6th Annual Greater Philadelphia SeaGlide Competition

1. Executive Summary

The Greater Philadelphia SeaGlide Competition (GPSGC) is an Autonomous Underwater Vehicle (AUV) Science, Technology, Engineering, Art, and Mathematics (STEAM) educational program and competition. A SeaGlide is a miniature underwater glider that moves by changing its buoyancy, taking in or expelling water, and shifting its center of gravity so it may dive or rise in the water. As the glider completes its dive and rise cycles, its wings generate lift, propelling the glider forward. Full scale underwater gliders 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. 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 and electrical circuits. The students are then encouraged to build upon that basic knowledge to innovate and create unique AUV designs to meet specific mission scenarios.

The 2023 GPSGC will take place in-person with some virtual components. In the case of unforeseen circumstances, virtual alternatives will be made available, if possible.

The GPSGC consists of six sections: White Paper, Technical Upgrade, Presentation, Vehicle Performance, Circuitry & Coding, and Bug Hunt. The White Paper emphasizes the documentation of the design approach, the engineering processes used, an explanation of the final design, and the future design plans. The White Paper is submitted on a predetermined deadline for judging in advance of the competition date. The Technical Upgrade is a student-designed addition to the base kit that meets provided specifications. It is included as part of the White Paper, but it is scored separately. The Presentation consists of both a commercial and a slide presentation, in which students discuss their designs and obstacles they overcame during the engineering process. Students should be prepared to answer questions afterwards. The Vehicle Performance will take place in a pool, where students will compete in challenges determined by the tier level they have entered. The Tier 1 challenge is a straight speed run and the Tier 2 challenge is a speed run that involves traversing a path with two turns. Circuitry & Coding is a timed, small-team competition where students use their SparkFun Inventor's Kit to create and program circuits according to provided specifications. Bug Hunt is a timed, small-team competition where students identify and fix errors in a virtual circuit and code.

Specifications for all sections are outlined in the document below and can be found on phillynavalstem.com along with other resources to aid teams with building, practice, and test setups prior to competition.

2. The Competition Scenario

The United States Navy is interested in acquiring a fleet of underwater gliders with a variety of capabilities. The Navy recognizes that the autonomous nature and low energy usage of underwater gliders may provide cost savings to the US taxpayer. Furthermore, their small size makes them ideal for clandestine operations. NASA has also shown interest in the Navy's development of AUVs because they believe that they are ideal for exploring liquid bodies on other planets and moons, and it is supporting the Navy's efforts. The Navy is seeking to fund companies to design and produce underwater gliders that will be ready for deployment within the next few years. Your school is competing as a company seeking this funding. Companies are not expected to produce a working prototype that meets all of the Navy's requirements, but they are expected to present a functional underwater glider, as well as research and plans that indicate the company will be capable of meeting the Navy's requirements.

The capabilities of the gliders that the Navy eventually wishes to deploy can be divided into two types. First, the US Navy wants to locate, deactivate, and recover unexploded warheads on the ocean floor. It believes that the location part of this effort can be undertaken by underwater gliders, and that the gliders' small size and lack of crew make them ideal for use in contested waters. The gliders should be capable of object avoidance, object recognition, detecting energy signatures, and communicating via satellite. Second, the US Navy, in conjunction with the National Oceanic and Atmospheric Administration, wishes to continuously gather data on the world's oceans. The gliders should be capable of object avoidance, measuring a variety of properties of the ocean water, and communicating via satellite. NASA is interested in this second type of AUV for exploring the hydrocarbon lakes of Saturn's moon, Titan, though the temperatures will be far colder than ocean water.

3. Program Structure and Format

3.1. Eligibility and Registration

3.1.1. Eligible Participants

The GPSGC is open to schools and youth organizations in the Pennsylvania, New Jersey, and Delaware tri-state area. Participants from other regions may be permitted upon approval. Reach out to gpssc@temple.edu to learn more.

3.1.2. Registration and Fees

Team registration typically opens in early fall until capacity is reached. Only one team per school or organization will be accepted. Teams may register for Tier 1 and/or Tier 2. If a team is competing in Tier 2, they may have a separate craft for the Tier 1 Vehicle Performance section only. There is no fee to register for the SeaGlide competition.

3.2. Timeline

3.2.1. Phase I – Program Kickoff

The program kickoff includes team registration, the delivery of the challenge mission, rules, and deliverables, and new advisor training. Each school may have up to two teachers attend a 2-day training session where each person may participate in either SeaGlide building or Arduino coding.

3.2.2. Phase II – Design, Build, and Test

This is the time between the program kickoff and the competition to learn, experiment, design, build, test, and practice. The AUV may be given multiple modifications to the original structure of the basic SeaGlide kit.

3.2.3. Phase III – Competition

There are six sections to the competition: White Paper, Technical Upgrade, Presentation, Vehicle Performance, Circuitry & Coding, and Bug Hunt. The White Paper (including Technical Upgrade) must be submitted one week prior to the competition day. The Presentation consists of two deliverables: a commercial and a slide presentation. The commercial and slide presentation must be submitted one day prior to the competition day, but will be presented and judged on the day of the competition. The Vehicle Performance will take place in a pool on the day of the competition. Circuitry & Coding and Bug Hunt will take place on the day of the competition. For more information, refer to the Competition Sections.

4. Competition Sections

4.1. White Paper and Technical Upgrade

4.1.1. Overview

The White Paper is a paper that states the purpose of the SeaGlide, provides background on the problems and solutions, and describes and justifies your current design and future plans. There is no minimum or maximum page length. The white paper should include the following sections:

- Cover Page
- Introduction
- Background
- Design Process and Solutions
- Technical Upgrade (reference 4.1.2 Technical Upgrade for details.)
- Future Plans
- Summary
- References
- Appendix (optional)

Reference 4.1.4 White Paper General Rubric for scoring details.

4.1.2. Technical Upgrade

The Technical Upgrade is a design addition that involves housing, circuitry, and coding. It must have its own designated section within the White Paper, and it is scored separately.

This year's Technical Upgrade is to incorporate a sensor for measuring and recording sound signals. Sound recording should begin when the measure exceeds a threshold and stop when it falls below that threshold for a set length of time. Both the threshold and the length of time should be easily determined and adjustable in the code. Sound should not be recorded during servo activation. The Technical Upgrade may be separately powered, use a separate Arduino or other microcontroller, and be completely external to the base SeaGlide; however, higher scores will be awarded to designs that share the power source, use the same microcontroller, and/or require limited external additions.

Reference 4.1.5 Technical Upgrade General Rubric for scoring details.

4.1.3. General Notes

- It is expected that the paper submitted was written only by students and is original and unique for this competition year. Papers with substantial portions copied from previous years' submittals will be penalized or disqualified.
- Students are highly encouraged to develop and include "future plans" of design elements that are not physically realized in their current design. This includes research, sketches, tests, graphs, calculations, etc.

- The following websites are resources for CAD and schematic design
    - https://www.autodesk.com/products/fusion-360/education
    - https://www.sketchup.com/try-sketchup#for-primary-and-secondary-education
    - https://www.onshape.com/en/education/
    - https://www.tinkercad.com/
- Limit file size to 3 MB by appropriately compressing pictures.
- Papers should be saved as a PDF with the following filename: "<SCHOOLNAME> SeaGlide White Paper 2023". You *must* send the file via email - do *not* share access to a file storage website.
- Submit papers to SeaGlideNotebooks@gmail.com, using subject line "Submission: <SCHOOLNAME> SeaGlide White Paper 2022".
- Papers are due on the Sunday prior to the competition.

4.1.4. White Paper General Rubric

Section	Points	Details
Cover Page	5	School name, Team name (optional), Advisor name and contact information, School ID#
Introduction	5	Briefly describe the problem and how your SeaGlide design is a solution.
Background	10	Provide detailed historical and/or scientific background on the problem and solutions for it.
Design Process and Solution	36	Describe the process by which you proposed and decided on your design and rejected alternative designs. Include any sketches/photos, research, tests, graphs/tables, calculations, and code.
Technical Upgrade	100*	Describe the process by which you proposed and decided on your design for the Technical Upgrade. Include any research, calculations and testing. *This section is scored separately from the White Paper. For rubric see Section 4.1.5 below.
Future Plans	24	Describe future plans for your design. Include any sketches/photos, research, tests, graphs/tables, calculations, and code.
Summary	10	Make your case as to why your team deserves a multi-year SeaGlide development contract. Include a cost breakdown (the cost of the basic kit may be listed as one item). Original 3D-printed components are to be valued at $0.05 per gram.
References	5	References should be cited throughout the document. Use the APA citation style.
Content/Organization	5	The white paper should have a professional appearance: section headings, page numbers, appropriate chart and figure titles with corresponding references in the text, appropriate use of references, and good organization.
Appendix A: SeaGlide Computer Code	0	This section should contain Arduino code that was newly developed for the SeaGlide. It should be clearly commented and indented. Do not include the basic buoyancy engine code unless it was modified, in which case only include the specific sections that were modified.
Total	100	

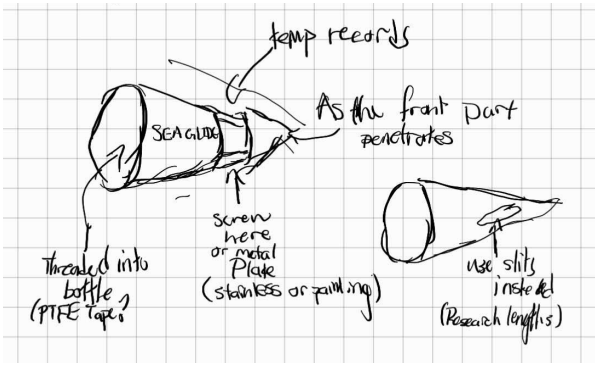
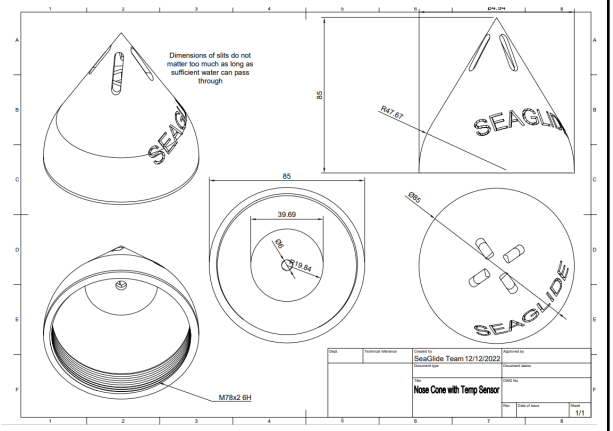
4.1.5. Technical Upgrade General Rubric

Section	Points	Details
Introduction	10	Briefly describe the problem being addressed and how your SeaGlide sensor design modification is a solution. Include design assumptions.
Housing Assembly CAD Design Process	15	Brief description of the process used to develop the sensor housing assembly design, including CAD figures
Housing Assembly Prototype	10	Photographs of the housing assembly prototype
Circuit Design Schematic	15	Brief description of the circuit design, including circuit schematic figures
Circuit Design Prototype	10	Photographs of the circuit in the housing assembly
Code	15	Fully commented supplemental sensor code
Test Results	15	Description of test methodology and results
Summary	10	Describe the process by which your team developed the final design, including considerations for future efforts
Total	100	

4.1.6 White Paper Design Process and Solution Examples

For the Design Process and Solution portion and the Future Plans portion, each design element can earn up to 12 and 8 points, respectively. Judges may award bonus points for exceptional work. Not every design element can earn full points (i.e. a design element that is not connected to any circuitry will not be able to earn a point for the associated code). There is no limit to the number of design elements.

Sketch/photo (nose cone):

Satisfactory:	Exceptional:
	

Research (nose cone):

Satisfactory: Cite a source, describe the shape of the nose cone recommended by the source, and explain how this information influenced the shape of the chosen nose cone.	Exceptional: Cite multiple sources, describe the shape of the nose cone recommended by the source, explain the science behind the recommended shape, and explain how this information influenced the shape of the chosen nose cone.

Alternative Designs (nose cone):

Satisfactory: Describe the alternative designs for the nose cone.	Exceptional: Describe the alternative designs for the nose cone and detail the reasons that the chosen design is superior to the alternative designs.

Test (nose cone):

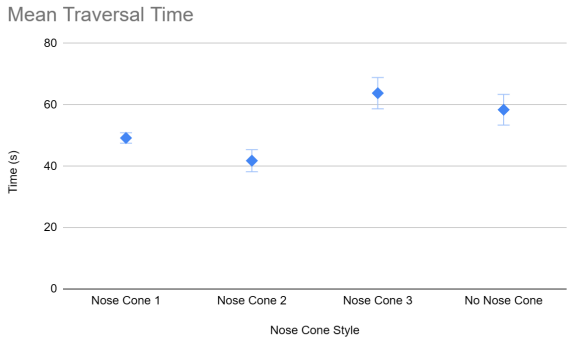
Satisfactory:	Exceptional:
Record and compare the times for the SeaGlide to traverse 20 feet with the nose cone and without the nose cone.	Record and compare the times for the SeaGlide to traverse 20 feet with multiple nose cone designs and without a nose cone, performing multiple experiments with each.

Graph/Table (nose cone):

Satisfactory:
Traversal time of each trial for nose cone and no nose cone.

	Traversal Time (s)	
Trial #	Nose Cone	No Nose Cone
1	45	61
2	55	50
3	39	58

Exceptional:
Mean traversal time for the five trials of each nose cone style, including standard deviation error bars.



Calculations (hull):

Satisfactory:	Exceptional:
For an original, 3D-printed cylindrical hull, calculate its volume from its inner diameter and height with the formula $V = \pi r^3 h$.	For an original, 3D-printed cylindrical hull, calculate its volume from its inner diameter and height with the formula $V = \pi r^3 h$, calculate the mass of the air contained with the formula $m = \rho V$, make a calculations-based estimate of the mass and volume of the internal components and solid portion of the hull, make a calculations-based estimate of the amount of additional ballast required to obtain neutral buoyancy, and compare it to the actual additional ballast required.

Justification for choosing design over alternatives (nose cone):

Satisfactory: Compare multiple designs based on one metric, i.e. mean traversal time, and select the design with the best metric.	Exceptional: Compare multiple designs based on several metrics, i.e. mean traversal time, standard deviation traversal time, and cost and select the design with the best combination of metrics.

Summary of how new code works (temperature sensor):

Satisfactory: General explanation of how new code works.	Exceptional: Excerpt of new code, clearly commented, with clear, detailed explanation of how it works.

Example design element and point breakdown:

- Students design a specific shape for the wings based on marine wildlife. (0 points)
- A **sketch/photo** of the wing is provided. (1 point)
- Speed of marine wildlife and their relationship to fin shape and surface area is **researched** and the source is cited. (1 point)
- A variety of **alternative designs** for the wings are provided. (1 point)
- A **test** of several different wing designs is conducted to determine which results in the fastest forward movement. (1 point)
- A **graph/table** of the results of the test is provided. (1 point)
- **Calculations** of the surface area and/or other aspects of the wing design are performed, provided that they are meaningful in relation to the research. Alternatively, or in addition, calculations may be based on the test results. (1 point)
- A **justification** is given for choosing the final design over the alternatives. (1 point)
- A summary of how new **code** works. (1 point)
- The design is **included** in the SeaGlide build. (4 points)

4.2. Presentation

4.2.1. Commercial

Teams must produce a professional marketing commercial with a duration between 60 and 90 seconds. The commercial must focus on product features, product differentiation, and current and future design solutions. The commercial must encourage the Navy to fund the design, research and manufacture of your SeaGlide. It should show elements that cannot be demonstrated as well in a white paper or slide presentation (motion, development process, testing, and teamwork).

4.2.2. Commercial General Rubric

Section	Points	Details
5-second Splash Screen	1	School name, Team name (optional), School/Team logo, School ID#
Introduction	2	Briefly introduce your SeaGlide and the problems it is designed to solve.
Product Features	5	Describe your SeaGlide's design features.
Design Process	6	Describe your team's design process.
Future Plans	4	Describe future plans for your design.
Summary	2	Make your case as to why your team deserves a multi-year SeaGlide development contract.
Graphics, Animation, Video	5	Demonstrate proper use of the video medium.
Content, Organization, Quality	5	The commercial should make good use of its time, be well-organized, and be clearly shot.
Total	30	

4.2.3. Slide Presentation

Teams must produce a slide presentation which they will present to judges. This slide presentation will contain more details than the commercial and last between 6 and 8 minutes. Any number of teammates may act as presenters. The slide presentation should discuss the design process and obstacles the team overcame. It should also show elements that could not be demonstrated in the commercial (close-up photos, tables of data, lists of parts). Each team should discuss alternative designs that your team considered, the pros and cons of each, and ultimately why you chose your final design. Each presenter should have a speaking role during the presentation. Following the oral presentation will be a Q&A by the judges. Be prepared to answer questions regarding both your commercial and presentation. During the presentation and Q&A, the teacher/advisor and non-presenting teammates may observe, but may not contribute.

Avoid having slides packed with text. Similarly, presenters should not just be reading each slide verbatim. One example of a well-presented slide is one that contains a picture and a few bulleted ideas that are each a few words or a sentence. The presenter then describes what is being shown in the picture and elaborates on each of the bullets.

4.2.4. Slide Presentation General Rubric

Section	Points	Details
Cover Slide	4	School name, Team name (optional), School/Team logo, School ID#, Names of presenters
Team Composition	6	Describe the team's composition and division of responsibilities.
Introduction	5	Briefly introduce your SeaGlide and the problems it is designed to solve.
Product Features	10	Present each of your SeaGlide's design features.
Design Process	10	Describe your team's design process for each design.
Future Plans	10	Describe future plans for your SeaGlide and progress you have made.
Graphics, Tables, Photos	10	Demonstrate proper use of the slide presentation medium.
Content, Organization, Quality	10	The slide presentation should make good use of its time, be well-organized, and be clearly presented.
Question & Answer	5	The presenters clearly answer all of the judges' questions.
Total	70	

4.3. Vehicle Performance

4.3.1. Tier 1 Competition Overview

Tier 1 is the introductory level SeaGlide competition in which teams will compete with a basic SeaGlide kit and have a maximum budget of $50.00. Original 3D-printed components are to be valued at $0.05 per gram. This must be presented to the judge at Vehicle Compliance. The performance requirement is to glide a straight distance of 20 feet in 15 minutes. There will be checkpoints at 10 and 15 feet (Figure 1). SeaGlides must be tethered with fishing line, which must remain slack at all times. At any time, teams may use the tether to pull their SeaGlide back to the starting line and re-release it. Teams must pull their SeaGlide back if the body crosses into another lane or if a judge deems that a wing is in danger of touching a SeaGlide in an adjacent lane. Re-releasing a SeaGlide does not reset the elapsed time. Points are based on two parts: 1) the elapsed time it takes to reach each checkpoint and the finish line, and 2) how close the SeaGlide is to the center of the finish line.

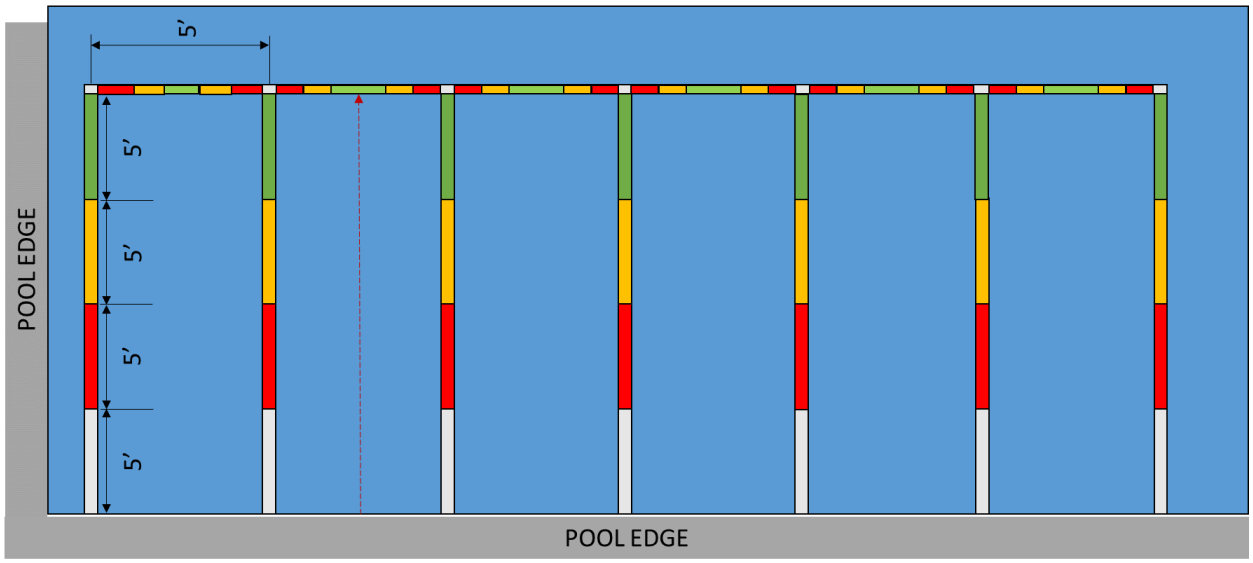


Figure 1. Six lanes of the Tier 1 Vehicle Performance

4.3.2. Tier 1 Vehicle Performance Rubric

(T = elapsed time, B = best elapsed time for that distance)

Section	Points
Checkpoint 1	10(B÷T)
Checkpoint 2	15(B÷T)
Checkpoint 3	20(B÷T)
Finish Line (time)	30(B÷T)
Finish Line (best target)	Green: +25, Yellow: +15

4.3.3. Tier 2 Competition Overview

Tier 2 is the intermediate level SeaGlide competition in which teams will compete by modifying a SeaGlide kit and have a maximum budget of $100.00. Original 3D-printed components are to be valued at $0.05 per gram. This must be presented to the judge at Vehicle Compliance. The performance requirement is to navigate a simulated canyon consisting of two turns in 15 minutes. The simulated canyon is 5 feet wide, and the center path is as follows: 7.5 feet straight, 90 degree turn left, 4 feet straight, 90 degree turn right, 10.5 feet straight (Figure 2). SeaGlides must be tethered with fishing line which must remain slack at all times. At any time, teams may use the tether to pull their SeaGlide back to the starting line and re-release it. Teams must pull their SeaGlide back if the body crosses into another lane or if a judge deems that a wing is in danger of touching a SeaGlide in an adjacent lane. Re-releasing a SeaGlide does not reset the elapsed time. Points are based on

three parts: 1) the elapsed time to reach the end of each straightaway or the finish line, 2) demonstration of autonomous turning, and 3) how close the SeaGlide is to the center of the finish line.

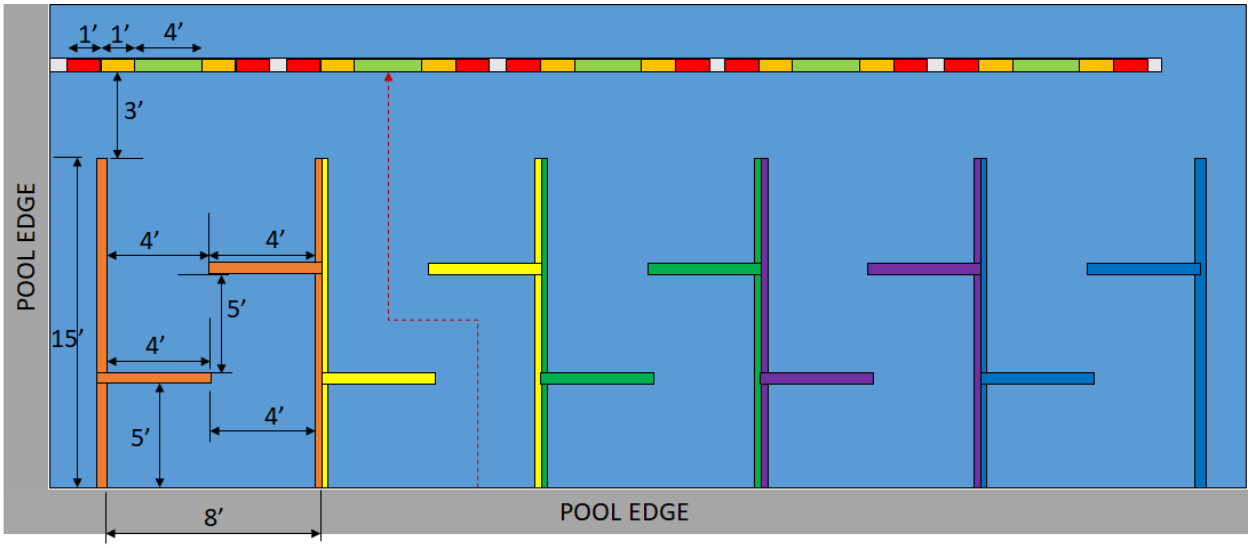


Figure 2. Five lanes of the Tier 2 Vehicle Performance

4.3.4. Tier 2 Vehicle Performance Rubric

(T = elapsed time, B = best elapsed time for that distance)

Section	Points
End of Straightaway 1	10(B÷T)
Autonomous Left Turn	10
End of Straightaway 2	15(B÷T)
Autonomous Right Turn	15
Finish Line (time)	25(B÷T)
Finish Line (best target)	Green: +25, Yellow: +15

4.4. Circuitry and Coding

4.4.1. Overview

The Circuitry and Coding section is a 90-minute race where 3-person teams compose and program multiple circuits using the SparkFun Inventor's Kit. The competition consists of

multiple, unrelated tasks that are scored separately. Some tasks have bonus tasks that will require additional circuitry and/or code.

4.4.2. Rules

- Each school may have one team consisting of no more than three students.
- Each team must supply their own computer, preloaded with the Arduino IDE and capable of connecting to a SparkFun Inventor's Kit. Each team is restricted to one computer.
- Each team will use a SparkFun Inventor's Kit, absent the Guidebook, which contains the Arduino microcontroller and all of the necessary components and accessories. This is the same kit that schools received at the two-day build training event. Teams may not provide any of their own additional materials. However, some tasks may require you to use a common office supply (i.e. a sheet of paper) that will be provided.
  SparkFun Inventor's Kit information: (https://www.sparkfun.com/products/15267)
- Each team may prepare a PDF document of notes, such as circuit diagrams and code snippets. Teams may access this document on their computer, as well as have their own hard copies. The document is limited to two pages (or one two-sided page) and must be a PDF. Teams may not access any resources besides their PDF and any resources provided by the judges. Teams may have blank paper and writing implements for planning purposes.
- Each team will be provided with a list of separate circuitry and coding tasks. Each task will specify the expected outcomes, which may include component and/or serial monitor output. Neither a circuit diagram nor code will be provided. A task may include bonus tasks, which will require additional circuitry and/or code.
- When a team believes they have successfully completed a task, they must call over a judge. They will then demonstrate the task according to the judge's instructions. If the judge determines that the task was successfully completed, the judge will award credit and note the elapsed time. Teams may demonstrate multiple tasks at once instead of calling a judge for each individual task.

4.4.3. Circuitry & Coding Rubric

The rubric will be provided at the competition, and will vary depending on the number and difficulty of the tasks and bonus tasks. Each successfully completed task and bonus task will be worth a set number of points. Ties will be broken based on the total time required by each team to complete their tasks.

4.4.4. Suggestions

- Teams should have completed every project in the SparkFun Inventor's Kit or have sufficient experience developing circuits and programming with the Arduino microcontroller. They should understand how the circuits work and how the code works.
- Teams should devise and complete their own small projects with the SparkFun Inventor's Kit or similar Arduino starter kit.

- The PDF should have important and/or common code snippets that can be quickly copy-and-pasted into the Arduino IDE and modified.
- Make sure that the computer you will be using can connect to the SparkFun Inventor's Kit and that basic code can be successfully compiled, uploaded, and executed.

4.5. Bug Hunt

4.5.1. Overview

The Bug Hunt section is a 90 minute race where three-person teams identify and correct a number of deliberately placed mistakes ("bugs") in a simulated Arduino circuit. The bugs may be errors in the Arduino code, or they may be physical misconfigurations in the wiring of the circuit.

4.5.2. Rules

- Each school may have one team consisting of no more than three students.
- Each team will provide their own, internet-connected computer.
- Each team will be given a link to a TinkerCad webpage that contains the "buggy" Arduino circuit simulation and its associated sketch.
- Each team will be given a document that describes the intended function of the circuit and provides a set of operational requirements. In addition, each team will be provided a short video clip of the circuit operating as intended.
- The competition will take place online by video conference. Each team must demonstrate that they are secluded during the competition, though an adult chaperone may be present. The team will share their screen so that judges can observe the team's progress.
- The team will be given 90 minutes to identify as many of the deliberately placed bugs they can, and to demonstrate that they can reproduce the behavior indicated in the video clip provided in (d) above.
- Each team will be given a log sheet to keep track of the bugs they've identified and the corrective actions they've taken. This log will be used to assign points; bugs that are identified and corrected in the circuit but are not reflected on the log sheet may not be scored appropriately.
- Teams are welcome to use online references for the Arduino language and for the components used in the circuit. These references should be identified on the log sheet in the designated section.

4.5.3. Bug Hunt Rubric

The rubric will be provided at the competition and will assign points to the bugs known to be in the circuit based on the subtlety of the error and its impact on the circuit's operation. Points will be awarded for bugs identified (and their associated corrective actions) on the provided log sheet. Bonus points will be awarded for restoring broken circuit features to their required operational behavior.

4.5.4. Suggestions

- All components in the bug hunt are included in the SparkFun Inventor's Kit. Understanding the projects in the kit will be invaluable in completing the Bug Hunt.
- When feasible, do not simply copy and paste the code for the Arduino sketches when building the projects in the kit. Manually typing in the sketch code will invariably introduce bugs; the same techniques needed to identify and correct these bugs will be useful in the Bug Hunt.
- Develop good coding habits when building and extending the kit projects. Adding comments to code and using meaningful names for variables and constants greatly simplifies the troubleshooting process.

5. Competition Day

5.1. Check-In

A schedule will be provided on the time of check-in ahead of the competition. Please plan to arrive up to 30 minutes prior to check-in. Advisors should report directly to check-in.

5.2. Vehicle Compliance

Each team will be handed a step-by-step compliance checklist that must be completed and certified by a judge before the team is eligible to compete. This is time critical and teams unable to meet vehicle compliance in a timely manner after check-in may be disqualified. Compliance will be verified at the pool. Once the compliance checklist has been completed, it should be handed to the Lead Compliance Officer. The items on the compliance checklist can be found at the end of this document.

5.3. Presentation of Colors and Opening Remarks

5.4. Vehicle Performance, Slide Presentations, Circuitry & Coding, Bug Hunt

Each team will be provided locations and time slots.

5.5. Awards Ceremony

6. Awards Ceremony

6.1. Awards and Scoring

6.1.1. Awards

Winners for each of the individual sections will receive certificates. The tiers will compete separately in the Vehicle Performance section. The tiers will not compete separately in the White Paper and Presentation sections. The overall winner from each tier will receive a trophy.

6.1.2. Scoring

The White Paper, Technical Upgrade and Presentation sections will be scored in accordance with more detailed rubrics than the general rubrics provided. The Vehicle Performance section will be scored in accordance with the rubric provided. Circuitry & Coding and Bug Hunt will have their rubrics provided at the time of the competition. The scores from each section will be combined to determine the overall GPSGC champion for each tier.

6.1.3. Breaking Ties

Scoring ties will only be broken where it is required to determine award places. White Paper and Technical Upgrade ties will be broken by additional judging. Presentation ties will be broken by discussion between judges. Vehicle Performance ties will be broken by the farthest checkpoint reached, followed by the least final elapsed time. Circuitry & Coding and Bug Hunt ties will be broken by elapsed time.

7. General Rules

7.1. Triage

- The vehicle may be worked on by the teams during the competition at the triage station.
- The triage station is equipped with select spare parts and hand tools.
- Triage engineers are not there to build your AUV's replacement parts.
- Triage is to be utilized for repairs and not for building your AUV.
- Triage engineers are there to ensure the safety of students and assist with minor repairs.
- Teams are encouraged to bring a laptop to make changes to their code at triage.

7.2. Pool Access and General Pool Performance Rules

7.2.1. Pool Access

To manage the amount of activity on the pool deck and maximize safety, the following rules are in place:

- A limit of two team members can be on the pool deck in the competition area during an event.
- Advisors are not permitted on the pool deck during competition events.
- All team members must wear shoes with rubber soles on the pool deck.
- Absolutely NO glass, chemicals, or loose materials are permitted in the pool or on the pool deck.

7.2.2. General Pool Performance

- Nothing other than the SeaGlide vehicle and launching platform shall be put into the pool during competition.
- 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 not the result of the

design or 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.

7.3. Redress, Challenges and Disputes

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 Lead Judge shall be final.

A team that wishes to have an issue considered shall send the student team captain and one additional student member 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.

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.

8. SeaGlide Mentor Program

8.1. What is the Mentor Program?

The mentor program is an important part of the GPSGC. 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 enhances a team's experience and provides the teacher/advisor with a greater chance of success.

8.2. How is the Mentor Relationship Established?

SeaGlide teams register online and it is at that time they can request partnership with a mentor. Once the request is received for a mentor one may be assigned to you. Every effort is made to find the best fit between the school and the mentor. A returning team may specifically request a mentor they have had in a previous competition. Once a mentor is assigned, an email is sent to the mentor and the team advisor containing email and telephone number contact information. It is up to the advisor and/or mentor to establish and maintain connection after the first introductory Email is sent.

8.3. Meeting with the Mentor

The mentor meets with their SeaGlide 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 are established where the students engage in the design of the SeaGlide and then on to the building phase.

9. Vehicle Compliance Checklist

COMPLIANCE (SeaGlide Tier 1)

Construction

No loose parts that will potentially fall off during competition or handling.	Pass Fail
All joints are tight. All tie wraps are trimmed and flush as much as possible. In the event exterior wiring is used, it must be fastened securely to the structure	Pass Fail

Safety

No exposed live wires	Pass Fail
No metallic sharp edges	Pass Fail
All electrical contacts are protected	Pass Fail
No chemicals, CO2 Cartridges or loose materials shall be introduced into the pool, NO GLASS	Pass Fail

Functional Tests

Team demonstrates function of internal syringe plunger operates properly	Pass Fail
If SeaGlide utilizes any controllable appendage(s), the team must demonstrate proper functionality	Pass Fail N/A
If SeaGlide utilizes any sensors, team must demonstrate proper functionality	Pass Fail N/A

Design Compliance

No more secondary means of propulsion are installed	Pass Fail N/A
Glider conforms to allowable budget of $50.00 or less for Tier 1. Proof provided.	Pass Fail N/A
Glider conforms to allowable budget of $100.00 or less for Tier 2. Proof provided.	Pass Fail N/A

SeaGlide Launcher (Optional Component)			
1. Must attach to the side of the pool at designated starting point/lane.	Pass	Fail	N/A
2. Must be easily deployed and removed from the side of the pool.	Pass	Fail	N/A
3. Must NOT require any team member to enter the pool deploy or adjust.	Pass	Fail	N/A
4. Must NOT extend greater than 2 feet into the pool lane.	Pass	Fail	N/A
5. End/back of the SeaGlide (i.e. rudder) being within 6" of side of the pool	Pass	Fail	N/A
6. Must NOT impart any force on the SeaGlide at launch.	Pass	Fail	N/A
7. Depth of the launcher Tier must not exceed 2.5 feet.	Pass	Fail	N/A
8. Width of the launcher Tier must not exceed 2 feet.			
9. Teams able to activate their SeaGlide without reaching into the pool.			

COMPLIANCE (Circle one) PASS FAIL