Physiology of Proprioception in Balance

Color index

- Important
- Further Explanation
- Note from Males' slides

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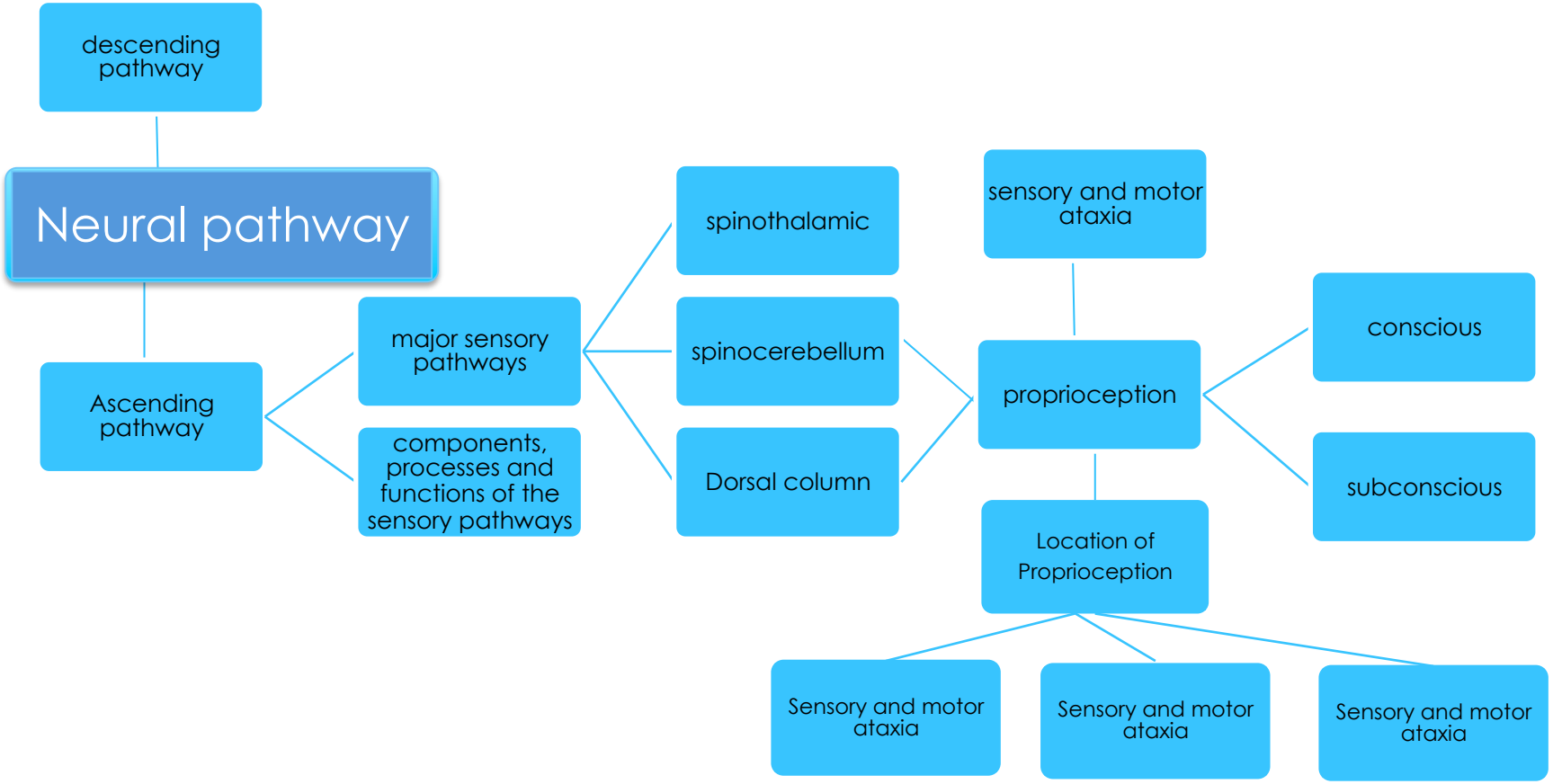
Recommended Videos!

Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work [Physiology Edit]


descending pathway
Neural pathway
Ascending pathway
major sensory pathways
components, processes and functions of the sensory pathways
spinothalamic
spinocerebellum
Dorsal column
sensory and motor ataxia
proprioception
Location of Proprioception
conscious
subconscious
Sensory and motor ataxia
Sensory and motor ataxia
Sensory and motor ataxia

Mind Map

Proprioception

Latin Proprius, meaning "one's own". "individual" and perception, is the sense of the relative position of neighboring parts of the body and strength of effort being employed in movement.

Exteroception: By which one perceives the outside world.

Interoception: By which one perceives pain, hunger…etc and the movement of internal organs. E.g.: peristalsis which is the typical movement of the esophagus, stomach, and intestine.

Mechanoreceptors: which detect mechanical compression or stretching of the receptor or of tissues adjacent to the receptor.

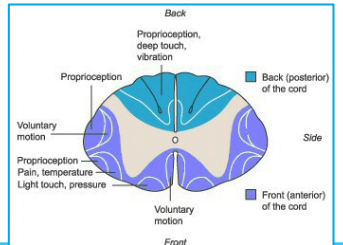
Types of Proprioception

Conscious
reach the level of **cerebral cortex** sensory area via dorsal column tract.

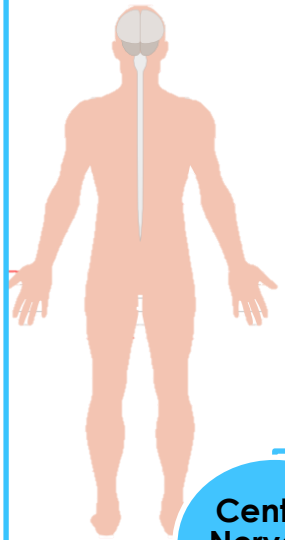
Subconscious
reach the level of **cerebellum** via spinocerebellar tracts

Spinal cord

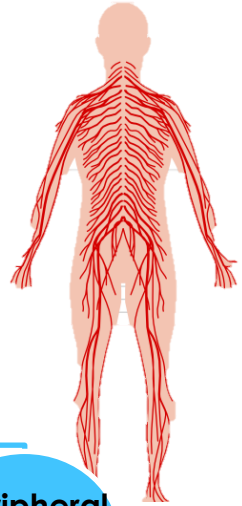
- A Cross-section view of spinal cord- wider laterally than antero-posteriorly. In the middle on the dorsal side is a shallow groove called the posterior median sulcus and on the ventral side is the anterior median fissure (deeper).
- Center consist of gray matter shaped like a butterfly and there is an opening at the center
- Spinal cord is protected by three layers of meninges. The only difference from the brain is that the dural matter does not attach to bone. The dural matter is surrounded externally by a layer of cushioning fat called epidural space.



AH.. WE KNOW ALL THAT ;)



Organization Of The Nervous System

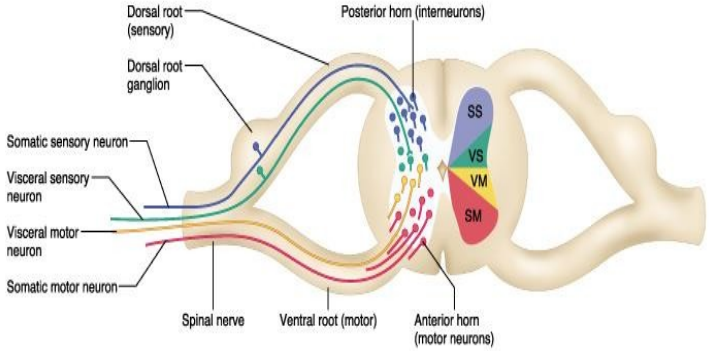


- **Central Nervous System**
  - **The brain**
  - **The spinal cord**
- **Peripheral Nervous System**
  - **31 spinal nerves carry info to and from the spinal cord**
  - **12 cranial nerves carry info to and from the brain**

All The Info Presented in This Slide Have Been Discussed Previously…

Gray Matte : Organization

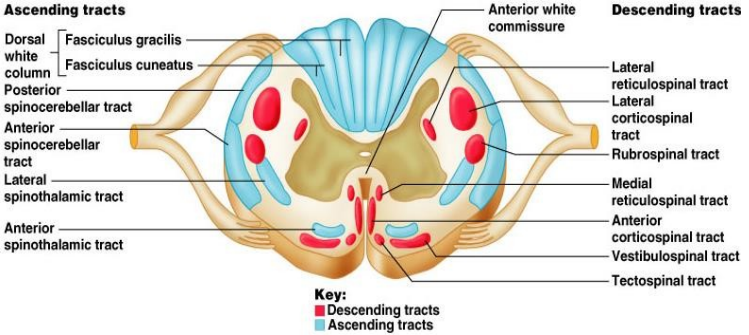
- Dorsal half – sensory roots and ganglia
- Ventral half – motor roots
- Dorsal and ventral roots fuse laterally to form spinal nerves
- Four zones are evident within the gray matter – somatic sensory (SS), visceral sensory (VS), visceral motor (VM), and somatic motor (SM)



White Matter in the Spinal Cord

AH.. WE KNOW ALL THAT ;) TOO!

- Fibers run in three directions – ascending, descending,and transversely
- Divided into three funiculi (columns) – posterior, lateral,and anterior
- Each funiculus contains several fiber tracks
  - Fiber tract names reveal their origin and destination
  - Fiber tracts are composed of axons with similar functions



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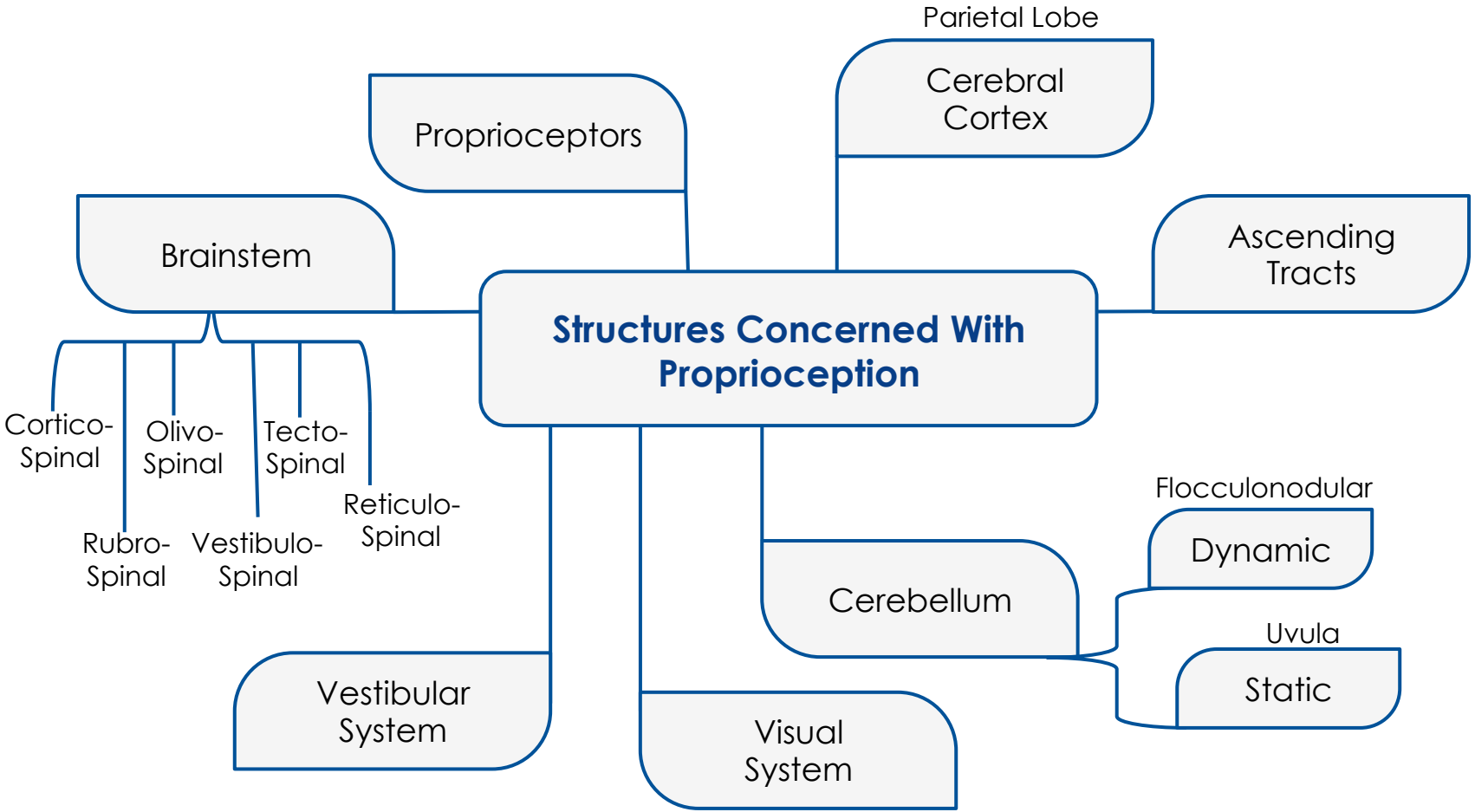

Parietal Lobe
Cerebral Cortex
Proprioceptors
Brainstem
Ascending Tracts
Structures Concerned With Proprioception
Cortico-Spinal
Olivo-Spinal
Tecto-Spinal
Reticulo-Spinal
Rubro-Spinal
Vestibulo-Spinal
Flocculonodular
Dynamic
Cerebellum
Uvula
Static
Vestibular System
Visual System

Peripheral Sensory Receptors

Sensory receptors classified according to:

1. Location 2. Type of stimulus detected 3. Structure

Encapsulated Nerve Endings

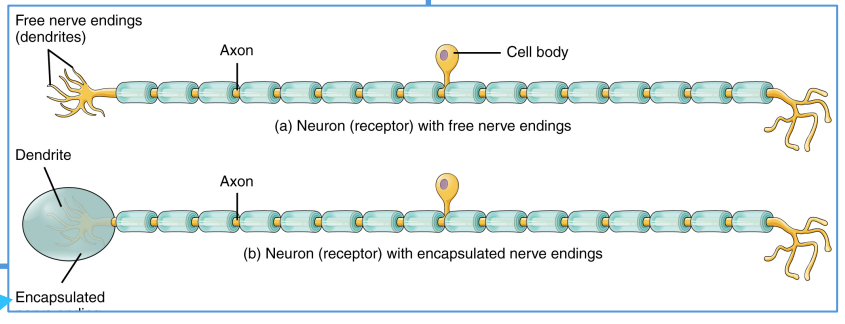
- ✧Consist of one or more end fibers of sensory neurons
- ✧Enclosed in connective tissue
- ✧Include four main types:

✓ Meissner's corpuscles

✓ Pacinian corpuscles

✓ Ruffini's corpuscles

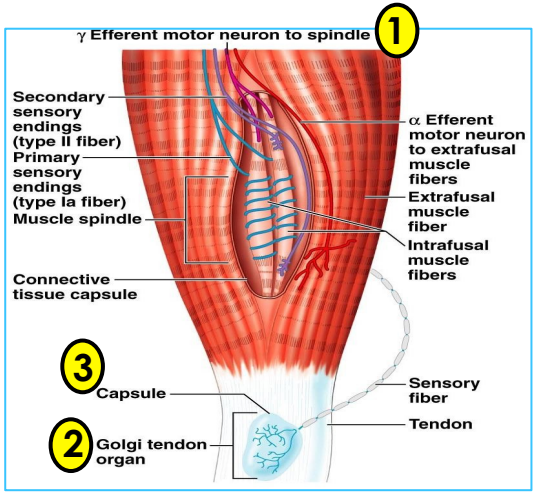
✓ **Proprioceptor**



Proprioceptors

- Encapsulated Nerve Endings
- Monitor stretch in locomotory organs
- Three types of proprioceptors:

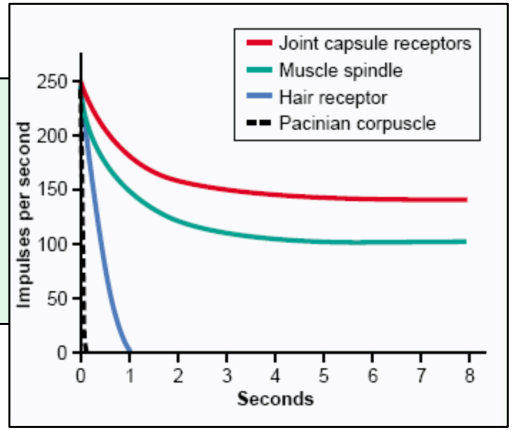
1. **Muscle spindles** – measure the changing length of a muscle (Imbedded in the perimysium between muscle fascicles)
2. **Golgi tendon organs** – located near the muscle-tendon junctionMonitor tension within tendons
3. **Joint kinesthetic receptors** Sensory nerve endings within the joint capsules



1) Static position sense: which means conscious perception of the orientation of the different parts of the body with respect to one another
2) Rate of movement sense: also called kinesthesia or dynamic proprioception

Adaptation of Receptors

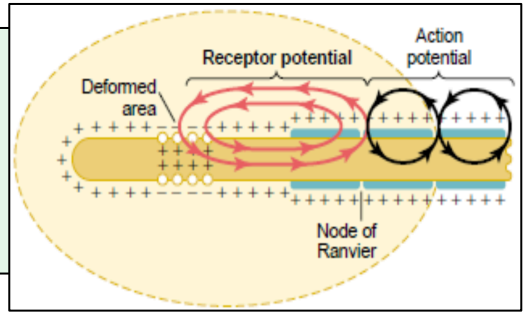
When a continuous sensory stimulus is applied, the receptor responds at a **high impulse rate at first** and then at a **progressively slower rate until finally the rate of action potentials decreases** to very few or often to none at all.



Receptor Potential of the Pacinian Corpuscle

For joint position and vibration sensation (Also Ruffini's Endings)

- The receptor potential produced by compression induces a local circuit of current flow that spreads along nerve fiber.
- The frequency of repetitive action potentials transmitted from sensory receptors increases approximately in proportion to the increase in receptor potential



Neural Pathways

Afferent pathways

- Sensory information coming from the sensory receptors through peripheral nerves to the spinal cord and the brain

Efferent pathways

- Motor commands coming from the brain and spinal cord, through peripheral nerves to effecter organs

Sensory Pathways

- Sensory systems allow us to detect, analyze respond to our environment
- "ascending pathways"
- Carry information from sensory receptors to the brain
- **Conscious**: reach cerebral cortex
- **Unconscious:** do not reach cerebral cortex
- Sensations from body reach the opposite side of the brain

Spinal Cord Tracts

These are known as sensory and motor pathways consisting of multi-neuron pathways connecting the CNS to the PNS.
At some point most pathways crossover (decussate)

Sensory pathways has 3 neurons:
1.Enters spinal cord from periphery
2.Crosses over ascends in spinal cord to thalamus
3.Projects to somatosensory cortex

Ascending (Sensory) Pathways		
1.Dorsal column pathway	**2.Posterior and anterior spinocerebellar pathways**	**3.Spinothalamic pathway**
carries signal of fine touch, pressure, vibration , stereognosis and concious proprioception	Carry subsconcious proprioception.	carries signals of pain, temperature, deep pressure, and course touch
ascends up dorsal white column in fasciculus gracilis or cutaneatus to medulla oblongata to the thalamus to primary somatosensory cortex (post central gyrus).	Dorsal gray horn- to lateral column- to medulla oblongata- to pons – to cerebellum.	From psterior gray horn decussate into lateral and anterior funiculi up to the thalamus to primary somatosensory cortex (postcentral gyrus).

Pathway	Carries	1st neuron	2st neuron	3st neuron	Damage
Dorsal column pathway	•Fine touch •2 point discrimination •Pressure •Vibration •Stereognosis[1] **•Conscious proprioception signals**	Enters spinal cord through dorsal root ascends to **Medulla (brain stem)**	Neuron crosses over in medulla ascends to **thalamus**	Neuron projects to **somatosensory cortex**	**Sensory ataxia** -Patient staggers cannot perceive position or movement of legs -Visual clues help movement
Spino-cerebellar pathway	**•Unconscious proprioception** **•Signals receptors in muscles & joints**	Enters **spinal cord** through **dorsal root**	Ascends to **cerebellum**	Neuron to **cortex,** hence unconscious	**Cerebellar ataxia** -Clumsy movements -Incoordination of limbs. -wide-based, reeling gait (ataxia) -Alcoholic intoxication produces similar effects

1: the mental perception of depth or three-dimensionality by the senses.

Ataxia & Gait Disturbances

Result from any condition that affects the central and peripheral nervous systems

Motor Ataxia

- Caused by cerebellar disorders
- Intact sensory receptors and afferent pathways
- Integration of proprioception is faulty
- Midline cerebellar lesions cause truncal ataxia
- Lateral cerebellar lesions cause limb ataxia
- Thalamic infarcts may cause contra lateral ataxia with sensory loss
- N.B cerebellar ataxia will discussed later with cerebellum

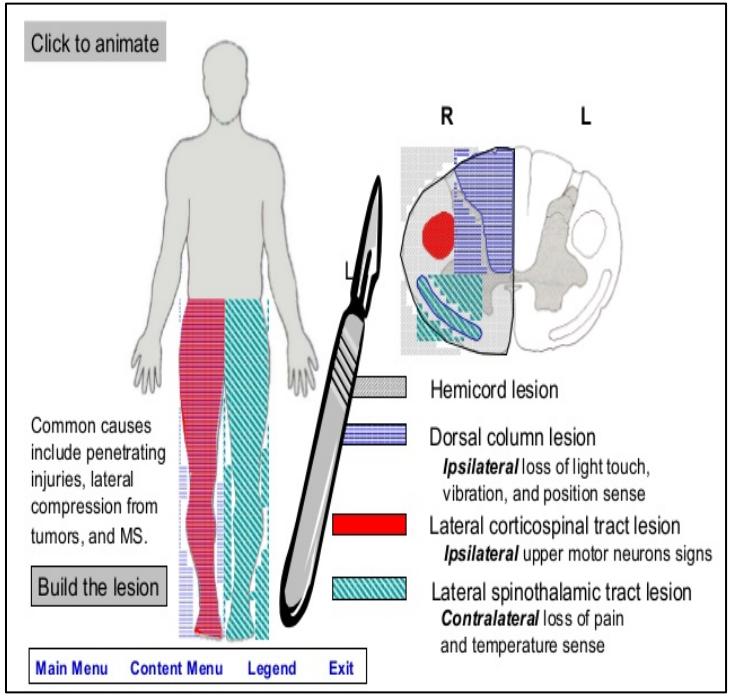
Sensory Ataxia

- Failure of proprioceptive information to the CNS
- May be due to disorders of spinal cord or peripheral nerves
- Can be compensated for by visual inputs

Brown Sequard Syndrome

Hemisection Of Spinal Cord

Contralateral Loss	
Loss of pain and temp	Lateral Spinothalamic
Loss of crude touch and Pressure	Ventral Spinothalamic
Minor Contralat Muscle Weakness	Ventral Corticospinal
Leg Ataxia	Ventral Spinocerebellar
Ipsilateral Loss	
Fine touch, Vibration, Proprioception	Dorsal Column
Leg Ataxia	Dorsal Spinocerebellar
Spastic Paresis below lesion	Lateral Corticospinal
Flaccid Paralysis	Ventral horn destruction



1- where dose the Golgi tendon organs is located?
A. Near the muscle-tendon junction
B. Golgi apparatus
C. Bones
D. The large muscles of the body

2-the unconscious sensory pathway is reaches the?
A. Spinal cord
B. Brainstem
C. Cerebellum
D. Cerebral cortex

3-how the Sensations from body reach reach the brain?
A. Opposite side
B. Same side
C. Both
D. Same

4-the spinocerebellar pathway has how many neurons?
A. 1
B. 2
C. 3
D. 4

5- Alcoholic intoxication produces similar to?
A. Spinocerebellar tract damage
B. Dorsal column damage
C. Vestibulocerebellar tract damage
D. None

6- signals that carry by the spinocerebellar tract is?
A. Fine touch
B. Unconscious proprioception
C. Subconscious proprioception
D. Course touch

7-sensory ataxia is happened due to damage of …… tract?
A. Pontocerebellum
B. Spinocerebellum
C. Vestibulocerebellum
D. Dorsal column

8-which one of these is not a proprioception pathway?
A. Anterior spinocerebellum
B. Posterior spinocerebellum
C. Spinothalamus
D. Dorsal column

1.A
2.C
3.A
4.B
5.A
6.B
7.C

MCQs

1-Give me an example of proprioception?
When we close our eyes we can walk and this is important for blind people

2-What are the three types of Proprioceptors ?
Muscle spindles
Golgi tendon organs
Joint kinesthetic receptors

3-What are the Neural pathways?
Afferent and Efferent

4-What is the different between conscious and unconscious pathway?
Conscious: reach cerebral cortex
Unconscious: do not reach cerebral cortex

5-Mention three of signals that carry by the dorsal column pathway?
Fine touch, pressure, vibration , stereognosis and conscious proprioception

6-What is the different between sensory ataxia and motor ataxia ? (2 differences)
sensory ataxia is due to disorder in spinal cord or peripheral nerves but motor ataxia is due to cerebellar lesion
sensory ataxia can be compensated by the visual input white the motor ataxia is not

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

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