**STEM Reaction Time Activity #1 – Facilitator Copy**

**Introduction**: This exercise is to help your participants understand how quickly loose clothing can become entangled in equipment and illustrate how important correct safety procedures are while working with machinery. Using the materials listed, complete the activity with your students and discuss the results afterwards.

**Objective**: Help students determine the amount of time it would take for your shoelace to be completely wrapped around a PTO shaft that is turning 540 rpms.

**Materials Needed**: A shoelace, tape measure, calculator, and access to a tractor equipped with a rear 540 rpm PTO stub.

1. Briefly explain the activity to the participants- give them directions on how to use the materials and how they are going to complete the problems on the worksheet.
2. Allow them 15-20 minutes to finish the problems on the worksheet.
3. Using 5 minutes or less, discuss the results of the participants and what they can interpret from this exercise.

Discussion Questions to Consider:

* Do you think you could react fast enough to keep your shoelace from pulling you into the shaft? Why or why not?
* What kind of precautionary measures *should* you take when dealing with rotating machinery?
* What kind of clothing/dress is appropriate while working with equipment?

Video Clip: <https://www.youtube.com/watch?v=pxLzIj68s5E>

**STEM Reaction Time Activity #1- Student Copy**

**Introduction**: This exercise is to help you understand how quickly loose clothing can become entangled in equipment while working. Using the materials, follow the steps below to solve the problem. Then discuss how this information can be used when learning about farm safety.

**Materials Needed**: A shoelace, tape measure, calculator, and access to a tractor equipped with a rear 540 rpm PTO stub.

Step 1: Take the shoelace and determine how long it is by using the tape measure.

Shoelace length: \_\_\_\_\_\_\_\_\_\_\_\_\_ ‘’ **(Answer A)**

Step 2: Find the circumference of the PTO shaft

*Note: Please make sure the tractor is shut down and the ignition key removed; be sure that the parking brake is engaged and it is unable to start.*

Circumference = π (3.14) x diameter

* Measure the diameter of the PTO shaft
* Times the diameter by π (3.14)

The circumference of the PTO shaft is \_\_\_\_\_\_\_\_’’ **(Answer B)**

Step 3: Determine how many times the PTO shaft (rotating 540 revolutions per minute) rotate in one second

(540 revolutions/1 min) x (1 min/60 secs) = \_\_\_\_\_\_ revolutions per second **(Answer C)**

Step 4: How many times does the PTO shaft rotate in 3 seconds?

\_\_\_\_\_\_\_ revolutions/sec x 3 seconds = \_\_\_\_\_\_ revolutions **(Answer D)**

Step 5: How much shoelace will become wrapped up in the PTO in 3 seconds?

**Answer A**: (\_\_\_\_\_ inches) x **Answer D** (\_\_\_\_\_ revolutions) = \_\_\_\_\_\_’’ of shoelace

*Discuss this activity with your instructor and identify ways to keep yourself safe around rotating machinery.*

**STEM Reaction Time Activity #2- Facilitator Copy**

**Introduction:** This exercise is to help your participants understand how being overly-tired or fatigued affects your ability to work efficiently. Using the materials listed, complete the activity with your students and discuss the results afterwards.

**Objective:** Students should be able to check their reaction time when they are well rested, as well as when they are tired.

**Materials Needed:** One yardstick covered with high-friction masking tape and marked in 0.5 cm increments, one ½ ‘’- 5/8 ‘’ thick 4’’ diameter plywood disk (attached to the end of the yard stick), a table and chair, a method to record your reaction times, and a partner.

1. Briefly explain the activity to the participants- give them directions on how to use the materials and how they are going to complete the exercise with their partner.
2. Allow them 5-10 minutes to complete the exercise with their partner.
3. Periodically complete the exercise again throughout the day (or complete the exercise several times prior to this and show the results for students to compare.)
4. Using 5 minutes or less, discuss the results of the participants and what they can interpret from this exercise.

Discussion Questions to Consider:

* + - * Is your reaction time different in the morning than in the evening?
      * What factors affect your reaction time?
      * In what ways can you improve upon your reaction time?

**STEM Reaction Time Activity #2- Student Copy**

**Introduction:** Often times, accidents happen because workers are fatigued or impaired due to dehydration or other common factors. Farm workers put in long hours outdoors and are highly susceptible to fatigue.

Perform this test three times at different times of the day to compare your reaction times.

**Materials Needed:** One yardstick covered with high-friction masking tape and marked in 0.5 cm increments, one ½ ‘’- 5/8 ‘’ thick 4’’ diameter plywood disk (attached to the end of the yard stick), a table and chair, a method to record your reaction times, and a partner.

Step 1: Person 1 will sit down with their dominant hand hanging over the edge of the table. Their thumb and index finger must be outstretched and level with the disk on the end of the yard stick.

Step 2: Person 2 is to stand next to the table, holding the yardstick so the top of the seated person’s outstretched thumb and index finger are level with the disk on the ruler.

Step 3: Person 2 will drop the yardstick and Person 1 will catch the yardstick as quickly as possible between their index finger and thumb when it is released.

Step 4: While Person 1 is holding the yardstick, record the distance between the bottom of the ruler (where it is attached to the disk) and the top of their thumb. Repeat the test two more times and determine the average distance.

Step 5: Take your average distance and use the formula to find your reaction time in seconds.

Time = √(( 2 x average distance)∕ (9.81m/s2)

*Discuss this activity with your instructor and reflect on how your reaction time varies at different times of the day.*

**PTO Shaft Answer Key**

**Using the Demo PTO shaft**

Step 1: Take the shoelace and determine how long it is by using the tape measure.

Shoelace length: \_\_\_\_\_\_\_**15.5**\_\_\_\_\_\_ ‘’ **(Answer A)**

Step 2:Find the circumference of the PTO shaft

*Note: Please make sure the tractor is shut down and the ignition key removed; be sure that the parking brake is engaged and it is unable to start.*

Circumference = π (3.14) x diameter

* Measure the diameter of the PTO shaft **(2’’)**
* Times the diameter by π (3.14) **(2 X 3.14)**

The circumference of the PTO shaft is \_\_**6.28**\_\_\_\_\_\_’’ **(Answer B)**

Step 3: Determine how many times the PTO shaft (rotating 540 revolutions per minute) rotate in one second

(540 revolutions/1 min) x (1 min/60 secs) = \_\_**9**\_\_\_\_ revolutions per second **(Answer C)**

Step 4: How many times does the PTO shaft rotate in 3 seconds?

\_\_\_\_\_**9**\_\_ revolutions/sec x 3 seconds = \_\_\_\_**27**\_\_ revolutions **(Answer D)**

Step 5: How much shoelace will become wrapped up in the PTO in 3 seconds?

**Answer A**: (\_\_**15.5**\_\_\_ inches) x **Answer D** (\_\_\_**27**\_\_ revolutions) = \_\_\_**418.5**\_\_\_’’ of shoelace