

THE REFLEX ARC AND REFLEXES

MATERIALS NEEDED

Textbook
Rubber percussion hammer

A reflex arc represents the simplest type of nerve pathway found in the nervous system. This pathway begins with a receptor at the dendrite end of a sensory (afferent) neuron. The sensory neuron leads into the central nervous system and may communicate with one or more interneurons. Some of these interneurons, in turn, communicate with motor (efferent) neurons, whose axons (nerve fibers) lead outward to effectors.

Thus, when a sensory receptor is stimulated by some kind of change occurring inside or outside the body, nerve impulses may pass through a reflex arc, and, as a result, effectors may respond. Such an automatic, subconscious response is called a reflex.

Most reflexes demonstrated in this lab are stretch reflexes. When a muscle is stretched by a tap over its tendon, stretch receptors called *muscle spindles* are stretched within the muscle, which initiates an impulse over a reflex arc. A sensory (afferent) neuron conducts an impulse from the muscle spindle into the gray matter of the spinal cord, where it synapses with a motor (efferent) neuron, which conducts the impulse to the effector muscle. The stretched muscle responds by contracting to resist or reverse further stretching. These stretch reflexes are important to maintain proper posture, balance, and movements. Observations of many of these reflexes in clinical tests on patients may indicate damage to a level of the spinal cord or peripheral nerves of the particular reflex arc.

PURPOSE OF THE EXERCISE

To review the characteristics of reflex arcs and reflex behavior and to demonstrate some of the reflexes that occur in the human body.

LEARNING OBJECTIVES

After completing this exercise, you should be able to

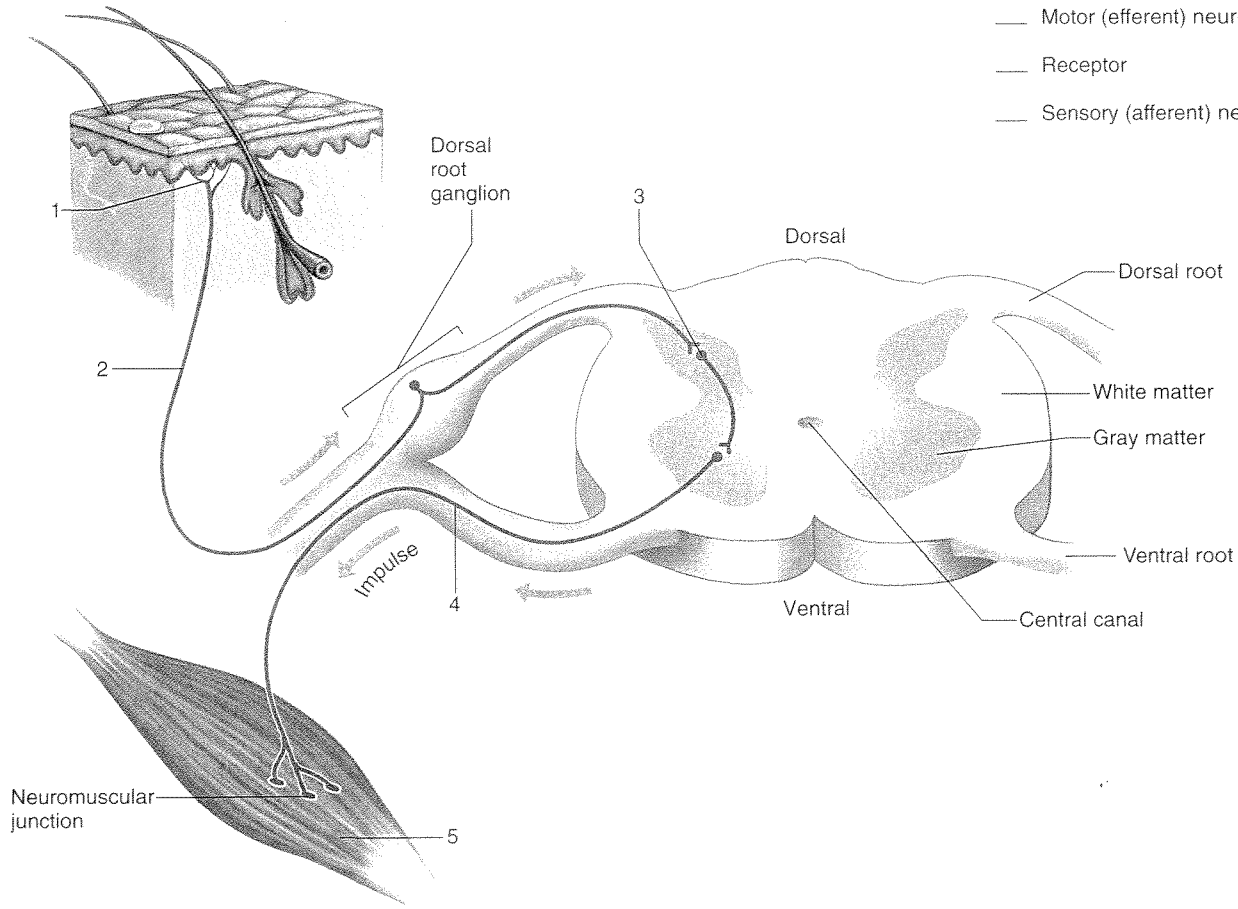
1. Describe a reflex arc.
2. Distinguish between a reflex arc and a reflex.
3. Identify and demonstrate several reflex actions that occur in humans.

PROCEDURE

1. Review the section entitled "Reflex Arcs" in chapter 11 of the textbook.
2. As a review activity, label figure 28.1.
3. Complete Part A of Laboratory Report 28.
4. Work with a laboratory partner to demonstrate each of the reflexes listed. (See fig. 28.2 also.) *It is important that muscles involved in the reflexes be totally relaxed in order to observe proper responses.* After each demonstration, record your observations in the table provided in Part B of the laboratory report.
 - a. *Knee-jerk reflex (patellar reflex).* Have your laboratory partner sit on a table (or sturdy chair) with legs relaxed and hanging freely over the edge without touching the floor. Gently strike your partner's patellar ligament (just below the patella) with the blunt side of a rubber percussion hammer. The normal response is a moderate extension of the leg at the knee joint.
 - b. *Ankle-jerk reflex.* Have your partner kneel on a chair with back toward you and with feet slightly dorsiflexed over the edge and relaxed. Gently strike the calcaneal tendon (just above its insertion on the calcaneus) with the blunt side of the rubber hammer. The normal response is plantar flexion of the foot.
 - c. *Biceps-jerk reflex.* Have your partner place a bare arm bent about 90° at the elbow on the table. Press your thumb on the inside of the elbow over the tendon of the biceps brachii, and gently strike your finger with the rubber hammer. Watch the biceps brachii for a response. The response might be a slight twitch of the muscle or flexion of the forearm at the elbow joint.
 - d. *Triceps-jerk reflex.* Have your partner lie supine with an upper limb bent about 90° across the abdomen. Gently strike the tendon of the triceps brachii near its insertion just proximal to the olecranon process at the tip of the elbow. Watch the triceps brachii for a response. The response might be a slight twitch of the muscle or extension of the forearm at the elbow joint.

Figure 28.1 Label this diagram of a withdrawal (polysynaptic) reflex arc by placing the correct numbers in the spaces provided. Most reflexes demonstrated in this lab are stretch (monosynaptic) reflex arcs and lack the interneuron.

- ___ Effector
- ___ Interneuron
- ___ Motor (efferent) neuron
- ___ Receptor
- ___ Sensory (afferent) neuron



e. *Plantar reflex*. Have your partner remove a shoe and sock and lie supine with the lateral surface of the foot resting on the table. Draw the metal tip of the rubber hammer, applying firm pressure, over the sole from the heel to the base of the large toe. The normal response is flexion of the toes and plantar flexion of the foot. If the

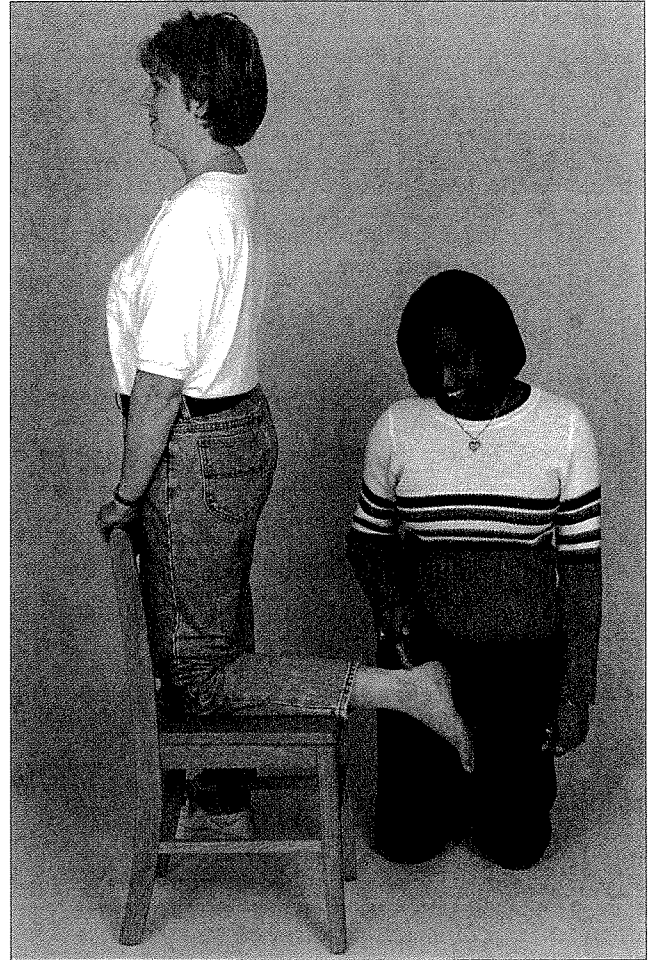
toes spread apart and dorsiflexion occurs, the reflex is the abnormal *Babinski reflex* response (normal in infants until the nerve fibers have complete myelination).

5. Complete Part B of the laboratory report.

Figure 28.2 Demonstrate each of the following reflexes: (a) knee-jerk reflex; (b) ankle-jerk reflex; (c) biceps-jerk reflex; (d) triceps-jerk reflex; and (e) plantar reflex.



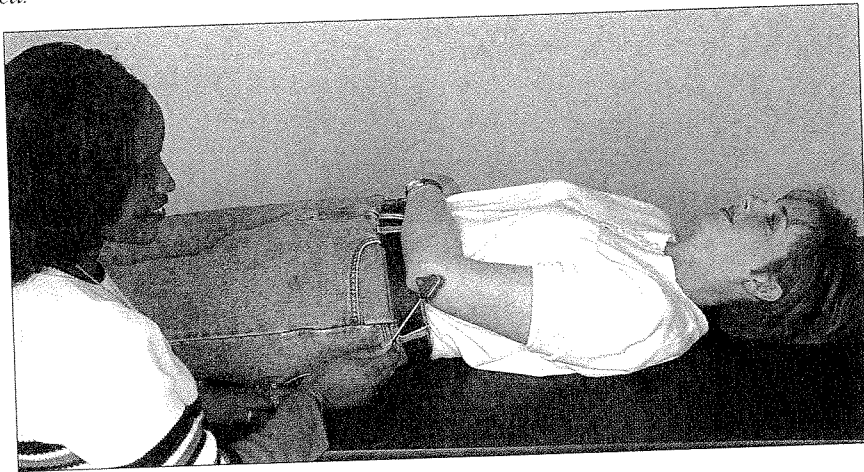
(a) Knee-jerk reflex



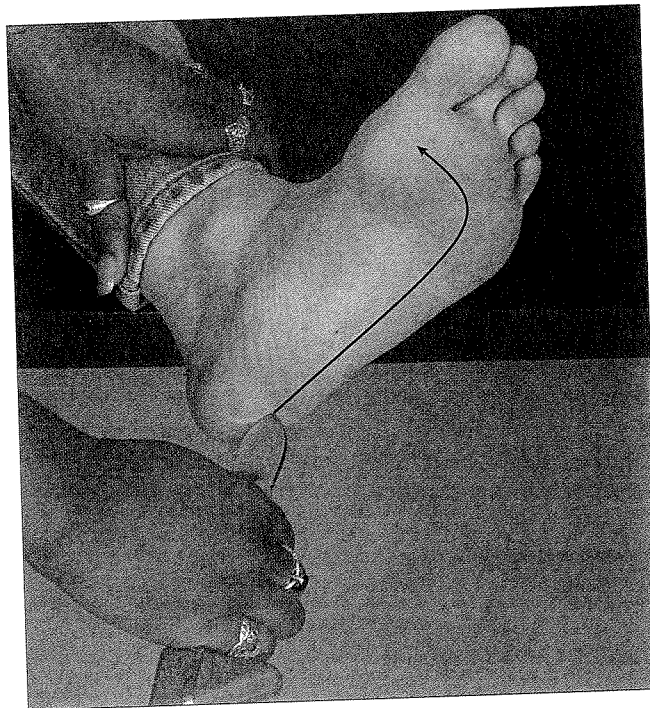
(b) Ankle-jerk reflex



(c) Biceps-jerk reflex



(d) Triceps-jerk reflex



(e) Plantar reflex