**ANS Reflex Physiology lab**

**Objectives:**

To understand what reflexes are, the processes involved, and purpose of reflexes.

**Introduction:**

A reflex is an involuntary neural response to a specific sensory stimulus that threatens the survival or homeostatic state of an organism. Reflexes exist in the most primitive of species, usually with a protective function for animals when they encounter external and internal stimuli. In humans and other vertebrates, protective reflexes have been maintained and expanded in number. Examples are the gag reflex that occurs when objects touch the sides or the back of the throat, and the carotid sinus reflex that restores blood pressure to normal when baroreceptors detect an increase in blood pressure. A second type of reflex, the stretch reflex, has evolved to help maintain muscle tone that is important for posture and movement. Reflexes can be categorized into one of two large groups: autonomic reflexes and somatic reflexes. Autonomic (or visceral) reflexes are mediated through the autonomic nervous system, and we are not usually aware of them. These reflexes active smooth muscles, cardiac muscles, and the glands of the body and they regulate body functions such as digestion, elimination, blood pressure, salivation, and sweating. Somatic reflexes include all those reflexes that involve stimulation of the skeletal muscles by the somatic division of the nervous system. An example of such a reflex is the rapid withdrawal of a hand from a hot object. An understanding the neural circuitry underlying each type of reflex also has clinical significance. When physicians test for potential damage to various components of the nervous system, they often begin by attempting to elicit reflex responses to the appropriate stimuli. Examples of reflexes with protective and diagnostic importance are the flexor withdrawal reflex, the corneal (blink) reflex, and the accommodation reflex. The loss of the papillary light reflex in a comatose patient often indicates extreme damage deep in the brain. Loss of the knee-jerk response may indicate problems with muscle tone, chronic diabetes, or damage at the L2, L3, or L4 vertebral level. All reflex arcs have five basic components: 1) a sensory receptor, 2) a sensory (or afferent) neuron, 3) interneurons, 4) a motor (or efferent) neuron, and 5) an effector organ (muscle fibers, or glands).

**Pre-Lab Questions**

1. What is a reflex? What is a reflex arc?

2. Explain the *differences* between the two basic types of reflexes.

3. Why do physicians test your reflexes?

4. What are the components of the Withdrawal Reflex Arc & the Knee-Jerk Reflex?

**Part I: Stretch Reflexes**

**Initiating the Stretch Reflex**

Stretch reflexes are important postural reflexes, normally acting to maintain posture, balance, and locomotion. Stretch reflexes are initiated by tapping a tendon, which stretches the muscle the tendon is attached to (the *Quadriceps femoris* muscle). This stimulates the muscle spindles and causes reflex contraction of the stretched muscle or muscles, which resists further stretching. Even as the primary stretch reflex is occurring, impulses are being sent to other destinations as well. For example, branches of the afferent fivers also synapse with interneurons controlling antagonist muscles. The inhibition of antagonist muscles that follows, called *reciprocal inhibition*, causes them to relax and prevents them from resisting (or reversing) the contraction of the stretched muscle caused by the main reflex arc. Additionally, impulses are relayed to higher brain centers to advise of muscle length, speed of shortening, and the like – information needed to maintain muscle tone and posture. Stretch reflexes tend to be absent or hypoactive in cases of peripheral nerve damage or ventral horn disease, and hyperactive in corticospinal tract lesions. They are absent in deep sedation and coma.

**Procedures:**

**A. Patellar Reflex**

1) Have your partner relax & sit on the edge of a table with his/her legs dangling loosing over the edge.

2) The experimenter should apply the stimulus by tapping, firmly, but carefully, the area just below the kneecap with the reflex hammer. (Do not hurt your partner!)

3) Test both knees and record your observations.

4) Test the effect of mental distraction on the patellar reflex by having the subject add a column of three-digit numbers or some other similar task (singing a song, reciting the alphabet backwards, etc) while you test the reflex again. Is the response greater than or less than the original response? Explain.

5) Test the effect of muscular activity occurring simultaneously in other areas of the body. Have the subject clasp the edge of the table and vigorously attempt to pull it upward with both hands. At the same time, test the patellar reflex again. Is the response more or less vigorous than the first response? Explain.

6) Fatigue also influences the reflex response. The subject should jog in position until she or he is *very* fatigued (no slacking!!). Test the patellar reflex again and record whether it is more or less vigorous than the first response.

7) Switch roles & repeat. Record all observations

**B. Achilles Reflex**

1) With your shoe removed and your foot dorsiflexed slightly (pointed up) to increase the tension in your *gastrocnemius* muscle (calf muscle) have your partner sharply tap your Achilles tendon with the reflex hammer. The experimenter should hold the subject’s ankle by supporting the foot lightly in the hand & then tap the tendon just above the ankle. Record your results.

2) Switch roles & repeat.

**C. Plantar Reflex**

The *plantar reflex,* an important neurological test, is elicited by stimulating the cutaneous receptors in the sole of the foot. In adults, stimulation of these receptors causes the foot to flex and move closer together. Damage to the corticospinal tract, however, produces *Babinski’s sign*, an abnormal response in which the toes flare and the great toe moves in an upward direction. (In newborn infants, Babinski’s sign is observed due to incomplete myelination of the nervous system).

1) Have the subject remove a shoe and lie on the table with knees slightly bent and thighs rotated so that the lateral side of the foot rests on the table. Alternatively, the subject may sit up and rest the lateral surface of the foot on a chair. Draw the end of a pencil, a ruler, or your finger, firmly down the lateral side of the exposed sole from the heel to the base of the great toe. Record the response. Is this a normal plantar reflex or Babinski’s sign?

2) Switch roles & repeat.

**Part II: Autonomic Reflexes**

The autonomic reflexes include the papillary, ciliospinal, and salivary reflex, as well as a multitude of other reflexes.

**A. Papillary Reflex**

There are several types of papillary reflexes. The papillary light reflex and the consensual reflex are two. In both of these reflexes, the retina of the eye is the receptor, the optic nerve is contains the afferent neurons, the oculomotor nerve is responsible for conducting motor impulses to the eye, and the smooth muscle of the iris is the effector. Many central nervous system centers are involved in the integration of these responses. Absence of the normal papillary reflexes is generally a late indication of severe trauma or deterioration of the vital brain stem tissue due to metabolic imbalance.

1) The lights must be dimmed in the room to conduct this portion of the lab. Before beginning, obtain a metric ruler to measure and record the size of the subject’s pupil as best you can. Record the size (in mm) for both the right and left pupils.

2) Stand to the left of the subject to conduct the testing. The subject should shield his or her right eye by holding a hand vertically between the eye and the right side of the nose. Shine a flashlight into the subject’s left eye. Record the response and measure the size of the pupil to the best of your ability.

3) Observe the right pupil. Has the same type of change (called a consensual response) occurred in the right eye? Measure the size of the right pupil to the best of your ability.

4) Switch roles and repeat.

The consensual response or any reflex observed on one side of the body when the other side has been stimulated, is called a contralateral response. The papillary light response, or any reflex occurring on the same side stimulated is referred to as an ipsilateral response.

5. Was the sympathetic *or* the parasympathetic division of the autonomic nervous system active during the testing of these reflexes?

6. What is the function of these papillary reflexes?

**Post Lab**

1) Draw a detailed diagram of the spinal cord on a separate sheet of white paper. **Label all parts**. Include this diagram in your lab notebook.

2) Draw arrows to indicate the pathway of a reflex. The textbook has an example. Colored pencils may be helpful to distinguish the pathways & components of the different reflexes.

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per \_\_\_\_\_\_\_\_\_\_\_

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**Part 1: Stretch Reflexes**

**A. Patellar Reflex**

3. Observations

4. Mental Distraction Observations: Is the response greater than or less than the original response? Explain.

5. Muscular Activity Distraction Observations: Is the response more or less vigorous than the first response? Explain.

6. Fatigue Observation: Is the response more or less vigorous than the first response?

**B. Achilles Reflex**

1. Observations

**C. Plantar Reflex**

1. Record the response. Is this a normal plantar reflex or Babinski’s sign?

**Part II: Autonomic Reflexes**

**A. Papillary Reflex**

1. Size of right pupil \_\_\_\_\_mm Size of left pupil \_\_\_\_\_mm

2. Size of left pupil \_\_\_\_\_mm

3. Size of right pupil \_\_\_\_\_mm

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6. What is the function of these papillary reflexes?

**Post Lab**

1) Draw a detailed diagram below of the spinal cord. Label all parts.

2) Draw arrows to indicate the pathway of a reflex. Colored pencils may be helpful to distinguish the pathways & components of the different reflexes.