

## **2010 Greater Philadelphia Sea Perch Challenge** *Recovery & Mine Clearing*

### **Background**

MIT Sea Grant's new Sea Perch program introduces pre-college students to the wonders of underwater robotics. Part of the Office of Naval Research's initiative, "Recruiting the Next Generation of Naval Architects," this program teaches students how to build an underwater robot (called a Sea Perch), how to build a propulsion system, how to develop a controller, and how to investigate weight and buoyancy. This endeavor is one of many exciting new projects funded by the Office of Naval Research (ONR) as part of its National Naval Responsibility Initiative. The initiative focuses on bringing academia, government and industry to work together to ensure that the talent needed to design the Navy's next generation of ships and submarines will be there when needed. To visit the MIT Sea Perch website please visit <http://web.mit.edu/seagrant/edu/seaperch/WhySP.html>.

#### *So how did it end up in Philadelphia?*

The Delaware Valley Section of the American Society of Naval Engineers (ASNE) and the Philadelphia Naval Surface Warfare Center (NSWC) brought the Sea Perch program to Philadelphia and Drexel University. ONR funds the kits that ASNE and NSWC provide for the competition. In 2005, SeaPerch outreach included a few local schools, and the educational value of SeaPerch was quickly realized. The first Greater Philadelphia Sea Perch Challenge competition was held at Drexel University on Saturday, Jun 3, 2006 and included about 20 schools. In both the 4<sup>th</sup> and 5<sup>th</sup> SeaPerch Challenge, approximately 40 schools participated in the challenge. The program has continued to evolve and has become a model for the national Sea Perch initiative.

### **Eligibility**

The Greater Philadelphia Sea Perch Challenge is open to middle school and high schools in the Philadelphia region. The goal is to increase student interest in robotics, science, mathematics, engineering and technology and to introduce students to naval engineering.

## The Structure of the Event

The event is structured to give students an overall experience in the engineering process. The first category, **Vehicle Performance**, is a test of how well the students did in designing and building their ROV. The second category, **Team Presentation**, is a test of how well the students can convey their engineering ideas and market their ROV. The third category, **Teamwork Summary**, is a test of the students organizational and documentation capabilities. The fourth category, **Spirit & Sportsmanship**, is a test of the students capabilities to recognize and encourage better solutions and engineering.

## Competition Categories & Judging

There will be separate competitions and awards for High Schools and Middle Schools. Each team is judged in each of the four competition categories:

- Vehicle Performance
  - Awards: First Place, Second Place, and Third Place
- Team Presentation
  - Awards: First Place, Second Place, and Third Place
- Teamwork Summary
  - Awards: First Place, Second Place, and Third Place
- Team Spirit & Sportsmanship
  - Awards: First Place, Second Place, and Third Place

Panels of external judges from industry, government agencies and higher education will evaluate the competition. Each category will have its own separate panel of judges. Each team will be given a score for each event and each category will have three awards.

### *Overall Greater Philadelphia SeaPerch Winner*

Each team will receive a score for each of the four competition categories listed below, these scores will be added together to determine the overall Greater Philadelphia Sea Perch Challenge Champion. There will be one award for Middle School and one award for High School.

### *ASNE Engineering Process Award*

This award goes to the SeaPerch team that best utilizes sound engineering principles and approach for assessing SeaPerch design variations and incorporating those changes into the final design. There will be one award for Middle School and one award for High School.

All awards will be announced at the end of the competition

## General Rules

### *1. The Tether:*

Throughout the competition, the vehicles must move only under their own power. Specifically, a team member pulling on the tether during the competition rounds is expressly prohibited and will be grounds for immediate disqualification.

### *2. Modifications to the Sea Perch Kit:*

Teams are encouraged to think outside of the box. Teams have a budget of \$20.00 to purchase any upgrades they deem necessary. Teams are not allowed to add additional thrusters and must use the motors that come with the kit. Everything else in the kit can be used at your own discretion. All purchases must have a receipt and that receipt must be included in the project notebook. Teams are permitted to change the shape and configuration of the sea perch. Hooks and attachments may be added/removed depending on the round. Extra batteries may be purchased or used from other kits and will not be included in your budget.

### *3. Competition Day*

- Only 2 team members are allowed on the pool deck during competition
- All team members must wear shoes with rubber soles to the competition
- Nothing other than the sea perch vehicle should be put into the pools
- Each robot will be inspected and qualified by a judge prior to competition.
- In the event that a vehicle is inadvertently interfered with during a trial or a malfunction of a vehicle's parts (i.e. the motor) that is beyond the design and construction put together by the team, the panel of judges will have the authority to allow the team time to fix their vehicle and allow them to complete later in the round. These malfunctions will be evaluated on a case by case basis.

## **Vehicle Performance**

### **Round 1: Maneuvering**

The first requirement of an underwater remotely operated vehicle is that it 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. Thus, the first round challenge is maneuvering.

#### **Middle school course:**

This round will consist of a submerged obstacle course involving large rings 24 inches in diameter through which the vehicles must travel. The rings will be oriented vertically and horizontally. Consideration towards optimal maneuverability, control, and speed should be given when constructing the Sea-Perch (motor placement and orientation, tether attachment, buoyancy and ballast, etc.) and your control box. This round will be scored based on who can successfully navigate the course the fastest.

#### **High school course:**

This round will consist of a submerged obstacle course involving large rings 24 inches in diameter through which the vehicles must travel. The rings will be oriented in any direction. Consideration towards optimal maneuverability, control, and speed should be given when constructing the Sea-Perch (motor placement and orientation, tether attachment, buoyancy and ballast, etc.) and your control box. This round will be scored based on who can successfully navigate the course the fastest

### **Round 2: Recovery & Mine Clearing**

Many times underwater vehicles are used to retrieve things from the sea floor, or the floor of a harbor or port. The ability to recover objects off the sea floor depends on the vehicle's ability to grasp or manipulate the object, and also to lift or carry it to some destination. If the object is too heavy, or it unbalances the craft, or the craft cannot get control of the object, the vehicle cannot successfully perform its mission.

In addition to recovering objects, ROVs are called upon to perform tasks that are too dangerous for humans to do. In these situations, the loss of a ROV is considered acceptable, but still a financial loss. Completing the mission without the loss of the ROV is considered a very successful mission.

#### **Middle school course:**

For this round, the Sea-Perch teams must have a rod or hook of some sort fitted to their vehicle in order to retrieve objects off the bottom of the pool. The objects will have a loop by which they can be picked up and will be of varying mass. Once picked up, the objects must be dropped into the team's

submerged collection bucket. This round will be scored based on the total mass of objects retrieved within the time limit. Considerations of buoyancy, thrust, and hook placement and attachment, and ballasting become more important in this round. The masses of objects will be between 1 ounce and 4 ounces. The objects will be shape and color-coded so that the weights can be easily determined.

**High school course:**

Remotely operated underwater vehicles are required to perform many duties from inspecting pipelines and ships hulls to identifying and disabling mines. Many times ROVs are put in harms way to prevent the loss of human life. In this scenario, your ROV has been tasked with clearing a mine field so that ships can pass safely into a harbor. For this round, the Sea-Perch teams must have a probe attached to the ROV for releasing the mines from the pool floor. Once the mines have been released, they must be collected and returned to the side of the pool where they can be retrieved by a judge. If your ROV touches the mine it will be destroyed, so a system has to be devised to retrieve the mine using only the mines mooring line. This round will be scored based on the number of mines released, the number of mines returned to the judge, and the time in which it takes. Considerations of thruster placement, maneuverability, and camera mounting will be very important in this round.

## Team Presentations

Each team will make a maximum 10-minute presentation to a panel of judges on the day of the competition. The team should present as though they are the sales team of the company that designed and built their sea perch. The client (panel of judges) has a mission (a recovery mission for the middle schools and a mine clearing mission for the high schools) and they are screening possible companies to determine which sea perch model would be right for them. It is the sales teams' responsibility to prove to the clients that their product is the best. The formal presentation will be followed by an informal 5-minute question, answer, and discussion period. At this time, teams that modified the original Sea Perch design should discuss their modifications. They should discuss the experiments they conducted during their design phase and what modifications came from them. At the conclusion of the question, answer, and discussion period, judges should have a clear understanding of how students implemented their basic knowledge of fluids and propulsion.

All teams must include the following in their presentation:

- Company Overview
  - Company name, size, demographics
  - Mission/Vision statement with and emphasis on naval engineering.
  - Organization of the company
- Recruiting
- Budget information and implementation
  - Identify additions to the Sea Perch
  - Explain any trade-offs
- Design and Manufacturing Process & Engineering Process
  - Identify the steps taken to achieve the design
  - Design research
  - Identify technical calculations or testing conducted and design priorities
  - Integrated lessons learned
  - Charts/Drawings/Pictures
- Use of computer technology

High School Teams must also:

- Hand out a corporate brochure to the clients which must include:
  - Mission/Vision statement of the company
  - Overview of the types of engineers involved in the process
  - Organizational Chart
- Each member of the sales team must have a resume to distribute

The format for the presentation is open to creative interpretation and teams are encouraged to use technology in their presentations. An overhead projector, TV/VCR (DVD player upon request), lap top and LCD projector are all available. Additional equipment may be brought in but it must conform to the existing layout of the room.

A maximum of eight team members will be allowed in the presentation room, including the advisor. **All** team members present in the room **must participate** in giving the presentation. The presentation may be videotaped by one of the eight representatives in the room and this must be done without causing a disturbance.

A schedule of presentation times will be posted during the competition. Teams are advised to arrive at their designated presentation room 10-minutes prior to their scheduled start time. Teams who are more than 5-minutes late will not be allowed to present.

## Teamwork Summary Notebook

Teams must demonstrate how they implemented the engineering process in their *Teamwork Summary Notebook*.

Teamwork Summary Notebooks should include:

- Cover which includes the following information
  - School
  - School District
  - Team Name
  - Teacher Name and Contact Information
  - Team website (if applicable)
- Title Page
- Table of Contents
- Up to 20 pages that outline the teamwork that went into building the Sea Perch
  - Research of naval and marine engineering
  - Discuss the possible naval scenarios for your Sea Perch
  - Describe how your team demonstrated teamwork
    - Provide concrete examples of how team members worked together and how they helped other team members
  - What challenges did the team face and how did they overcome them?
  - What is the biggest lesson that the team learned?
  - What were the biggest factors of success for the team?
- Team List
- Feel free to include any photos, drawings, organizational charts, or any addition supporting information.
- Experiment worksheets on basic underwater principals
- Receipts for purchased materials.

Notes: Minimum font size is 12 pt and projects should use only 8 ½ " x 11" paper

Notebooks must be turned in two weeks prior to the day of competition. Due date is April 12, 2010

## **Team Spirit & 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.

Each team will sit together in the bleachers of the pool area. Teams are asked to have a team flag to identify their team to the judges.

Flag specifications should be:

- Maximum flag pole height is 7 feet
- Maximum flag dimensions are 3x3
- Prominently display the school and team names
- 1 flag per school

Other ways to show school spirit:

- Cheering for teammates during team competition
- Demonstrate sportsmanship by cheering for other schools
- Posters & signs
- Team clothing
- Cheers