

## REFLEX LAB - Advanced

**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. In this lab, you will explore how your nervous system allows you to react to signals from the world around you. You will measure your reaction times to various visual and auditory stimuli and observe the effects of several variables on these reaction times. You will also elicit and observe some innate reflexes.

### Ruler Station

- Holding your thumb and index finger 1 inch apart, catch the ruler when your partner drops it. Do this five times. Record the distance that the ruler fell.
- Repeat the experiment holding your fingers 3 inches apart. Record your results:

	1 inch	3 inches	Alphabet
<b>Trial 1</b>			
<b>Trial 2</b>			
<b>Trial 3</b>			
<b>Trial 4</b>			
<b>Trial 5</b>			
<b>Average Distance</b>			
<b>Reaction time</b>			

To calculate the **reaction time**, use the formula:

$$h = \frac{1}{2}gt^2$$

$$Gravitational Force (g) = 980 \left( \frac{cm}{s^2} \right)$$

$$Height(h) = Average Distance$$

$$t = \underline{\hspace{2cm}}$$

*Is there a difference in the calculated reaction time between the 1 inch and 3 inch trials? What could you learn from a series of experiments where the subjects fingers start at different separations?*

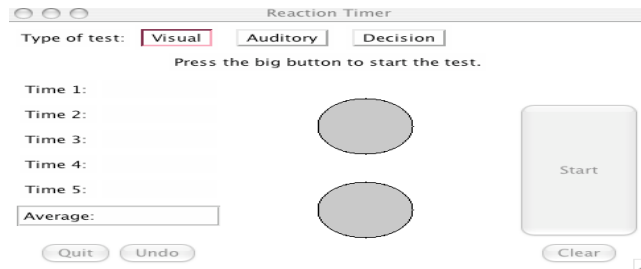
- Then, repeat the experiment with your dominant hand and 1 inch apart saying the alphabet backward (out loud) while waiting for the ruler to drop. Record your results in the chart above. Was there a difference in your reaction time depending on the hand that was used? Did the faster reaction time correspond to the dominant hand for each subject?**

*Did your reaction time increase or decrease while you were saying the alphabet? Explain why you think this happens.*

### **Concept Questions: Ruler Station**

1. How would you classify the process of catching the ruler as a reflex? Is this reflex: (circle one)  
Innate or acquired  
Somatic or visceral  
Spinal or cranial  
Monosynaptic or polysynaptic
2. Consider the 5 steps of a reflex arc (you should be able to look these up in any anatomy book). What are the components of the neural system involved in each of the 5 steps for the specific case of the subject catching the ruler?
3. You answered several questions asking if there was a difference between two runs of the experiment. Of course, no two measurements will ever come out identically the same. Explain how you would determine whether the difference between two runs of the experiment is significant (meaningful) or not?

## Computer Station



NOTE: USE THE REACTION TIMER IMAGE TO HELP GUIDE YOU THROUGH THE INSTRUCTIONS.

**1. Visual:** Click on the “Visual” button near the top of the window. You should see two gray circles and a big square labeled “Start” to the right of them. Click on the Start button. The top circle will turn red and the timer will wait for a few seconds. As soon as you see the red light on top switch to a green light on the bottom, click and release the big square (now labeled “End”) again. The timer will record your reaction time in the table to the left. Do this until 5 reaction times are obtained. If you click the End button before the light turns green, that test will not count. If you want to erase the last recorded time, click on the Undo button at the bottom. Record your results:

	Visual	Auditory Loud	Auditory soft	Decision
Time 1:				
Time 2:				
Time 3:				
Time 4:				
Time 5:				
Average:				

*How does your reaction time, as measured in this experiment, compare with the reaction times calculated in the first part of the ruler-drop section? Comment on any differences.*

**2. Auditory:** Now click on the button labeled “Auditory” to record your reaction time to an auditory stimulus. Again, click on the Start button to start the test. The light will turn red, the computer will wait a few seconds and then produce a beep. If you do not hear a beep for more than 10 seconds, make sure that the volume on the computer is turned up. Run the auditory test first with the volume turned up to produce a loud beep, then with the volume turned down for a softer (but still audible beep). As soon as you hear the beep, click on the big button again and your reaction time will be recorded. Record your results in the chart above for 5 reaction times for both the loud and soft beep.

*Was there a difference between your average reaction time for the visual and the auditory stimuli?*

**3. Run the auditory test first with the volume turned up to produce a loud beep, then with the volume turned down for a softer (but still audible beep).**

*Did you notice a difference in your reaction times? Why do you think a louder beep might lead to shorter (or longer) times?*

**4. Decision:** Now click on the button labeled “Decision”. Click the Start button to run the test. After a short pause, a picture will appear on the screen. Click the End button **only** if it is a picture of a cat. If the picture does not show a cat, it will disappear on its own in 2 seconds, or you can click on the Clear button to reset the test. If the picture is **not** a cat, re-click start to continue the test. Repeat until you measure 5 reaction times where you correctly clicked on the cat pictures only.

*Did your reaction time increase or decrease? Explain why.*

### **Concept Questions: Ruler and Computer Stations**

1. Consider again the 5 steps of a reflex arc.
  - (a) Which component(s) changed between the first ruler-drop experiment and the first experiment in this section?
  
  - (b) Which component(s) changed between steps 1 and 2 in this section?
  
  - (c) Which component(s) changed between steps 1 and 4 in this section?
  
2. (a) Use the data obtained in this experiment (or in the ruler station) to make a rough estimate of the average rate of signal propagation in your nervous system. (Hint= Distance X Time)
  - (b) List the events of conducting a signal from one part of the body to another.
  
3. Come up with another variable in the presented stimulus (eg: color of the dot, duration of the beep, etc.) that you think would influence the reaction times, and explain why you think the reaction times would differ? Would you expect the times to get longer or shorter using the modified stimulus you're proposing?

## **Reflex Station**

Work in teams of 2 – the subject and the experimenter. The subject should sit on a desk or someplace where his/her legs can dangle freely. The experimenter should try to elicit the **patellar reflex** (also known as the knee-jerk reflex). Using the side of your hand, tap one of the subject's legs just below the kneecap. You should not need to hit very hard! Trade roles so that all of you have a chance to be the subject.

*Is this a voluntary or involuntary reflex? Are you able to stop yourself from kicking your leg?*

*What are some variables that might affect the magnitude of the observed response?*

*If you have extra time, repeat the experiment while altering these variables and observe whether the response changes and, if so, in which direction.*

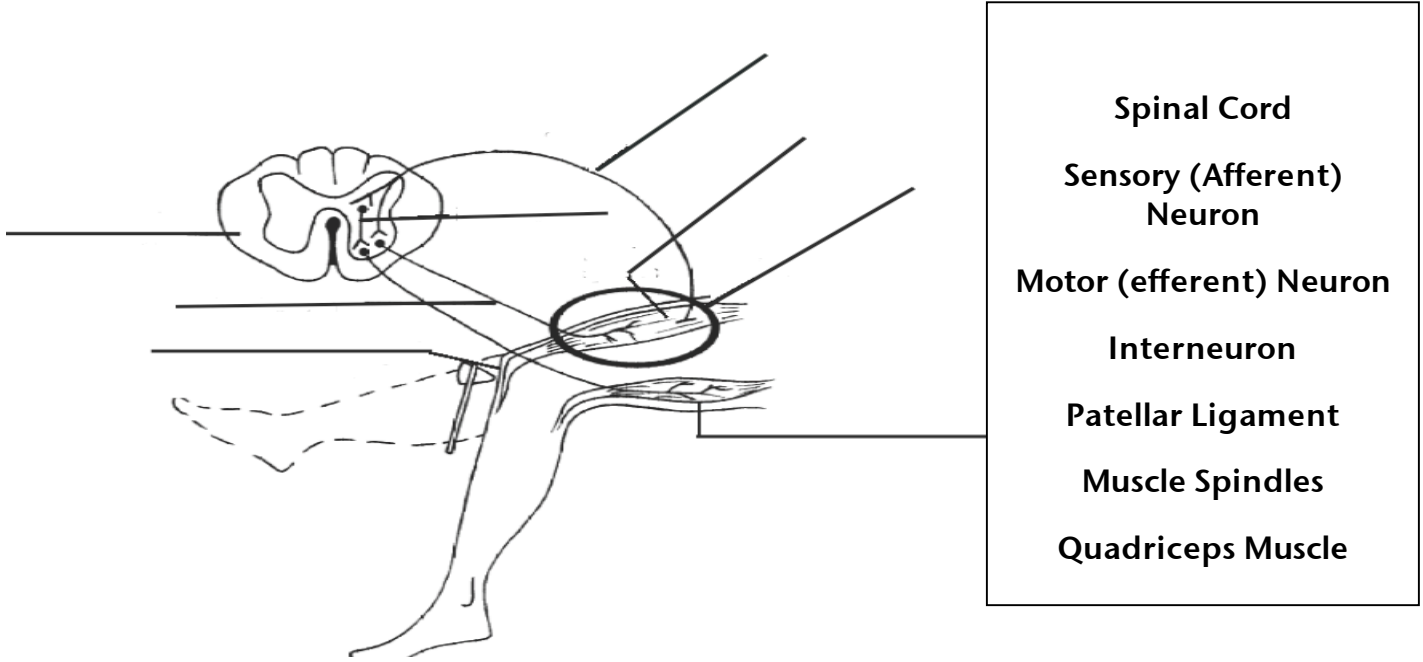
**Direct / consensual pupillary reflex:** If possible, dim the lights in the room. Hold a piece of cardboard at your nose, separating your left and right eye. The experimenter should briefly shine the penlight in the your left eye (5-10 cm away from the eye) and observe the size of the pupil in that eye. Wait a little while for the pupil to readjust and repeat the experiment, this time shining a light in the right eye while observing the left.

*What happened to the pupil in each eye when you shone the light in the left eye?*

*Is this a voluntary or involuntary reflex?*

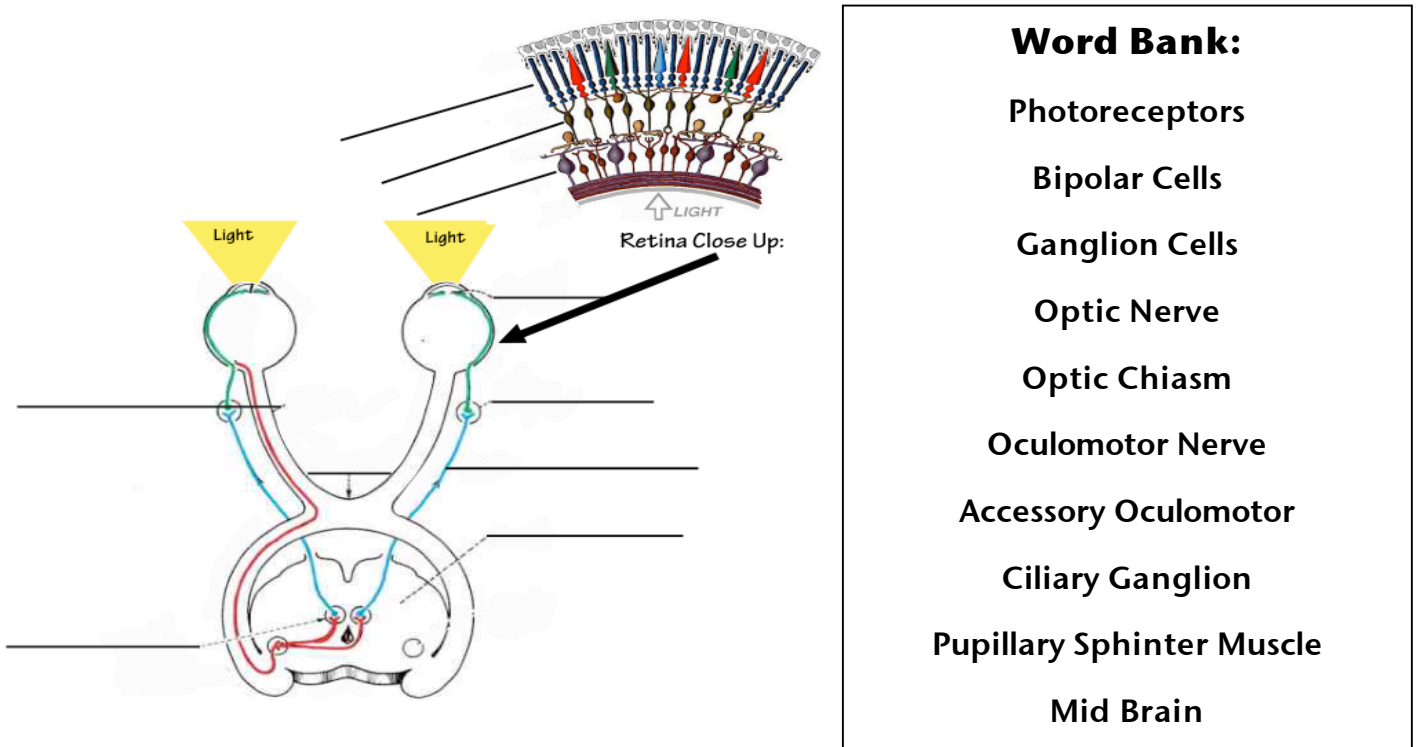
### Concept Questions: Patellar Reflex and Pupillary Reflex Stations

1. In the following diagram, label as many as possible of the components involved in the patellar reflex:



- Spinal Cord
- Sensory (Afferent) Neuron
- Motor (efferent) Neuron
- Interneuron
- Patellar Ligament
- Muscle Spindles
- Quadriceps Muscle

2. In the following diagram, label the nervous system components involved in both the direct (same eye) and consensual (opposite eye) pupillary light reflex:



- Word Bank:**
- Photoreceptors
  - Bipolar Cells
  - Ganglion Cells
  - Optic Nerve
  - Optic Chiasm
  - Oculomotor Nerve
  - Accessory Oculomotor
  - Ciliary Ganglion
  - Pupillary Sphincter Muscle
  - Mid Brain

At what point is the signal transmitted from one side of the body to the other? (Hint: Use the diagram)

3. (a) What is the role of the pupillary light reflex? Why is it important to us?  
(b) Can you think of a useful role for the knee jerk reflex?
4. Why do we need to have innate reflexes at all? Why do we need involuntary reflexes? Wouldn't we be better off being able to control everything that our body does?
5. Why do doctors measure reflexes during a diagnostic exam? What information can they get out of each of the reflexes observed above?

**References:**

Information on the nervous system -- Martini ,F.H. Fundamentals of Anatomy & Physiology

Patellar reflex figure obtained from -- Winter, S. "What's the Connection?", *from The Neural Sciences Activity manual.*

National Association of Biology Teachers; download from: [www.utsa.edu/tsi/assign/nlca/nlcapdf/05chp3.pdf](http://www.utsa.edu/tsi/assign/nlca/nlcapdf/05chp3.pdf)

Pupillary Light Reflex figure obtained from- <https://courses.stu.qmul.ac.uk/smd/kb/microanatomy/brain/CAL3/Image63.jpg>

Retina Layers figure obtained from- [http://www.medgadget.com/archives/img/retinal\\_layers.jpg](http://www.medgadget.com/archives/img/retinal_layers.jpg)

Literature review on the variables affecting reaction time --<http://biae.clemson.edu/bpc/bp/Lab/110/reaction.htm>