



**2017 Square One Education Network
Underwater Innovative Vehicle Design
Challenge Competition Parameters**

2017 Underwater Innovative Vehicle Design Challenge

OVERALL OBJECTIVE:

To challenge the Engineering and Technological skills of students through underwater courses that stress speed, agility, fun, problem solving and teamwork.

PURPOSE:

- Engage youth in an exciting project that purposefully blends engineering, science, math, and advancing technologies.
- Provide schools with an enjoyable, challenging and unique project focused on engineering, science, math and technology in a marine environment.
- Link excellent teaching and learning practices with increasing corporate demands for skilled, creative and energetic employees.
- Showcase the creative engineering strengths of today's students at a regional competition that focuses on vehicle performance and endurance.
- Honor marine engineering and innovation through fun competition

UNDERWATER - INNOVATIVE VEHICLES

Square One UNDERWATER-IVD vehicles may begin as a collection of miscellaneous PVC pipes, bilge motors, camera, electrical wire and rope. Instructions are provided to engineer a basic ROV (Remotely Operated Vehicle) that can fully function in a sub-marine environment. It must meet specific design and safety rules (See below). Alternate materials may be used, but they must be pool appropriate, i.e. non-contaminating/hazardous. Each school originated with the same off-the-shelf materials provided by SQ1 via the teacher workshops. This program has grown from this initial endeavor.

SAFETY

Safety is of key concern at all events. The design of the vehicles is only one variable in the safety of an event. Inspection of the vehicles to ensure that they meet safety rules, having an operations area that is free from obstructions, and making sure participants and spectators are not in harm's way are some of the requirements of sanctioning and of these regulations.

Notes:

- All team members are **REQUIRED** to wear safety glasses during the performance of each ROV. Additionally, the team is required to follow other common safety procedures during the design, build and performance portions of Underwater IVD.
- **A 12-volt power limit is in place for each U-ROV entered into this IVD competition. Use of more than one power unit at the same time is not permitted. The power source must be a jump box style device, not an auto or marine style battery.**

OVERVIEW:

- **Elementary, Middle and High School students** incorporate innovation and creativity into their design of an Underwater Remotely Operated Vehicle (U-ROV).
- Square One (SQ1) supports each participating team through the teacher workshops that are provided in several communities in the Great Lakes region.
- Each design team is **REQUIRED** to develop a plan to excite younger students about engineering, science and math around the IVD project in their school (SQ1 Engineering Ambassadors). Additional points will be earned based on the effectiveness of this element.
- U-IVD Performance Showcase will be held on **Saturday, March 4, 2016, at Waterford Mott High School, Waterford MI.** This competition was created by Square One as a component of their *Signature Series* of Innovative Vehicle Design programs for students.

Three Divisions in which you may register to compete!

- **Grades 3 – 8: Junior Class Division**...Basic ROV's – (Similar to those developed as a part of the SQ1 teacher workshops)
- **Grades 9 – 12: Senior Class Division**...Basic ROV's – (Similar to those developed as a part of the SQ1 teacher workshops)
- **Grades 3 – 12: Advanced Technology Division**...Digitally controlled ROV's...RC / Microcontrollers / other complex technologies utilized.

SCHOOL DESIGN TEAM DETAIL:

- Teams/Clubs must consist of at least 5 dedicated high school students and one dedicated, certified teacher.
- Teams can be comprised of a dedicated class within an existing curriculum.
- Teams should develop a well-articulated, professional plan toward the innovative designs of their vehicle.
- Teams must register and commit to the Performance Showcase no later than February 15th, 2017. Teams are expected to keep this commitment, unless extreme last minute circumstances prevent participation.
- Teams must meet all safety requirements as outlined in the U-IVD Teacher's Guide, Assembly Manual authored and presented during the aforementioned workshops by Keith Forton, Traverse City Central High School, MI, or Bill Grimm, Oak Park High School.
- No pressure accumulators (purchased or homemade) are allowed. Pressure accumulators are chambers or cylinders that accumulate and store compressed air at high pressures. They are essentially pressurized bombs that if ruptured, would spray fragments into the surrounding area.
- All travel and associated fees are the responsibility of the team/school

SQUARE ONE EDUCATION NETWORK DETAIL:

- SQ1 will provide all coordination of the U-IVD Performance Showcase.
- SQ1 will develop the parameters/guidelines of the U-IVD Performance Showcase.
- SQ1 will provide appropriate awards based upon scoring by judges.
- SQ1 will release \$200 of engineering materials support funds (exclusively for use in this competition).

2017 Underwater Innovative Vehicle Design Challenge

The Michigan Department of Natural Resources needs your help! They are working hard at maintaining the fresh water, natural beauty, and wildlife of the Great Lakes State. Underwater remotely operated vehicles can play an important role in their success.

Students are to engineer (or re-engineer) an underwater ROV that will successfully meet the performance demands necessary to complete the following challenges:

Challenge 1: Swimming Upstream

Task: The Swimming Upstream challenge consists of multiple events that will challenge a team's craft and driving skill. **Your** ROV team's mission will begin from the near edge of the pool, where the ROV must dive beneath the surface and maneuver through the underwater tunnel to locate the salmon eggs that must be moved to safety. Teams are challenged to gather as many eggs and move them to safety (tee's picked up from one bin and dropped into another) as possible, allowing enough time to return through the "tunnel" to the finish line.

Description: With his or her backs facing the pool, each ROV pilot will race through the structure created to simulate a "tunnel" (a PVC tunnel) and complete the task as best as possible before racing back through the "tunnel" to the finish/start line. Points will be awarded for all tasks; there is no penalty for incompleteness of the mission other than a lack of points being awarded.

- The "tunnel" structure will rest in approximately 6 feet of water.
- The "tunnel" will be a 2.5 feet by 2.5 feet by 5 feet in length PVC structure.
- The "polluted nest" (bin) will be filled with ½" PVC T's. The bin will rest on the bottom of the pool floor with some additional weight placed in the bottom of the container to help prevent sliding.
- PVC T's ("salmon eggs") are to be picked out of one bin ("polluted nest") and dropped in another bin ("safe nest").
- Return through the "luge tunnel"
- Cross the finish line! (ROV touches the pool wall where the ROV began)
- Each team is REQUIRED to switch pilots at the halfway mark of the exploration, and may do so more frequently if desired.

Scoring:

- Successful run through the “tunnel” = 20 pts.
- Each PVC Tee (egg) picked up = 5 pts.
- Each PVC Tee (egg) dropped into the “safe nest” bin = 10 pts.
- Successful return through the “tunnel” = 20 pts
- Return to the finish line before time is called = 20 pts
- If an egg (PVC Tee) is dropped outside the bin, onto the pool floor, no penalty will be assessed.
- If the Tee is dropped, team is allowed to attempt recapture or return to the bin for more as long as time allows.

Time: The team will have a total of 15 minutes to complete “Swimming Upstream”. To ensure consistency, ROV batteries will be disconnected at the 15-minute mark.



½" PVC T's in the Sterilite bin to the left are the “salmon eggs” that must be picked up and moved into a new Sterilite “safe nest” bin that will be weighted a short distance away.

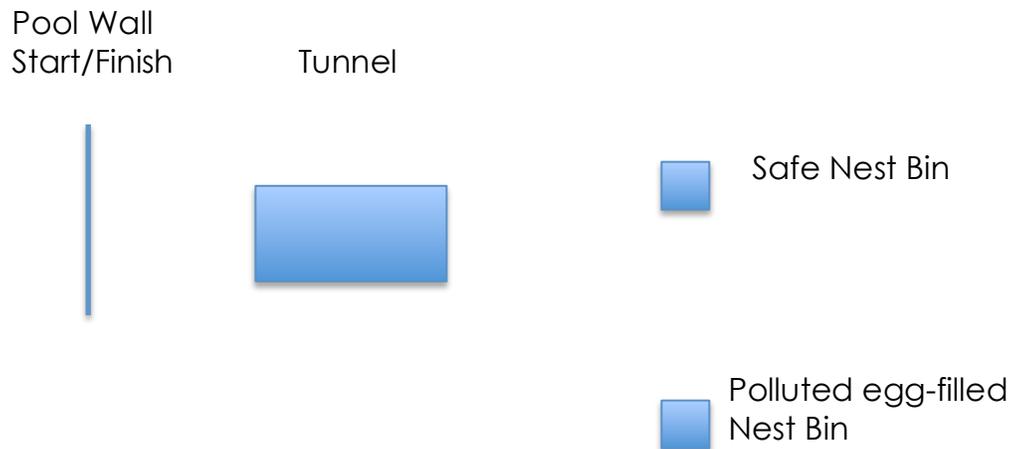
Photo courtesy of 2014 MATE Competition Manual. Used with permission.

Allowances: Each team has the opportunity to place additional team members at any point along the side of the pool to assist the pilot during the competition. No team members may enter the water at any time during the competition.

Clock: Once the 15-minute clock starts, it will not stop. Should a failure occur during the competition, the team has the option to remove the vehicle and attempt necessary repairs. Should the ability to re-enter the Challenge become an option, the ROV must be placed in the water at the starting point and reassume the tasks.

Disqualifications: If, at any time, the judges rule that a team is not taking extreme safety precautions when in the pool area, they may opt to disqualify that team for that portion of the competitions.

Penalty: A 10-point penalty shall be deducted each time the U-IVD pilot is observed looking at or into the pool during the 15-minute race window.



Challenge #2 – Raising the “All Clear” Flag!

Task: It is key for the team to recover all invasive species from the lake bed and signal that all is clear. The circular “ring” of Eurasian watermilfoil must be collected from the pool floor and hung on the hooks that will be found just beneath the surface of the water. More than one ring may be collected at a time. If rings are dropped the pilot can make additional attempts to capture as long as time allows.

Description:

- 10 standard swimming pool diving rings will be available to capture
- A standard ice fishing “tip up” will be floating on the surface
- The rings must be transferred from the ROV to the hooks hanging from the “tip up” structure at the surface
- Each rescue team is **REQUIRED** to switch pilots at the 7-minute mark of the adventure, yet may do so more frequently if desired.
- If all ten rings are collected AND hung on the hooks before time expires, the team may request that the rings be scattered on the pool floor for capture again.

Scoring: One point will be awarded for each ring captured; ten points will be awarded for each ring successfully transferred to the “tip up” hook; fifteen points will be awarded once the flag is raised.

Each team will have two opportunities to meet this challenge. The total from BOTH attempts will become the final score presented to the Square One judging center.

Time: The team will have a total of 15 minutes to complete the Raise the Red Flag procedure. To ensure consistency, ROV batteries will be disconnected at the 15-minute mark.

Allowances: Each team has the opportunity to place additional team members at any point along the side of the pool to assist the pilot during the competition. No team members may enter the water at any time during the competition. Teams may switch pilots as many times as they wish during the race, should they choose to do so.

Clock: Once the 15-minute clock starts, it will not stop. Should a failure occur during the race, the team has the option to remove the vehicle and attempt necessary repairs. Should the ability to re-enter the race become an option, the ROV must be placed in the water at the starting point and pursue the furthest target.

Disqualifications: If, at any time, the judges rule that a team is not taking extreme safety precautions when in the pool area, they may opt to disqualify that team for that portion of the competitions.

Penalty: 1 point will be deducted each time the U-IVD pilot is observed looking at or into the pool during the 15-minute mission window.



Plastic J Hook 6”



Dive Rings

Challenge #3 “Sea Lamprey Burrow* Density”

Task: Survey “beds” of sea lamprey burrows, and determine the population density to the nearest cm. (Number of burrows/cm.)

Description: With their backs facing the pool, drivers will locate the beds of sea lamprey burrows, hover over them so that team members may measure the size of the bed and number of holes via the underwater camera’s images. Sea lamprey “burrows” are holes of varying sizes drilled in a random fashion to a flat “bed” resting on the pool floor.

Course Design: **Teams will self-schedule this event. There will be multiple identical beds in the deep end of the pool. There is no time limit.**

Scoring: The final scoring is based on the mathematical computation to determine density of holes within the bed. 100 points will be awarded to teams with exactly the correct answer; +/- 5% = 90 points, +/- 10% = 80% and so on.

Time: There is no time limit on this event.

Allowances: No team members may enter the water at any time during the competition.

Clock: Should a failure occur during the competition, the team has the option to remove the vehicle and attempt necessary repair. Should the ability to re-enter the event become an option, the ROV must be placed in the water at the starting point and reassume the tasks.

Disqualifications: If, at any time, the judges rule that a team is not taking extreme safety precautions when in the pool area, they may opt to disqualify that team for that portion of the competitions.

Penalty: 1 point will be deducted each time the U-IVD pilot is observed looking at or into the pool during the event.

*Please note that sea lamprey’s probably do not make burrows. We just thought it made the mission more interesting!

Optional Challenge #4: Underwater IVD Drag Racing!

Each team has the option to re-fit their existing ROV, or bring a second ROV to compete in this first-ever racing competition. In order to qualify for this third challenge, each team **MUST** compete in each of the other challenges. Considerations for the U-IVD Drag Racing teams are:

- This will be a single elimination competition, with two ROV's racing simultaneously.
- Each lane will be that of a standard swim lane, and the distance of the race will be 40 feet from the edge of the pool.
- No additional power can be supplied to the vehicles. The same base power systems apply to the racing competition. In other words, you may **NOT** ramp up the voltage for this challenge.
- This racing ROV can be of any size (**see limitation below**), with no limitations on numbers of motors, types of motors, propellers, or other adaptations considered to be appropriate but **SAFE** for the challenge.
- The race will begin with the ROV touching the side of the pool with one team member holding the unit firmly against the pools edge.
- At the sound of the signal, each ROV will travel straight ahead until the rear of the ROV crosses the finish line. The first ROV to completely pass the finish line wins.
- Please note for this challenge, the ROV "pilot" will be facing the pool.
- The racing ROV does NOT have to have a camera unit.
- The length of the racing ROV may NOT exceed 24 inches.
- If the team has any concern about the legality of their ROV being outside the parameters of this competition, be sure to contact Square One representatives prior to the day of competition.

SHOWCASE AWARDS (Combined Event Scores)

Judges will evaluate each scoring category using a 1 – 100 rating scale, with 100 being the greatest value: (500 points maximum possible)

- **Design Innovation**

How creative or innovative were the students with their design approach?

Did they think "out of the box"? (Even if in the end the innovation became a detriment to the device)

Design Innovation	Guideline	
Judges will score Innovation as follows:	Max Points	Score
1. Innovative design (risk taking)	30	
2. Innovative or unique use of materials	20	
3. Execution of Innovation	30	
4. Style (overall pizzazz!)	20	
Total	100	
Comments:		

- **Engineering/Craftsmanship**

How well did the design translate into performance? Was the device robust and built in a high quality manner or barely able to make it through the competition?

Were there design attributes that could be seen to solve problems or overcome issues with the target performance?

Engineering and Craftsmanship:	Guideline	
Judges will score Engineering and Craftsmanship as follows:	Max Points	Score
1. Craftsmanship- construction, quality of assembly, structural integrity	30	
2 Use of space and materials	20	
3. Applied reasoning, effectiveness, problem solving	30	
4. Style (overall pizzazz!)	20	
Total	100	
Comments:		

- **Performance:**

How well did the rover and the entire team perform in each of the challenges?

Scores/times will be used to determine these placements. Score sheet samples will be released prior to the event day.

- **Ambassadorship: (REQUIRED)**

What did the team do to share their learning and inspire younger students?

Guidelines:	Max	
How well were 100 younger students involved and inspired:	40	
How innovative was the ambassadorship:	40	
Were 100 students engaged:	0 or 20	
Comments:	100	

- **Presentation:**

Each team will present to the judges for 10 minutes and will formally explain what makes their design, engineering, craftsmanship, and ambassadorship unique. **New this year: Teams MUST have visual aides, including but not limited to a tri-fold board which will be displayed at the team's pit space throughout the day.**

Judges will score the oral presentations as follows:	Maximum Points	Score
1. Clear and understandable explanation of ambassadorship, innovations and engineering.	25	
2. Logical organization of the presentation.	10	
3. Effective use of graphic aids (Don't block them from view, use large print rather than tons of tiny text, etc.) including team designed tri-fold display	20	
4. Articulation (Speaking clearly and with forethought)	15	
5. Team support (Multiple team members are able to speak to questions)	10	
6. Response to questions (knowledgeable, clear, concise)	10	
7. Enthusiasm and pride	10	
Total	100	

- **Eisbrenner Public Relations Social Media Award**

Prior to developing a Twitter, Facebook, LinkedIn, Instagram or YouTube account for your school's program, be sure to review your school's **social media policy** and keep those regulations in mind when posting to the social media outlets. **Now you're ready to be social!**

Guidelines	Points	
Did the team have a social media strategy?	0-30	
How effectively did the team use Facebook, Twitter, LinkedIn and/or YouTube to share their story?	0-30	
How diverse was the audience reached by the team's social media plan (Demographics beyond peers?)	0-30	
What are the team's metrics (# of followers, likes, posts, tweets)? Team should provide stats.	0-10	

- **Square One Nation Award**

Who demonstrated the overall best combination of Design Innovation, Engineering and Craftsmanship plus team dynamics, including enthusiasm and spirit to produce a superior device and outcome for the competition? This is the **"Convergence of Innovation, Engineering and Team Work"** to provide a superior solution to the challenge of the competition.

Guidelines:	Max	
Vehicle Performance	25	
Team dynamic, Leadership, Cooperation, Collaboration	25	
Engineering and Craftsmanship	25	
Design Innovation	25	
Comments:	100	

Supporting Graphics will be shared in a Separate file as requested

ADDITIONAL PARAMETERS

- *These parameters are provided to promote safe and fair competition.*
- *Since safety is of key concern, these parameters should be considered minimum requirements. These parameters will be in force and must be maintained during the entire competition.*
- *Any vehicle should be able to pass inspection at any time during a demonstration.*
- *Experimentation of design and ingenuity are encouraged, but keep in mind the intent of safe competition for the operators and the other participants of an event.*
- *If a new concept is being attempted that does not fit the rules exactly, it may be wise to contact a Square One U-IVD official before proceeding with construction. It would be unfortunate to complete a vehicle and then have it disqualified at a competition.*
- *Please remember that safety and high quality, innovative designs are our primary goals.*

RESOURCES AND MATERIALS

www.squareonenetwork.org

U-IVD Contacts:

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248.917.1399

Many thanks to Keith Forton and Karl Klimek for their dedicated leadership in STEM education through the marine environment

SQ1 Underwater IVD Performance Challenge 2017 Safety Reminders and Event Clarifications

Safety is of key concern at all events. The design of the vehicles is only one variable in the safety of an event. Inspection of the vehicles to ensure that they meet safety rules, having an operations area that is free from obstructions, and making sure participants and spectators are not in harm's way are some of the requirements of sanctioning.

Safety Reminders:

The use of safety glasses is **required** when working on or around the ROV, **and** when on the pool deck. Penalties WILL be assessed for noncompliance.

Appropriately ventilated work areas and other common safety procedures are expected during the design and construction of the ROV as well as the performance and competition phase of the competition.

A 12-volt power limit is in place for each U-ROV entered into this IVD competition. Use of more than one power unit is not permitted.

An Inline fuse (25 Amp Maximum) must be placed within 30 cm (approximately 12") of the power supply. All power servicing the ROV and any of its components must pass through this fuse. Teams will not be allowed to participate without the fuse protection. This inline fuse is in addition to any built in fuse protection that may exist on the power supply.

Use of any type of 120 V AC devices during the competition or along poolside is not permitted. This includes plugging in and charging the power supply while being used during the competition.

No pressure accumulators (purchased or homemade) are allowed. Pressure accumulators are chambers or cylinders that accumulate and store compressed air at high pressures. They are essentially pressurized bombs that if ruptured, would spray fragments into the surrounding area.

No oil filled devices or chambers. This includes any fluid that if leaked would compromise or contaminate the pool water.

Onboard power supplies (i.e. batteries) are not allowed.

No 12V car or boat batteries along poolside. This is at the request of our host facility. All power servicing the ROV is to come from a 12V "Jump Pack" style battery pack.

Event Clarifications:

Teams are required to use the same ROV for each performance mission. Multiple ROVs for different mission parts are not allowed. The exception is the 40' drag race event. A separate ROV can be built specifically to compete in the drag race portion of the event.

Does the drag racer have to have camera mounted on it? No.

Does the drag racer have to be submersible or can it float on the surface? The intent here is to be appropriately neutrally buoyant underwater during the race, staying between the floor of the pool and surface of the water. **Momentarily** breaking the surface or touching the bottom of the pool would be permissible. Having the ROV act like a boat and rest on the surface or drive along the floor of the pool would not be permissible.

Is there a limit to the number of motors or size of the motors on the drag race ROV? No there is no limit to the size or number of motors or propellers; however the ROV is limited to one 12V battery pack.

Can Go Pro or other cameras that do not require cables be used on the ROVs? Yes as long as they do not have an onboard battery. GoPro cameras are a great addition to any ROV, however they would violate the "onboard power supplies (i.e. batteries) are not allowed" event guideline.

If yes, is it OK for us to use a laptop as our TV? Yes, provided it is not powered from the wall outlet.

