

Myelin Components

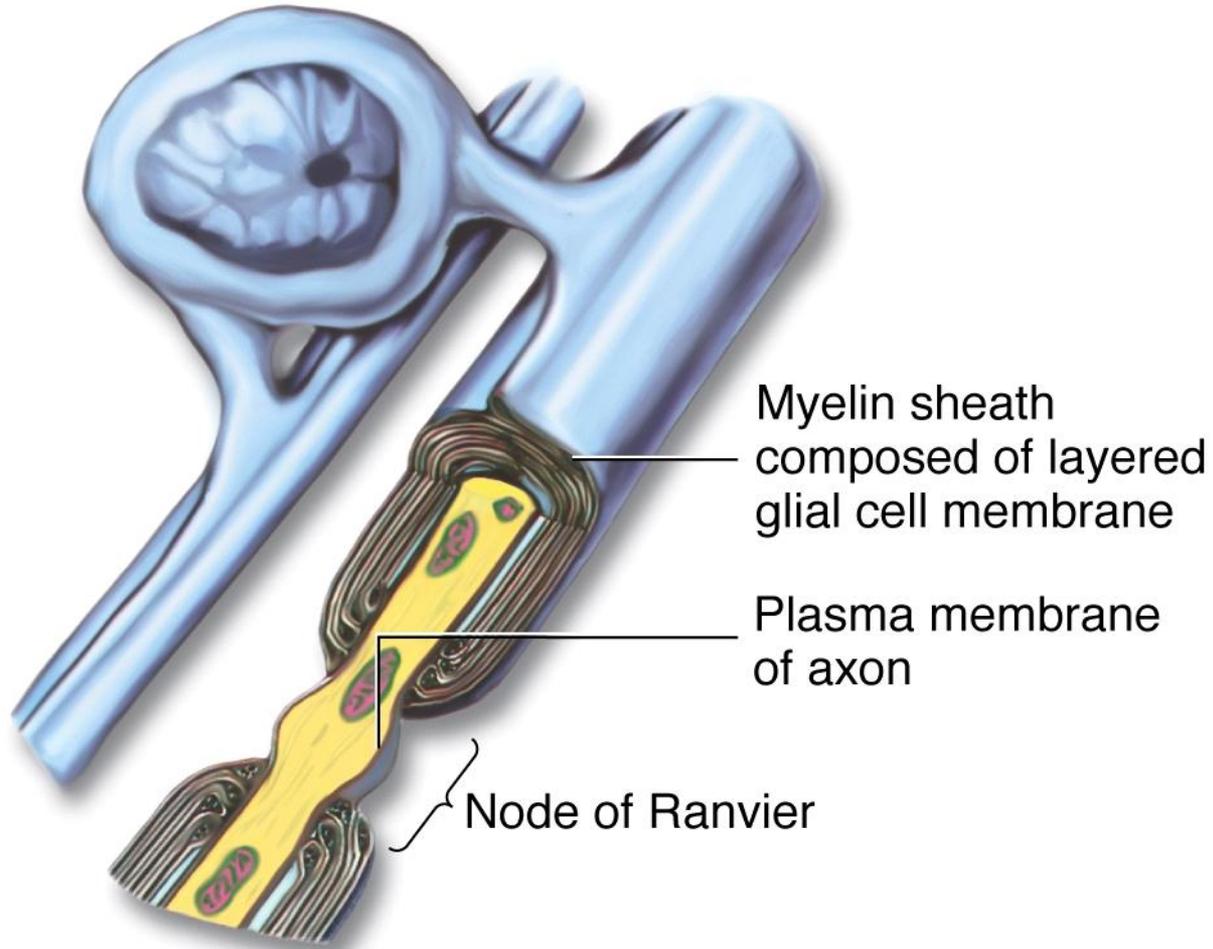
Central and peripheral myelin also contain **myelin basic proteins**.

Seven related proteins **produced from a single gene** by alternative splicing.

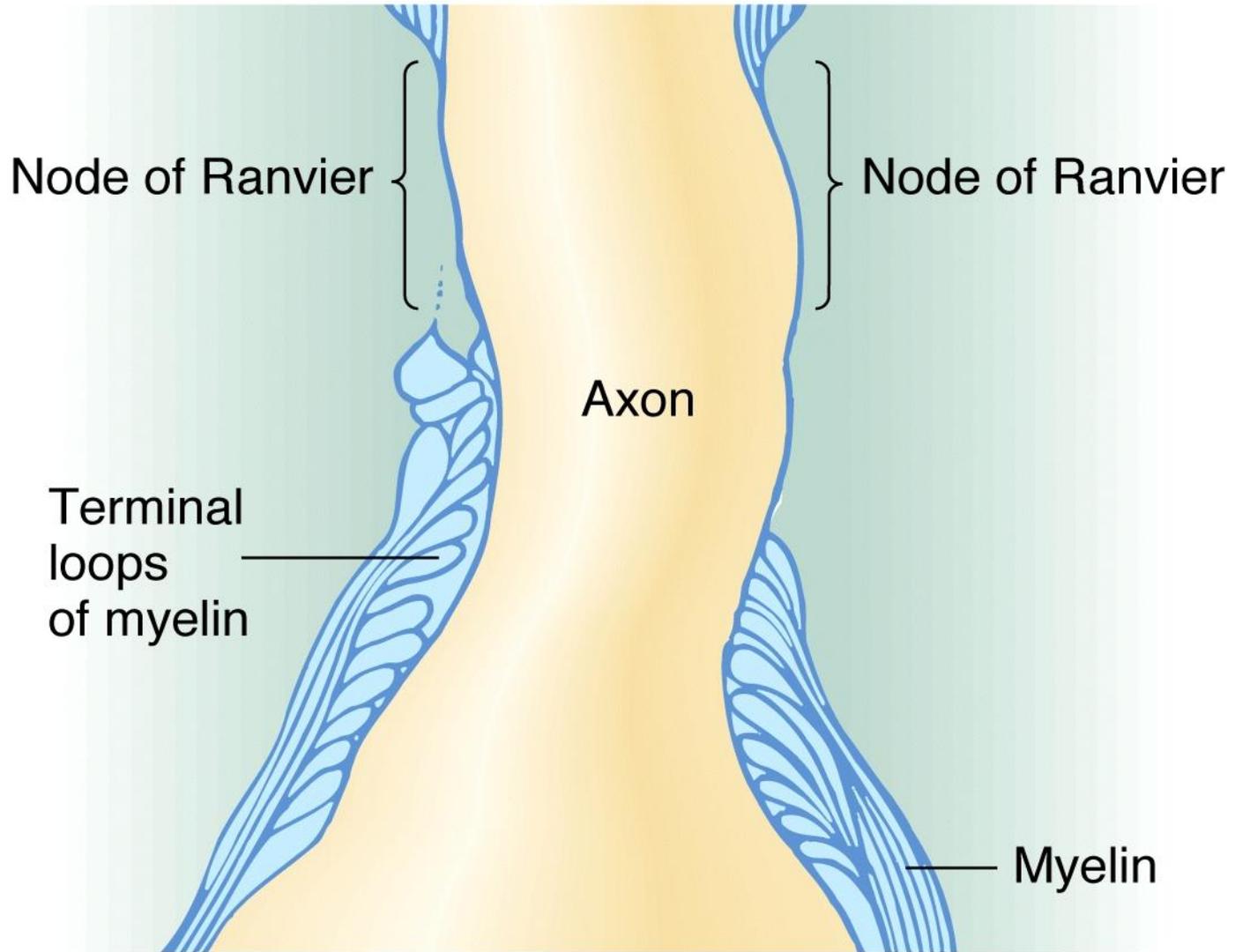
Proteins are highly antigenic.

Inject into animals  autoimmune response called **experimental allergic encephalitis** (demyelination in CNS)

(a) Oligodendrocyte



Schwann cells in the peripheral nervous system.



Mice - shiverer mutation (recessive) - Deletion 5 of 6 exons for myelin basic protein on chromosome 18

cause tremors, frequent convulsions and die young

Homozygous - less than 10% normal myelination

Inject wild type gene into fertilized eggs - transgenic mice express gene at right time

produce about 20% of normal amount of proteins

much more myelination

occasional tremors but do not convulse and have normal life span

Glia and Axon Regeneration

If peripheral axons severed, they grow back because:

- axons and associated myelin break down
- axonal and myelin debris, removed by surviving Schwann cells and macrophages.
- tubular structures defined by basal lamina retained. Components contained in basal lamina potent promoters of neurite growth

Schwann cells secrete their own growth factors and have membrane proteins that aid neuron growth

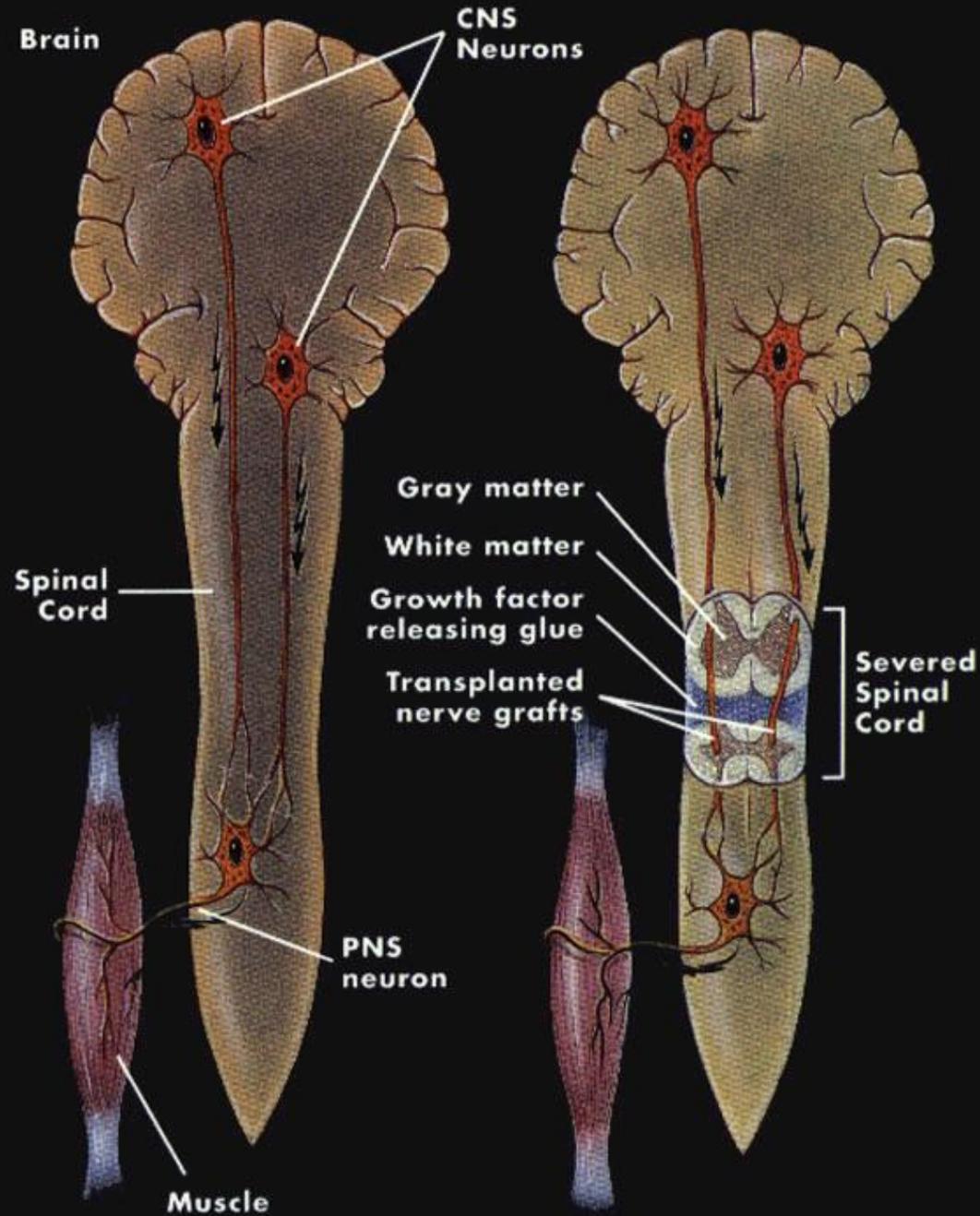
See CNS repair chapter ([PDF](#))

**Make natural tubes to
“guide” axons**

**peripheral grafts
containing
support cells and
cut axons**

**Also use of embryonic
cells which are not
subject to regeneration
limitations**

**Inject Schwann cells into
area**



Myelin in the brain and spinal cord gets in the way of axon regeneration

Interfering with myelin can aid axon repair and restore some function in rodents with spinal cord injuries.

- a vaccine against myelin prompted axons regrowth and treated animals regained some movement in their hind legs**

Other possible approaches?

Identify specific molecules signaling macrophages to ingest and remove myelin from the damaged spinal cord.

Target specific components of myelin, instead of whole sheath

Some proteins present in CNS myelin:

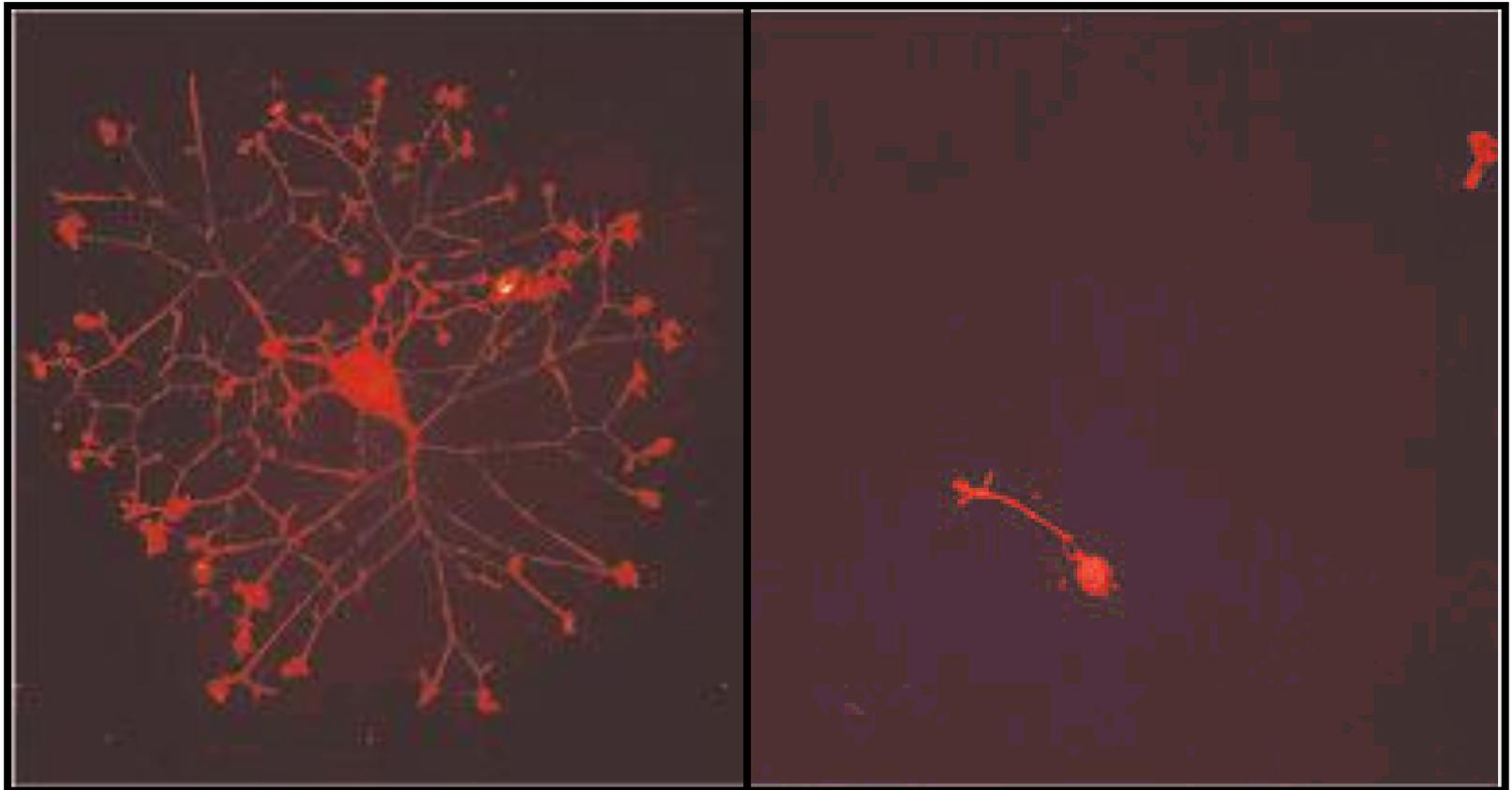
At least MAG and Nogo are capable of causing growth cone collapse and inhibiting neurite outgrowth in vitro.

Have a common receptor (NgR).

[See Paper PDF](#)

myelin-associated glycoprotein (MAG)
Nogo-66 receptor (NgR).

Nogo, may be partly responsible for the inability of damaged axon fibers to repair.



Normal neuron

Neuron treated with synthesized Nogo

The Nervous System

1) Central Nervous System

Brain, spinal cord, retina

2) Peripheral Nervous System

Everything (except the retina) outside of
the brain and spinal cord

Peripheral Nervous System

1) **Somatic** - carries voluntary motor and sensory information both to and from the CNS.

2) **Autonomic**

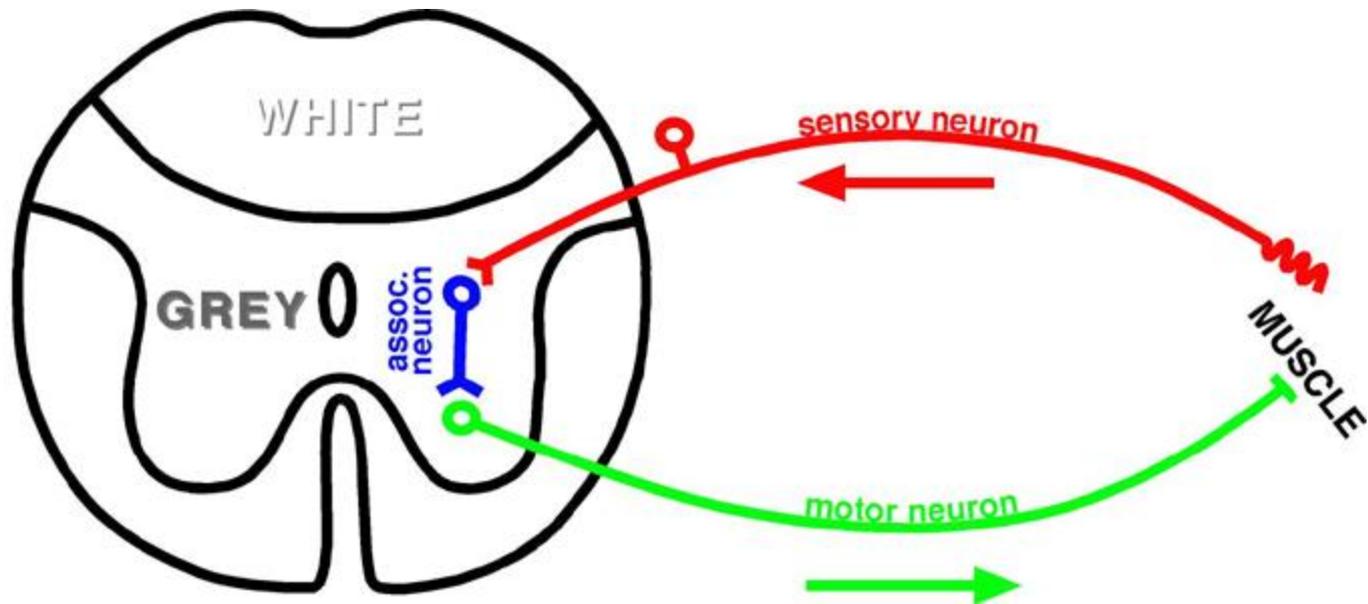
a. sympathetic

b. parasympathetic

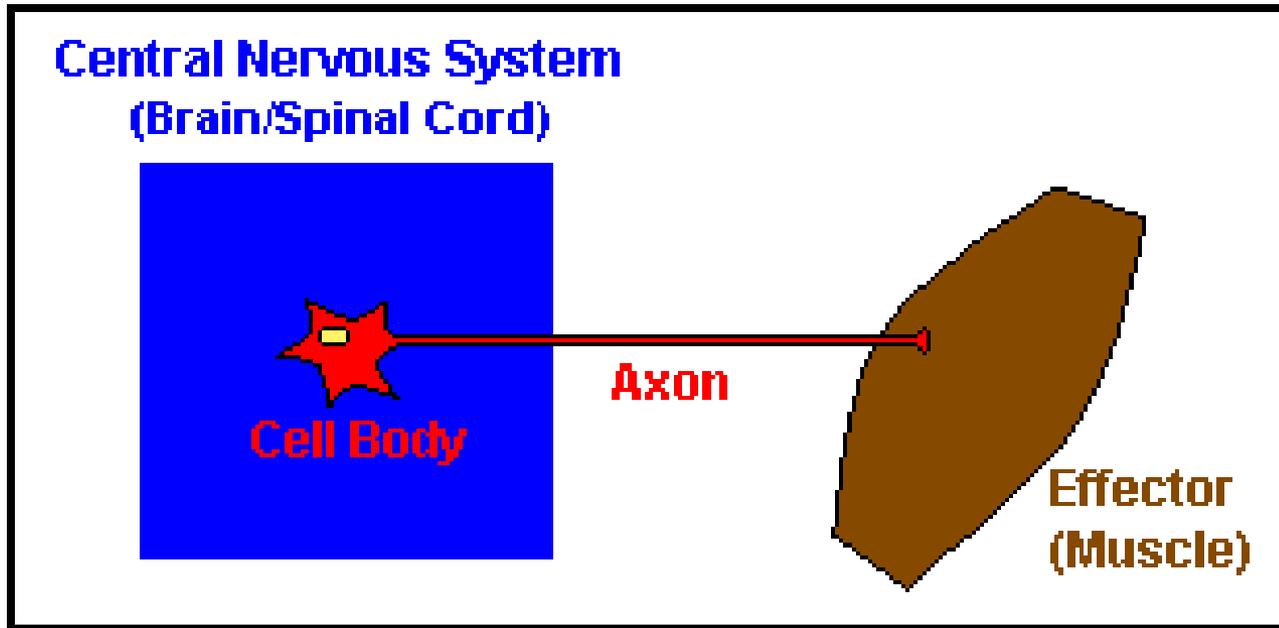
3) **Enteric** - meshwork of nerve fibers that innervate the viscera (gastrointestinal tract, pancreas, gall bladder).

Peripheral Nervous System

1) **Somatic** - peripheral nerve fibers that send sensory information to the central nervous system AND motor nerve fibers that project to skeletal muscle.



Somatic Nervous System



<http://faculty.washington.edu/chudler/nsdivide.html>

The cell body is located in either the brain or spinal cord and projects directly to a skeletal muscle.

Peripheral Nervous System

1) Somatic

2) Autonomic - controls smooth muscle of the viscera (internal organs) and glands.

a. sympathetic - "fight" or take "flight"
(run away)

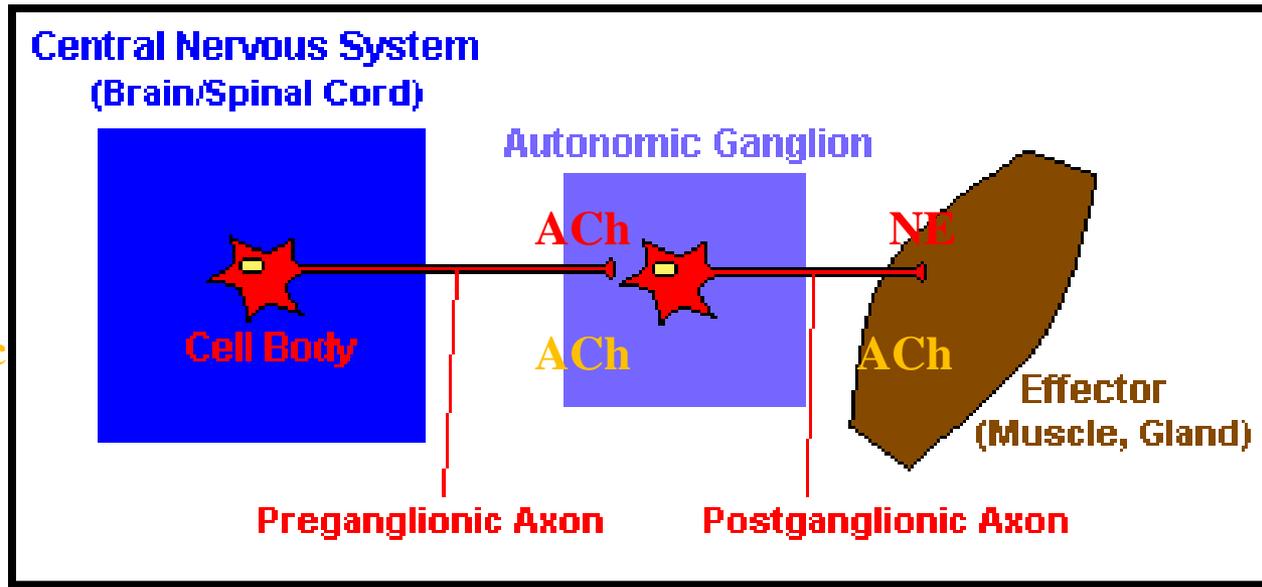
b. parasympathetic - "rest" and "digest"

3) Enteric

Fight-or-Flight Response



Autonomic Nervous System



<http://faculty.washington.edu/chudler/nsdivide.html>

Preganglionic neuron - located in either the brain or the spinal cord and projects to an autonomic ganglion.

Postganglionic neuron - projects to the target organ.

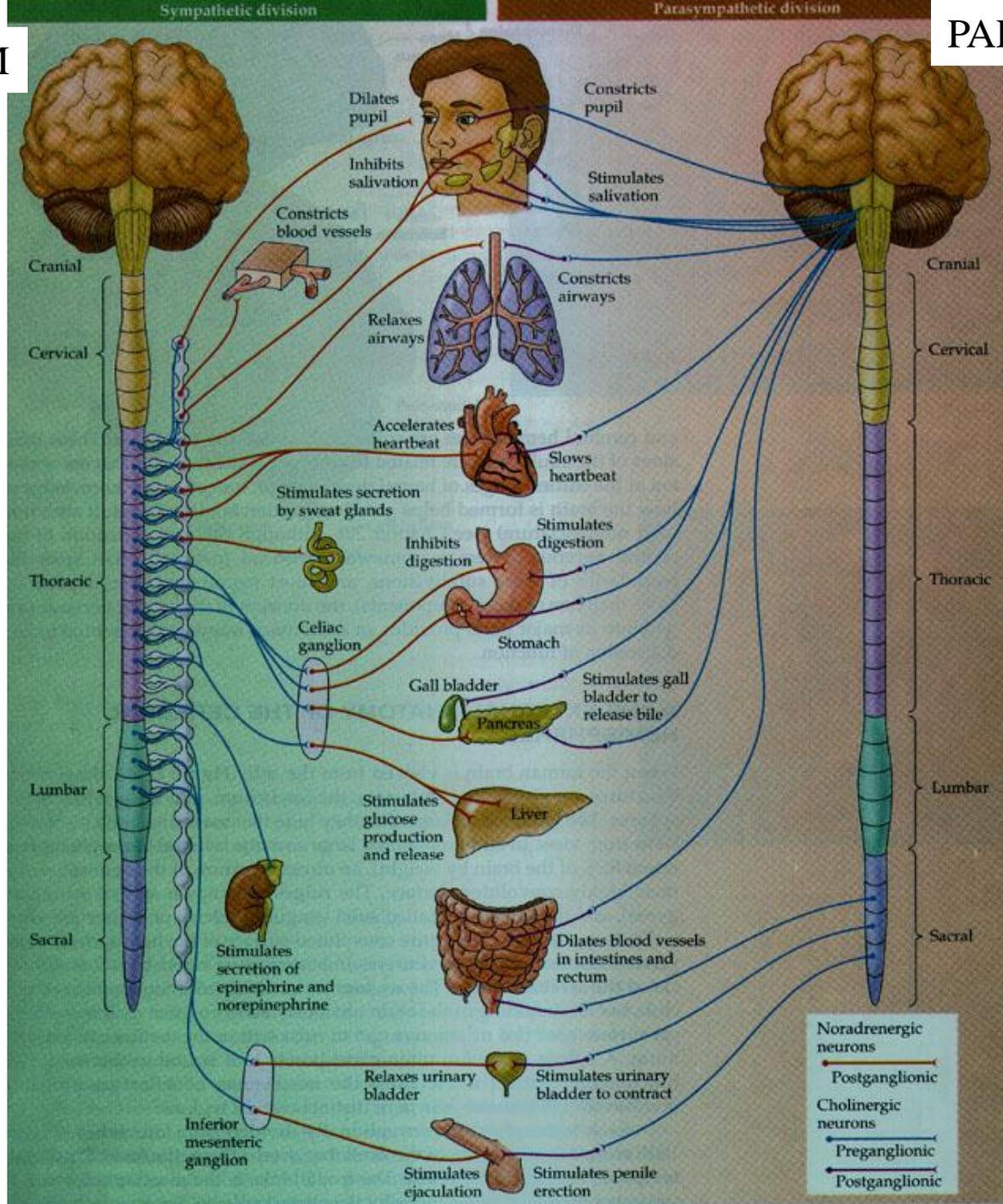
Table 8-2 Pharmacology of neurotransmission in the autonomic nervous system

	Transmitter of preganglionic neuron	Receptors on postganglionic neuron	Transmitter of postganglionic neuron	Receptors on target tissue
Sympathetic division	Acetylcholine (ACh)	Nicotinic ACh receptors	Norepinephrine	α - or β -adrenergic receptors
Parasympathetic division	Acetylcholine	Nicotinic ACh receptors	Acetylcholine	Muscarinic ACh receptors

SYM

PARASYM

ACh
↓
NE



ACh
↓
ACh

<http://home.swipnet.se/sympatiska/nervous.htm>

Ways of Characterizing Peripheral Nervous System Nerves

Sensory (afferent) - carry information INTO the central nervous system from sense organs.

1

OR

Motor (efferent) - carry information away from the central nervous system (for muscle control)

Cranial Nerve - connects the brain with the periphery.

2

OR

Spinal Nerve - connects the spinal cord with the periphery.

Somatic - connects the skin or muscle with the central nervous system.

3

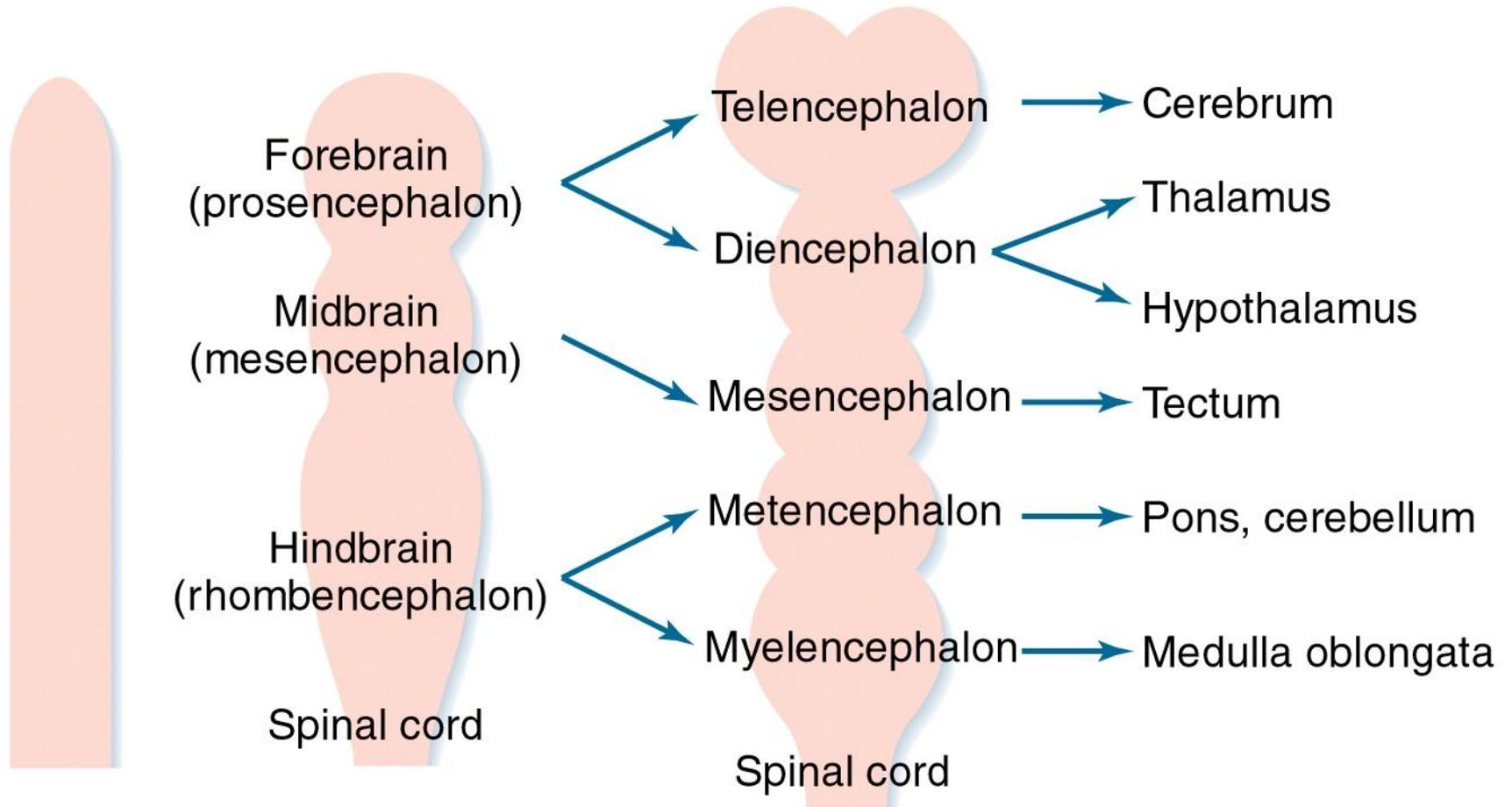
OR

Visceral - connects the internal organs with the central nervous system.

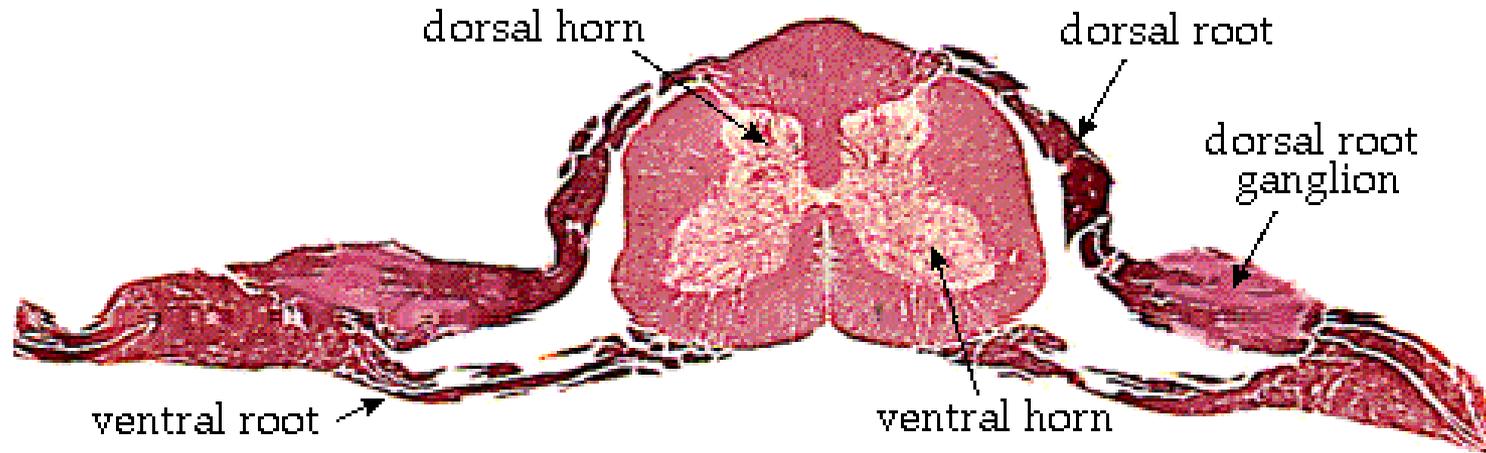
Central Nervous System

- 1) **Spinal Cord**
- 2) **Cerebral Hemispheres** - cerebral cortex and 3 deep lying nuclei: basal ganglia, hippocampus and the amygdala.
- 3) **Diencephalon** - thalamus and hypothalamus
- 4) **Midbrain** - superior and inferior colliculi
- 5) **Medulla**
- 6) **Pons**
- 7) **Cerebellum**

Neural tube Primary vesicles Secondary vesicles Adult structures



The Spinal Cord

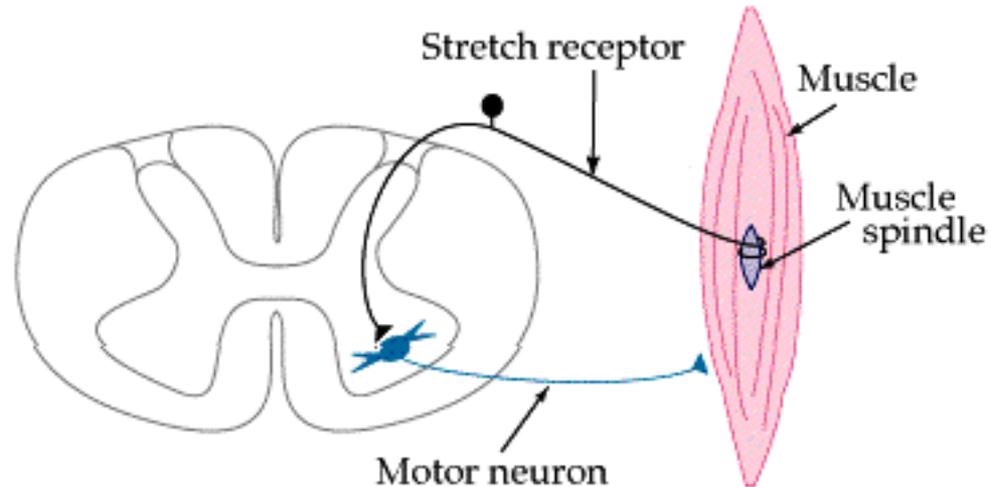


<http://thalamus.wustl.edu/course/spinal.html>

The spinal cord runs from the base of the skull to the first lumbar vertebrae.

31 pairs of spinal nerves

A Simple Reflex

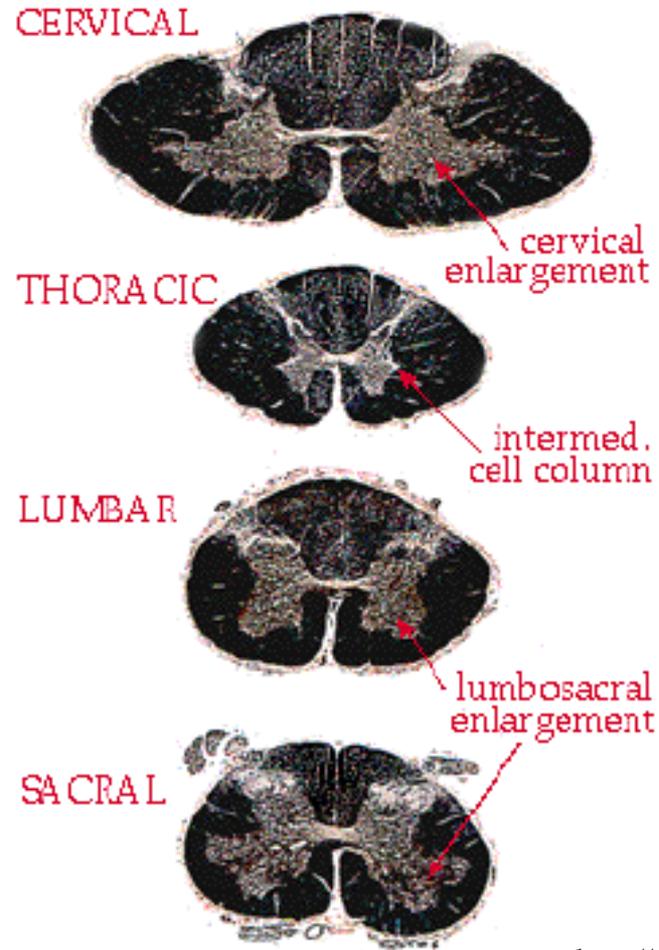


<http://thalamus.wustl.edu/course/spinal.html>

Afferent - sensory input.

Efferent - motor output.

Levels of the Spinal Cord



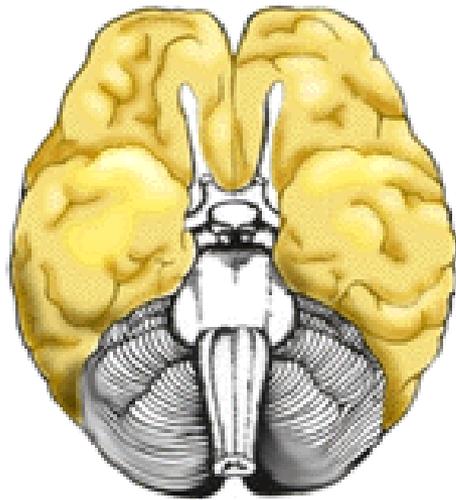
Dorsal Columns - contains primary afferent axons.

Ventral Columns - descending motor axons controlling posture.

Axons relaying info about pain and thermal sensation to higher levels

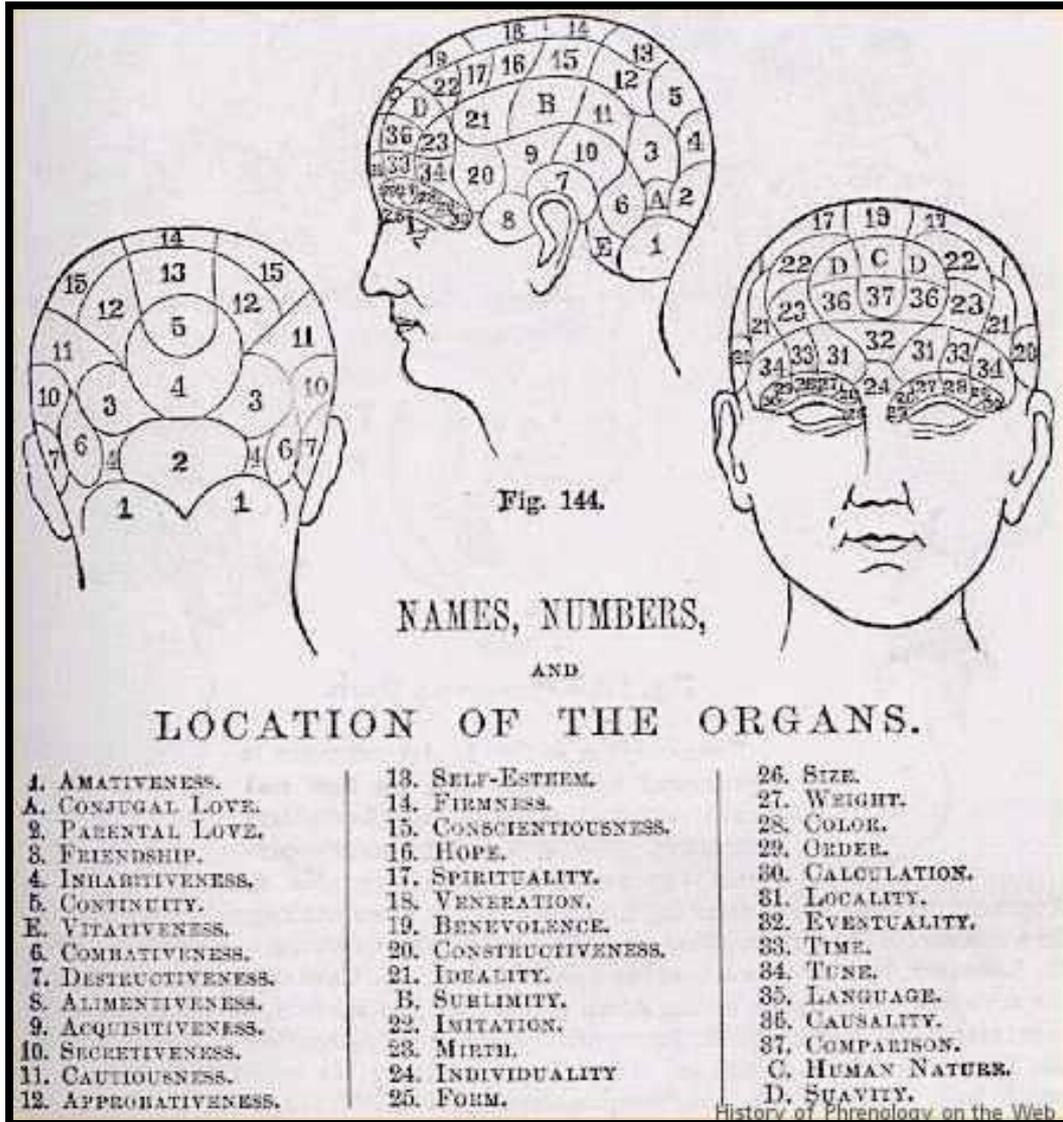
Lateral Columns - axons that ascend to higher levels and axons from nuclei in brain stem to motoneurons and interneurons in spinal cord.

The Cerebral Cortex

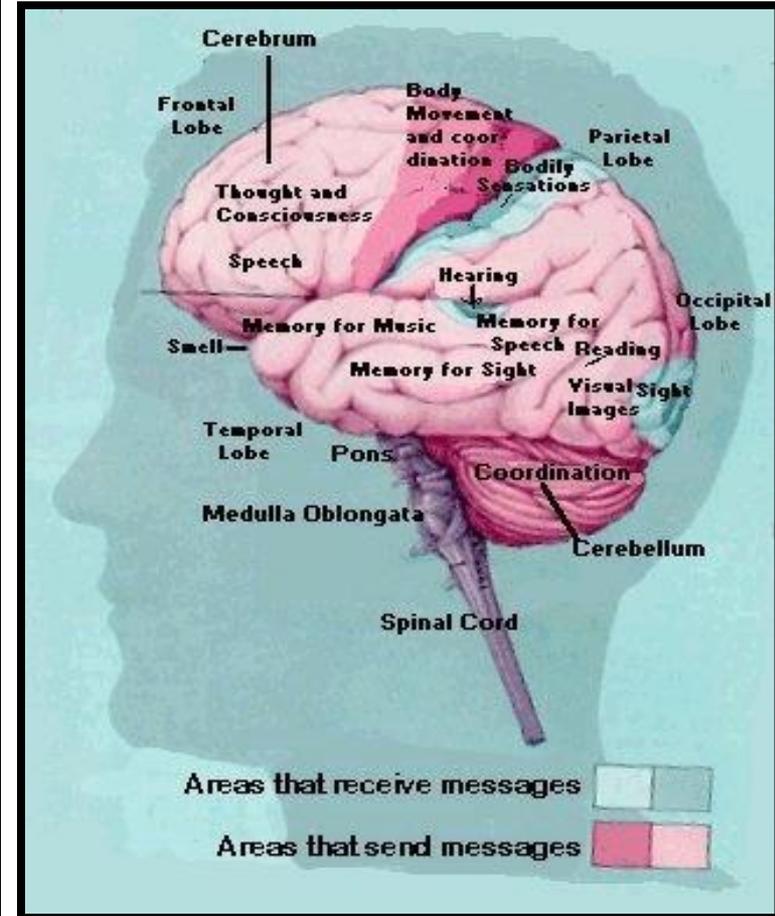


- Outermost layer of the cerebral hemisphere.
- Composed of gray matter.
- Cortices are asymmetrical. Both analyze sensory data, perform memory functions, learn new information, form thoughts and make decisions.

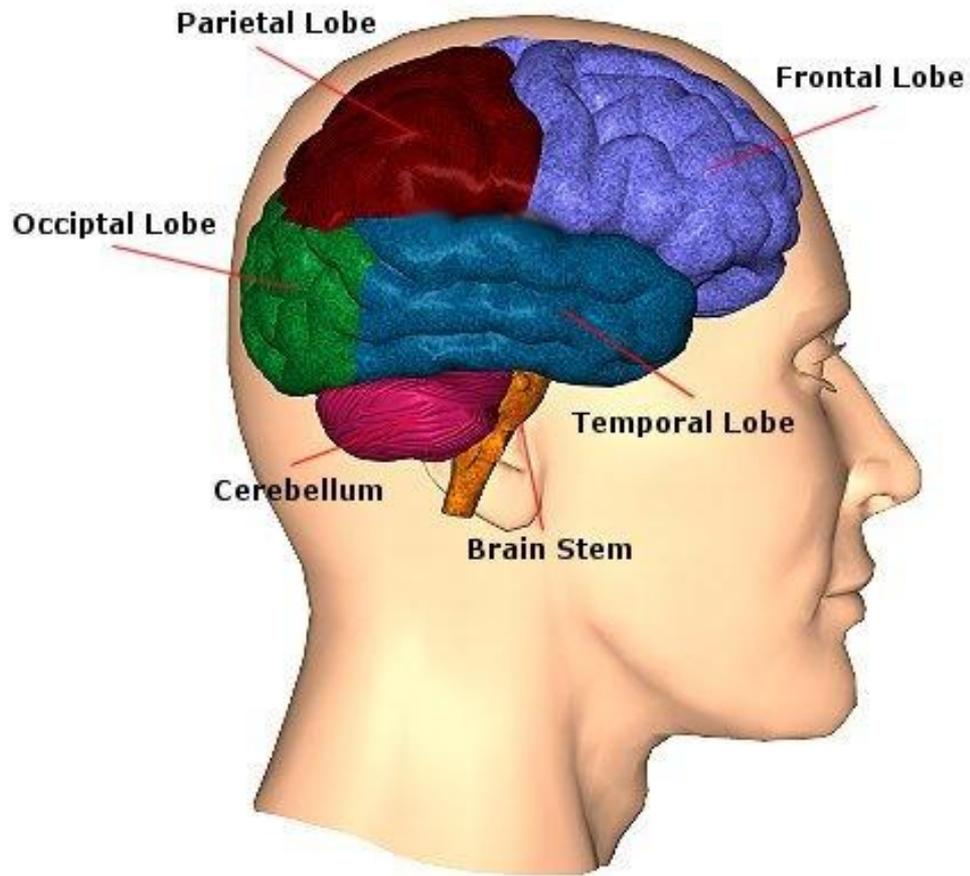
Then:



and Now:

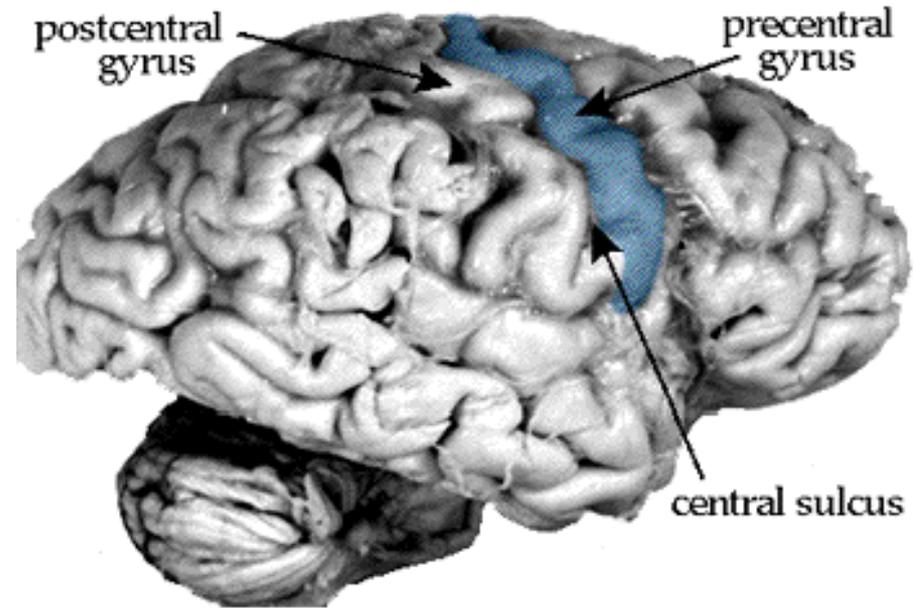


<http://www.niehs.nih.gov/kids/brain.htm>



Sulci - grooves

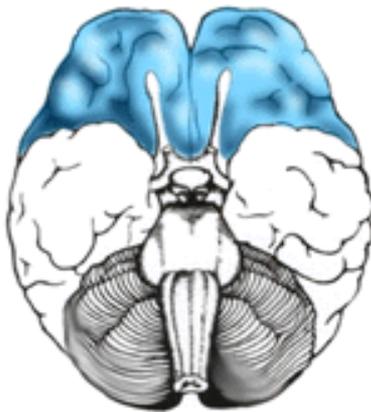
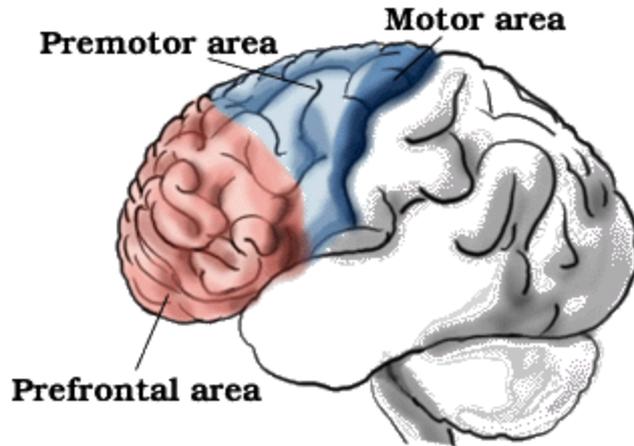
Gyri -elevated regions



<http://thalamus.wustl.edu/course/basmot.html>

The Frontal Lobes

Frontal Lobe:

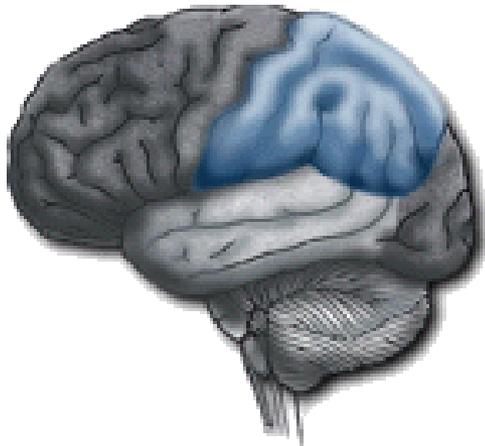


Divided into:

a) **prefrontal area**- emotional control center and home to our personality. Involved in motor function, problem solving, spontaneity, memory, language, initiation, judgement, impulse control, and social and sexual behavior.

b) **premotor area** -contains neurons that produce movements.

The Parietal Lobes

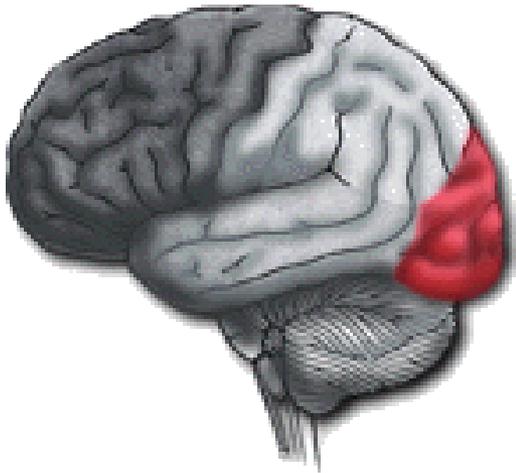


Two functional regions:

1) Involves **sensation** and **perception**. Integrates sensory information to form a single perception (cognition).

2) Integrates **sensory input**, primarily with the **visual system** to construct a spatial coordinate system to represent the world around us.

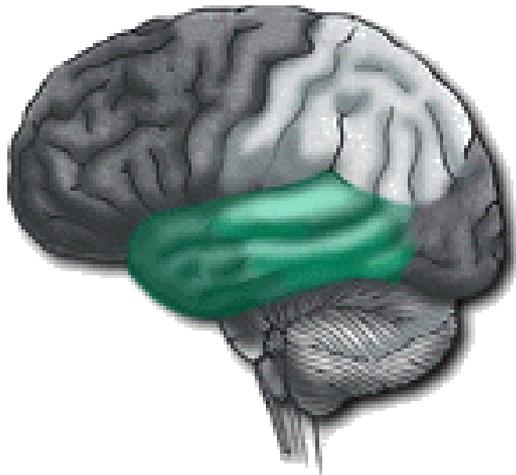
The Occipital Lobes



Center of our visual perception system.

Disorders of this lobe can cause visual hallucinations (visual images with no external stimuli) and illusions.

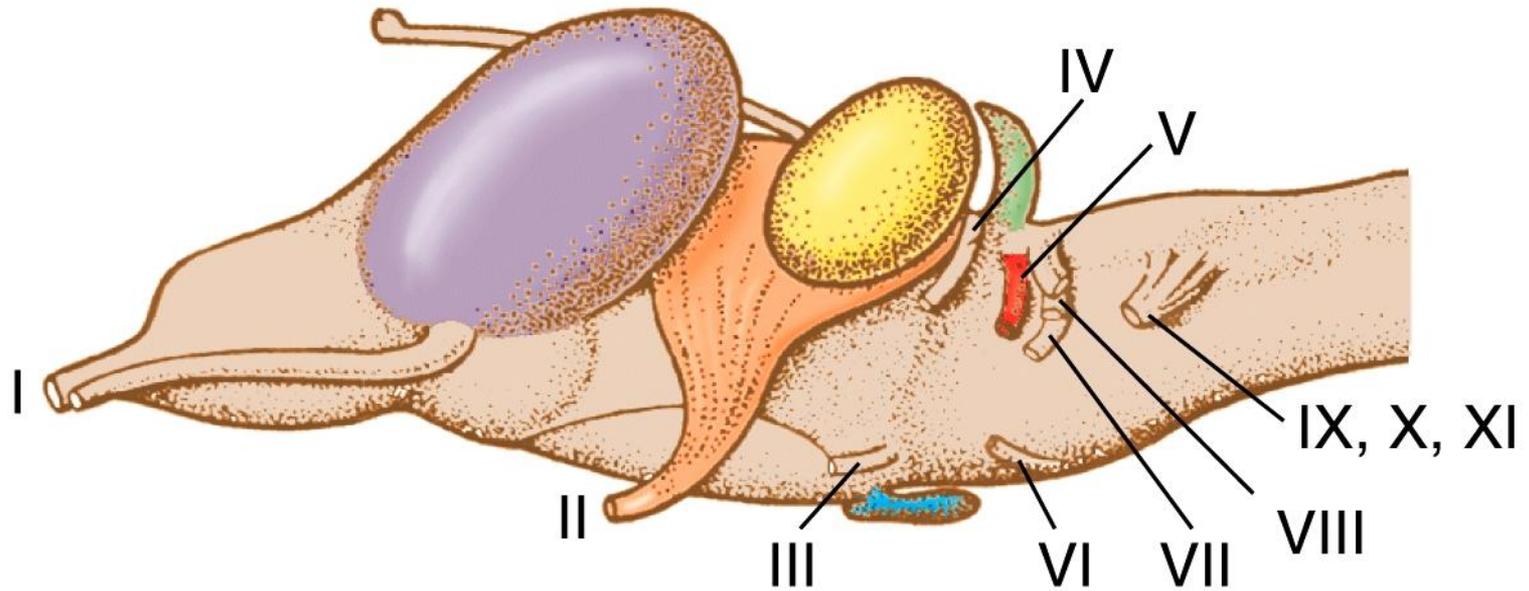
The Temporal Lobes



[http://www.neuroskills.com/index.html?
main=tbi/brain.shtml](http://www.neuroskills.com/index.html?main=tbi/brain.shtml)

Involved in the primary organization of sensory input and also highly associated with memory skills. Left temporal lesions result in impaired memory for verbal material. Right side lesions result in impaired recall of non-verbal material, such as music and drawings.

Language can also be affected by temporal lobe damage. Left lesions disturb recognition of words. Right damage can cause a loss of inhibition of talking.



I Olfactory

II Optic

III Oculomotor

IV Trochlear

V Trigeminal

VI Abducens

VII Facial

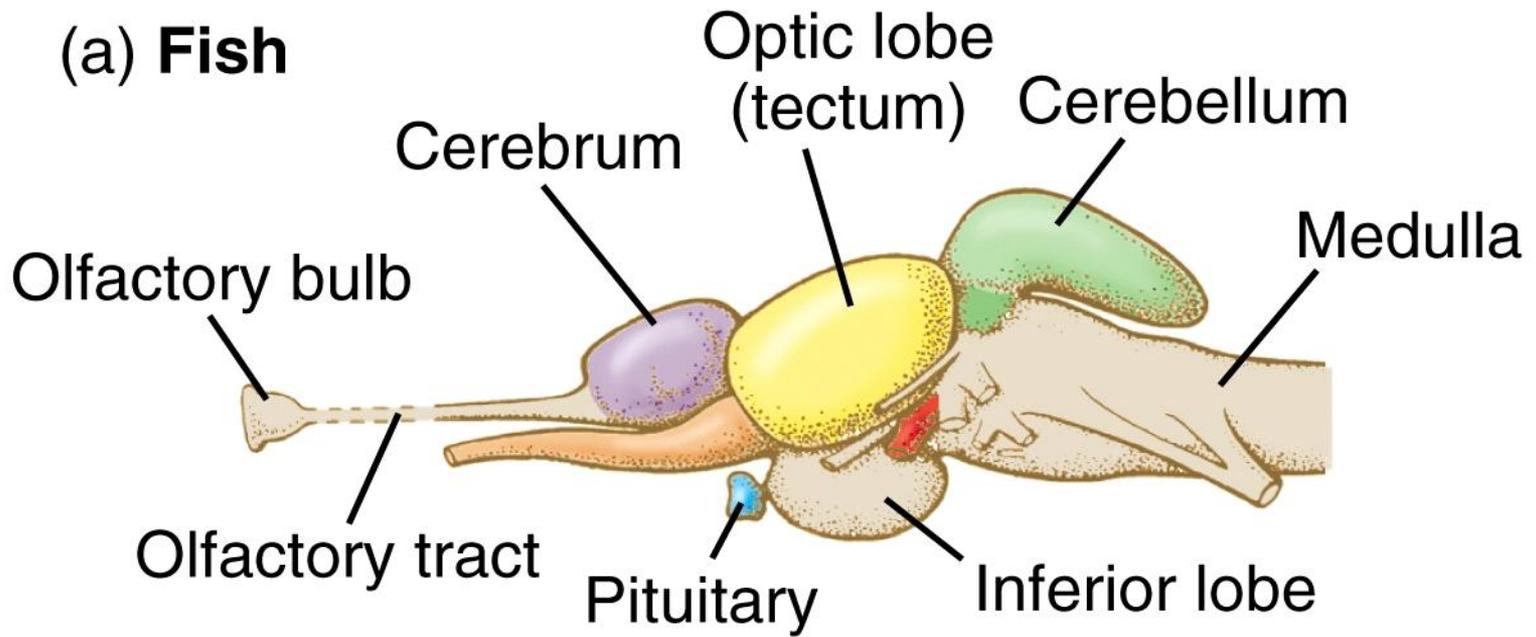
VIII Vestibulocochlear

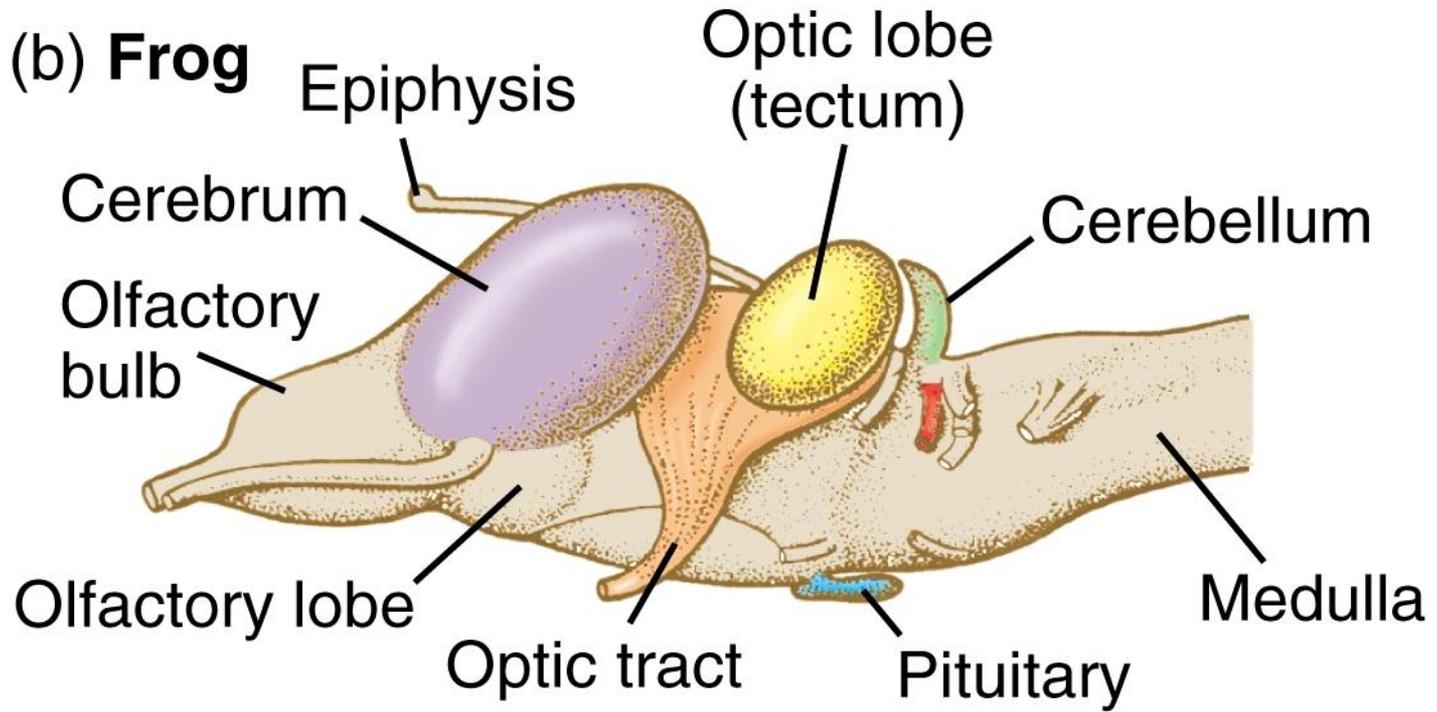
IX Glossopharyngeal

X Vagus

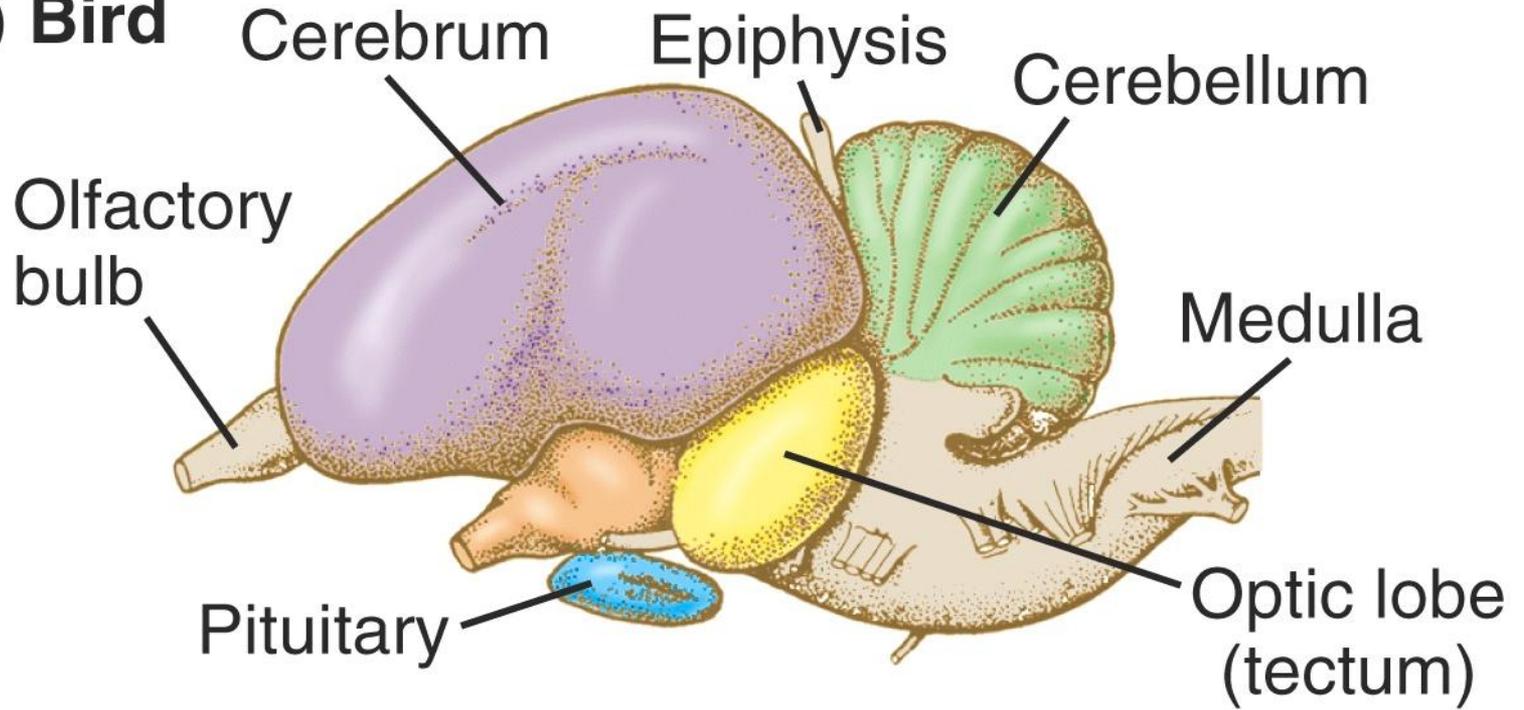
XI Spinal accessory

XII Hypoglossal

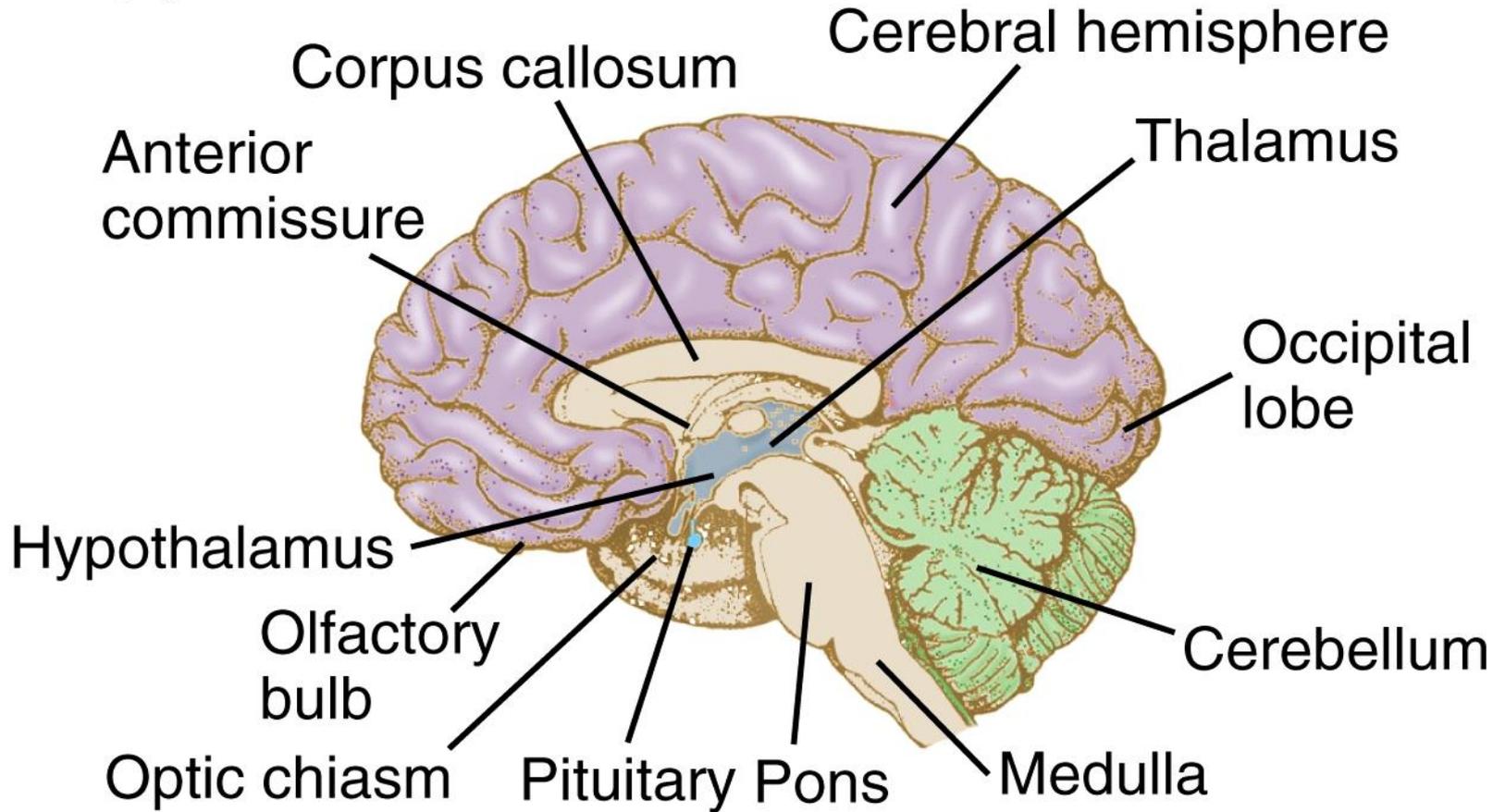




(c) **Bird**



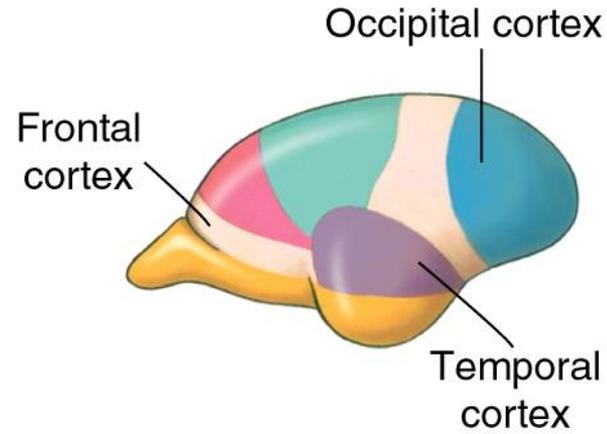
(d) Human



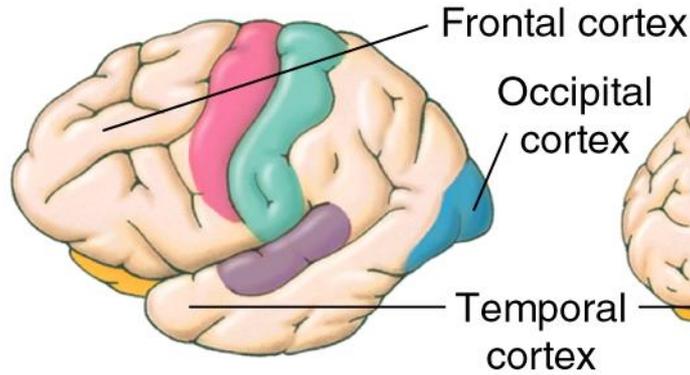
(a) Rat



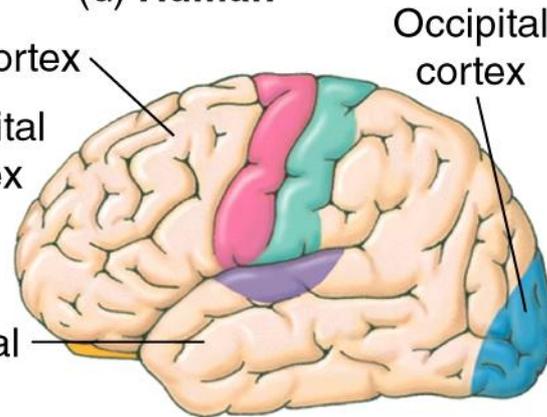
(b) Tarsier



(c) Chimpanzee

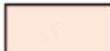


(d) Human



 Primary visual

 Primary somatosensory

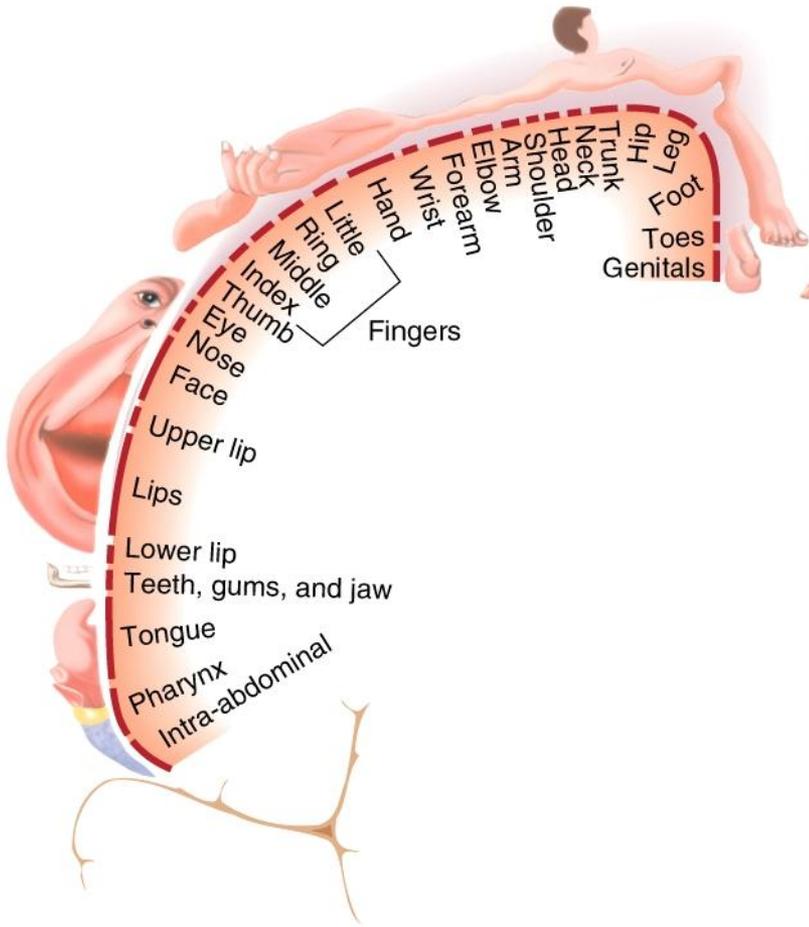
 Association

 Primary auditory

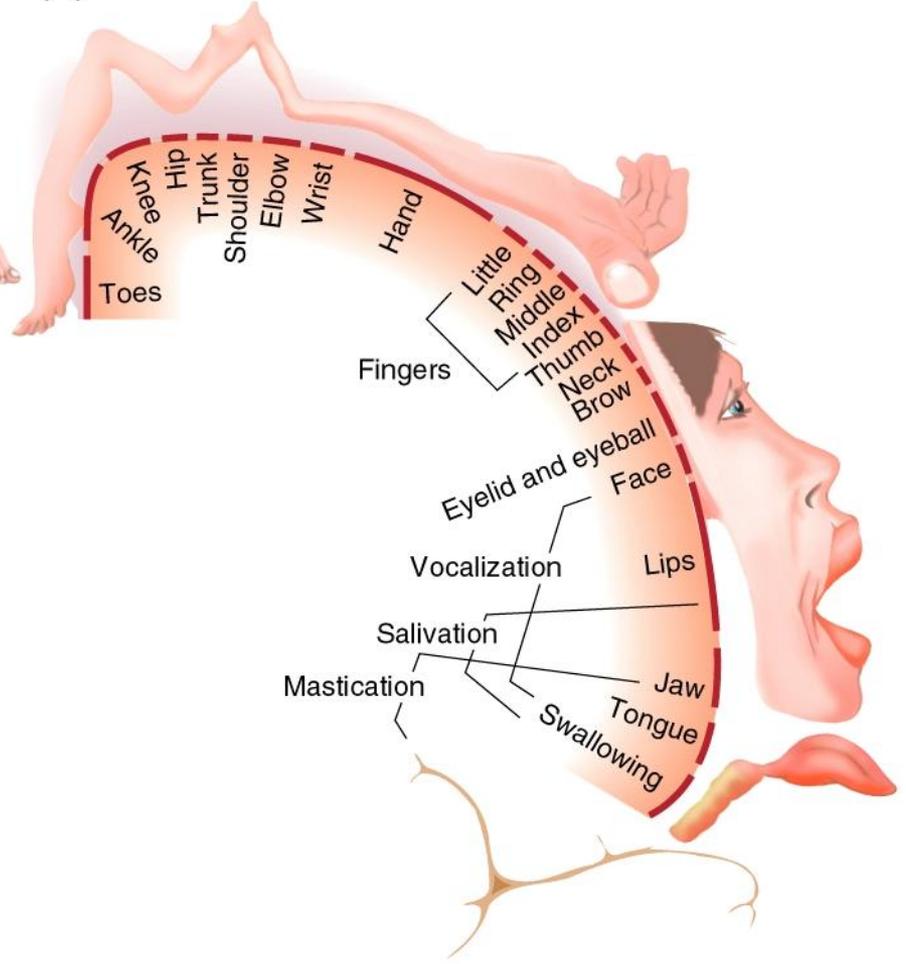
 Olfactory (paleocortex)

 Motor

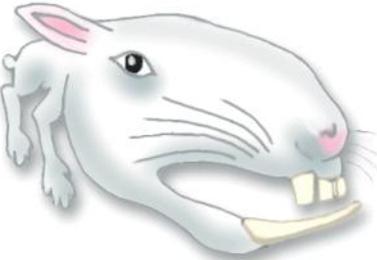
(a) Sensory



(b) Motor



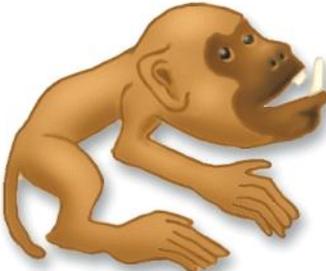
Rabbit



Cat



Monkey



Human

