



8TH Annual Greater Philadelphia Sea Perch Challenge

2013 Competition Specification

Deep Water Transfer

Executive Summary

Underwater Remotely Operated Vehicles (ROVs) are commonly used at deep depths to perform a variety of tasks. One on these tasks is the retrieval and relocation of objects. This year, the Sea Perch Challenge Mission simulates retrieving objects from complex locations at different depths, and then placing them in designated locations.

The Sea Perch Challenge Competition will be held at Drexel University’s Recreation Center located at 3301 Market Street, Philadelphia, PA, 19104. The competition will take place on Friday, April 26, 2013 for middle schools and Saturday, April 27, 2013 for high schools. The competition will begin with team check-in and compliance checks followed by an opening ceremony, competition rounds, and the presentation of awards.

The Sea perch Challenge Competition will feature poster and pool events. A juried poster competition is planned for both middle and high school teams to introduce their graphic displays and deliver oral presentations about their design philosophy, construction challenges and answer questions posed by the judges.

An engineering design notebook must be delivered for judging before the submittal deadline. The engineering design notebook submittal deadline is in advance of the competition date. The engineering design notebook emphasizes process documentation and captured the lessons team learned during the design, build and test phase.

The pool's technical competition events will consist both of an Obstacle Course and a new Deep Water Transfer challenge. Specifications for the underwater events are contained within this document and are posted on the www.phillyseaperch.org website to aids teams with building practice and test setups prior to the competition.

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1. Sea Perch Challenge Background

a. Problem Statement

1. The United States is currently ranked 27th (out of 29) for the number of Science, Technology, Engineering and Mathematics (STEM) Bachelor's Degrees awarded by developed countries. Only six percent of our nation's undergraduates complete engineering degrees compared to 12% in Europe, 20% in Singapore, and 40% in China. It is estimated that more than 400,000 engineers will be needed by 2014 to maintain the level of scientific innovation that has produced roughly half of all US economic growth over the past 50 years. Based on current trends, only one quarter of them will be developed by US universities. Three out of every four engineering, computer science and physics graduates will be male.

b. Sea Perch is Making a Difference

1. Sea Perch is one of the STEM education and outreach programs sponsored by the Navy to address the national crisis of decreasing college enrollments and careers in science and engineering. The principle goal of Sea Perch is to engage and inspire middle and high school students by exposing them to exciting, hands-on, and mentor-based programs that build science, engineering and technology skills, while at the same time fostering self-confidence and life skills.

2. Sea Perch accomplishes its principle goal through 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 and easily accessible parts, following a curriculum constructed around basic engineering and science concepts with a marine engineering theme. Sea Perch students have the opportunity to learn about robotics, engineering, science and mathematics, problem solving, and teamwork while building an underwater ROV.

3. This year over 2,000 students from approximately 100 regional middle and high schools will participate in the Greater Philadelphia Sea Perch Challenge. Teams will design, build, and compete underwater ROVs during a competition at Drexel University in downtown Philadelphia. The first place winners of the pool performance category advance to the national competition and compete against other regional Sea Perch Challenge winners from 35 participating states (over 15,000 students nationally). Since the Sea Perch Challenge was created in Philadelphia eight years ago, more than 50,000 students have participated in the Sea Perch program nationally.

2. Sea Perch Challenge Competition Eligibility

a. *Eligible Participants*

1. The Greater Philadelphia Sea Perch Challenge is open to middle schools, high schools, and youth organizations in the Pennsylvania, New Jersey and Delaware tri-state area.

b. *Registration*

1. Team registration for the 2013 Sea Perch Challenge will remain open from Wednesday, October 31, 2013 until all 100 competition spaces have been filled on a first come first served basis. Only one team per school or organization will be accepted. A \$25.00 registration fee will be assessed from each registrant.

3. Sea Perch Challenge Program Format and Overview

a. *Phase I: Program Kickoff*

1. The Sea Perch Challenge Program Kickoff Phase includes all activities associate with the Challenge planning, team registration, material distribution, and new advisor training. The Program Kickoff Phase ends with the official Sea Perch Challenge Kickoff Event at Drexel University on November 14, 2013.

b. *Phase II: Design – Build – Test*

1. The Sea Perch Challenge Design – Build – Test Phase is all time between Kickoff and Competition. It is the time to learn, teach, experiment, and practice. Teams shall function as companies competing for a simulated Navy contract by designing an underwater ROV and that meets the technical requirements while staying within specified budgetary restrictions. Phase II is when the Competition products are developed.

c. *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 Classes:

(1) Middle School

(2) High School

Competition Categories:

- (1) Engineering Design Notebook
- (2) Team Poster Presentation
- (3) Vehicle Performance (obstacle/maneuverability and mission)
- (4) Team Spirit and Sportsmanship

(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 shall be electronically submitted in an approved file and within file size limitations specified in advance of the competition. The deadline for Notebook submittals is 5:00 pm on April 04, 2013.

The Team Poster 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 budget.

(2) 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 transfer 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.

(3) The Team Spirit and Sportsmanship category judges a team's capabilities to recognize and encourage better solutions and engineering.

d. Awards and Competition Advancement

(1) *Engineering Design Notebook Category Awards:*

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

(2) Team Poster Presentation Category Awards:

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

(3) Vehicle Performance Category Awards:

Trophies for first, second, and third place awarded for the combined score of both pool rounds for both Competition Classes (six total). The winners of the Vehicle Performance Category Awards will receive invitation to represent the Greater Philadelphia Sea Perch Region at the National Competition.

(4) Team Spirit and Sportsmanship Category Awards:

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

(5) Overall Greater Philadelphia Sea Perch Challenge 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 Greater Philadelphia Sea Perch Challenge Champion. There will be one overall Middle School Champion and one High School Champion.

(6) Simulated Navy Contract Cash Award

A \$100.00 cash award presented to the middle school and high school teams that are identified as the Overall Greater Philadelphia Sea perch Challenge Winners.

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

A \$100.00 cash award presented to one middle school and one high school team that best utilizes sound engineering principles and approach for assessing Sea Perch design variations and incorporating those changes into the final design.

(8) Atlantic Rangers 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.

Engineering Design Notebook Overview

a. 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 shall be electronically submitted in an approved file and within file size limitations specified in advance of the competition. The deadline for Notebook submittals is 5:00 pm on April 04, 2013. *Notebooks will not be accepted after the deadline.*

b. 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 Sea Perch
- V. Teamwork
- VI. Bill of Material
- VII. Supporting Documentation

NOTE: Sections II through VII shall not exceed 20 pages in length.

NOTE: Acceptable fonts and size should be 12 point, standard form (i.e. 12 pt Times New Roman, Arial or Calibri).

NOTE: Design Notebooks shall utilize an 8 ½ " x 11" paper format only.

2013 Sea Perch Design Notebook Information Guide

School Guide		
Notebook Section	Mentor Tips	
I. Front Matter		
A. Cover Page	Decorative art with Team Name and School Name	
B. Title Page, including:	Separate from the Cover Page - plain white with the Team Name, School Name, School District, and Advisor Name and Contact Information all appears on the cover page.	
Team Name		
School, School District		
Advisor Name and Contact Information		
C. Table of Contents included (and all pages numbered)	Make sure all pages in your document are numbered and show numbers on the Table of Contents.	
D. List of Figures	Figures in the notebook should be labeled "Figure 1", "Figure 2", etc.. With a brief caption and listed in the List of Figures (with page numbers) following the Table of Contents.	
E. List of Tables	If the Notebook contains any Tables they should be labeled "Table 1", "Table 2", etc.. With a brief caption and listed in the List of Tables (with Page numbers) following the List of Figures.	
II. Naval Engineering Research		
Note: Sections II. through V. should be no more than a total of 20 pages. This constitutes the bulk of the Notebook score.		
A.	Naval engineering principles that the team researched and used in the building of the SeaPerch. Describe engineering concepts that the team found in books, online or through interviews and show how that information was used to improve the Sea Perch design.	This is the theoretical foundation for your design work. Be thorough in describing what concepts you investigated, what you learned and how you applied that knowledge to your design. Examples are: buoyancy, thrust, center of gravity, center of mass, force vectors (applied to propulsion and steering).
B.	Description of the learning modules completed (buoyancy, electricity, vectors) showing results and how they are applicable to the Sea Perch Design.	Teams should complete the learning modules provided on the Sea perch Website. Be detailed in showing all calculations you did during the learning modules. State how the concepts learned were applied in the design of the SeaPerch.
III. Design, Engineering, and Manufacturing Process		
A.	Design & Manufacture	
1.	Description of the process used to refine the design and manufacture the final product.	Define the requirements and show how you designed the Sea perch to meet those requirements. Be specific and detailed in your description of how you set performance specifications for each component of the craft (frame, thrusters, etc...) to meet the requirements. Concept drawings and drawings or photos of the final design can be included.
2.	Discussion on what design modifications were considered to enhance ROV performance and why they were or were not incorporated.	
3.	Discussion on the factors considered in selecting the final design.	
B.	Experimentation	
1.	Description of any experiments completed to test theories, validate performance, etc...	This is not a repeat of the learning modules. It should document in detail any experimentation you conducted. One example is to compare the actual ballast you need for your SeaPerch to the theoretical amount you calculated. Testing of the completed SeaPerch can be documented here.
IV. Naval Scenario for Sea Perch		
A.	Detailed discussion related to how the Sea Perch could be implemented in a practical scenario or task. Highlight how their particular design aids in the accomplishment of the requirements.	Be creative. It should read like a good English assignment. Incorporate some mention of the design requirements relating to a real-world situation.
V. Teamwork		
A.	Team participant list.	List each member
B.	Description of how the responsibilities were split up and assigned among team members.	Show what each member worked on.
C.	Provide concrete examples of how team members worked together and helped each other.	Demonstrate the positive aspects of teamwork!
D.	Detailed discussion of the challenges the team faced and the steps they took to overcome the challenges.	Any time or scheduling problems? Technical problems? Personality issues? What impact did they have on the completion of the project and how did you overcome them?
E.	Listing of the biggest lesson learned by the team.	What did you learn working as a team and how will that help you in the future (during college and/or in a career setting)?
F.	Describe the biggest factors for the success of the team.	What made you successful and why?
VI. Bill of Material		
A.	List of all material used	List the parts of the standard kit you used as well as anything purchased.
B.	Included receipts for purchased materials.	Items added to the basic kit must be \$20 or less. If items were donated, estimate what it would have cost to buy them. Bought and donated items must total \$20 or less.
VII Supporting Documentation		
A.	Any photos, drawings, organizational charts or any additional supporting information	Drawings of design ideas are nice (even if you ended up with a different design). Photos are always good (build process, etc...)

4. Poster Presentation Overview

a. Teams shall conduct their oral presentation from poster displays set up on Competition Day. Electronic media, physical models, additional posters, or other items can be used by a team to supplement their Poster Presentation. The Poster Presentation rubric for middle schools and high schools will form the basis of scoring. Bonus points may be awarded based on the technical merits of the Sea Perch design and/or supplemental items. Teams will have 10 minutes to present their poster and 5 minutes answer follow-up questions by the judges.

b. Teams shall present as though they are the sales team for a company competing to design and built a Sea Perch ROV in response to a US Navy Contract Solicitation. The Panel of Naval Engineering Clients (the panel of judges) have an “Underwater Transfer” mission and they are screening possible companies to determine which Sea Perch design is the best option for their need. It is the Poster 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 mission.

c. The Poster Presentation session is the best time for teams who modified the original Sea Perch design should 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 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 basic knowledge of design and engineering.

d. All teams must include the following in their presentation:

- Company Overview
 - Company name, size, demographics
 - Mission/Vision statement with an 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

e. 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

f. The format for the presentation is open to creative interpretation and teams are encouraged to use technology in their presentations. Any additional equipment including computers with special software must be furnished by the team.

g. A maximum of eight team members and one advisor will be allowed to staff the poster during the judging. All team members present must participate in giving the presentation. The presentation may be videotaped by one of the eight representatives and must be done without causing a disturbance.

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

i. The poster size shall not exceed 36" x 48".

j. Teams are encouraged to walk around and view/discuss presentations with other teams.

2013 Sea Perch Challenge Poster Presentation Checklist

I. PRESENTATION OF THE COMPANY

- Company Information and Objectives
 - Company Description
 - Mission/Vision statement and purpose that includes naval engineering focus
 - Organization/structure of company explained
 - Recruiting methods for new company members

- Budget Management
 - Identified and itemized modifications
 - Explained trade offs for various modifications

II. KNOWLEDGE OF DESIGN AND MANUFACTURING PROCESS/ENGINEERING PROCESS

- Design Process
 - Identified steps to achieve design modifications/alternatives
 - Demonstrated design research as part of their process, (naval engineering research)
 - Identified technical calculations or testing to optimize/select design
 - Practicing and testing was well planned
 - Lessons learned from testing were present and specific

- Engineering Process and Roles
 - Discusses naval engineering field and roles
 - Demonstrates knowledge of design process: problem definition, tradeoffs, and testing.
 - Identifies naval engineering design considerations.

III. PRESENTATION CONTENT AND PROFESSIONALISM

- Overall Appearance (Max. size: 48" x 36")
 - Poster Size
 - Use of colors
 - Text, Graphics Balance
 - Organization & Flow

- Objectives & Main Points/Summary

- Presentation Skills
 - Focus on naval engineering
 - Fluent, clear, audible delivery. Correct grammar and language use
 - Non-verbal skills: Posture; practiced use of visual aids
 - Overall confident, direct, and animated.
 - Presenters and teamwork (at least 2 presenters and less than 9)

- Visual Aids
 - CAD/other, visualization (Power Point Rendering) aids
 - Visual aids (charts etc.) neat well prepared
 - Creative use of other visual aids presentation techniques

IV. INNOVATIVE DESIGN INTERVIEW Q and A (5 min. max)

- Clarification of System Designs
 - Team response to judges questions

5. Craft Construction Requirements and Compliance

a. Craft Compliance

1. All Sea Perch ROV entries will be subjected to a compliance review prior to the competition. All Sea perch ROVs must and approved by a judge prior the team competing in the pool events. A triage station will be provided for student teams to make repairs, adjustments and rebalance their ROV's during the competition.

b. Craft Design Rules

1. Vehicles shall consist of the parts and components contained within the equivalent of one Sea Perch kit, with the following exceptions:

- Teams have a budget of \$20.00 to modify the Sea Perch. It is the actual value of the modifications that must be \$20.00 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 vehicle. Reasonable spare parts are not included in this budget.
- Hooks and other attachments may be added/removed between competition rounds.
- 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 Sea Perch thrusters (Jameco P/N 232022).
- Teams may not add additional thrusters to the Sea Perch. A thruster is defined as a means of propulsion for the Sea Perch, 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 vehicle may be reset by the teams during the competition
- The vehicle cannot be dragged via the tether.
- No dimension shall be larger than 22" (minimum obstacle diameter)

6. Competition Day Rules and Requirements

a. General Competition Rules

1. All team members must wear shoes with rubber soles to the competition.
2. Each ROV will be inspected and qualified by a judge prior to competition.
3. Only 2 team members are allowed on the pool deck during competition. Teams are permitted to change drivers for each round.
4. Nothing other than the Sea Perch vehicle shall be put into the pool during the competition.
5. 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 later in the round. Malfunctions will be evaluated on a case-by-case basis.

b. 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 Head 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.

c. Obstacle Course Maneuvering

1. 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.
2. The submerged obstacle course involves large rings (22" – 24" minimum diameter), oriented in various directions, through which the vehicles must travel.
3. Teams must navigate through the obstacle course, surface, then re-submerge and return through the course to the end. Consideration of optimal maneuverability, control and speed should be given when constructing your Sea Perch (thruster placement and orientation, tether attachment, buoyancy and ballast, etc.) and control box.
4. Scores for this round will be based on the fastest time for successfully navigating the obstacle course.
5. There are five (5) hoops in the obstacle course.



Figure 1: Obstacle Course Assembly Layout Example

d. Underwater Mission: Deep Water Transfer

1. ROVs are commonly used at deep depths to perform a variety of tasks. One of these tasks is the retrieval and relocation of objects. This task simulates retrieving objects from complex locations at different depths, and then placing them in designated locations.

2. The course shall consist of two racks of rings anchored at different depths. Each rack will hold Six (6) rings (12 rings total), three on the side closest to the craft driver and three on the side furthest away from the craft driver. Rings retrieved shall be placed in one of two bins located at different depths. A larger bin shall be located at a shallow depth with a smaller bin beneath it at a deeper depth.

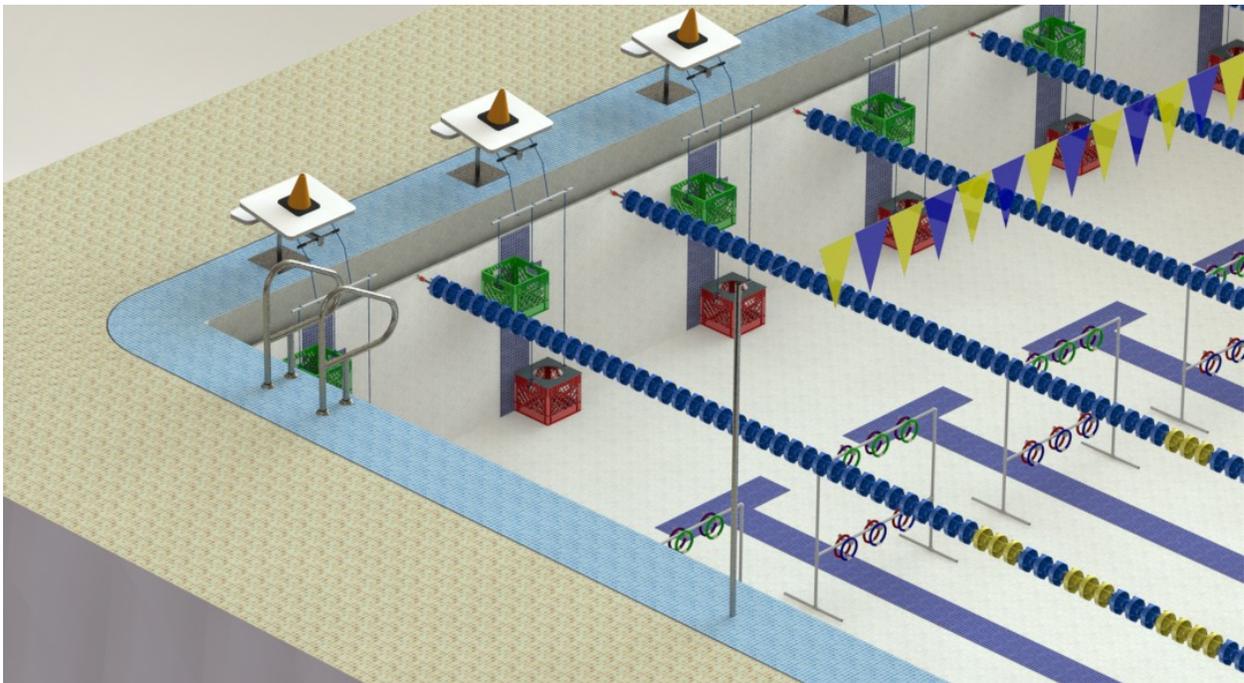


Figure 2: Mission Course Layout Example

3. Scores for this round shall be based on the following:

- 1 point shall be awarded for each ring removed from the close side of the rack
- 2 points shall be awarded for each ring removed from the farther side of the rack
- 1 point shall be awarded for each ring placed in the upper bin
- 2 points shall be awarded for each ring placed in the lower bin

4. There is a maximum of 42 points that can be earned by retrieving all rings from the rack and depositing them in the lower bin.

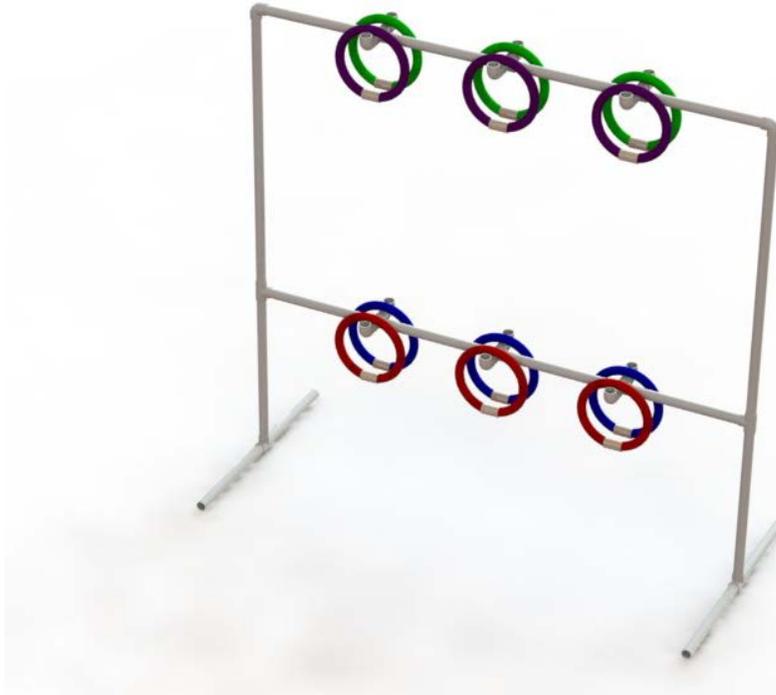


Figure 3: Mission Assembly Layout Example

5. In the event that more than one team finishes the underwater mission with the same point total, the team that acquired the last point in the shortest time shall be placed ahead of another team with the same point total and a slower acquire time.

7. Team Spirit and Sportsmanship

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. Percussion instruments are prohibited.

4. Flag specifications shall conform to:

- Maximum flag pole 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 1 flag per school is allowed

5. Other ways to show school spirit:

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