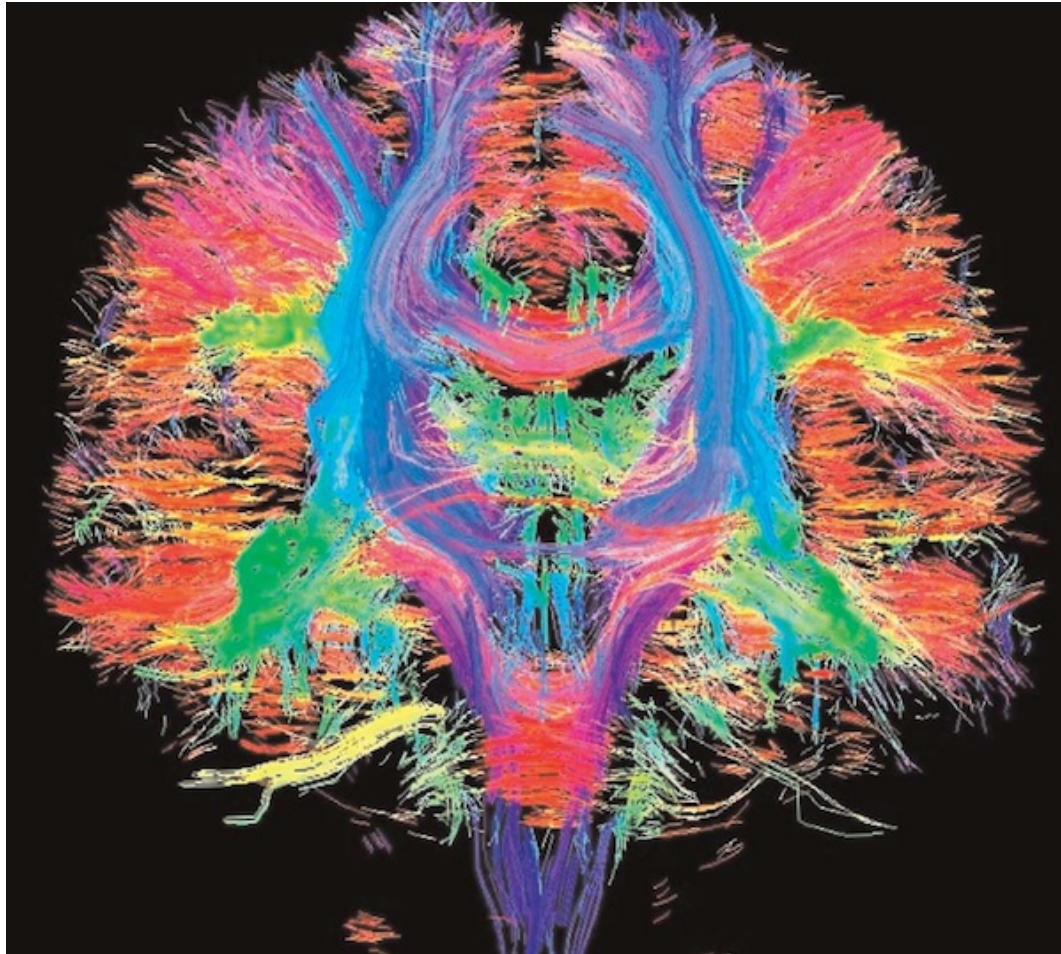


LEC 1B

# ANATOMY OF THE NERVOUS SYSTEM



Cogs 17 \* UCSD

## Cerebral Cortex

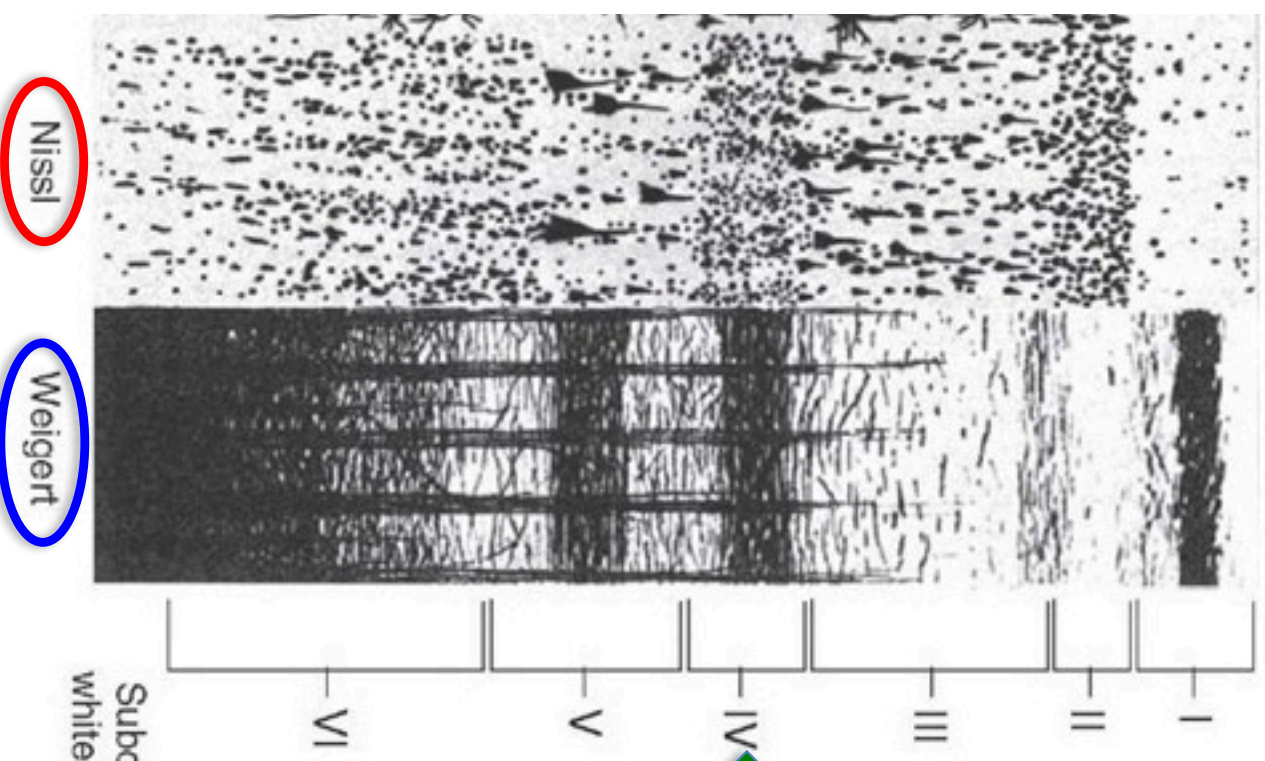
A 6-layer sheet of cells, unfolded = < 1 m square X 3 mm thick



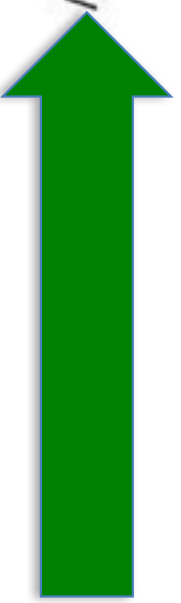
# Cortex – 6 layers of cells

**Nissl Stain**  
for  
**Cell Bodies**

**Weigert Stain**  
for  
**Fibers**



Info projected to cortex  
enters at  
Level 4



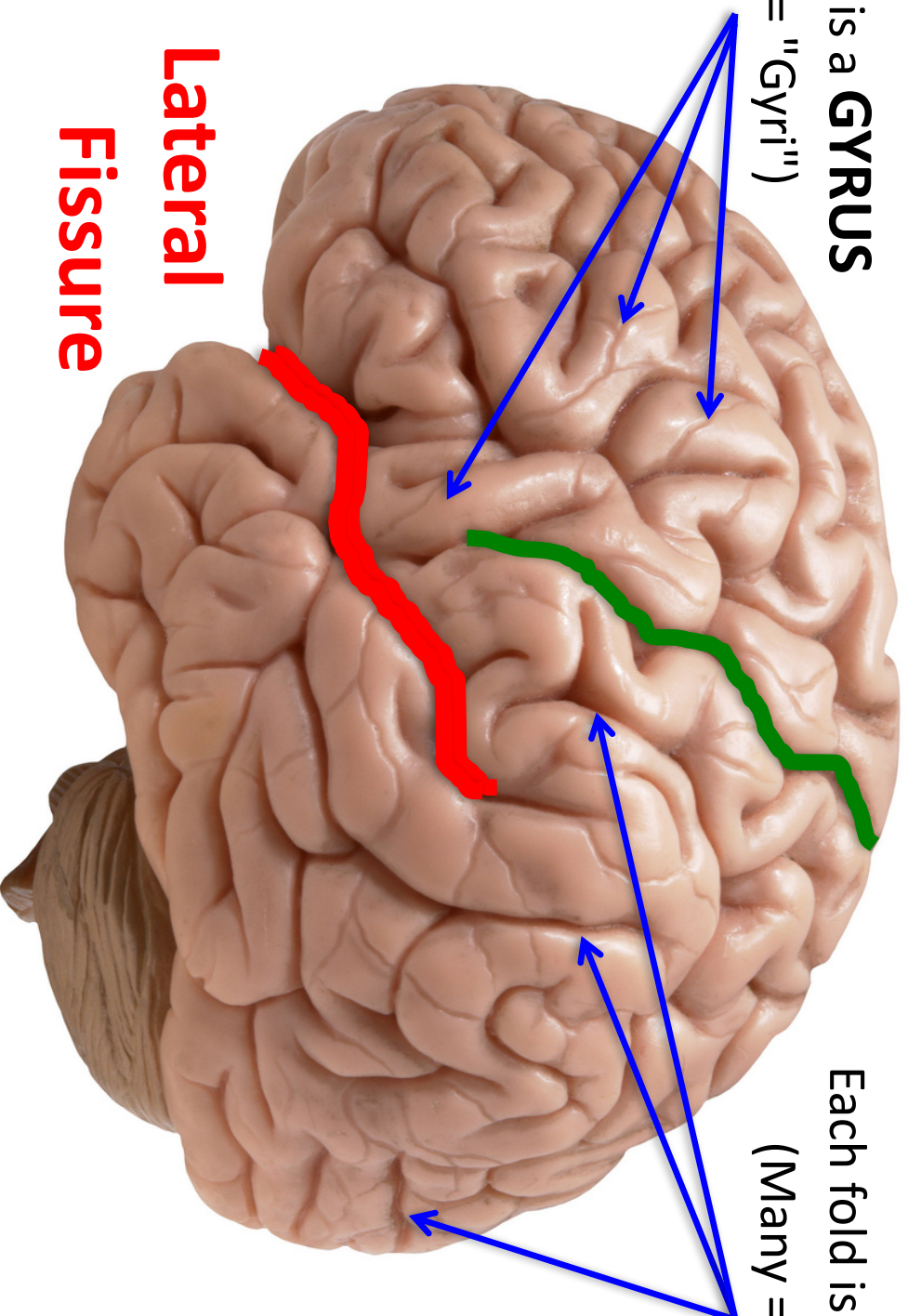


# Convoluted (folded) Cortex

## Central Sulcus

Each bulge is a **GYRUS**  
(Many = "Gyri")

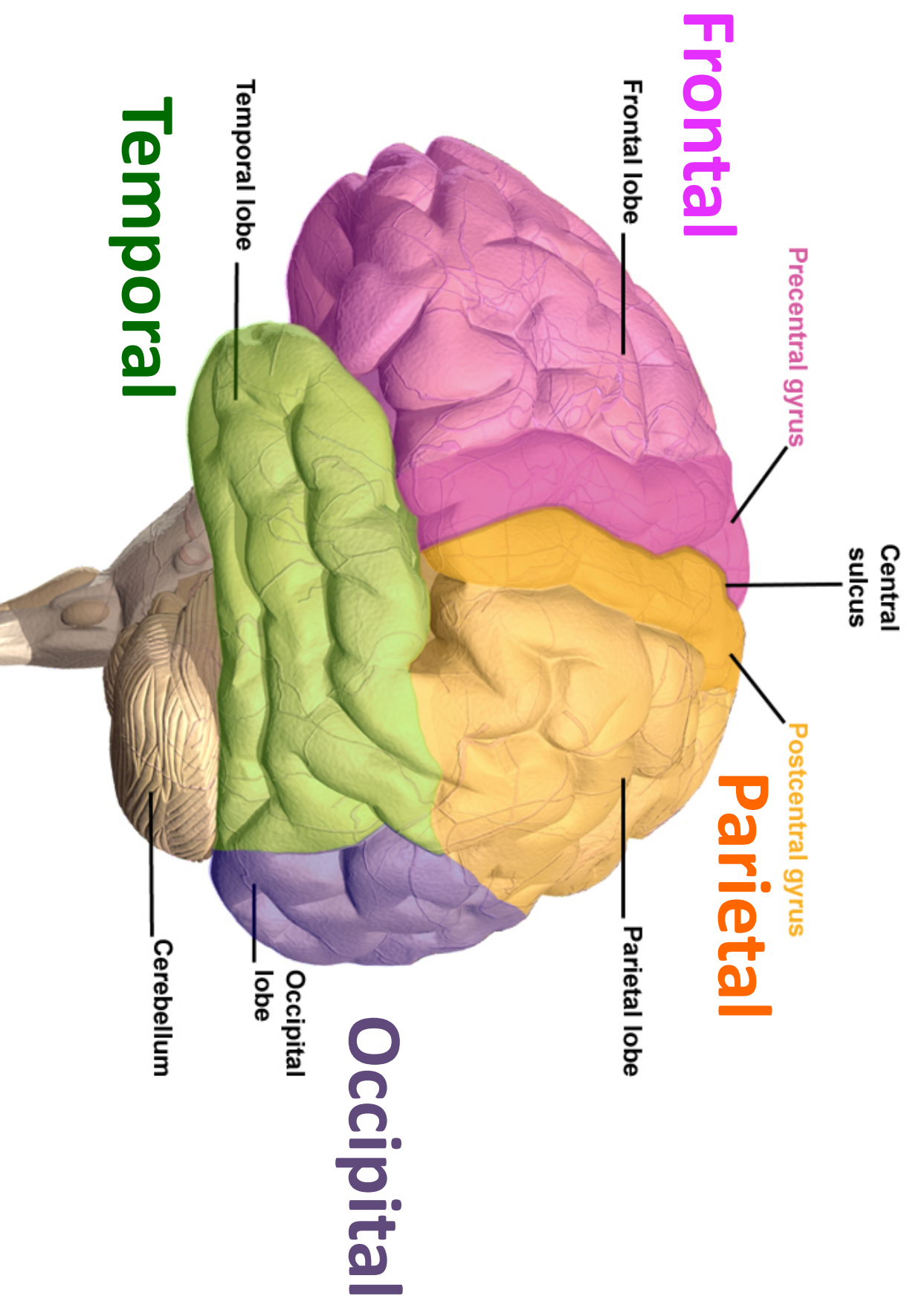
Each fold is a **SULCUS**  
(Many = "Sulci")



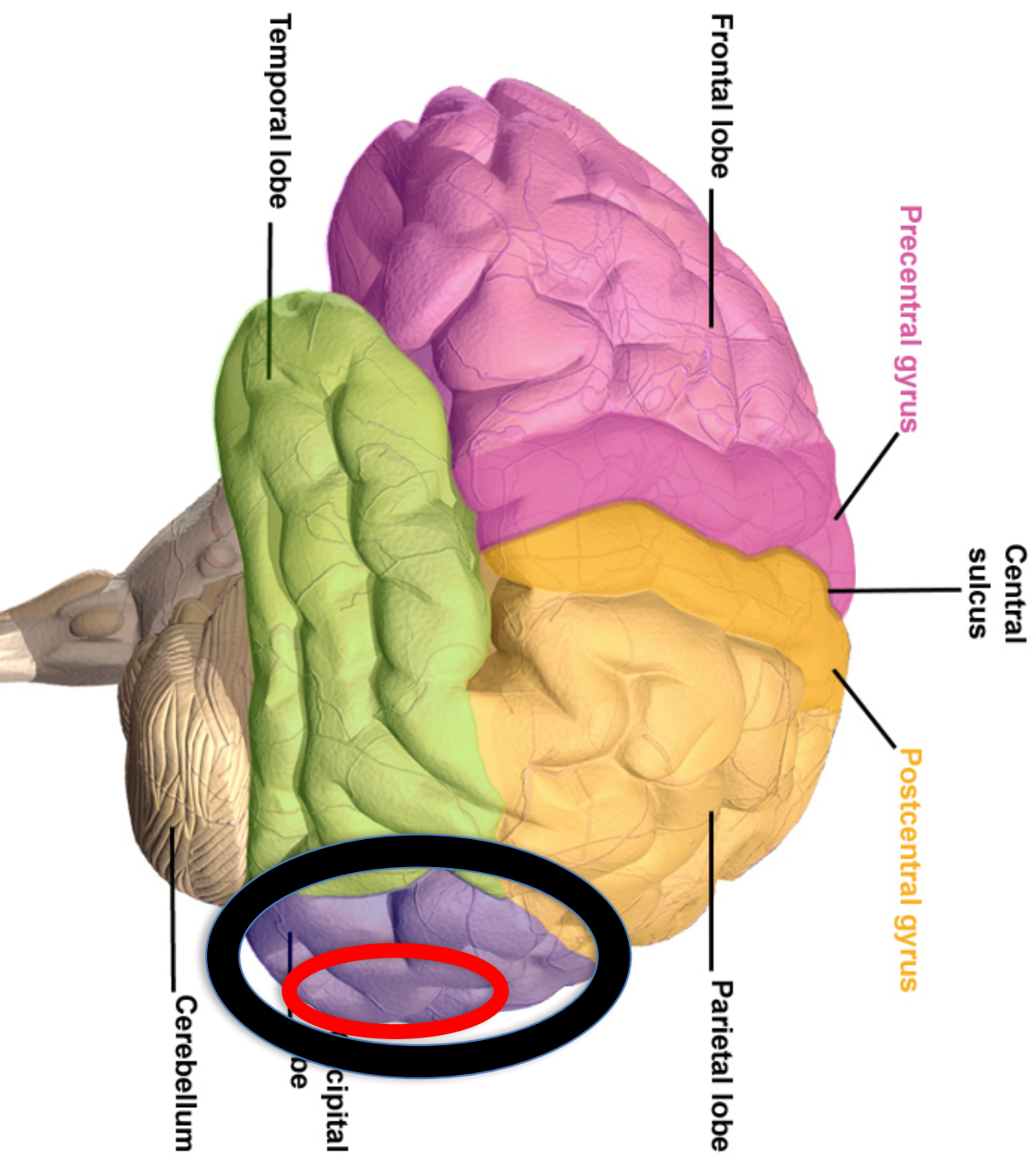
**Lateral Fissure**



# 4 Lobes of the Cerebral Cortex



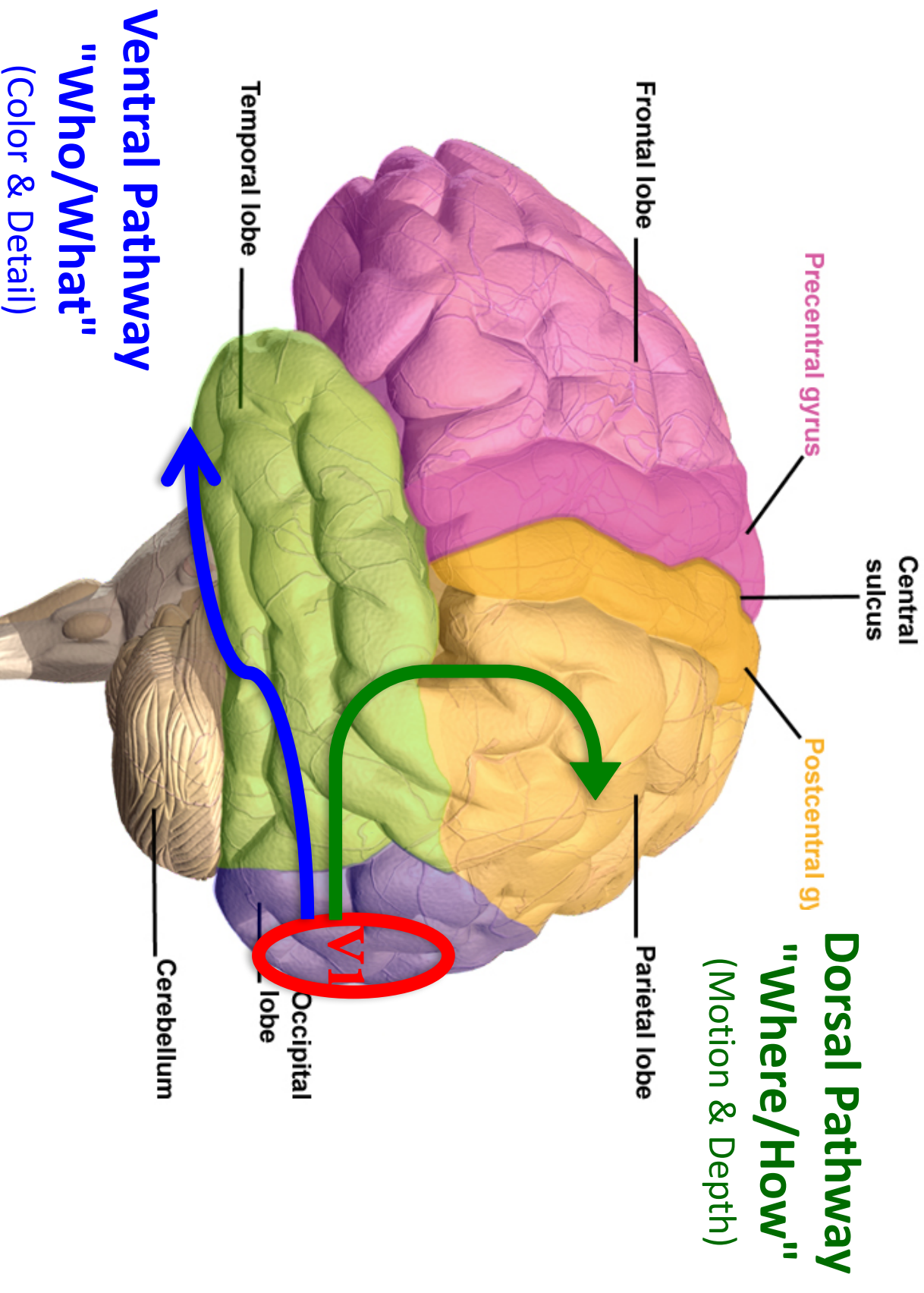
# Occipital Lobe - Vision



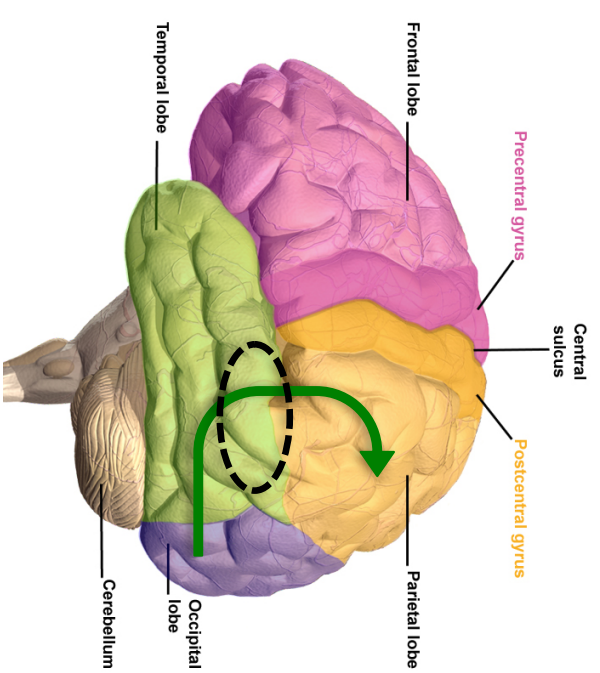
# V1

**Primary  
Projection  
Area,  
from  
Thalamus**

# Major Visual Pathways



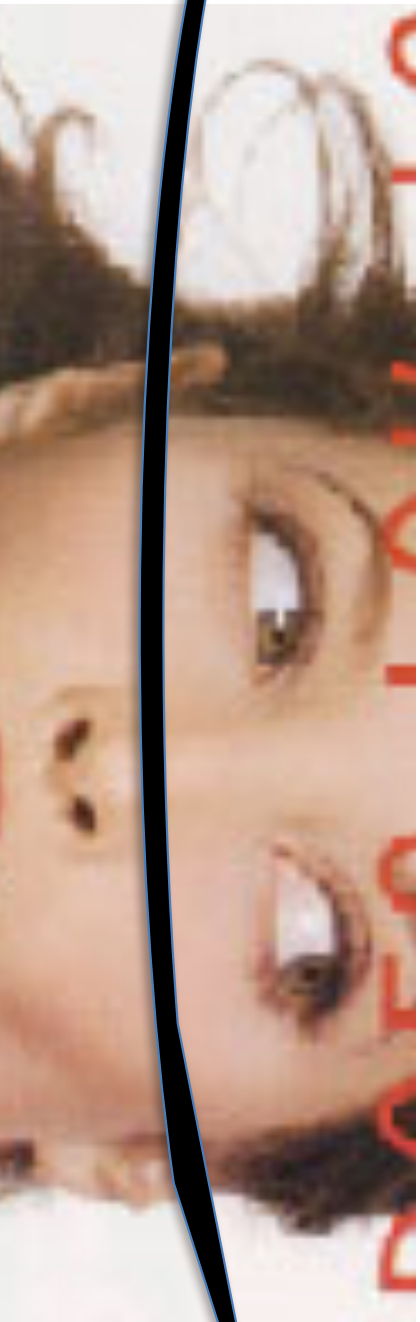




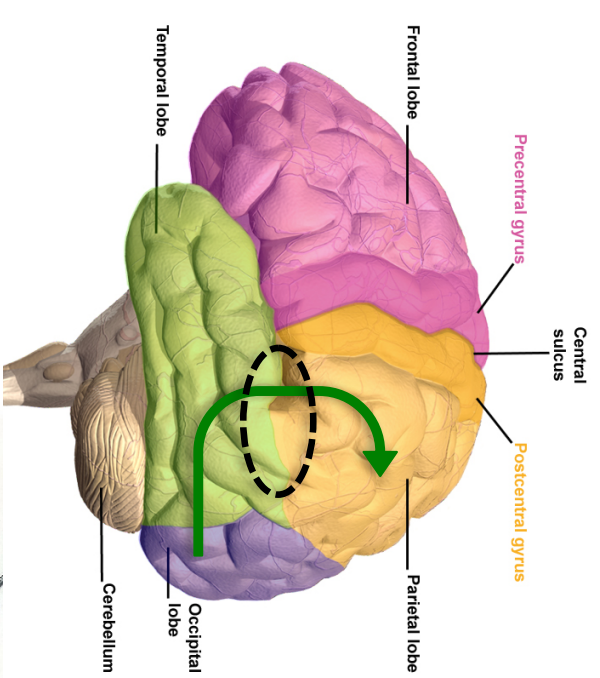
(----- = Medial, NOT on outer surface)

# MT (Medial Temporal)

Along "Where/How"  
Visual pathway to Parietal

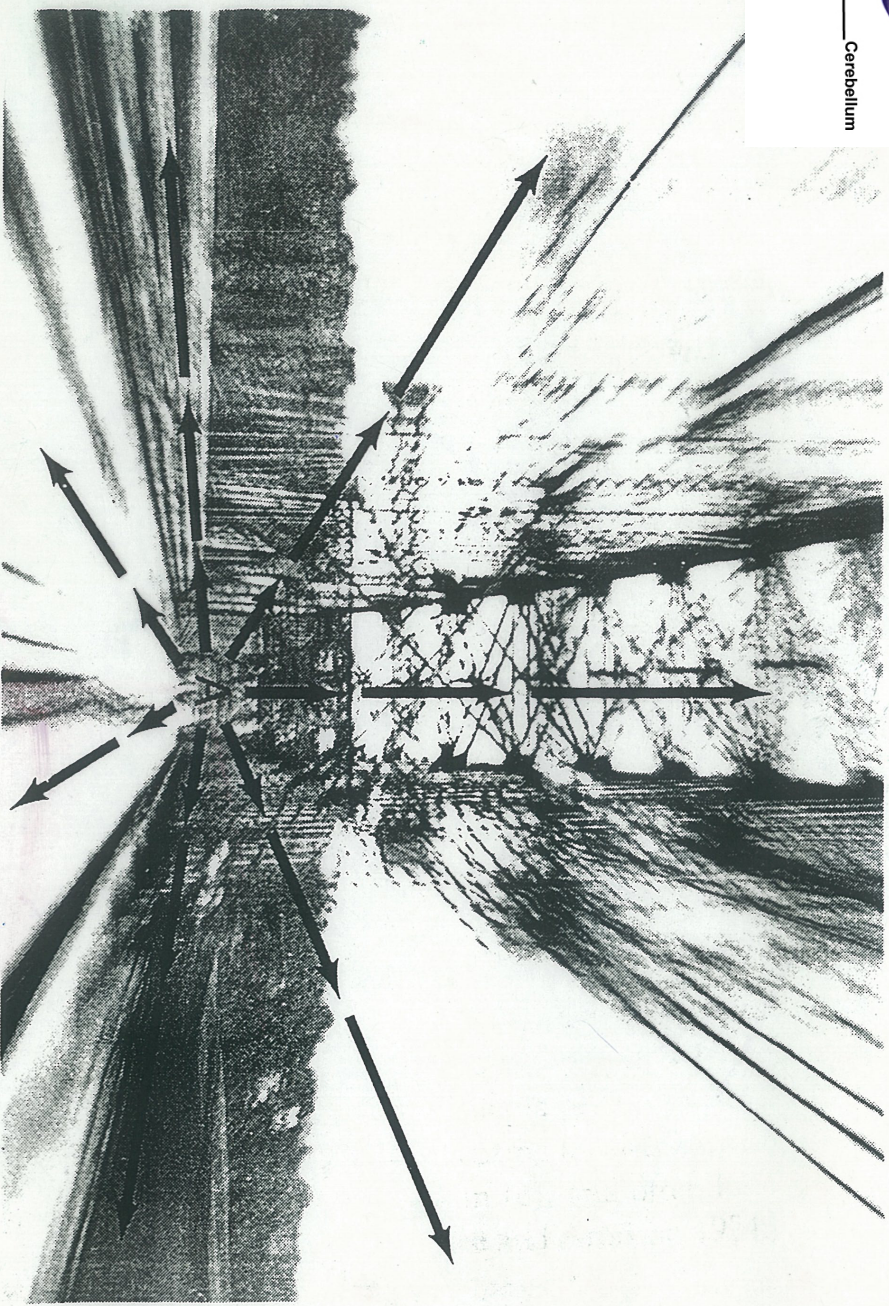


Includes Direction-Sensitive  
Motion Detectors



# MST (Medial Superior Temporal)

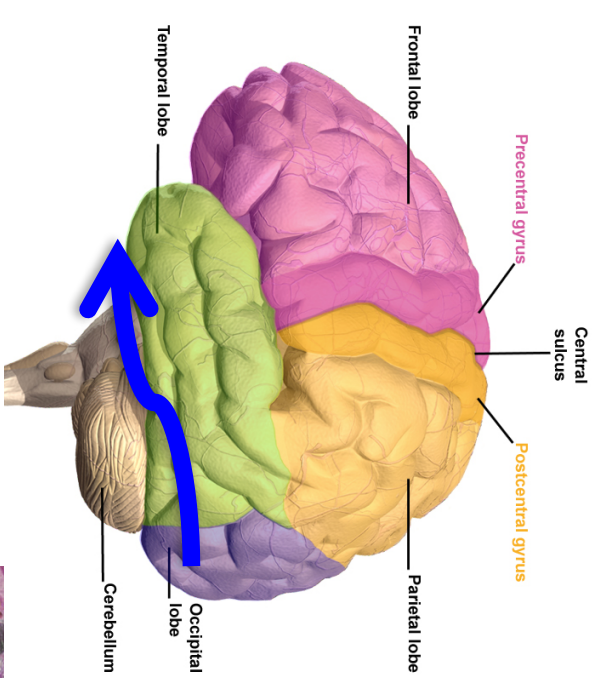
Includes "Optic Flow" Detectors



**FIGURE 8.49** The flow of the environment as seen from a car speeding across a bridge toward point A. The flow, shown by the arrows, is more rapid closer to the car (as indicated by the increased blur) but occurs everywhere except A, the focus of expansion, toward which the car is moving. (Also see Figure 8.48a)



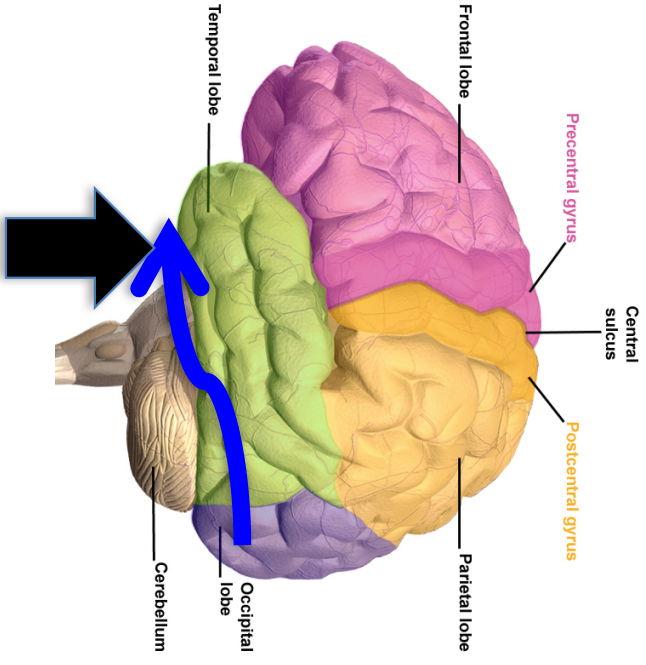
# Ventral Visual Pathway



**Color  
and  
Detail**







# Ventral Visual Pathway

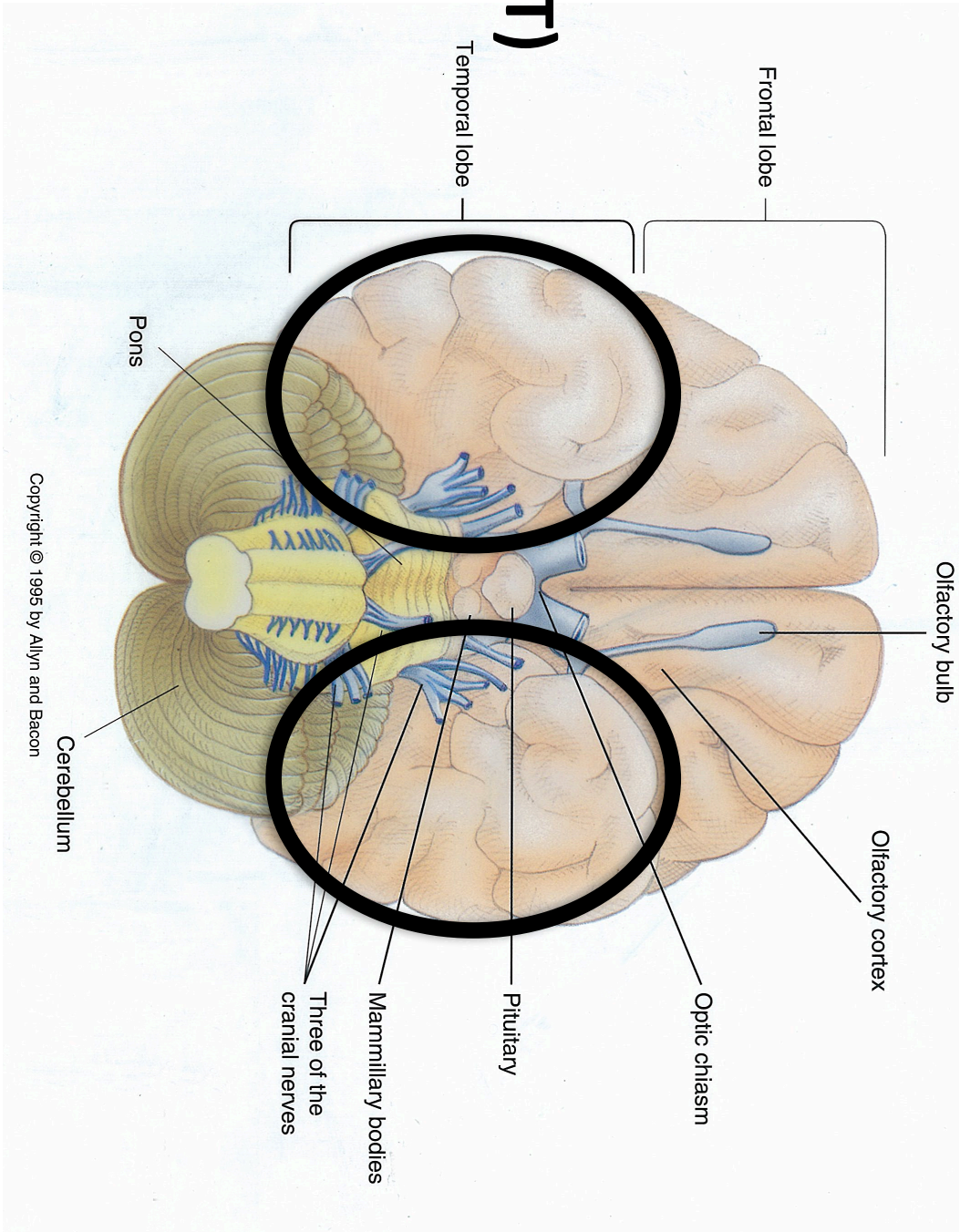
Terminates at

# Inferior Temporal (IT)

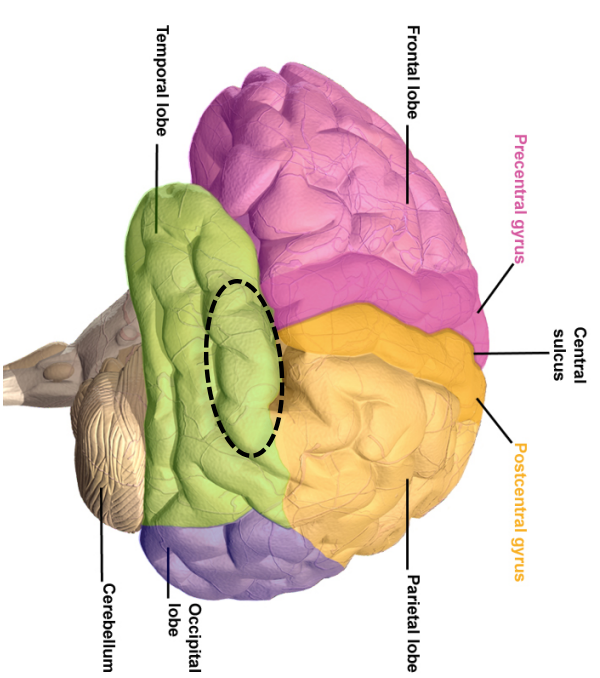
Higher Visual Cortex

includes

# Face Cells



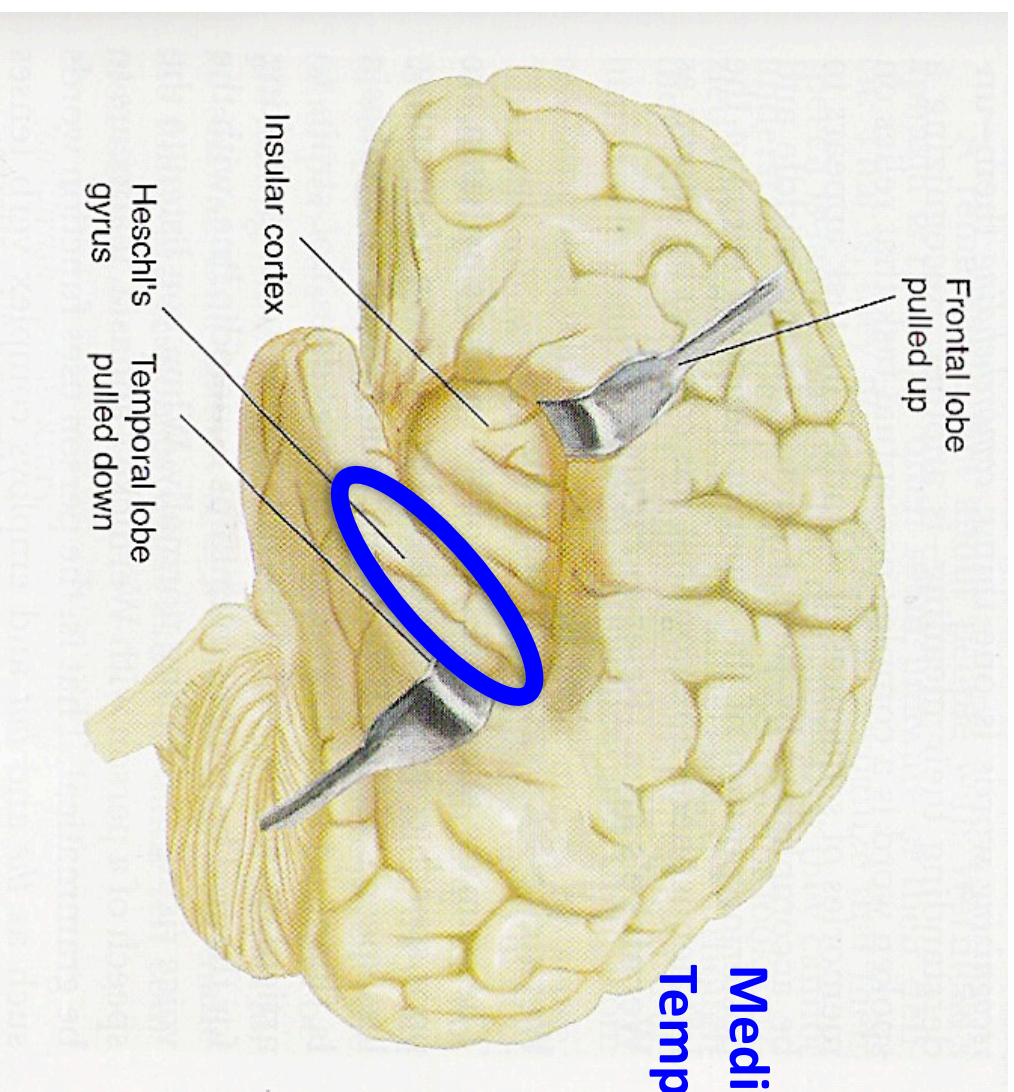
Copyright © 1995 by Allyn and Bacon



# AI

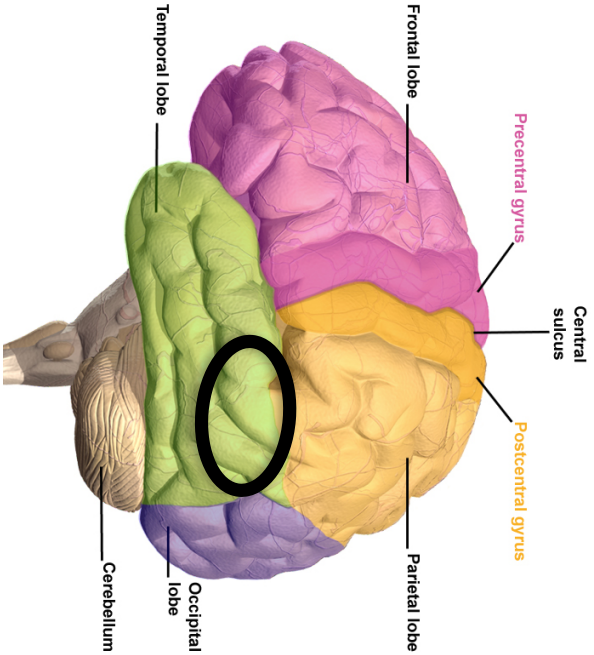
Primary  
Projection Area  
for Audition,  
from  
Thalamus

## Temporal Lobe - Audition



## Medial face of Temporal Lobe

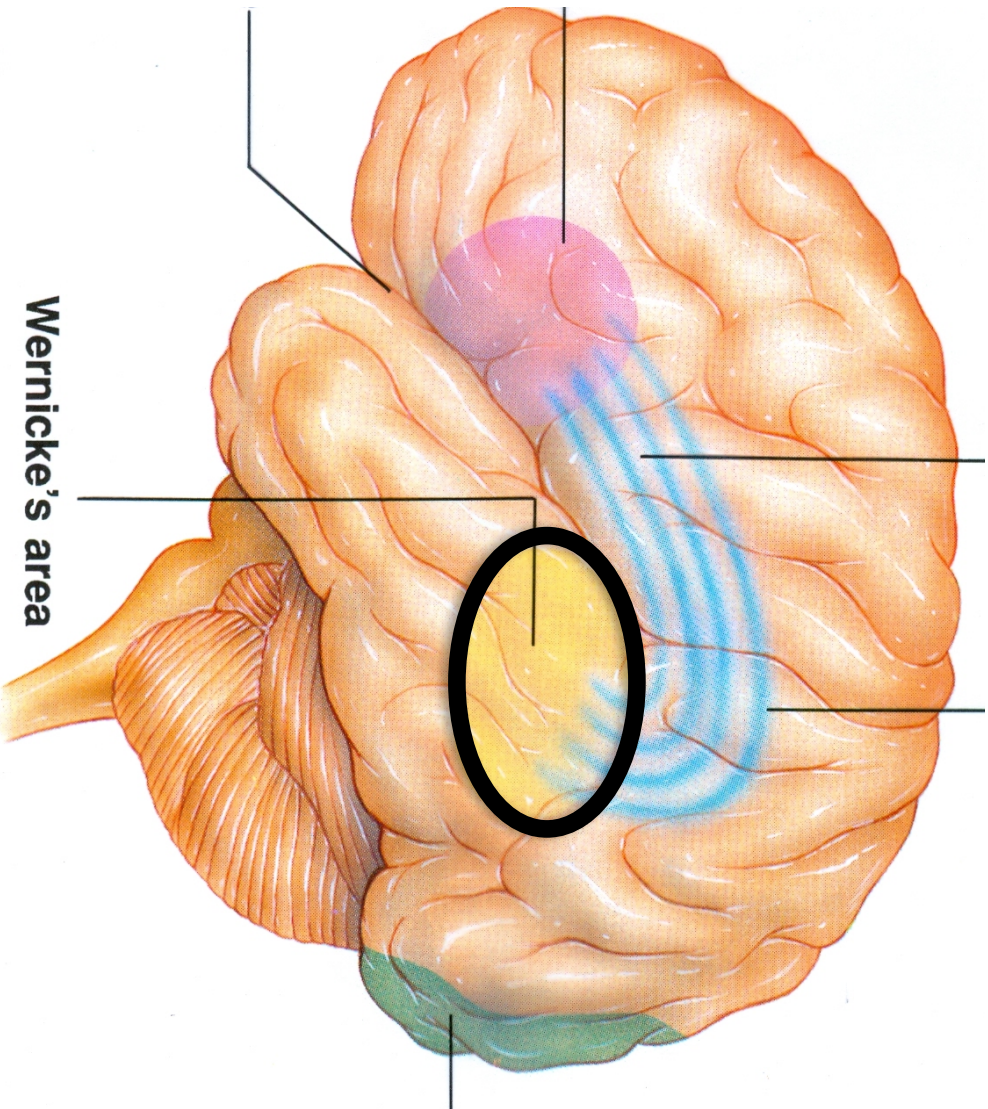




# Wernicke's Area for Speech Recognition

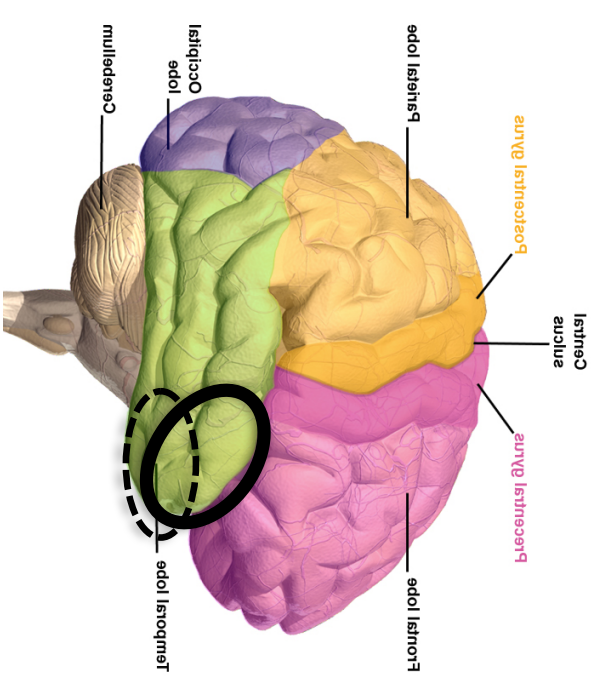
# Higher Auditory Cortex

*Major language areas of cerebral cortex*



Wernicke's area

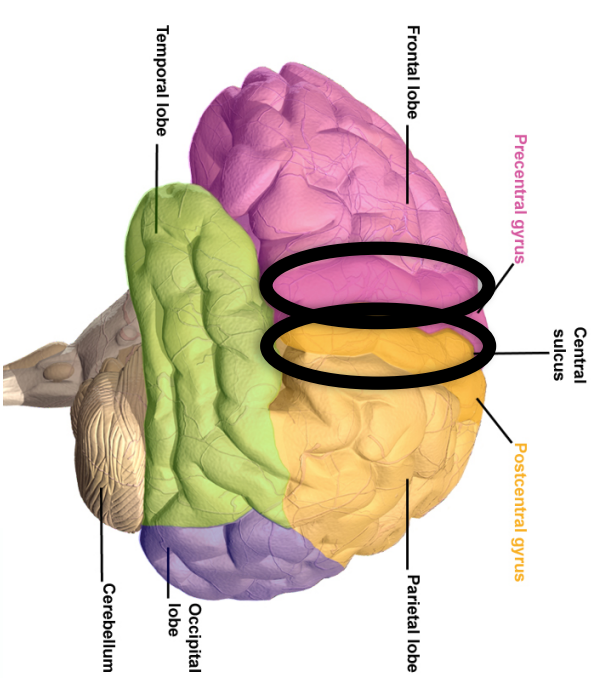




# Emotional Expression & Interpretation

Right Hemisphere dominant

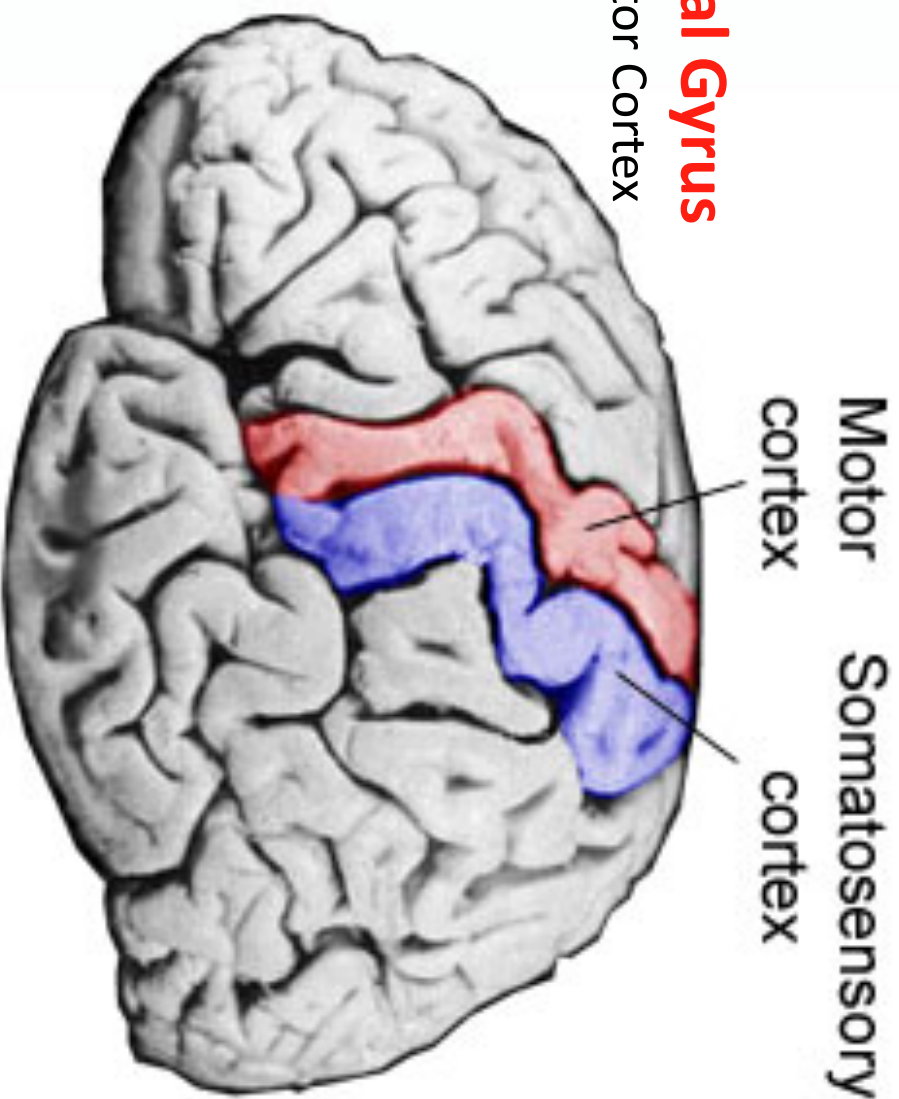


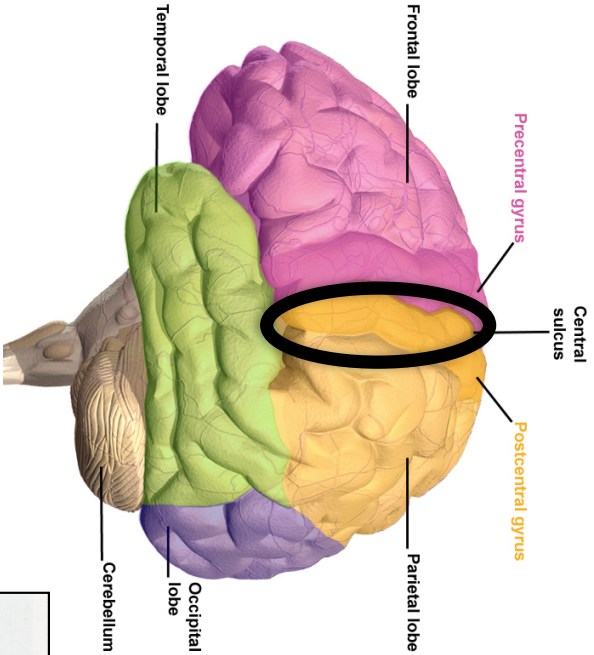


Parietal (Somatosensory) &  
Frontal (Motor) Cortex

**Post-Central Gyrus (S1)**  
Primary Projection area  
for Somatosensory info

**Pre-Central Gyrus**  
Primary Motor Cortex

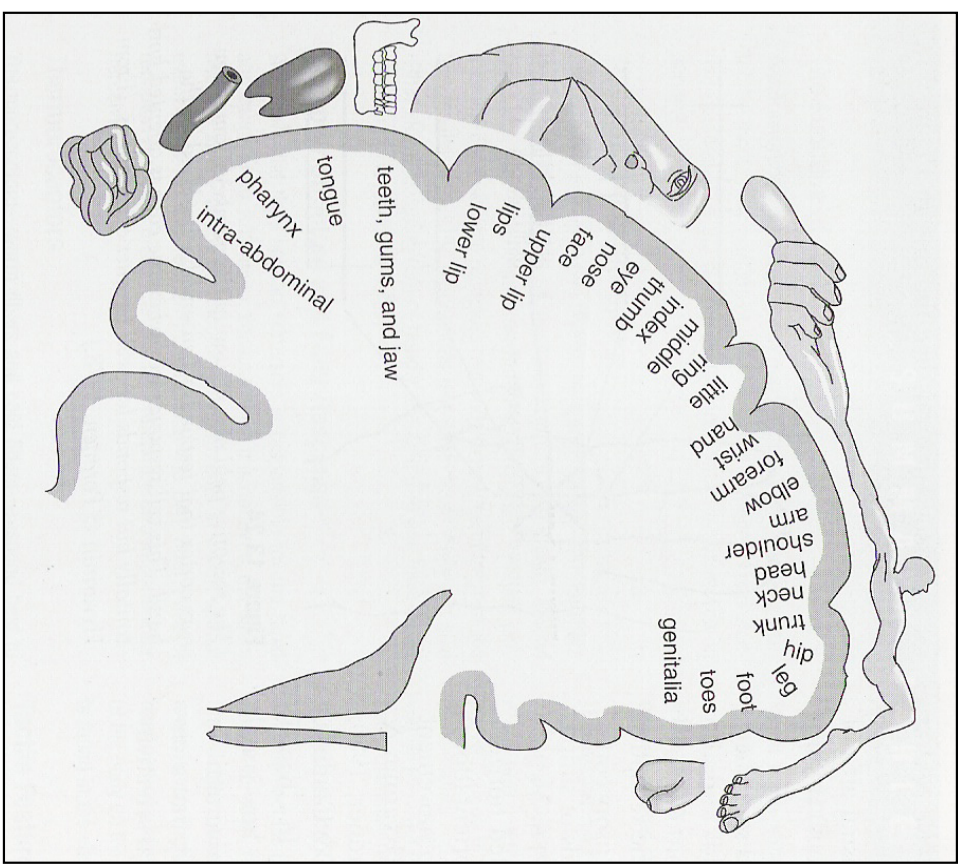




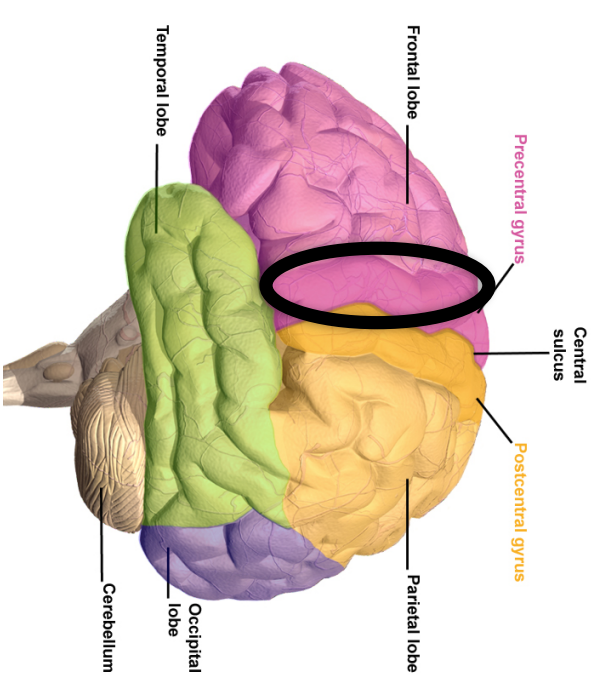
# Parietal (Somatosensory) & Frontal (Motor) Cortex

## Post-Central Gyrus (S1)

Primary Projection area for Somatosensory info



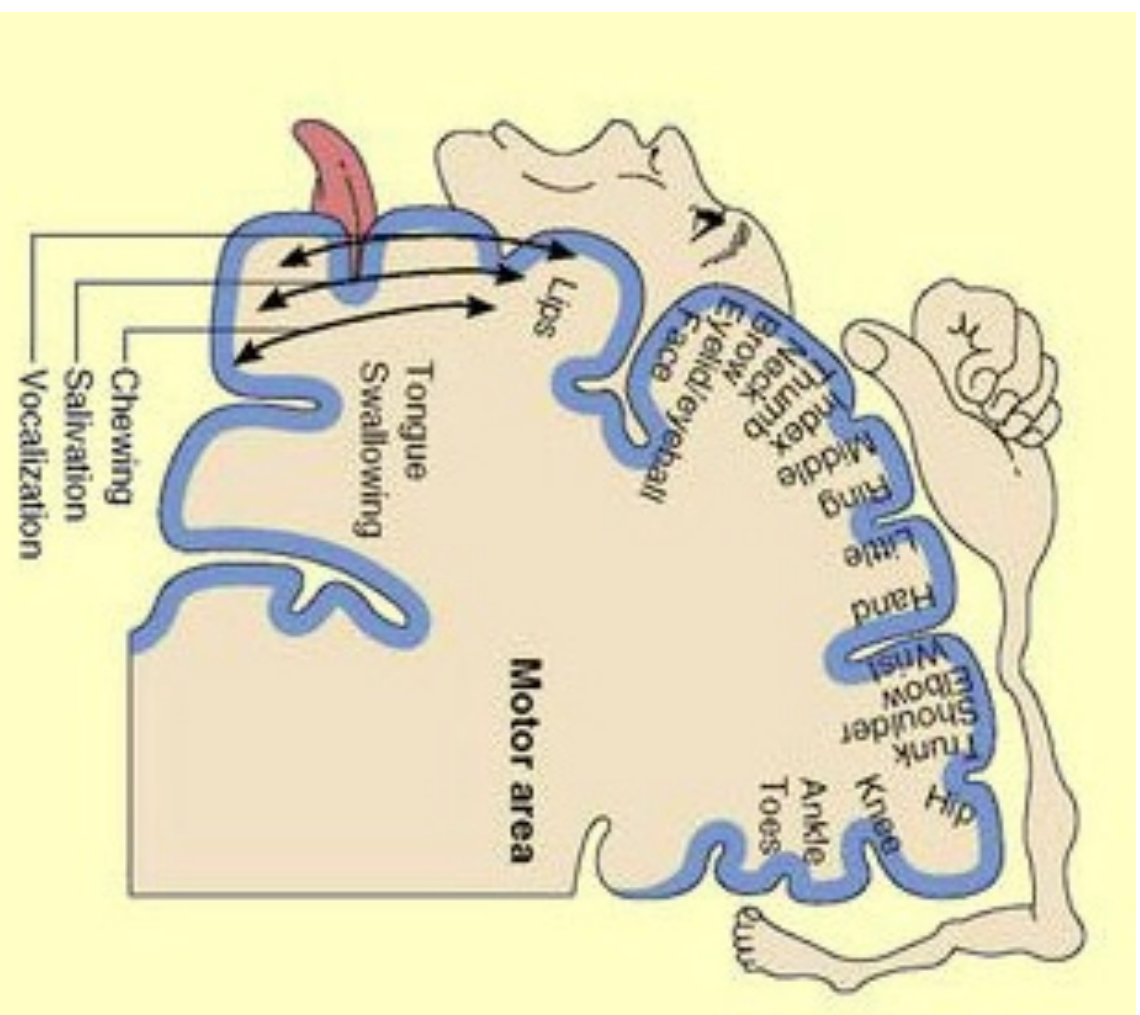


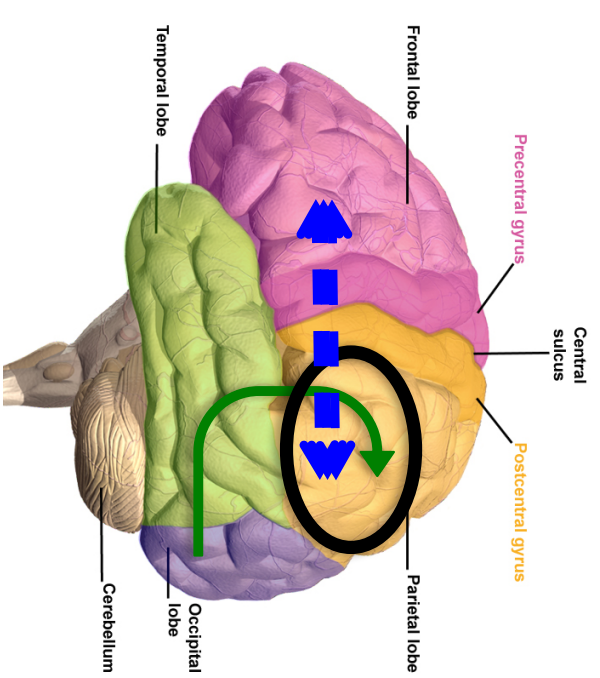


# Pre-Central Gyrus

## Primary Motor Cortex

# Parietal (Somatosensory) & Frontal (Motor) Cortex





**Activity reverberates  
w/Premotor Cortex,  
to shape  
how hand approaches**



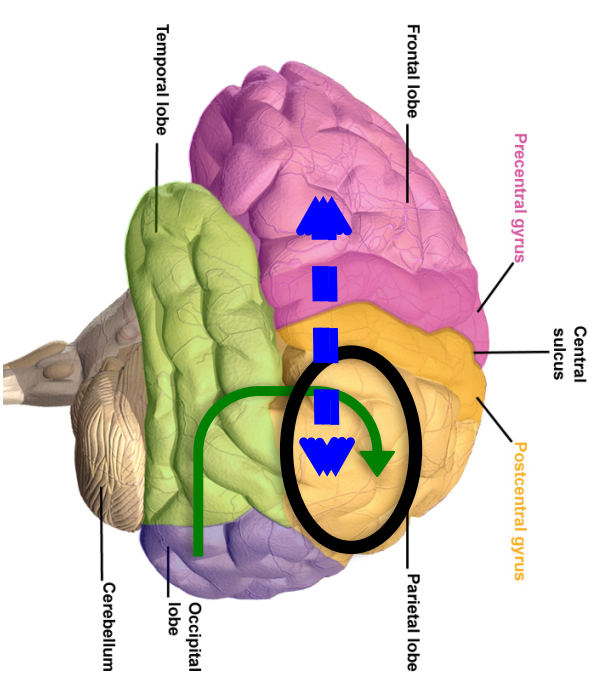
## Parietal Lobe

Dorsal Visual Pathway "Where/How"  
- integrated w/ Tactile & Proprioception



**Canonical Cells**  
Respond to "affordances"  
of objects





## Activity reverberates with Mirror Cells in Premotor Cortex

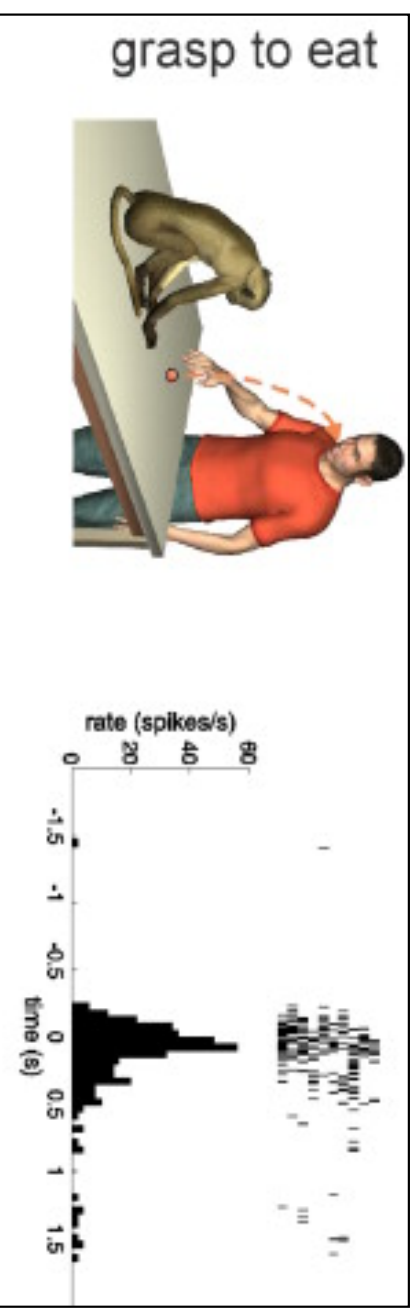
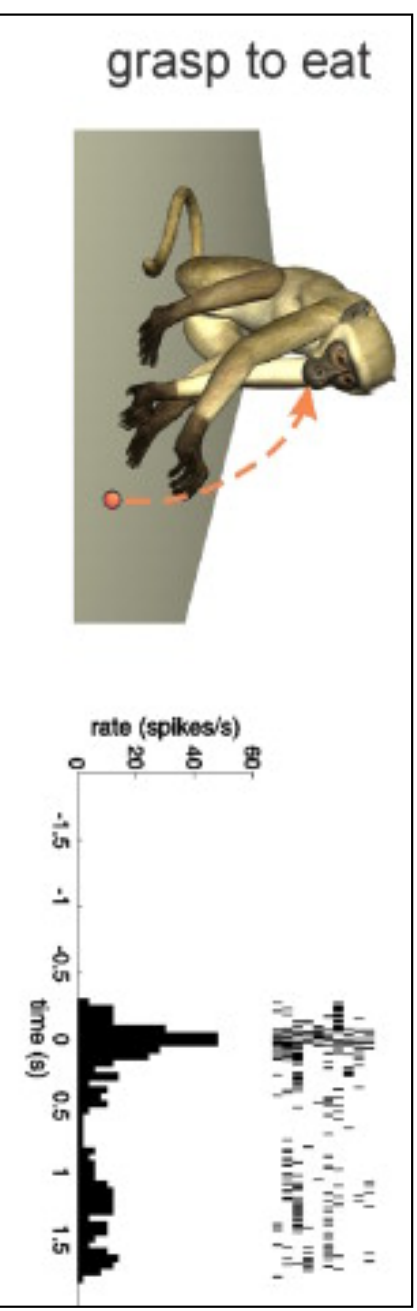
Promotes Imitation



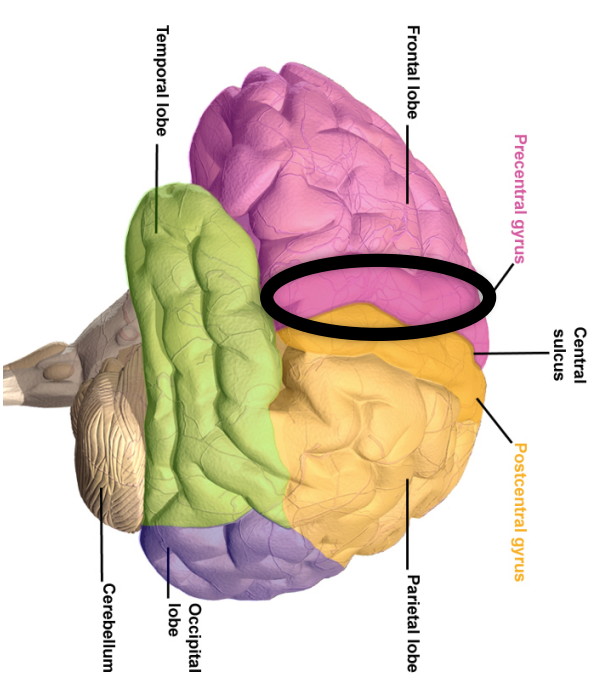
## Parietal Lobe

### Mirror Cell System

Respond to seeing self, or other, perform and action.



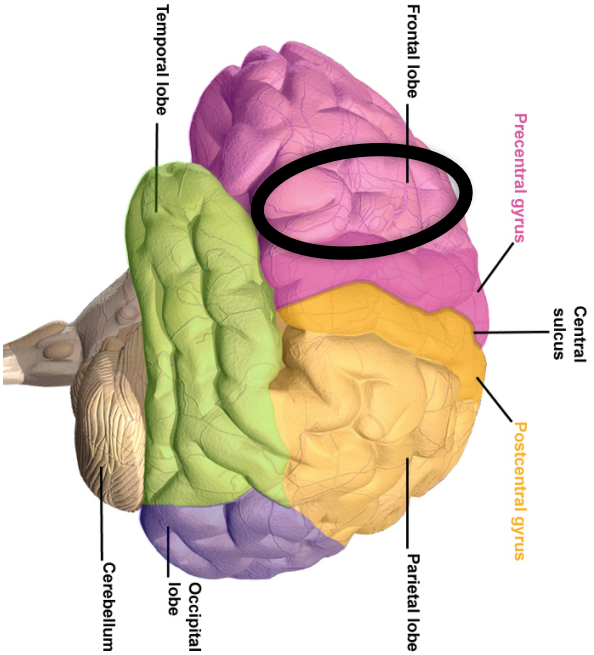




# Frontal Lobe



**Primary Motor Cortex**  
Voluntary action

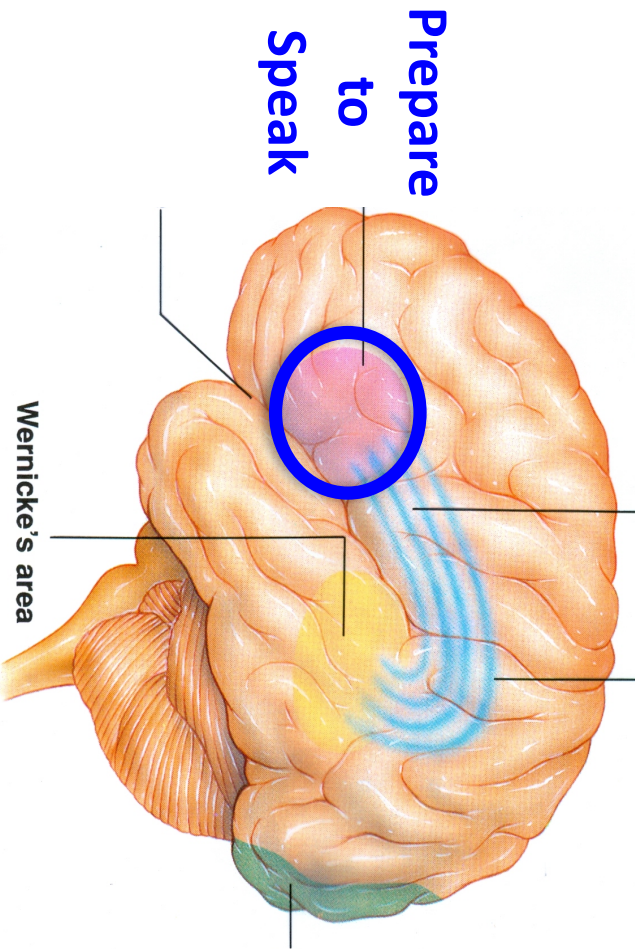


# Frontal Lobe

**Pre-Motor Cortex**  
 Prepare to act;  
 Planning

# Broca's Area

*Major language areas of cerebral cortex*

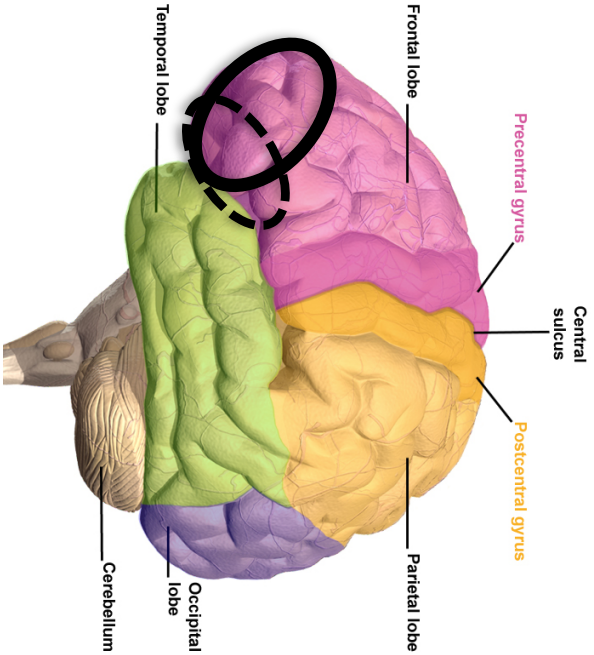


# Mirror Cells



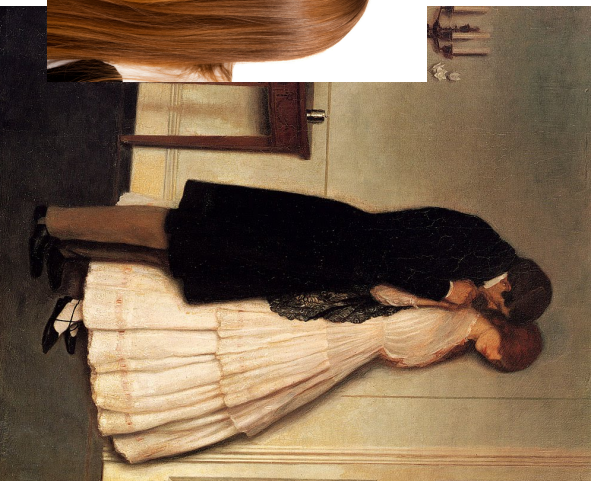
**Simulation  
 of observed action**



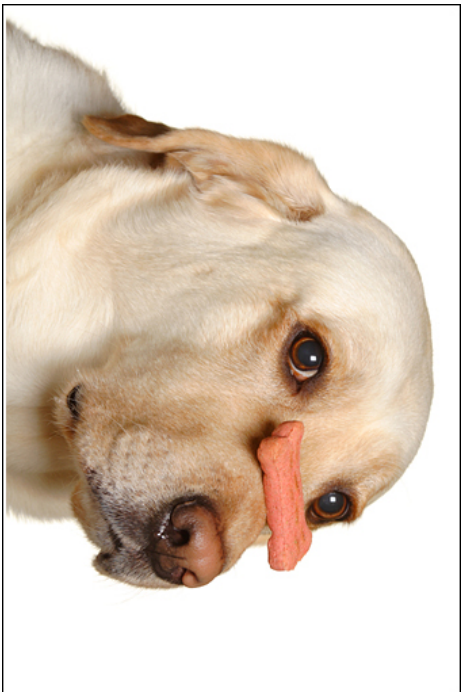


# Orbito-Frontal Cortex

Evaluation behavior of self and other, ToM, Social strategy



# Prefrontal Cortex

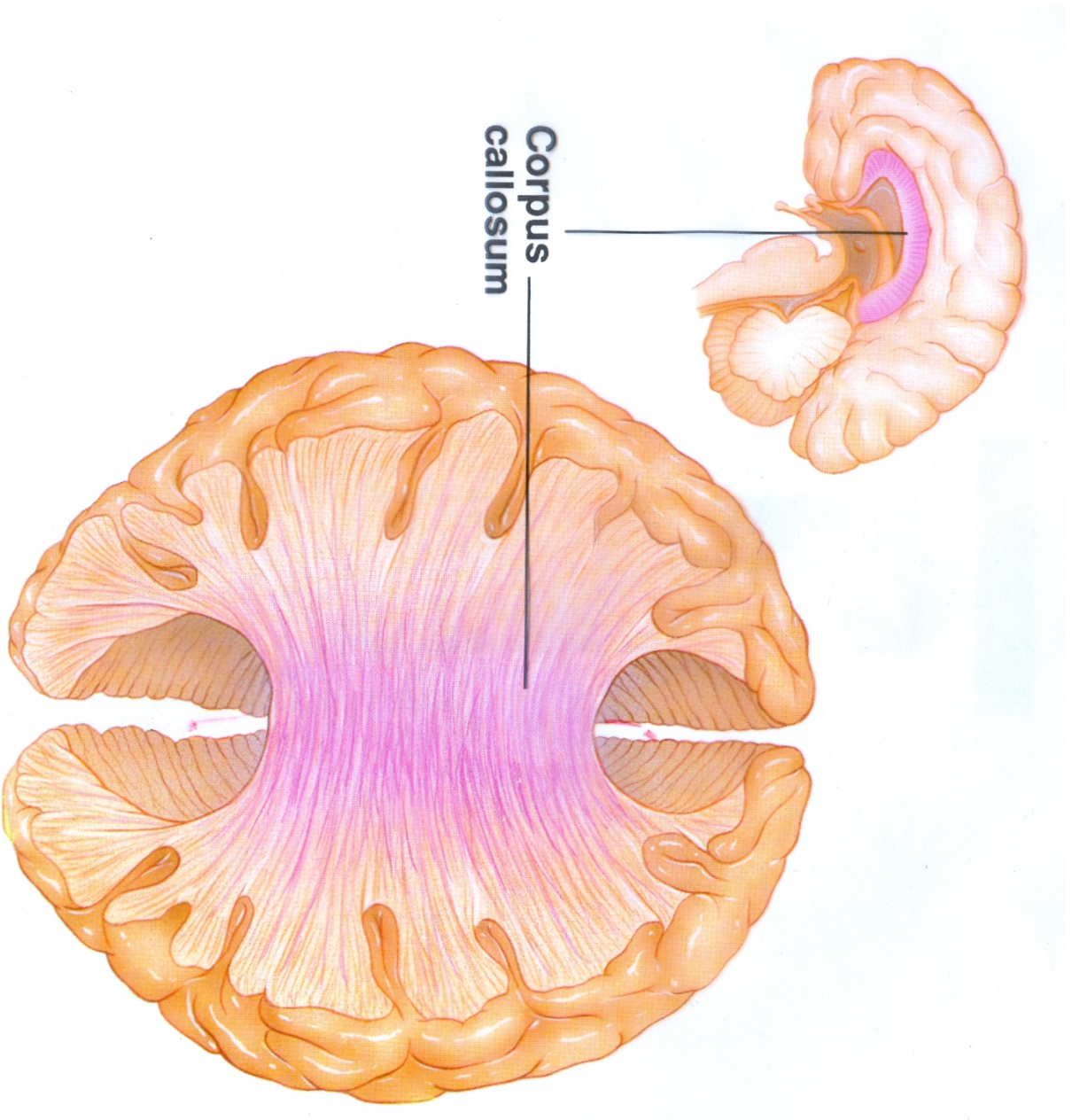


Exercising **Self Control**, delayed gratification, planning, cultural rules, etc.



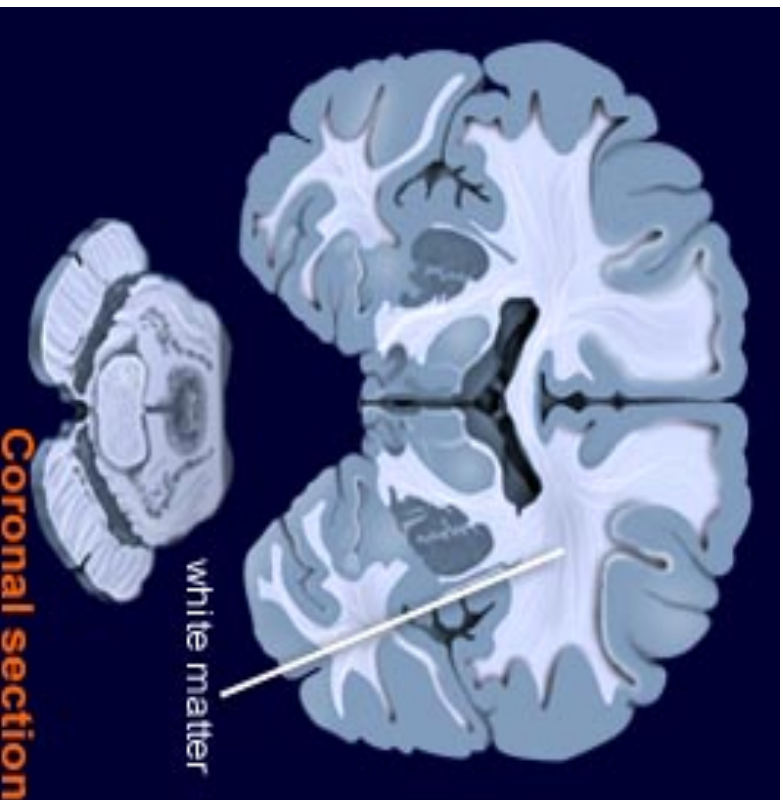


# Corpus callosum

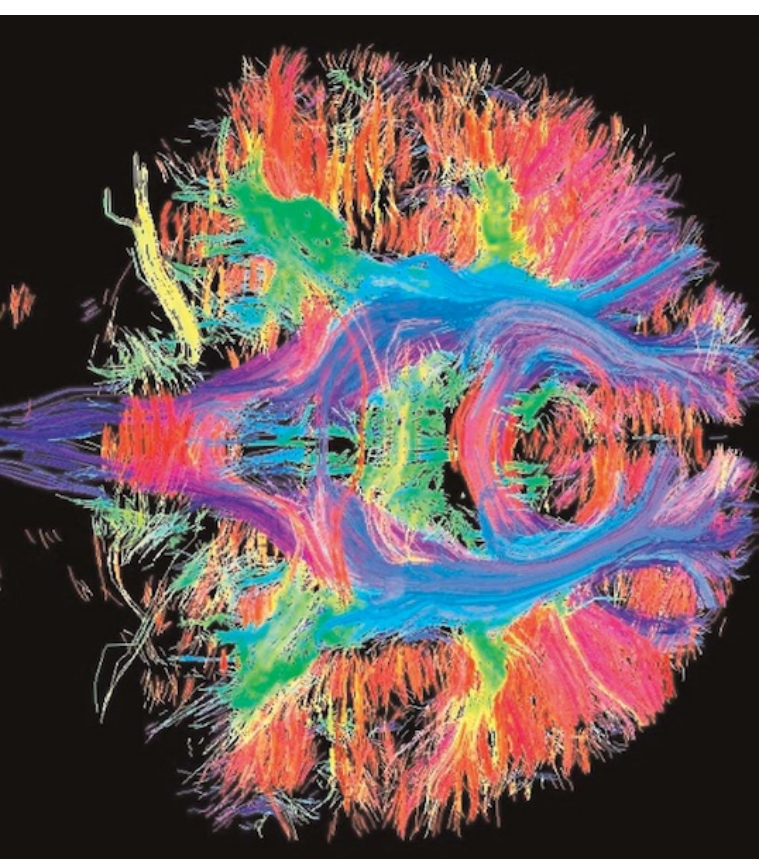


## White Matter

The connections between "the little grey cells".  
Consisting mainly of Myelinated axons



"Diffusion  
Tensor  
Imaging"  
DTI  
>>>>



Tshibanda et al. (2009) *Progress  
in Brain Research*, 177:215-229.

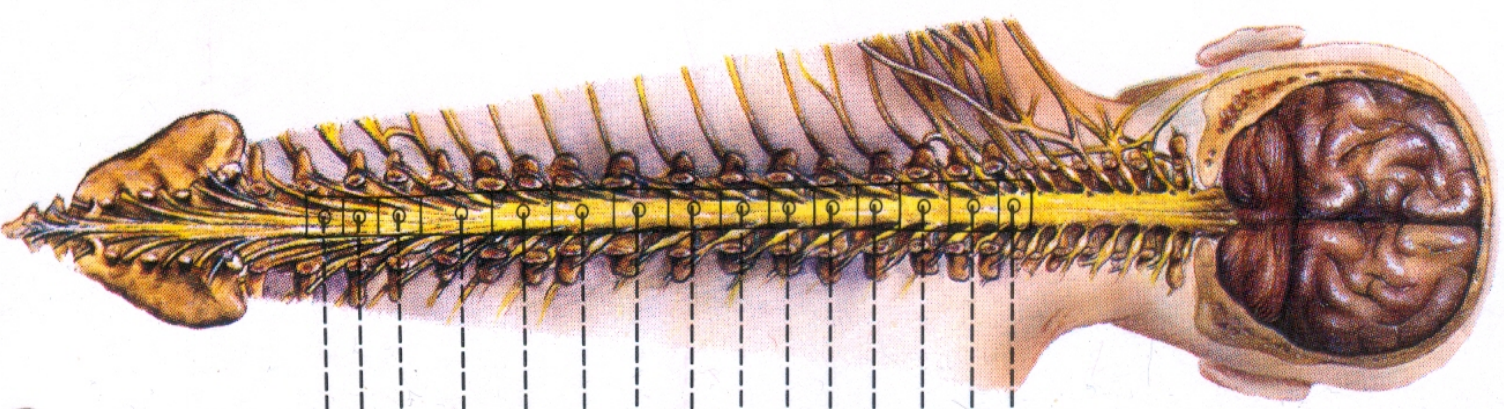
Brain = ~66% **White Matter**, by volume



# Spinal Cord

31 Segments

Like the brain,  
encased in bone & meninges



# Spinal Cord in Cross Section

**Dorsal Horns**

**Grey Matter**

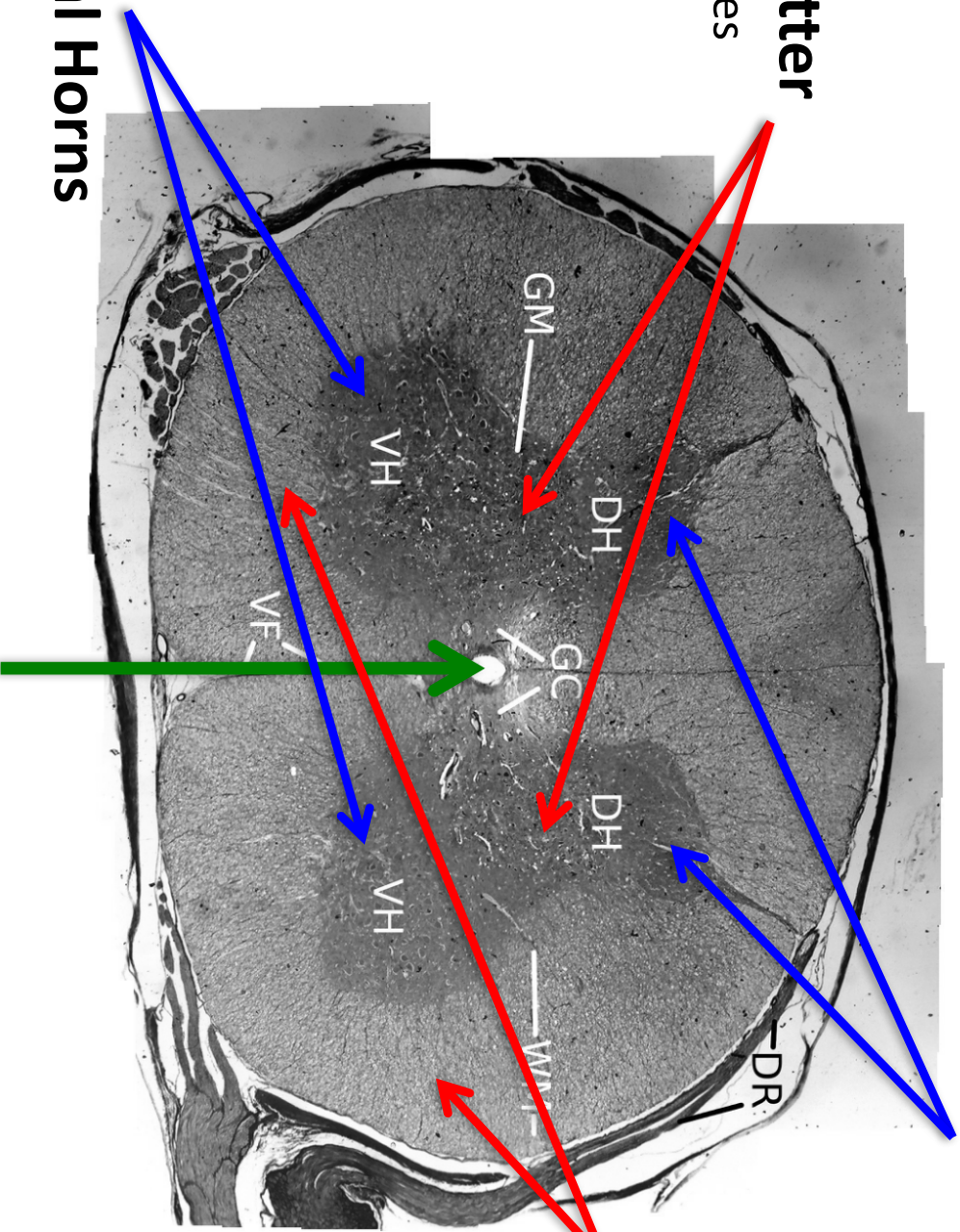
Cell Bodies

**White Matter**  
Myelinated Axons

**Ventral Horns**

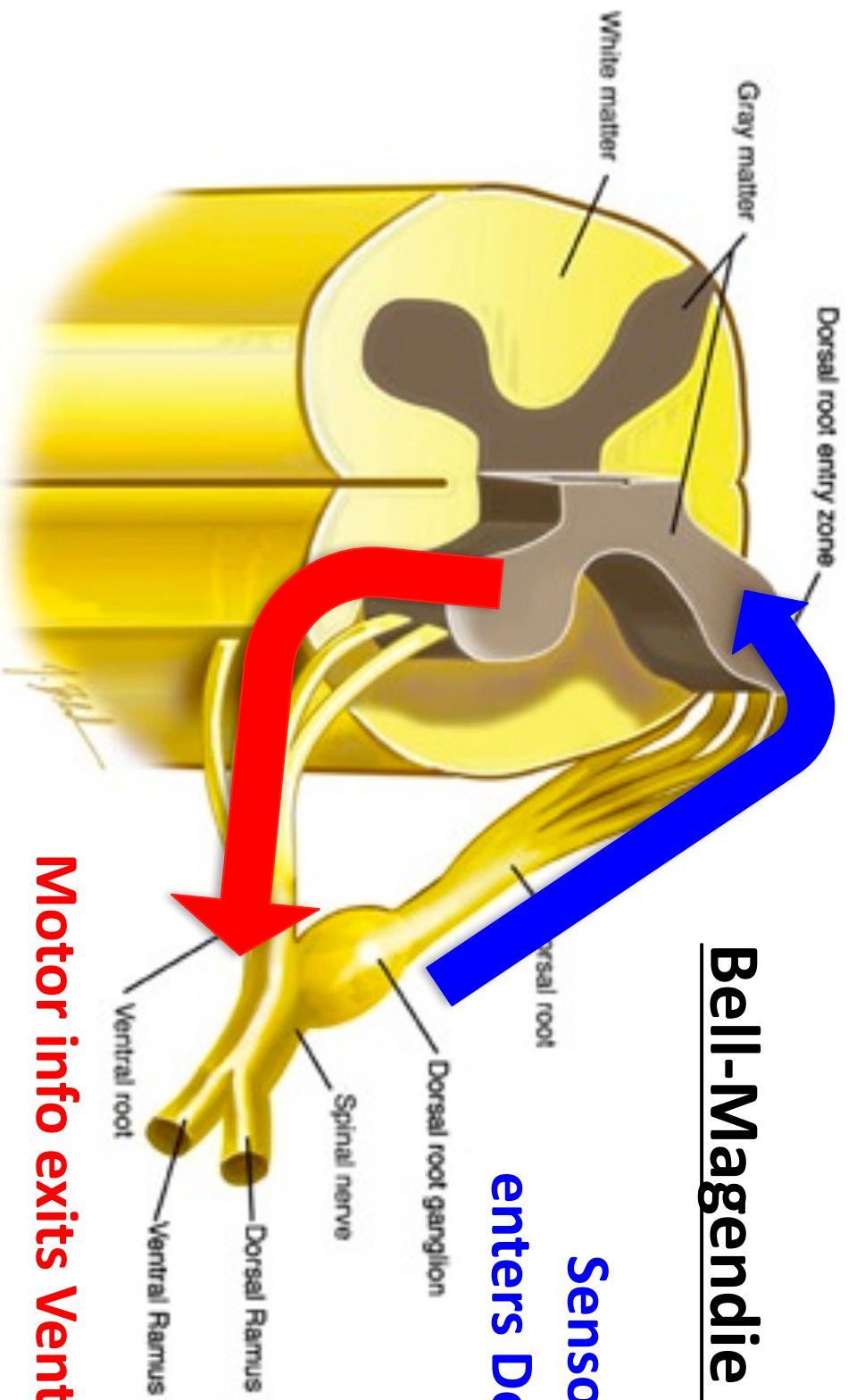
**Central Canal**

w/ Cerebral Spinal Fluid





# Spinal Cord



## Bell-Magendie Law:

Sensory info  
enters Dorsal Horn

Motor info exits Ventral Horn

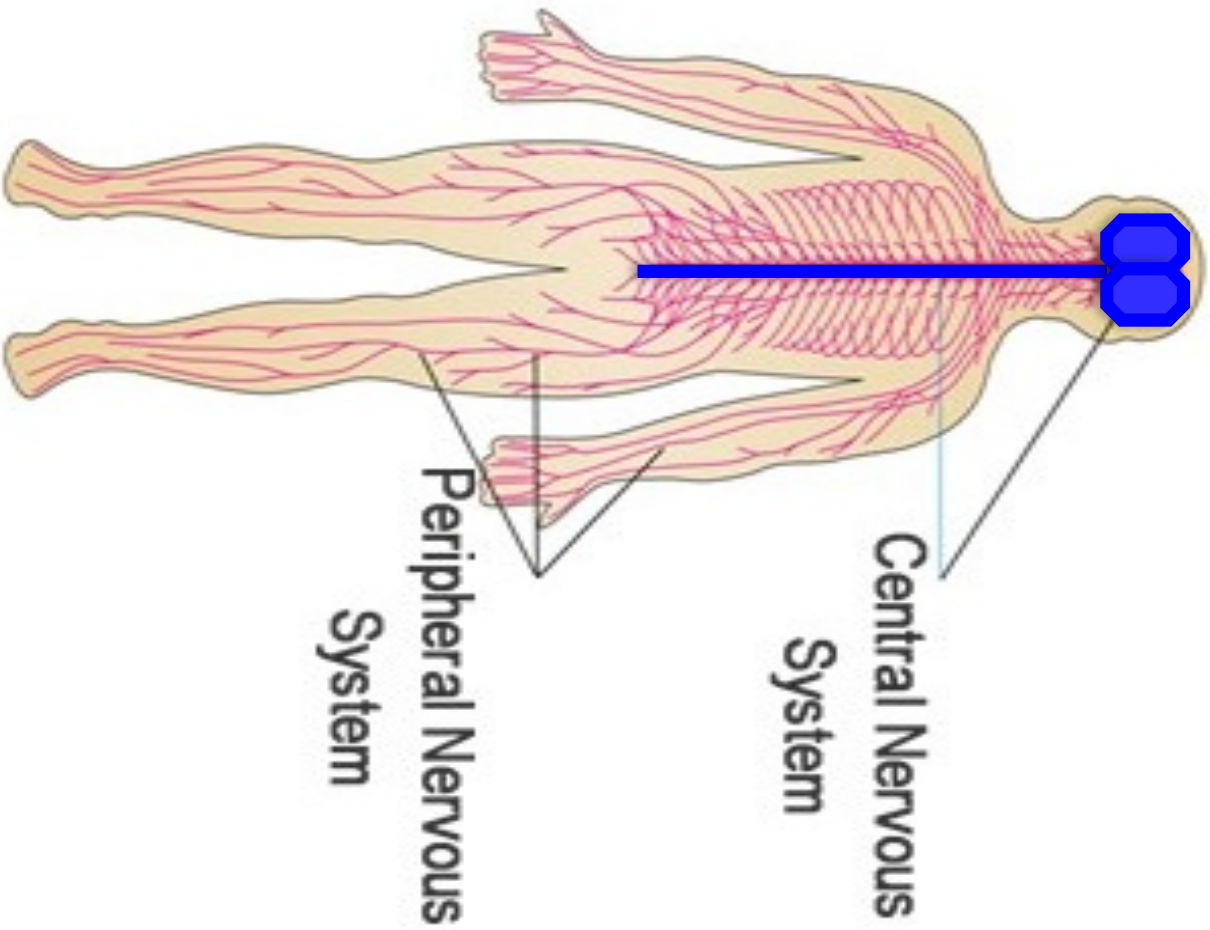
## MNEMONIC:

In the Door

and out the Vent,

that's how Spinal info's sent!

# CNS & PNS



## CNS

Central Nervous System

= Brain & Spinal Cord

Surrounded by bone  
and meninges

## PNS

Peripheral Nervous System

**SOMATIC** System

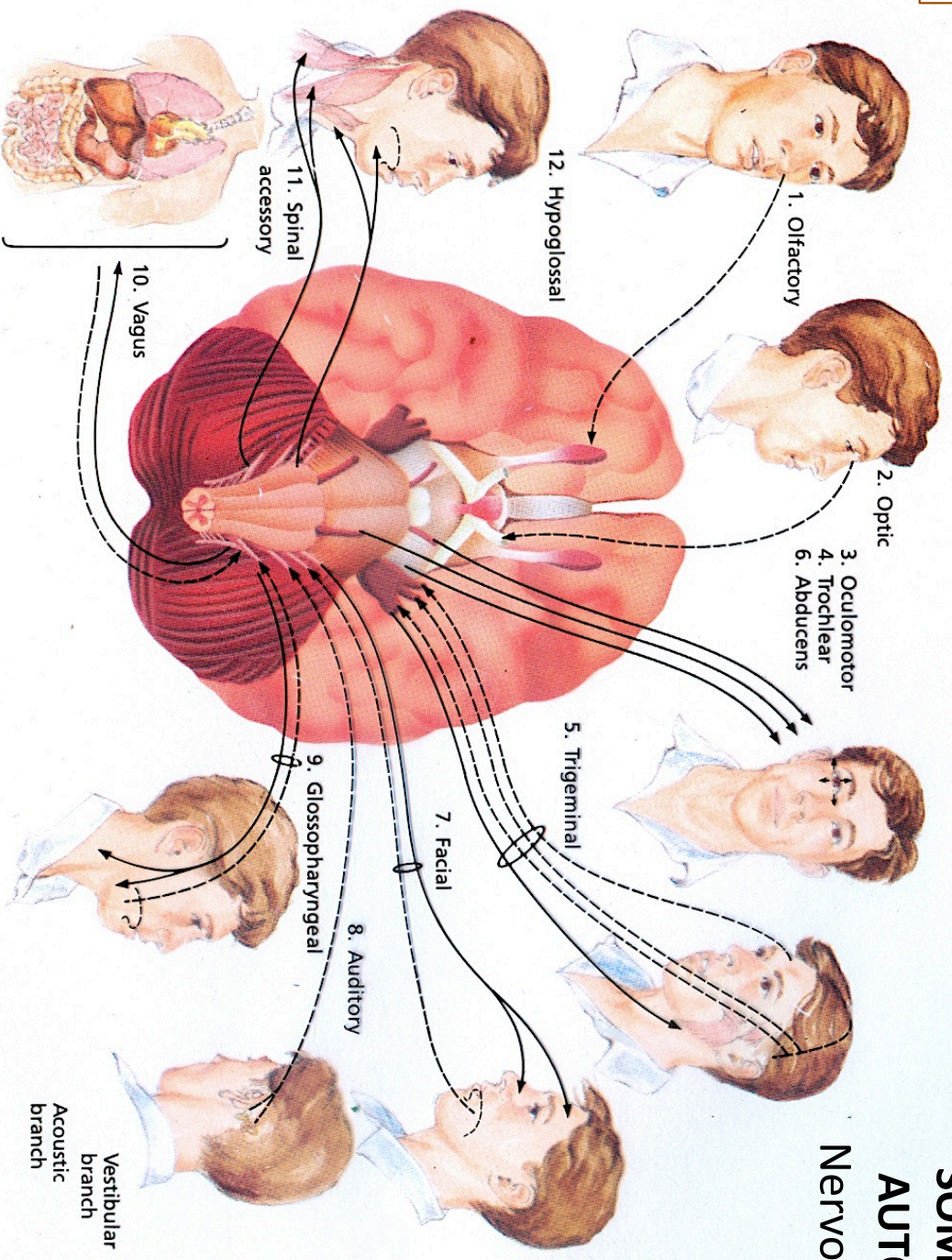
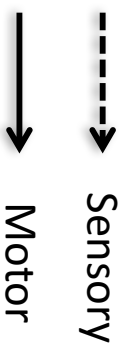
= Interaction w/external env.

**AUTONOMIC** System

= Regulates internal env.



# PNS includes Cranial Nerves



Involved in  
**SOMATIC** and  
**AUTONOMIC**  
Nervous Systems

# The Twelve Pairs of Cranial Nerves and the Regions They Serve

# PNS – Spinal Nerves

31 Segments

1 pair of afferent  
(in-flowing)

**Dorsal Root Nerves**

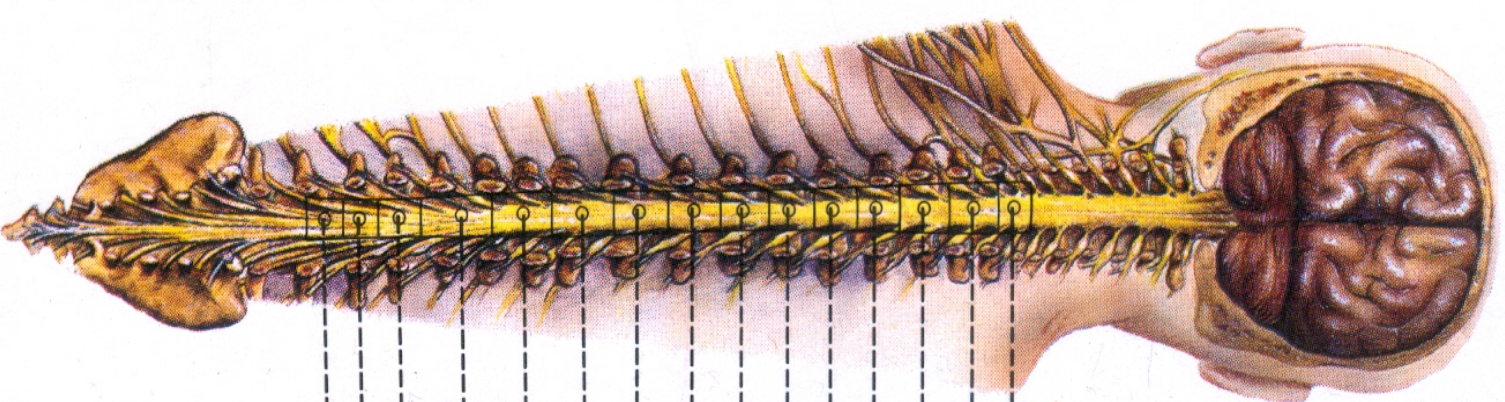
...for each...

1 pair of efferent  
(out-flowing)

**Ventral Root Nerves**

Many of these play crucial role in

**Autonomic Nervous System**



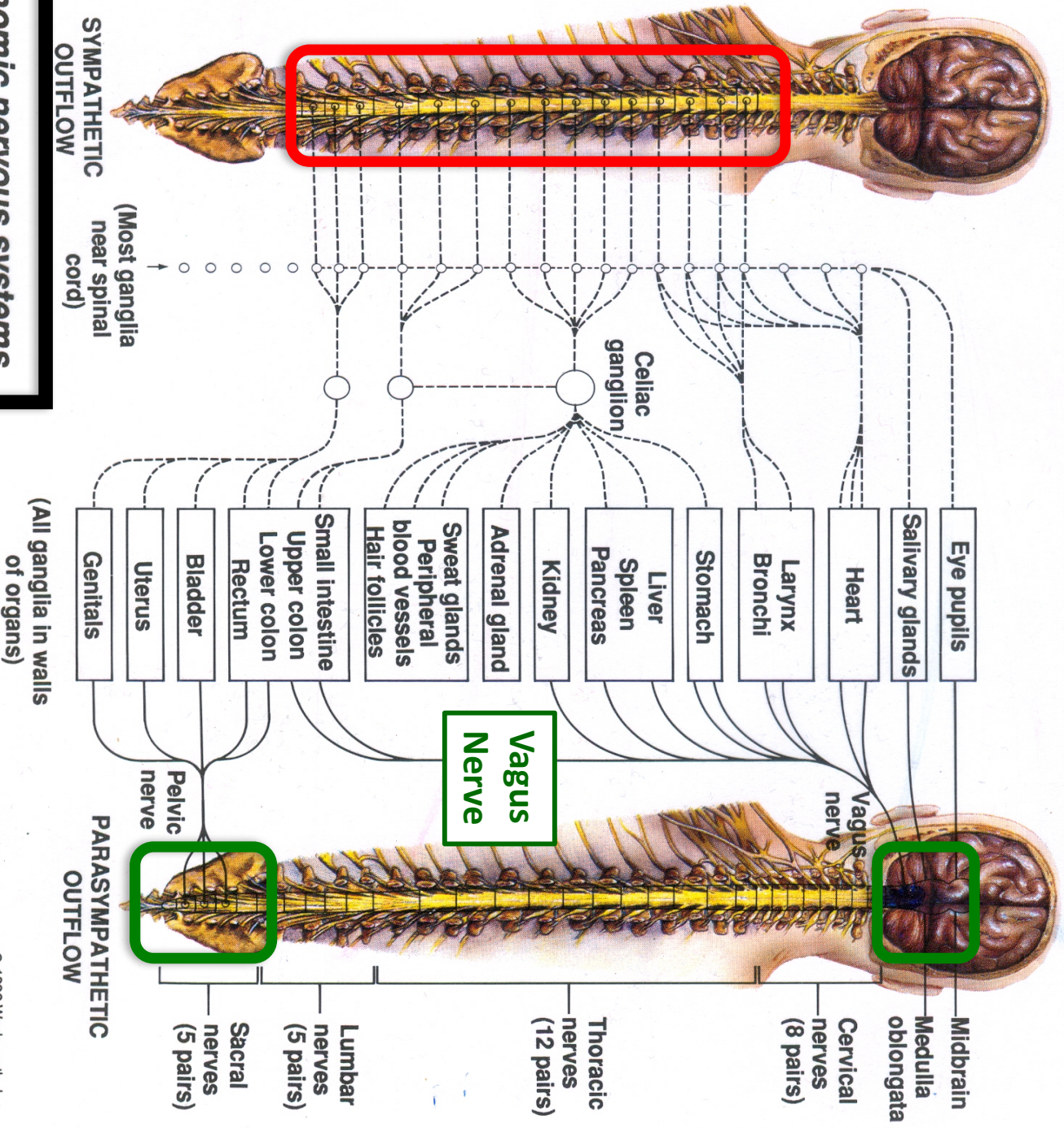


# Sympathetic System

**Fight  
Or  
Flight**

# Parasympathetic System

**Rest  
&  
Digest**

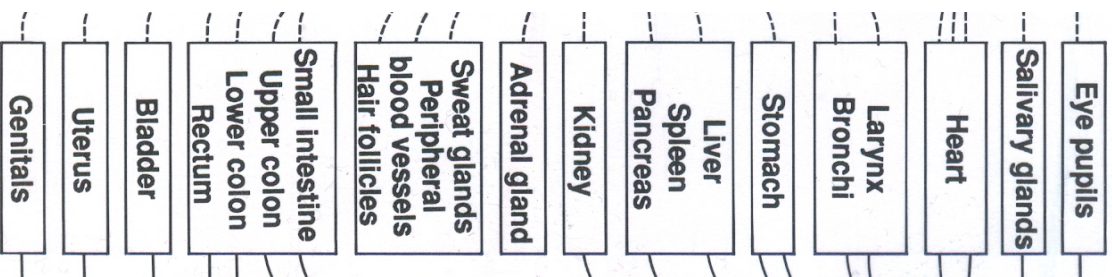


**Autonomic nervous systems**

# Sympathetic System

**Fight  
or  
Flight**

- Pupils dilate
- Mouth dry
- Heart rate increase
- Bronchi expand
- Halt digestion
- Liver release blood-sugar
- Activate adrenal glands and sweat glands
- Constrict blood vessels
- Pilo-erection
- Halt digestive juices
- Halt intestinal motility
- Constrict bladder
- Genitalia inactive (except at orgasm)



# Parasympathetic System

**Rest  
&  
Digest**

- Pupils constrict
- Produce saliva
- Heart rate decrease
- Bronchi constrict
- Promote digestion
- Produce digestive juices
- Increase intestinal motility
- Release bladder
- Genitalia active



# Sympathetic System

# Parasympathetic System

**Fight  
Or  
Flight**

When this system gives extreme reaction...



e.g. Repeated stressors...



- Eye pupils
- Salivary glands
- Heart
- Larynx  
Bronchi
- Stomach
- Liver  
Spleen  
Pancreas
- Kidney
- Adrenal gland
- Sweat glands  
Peripheral blood vessels  
Hair follicles
- Small intestine  
Upper colon  
Lower colon  
Rectum
- Bladder
- Uterus
- Genitals

...this system will "Rebound"

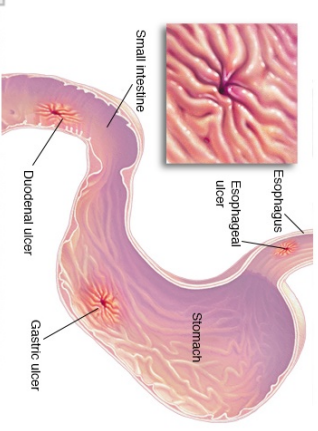


**Rest  
&  
Digest**

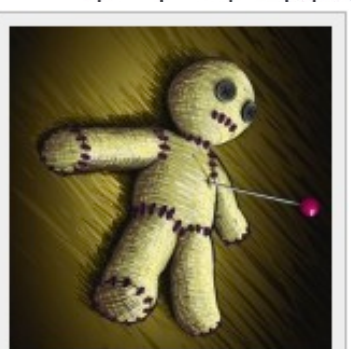
## Parasympathetic Rebound

Ulcers

...lead to  
Ulcers



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Even Voodoo death...

