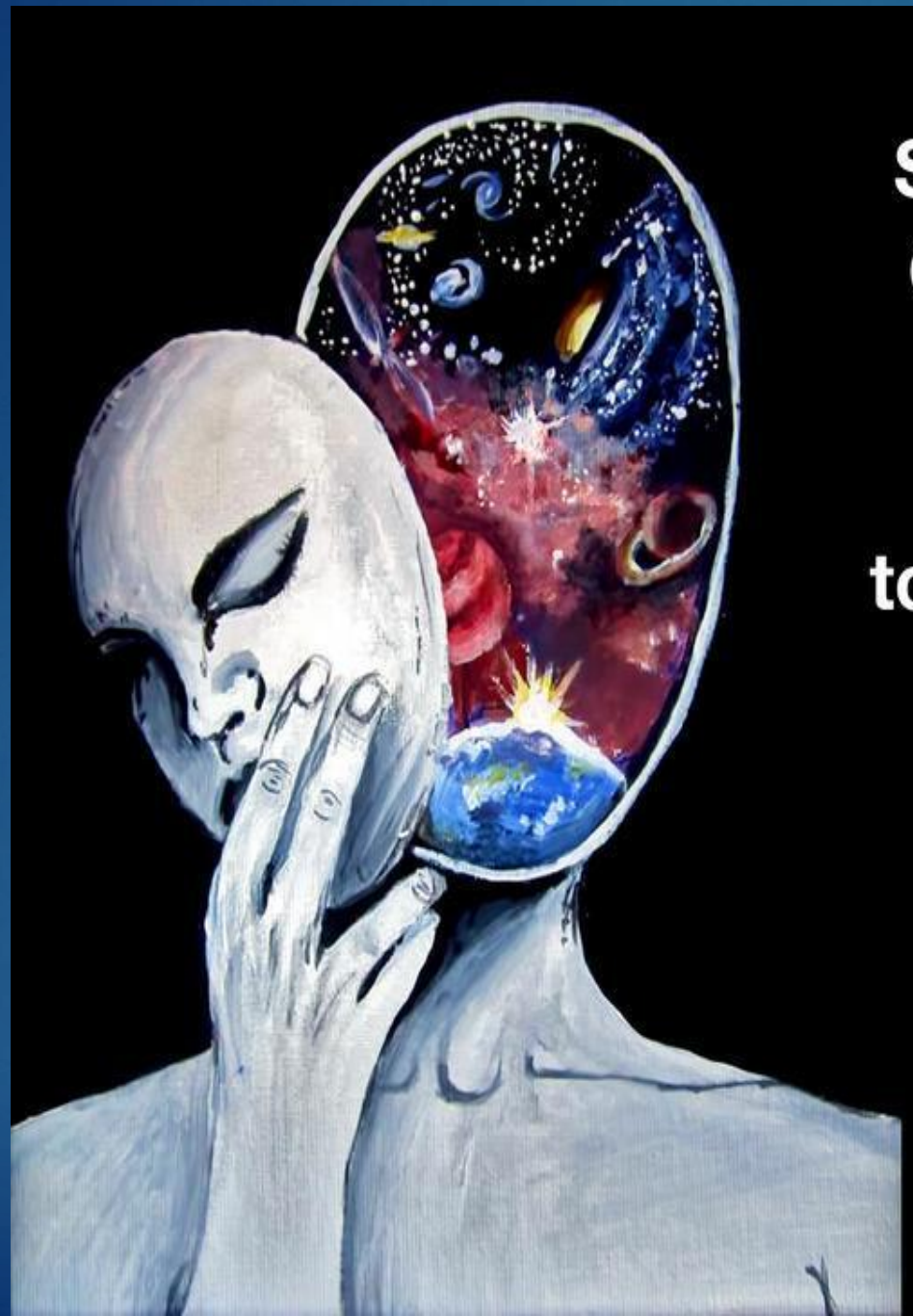


Soon We shall show them
Our signs in the horizons
and in their own souls
until it becomes clear
to them that He is the Real.
Is it not sufficient that
your Lord is witness
to all things?


Me trying to get out of bed
every morning, like...

EVEN YOUR COFFEE

is suprised you woke up this early


Begin Everything With
بسم الله الرحمن الرحيم
In The Name Of Allah, The Most Gracious, The Most Merciful.
@salma5x

Case Scenario

Numbness & Tingling on left side of the body

- Lets fast forward to 6 years from now…… You are the attending doctor in the OPD…….
- A young female patient comes to you with complaints of difficulty in walking, numbness and tingling on left side of body.
- On examination she has loss of vibration sense in lower limb and two point discrimination on right finger is 5 mm while it is 15mm on left side.
- Pain and temperature sensations are normal on both sides. Strength and tone of muscles is normal
- What is the condition and can you localize the leison?

Ascending Pathways-

Dorsal Column Medial Leminiscus System

DR SARAH SHAHID
ASSISTANT PROFESSOR
PHYSIOLOGY DEPT

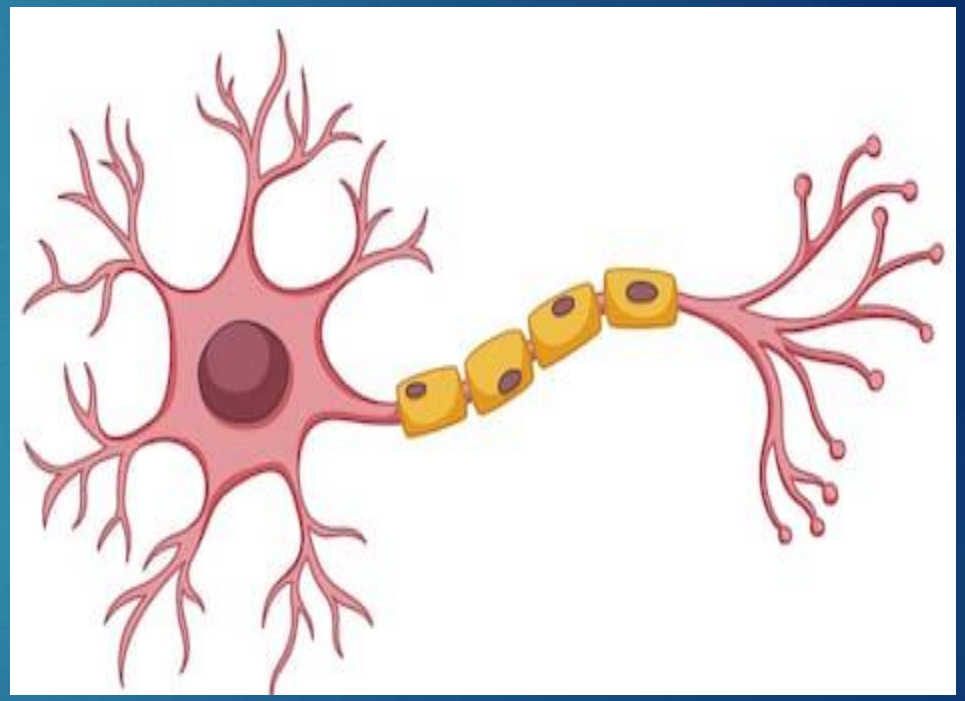
Sensory Pathways

LEARNING OBJECTIVES:

- At the end of this lecture the students should be able to:
- Enumerate the Ascending tracts responsible for carrying different type of sensations.
- Describe the formation, course & functions of each tract.
- Explain the Lesions associated with these Tracts

Recall our knowledge…

- Divisions of CNS
- Spinal cord structure
- What are tracts?
- Types of receptors?



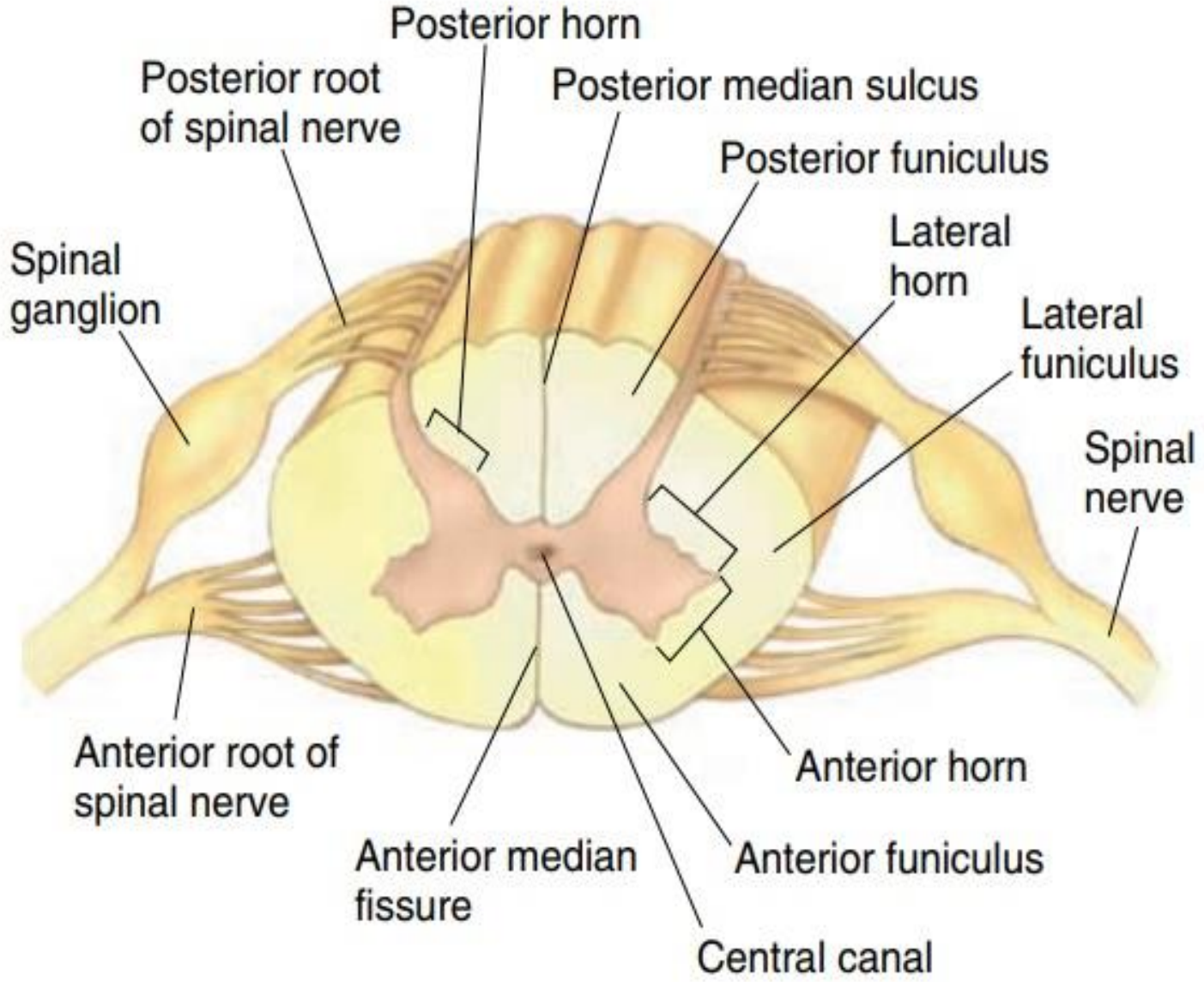
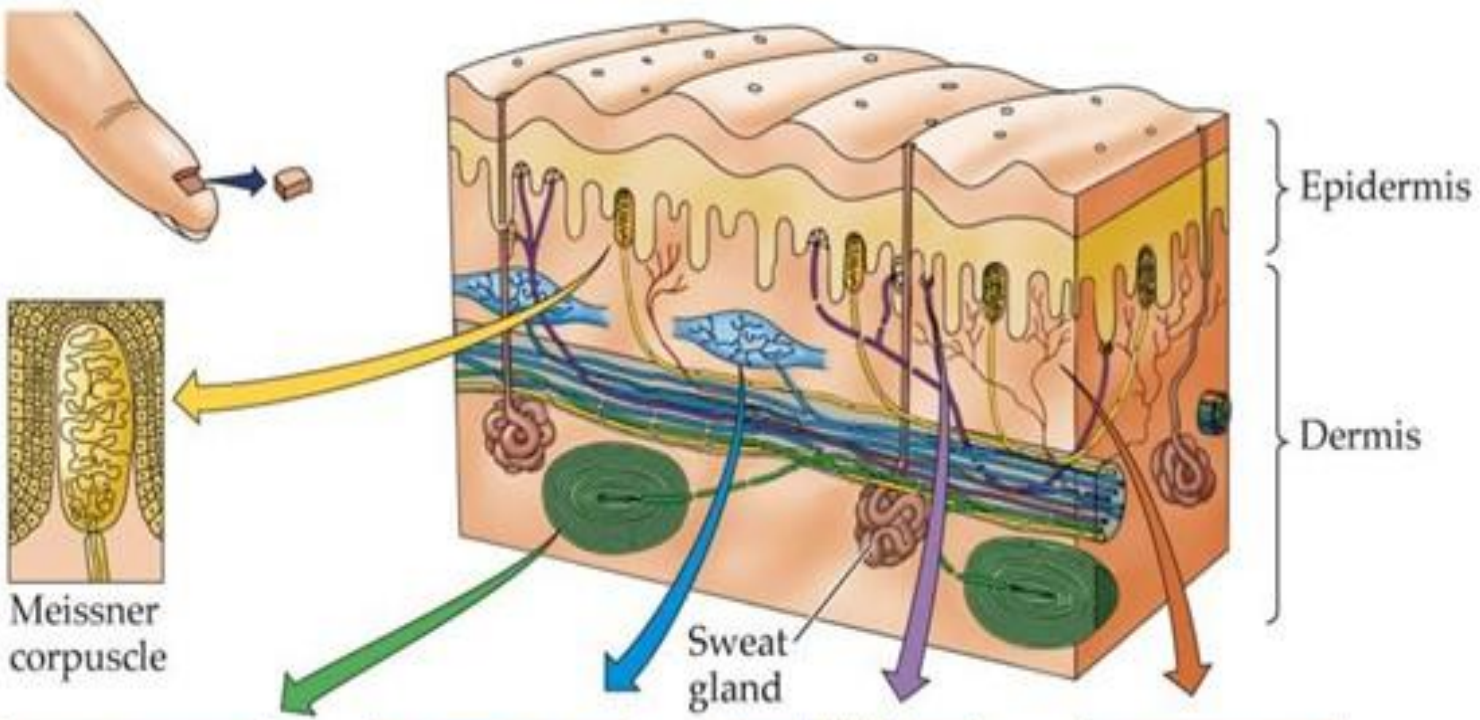
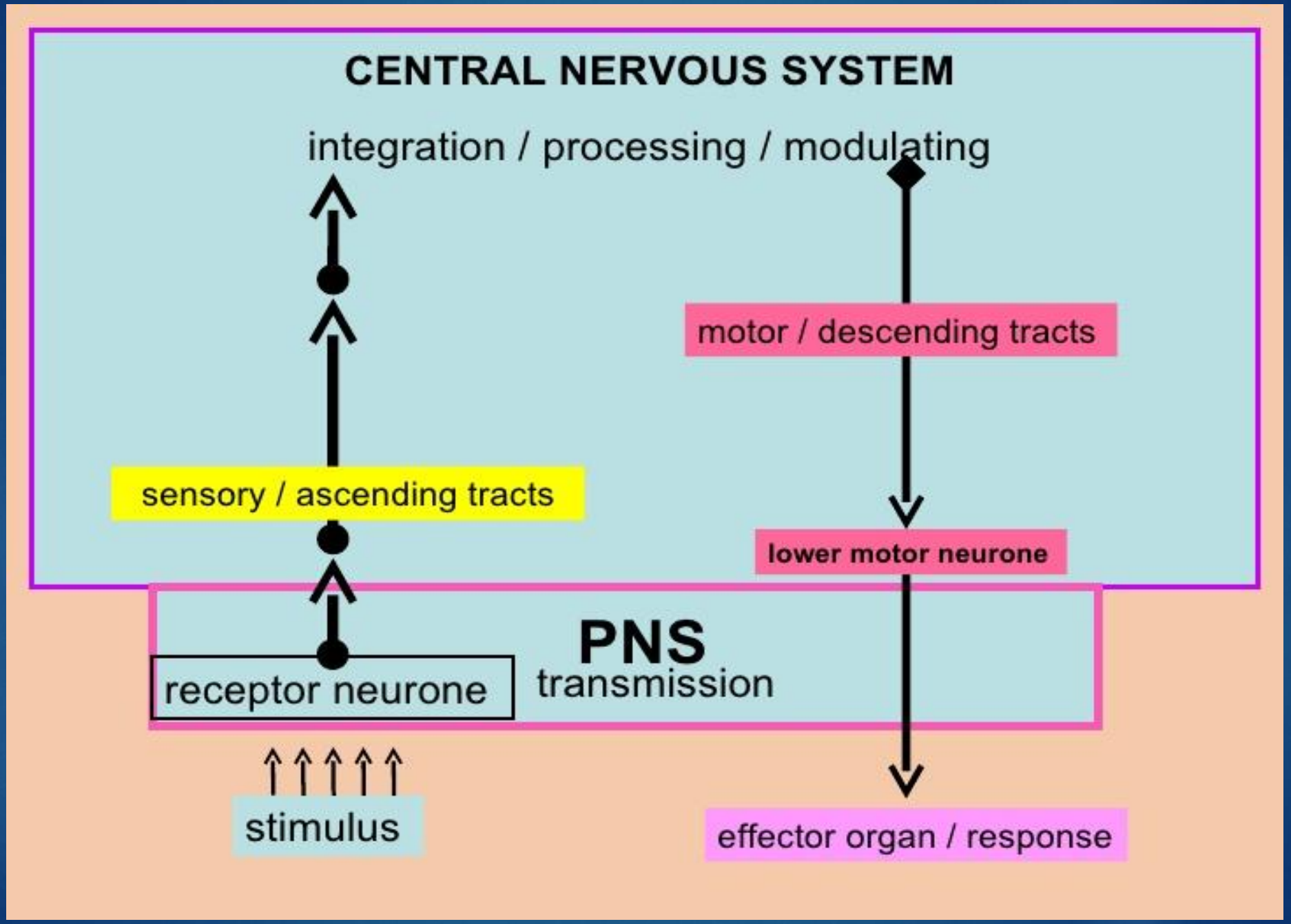


FIGURE Structure of the Spinal Cord—Transverse Section



NEUROSCIENCE, Third Edition, Figure 8.3 © 2004 Sinauer Associates, Inc.


CENTRAL NERVOUS SYSTEM
integration / processing / modulating
motor / descending tracts
sensory / ascending tracts
lower motor neurone
PNS
transmission
receptor neurone
stimulus
effector organ / response

Transmission of Somatic Sensations

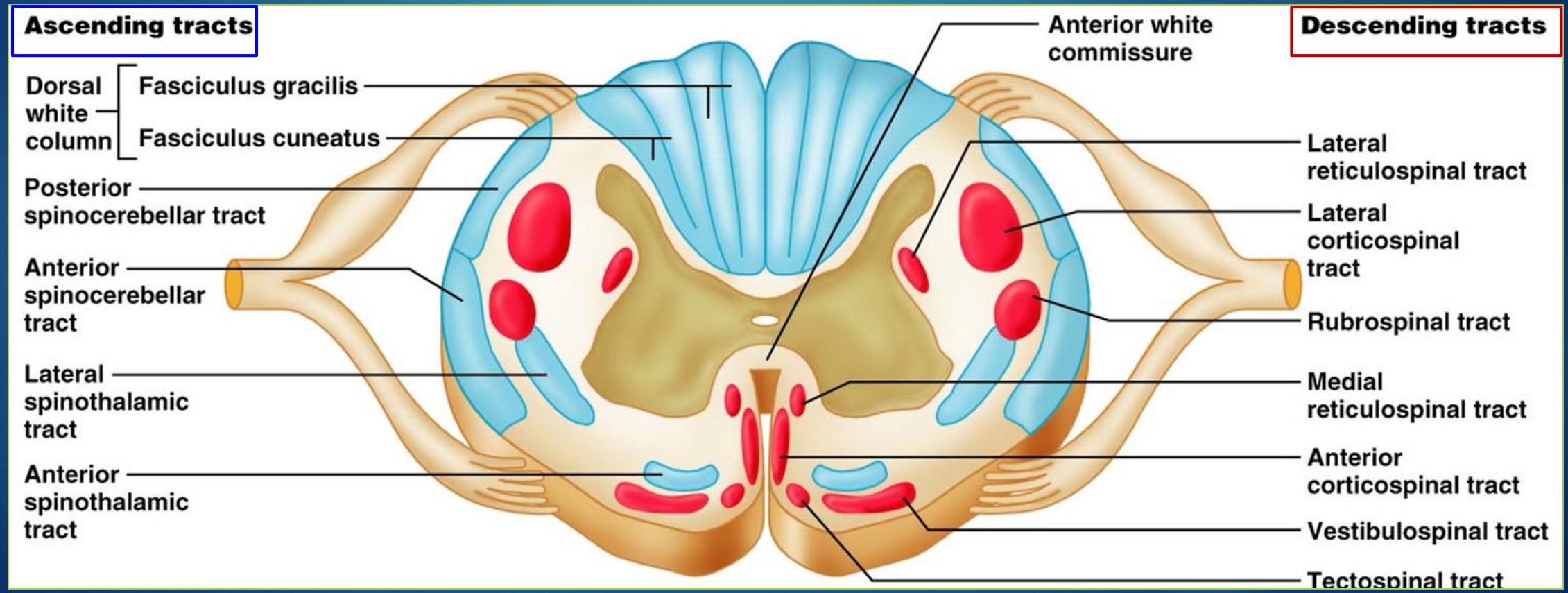
Bell Magendie Law

- All sensory information enter the spinal cord through dorsal root, from where they are carried through the ascending tracts

Long Tracts:

(a) Ascending (sensory or afferent).

(b) Descending (motor or efferent).



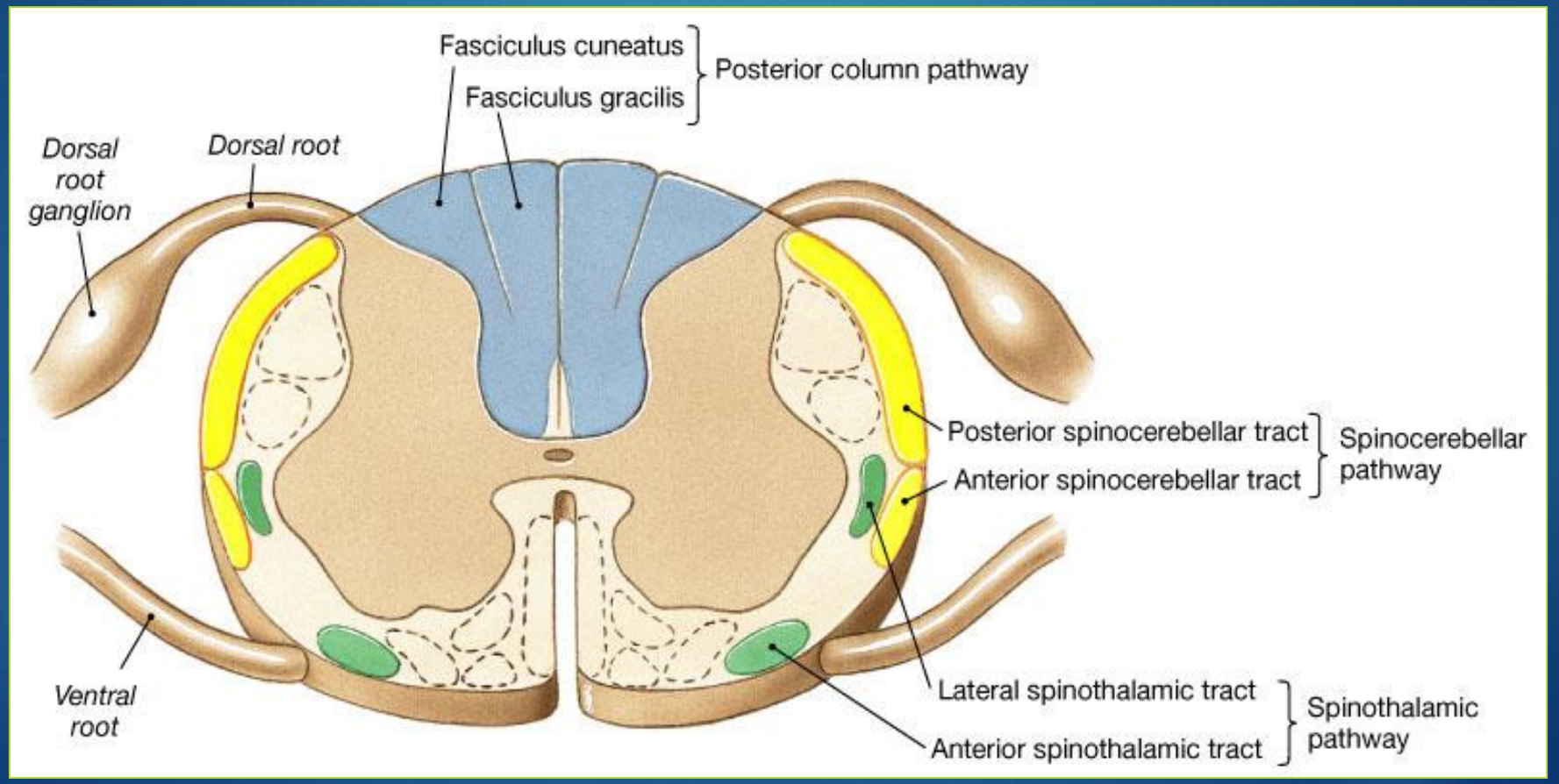
Ascending Tracts

- Bundles of nerve fibers linking the spinal cord with the higher centres of the brain, and conveys information from skin and viscera.

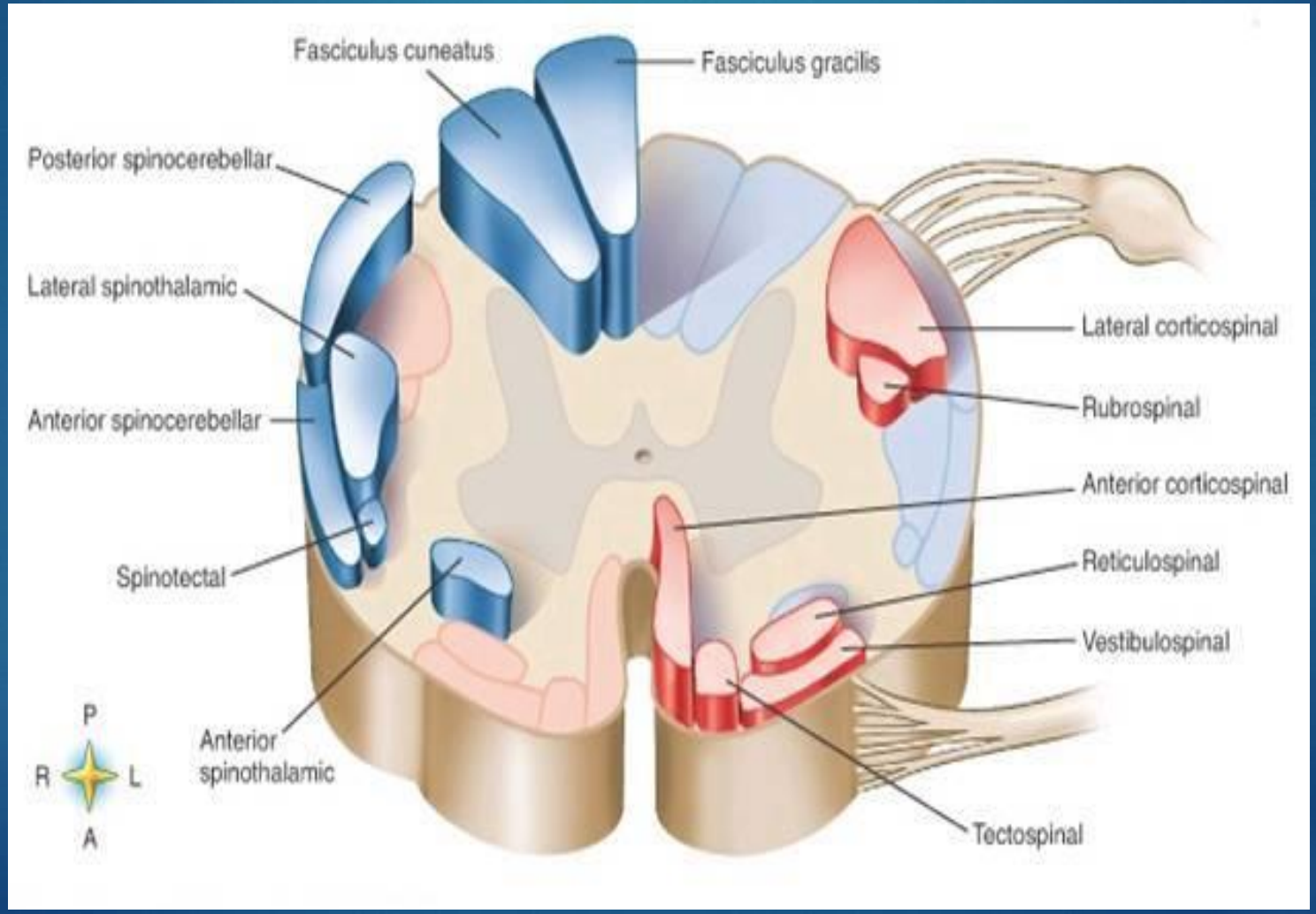
Ascending Pathways:

1. **Dorsal column-medial Leminiscal System**
    1. Fasciculus Gracilus (Medial)
    2. Fasciculus Cuneatus (Lateral)
2. **Antero-lateral system (Spino-thalamic)**
    1. Anterior Spinothalamic Tract
    2. Lateral Spinothalamic tract
3. **Spinocerebellar tracts**
    1. Dorsal
    2. ventral
4. Spino-tectal, Spino-olivary, Spino-Vestibular tracts

- **Three major pathways carry sensory information:**
  - ***Posterior column (Gracile & Cuneate fasciculi)***
  - ***Anterolateral pathway (Spinothalamic)***
  - ***Spinocerebellar pathway***



Transverse section of Spinal cord showing Ascending & Descending Tracts



Dorsal Column Medial Leminiscus System

DORSAL COLUMN/POSTERIOR COLUMN

Dorsal Column-Medial Leminiscal System

Functions:

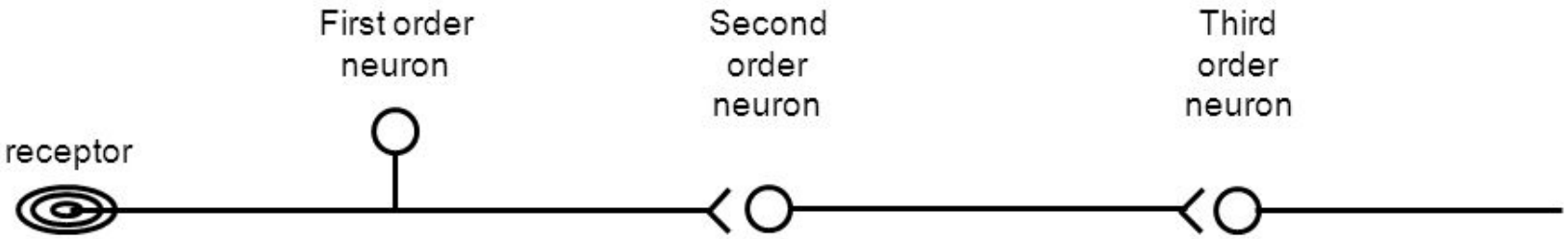
(Types of sensations carried)

- **Fine Touch requiring high degree of localization & gradations of Intensity.**
- **Two point discrimination**
- **Vibration**
- **Sense of Position (Proprioception)**
- **Fine Pressure**
- **Sensations that signals movement against the skin**

Dorsal Column-Medial Lemniscus system

Some terminology

We use the terms *first*, *second* and *third order neurons* to describe the steps of the pathway to cortex.



Dorsal Column–Medial Leminiscal System

Gracile Fasciculus

- The **fasciculus gracilis (containing ascending fibers from the lower limbs)** is located medially

Cuneate Fasciculus

- the **fasciculus cuneatus (containing ascending fibers from the upper limbs)** is located laterally in the dorsal column

Gracile Fasciculus

- carries signals from midthoracic and lower parts of the body
- below T6, it composes the entire posterior column
  - at T6 joins cuneate fasciculus
- consists of first-order nerve fibers that travel up the ipsilateral side of the spinal cord
- terminates at the gracile nucleus of the medulla oblongata
- carries signals for vibration, visceral pain, deep and discriminative touch, and proprioception from lower limbs and lower trunk
- **proprioception** – nonvisual sense of the position and movements of the body

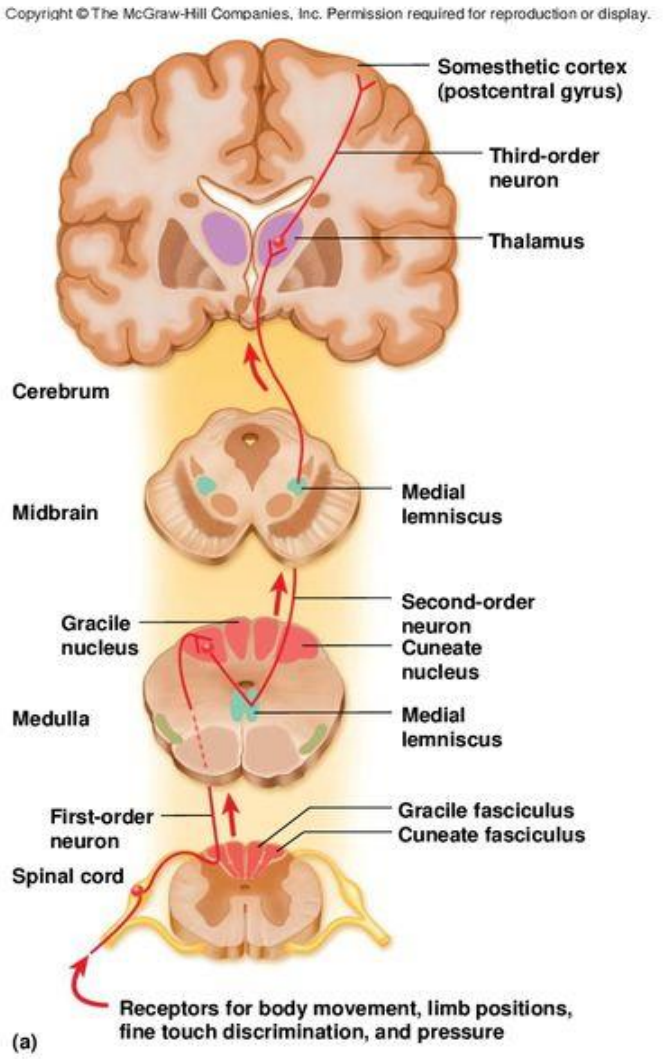


Figure 13.5a

Cuneate Fasciculus

- joins gracile fasciculus at T6
- occupies lateral portion of the posterior column
  - forces gracile fasciculus medially
- carries the same type of sensory signals
- originate from the level of T6 and up
  - upper limb and chest
- fibers end in the cuneate nucleus on the ipsilateral side of the medulla oblongata
- **medial lemniscus** – formed from the second-order neurons of gracile and cuneate systems that decussate in the medulla
  - tracts of these nerve fibers lead the rest of the way to the thalamus
- third-order neurons go from thalamus to cerebral cortex
- carry signals to contralateral cerebral hemisphere

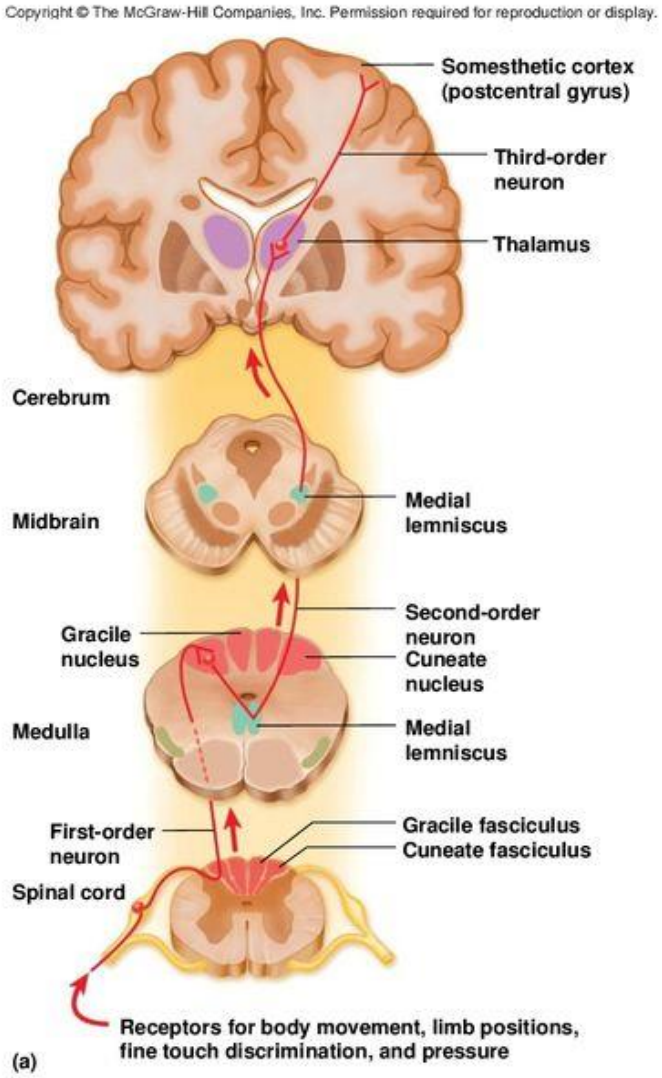
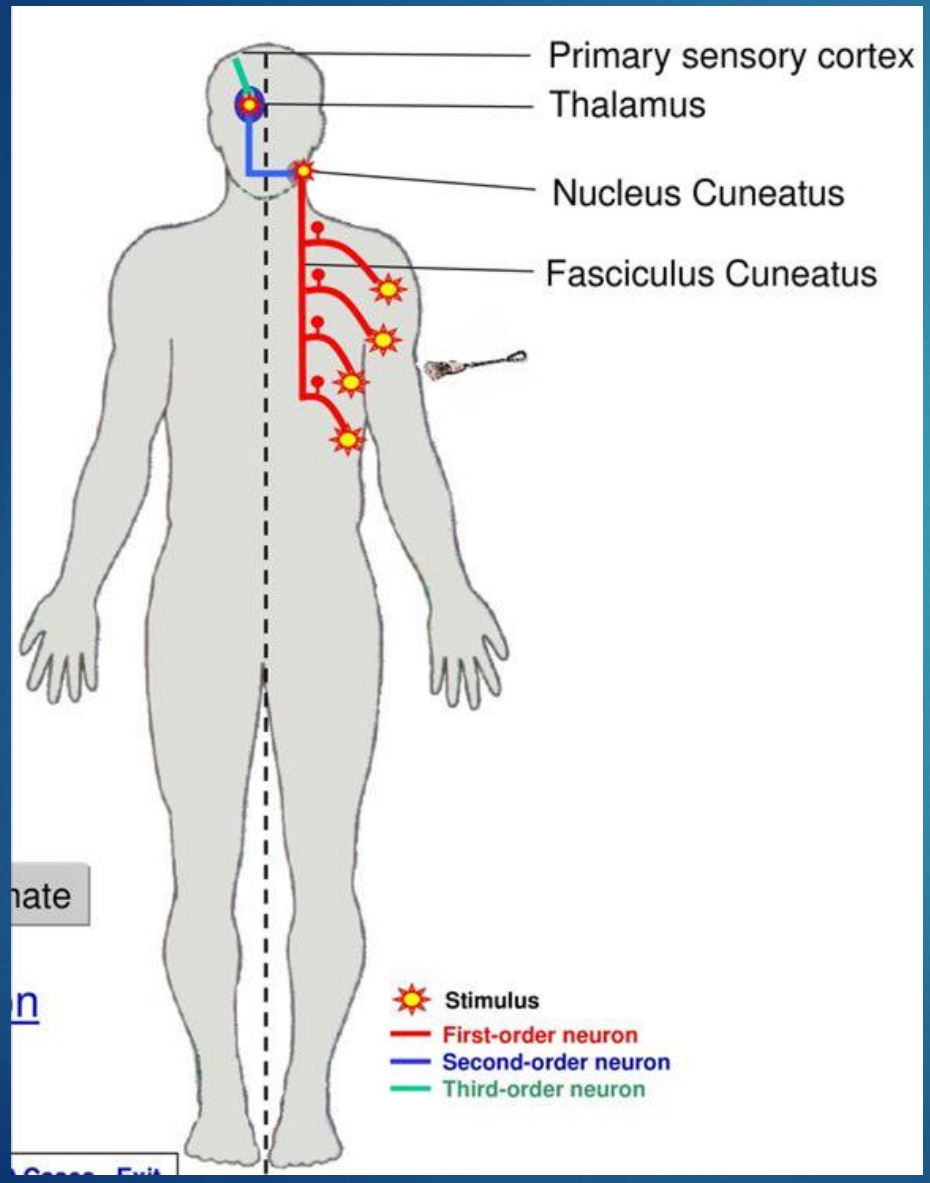
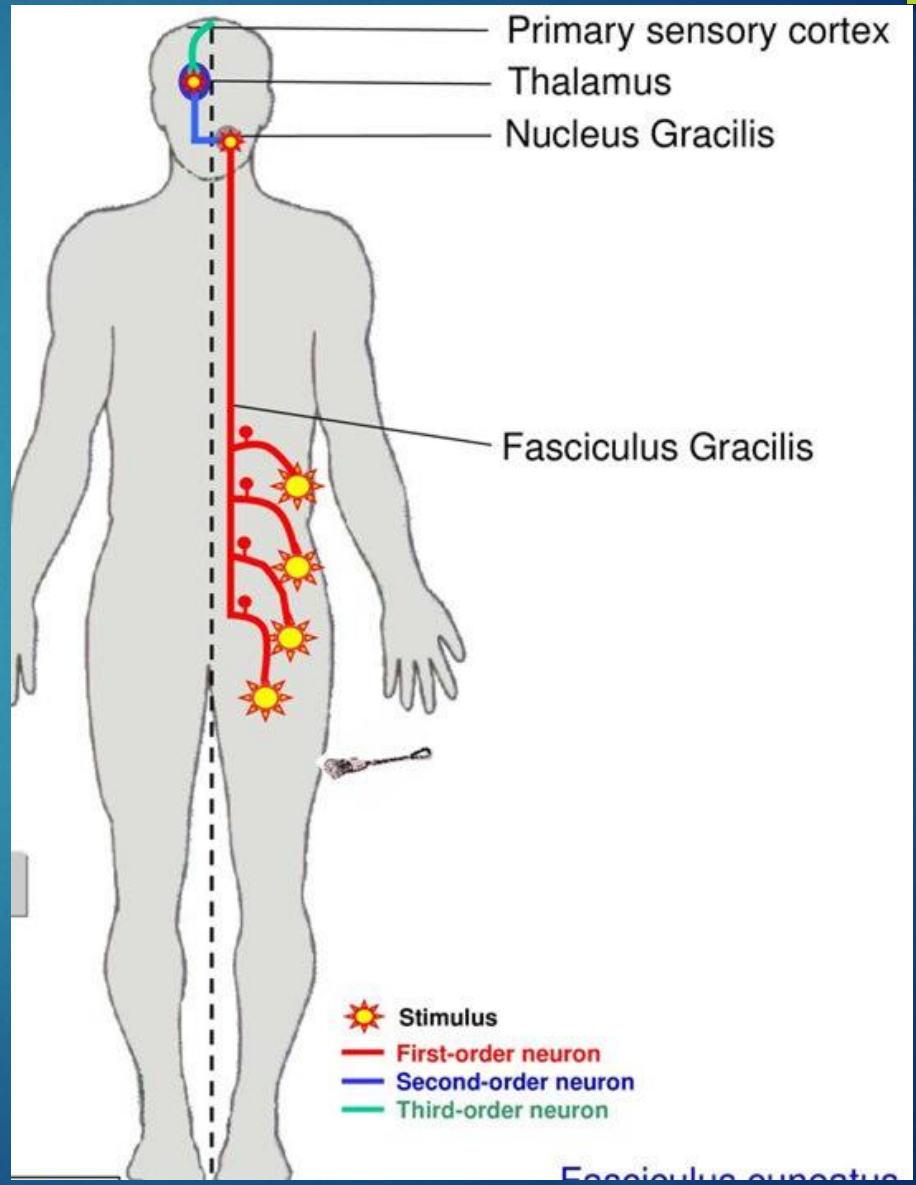


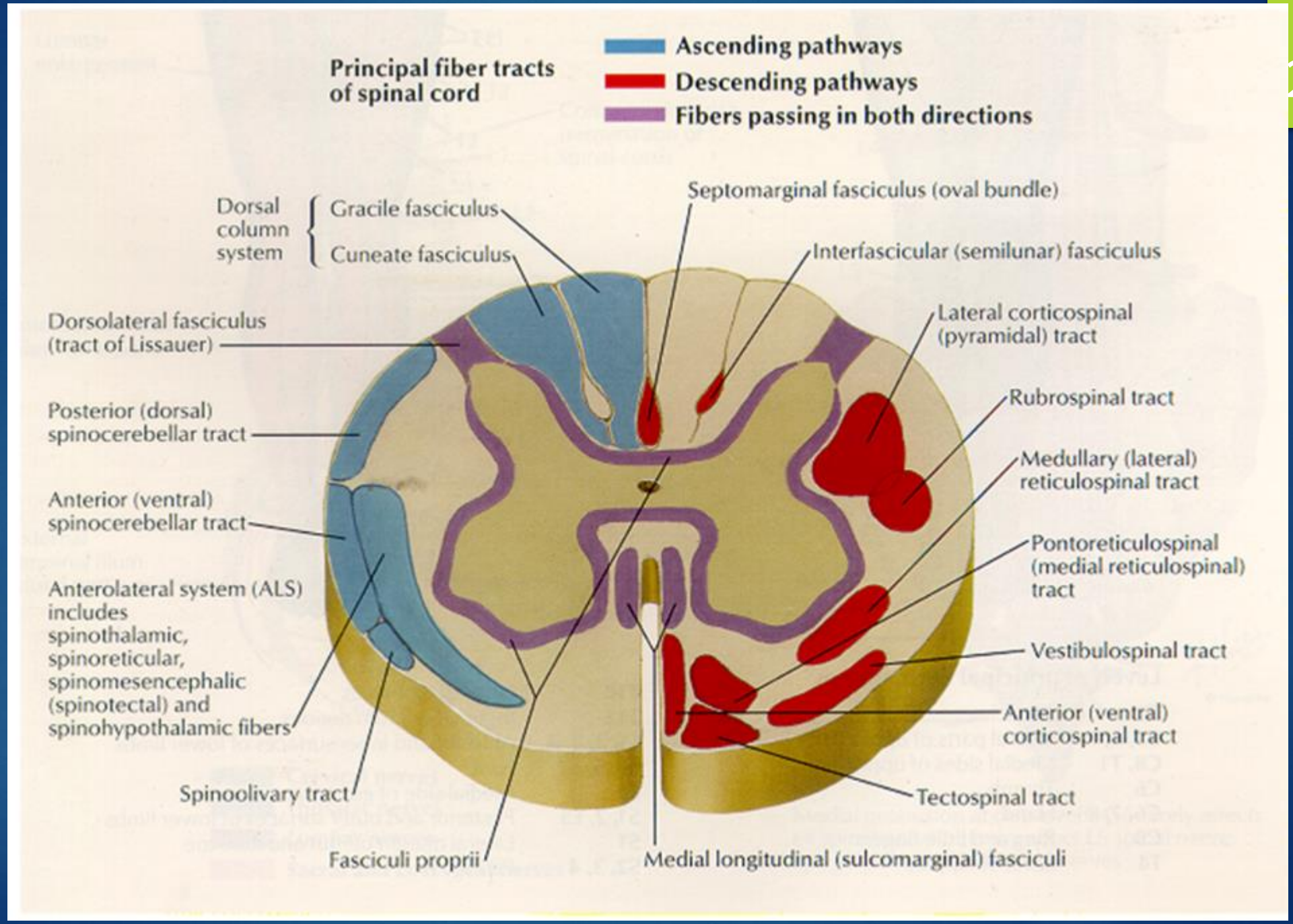
Figure 13.5a

Cuneate



Gracile




Principal fiber tracts of spinal cord
Ascending pathways
Descending pathways
Fibers passing in both directions
Dorsal column system
Gracile fasciculus
Cuneate fasciculus
Septomarginal fasciculus (oval bundle)
Interfascicular (semilunar) fasciculus
Dorsolateral fasciculus (tract of Lissauer)
Lateral corticospinal (pyramidal) tract
Posterior (dorsal) spinocerebellar tract
Rubrospinal tract
Medullary (lateral) reticulospinal tract
Anterior (ventral) spinocerebellar tract
Pontoreticulospinal (medial reticulospinal) tract
Anterolateral system (ALS) includes spinothalamic, spinoreticular, spinomesencephalic (spinotectal) and spinohypothalamic fibers
Vestibulospinal tract
Anterior (ventral) corticospinal tract
Spinoolivary tract
Tectospinal tract
Fasciculi proprii
Medial longitudinal (sulcomarginal) fasciculi

- **Ist Order Neuron:**

From Receptor Enter the spinal cord & divide into Lateral & Medial Branches.

- The medial Branch goes to the Medulla (Gracile or Cuneate Nucleus).

- The lateral branch divide & relay in the Ventral horn to serve as:. Local spinal Reflex action for formation of Spino-Cerebellar Tract

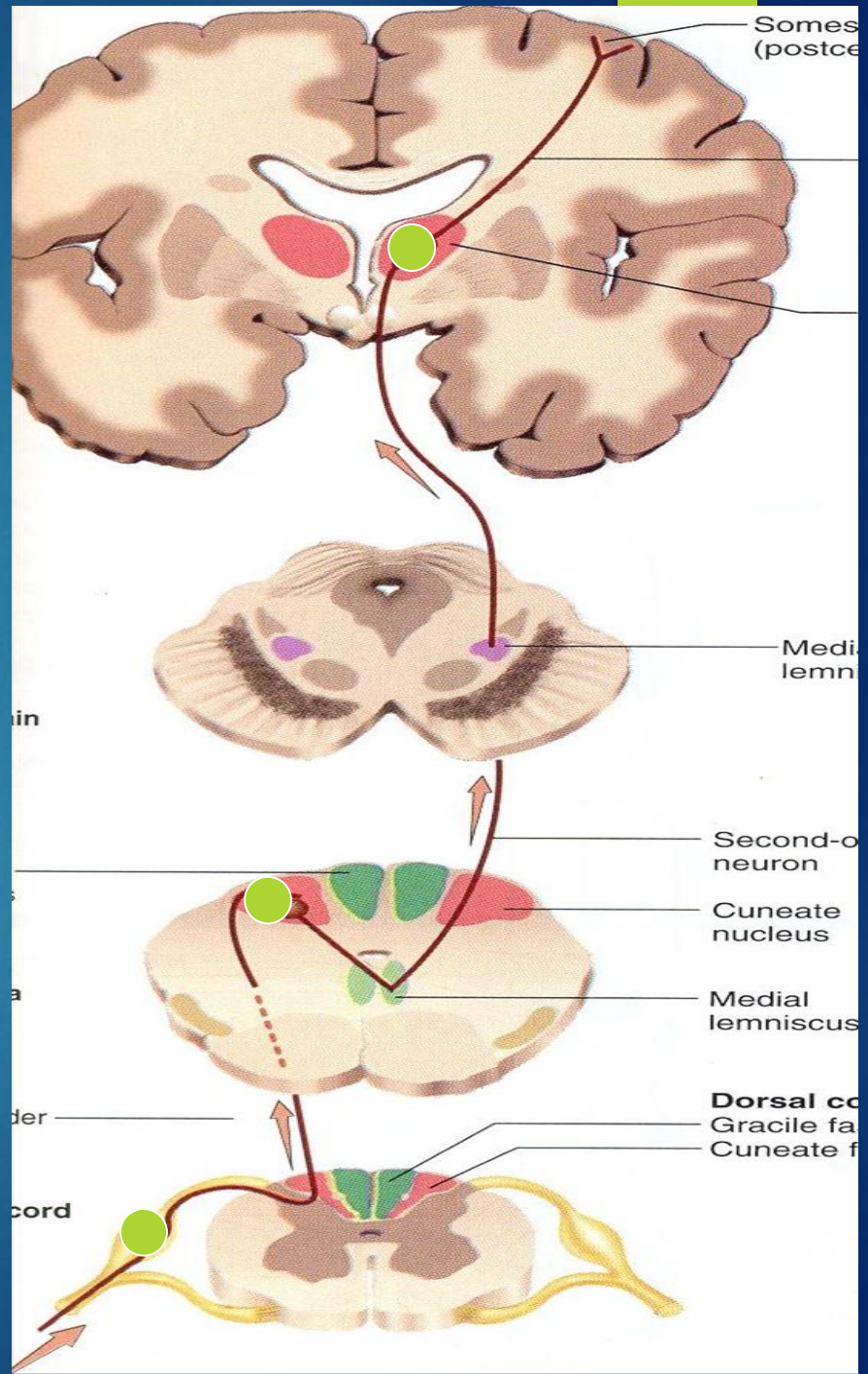
- **2nd. Order Neuron**:

From Gracile or Cuneate N in the Medulla to the VPL nucleus of the Thalamus (Ventrobasal Complex) After Crossing over to the Opposite side (Internal Arcuate fibers) - forming Medial Leminiscus

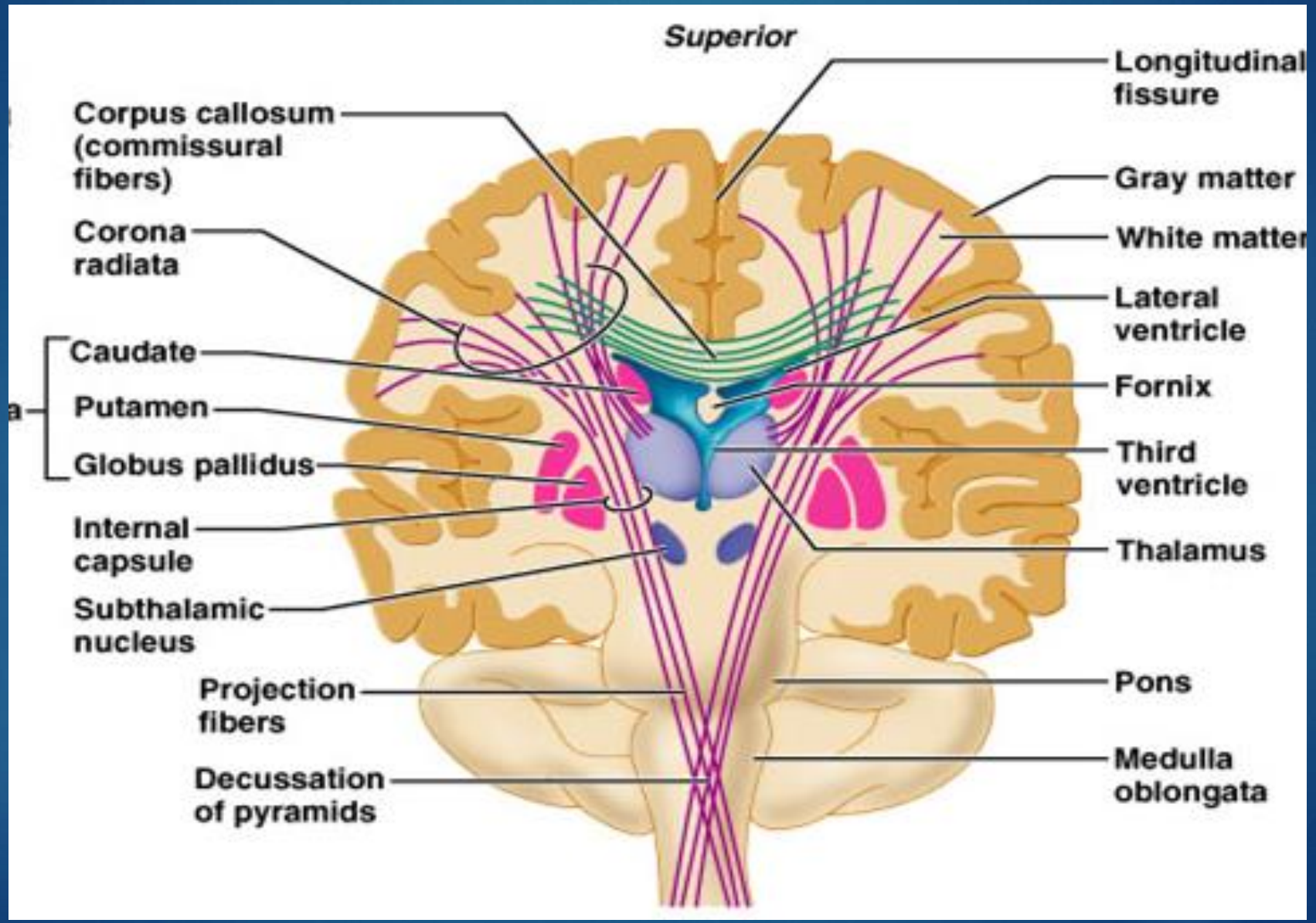
where fibers of 5th Cranial N also join (Carrying same sensations from the face as Dorsal column from the rest of the body.

- **3rd Order Neuron:**

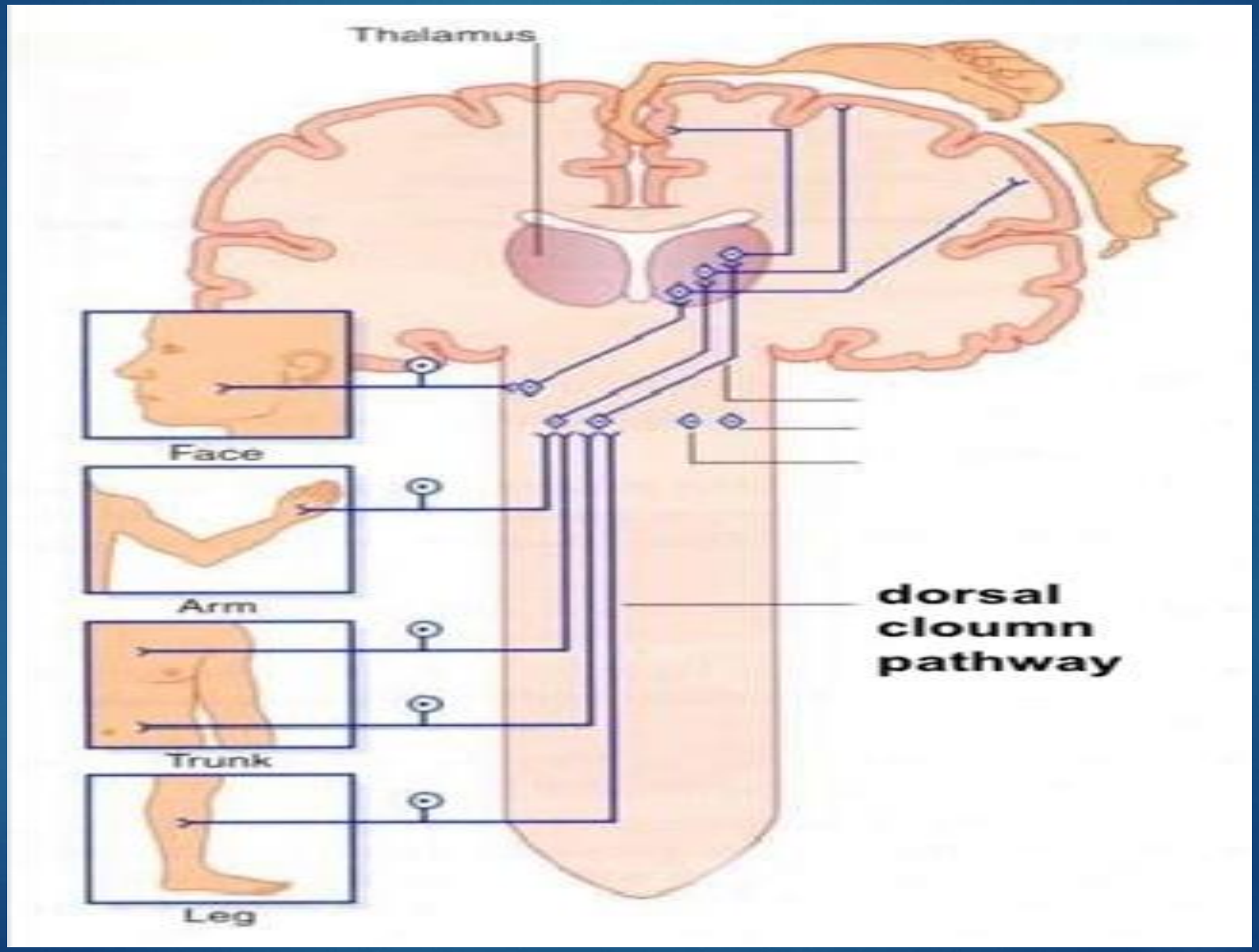
- From VPL (Ventro Postero-Lateral) nucleus of the thalamus Pass through Internal Capsule to the Primary Sensory Cortex (Somatosensory Area-I) - (Broadman)- (3,1,2)



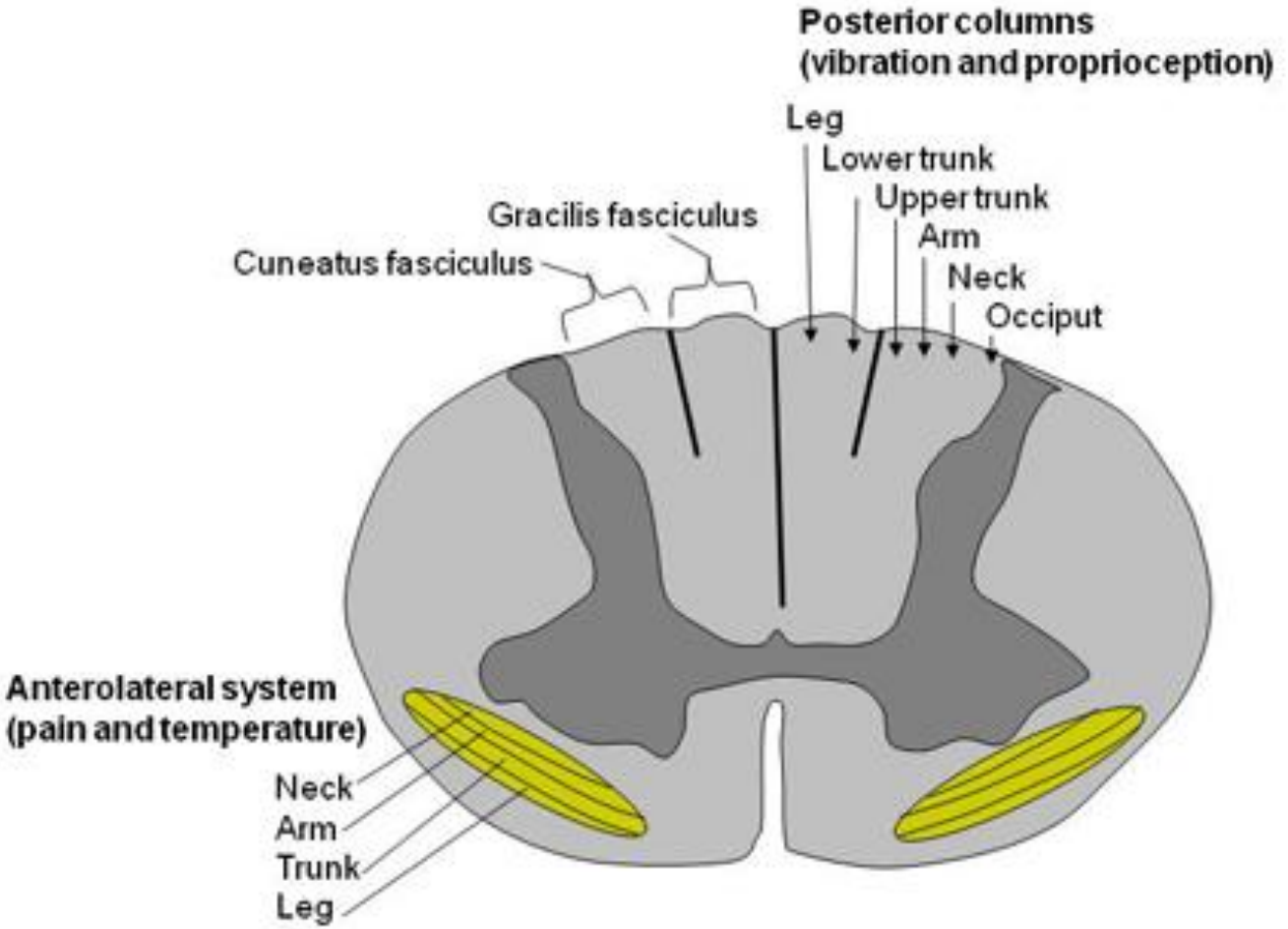
Coronal Section showing pathway of ascending fibers



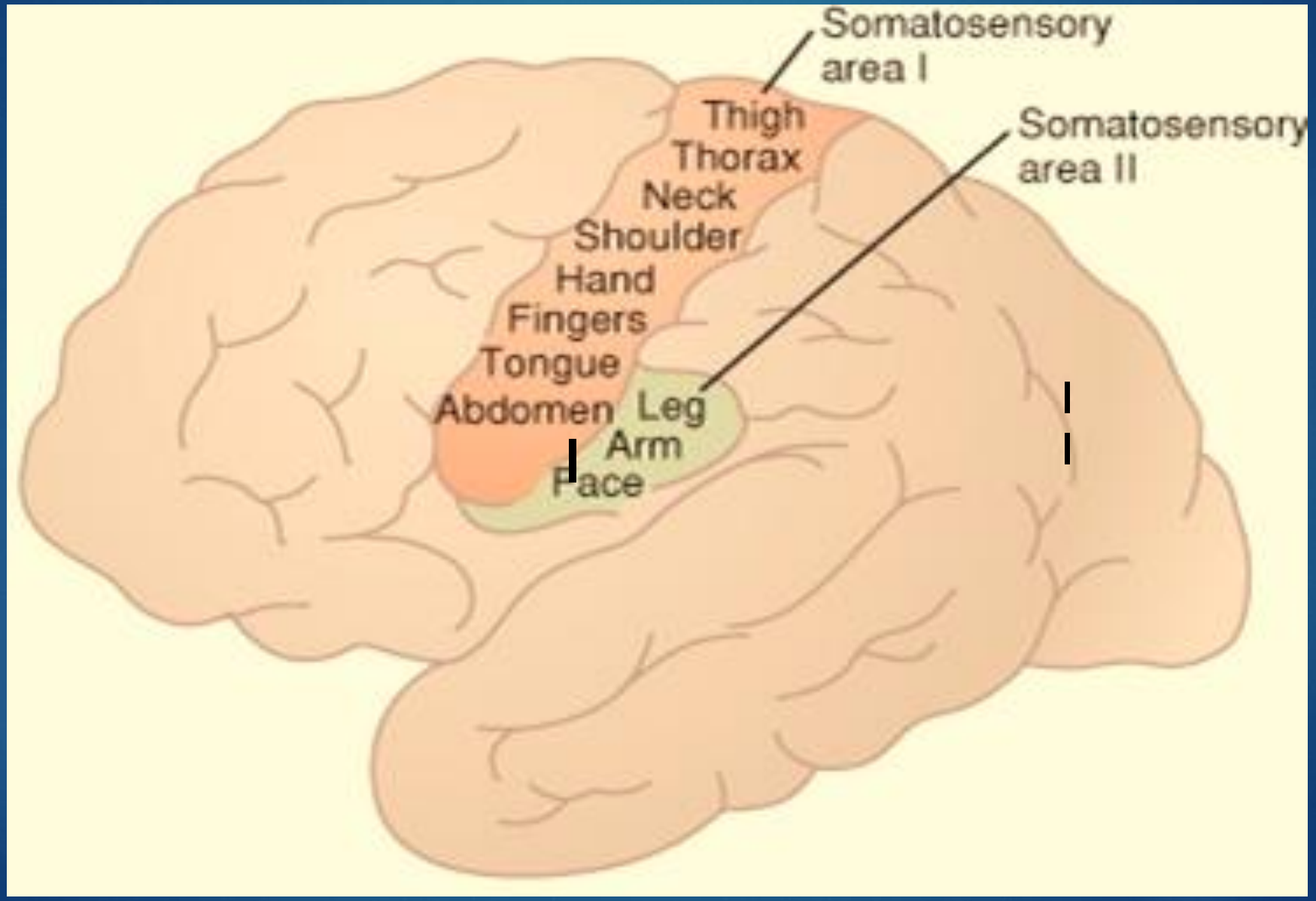
Somatotrophic arrangement



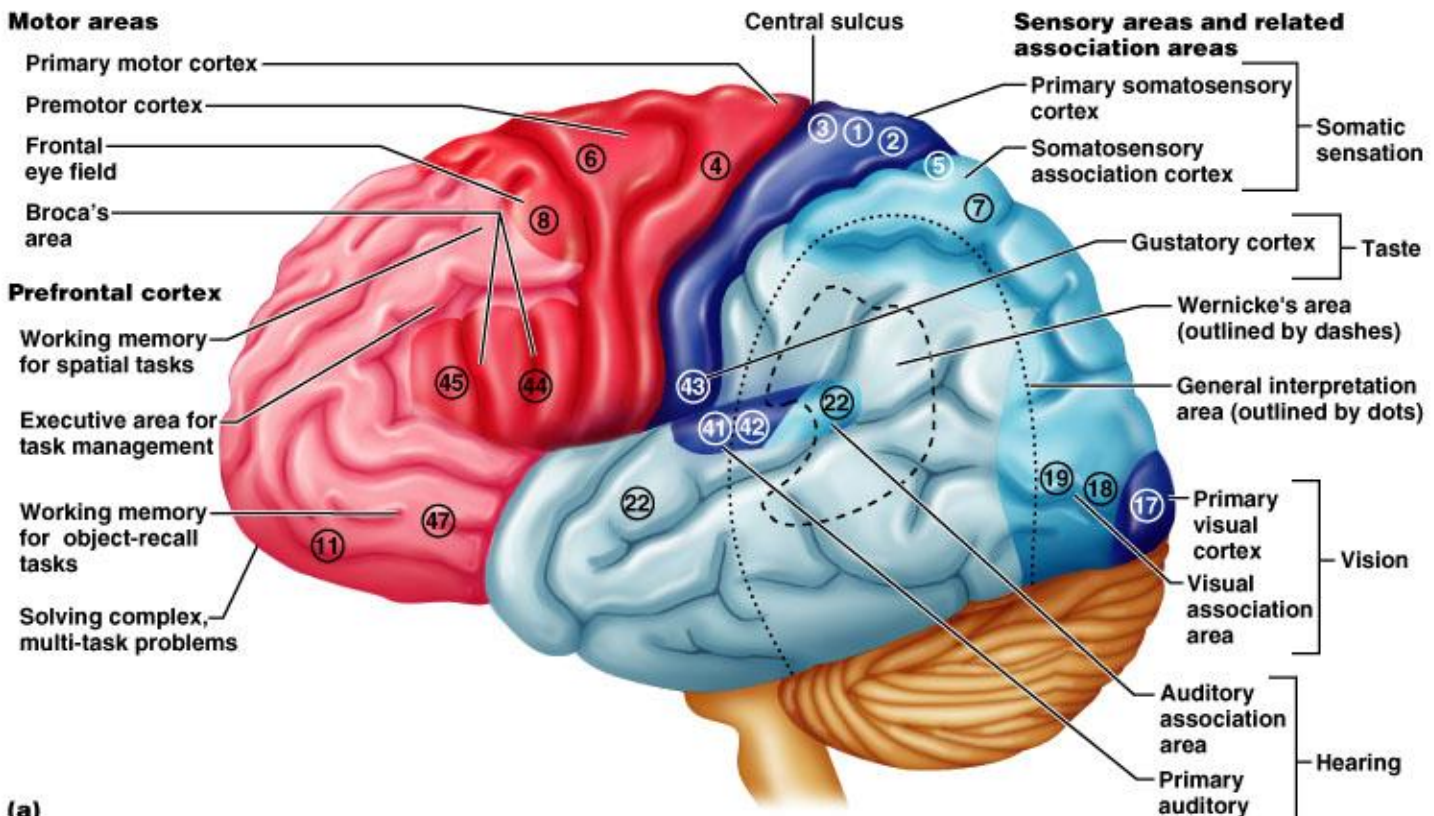
Somatotopic Organization



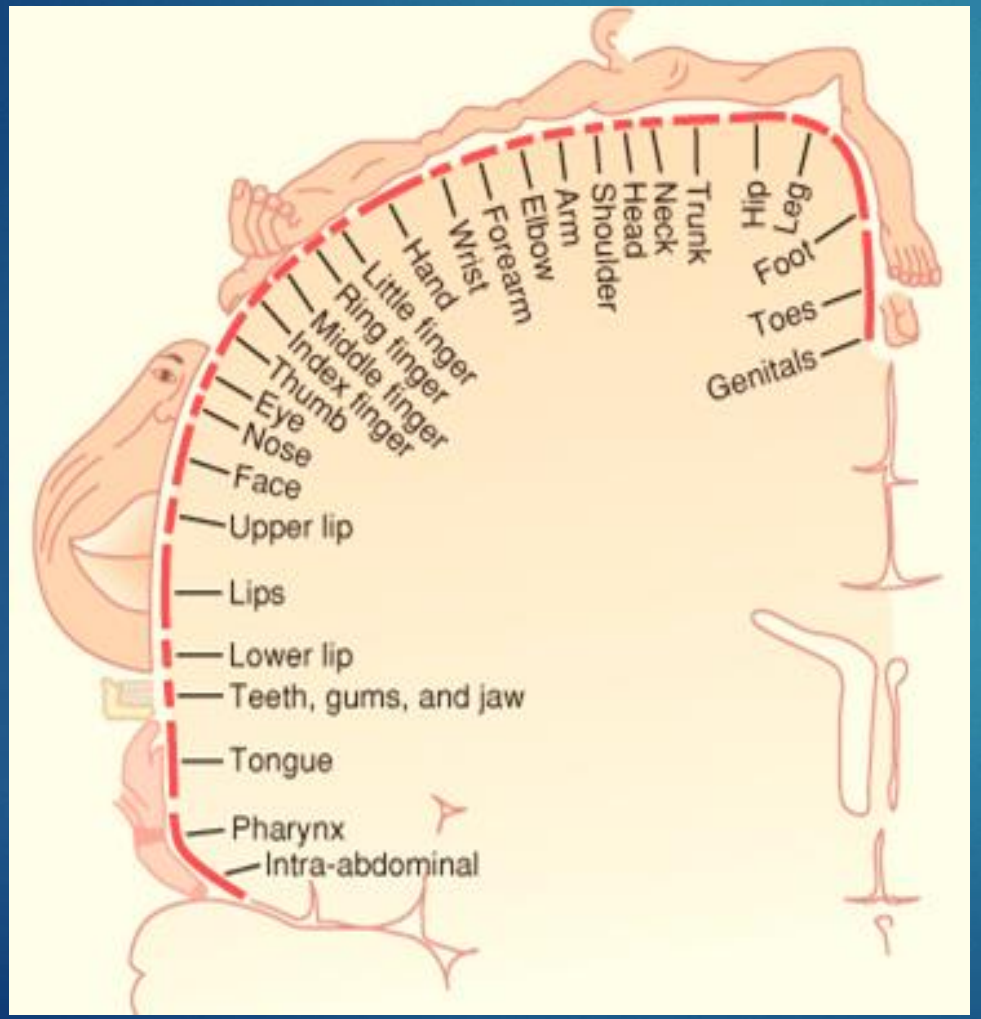
Somatosensory Cortex I & II



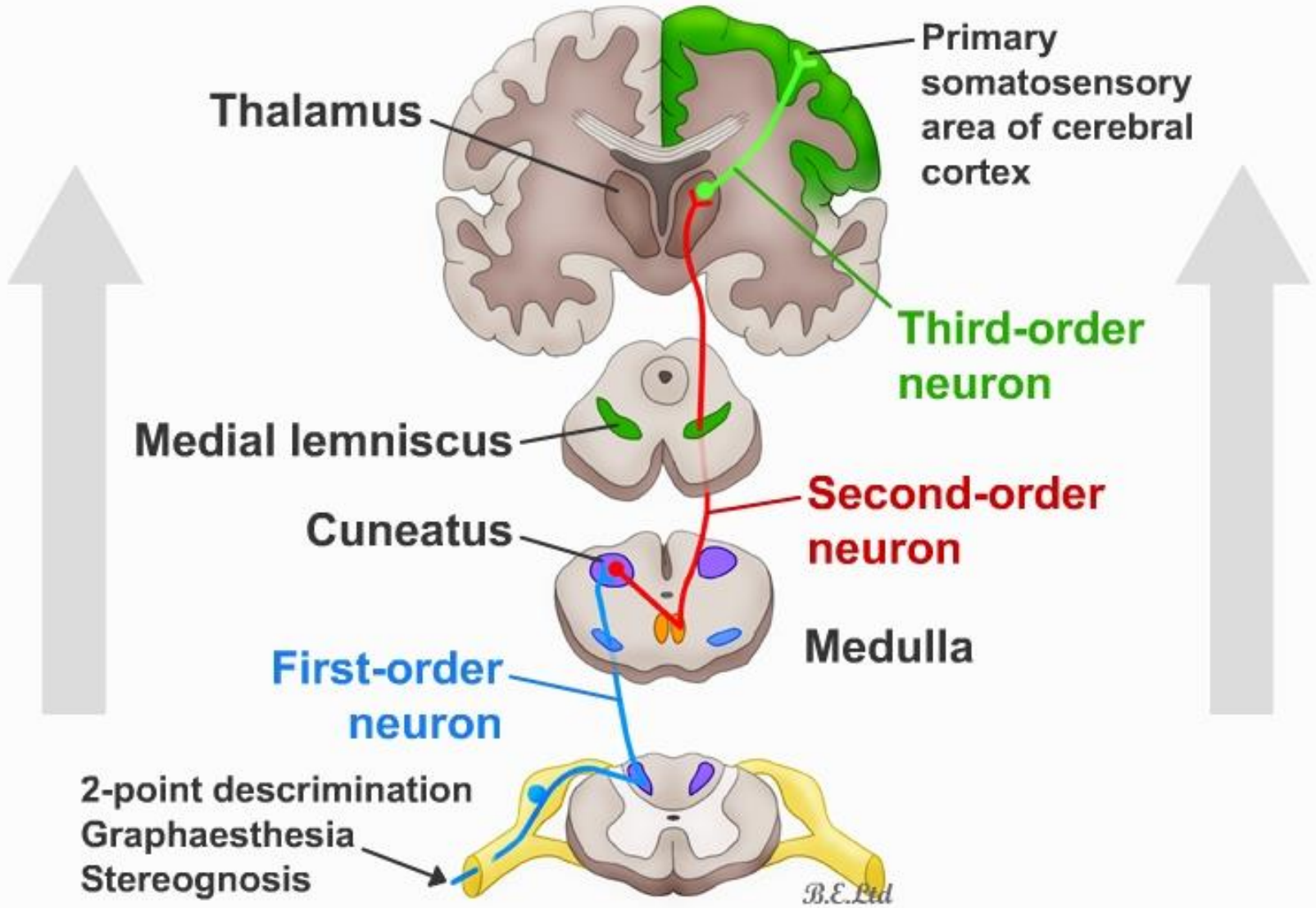
Brodmann's Areas



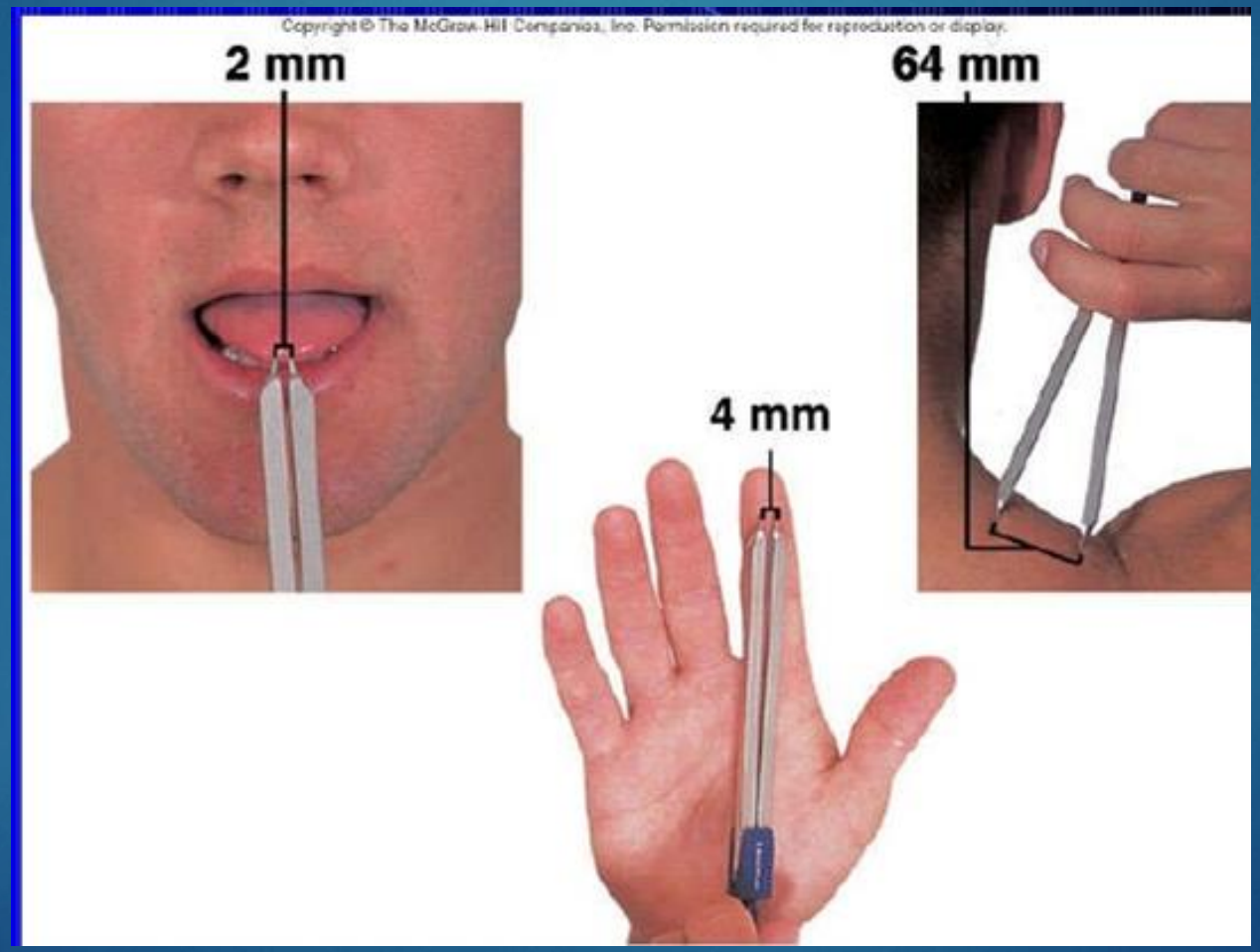
Representation of different areas of the Body in the Somatosensory Cortex-I



Posterior column-medial lemniscus pathway



Two point discrimination

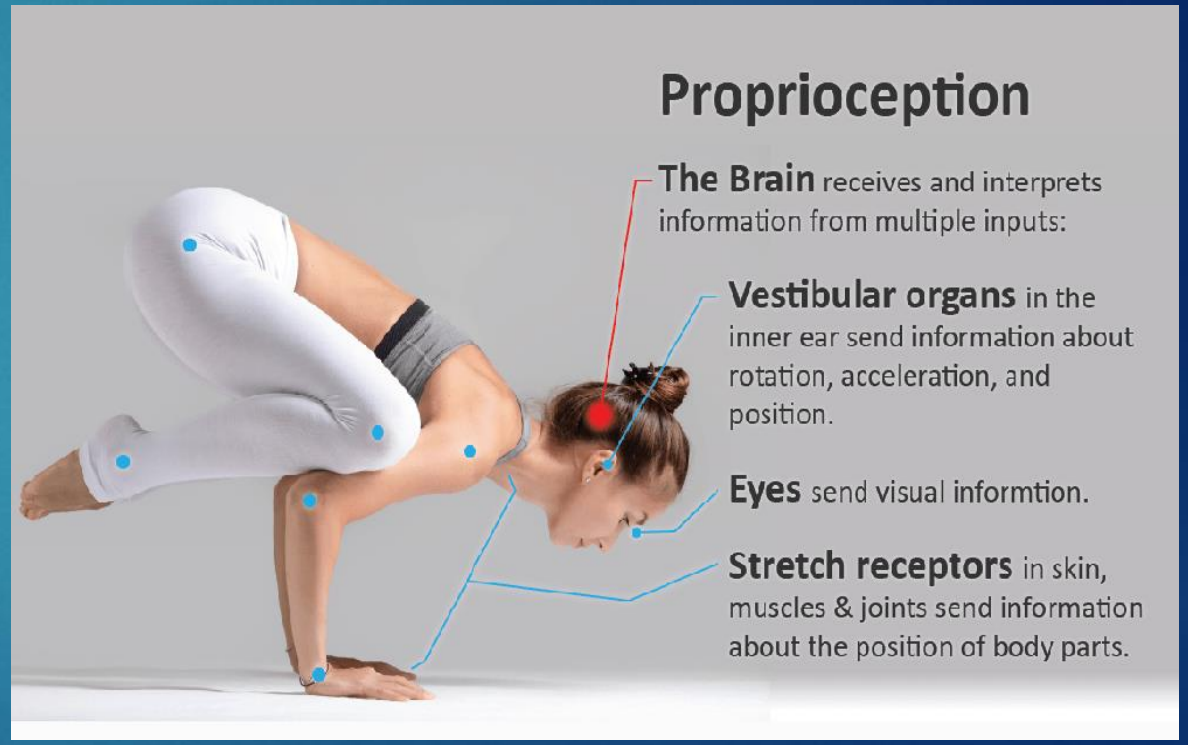


Stereognosis

The ability to perceive and recognize the form of an object in the absence of visual and auditory information, by using tactile information to provide cues from texture, size, spatial properties, and temperature

Proprioception

- perception or awareness of the position and movement of the body.
- Proprioception, also referred to as kinesthesia, is the sense of self-movement and body position.
- Proprioception is mediated by proprioceptors, mechano sensory neurons located within muscles, tendons, and joints.



Lesion of the Dorsal column

- Loss of fine tactile sensations
- Loss of tactile localization
- Loss of two-point discrimination
- Loss of sense of vibration
- Loss of propioception (inability to appreciate the position and movement of different parts of the body)
- Sensory Ataxia (uncoordinated, clumsy movements because of loss of propioception)

Case Scenario

Numbness & Tingling on left side of the body

- Lets fast forward to 6 years from now…. You are the attending doctor in the OPD….
- A young female patient comes to you with complaints of difficulty in walking, numbness and tingling on left side of body.
- On examination she has loss of vibration sense in lower limb and two point discrimination on right finger is 5 mm while it is 15mm on left side.
- Pain and temperature sensations are normal on both sides. Strength and tone of muscles is normal
- What is the condition and localize the leison?

Lesions of the Dorsal Column

Tables dorsalis

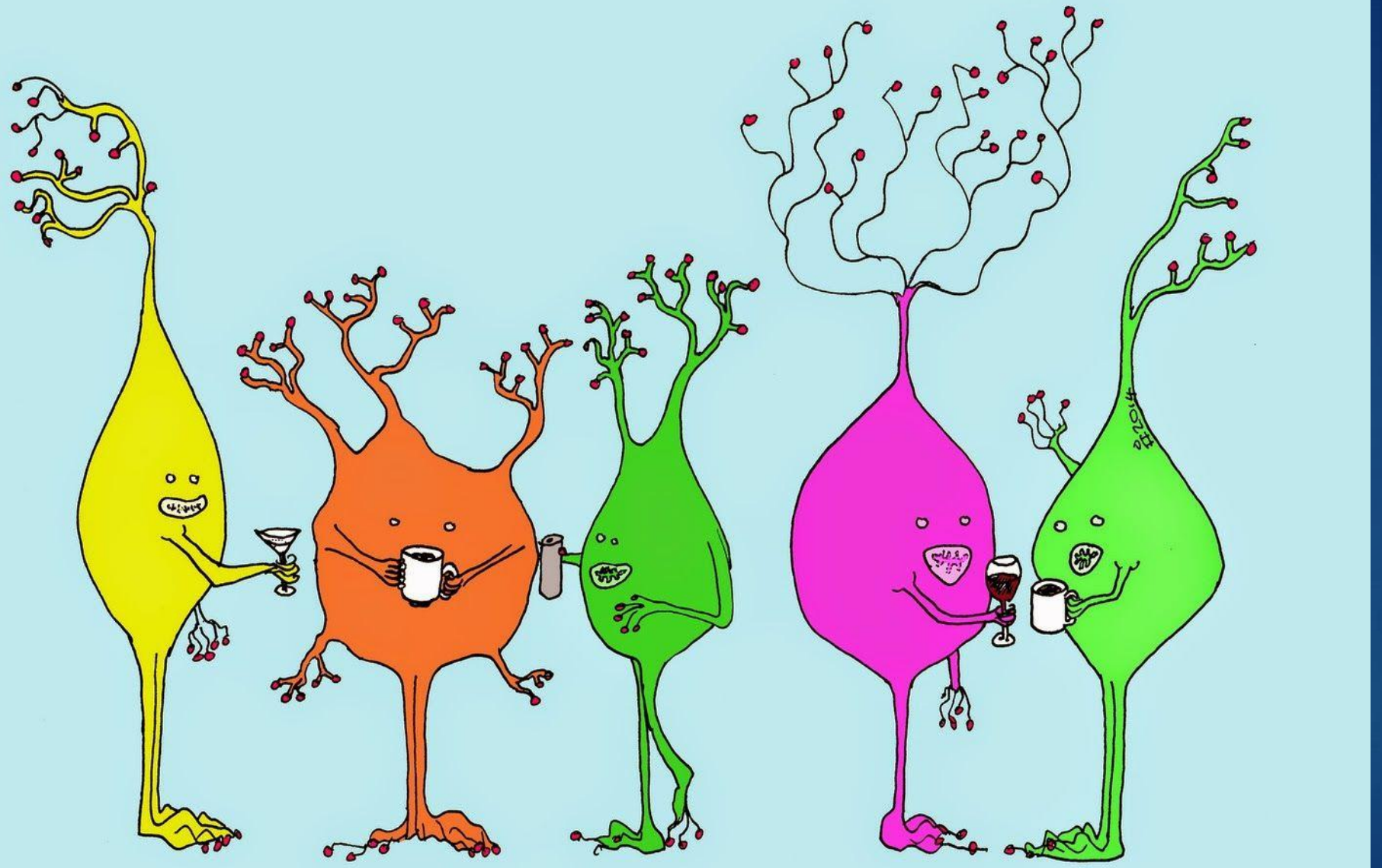
- Late manifestation of syphilitic CNS.
- Affects lumbosacral dorsal spinal roots and dorsal column of spinal cord.
- Loss of proprioception leads to unsteady gait (sensory ataxia) exacerbated with closing of eyes.

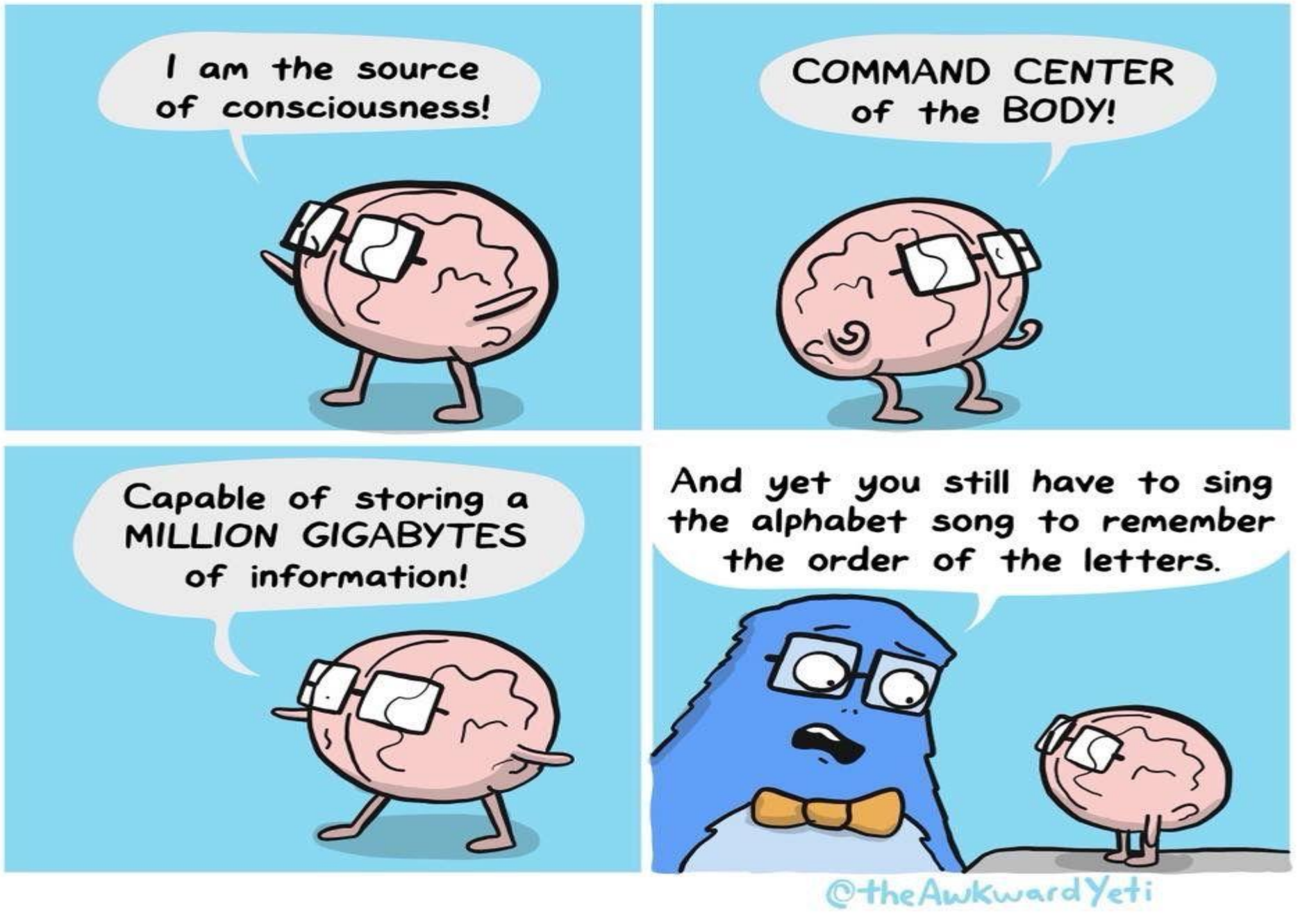
Subacute combined degeneration.

- Systemic disease due to vitamin B12 deficiency
- Degeneration of dorsal column causes sensory ataxia
- Combined with lateral column causes weakness and spasticity of limbs

Multiple sclerosis

- Immune disease affects fasciculus cuneatus of cervical region
- Leads to loss of proprioception in hands and fingers (asteriognosis)

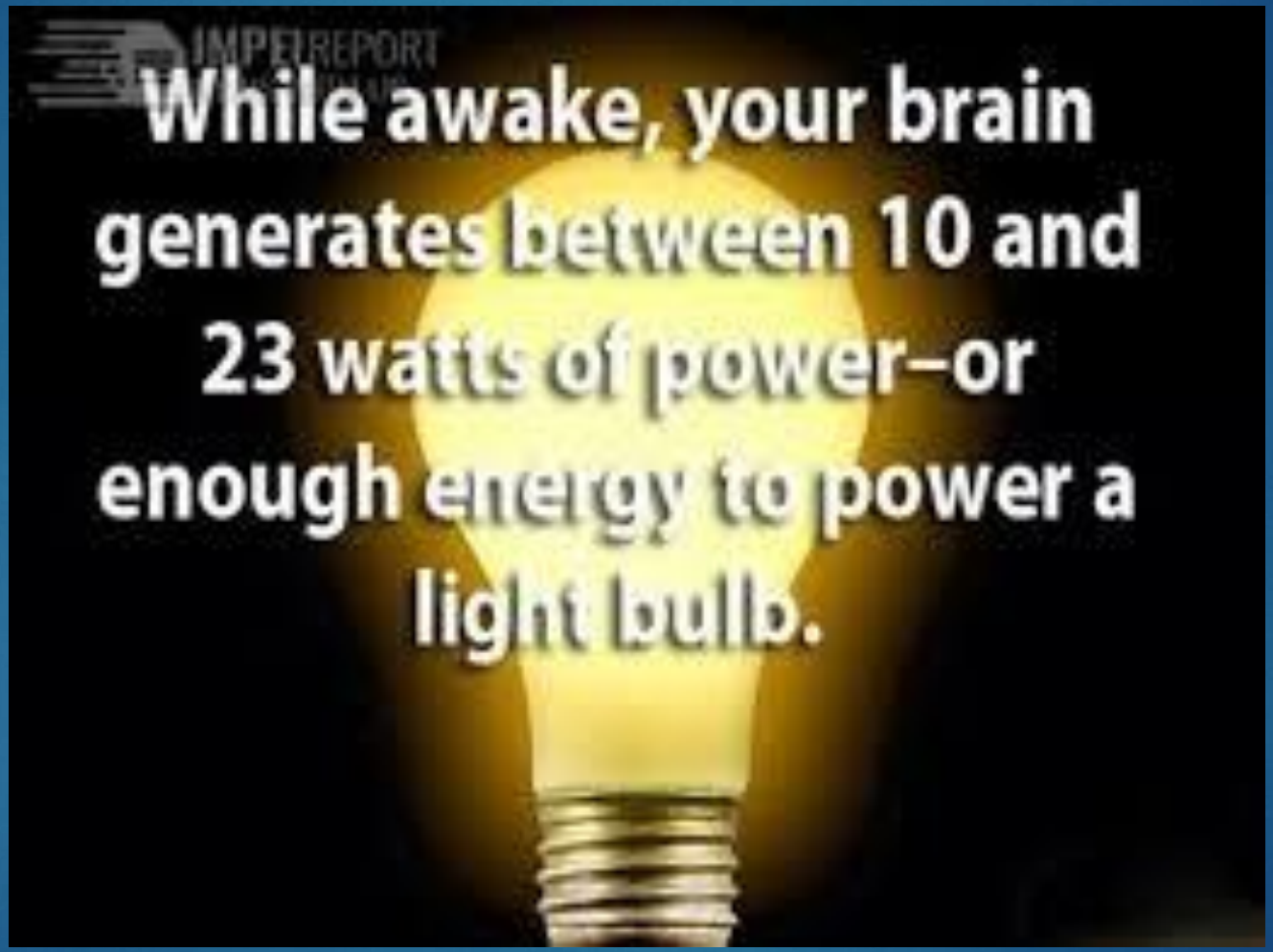

NEURAL NETWORKING

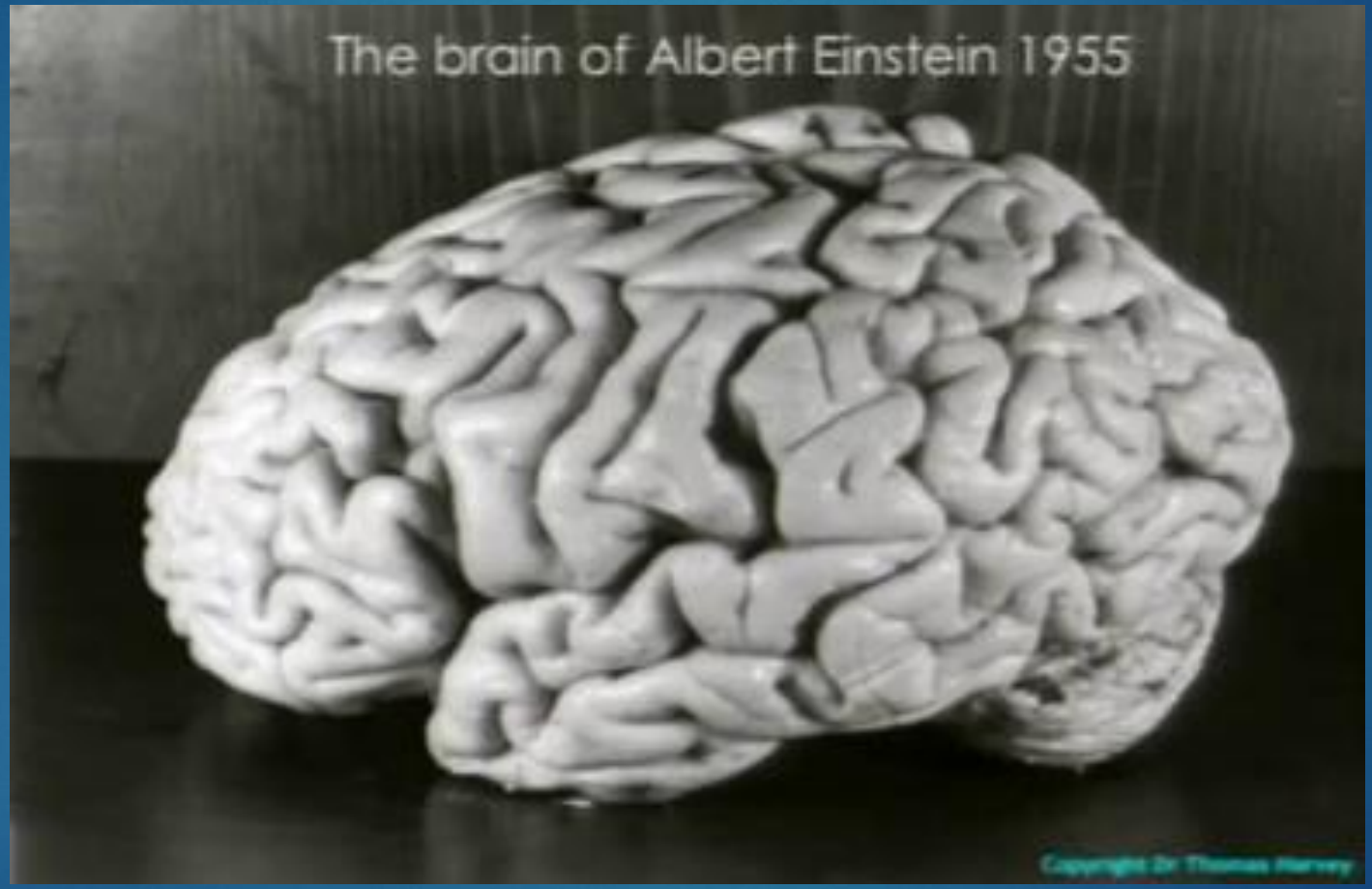

I am the source of consciousness!
COMMAND CENTER of the BODY!
Capable of storing a MILLION GIGABYTES of information!
And yet you still have to sing the alphabet song to remember the order of the letters.
©theAwkwardYeti


Fun Facts

Interesting facts…

- The human brain is the greatest wonder of creation.
- This little organ weighs only 1500 grams, but contains more nerve cells than there are people on the earth, more than 10,000 million a simply unimaginable number.
- Each nerve cell is joined to others by hundreds of little offshoots, and the exchange of information between them is brisker than the telephone exchange of a busy capital city.
- The number of connections« in one brain exceeds the number of stars in a galaxy. It would be more than 1,000,000,000,000!
- No computer or telephone exchange is in a position to store and exchange so much information in such a small space as that occupied by the human brain.


While awake, your brain
generates between 10 and
23 watts of power–or
enough energy to power a
light bulb.


The brain of Albert Einstein 1955

Recommended Books

- Principles of Human Physiology

  -Lauralee Sherwood
- Guyton & Hall
- Ganong's review of Medical Physiology


That's all Folks!