Nervous system
Reflexes and Senses

Physiology Lab-5
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Nervous System

- The **nervous system** consists of two main parts, the central nervous system (CNS) and the peripheral nervous system (PNS).

- The CNS contains the brain and spinal cord. The PNS consists mainly of nerves, which are enclosed bundles of the long fibers or axons, that connect the CNS to every other part of the body.

- Nerves that transmit signals from the brain are called *motor* or *efferent* nerves, while those nerves that transmit information from the body to the CNS are called *sensory* or *afferent.*

Reflexes

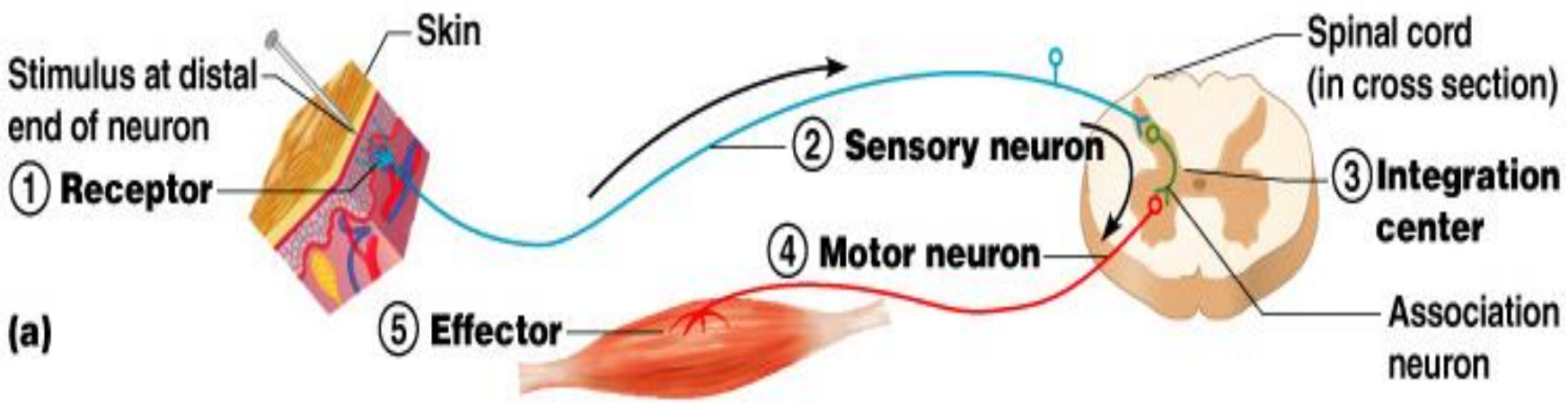
- Our sensory receptors detect changes in the surrounding environment and transmit them to the central nervous system , where they would be interpreted and processed to form a motor order, that will be transported to an effector organ to perform a response.

- The mentioned process is called neural reflex. So **neural reflex is a rapid involuntary , and repeatable response to a stimulus.**

- **Reflex arc:** a pathway in which signals travel over many synapses on their way back to the muscle .

There are five parts to a reflex arc:

1. The receptor detects a stimulus.
2. The sensory (afferent) neuron sends an electrical signal to the CNS.
3. The integration center consists of one or more synapses in the CNS, and processes the information.
4. The motor (efferent) neuron sends an electrical signal from the CNS to the effector.
5. The effector, which may be muscle tissue or a gland, responds appropriately.



Reflex Arc

There are two types of reflex arc:

1. Autonomic reflex arc (affecting cardiac ,smooth muscles and glands).
2. Somatic reflex arc (affecting skeletal muscles).

Autonomic Reflexes:

- Autonomic reflexes control and regulate smooth muscle cells, cardiac muscle cells and glands. In general these reflexes contain the same basic components as somatic.
- Examples of Autonomic Reflexes:
  1. Pupillary-pupil constricts on both sides when shine a light into the eye
  2. Accomodation-focus on distant object then near object-pupil constricts on both sides.

Somatic Reflexes

- Somatic reflexes an unlearned skeletal muscle reflex mediated by the brainstem and spinal cord result in an involuntary contraction of skeletal muscle.

- Examples of Somatic reflexes :

1. Corneal- blink reflex (respond to stimulus)
2. Pateller: knee jerk (tap patellar ligament-stretches quads)

Purpose of the Reflexes tests:

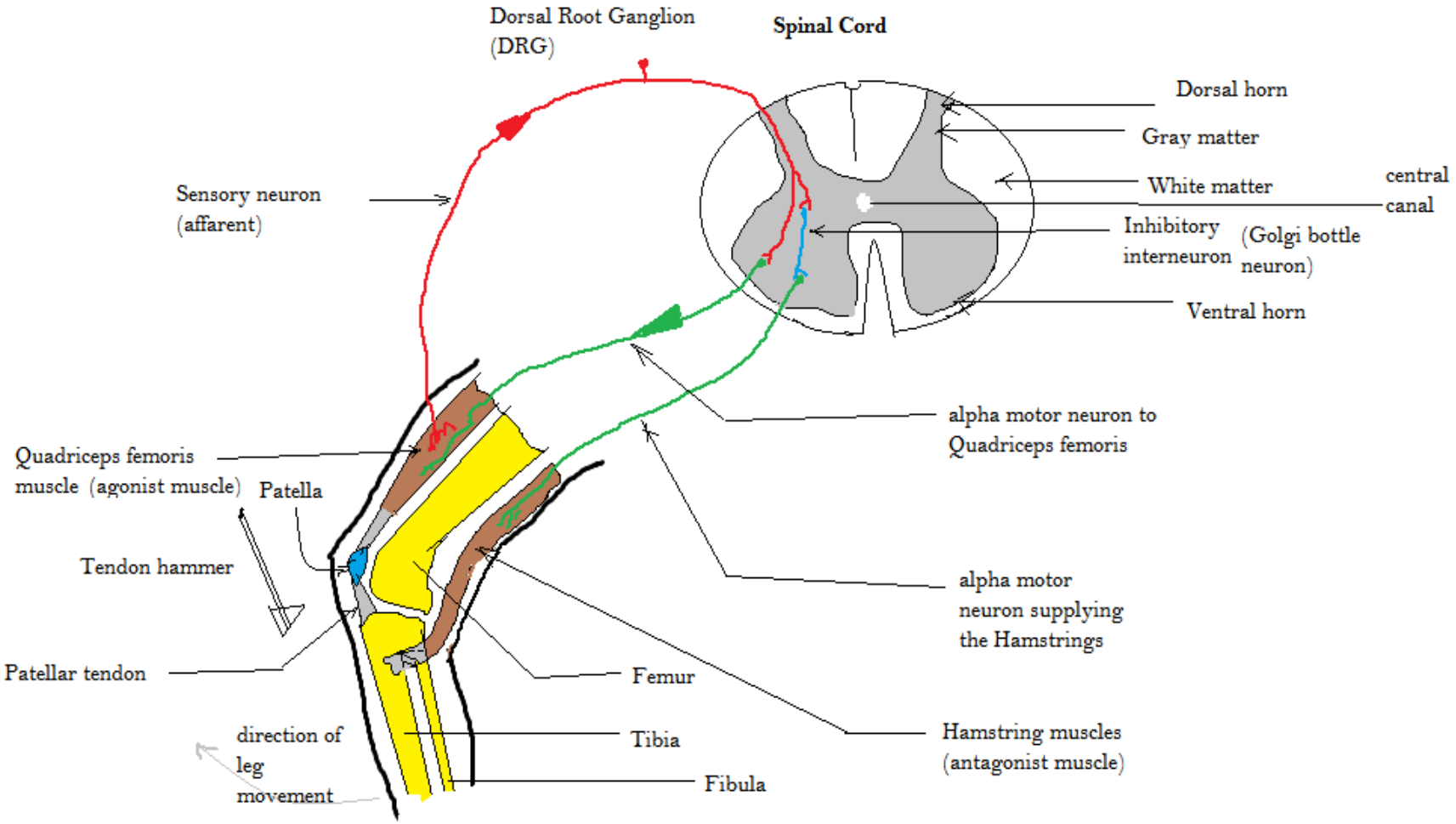
- Reflex testing is an important diagnostic tool for assessing the general health of the nervous system. Distorted, exaggerated or absent reflexes may indicate pathology. If the spinal cord is damaged, reflex tests can help pinpoint the level of damage

Activity 1: Somatic Reflex :The Patellar Reflex

- The patellar (or knee-jerk) reflex is called a stretch reflex because it is initiated by tapping a tendon, which stretches the muscle
- Stretch reflexes generally act to maintain posture, balance and locomotion.
- it tests the L2, L3, and L4 segments of the spinal cord.

Procedure for knee jerk reflex:

1. We keep the muscle of the lower limb in a neutral position.
2. we locate the patella tendon
3. we apply a strike on the patellar ligament just below the patella by a reflex hammer .
4. we notice that the leg kicks after striking the patellar tendon.



Mechanism:

Tapping a tendon, which stretches the muscle, This produces a signal which travels back to the spinal cord and . From there, an alpha-motor neuron conducts an efferent impulse back to the quadriceps femoris muscle, triggering contraction. This contraction, coordinated with the relaxation of the antagonistic flexor hamstring muscle causes the leg to kick .

Purpose of testing:

- After the tap of a hammer, the leg is normally extended once and comes to rest.
- The absence or decrease of this reflex is problematic, and known as Westphal's sign.
- This reflex may be diminished or absent in lower motor neuron lesions and during sleep.
- The test itself assesses the nervous tissue between and including the L2 and L4 segments of the spinal cord.

Activity 2: Autonomic Reflexes :Pupillary Reflexes test

- The pupillary light reflex (PLR) is a reflex that controls the diameter of the pupil, in response to the intensity of light

- A greater intensity of light causes the pupil to constrict (miosis) (allowing less light in), whereas a lower intensity of light causes the pupil to dilate (mydriasis, expansion) (allowing more light in).

- We will test the pupillary light reflex and the consensual reflex. In both, the retina of the eye is the receptor, the optic nerve holds the afferent fibers, the oculomotor nerve contains the efferent fibers, and the smooth muscle of the iris is the effector organ.

Procedure for activity 2:

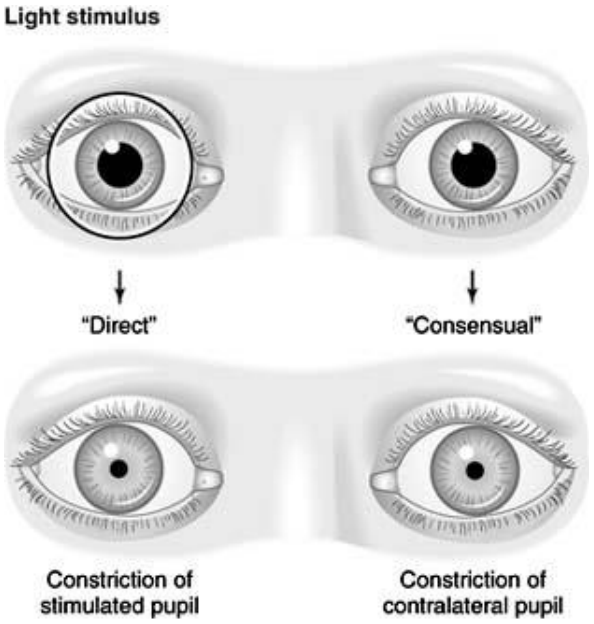
1. For the pupillary light reflex, have the subject in a relatively dim area (turn off lights in lab if helpful). The subject should shield the right eye. Shine a penlight into the subject's left eye. What happens to the pupil?

2. Also observe the right pupil. Does the same change (called a consensual response) occur?

   When a reflex is observed on the same side of the body that was stimulated, that is called an **ipsilateral** response. When a reflex occurs on the opposite side of the body that was stimulated, that is a **contralateral** response.

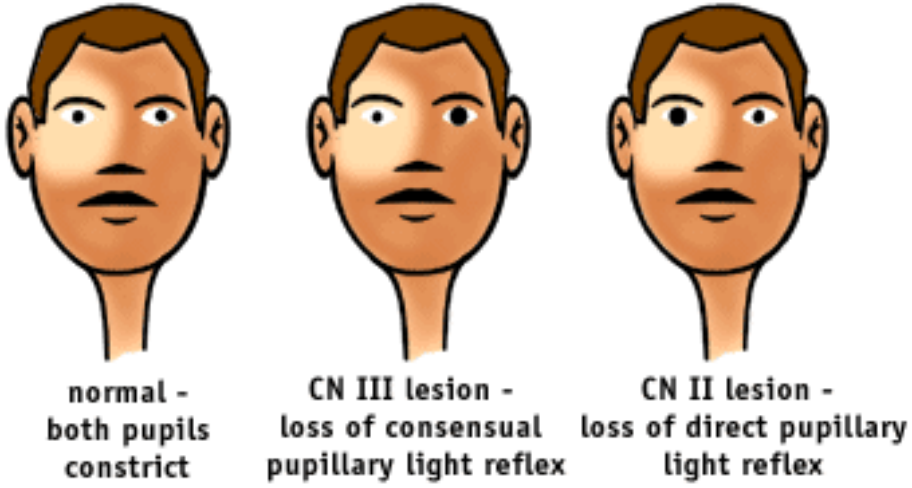
Clinical signification

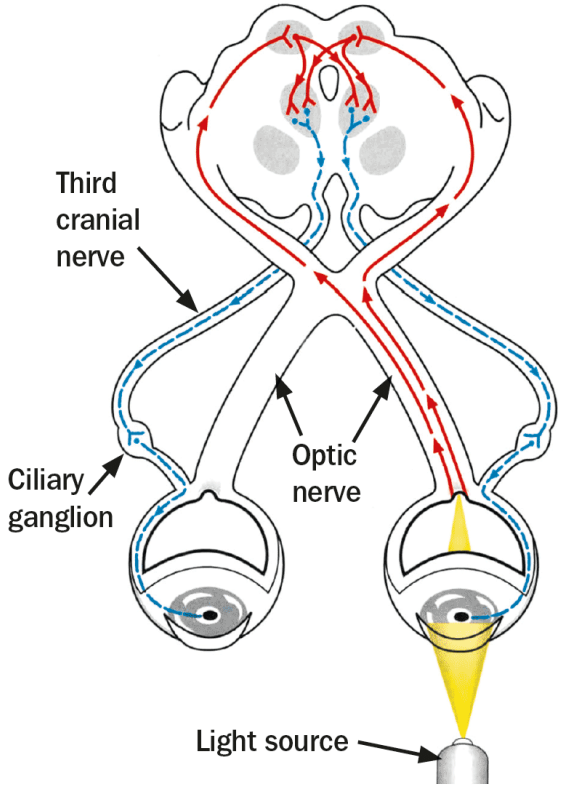
- Under normal conditions, the pupils of both eyes respond identically to a light stimulus, regardless of which eye is being stimulated. Light entering one eye produces a constriction of the pupil of that eye, the **direct** response, as well as a constriction of the pupil of the un stimulated eye, the **consensual** response.
- For example, if light is shone into right eye only, right pupil constriction is a direct pupillary light reflex, and simultaneous left pupil constriction is a consensual pupillary light reflex. Therefore, light shone into one eye causes ipsilateral direct pupillary light reflex and contralateral consensual pupillary light reflex
- Comparing these two responses in both eyes is helpful in locating a lesion



Purpose of testing:

- **Pupillary light reflex** can distinguish between damage to CN II (the optic nerve) and damage to CN III (the oculomotor nerve)
- The optic nerve controls the direct pupillary light reflex.
- The oculomotor nerve, controls the consensual pupillary light reflex

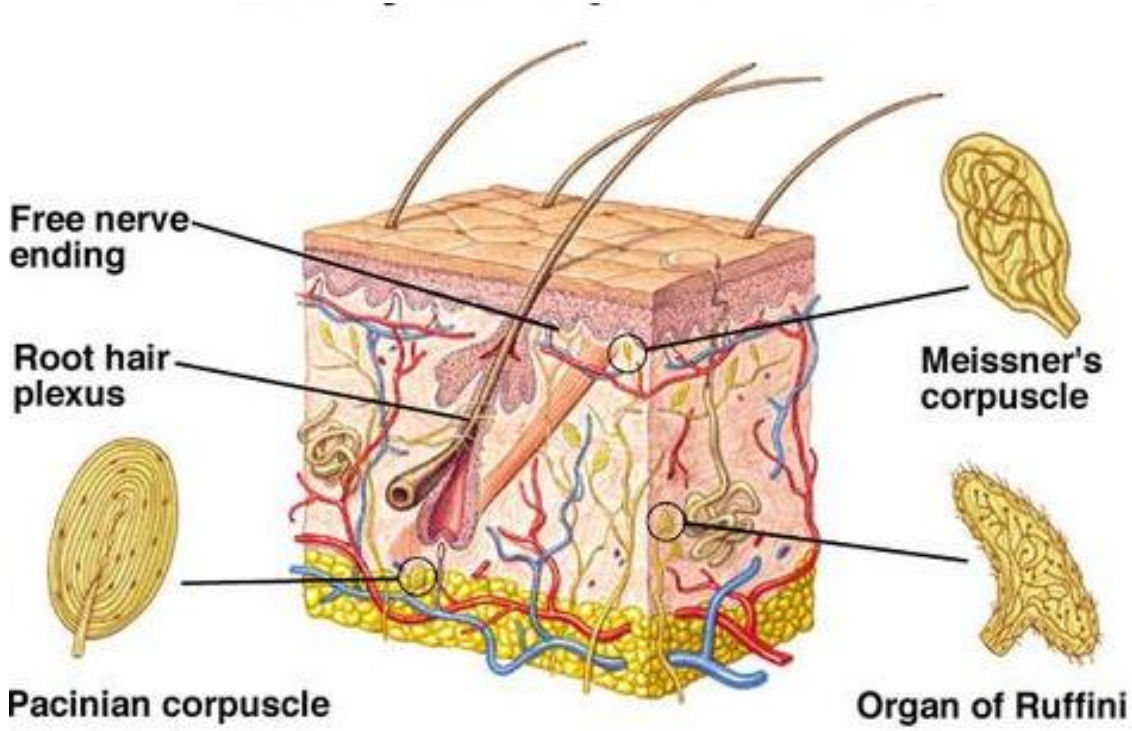




B) General Sensation and Sensory Receptor Physiology:

•A **sense** is a physiological capacity of organisms that provides data for perception. Humans have a multitude of senses. Sight (vision), hearing (audition), taste (gustation), smell (olfaction), and touch (somatosensation) are the five traditionally recognized senses.

•The somatosensory system is a complex system of sensory neurons that responds to changes to the surface or internal state of the body

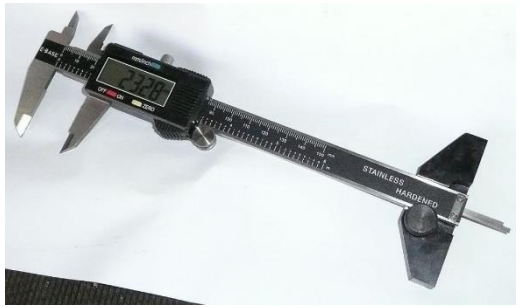


Activity 3: Cutaneous Senses :Two-point Discrimination Test

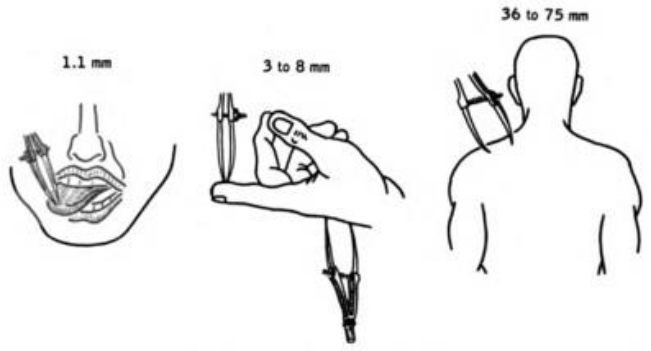
- The minimum distance in millimeters at which the two points of the compass are felt separately is noted.
- There is a marked difference in the distances at which the two points of the compass are felt separately at the finger tip, palmar surface of finger, the forearm or middle of the back. Normally 2 mm of separation of the points can be recognized as two separate stimuli on the finger tips, 1 cm on the palmar surface and more in other area
- If the two stimulated points belong to the same receptive field, the sensation is felt as one stimulus. If the points belong to separate receptive fields, the subject feels two stimuli. The distance between the points, at which the subject loses the ability to feel two points is the diameter of the receptive field.
- The two point discrimination threshold is less than 5 mm at the finger tips and is about 40 mm at the thigh

Procedure

1. Using calipers, test the ability of the subject to differentiate two distinct sensations when the skin is touched simultaneously at two points
2. Start with the points right together, then gradually increase the distance apart. Record the distance at which the subject first reports feeling two distinct points of contact with the skin (the two-point threshold).
3. Find the shortest distance of compass spikes at which the subject still senses two touches.
4. Repeat this measurement and Test the areas of the body as listed in the chart.



Body area	Two-point threshold (mm)
Face	
Back of hand	
Palm of hand	
Fingertips	
Lips	
Back of neck	
Back of calf	



Q/ Of the tested areas of the body, which ones seem to have the greatest density of receptors (smallest two-point threshold)?

Activity 4: Adaptation of Touch Receptors

- The number of signals sent by the sensory receptors may change with the intensity of the stimulus and the length of time the stimulus is applied.
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- When the awareness of a stimulus decreases, it is called adaptation.

- Some receptors adapt rapidly, such as certain types of touch receptors, and others, such a pain receptors, may not adapt at all.

Activity 4: Adaptation of Touch Receptors

- 1. The subject should sit with eyes closed, arm resting on the lab bench. Place a coin on the anterior surface of the subject's forearm. Time (in seconds) how long it takes for the sensation to disappear.
- 2. Now stack three more coins on top of the first one. Does the sensation return? How long does it take for the sensation to disappear?
- Do you think the same receptors are being stimulated by the four coins as with the one coin?