Reflex Physiology

Objectives
1. To define reflex, reflex arc, somatic reflex, autonomic reflex, and stretch reflex.
2. To name, identify, and to describe the function of each component of a reflex arc
   As you follow the instructions for this activity, it is your job to review any anatomy
   that you may have forgotten, as well as any type of movements (so in other words if
   you can’t remember what the patella or what dorsiflexion is off the top of your
   head→ take the initiative and GO LOOK IT UP).
3. To explain why reflex testing is an important part of physical examination
4. To describe the components of reflex arcs involved in the following types of reflex
   activities as observed in the lab (patellar reflex, Achilles reflex, corneal reflex, gag
   reflex, pupillary reflex, and cilio-spinal reflex); to indicate the functional importance
   of each.

Introduction
Overview: If someone throws a ball towards your head, you may react by catching the
ball, by ducking, or by blinking and turning your head. In each case, you must sense the
arrival of a signal (ie: the sight of the ball flying towards you), process this information,
and react to it.

Reflexes are rapid, unlearned, involuntary motor responses to stimuli. A reflex arc
is the neural pathway involved in accomplishing reflex activity. The reflex arc allows the
body to react automatically to a variety of internal and external stimuli so as to maintain
homeostasis. Nearly every function of the body involves reflexes. Reflexes can be
categorized into two groups: autonomic and somatic reflexes. Autonomic reflexes are
mediated through the autonomic nervous system using smooth muscle and glands as
effectors. They regulate body functions such as digestion, elimination, blood pressure,
salivation, and sweating. Somatic reflexes include all those reflexes that involve
stimulation of skeletal muscles by somatic division of the nervous system. An example
of such a reflex is the rapid withdrawal of a hand from a hot object. Some reflexes are
structurally and functionally simple, e.g., knee jerk reflex. Some are very complex, such
as those involved with controlling respiration and heart function. Nevertheless, all reflex
arcs consist of the following components: receptor, sensory neuron (or afferent pathway),
integrating center (CNS), motor neuron (or efferent pathway), effector.

Reflex testing is another way of obtaining information about a patient by health care
personnel. Many of us are acquainted with some reflexes by virtue of having physical exams,
e.g., patellar reflex (knee jerk), biceps, triceps, corneal and Achilles’ tendon reflex.

In this lab, we will conduct several experiments to demonstrate the reflex responses
and to identify the components of the reflex arc involved in the reflexes. Most reflexes in
the human body are difficult to demonstrate in the lab, we will only test the reflexes that
are easily demonstrated in a teaching lab.

Somatic Reflexes

A. Stretch Reflex
The stretch reflex is a reflex in which stretching a particular muscle leads to its contraction. It is initiated by tapping a tendon, which stretches the muscle the tendon is attached to. This stimulates the muscle's stretch receptor (spindles) and causes reflex contraction of the stretched muscle(s), which resists further stretching. Stretch reflexes tend to be hypoactive or absent in cases of peripheral nerve damage, and hyperactive in corticospinal tract lesions. They are absent in deep sedation and coma. Test the following stretch reflexes:

1. **Patellar Reflex** (knee-jerk reflex)
   a) Work in pairs. Have the subject close his eyes (why?) and sit on the edge of the examining table with his/her legs dangling free.
   b) Locate the patellar ligament (Which muscle will be stretched if this ligament is tapped? ___________________________). What nerve innervates this muscle? ___________________________, palpate the soft tissue depression on either side of the ligament.
   c) Elicit the reflex by tapping the ligament with a reflex hammer at the level of the knee joint, using a short, smart wrist action, note the response.
   d) Is this a voluntary or involuntary reaction? Are you able to stop from doing this reaction?
   e) Test the effect of mental distraction on the patellar reflex by having do their times tables as quickly and accurately as they can aloud while you test the reflex again. Make certain that the times tables your partner is doing is difficult enough so he/she is focusing on the multiplication task. Is the response greater or less than the first time?
   f) Now test the effect of muscular activity occurring simultaneously in other areas of the body. Tap the patellar ligament while the subject performs the **Jendrassik's maneuver**, that is, to clap his/her hands in front of him/her and, with fingers locked, try vigorously to pull his/her hands apart. Is the response greater or less than the first time?
   g) Change places with your partner and repeat steps "a" through "e".
   h) Draw a diagram showing the reflex arc involved in the patellar reflex and label each component with specific structural names (like retina, spinal cord, sciatic nerve, biceps brachii, appropriate neurotransmitters... yes, you will have to research the texts) instead of general names (like receptor, controlling center, afferent pathway, and effector, etc.) Also, note that muscles operate in functional groups antagonistically to each other. So, for example, for the quadriceps to contract, the hamstrings have to relax. So you’re reflexes are actually a bit more complicated than just a simple contraction of one muscle group, but for simplicity of the lab we will focus on a single muscle.
   i) What is the effect of mental distraction and the Jendrassik's maneuver on the patellar reflex? Explain why mental distraction affects the reflex this way.
   j) Explain the protective function of this reflex.
   k) What would the result be if the result is not witnessed?

2. **Achilles Reflex** (ankle-jerk reflex)
a) Work in pairs. Have your subject close his/her eyes, and stand with one knee on a chair with ankle and foot projecting over the edge of the chair, the other leg on the floor and largely supporting the body weight.

b) Locate the Achilles tendon (Which muscle will be stretched if this tendon is tapped? _____________________________). What nerve innervates this muscle? _____________________________), place your thumb and fingers into the soft tissue depressions on either side of it.

c) Tap the tendon with the reflex hammer to induce a sudden, involuntary plantar flexion of the foot.

d) Change places with your partner and repeat steps "a" through "c".

e) Draw a diagram showing the reflex arc involved in the Achilles reflex and label each component with specific structural names (like retina, spinal cord, sciatic nerve, biceps brachii) instead of general names (like receptor, controlling center, efferent pathway, and effector, etc.). Explain the protective function of this reflex.

f) What would be the implications of this result is not witnessed?

B. Corneal Reflex

Move your hand suddenly toward your partner's eyes. The automatic closing of the eyelids is the protective corneal reflex to prevent eye injury. This reflex is mediated through the cranial nerve V. The absence of this reflex is an ominous sign because it often indicates damage to the brain stem resulting from compression of the brain or other trauma.

Draw a diagram showing the reflex arc involved in the corneal reflex and label each component. What is the function of this reflex?

C. Various other reflexes:

Peruse the following two table which summarizes the techniques for these reflexes:

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babinski's reflex</td>
<td>This reflex is elicited by stroking the sole of the foot from lateral to medial with the handle of the reflex hammer. Dorsiflexion of the great toe (toe #1) is considered normal. If the toe extends (plantar flexes) and the outer toes flare, this is positive for pyramidal tract lesions. This reflex is present in infants &lt; 6 months of age. This reflex is of necessity performed on bare feet. Perform this reflex test in the class room or somewhere outside the lab.</td>
</tr>
<tr>
<td>Ciliospinal reflex</td>
<td>Stroke/scratch/pinch – you work this out with your lab partner (umm... let's keep it appropriate please 😊)- the skin of the back of the neck and observe the pupils for dilation – this reflex takes two to do.</td>
</tr>
<tr>
<td>Triceps reflex</td>
<td>Percuss the triceps tendon. A positive response is that the forearm extends while the examiner holds the arm loosely in a bent position. To perform this test, the examiner stands next to the examinee, holding the examinee's upper arm in his or her hand – sling-like. The examiner then strikes the triceps tendon and observes the examinee's arm for extension of the forearm. Sometimes you may only see a “twitch” of the tendon after striking.</td>
</tr>
</tbody>
</table>
Biceps reflex: The idea here is to percuss the biceps insertion tendon and observe for forearm flexion. The technique is a bit different from the other reflexes. The examiner needs to grasp the examinee's arm in such a manner that his or her thumb rests on the biceps insertion tendon. The examiner strikes his or her OWN thumb (nail is best) with the pointed end of the reflex hammer. As it may be difficult to observe forearm flexion, the observer feels for and looks for a twitching in

Copy and expand the data table to record your results/observations in the table based on instructions from above:

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babinski's reflex</td>
<td></td>
</tr>
<tr>
<td>Ciliospinal reflex</td>
<td></td>
</tr>
<tr>
<td>Biceps reflex</td>
<td></td>
</tr>
<tr>
<td>Triceps reflex</td>
<td></td>
</tr>
</tbody>
</table>

D. Autonomic Reflexes

1. Pupillary Reflex
   The pupillary reflex is a protective change in the size of the pupils in response to a change in light intensity. Absence of the normal pupillary reflex is generally a late indication of severe trauma or deterioration of the vital brain stem tissue.
   a) Conduct the reflex testing in an area where the lighting is dim. Before beginning, obtain a metric ruler to measure and record the size of the subject's pupils:
      
      \[ \text{Rt. pupil} = \phantom{0} \phantom{0} \ mm \]
      \[ \text{Lt. pupil} = \phantom{0} \phantom{0} \ mm \]
   b) Stand to the left of the subject to conduct the testing. The subject should shield his/her right eye by holding a hand vertically between the eye and the right side of the nose.
   c) Shine a flashlight into the subject's Lt. eye. What is the pupillary response?
      \[ \text{Lt. pupil} = \phantom{0} \phantom{0} \ mm \]
   d) Observe the Rt. Pupil while light is shining in Lt. pupil. Has the same type of change (contralateral response) occurred in the Rt. eye?
      \[ \text{Rt. pupil} = \phantom{0} \phantom{0} \ mm \]
      Any reflex response observed on one side of the body when the other side has been stimulated is called a contralateral response.
   e) Draw a diagram showing the reflex arc involved in the pupillary reflex and label each component. What is the function of pupillary reflex?