



SeaPerch – “Bounty Hunter”

Virtual ... “This is the Way”

To ensure safety and equity across the entire community, the 2021 SeaPerch Challenge event will be hosted 100% virtually with no in-person event. These events are designed to be flexible to support team participation regardless of the team’s ability to come within physical proximity of one another during the season.

As in previous years, the competition will be split up into the Mission, the Presentation, and the Technical Design Report. This document will focus on the Mission. This year’s Mission will include optional and mandatory components. All physical, in-person portions of the Mission will be optional. All virtual aspects of the Mission will be required. Similar to recent years, two classes with two differing Mission requirements will occur this season. The two classes are Captain’s Class and Admiral’s Class. Participating teams must choose either Captain’s Class or Admiral’s Class to participate in.

In previous years we have given an award for spirit and sportsmanship. This year, we wanted to bring some positivity to 2021 and introduce the “Make a Splash” award. We encourage all teams to participate in this optional challenge.

OPTIONAL MISSION FOR 2021

“Pool Courses”

Overview: If you have access to a pool or tank, you can still compete in the pool courses this year. Navigate your SeaPerch Remotely Operated Vehicle (ROV) through a series of tasks and score points for time and successful task completion.

Objective: Construct one of the two courses below and demonstrate the performance of your novel ROV design.

Submission Format: Video of pool course run, submitted to nswcpdstem@gmail.com by April 15, 2021. Links to videos stored on an external drive are acceptable. Late submissions may be accepted, but subject to a point deduction. The measurement of the “mission distance” in inches is required to be included in the body of the e-mailed video submission.

Options:

- Complete your run using a Mini Competition (“Bounty Hunter”) Course
- Complete your run using a Mini Practice Mini (“Bounty”) Course

The course, tests a team's SeaPerch design and driver skill by accomplishing a series of challenges. The capabilities tested include:

- Vehicle speed
- Navigational accuracy and obstacle avoidance
- Vehicle maneuverability
- Weight and buoyancy
- Vehicle stability
- Functionality

The qualities of a successful SeaPerch should be:

- Fast forward speed
- Appropriate height and width to ease navigation
- Strong upward thrust to lift weight and rise rapidly to surface
- Ability to maneuver quickly in a small turning radius

For the driver, the individual challenges are designed to be simple but test their navigational and maneuvering skills. Challenges require the SeaPerch to accurately and rapidly traverse a desired path, lift, push, pivot in place, and coordinate forward and rising motions to the surface.

The 2021 season will extend from the 2020 season, allowing teams to further develop their ideas for the international mission focused on Water Cleanup.

Water Cleanup

An estimated 8 million metric tons of plastics enter the ocean every year adding to the approximately 150 million metric tons already in the ocean. Plastic waste has been ingested by many different types of aquatic life and can injure or kill them. Many different organizations around the world are involved in cleaning up the oceans and preventing trash from entering the oceans. In the ocean there are large circular currents called gyres. Gyres essentially will concentrate the floating trash. One such gyre in the north central Pacific Ocean is the size of Texas.

Prior to 1990 ships would dispose of their trash at sea. Regulations from the International Maritime Organization has prohibited ships from disposing of plastics at sea. Now most of the plastic trash comes from people who just throw their plastics anywhere. Rainwater will wash the plastic into rivers and the rivers will dump into the ocean.

Whenever operations happen at sea, a ship that is using a remote operating vehicle has to be aware of the weather and ocean conditions. Weather will cause high sea states making water cleanup efforts impossible.

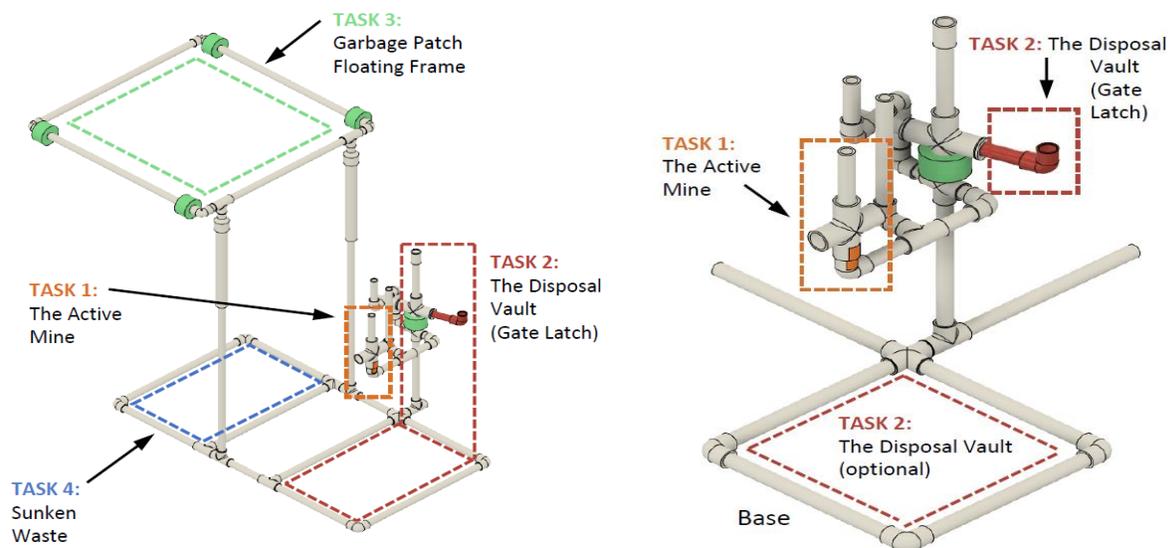
(Keep the Frog Ladies safe. Bounty Hunters.)

Challenges

The challenges in this course require all the SeaPerch features and pilot skills needed to compete in the international mission which include:

1. *The Active Mine*: A simulated active mine is submerged in the water and must be disarmed. The mine can be disarmed by rotating the arming device affixed to the mine. Additional points can be obtained by removing the arming device and disposing it on a platform in the vault.
2. *The Disposal Vault*: A disposal vault will be used to dispose of sunken trash, unexploded mines, and the active mine arming device. Specific tasks will include:

- a. Opening the Vault: The vault will be closed at the start of the challenge must be opened by rotating a latch.
 - b. Closing the Vault: The disposal vault can be closed by hooking an unexploded mine onto the vault gate's closing arm. Additional points can be obtained by latching the gate after it is closed.
3. *The "Garbage Patch"*: A debris field containing multiple pieces of floating trash will be confined by a floating containment ring. The trash must be removed from this ring and transported to the pool deck.
 4. *Sunken Waste*: A platform will contain sunken trash and unexploded mines simulated by weighted balls with rope loops. Waste must be removed from the platform and transported to the disposal vault. Waste can be deposited on the disposal platform (without entering the vault) or released into the disposal vault for additional points.



Mini Competition "Bounty Hunter" Course

Mini Practice Mini "Bounty" Course

Please review the competition course design document for participating in this optional portion of the competition here:

https://robonation.org/app/uploads/sites/5/2020/09/2021-SeaPerch-Challenge-Mini-Course_Final_v3.pdf

Teams competing in this optional event are required to measure the straight-line distance from the forward most point of their SeaPerch when in the water nearest to the edge of the pool (or other body of water) to the first challenge encountered (ex. the disposal vault). This will be defined as the "mission distance".

Teams are required to record their vehicle driving to and completing each task and returning to the starting point.

REQUIRED MISSION FOR 2021 Captain's and Admiral's Classes "SeaPerch: Bounty Hunter"

Just as in Disney's "The Mandalorian", your mission for this season is to complete several smaller missions that will require different design solutions. Your team will virtually design a SeaPerch vessel to accomplish the "Bounty Hunter" mission described in the above "Pool Courses" section of this document. (Not to be confused with the smaller, "Bounty" mission.) This mission is common across both Captain's Class and Admiral's Class.

Overview: The mission will require a digital design via a computer aided design (CAD) software of a SeaPerch vessel to complete the "Bounty Hunter" mission described in the above "Pool Courses" section of this document. This is a digital design, not a physical design. A physical design will not be an acceptable replacement for a digital design. We encourage teams to learn and utilize a CAD software for this portion of the competition. Scanned designs completed on paper will be accepted, but will receive a point penalty.

Some great examples to consider are listed below.

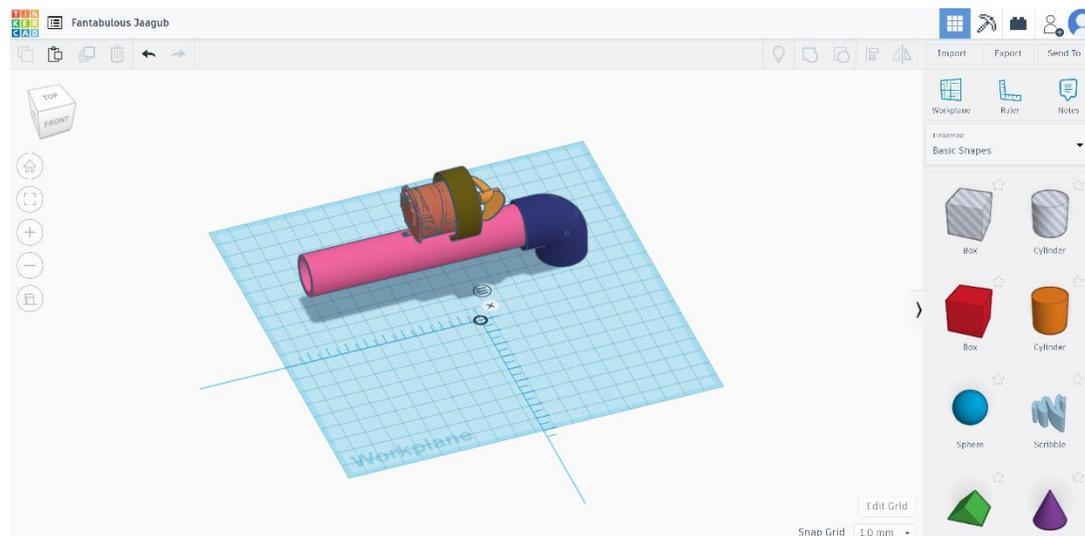
<https://www.tinkercad.com>

<https://www.sketchup.com/try-sketchup#for-primary-and-secondary-education>

Many tutorials for these programs exist on YouTube and it is highly encouraged one or more be reviewed to learn these software. You're also more than welcome to utilize other software not listed here.

SeaPerch component CAD part files (in .STL format) are available to teams from a Google Drive shared folder. Teams are welcome to download and utilize these files in the design and digital construction of their vehicle designs. Teams can access this repository at the following link:

https://drive.google.com/drive/folders/1sx3EY4k_mlnwWsXTuypNDzFocMjcr4NS?usp=sharing



Sample digital SeaPerch CAD design being created in TinkerCAD from provided .STL files

Teams should consult the SeaPerch design documentation at <https://www.seaperch.org> for more information on the physical construction of a SeaPerch ROV.

Ideally teams will submit full CAD assemblies of a SeaPerch design, but demonstration of any capability to design in CAD will be accepted, including partially completed designs.

For this portion of the competition, teams are limited to the materials that would come in a standard SeaPerch kit plus any additional materials up to a \$25 budget. The materials included in the standard SeaPerch kit are not included in the \$25 budget. There are no restrictions on the type of materials or how you utilize the \$25 budget this season. Materials used in the design (although digital) should be monetized and included in a bill of materials in the Technical Design Report. A list of materials in the standard SeaPerch kit can be found here:

http://www.phillynavalstem.com/uploads/7/5/2/1/75215467/seaperch_kit.pdf

To represent the “driver” portion of this competition, we are asking teams to submit pseudocode on how a driver or operator would control and steer the vessel to complete each portion of the “Bounty Hunter” mission.

Pseudocode is a text-based informal programming language that allows computer programmers to develop algorithms. An example of a pseudocode (not related to the “Bounty Hunter” mission) is provided below.

This pseudocode is designed to steer a standard SeaPerch vessel through a hoop situated horizontally, parallel to the surface of the water, located 6 feet below the surface and 12 feet away from a pool deck, is described below. In this example, the SeaPerch vehicle starts roughly 1 foot below the surface of the water. The goal of this example is to drive the SeaPerch through the hoop and back. The example includes both commands and comments (denoted by “//” and italics) to describe what is happening and why.

Turn on port and starboard thrust motors	<i>//Drive SeaPerch to hoop location</i>
Travel 12 feet forward	
Turn off port and starboard thrust motors	<i>//Stop driving forward and dive through hoop</i>
Turn on dive motor	
Travel 6 feet down	
Turn on dive motor in reverse	<i>//Come back up through the hoop</i>
Travel 6 feet up	
Turn on port motor	<i>//Turn around</i>
Travel in a semi-circle until facing forward	
Turn on starboard motor	<i>//Drive back to pool deck</i>
Travel 12 feet back to pool deck	

Objective: Demonstrate the ability to produce a digital design of a SeaPerch ROV to virtually complete the “Bounty Hunter” mission. This includes both a digital physical and functional design.

Submission Format: Portions of your final designs and pseudocode should be shared in the body of your Technical Design Report and in the Presentation. The complete designs and pseudocode for each mission completed should be included in Appendices of the Technical Design Report. Final CAD designs should be exported as a .STL and sent to nswcpdstem@gmail.com by April 20, 2021. Late submissions may be accepted, but subject to a point deduction.

**ADDITIONAL REQUIRED MISSION FOR 2021 Admiral's Class
"SeaPerch: In the Wild"**

SeaPerch "In the Wild"

It's a lot of fun to build a SeaPerch ROV and compete in a closed environment like a pool, but did you know there are many applications for SeaPerch outside of the pool? From underwater exploration to data collection and clean-up, a SeaPerch can be modified to research and respond to real-world questions and challenges facing all of our communities.

Below are two mission projects required for the Admiral's Class only. There is no one "right" solution and the parameters are intentionally broad – use your imagination and evolving engineering prowess to come up with your own unique approach.

Missions:

1. Sunken Debris Clean Up Project

Project Goal: Research sources and types of sunken marine debris in your local area as well as methods that can be used to detect and remove it. Build and test a prototype of a device or other remotely controllable addition for your ROV that is capable of identifying and/or retrieving sunken garbage. Be sure that your device accounts for and overcomes your local marine conditions while not posing risk to marine life or protected species and that it isn't a hazard to navigation.

2. Sample & Data Collection Project

Project Goal: Identify and utilize an app to document where you find marine debris, document the type of trash you find, and/or share water quality data you gather in your local area. Analyze data gathered by others in your area and look for trends. Develop a plan for how your findings can be used to increase awareness or to identify solvable solutions to the problem and tell us all about it.

Teams are encouraged to think outside the box on these designs. You are not limited in terms of materials you wish to use. Teams may physically construct their designs if they wish, but all designs considered for judging purposes should be digital. No additional points will be awarded for physical construction. This may include CAD designs, sketches, descriptions, and more.

Objective: Demonstrate advanced engineering design and show off your creative thinking skills by expanding the design of a standard SeaPerch ROV.

Submission Format: Your final design solutions for the Sunken Debris Clean Up Project and the Sample & Data Collection Project should be shared in a separate Appendix of your Technical Design Report and in the Presentation. Teams are also encouraged to submit their designs on SeaPerch.org

**OPTIONAL MISSION FOR 2021 Captain's and Admiral's Classes
"Make a Splash"**

"Make a Splash" Community Outreach Project

We encourage all teams to pursue the optional "Make a Splash" community outreach project. An award will be given to a single team in the Greater Philadelphia SeaPerch and SeaGlide Challenge that demonstrates making a positive impact in their community. This portion of the competition is optional, but recommended.

This award will be given to the team that best represents positive change to make a difference in their community and acts as a model for other teams, and all of us, to bring positivity to one another by "making a splash".

This is the first year for this category, and we encourage teams to explore and help us define what is involved in this. We want to highlight YOUR contributions and bring some positivity to the local community. We ask teams to submit a brief message included in the submission of their Technical Design Report of how they demonstrated making a positive impact in their community this season. Your efforts will be highlighted during the Greater Philadelphia SeaPerch and SeaGlide Challenge and we will announce a winner during the award ceremony on April 23, 2021.