# Somatic Sensations

# Objectives

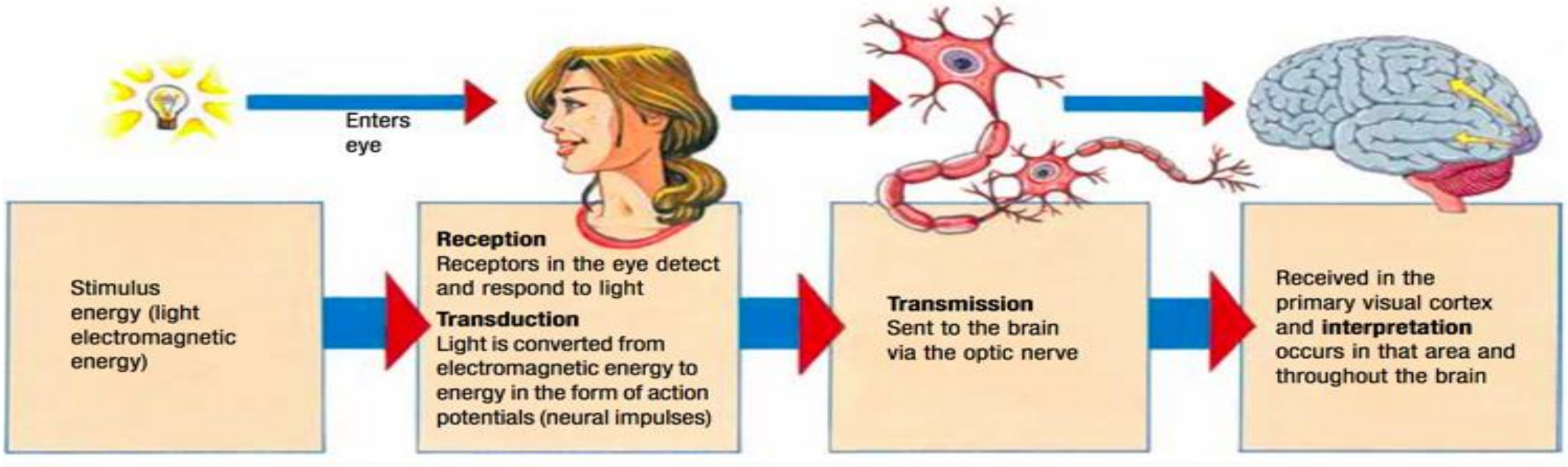
**Definition of sensation**

**Classification of sensations**

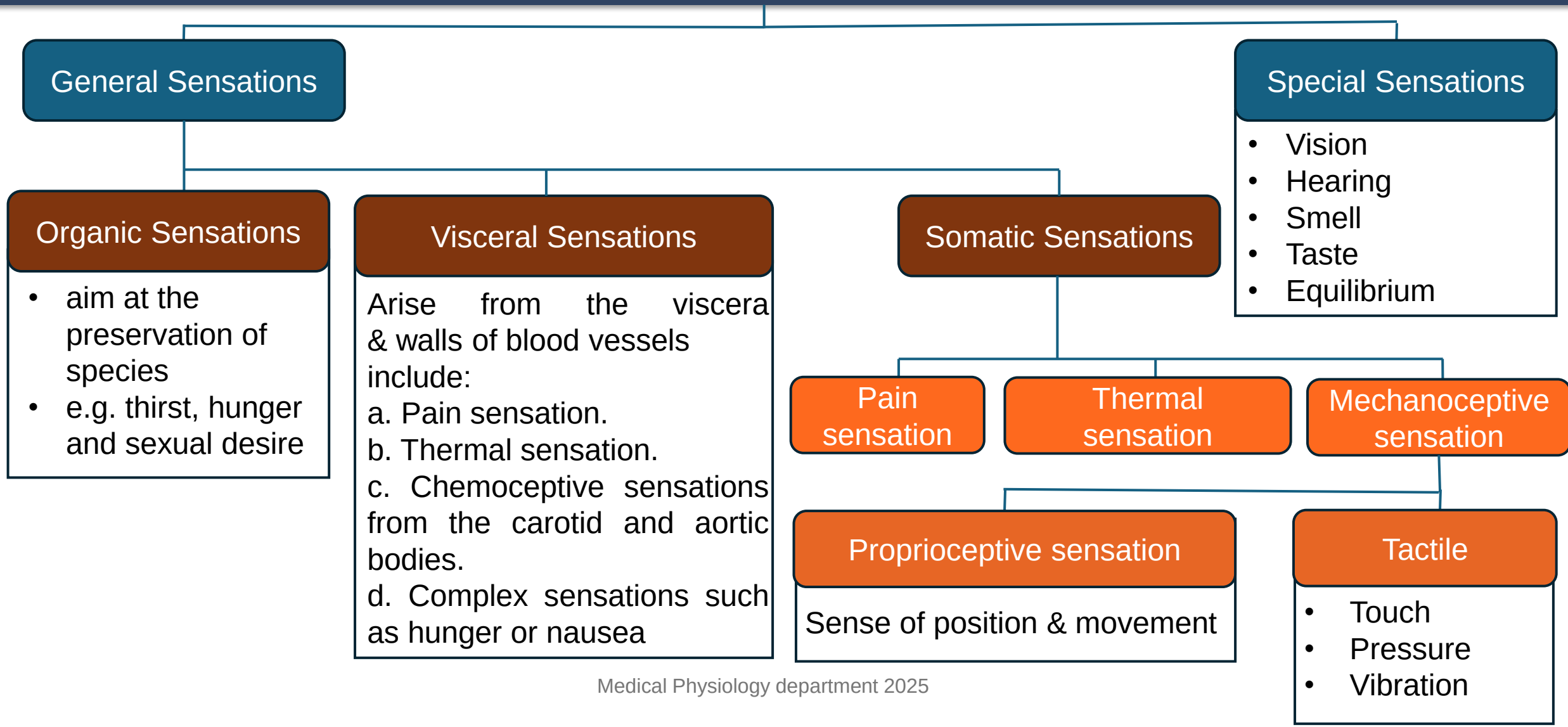
**Examination of somatic sensations**

# Definition of sensation

**The conscious perception of a particular feeling caused by stimulation of certain receptors by its adequate stimulus.**



# Classification of sensations



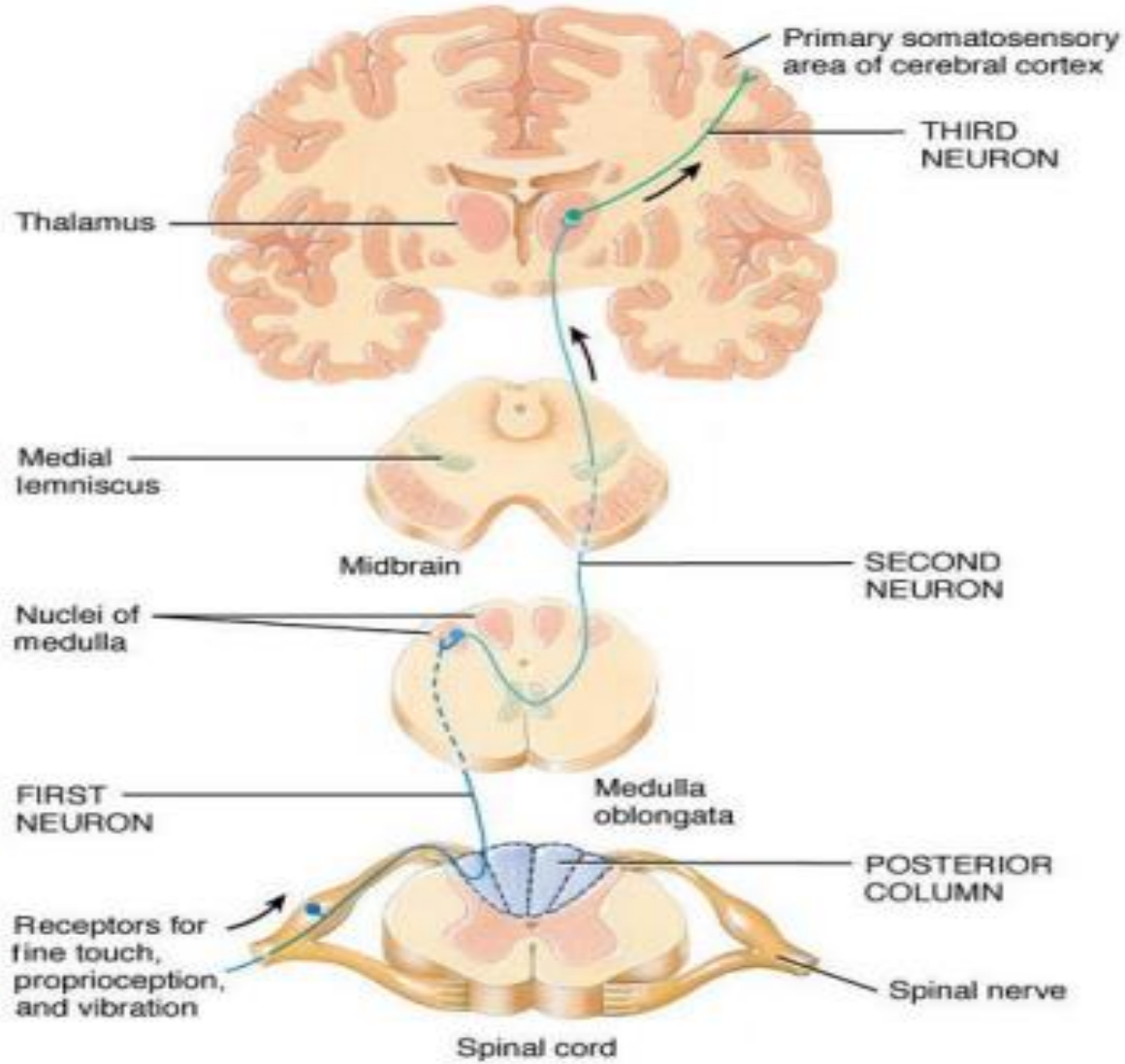
# Component of Sensory System

**Centers**

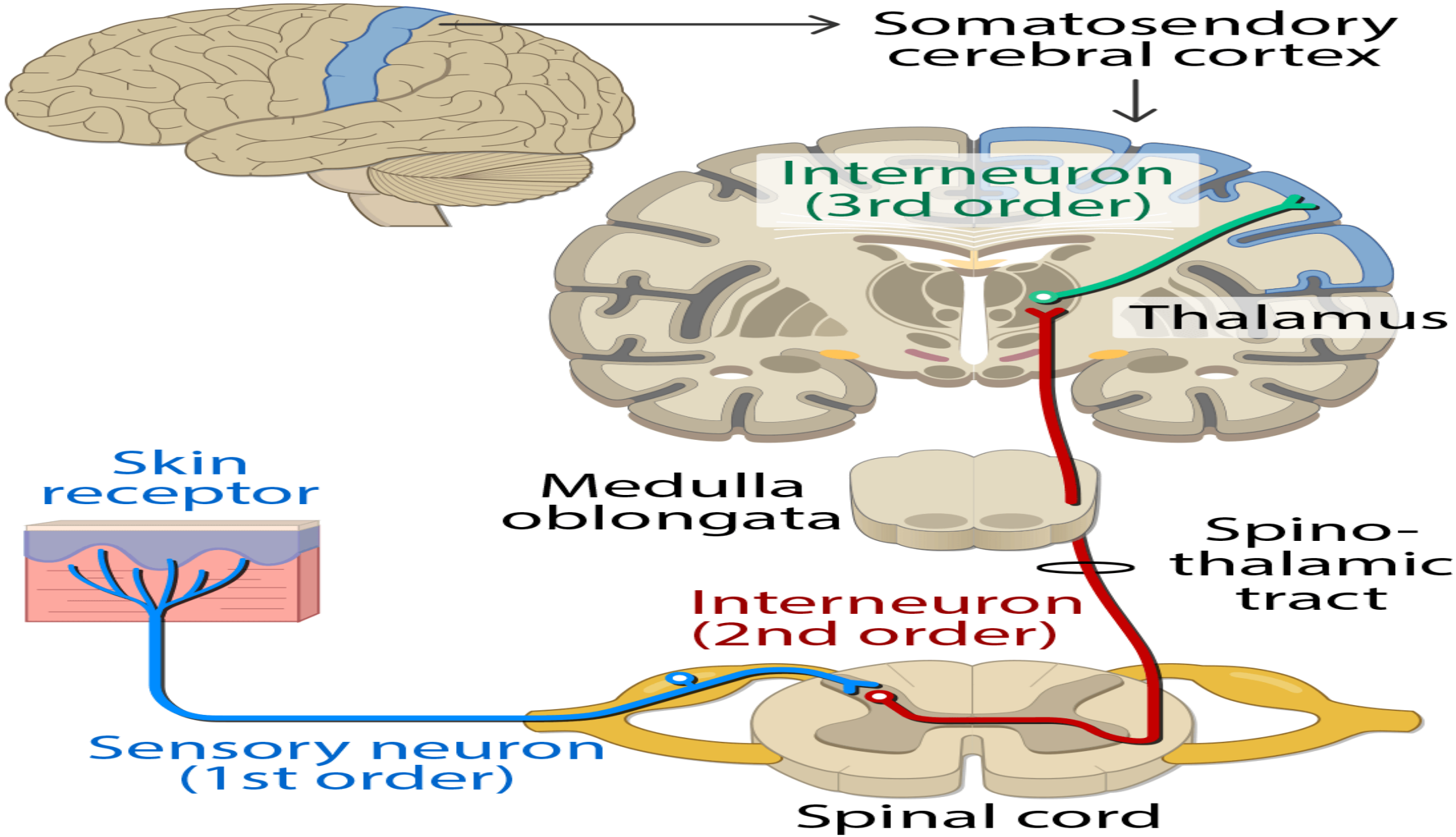
**Pathway**

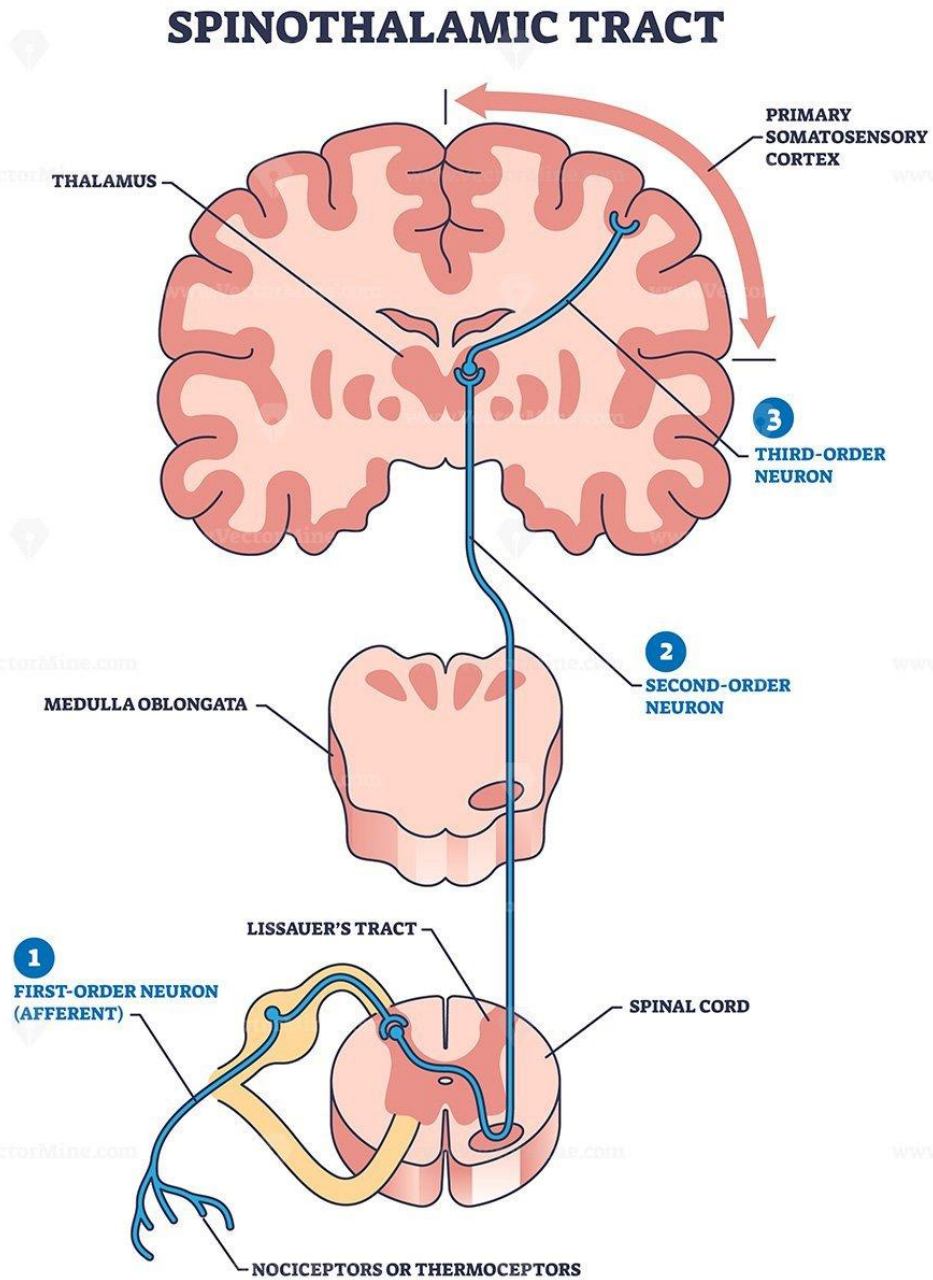
**Afferents**

**Receptors**

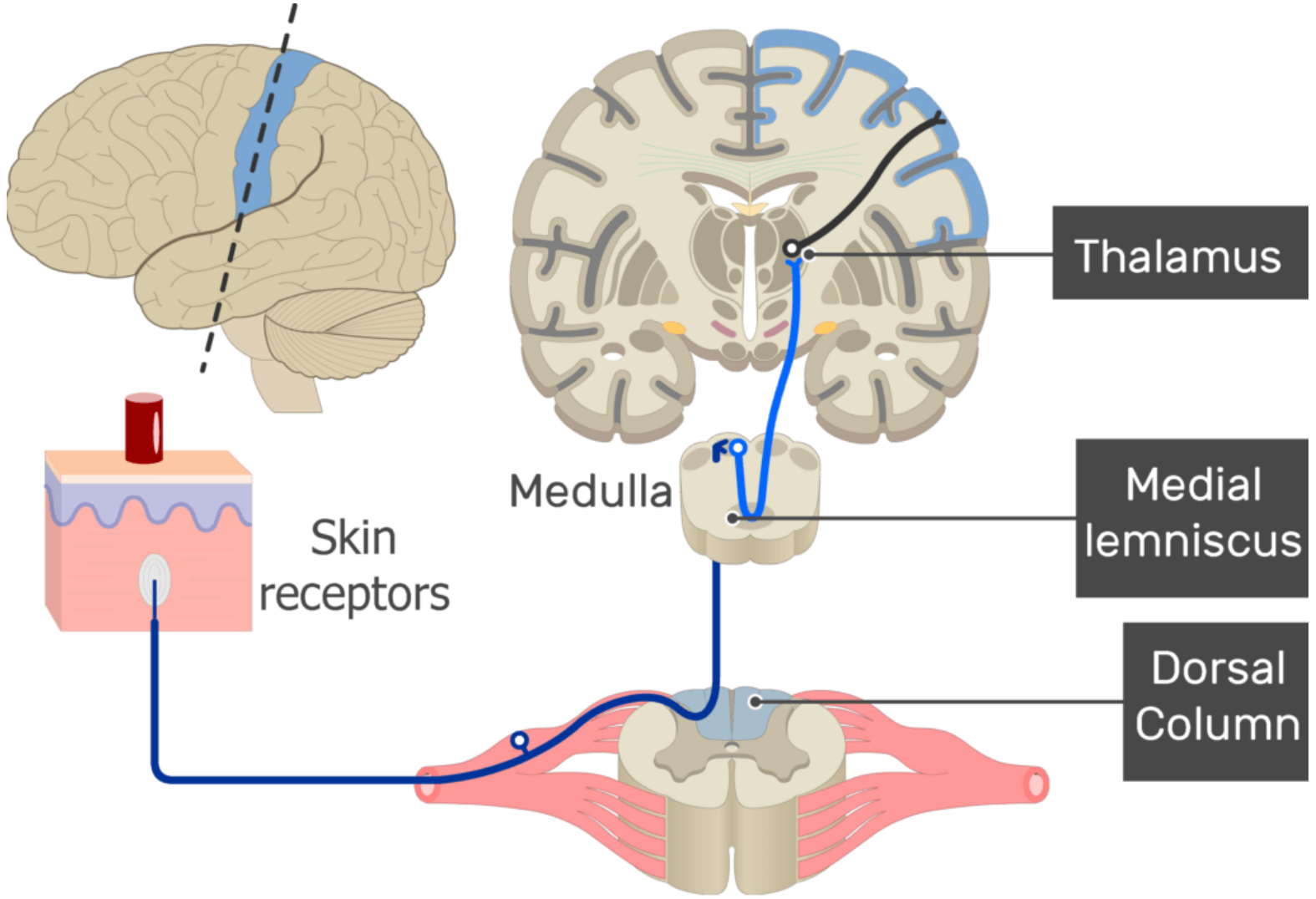



(a) Posterior column–medial lemniscus pathway


Somatosendory
cerebral cortex
Interneuron
(3rd order)
Thalamus
Skin
receptor
Medulla
oblongata
Spino-
thalamic
tract
Interneuron
(2nd order)
Sensory neuron
(1st order)
Spinal cord

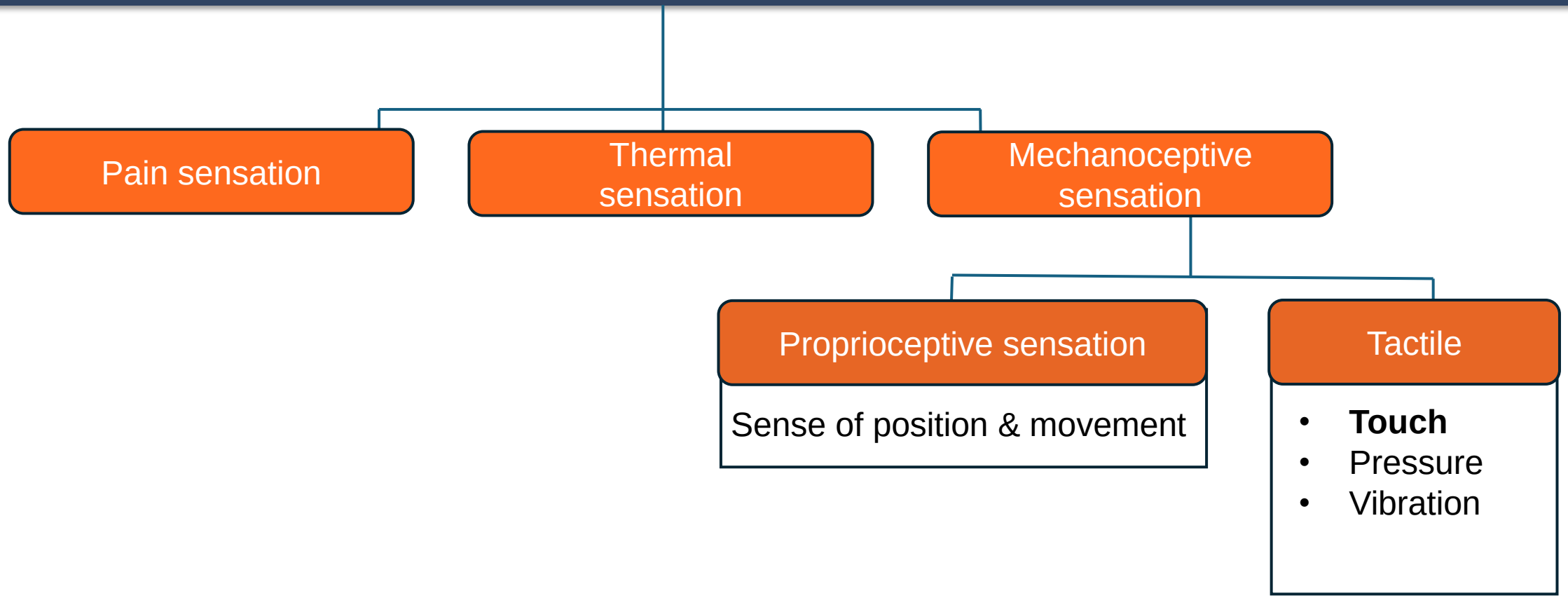



**Anterolateral pathway**




Dorsal column medial lemniscus pathway

# Somatic Sensations

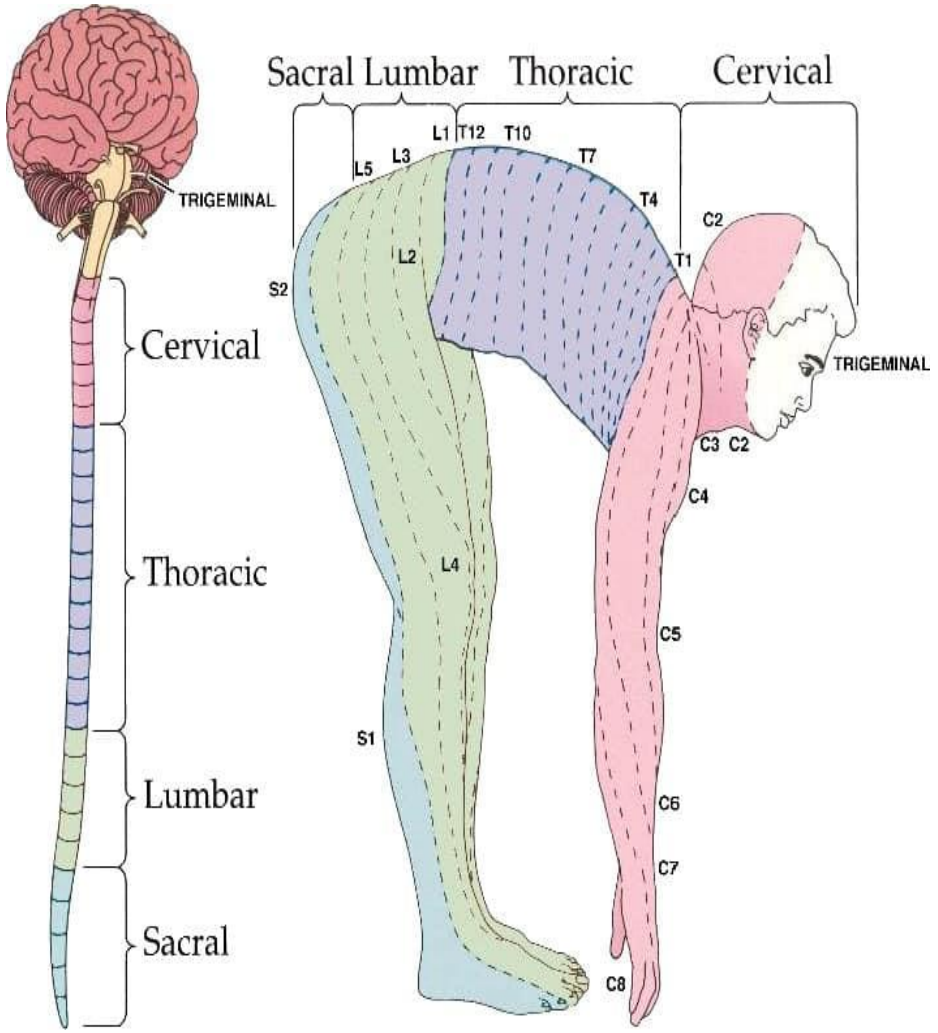


# Somatic Sensation Examination

## Aim of examination :

a. To assess the integrity of sensory pathways.

b. To localize the site of lesion in central nervous system.

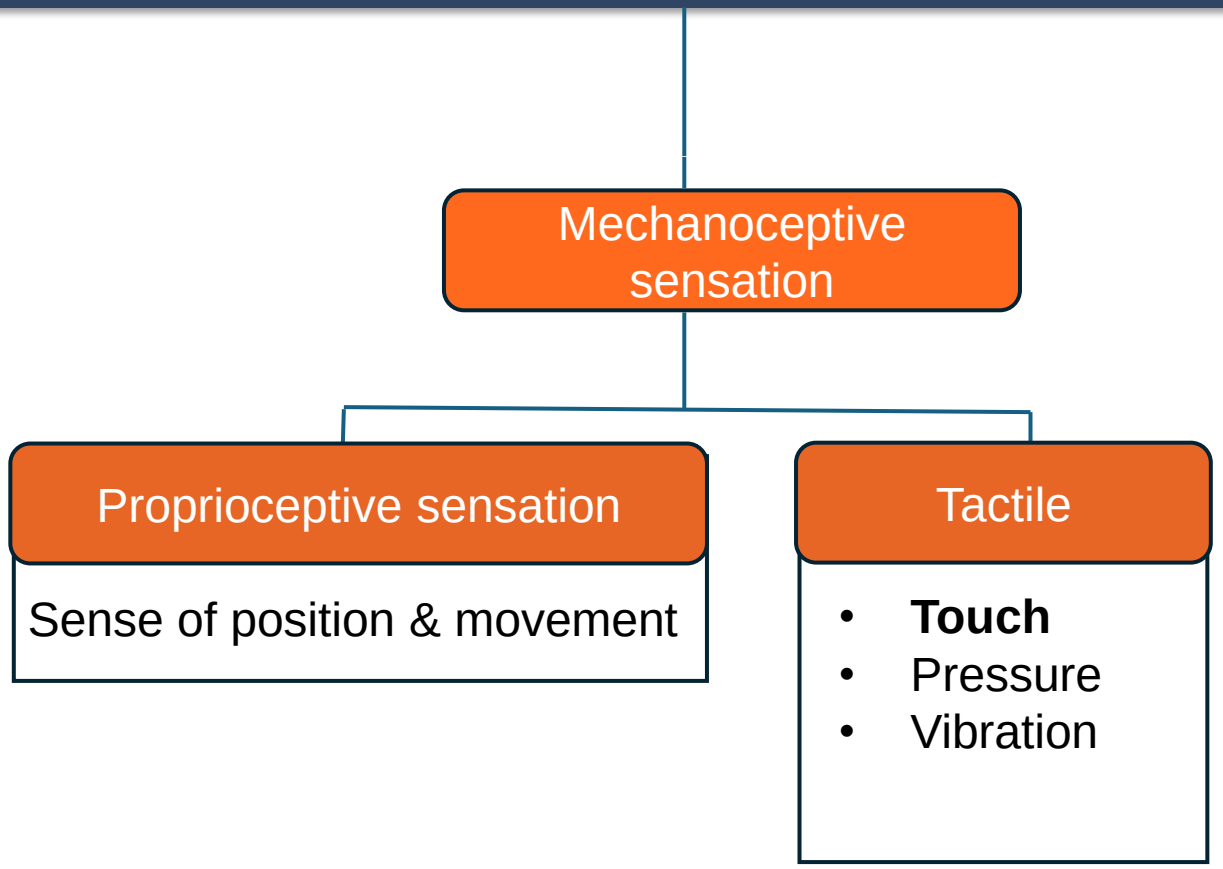


# Somatic Sensation Examination

## Principle of the examination:

- Teach patient first
- Test Done quickly
- Compare both sides
- Examine Distal to proximal
- Patient’s Eyes closed
- Test Done dermatomal
- Outline sensory loss area
- Move from area of sensory loss to normal

# Somatic Sensations



| | Fine touch | Crude touch |
|---|---|---|
| **Definition** | It is produced by application of **a well localized** object to the skin e.g. a tip of a pencil or a head of a pin or teeth of a comb. | It is a **poorly localized gross** touch sensation, which needs a relatively strong touch stimulus to be elicited. |
| **Receptors** | a. Meissner's corpuscles (rapidly adapting)<br>b. Merkel's discs (slowly adapting) | a. Less differentiated free nerve endings<br>b. Hair end organs |
| **Afferent** | **A-beta** nerve fibers | A-δ nerve fibers<br>**C**-non myelinated nerve fibers |
| **Pathway** | **dorsal column medial leminiscal system (DCML)** or gracile and cuneate tracts | **Ventral spinothalamic tract (VST)** |
| **Test and types** | 1. tactile localization (topognosis)<br>2. tactile discrimination (two-point discrimination)<br>3. Stereognosis and texture of material | Cotton Wool Test |

# Crude Touch

## How to test (Cottonwool test):

1. Ask the patient to close his eyes
2. Touch the skin with a small piece of cotton wool or soft brush or tissue paper
3. Ask the patient to say “yes” every time he is touched
4. Examine each dermatome
5. Compare the touch sensation in hairy and non-hairy areas of skin
6. Outline the borders of any abnormal area of sensations

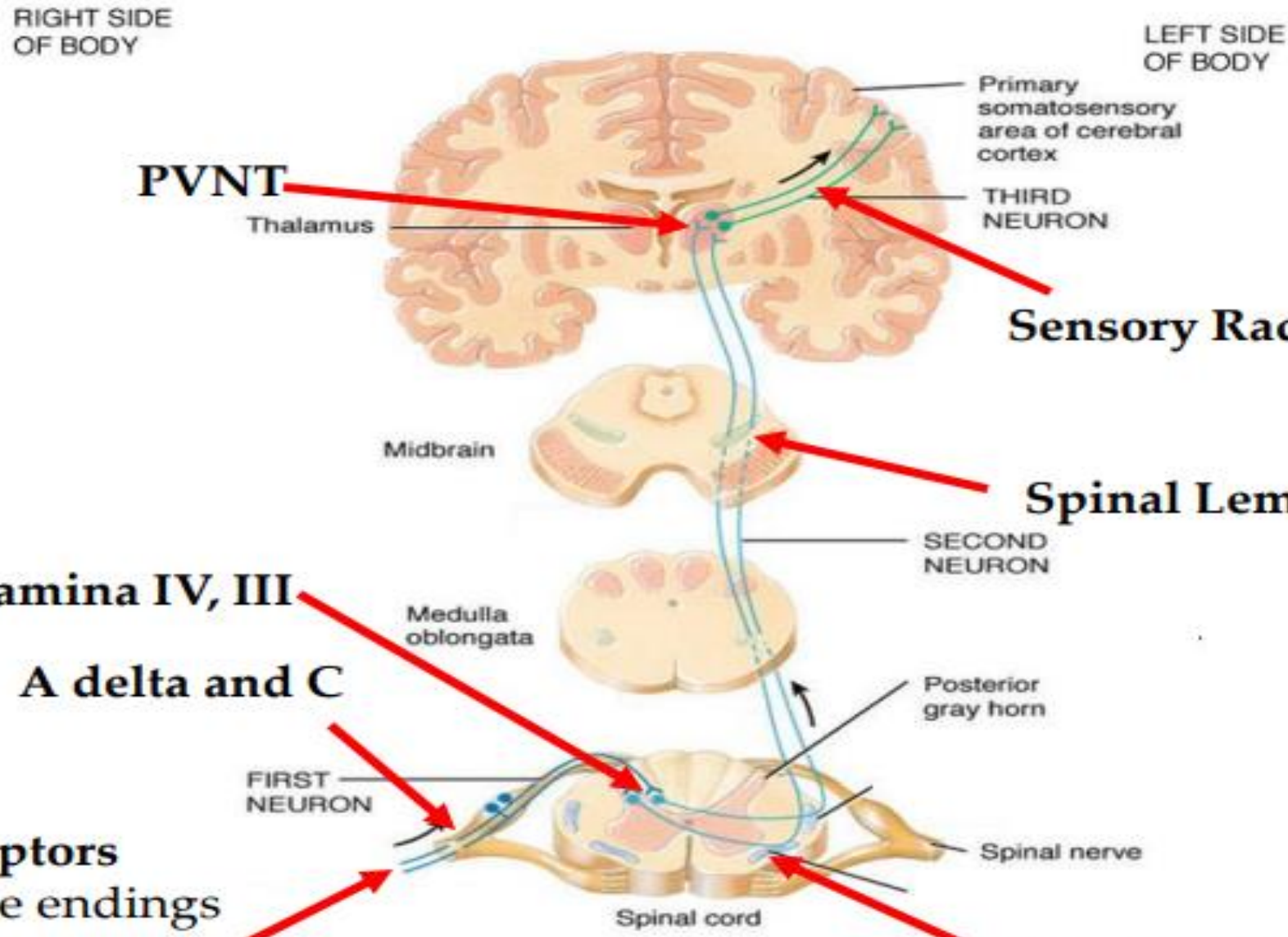
**AVOID**

**AVOID** Regularly timed stimuli (so that the patient can’t predict the location)

**AVOID** Dragging the cotton wool across the skin (stimulates tickle sensation)




# Crude Touch




**PVNT**

**Sensory Radiations**

**Spinal Leminiscus**

**Lamina IV, III**

**A delta and C**

**Receptors**

Free nerve endings

Hair end organs

**Ventral spinothalamic tract**

# Fine Touch

## 1. Tactile Localization (Topognosis):

### ➢ Definition:

The ability of the person to localize

exactly the point touched with eyes closed.

### ➢ How to test:

apply gently head of pin to the skin

(bilateral, dermatomal, distal to proximal).

# Fine Touch

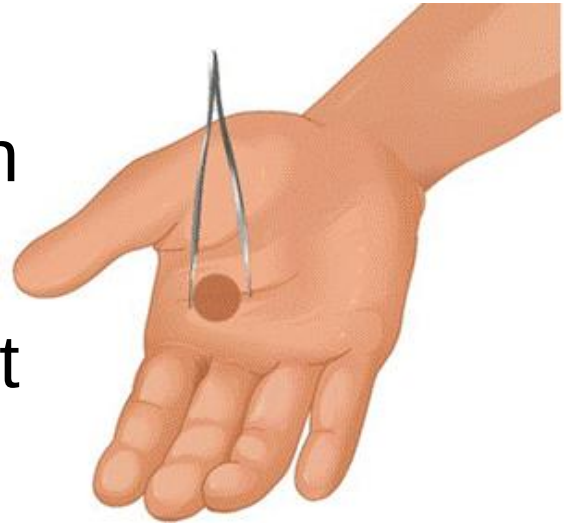
## 2. Tactile discrimination (two-point discrimination)

### ➢ Definition:

The ability of the person to perceive **two stimuli** applied **simultaneously** as **two separate points** of touch provided that both eyes are closed.


### ➢ How to test:

1. Apply the two points of a **blunt compass** simultaneously to the skin.



2. Record the **least distance** between the two points which gives a sensation of two points being touched and not one.

3. Compare tactile discrimination at the finger tips with that of the hand, forearm and arm.

# Fine Touch

## 2. Tactile discrimination (two-point discrimination)

### ➢ Minimal Distance:

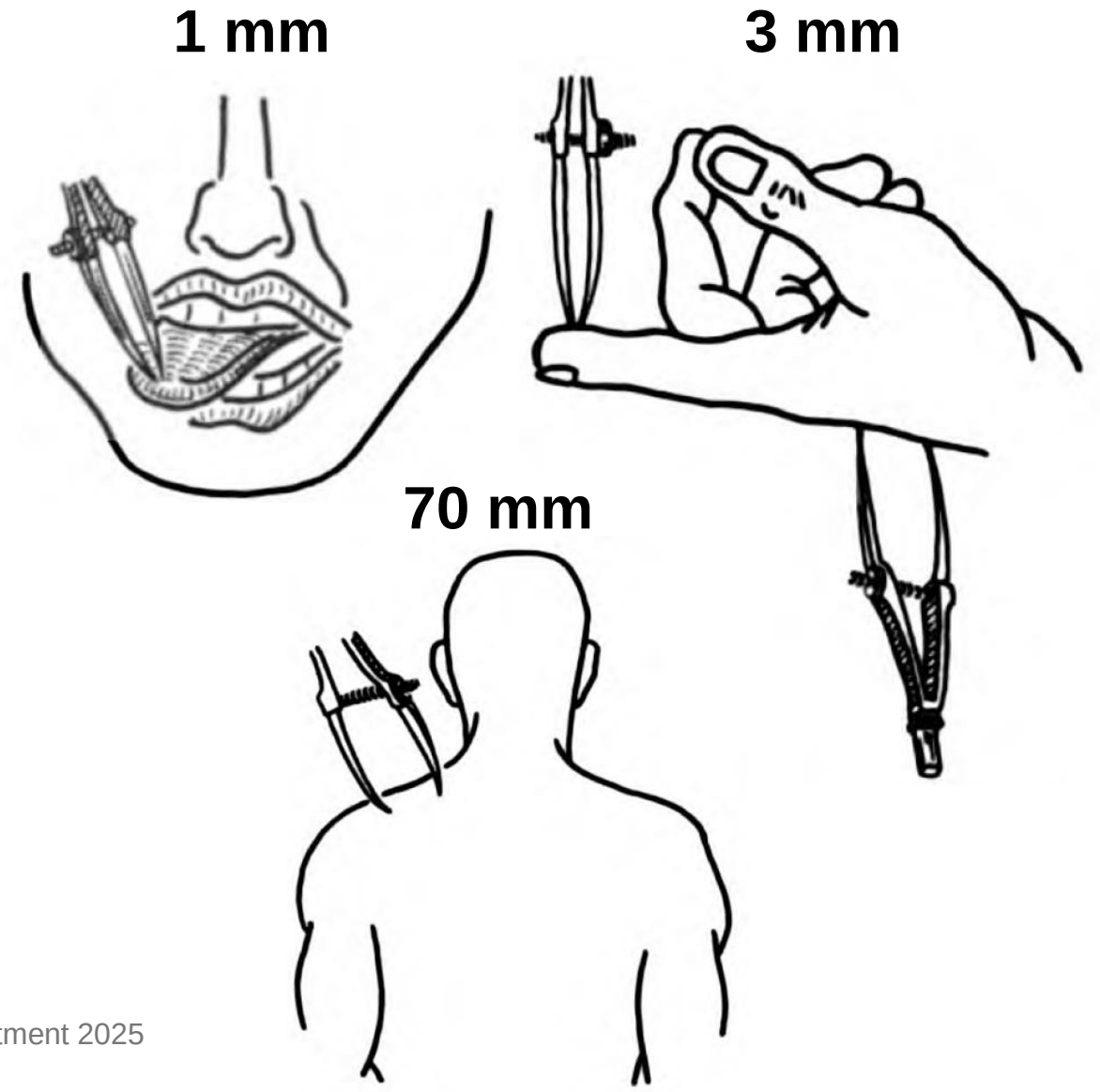
the shortest distance between 2 points to be felt as 2 separate points.

### ➢ Factors decreasing it:

1. ↑ Number of receptors
2. ↑ Number of afferents
3. ↑ size of represented cortical area
4. ↓ convergence of afferents

### ➢ Value:

- **1** mm in the tip of the **tongue**,
- **2** mm in the **lips**,
- **3** mm in the tip of **the fingers**,
- **70** mm in the **back**.



# Fine Touch

## 3. Stereognosis

### ➢ Definition:

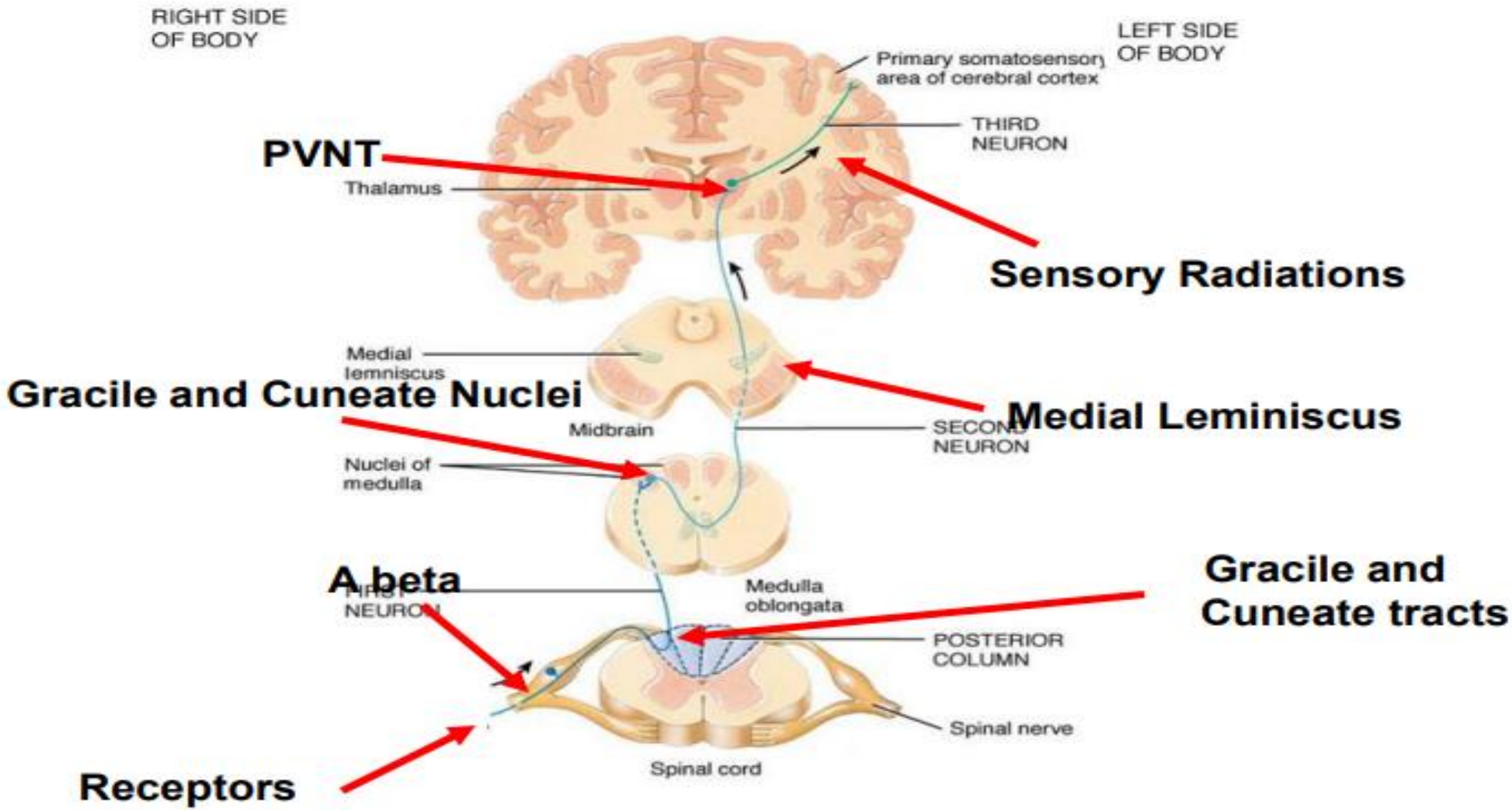
The ability of the person with his eyes closed to recognize an object by touching it.
e.g. recognition of a key, a pen or a coin.

### ➢ How to test:

1. Put any familiar object in the hand of the subject (e.g. coin, key or pen).
2. With eyes closed ask him to identify it.
3. Repeat the experiment by changing the object.

# Stereognosis

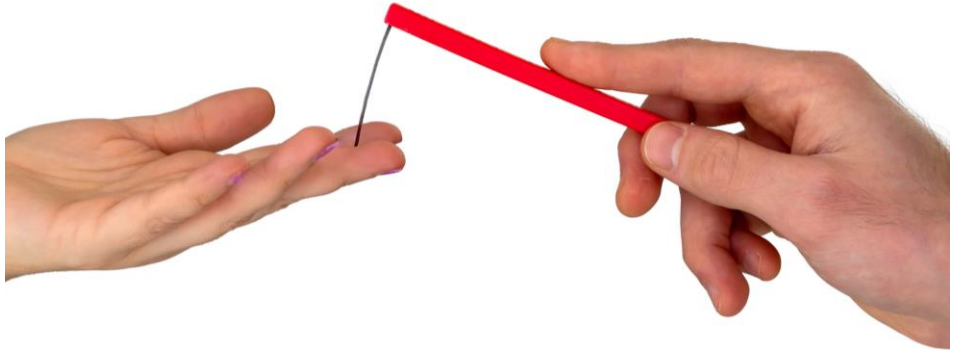
# Gracile and Cuneate Tracts



# Pressure Sensation

## ➢ Definition:

a feeling produced by the application of heavy mechanical stimuli to the skin (which can cause deformation of the different skin layers).



## ➢ Receptors:

a. Rapidly adapting receptors (**Pacinian** corpuscles).
b. Slowly adapting receptors (**Ruffini's** nerve endings).

## ➢ Pathway:

Dorsal Column Medial Lemniscus Pathway

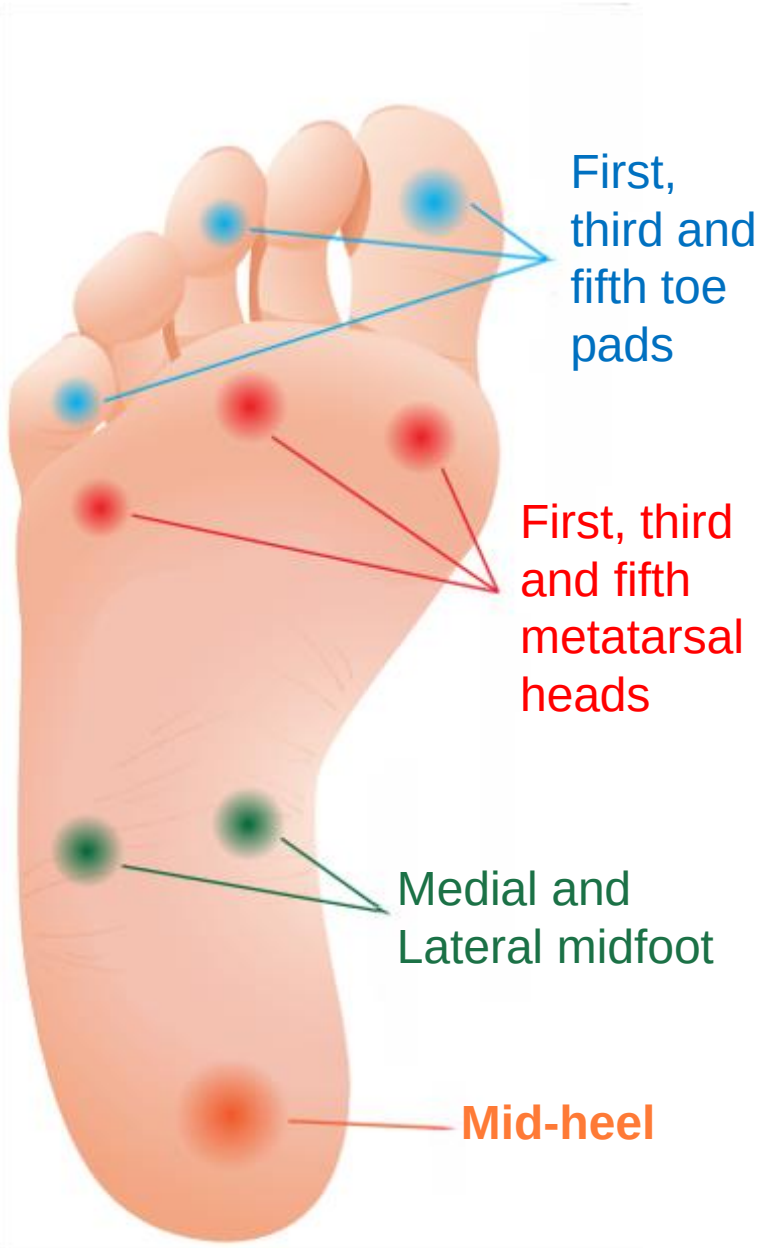
## ➢ Equipment:

Monofilament **OR** weights

# Pressure Sensation

## ➢ How to test:

1. Ensure the area to be tested is **exposed** and **dry**.
2. **Demonstrate** the test, ensuring understanding.
3. Ask the patient to **close his eyes**.
4. Hold the monofilament **perpendicular** (at 90°) to skin.
5. Apply **gentle pressure** until it bends, maintaining it for **1-2 seconds**.
6. Apply the filament at the **9 standard sites** of the sole.
7. Instruct the patient to **say "yes"** when he feels pressure.
8. Record a positive response if **2 out of 3 tries** for every site are identified correctly.



# Pressure Sensation

## ➢ How to test:

1. Place the hand of the subject on the table with the palm facing upwards.
2. Using the weights provided, investigate the least difference in weight which can be appreciated by the subject. e.g. first apply the 50 grams weight and then the 60 grams weight. Ask the subject which weight is heavier?
3. If the difference is appreciated, try the 50- and 55-gram weights and so on.
4. Check the test by putting down the same weight for comparison.
5. Ask the subject to compare different weights while his hand is unsupported to test muscle tension.


# Vibration Sensation

## ➢ Definition:

a feeling of **rhythmic pressure changes** produced by the rapid repetitive stimulation of mechanoreceptors.

## ➢ Receptors:

- Present in the subcutaneous tissues and muscle fibers.
- Respond to different frequencies:

a. Meissner's corpuscles: up to 200 cycles/second.

b. Pacinian corpuscles: up to 700 cycles/second.

## ➢ Pathway:

Dorsal Column Medial Lemniscus Pathway
(Gracile and Cuneate tracts)

# Vibration Sensation

## ➢ How to test:

1. Ask the patient to close his eyes
2. Apply the end of a tuning fork (**128 Hz**) to the superficial bones in any part of the body. e.g. toe tips, medial or lateral malleoli, tibial tuberosity, lower end of radius and ulna, olecranon, and clavicle
3. Check that patient reports feeling of vibration or thrill.
4. Ask the patient to identify as soon as the tuning fork stops.
5. Compare the left and right sides.

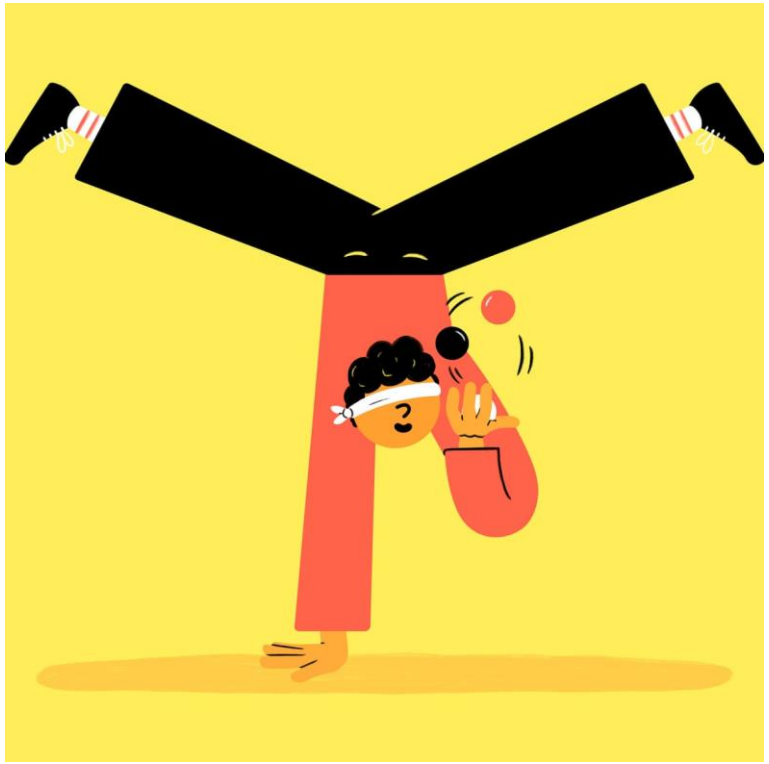
# Proprioceptive Sensation

## ➢ Definition:

a feeling of the **position and movements** of the body.

## ➢ Receptors:

| Muscle proprioceptors | Joint proprioceptors |
|---|---|
| Muscle spindles | **Rapidly adapting Receptors**<br>“Pacinian corpuscles” |
| Golgi tendon organs | **Slowly adapting Receptors**<br>Ruffini corpuscles<br>Golgi tendon organs |



## ➢ Pathway:

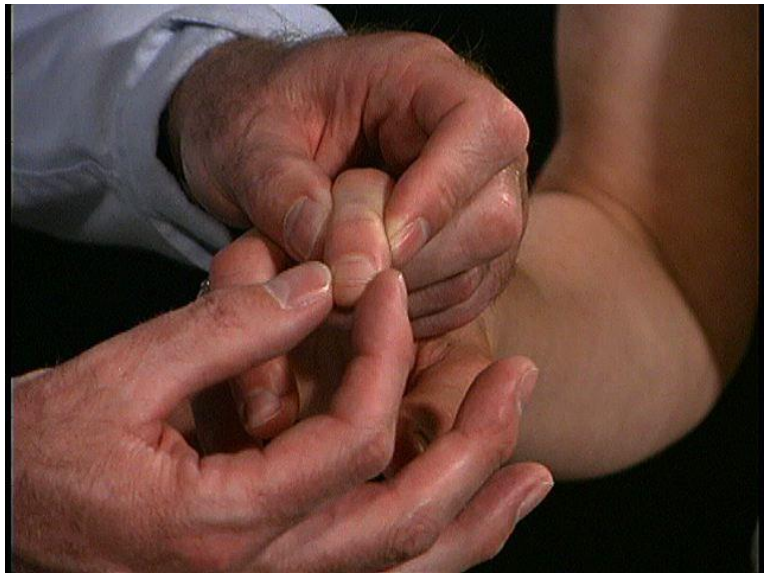
Dorsal Column Medial Lemniscus Pathway
(Gracile and Cuneate tracts)

# Proprioceptive Sensation

## ➢ Types:

**1- Sense of Position**: conscious orientation of the relative position of the different parts of the body to each other. “It is a **static sense**”.

## How to test:



- The subject’s big toe or thumb is flexed or extended with eyes closed.
- Then the subject is asked about the position of the joints or to place his other limb in a similar position.

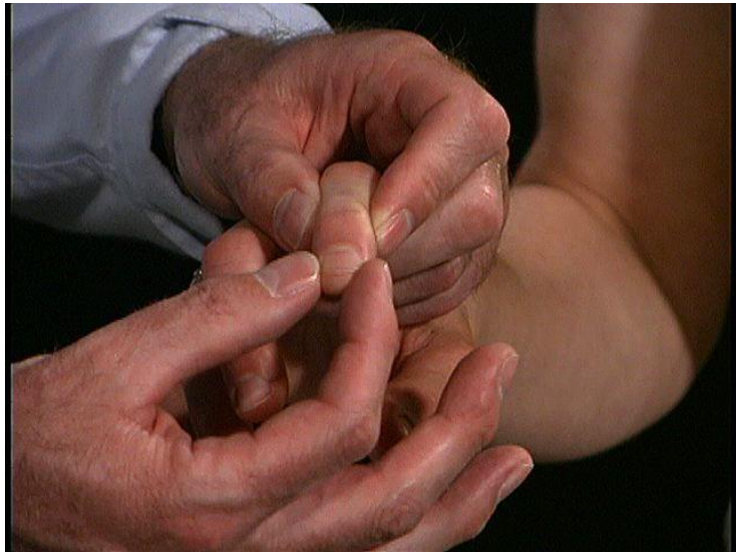
# Proprioceptive Sensation

## ➢ Types:

**1- Sense of Movement**: Conscious orientation of the changes in the relative position of the different parts of the body to each other - “It is a **dynamic sense**”.

## How to test:

- The subject’s big toe is passively moved with eyes closed
- He is asked about the feeling of movement, its direction and extent.



# Pain Sensation

## ➢ Definition:

An unpleasant sensory and emotional experience associated with actual tissue damage.

## ➢ Significance:

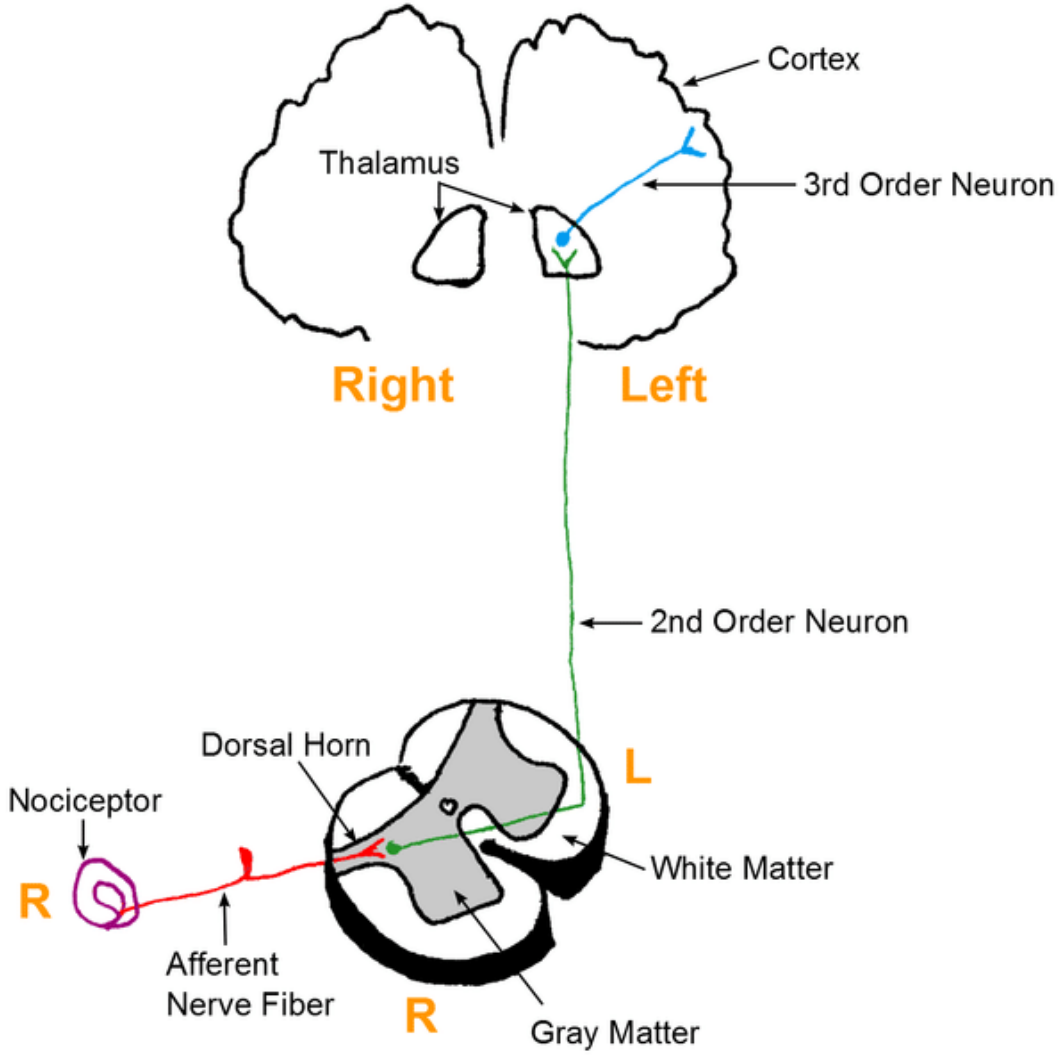
Pain is a protective mechanism for the body.

## ➢ Receptors:

free nerve endings.

## ➢ Pathway:

Lateral spinothalamic tract.



# Pain Sensation

## ➢ How to test:

**A) Cutaneous pain:** Pin prick test

**B) Deep pain:**

Squeeze or pinch the muscles of calf or biceps and ask the patient to report as soon as the sensation becomes painful.

# Thermal Sensation

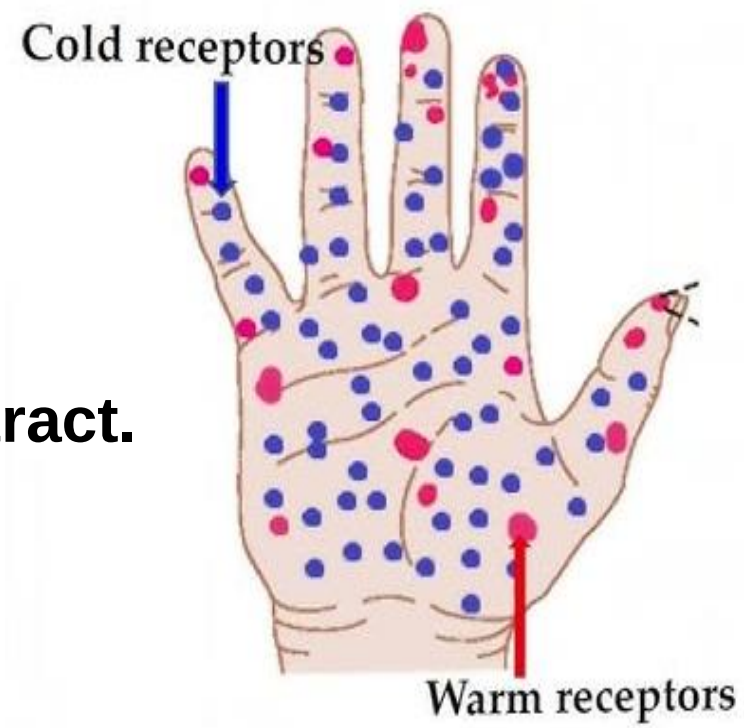
## ➢ Definition:

**The sensation that enables us to detect temperature change.**

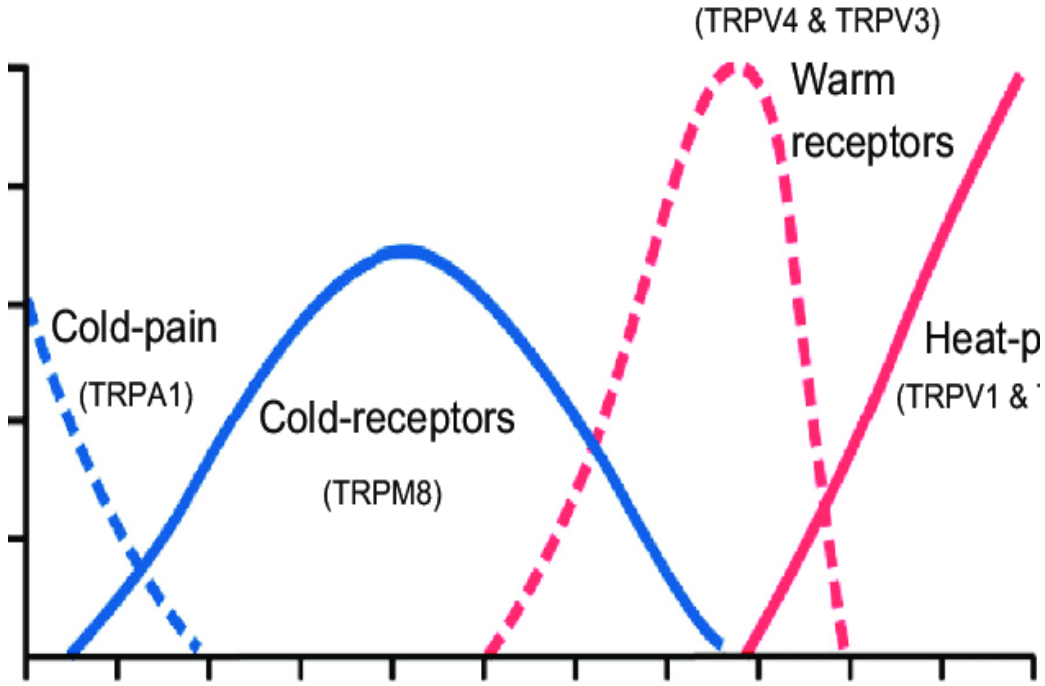
## ➢ Receptors:

a. **Cold receptors**

b. **Warm receptors**








## ➢ Pathway:

**Lateral spinothalamic tract.**

| Warmth receptors | Cold receptors |
| --- | --- |
| Free nerve endings. | Encapsulated nerve endings |
| Transmit mainly via **C fibers**. | Transmit mainly via **A delta** |
| Deeper | More Superficial |
| Fewer | 3-10 times number of warm receptors. |
| their range of stimulation is **25 - 45 °C** | their range of stimulation is **10-35 °C** |
| • Inactive at **25°C**<br>• Rate of discharge ↑ with ↑ temperature<br>• Reach maximum at **37- 40 °C**.<br>• ↓ discharge above **40°C**<br>• Stop discharging at **45°C**. | • Inactive at **35°C**<br>• Discharge ↑ with ↓ temperature<br>• Reach maximum discharge at **24°C.**<br>• ↓ discharge below **24°C.**<br>• Stop discharging at **10°C**. |

# Thermal Sensation

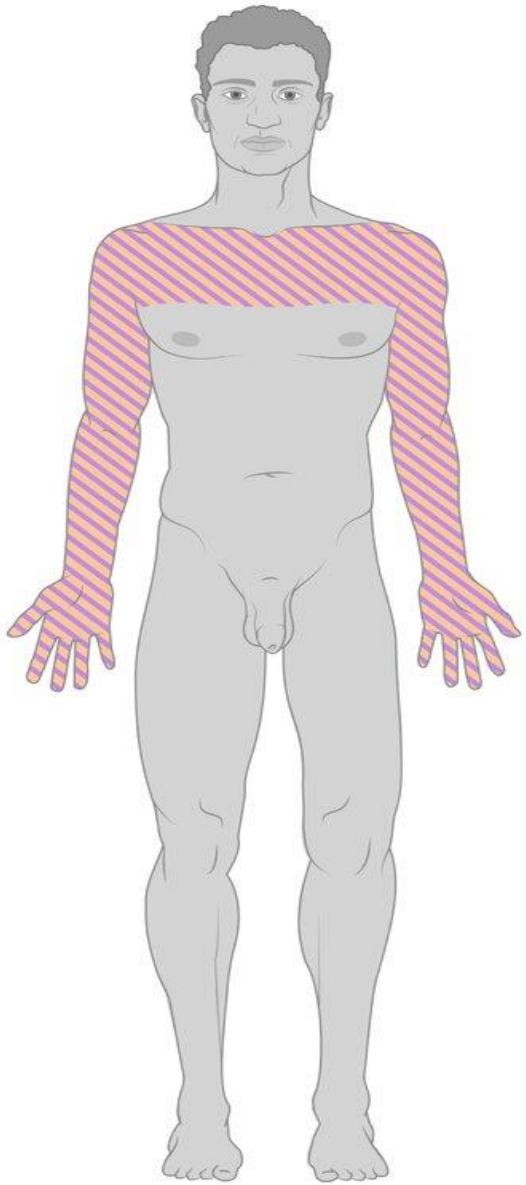
## ➢ How to test:

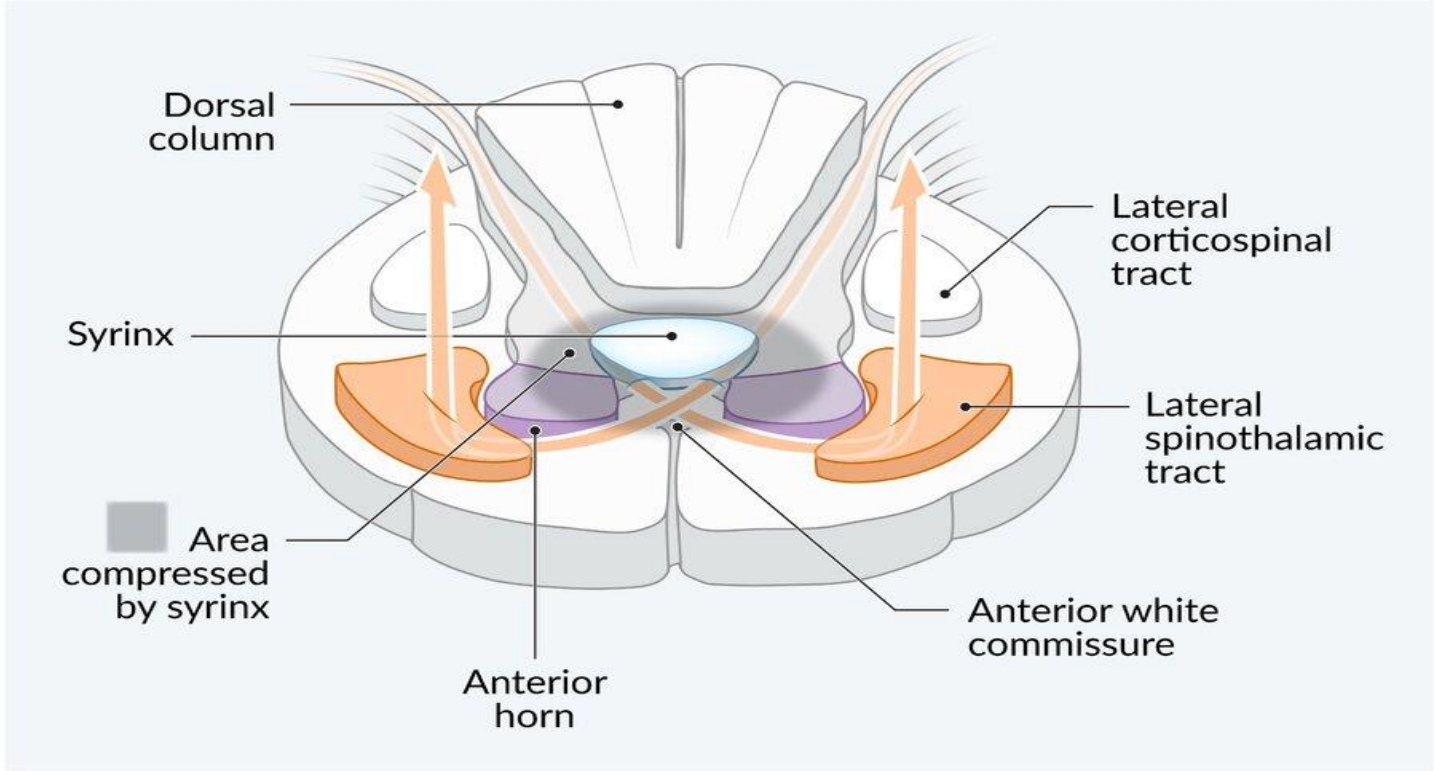
- Prepare **two test tubes** one containing water at **36ºC** and the other at **38ºC**.
- Test whether the subject can **distinguish** which is colder or warmer, when they are applied to the skin **once simultaneously** and another time **successively**.
- Touch the skin of different regions of the arm and face with a test tube containing water at **20ºC (cold)** and at **42ºC (warm)**.
- Investigate the **least difference** in temperature which can be recognized. Compare this threshold difference in various regions of the skin.

# Sensory Disturbances

# Syringomyelia

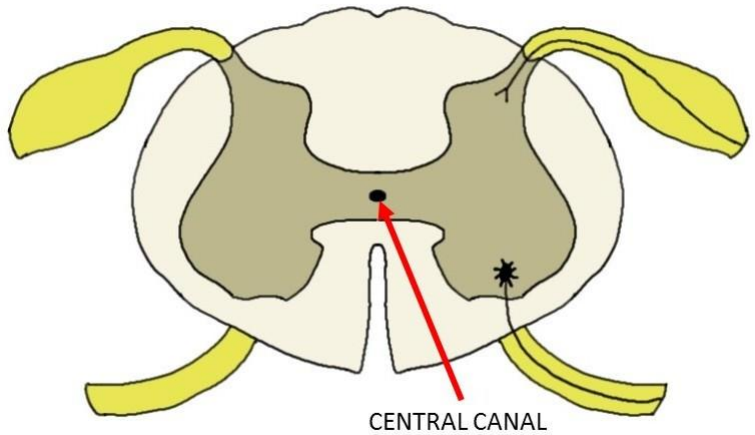
| | |
|---|---|
| **Def** | cavities formation in the grey matter of the spinal cord around the central canal. |
| **Site** | the spinal cord is in the lower cervical and upper thoracic segments (jacket sensory loss). |
| **Lesion** | Damage of the crossing fibers of the anterolateral system which decussate in front of the central canal |
| **Manifestation** | -Bilateral loss of pain, temperature and crude touch sensation at the level of lesion taking Jacket distribution.<br>"Dissociated sensory loss" because:<br>i) Pain, temperature and crude touch sensations are lost while.<br>ii) Other sensations remain intact |






Loss of temperature and pain sensation

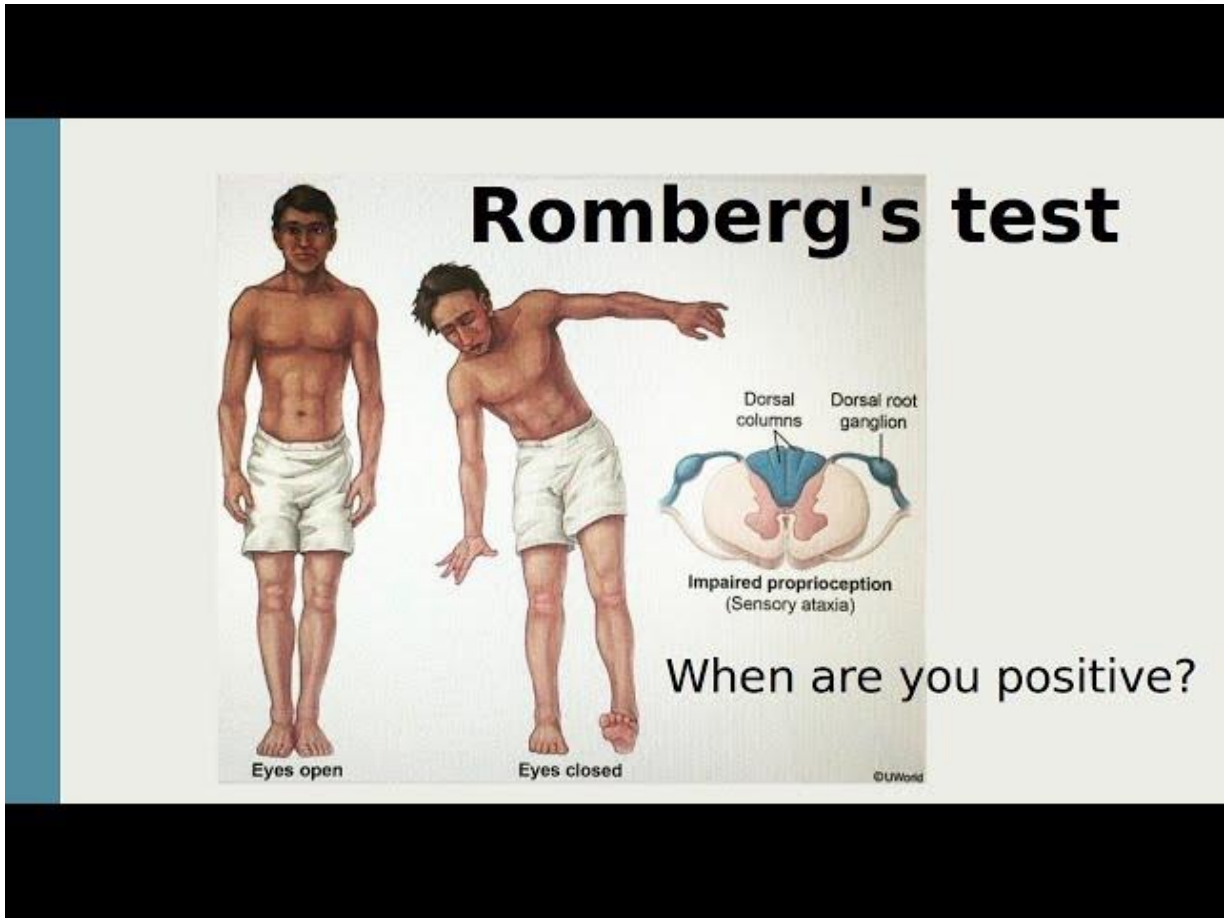
Flaccid paresis



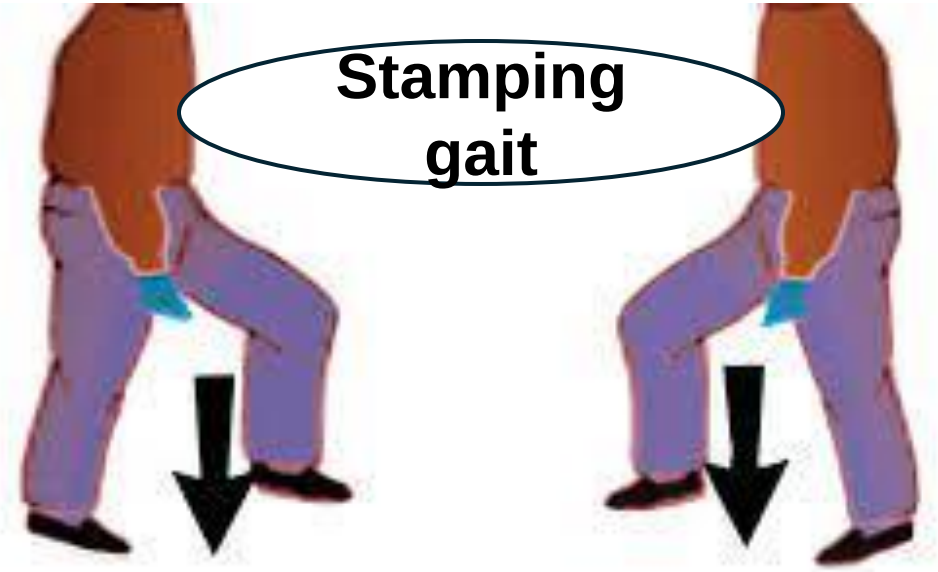
# Tabes dorsalis

| | |
|---|---|
| **Def** | It is disease affecting the dorsal roots of the spinal cord due to syphilis “sexually transmitted disease”. |
| **Site** | DRG, dorsal horn, dorsal column fibers. |
| **Lesion** | Syphilis causes inflammation leading to irritation followed by compression and degeneration of thick fibers first A alpha and A beta |
| **Manifestation** | -leading to loss of fine touch, pressure, vibration and proprioception sensation causing **sensory ataxia** . |

# sensory ataxia

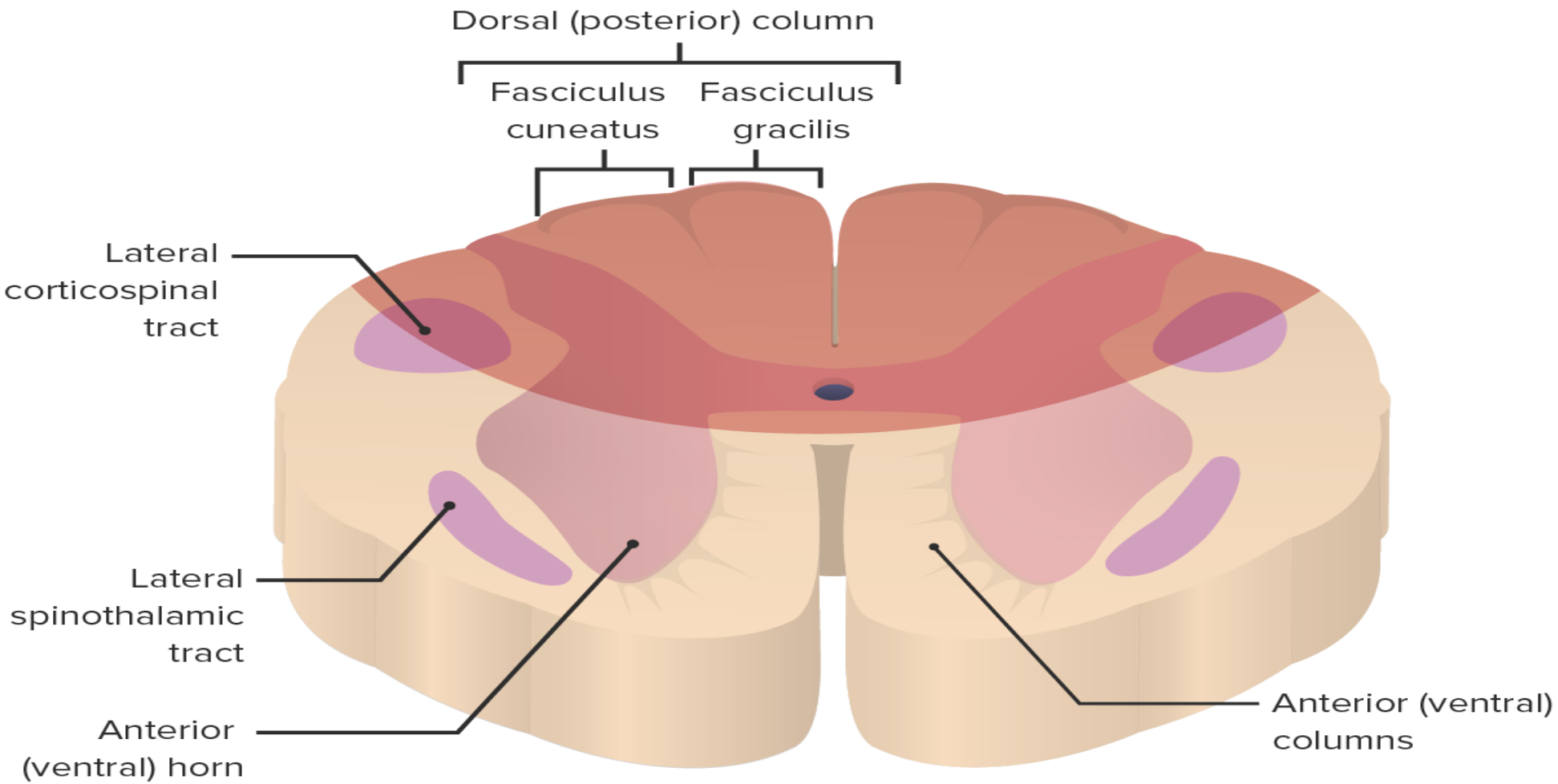



disturbed equilibrium where if the tabetic patient closes his eyes (e.g.) during washing his face, he sways or may fall.




During walking he raises his lower limb extremely, then hits it against the ground.

## Location of lesion in posterior cord syndrome



## Any questions?

# Thank you