2020 Greater Philadelphia SeaPerch & SeaGlide Challenge Kick Off

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College of Science and Technology

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Philadelphia

Program Goals

- Program goal is to sustain a long-term effort to address the need for college enrollments in engineering and technical programs
  - Increase student interest in STEM related studies through hands-on activities at the middle and high school level
  - Provides awareness of Naval Engineering and Naval Architecture as career fields
  - Helps students prepare for college level work
    - Interface with industry, academia, and government engineers
    - Work in collaborative environment
    - Participate in a realistic business
    - Experience a major university campus
    - Participate in a realistic technical scenario

Create a Fun, Challenging and Educational experience for students

Role of the Mentor

- Share career experiences
  - their job as an engineer or scientist
  - math and science education
  - how science and math are used in engineering
- Provide help with kit construction
- Assist with the build & troubleshooting
- Provide guidance on competition requirements
- Assist students with troubleshooting
  - Teacher must be present whenever mentors are with teams
  - All communications with mentor must be via the teacher

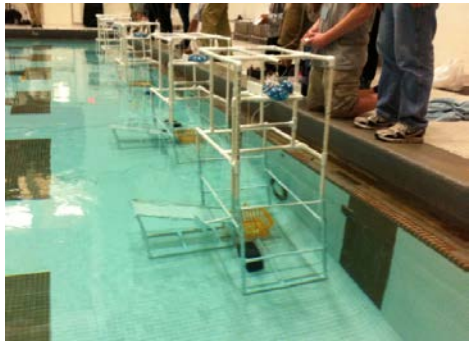
Team Spirit & Sportsmanship

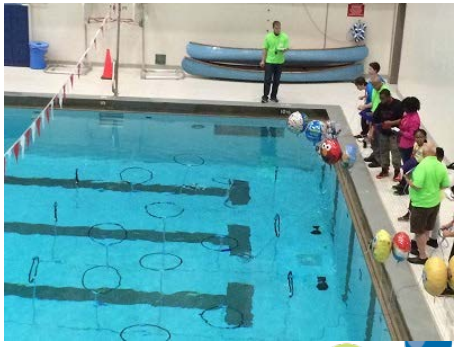
- The experience is about more than winning
- Teams sit together in bleachers
- Use flags, signs, mascots, cheers, etc. to show your team spirit
- NO INSTRUMENTS OR NOISE MAKERS (DRUMS, HORNS, SHAKERS, ETC.)


seaperch
TEACH • BUILD • BECOME

What is the Sea Perch Challenge?

- SeaPerch is a Remotely Operated Vehicle (ROV) educational program
  - Consists of an educational tool kit that allows middle and high school students to construct and compete a simple ROV
  - Includes a curriculum-designed program that teaches students about basic marine design skills
    - Naval Architecture
    - Marine Engineering
    - Ocean Engineering
  - Objective is to develop the next generation of naval architects, marine engineers, naval engineers, and ocean engineers



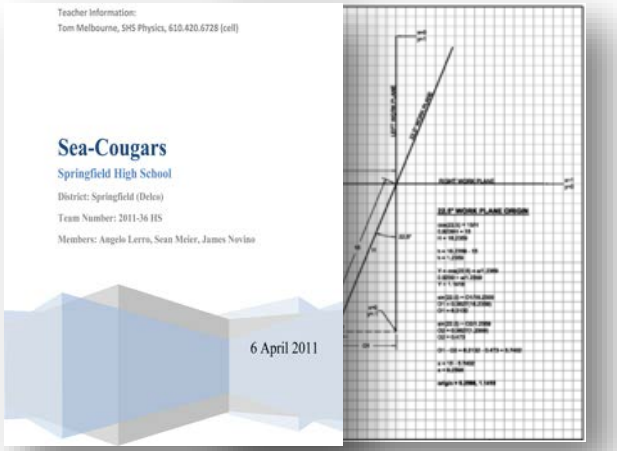


What is provided?

- Online construction manual, parts lists, lesson plans, and other resources via web and social media sites
- Access to Learning Modules and Videos
  - Hydrodynamics
  - Propulsion Systems
  - Control Systems
  - Stability
  - ROVs in the navy
- Construction training for new advisors and mentors
- A naval engineer mentor may be available to visit your team and provide support

Challenge Overview

- **Two Competition Classes**
  - **Middle School** **(Grades 5 – 8)**
  - **High School** **(Grades 9 – 12)**
- **Two Skill Levels**
  - Captain
  - Admiral
- **Four Competition Categories**
  - **Technical Design Report**
  - **Ten Minute Oral Slide Presentation (+ Five Minute Q&A)**
  - **Vehicle Performance (2 Rounds)**
    - **Round 1: Obstacle Course**
    - **Round 2: Mission**
  - **Team Spirit and Sportsmanship**



Teacher Training

- Temple University is hosting a one day training event
- Date: TBD
- Kits will be distributed to teams participating in the training

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2020 Challenge Requirements Overview

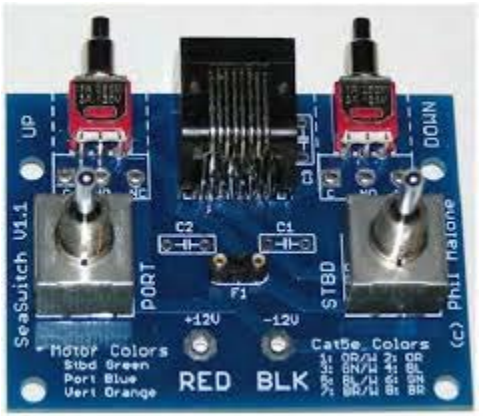
- Check www.phillynavalstem.com frequently for updates and information
- Familiarize yourself with all posted competition rules
- Design, Build and Test SeaPerch (November thru February)
- Competition Challenge practice (Critical for vehicle performance success)
- Technical Design Report – date for submission to be announced
- Oral Slide Presentation (competition day)
- Vehicle Performance round 1 – Obstacle Course
- Vehicle Performance round 2 – Mission
- Team Spirit and Sportsmanship
- Utilize engineering learning modules and other resources
- Other resources on national site www.seaperch.org

Primary source for all Philadelphia Challenge Information and Questions.

PhillyNavalSTEM.com

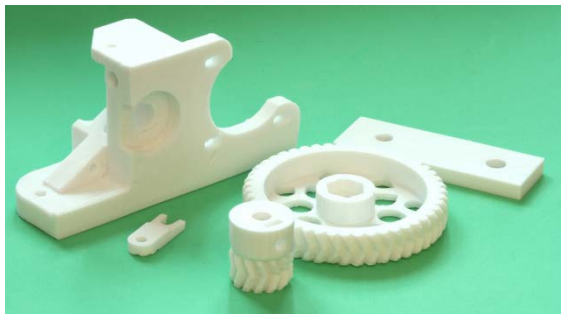
Design, Build & Test Phase

- The time to teach the engineering principles involved
  - Use the learning modules and the online resources as guidance, as necessary
  - Use the SeaPerch.org construction manual
- The time to practice
  - Practice in a pool or large tank is essential to achieving successful vehicle performance for competition
- The time to fulfill competition requirements
  - Develop your Technical Design Report
  - Work on the Oral Slide Presentation
- The time to work with mentors



3D Printing

- 3D printing of SeaPerch parts to replace or modify minor parts is permissible under the following guidelines:
  - Shall provide technical advantage or innovation
  - Rationale documented in Technical Design Report and Oral Presentation
  - Included in $25 design improvement budget limit (Captain's Class Only)
  - Parts shall be costed out at $0.05 per gram
  - Vehicle's primary structure shall be built using only PVC, CPVC, PEX pipe and fittings (Captain's Class Only)



Competition – Presentation

- Teams must create and prepare a 10 minute Slide Presentation followed by a 5 minute Q&A
  - Team is a simulated company
  - Seeking navy contract award for their SeaPerch design
  - Focus on Naval Engineering
  - Highlight innovation and creative thinking
  - Time management will affect scoring
  - SeaPerch must be present at presentation
  - All team members must participate in the Slide presentation

THIS IS NOT A POSTER PRESENTATION.

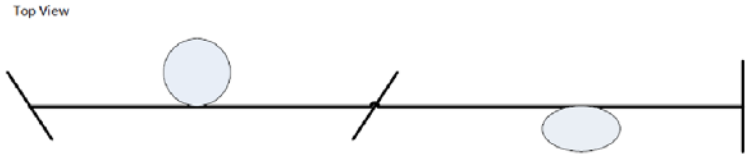
30% to 50% of presentation score is based upon "Innovative Product Design"

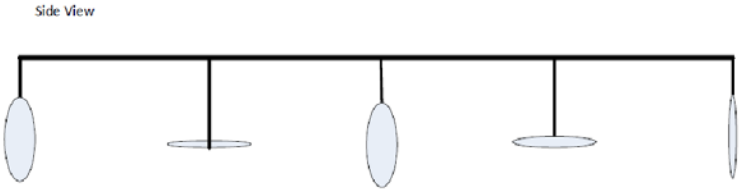
Competition – Obstacle Course

- Craft Performance Round 1:

  Complete the Obstacle Course

  - Maneuver through a submerged obstacle course of 5 pre-arranged hoops
  - SeaPerch must surface after clearing the furthest ring before starting its return
  - All rings at a depth of 4 feet





Competition – Mission Components

Mission Components

1. An air cannon
2. One vertical tunnel
3. A beacon
4. A plastic bottle
5. A plastic bottle trap
6. A weighted rope ring
7. A vault gate
8. A flag raiser
9. A bubbler
10. A horizontal tunnel
11. An inclined challenge
12. A 2nd air cannon

Competition – 2020 Mission Theme

SeaPerch Ninja Warrior

The course features representative challenges from this year's international mission, which has an **Ocean Cleanup** theme. The challenges in this course require all the SeaPerch features and pilot skills needed to compete in the international mission. The international challenges included in "SeaPerch Ninja Warrior" are:

- Marking the location of floating waste by lighting a beacon
- Move solid waste trapped in a gyre so it can be collected
- Lifting sunken solid waste to a collection "vault"

Ocean Clean Up

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 ocean cleanup efforts impossible.

Competition – Technical Design Report

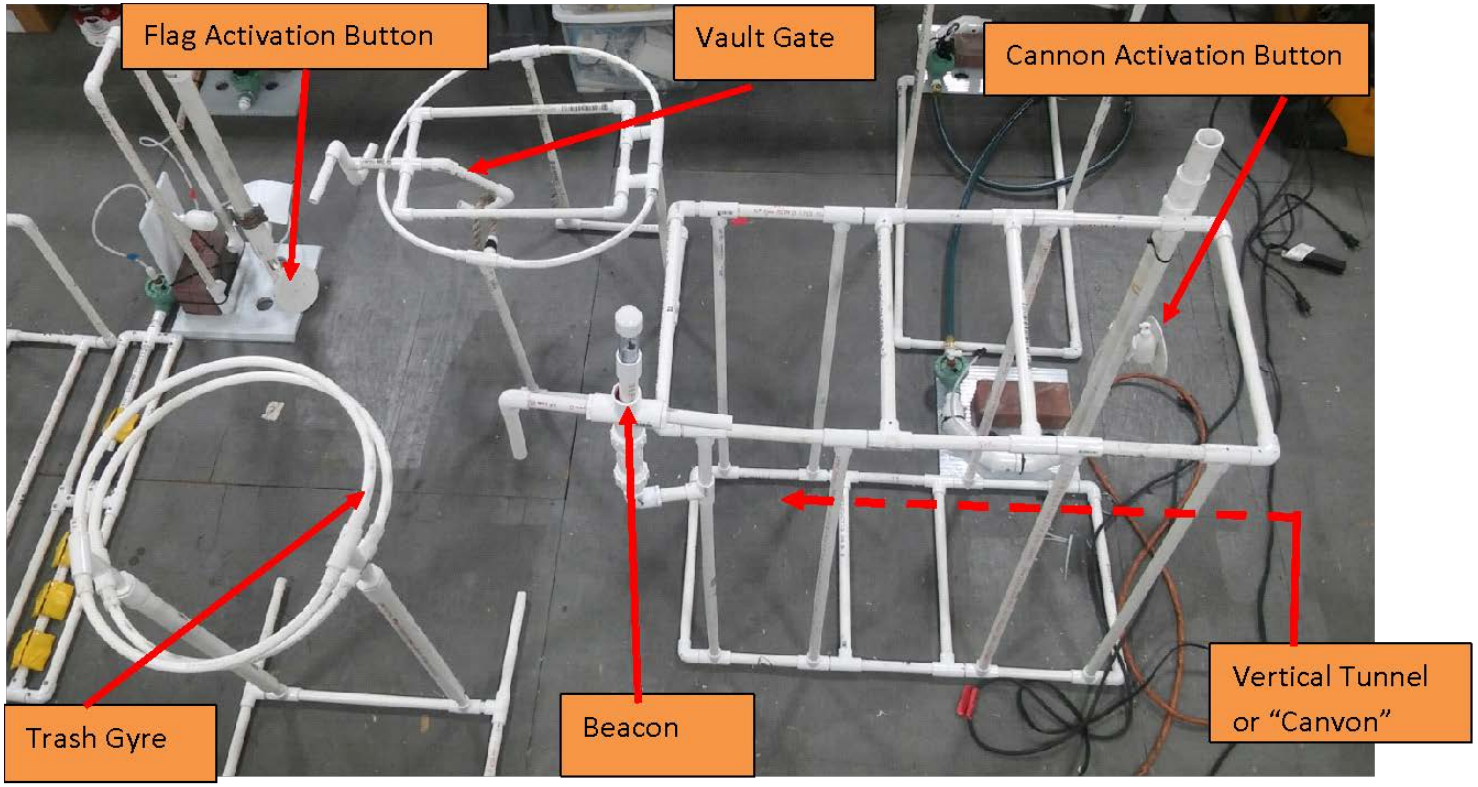
- A Technical Design Report (new this year) will consists of a written paper with the following six mandatory Sections and two mandatory Appendices describing the team's SeaPerch design
  - Abstract (½ page) - Short summary
  - Task Overview (½ page) - Tasks SeaPerch must complete & how it affected design
  - Design Approach (2 pages) - Strategy & approach to developing your design
  - Experimental Results (1 page) - Description of tests conducted & their results
  - Reflection & Next Steps (1 page) - What are the takeaways? What would be your next steps if you had more time?
  - Acknowledgements
  - References - Use APA style guide
  - Appendix A: Budget - Itemized costs (Captain's Class <= $25, Admiral's Class > $25)
  - Appendix B: Fact Sheet - 1 page Overview "Quad Chart"
  - Appendix C: Additional Info (Optional) - Results, Calculations, Figures, Tables, Engineering Design Notebook, etc.
- Additional sections may be included; however, the overall limit of 5 pages applies (excluding References, Acknowledgements, and Appendices)
- Teams are required to submit Design Notebooks electronically (16 MB limit)

Competition – Mission Challenges

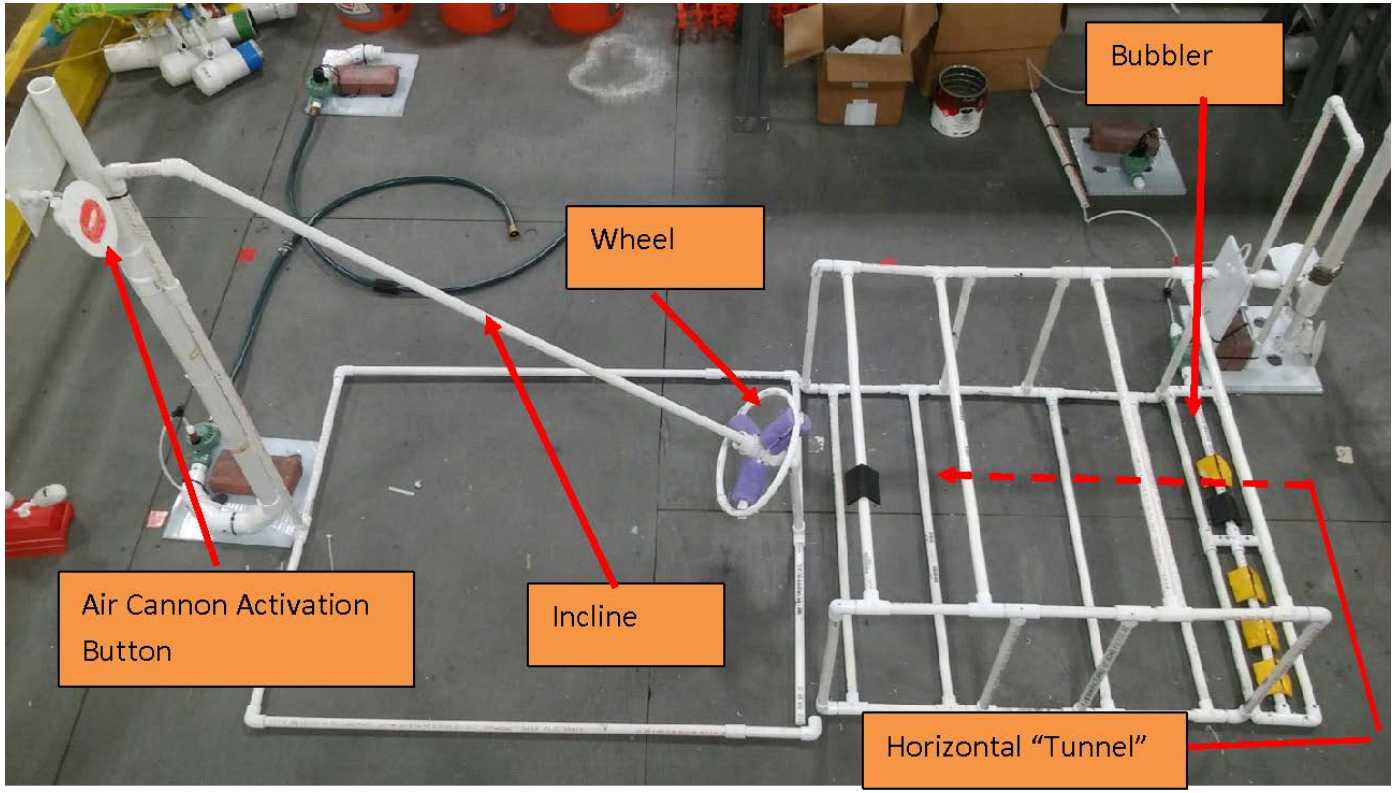
- **"SeaPerch Ninja Warrior" Mission Challenges**

1. The first challenge is to sprint to a 5-inch diameter target, punch the target to release a 20-foot geyser. The first cannon to be released will be triggered by the team with the fastest start.
2. The second challenge is traverse 3 feet through an 18-inch wide "canyon." Colliding with the side posts will slow the SeaPerch. This is a test of the operator's navigational skills.
3. The third challenge is to turn on a beacon. There is an arm attached to a PVC cross. The robot has to pivot at the "canyon" exit to rotate the cross, which will turn on the light. (Note: the beacon is the same that was used last year.)
4. The fourth challenge is to remove a small plastic bottle from the floating ring (gyre). The bottle must be pushed over the top of the rings or pulled below.
5. The fifth challenge is to close the gate on the vault. The robot will pick a weighted rope ring and place it on a hook on the vault gate.
6. The sixth challenge is to raise a flag. The robot will push and hold red button, which will raise a flag above the surface of the water. This action will require the robot to apply constant pressure to the button. The activation will also activate a bubbler.
7. The seventh challenge is to navigate through the bubbler. The bubbles will make it difficult to enter the horizontal "tunnel." However, the robot operator may accept a time penalty and choose to wait until the flag descends. When the flag descends, it will shut off the bubbler.
8. The eighth challenge is to navigate the horizontal tunnel, challenging the operator's navigational skills by maintaining a low horizontal course. Colliding with the posts above or below will slow the SeaPerch.
9. The ninth challenge is to slide the wheel up an inclined pipe past a set mark on the pipe. This requires carefully coordinated applications of forward and upward thrusts.
10. The tenth challenge is to maneuver away from the wheel and push the red course completion button. This will activate the second air cannon releasing a 20-foot geyser signaling time stop.

Competition – Mission Overview



Competition – Mission Overview



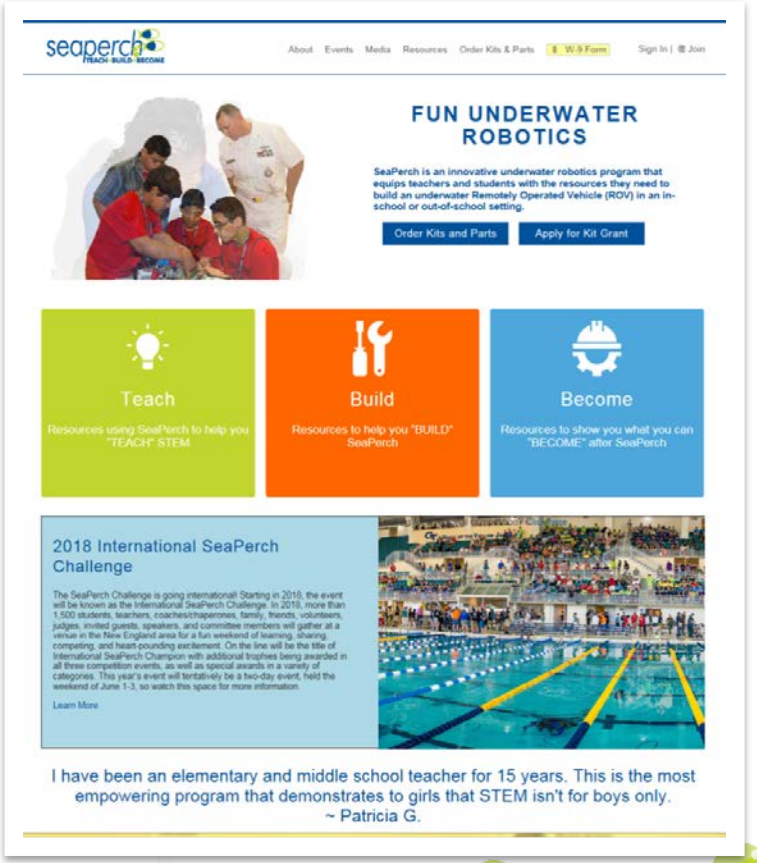
What's New for 2020

- Obstacle Course
  - All hoops at a depth of 4 feet from the surface
- New Themed Mission
  - SeaPerch Ninja Warrior
- Captain & Admiral Classes
  - Captain: $25 Limit
  - Admiral: No $ Limit
- Technical Design Report
  - Replaces Engineering Design Notebook requirement

International SeaPerch Challenge

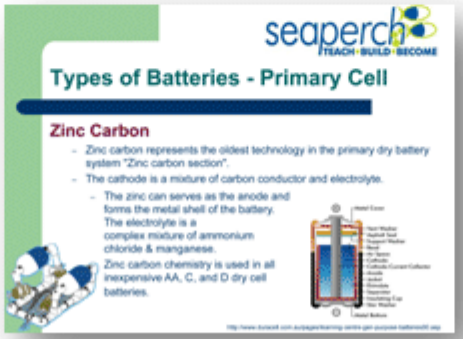
- The Greater Philadelphia Regional High School and Middle School teams awarded 1st Place in Pool Performance will be invited to move onto the International SeaPerch Challenge
- Location: University of Maryland
- Dates: May 30-31, 2020
- Teams may only compete in ONE Regional qualifying competition
- Up to 100 teams will participate

For more info visit:
seaperch.org



Technical and Teaching Resources

SeaPerch Learning Modules



Technical and Teaching Resources

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Teacher Tools

Manuals & Instructions

SeaPerch ROV Build Manual - 2011-02S (PDF 3.3 MB)

SeaPerch Official Certificate of Participation (PDF 625k)

SeaPerch Start-up Manual (405 KB)

Bring SeaPerch To Your School*

Content Provided by MIT Sea Grant

Labs & Lesson Plans*

Attenuation of Light in Water (PDF 462 KB)

Biological Sampling Device Using a SeaPerch (PDF 87.8 KB)

Buoyancy/Density Pertaining to Submersibles

Exploring Underwater Habitats and Environments

Hunt for Red October

Measurement of the Depth of the Ocean

Student-Designed Modification of SeaPerch

How Everything Works

PVC

Relays

Microcontrollers

Switches

Electric Motors

How Everything Works - Advanced*

Buoyancy

Electricity

Sensors

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Online Training Videos

Constructing a SeaPerch

Below are a series of instructional videos that provide hands-on demonstrations of how to construct a SeaPerch.

Instructor: Chris Hansen, SeaPerch Technical Director

Resources Needed:

SeaPerch Kit

SeaPearch Construction Manual - 2011-02S (PDF 3.3 MB)

SeaPerch Basics

Description: Chris Hansen, SeaPerch Technical Director, walks you through the tools utilized in buliding a SeaPerch.

TIP: These videos are helpful to anyone who has never used power tools and soldering irons. If you have some knowledge and skills in this area, you can move on to Unit 1.

	Time	Download (MOV)	Download (MP4)
SeaPerch Basic Modules 1 Intro	00:25	.MOV (62.8 MB)	.MP4 (9.1 MB)
Measuring PVC Pipe	01:05	.MOV (26.3 MB)	.MP4 (24.2 MB)
Drilling PVC Pipe	03:59	.MOV (94.9 MB)	.MP4 (94.1 MB)
Cutting the PVC	01:03	.MOV (25 MB)	.MP4 (24.4 MB)
Cutting the Wire	01:01	.MOV (24.8 MB)	.MP4 (24 MB)
Soldering	03:48	.MOV (90.5 MB)	.MP4 (87.7 MB)

Unit 1: Assembly of the Vehicle Frame

Description: Chris Hansen, SeaPerch Technical Director, with Fiona Redman and Gwen Gray will walk you through the entire process of how to build a SeaPerch frame.

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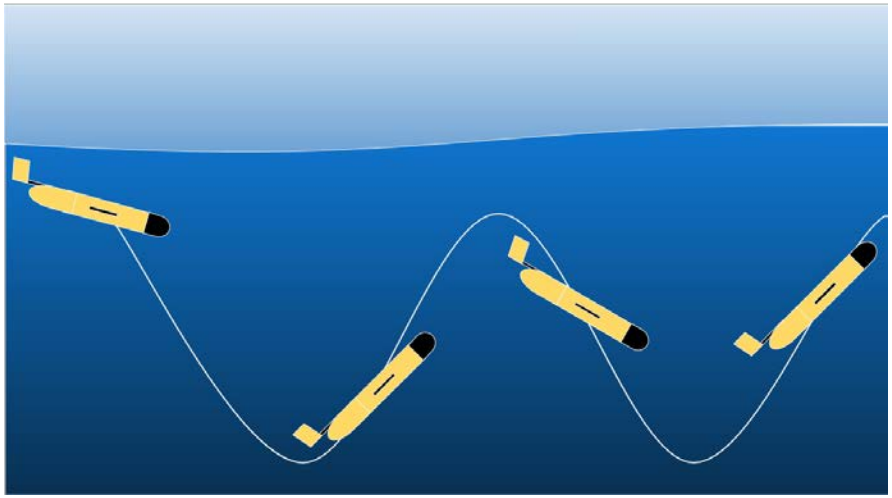
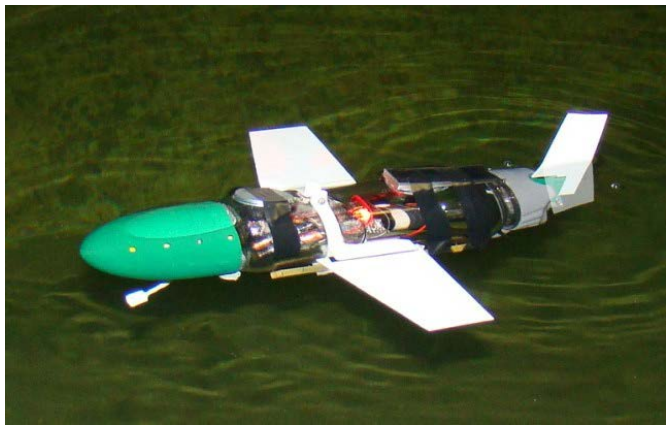
What is a SeaGlide?

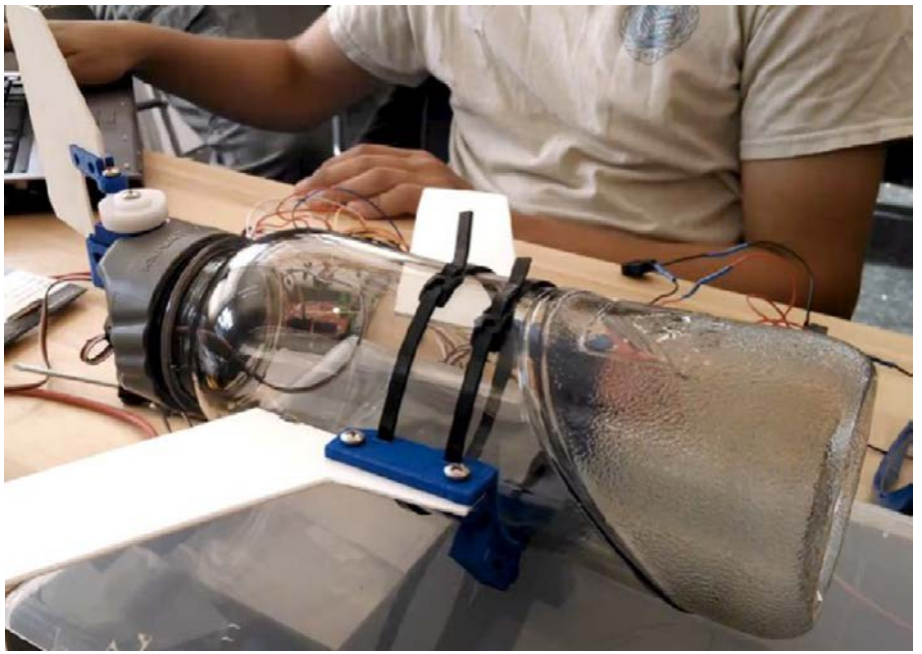
- A SeaGlide is an autonomous, miniature underwater glider which moves by variable-buoyancy propulsion. A buoyancy engine takes in or expels water, causing it to dive or rise. At the same time it shifts its center of gravity, changing its pitch. This causes the wings to provide lift, and thus propulsion.
- SeaGlide is inspired by full scale underwater gliders which require very little energy and can be fully or partially autonomous, allowing them to deploy for months at a time to collect valuable data about the world's oceans.

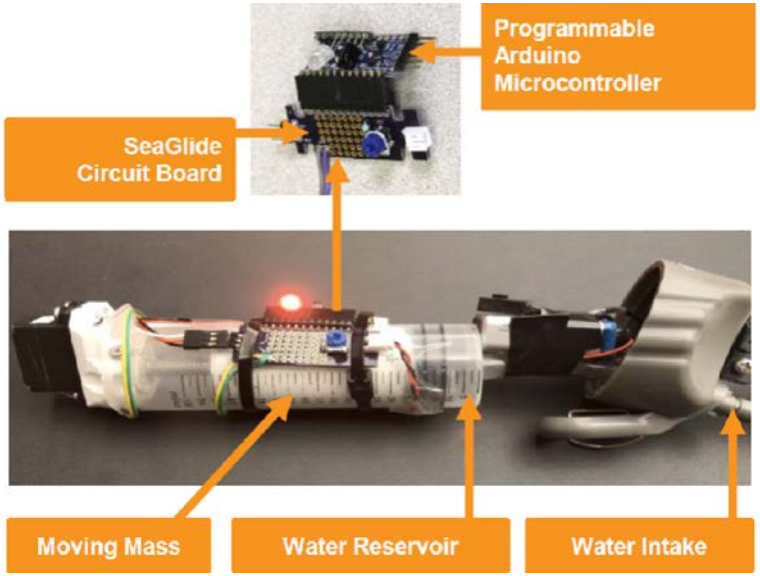


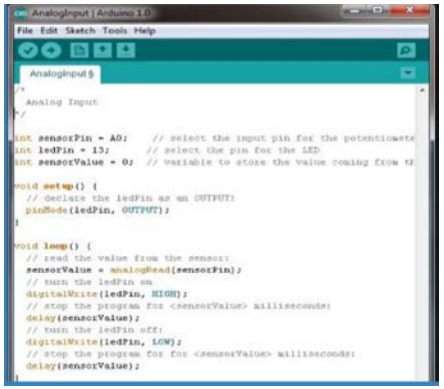
What is the SeaGlide Competition?

- The SeaGlide Competition is the culmination of months of research, building and testing. It involves writing a white paper, giving a presentation, and demonstrating the vehicle's performance.
- SeaGlide consists of an educational tool kit that centers on a curriculum-designed program that teaches students about the basics of
  - Naval architecture
  - Marine engineering
  - Computer programming
  - Electrical circuits and microcontrollers
- SeaGlide is an open platform that allows design modifications to incorporate sensor readings, increased maneuverability, and more. *Incorporating modifications beyond what is required, along with research and testing, should be the goal of every team and is key to doing well in the competition.*






Programmable
Arduino
Microcontroller
SeaGlide
Circuit Board
Moving Mass
Water Reservoir
Water Intake


AnalogInput | Arduino 1.0
File Edit Sketch Tools Help
AnalogInput §
Analog Input
int sensorPin = A0;
int ledPin = 13;
int sensorValue = 0;
void setup() {
pinMode(ledPin, OUTPUT);
}
void loop() {
sensorValue = analogRead(sensorPin);
digitalWrite(ledPin, HIGH);
delay(sensorValue);
digitalWrite(ledPin, LOW);
delay(sensorValue);
}

TEACHER & STUDENT TRAINING

2 Day Training at Temple University

Date: Nov 22-23, 2019

Participation Limit: 2 Teachers and 2 Students

Kits will be distributed to teams participating in the training

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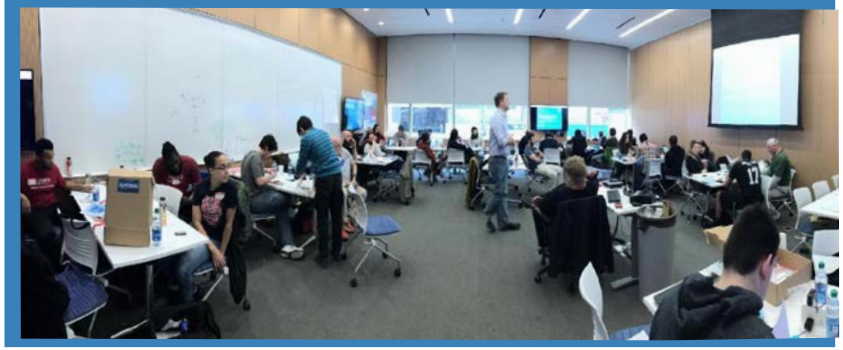
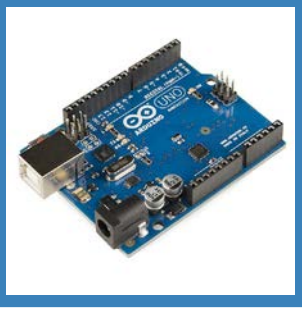
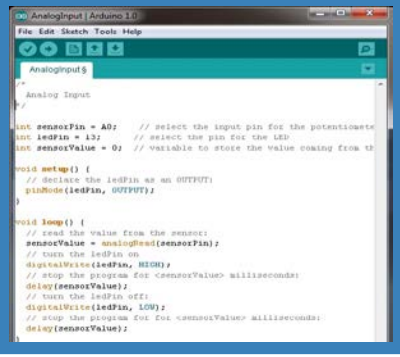
- 2 Day Build Training
  - Construct and test a glider



- 2 Day Programming Training
  - Learn introductory to advanced coding





SeaGlide Phases

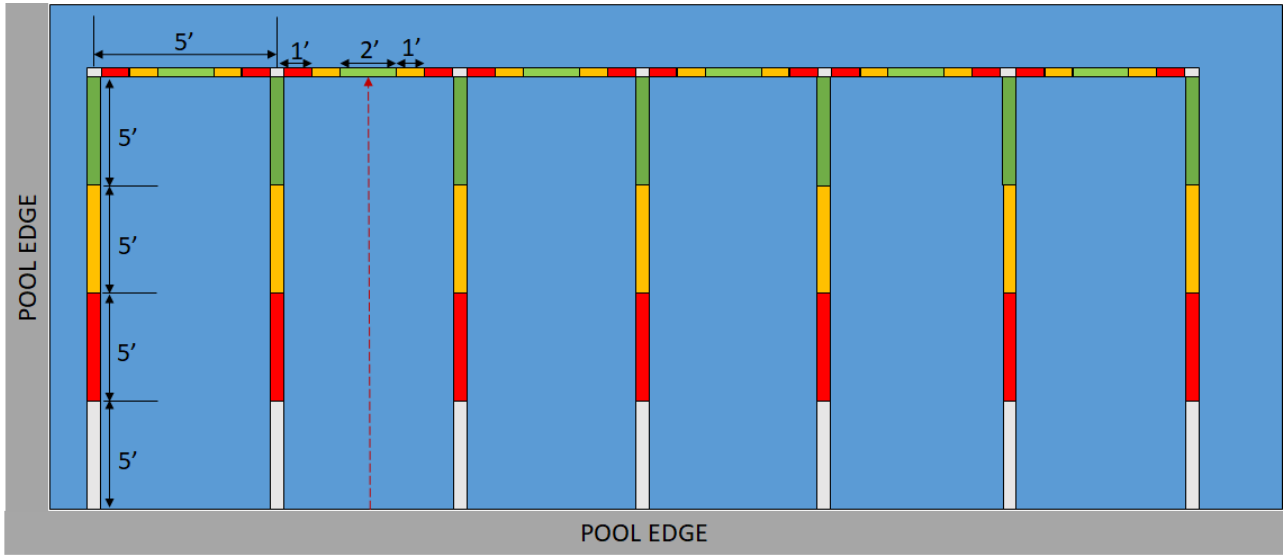
- **Phase I: Program Kickoff**
  - Registration
  - Delivery of Overview and Rules document.
  - Teachers and students attend a 2-day training for building SeaGlide and Arduino coding. Participation limited to 2 teachers and 2 students per team. Kits will be distributed to teams participating in the training.
- **Phase II: Design – Build – Test**
  - Time between the program kickoff and competition to research, brainstorm, experiment, design, build, test, and practice.
- **Phase III: Competition**
  - The White Paper will be submitted prior to the competition day.
  - The Commercial and Slide Presentation are presented together, followed by a Q&A.
  - The Vehicle Performance will take place in a pool.

SeaGlide Competition Specifics

- Three sections: White Paper, Presentation, and Vehicle Performance
- White Paper
  - Provide historical and scientific background of problems and solutions
  - Describe the design process, including research, calculations and testing
  - Describe future plans
- Presentation
  - Produce a commercial
  - Produce and present a slide presentation
- Vehicle Performance
  - Tier 1: Straight-line race (basic SeaGlide kit)
    - $50 modification limit
  - Tier 2: Two-turn race (SeaGlide kit modified with moving rudder)
    - $100 modification limit

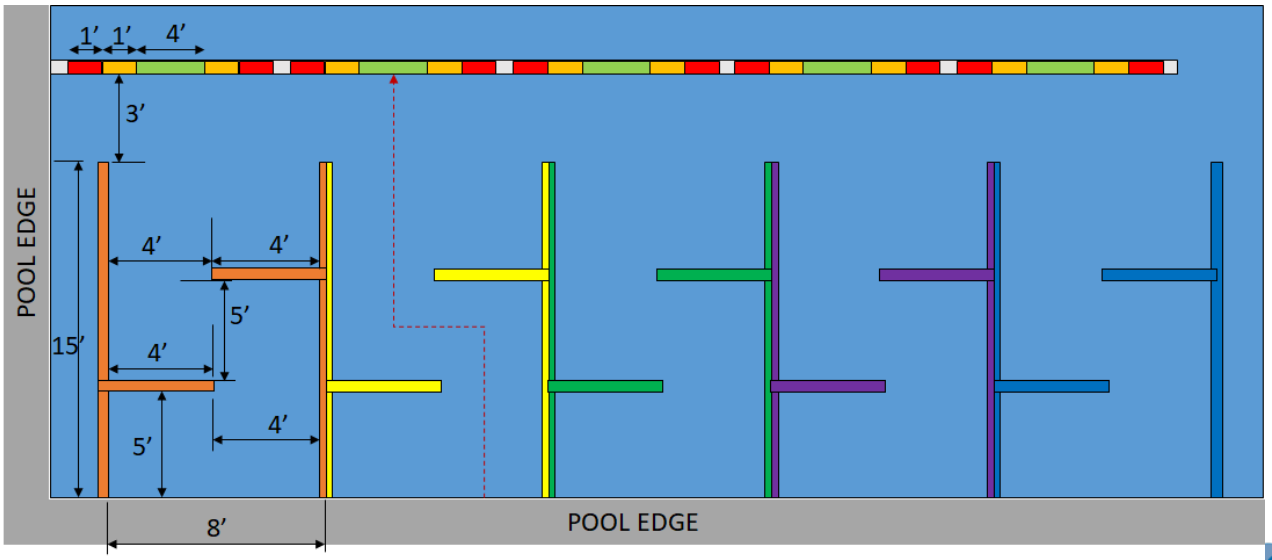
What's New for 2020?

- SeaGlide Overview and Rules document contains clarifications and rubrics.
- Tier 1 Course
  - Shorter course, with improved set-up and stability
  - Unlimited position resets (elapsed time does not reset)
  - New point award system
    - Time to reach each checkpoint, relative to best competition time
    - Accuracy when reaching last checkpoint



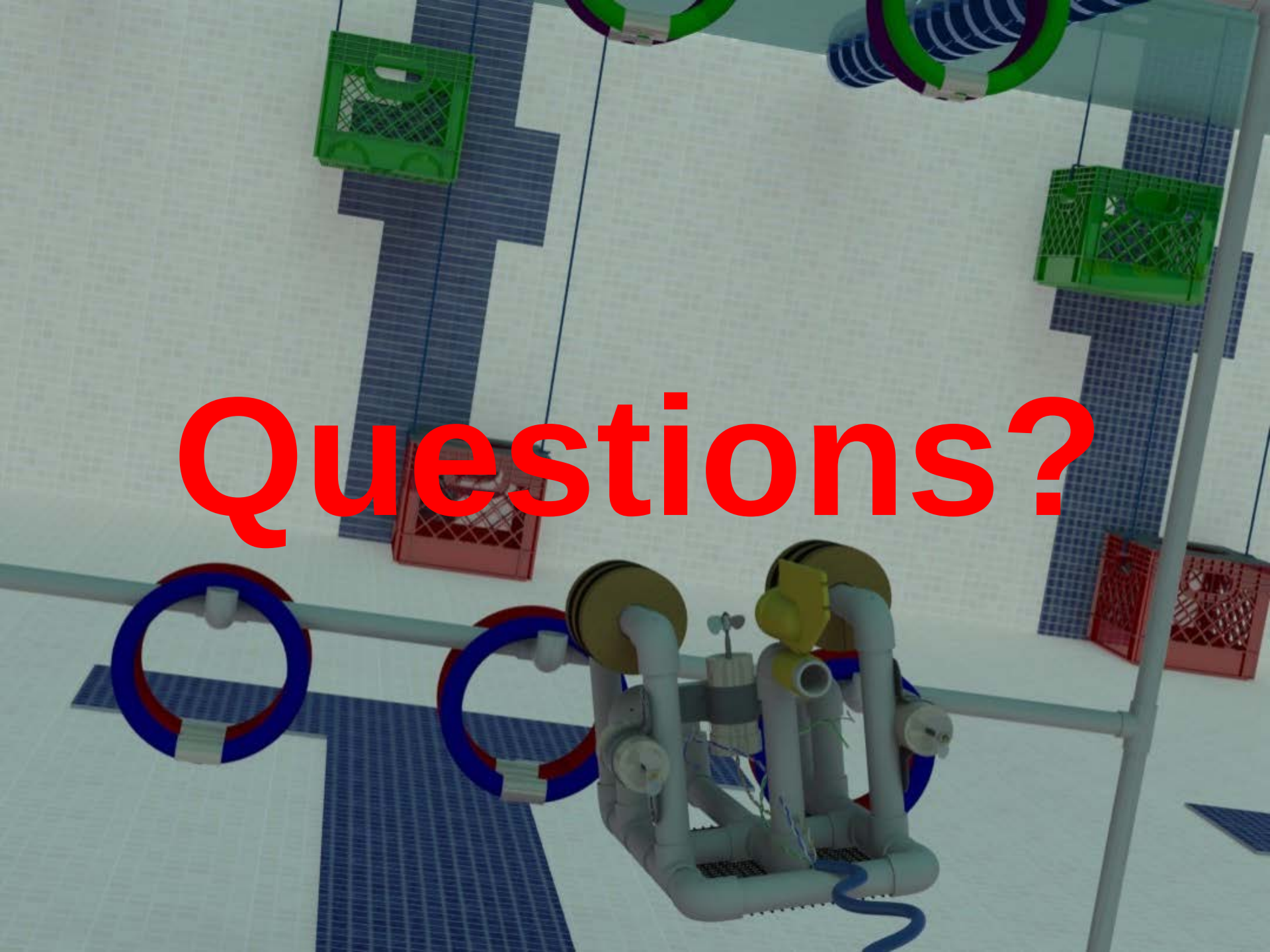
What's New for 2020?

- SeaGlide Overview and Rules document contains clarifications and rubrics.
- Tier 2 Course
  - Shorter course, with improved set-up and stability
  - Unlimited position reset (elapsed time does not reset)
  - New point award system
    - Time to reach each checkpoint, relative to best competition time
    - Demonstration of autonomous turns
    - Accuracy when reaching last checkpoint



Technical and Teaching Resources

phillynavalstem.com


Questions?