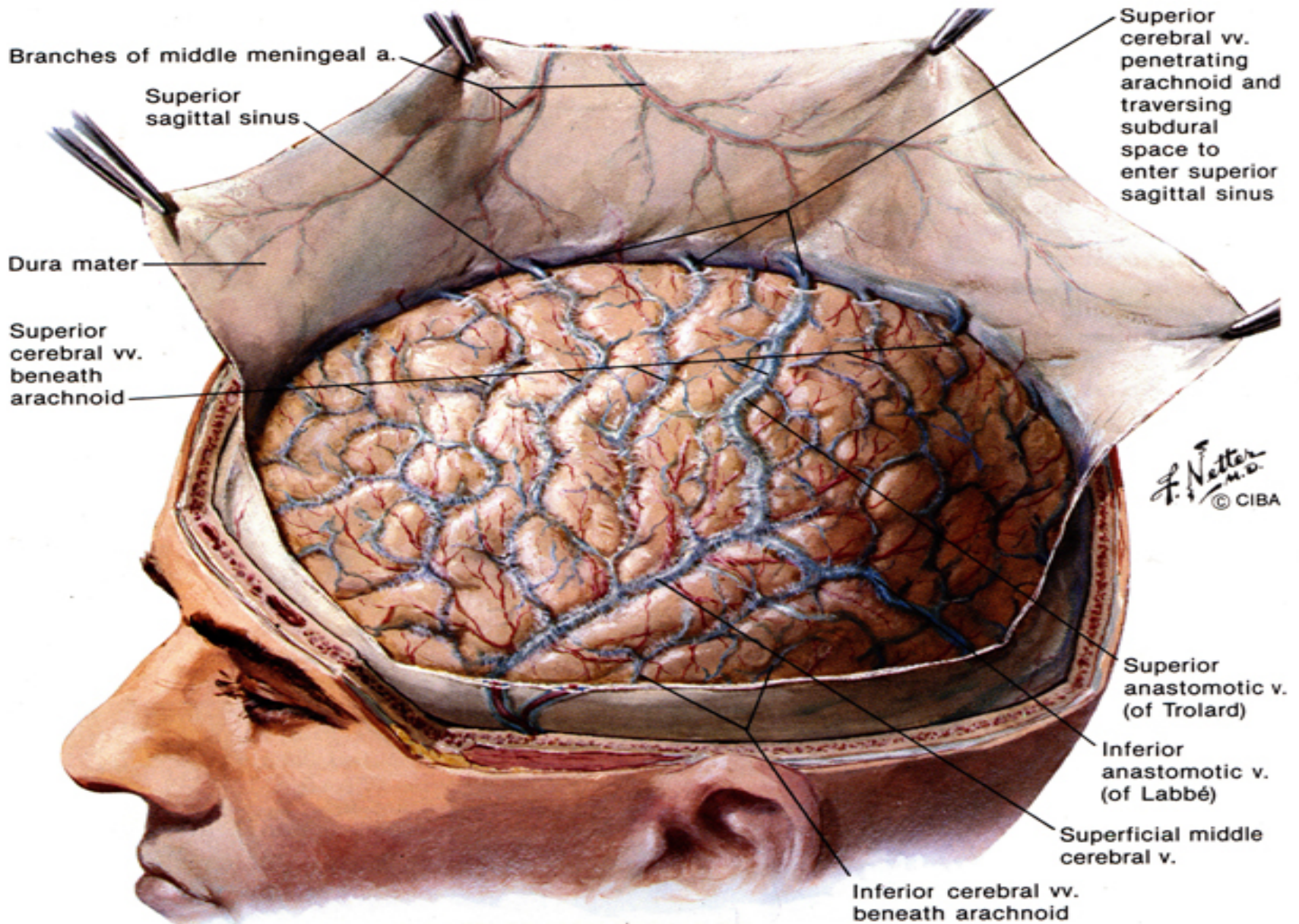


Announcement

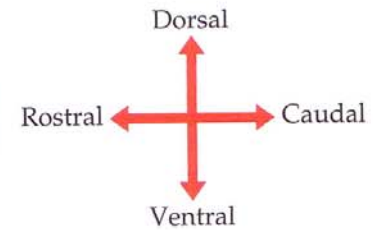
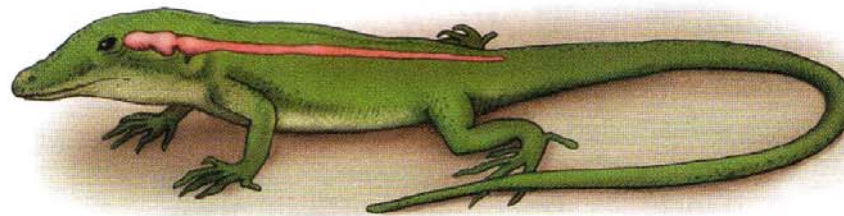
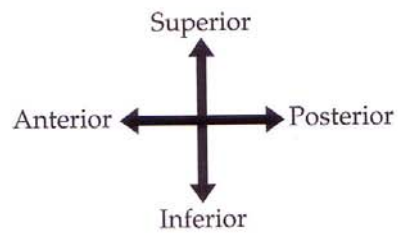
- If you need more experiments to participate in, contact Danny Sanchez (dsanchez@ucsd.edu) – make sure to tell him that you are from LIGN171, so he will let me know about your credit (1 point).
- Email Danny to schedule a time if you are interested.

Braaaiinnsss

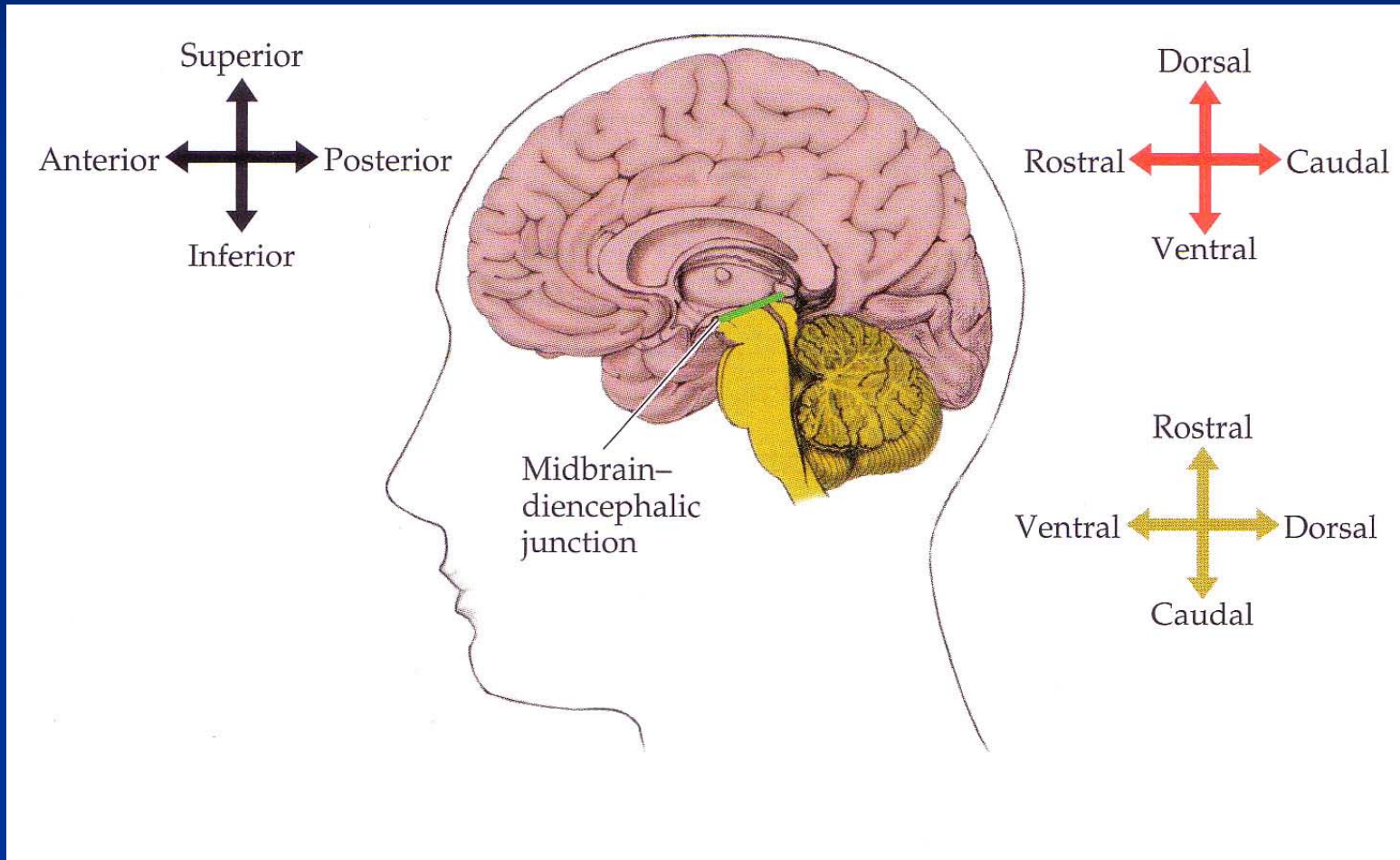
Meninges and Superficial Cerebral Veins



Orientation: Compass Points

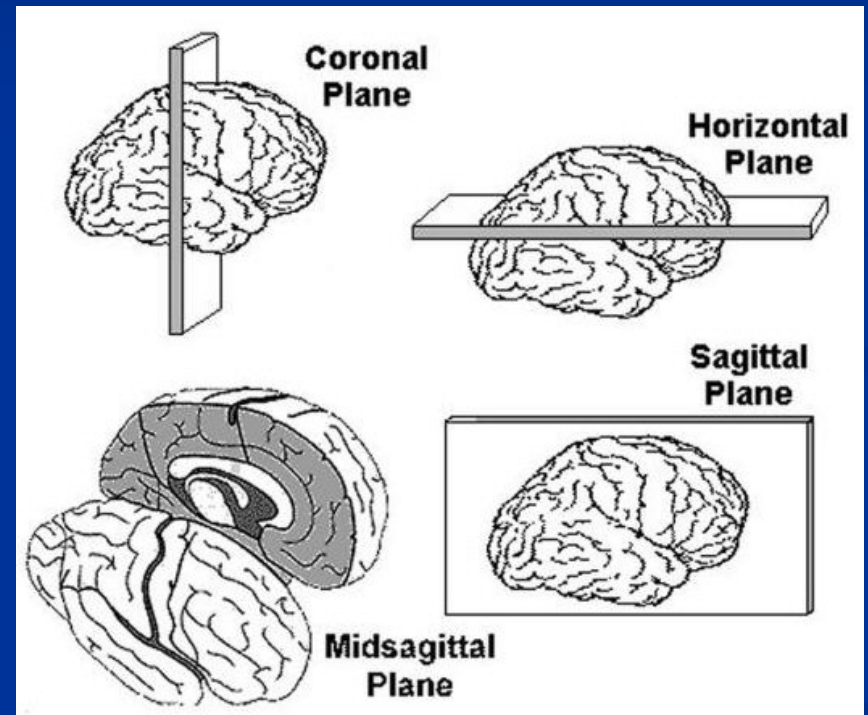


Orientation: Compass Points

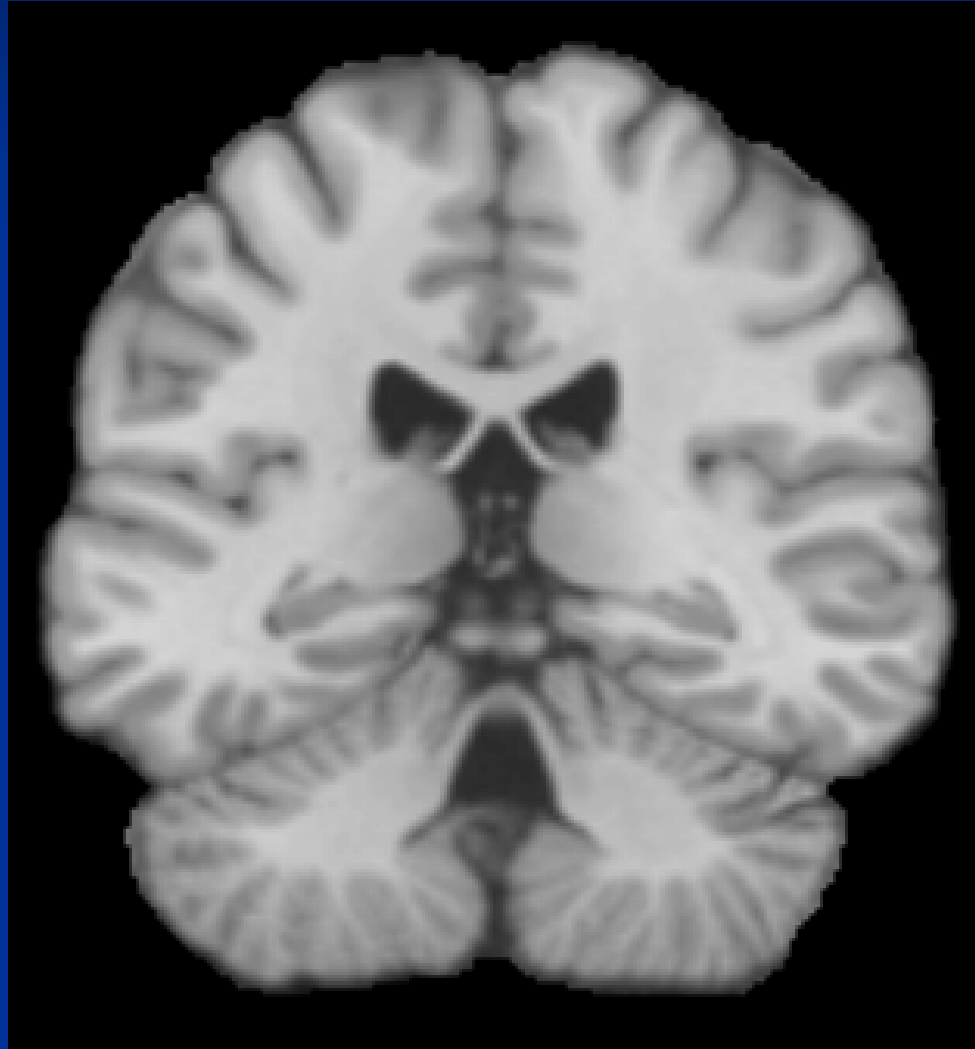


Orientation: Slices

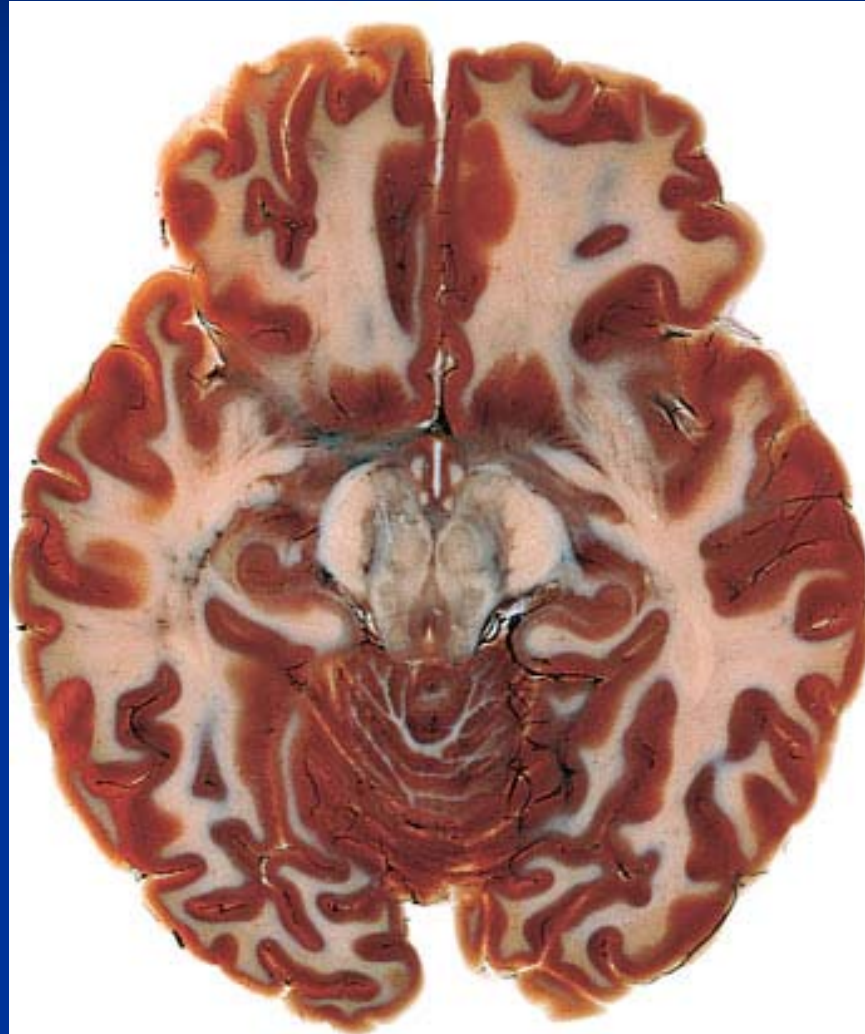
- Coronal plane
 - Like a 'crown' or tiara
 - Anterior to posterior
- Horizontal plane (axial, transverse)
 - Parallel to the floor
 - Superior to inferior
- Sagittal plane (mid-sagittal through midline)
 - Medial to lateral
- Anything else: oblique



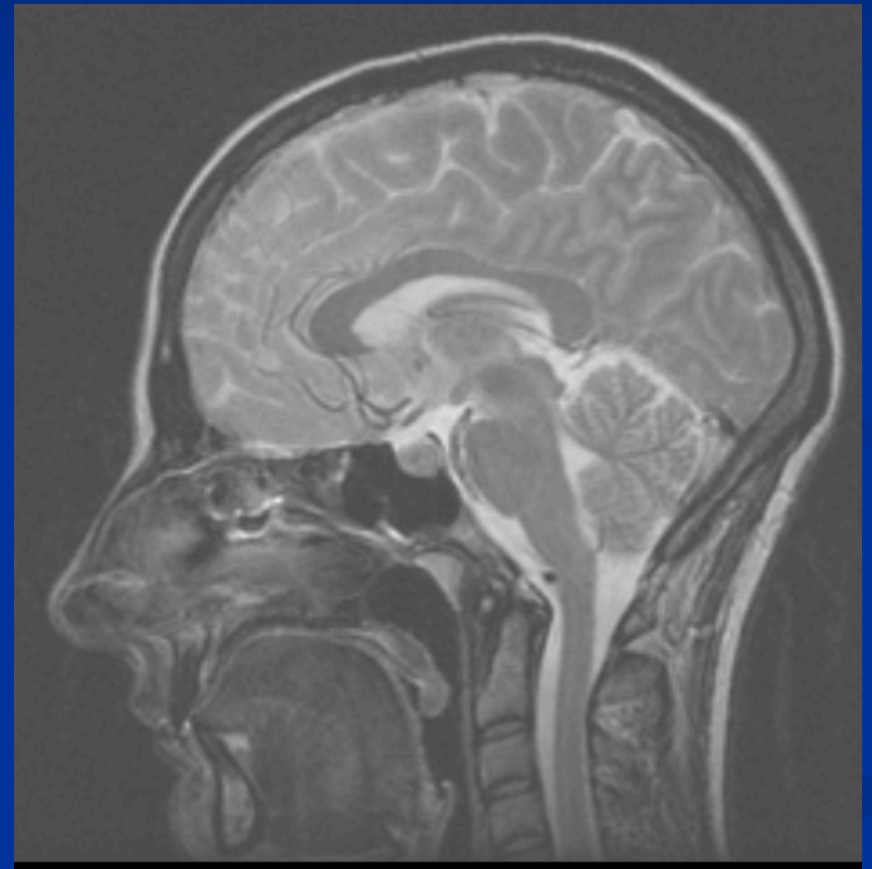
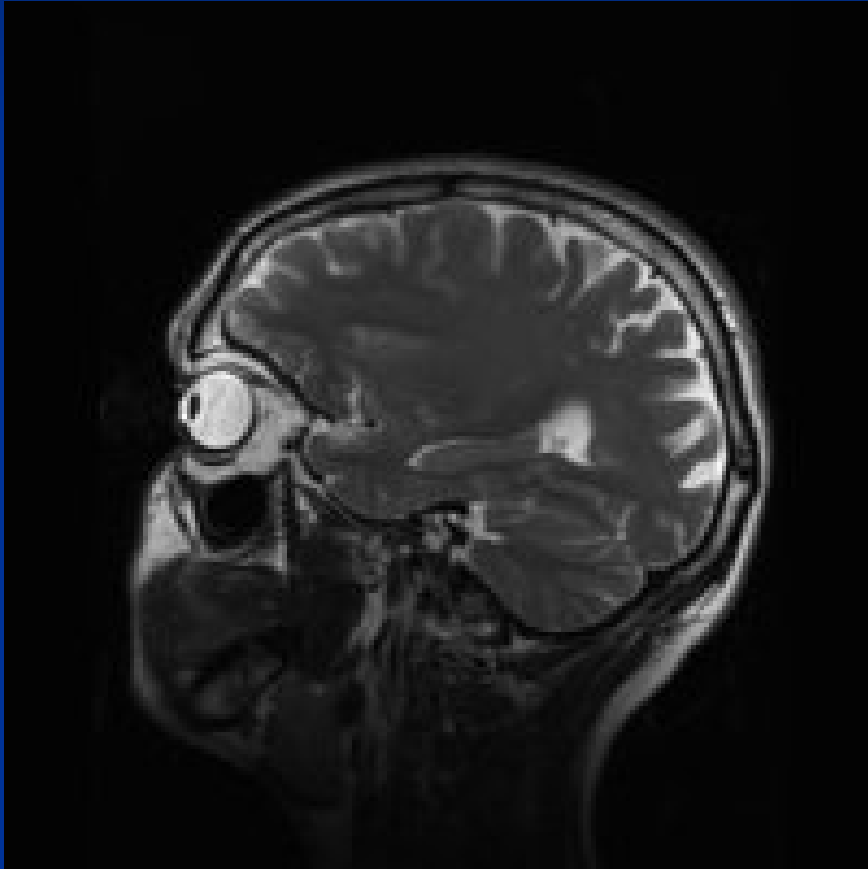
Coronal Slice



Horizontal Slice



Sagittal (mid-sagittal) Slice

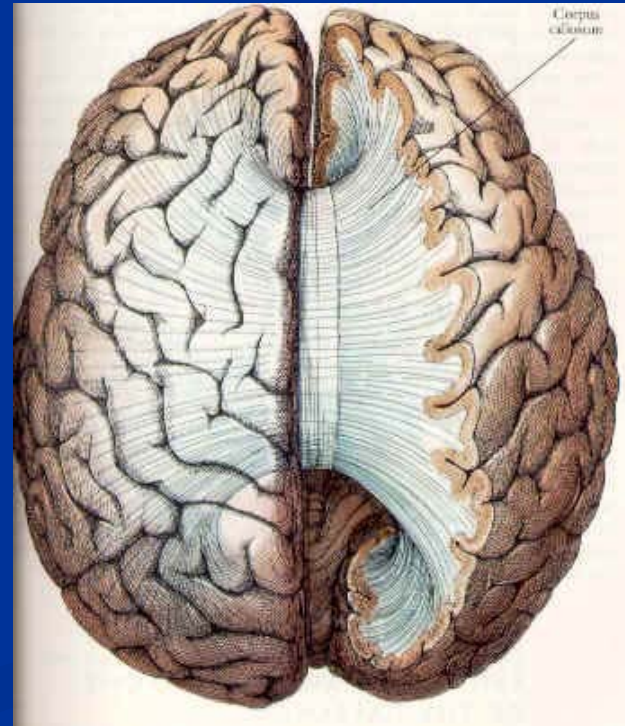
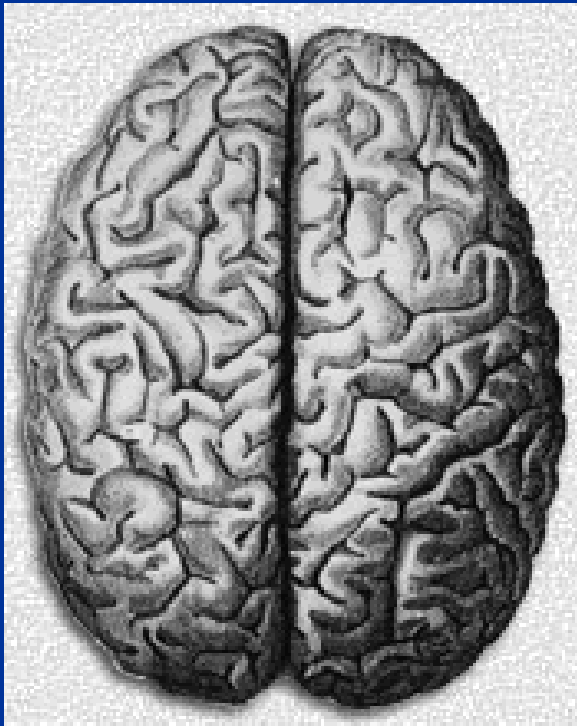


Big Pieces

Cerebrum, Subcortical structures,
Cerebellum

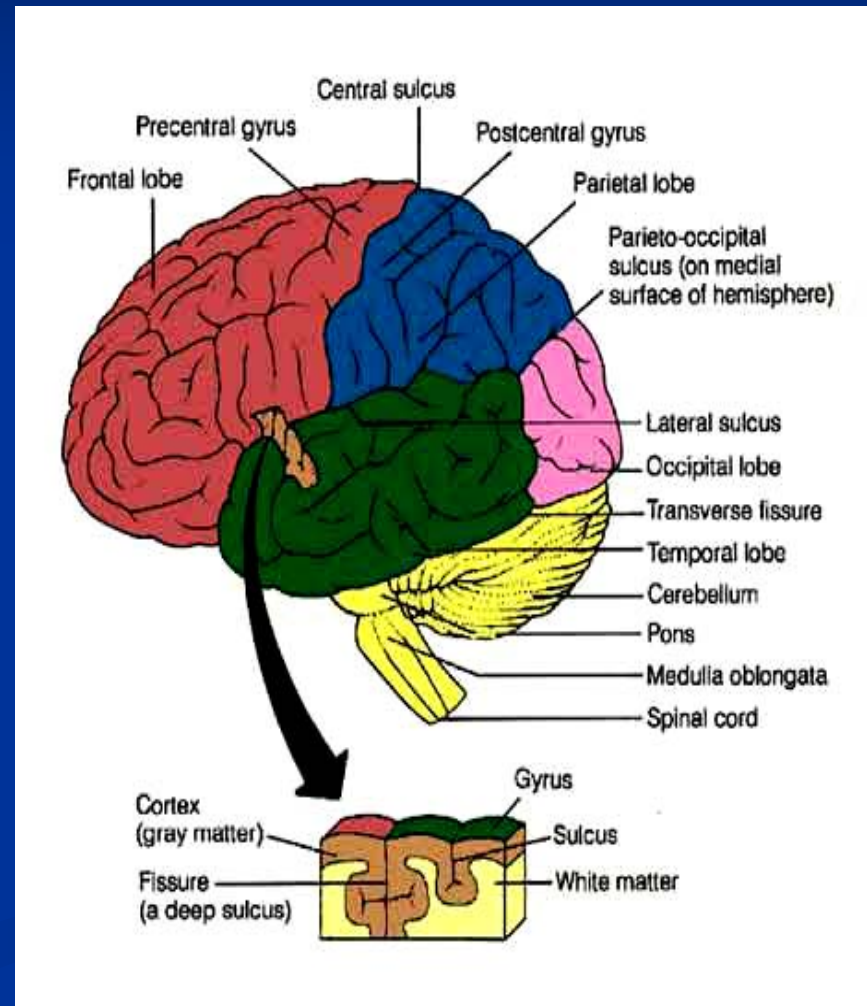
Cerebrum

- Two *hemispheres*, separated by the *inter-hemispheric fissure (longitudinal fissure)*, joined by the *corpus callosum*



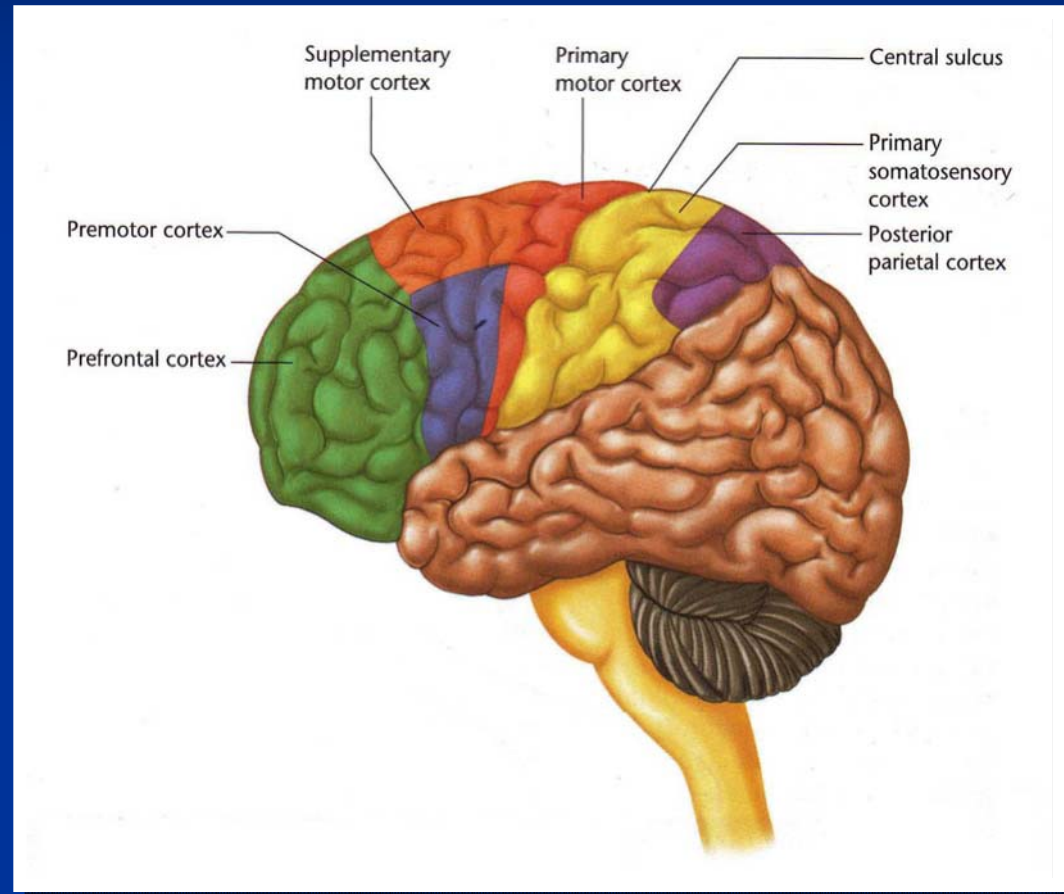
Divisions of the Cerebrum

- Divided into four lobes:
 - *Frontal Lobe*
 - *Parietal Lobe*
 - *Temporal Lobe*
 - *Occipital Lobe*
- Cortex (“bark”) is folded
 - Gyrus / gyri
 - Sulcus / sulci

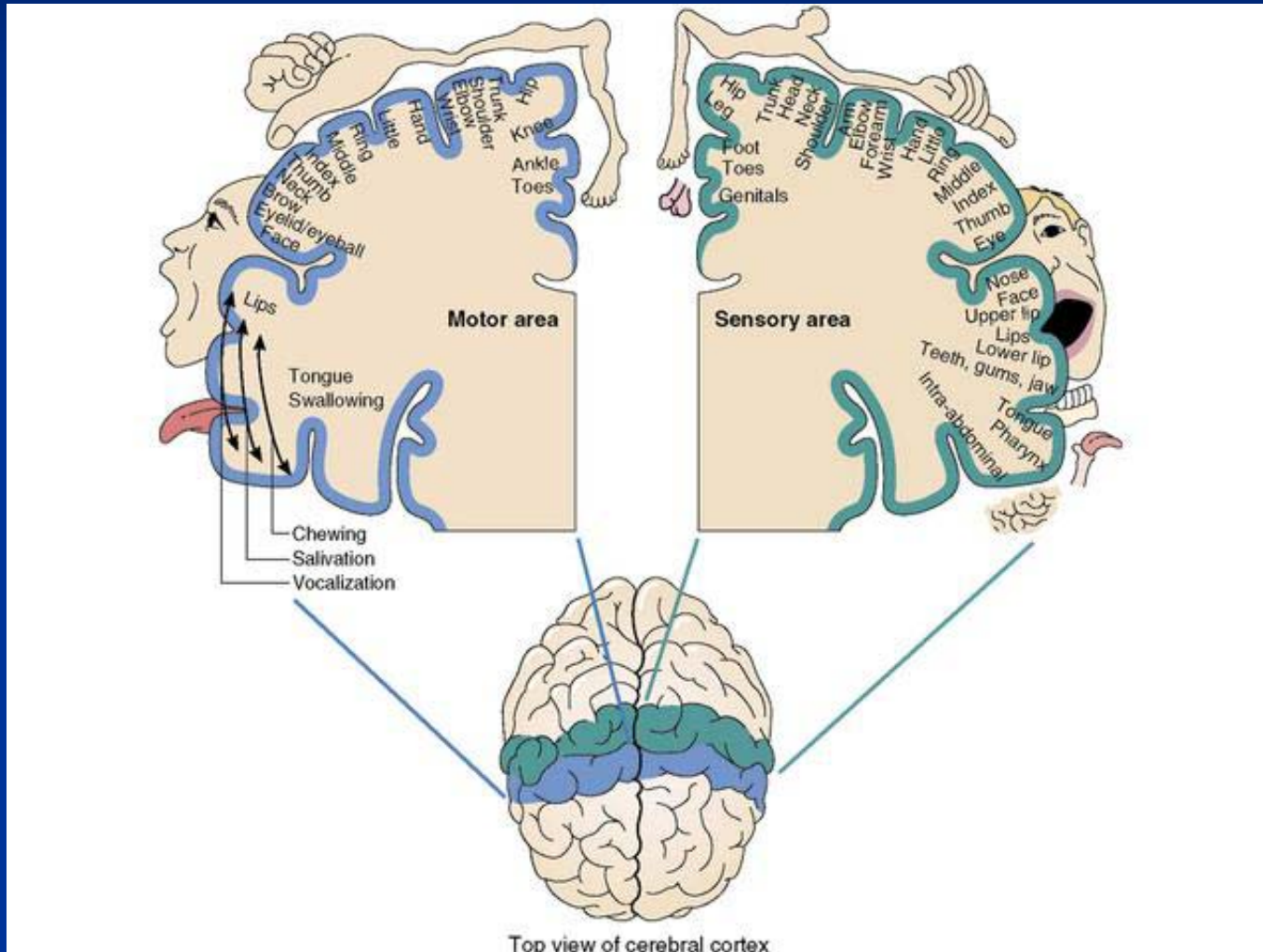


Some major functional areas

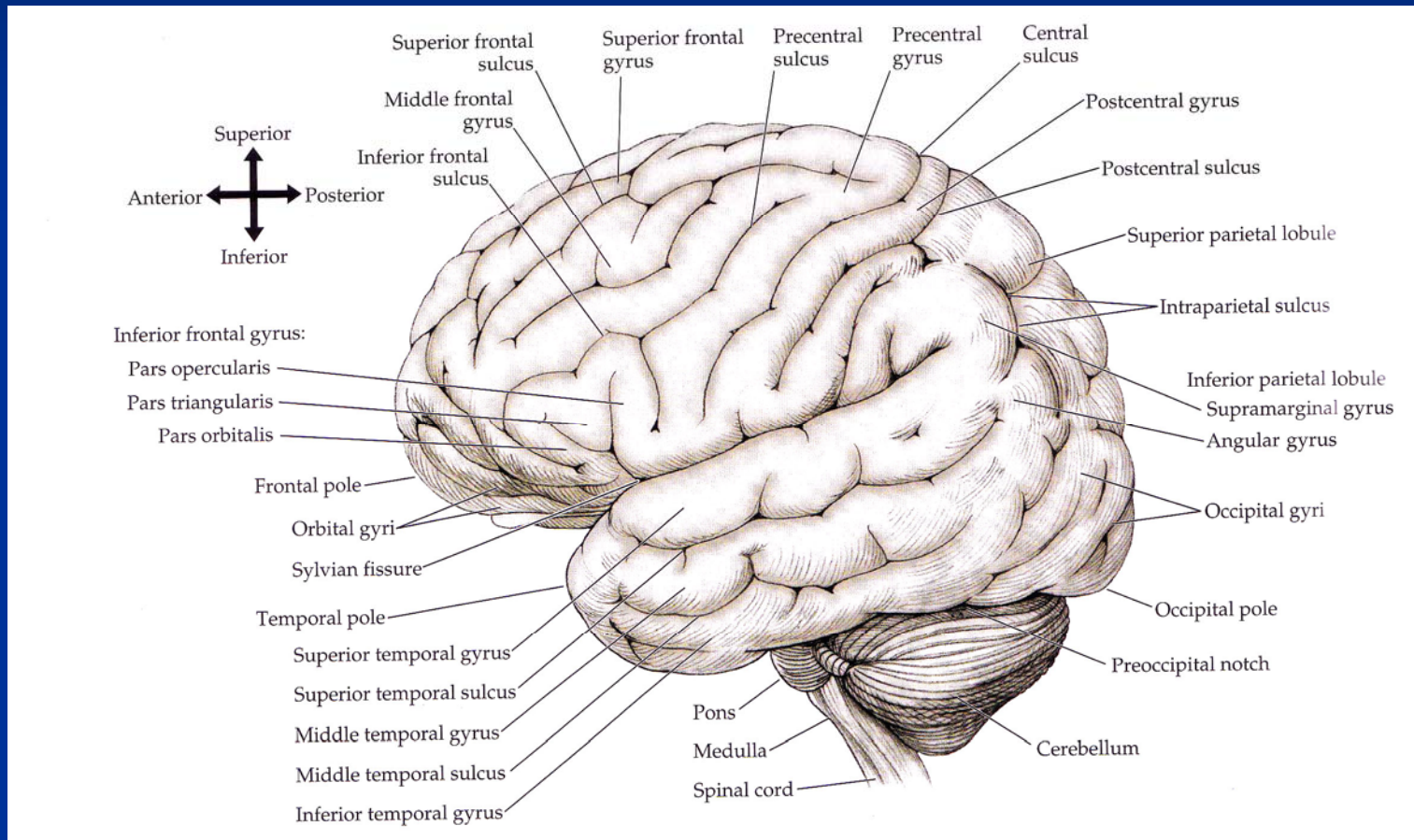
- Note the use of the term 'pre-' meaning 'in front of' (towards the front); 'post-' meaning 'behind'
- Premotor cortex is in front of motor cortex
- Postcentral cortex is behind the central sulcus; precentral in front of



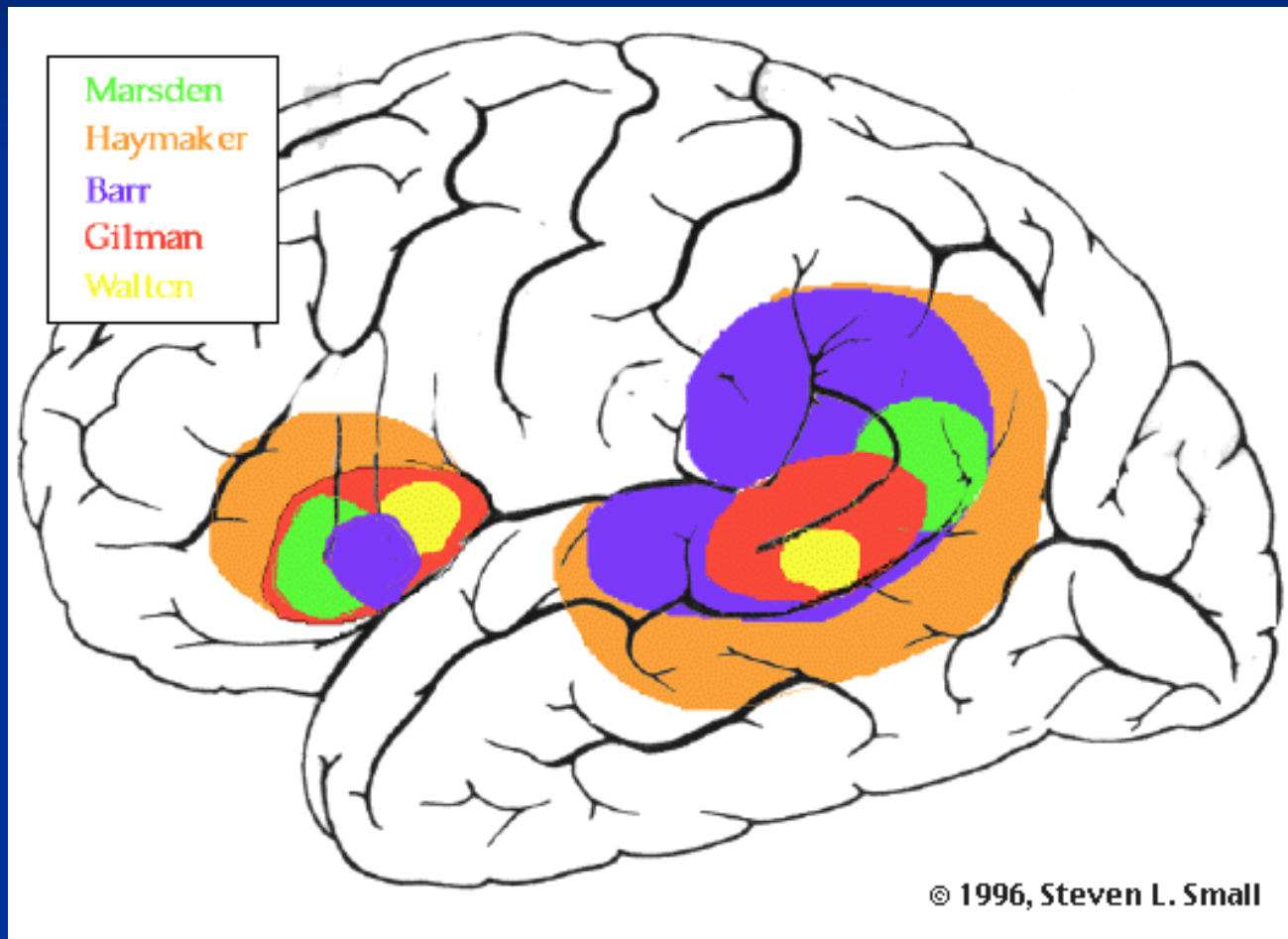
Sensory and Motor Cortex



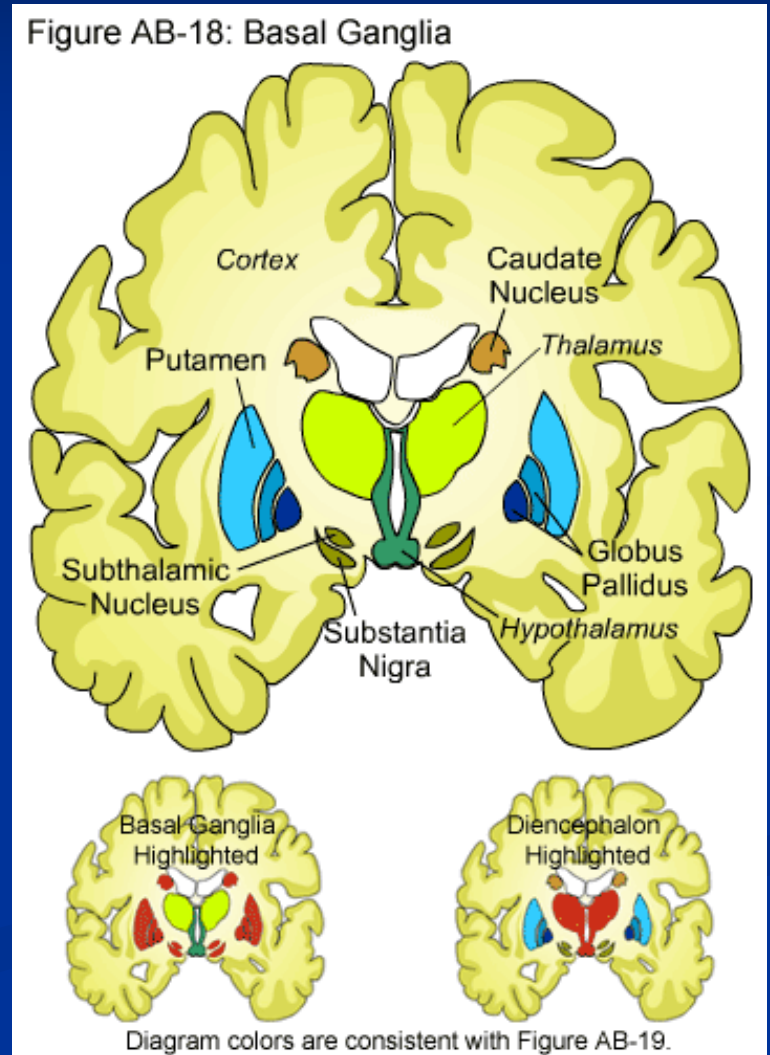
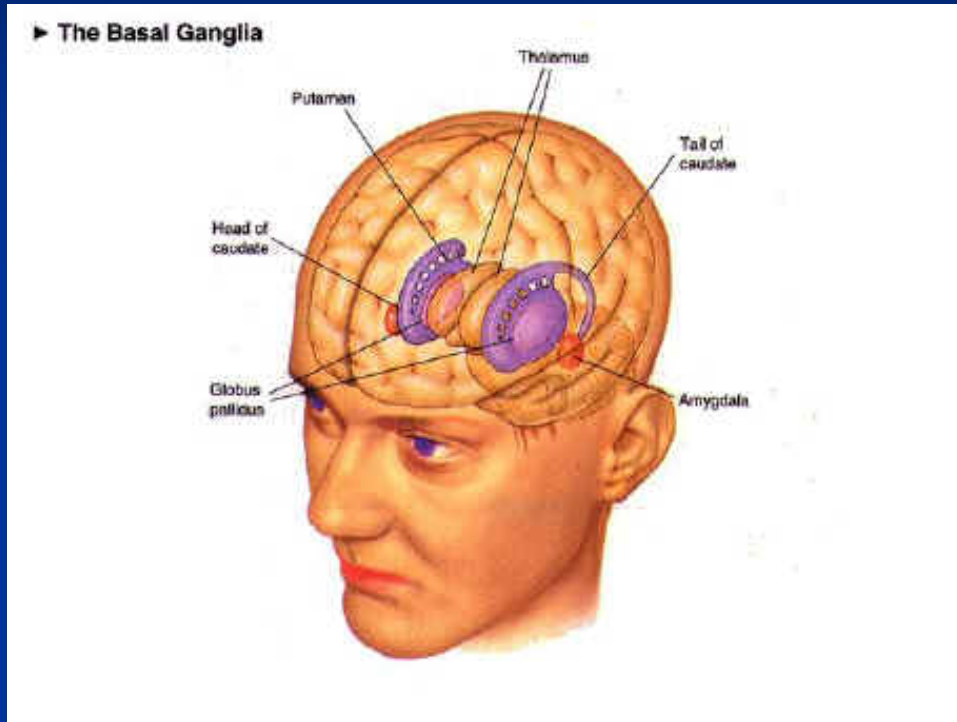
Gyri and Sulci



Broca's and Wernicke's areas

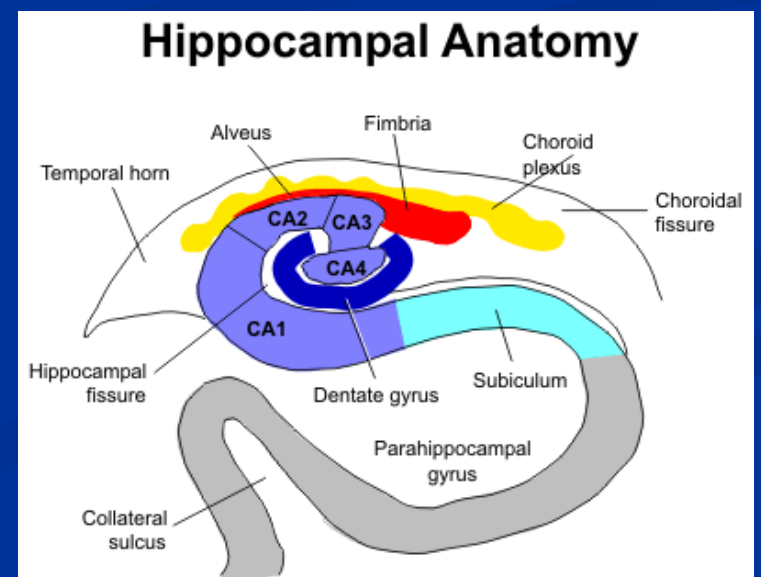
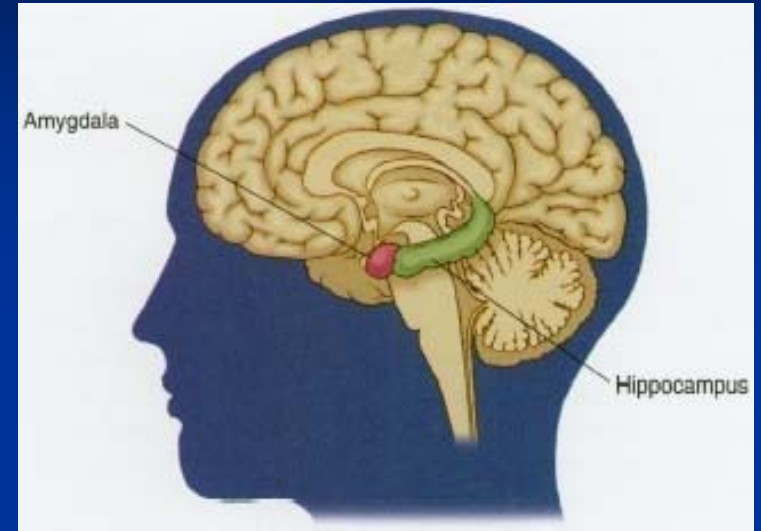
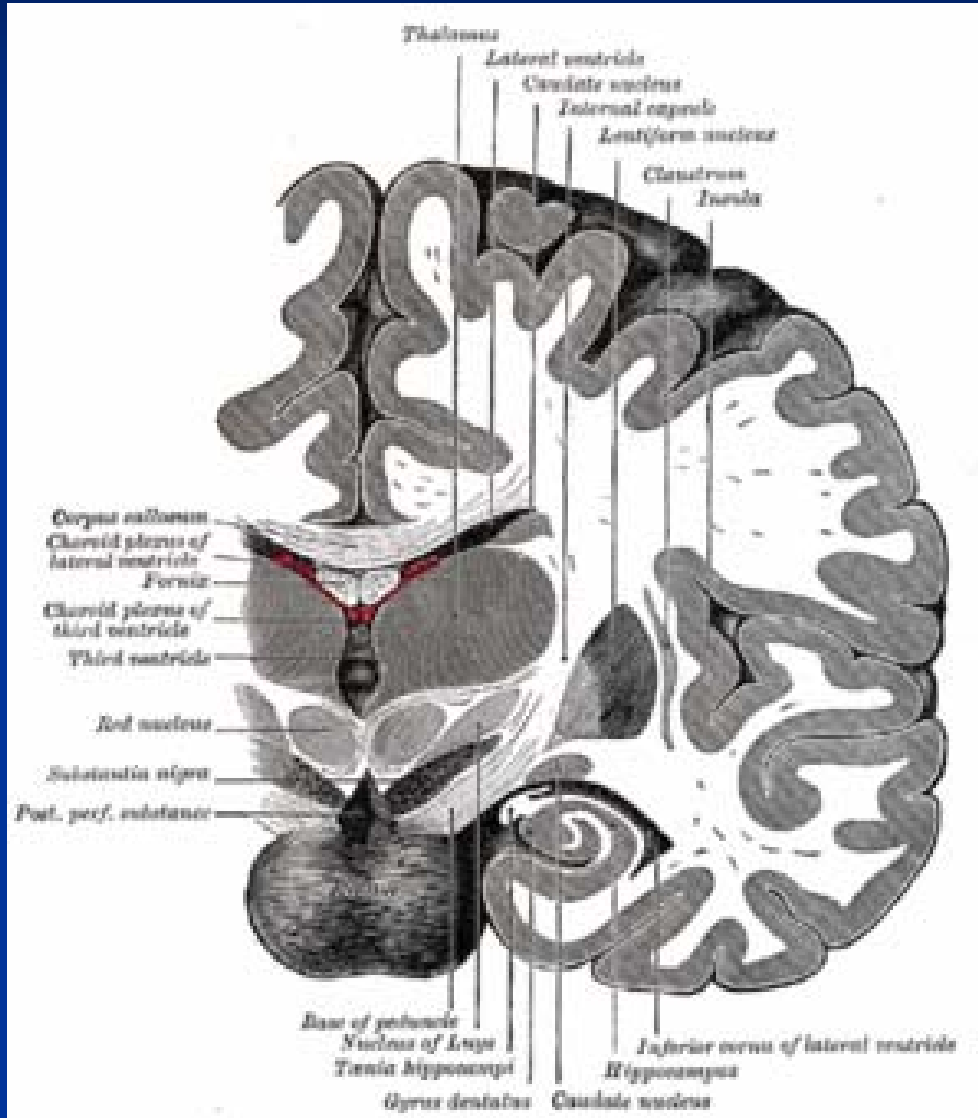


Subcortical Structures: Basal Ganglia

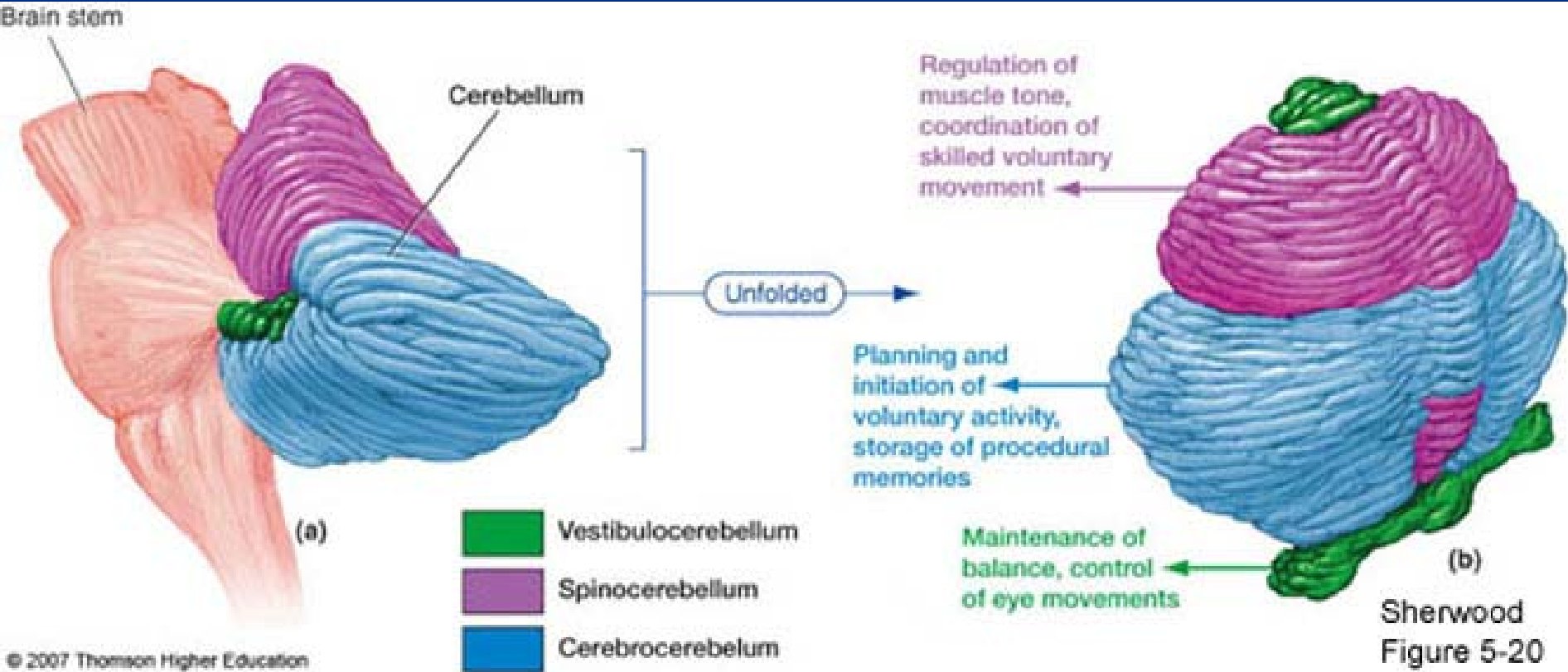


Striatum = Neostriatum
(caudate, putamen) plus
globus pallidus

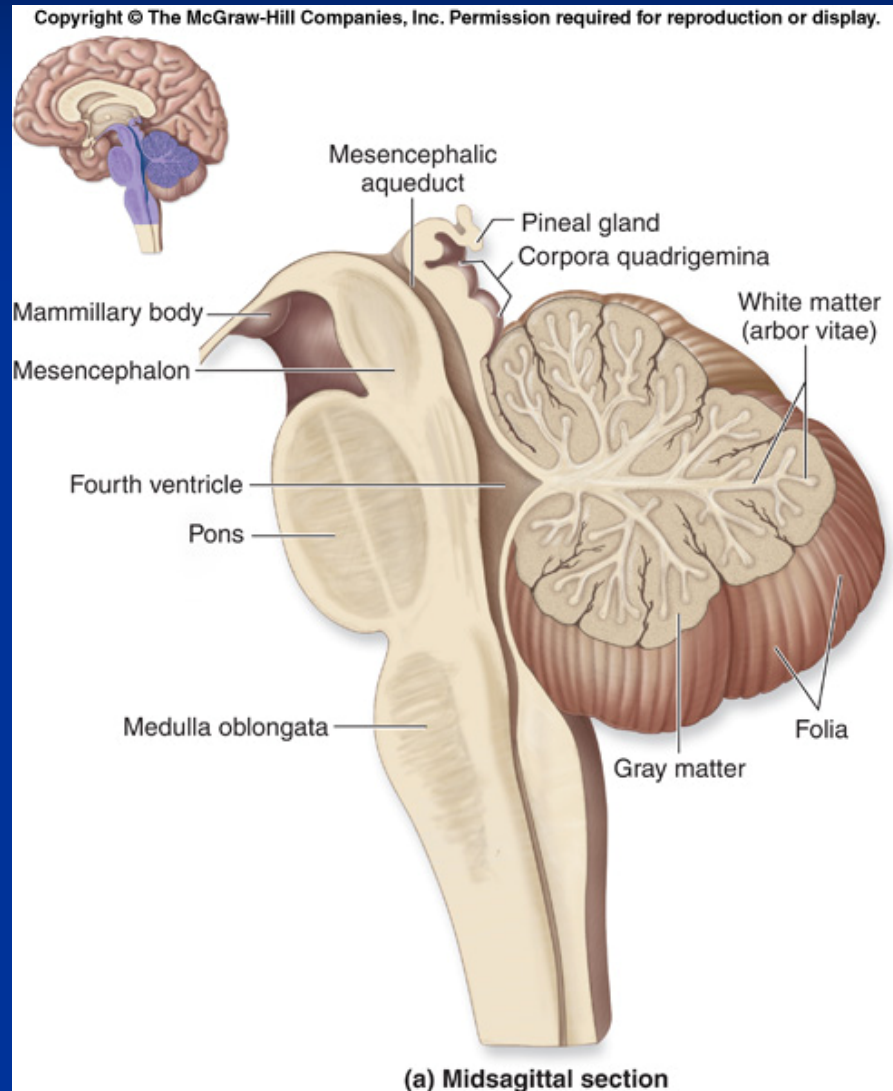
Subcortical Structures: Medial Temporal Lobe



Cerebellum (“little brain”)



Cerebellum (“little brain”)



Little Pieces

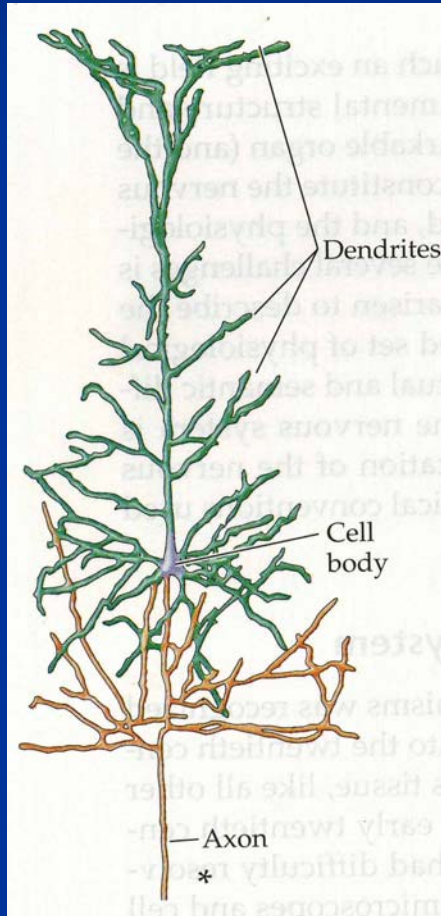
Neurons and Glia

Neurons

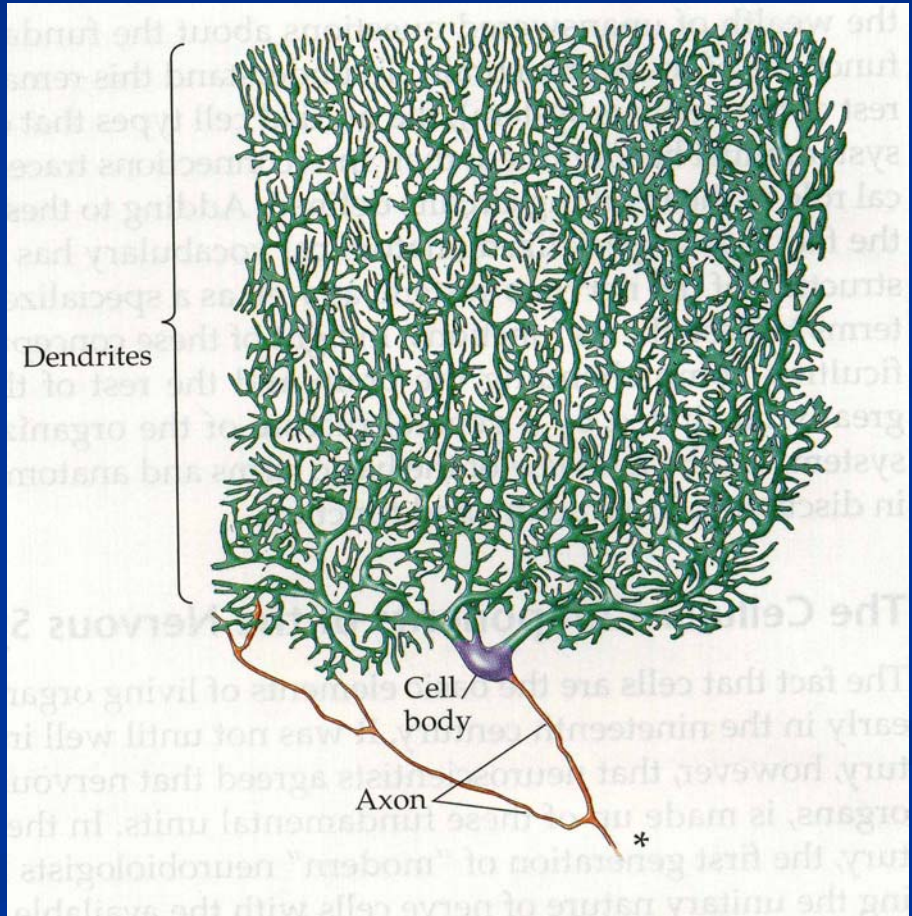
- 50,000 neurons per cubic millimeter of cortex
- Types of neurons in cerebral cortex
 - Pyramidal (may receive up to 200,000 inputs)
 - Stellate (~ 10,000 – 50,000 dendritic synapses; local circuitry)
 - Granule (~ 10 billion in cortex; very small)
- Types of neurons in cerebellar cortex
 - Purkinje (extensive arborization of dendrites)
 - Stellate (basket cells, Golgi cells)
 - Granule

Neurons

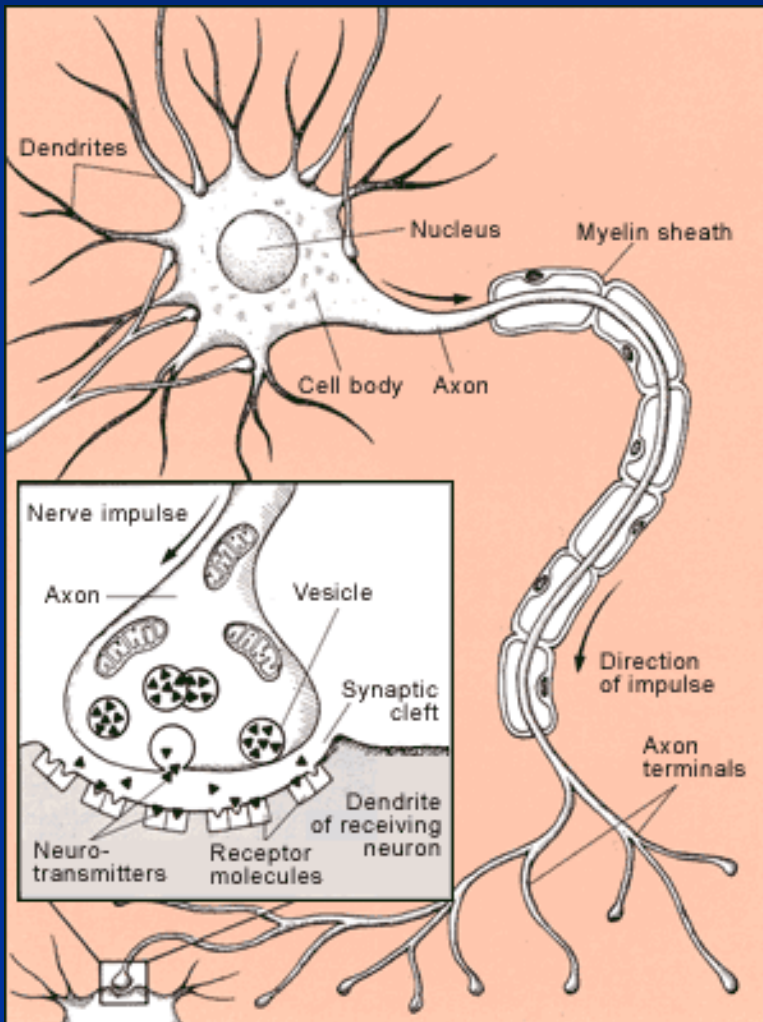
Pyramidal cell



Purkinje cell



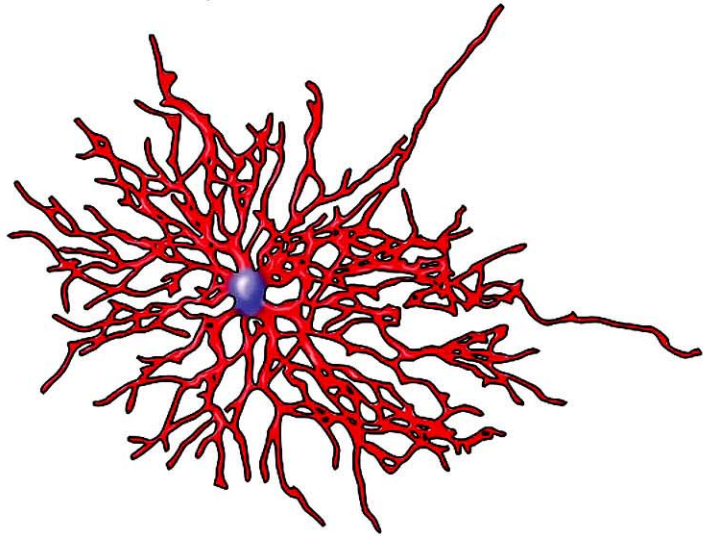
Anatomy of a Neuron



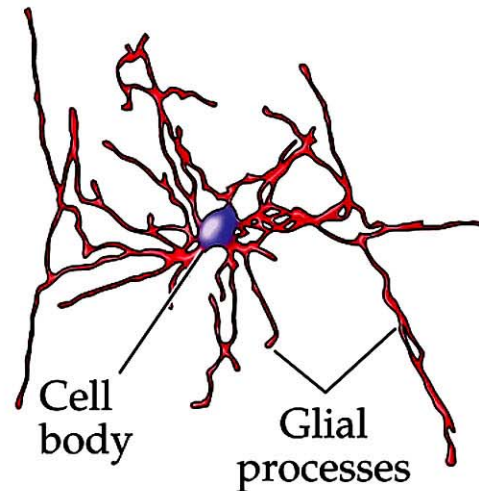
- **Dendrite** (input)
- **Cell Body (Soma)**
- **Nucleus**
- **Axon** (output)
- **Myelin (node of Ranvier)**
- **Synapse** (5,000 billion in adults)
- **Synaptic Cleft** (20 nm wide)
- **Vesicle**
- **Neurotransmitter**

Glial Cells

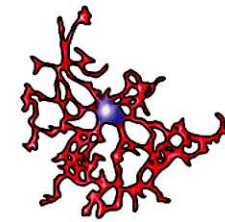
(A) Astrocyte



(B) Oligodendrocyte



(C) Microglial cell



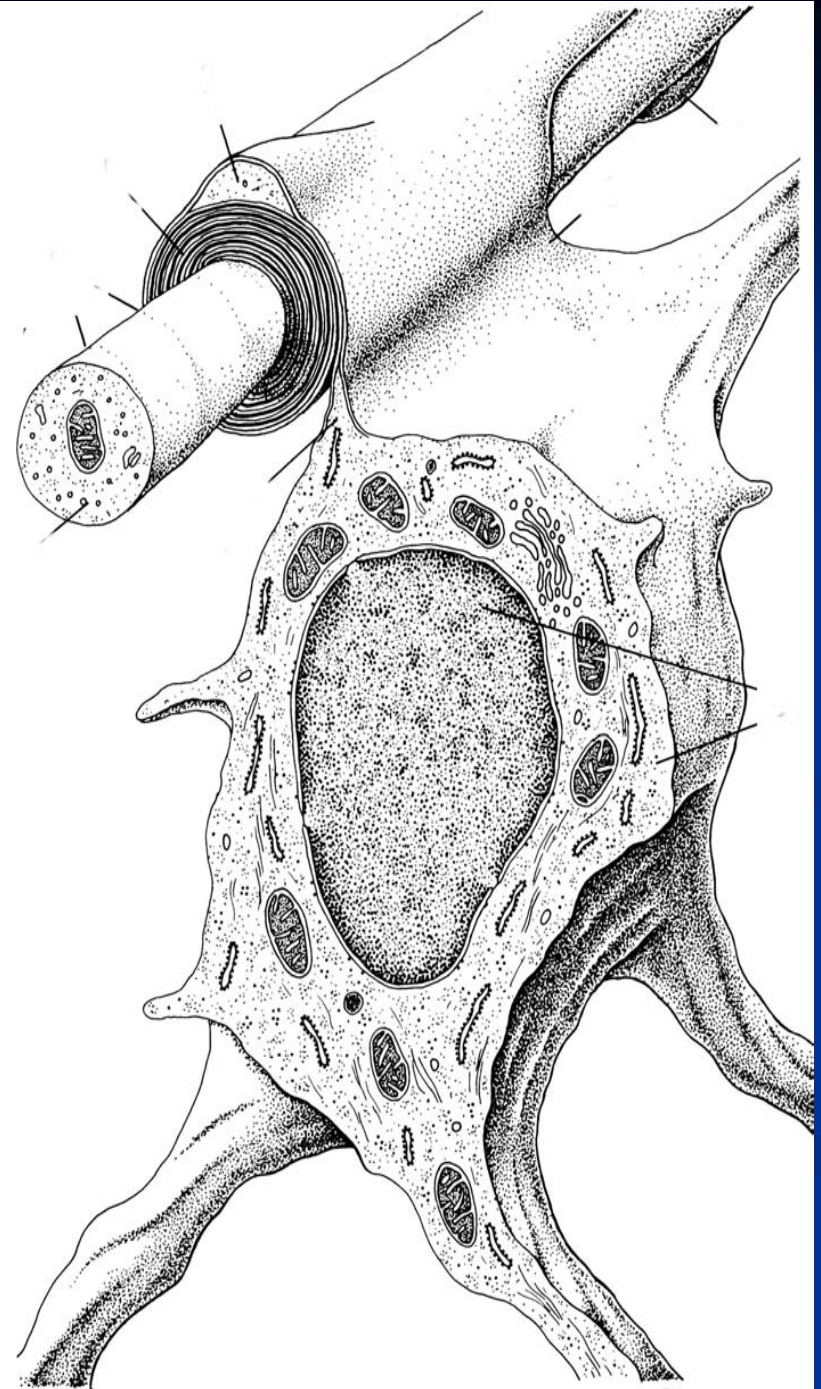
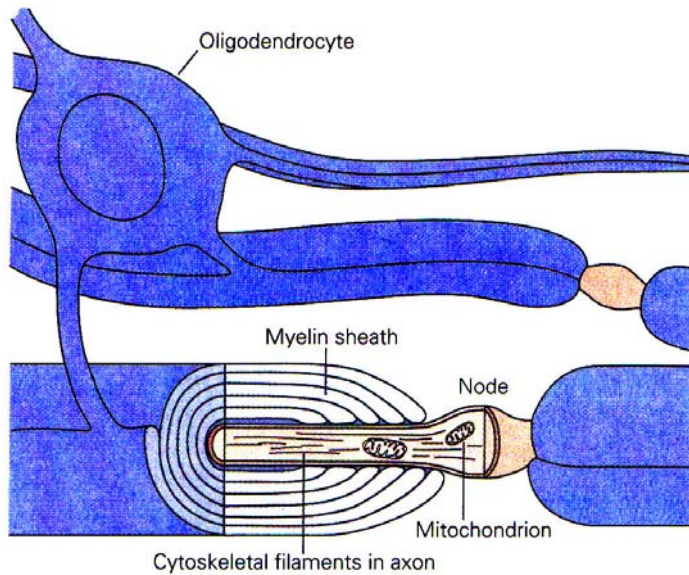
© 2001 Sinauer Associates, Inc.

Glial ('glue"; from Greek) cells outnumber neurons about 10 to 1.

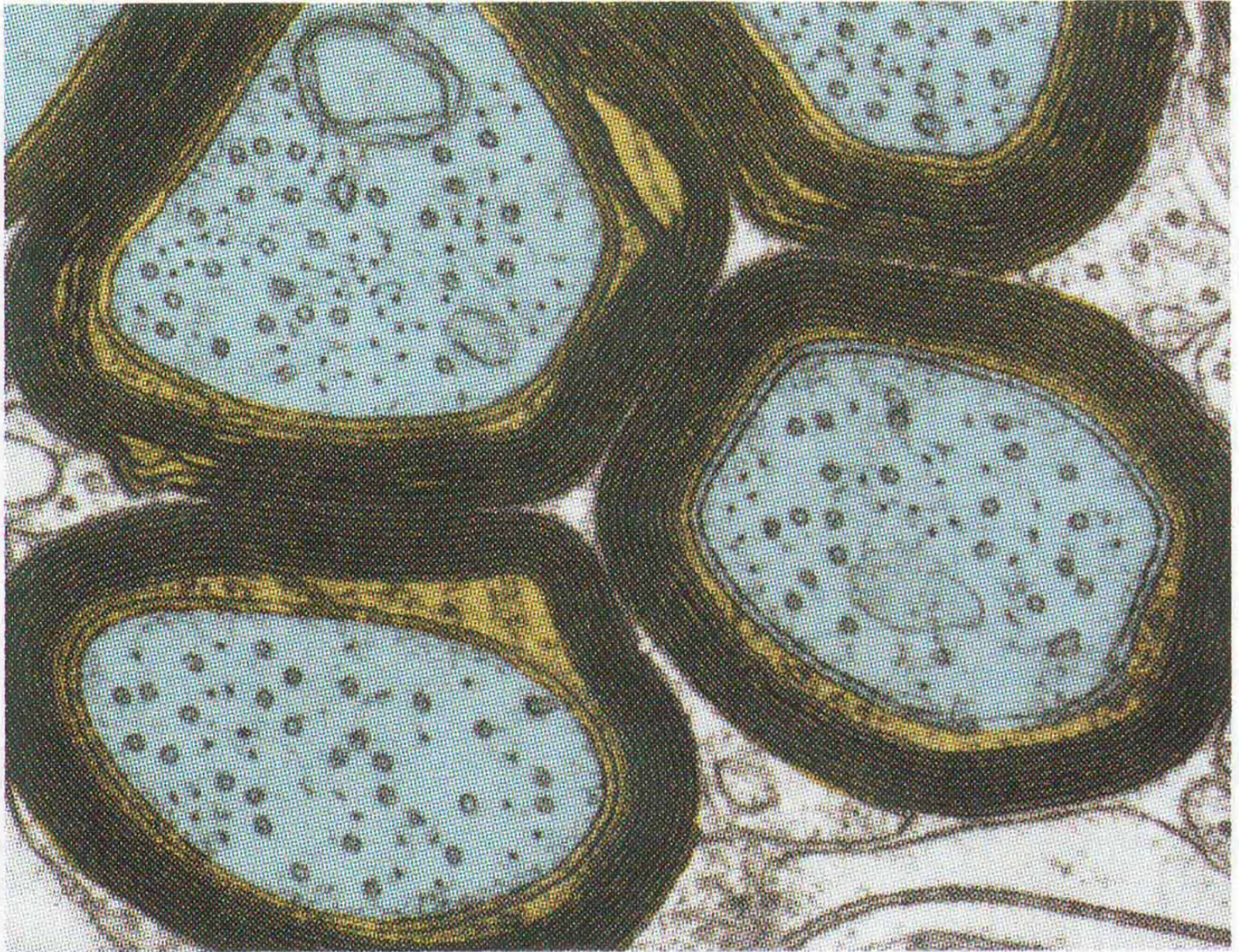
Functions include myelination and clearing neurotransmitter from the synaptic cleft

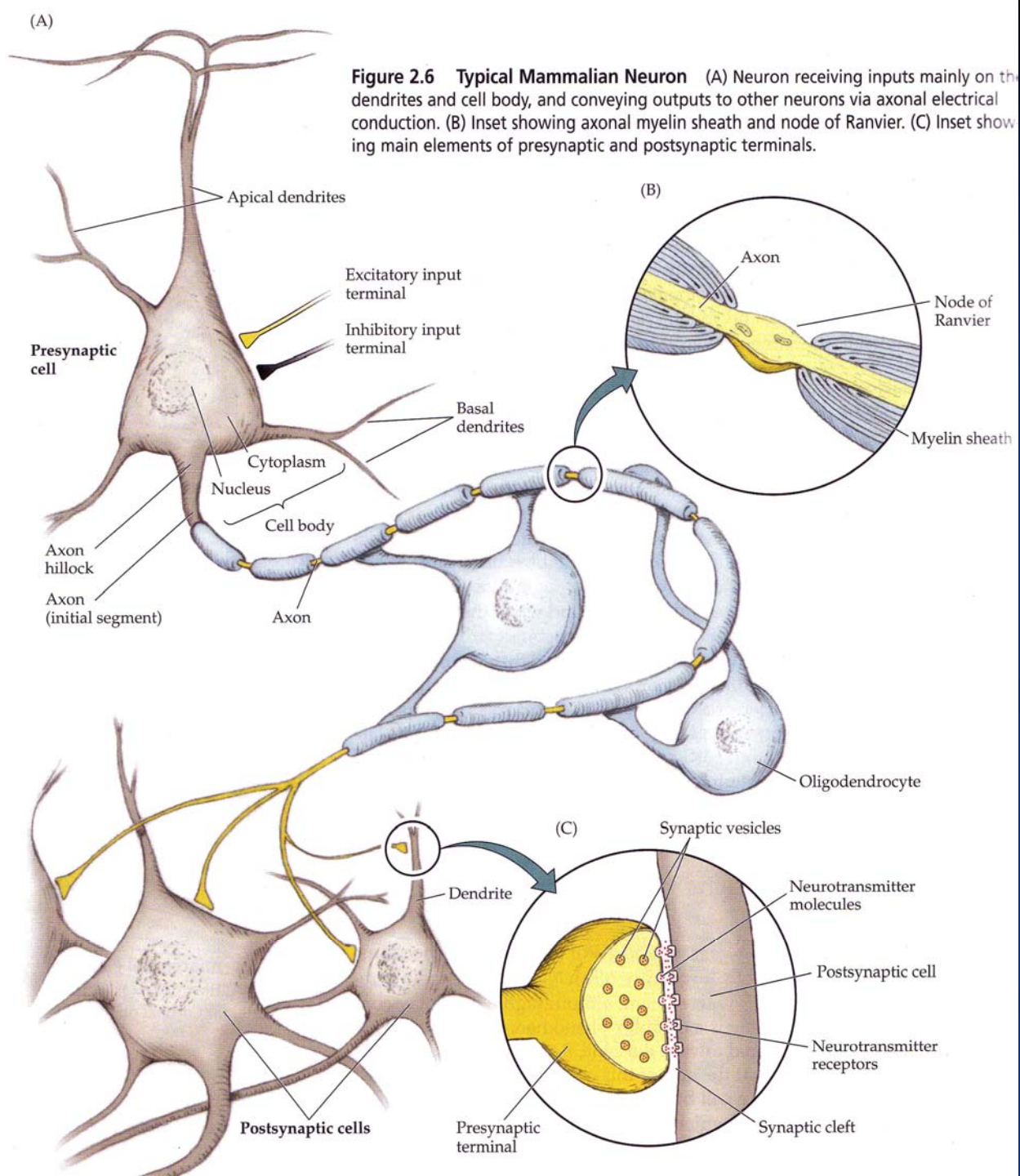
Oligodendrocyte Myelination

A Myelination in the central nervous system

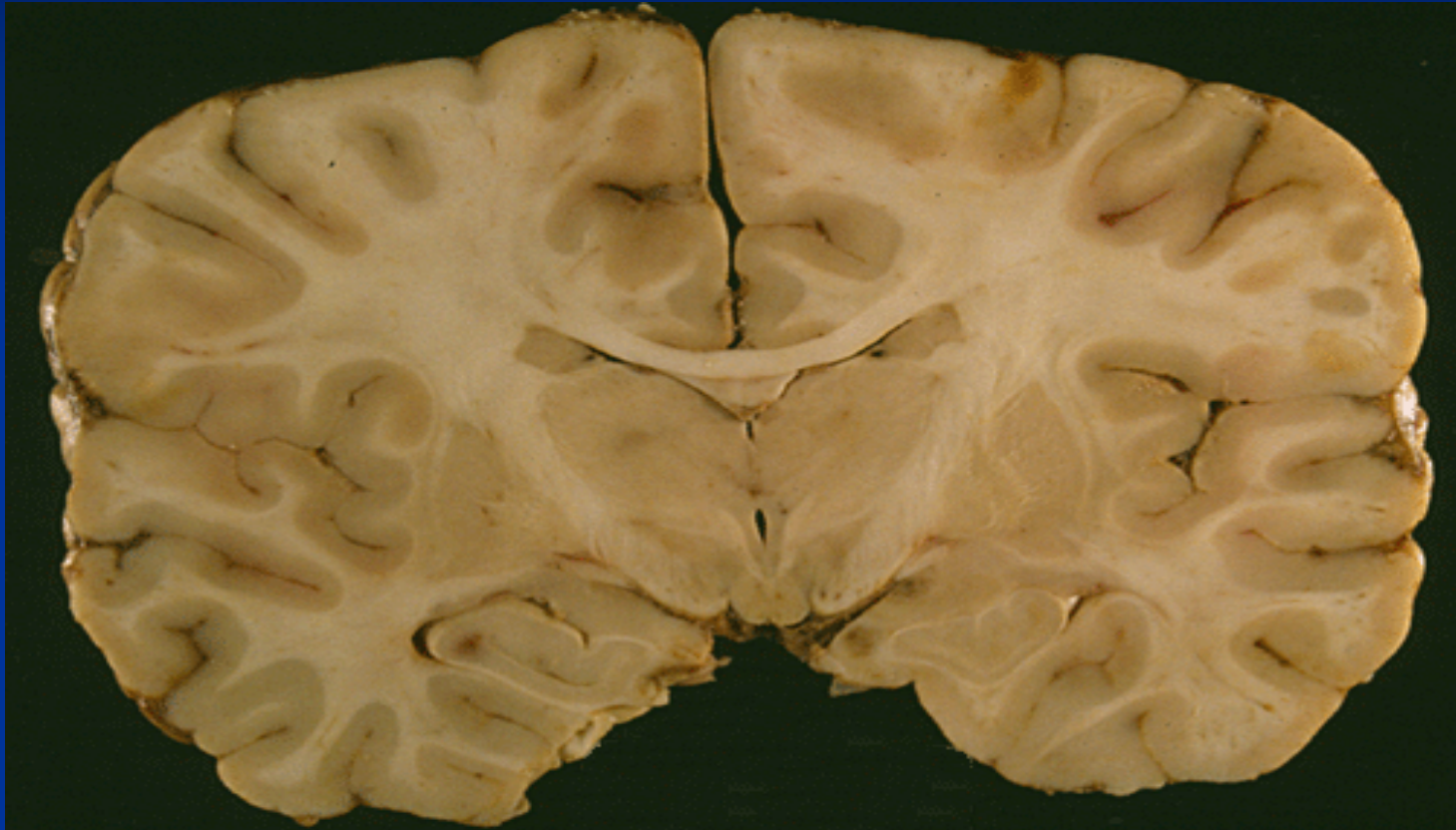


(D) Myelinated axons





Gray vs white matter



- Gray matter

- Cortex (layered)
- Subcortical structures

- White matter

- Myelinated axons

Cortical Layers: Cerebrum

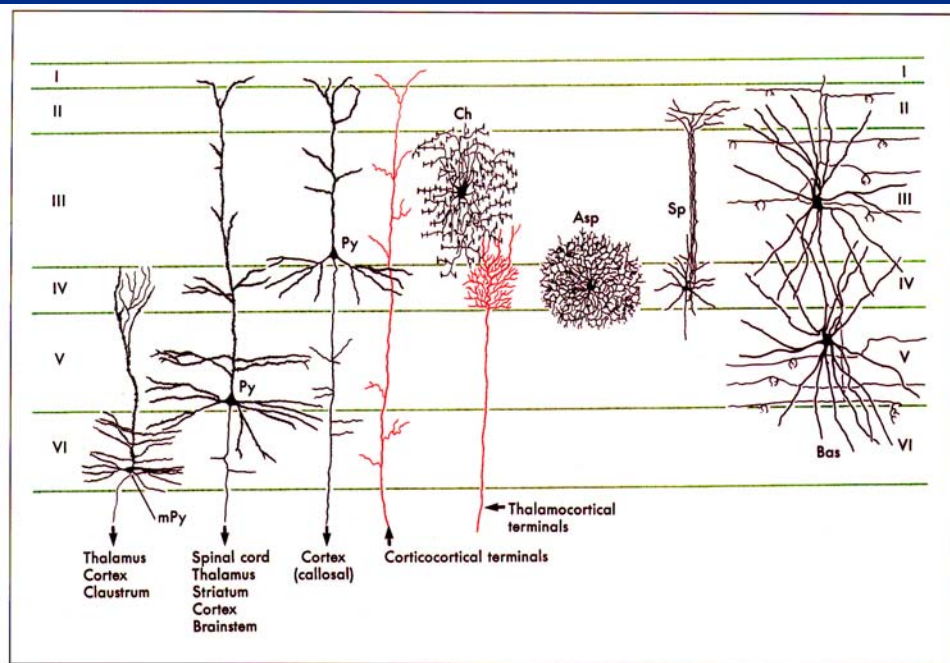
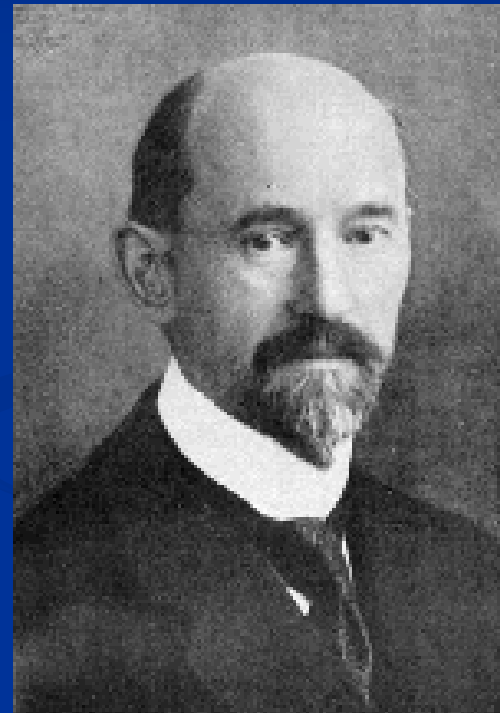


FIGURE 31-4 Representative cell types in the cerebral cortex and the layers in which their cell bodies and dendrites are found. Dendrites of pyramidal cells (Py) of layers II, III, and V extend into layer I, whereas those of modified pyramidal cells (mPy) in layer VI extend only to about layer IV. Chandelier cells (Ch) are restricted almost entirely to layer III. The somata of aspiny and spiny stellate neurons (ASp, Sp) are in layer IV, although their processes extend into other layers. Basket cells (Bas) have processes that collectively extend into all cortical layers from cell bodies located mainly in layers III and V. (Adapted from Hendry and Jones, 1981, and Jones, 1984, with permission.)

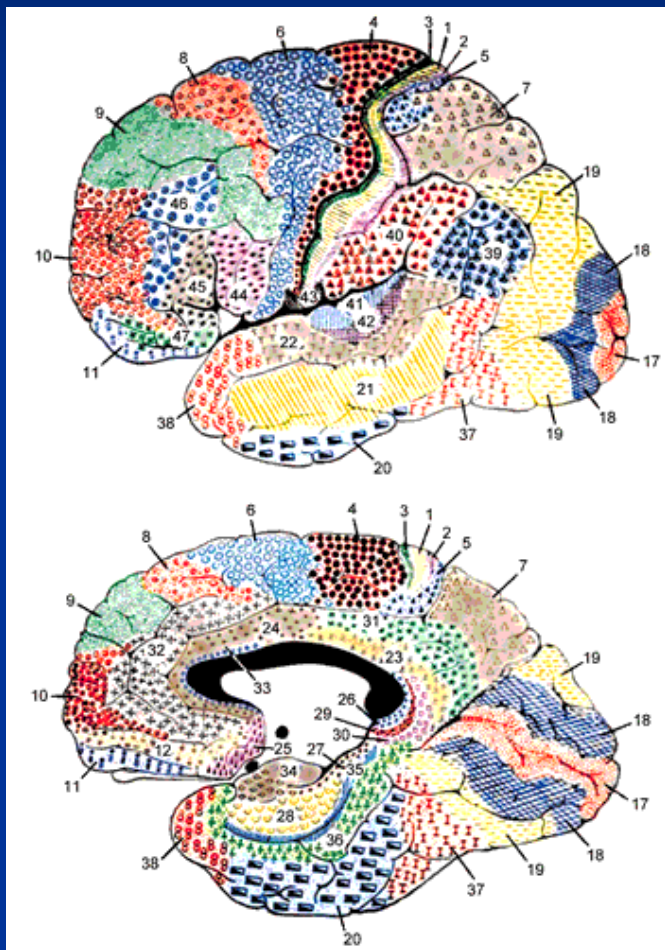
I	Molecular Layer	Dendrites, axons from other layers
II	Small Pyramidal Layer	Cortical-cortical connections
III	Medium Pyramidal Layer	Cortical-cortical connections
IV	Granular Layer	Input from thalamus
V	Large Pyramidal Layer	Output to subcortical structures
VI	Polymorphic Layer	Output to thalamus

Cellular Organization in the Cerebrum

- **DR. KORBINIAN BRODMANN (1868-1918)**
- **Cyto-architectonic map of cortex in 1909**

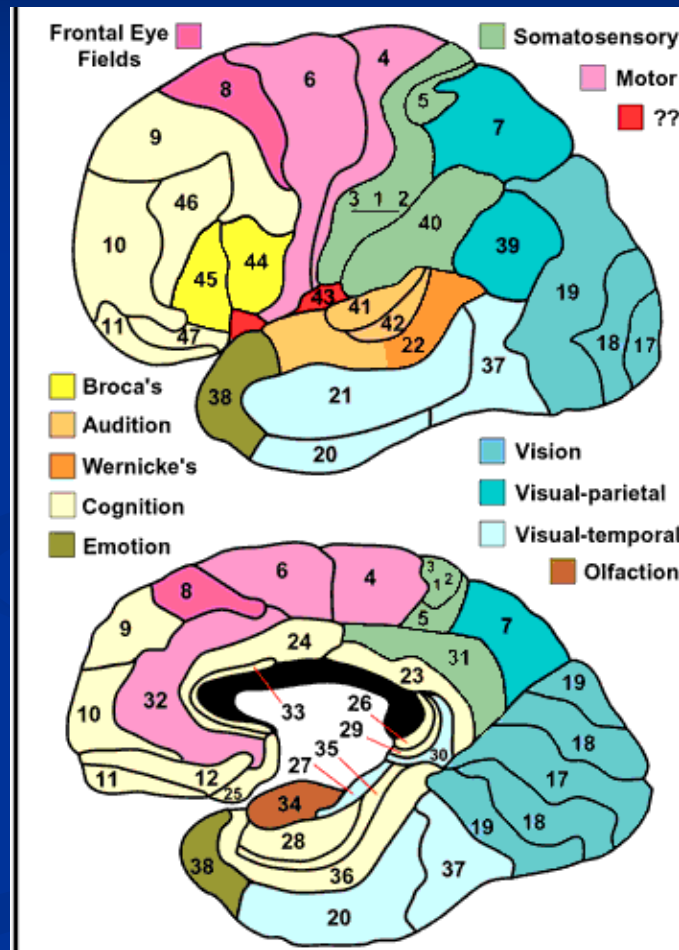


Brodmann Areas

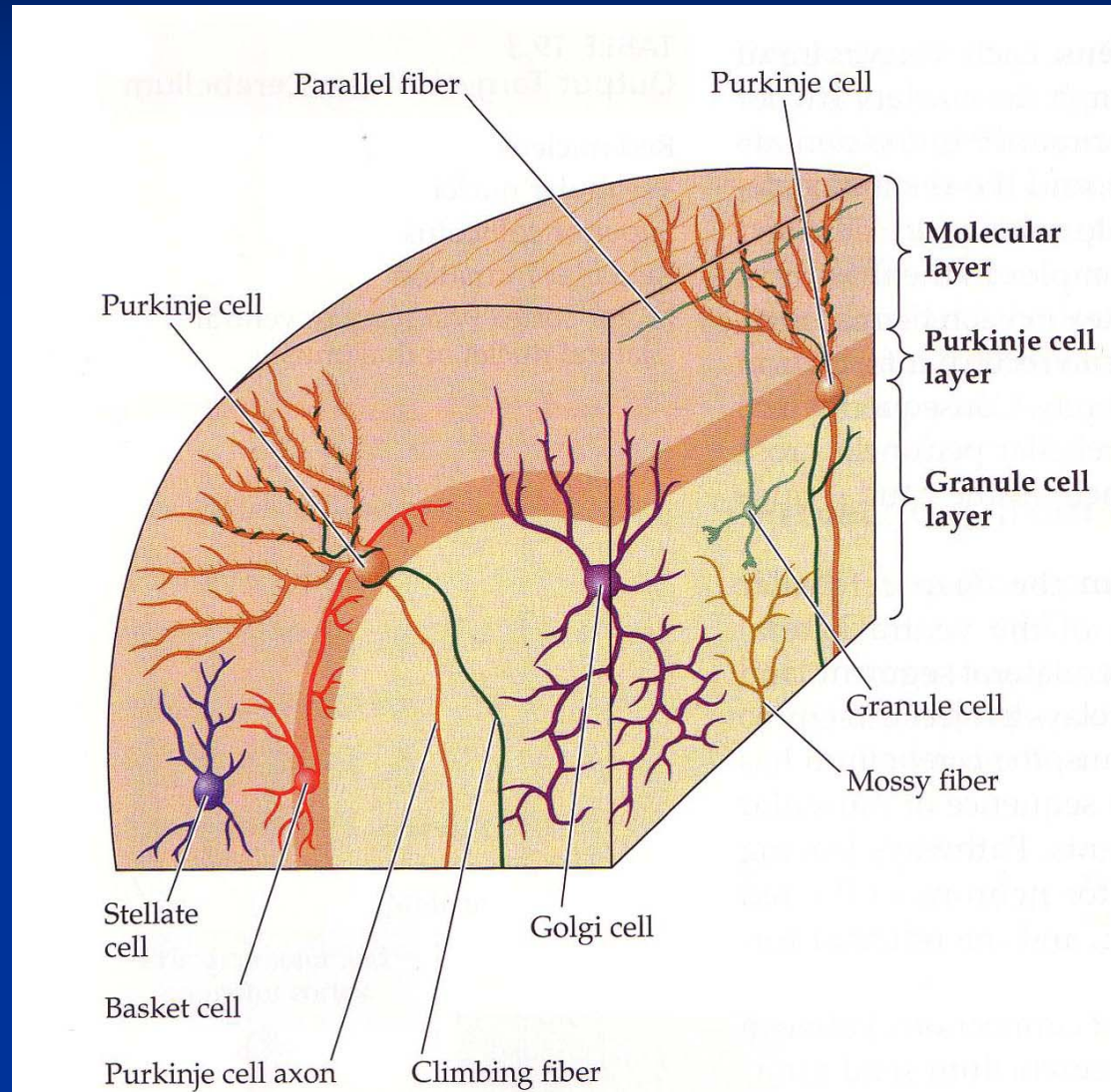


Broca's
area:

BA 44
BA 45

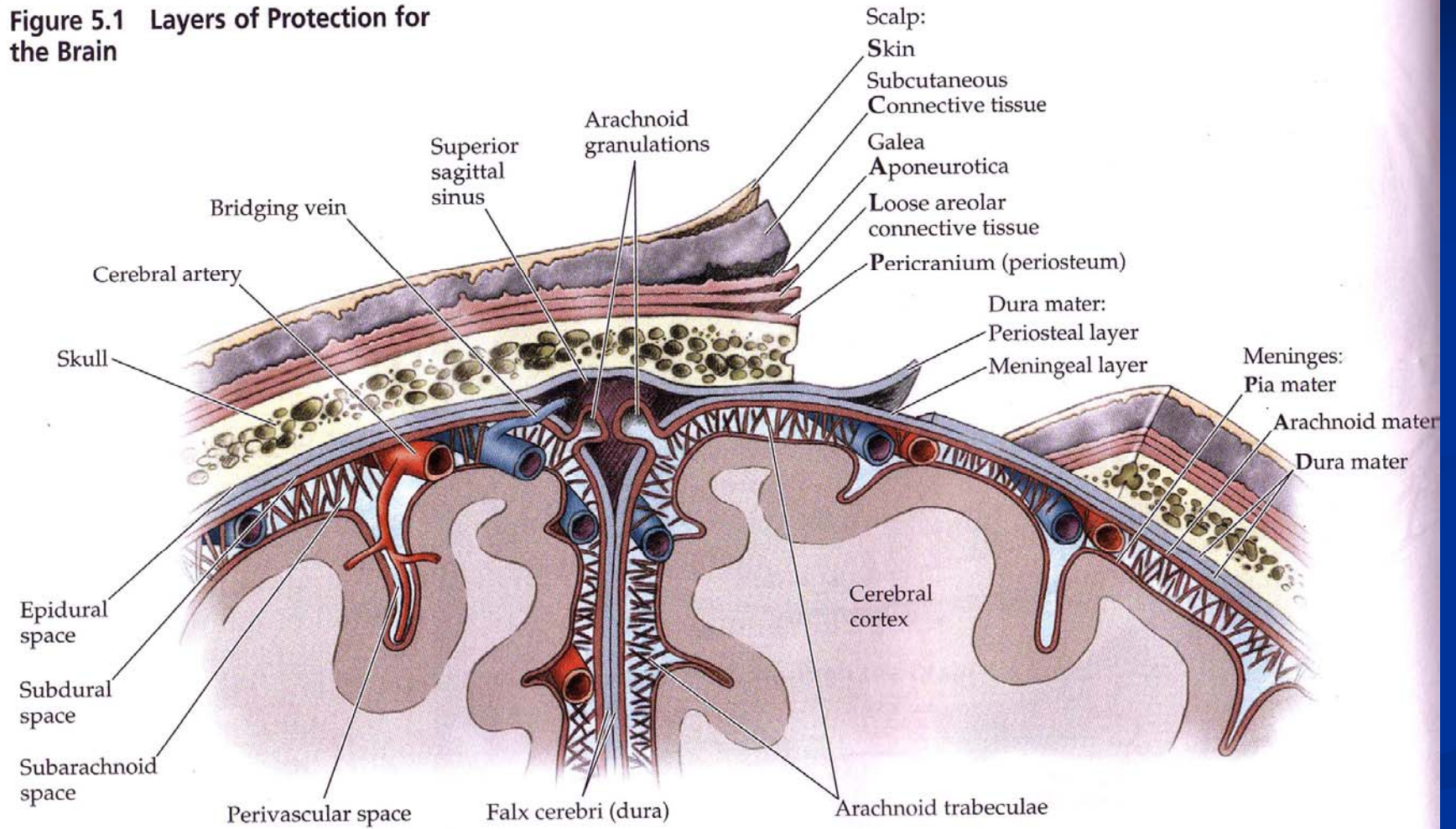


Cortical Layers: Cerebellum

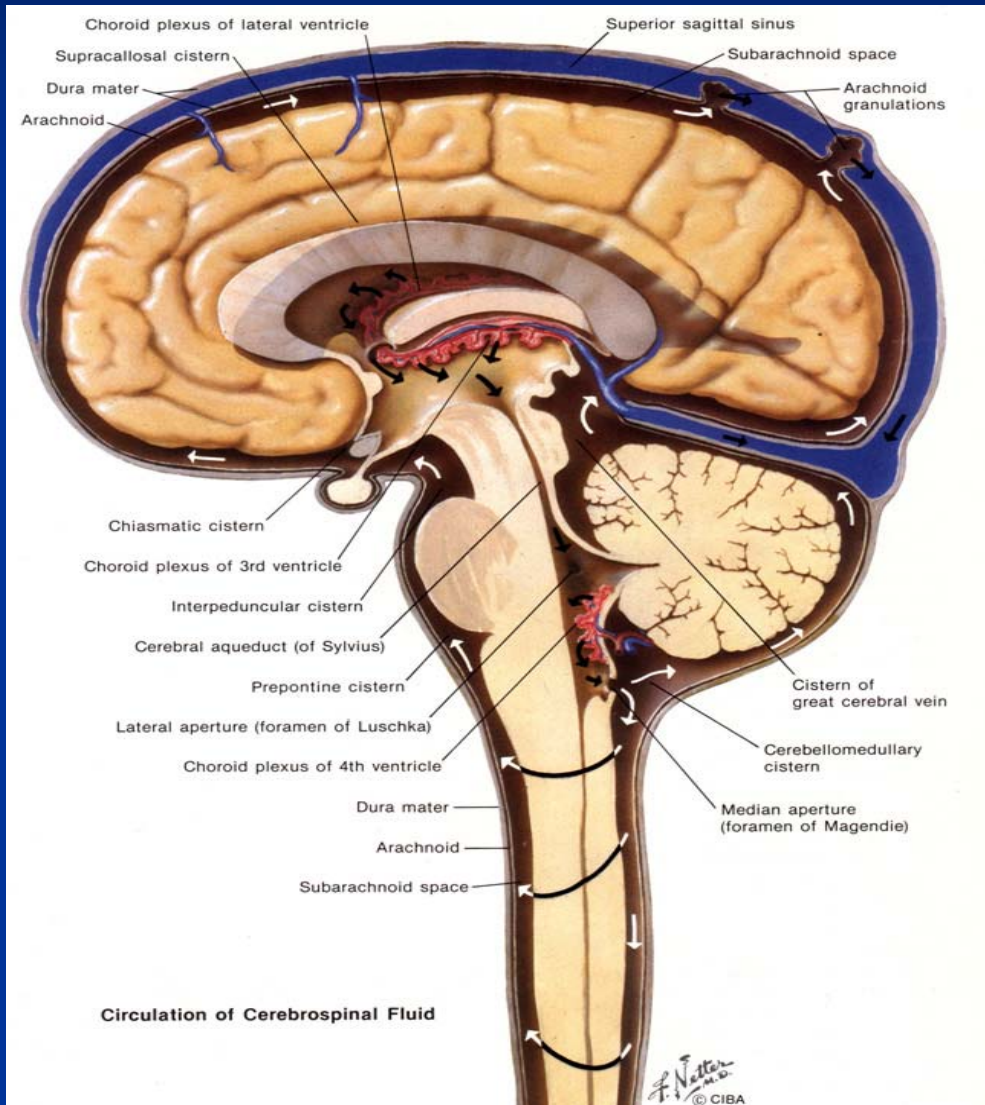


Fluids in the brain

Figure 5.1 Layers of Protection for the Brain

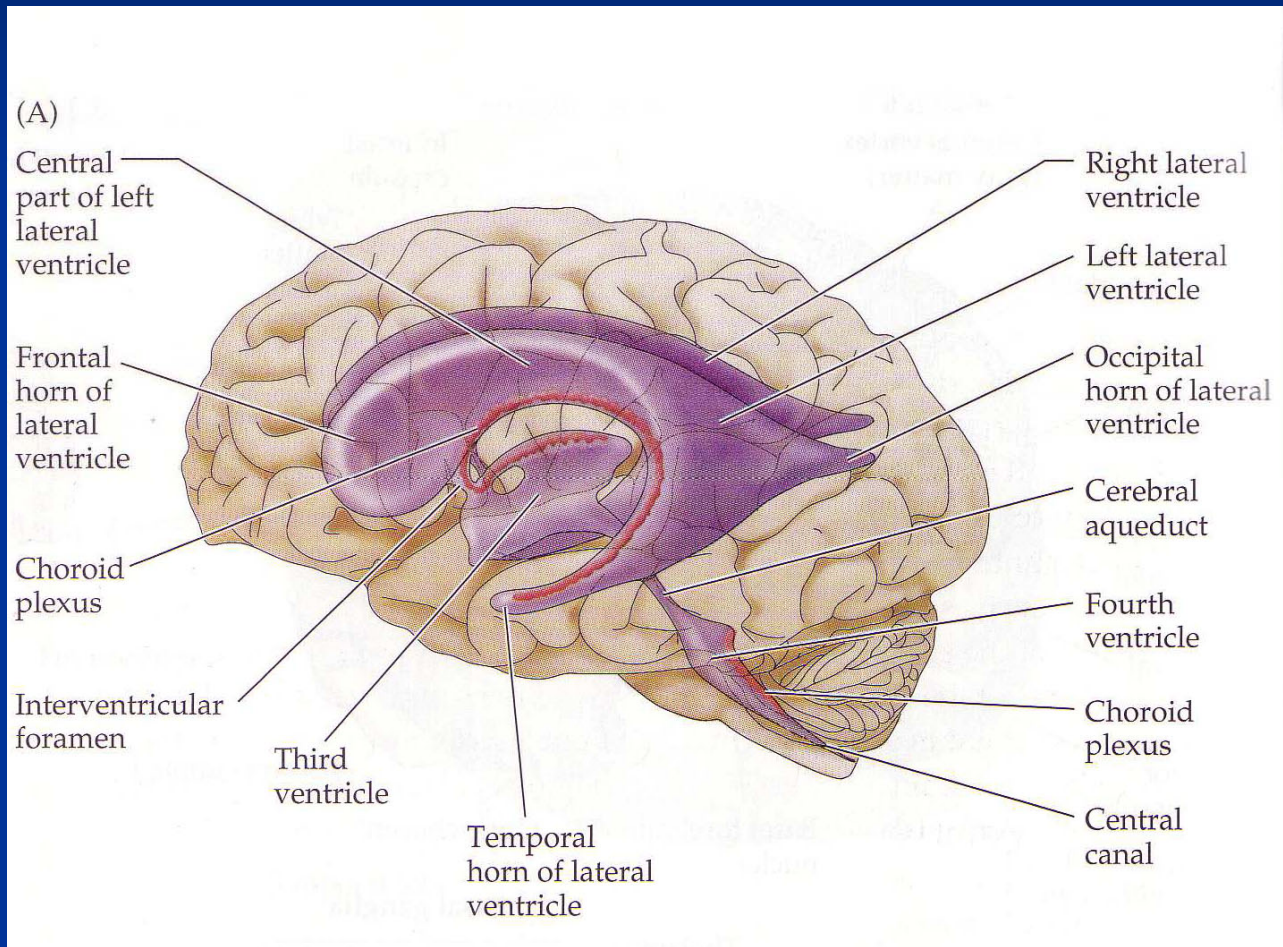


Cerebrospinal fluid (CSF)

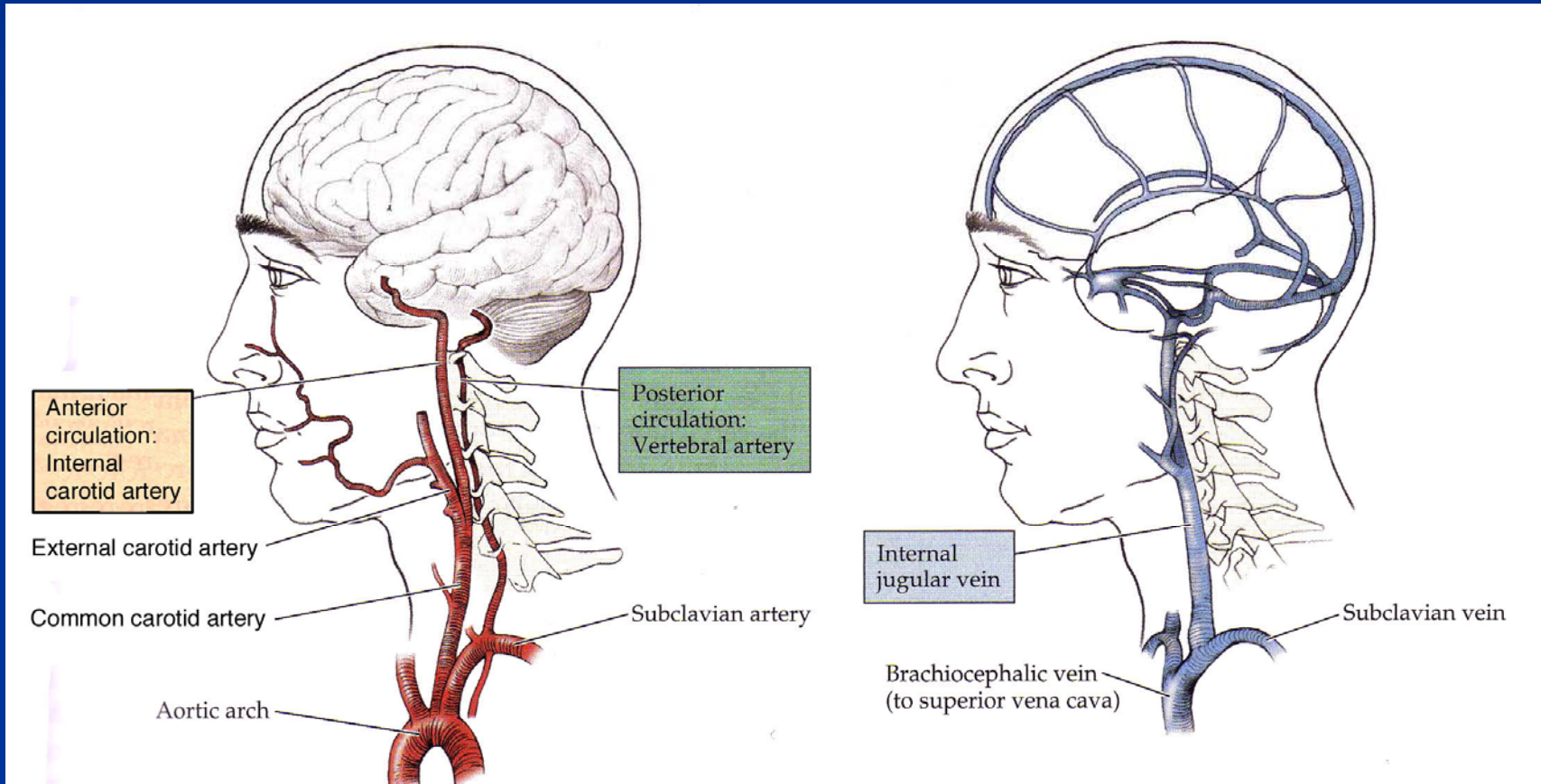


- Occupies all sub-arachnoid space
- Produced by the choroid plexus
 - About 500 ml/day
- Volume of CSF in ventricles about 150 ml
- Fluid drains into venous system, and is replaced

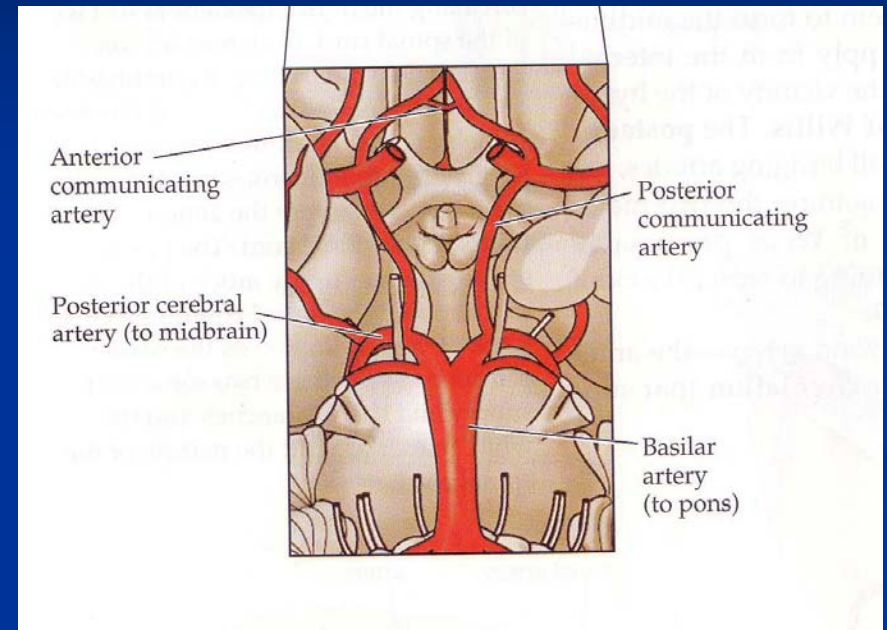
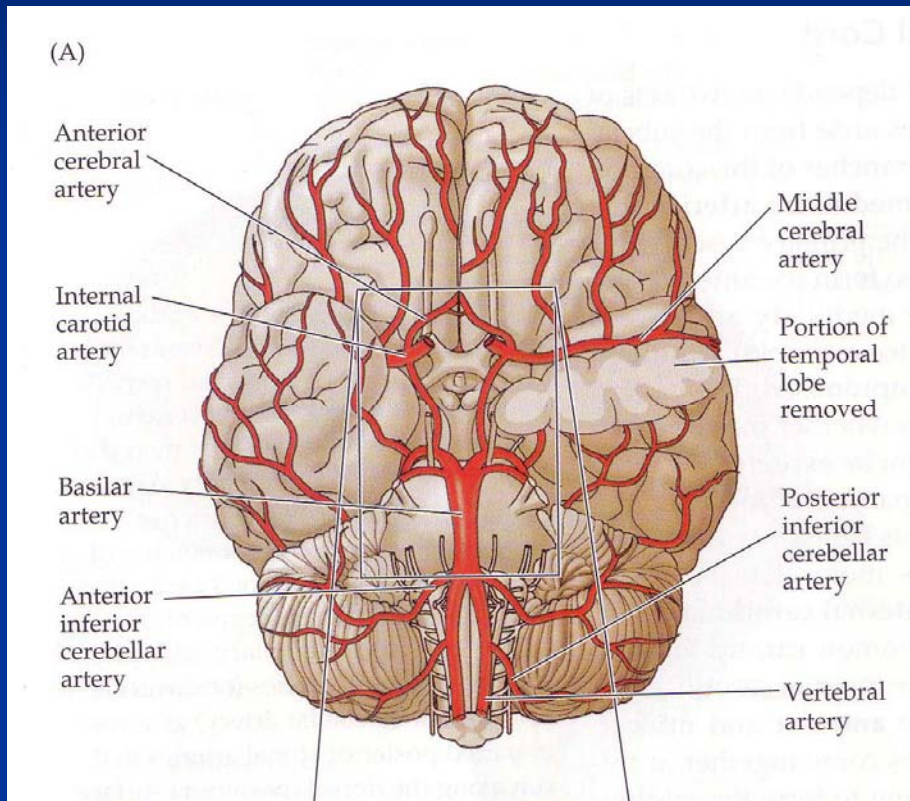
Ventricles



Blood supply and drainage

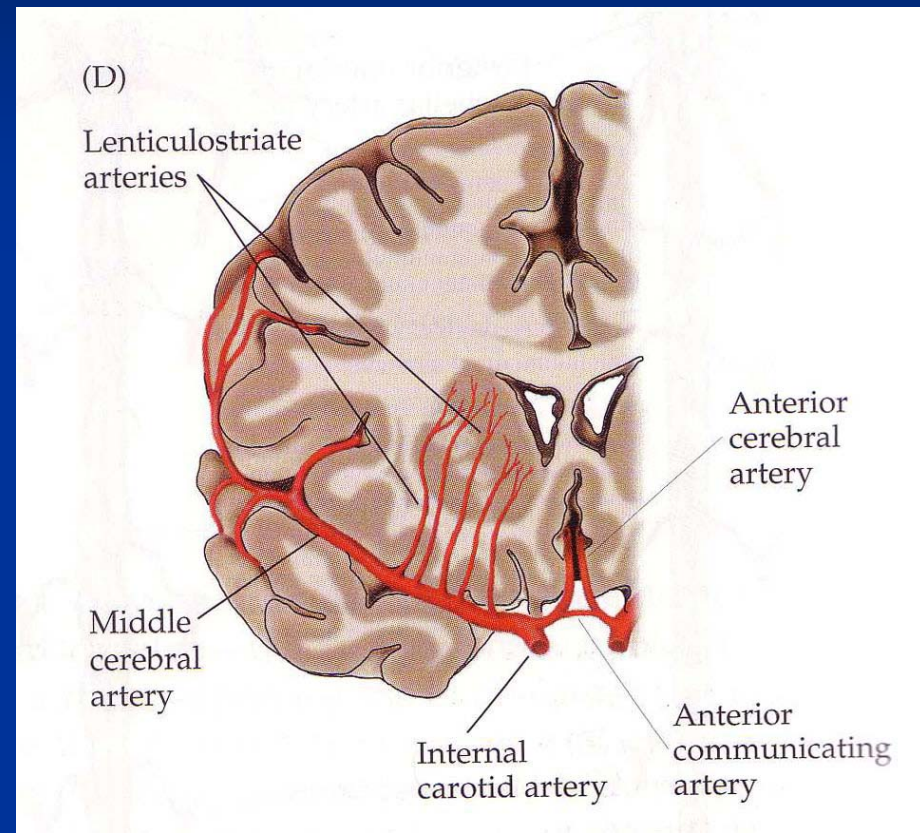
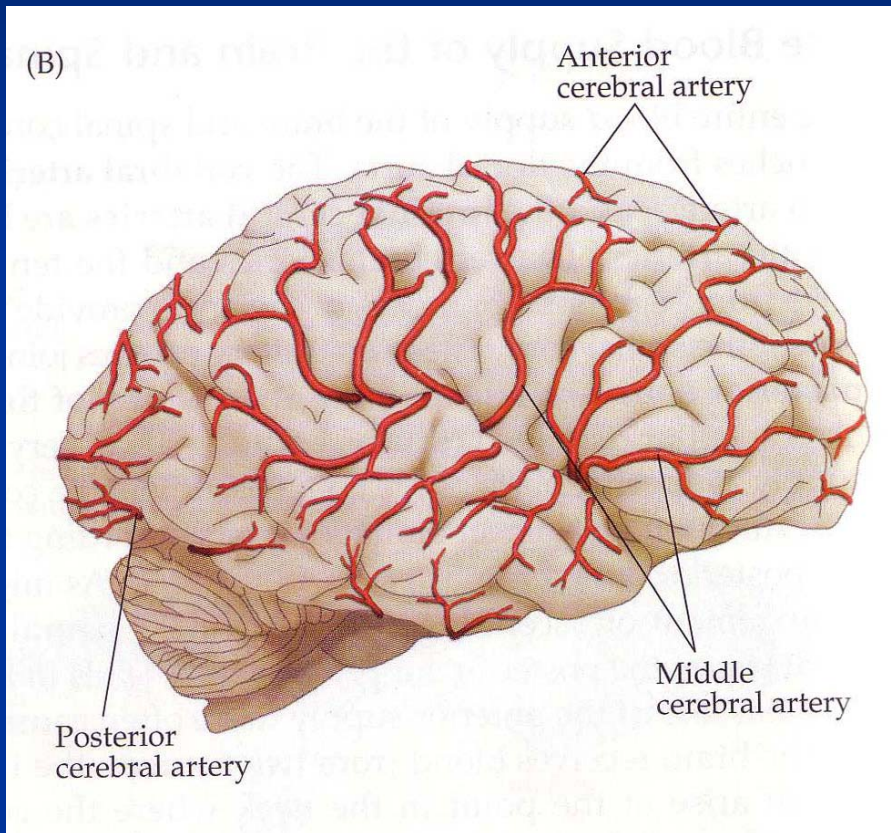


Arterial Blood Supply



Circle of Willis

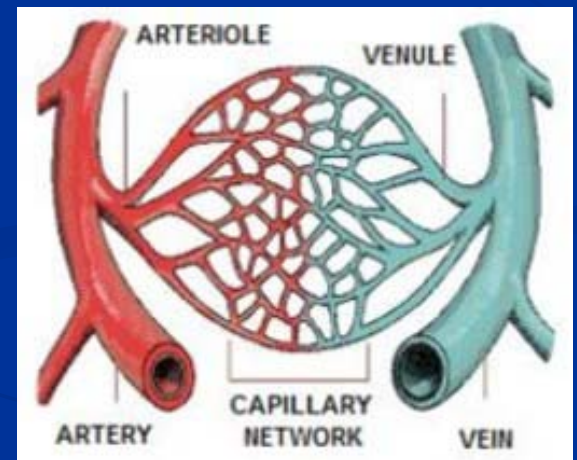
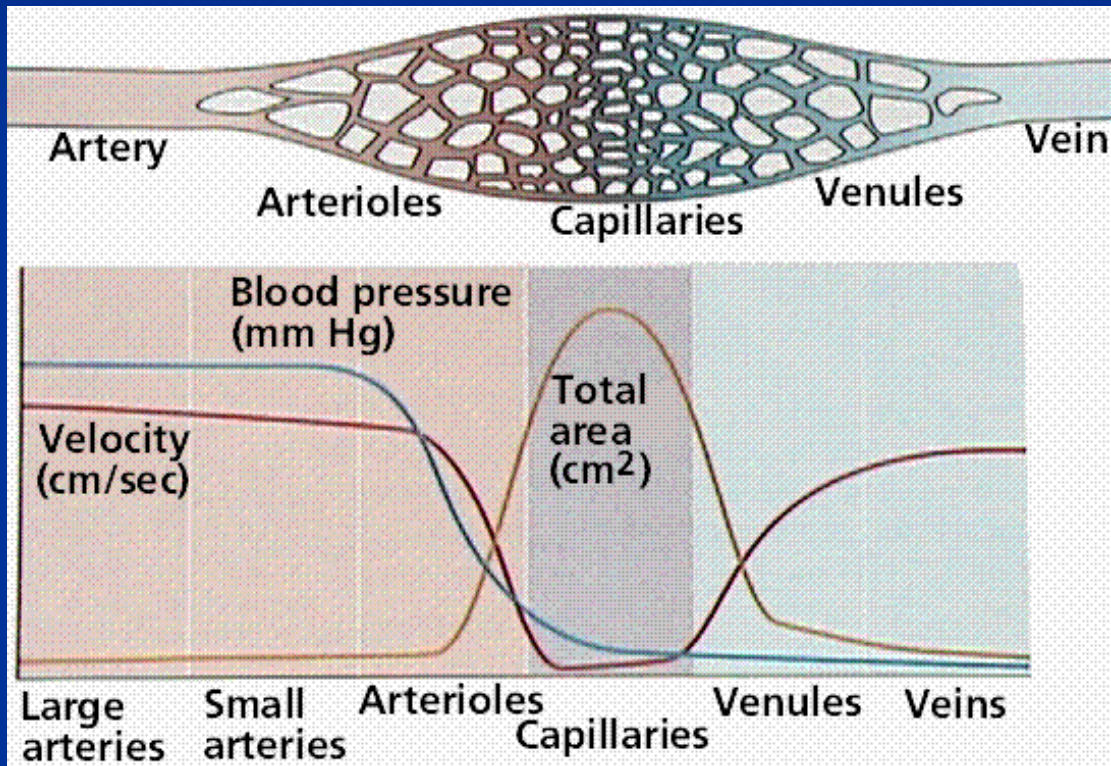
Middle Cerebral artery



The middle cerebral artery is the largest branch of the internal carotid. The artery supplies a portion of the frontal lobe and the lateral surface of the temporal and parietal lobes, including the primary motor and sensory areas of the face, throat, hand and arm and in the dominant hemisphere, the areas for speech.

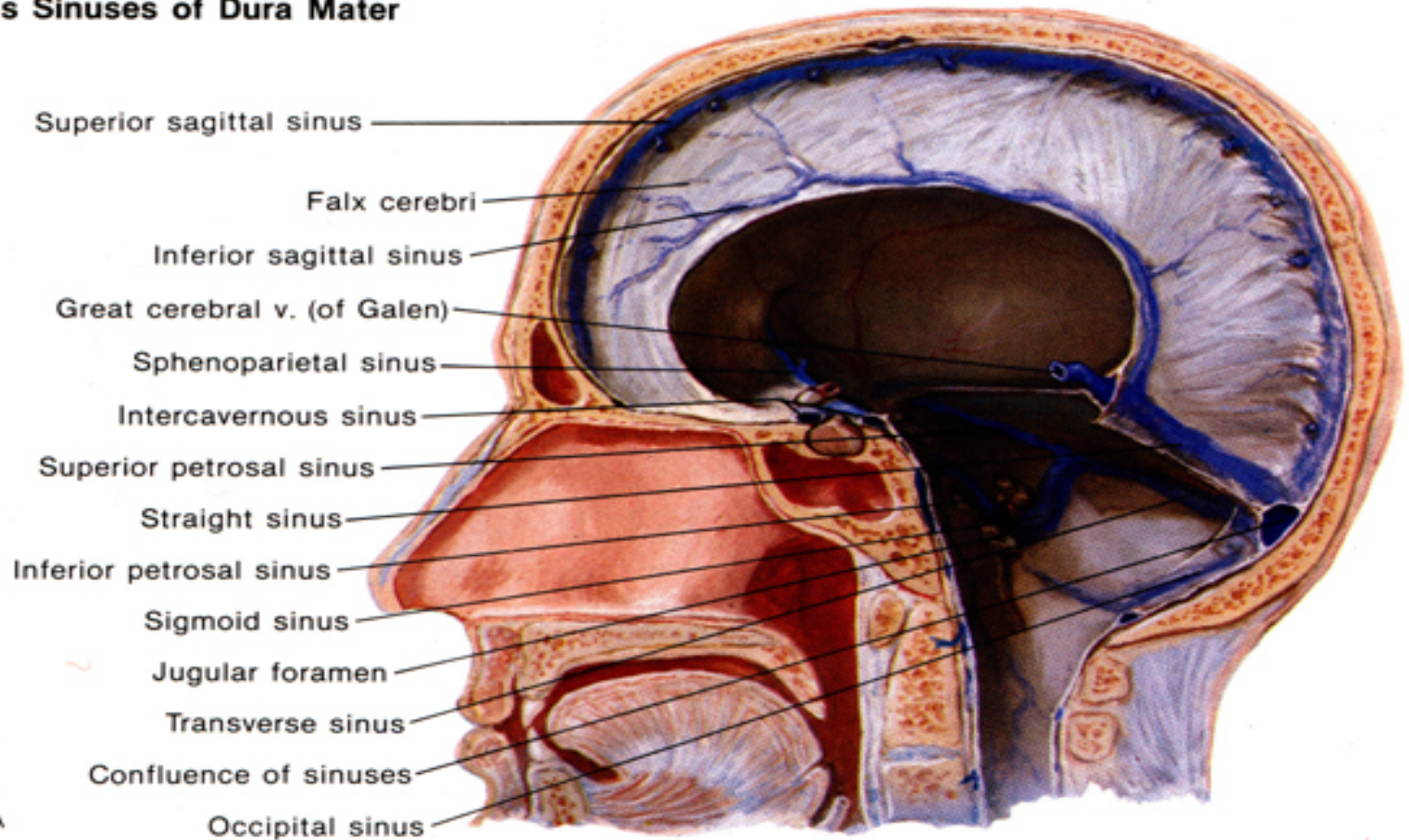
- The middle cerebral artery is the artery most often occluded in stroke.

Capillaries



Venous Blood Drainage

Venous Sinuses of Dura Mater



Brain Development

Summary of brain divisions

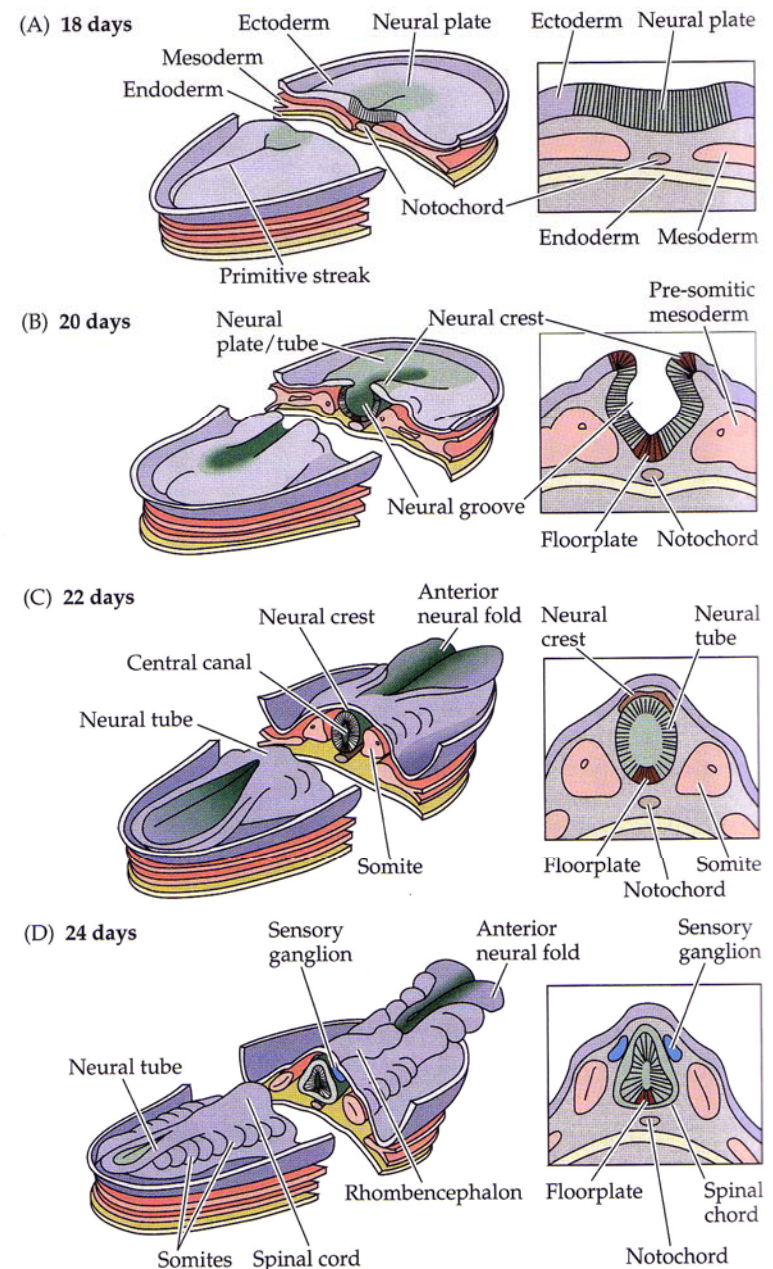
	EMBRYONIC BRAIN	ADULT BRAIN DERIVATIVES	ASSOCIATED VENTRICULAR SPACE
Prosencephalon	Telencephalon (forebrain)	Cerebral cortex	Lateral ventricles
		Basal ganglia Hippocampus Olfactory bulb Basal forebrain	
	Diencephalon	Dorsal thalamus Hypothalamus	Third ventricle
	Mesencephalon	Midbrain (superior and inferior colliculi)	Cerebral aqueduct
Rhombencephalon	Metencephalon	Cerebellum	Fourth ventricle
		Pons	
	Myelencephalon	Medulla	Fourth ventricle
	Spinal cord	Spinal cord	Central canal

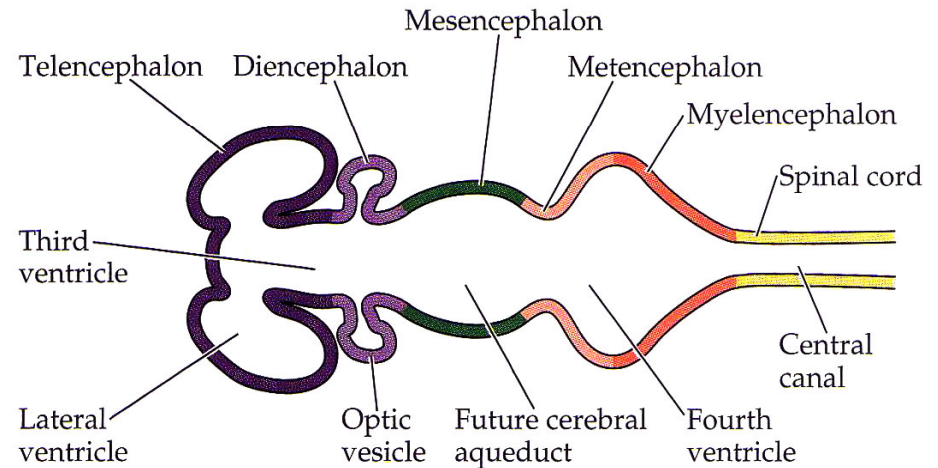
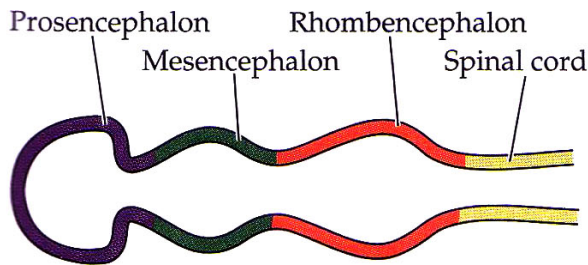
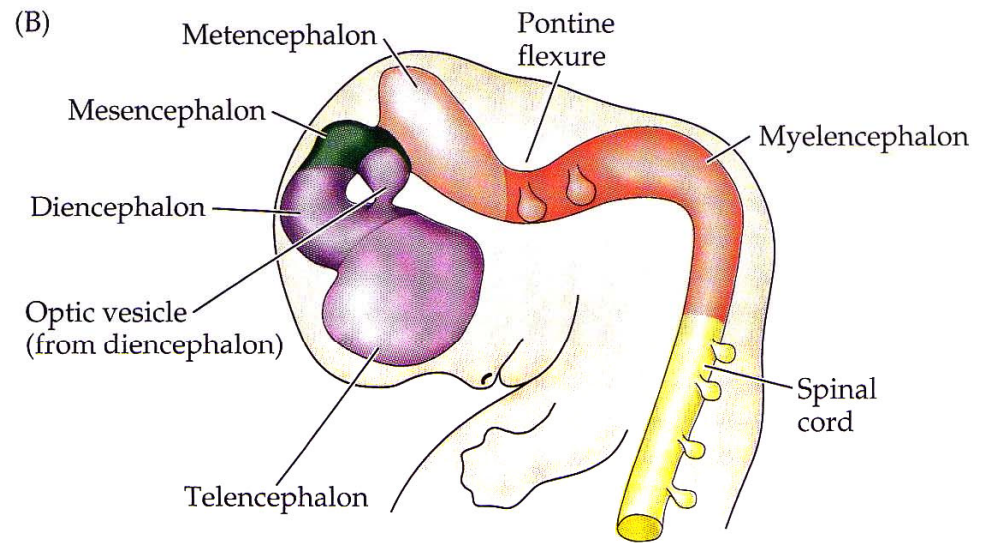
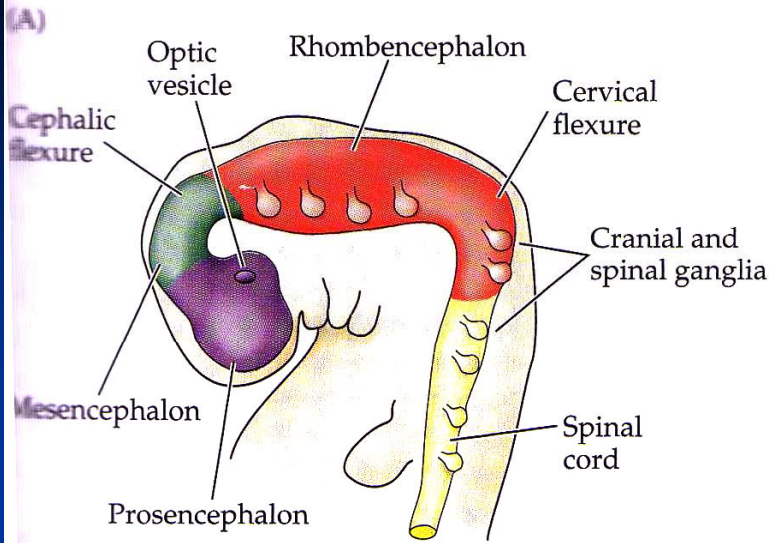
Forebrain

Midbrain

Hindbrain

- Starts with notochord
- Notochord guides formation of neural plate
- Neural plate folds in on itself
 - Forms neural groove
 - Then neural tube
- Somites give rise to musculature and skeleton
- Neural tube adjacent to somites becomes spinal cord
- Anterior ends of neural plate (anterior neural fold) becomes brain





Neural tube bent, folded, and constricted
 Prosencephalon → telencephalon; di-encephalon
 Rhombencephalon → metencephalon; myelencephalon