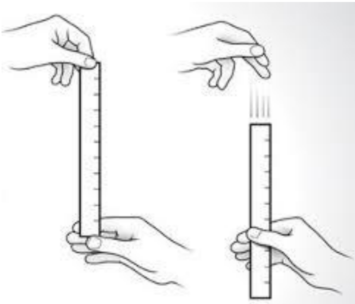
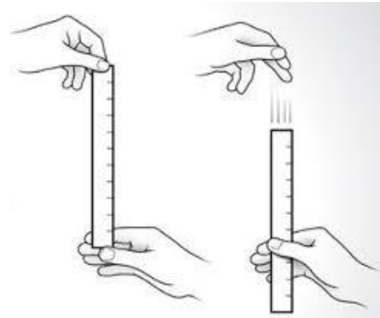
Name ___________________________________ Date _____________
AP Biology Mr. Collea



Reaction Times



Background Information:

Reflexes are primarily intended to protect you. Things like blinking your eye, the contraction of your pupil, or pulling your hand back from a hot surface are all reflex actions. Reflexes involve **sensory** and **motor neurons** of your **peripheral nervous system** and often **inter-neurons** of the spinal portion of your **central nervous system.** Reflexes don't require higher brain activity. If you touch a hot surface, you will actually pull your hand back before your brain perceives the heat.

Reaction time is a measure of how quickly an organism can respond to a particular stimulus. Reaction time has been widely studied, as its practical implications may be of great consequence, e.g. a slower than normal reaction time while driving can have grave results. Many factors have been shown to affect reaction times, including age, gender, physical fitness, fatigue, distraction, alcohol, personality type, and whether the stimulus is auditory or visual. Reactions require higher brain function. Putting your foot on the brake of the car when the car in front of you slows or comes to a stop is an example of a reaction. You must first see the leading car's brake lights; that information must be processed by your brain and a signal must be sent to the muscles of your back and legs. The signal not only tells you to step on the brake, but how hard to step on the brake.

This is a relatively simple lab in which you will attempt to catch a meter stick between your thumb and index finger to determine how far it falls before you react and catch it. The slower the reaction, the farther the meter stick will fall. You will then convert this distance into time to determine your reaction time. Differences in the reaction times to different stimuli can be compared to see if there is indeed a **SIGNIFICANT DIFFERENCE**.

<u>Hypothesis</u>:

Hypothesize which type of stimulus will elicit the fastest reaction time: **Visual** **Auditory** **Tactile**

Explain your Prediction:

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State your Null Hypothesis (H_o):

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Procedure:

1. A meter stick will be held vertically between the experimental student's thumb and index finger. The stick should be held so that the **10 cm** (.1 meter) mark is between the thumb and index finger. (*This makes it easier on the lab partner dropping the meter stick.*)

2. The lab partner will drop the meter stick and the experimental student must catch it between his/her thumb and index finger as quickly as possible. The distance the meter stick traveled before being caught will be measured in cm (*round to the nearest tenth*) and recorded in **Table 1**.

Remember to subtract the 10 cm that were below the finger level at the beginning of the experiment.

3. Repeat the procedure for a total of five trials and then **calculate** the average reaction distance **(d)** for visual stimuli and record your answer on **Table 1.**

4. The experimental student will now measure reaction to an auditory (sound) signal by having the experimental student will close his/her eyes and the lab partner will hold the meter stick as before. As the student scientist releases the meter stick he/she will say, "Now," and the experimental student will catch the meter stick. The distance will be measured and recorded on the **Table 1**. After five trials, **calculate** the average reaction distance **(d)** for the auditory stimuli and record your answer on **Table 1.**

5. Finally, the reaction distance for tactile (*touch*) stimuli will be measured. This time the experimental student will close his/her eyes, and the while the lab partner holds the meter stick in one hand, he/she places the other hand on the experimental student's shoulder. When the student scientist drops the meter stick, he/she should simultaneously lightly squeeze the experimental student's shoulder. After five trials, **calculate** the average reaction distance **(d)** for the tactile stimuli and record your answer on **Table 1.**

Table 1.

	Distance (cm)					
Stimulus	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Mean** (x)
Visual *(control)*						
Auditory						
Tactile						

6. **Calculate** the standard deviation and standard error for distance **(d)** of each of the stimuli.

VISUAL STIMULUS

Trial	(x)	Mean (x)	$x-\bar{x}$	$(x-\bar{x})^2$
1				
2				
3				
4				
5				

Standard Deviation:

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Standard Error:

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

$\Sigma(x-\bar{x})^2$ = ________

AUDITORY STIMULUS

Trial	(x)	Mean (x)	$x-\bar{x}$	$(x-\bar{x})^2$
1				
2				
3				
4				
5				

Standard Deviation:

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Standard Error:

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

$\Sigma(x-\bar{x})^2$ = ________

TACTILE STIMULUS

Trial	(x)	Mean (x)	$x-\bar{x}$	$(x-\bar{x})^2$
1				
2				
3				
4				
5				

Standard Deviation:

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Standard Error:

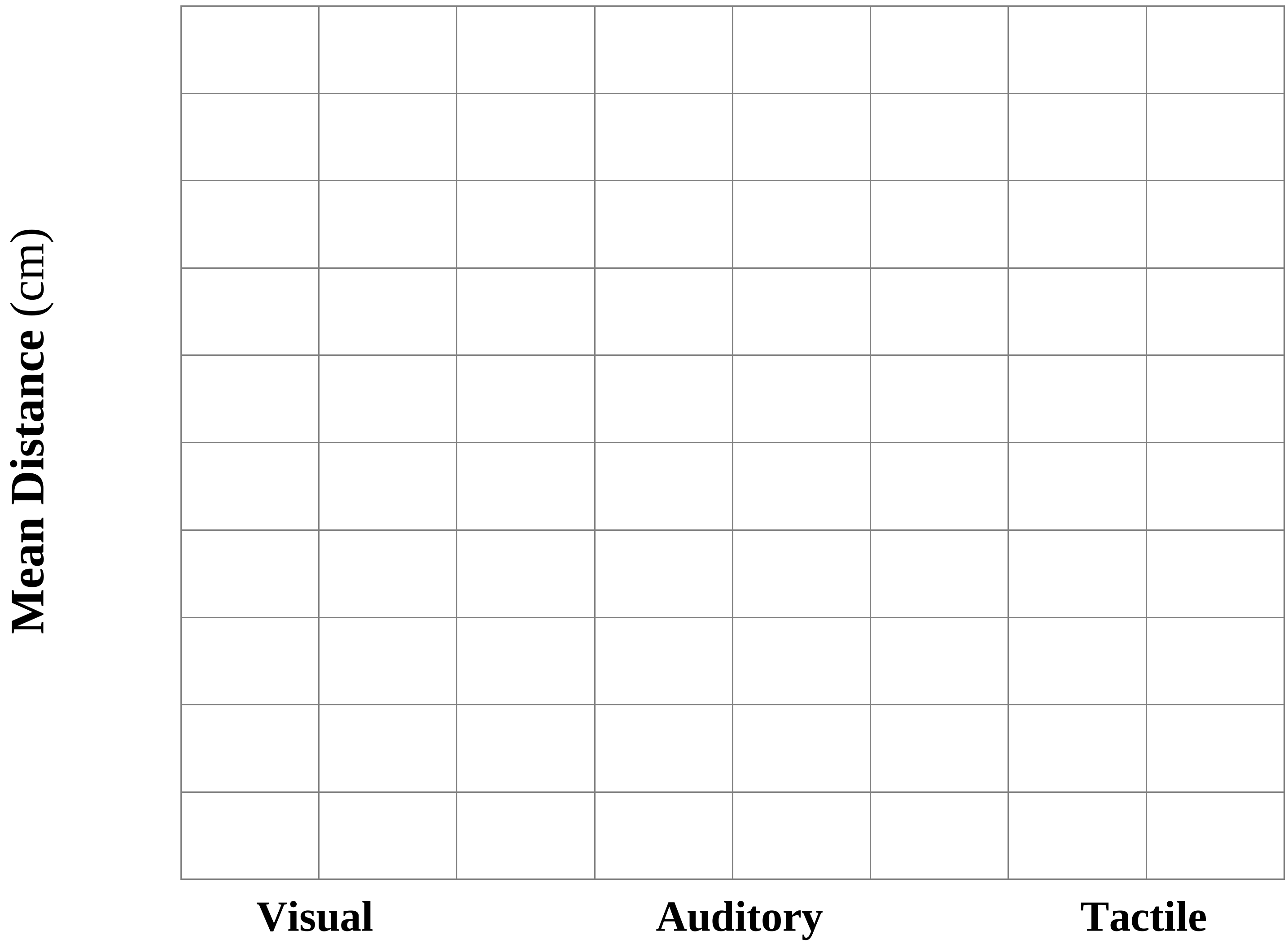
$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

$\Sigma(x-\bar{x})^2$ = ________

7. **Graph** the mean distance **(d)** for each stimulus on the grid below being sure to include error bars for **TWO** standard error measurements.

A common rule-of-thumb is that the 95% confidence interval is computed from the mean plus or minus two SEMs

Graph 1.



According to the graph, was there a ***significant difference*** between any of the results? **EXPLAIN**.

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8. Using the formulas below, **calculate** the reaction time (*seconds*) for each stimulus.

The formula is: $$t = \sqrt{\frac{2d}{g}}$$

[d = average distance (cm)]

[g = *standard acceleration of gravity 9.8* m/s^2 = **$980\ cm/s^2$**]

Reaction Time (milliseconds)		
Visual	**Auditory**	**Tactile**

9. **Calculate** the Chi-Square value to determine if there was a *significant* difference between the 3 reactions times using the Visual Stimulus as the expected value.

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51
0.01	6.64	9.21	11.34	13.28	15.09	16.81	18.48	20.09

Stimulus	**Time** *(milliseconds)*
Visual	
Auditory	
Tactile	

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

(a) Should you *accept* or *reject* the Null Hypothesis?

Visual vs Auditory	**Visual vs Tactile**
ACCEPT or REJECT	**ACCEPT or REJECT**

Analysis Questions:

10. Identify each of the following in this experiment:

Independent Variable: ____

Dependent Variable: ____

Controlled Variables: ____
(constants)
____

11. Specifically, how could you modify this experiment to get more reliable or valid results?

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12. Specifically, which parts of the nervous system were used when you responded to the dropped meter stick in the test for visual stimuli?

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13. If you continued to repeat the test for visual stimuli, do you think you would get faster? Why or why not?

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14. What factors would ultimately limit your speed of response?

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15. Do you think one's reaction time can be improved? If so, how?

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16. Did your reaction times improve over time as you performed each test?
Use the data table and graph below to help support your answer.

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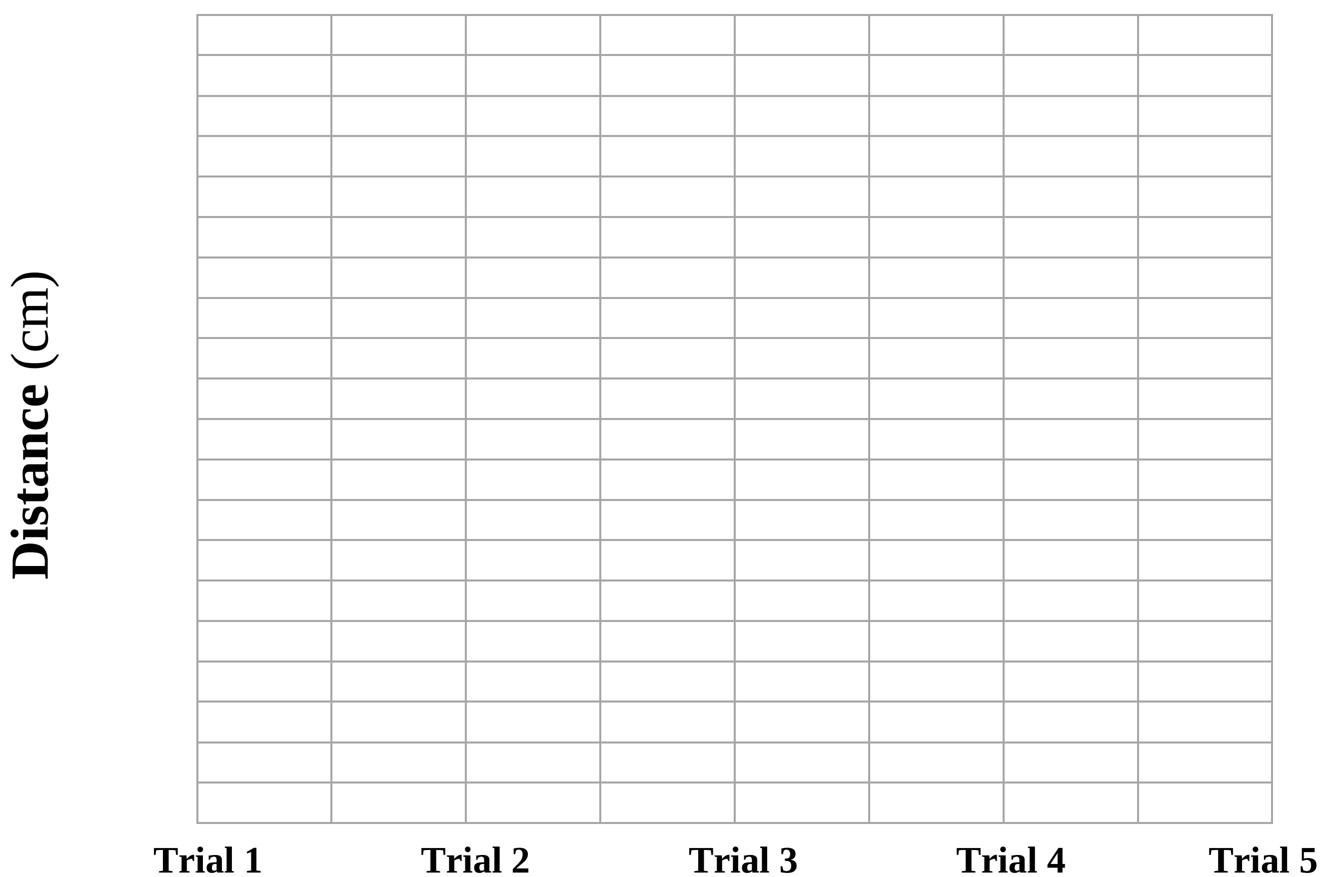
Table 2.

Distance (cm)					
Stimulus	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Visual					
Auditory					
Tactile					

Graph 2.



17. Measure the length of a dollar bill. Using your average reaction time, **predict** if you can catch the dollar bill if it is released from rest between your fingers. After writing down your prediction, try catching the dollar bill as see if it agrees with your prediction.

Can you catch a dollar bill? ________ Were you able to catch the dollar bill? ________

Was your prediction right? ________

18. How does the behavior displayed in this activity differ from a reflex?

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19. Label the diagram of the simple reflex arc to the right?

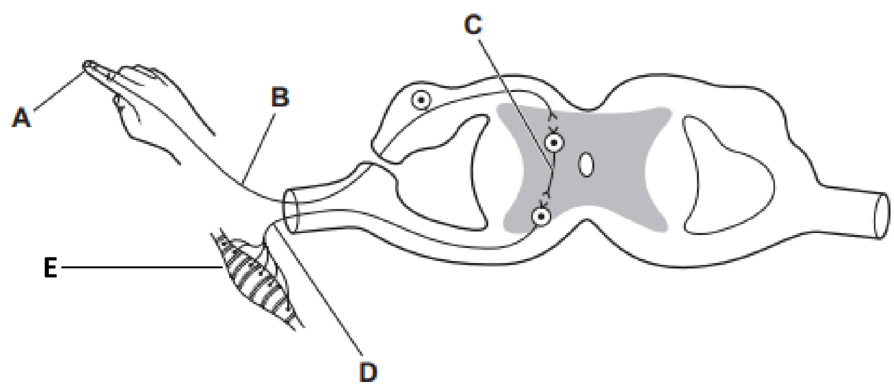
A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________



20. Do you think reaction time is more heavily influenced by genetics (*nature*) or the environment (*nurture*)? Use specific real-life examples to help support your answer.

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