Brevard Public Schools
SeaPerch Challenge

March 2020

SEAPERCH

SeaPerch is an innovative underwater robotics program that equips teachers and students with the resources they need to build an underwater Remotely Operated Vehicle (ROV). Students build the ROV from a kit comprised of low-cost, easily accessible parts, following a curriculum that teaches basic engineering and science concepts with a marine engineering theme. The SeaPerch Program provides students with the opportunity to learn about robotics, engineering, science, and mathematics (STEM) while building an underwater ROV as part of a science and engineering technology curriculum. Throughout the project, students will learn engineering concepts, problem solving, teamwork, and technical applications.

Building a SeaPerch ROV teaches basic skills in ship and submarine design and encourages students to explore naval architecture and marine and ocean engineering principles. It also teaches basic science and engineering concepts, tool safety and technical procedures. Students learn important engineering and design skills and are exposed to all the exciting careers that are possible in naval architecture and naval, ocean, and marine engineering.

SeaPerch information, resources, and materials are available at https://www.seaperch.org/index

General Competition Rules (Rules based on the SeaPerch National Challenge rules)

1. On competition day there will be three competition events: two ROV performance events (pool events) and one question and answer (group response) category. All events will be comprised of two classes: elementary and secondary schools, with each class competing in two in-water events and the Q & A category.

2. For each of the classes, awards will be given for the first three finishers from a combined score from the two ROV performance events and the Q & A category.

3. Three overall awards will also be presented, one in each of the two classes (elementary and secondary) for the best combined scores from all three events.

4. Teams may be comprised of 3 to 4 members only.

5. Each SeaPerch ROV must be presented for a compliance check during check-in upon arrival prior to the team competing in the pool events. Once the team has passed the compliance check-in no further modifications may be made to the SeaPerch, only emergency repairs. See Compliance Checklist for more details.

6. In the event that a ROV is inadvertently interfered with during a competition, or a malfunction of a ROV's parts (i.e., the motor) occurs that is beyond the design and construction, the lead pool judge will have the sole authority to provide the team time to fix their ROV and to allow them to compete later in the round. Malfunctions will be evaluated on a case-by-case basis.

ROV Design Rules (Based on National SeaPerch Stock Class rules)

Teams are encouraged to think outside the box and change the shape and configuration of the SeaPerch ROV.

ROVs shall consist of the parts and components contained within the equivalent of one SeaPerch kit, with the following exceptions:

- Teams have a budget of $20.00 to modify the SeaPerch. It is the actual value of the modifications that must be $20 or less. Donated material should be assessed at what the cost would be to procure the material. The $20 limit is for costs of the materials utilized on the final competition ROV. Reasonable spare parts are not included in this budget.
- Hooks and attachments MAY NOT be added/removed depending on the competition round.
- Additional motors may be utilized for actuation or other non-propulsion uses. Motors may be found at Jameco P/N 232022.
- Teams may only utilize stock SeaPerch motors in thrusters (Jameco P/N 232022).
- Teams may not add additional thrusters to the SeaPerch. A thruster is defined as a means of propulsion for the SeaPerch, normally but not limited to a motor and propeller assembly.
- Teams will design for and utilize a 12-volt power source. Over charging or stacking batteries is not allowed.
- The ROV may be worked upon by the teams during the competition.
- The ROV cannot be dragged via the tether.
- ROVs shall fit through a 46 cm diameter circle (minimum obstacle diameter).

ROV Performance (pool events)

Obstacle Course
An underwater ROV must be able to maneuver successfully under its own power. If a vehicle cannot maneuver to the appropriate location to perform its task, the vehicle is of no use. A submerged obstacle course gauges whether an ROV design is capable of maneuvering successfully under its own power. Teams must navigate through the obstacle course, surface, then resubmerge and return through the course to the end. The basic obstacle course may vary slightly, but the layout remains the same.

The submerged obstacle course involves large rings (46cm minimum diameter), oriented in any direction, through which the ROV must travel. Teams must navigate their ROV through the obstacle course, surface, then re-submerge and return through the course to the end. Scores for this round will be based on the fastest time for successfully navigating the obstacle course. There are five 46 cm diameter hoops in the obstacle course. Final configuration of hoop orientation and heights will not be revealed until the competition.

See graphic below for an example of the obstacle course.
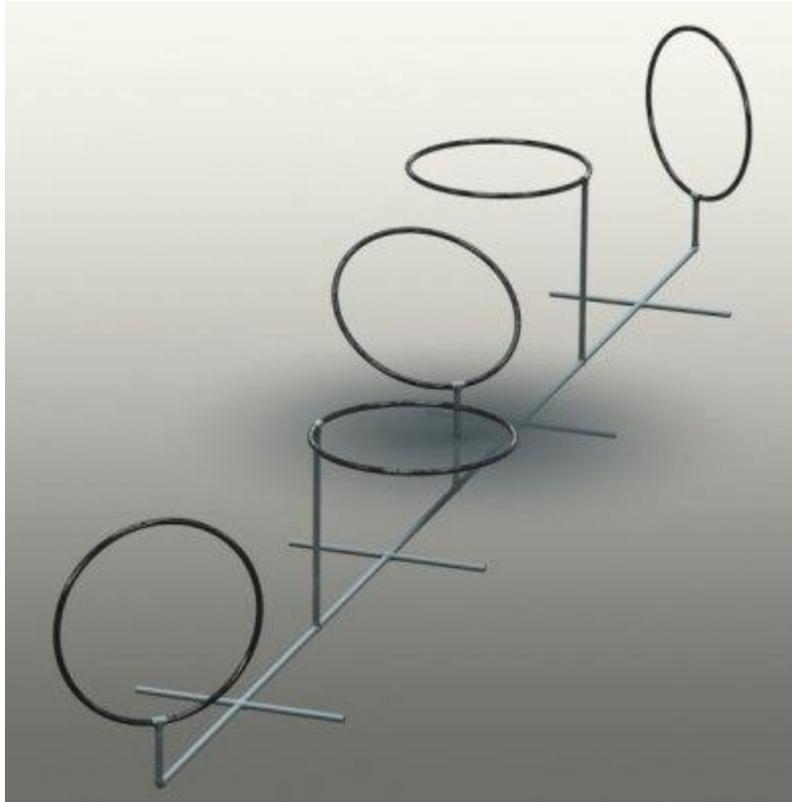
Teams are required to traverse each of five 46 cm rings, surface and return through the five rings. All Rings must be traversed in both directions. Fastest elapsed time wins. If a diver assist is required to move, untangle, etc. the ROV an additional two minutes will be added to the time. Teams will have two attempts at the course during their 15-minute time allocation. See Obstacle Course Scoring sheet for more details.

1. Only three team members are allowed on the pool deck during the competition.

2. The rings shall be traversed in order, closest to the wall first.

3. The SeaPerch must move only under their own power. It is prohibited for a team member to pull the ROV by the tether, or attempt to maneuver the ROV using the tether. This action will incur a 2-minute penalty per occurrence.

4. In the event that a ROV is inadvertently interfered with during a competition, or a malfunction of a ROV's parts (i.e., the motor) occurs that is beyond the design and construction, the lead pool judge will have the authority to provide the team time to fix their ROV and to allow them to compete later.

Underwater Mission (Challenge Course)
The ROV Performance category is a series of tests that determine how well a team did in designing and building an underwater ROV. A deep-water mission objective tests a craft's ability to perform a common function of ROVs: the underwater retrieval of objects from locations, and then placing them in designated locations.

See graphic below for an example of the obstacle course.
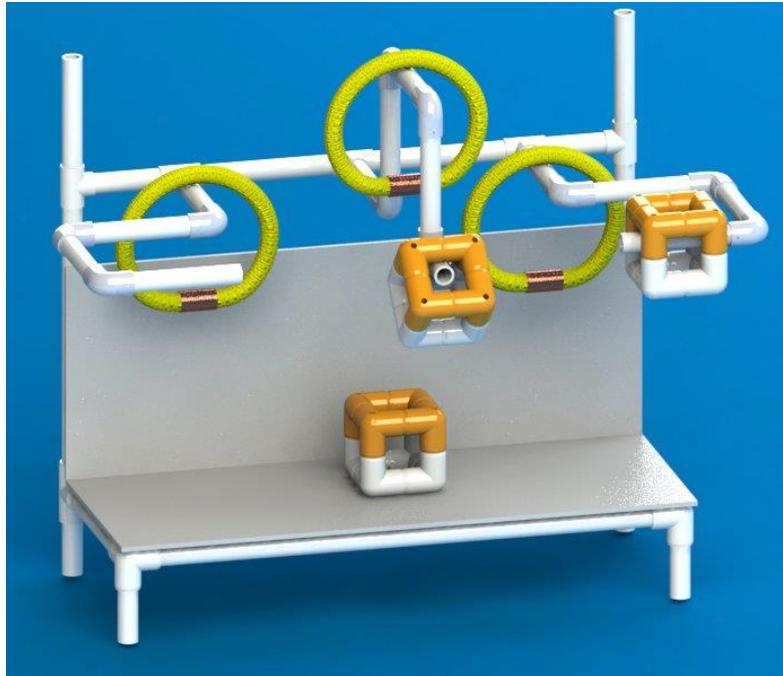
All competitors should become familiar with the following items/devices.

• The Rings: There are rings on each of the courses. Each ring is made of 46 cm of 1.9 cm Polypropylene line, the line is held together with a 3.81cm length of 1.9 cm copper pipe crimped to hold the assembly together. This simple ring configuration is only 8 grams when placed in the water.

• The Cubes: Each cube is made of eight 3-way elbows. 12 x 3.81 cm pieces of PVC pipe hold the cubes together. There are 4 x 3.81 cm pieces of 1.59 cm backer foam in the top four pieces of PVC pipe.

Teams are given 10 minutes to maneuver rings and cubes to the platform, arms or spikes. The goal is to maximize the number of points in the shortest amount of time. The clock stops when the team maneuvers their ROV to touch the starting wall or 10 minutes is reached. If a diver assist is required to move, untangle, etc. the ROV an additional two minutes will be added to the time.

1. Only three team members are allowed on the pool deck during the competition.

2. The SeaPerches must move only under their own power. It is prohibited for a team member to pull the ROV by the tether, or attempt to maneuver the ROV using the tether. This action will incur a 2-minute penalty per occurrence.

3. In the event that a ROV is inadvertently interfered with during a competition, or a malfunction of a ROV's parts (i.e., the motor) occurs that is beyond the design and construction, the lead pool judge will have the authority to provide the team time to fix their ROV and to allow them to compete later.

Scoring
Rings can be placed as follows for points:

- on the platform for 1 point
- on the upper spikes for 2 points
- on the Zig-Zags for the following points:
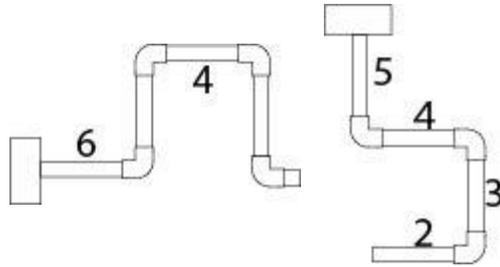
Note: only one ring scores per Zigzag (additional rings will not be scored) and rings on fittings score the lower of the point options.

Cubes can be placed as follows for points:

- on the platform for 1 point (stacking gains an additional point)
- on the upper spikes for 2 points
- Cubes hung in the Zig-Zags double the ring points (no ring, no points)

See Underwater Mission Scoring sheet for more details.

General Pool Performance Rules

1. All team members must wear shoes with rubber soles on the pool deck.

2. Teams will report to the "Obstacle Course" side the pool deck at least 5 minutes before their scheduled heat time.

3. Only three team members are allowed on the pool deck during competition. Teams are permitted to change drivers for each round. REMEMBER! At least 2/3 of your team MUST drive your ROV. No one team member will be designated as the sole driver!

4. The ROV may be reset by the teams during the competition.

5. Hooks and other attachments may be added/removed between competition rounds.

6. Nothing other than the Sea Perch ROV shall be put into the pool during the competition.

7. In the event that a ROV is inadvertently interfered with during a competition, or a malfunction of a ROV's parts (i.e., the motor) occurs that is beyond the design and construction, the lead pool judge will have the sole authority to provide the team time to fix their ROV and to allow them to compete later. Malfunctions will be evaluated on a case-by-case basis and the lead pool judge will have the sole authority to limit the number of times a team may retry to compete.

Questions and Answer Category

Be prepared to speak to a panel regarding the following:

1. Provide an overview of the robot.

2. Discuss the design features of the robot.

3. Discuss any changes that were made due to testing.

4. Show the team members understanding of the build they completed and related engineering and science principles.

Frequently Asked Questions

1. What happens if my ROV breaks down during competition?
A Triage Station will be provided for teams to make repairs, adjustments and rebalance their ROV's during the competition. In a competition, you can be sure that something will go wrong. It is always better to be prepared rather than have to scramble for extra parts in the heat of the moment. Triage will be set-up in close proximity to the pool deck area. Minor repairs and adjustments to your ROV can be done in triage.

2. Where can I purchase a kit?
Kits are available for purchase thru www.seaperch.org.

3. What if I need tools?
A Tool Bag containing tools that can be used for multiple SeaPerch builds (and reused year after year) are available at www.seaperch.org.

4. How long does the build take?
At a minimum, it is recommended to schedule 10 hours of build time. The remaining time should be spent on designing, modifying and testing.

5. Can I add enhancements?
Yes, as long as the enhancements are within the $20.00 budget permitted.

6. How many team members are permitted on a team? Refer to the rules and guidelines regarding the number of team members permitted to actually compete in each of the categories during the competition. Spectators and excess team members are welcome.

Compliance Checklist

Team Name: _____   School: _____

Your ROV MUST pass all of the compliance checks to compete in the performance events.

Construction

No loose parts that will potentially fall off during competition or handling	☺ Pass	☹ Fail
Ballast attachment is secure	☺ Pass	☹ Fail
Propeller is properly and securely fastened to motor shaft	☺ Pass	☹ Fail

Safety

No exposed wires on controller	☺ Pass	☹ Fail
No exposed live wires on robot or tether	☺ Pass	☹ Fail
No sharp edges	☺ Pass	☹ Fail
Alligator clip covers (supplied with kit) are installed on electrical contacts as appropriate	☺ Pass	☹ Fail

Operations

Team demonstrates forward and reverse operation of each propeller to ensure they are in proper working order	☺ Pass	☹ Fail

Design Compliance

No more than 3 propellers are installed	☺ Pass	☹ Fail
All motors are standard issue and have not been upgraded	☺ Pass	☹ Fail
If design modifications appear to approach the $20 allowable limit, team identifies that they have valid receipts to support the design modifications	☺ Pass	☹ Fail
ROV fits inside the dimensions of 46 cm circular diameter, including collection arm.	☺ Pass	☹ Fail

Obstacle Course Score Sheet

Team Name: _____ **School:** _____

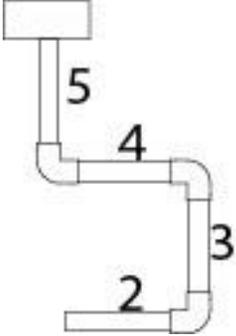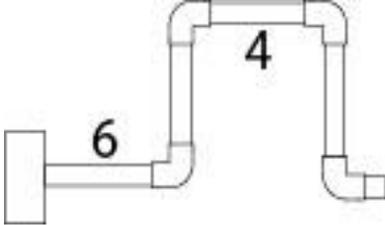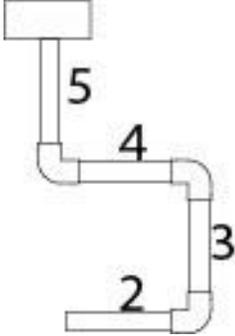Challenge Performance *(Goal: All gates in the shortest amount of time)*

Scoring
1. Each ROV must be touching the wall of the pool prior to start.
2. The score sheet will be marked for each ring traversed.
3. Time is stopped when the SeaPerch returns and touches the wall. The SeaPerch does not need to be on the surface.

Attempt One	
Elapsed Time (in hundredths of a second): _____:_____._____ **Diver assist?** (add 2 minutes) □ **All Gates Cleared:** □ **Attempt One, Final Score Time** (in hundredths of a second): _____:_____._____	**Gates Cleared (Outbound):** Gate 1 □ Gate 2 □ Gate 3 □ Gate 4 □ Gate 5 □ ROV Surfaced □ **Gates Cleared (Inbound):** Gate 1 □ Gate 2 □ Gate 3 □ Gate 4 □ Gate 5 □ ROV touched wall □
Attempt Two	
Elapsed Time (in hundredths of a second): _____:_____._____ **Diver assist?** (add 2 minutes) □ **All Gates Cleared:** □ **Attempt Two, Final Score Time** (in hundredths of a second): _____:_____._____	**Gates Cleared (Outbound):** Gate 1 □ Gate 2 □ Gate 3 □ Gate 4 □ Gate 5 □ ROV Surfaced □ **Gates Cleared (Inbound):** Gate 1 □ Gate 2 □ Gate 3 □ Gate 4 □ Gate 5 □ ROV touched wall □

Underwater Mission Score Sheet

Team Name: _____ **School:** _____

Challenge Performance *(Goal: Accumulate the highest possible points in the given time)*

Arm One Points for Ring Placement	Arm Two Points for Ring Placement	Arm Three Points for Ring Placement
Cube Hung on the Arm with a Ring Double the Point Value Indicated Points Earned: _____	Cube Hung on the Arm with a Ring Double the Point Value Indicated Points Earned: _____	Cube Hung on the Arm with a Ring Double the Point Value Indicated Points Earned: _____
Diver Assist Required Yes ☐ add 2 minutes No ☐	**Finish Time** _____:_____._____ M S 1/100	**Total Points** _____

Notes:

Total Score Sheet

Team Name: _____ **School: _____**

Team placement determination is from total points earned for the two performance events and the Q & A category.

Category	Points Possible	Points Earned
Challenge Performance- Obstacle Course	Placement based on best time of the two attempts. 1st: 20 2nd: 15 3rd: 10 4th: 5	
Challenge Performance- Underwater Mission	Total points from Underwater Mission Rubric. Total points possible: 32	
Student: Question & Answer	Total points possible: 15	
	Total Points Earned:	

Note: In the event of a tie, the time from the Underwater Mission will be utilized, with the faster time determining the winner.

Team Placement: _____