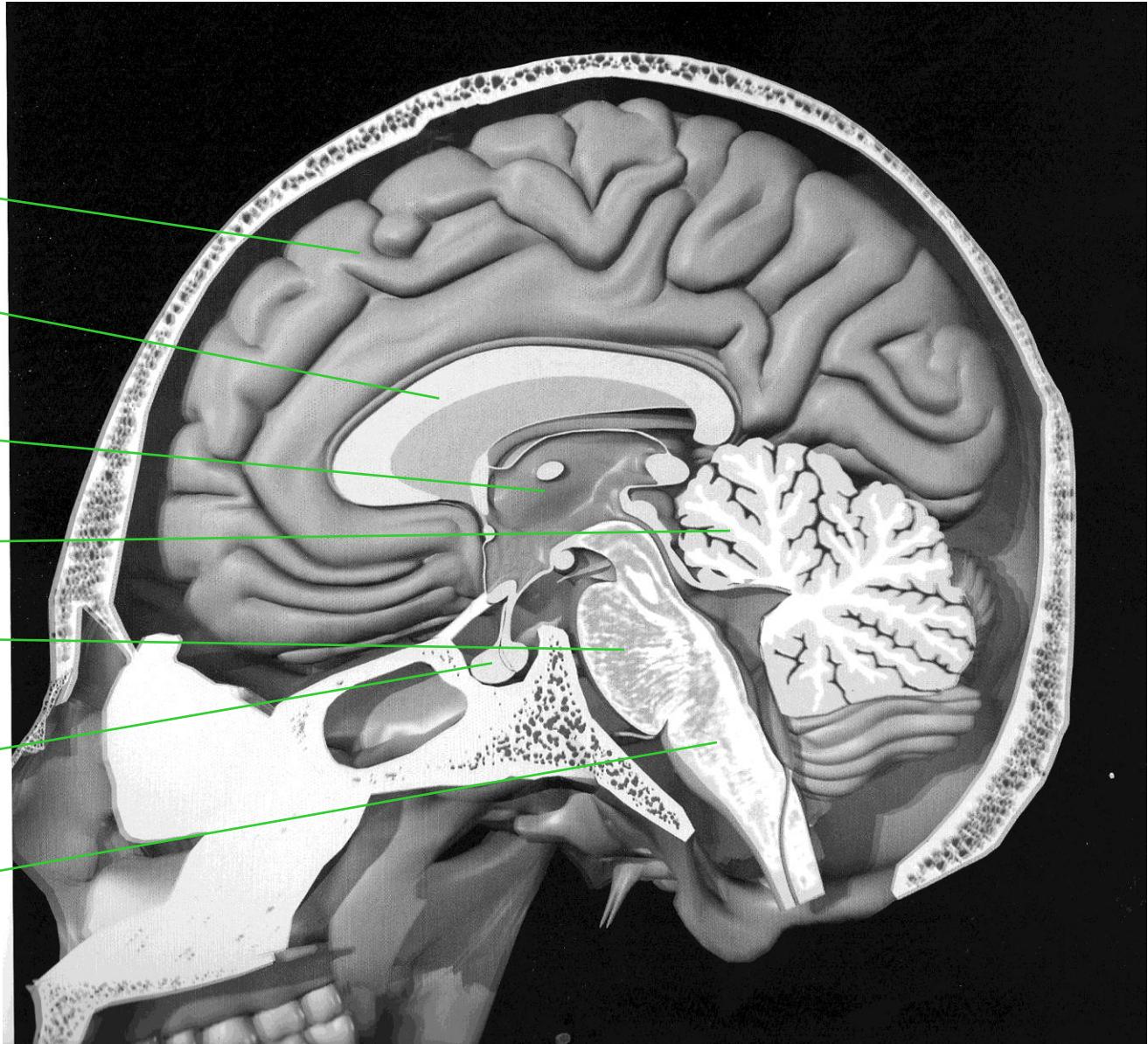
cerebelo

ponte

hipófisis

glándula asociada  
al sist hormonal

médula



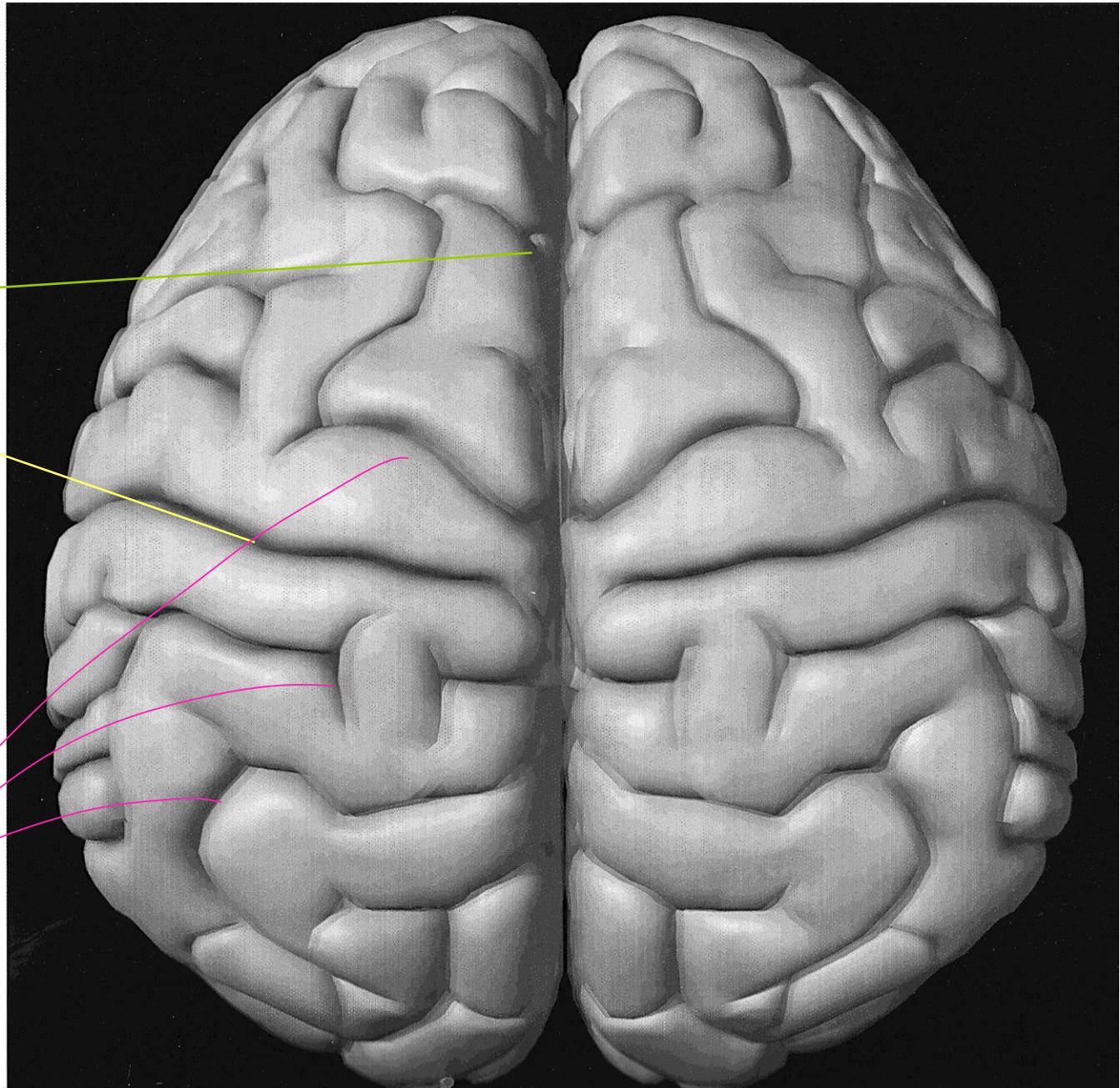
los dos hemisferios del cerebro están conectados por el cuerpo calloso

# corteza cerebral vista superior

fisura longitudinal  
separación entre  
hemisferios

fisura central  
(de Rolando)  
Todos los personas  
tienen las mismas  
fisuras de Rolando,  
Todos tienen nombre  
a la marco se  
llama Rolando

fisuras

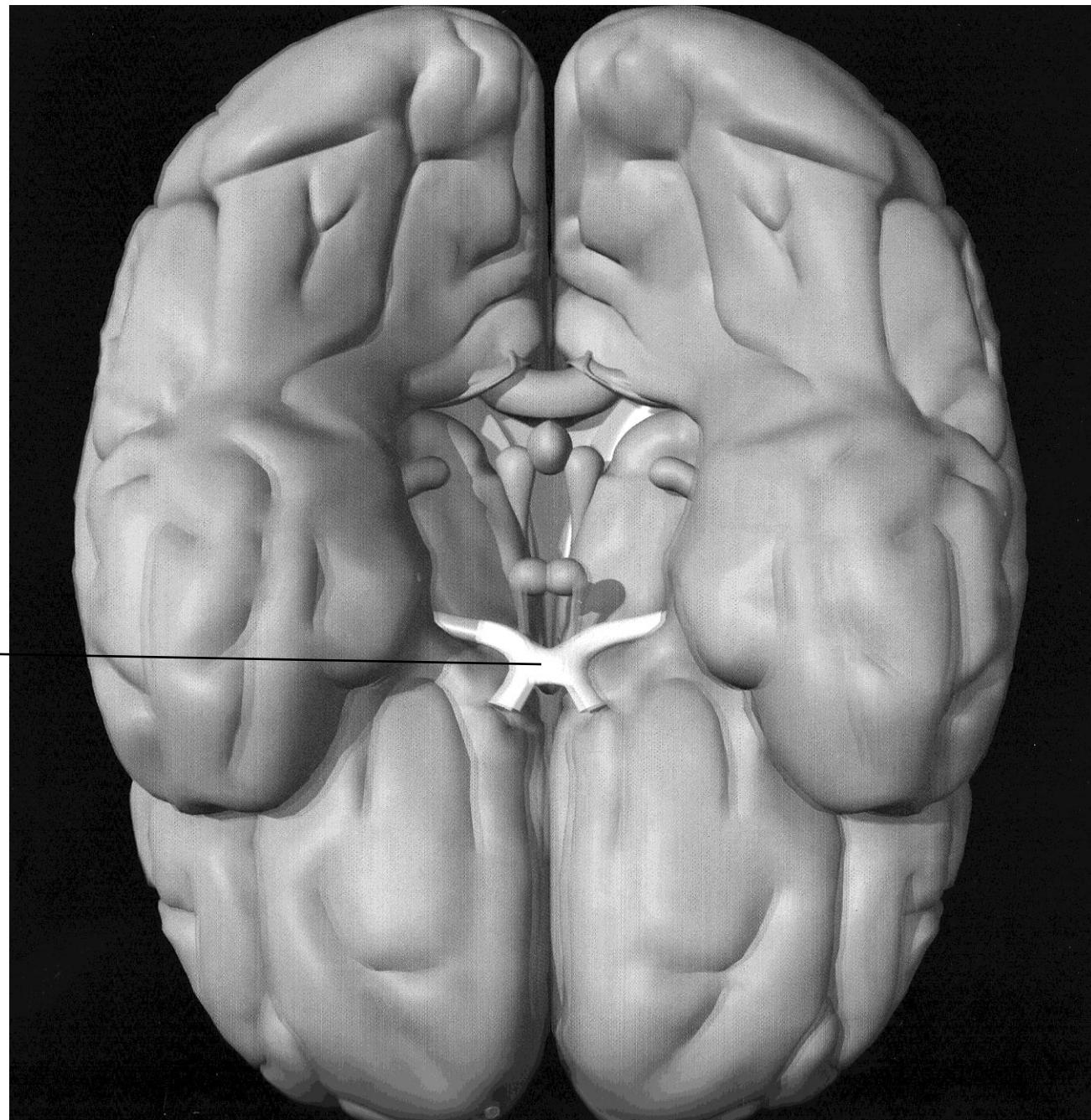


corteza cerebral  
vista inferior

quiásma  
óptico

---

se donde  
se  
cruzam los  
nervios ópticos  
(doble poro da)

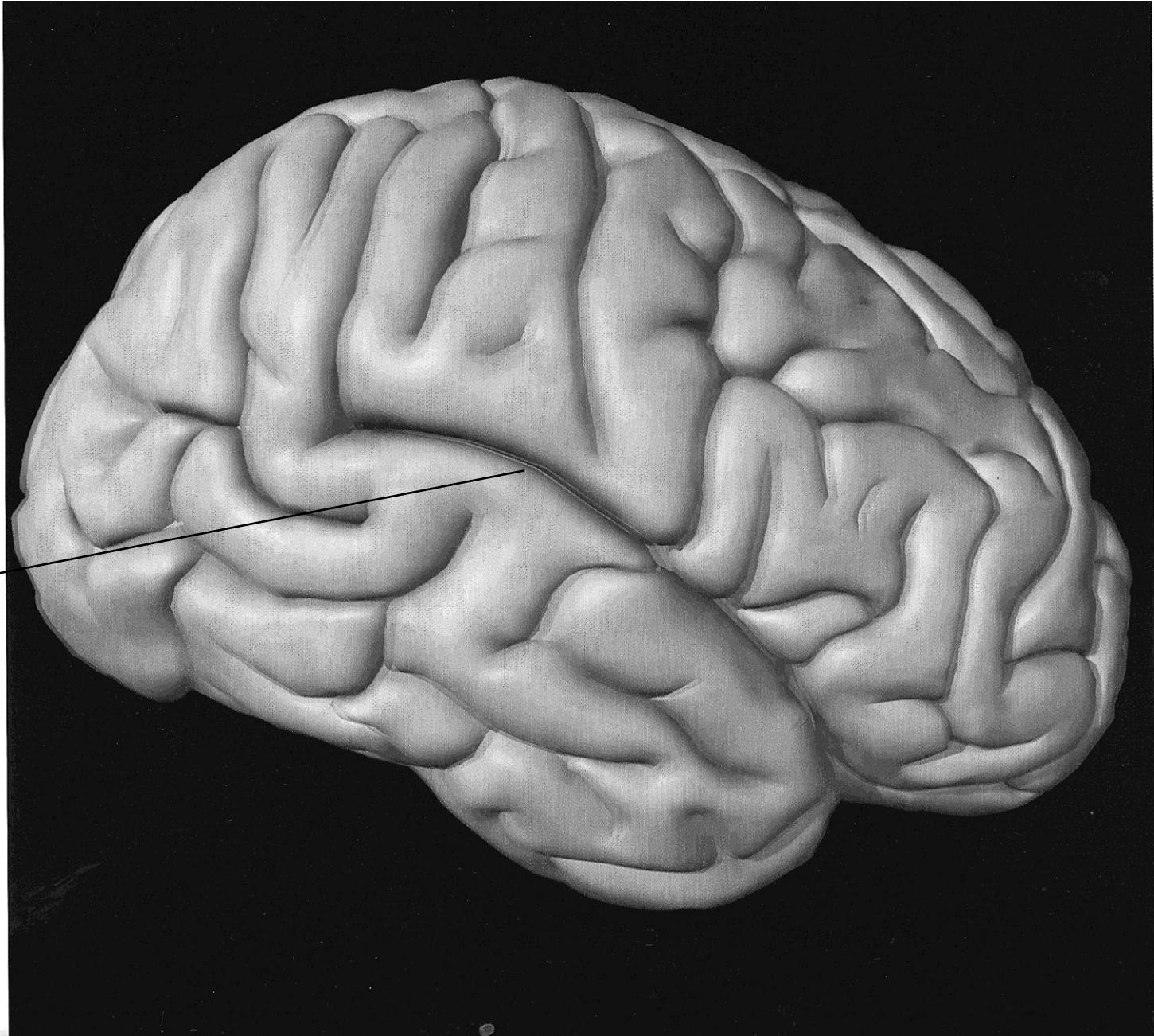


corteza  
cerebral

vista  
lateral

fisura lateral  
(de Silvio)

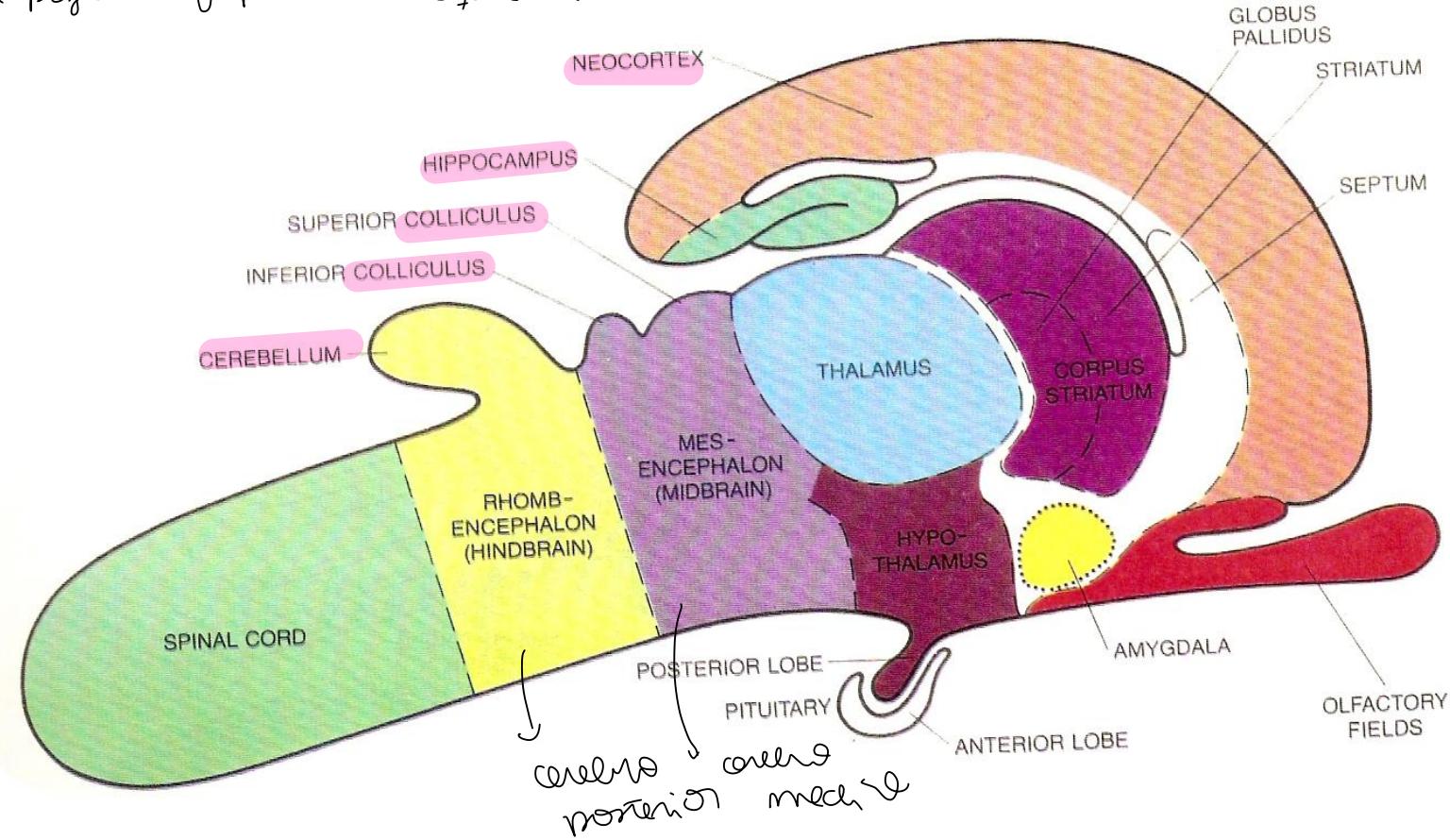
fisura más  
grande del  
cerebro



# Esquema del sistema nervioso central de un mamífero

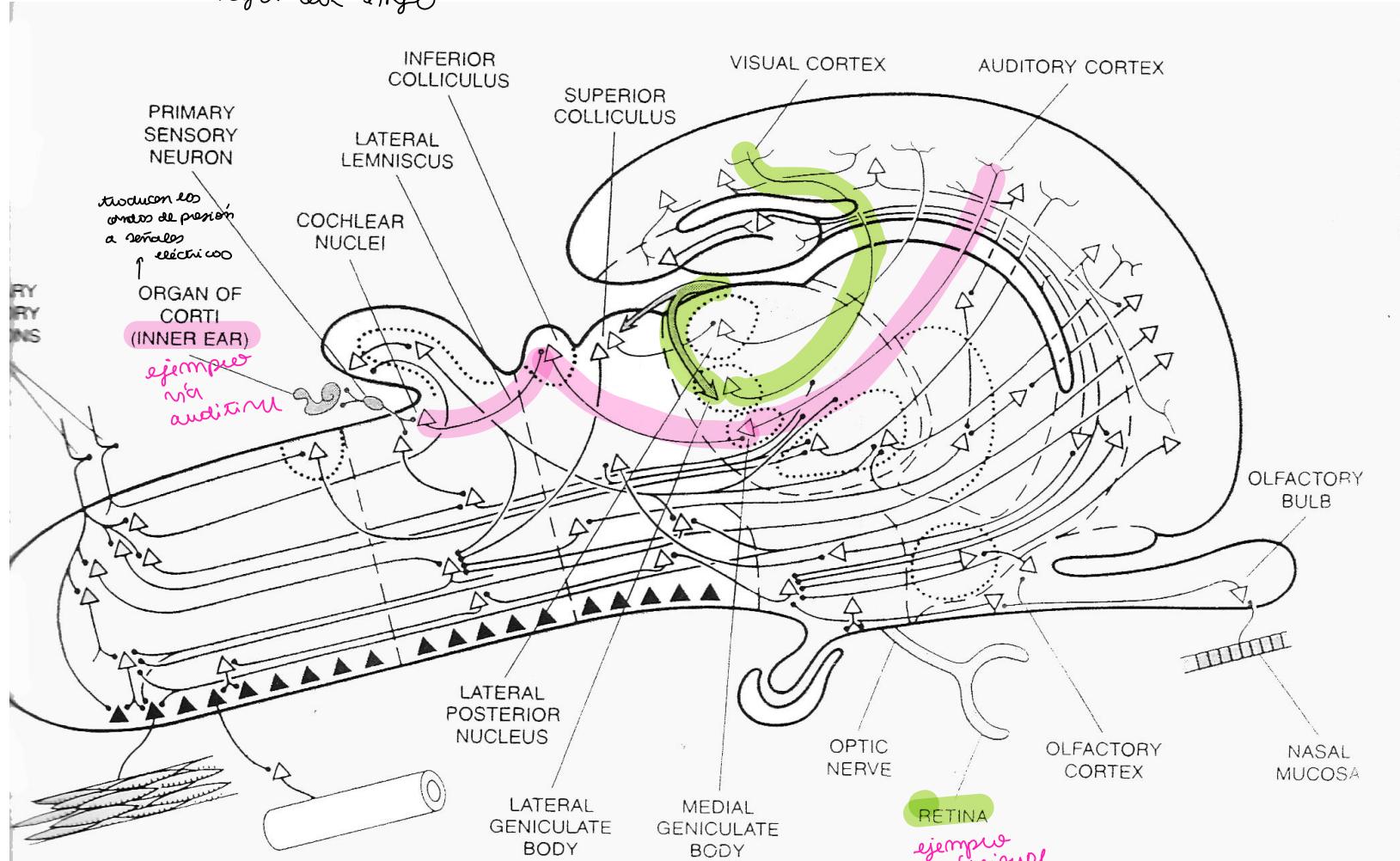
(continuación)

Todos los mamíferos tienen el mismo plano genérico  
y las zonas difieren en tamaño según la especie  
Para pájaros y peces el esquema es completamente dist



## Esquema de vías sensoriales (conexiones)

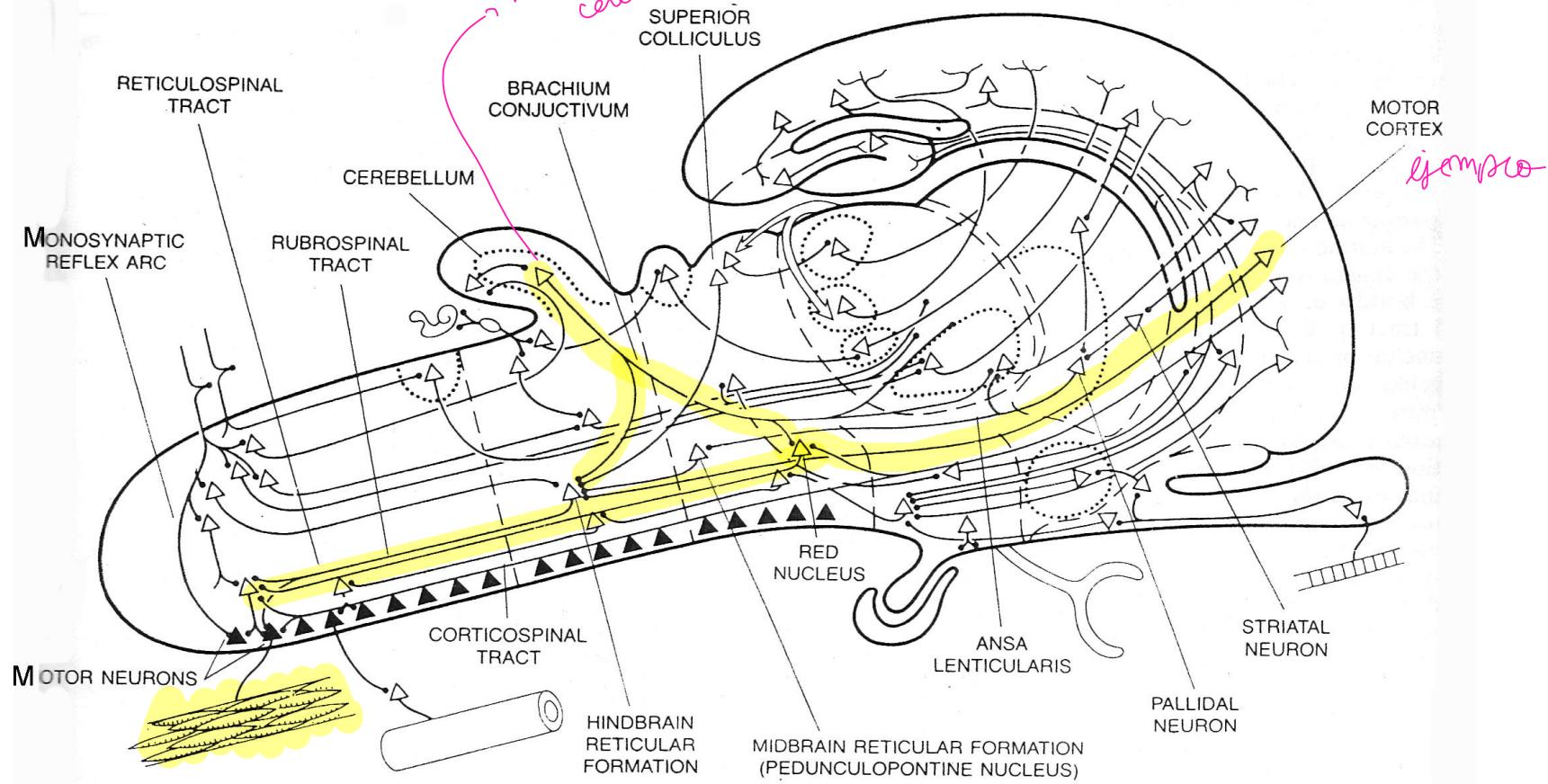
Siguientes los flecos se puede trozar como sigue en foto



## Esquema de vías motoras

la corteza del cerebro  
es quien informa  
información motora

pone ms al  
cerebelo

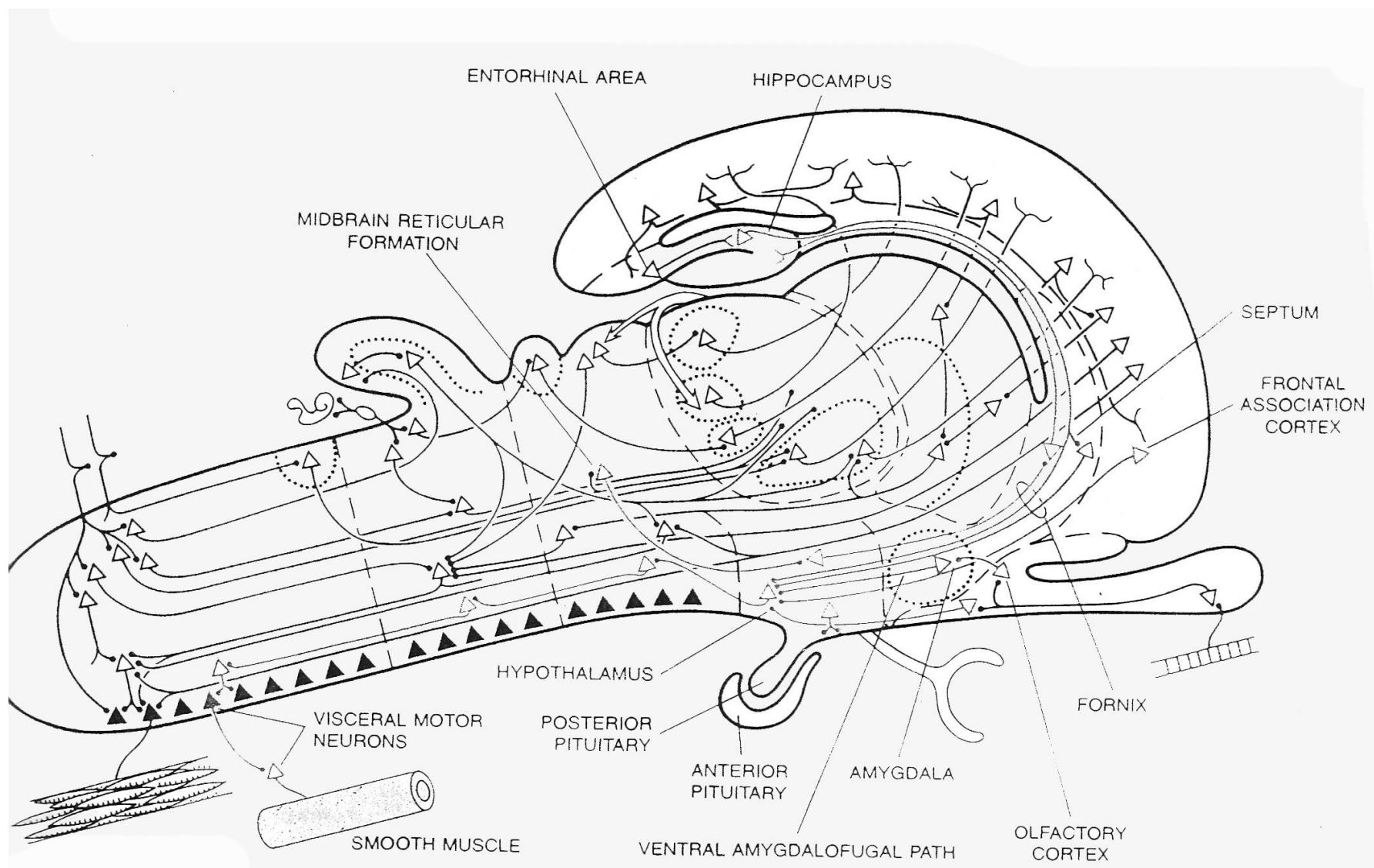


No encuentran circuitos en la corteza

en la corteza frontal asociativa, en el aro., estriatal, ...

Vamos a estudiar esto en redes neuronales recurrentes

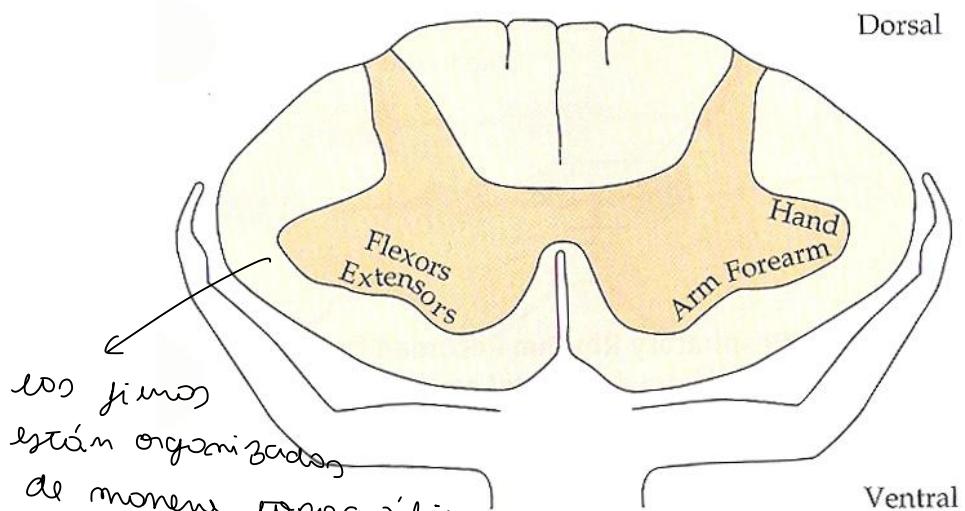
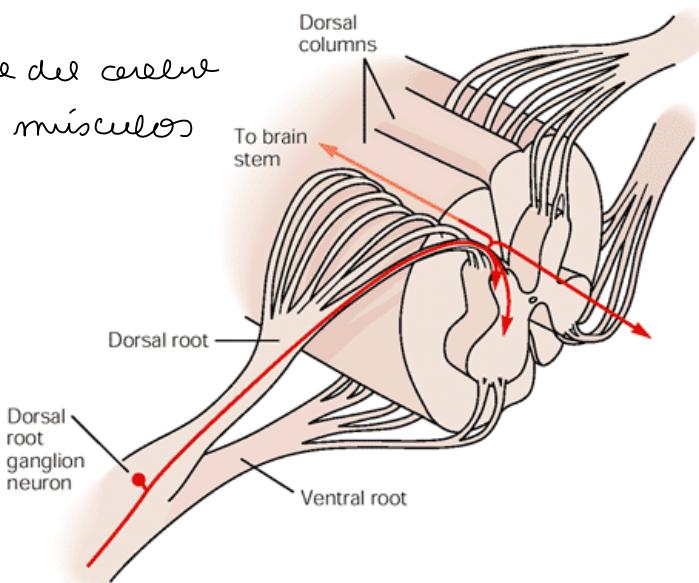
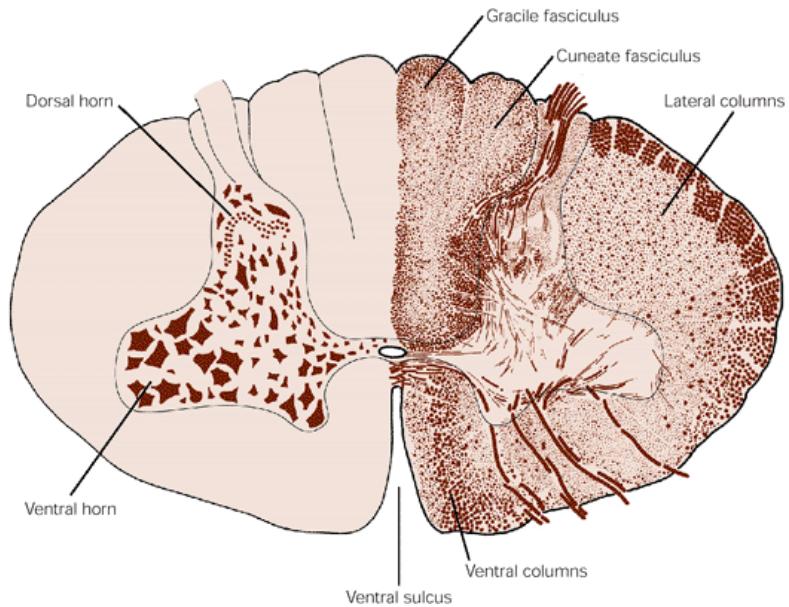
# Circuitos en bucle



# Organización de la médula espinal

Organización compleja

No se encuentra de transmitir info sensorial del cerebro  
y info motora del cerebro a los músculos



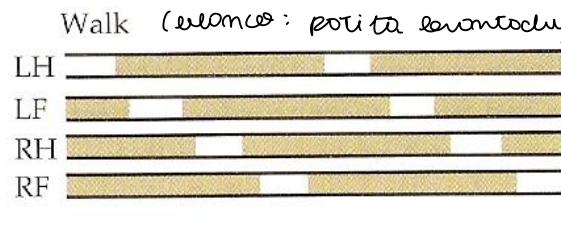
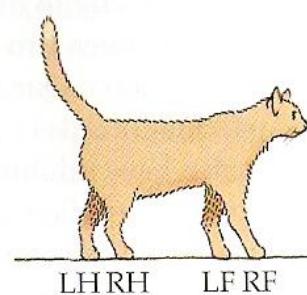
Al mover un miembro un movimiento se mueven dos músculos  
uno se contrae y el otro se expande

# CPGs

## La marcha del gato

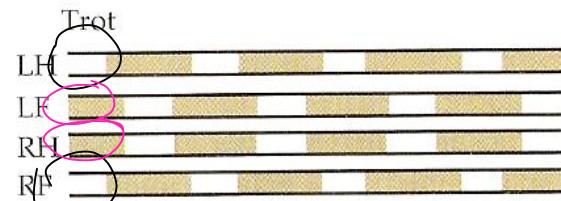
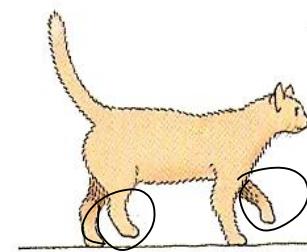
patrones ritmicos

es automatico,  
ni lo pones en  
una cinta, e  
incrementos en  
velocidad,  
se cumple  
el patrón

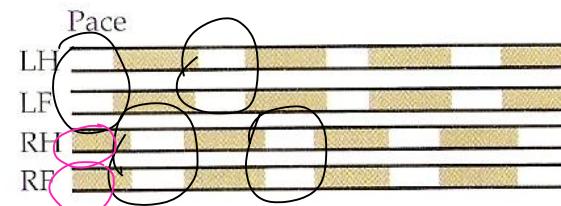
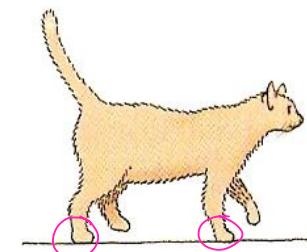


→ hay una serie  
potro levantado  
a la vez

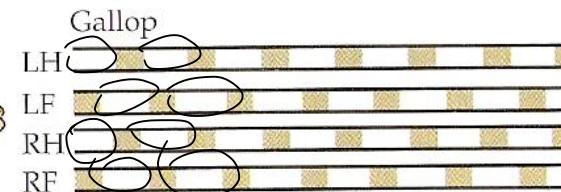
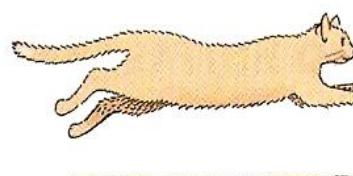
Limbs move  
in sequence  
LH → LF → RH → RF



Two opposite legs  
on ground (LH, RF)  
and off ground  
(LF, RH)



Both legs on same  
side on ground  
or off ground

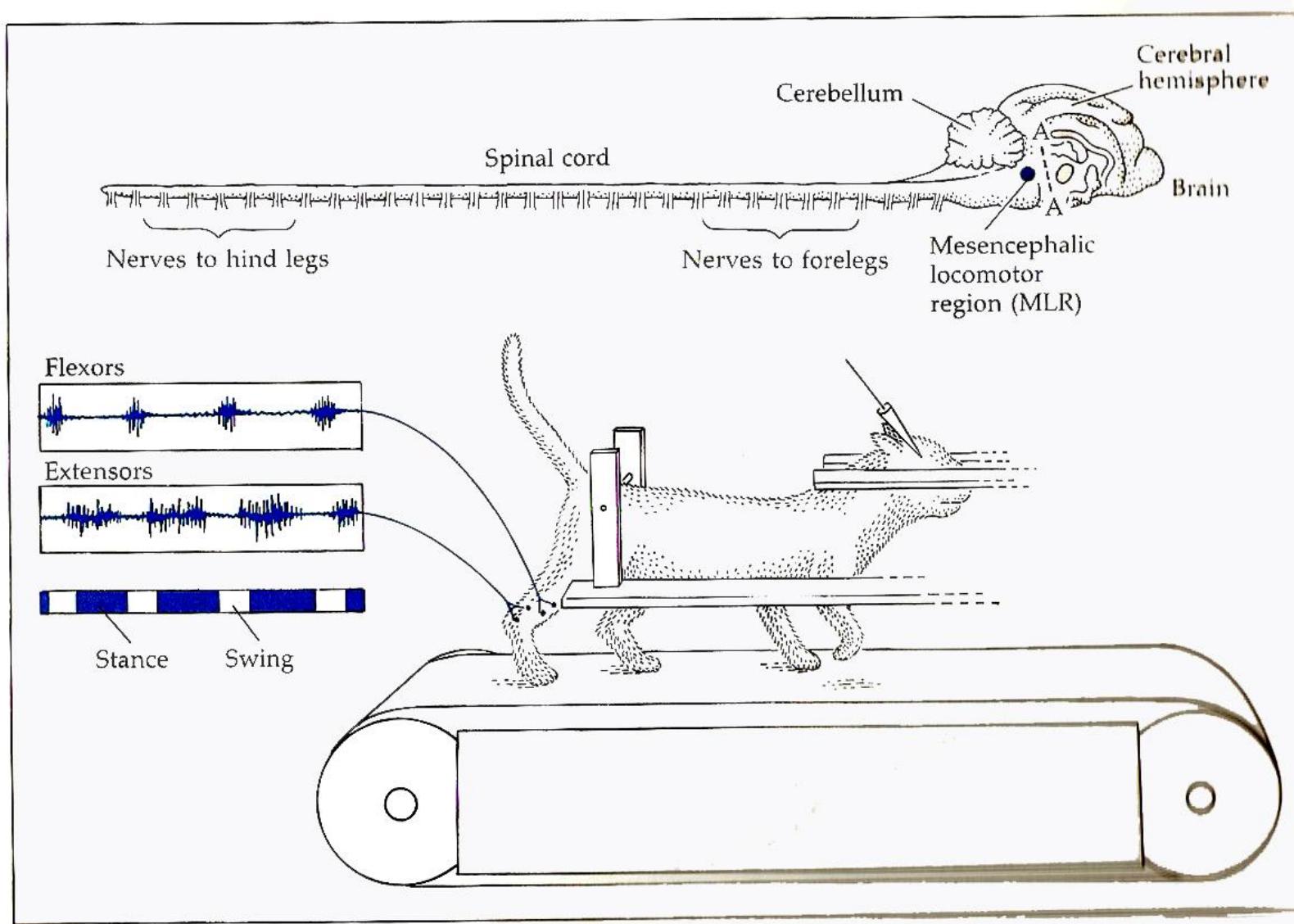


Both hindlegs or  
both front legs off  
ground, or all  
four legs briefly

Time →  
se apoya en  
dos elementos o  
dos tramos

# CPG en ausencia del cerebro anterior

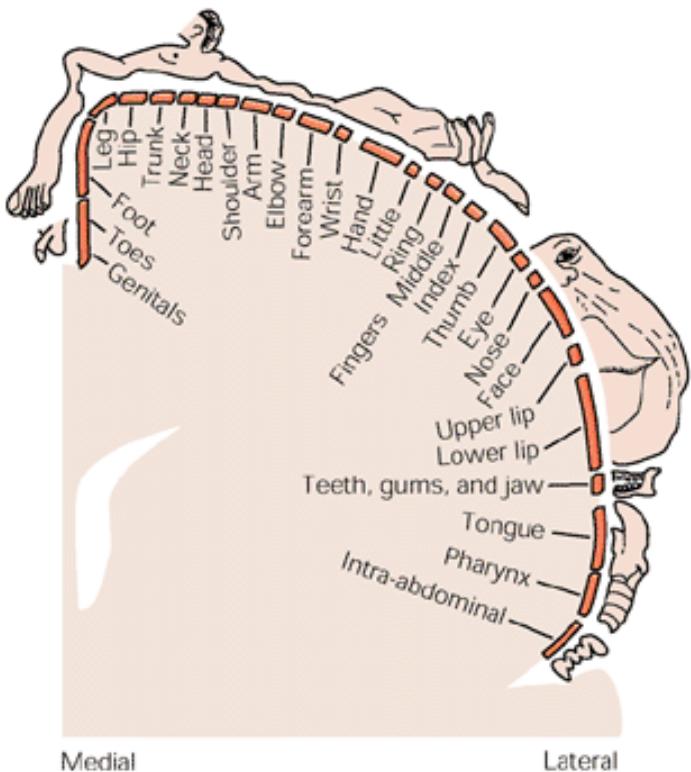
Se sabe que el movimiento continúa por la región mesencefálica locomotora



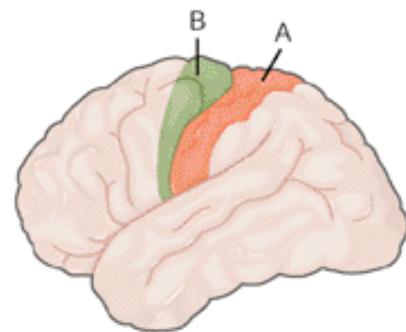
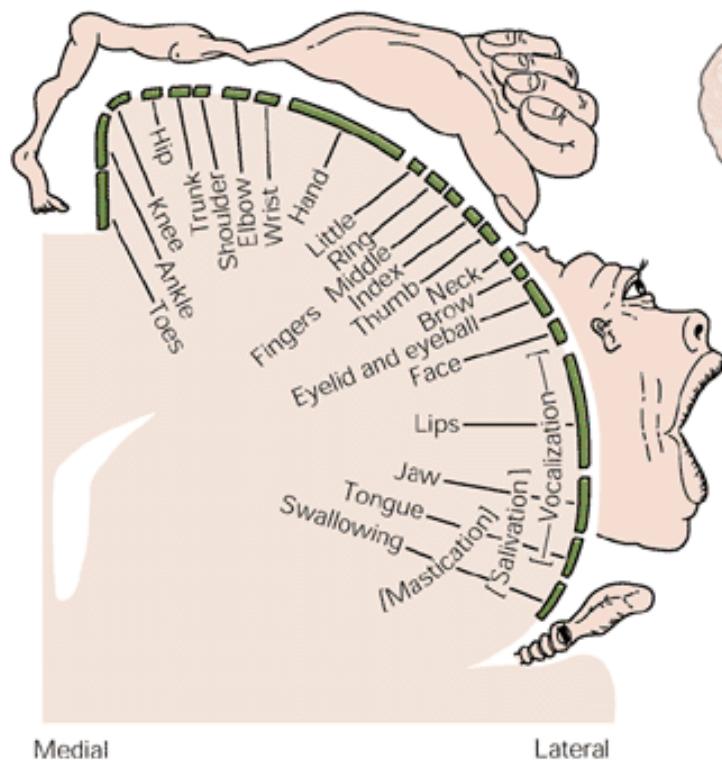
# Organización topográfica de la corteza

corteza somato sensorial

A Sensory homunculus

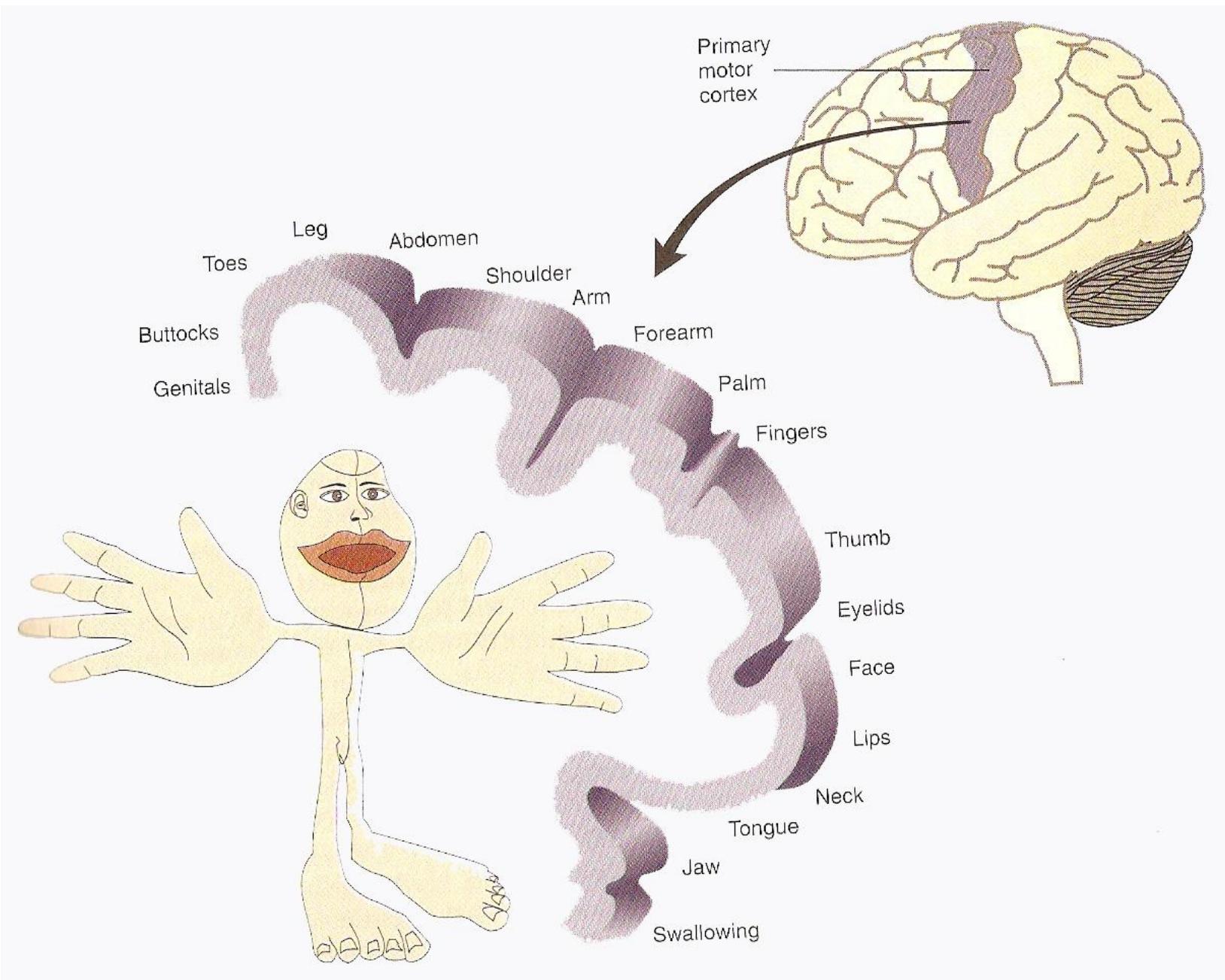


B Motor homunculus



omnínculo  
impres no continuo

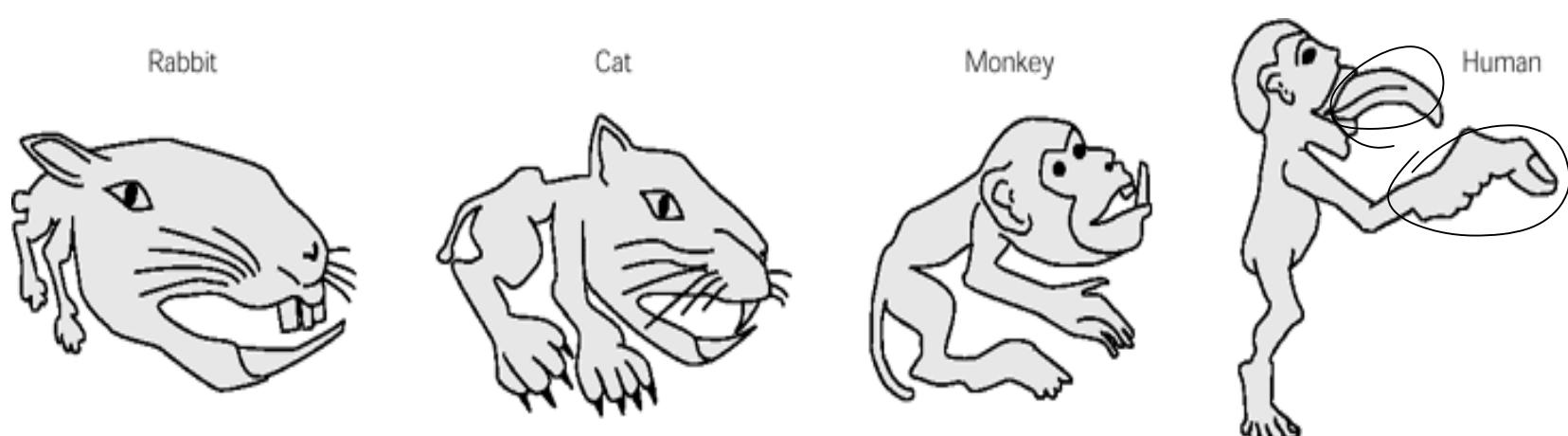
# El homúnculo motor



# Organización topográfica de la corteza

## Depende de la especie

tamaño según el omínculo



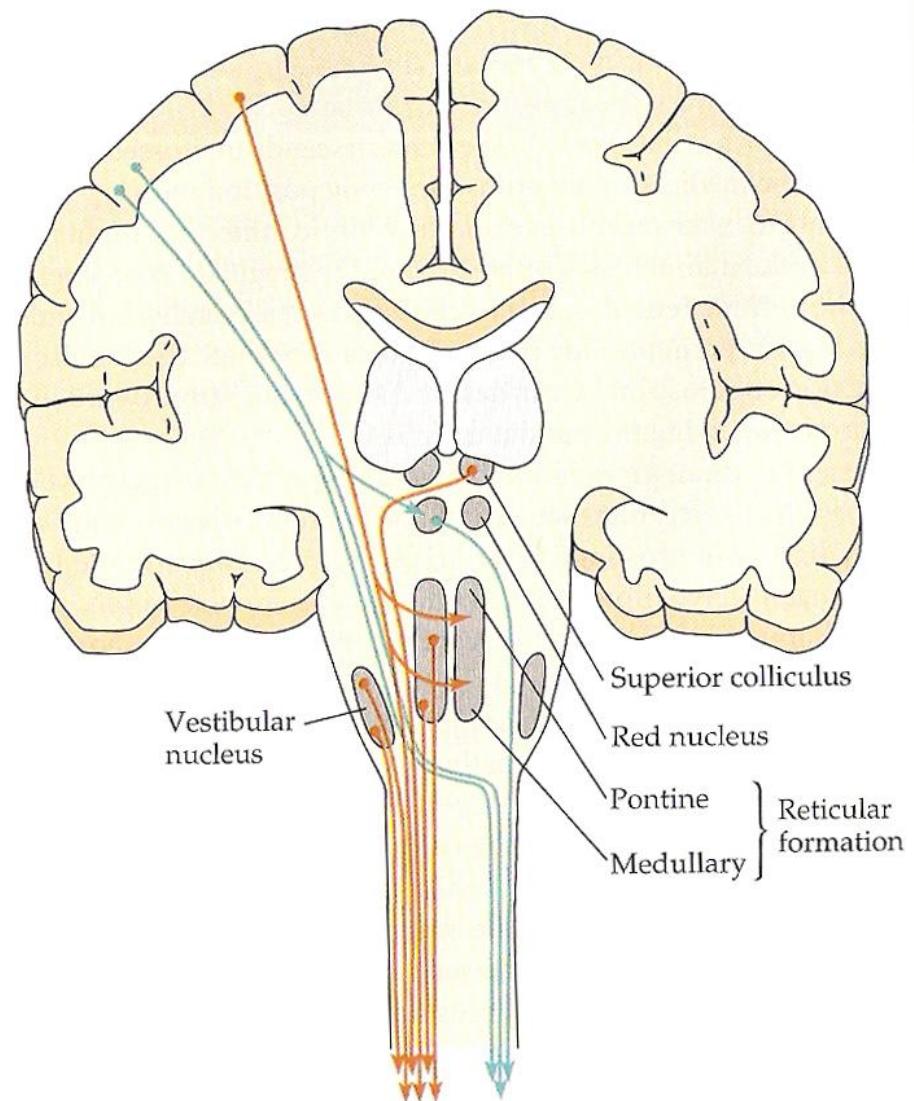
la diferencia entre el "lado móvil" y el que no es móvil no está en el omínculo motor (están en otro nivel) i.e el tamaño de ambos regiones es el mismo

Organización topográfica de la corteza

Depende de la especie: Topo de nariz estrellada



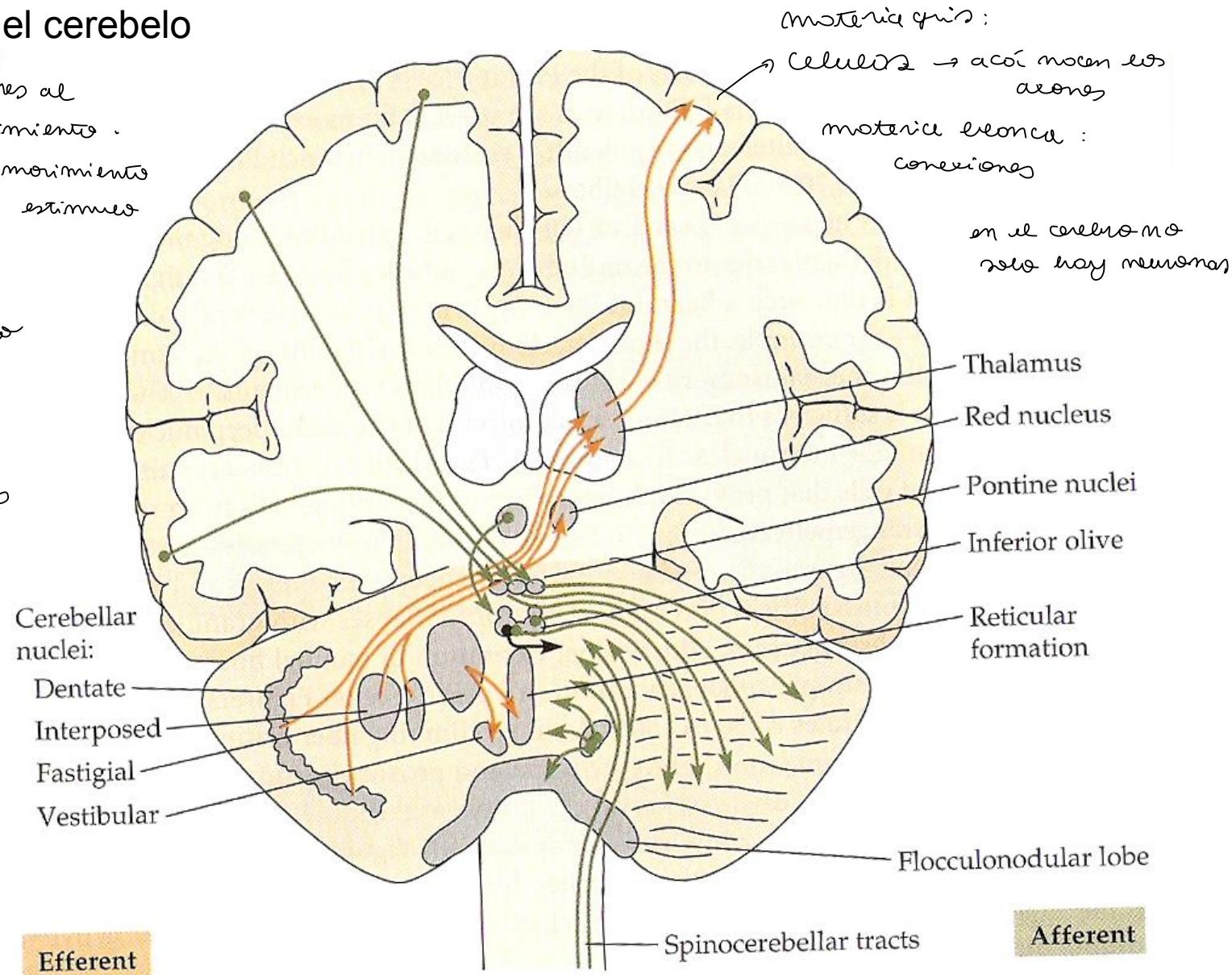
## Vías motoras



# Contribución del cerebelo

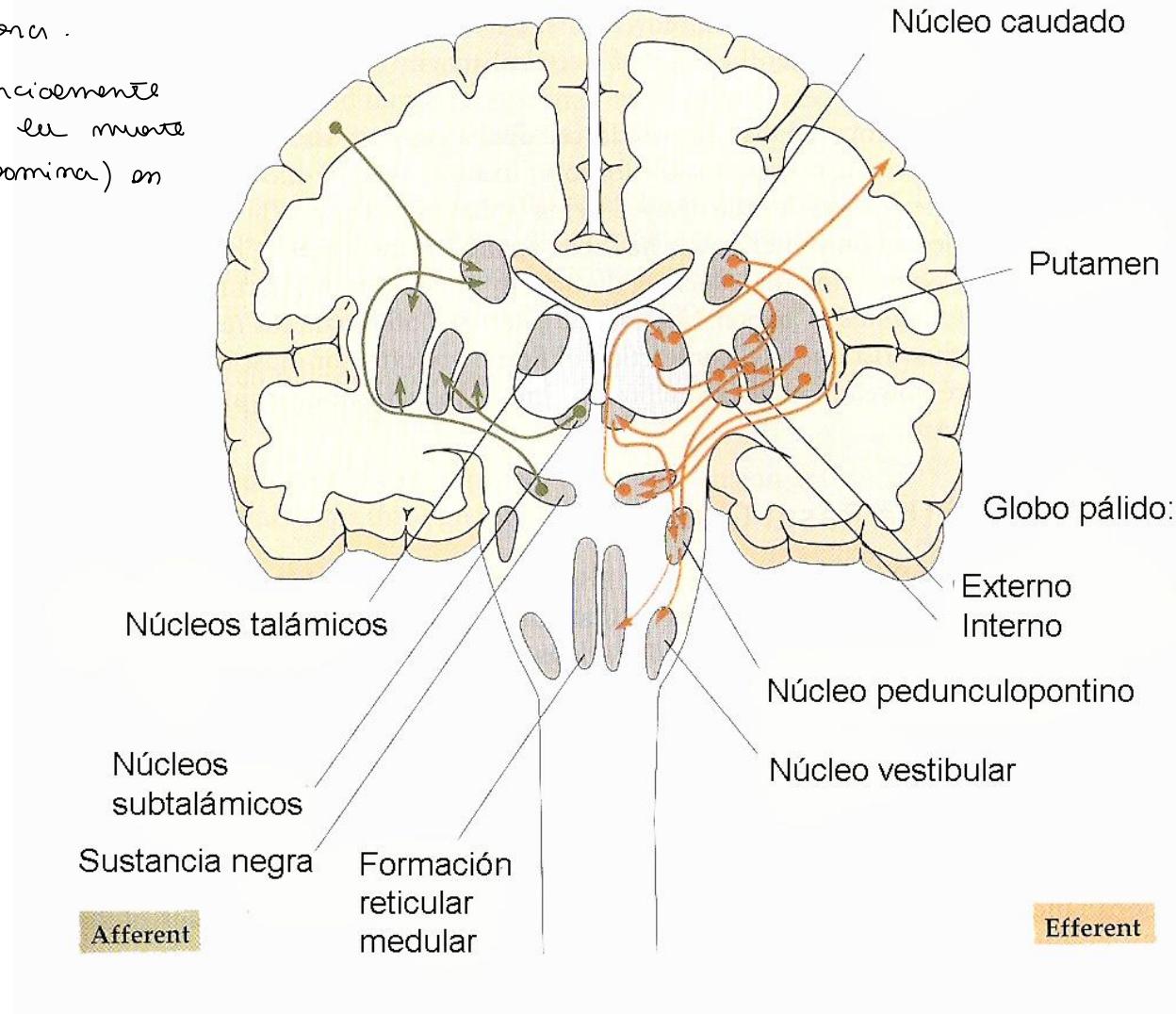
siempre hay errores al  
comenzar un movimiento.  
Para conseguir el movimiento  
uno necesita un estímulo  
visual  
órdenes

sin visual → cerebelo  
sin visual →  
comparando se  
pueden hacer  
los conexiones

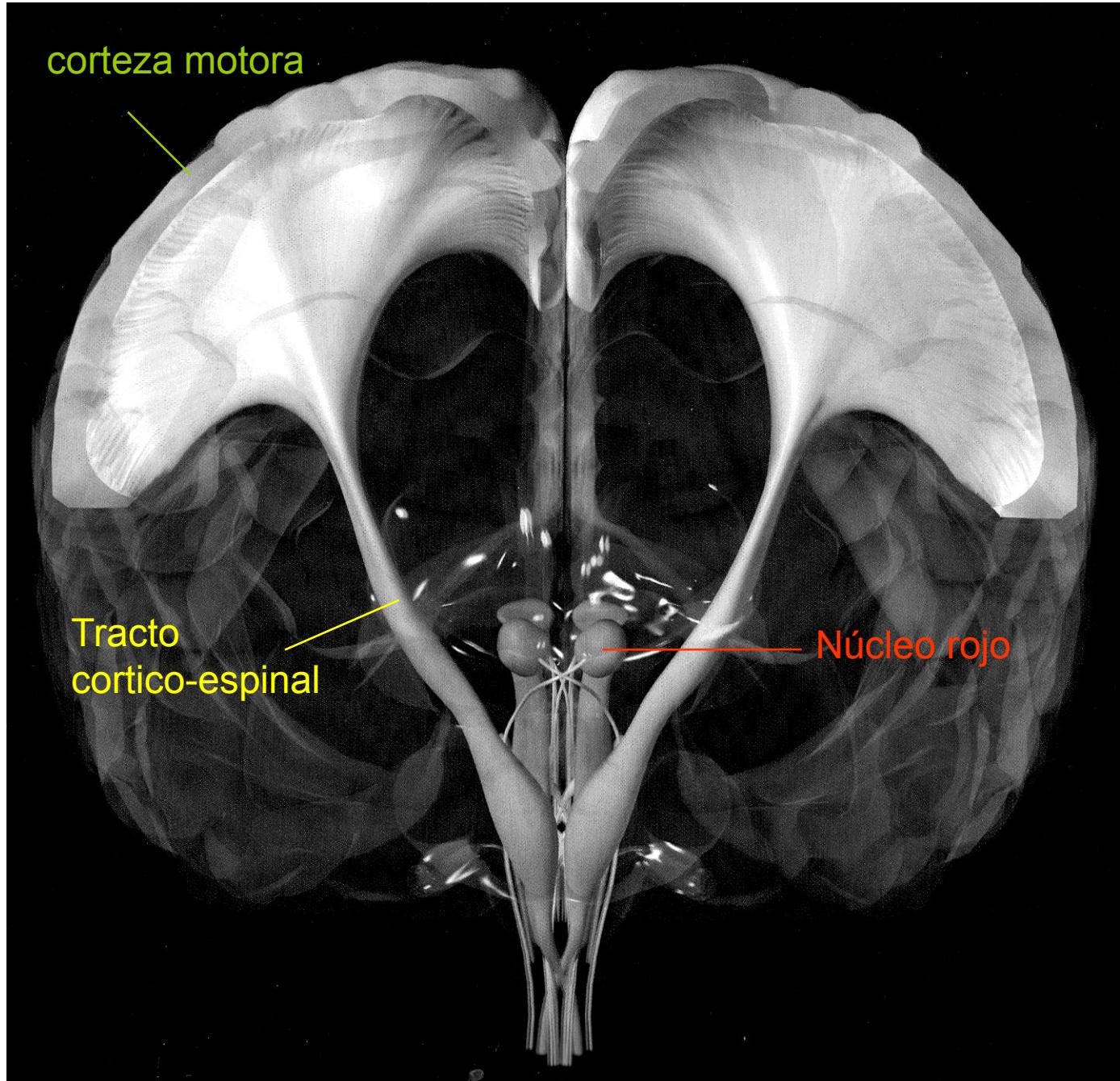


# Contribución de los ganglios basales (corte coronal)

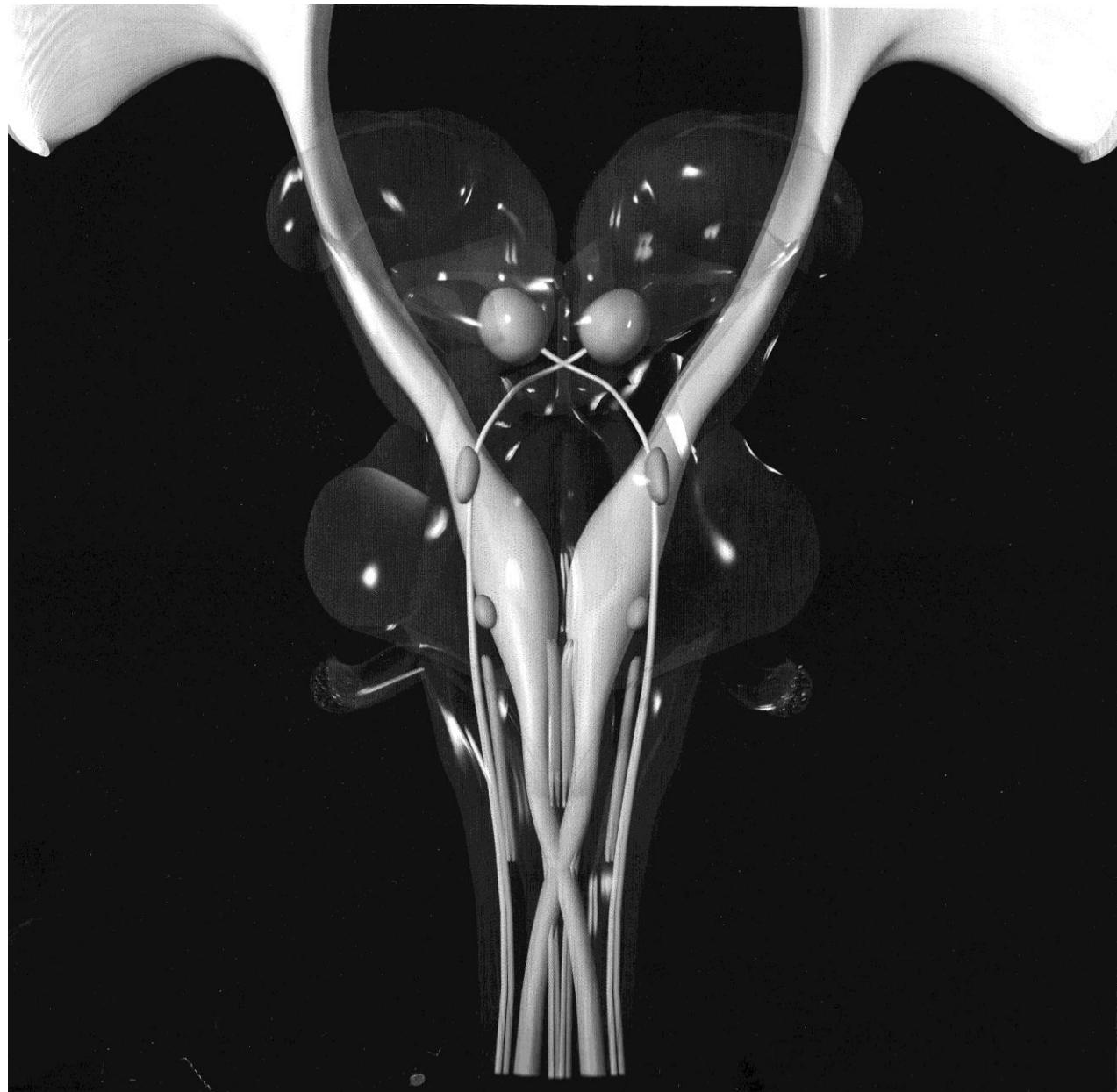
- realizan info motora
- refinen la info que sale del la corteza motora.
- ej: Parkinson esencialmente está asociado a la muerte de células (dopamina) en la región negra



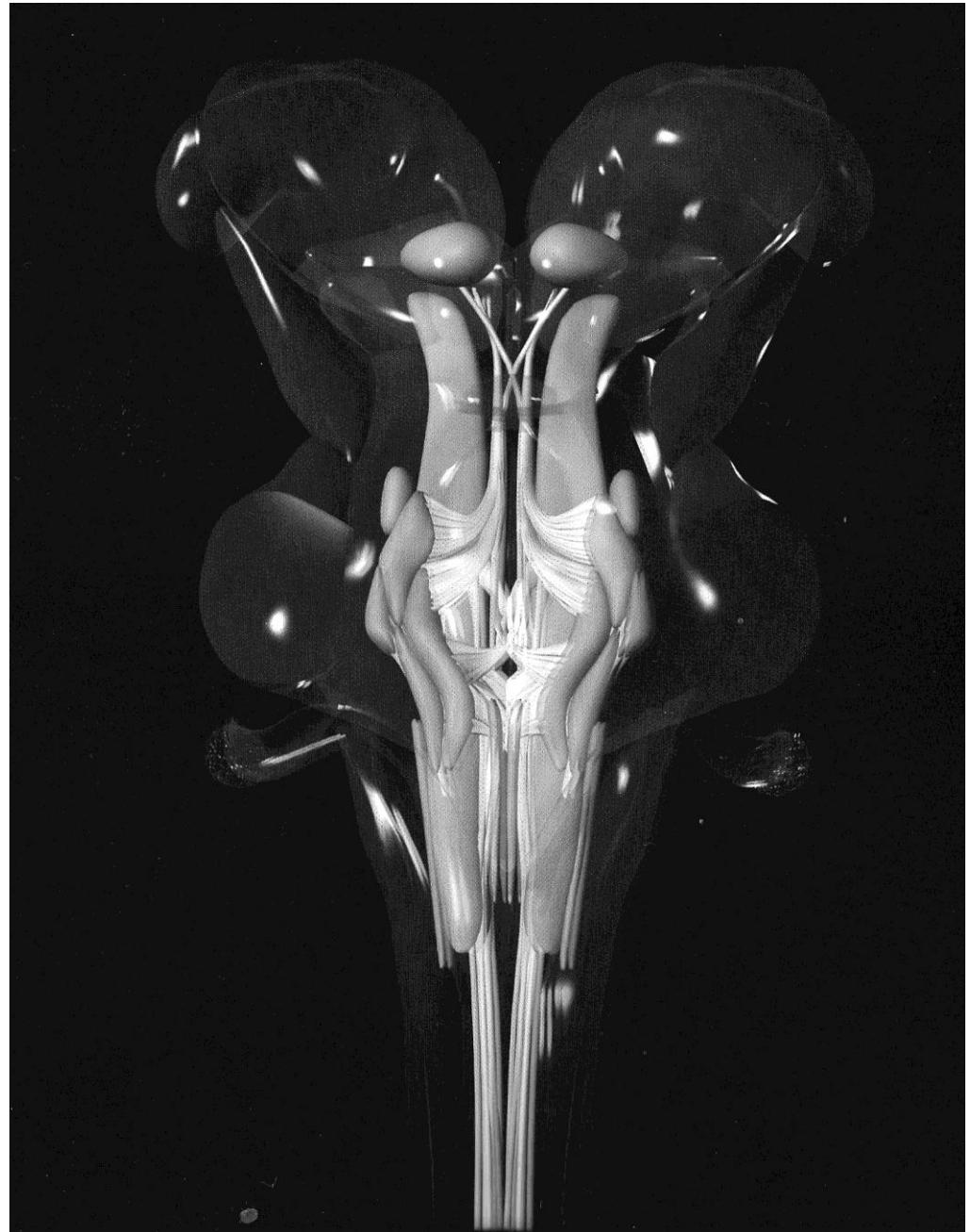
# Vías motoras en el cerebro humano



## Vías motoras laterales

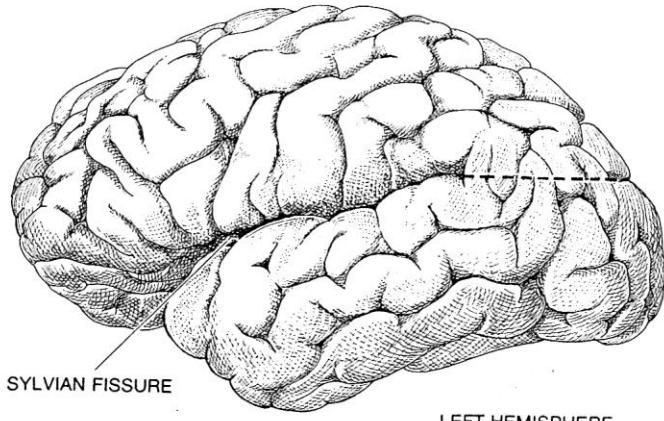


## Vías motoras mediales



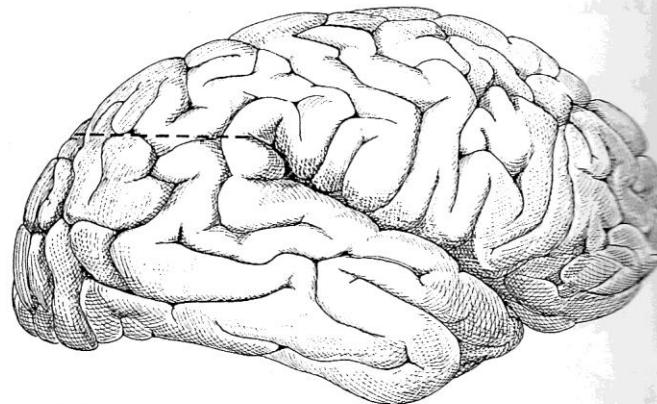
# Asimetría del cerebro humano (cerebro asimétrico)

ej. lenguaje se desarrolla en el hemisferio izq (Broca y Wernicke, si así se escribe)

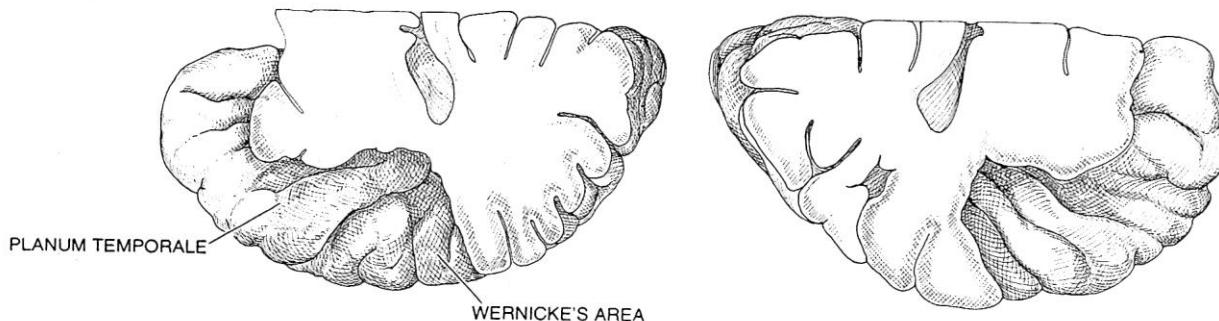


SYLVIAN FISSURE

LEFT HEMISPHERE



RIGHT HEMISPHERE



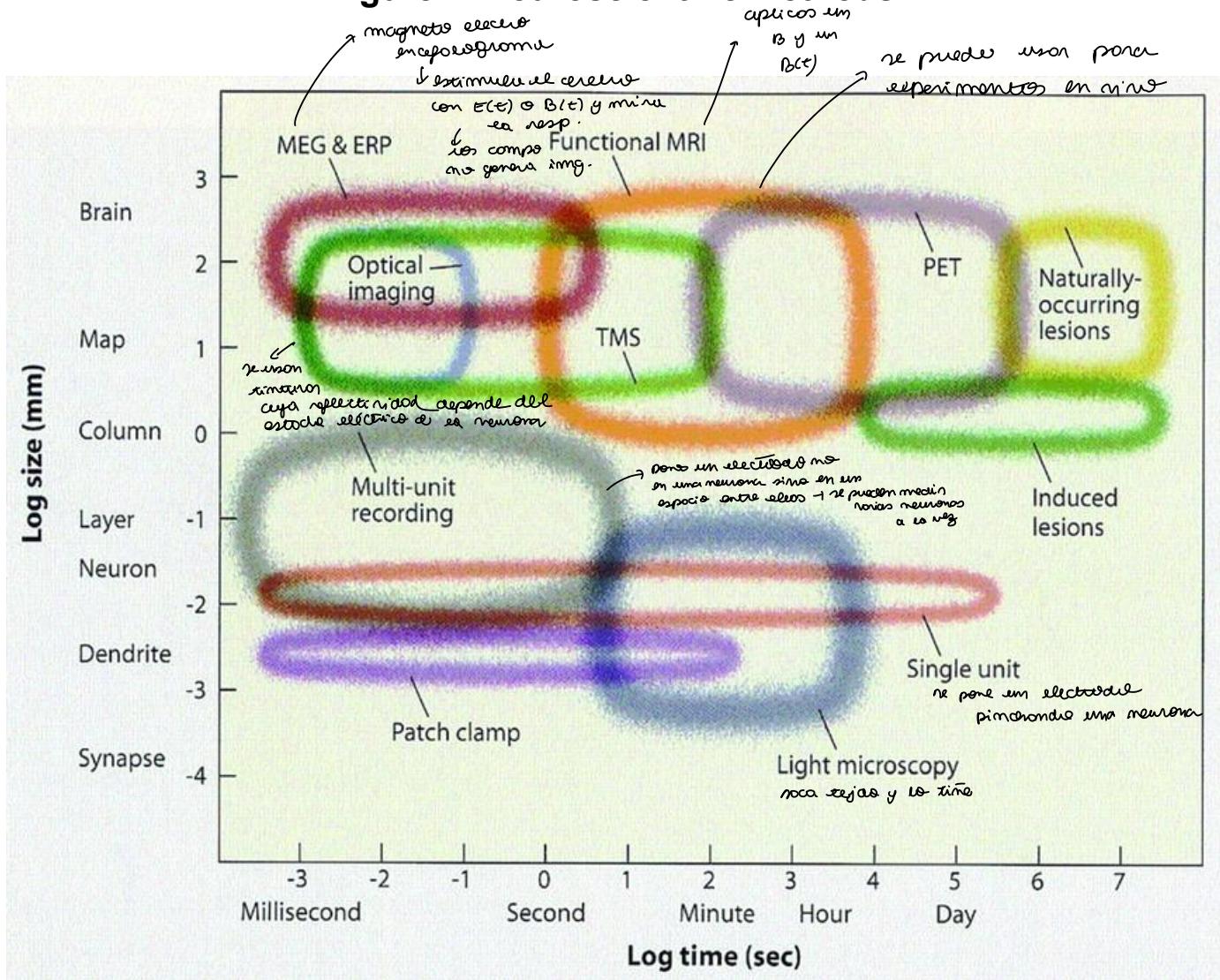
PLANUM TEMPORALE

WERNICKE'S AREA

**ANATOMICAL ASYMMETRY** of the cortex has been detected in

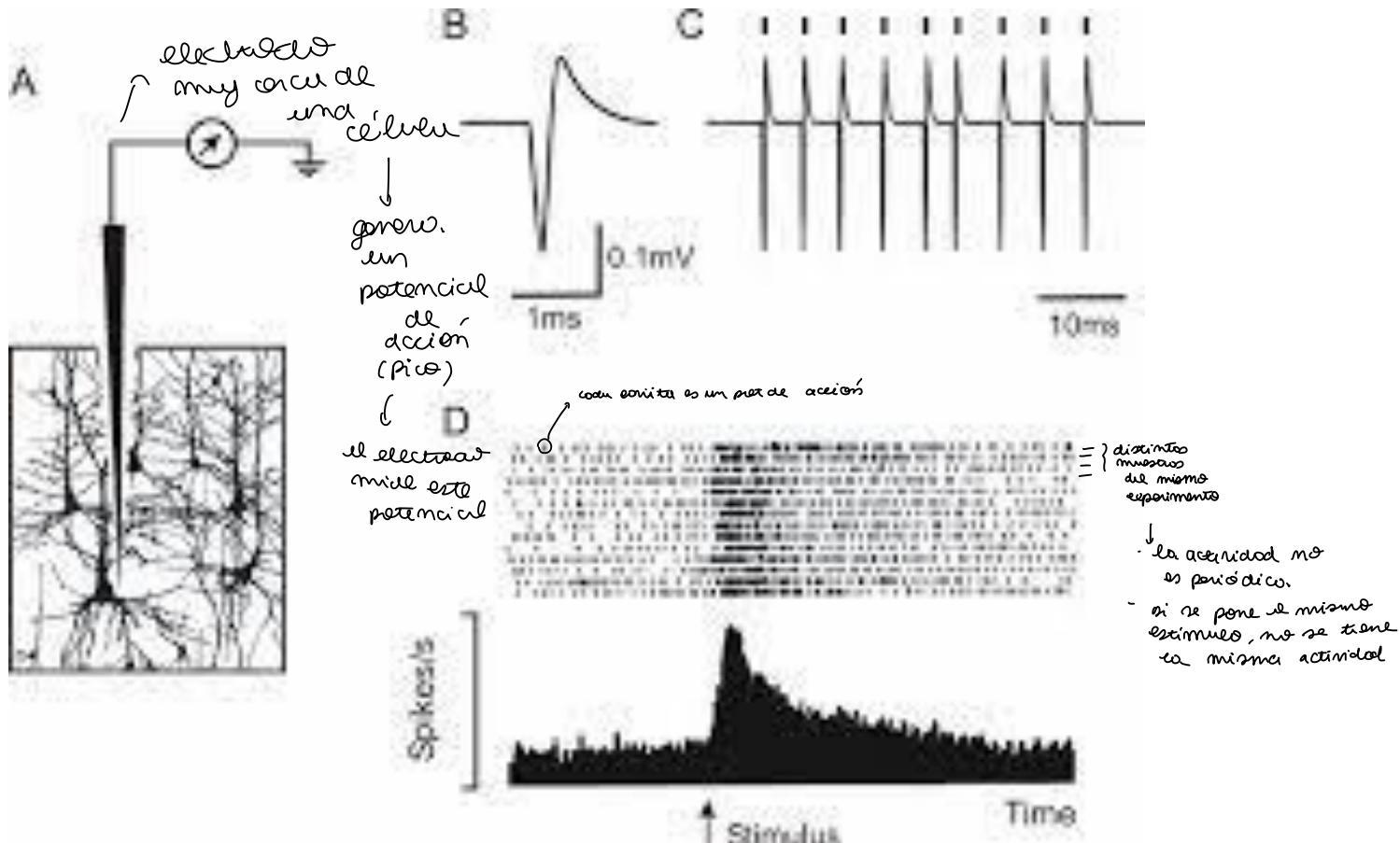
the **planum temporale**, which forms the upper surface of the **temporal lobe**.

**Figure 1. Neuroscientific methods.**

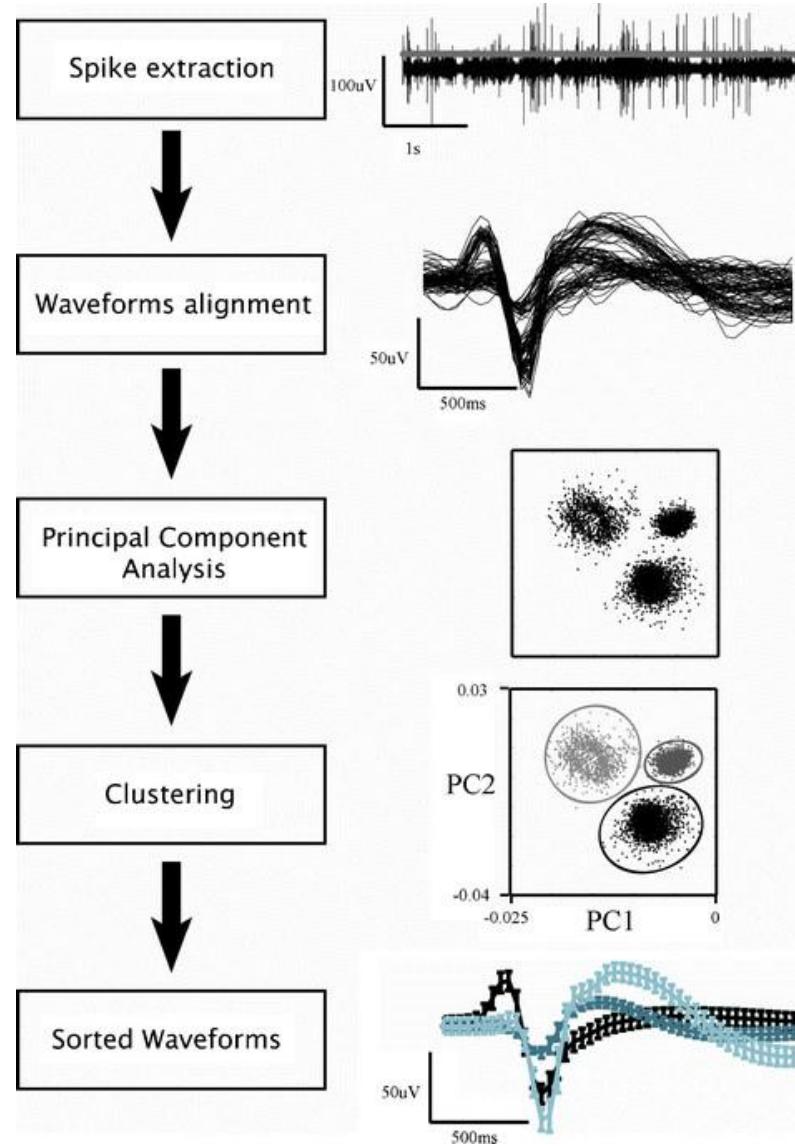


Lane R D et al. Psychosom Med 2009;71:117-134

# Extracellular single unit recording

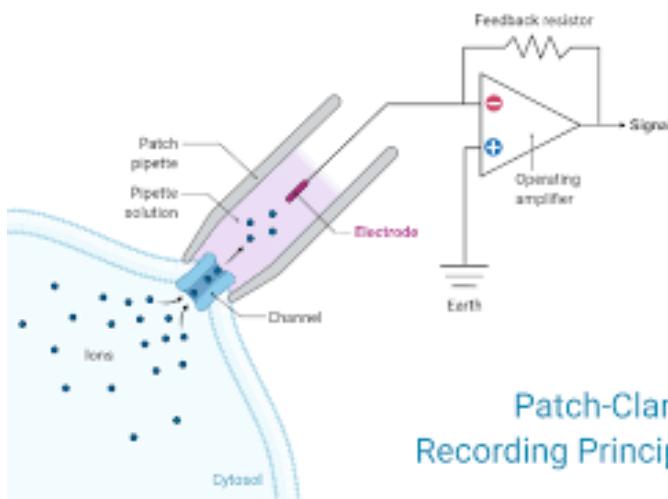
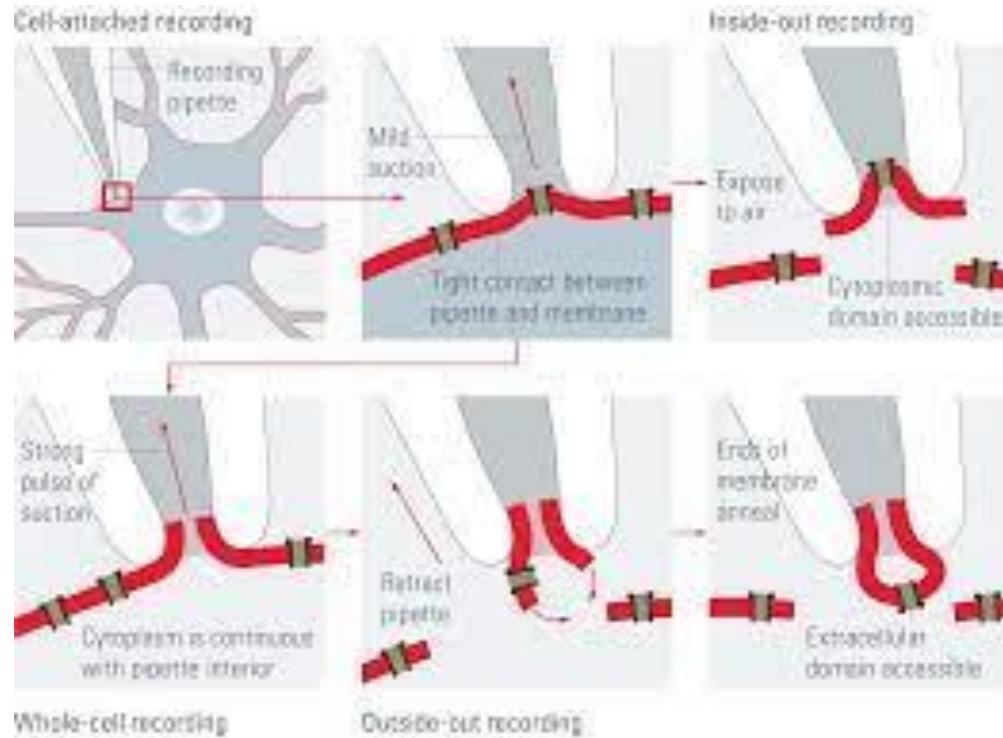


# Spike sorting



# Patch clamp

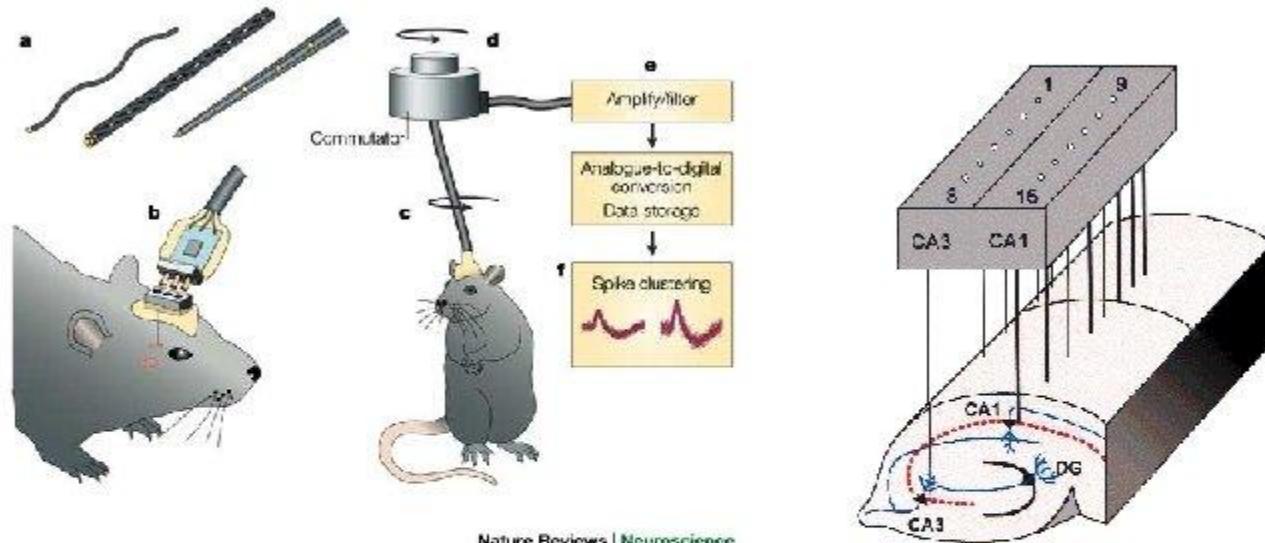
“más fina” que pinchan una neurona. Se usa un electrodio de mano sobre la superficie de la célula. Se hace succión y se rompe la membrana y se puede medir la corriente que pasa por el poro.



Patch-Clamp  
Recording Principle

Se usan decenas de electrodos en el cerebro y cada uno mide varias neuronas  
sin registros cuádruples, puede estar dices, sombras, masas

## Multi-unit Array Recordings

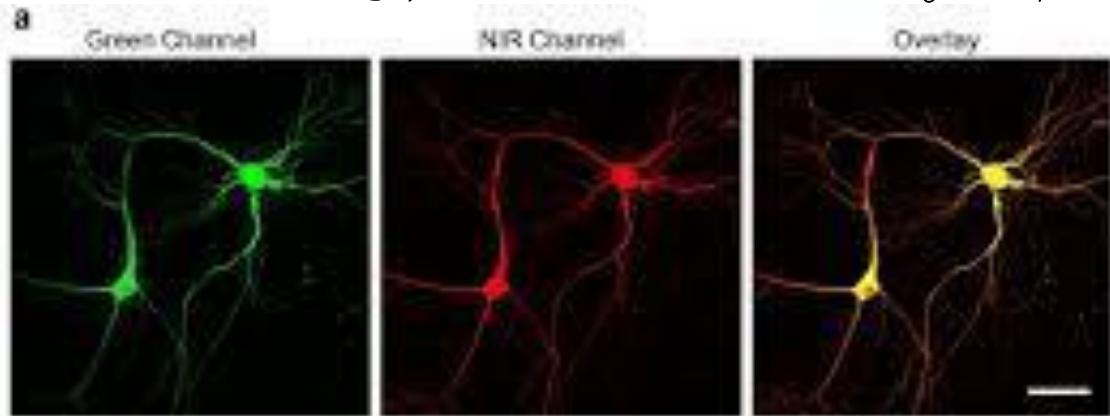


**Pros:** recording from an *in vivo* situation, network activity, population & single cell activity, phase locking of gamma & theta rhythms, correlation of neuronal or network activity with ongoing behavior, becoming more common

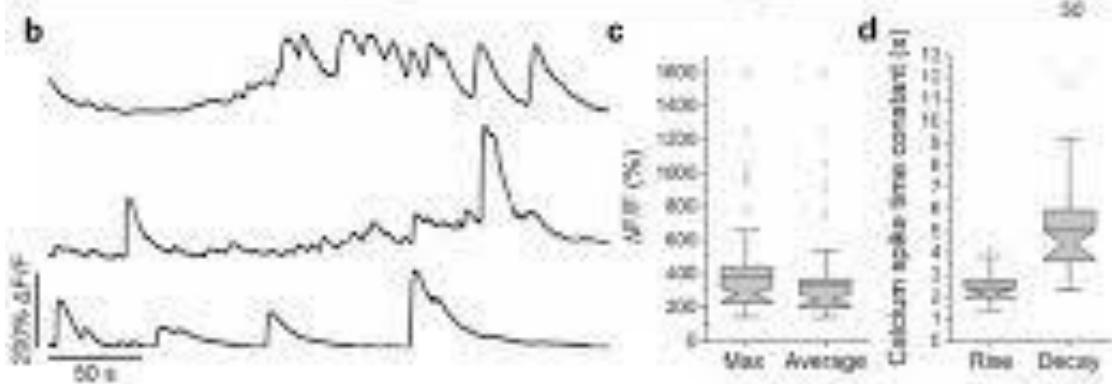
**Cons:** Technically difficult, confound of anesthesia, application of mathematics to isolate data, probes are time-consuming to fabricate

## Optical Imaging: Calcium

xinterna que se activa cuando entra calcio  
Los spikes están asociados a la entrada de calcio  
a la célula  $\Rightarrow$  un o más colores cuando hay un spike

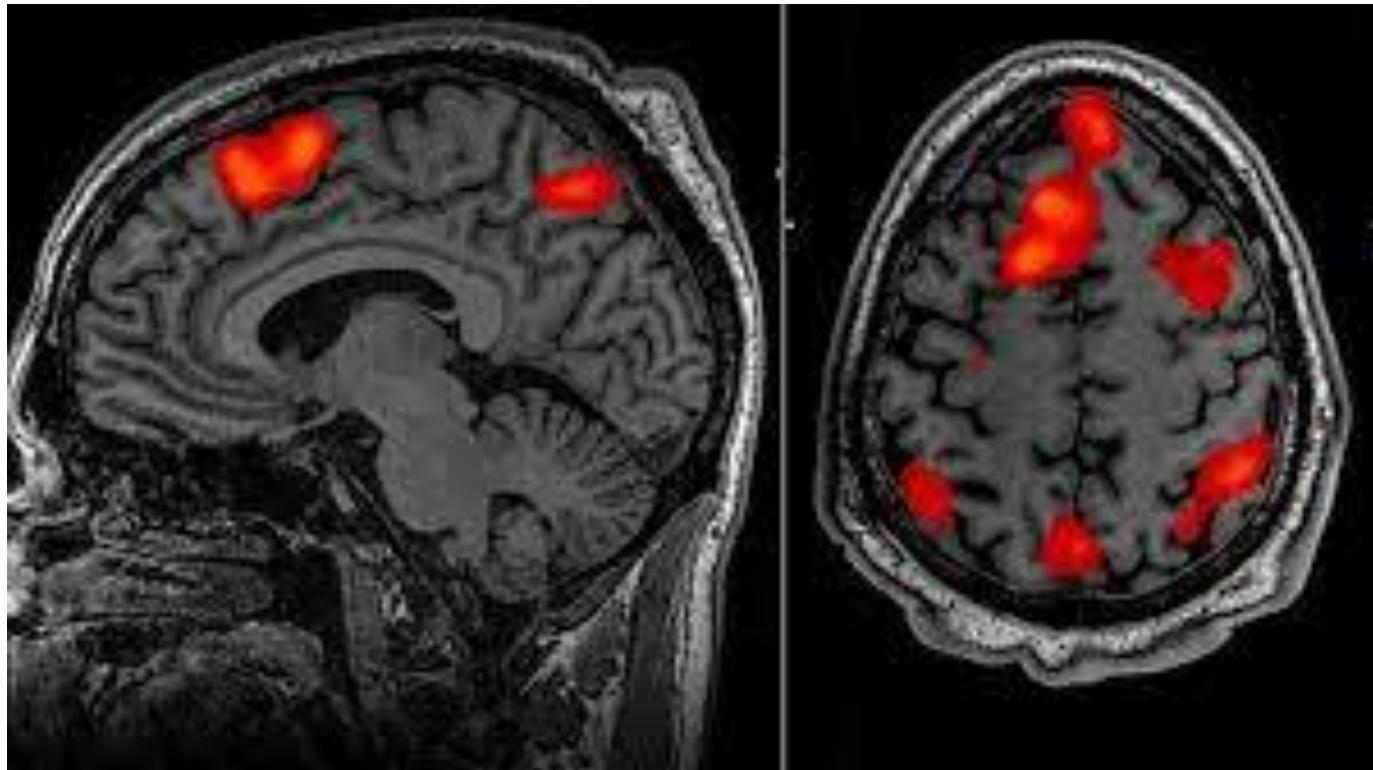


hay dif pigmentos donde se miden medianas dist tipos de colores



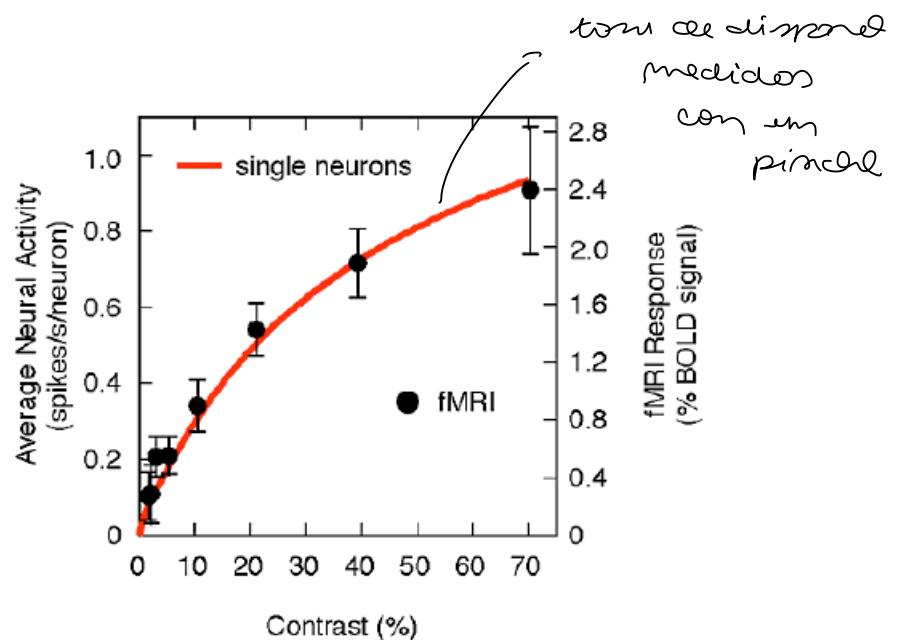
## Functional MRI

uno puede ver en vivo como se activan las regiones



## Functional MRI

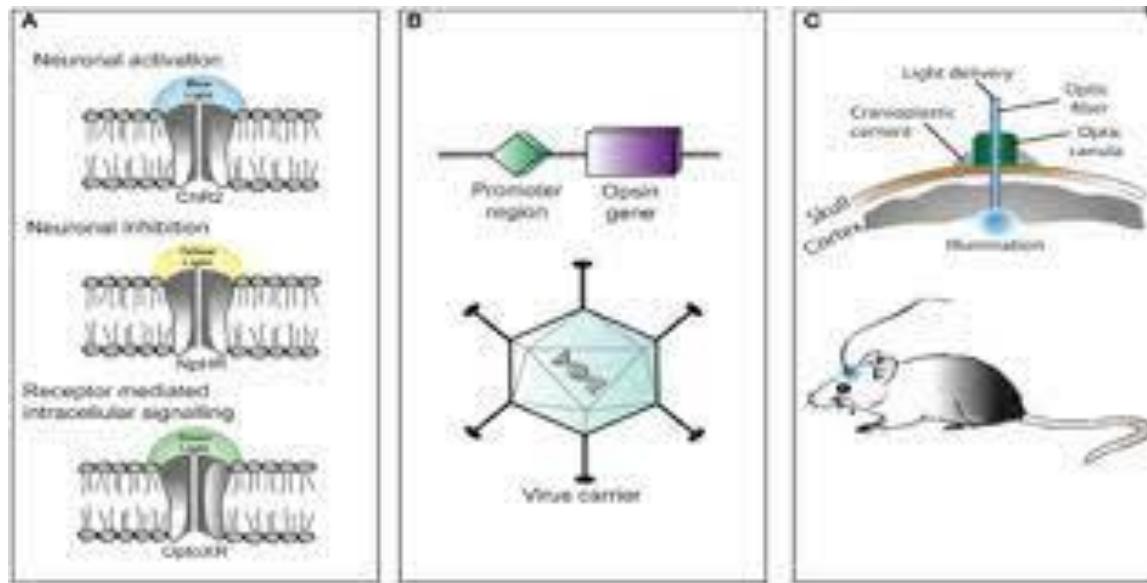
**Red curve:** “average firing rate in monkey V1, as a function of contrast, estimated from microelectrode recordings (333 neurons).”



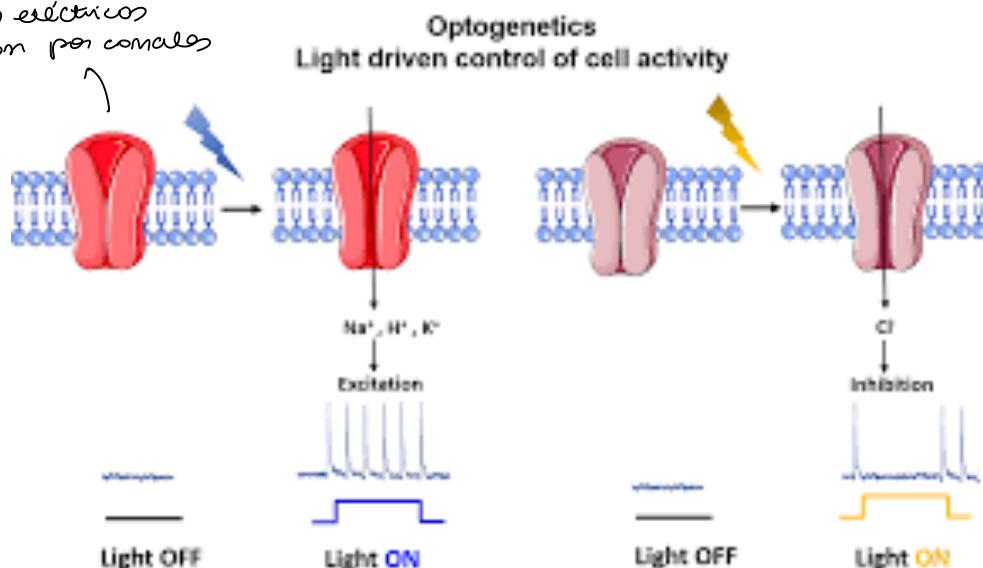
In early experiments comparing human BOLD signals and monkey electrophysiological data, BOLD signals were found to be correlated with action potentials.

Heeger et al 2000, *Nat. Neurosci.*  
Rees et al. 2000, *Nat. Neurosci.*

# Optogenetics



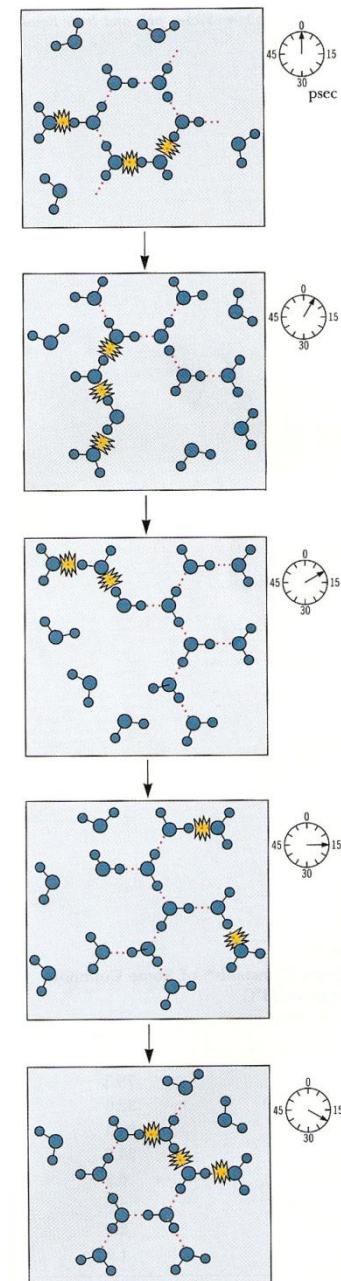
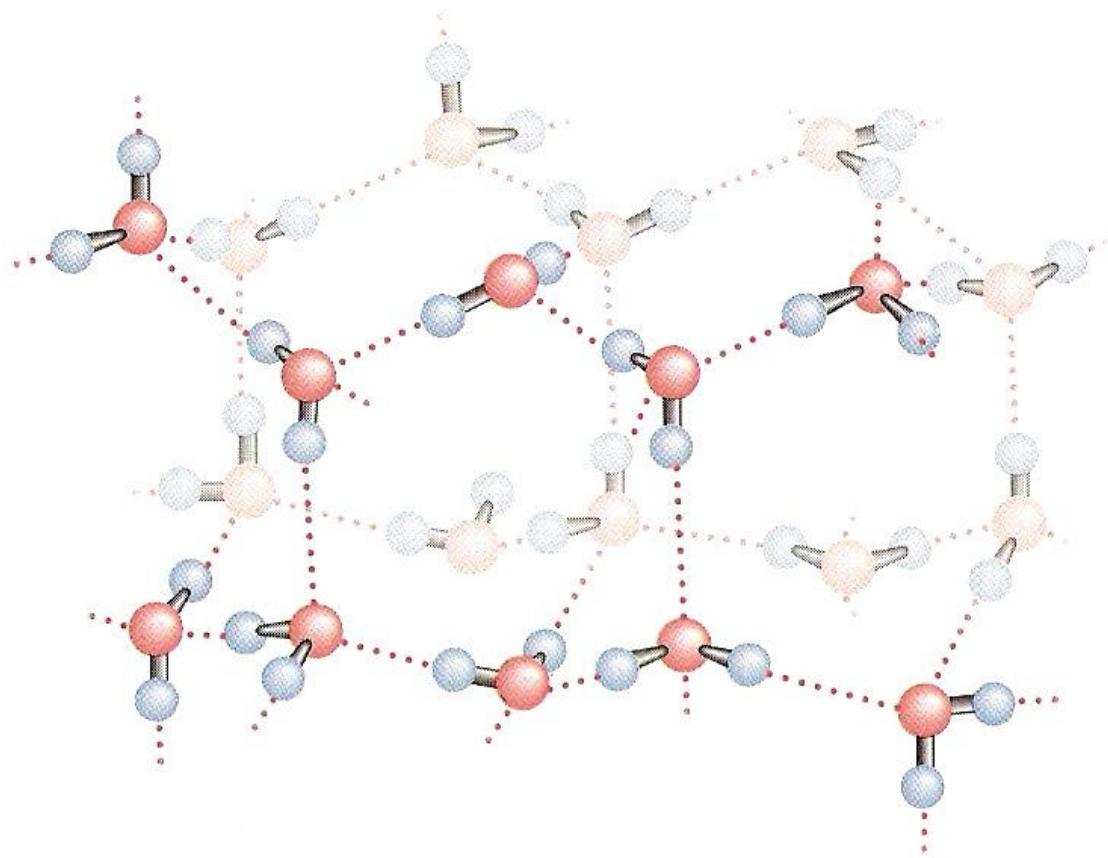
comodos:  
congen electicos  
posson per comodos



# MEMBRANA CELULAR

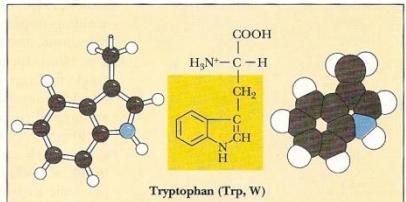
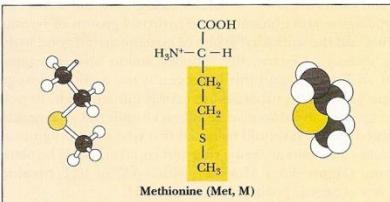
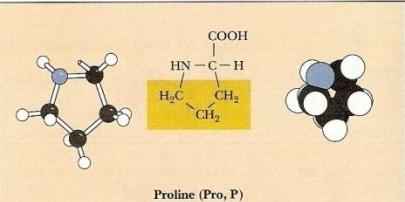
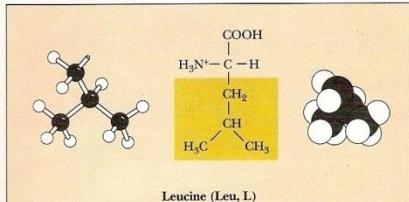
→ divide el interior del exterior  
de los neuronas

## La estructura del agua

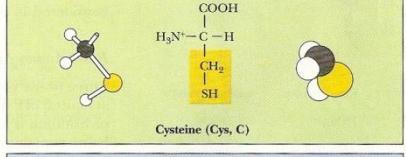
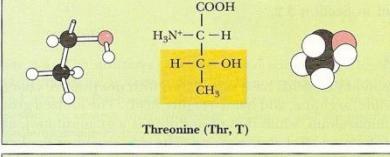
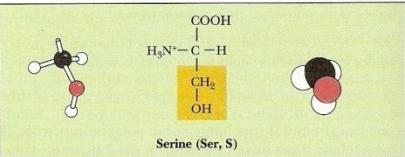
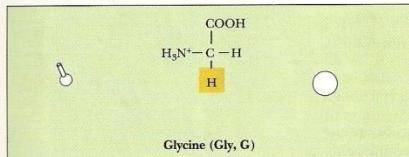


# Los aminoácidos

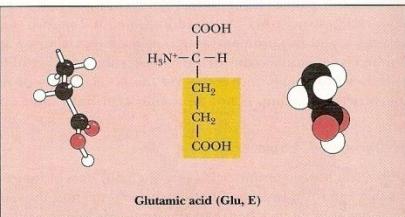
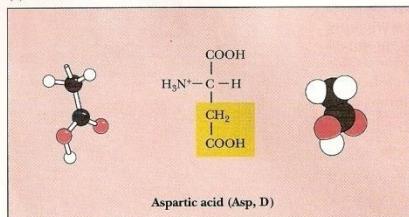
(a) Nonpolar (hydrophobic)



(b) Polar, uncharged



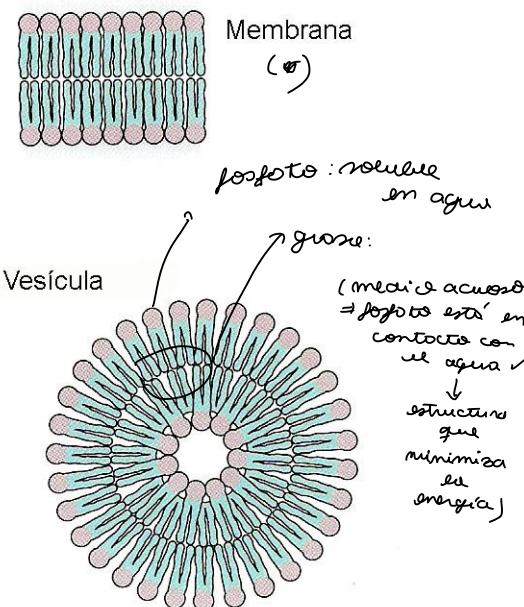
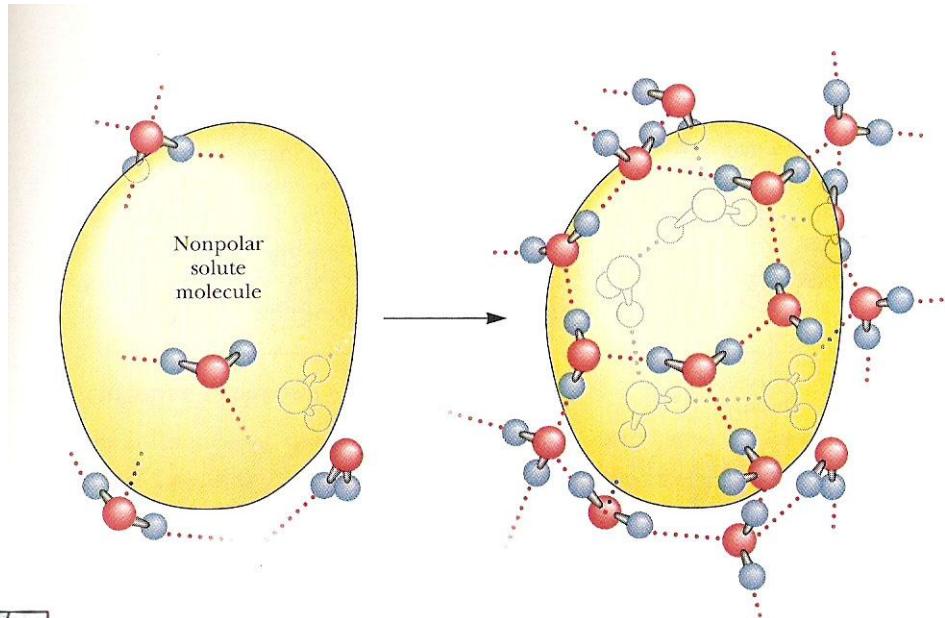
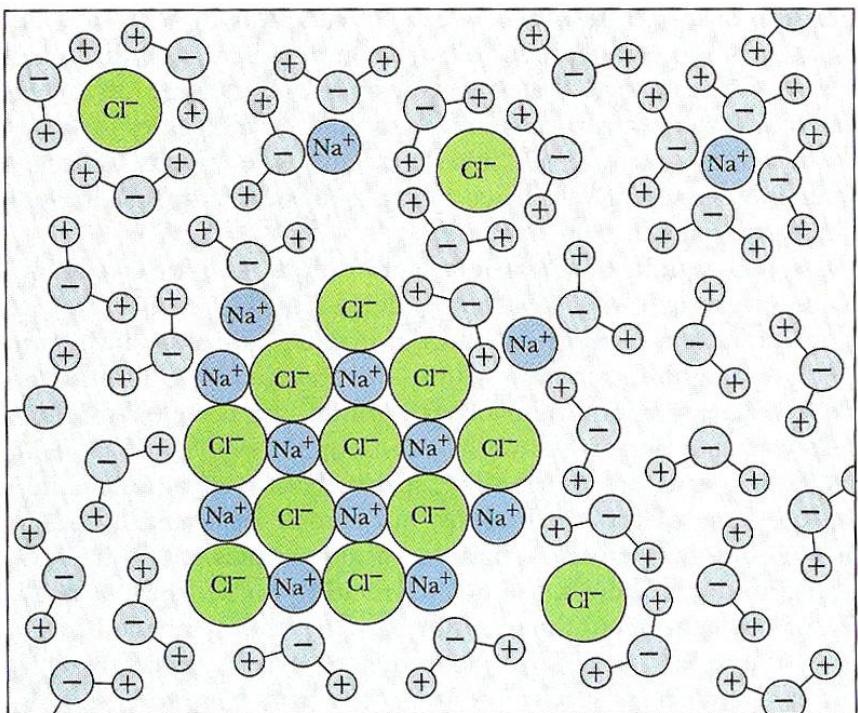
(c) Acidic



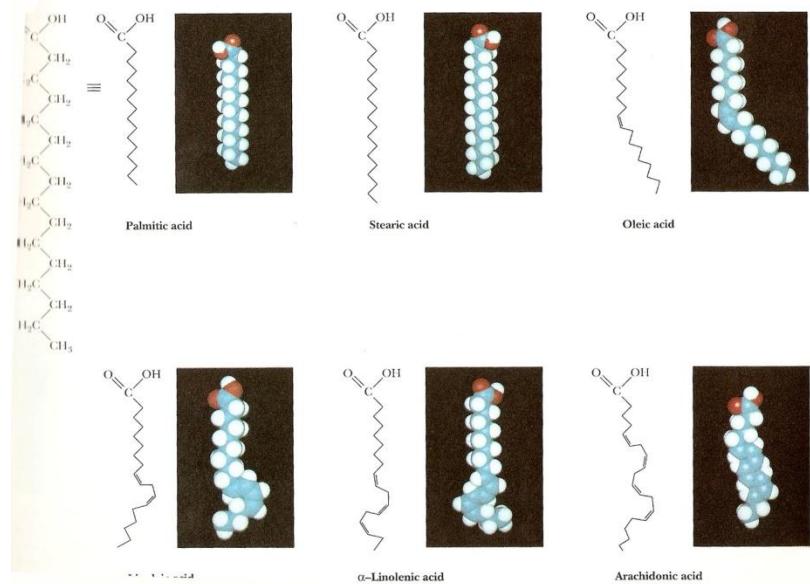
(d) Basic

# El agua y sus solutos

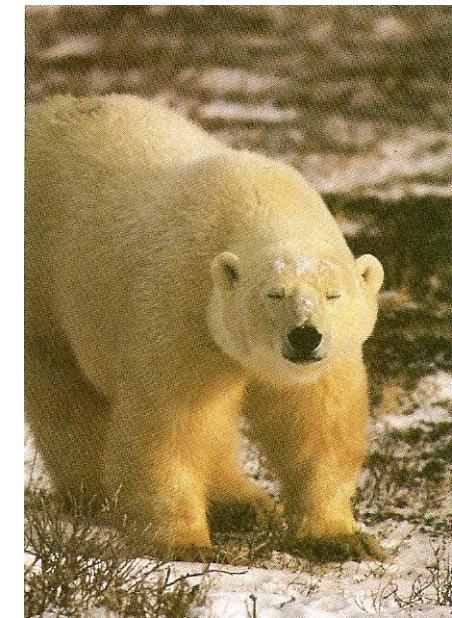
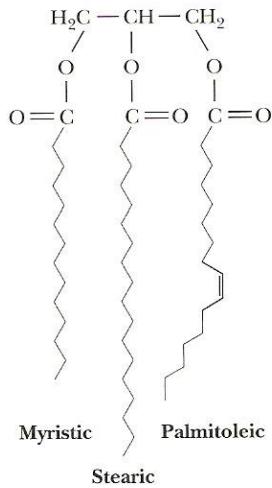
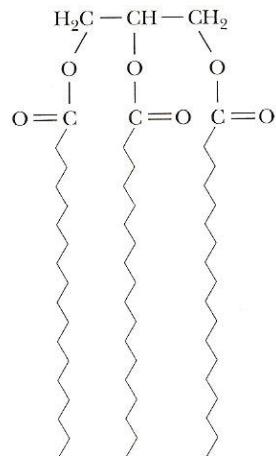
la membrana celular es una  
lámina muellellor. se tienen dos  
tipos de moléculas (\*)  
↓  
tienen una estructura  
llamada fosfolípida



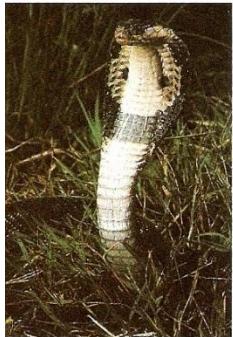
# Ácidos grasos



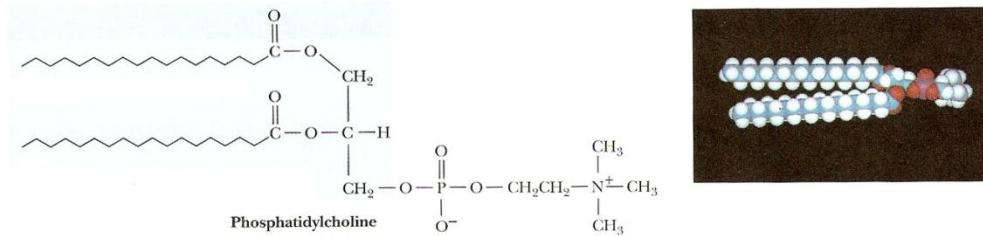
# Grasas



# Algunos fosfolípidos



## Venenos que rompen los fosfolípidos



### GLYCEROLIPIDS WITH OTHER HEAD GROUPS:

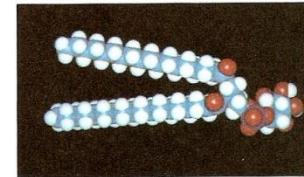
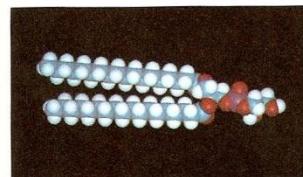
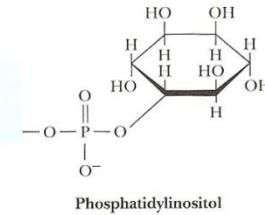
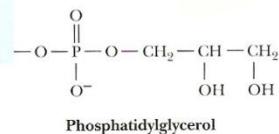
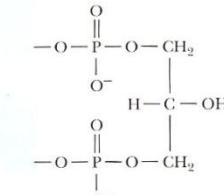
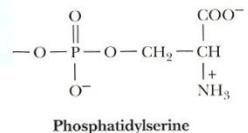
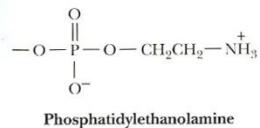


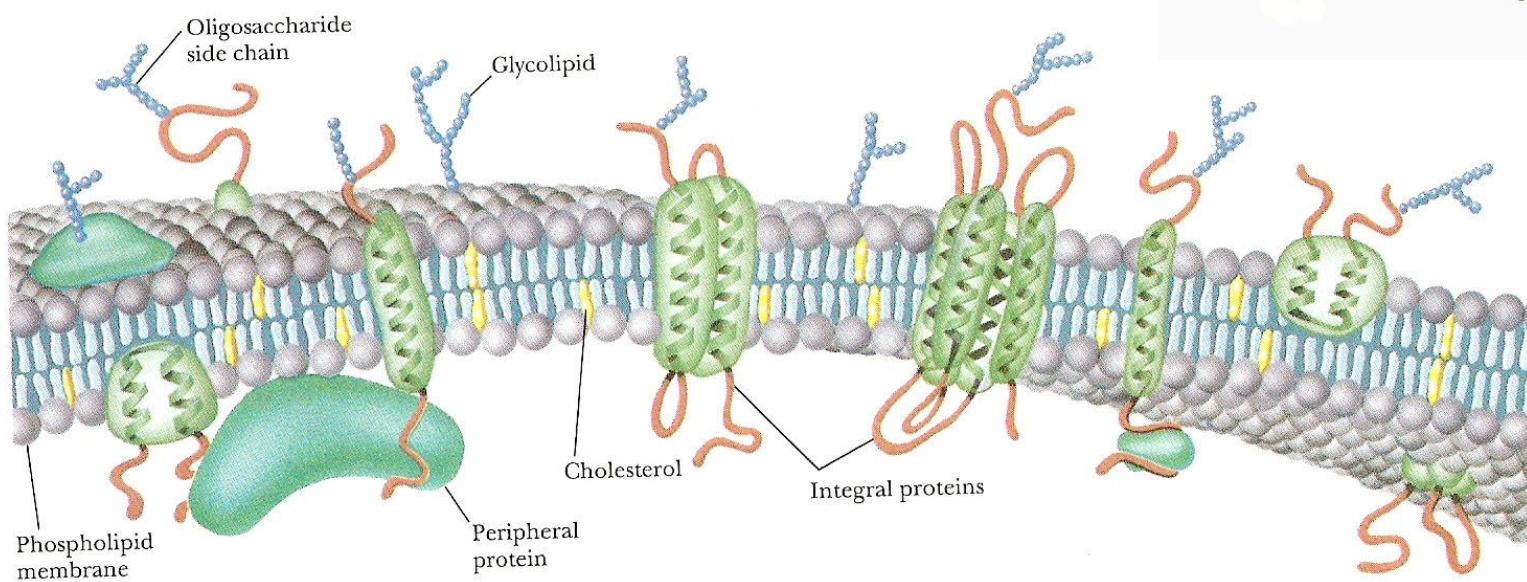
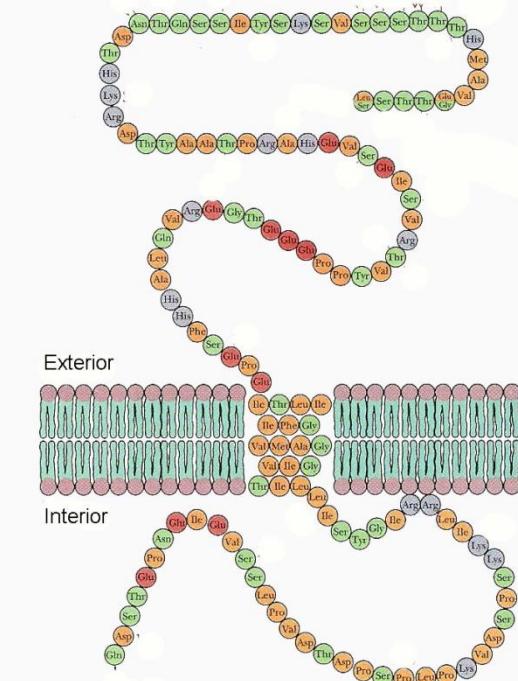
Figure 9.6 Structures of several glycerophospholipids and space-filling models of phosphatidylcholine, phosphatidylglycerol, and phosphatidylinositol.

# Proteínas transmembrana

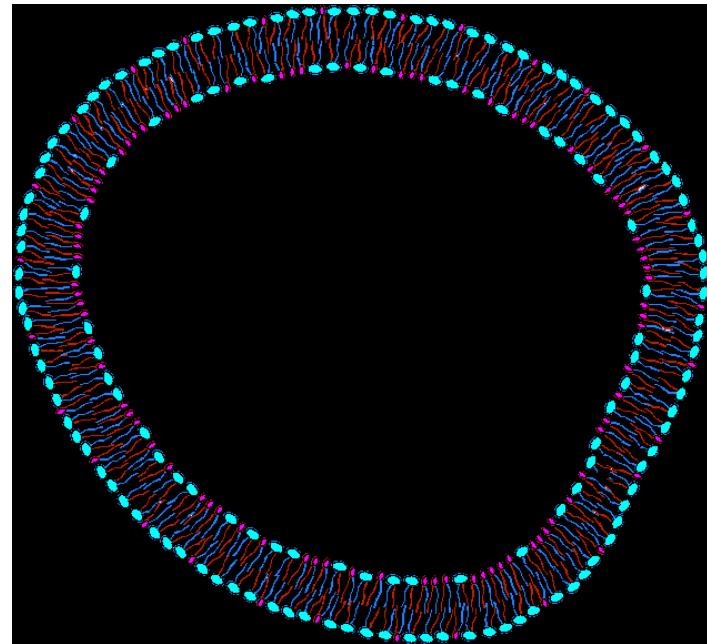
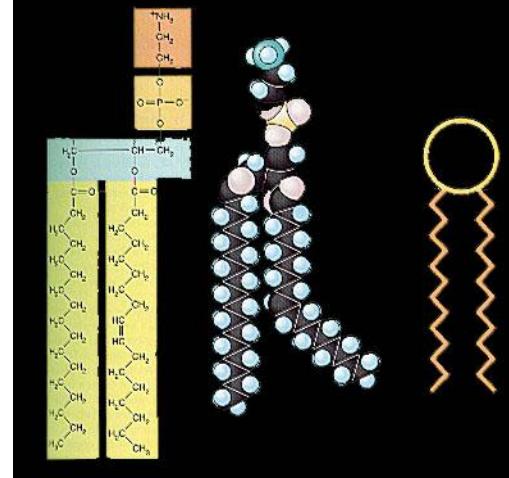
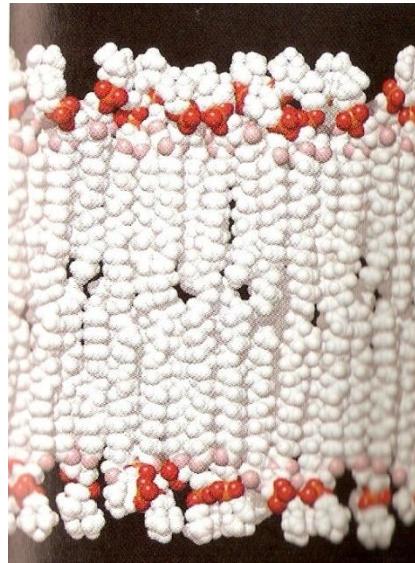
se encuentran  
dentro de la  
membrana

↓  
son algunos periféricos  
que están pegados por adentro  
o afuera de la  
membrana

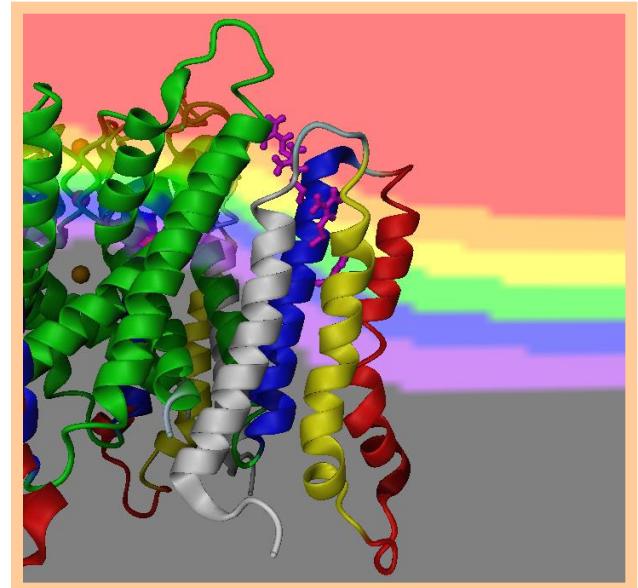
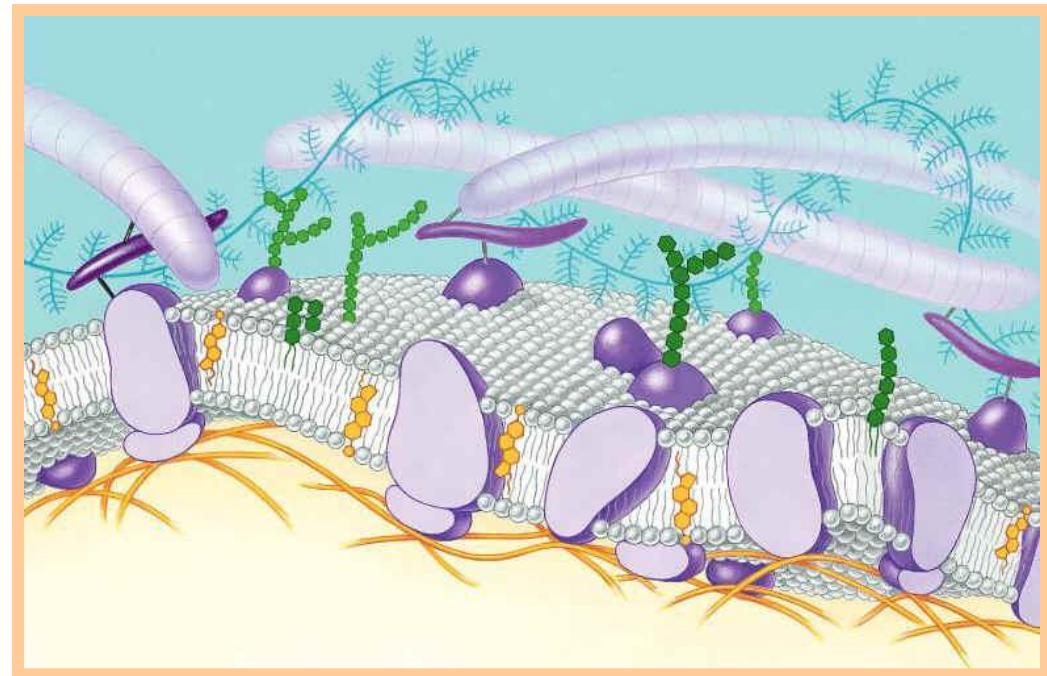
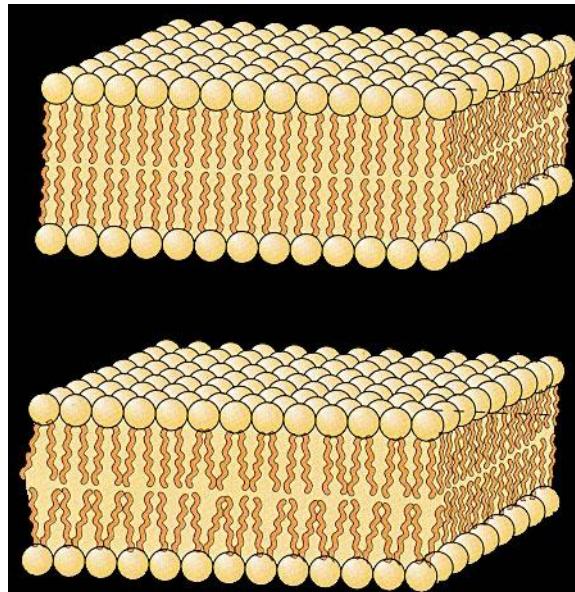
transversales:



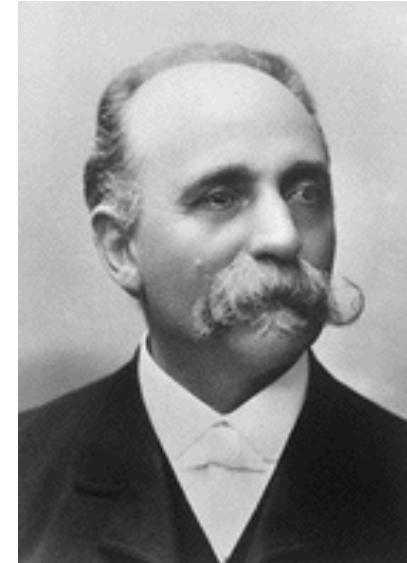
Cellos



membrana  
con bolas  
sus componentes



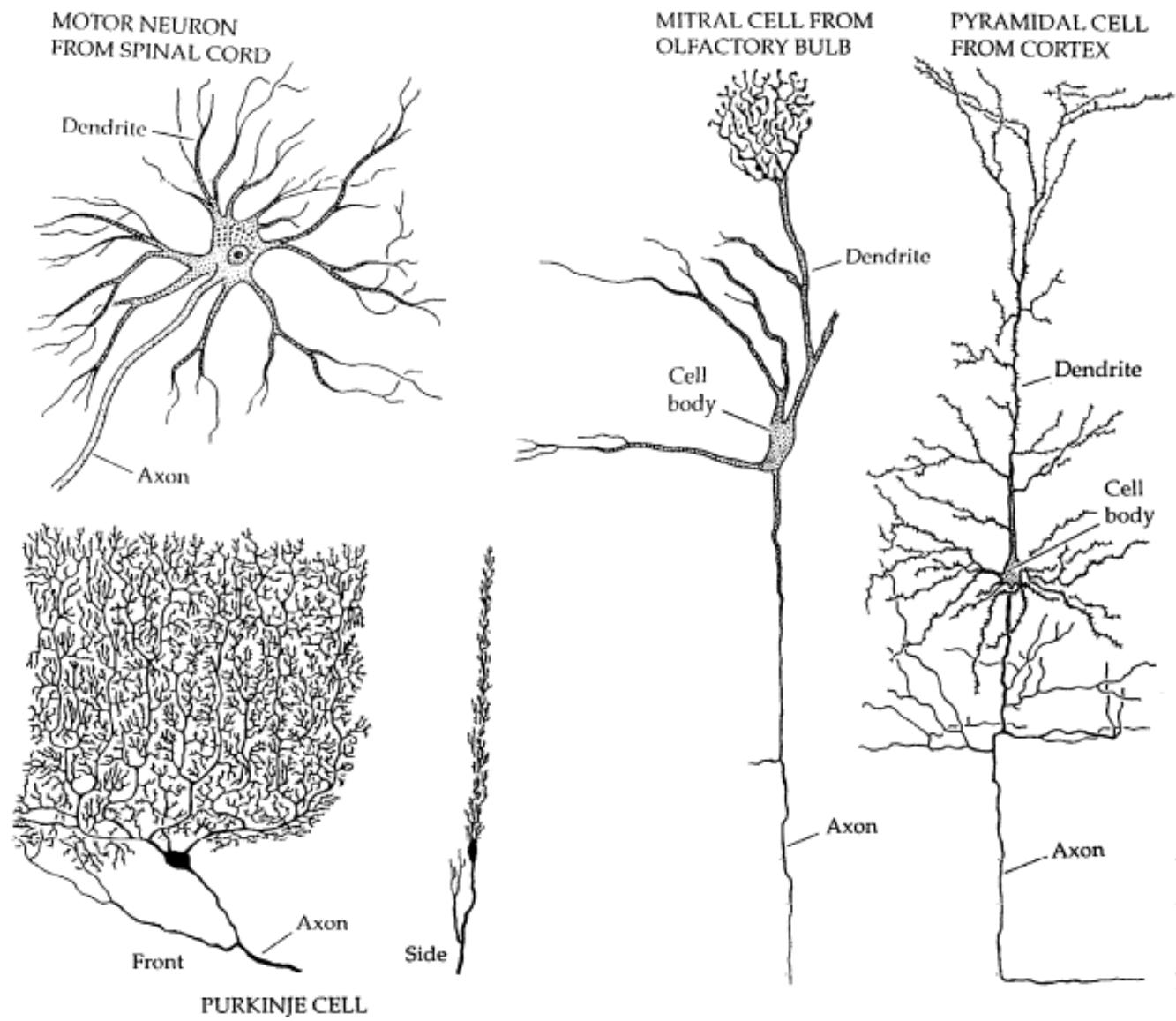
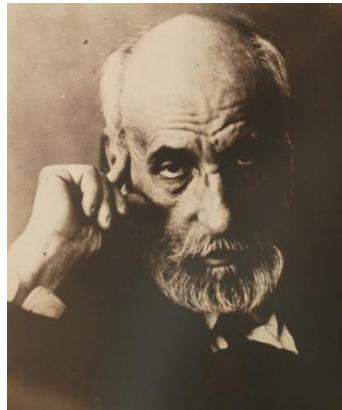
## La doctrina neuronal



Camilo Golgi  
(PN 1906)

Método de Golgi,  
con nitrato de plata

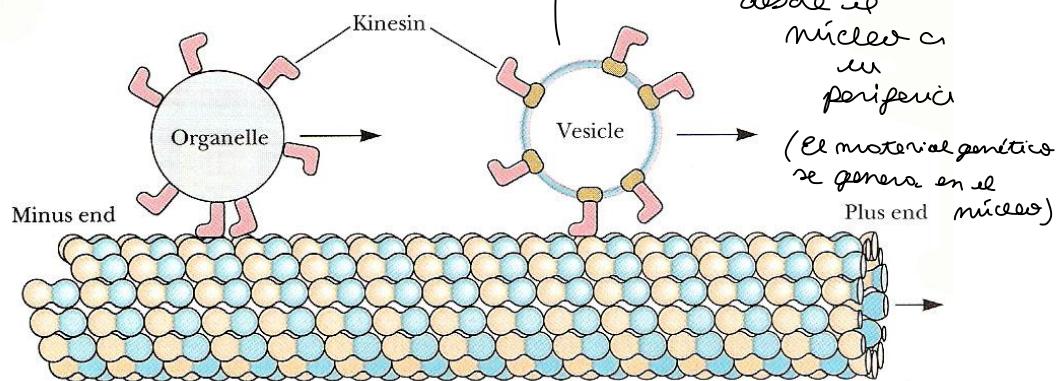
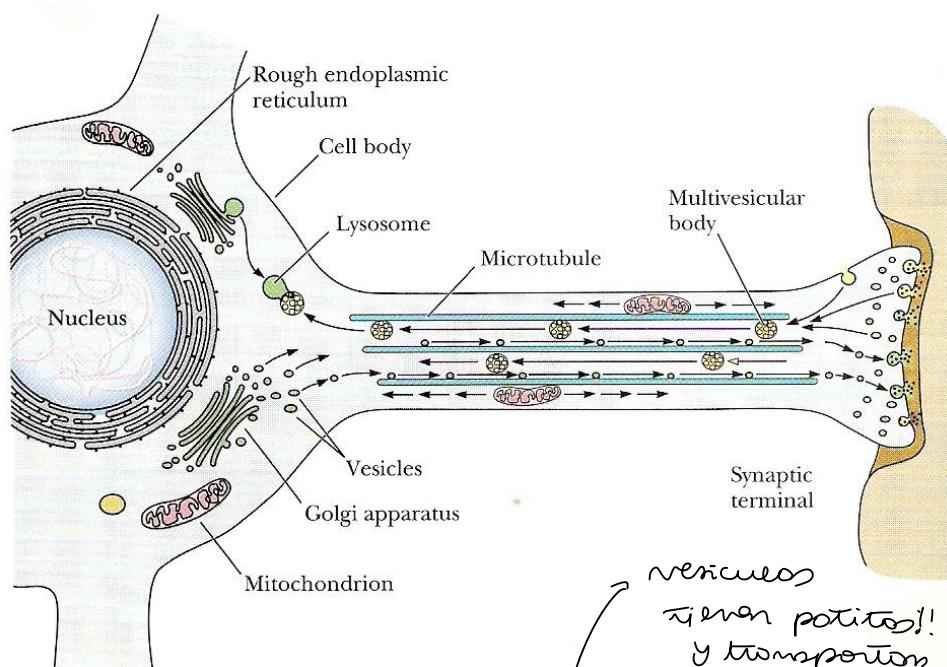
# El citoesqueleto: geometría de las neuronas



Santiago Ramón  
y Cajal (PN 1906)

# El citoesqueleto: funciones de transporte

La neurona tiene un esqueleto  
estructuras largas y rígidas que  
funcionan como un agente de  
transporte



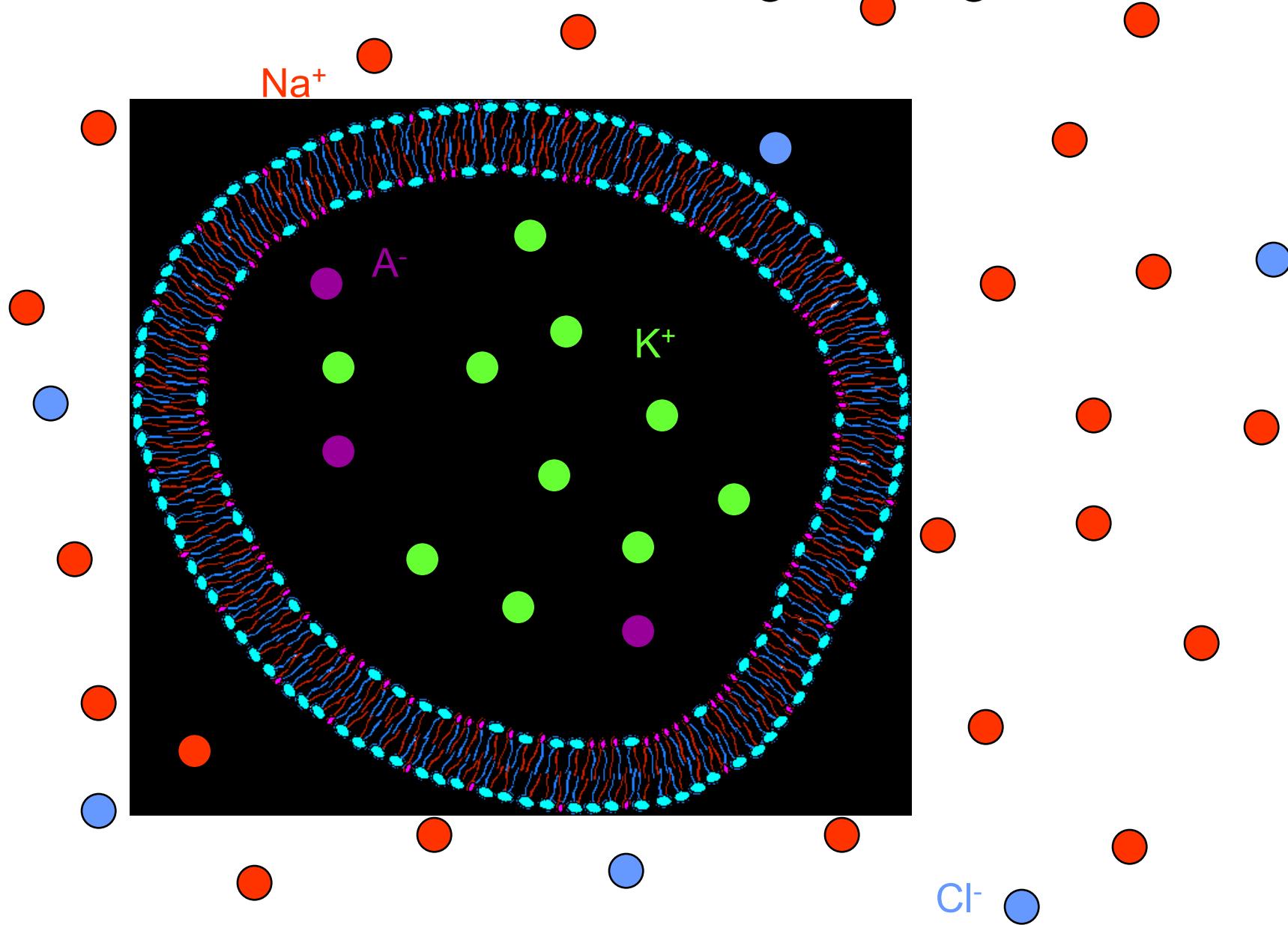
1) se puede medir la concentración de sustancias dentro y fuera de los célulos

=

dentro : exceso de  $K^+$

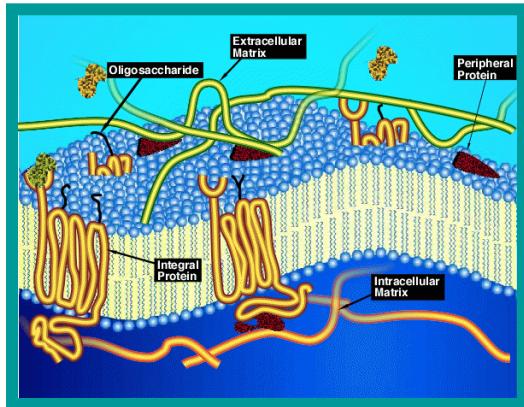
fuerza : exceso de iones  $Na^+$ ,  $Cl^-$  y  $Ca$

## El potencial de membrana

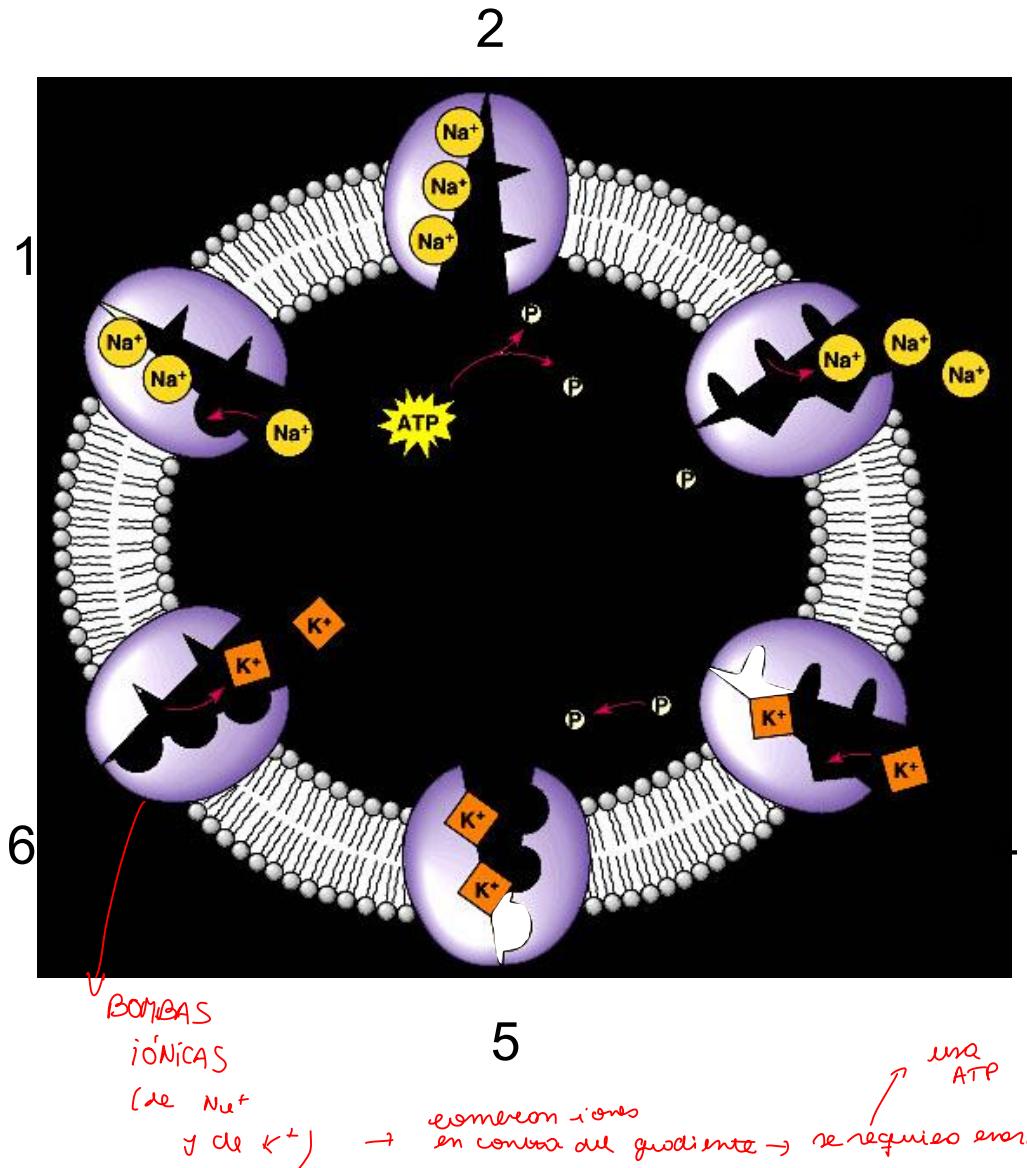
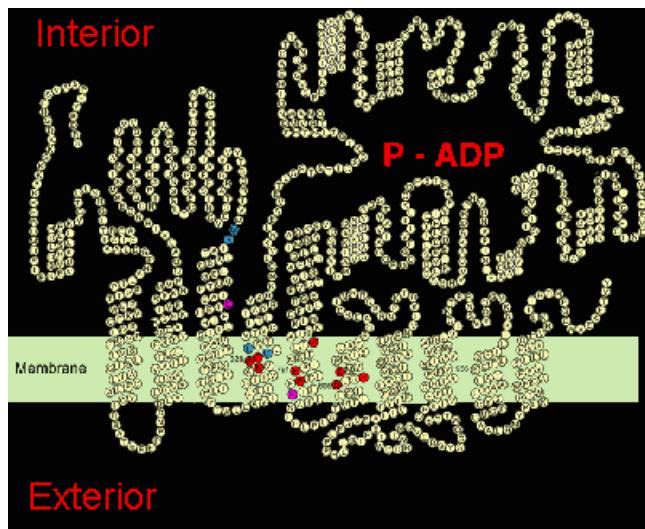


# Transporte iónico activo a través de la membrana:

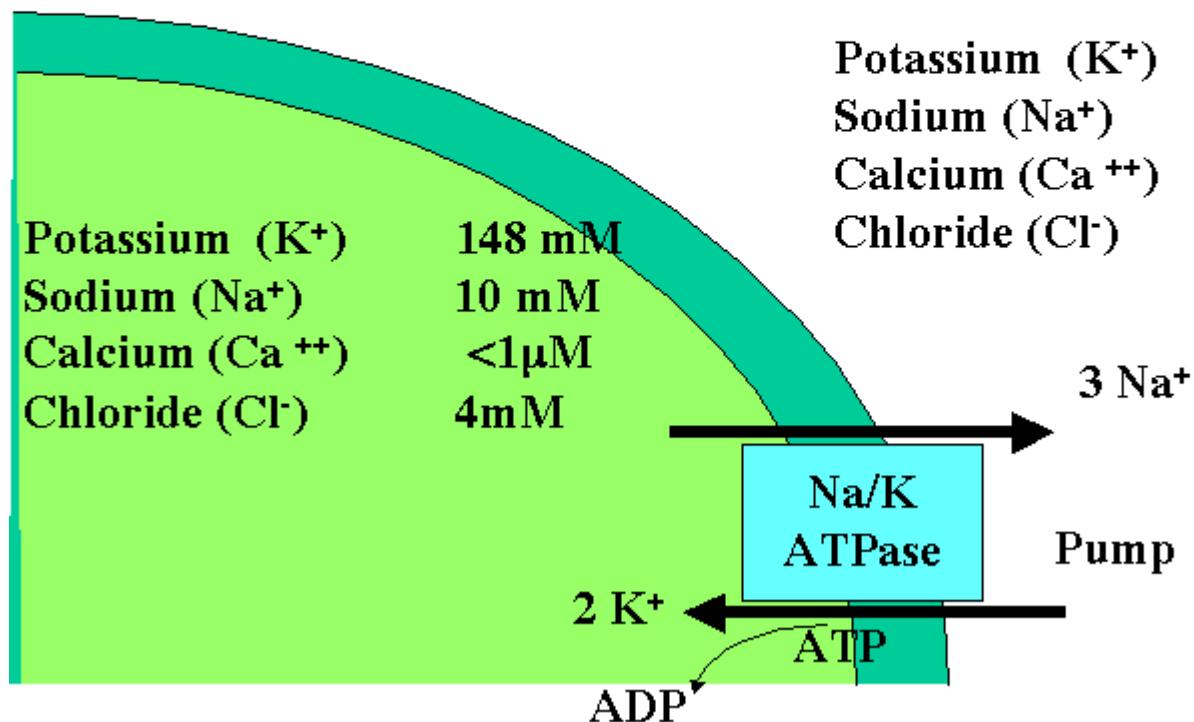
BOMBAS  IÓNICAS



## Na-K-ATP-asa



# Membrane potential

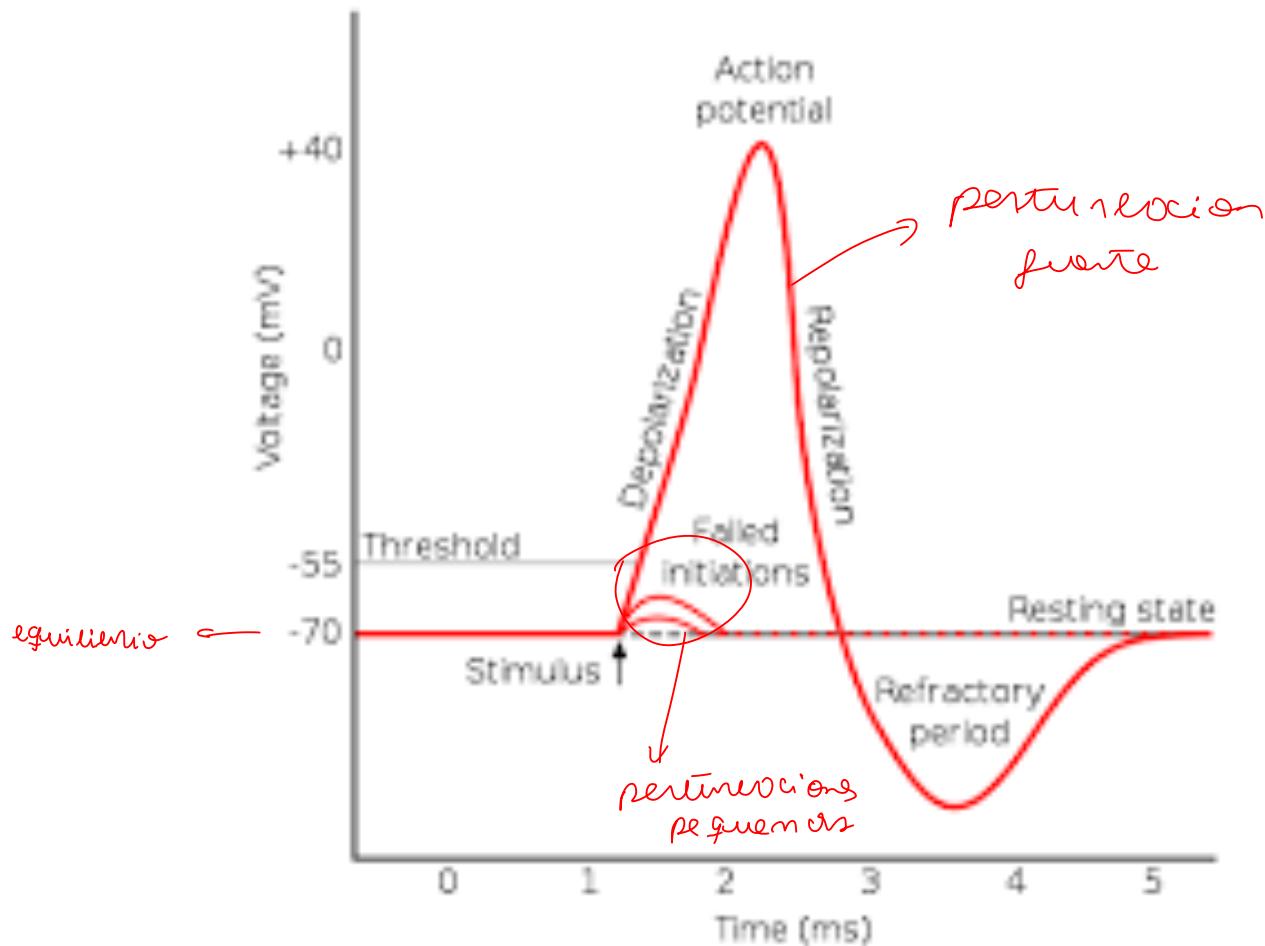


esto genera  
una dif de  
potencial  
eléctrico  
(más negativo  
adentro)

## Action potential

amplitud varia con los que los neuronas interconvierten info

encogido de un comunicacion



## Propagation of action potential in an axon

