Nervous System

Part Two

CNS: Spinal Cord

- Protected by bone, fluid, & membranes
- Composed of gray and white matter
- Serves as conduction pathway btwn brain and peripheral nerves
- Extends from base of brain to 1-2 lumbar vertebra

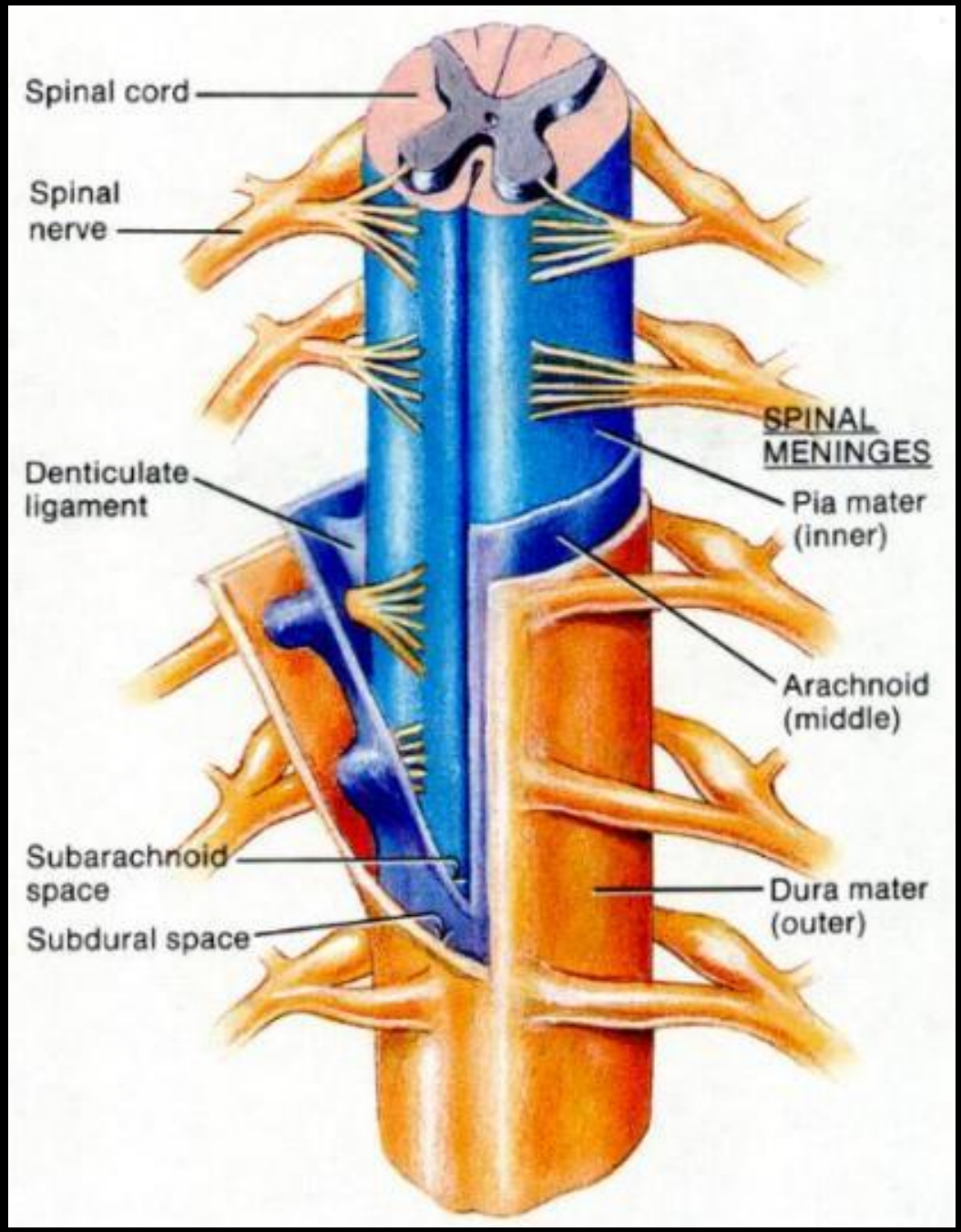
CNS: Spinal Cord

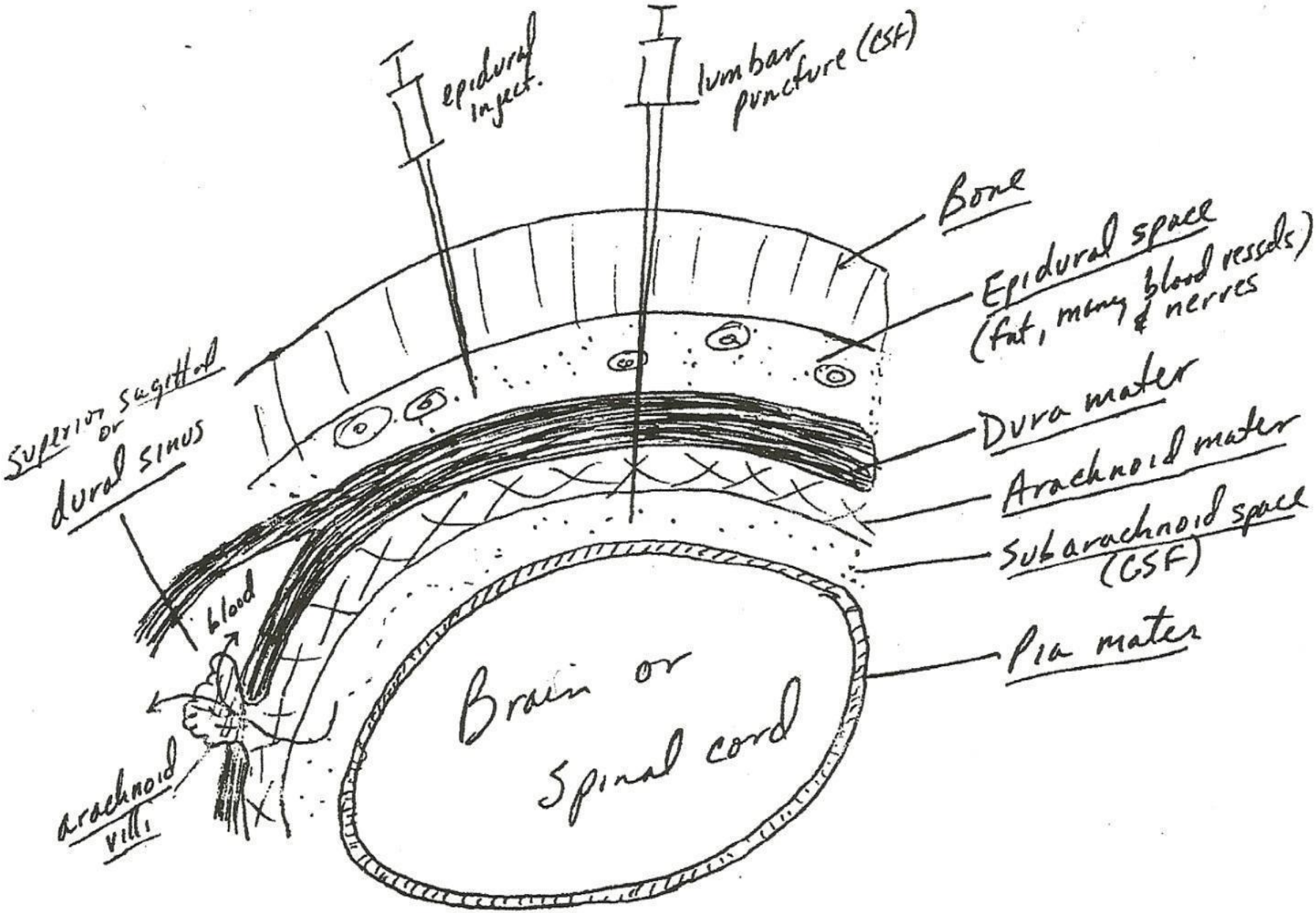
- Protective coverings:
  - Vertebral column, fluid, several layers of membranes (meninges)
- 3 meninges:
  - Dura mater (outer)
  - Arachnoid (middle)
  - Pia mater (inner)
- *dura mater separated from VC by epidural space (fat, tissue)
- *arachnoid separated from pia mater by subarachnoid space (CSF)

CNS: Spinal Cord

- Cerebrospinal fluid (CSF):
  - Clear, colorless
  - Circulates around/through SC and brain
  - Provides shock absorbing cushion
  - Transports vital materials

- Epidural anaesthesia: (btwn outer membrane and VC
- Blocks nerve routes that lead to the uterus and lower part of the body


Spinal cord
Spinal nerve
SPINAL MENINGES
Denticulate ligament
Pia mater (inner)
Arachnoid (middle)
Subarachnoid space
Dura mater (outer)
Subdural space


epidural inject.
lumbar puncture (CSF)
Bone
Epidural space
(fat, many blood vessels & nerves
Dura mater
Arachnoid mater
Subarachnoid space
(CSF)
Pia mater
Brain or
Spinal cord
Superior Sagittal
or
dural sinus
blood
arachnoid
villi

CNS: Spinal Cord

- Continuous series of 31 segments → each leads to pair of spinal nerves
  - Relay info btwn SC to peripheral areas
- 2 thickened areas due to abundance of spinal nerves → cervical and lumbosacral enlargement (upper and lower limbs)

Gray & White Matter

- Nerve tissue consisting of unmyelinated nerves
- Located in the center of SC → letter “H”
- 3 regions: anterior, posterior, lateral horns
- Anterior section: motor neurons (exit cord)
- Posterior section: sensory neurons (enter cord)
- Lateral section: autonomic in fxn

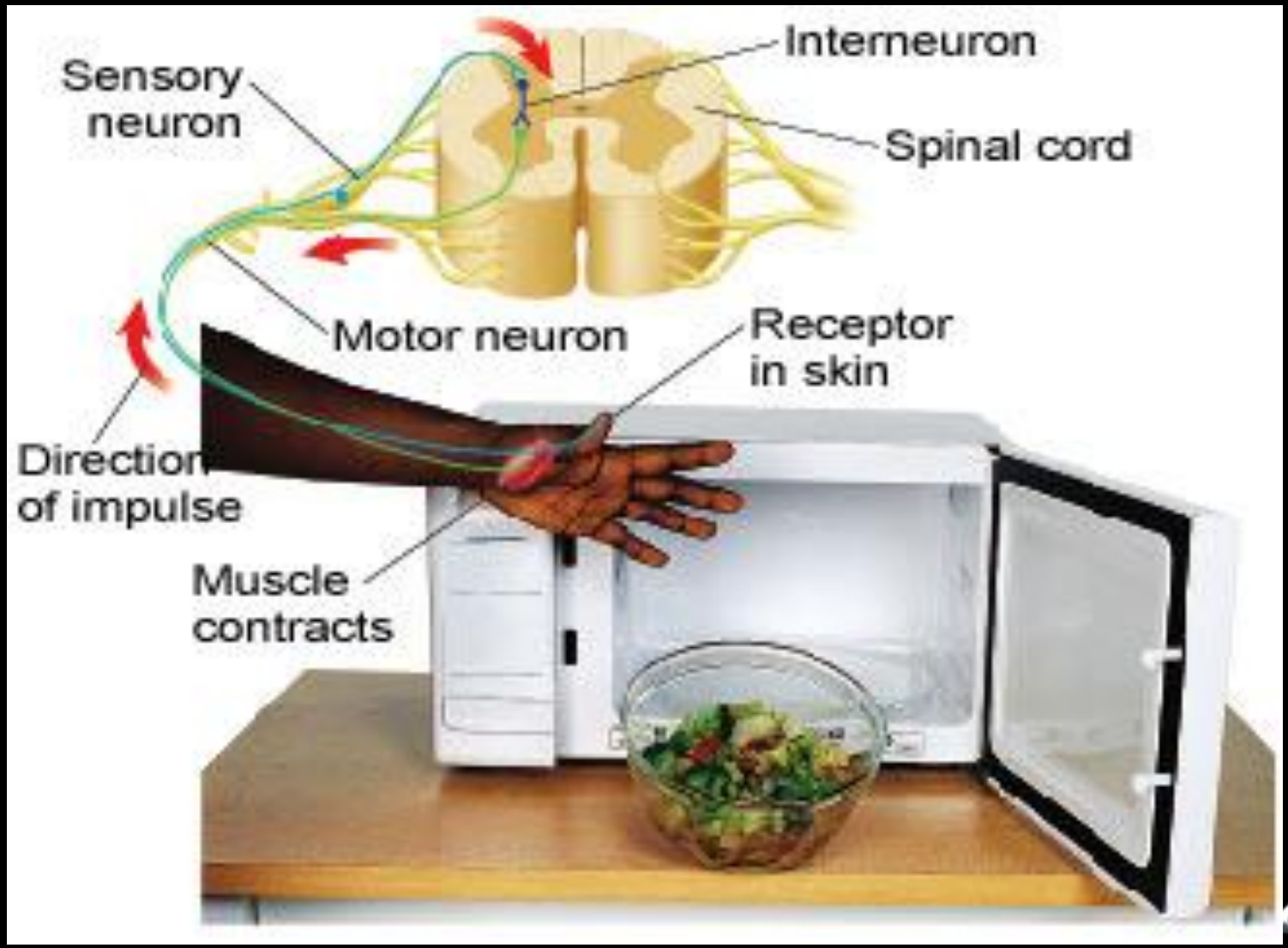
- Nerve tissue consisting of myelinated nerves
- Surrounds gray matter
- 3 regions: anterior, posterior, lateral columns

Spinal Cord Fxns

- 1. Conduction pathway for impulses btwn brain and peripheral nerves
  - 2 nerve tracts:
    - ascending (to the brain – sensory)
    - descending (from the brain-motor)
  - tracts further divided into myelinated fibers → named by point of origin and destination
- 2. As a reflex center

Reflexes

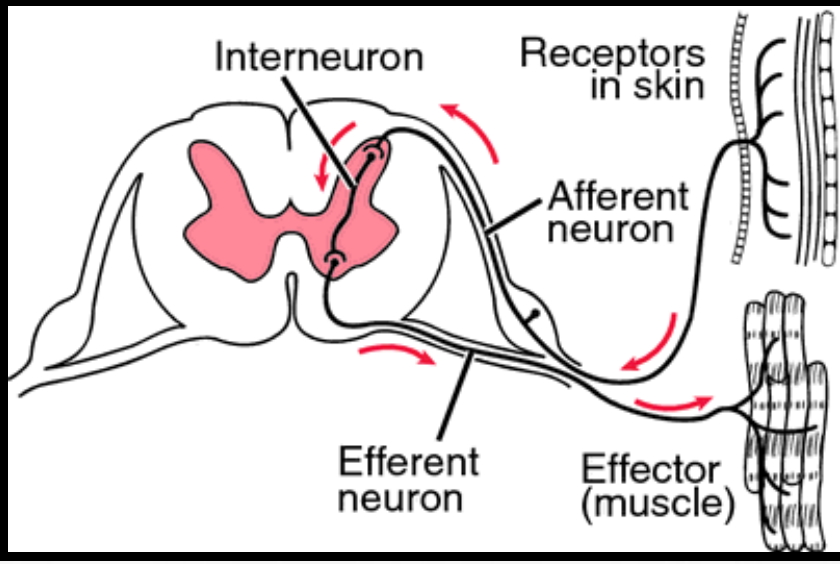
- Involuntary, automatic response to a stimulus
- Involves a simple nerve pathway called a reflex arc
- Rapid response due to impulse not travelling to high portions of brain

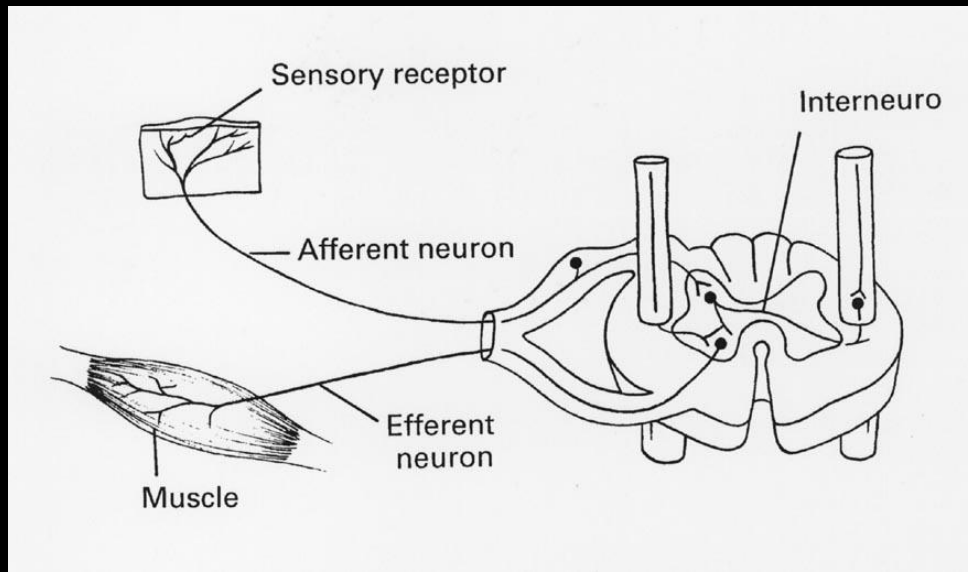

Interneuron
Sensory neuron
Spinal cord
Motor neuron
Receptor in skin
Direction of impulse
Muscle contracts

Parts to all Reflex Arc's (pgs. 255-256)

made of either 2 or 3 neurons

1. Stimulus
2. Sensory receptor
3. Sensory / afferent neuron
4. CNS
5. Motor / efferent neuron
6. Effector





Reflex Arc Examples

- Somatic reflexes→ (effectors = skeletal muscles)
  - Withdrawal reflex: protective response; rapid response minimizes extent of an injury
  - Patellar reflex: knee jerk
    - Involves 2 neurons (sensory 2 motor)

Reflex Arc Examples

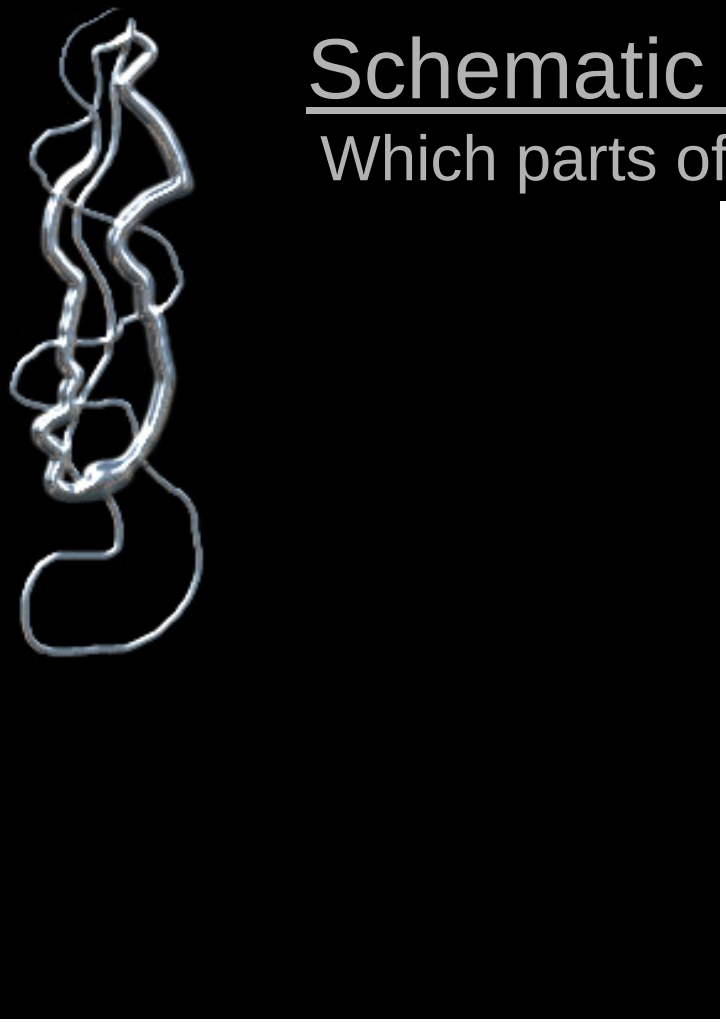
- Visceral reflexes→ (effectors = smooth and cardiac muscles); cause automatic responses
  - (ex: heat rate, breathing, vomiting, sneezing, coughing)

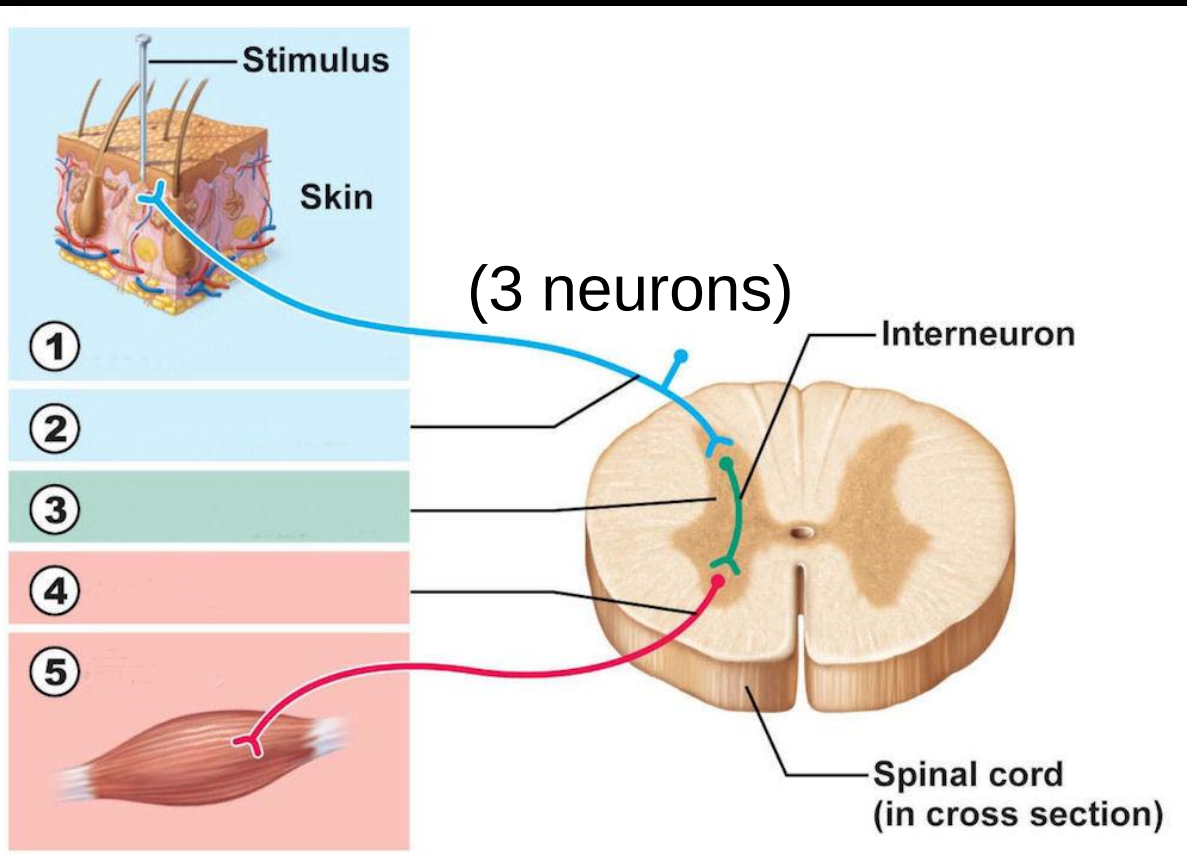
Reacting to Changes

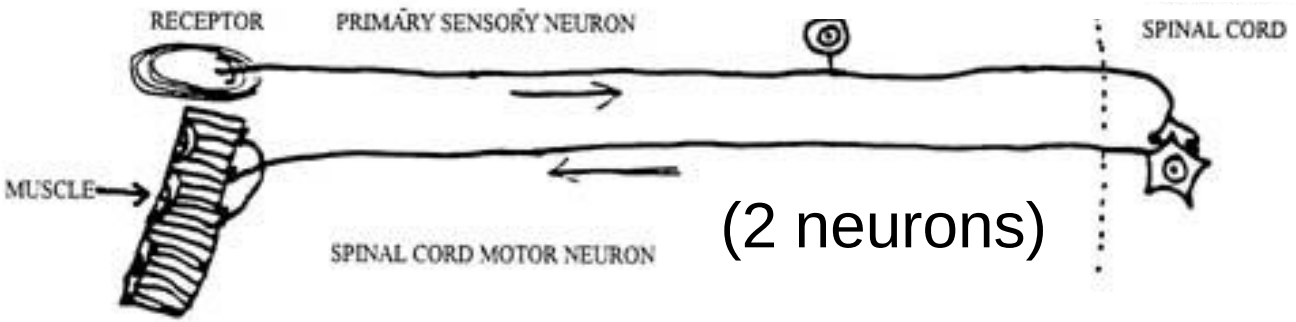
- Examples : when cold outside (stimulus) you shiver (response) and keep the temperate inside your body from dropping
- When its gets hot outside (stimulus) you perspire (response) and keep the temperate inside your body from rising

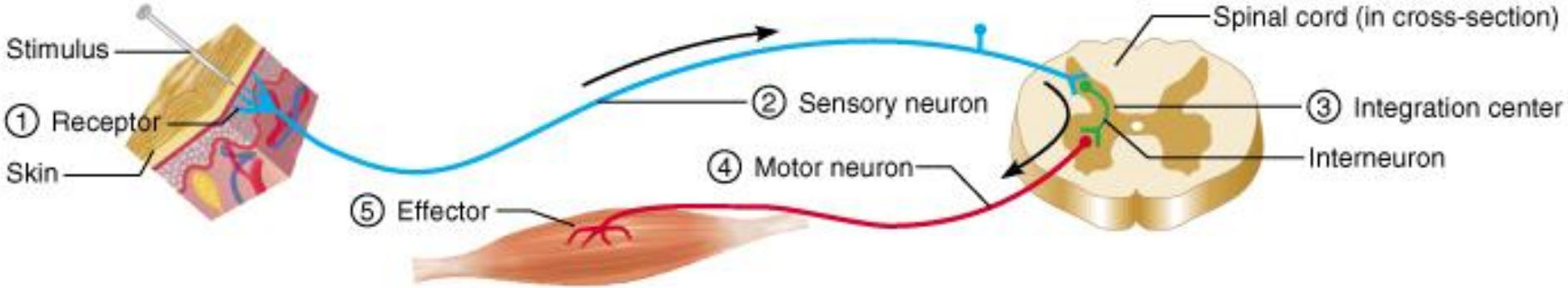
Schematic Diagrams for Reflex ARC:

Which parts of the reflex represent CNS & PNS?









Knee-Jerk Response

- Hammer hits knee – foot jerks up

- Stimulus = hammer ; hits tendon
- Response = muscle contracts → foot jerks upwards

- * pdf powerpoint on reflexes* slide 6

The EYE

Eye Diagram: (10) Terms to be used for labeling

1. Blind spot / optic disc
2. Choroid
3. Cornea
4. Iris
5. Lens
6. Optic nerve
7. Pupil
8. Retina
9. Sclera
10. Suspensory ligaments

Pathway of Light through the Eye

** refracts (bends) light **

1. ** cornea – static, transparent, “window of the eye”
2. * aqueous humor – watery fluid between cornea & iris
   - minor shape, nourishes because fluid is recycled
3. pupil – hole in center of iris, light passes through
   - size changes with amount of light available
4. * lens – changes the amount of refraction
   - accomodation – concave/convex – lens changes shape to focus light on the retina in <u>one</u> spot
5. * vitreous humor – thick, jelly-like fluid in posterior cavity that supports eye shape, holds retina in place, & is not recycled
6. Retina – like a wet piece of tissue paper
   - Change in light = impulses
   - Image on retina – smaller, upside down, backwards
   - Photoreceptors
     - Rods – black & white (dim)
     - Cones - color

Vision

- ROYGBIV – reflected wavelength of light is what is perceived by the viewer
- Photorectors
  - Rods – for Dim light (black & white)
    - Ex. Owls, dogs, cats
  - Cones – Color
    - Ex. Humans
    - 3 types
      - **Erythrolabe**
      - **Chlorolabe**
      - **Cyanolabe**

Trichromatic – 3
Dichromatic – 2
Monochromatic – 1
Achromatic – B/W

Sex – linked recessive **(usually affects men – from mom)**

normal = c

colorblind = c

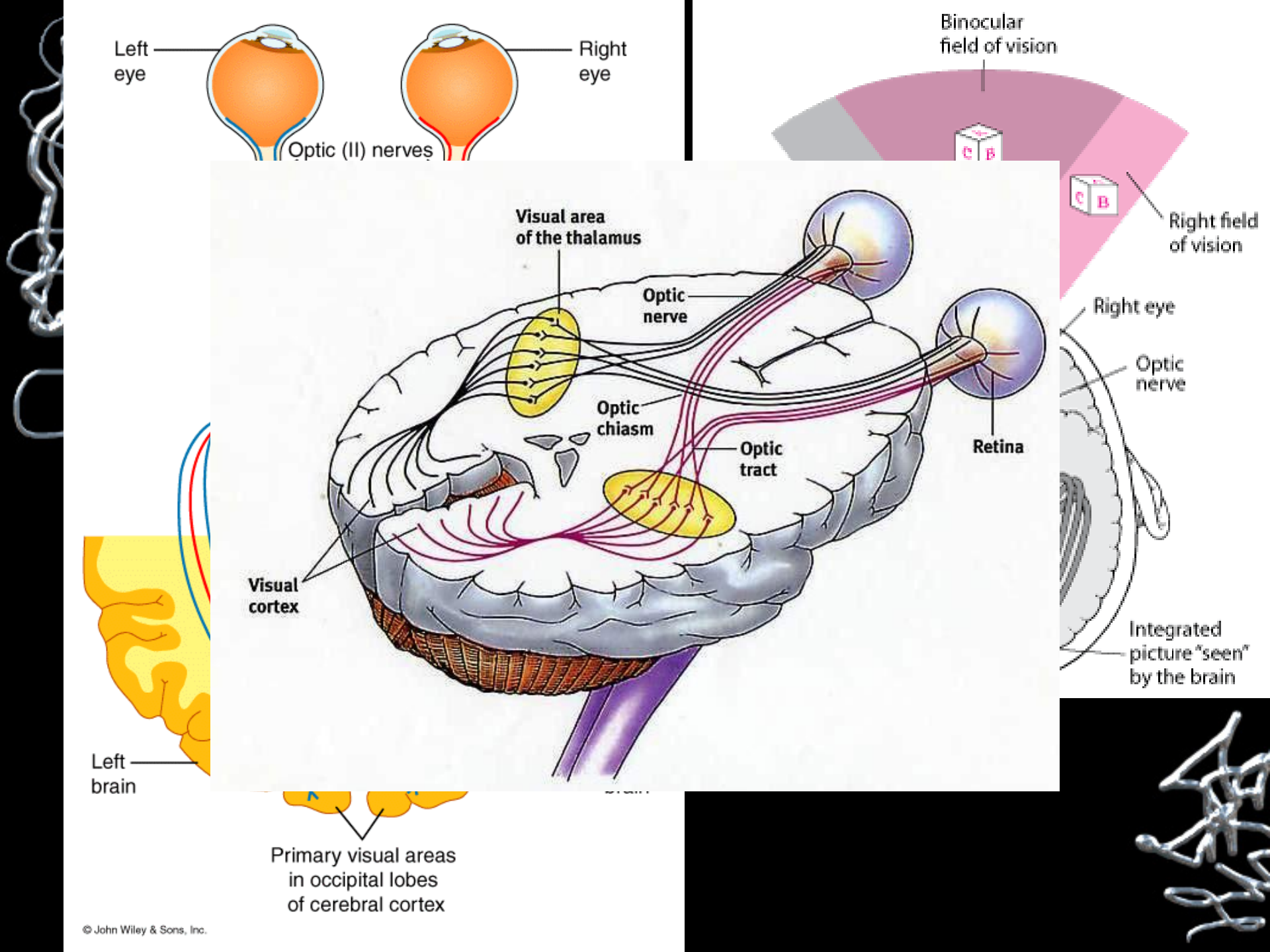
$X^{c}Y$ $X^{c}X^{c}$ $X^{c}X^{c}$

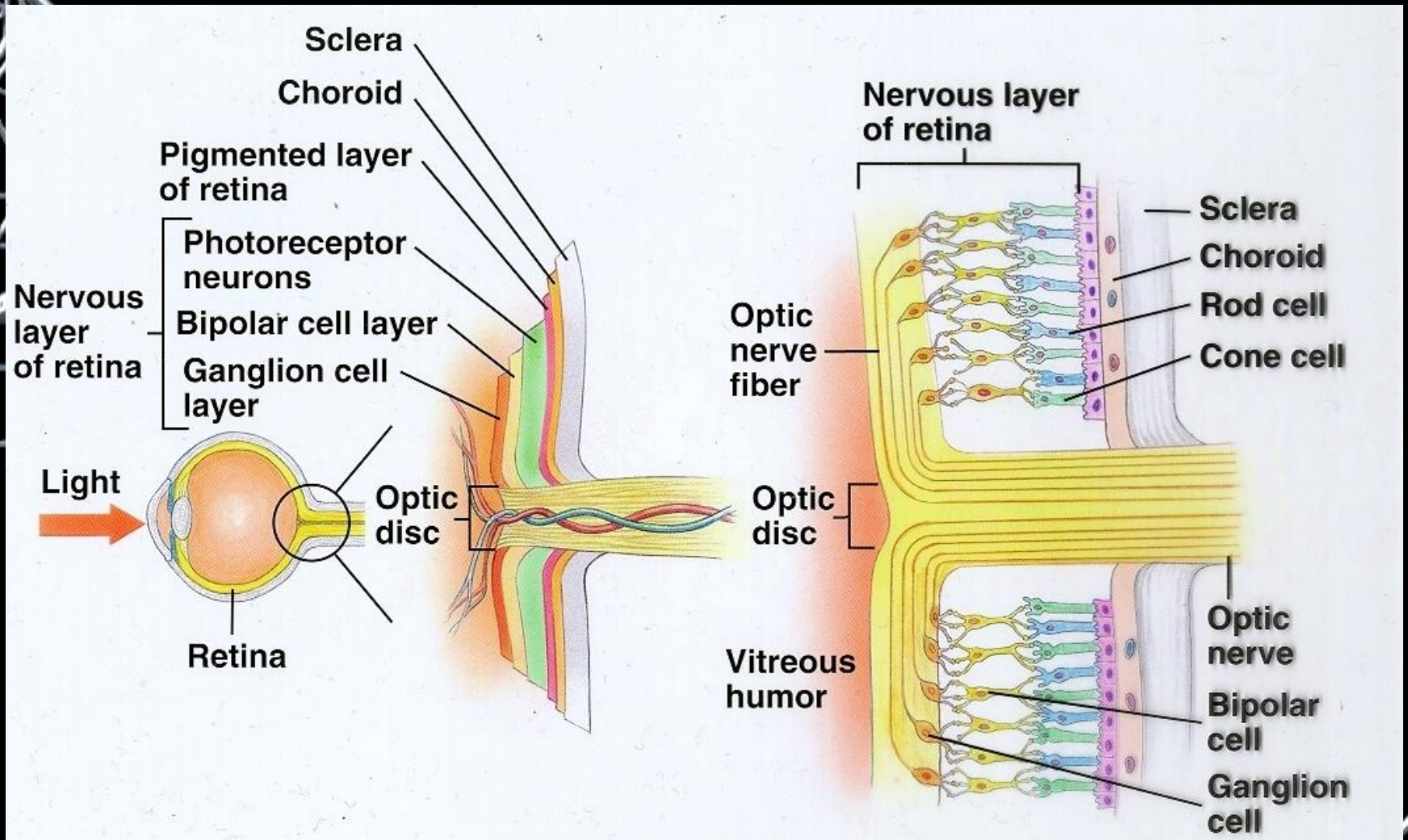
Vision

- Normal Vision (macula)
  - "blind spot" – optic disc / optic nerve
- Nearsighted (myopia)
  - Focuses before the retina
- Farsighted (hyperopia)
  - Focuses after the retina
- Astigmatism
  - Unequal curvature from lens & cornea
  - Blurred vision near & far
- Drawings

Impulse to the Brain

- Optic nerve
  - Impulse leaves eye
- Optic chiasma
  - Where impulses cross (X)
- Optic tract
  - Leads from chiasma to…
- Thalamus
  - Relay switch for sensory impulses
- Occipital lobe of Cerebral Cortex
  - Interprets signal
  - Larger & right side up (& not reversed)


Left eye
Right eye
Optic (II) nerves
Binocular field of vision
Right field of vision
Visual area of the thalamus
Optic nerve
Optic chiasm
Optic tract
Retina
Visual cortex
Right eye
Optic nerve
Integrated picture "seen" by the brain
Left brain
Primary visual areas in occipital lobes of cerebral cortex
© John Wiley & Sons, Inc.



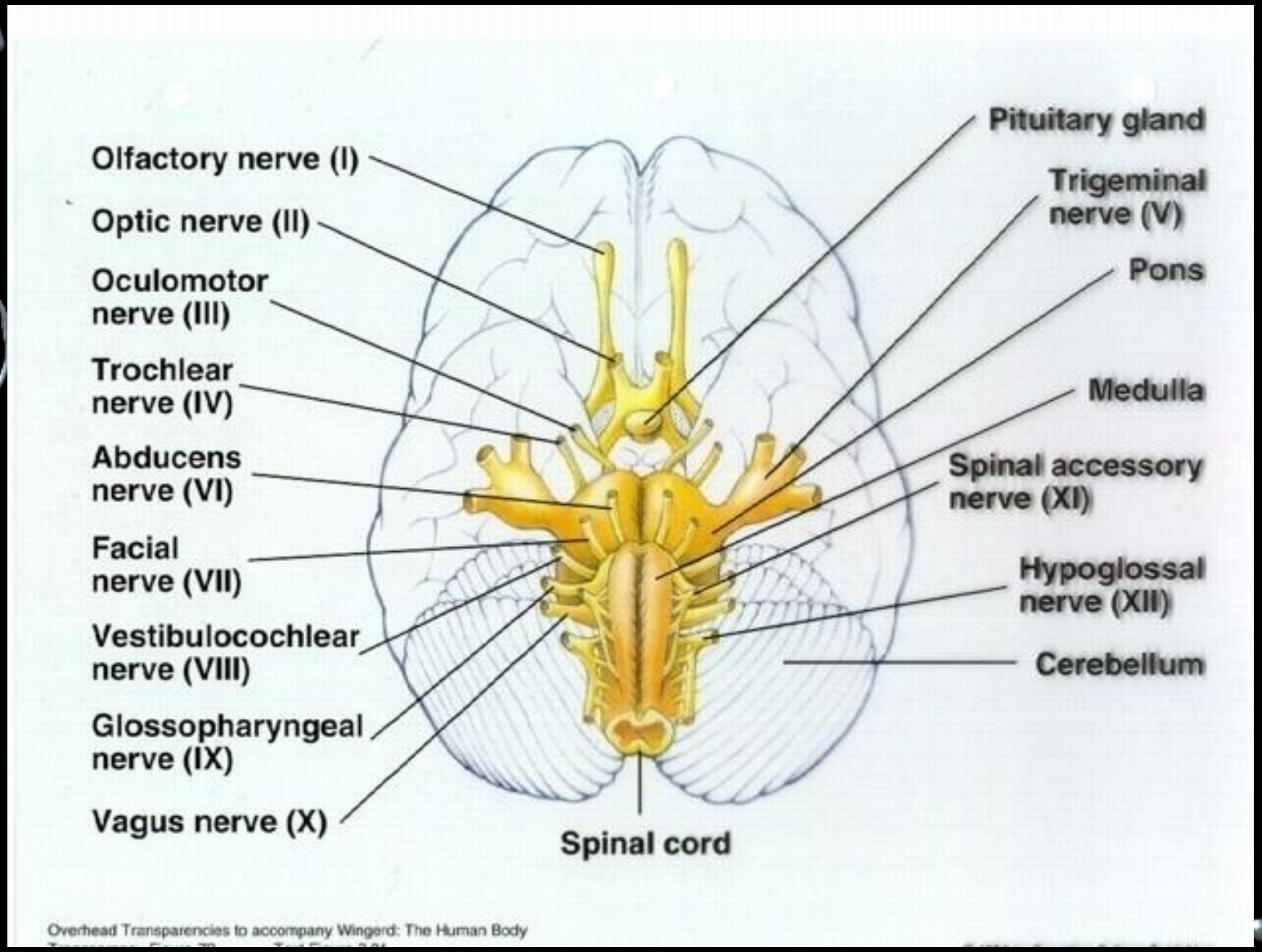
Overhead Transparencies to accompany Wingerd: The Human Body
Transparency Figure 86 Text Figure 10.11

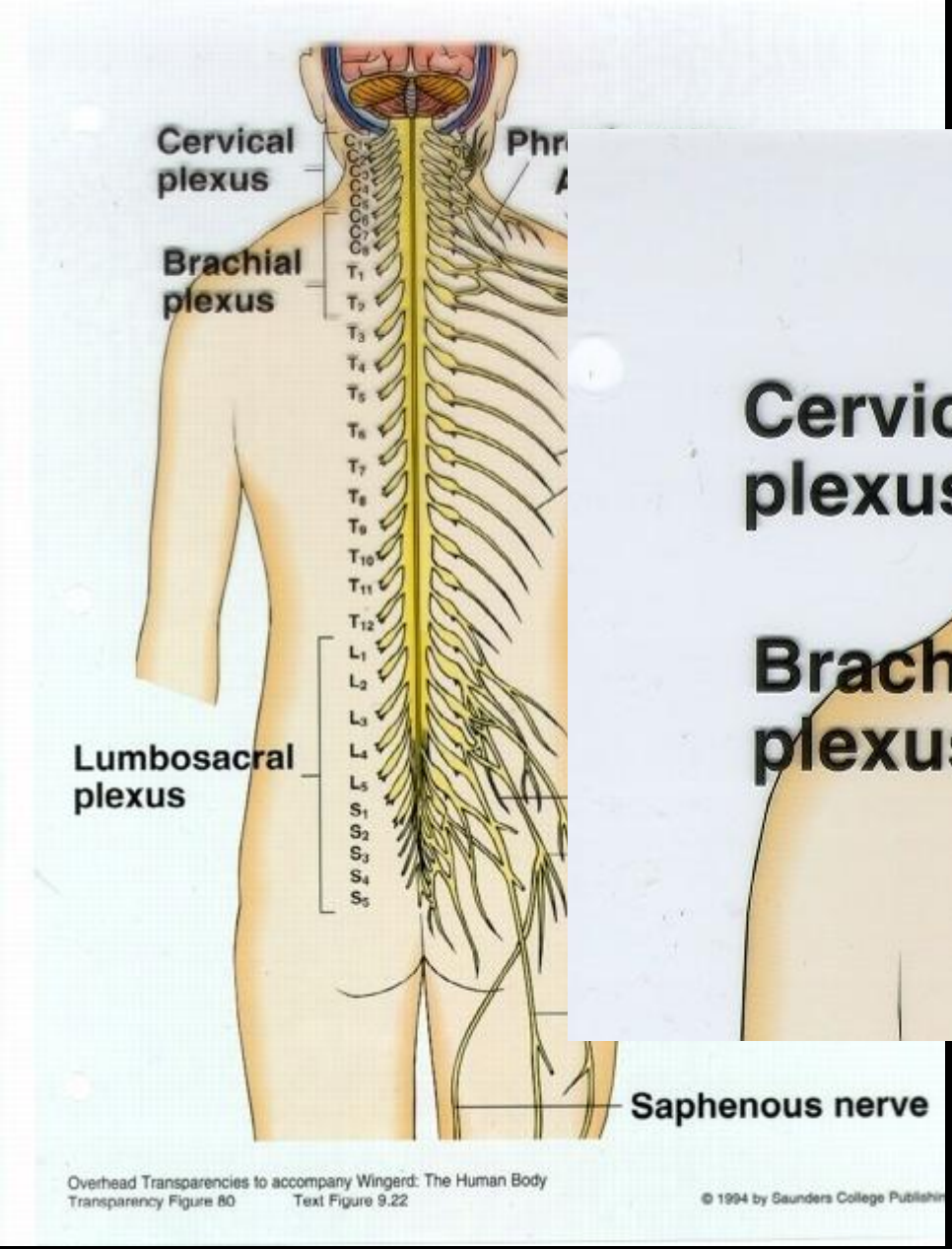
Nerve Types

Cranial Nerves vs. Spinal Nerves

- Attach to brain
- 12 pairs
- Head & neck
- Named with Roman numerals such as I, II, III, IV, V, etc…
- Sensory
  - Toward CNS (attached to sensor
- Motor
  - Away from CNS (muscles)
- Mixed
  - Toward/away CNS

- Attached to spinal cord
- 31 pairs
- Neck, trunk, limbs
- C, T, L, S, C


Olfactory nerve (I)
Optic nerve (II)
Oculomotor nerve (III)
Trochlear nerve (IV)
Abducens nerve (VI)
Facial nerve (VII)
Vestibulocochlear nerve (VIII)
Glossopharyngeal nerve (IX)
Vagus nerve (X)
Pituitary gland
Trigeminal nerve (V)
Pons
Medulla
Spinal accessory nerve (XI)
Hypoglossal nerve (XII)
Cerebellum
Spinal cord



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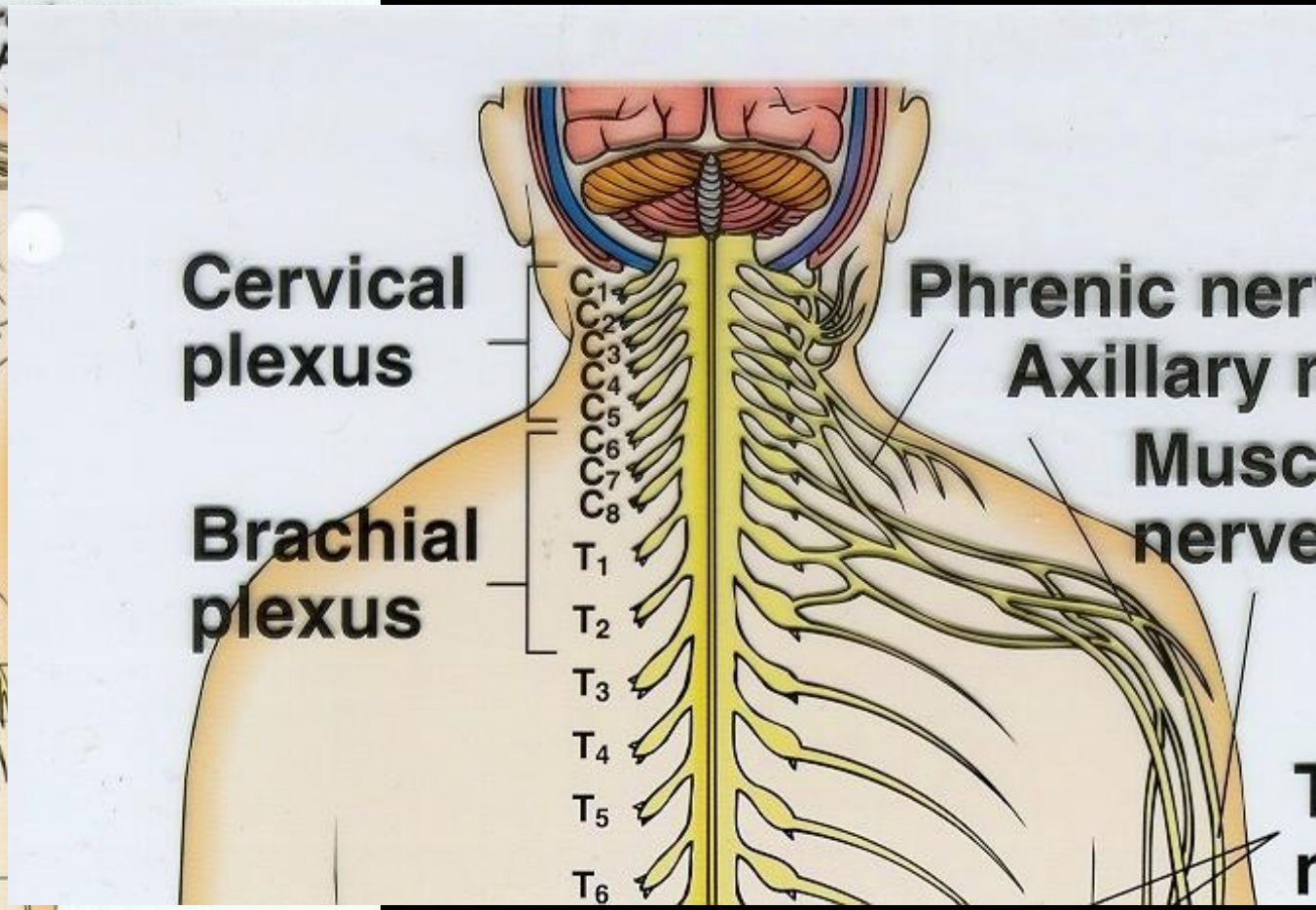
Transparency Figure 80 Text Figure 9.22



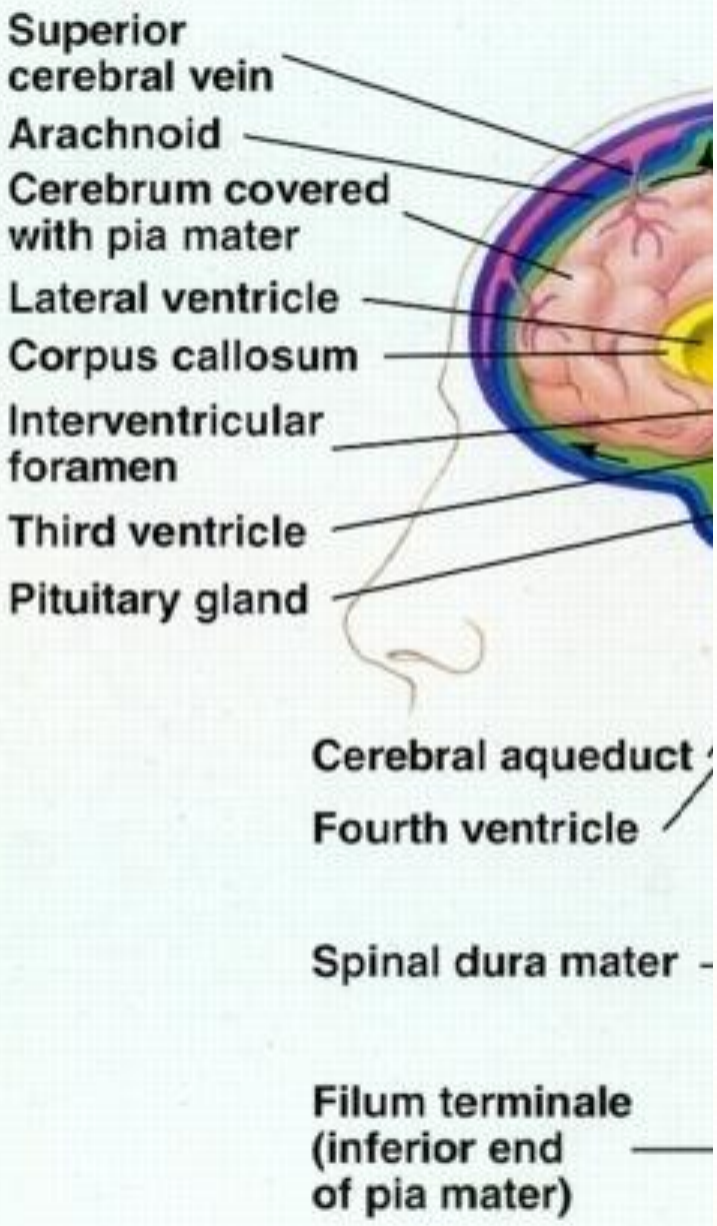
Protective Coverings of CNS

(brain & spinal cord)

1. Bones
   - Cranium / skull
   - Vertebra
2. CSF (cerebral spinal fluid)
   - Protection
   - Nutrients (O_2 to CNS)
   - Wastes (CO_2 away from CNS)
- Choroid plexus – ventricles
  - Filtration
- Arachnoid villi
  - Reabsorption

accumulation of fluids in the brain pg. 259

3. Meninges
   - Dura mater – “tough mother”
   - Arachnoid – spider-like
   - Pia mater – “delicate mother”



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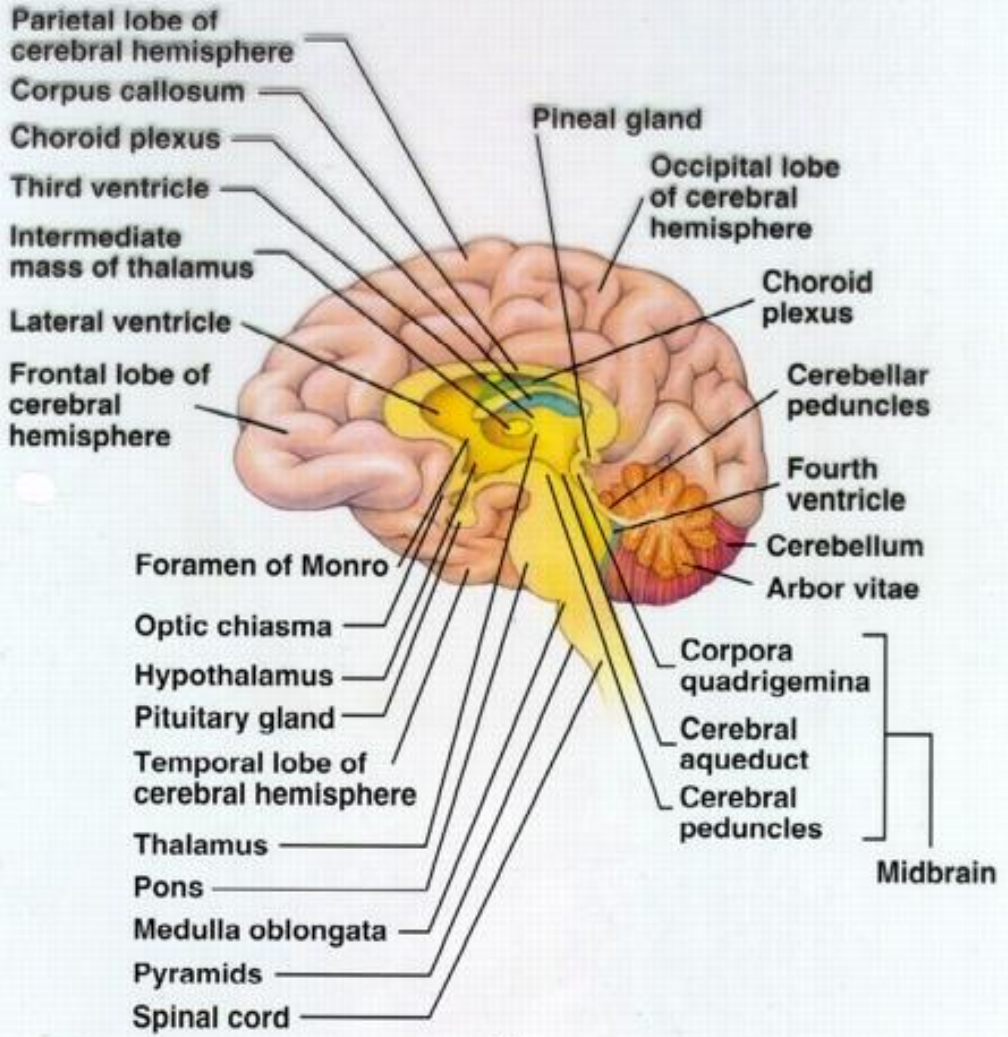


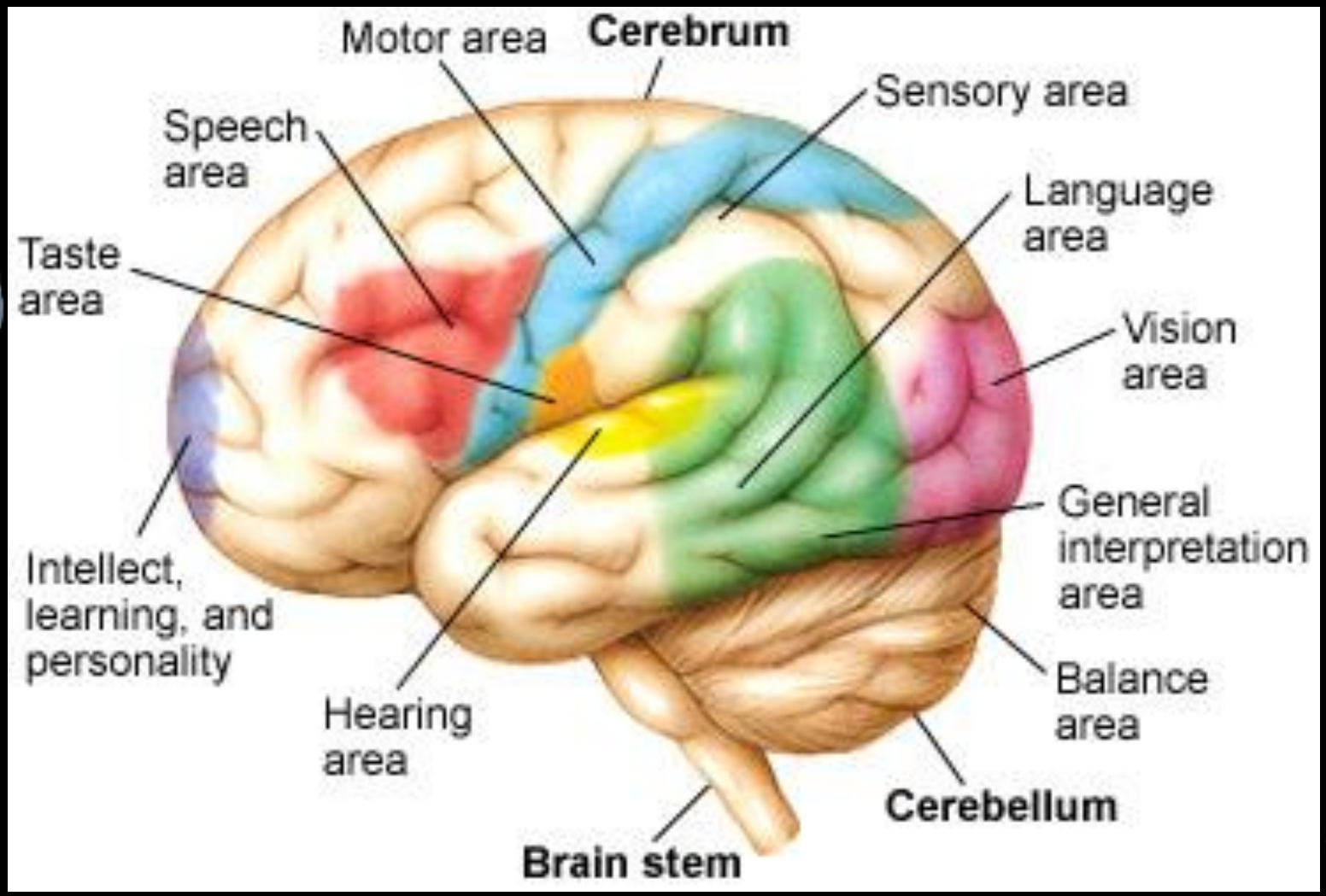
Overhead Transparencies to accompany Wingerd: The Human Body
Transparency Figure 78 Text Figure 9.19a

Brain – iTouch items

- Cerebrum
- Cerebellum
- Pons
- Medulla oblongata
- Midbrain
- Ventricles

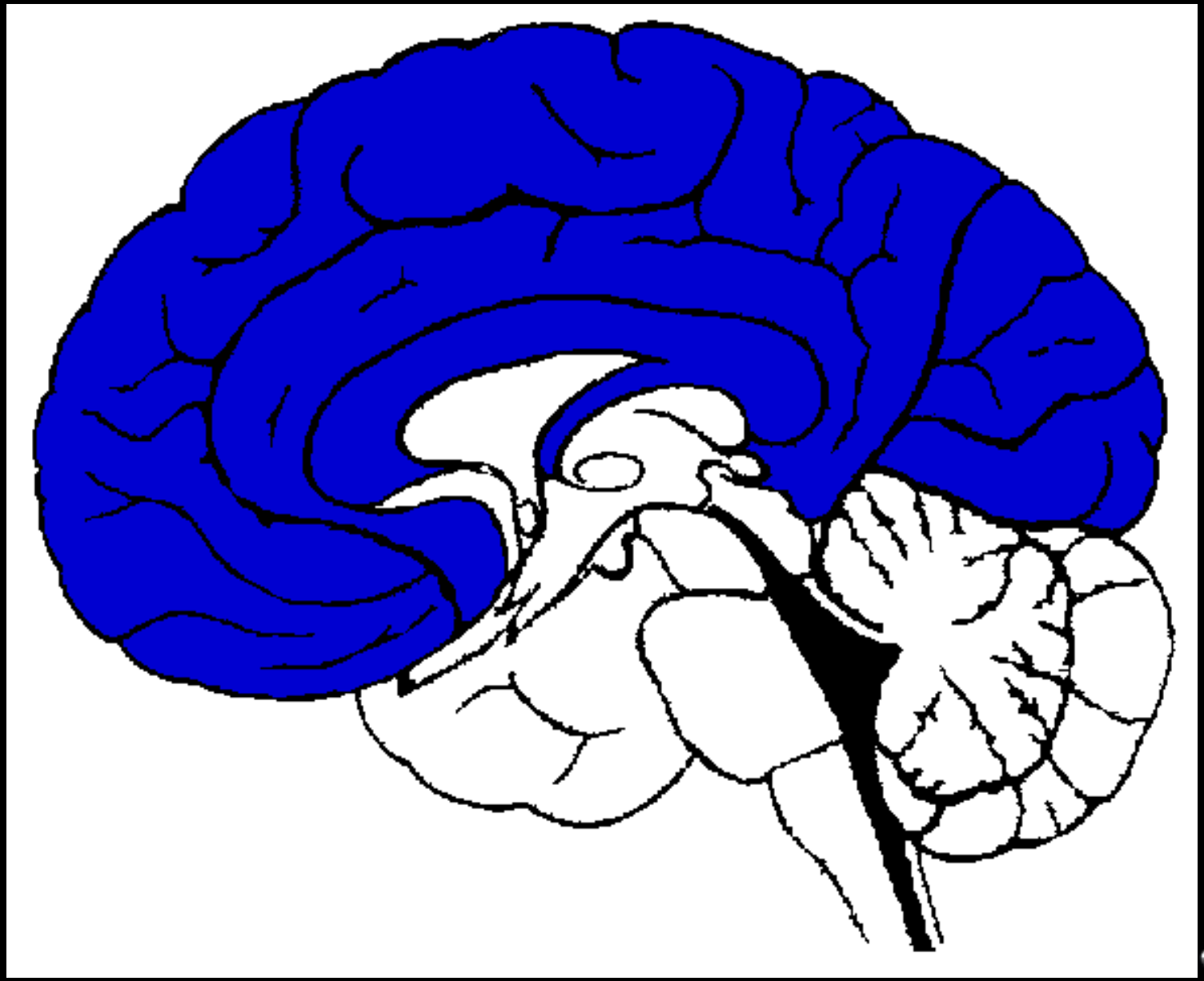
The Brain

- Coordinates body activities
- Made up of approximately 100 billion neurons
- Divided into three major parts-
  - the cerebrum
  - the cerebellum
  - the brain stem.


Motor area
Cerebrum
Sensory area
Speech area
Language area
Taste area
Vision area
General interpretation area
Intellect, learning, and personality
Balance area
Hearing area
Cerebellum
Brain stem

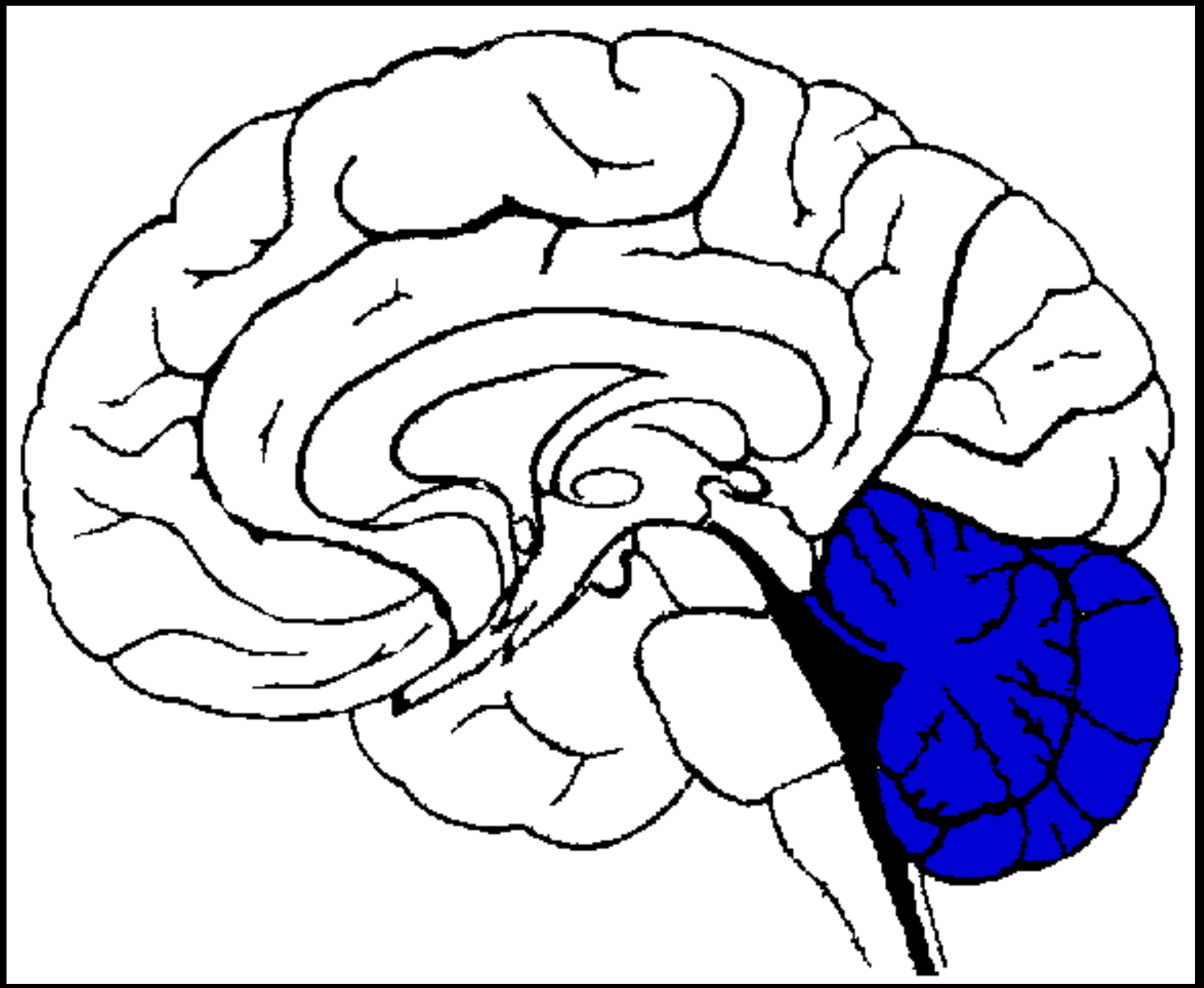
Cerebrum

- Largest part of the brain
- Thinking
- Memory is stored
- Movements are controlled
- Impulses from the senses are interpreted.



Cerebellum

- Interprets stimuli from eyes, ears, muscles
- Controls voluntary muscle movements
- Maintains muscle tone
- Helps maintain balance

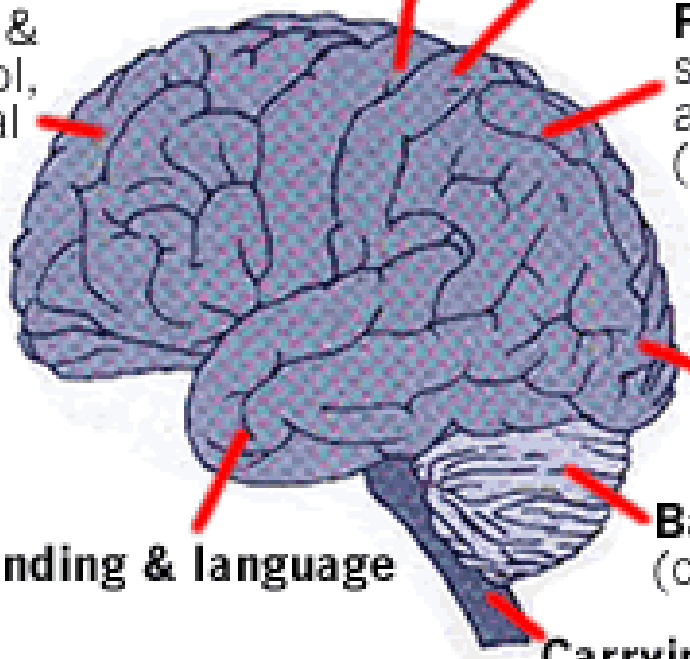


Brain Stem

- Connects brain to spinal cord
- Made up of the midbrain, the pons,
  - Act as pathways connecting various parts of the brain with each other
- Medulla
  - controls involuntary actions

The Brain and its functions

Based on Diagrams from
Head injury - A Practical Guide By Trevor Powel



Executive functions, thinking, planning, organising & problem solving. Emotions & behavioural control, personality (frontal lobe)

Movement (motor cortex)

Sensation (sensory cortex)

Perception, making sense of the world, arithmetic, spelling (parietal lobe)

Vision (occipital lobe)

Balance (cerebelium)

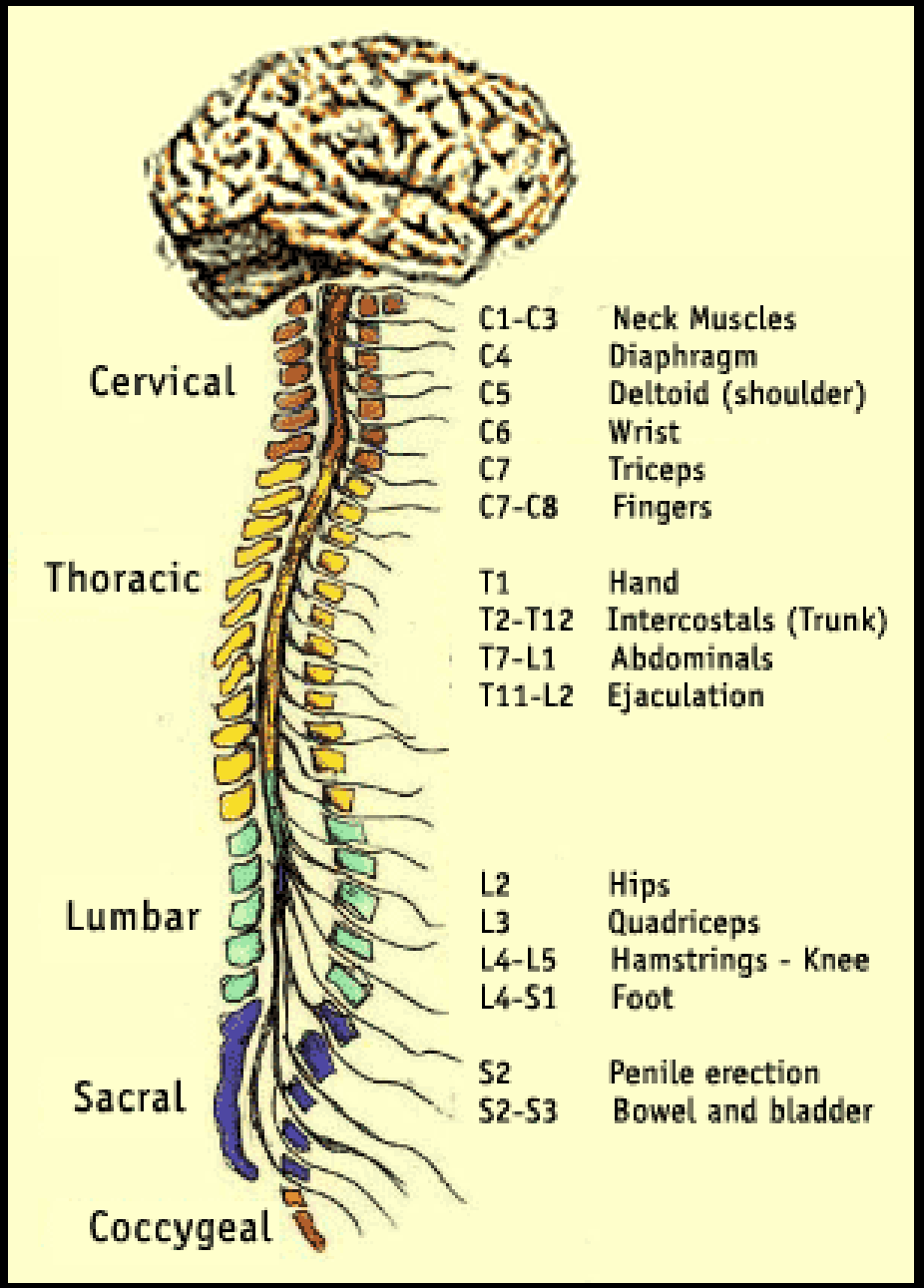
Memory, understanding & language (temporal lobe)

Carrying messages (spinal cord)

http://www.cbituk.org/GRAPHICS/brain.gif

Peripheral Nervous System

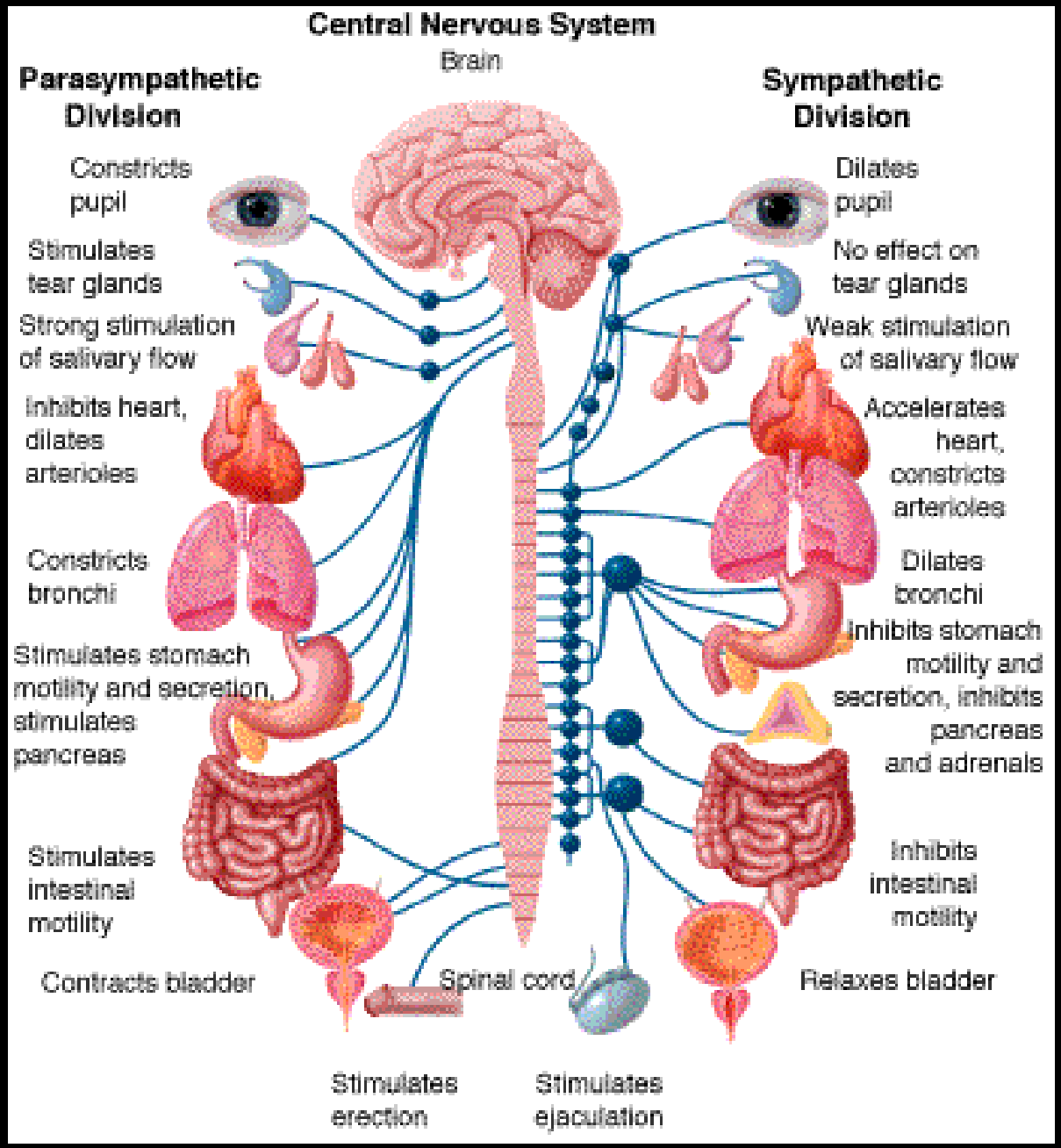
- Connects body to brain & spinal cord
- 12 pairs of nerves from your brain (cranial nerves)
- 31 pairs from your spinal cord (spinal nerves)
  - Bundles of sensory and motor neurons held together by connective tissue



http://www.christopherreeve.org/Research/Research.cfm?ID=178&c=21

Peripheral Nervous System

- Two divisions
  - Somatic
  - Autonomic



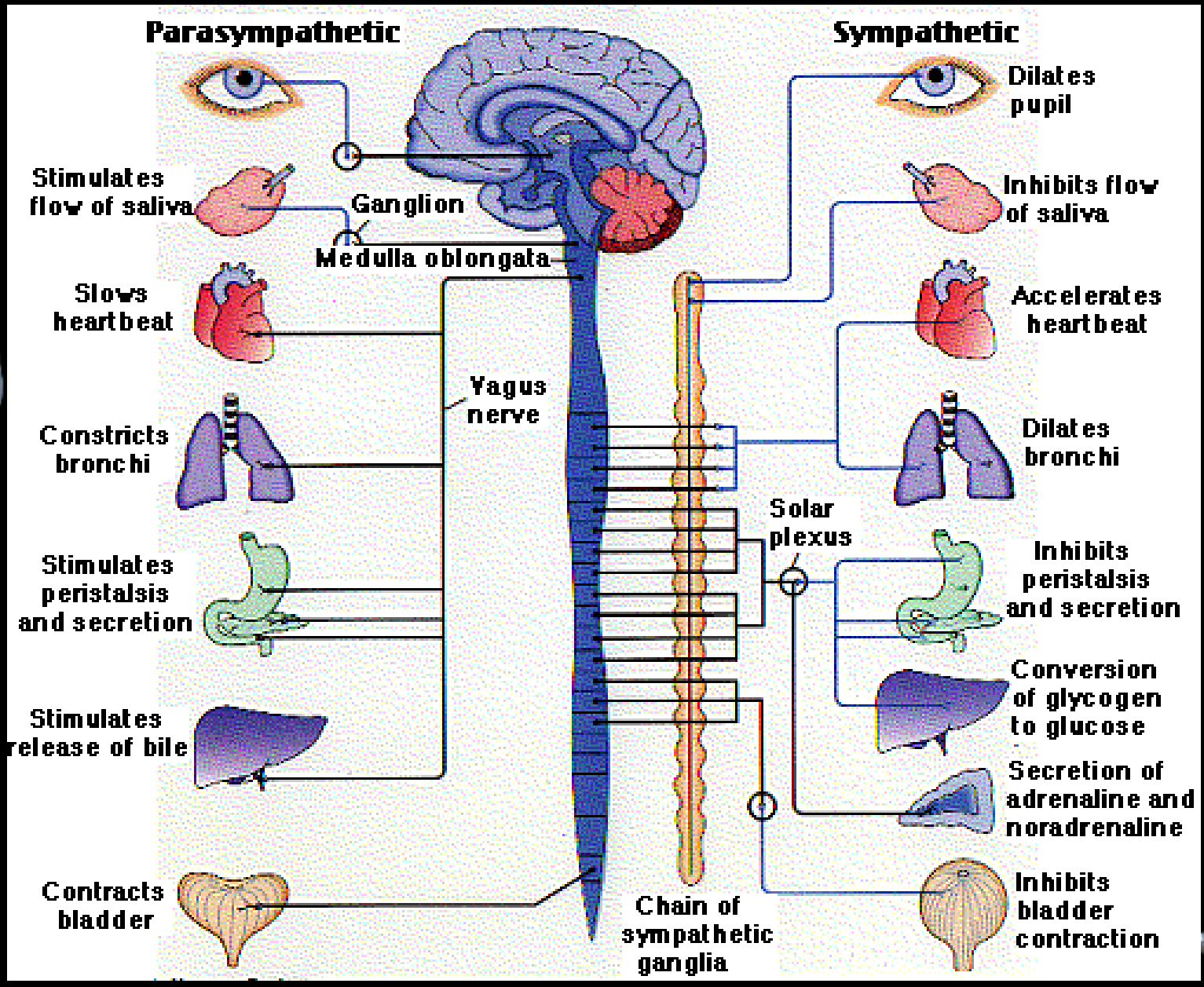
http://abdellab.sunderland.ac.uk/lectures/Parmacology/Pics/anatomy/PNS.GIF

Somatic Nervous System

- Controls voluntary actions
- Made up of the cranial and spinal nerves that go from the central nervous system to your skeletal muscles

Autonomic Nervous System

- Controls involuntary actions-those not under conscious control-such as your heart rate, breathing, digestion, and glandular functions



http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/A/autonomic.gif