Virtual Reflex Lab

Background:

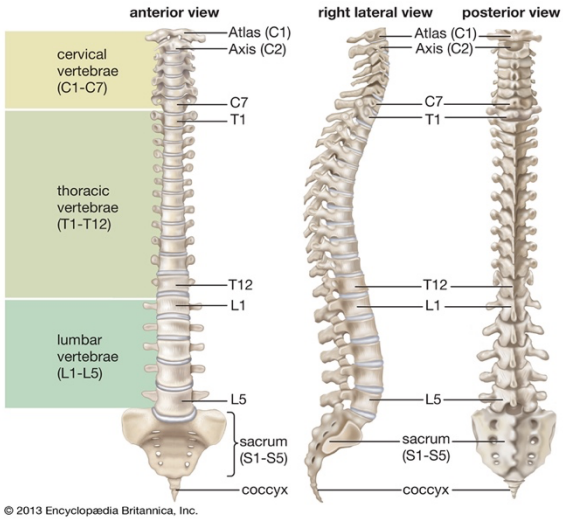
Nerve impulses follow routes through the nervous system called **nerve pathways**. Some of the simplest nerve pathways consist of little more than two **neurons** that communicate across a single connection (**synapse)**. A **reflex** is a relatively simple motor response that does not involve a large number of **interneurons** (or **association neurons**). The simplest version is a mono-synaptic reflex that uses one sensory and one motor neuron (for example, **the patellar reflex)**. Most reflexes are **polysynaptic** (involving more than two neurons) and involve the activity of interneurons in the integration center. In these more complicated reflexes, impulses may travel up, down, and transversely in the spinal cord. Since there is delay in neural transmission at the synapses, the more synapses there are in the reflex pathway, the more time that is required to illicit the reflex.

Reflexes can be categorized as either autonomic or somatic. **Autonomic reflexes** are not subject to conscious control, are mediated by the autonomic division of the nervous system, and usually involve the activation of smooth muscle, cardiac muscle, and glands. Involuntary reflexes are very fast, traveling in milliseconds. The fastest impulses can reach 320 miles per hour. **Somatic reflexes** involve stimulation of skeletal muscles by the somatic or voluntary division of the nervous system.

Reflex testing is an important diagnostic tool for assessing the condition of the nervous system. Distorted, exaggerated, or reflexes that are absent may indicate degeneration or pathology of portions of the nervous system, often before other signs are apparent. If the spinal cord is damaged, then reflex tests can help determine the area of injury. For example, motor nerves above an injured area may be unaffected, whereas motor nerves at or below the damaged area may be unable to perform the usual reflex activities.

PART A – Stretch Reflexes

Stretch reflexes are those that result from the stimulation of stretch receptors. Here, reflex arcs will be tested that are initiated by stretch receptors within the muscle. Some of these will produce a quite noticeable contraction; others will only display a slight rippling or dimpling of the muscle.



1. Patellar tendon reflex

The patellar tendon reflex, or knee-jerk reflex, is a monosynaptic stretch reflex that assesses the nervous tissue between (and including) the **L2 and L4** segments of the spine. It can be elicited by sharply tapping the patellar ligament (just below the knee) with the base of a reflex mallet. Watch the video.

a. What did you observe happen?

b. What muscle(s) are used to produce this movement?

Testing the effect of mental distraction on the patellar reflex by having the subject compute a math problem during reflex testing. Watch the video.

c. Is the response greater, lesser or the same than without metal distraction? _____ Explain.

Test the effect of muscle exertion elsewhere in the body on the patellar reflex by having the subject flex their arms during reflex testing. Watch the video.

d. Is the response greater, lesser or the same than without physical exertion? _____ Explain.

e. Would the effect be the same if the muscle exertion was in the legs?_____ Explain

3. Biceps reflex
The biceps reflex is a spinal reflex that involves nerves C5 and C6. Watch the video
a. Describe the movement of the arm.

PART B – Cutaneous Reflexes

Cutaneous reflexes are those that result from the stimulation of **cutaneous (skin) receptors**.

1. **Plantar reflex (Babinski)**
The plantar reflex is elicited by cutaneous receptors of the foot rather than deep receptors in muscles or tendons. This requires uninterrupted conduction of impulses along the motor tracts L4-S2. Damage anywhere along these pathways produces **Babinski's Sign** to this stimulation where the big toe extends and the other toes fan laterally. Babinski's sign is normal in infants whose neural control is not yet fully formed (nerves have not fully myelinated). Watch the video

a. What movement was observed?

PART C – Cranial Reflexes

Cranial reflexes are a type of reflex mediated by the brain. **Pupillary reflexes** are centered in the brainstem and involve cranial nerves (C1-C3) and **autonomic** reflex centers. To test this reflex, you will need a mirror in a dark or dimly lit room. Close your eyes for 20-30 seconds until eyes dilate. Simultaneously, turn on light and open eyes while looking directly into mirror. To exaggerate the reflex, you can shine a light towards the eyes after letting them dilate. Test on yourself then watch the video to compare.

a. What is the advantage of this response?

b. Which division of the peripheral nervous system was active during the pupillary reflex? _____

PART D – Follow Up Questions

1. Put these components of the reflex arc in the order in which nerve signals pass through them.
   ____ Association neuron
   ____ Effector
   ____ Motor Neuron
   ____ Receptor
   ____ Sensory neuron

2. Complete each statement with the correct term.

- Afferent neurons are _____ neurons.
- Efferent neurons are _____ neurons.
- How many synapses are crossed in a typical polysynaptic reflex **arc**? _____
- Interneurons are located within the _____
- In the biceps reflex demonstration, the biceps muscle was the effector. One or more _____ receptors were stimulated in the tendon.
- _____ reflexes result from the stimulation of sensory receptors in the skin.

3. Suppose a person has spinal cord damage at the **C6-C7** level. Would this stop the knee-jerk reflex? How would it affect the pupillary reflex? Explain.