Testing & Troubleshooting – SeaPerch ROV Performance Testing

Legacy SeaPerch Resource *www.seaperch.org*

Grade Level: 7th – 12th

Length of Lesson: 3 days

Goals:

- Students will test their SeaPerch ROV for buoyancy, control, guidance, speed, and friction.
- Students will familiarize themselves with the control box.

National Science Standards:

- PS2.A: Forces and Motion
- PS2.B: Types of Interactions
- PS3.C: Relationship between Energy and Forces
- ETS1.A: Defining and Delimiting an Engineering Problem
- ETS1.B: Developing Possible Solutions

Materials:

- SeaPerch ROV
- Water source (such as a pool or 100 gallon tank)
- Guidance Testing Documentation Worksheet (below)
- Measuring Velocity and Acceleration Worksheet (below)
- Measuring tape or meter stick
- Tape
- Stop watches or timer

Background:

Engineers who are developing a technology use a particular approach called the engineering design process. The design process is fundamental to technology and to engineering. Also referred to as technological design, the engineering design process demands critical thinking, the application of technical knowledge, creativity, and an appreciation of the effects of a design on society and the environment. Performance testing is a major part of the engineering design process.

©2020 SeaPerch.org

Lesson: LAUNCH

Students submerge their SeaPerch in water and observe how it floats and/or sinks. Ask students to hypothesize what needs to be done to get their SeaPerch to be neutrally buoyant. Students can calculate and add weights in order to get their ROV to a neutrally buoyant state. *Note: Teachers may want to refer to the lesson plan:* ***Determination of Mass, Volume, and Ballast.***

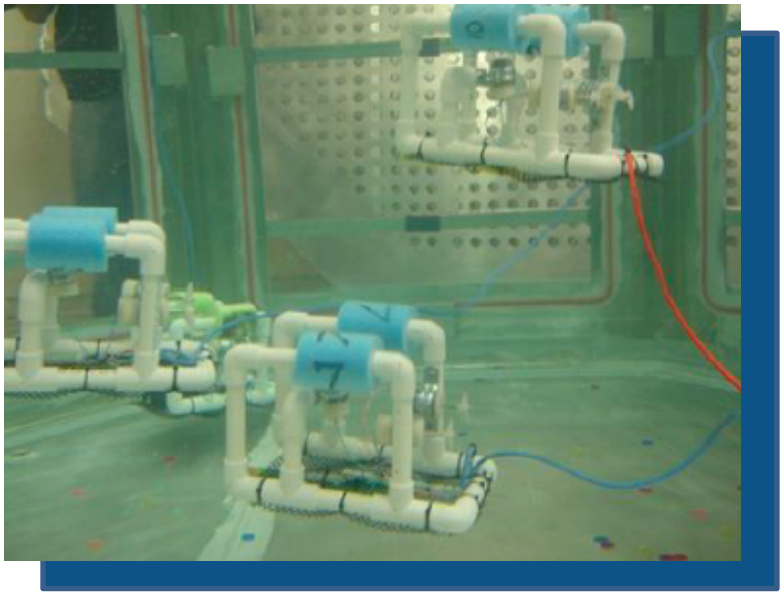
Lesson: INVESTIGATE

Once the SeaPerch ROVs have been modified to be neutrally buoyant, explain that the students will test their SeaPerch for buoyancy (in engagement and exploration), guidance, and speed. Through data collection, students can use the testing information to refine or improve the performance of their SeaPerch.

Students will place their SeaPerch in the water (attempt to keep ROVs separate from one another so as not to disturb the water for other robots) and operate each switch to determine which switch controls the vertical thruster, left motor, right motor, forward motion and backward motion. Students will use their observations to fill out the **Guidance Testing Documentation Worksheet**.

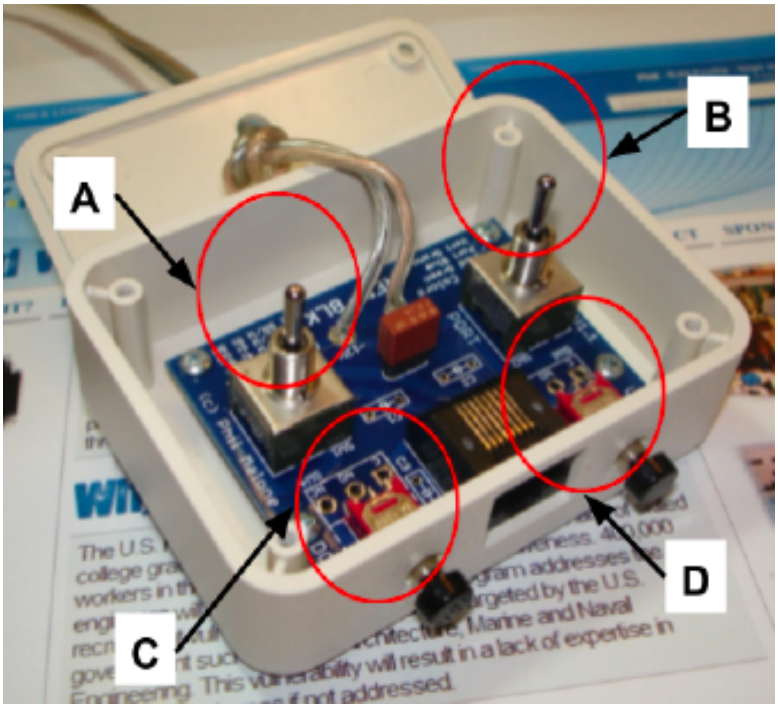
Lesson: PRACTICE

Students should investigate the vertical and horizontal speed of their ROVs. Allow them time to study their ROV's motions and fill out the **Measuring Velocity and Acceleration Worksheet.**



©2020 SeaPerch.org

Guidance Testing Documentation Worksheet



Motion Desired	Switches	Up (U) / Down (D)
Left Motor On / Off		
Right Motor On / Off		
Vertical Thrust Toward Water Surface		
Horizontal Forward Motion		
Horizontal Backward Motion		

Based on your testing, label your switches on your remote box to help you control the SeaPerch ROV.

©2020 SeaPerch.org

Measuring Velocity & Acceleration Worksheet

If you were using an ROV to collect data or perform a task, you would need to know how fast the ROV could move in the water in order to estimate the amount of time required to power the vehicle under water. You would also need this information to determine how quickly you could arrive at your target location.

Testing Question: How do you measure horizontal velocity of the SeaPerch?

Prediction:

_____

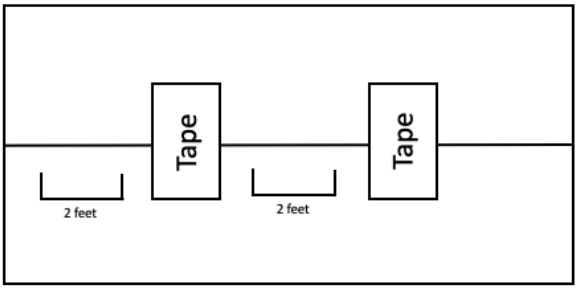
_____

_____

Materials: SeaPerch Test Tank Tape Stop Watches Meter Stick/Measuring Tape

Directions:

1. Using the meter stick or ruler, measure 2 feet (61 cm) from the one end of the test tank and mark it with a small piece of tape. Continue to mark every two feet (61 cm) with a small piece of tape for the entire length of the tank. See set-up below.



2. Place the SeaPerch in the tank at neutral buoyancy at one end of the tank. Practice moving the SeaPerch in a straight line down the length of the tank.
3. Practice driving the SeaPerch the length of the tank and timing from the end of the tank to each of the tape marks. Have the same people serve as the "timers" throughout the entire investigation. Both must start the stopwatches at the same time.
4. Begin the trial by starting the SeaPerch at the end of the tank and time how long it takes for the back of the SeaPerch to travel to the first 2 foot mark (Distance A) and time how long it takes to get to the next 2 foot mark (Distance C).
5. Record times in seconds in the Data Table 1 and then clear the timers.
6. Repeat steps 4- 5 for three trials. Return your materials to their appropriate spots at the end of the investigation.

©2020 SeaPerch.org

Observations and Data Tables

Distance Observations

Data Table 1:

	Distance of Travel			
	Trials	**Distance A (1st tape mark) (2 feet)**	**Distance B (2 feet)**	**Distance C (2nd tape mark) (2 feet)**
Time of SeaPerch in Seconds	**1**			
	2			
	3			
	Average Time			

Hint: Distance B reflects the time between 1st and 2nd tape marks and can be found by the following equation:

Distance B = Distance C – Distance A

Velocity Calculations

Note: Convert feet into meters using the following: (1 foot = 0.3048 meters)

$$\text{Average Velocity} = \frac{\text{Distance}}{\text{Seconds}} = \frac{\text{Meters}}{\text{Average Time}}$$

Data Table 2:

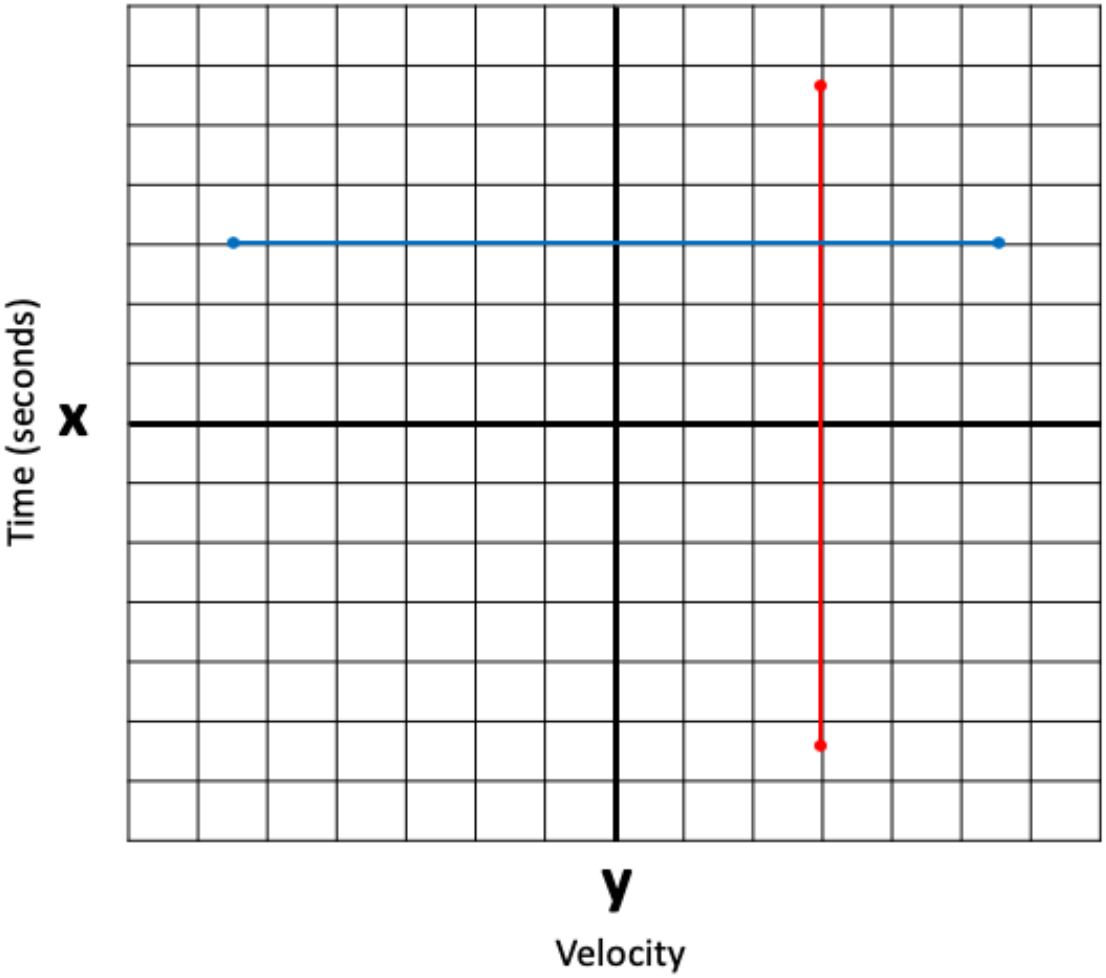
	Distance A	**Distance B**	**Distance C**
Velocity (show your work)			

Hint: Distance C is the total distance (4 feet)

Graph

On the graph below, create a scatter plot (graph of the data points) of velocity vs. time. Draw a best fit line through your plotted points.

Velocity vs. Time



Summary Questions

1. Describe what happened to the time it took the SeaPerch to travel an equal distance as it moved along the tank.

2. Did the velocities in this investigation remain constant? Explain your answer.