



# 13th Annual Greater Philadelphia SeaPerch Challenge 2018

## **Executive Summary**

SeaPerch is a Remotely Operated Vehicle (ROV) Science, Technology, Engineering and Mathematics (STEM) educational program and competition. SeaPerch consists of an educational tool kit that centers on a curriculum-designed program that teaches students about the basics of naval architecture, marine engineering, and basic electrical circuits. The program is designed to provide middle and high school students with the materials and knowledge to construct a simple ROV. The students are then encouraged to build upon that basic knowledge to innovate and create unique ROV design to meet specific mission scenarios.

The Greater Philadelphia SeaPerch Challenge, (GPSPC) is held in early spring at Temple University's Pearson Hall located at 1800 N. Broad St, Philadelphia, PA 19122. The middle school teams compete on a Friday and the high school level competes on a Saturday. The competition begins with team check-in and compliance checks followed by an opening ceremony, competition rounds, and the presentation of awards.

The GPSPC is the culminating competition that consists of three technical sections where the students are able to showcase their final designs. The three technical sections are the engineering notebook, design presentation, and operational performance evaluation in the pool. An engineering design notebook is delivered for judging on a predetermined submittal deadline in advance of the competition date. The engineering design notebook emphasizes engineering process documentation and captured the lessons team learned during the design, build and test phase. The design presentation is the opportunity for the students to sell their designs to Navy. The design presentation is an on screen presentation. Students discuss their design philosophy, construction challenges, and answer questions posed by the judges. The operational performance evaluation takes place in the pool, where the students compete in two separate challenges. There is a performance and speed course and an underwater mission based course.

Specifications for the underwater events are outlined each year in documents found on the [www.phillynavalSTEM.com](http://www.phillynavalSTEM.com) website to aid teams with building, practice and test setups prior to the competition.

## **What is the Greater Philadelphia SeaPerch Challenge (GPSPC)?**

The GPSPC is an innovative, mentor-based underwater robotics program that includes classroom visits by engineering professionals. Teams build a standard Sea Perch and are challenged to design; build, and compete with their underwater ROVs at the GPSPC at Temple University in downtown Philadelphia. Since the Sea Perch Challenge was created in Philadelphia 13 years ago, more than 60,000 students have participated in the SeaPerch program nationally. GPSPC is a fun, educational and challenging way to get students not only interested in Science, Technology, Engineering and Math (STEM), but excited about it.

In 2018, SeaPerch will reach over 1,000 middle and high school students from Philadelphia and surrounding Pennsylvania and New Jersey areas through the Greater Philadelphia SeaPerch Challenge.

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## **Section 1 Program Structure and Format**

### **1.1 Eligibility and Registration**

#### *a. Eligible Participants*

The GPSPC is open to middle schools, high schools, and youth organizations in the Pennsylvania, New Jersey, and Delaware tristate state area. Teams may only register for one (1) regional challenge in the tristate area to qualify for the national competition.

#### *b. Registration*

Team registration opens in early fall until capacity is reached. Only one high school level team, (9<sup>th</sup>- 12<sup>th</sup> grade), and one middle school level team, (5<sup>th</sup> - 8<sup>th</sup>) per school or organization will be accepted. A middle school team may compete on a high school level if there is a high school level student on the team. High school level students may not compete down to the middle school level. A team may register for only one local qualifying regional SeaPerch competition.

#### *c. Fees*

There is no fee to participate in the SeaPerch Challenge.

#### 1.1.1 *Phase I: Program Kickoff*

1. The Sea Perch Challenge Program Kickoff Phase includes all activities associated with the challenge mission and rules, team registration, and information on new advisor training. Teachers attend a one-day SeaPerch build training session and a one-day curriculum workshop.

#### 1.1.2 *Phase II: Design – Build – Test*

1. The Sea Perch Challenge Design Build – Test Phase is all the time between Kickoff and Competition. It is the time to learn, teach, experiment, and practice. Teams function as companies competing for a simulated Navy contract by designing an underwater ROV that meets the technical requirements while staying within the specified budgetary restriction of \$20.00. Phase II is when the competition products are developed.
2. A complete 32-page SeaPerch build manual is available for download from the SeaPerch website under “Build”:<http://www.seaperch.org/build> . The manual is updated annually to give students and teachers the most récent instructions.
3. The GPSPC is an innovative, mentor-based underwater robotics program that includes classroom visit by engineering professionals. Teams are encouraged to sign up and take advantage of the Challenge's mentoring resources. Details of the mentor program are explained in section 5 of this handbook.

### 1.1.3 *Phase III: Competition*

1. The Sea Perch Challenge Competition Phase is designed to give students and advisors an overall appreciation of the scientific process at work. The competition consists of two competition classes competing in four competition categories.

#### Competition Levels:

- (1) Middle School 5<sup>th</sup>-8<sup>th</sup>
- (2) High School 9<sup>th</sup>-12<sup>th</sup>

#### Competition Categories:

- (1) Engineering Design Notebook
- (2) Presentations
- (3) Two Part Vehicle Pool Performance
- (4) Team Spirit and Sportsmanship

2. Each team will receive a score for each of the four competition categories listed above. Scores from all categories except Team Spirit & Sportsmanship will be combined to determine the overall GPSPC Champion.
3. The first and second place pool performance winners qualify to move on to the National Challenge.

## **Section 2 The Sea Perch Challenge Categories**

### **Category I Engineering Design Notebook**

- 2.1 The Engineering Design Notebook category measures a team's ability to document the scientific process in a meaningful and organized manner. *The Engineering Design Notebook must document how teams implemented the engineering process. The Design Notebooks shall include the following sections:*

- I. Front Matter
- II. Naval Engineering Research
- III. Design, Engineering, and Manufacturing Process
- IV. Naval Scenario for SeaPerch
- V. Teamwork
- VI. Bill of Material
- VII. Supporting Documentation

The Engineering Design Notebook Guide and rubric is found on [www.phillynavalstem.com web site.](http://www.phillynavalstem.com)

## **Category II Vehicle Performance**

1. Obstacle Course
2. Underwater Mission

### *2.2 Obstacle Course Pool*

An underwater remotely operated vehicle (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 re-submerge and return through the course to the end. The basic obstacle course may vary slightly from year to year, but the layout remains the same. Detailed information on the Obstacle Course challenge can be found on [www.phillynavalstem.com](http://www.phillynavalstem.com) under the Obstacle Course link.

### *2.2.1 Underwater Mission*

The Vehicle Performance category is a series of tests that determine how well a team did in designing and building an underwater Remotely Operated Vehicle. A deep-water mission objective tests a craft's ability to perform a common function of ROVs: the underwater retrieval of objects from complex locations at different depths, and then placing them in designated locations. The Underwater Mission is new each year and is announced at the GPSPC Kickoff event in the fall. Detailed information is posted on [www.phillynavalstem.com](http://www.phillynavalstem.com) under the Underwater Mission link.

## **Category III Presentations**

### **2.3 Overview**

Teams shall present as though they are the sales team for a company competing to design and build a Sea Perch ROV in response to a US Navy Contract Solicitation. The Panel of Naval Engineering Clients, (the panel of judges) has a mission and they are screening possible companies to determine which Sea Perch design is the best option to meet their need. It is the Presentation Sales Team's job to prove to the Panel of Naval Engineering Clients that their company's design is the best all-around solution for the Underwater Mission.

The Presentation session is the best time for teams who modified the standard Sea Perch design to discuss their modifications. They should highlight experiments they conducted during Phase II and what modifications came from them. Demonstration of the team's knowledge and understanding of Naval Engineering principles used in the design and performance of the Sea Perch are key selection criterion that judges will consider. At the conclusion of the question, answer, and discussion period, judges should have a clear understanding of how students implemented their knowledge of design and engineering. Bonus points may be awarded based on the technical merits of the Sea Perch design and/or supplemental items. The Oral Presentation guide and rubric can be found on [www.phillynavalstem.com](http://www.phillynavalstem.com).

## **Category IV Spirit and Sportsmanship**

Teams are encouraged to show their team spirit during the competition. Judges will watch throughout the competition to determine the teams with the highest levels of team spirit. The sportsmanship award will be determined through a voting process. Teams will be observed by competition judges. Teams displaying sportsmanship will be nominated by the judges and the nominations will be placed in a voting box. The lead Spirit & Sportsmanship judge will make the final decision on the winner by calculating the combined Spirit & Sportsmanship scores.

1. Teams are encouraged to show their team spirit during the competition. Judges will watch throughout the competition to determine the teams with the highest levels of team spirit.
2. Each team shall sit together in the bleachers of the pool area. Teams are asked to have a team flag to identify their team to the judges.
3. Drums, plastic bottles containing beads, cowbells, and bullhorns and all percussion instruments are strictly prohibited.
4. Flag specifications shall conform to:
  - Maximum flagpole height is 7 feet
  - Maximum flag dimensions are 3 feet by 3 feet
  - The flag shall prominently display the school and team names
  - A maximum of one flag per school is allowed
5. Other ways to show school spirit and sportsmanship:
  - Cheering for teammates during team competition
  - Demonstrate sportsmanship by cheering for and assisting other schools
  - Posters & Signs
  - Team clothing
  - Cheers

## Section 3 Competition Day

### 3.1 Vehicle Compliance

All Sea Perch ROV entries will be subjected to two (2) compliance reviews upon entry into the competition. Your vehicle will receive its first review consisting of an overall safety compliance check and a 2<sup>nd</sup> review to check the craft for maneuverability in the water. Your team cannot proceed to any of the follow-on events unless these requirements are fulfilled. A sticker will be provided to show you have passed Compliance #1 and #2.

#### 3.1.1 Craft Compliance Inspection Overview

a. Compliance #1 - Judges check the following:

1. Sturdy Construction

- a. No loose parts that will potentially fall off during competition or handling
- b. Ballast attachment is secure
- c. Propeller is properly and securely fastened to motor shaft

2. Safety

- a. No Exposed wires on controller
- b. No Exposed live wires on SeaPerch or tether
- c. No sharp edges
- d. Alligator Clip covers (supplied with the kit) are installed on electrical contacts

3. Operations

- a. Team connects battery to demonstrate forward and reverse operation of each propeller to ensure they are in proper working order.

4. Design Compliance

- a. No more than three motors are used for propulsion (3 props)
- b. Propeller motors are standard issue and have not been upgraded
- c. If design modifications appear to exceed \$15, team identifies that they have valid receipts submitted with their notebook to support their design modifications are less than \$20.

b. Compliance Station #2 - Water Compliance Maneuverability - Judges will be checking the following:

1. Buoyancy
2. Maneuverability - Demonstrate that the SeaPerch has the ability to submerge and can surface

Each compliance officer places a serialized tag (label tape) to the Sea Perch frame to signify the Sea Perch has passed compliance 1 and 2.

### 3.1.2 3-D Printing Compliance

3-D printing of SeaPerch parts is permissible as long as it is used to make contact with the mission object and:

- Shall provide technical advantage or innovation
- Rationale is documented in design notebook and presentation
- Value of 3D part is based upon the value of part it replaces
- Value of 3D printed parts shall not exceed \$10
- Included in \$20 design improvement budget limit

## 3.2 Competition Day Structure

The time between the morning check-in process and the first round of the competition is approximately 1 ½ hours. Listed below is a sample of the day's' schedule.

- Team Registration and compliance
- Presentation of Colors
- Opening Remarks
- Performance Rounds and Oral Presentations begin
- Awards Ceremony (approximate time 3:00 pm)

### 3.2.1 Arrival and Check In

1. Plan to arrive between 7:30 and 8:00 am. Allow time for traffic.
2. Registration begins at 8:00 am. Advisors report directly to registration.
3. Each team is handed a step-by-step checklist that must be completed and certified (initialed) by a lead judge at each location before a team is eligible to compete.
4. Once the checklist has been completed, it should be handed into the lead compliance officer.

Steps outlined on the checklist to complete:

1. Team Registration
  - a. teams check-in to be added to the roster
  - b. t-shirts for your team are distributed
  - c. program books are distributed
  - d. check list is initialed
2. Compliance 1 Craft Inspection (only 2 team members including advisor)
  - a. craft must pass compliance and receive a serialized label
  - b. check list is initialed
3. Report to Oral Presentation
  - a. check in to receive information or to drop off media/materials for you presentation
  - b. check list s initialed
4. Compliance 2 Water Test (only 2 team members including advisor)

- a. craft must pass water compliance and receive a serialized label
  - b. check list is initialed
5. Return the completed checklist to the Lead Compliance Officer at Compliance Station 1
4. Only two (2) team members, with their Sea Perch and checklist, should report directly to compliance station #1. Once you pass compliance #1, the compliance officer signs your checklist and you will be dispatched over to the presentation area to check in any materials being used in the presentation. Once the presentation officer signs your checklist, you can move onto compliance station #2 at the pool.
5. Only two (2) team members are permitted to be at compliance station #2, prior to the start of the competition to pass the maneuverability test. All other team members and spectators must report to the gym for the opening ceremony. The compliance station 2 officer signs your checklist when you complete the test.
6. When all steps on the checklist have been completed and initialed by the station officers you must return to compliance one officer in the gym where he will clear you to compete.

\*\*\* ONLY AUTHORIZED PERSONNEL ARE PERMITTED IN THE POOL AREA \*\*\*

**Team Checklist**

Team Name: \_\_\_\_\_

ID #: \_\_\_\_\_

Instruction: This step-by-step checklist must be completed and initialed by a judge at each location before a team is eligible to compete. Once the checklist has been complete, it should be handed into the lead compliance officer in the gym. Checklist must be completed by 9:00 am.

Completed	Initials of Judge	
Step 1-Did your team check in?	Yes No	
Step 2 – Two team members completed Compliance Check 1 at Station 1 in the gym.	Yes No	
Step 3 – Team reported to Presentation area.	Yes No	
Step 4 – Two team members completed Compliance Check 2 at Station 2 on the pool deck.	Yes No	

## **Section 4 Awards and Competition Advancement**

4.1 *The Engineering Design Notebook Category Awards:*

Trophies for first, second, and third place awarded in both Competition Classes (six total).

4.2 *Team Presentation Category Awards:*

Trophies for first, second, and third place awarded in both Competition Classes (six total).

The Team Oral Presentation category measures a team's ability to communicate ideas and market solutions to a panel of external judges made up of actual marine engineering professionals from Government, Industry, and Academia. The judges will assess each team's design innovation, adherence to technical specifications, and adherence to a \$20.00 budget.

4.3 *Vehicle Performance Category Awards:*

Trophies for first, second, and third place awarded for combined score of both pool rounds for both Competition Classes (six total). First and second place Vehicle Performance winners receive an invitation to represent the Greater Philadelphia SeaPerch Region at the National Competition.

The Vehicle Performance category is a series of tests that determine how well a team did in designing and building an underwater Remotely Operated Vehicle. A submerged obstacle course gauges whether an ROV design is capable of maneuvering successfully under its own power. If a vehicle cannot maneuver to the appropriate location to perform its task, the vehicle is of no use. Teams must navigate through the obstacle course, surface, then re-submerge and return through the course to the end. A deep-water mission objective tests a craft's ability to perform a common function of ROVs: the underwater retrieval of objects from complex locations at different depths, and then placing them in designated locations.

4.4 *Team Spirit and Sportsmanship Category Awards:*

Trophies for first, second, and third place in both Competition Class (six total) the Team Spirit and Sportsmanship category judges a team's capabilities to recognize and encourage better solutions and engineering. Teams are encouraged to support their team and assist opposing team to show sportsmanship.

4.5 *Overall GPSPC Winners*

Each team will receive a score for each of the four competition categories listed above. Scores from all categories except Team Spirit & Sportsmanship will be combined to determine the overall GPSPC Champion. There is one overall Middle School Champion and one High School Champion.

4.6 *Simulated Navy Contract Cash Award*

A \$100.00 cash award presented to the middle school and high school teams that best meets the needs of the Navy.

4.7 *American Society of Naval Engineers (ASNE) Engineering Process Cash Award*

A \$100.00 cash award to the team that best utilizes sound engineering principles and approach for

assessing SeaPerch design variations and incorporating those changes into the final design

4.8 *Atlantic Rangers Scuba Club, Against All Odds Award*

An award presented to one middle school and one high school team that overcomes the most significant obstacle(s) and still competes in the challenge

## **Section 5      SeaPerch Mentor Program**

5.1      What is the Mentor Program?

The mentor program is an important part of the GPSPC. Bringing engineers and students together in a classroom environment is increasing student interest in math, science, and engineering. It increases awareness of Naval Engineering and Naval Architecture as career fields. Benefits of the mentor program include:

- Helping students prepare for college level work
- Provides students with the opportunities to:
  - work in a collaborative environment
  - experience a major university campus
  - participate in a realistic business and technical scenario
  - interface with industry, academia, and government engineers

Working with a mentor will enhance your team's experience and provide you with a greater chance of success.

5.1.1      How is the mentor relationship established?

SeaPerch teams register online and it is at that time they can request partnership with a mentor when we receive your request for a mentor one will be assigned to you. We do our best to find the best fit between the school and the mentor. You may specifically request a mentor you have had in the previous challenge. Just let us know who they are. Once a mentor is assigned, an email will be sent to the mentor and the first team advisors. Mentors will be given the first and second advisors name, email address and telephone numbers. The advisor will be contacted by the mentor via email or telephone.

5.1.2      Meeting with the Mentor

It is suggested that the mentor meet with their SeaPerch team at least four times throughout the Design and Build phase. The first meeting is a great introductory opportunity for the mentor to discuss their career, the fields of science and math and share the fun aspects of math and science. The mentor can provide examples of how they use science and engineering every day. Subsequent meeting times can be established where the students engage in the design of the Sea Perch and then on to the building phase.

5.1.3      The Benefits of Working with a Mentor

- The mentor program is increasing student interest in math, science, and engineering.
- Increase awareness of Naval Engineering and Naval Architecture as career fields
- Helping students prepare for college level work
- Provides students with the opportunities to:
  - work in a collaborative environment
  - experience a major university campus
  - participate in a realistic business and technical scenario
  - interface with industry, academia, and government engineers

Working with a mentor will provide your team with a greater chance of success.

## **Section 6 General Rules**

### **6.1 General Pool Performance Rules**

1. All team members must wear shoes with rubber soles on the pool deck.
2. Teams will report to the “Mission Course” or “Obstacle Course” side the pool deck at least 5 minutes before their scheduled heat time.
3. Only 2 team members are allowed on the pool deck during competition. Teams are permitted to change drivers for each round.
4. The vehicle 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 vehicle shall be put into the pool during the competition.
7. In the event that a vehicle is inadvertently interfered with during a competition, or a malfunction of a vehicle'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 vehicle and to allow them to compete at a later time. 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.

#### **6.1.1 Challenges and Disputes**

1. Sportsmanship is expected at all times. Should a protest or dispute occur during the competition it is the intent to resolve the grievance at the time it occurs, and the ruling by the Head Judge shall be final.
2. A team that wishes to have an issue considered shall send the student team captain and one additional student member (2) to the lead judge with the inquiry or question. The lead judge will make the decision on the issue, and this decision is final. The same issue may not be brought to the judge a second time by any member of the team. Adults may not approach the lead judge on the pool deck regarding any perceived issues.

3. Teams may not question the legality of other competing vehicles; it is the Lead Compliance Judge's role to determine if vehicles meet the entry and compliance requirements.
4. Unsportsmanlike conduct is grounds for the disqualification of a team. Team members and advisors are responsible for the conduct of all members and adults accompanying the team.

## **Section 7 Frequently Asked Questions**

### **1. What happens if my vehicle breakdown during competition?**

A Triage Station equipped with spare parts and tools 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's 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 vehicle can be done in triage. A qualified volunteer will be assigned to the triage station to provide you with assistance.

### **2. Where can I purchase a kit?**

Kits are available for purchase thru [www.seaperch.org](http://www.seaperch.org).

### **3. What if I need tools?**

Tools are loaned based on need and availability. You may request tools through the [www.phillynavalstem.com](http://www.phillynavalstem.com) website. A Tool Bag containing tools that can be used for multiple SeaPerch builds (and reused year after year) are available at [www.seaperch.org](http://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. Follow the sample Plan of Action & Milestones (POA&M) published on the [phillynavalstem.com](http://phillynavalstem.com) website.

### **5. 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.