Name: ______________________________ *Lab Time:* __________

BIO 201 — Human A & P 1

Lab 11 Nervous System Supplement

Part A: Reflexes

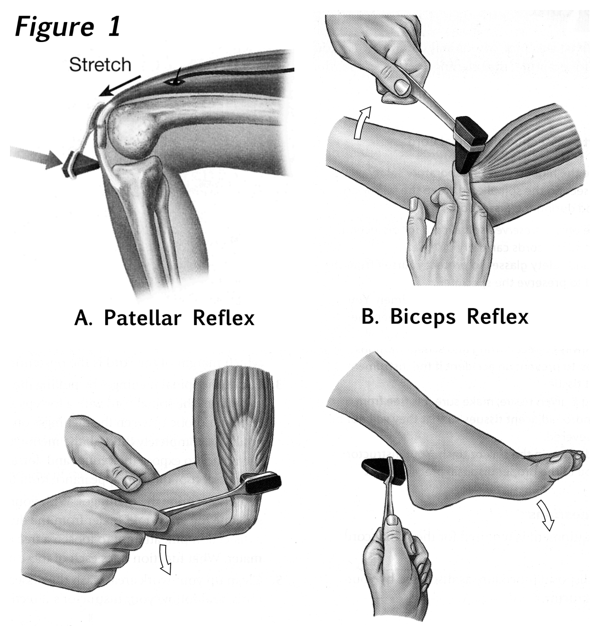
Reflexes are involuntary, predictable responses to particular stimuli and have a homeostatic function. The simplest functional unit of the nervous system, capable of receiving a stimulus and responding to it, is the **reflex arc**. All reflex arcs feature five components: the **sensory receptor** that receives stimulus (you will examine several general sensory receptors in this lab and specialized sensory receptors in a later lab), an **afferent** or **sensory neuron** that transmits information from the receptor to the central nervous system (CNS), an **integration center** in the CNS that involves one or more synapses and usually interneurons, an **efferent** or **motor neuron** that sends signals to the **effector**, the muscle or gland that produces a response. A simple somatic reflex arc (i.e. one that involves the skeletal muscles as effectors) is illustrated in Fig. 13.7 (pg 246) of your lab manual. Even though your skeletal muscles are under voluntary control, they are also controlled by involuntary reflexes. Since such reflex pathways are short and involve very few synapses, they can produce a faster response than involving conscious processes. Such a fast response is repsonsible for helping to maintain body position and posture as well as to retract the body from potentially harmful stimuli.

We will examine the simplest of reflexes, the **stretch reflexes**. The sensory receptor for a stretch reflex is the muscle spindle, which you will observe as a separate part of this lab (see pages 247-248). This receptor is imbedded in skeletal muscle (it is in fact a highly modified muscle fiber) and produces action potentials along the afferent neuron whenever it is stretched, indicating that the muscle has been stretched. Impulses from the afferent neuron reach the spinal cord where signals are transmitted to the appropriate motor neurons for that same muscle, stimulating the muscle to contract to counteract the stretching. By quickly striking a muscle or tendon, the muscle will be temporarily stretched enough to stimulate the reflex and produce a visible response. You will produce and observe four commonly used stretch reflexes, the patellar reflex, biceps reflex, triceps reflex, and ankle calcaneal reflex. These reflex tests are important clinically as they test the conduction of major nerves.

Procedure 1: The Patellar Reflex

1. The patellar reflex is a monosynaptic reflex arc, in that the sensory neuron synapses directly on the motor neuron without intervening interneurons. It tests the function of the femoral nerve.
2. One person, the subject, should be sitting on a stool so that the feet are hanging free and not touching the ground.
3. The other lab partner, the tester, should use the reflex hammer to strike the patellar ligament on the anterior surface of the knee, about 3-4 cm below the inferior edge

Figure 1



A. Patellar Reflex B. Biceps Reflex C. Triceps Reflex D. Ankle Calcaneal Reflex of the patella (Fig. 1A). The strike should be firm but not so hard that it hurts (unless the subject owes the people the tester works for a lot of money).

4. Observe the lower leg and note the degree of extension. Indicate if it is normal (foot moves a few inches), hyperreflexic (extensive leg movement) or hyporeflexic (little or no leg movement):

Procedure 2: The Biceps Reflex

1. The biceps reflex tests the function of the musculocutaneous nerve.
2. The subject should be sitting with their arm supinated (palm up) and resting on their lap.
3. The tester should place two fingers in antecubital fossa of the forearm (the inside bend of the elbow) and tap the fingers with the reflex hammer (Fig. 1B). There should be a visible contraction of the biceps brachii muscle but it probably will not result in arm movement.
4. Observe the biceps brachii muscle for a contraction and describe your observation:

Procedure 3: The Triceps Reflex

1. The triceps reflex tests the function of the radial nerve.
2. The subject should be sitting with their arm flexed and held across the abdomen.
3. The tester should use the reflex hammer to tap the triceps brachii muscle about 2 inches proximal to the olecranon process (elbow) (Fig. 1C).
4. Observe the triceps brachii muscle for a contraction and describe the response:

Procedure 4: The Ankle Calcaneal Reflex

1. The ankle calcaneal (or achilles tendon) reflex tests the tibial nerve.
2. The subject should be sitting on the lab chair, with one leg extended so that it doesn't touch the ground. Alternatively, the subject can be kneeling on the lab chair.
3. The tester should use the reflex hammer to tap the calcaneal tendon just above the ankle (Fig. 1D).
4. Look for plantar flexion of the foot (there may be two movements: the first in direct response to hitting the tendon, followed by a pause and the actual reflex flexion). Describe your observation:

Part B: Testing the General Senses

Follow the procedures in your lab manual to observe common sensory receptors on the skin model: **tactile** (or Meissner's) **corpuscles**, **lamellar** (or Pacinian) **corpuscles**, **bulbous** (or Ruffini's) **corpuscles**, **free nerve endings**, and **hair follicle receptors** and note their locations and functions (bulbous/Ruffini's corpuscles are only on one of the models). Two of these, tactile corpuscles and lamellar corpuscles, are also observable in prepared slides. Both tactile and lamellar corpuscles are involved in sensing touch, but respond to different aspects. Tactile corpuscles are sensitive to light touch while the deeper lamellar corpuscles sense pressure and vibrations. We will use several common techniques used to measure tactile sensitivity.

Most receptors are subject to **adaptation**, that is, their response to a repeated stimulus declines over time. They become less sensitive following repeated stimulation. Adaptation can be peripheral, where the sensory receptor becomes less sensitive, or central, where the receptor continues to send signals to the CNS but the CNS filters out repetitive information. The pace of adaptation also varies. **Phasic receptors** adapt quickly to repeated stimuli and can be thought of as providing information about a *change* in conditions. In contrast, **tonic receptors** adapt much more slowly or not at all and provide information about the current state of conditions. Nociceptors that produce the sensation of pain and **proprioceptors** that provide information about body position both tend to be tonic receptors.

Procedure 5: Two-Point Discrimination Test

1. Two-point discrimination is the ability to detect two points of contact with the skin as separate points instead of a single point. It is dependant on the density of the sensory receptors: the greater the density, the smaller the distances that can be discriminated.
2. The subject should sit with their eyes closed and hand resting on the lab counter with the palm up.
3. The subject's lab partner, the tester, should use the finer points of a caliper (used to measure inside diameters) to touch the subject's skin on the fingertips.
4. Starting with the smallest possible distance between the points, gently place the points on the tip of the finger, being sure that both points touch simultaneously, and have the subject report if they feel one or two points of contact.
5. Gradually increase the distance between the points a few millimeters at a time until the subject reports feeling two points. Record your results in the table on the following page.
6. Repeat the procedure on the palm, posterior forearm and shoulder or neck and record these results also.

Distance between 2 points (mm)	Indicate if subject felt 1 or 2 points:			
	Fingertip	Palm	Forearm	Shoulder or neck

Procedure 6: Tactile Receptor Distribution

1. In this experiment you will determine the distribution of fine-touch receptors (such as tactile corpuscles and Merkel disks).
2. Using a *non-permanent* fine-point marker (such as an erasable overhead marker; *not* a Sharpie), draw a 2cm by 2 cm square on the subject's anterior forearm.
3. Using a bristle attached to a paintbrush handle, gently touch the bristle to the subject so that the bristle bends slightly. Too strong pressure will activate other, deeper receptors.
4. *Without looking*, have the subject note if they feel the touch and if so, mark the spot with a non-permanent marker.
5. Record the total number of points at which the subject was able to detect the bristle.

   These represent the location of fine-touch receptors: ________
6. Repeat these procedures on the posterior surface of the arm: ________

Procedure 7: Thermoreceptors

1. Temperature is not sensed using distinctive sensory structures, and instead appears to be detected by structurally unspecialized free nerve endings (dendrites). To measure the distribution of temperature receptors you will emply a procedure similar to Procedure 6, above.
2. Mark a 2 x 2 cm square on the subject's anterior foream using a non-permanent marker.
3. The tester should obtain a blunt probe that has been sitting in either warm or ice cold water (without the subjects knowledge of which one) and quickly (before it returns to room temperature) touch it inside the square on the forearm.
4. Mark the area with a blue (or similar color) if the subject was able to determine that the probe was cold, and mark the area with a red (or similar) spot if the subject was able to determine if the probe was warm.
5. Count up and record the number of red spots (____) and the number of blue spots (____).
6. What was the ratio of cold (blue) to warm (red) receptors? ___________

Procedure 8: Receptor Adaptation

1. You will determine if light touch receptors are **phasic** (adapt rapidly) or **tonic** (show little adaptation). Based on your own experience, which do you think they will be?
2. Cut out a small 2 cm x 2cm piece of paper and crumple it into a small pea-sized ball.
3. The subject should rest his/her arm on the lab bench with the hand open and palm up.
4. The tester should use a pair of forceps to place the paper ball on the palm of the subject. The subject should report when they no longer feel the ball on their palm. How long did it take for adaptation to take place: _______ seconds.
5. Are the light touch receptors of your palm phasic receptors or tonic receptors?

Procedure 9: Proprioception

1. **Proprioception** is the ability to detect the position and tension of various body parts. To test for this ability the subject will try to replicate the arm position after moving without using visual cues.
2. Using the dominant hand, the subject should hold a pen or marker vertically so that the tip touches the middle of a piece of paper. Be sure that the point of contact is marked on the paper. No part of the arm should be resting on the lab bench.
3. The subject should then close their eyes and keep them closed for a few moments.
4. *Without opening their eyes*, the subject should lift the pen about 3-4 inches (8-10 cm) above the paper and then try to lower the pen to the same mark from which they lifted it.
5. Repeat this procedure 3 times, and for each, measure the distance from the starting spot to where the pen was lowered.
6. Repeat the experiment using the subject's non-dominant hand and a different colored pen.
7. Record the results in the following table:

	Distance (in mm) from starting point for	
Trial	Dominant hand	Non-dominant hand
1		
2		
3		
Mean		

8. Were your marks distributed evenly around the starting point or was their a directional bias?
9. Was there a difference in the accuracy between your right and left hands?