

Nervous System

Organization, Neuron, Brain, Spinal Cord & Nerves, Ear and Eye

Video Links and Diagrams

Chapters 10 & 11

Class 1

April 22, 2014

Video

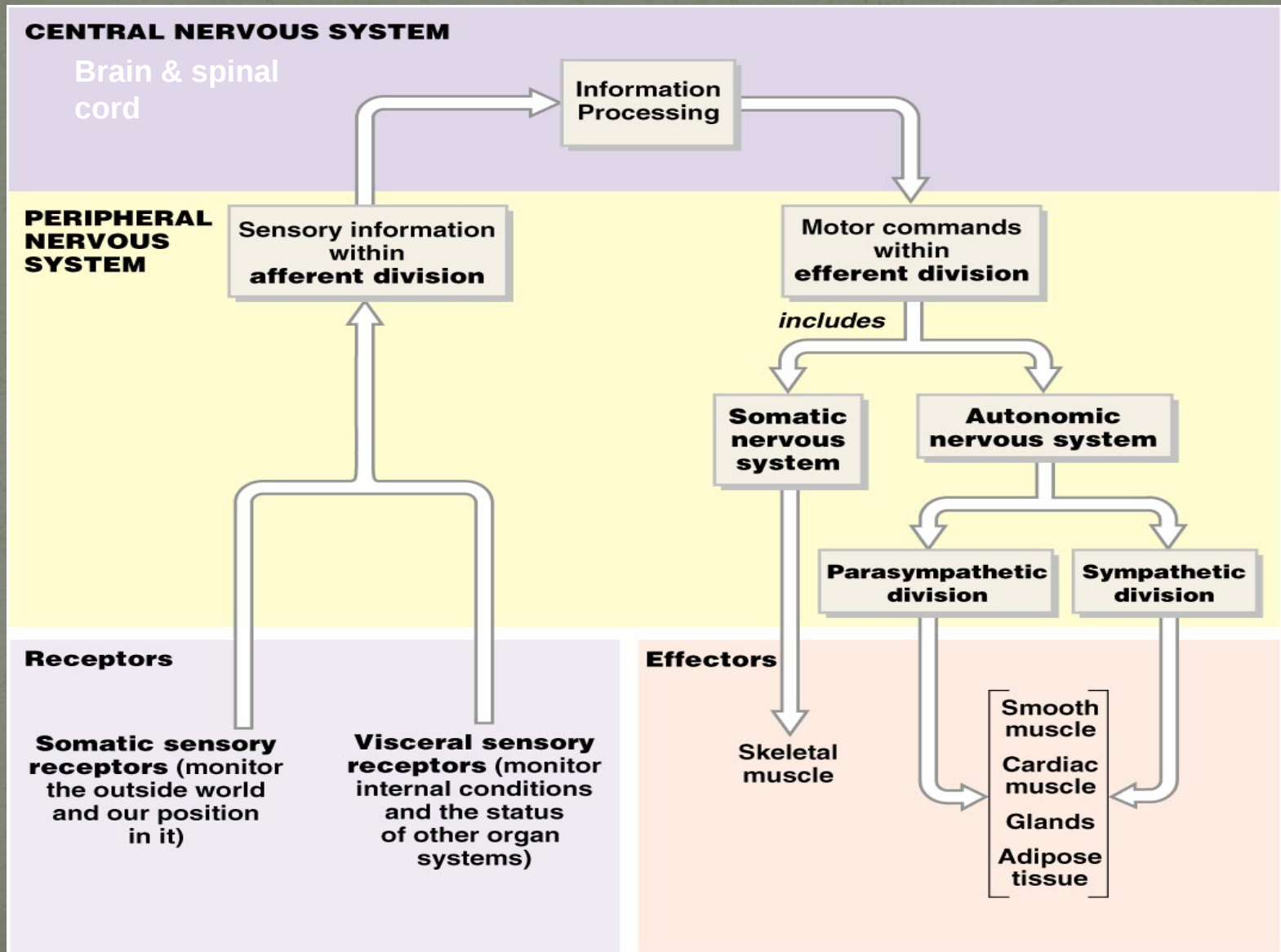
- <http://www.youtube.com/watch?v=4M82WwFACLg>
 - Part 1
- http://www.youtube.com/watch?v=PE2b5go7V_o
 - Part 2

Division of Nervous System

- Two Anatomical Divisions
 - Central nervous system (CNS)
 - Brain
 - Spinal cord
 - Peripheral nervous system (PNS)
 - All the neural tissue outside CNS
 - *Afferent* division (sensory input)
 - *Efferent* division (motor output)
 - Somatic nervous system
 - Autonomic nervous system

Somatic means “Body”

General Organization of the nervous system



Central Nervous System

- <http://www.youtube.com/watch?v=yq6GJ1yj3HA>

*Fill in your
Chart!*

Nervous System

*Add the Arrows
to your
diagram!*

CNS – Central Nervous System

Brain & Spinal Cord

PNS – Peripheral Nervous System

12 Cranial Nerves
31 Spinal Nerve Pairs

Somatic Division

Autonomic Division

**Sensory Neurons from
skin, skeletal muscles
and joints to CNS**

**Motor Neurons
from CNS to
skeletal muscles**

**Sensory
Neurons from
visceral organs
to CNS**

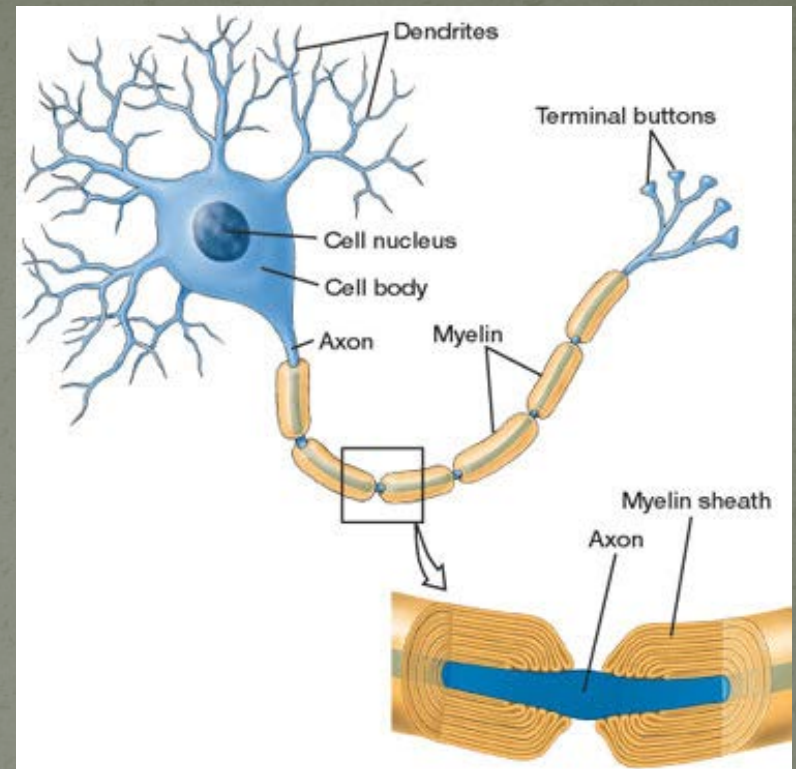
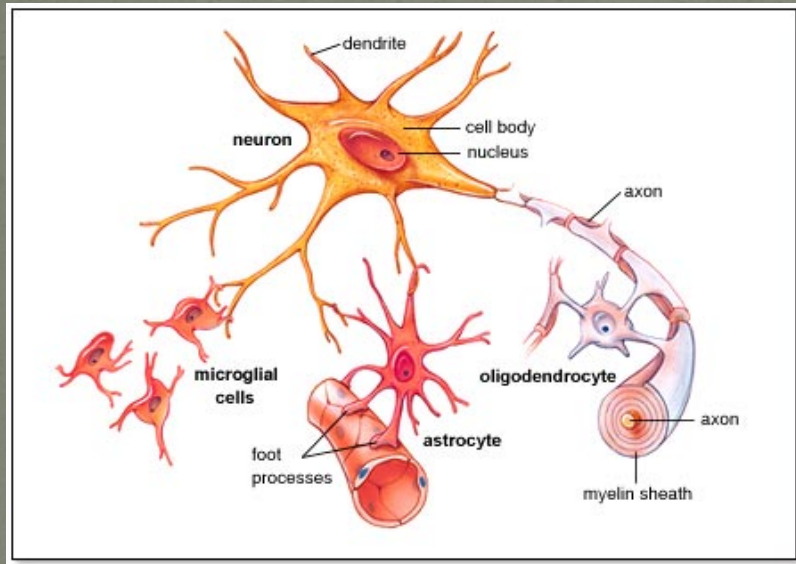
**Motor Neurons
from CNS to
smooth &
cardiac muscle
and glands**

The Nervous system has three major functions: **Fill in the Chart!**

- **Sensory** – monitors internal & external environment through presence of *receptors (sensory)*
- **Integration** – interpretation of sensory information (information processing); complex (higher order) functions
- **Motor** – response to information processed through stimulation of *effectors (motor)*
 - muscle contraction
 - glandular secretion

Class Two

April 23, 2014



Neurons and Neuroglia

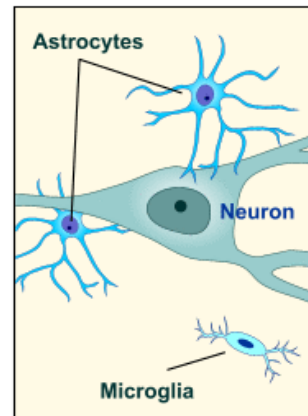
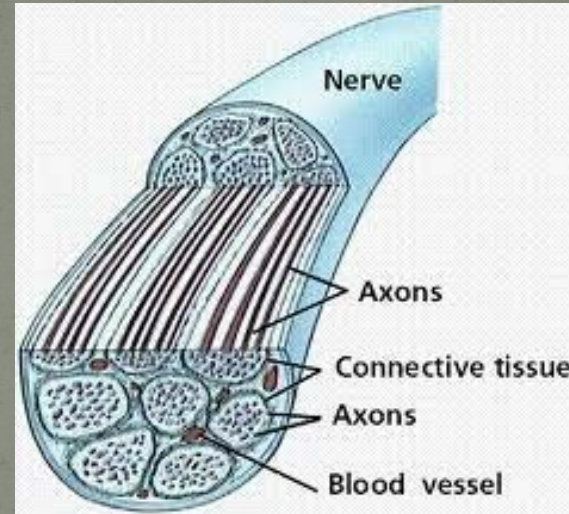
Cell body, axon, dendrites, myelin sheath, synapse

Use the Graphic Organizer to take Notes

What makes up the brain, the spinal cord or your peripheral nerves?

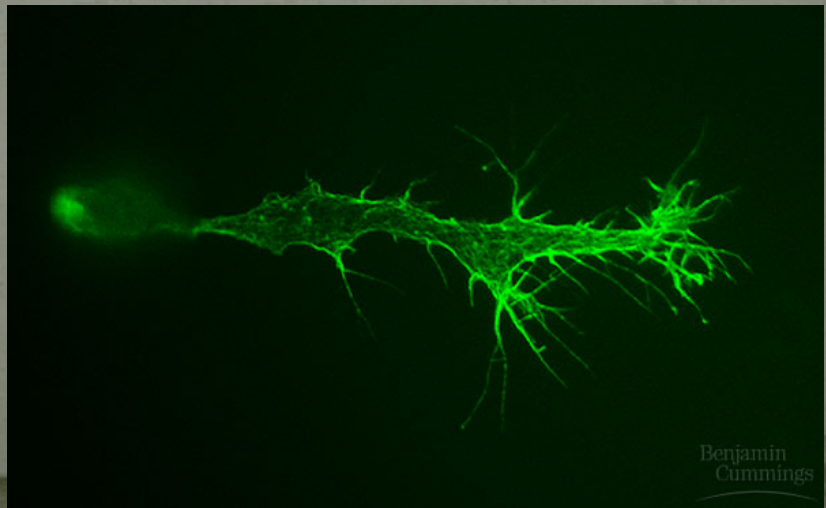
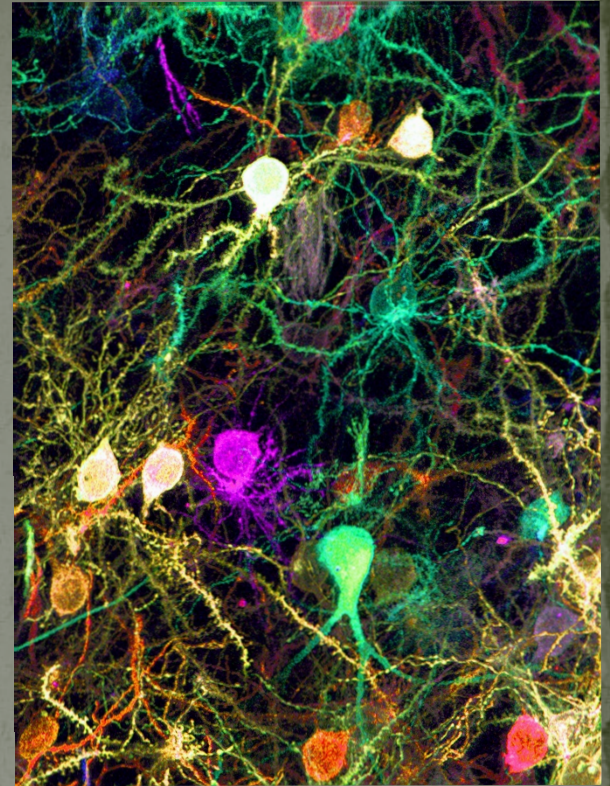
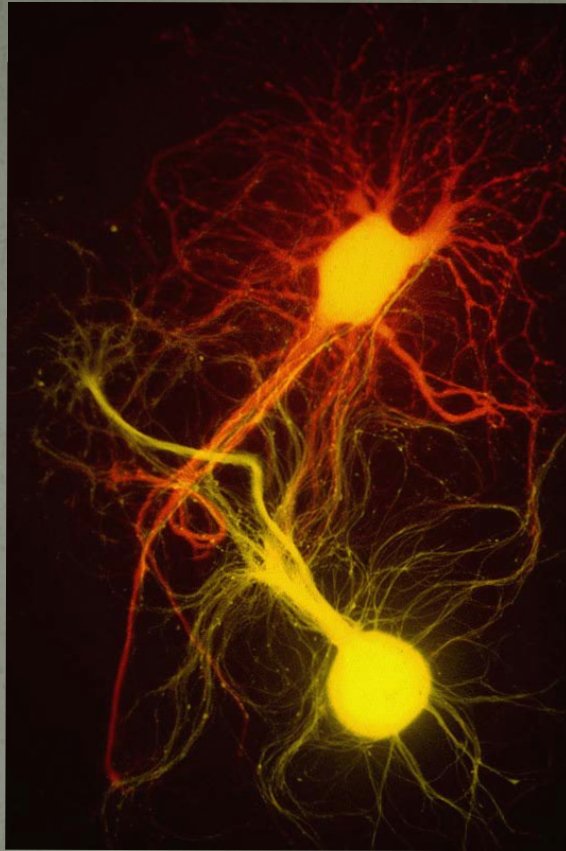
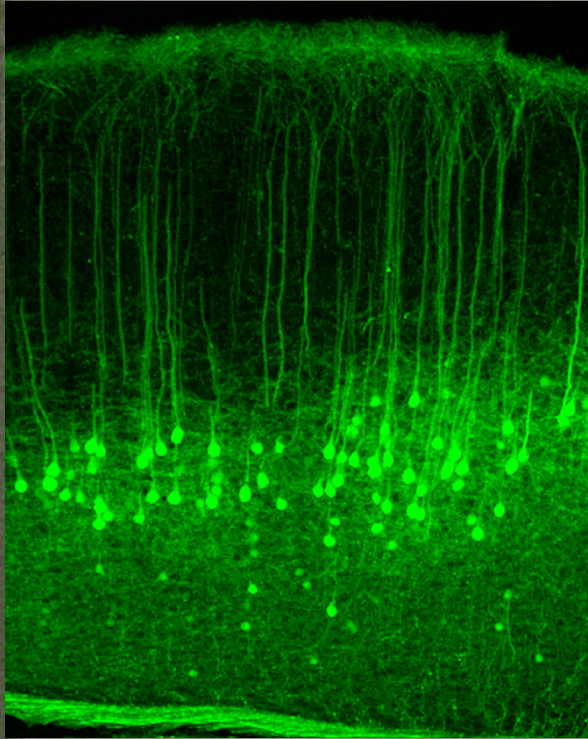
- **Nerves** – bundle of neurons
- **Neurons** – cell that can conduct impulses by electrochemical changes
- **Neuroglia** – (glial cells) support and protection, 60% of the brain tissue

Fill in your Graphic Organizer



Slide 3 Spinal cord





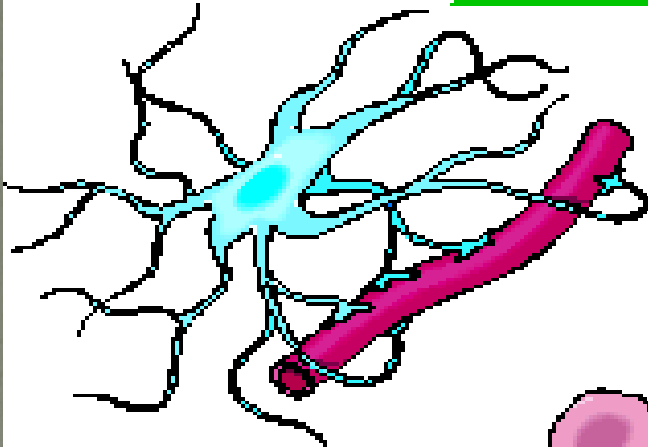
Neuroglial Cells

- **Astrocytes** – star shaped cells that support brain and spinal cord
- **Oligodendroglia** – small stars, semi-rigid support
- **Microglial** – small cells that protect the CNS, phagocytic (engulf bacteria and cellular debris)
- **Ependymal Cells** – produce cerebrospinal fluid and have cilia to move fluid
- **Schwann Cells** – form myelin sheaths around nerve fibers in the PNS



Neuroglial Cells of the CNS

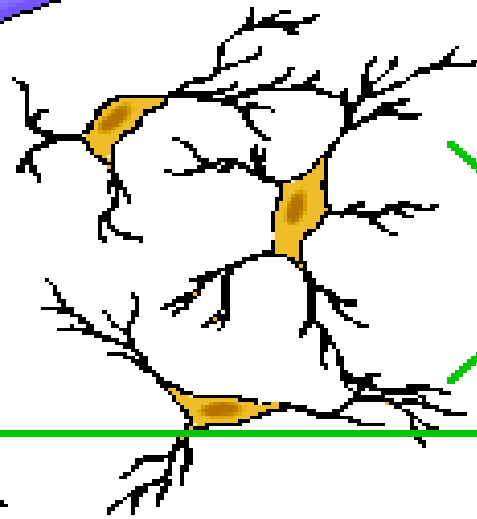
Astrocyte



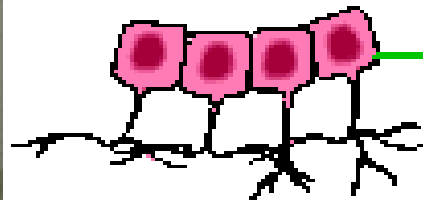
Oligodendrocyte

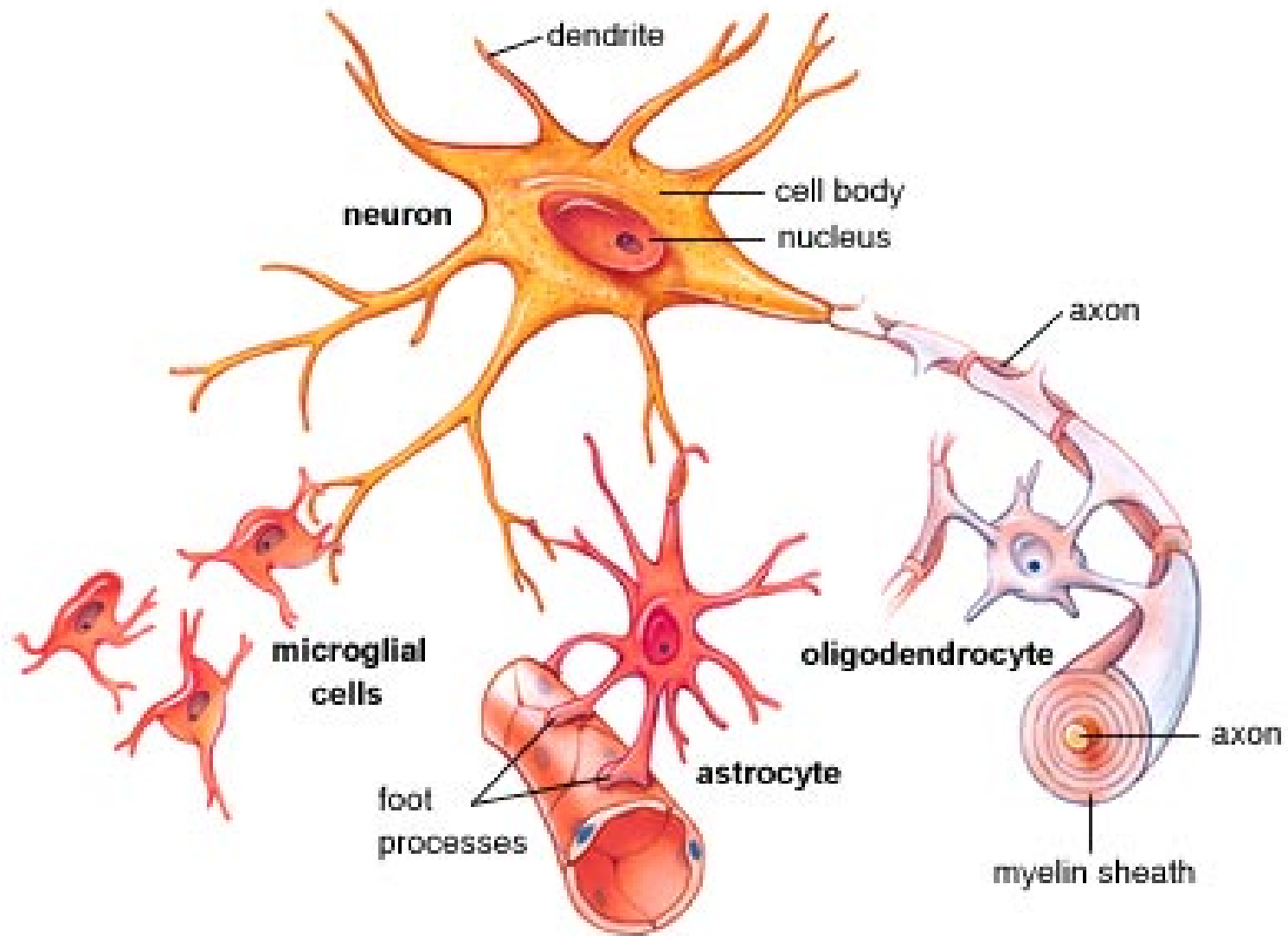


Microglia



Ependymal cells

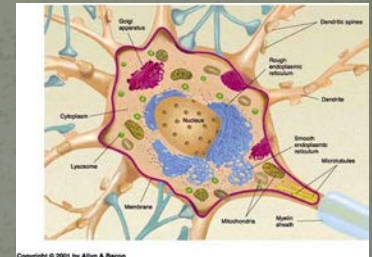




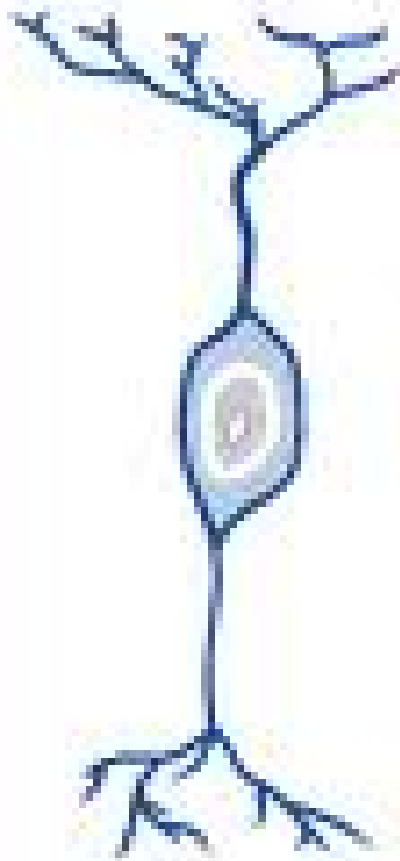
Neurons

Structure

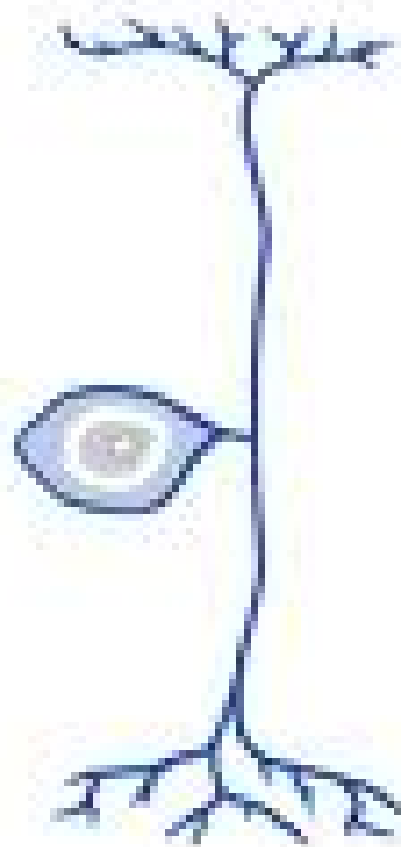
- Single nucleus; Cytoplasm with mitochondria, Golgi bodies, lysosomes, neurofibrils, rough ER
- **Dendrites** – short and branched processes
- **Axons** – single long process with an axon terminal that connects with the dendrites of other neurons
 - Enclosed in **Myelin Sheaths**
 - lipoprotein
 - Produced by Schwann cells
 - Node of Ranvier – gap in the sheath
- **Structural Types:** multipolar neurons, bipolar neurons, unipolar neurons
- **Functional Types:** sensory or afferent neuron, internuncial or association neurons, motor or efferent neurons



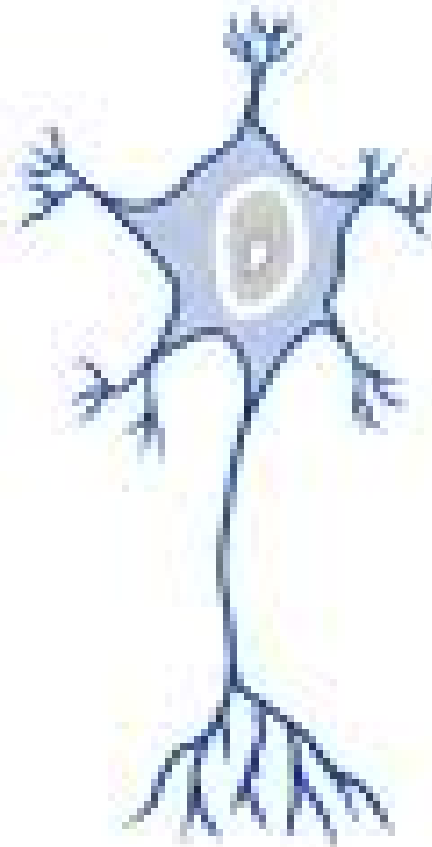
Basic Neuron Types



Bipolar
(Interneuron)



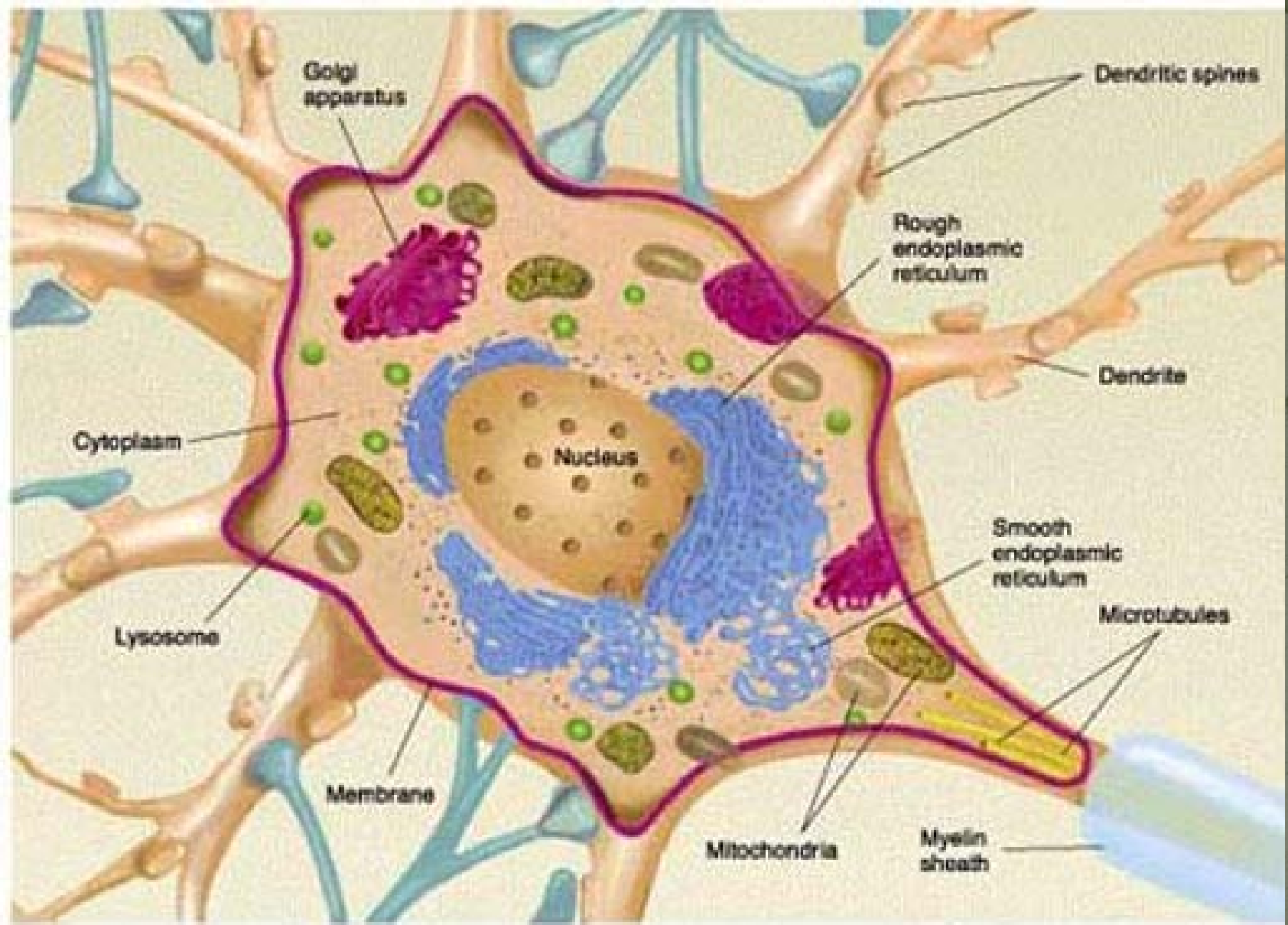
Unipolar
(Sensory Neuron)



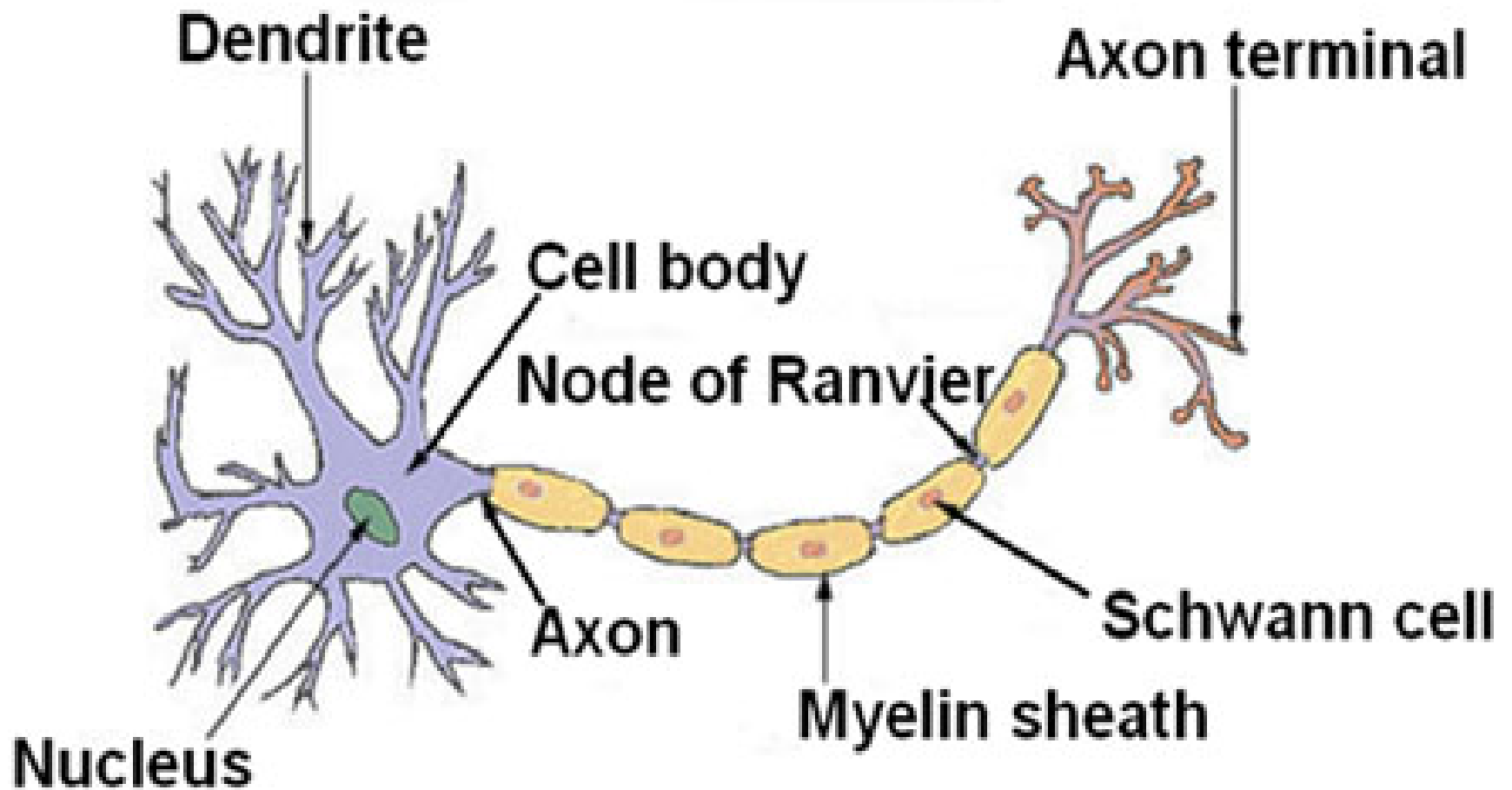
Multipolar
(Motoneuron)



Pyramidal
Cell

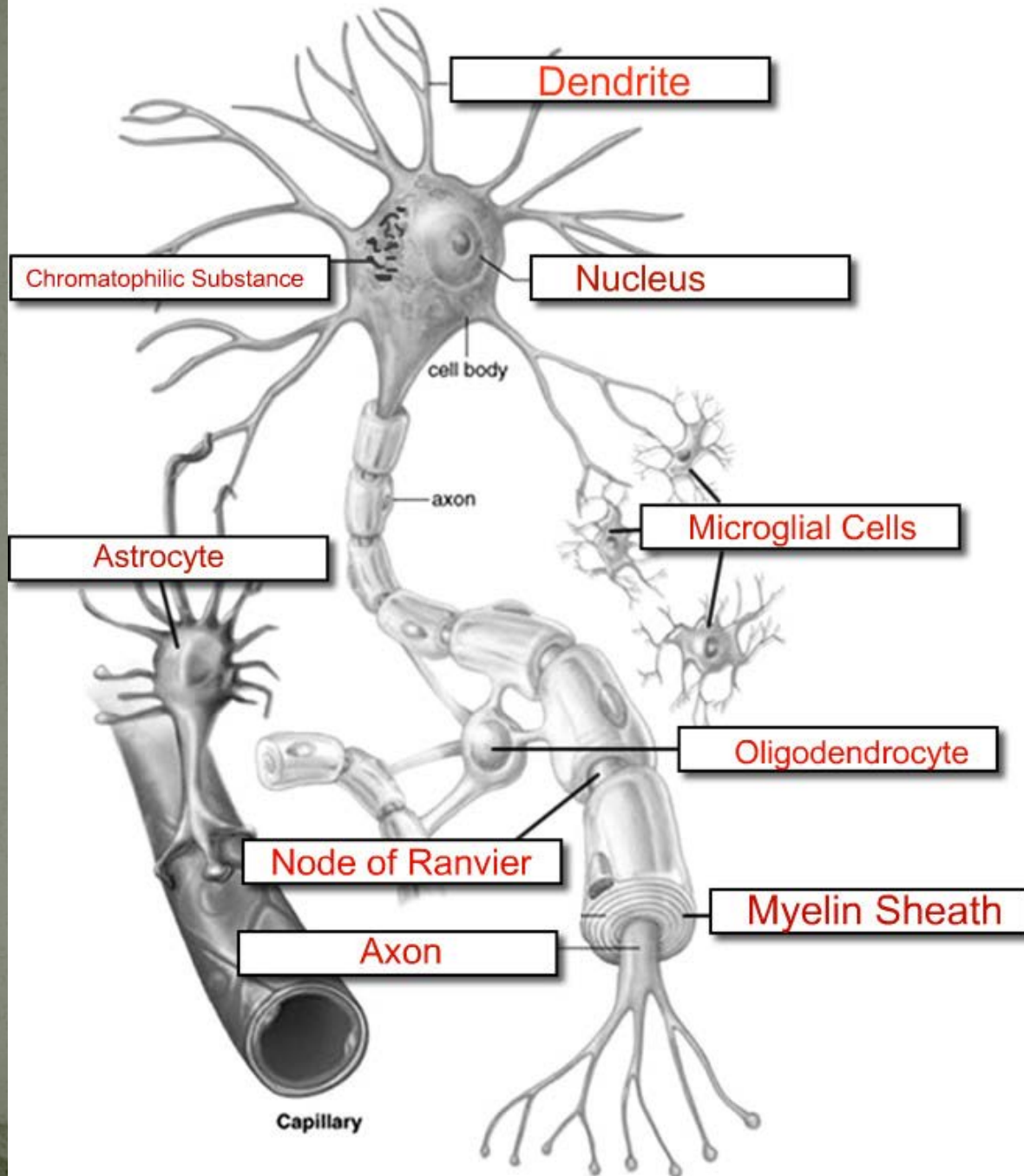


Structure of a Typical Neuron



Label your diagram of the Neuron

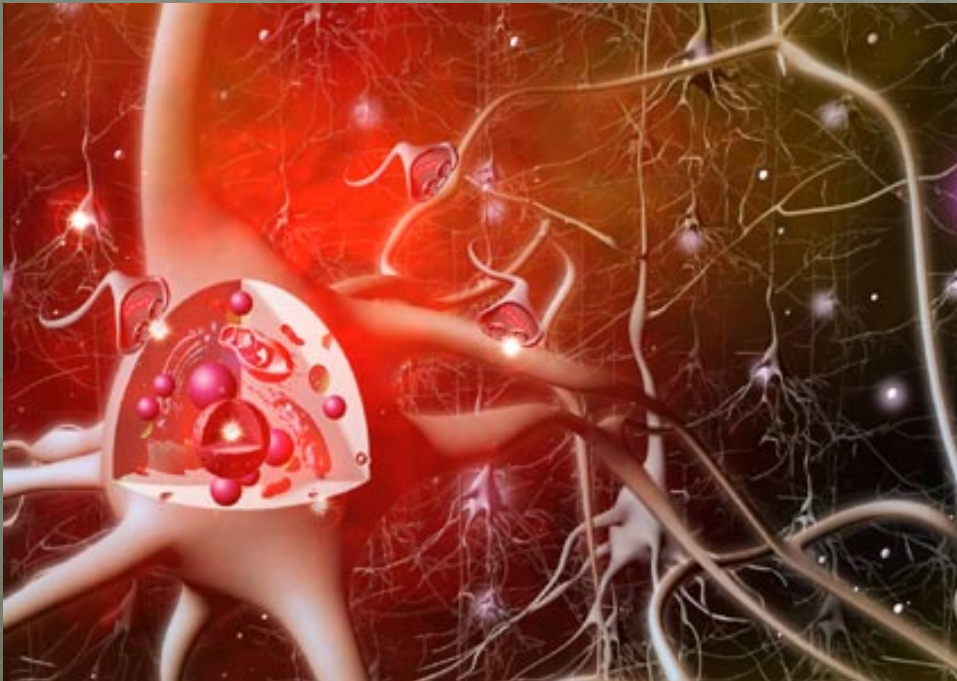
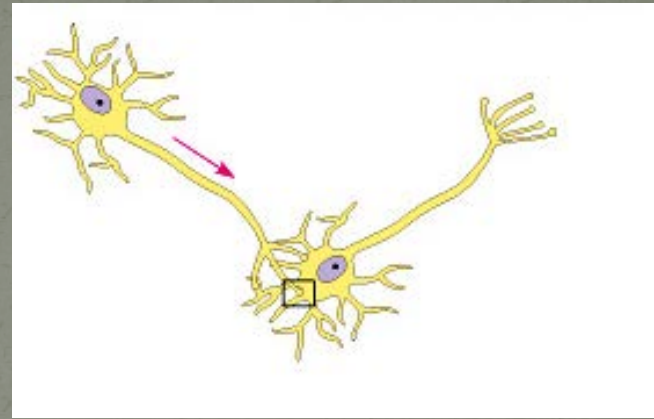
- Axon
- Astrocyte
- Chromatophilic Substance
- Dendrite
- Microglial cells
- Myelin sheath
- Nucleus
- Node of Ranvier
- Oligodendrocyte
- Schwann cell
- Synaptic knobs



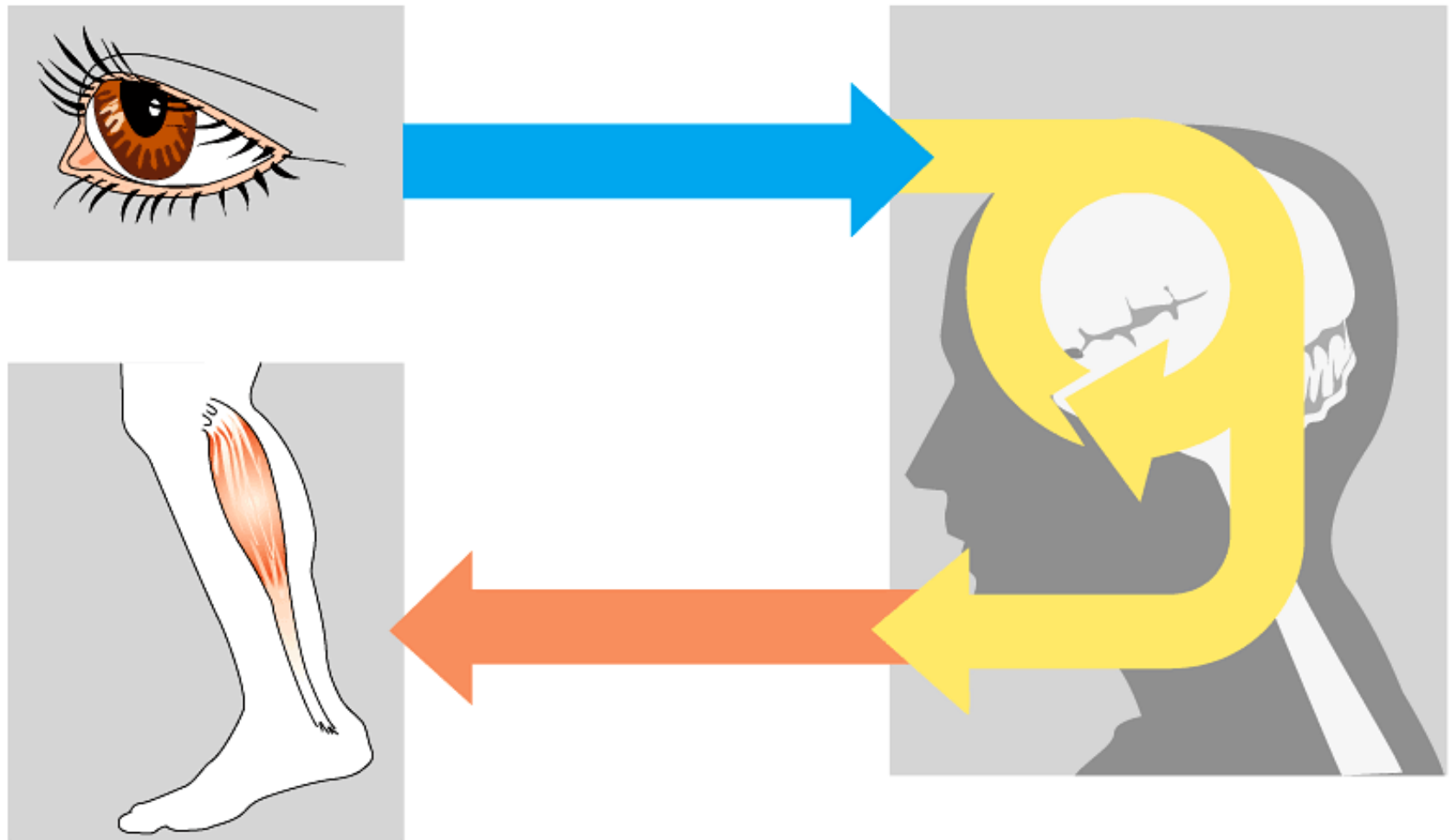
*Check
your
diagram*

Neurons are connected by Synapses

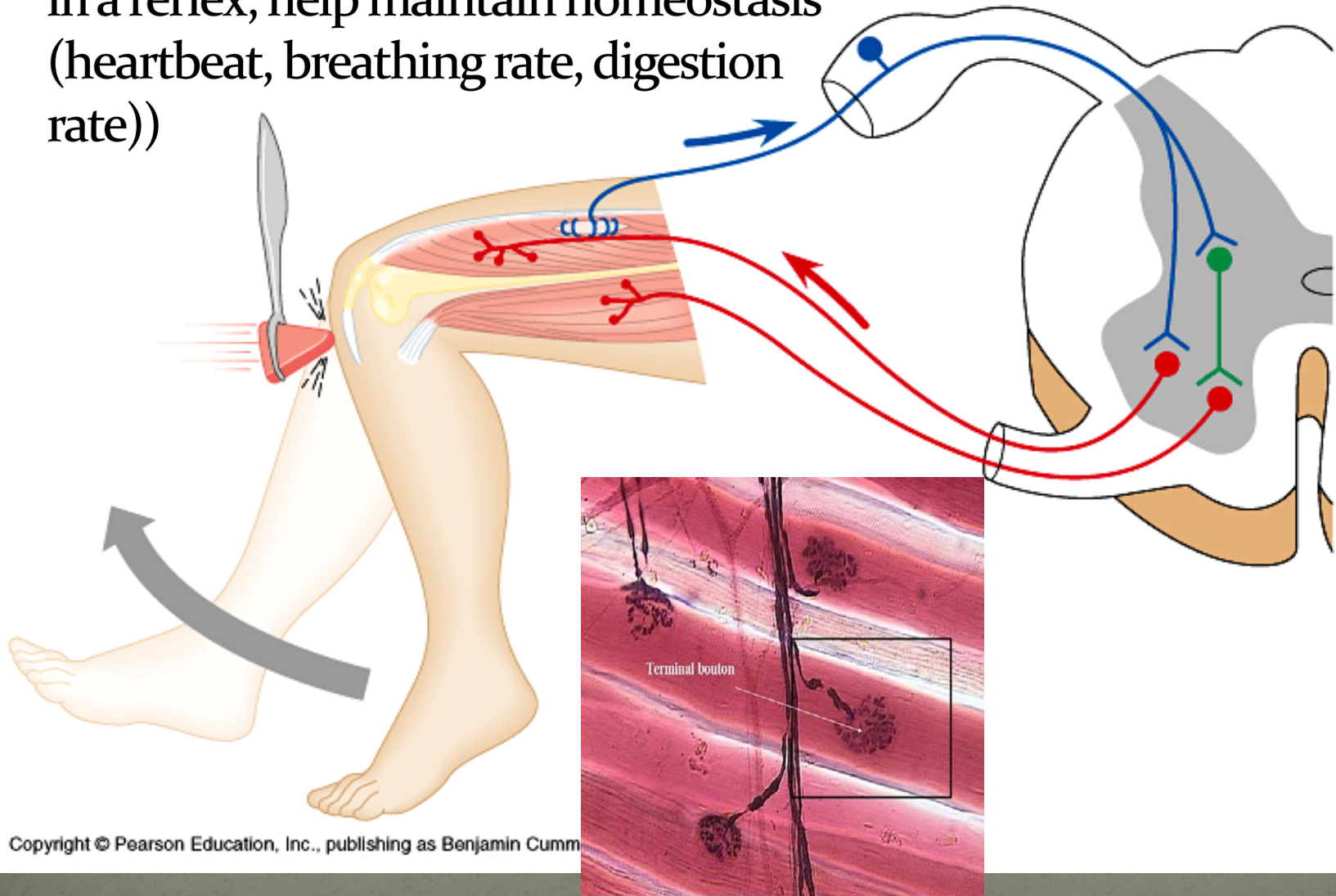
- One-way junctions that ensure the nerve impulse travels in only one direction



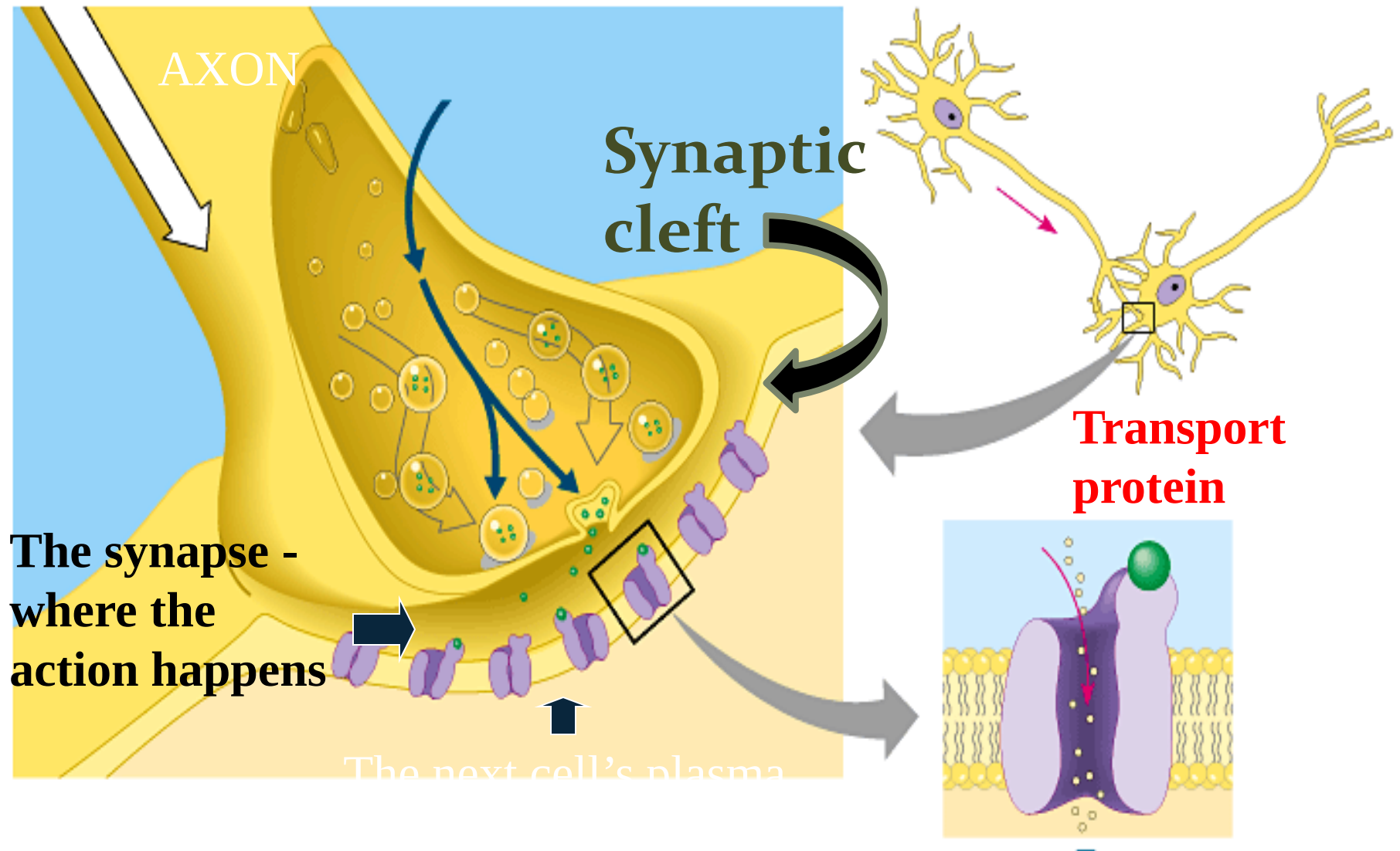
Why are neurons connected?



Reflex Arc – pathway that results in a reflex; help maintain homeostasis (heartbeat, breathing rate, digestion rate))



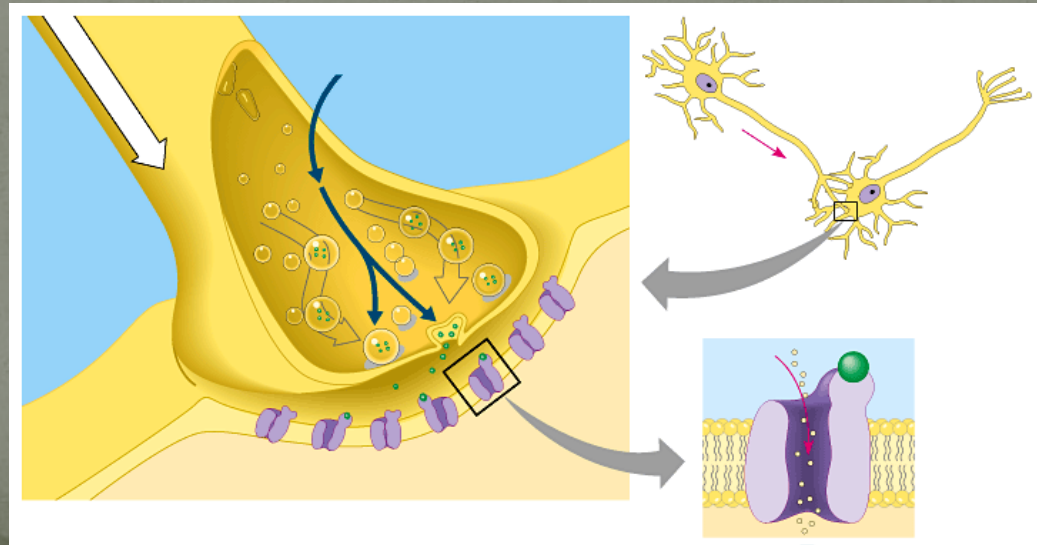
Synapse



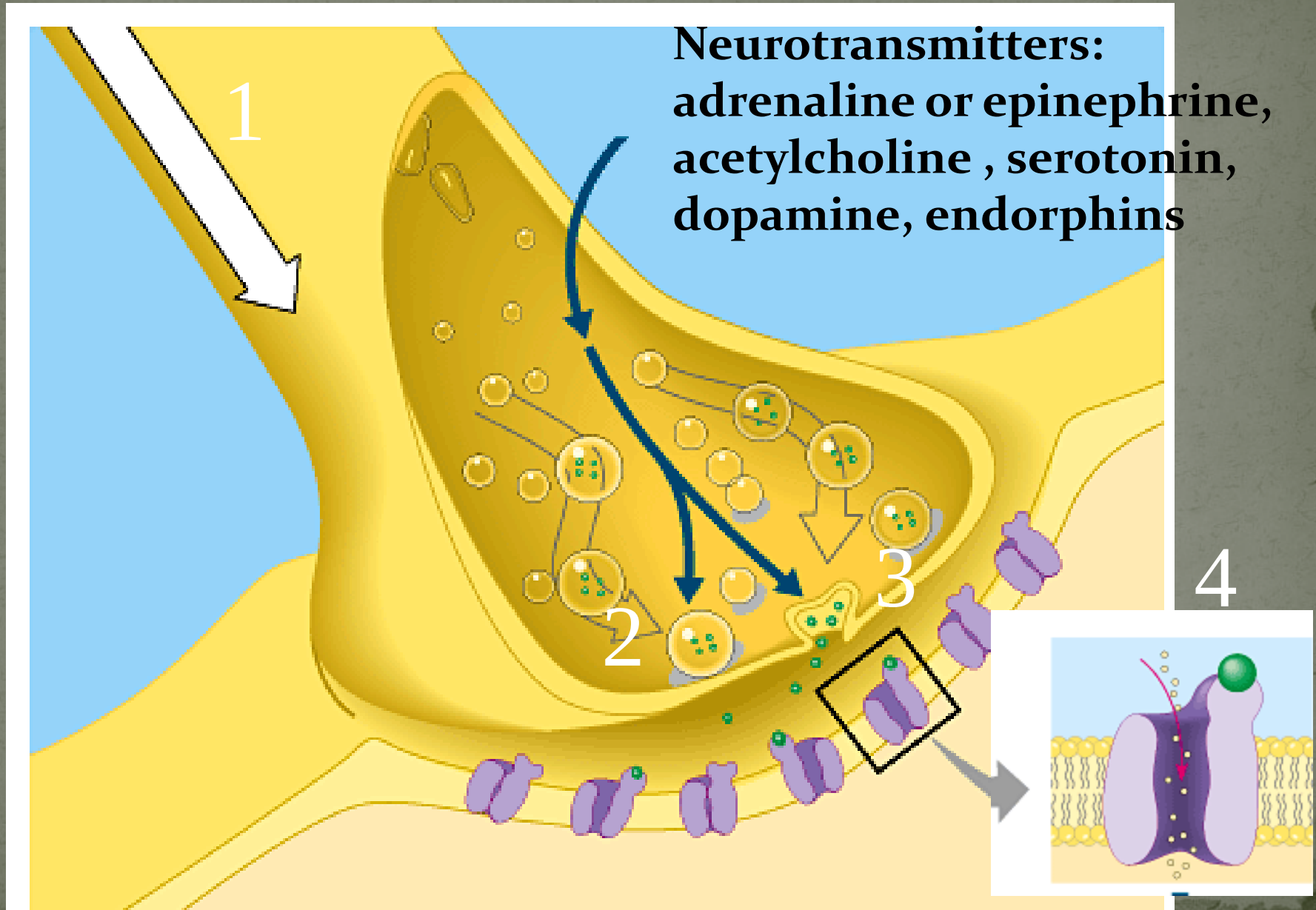
How does the Synapse carry the signal?

“Synapse Steps”

1. Electrical current travels down the axon
2. Vesicles with chemicals move toward the membrane
3. Chemicals are released and diffuse toward the next cell's plasma membrane
4. The chemicals open up the transport proteins and allow the signal to pass to the next cell

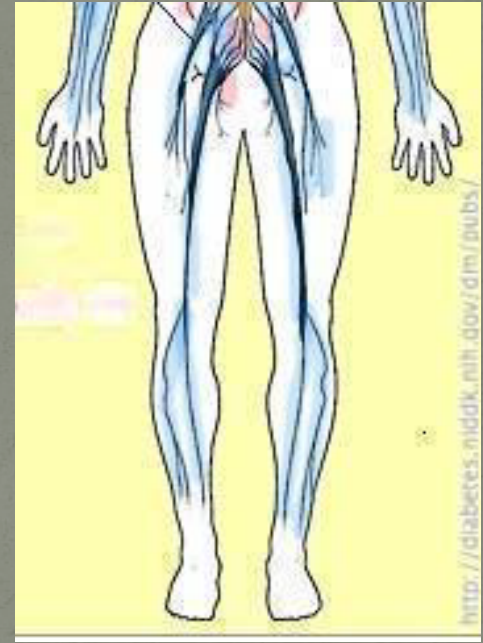
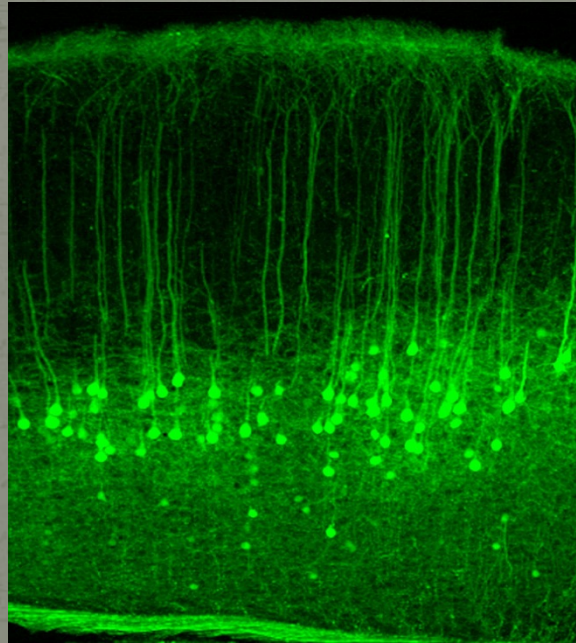
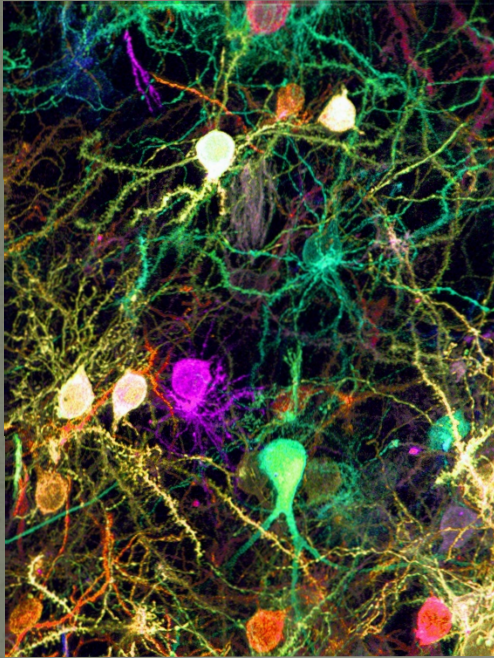


The synapse carries a signal from cell to cell.



Are all neurons equal in size?

- Brain vs spinal cord vs peripheral nerves?



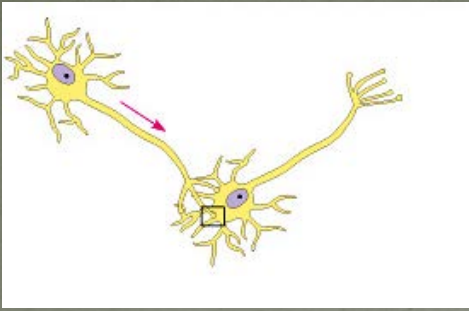
About how many neurons are in the human brain?

100 billion

About how many neurons are in the spinal cord?

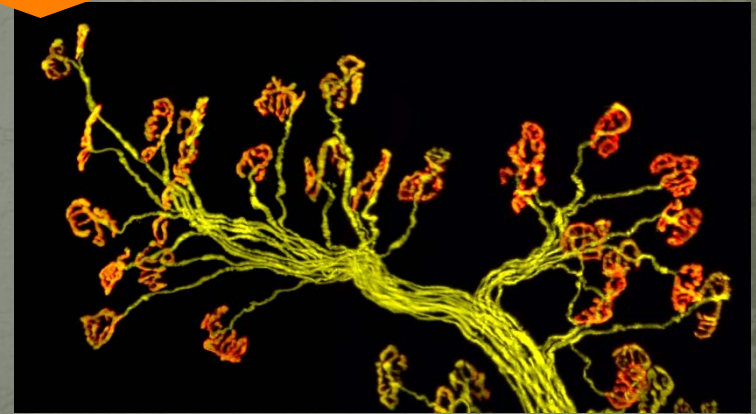
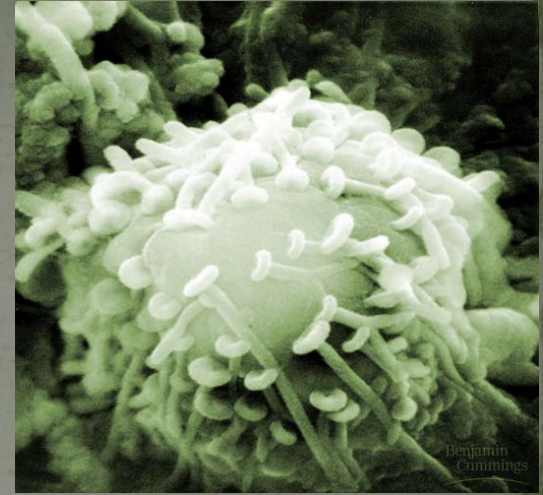
1 billion

How long do you think the longest axon in the world is? around 15 feet



**How many synapses
are in one neuron?**

1,000 to 10,000!!

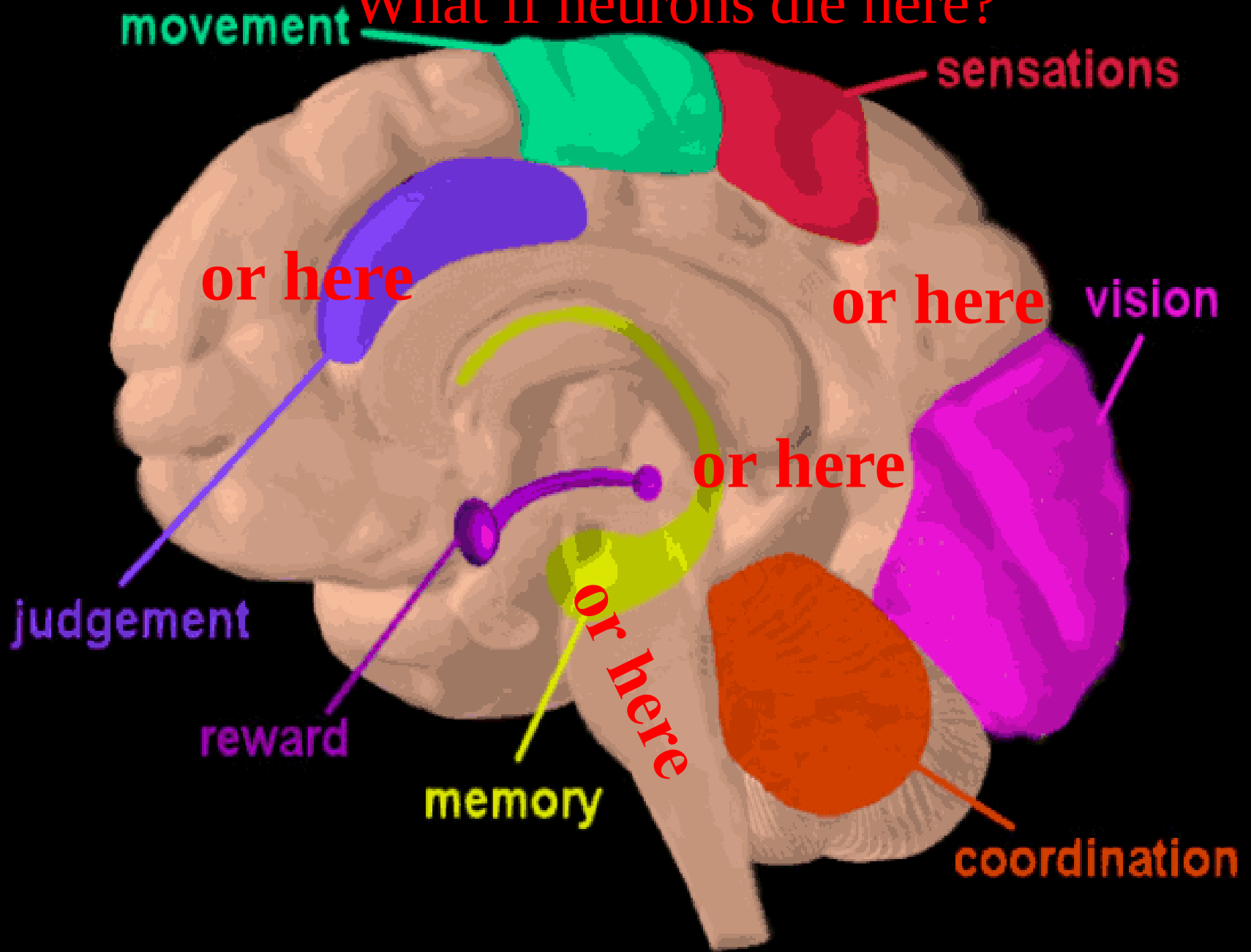


What do you think can change neurons and their connections?

- Accidents
- Drugs
- Alcohol
- Disease



What if neurons die here?

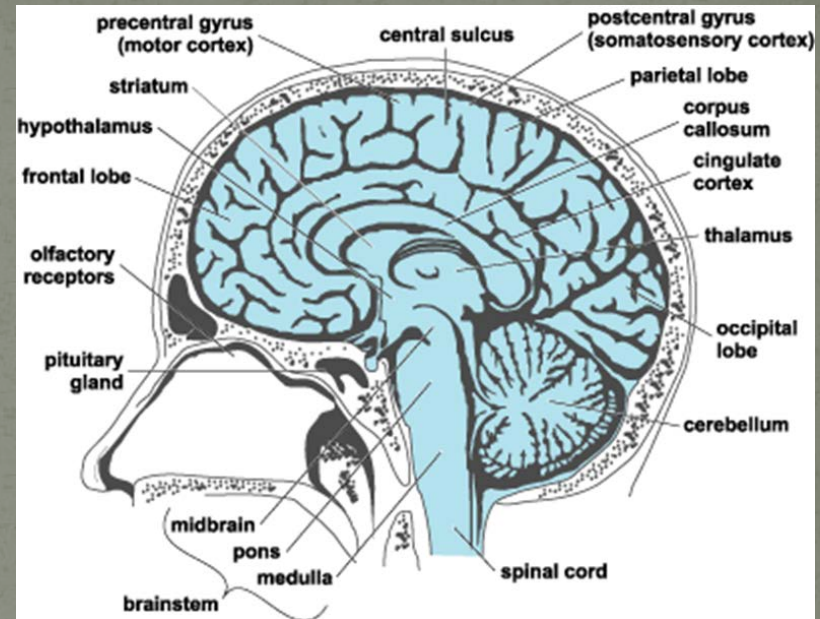


Mindboggling Activity

- https://docs.google.com/presentation/d/1UXSZK_2p_rGHNUYQXzCyhjHviFdsDAA3SRY8CSD4pFo/present#slide=id.io

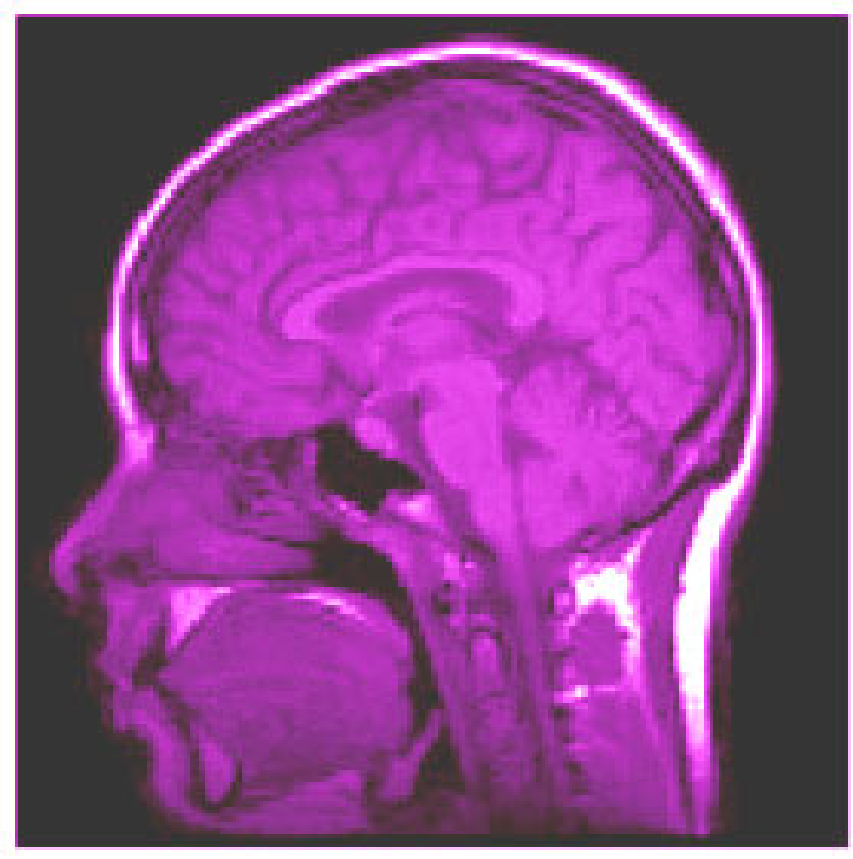
You need a piece of scrap paper and something to write with.

Brain



Cerebrum, cerebellum (occipital, parietal, frontal, temporal lobes), brain stem (medulla oblongata, pons, midbrain), thalamus, hypothalamus, pia mater, subarachnoid space, subdural space, dura mater, corpus callosum, cerebrospinal fluid, mesencephalon, diencephalon, pituitary gland, pineal gland, infundibulum, mamillary bodies

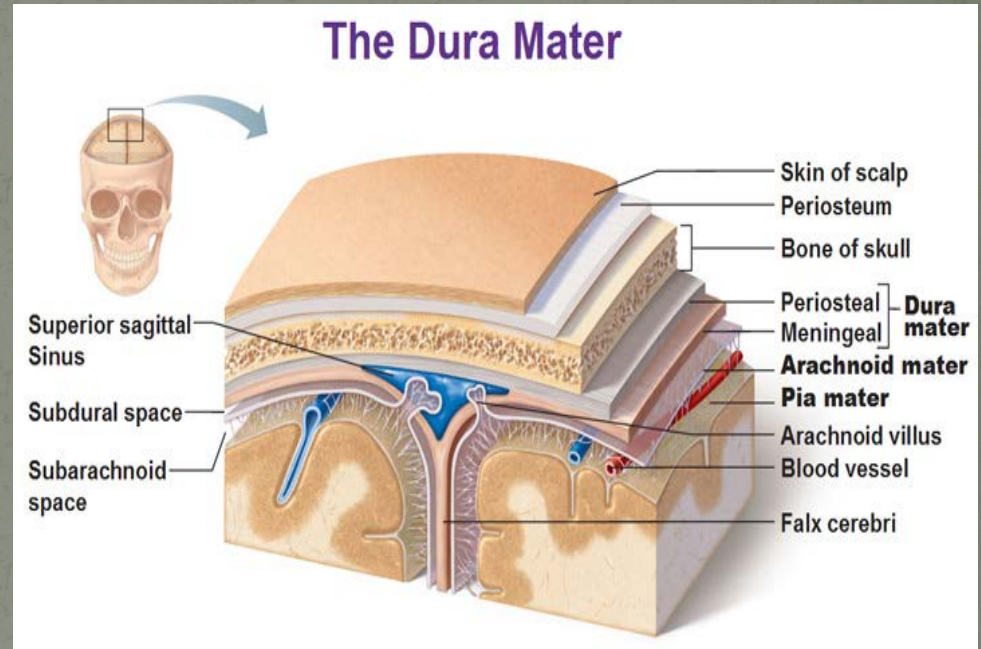
The Brain



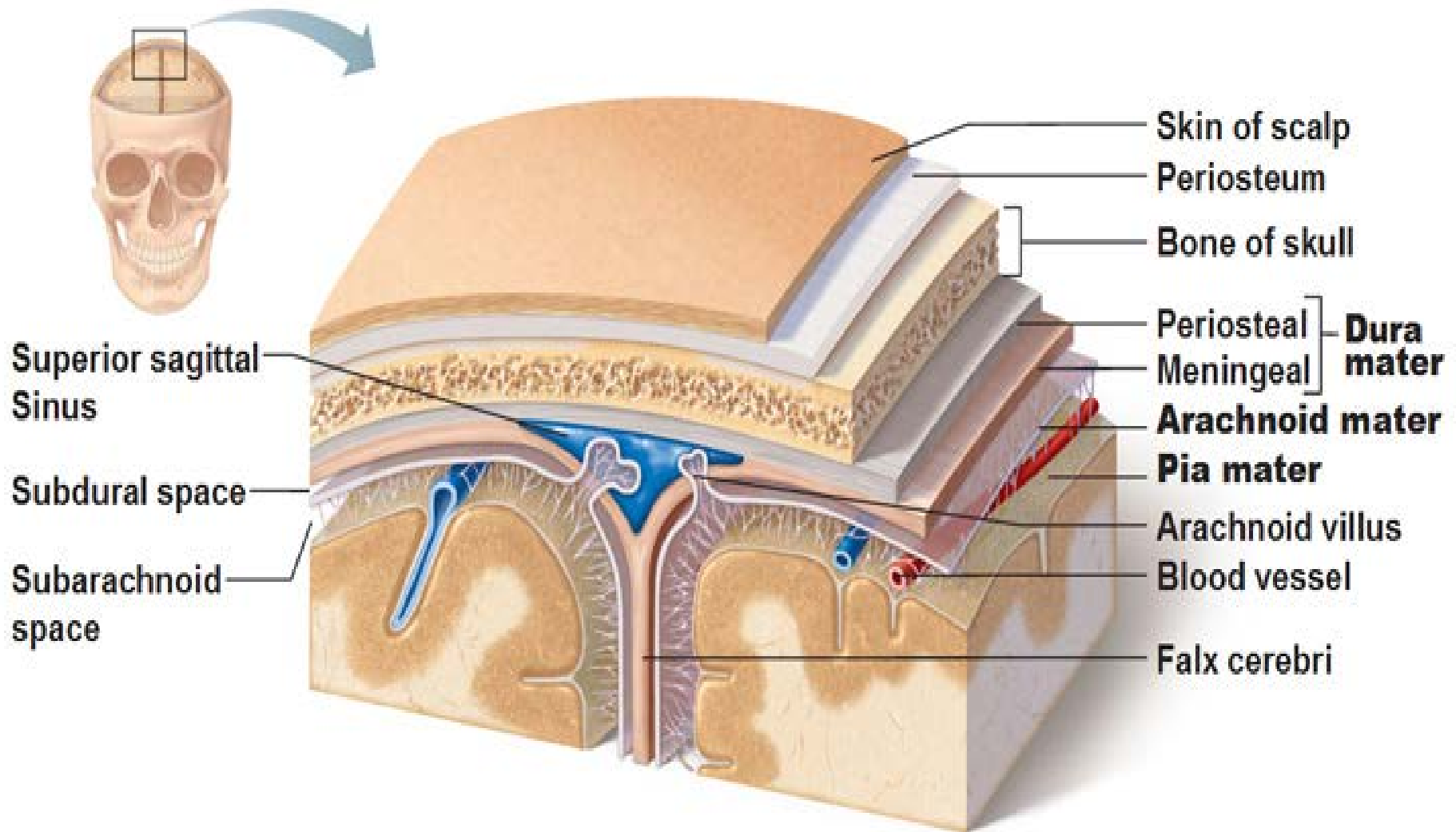
- Weighs 1300 - 1400 g
or 3 lbs
- One of the largest organs in
body
- Made up of about 100 billion
neurons
- "The most complex living
structure on the universe"
Society for Neuroscience
- Makes us who we are

Protect the Brain

1. Cranial Bones
2. Meninges
 - **Dura Mater** – outer
 - **Arachnoid Mater** – middle
 - **Pia Mater** – inner
3. Cerebrospinal fluid – shock absorber and circulates nutrients



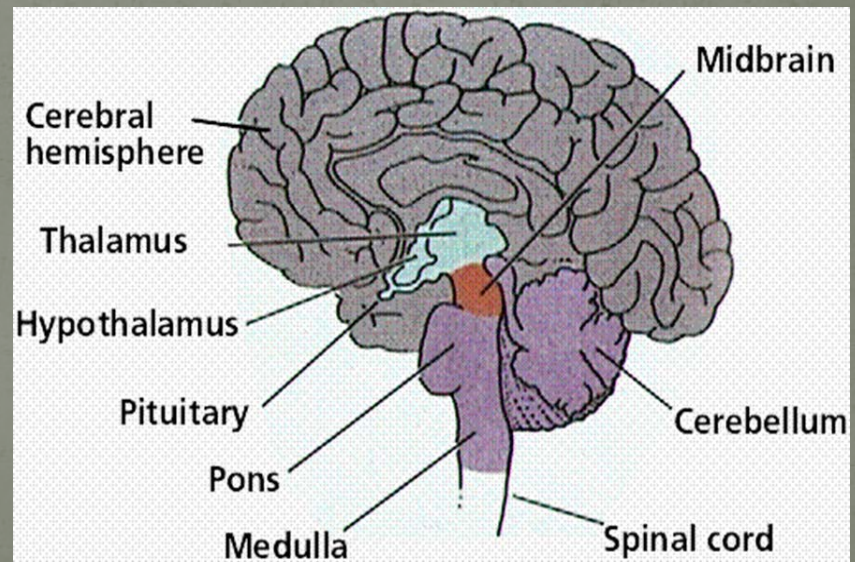
The Dura Mater

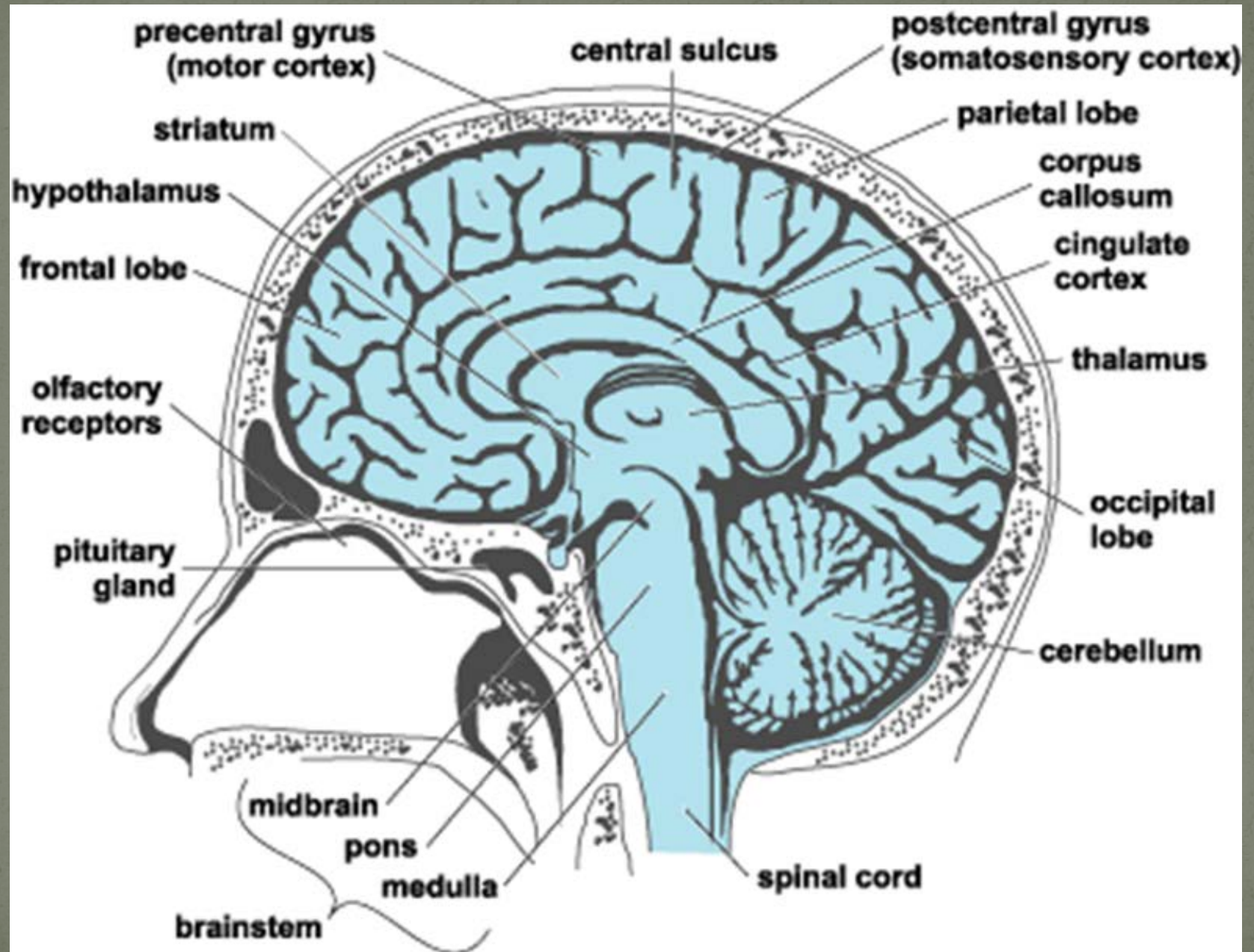


Principal Parts of the Brain

- **Brainstem** – medulla oblongata and pons varolii
- **Diencephalon** – thalamus and hypothalamus
- **Cerebellum**
- **Cerebrum**

See the Graphic Organizer





Fill in the chart!

- Work with the class to complete the table with the functions of each part of the brain.



Sensory information such as vision, smell and hearing processed here. Higher cognitive functions.

cerebral cortex

corpus collosum

Connects the left and right hemispheres to coordinate information

hypothalamus

Homeostasis: control of body temperature and osmoregulation.
Secretes hormones

cerebellum

Fine motor control, posture and balance

pituitary gland

Produces hormones that control growth, sexual development and metabolism

pons

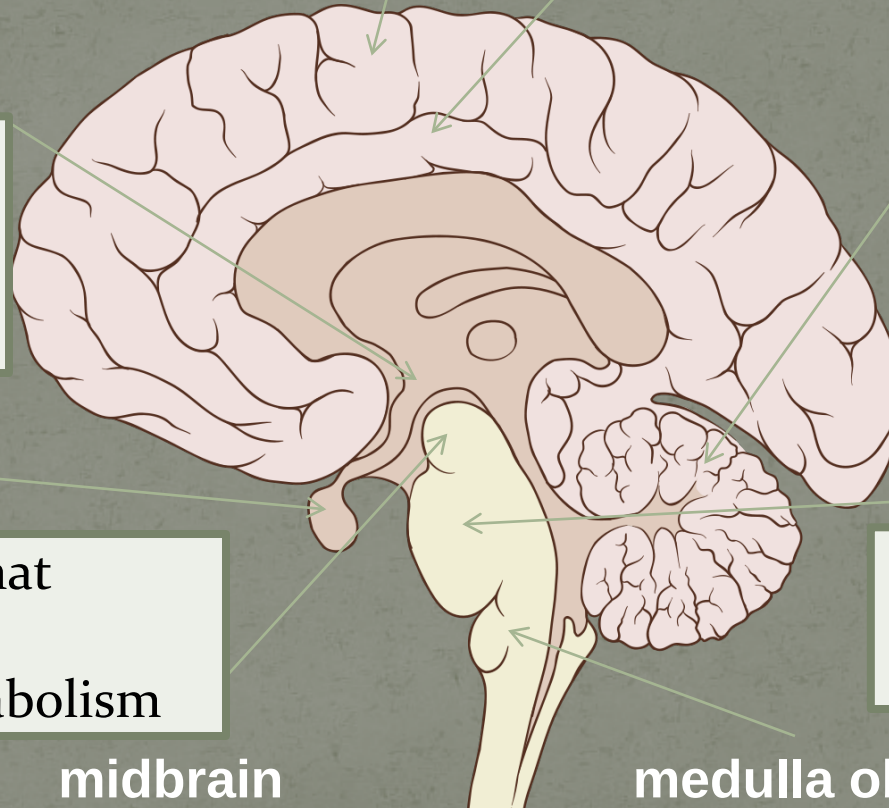
Links the medulla with the thalamus

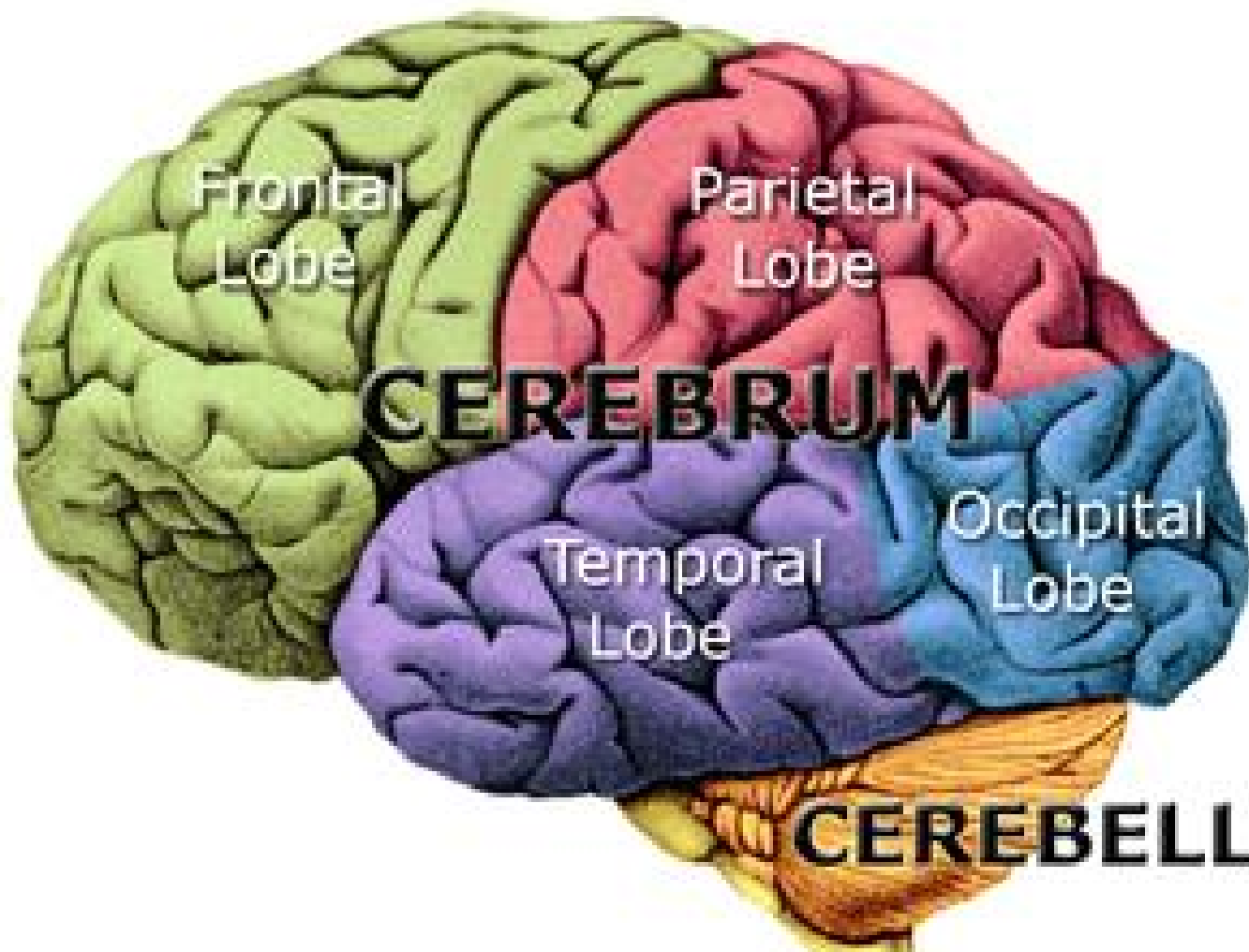
midbrain

Involved in control of visual and auditory systems. Also controls body movement

medulla oblongata

Controls breathing, heart rate and blood pressure; reflex actions such as vomiting and sneezing





Frontal
Lobe

Parietal
Lobe

CEREBRUM

Temporal
Lobe

Occipital
Lobe

CEREBELLUM

BRAIN STEM

Brain Functions (Superior View)

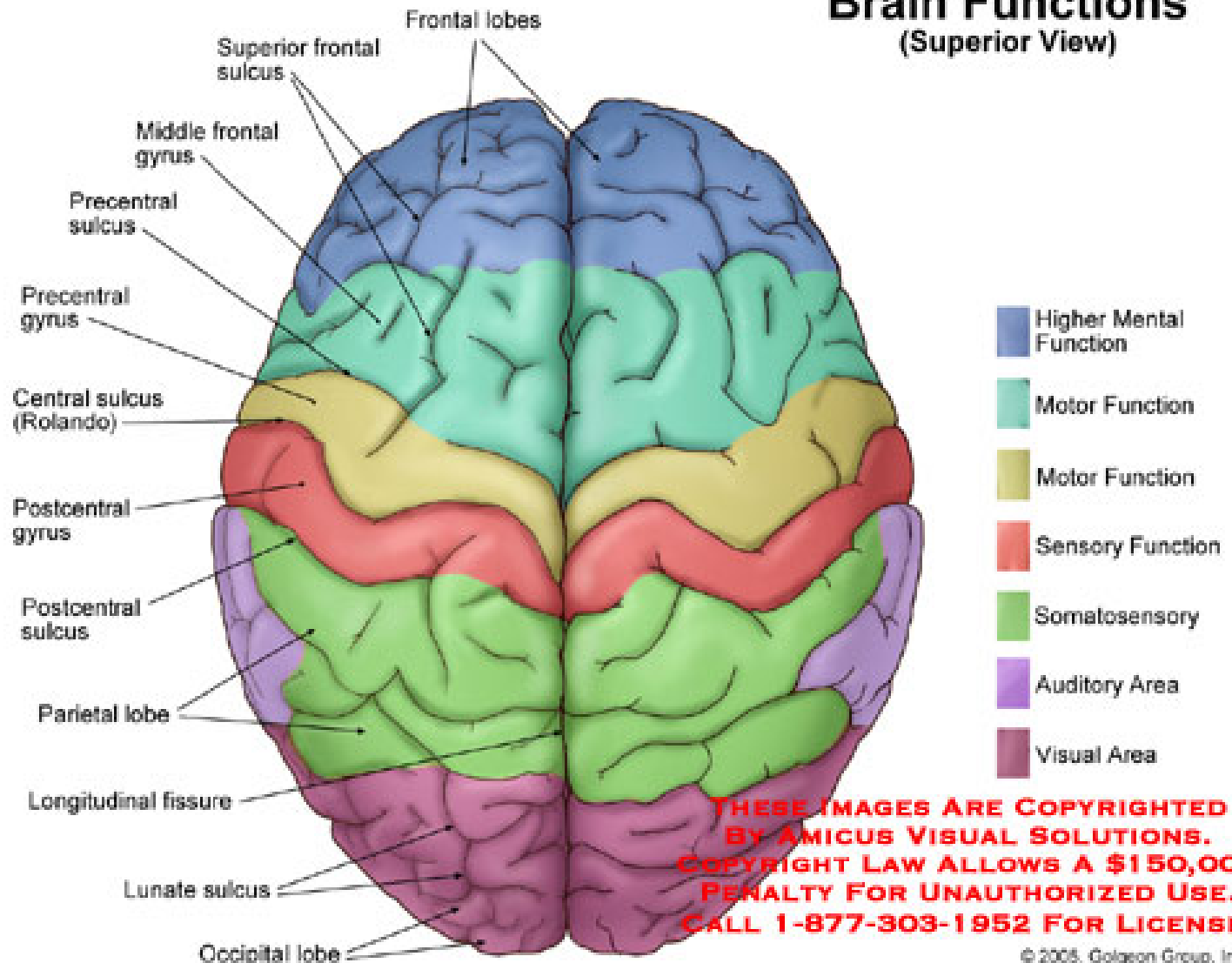


Diagram of Brain Stem

Forebrain
(Cerebrum)

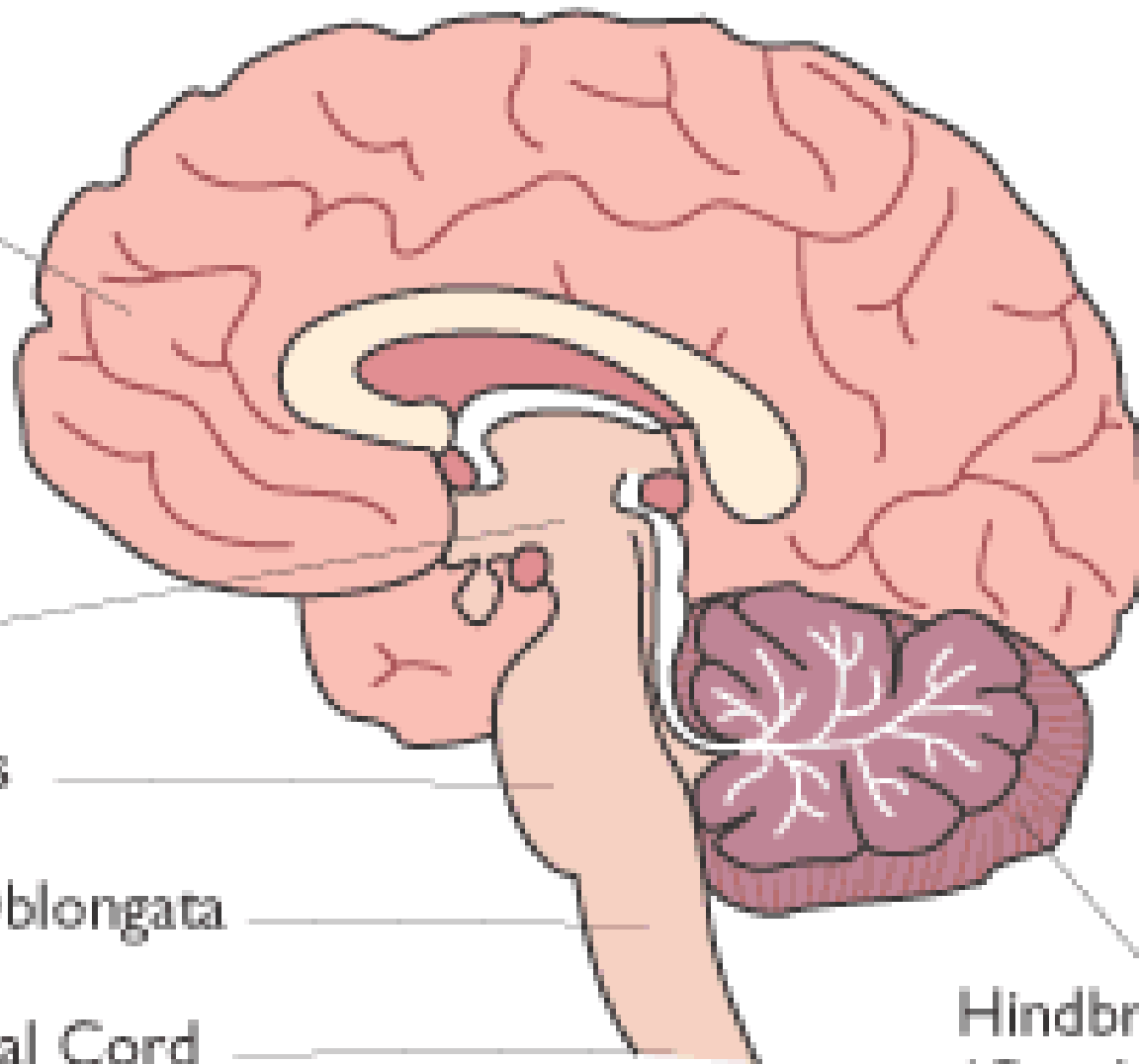
Midbrain

Pons

Medulla Oblongata

Spinal Cord

Hindbrain
(Cerebellum)



Label Your Diagrams

Use the pictures and
your textbook.

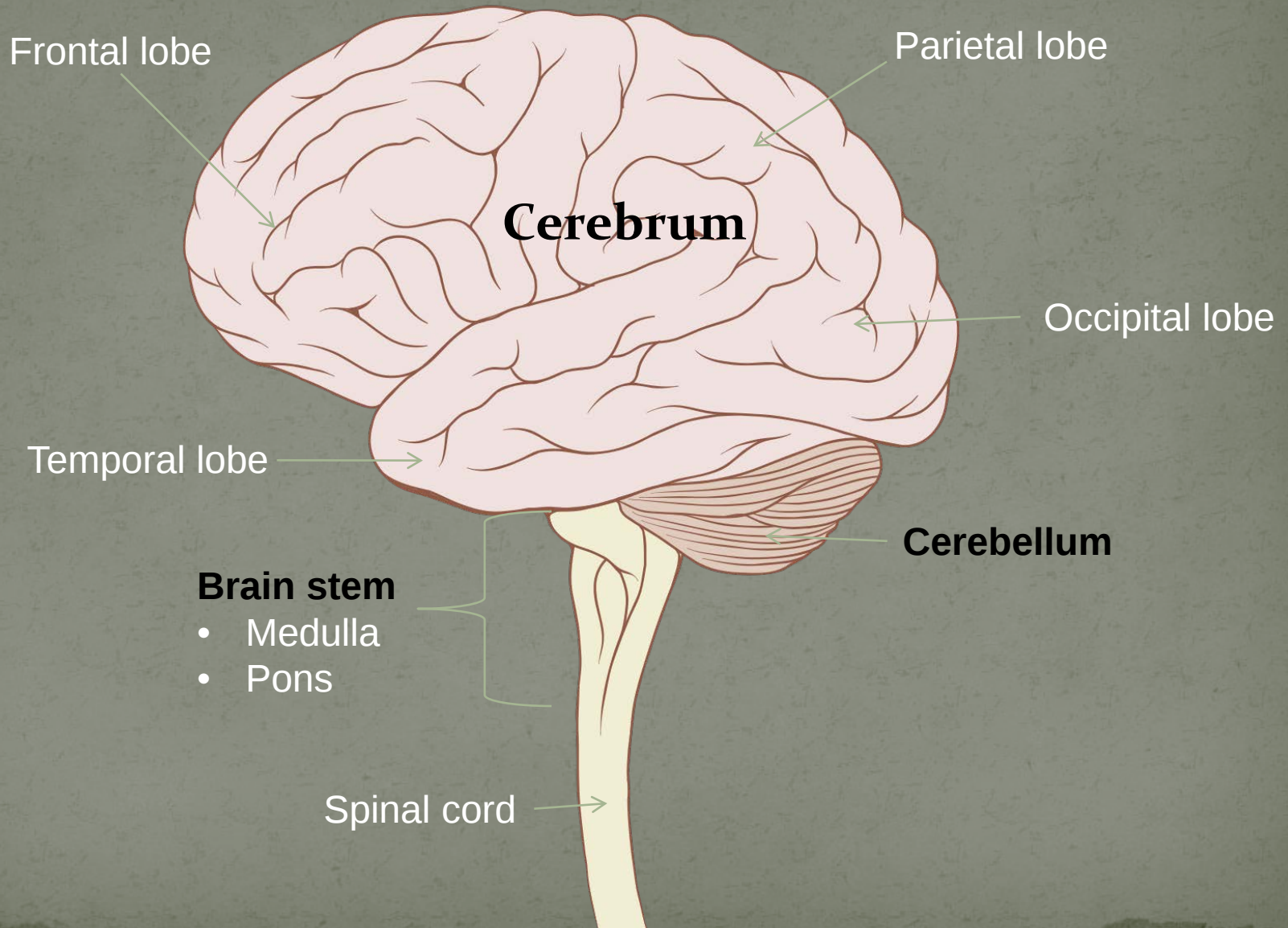
The labels are on the
diagrams.

Use the next three
slides to check your
brain diagrams.

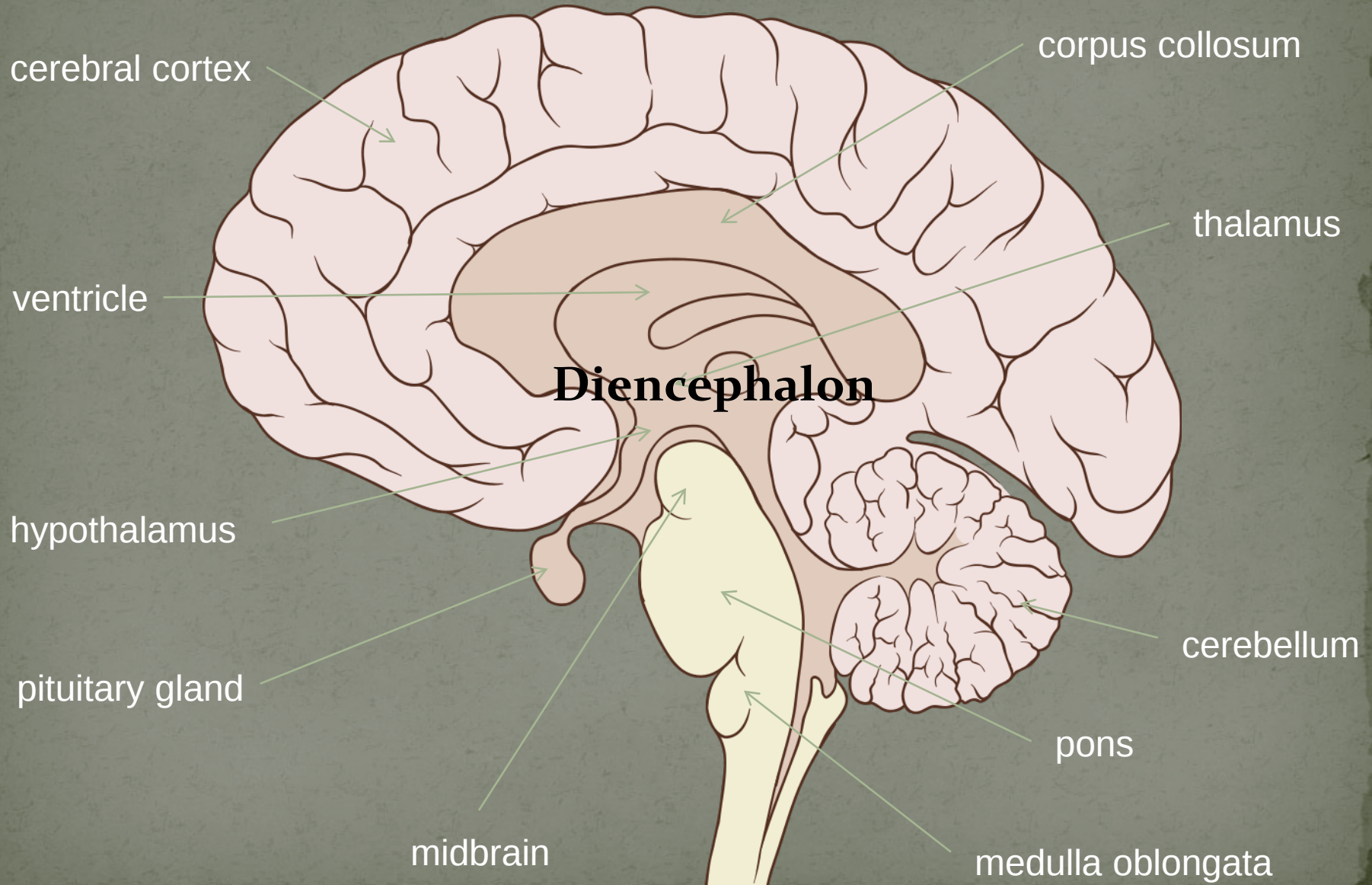
You may add color
later on .



External structure of the brain



Internal structure of the brain



Fill in the Tree Diagram

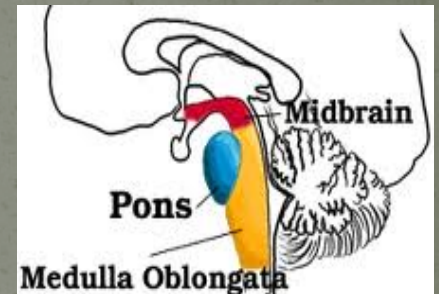
- Take notes on the 4 parts of the brain using the note taker tree diagram pages.

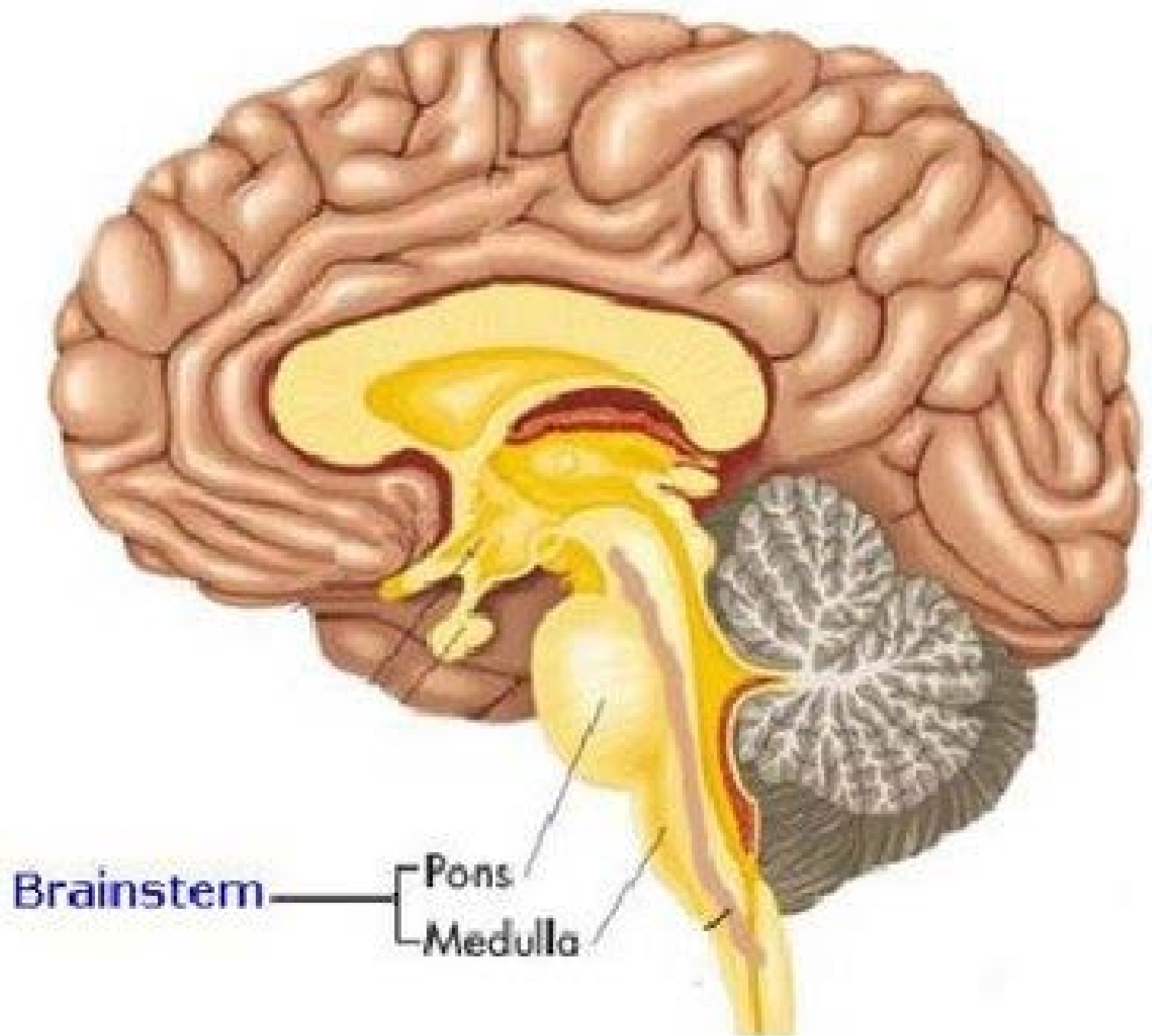


I. Brainstem –

Connects brain to spinal cord

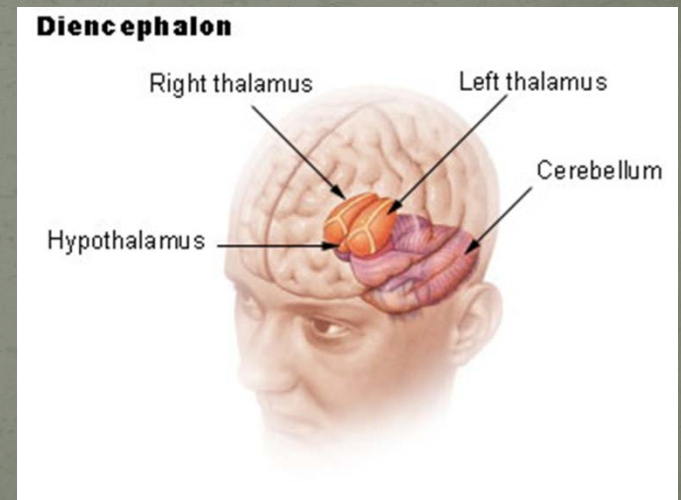
- **Medulla Oblongata**
 - **White Matter** - ascending and descending tracts from brain parts to spinal cord
 - **Gray Matter** – consciousness and arousal
 - Diameter of blood vessels
 - Force of contraction and heartbeat
 - Basic rhythm of breathing
- **Pons Variolii** – bridge between spinal cord and brain
 - Control breathing
- **Midbrain – mesencephalon**
 - Movement of eyeballs and movement of head and trunk in response to loud noise.





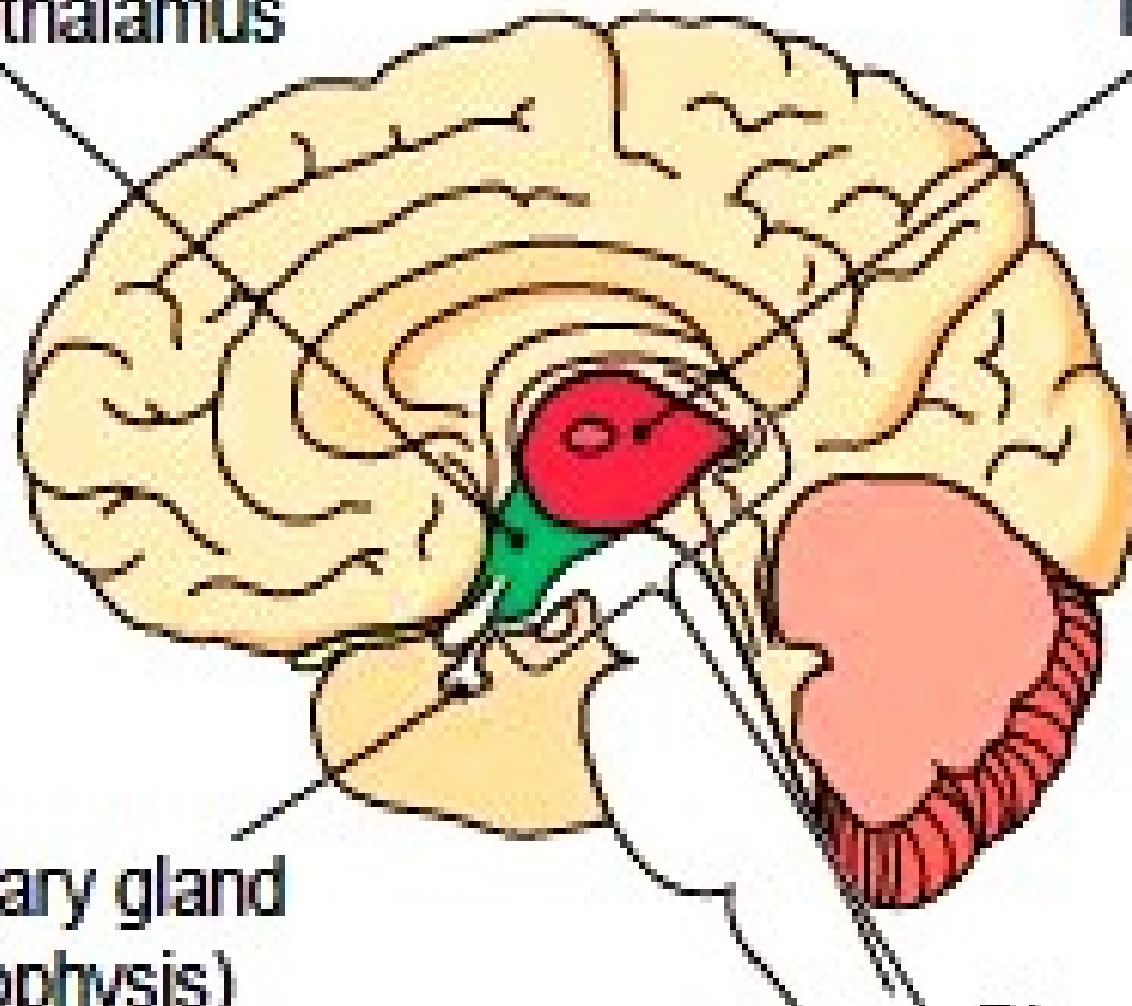
II. Diencephalon – Part 1

- **Thalamus** – relay station for sensory impulses to reach the cerebral cortex
 - Pain & temperature recognition
- **Hypothalamus**
 - Body functions related to homeostasis
 - Controls and integrates the ANS
 - Mind over Body
 - Rage and aggressive feelings
 - Thirst
 - Waking and sleeping
 - Food Intake



Hypothalamus

Thalamus

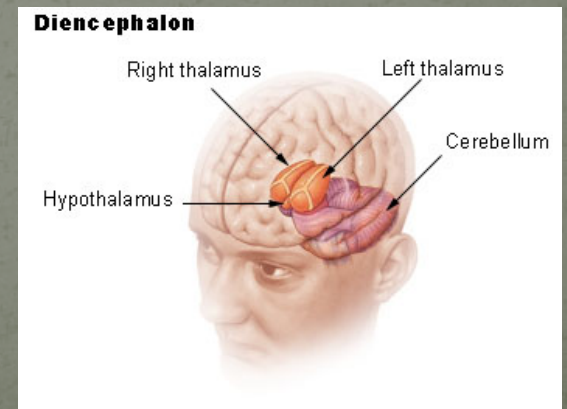


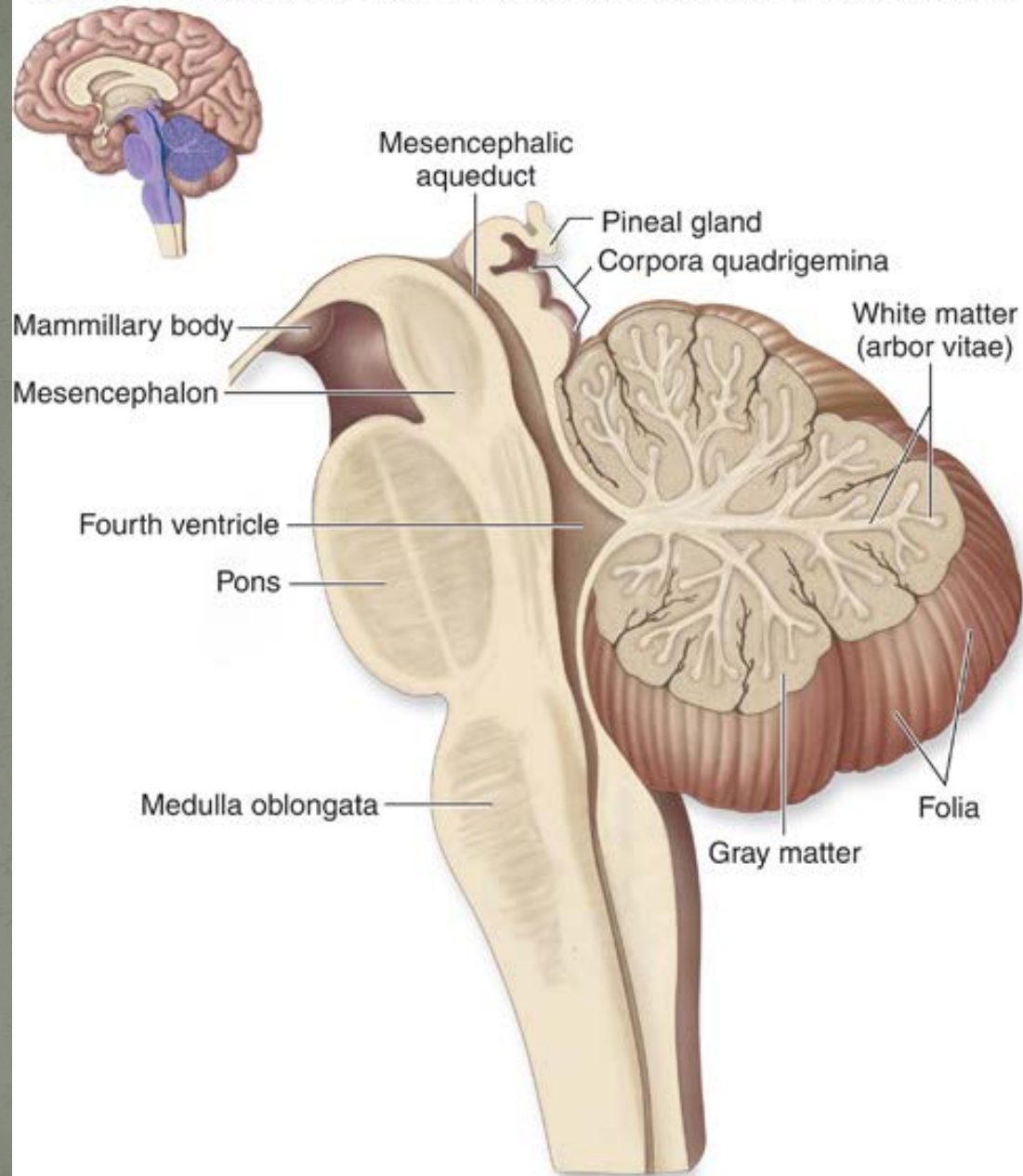
Pituitary gland
(hypophysis)

Diencephalon

Diencephalon – Part 2

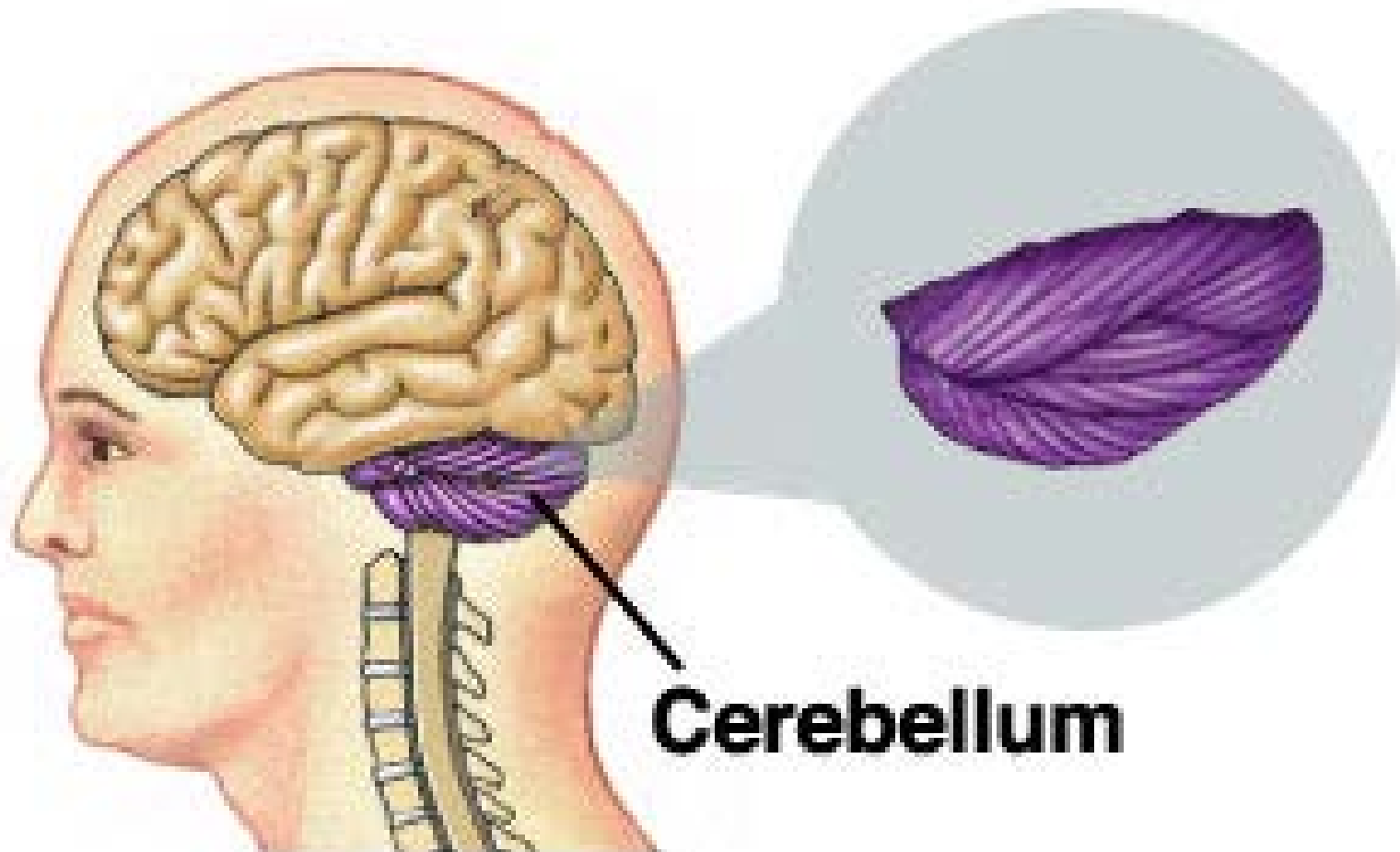
1. **Optic Tracts and Optic Chiasma** (optic nerves cross)
2. **Infundibulum** which attaches to the pituitary gland
3. **Mamillary bodies** – memory and emotional responses to odor
4. **Pineal Gland** – part of the epithalamus, secretes melatonin (moods and behavior)





(a) Midsagittal section

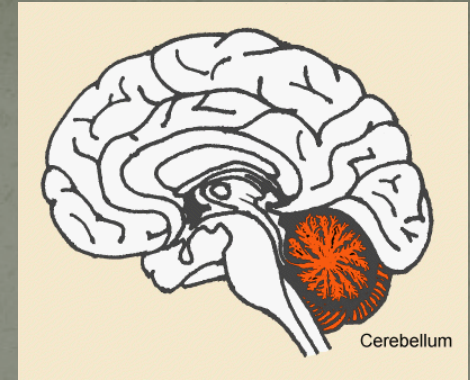
Figure F-2: The Cerebellum

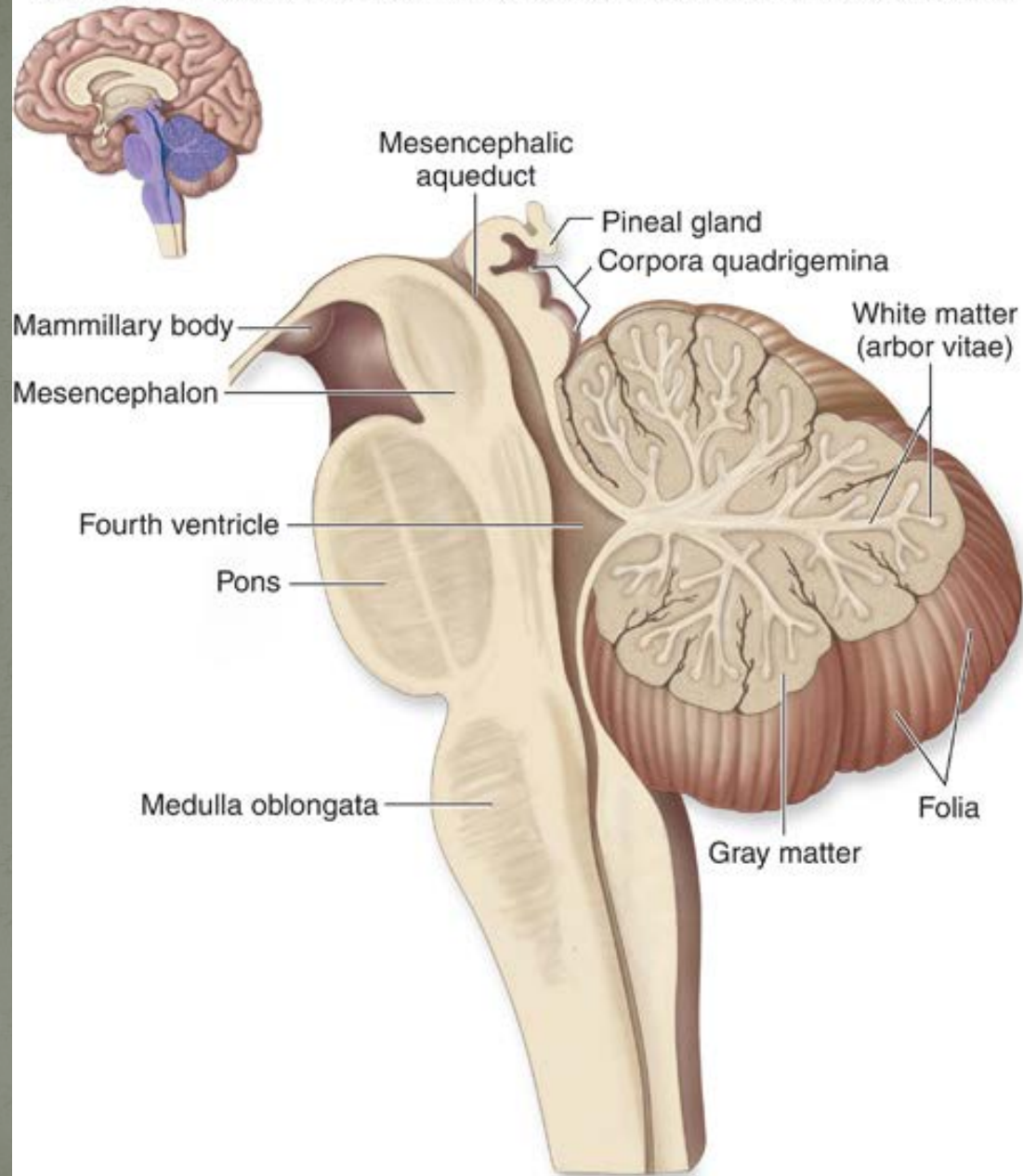


The cerebellum is where learned movements are stored.

III. Cerebellum

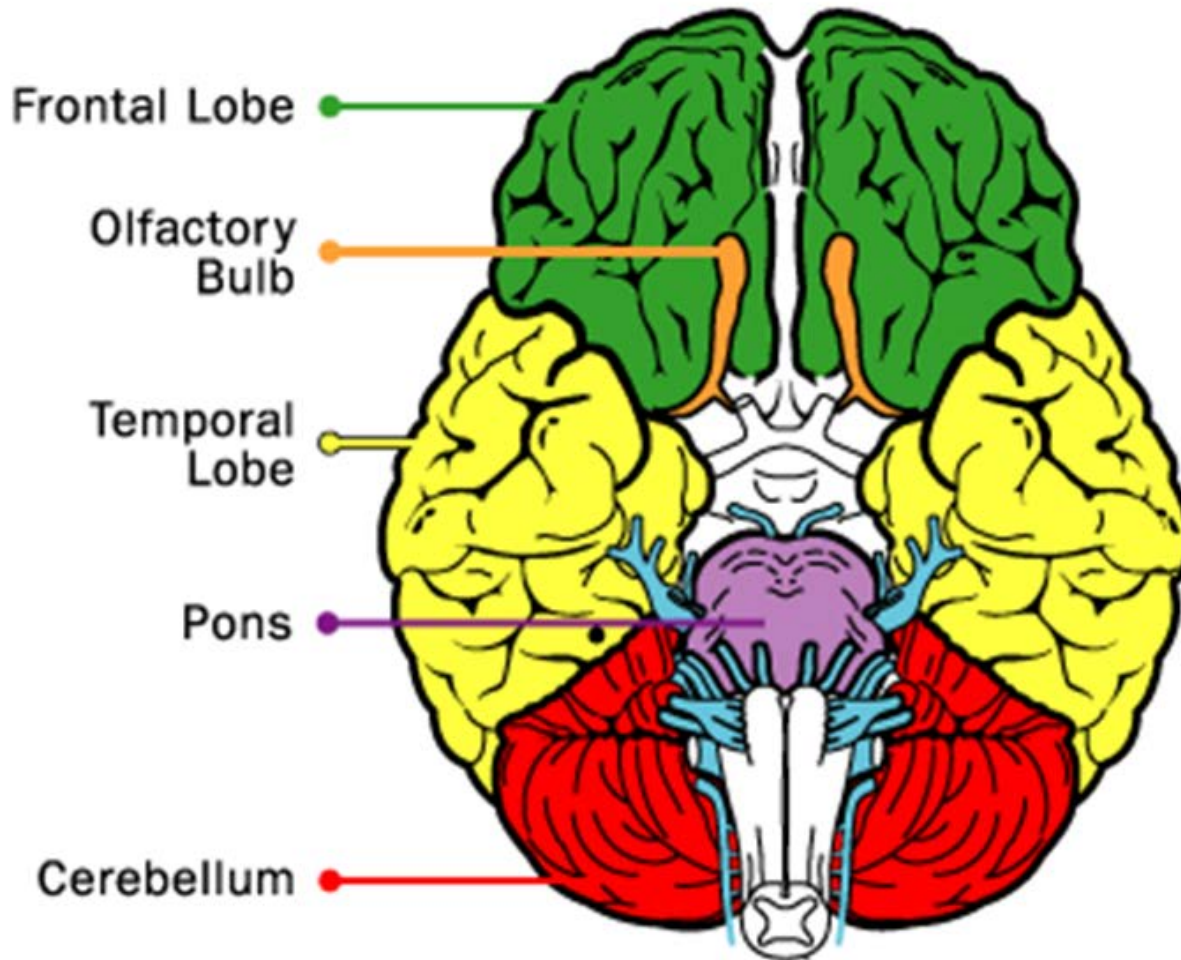
- Second largest portion of the brain
- Shaped like a butterfly
- Two partially separated hemispheres connected by the **vermis**
- Mostly White Matter with a thin layer of Gray Matter (Cerebellar Cortex)
- Reflex center in coordinating complex skeletal muscular movements
- Body Balance





(a) Midsagittal section

Major External Parts of the Human Brain (Underside View)



©2001 HowStuffWorks

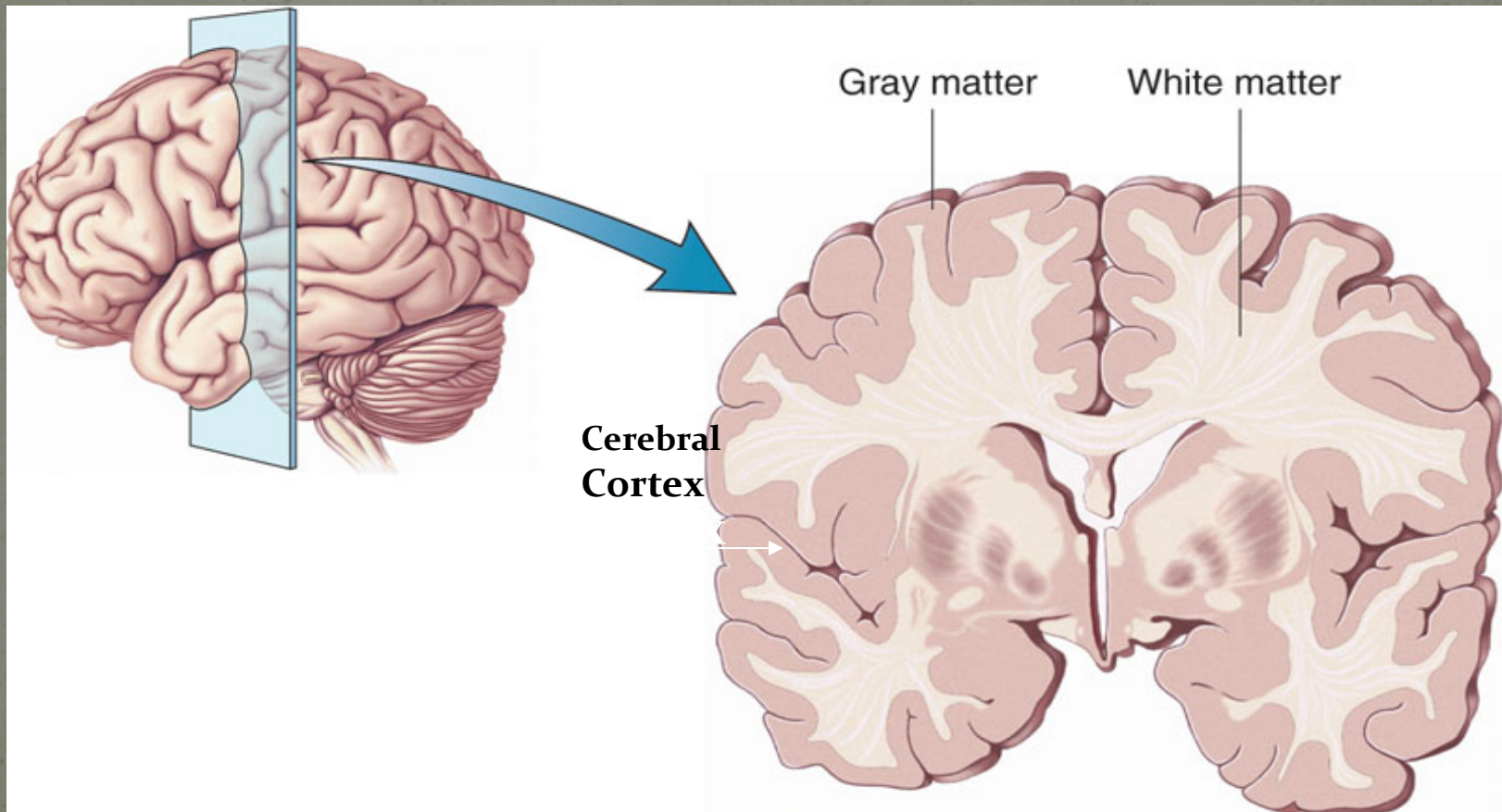
Cranial Nerves Shown in **BLUE**

Part IV. Cerebrum

The largest division of the brain. It is divided into two hemispheres, each of which is divided into four lobes.



Cerebral Cortex - The outermost layer of gray matter making up the superficial aspect of the cerebrum.



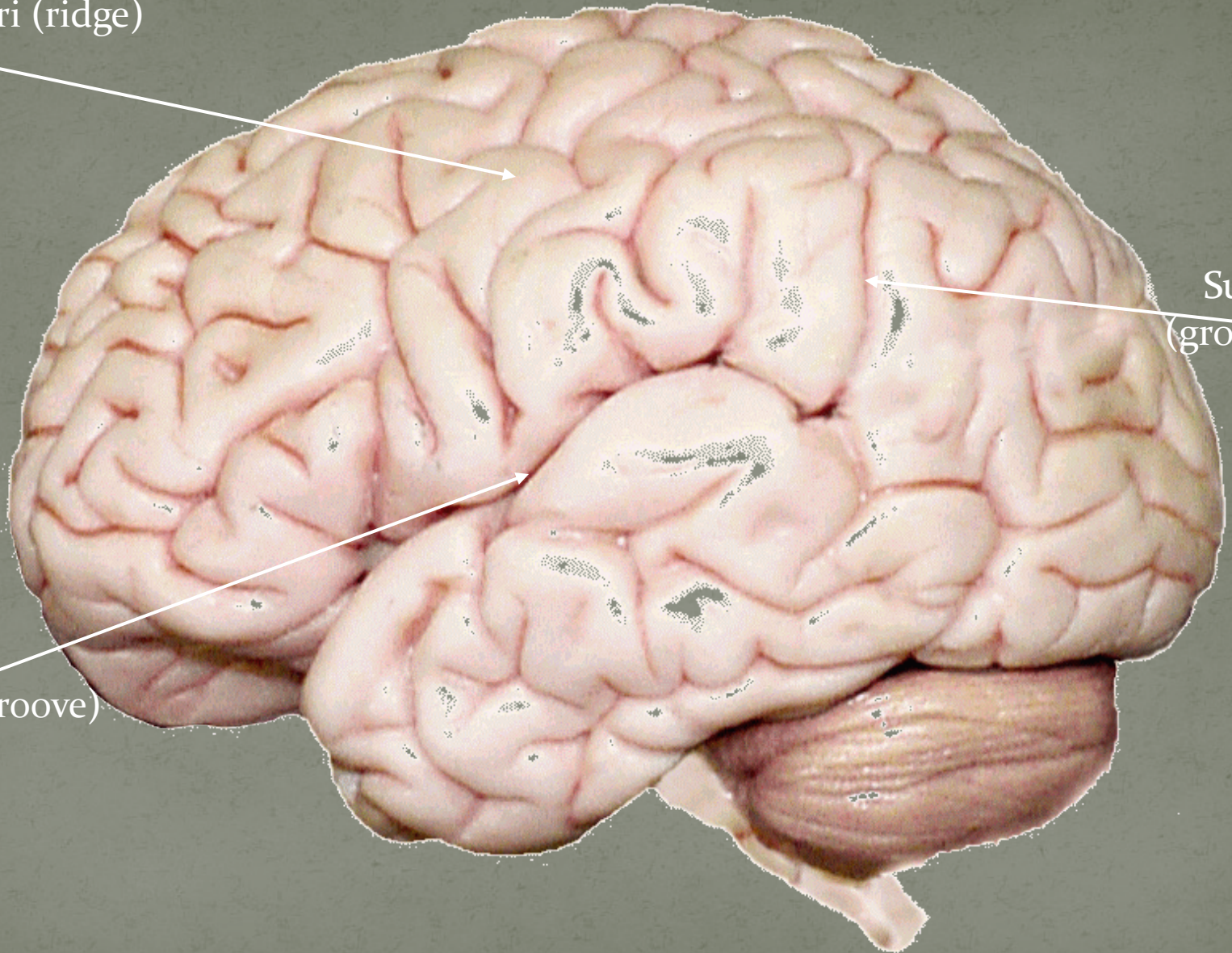
Cerebral Features

1. **Gyri** – Elevated ridges “winding” around the brain.
2. **Sulci** – Small grooves dividing the gyri
3. **Fissures** – Deep grooves, generally dividing large regions/lobes of the brain

Gyri (ridge)

Sulci
(groove)

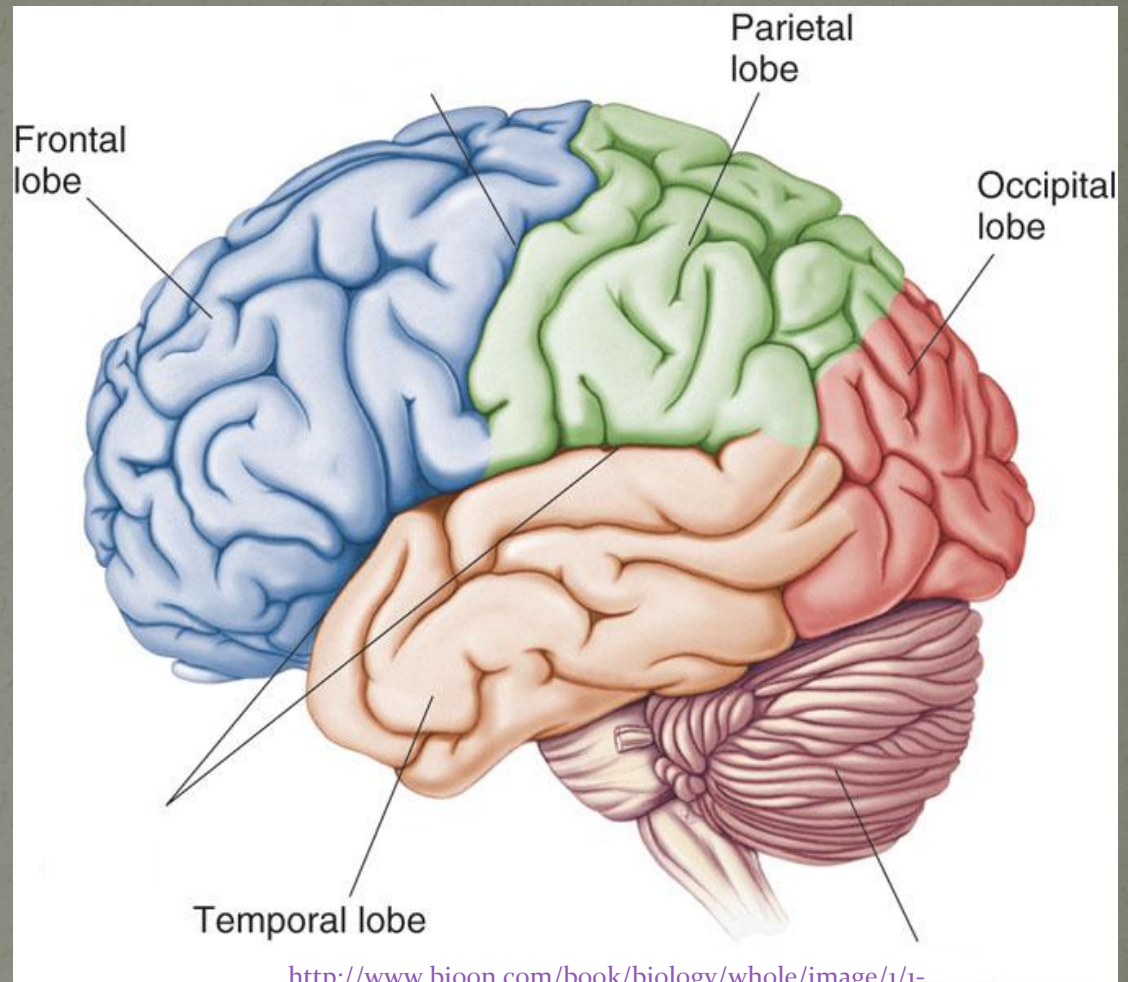
Fissure
(deep groove)



Lobes of the Cerebrum

- Frontal
- Parietal
- Occipital
- Temporal

**Use the
Graphic
Organizer to
take Notes**

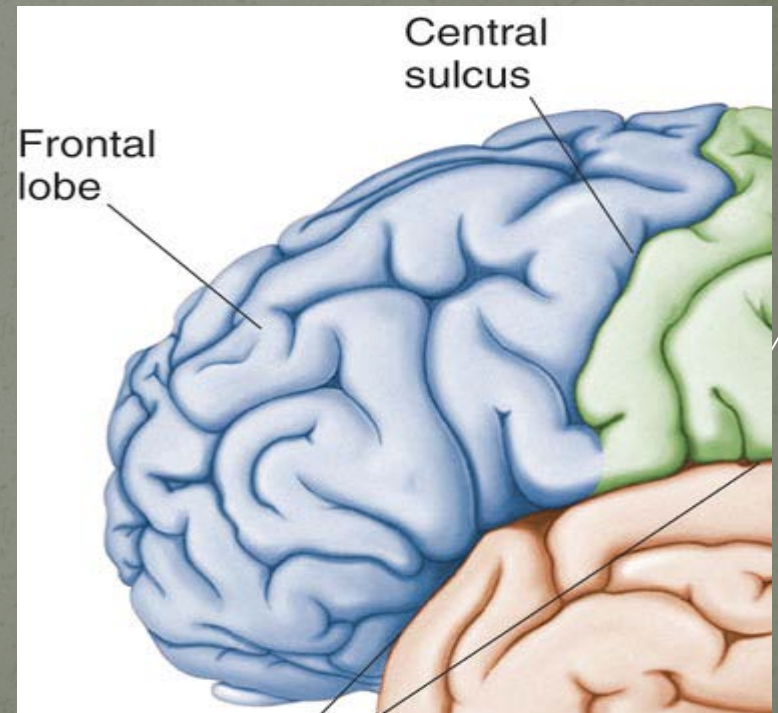


<http://www.bioon.com/book/biology/whole/image/1-1-8-01.jpg>

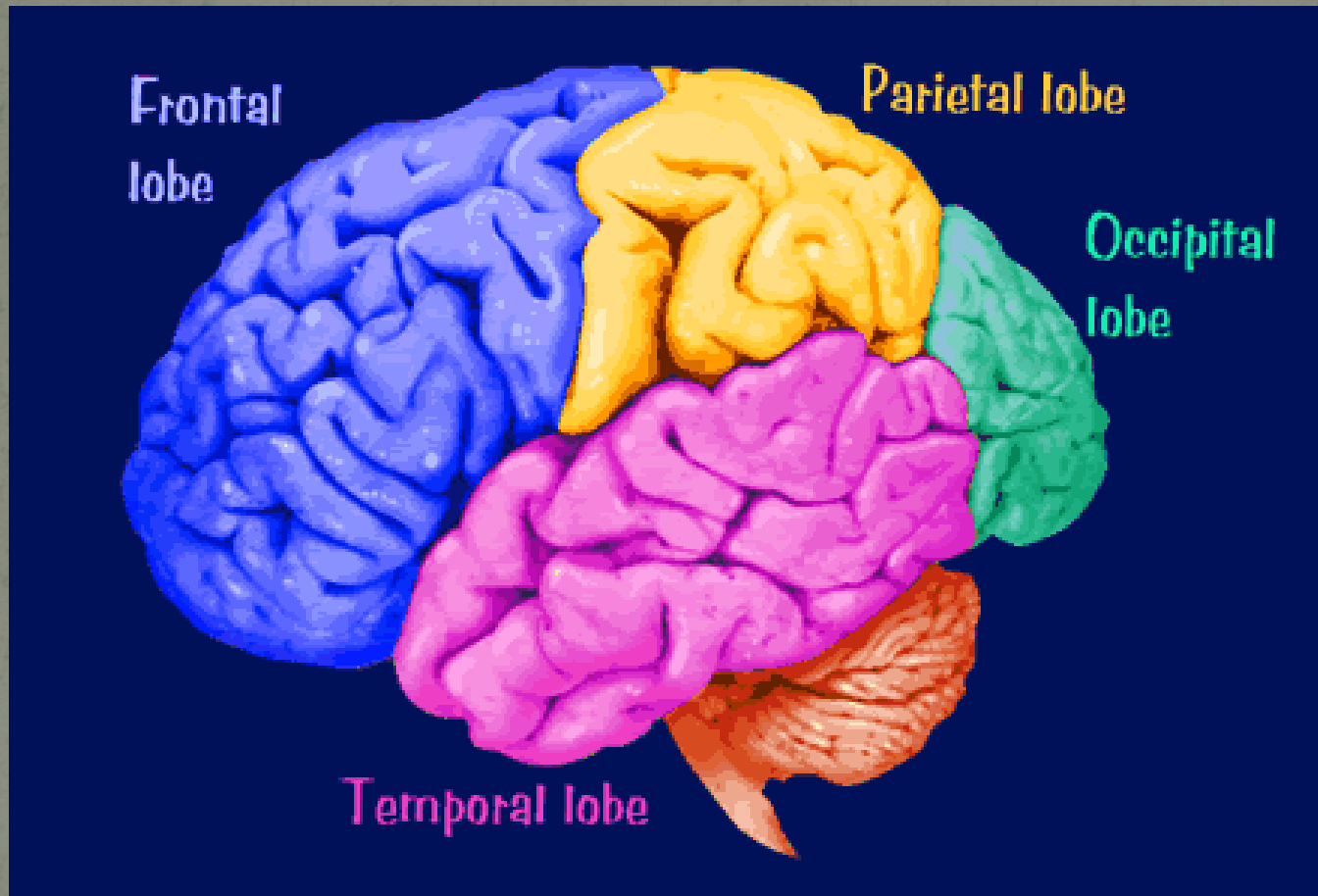
* Note: Occasionally, the Insula is considered the fifth lobe. It is located deep to the Temporal Lobe.

Lobes of the Cerebrum - Frontal

- It plays an integral role in the following functions/actions:
 - Memory Formation
 - Emotions
 - Decision Making/Reasoning
 - Personality

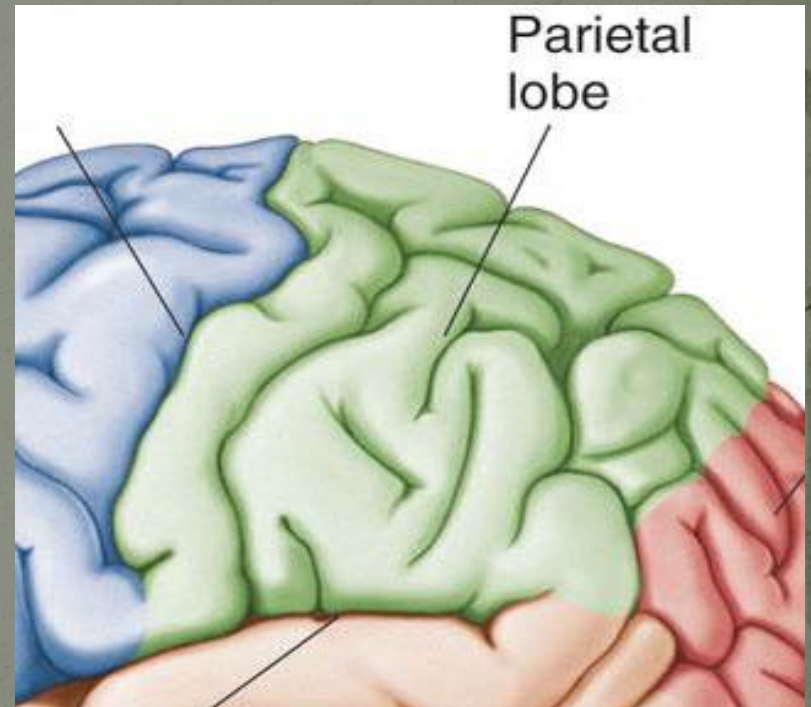


Lobes of the cerebrum

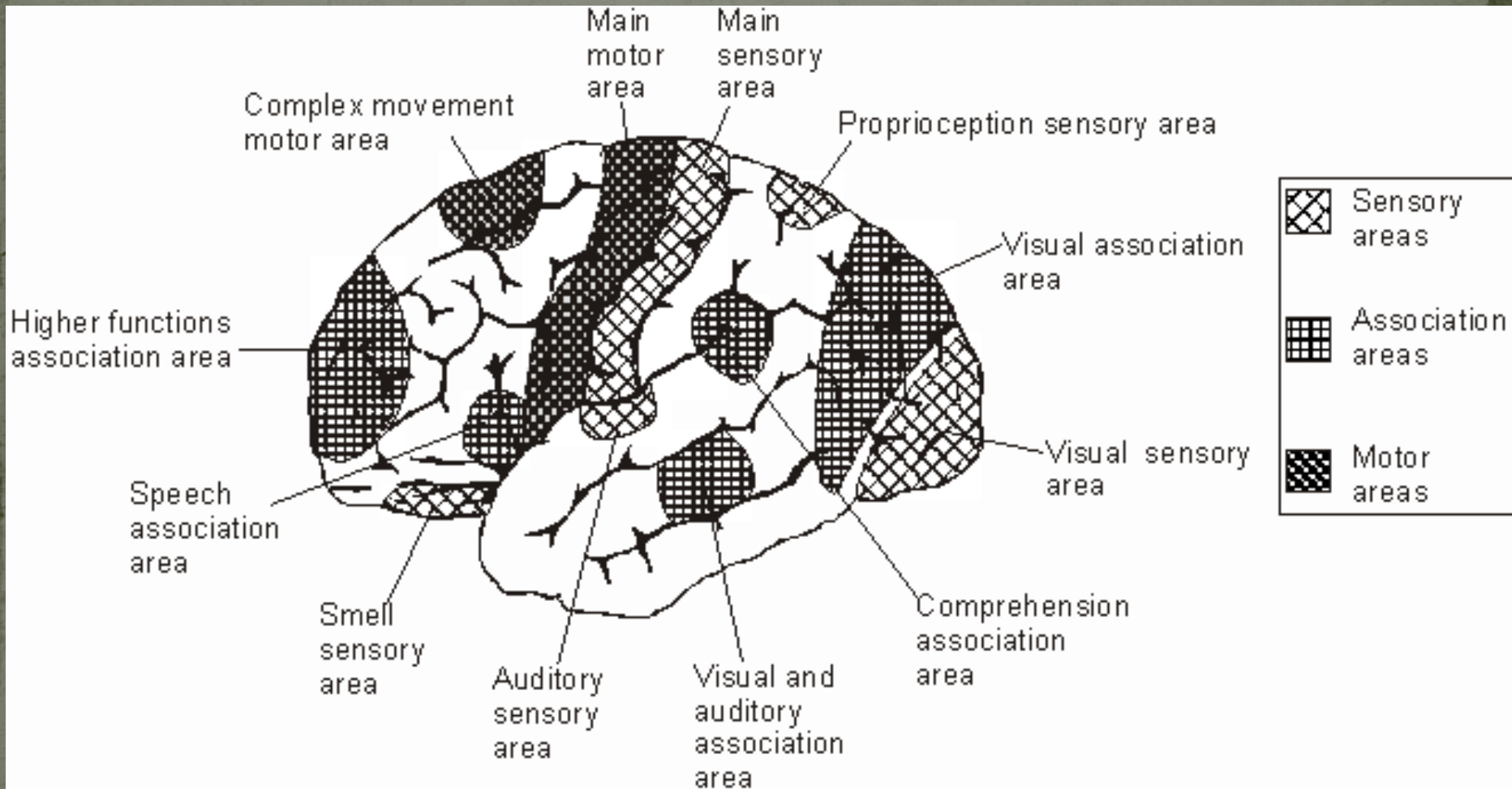


Lobes of the Cerebrum - Parietal Lobe

- It plays a major role in the following functions/actions:
 - Senses and integrates sensation(s)
 - Spatial awareness and perception

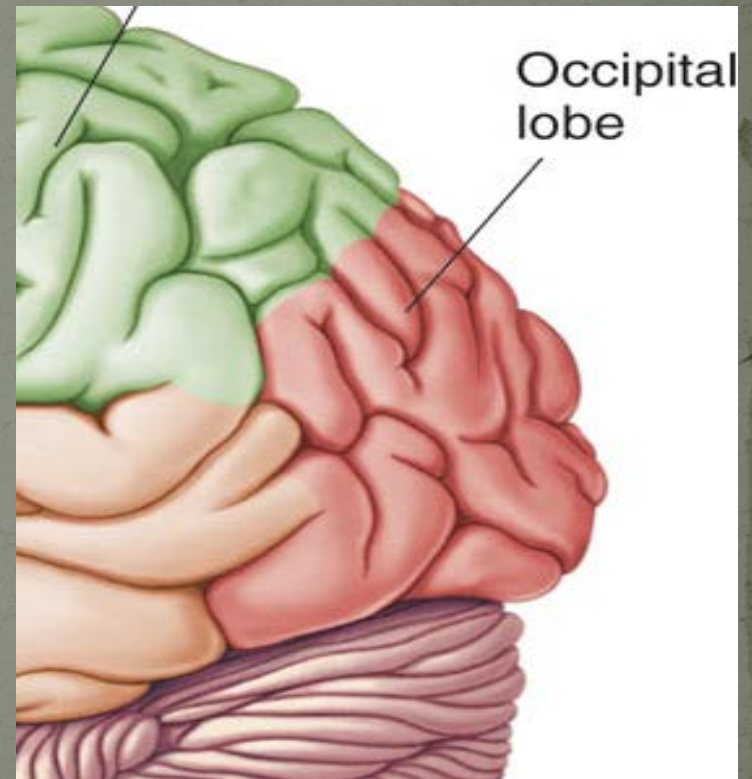


Lobes of the cerebrum



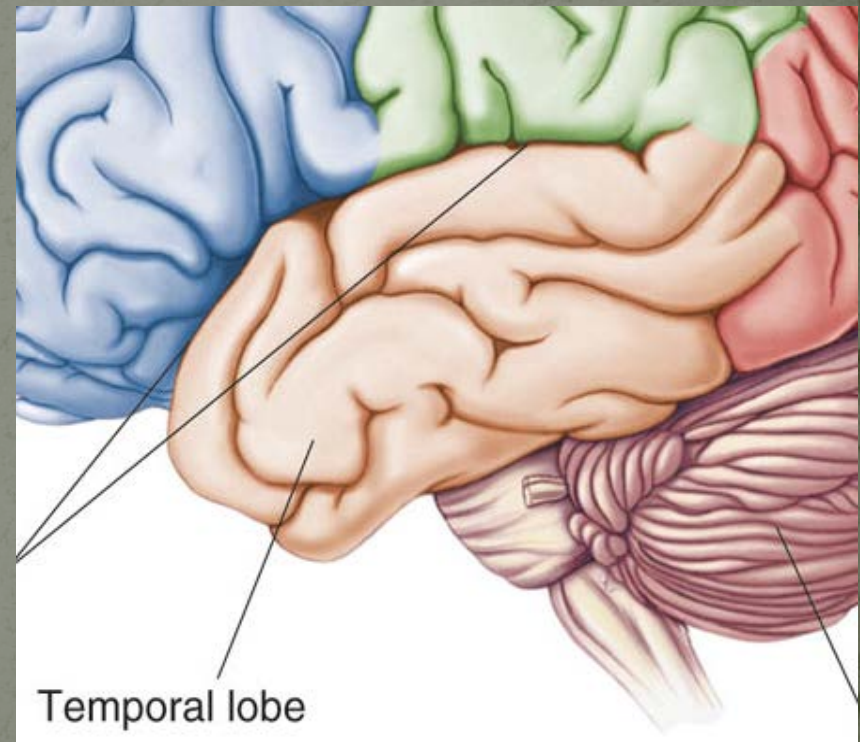
Lobes of the Cerebrum – Occipital Lobe

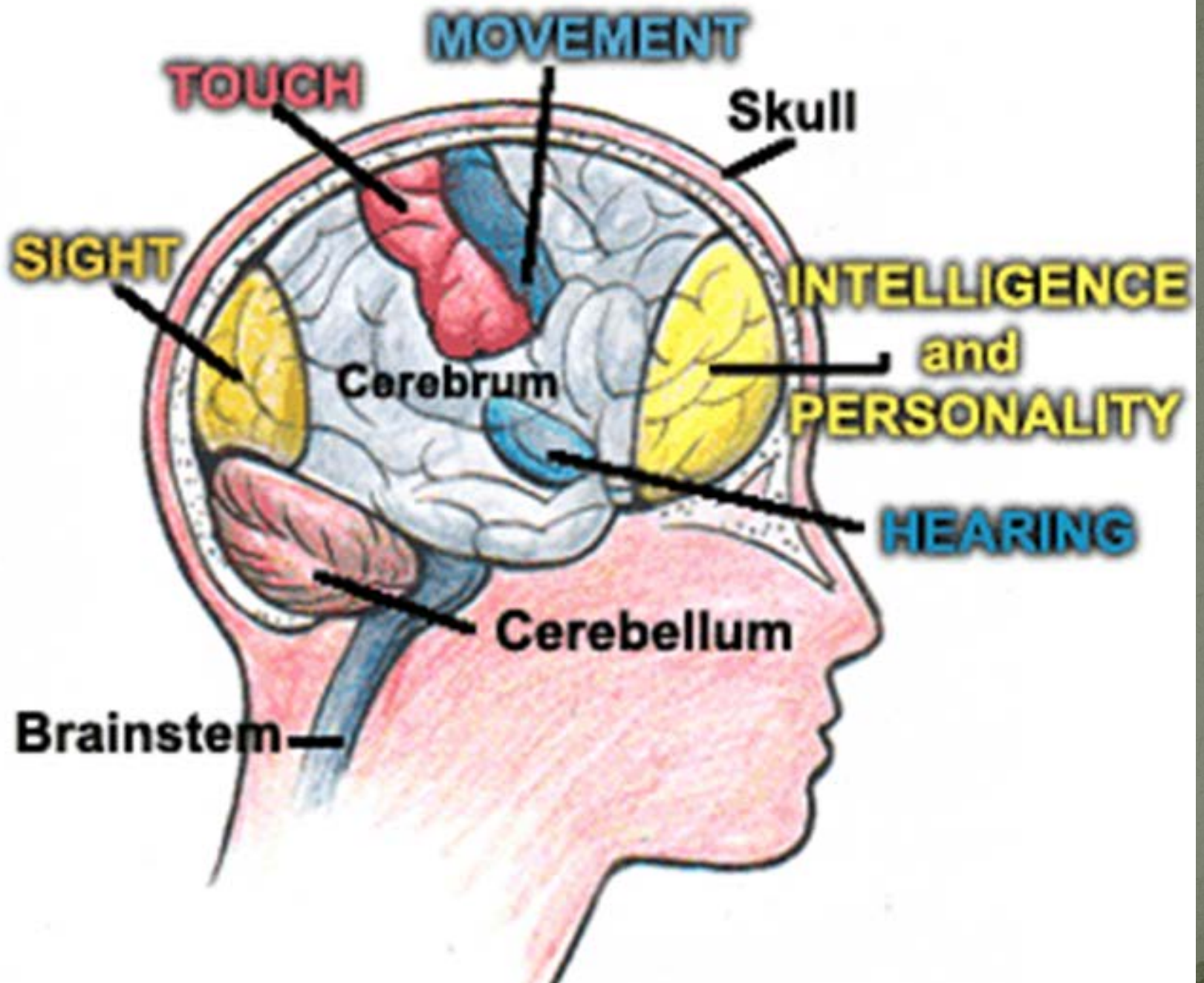
. Its primary function is the processing, integration, interpretation, etc. of VISION and visual stimuli.

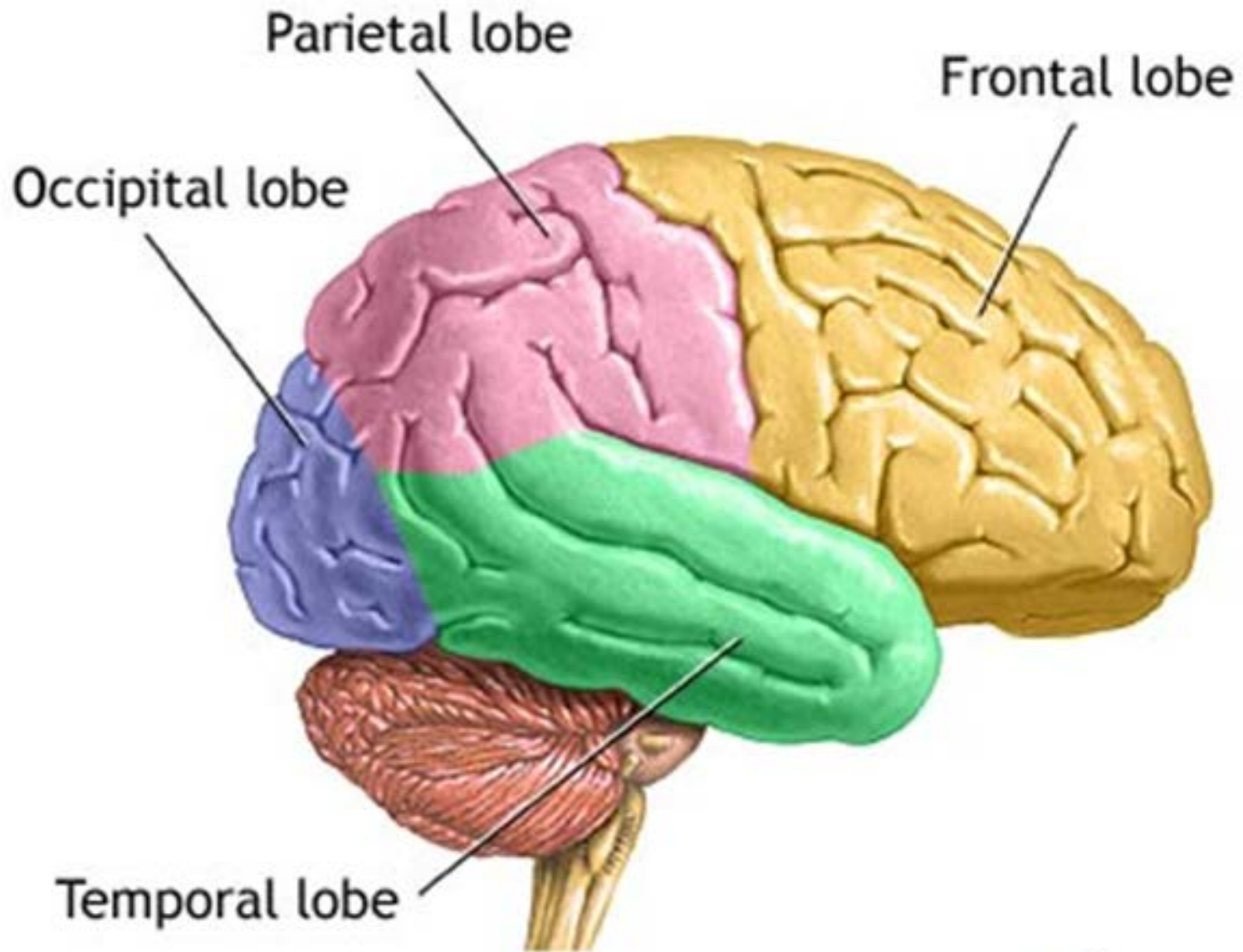


Lobes of the Brain – Temporal Lobe

- They play an integral role in the following functions:
- Hearing
- Organization/Comprehension of language
- Information Retrieval
 - (Memory and Memory Formation)





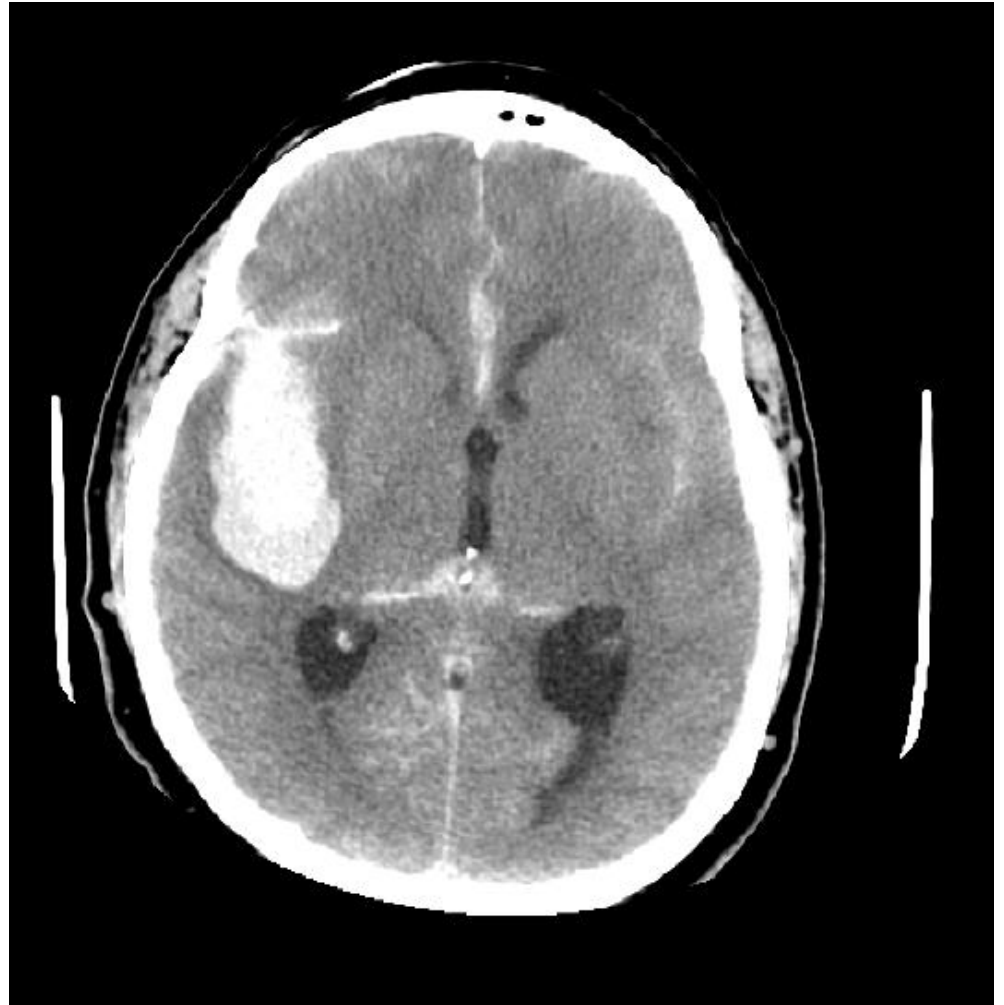


Medical imaging technology

CT scans (computerised tomography):

Use X rays to identify major structures and can detect problems such as tumours and aneurisms.

Sometimes a dye has to be injected into the blood.



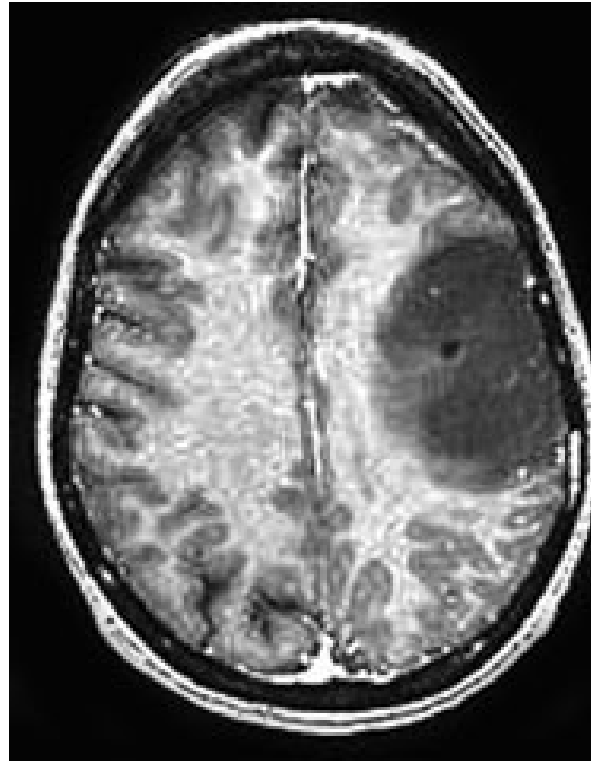
CT scan showing a brain aneurism (swelling of the artery)

Medical imaging technology

Magnetic resonance imaging (MRI):

Uses high level magnetic field and radio waves to image soft tissues.

It is useful for diagnosing tumours, clots, infections and brain damage



MRI scan of a brain tumour



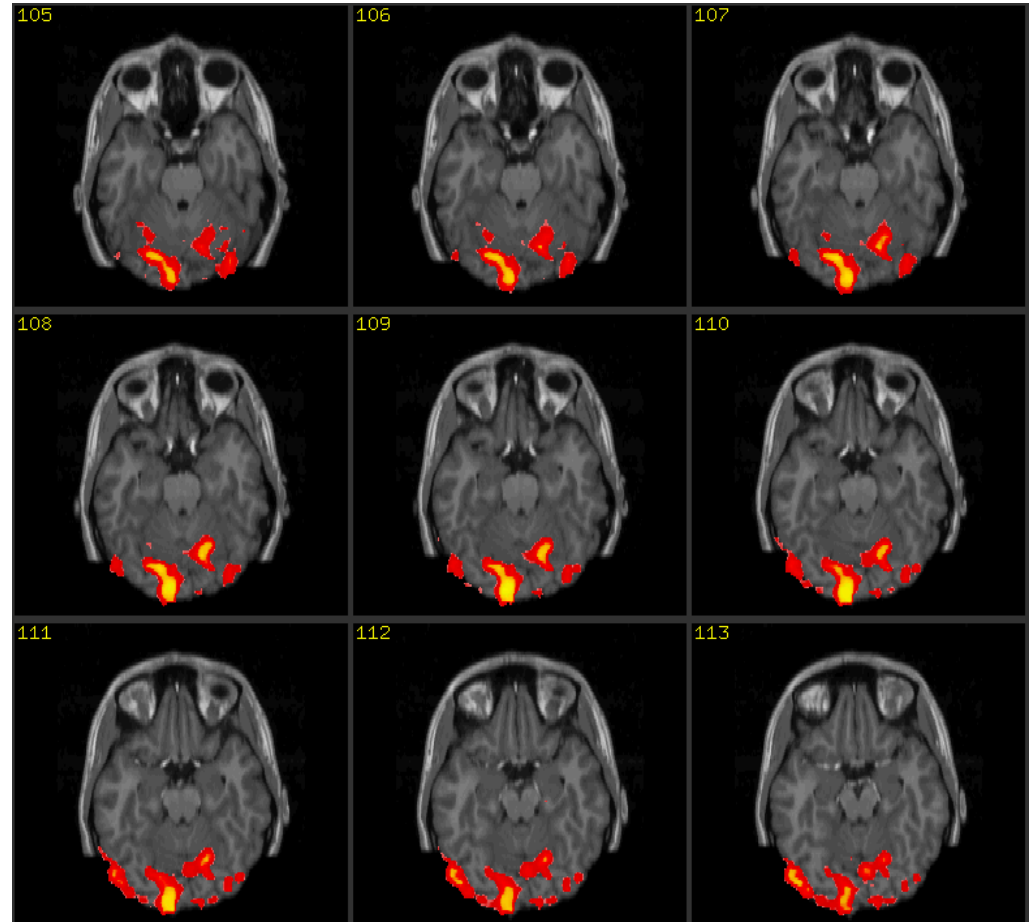
CT scan of same tumour

Medical imaging technology

Functional magnetic resonance imaging (fMRI):

Monitors changes in brain activity by measuring the changes in blood flow and oxygen uptake.

Allows for the study of the different functions of the parts of the brain.



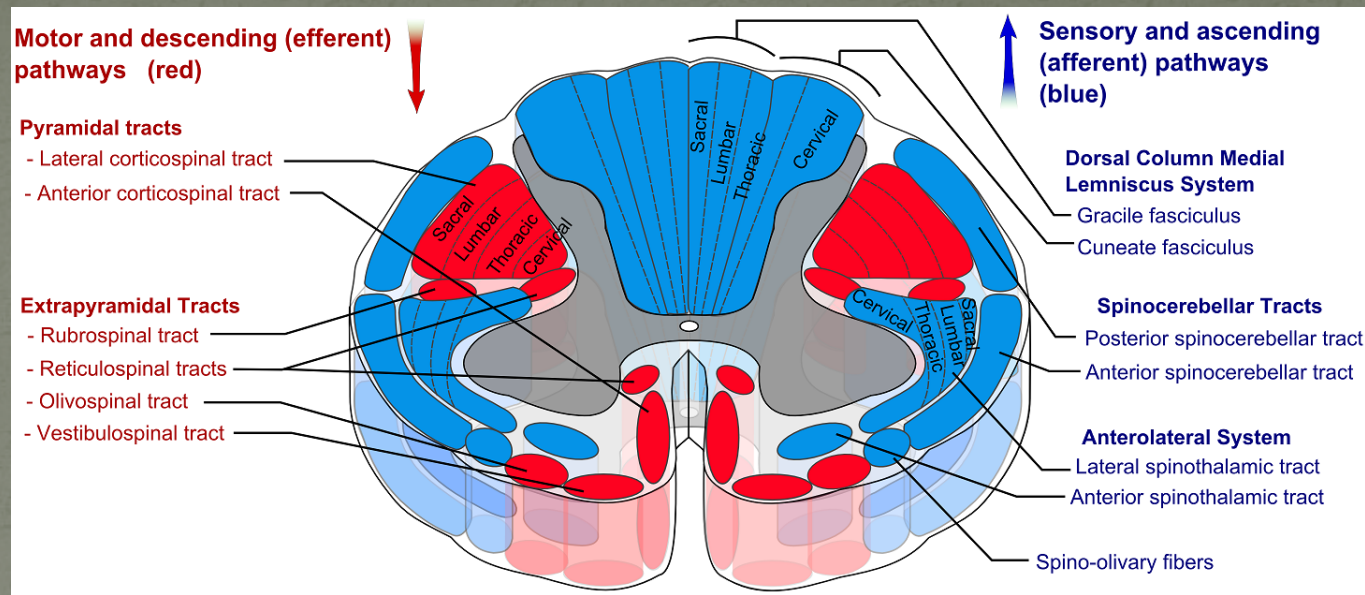
FMRI images of the brain showing brain activity

Brain and Art Activity

- <http://www.brainharmonycenter.com/brain-diagrams.html>
 - Using the markers draw your interpretation of the brain and it's importance to the body

Class 3

April 24, 2014



Neural Tissue, Spinal Cord, and Spinal Nerves

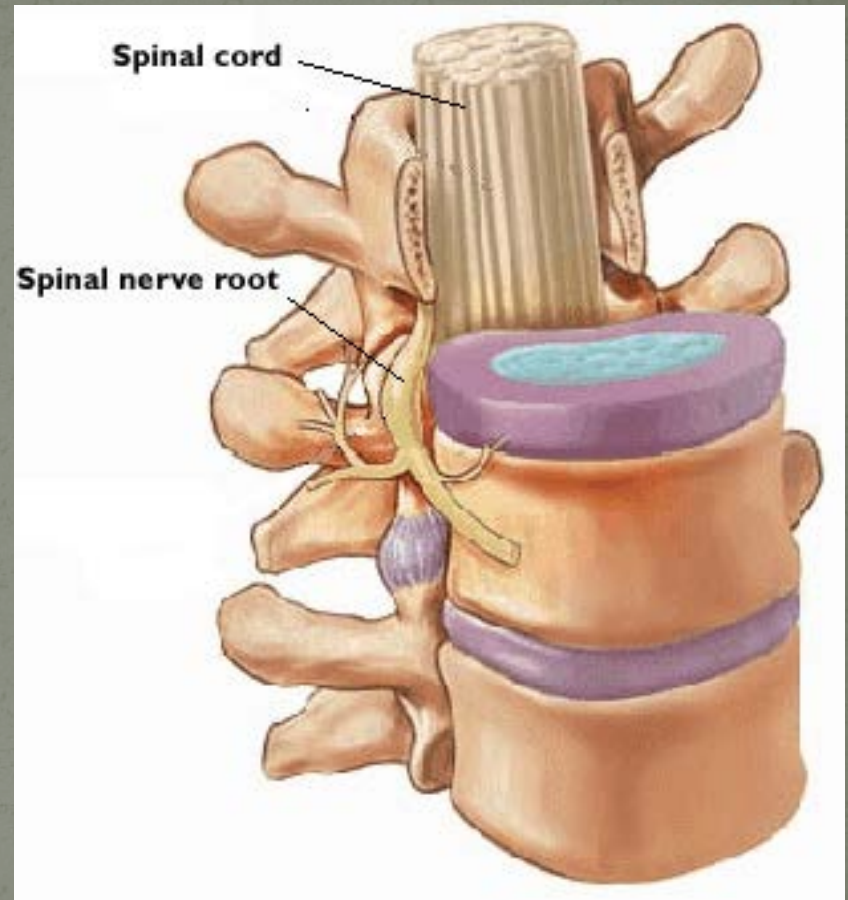
Use the Graphic Organizer to take Notes

Neural Tissue

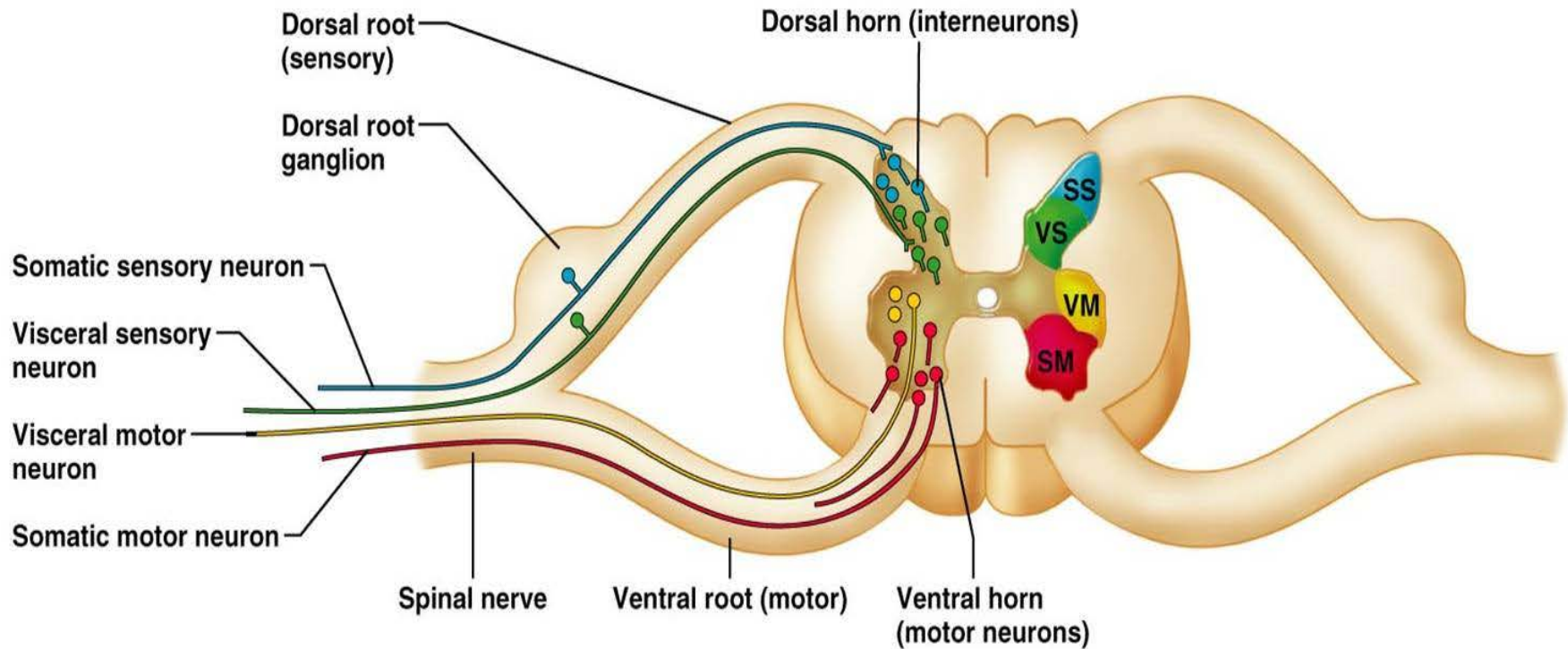
- **White Matter** – groups of myelinated axons from many neurons with neuroglia.
 - Nerve tracts of the CNS
 - **Nerve** – bundle of fibers located outside the CNS, most are white matter
- **Gray Matter** – nerve cell bodies and dendrites
 - Cortex of brain
 - **Ganglia** – nerve cell bodies that are grouped together, gray matter
- **Tract** – white matter, bundle of fibers inside the CNS, long distances up and down the spinal cord, brain
 - Ascending (sensation) and descending (motor function) tracts

Spinal Cord

1. Continuation of the medulla oblongata of the brain stem
2. 16-18 inches
3. 31 segments each with a pair of spinal nerves
4. Protected by the bony spinal column, meninges, cerebrospinal fluid, loose connective tissue and adipose tissue.

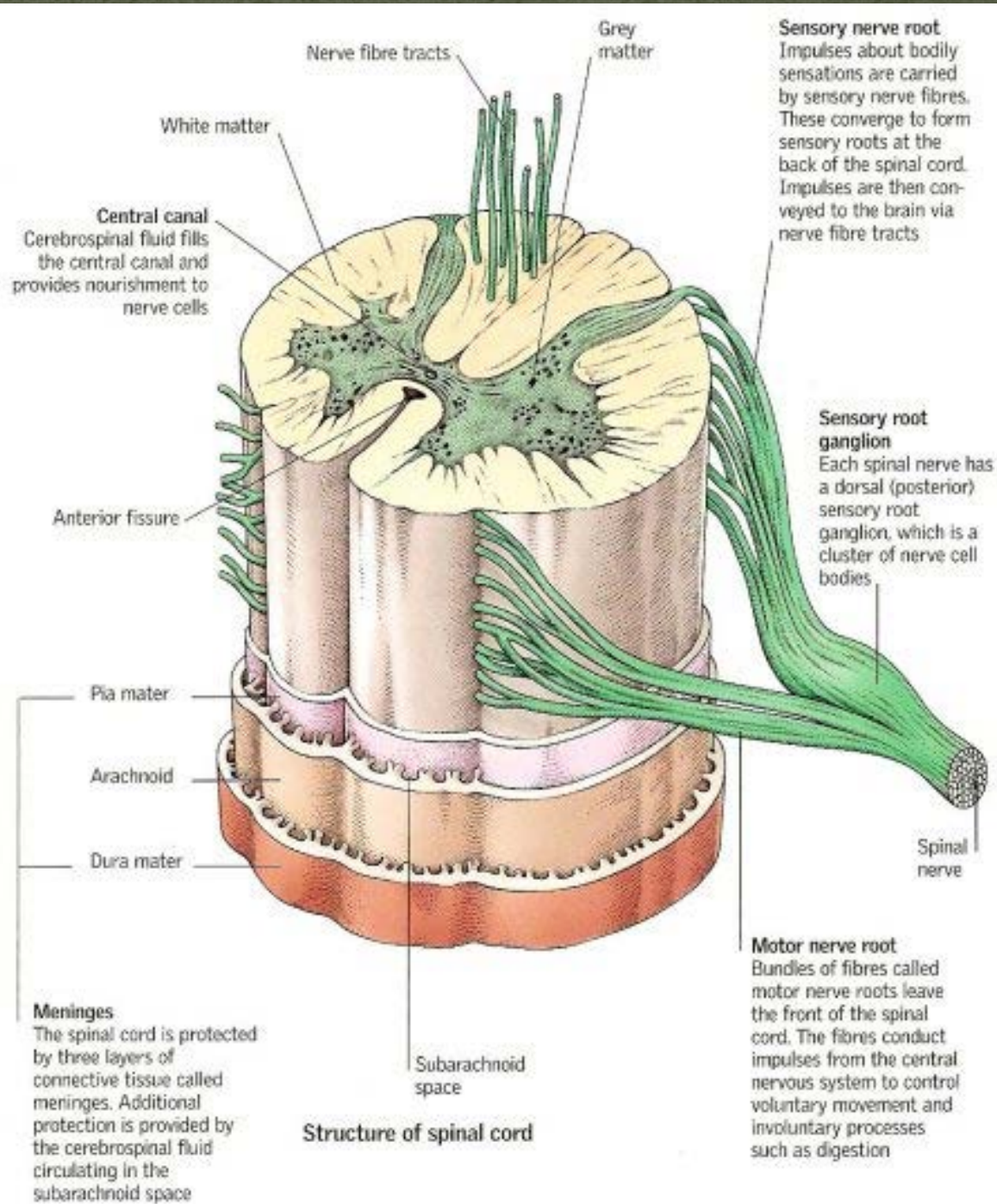


Spinal Cord



Copyright © 2006 Pearson Education, Inc., publishing as Benjamin Cummings.

5. Functions – convey sensory impulses from the periphery to the brain and conduct motor impulses from the brain to the periphery; integrate reflexes

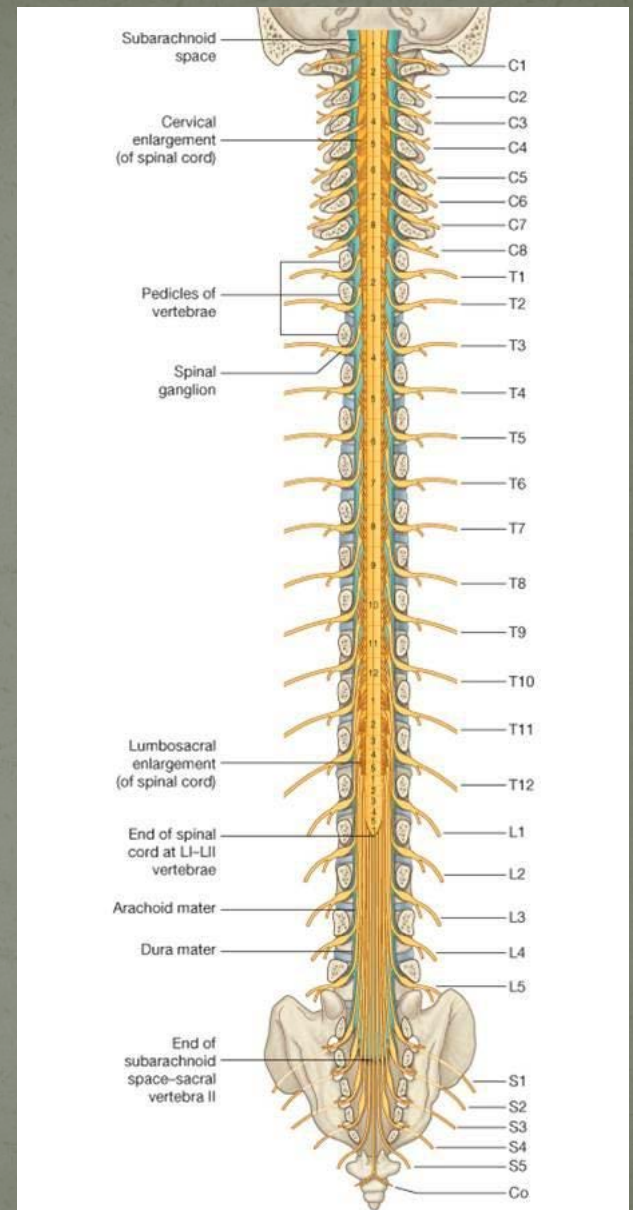


Spinal Nerves

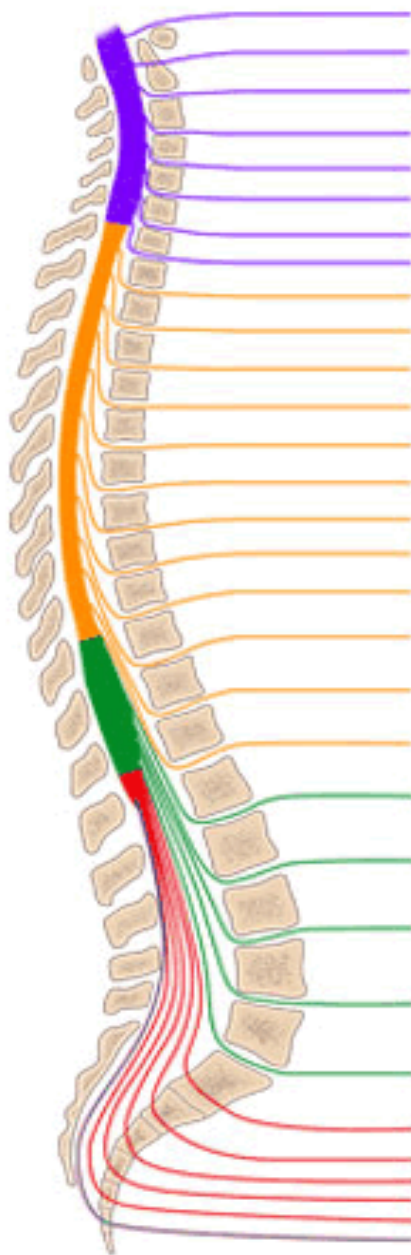
1. 31 pairs
2. Ventral and Dorsal Roots
3. Mixed nerves – both motor and sensory fibers

Named and numbered according to the region and level of the vertebral column

- 8 pairs cranial nerves
- 12 pairs of thoracic nerves
- 5 pairs of lumbar nerves
- 5 pairs of sacral nerves
- 1 pair of coccygeal nerves



The Spinal Cord



Cervical
(8 Cervical Nerve Pairs)

Thoracic
(12 Thoracic Nerve Pairs)

Lumbar
(5 Lumbar Nerve Pairs)

Sacrum (5 Sacral Nerve Pairs)

1 Coccygeal Nerve

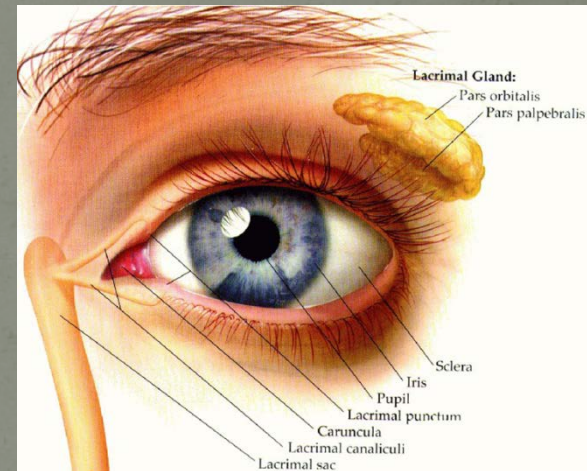
Brain and Mind Video

- [Icons of Science Mind and Brain.smi](#)

Class 4

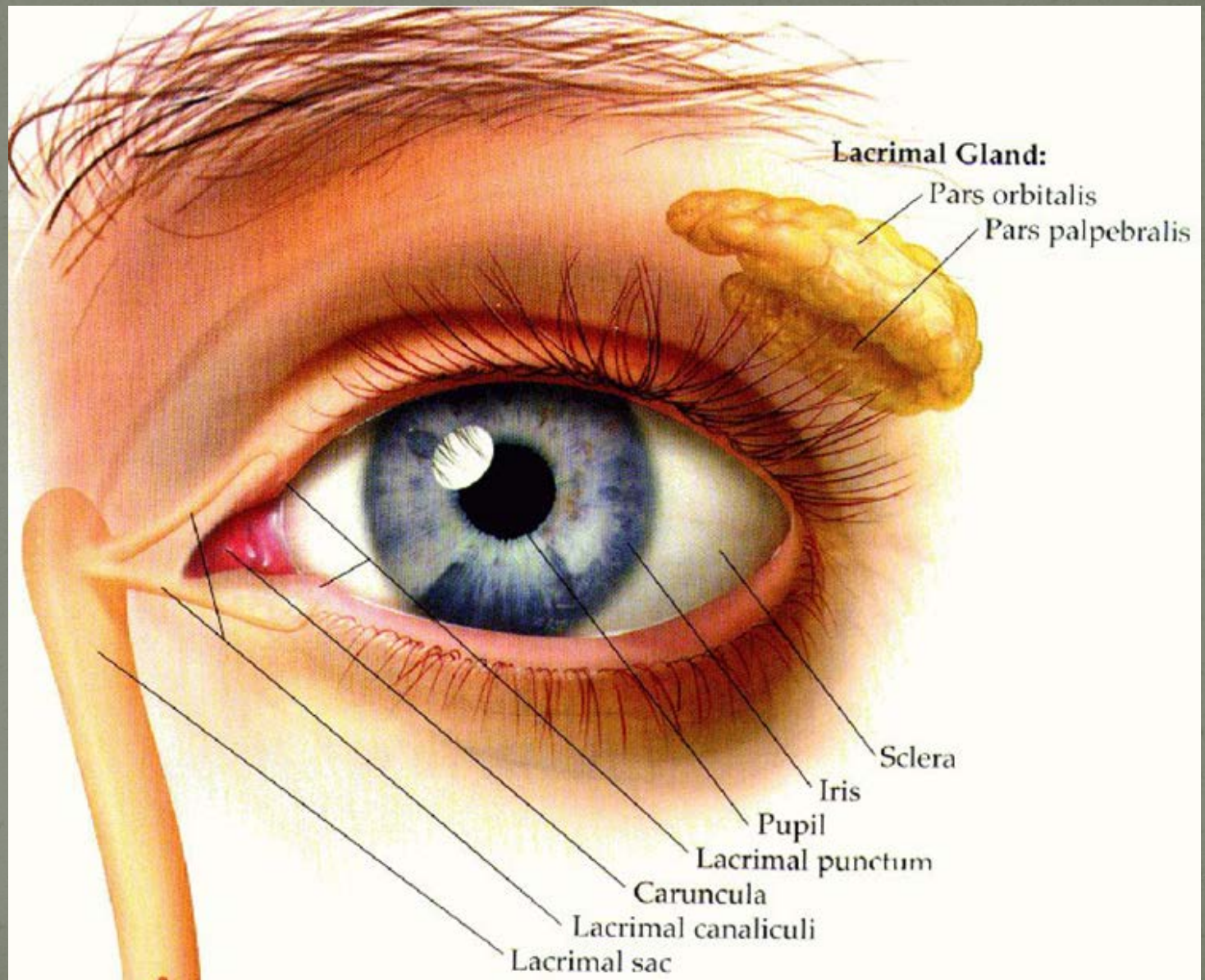
April 25, 2014

Eye



Sclera (white), cornea, choroid, ciliary body, lens, iris, pupil, aqueous humor, vitreous humor, optic nerve, retina (rods/cones), macula lutea with fovea centralis, optic disc (blind spot),

Eye

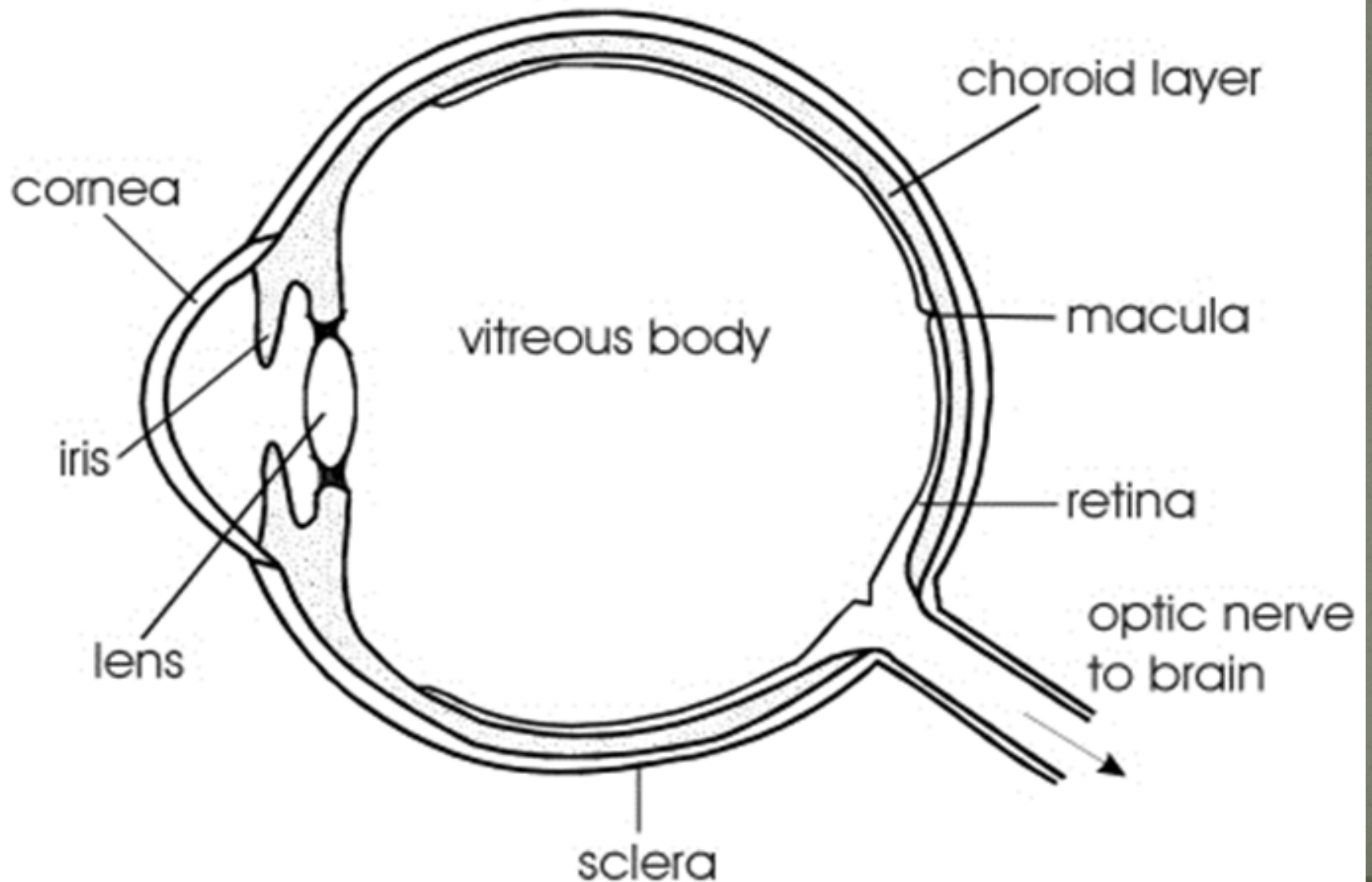


A sphere filled with two fluids

- Layer One:
 - **Sclear** – white connective tissue; White of Eye
 - **Cornea** – transparent part that allows light into eye
- Layer Two:
 - **Choroid** – blood vessels and pigment cells, black and absorbs light
- Layer Three:
 - **Retina** – gray with light sensitive cells called rods and cones

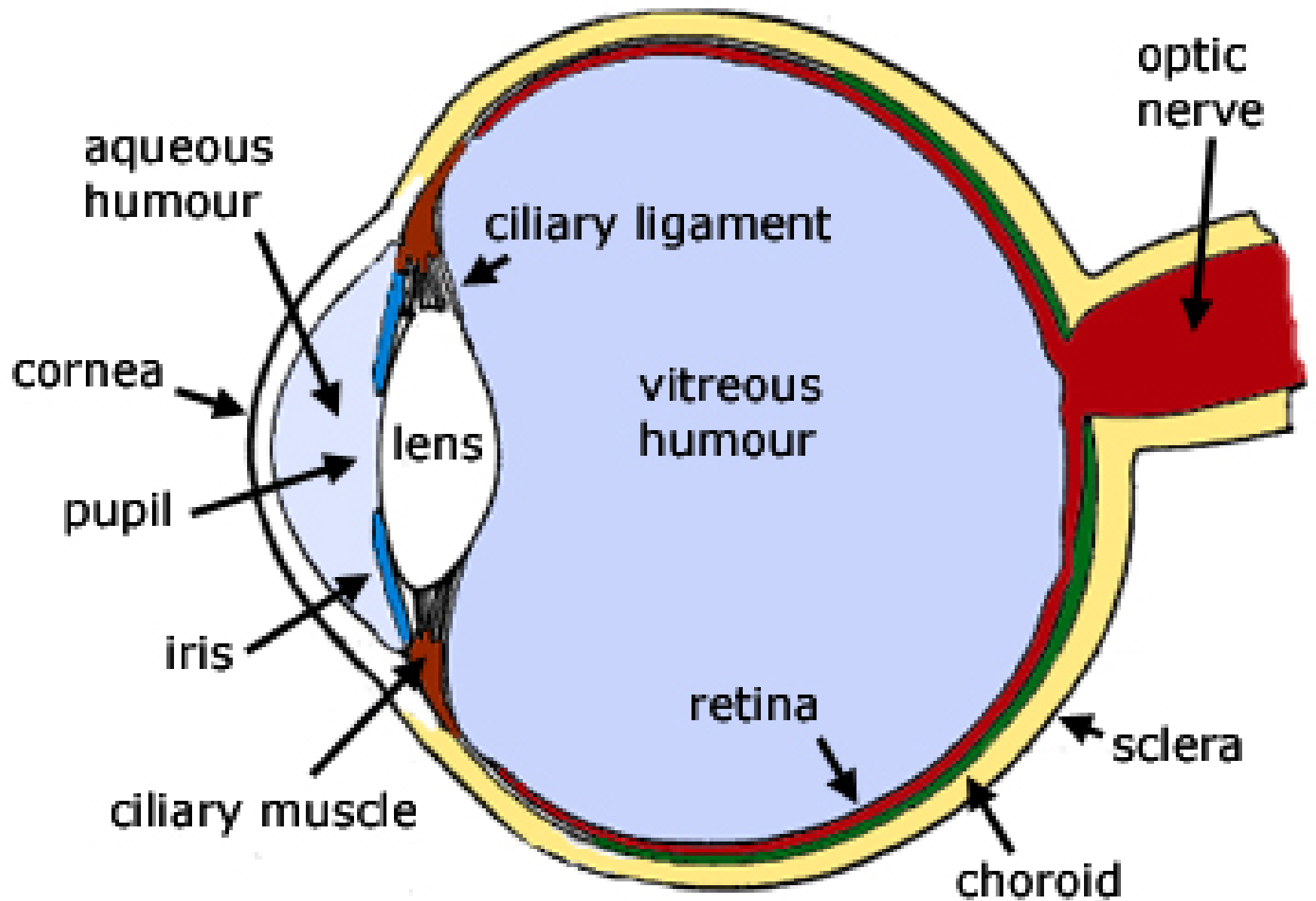
Use the Graphic Organizer to take Notes

CROSS SECTION OF THE EYE



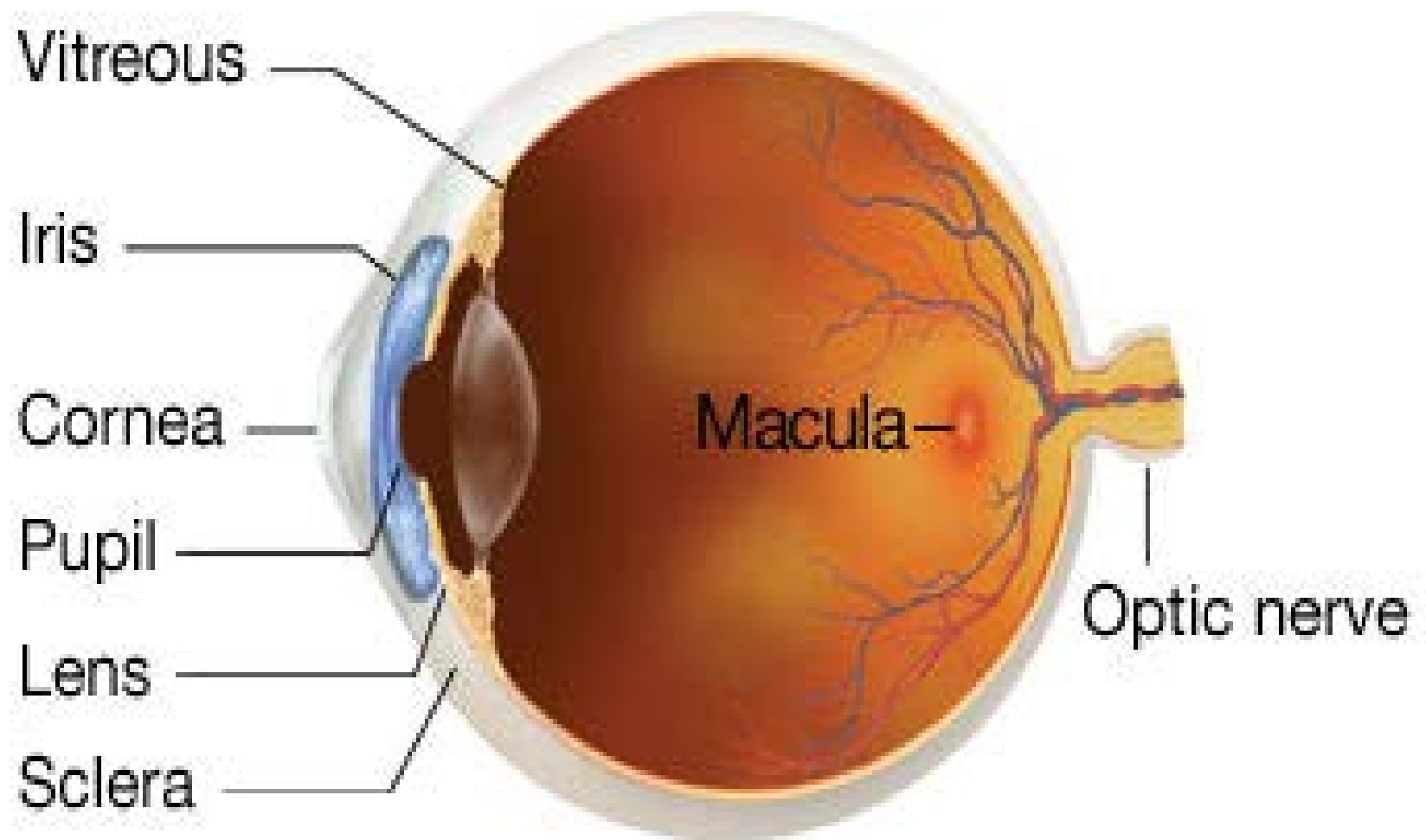
Other parts

- **Ciliary Body** – smooth muscle that holds the **lens** in place
- **Lens** – biconvex, transparent and flexible
- **Iris** – colored part of the eye, smooth muscle that surrounds the pupil, regulates the amount of light
- **Pupil** – opening for light to enter eye



Interior of Eye – Two Compartments

- Front of Lens – Aqueous Humor
 - Bends light
 - Source of nutrients
 - Maintains ocular pressure
- Posterior to Lens - Vitreous Humor
 - Ocular pressure
 - Bends light
 - Holds the retina and lens in place



Retina

- Photosensitive cells
 - **Rods** – sensitive to light and function in dim light
 - **Cones** – need lots of light, produce color
 - Red, green or blue
- Rods and Cones synapse with the neurons of the eye and synapse with the **optic nerve**
 - **Rhodopsin** – pigment in rod cells that uses Vitamin A
- **Macula Lutea** – center of retina, yellowish spot
 - **Fovea centralis** – sharpest vision
 - **Optic Disc** – blind spot, no receptor cells

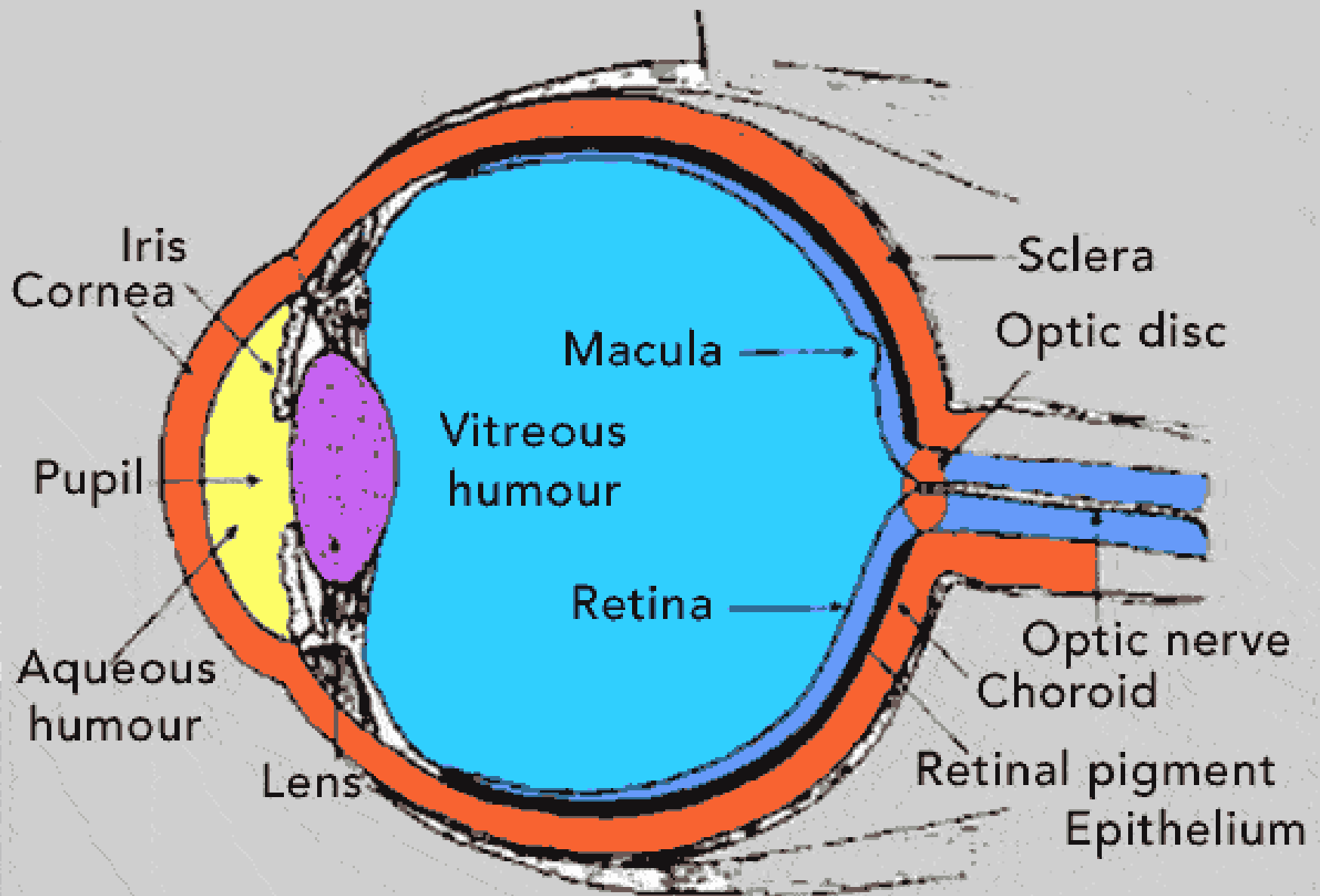
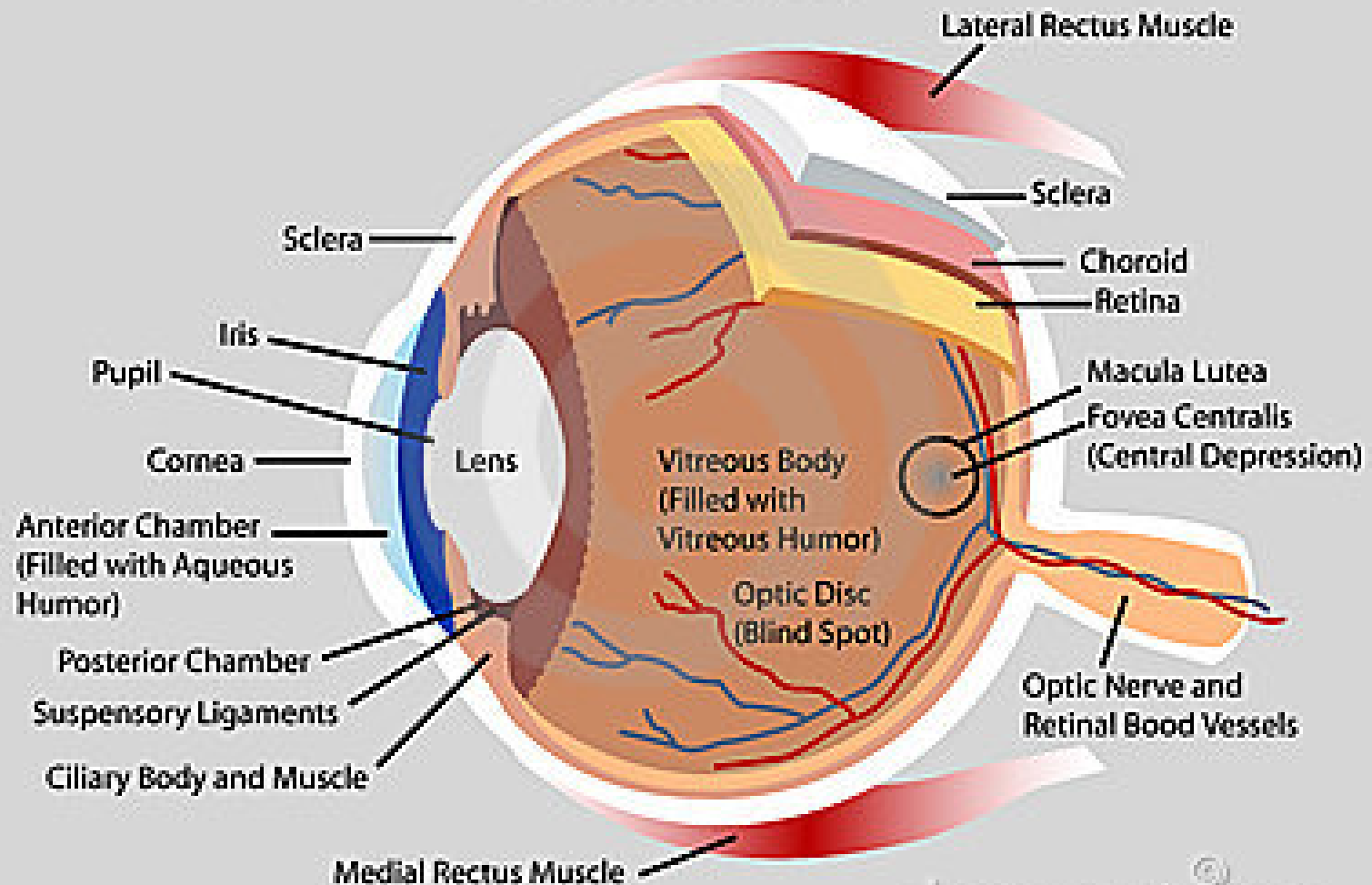
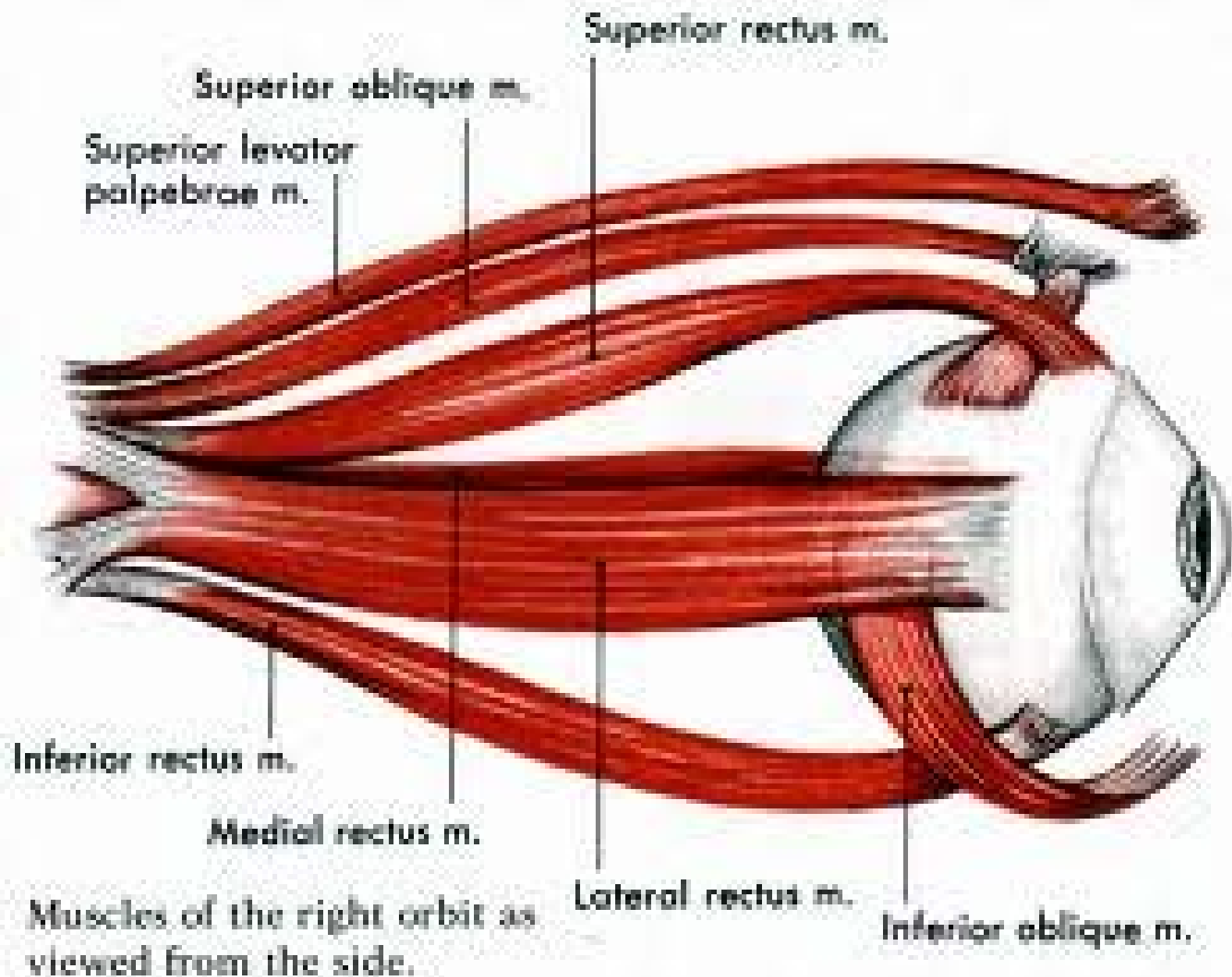


Diagram of the Human Eye

Viewed from the Top





Add the missing labels to your diagram of the Eye!

- Anterior Chamber
- Choroid
- Ciliary Body
- Cornea
- Iris
- Lens
- Macula
- Optic disk
- Optic Nerve
- Retina
- Sclera
- Vitreous body

Aqueous Humor

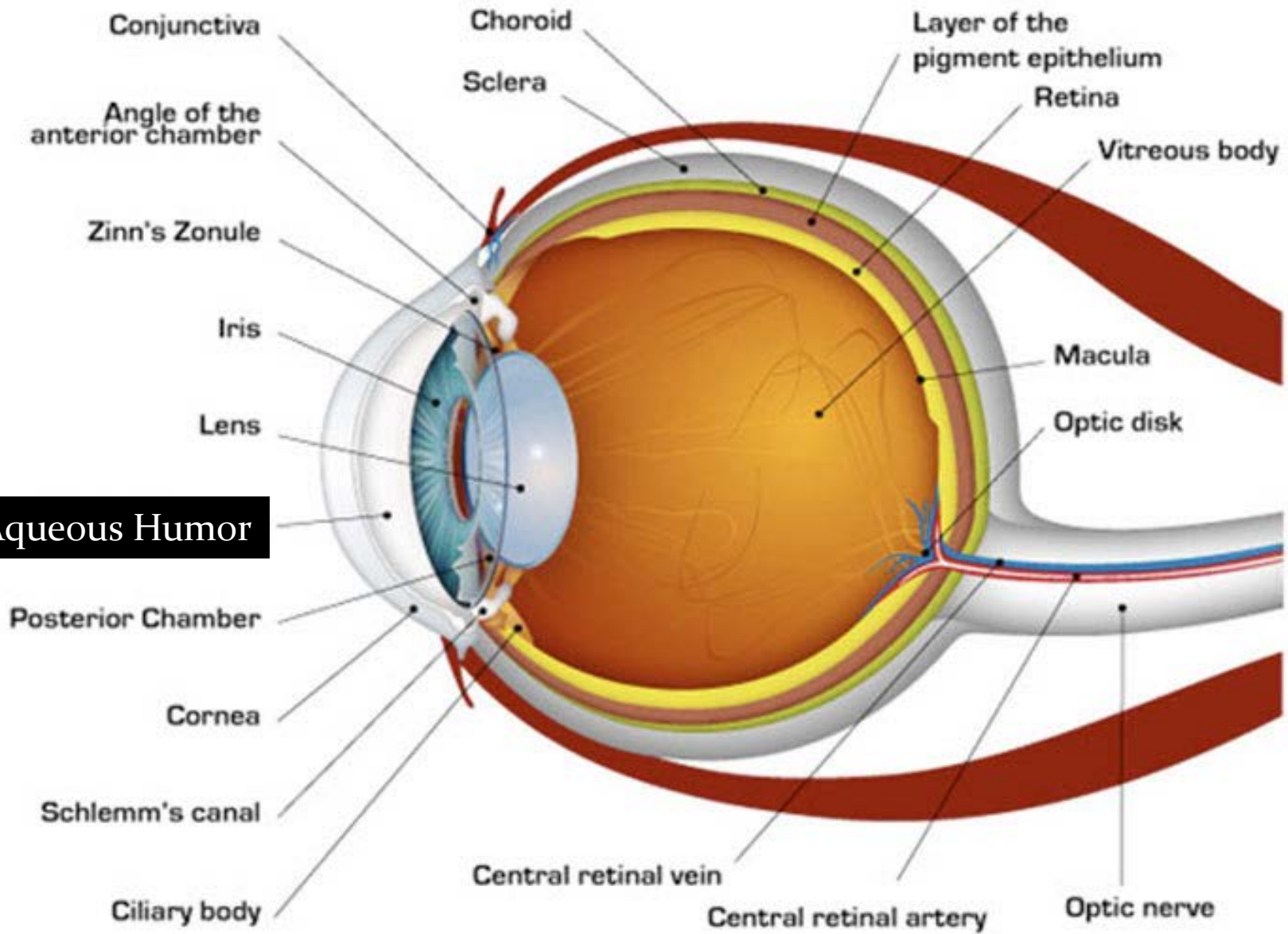
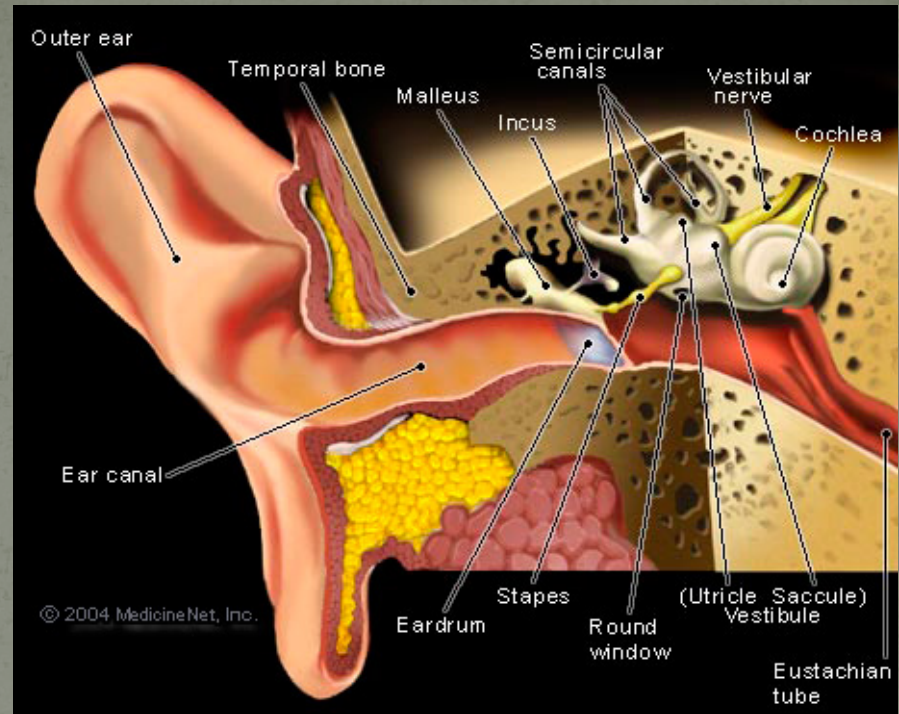


Diagram of the Eye

Check your diagram

Optical Illusions Activity

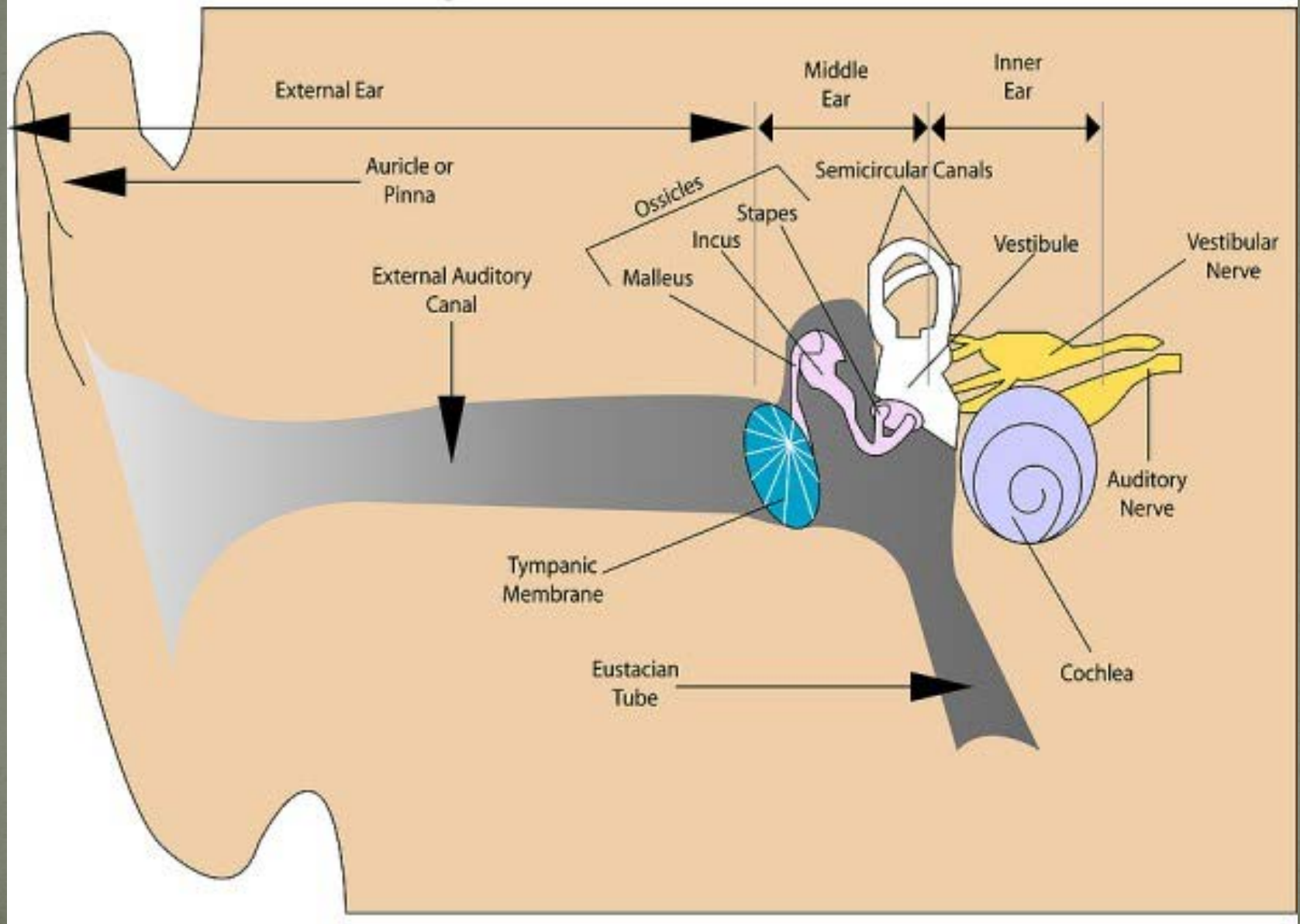
- <https://docs.google.com/presentation/d/1dDRx9a7M-1104Y13aTB35zvwcTfrBeG1QruLk7AUocg/present#slide=id.i0>
- You need scrap paper and something to write with



Ear

External/Middle/Internal Ear; Pinna (auricle) , external auditory meatus, tympanic membrane (ear drum), cerumen (ear wax), malleus (hammer), incus (anvil), stapes (stirrup), oval window, round window, auditory or Eustachian tube, cochlea, vestibule, semicircular canals

Diagram of a Human Ear



External Ear

- **Auricle or Pinna** – elastic cartilage, allows sound waves to enter
- **External Auditory Meatus** – ear canal, directs sound waves to ear drum, lined with hairs and **cerumen** (ear wax) to protect ear drum from foreign objects
- **Tympanic Membrane** – ear drum, silver gray and thin, vibrates with sound waves

**Use the Graphic Organizer to
take Notes**

Outer ear

Temporal bone

Malleus

Semicircular
canals

Vestibular
nerve

Cochlea

Incus

Ear canal

© 2004 MedicineNet, Inc.

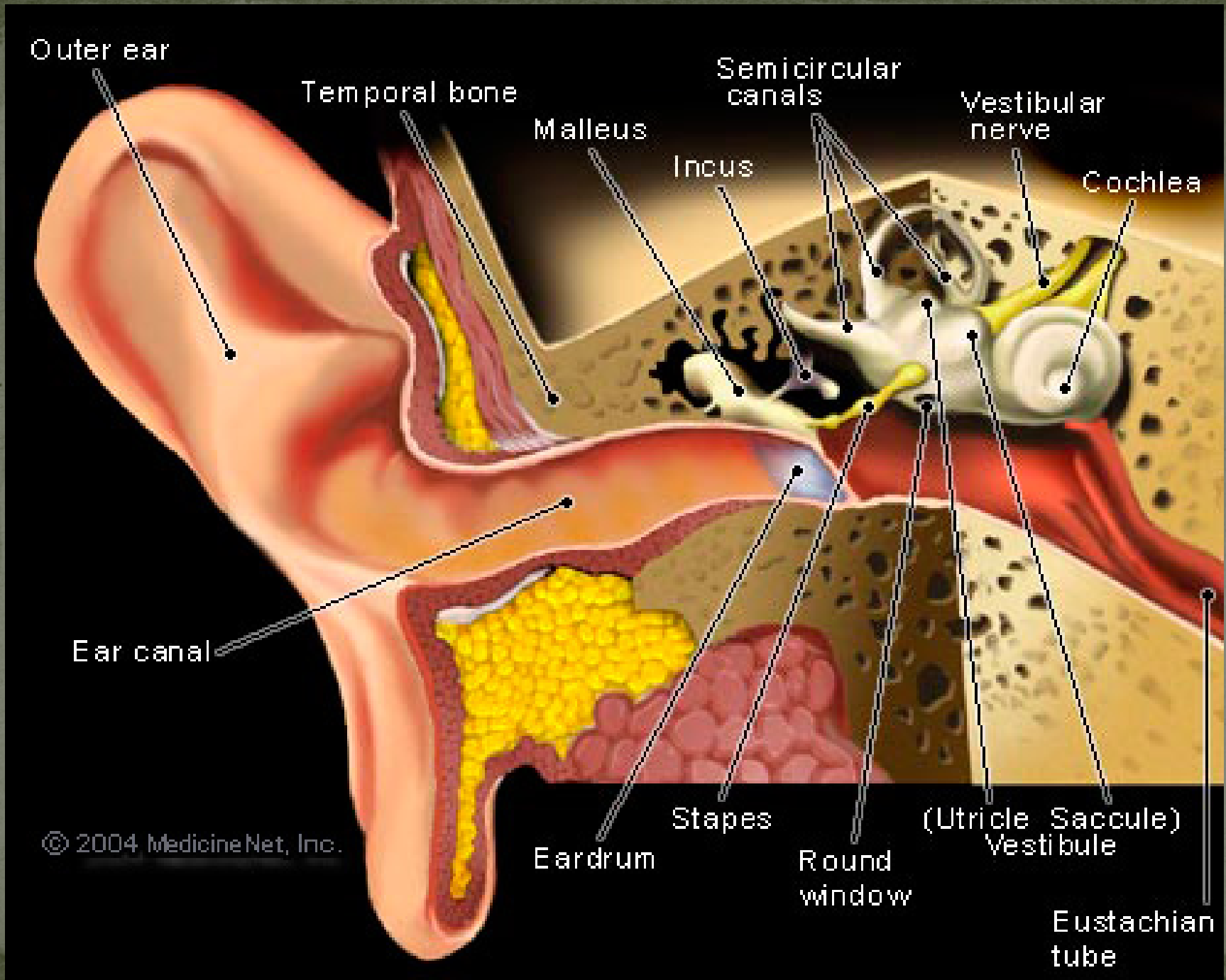
Eardrum

Stapes

Round
window

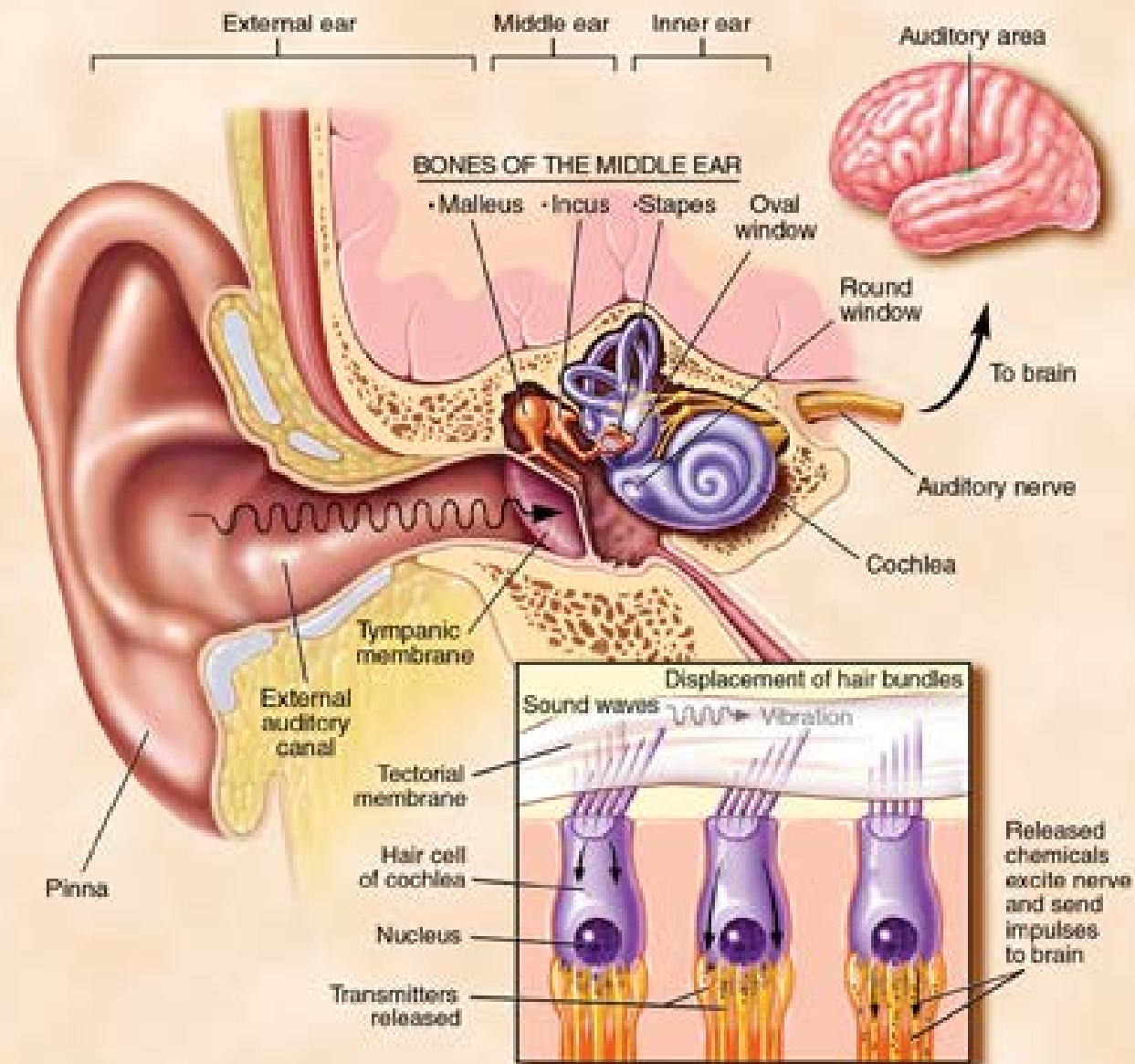
(Utricle Saccule)
Vestibule

Eustachian
tube



Middle Ear

- **Auditory Ossicles** or ear bones
 - **Malleus** – hammer
 - **Incus** – anvil
 - **Stapes** – stirrup
- Transmit and amplify sound vibrations to **Oval Window** and **Round Window** to connect to inner ear.
- **Auditory or Eustachian Tube** – opens to the pharynx to equalize air pressure between middle ear and environment



Inner Ear

- Interconnecting chambers and tunnels within the temporal bone
- Cochlea
- Vestibule
- Semicircular Canals
- Equilibrium (balance) is controlled in the inner ear

How Does Hearing Work?

Sound waves are collected by the outer ear and are funnelled through the ear canal to the eardrum.

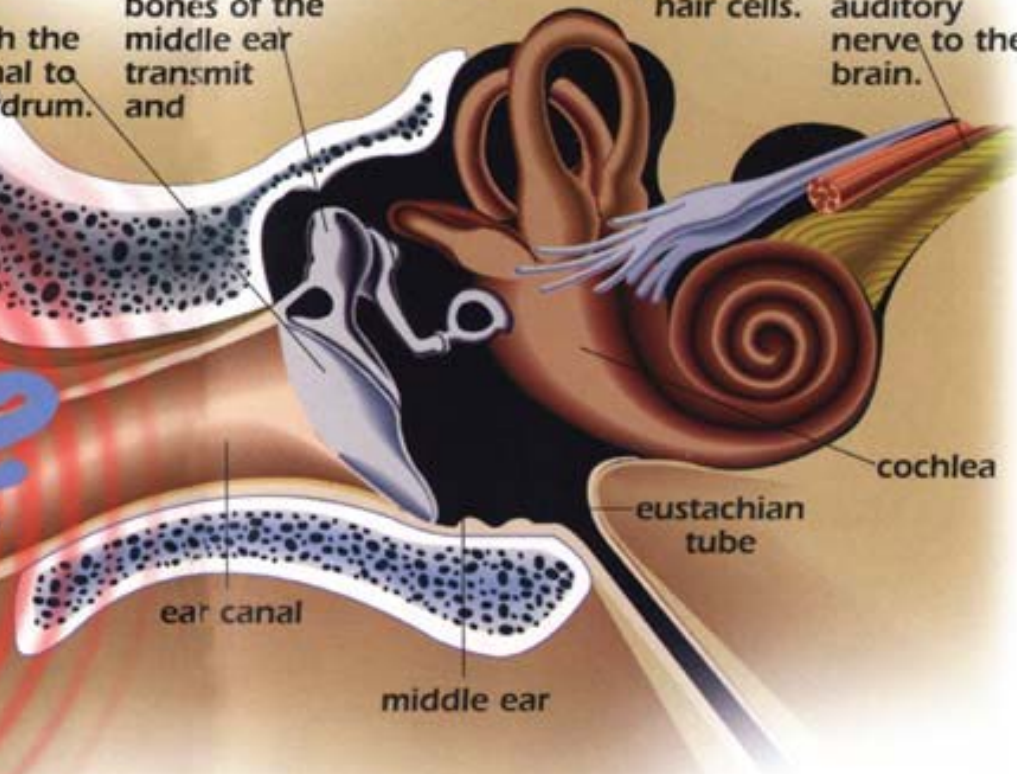
Sound waves cause the eardrum to vibrate. The three bones of the middle ear transmit and

amplify the vibrations to the oval window of the inner ear.

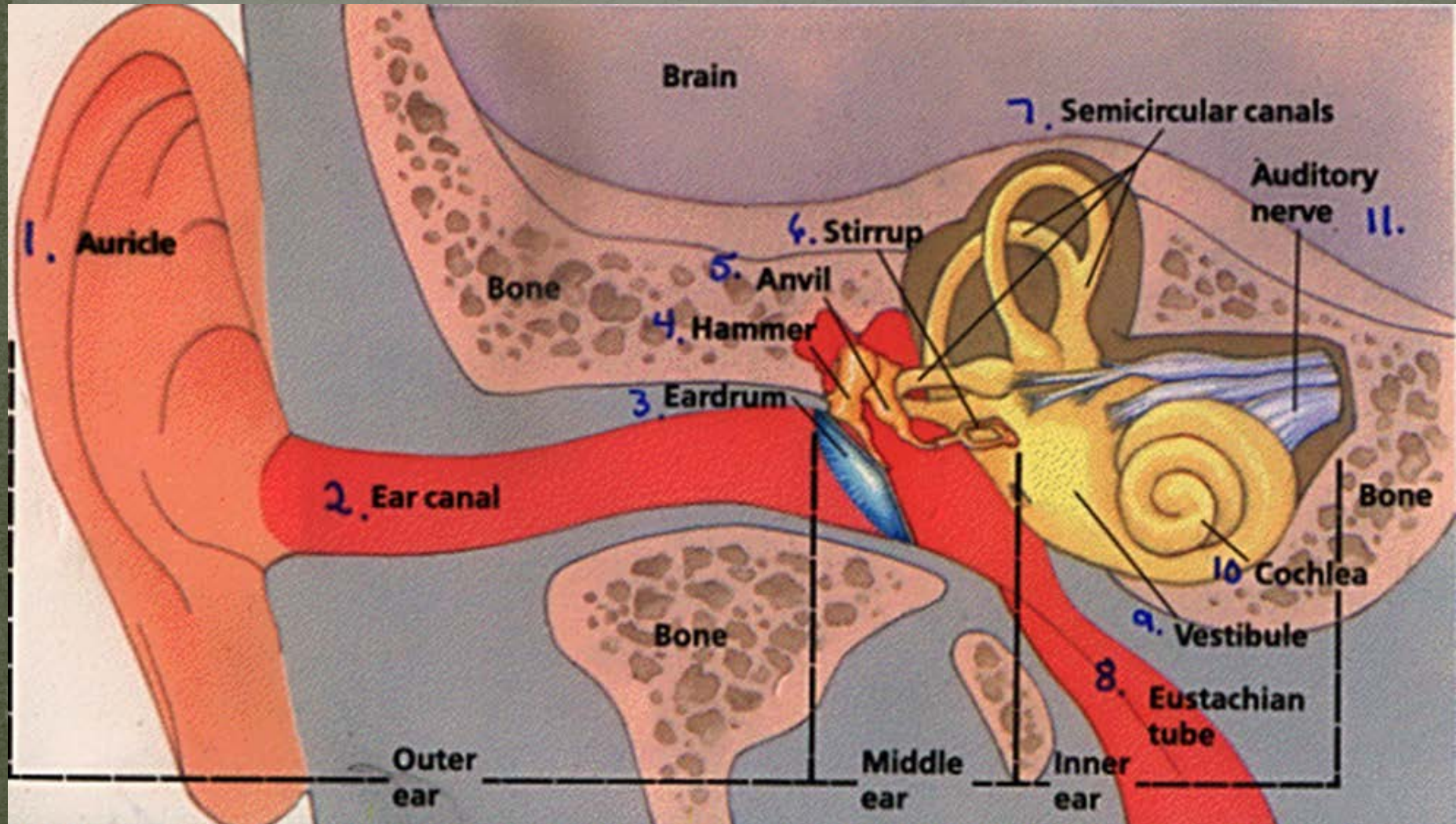
Fluid in the inner ear stimulates nerve endings called hair cells.

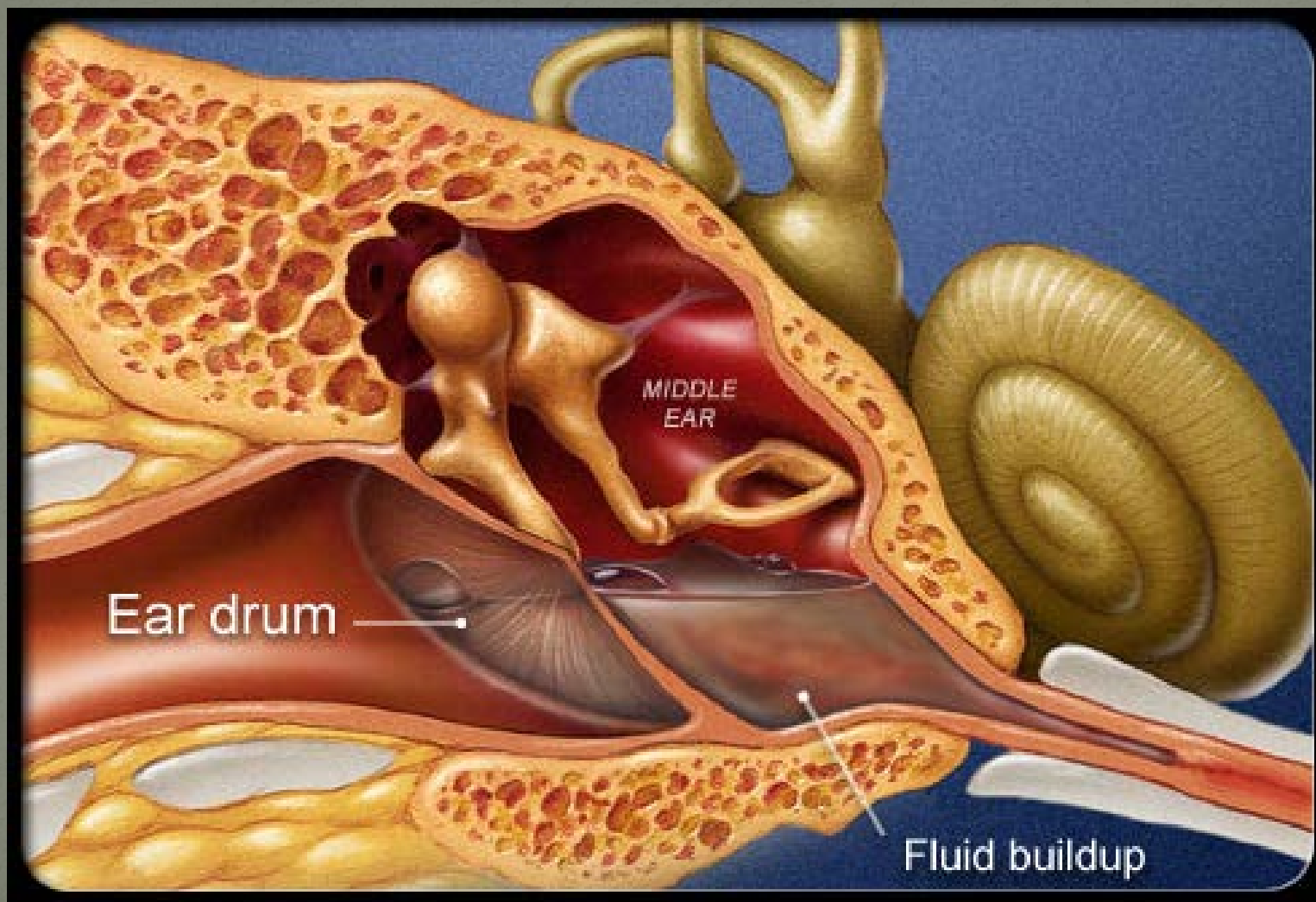
Electrical impulses are sent from the hair cells along the auditory nerve to the brain.

Excessive noise exposure is one of the leading causes of hearing loss. The tiny hair cells in the inner ear are easily damaged by loud noise and once you lose them, they never grow back!



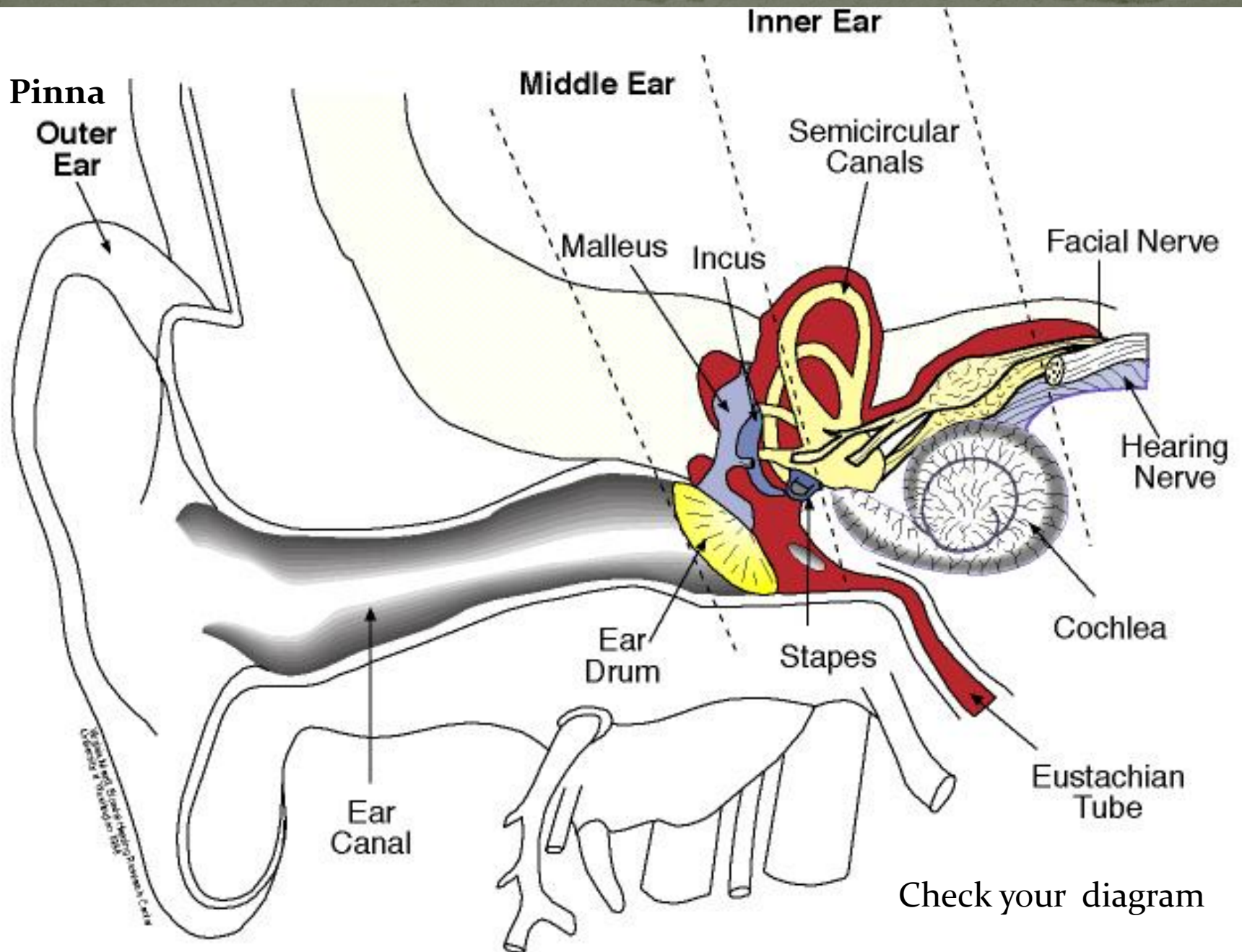
Ear





Label your diagram of the Ear

- Pinna (Outer Ear)
- Ear Canal
- Middle Ear
- Inner Ear
- Malleus
- Incus
- Semicircular Canals
- Cochlea
- Eustachian Tube
- Ear Drum
- Stapes



Focus Free-Write

- The next slide is a drawing by MC Escher. Write for 3 minutes about what you see in the picture and how it challenges your mind.







