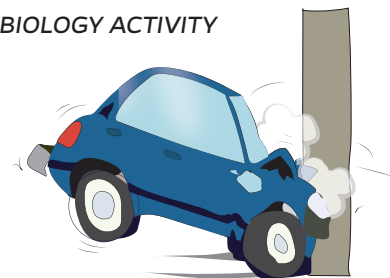




Name: _____ Class: _____ Date: _____

UNDERSTANDING CAR CRASHES: WHEN PHYSICS MEETS BIOLOGY ACTIVITY

THINK FAST, ACT FAST!



MATERIALS NEEDED

Per pair of students

- » 1 metric ruler

Per student

- » 1 “Think Fast, Act Fast” Student Activity Sheet
- » 1 calculator with a square root function ($\sqrt{\quad}$)

Key Question(s)

- » How fast is your reaction time?
- » How far can a vehicle travel during your reaction time?

Purpose

- » To calculate reaction time using a measured distance.
- » To calculate the distance a moving vehicle travels during your reaction time.
- » To describe how your senses, nervous system, and muscles work together during your reaction time to produce a desired behavioral response.

Did You Know?

Experimental psychologists, physiologists, and even baseball batting coaches use human reaction time tests to gauge mental and physical performance. Reaction time is a measure of the time it takes you to physically react to a sensory stimulus once you detect it. In this activity you will use a ruler to conduct a simple reaction time test using a visual stimulus and determine your own reaction time.

Procedure

Part 1 - Conducting the Ruler-Drop Reaction Time Test

Each person in your pair needs to complete 10 trials of the ruler-drop reaction time test as the “catcher” while their partner is the “dropper.” Follow the ruler-drop test instructions below and record the distances for each of your own trials as the “catcher” in Column 1 of Table 1 on your own copy of the activity sheet.

Ruler-Drop Reaction Time Test Instructions:

- Catcher: Rest your arm on the edge of a table or desk and spread your thumb and index finger 4.0 cm apart.
- Dropper: Position the zero centimeter mark (0.0 cm) of the ruler so that it is level with the top of the catcher’s open fingers. See Figure 1.
- Dropper: Without any advance notice, release the ruler so that it drops vertically between the catcher’s open thumb and index finger.
- Catcher: Try to catch the ruler as quickly as possible with your thumb and forefinger and keep holding the ruler vertically. DO NOT MOVE your fingers once you catch the ruler!
- Dropper: Read the number (in centimeters) at the bottom of the catcher’s index finger on the ruler and measure to the nearest millimeter (hash mark) on the ruler. For example, if the bottom of the catcher’s finger is three hash marks above the 12 centimeter number, the distance measurement would be 12.3 cm.

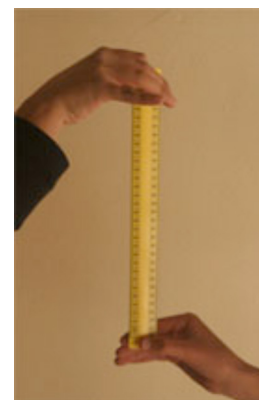


Figure 1.



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Procedure (continued)

Part 2 - Calculating Your Reaction Time

1. Use the formula below and the distance data from Column 1 of the Data Table to calculate your reaction times. Record your reaction time for each trial in seconds (to the nearest thousandth of a second) in Column 2 of the Data Table.

Formula for calculating reaction time: $t = 0.0452\sqrt{d}$

t = reaction time

d = distance ruler dropped, in centimeters (cm)

2. Calculate and record your average reaction time for the 10 trials at the bottom of the Data Table.

Analysis Questions

Answer these two questions individually using your own reaction time test data:

1. How did your reaction times vary across the 10 trials?

2. What trends, if any, do you see in your reaction times over the 10 trials?

Answer these questions with your partner:

3. List at least 3 factors that might affect someone's reaction time.

4. Identify at least 3 examples of distractions that might increase your visual or auditory reaction time while driving.

Table 1. Reaction Time Test Results

MEASURED DISTANCE ON RULER (d) (cm)	CALCULATED REACTION TIME $t = 0.0452\sqrt{d}$ (s)



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Analysis Questions (continued)

5. An individual's reaction time is determined by the actions of several human body systems working together in response to a stimulus and this response occurs in three stages. Analyze the diagram below and write a maximum three-sentence description of how sensory organs (such as the eyes), the nervous system, and muscles work together during the reaction time process.

Blank lines for student response.

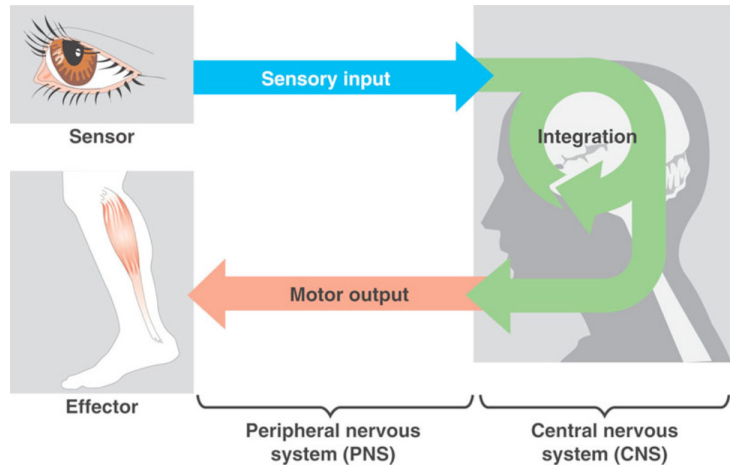


Figure 1. Campbell N.A., Reece, J.B., BIOLOGY, 7th ed., Pearson Publishing, p.1013.

Use your own personal average reaction time test result to answer these three questions:

Imagine you are driving straight ahead at a speed of 105 km/hour (65 miles per hour) and an incident forces you to quickly react and step on your brakes. Complete the following calculations to determine how far your vehicle would travel during your personal reaction time. (To simplify the calculation, we will assume that the velocity of your vehicle does not change during the time it takes you to react and hit the brakes). Show your work in the spaces provided!

The distance a vehicle will travel during a given reaction time can be found using the following equation:

distance = velocity x time

6. Calculate in meters how far your vehicle would travel during your average reaction time using the following velocity conversion: 105 km/hr = 29 m/s.



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Analysis Questions (continued)

7. Calculate in feet how far your vehicle would travel during your average reaction time using the following velocity conversion: 65 mph = 95 ft/s.

8. In general, how might a brief distraction (such as glancing at a cell phone to read a text message) combined with your reaction time affect the distance your vehicle would travel while driving?
