SECTION 2: Pool Courses

2024 International SeaPerch Challenge https://seaperch.org/

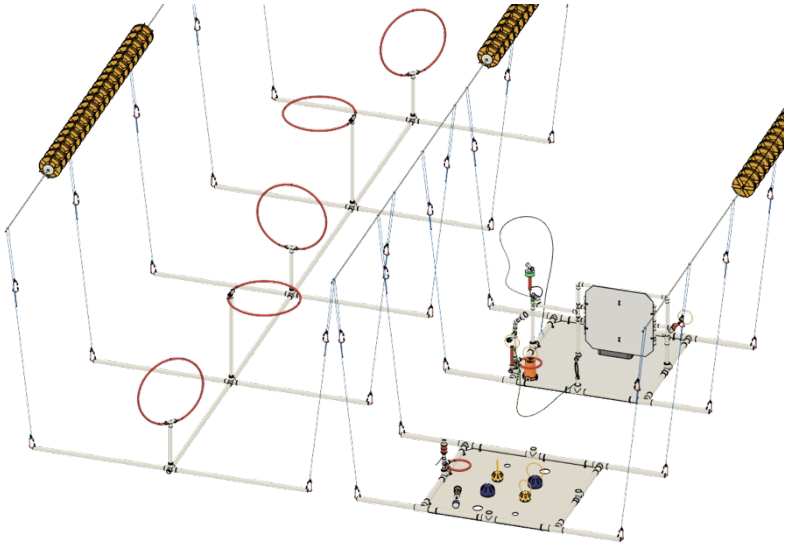
2.1. Pool Course Events Overview

The competition will include two in-pool courses:

- **The Obstacle Course** tests high-speed maneuverability and requires the SeaPerch ROV to navigate the course as quickly as possible.
- **The Mission Course** incorporates a mission that teams must complete related to Deep-Sea Exploration. This course simulates the tasks and environment that an ROV might encounter while exploring the harsh environments that surround hydrothermal vents.

2.2. Lane Setup

Courses will be suspended from the pool's lane dividers with the lower course frames approximately 5-6 feet below the water surface and 5-6 feet from the side of the pool.



The obstacle course and mission course will be arranged beside each other and considered a single competition lane. The pool will include eight (8) competition lanes to accommodate eight (8) teams simultaneously. Competition lanes will be separated by a vacant pool lane (i.e. no course). Each team will have sole use of their assigned competition lane for their allotted time slot.

2.3. Timing

Teams have 20 minutes to complete Pool Course runs. After the course judge verifies the team and provides instructions, a 20-minute course timer will start. Teams are responsible for managing their time and may take as much time as needed for setup and reset within the twenty minutes allocated. When the course timer expires and reaches zero, the team must depart the Pool Course.

Runs will be timed using a run timer. The run timer starts when the run starts and records the official run times. Teams may start subsequent runs immediately after completing a prior run but much receiving a start signal from the judge to ensure the run will be scored. Teams may abort runs at any time without completing the course if they are experiencing problems and want to ensure they have enough time for subsequent runs. A run ends when the run time expires, the team has aborted the run, or the team has completed the course (whichever comes first). Guidelines for obstacle course and mission course runs are below.

2.3.1. Obstacle Course Timing

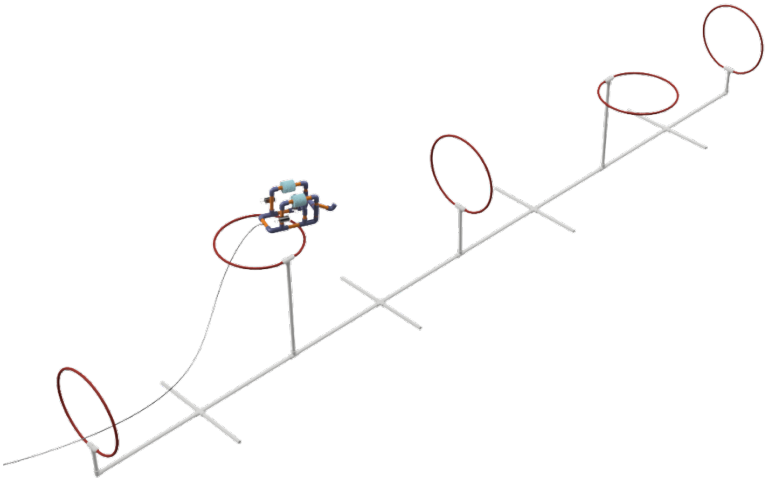
- Teams may attempt up to two (2) runs.
- Each run is limited to four (4) minutes maximum.

2.3.2. Mission Course Timing

- Teams may attempt one (1) run on the mission course.
- The mission course time limit is eight (8) minutes maximum.

2.4. Obstacle Course

The Obstacle Course consists of five 18" hoops oriented at different angles and suspended 5-6 feet below the water surface. *Please note that there is no guarantee of the position of the hoops when the course is deployed in the pool at the International SeaPerch Challenge and may not appear as pictured below.* Operators should not try to memorize actions such as in playing a video game but should instead practice a variety of general high-speed maneuvers.



2.4.1. Navigation Overview

- *Start of run:* The ROV must be surfaced, within six inches (6") of the wall, and under its own power. Team members are not allowed to touch the ROV after the lane judge begins the countdown to start the run.
- The ROV is required to pass through each of the five obstacle course hoops in order starting at the hoop closest to the pool wall.
- The ROV must surface after clearing the hoop furthest from the pool wall. Surfacing is considered complete when any part of the ROV breaks the surface of the water.
- The ROV must re-submerge and head back to the pool wall by passing through each of the five hoops in reverse order.
- *End of run:* The run is complete when the ROV touches the pool wall while surfaced (any part of the ROV breaks the surface of the water). The run will be aborted if the allotted time expires even if the ROV has not completed the course.

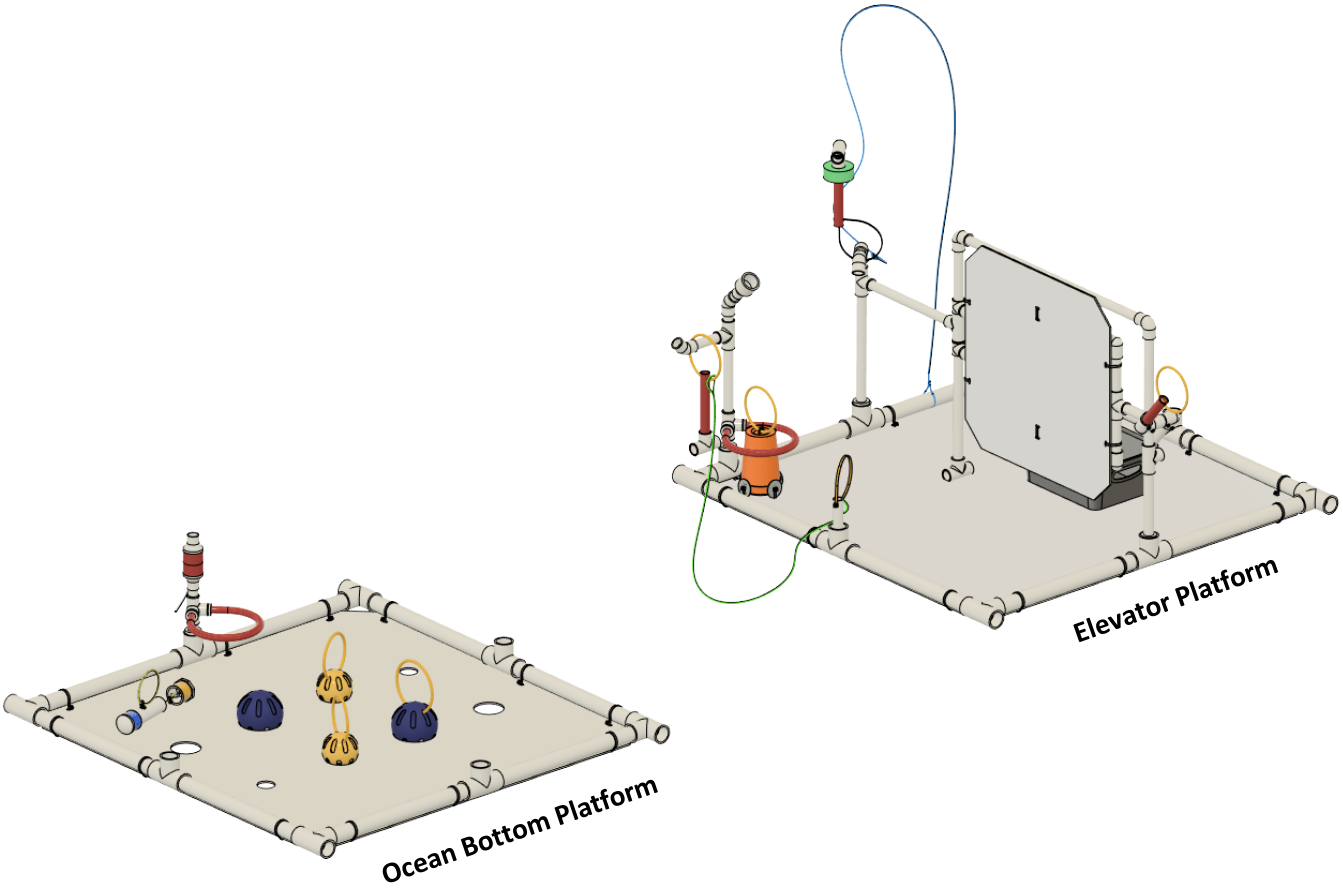
2.4.2. Scoring Overview

Teams are ranked based on time. The obstacle course scoresheet is available in Appendix B: Scoring Rubrics and Scoresheets

2.5. Mission Course

The Mission Course consists of six tasks across two task frames and will be suspended 5-6 feet below the water surface (see course layout on next page). Tasks are described in detail below and include:

- Task 1: Elevator Preparation
- Task 2: Temperature Sensor
- Task 3: Fluid Sample Collection
- Task 4: Gas Sample Collection
- Task 5: Rock Sample Collection
- Task 6: Prepare for Elevator Recovery



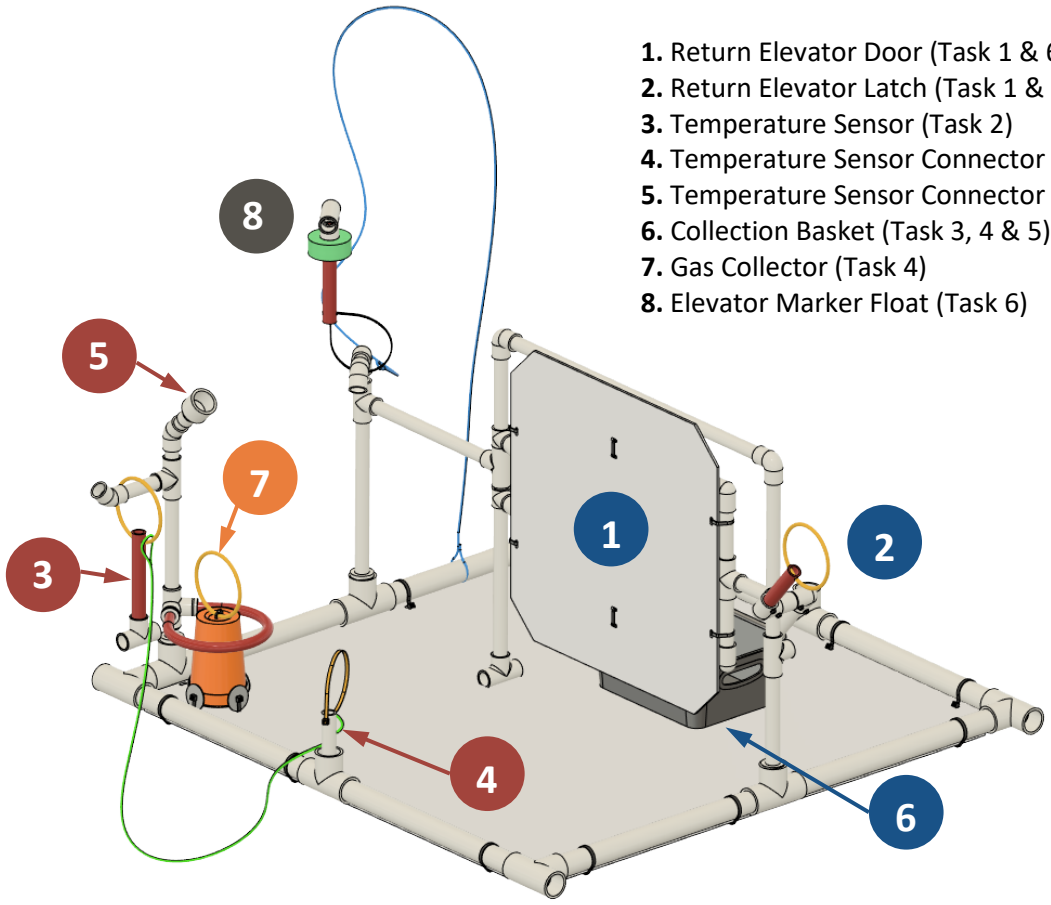
2.5.1. Navigation Overview

- *Start of run:* The ROV must be surfaced, within six inches (6”) of the wall, and under its own power. Team members are not allowed to touch the ROV after the lane judge begins the countdown to start the run.
- Objects falling past the suspended task frame are out of play and the ROV is not allowed to attempt to retrieve them.
- *End of run:* The run is complete when the ROV touches the pool wall while surfaced (any part of the ROV breaks the surface of the water). The run will be aborted if the allotted time expires even if the ROV has not completed the course.

The ROV may transport multiple objects simultaneously. Objects may be moved between platforms for staging without completing the task. (For example, the rock samples can be moved to the return elevator and placed in the basket after completing other tasks.)

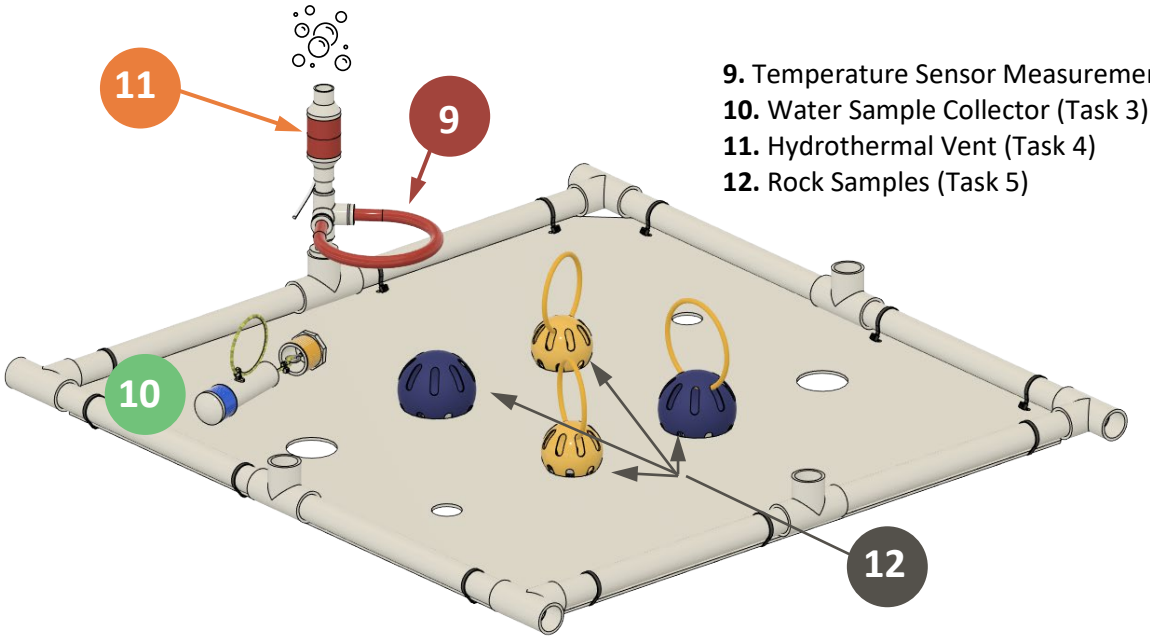
Tasks may be completed in any order with the following exceptions:

- To receive points for opening the elevator door, it must be opened before placing objects in the sample collection basket. If the team fails to open the door, they may still place objects in the basket; however, points will not be awarded for opening the door once an object is placed in the basket.
- Releasing the elevator marker float must be the last task completed. Points will not be awarded for the elevator marker float release if other tasks are completed after its release.



1. Return Elevator Door (Task 1 & 6)
2. Return Elevator Latch (Task 1 & 6)
3. Temperature Sensor (Task 2)
4. Temperature Sensor Connector (Task 2)
5. Temperature Sensor Connector Port (Task 2)
6. Collection Basket (Task 3, 4 & 5)
7. Gas Collector (Task 4)
8. Elevator Marker Float (Task 6)

Elevator Platform with Task



9. Temperature Sensor Measurement Area (Task 2)
10. Water Sample Collector (Task 3)
11. Hydrothermal Vent (Task 4)
12. Rock Samples (Task 5)

Ocean Bottom Platform with Task Elements

2.5.2. Scoring Overview

A maximum of 110 points can be earned on the Mission Course through successfully completing tasks with bonus points awarded for completion of the course under a time limit. Points are not official until verified by master scorekeeper.

Task Points

Tasks can be completed for a total of 100 points divided across the tasks as follows:

- Task 1: Elevator Preparation has a max of 5 points
- Task 2: Temperature Sensor has a max of 30 points
- Task 3: Fluid Collection has a max of 10 points
- Task 4: Gas Collection has a max of 15 points
- Task 5: Rock Collection has a max of 25 points
- Task 6: Elevator Recovery has a max of 15 points

Points will be earned at completion of each task action. If tasks are disturbed in subsequent actions, teams will still earn the points for completion.

Time Bonus Points

Teams may earn bonus points for successfully completing all tasks in less than 6 minutes. Bonus points are based on adjusted finished time including any time penalties incurred during the run. Bonus points are applied for:

- Finish times less than 4 minutes earn teams 10 points
- Finish times less than 6 minutes earn teams 5 points

Rubric

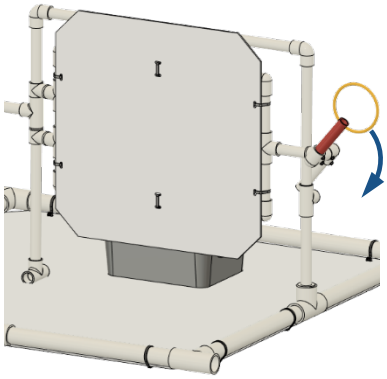
The mission course scoring rubric is available in Appendix B: Scoring Rubrics and Scoresheets

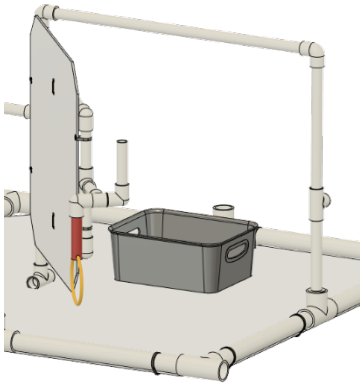
2.5.3. Elevator Preparation (Task 1)

The ROV must move a lever to open a door on the return elevator to expose the collection platform in preparation for sample collection (simulated in the image by a small basket).

Scoring

Teams will receive five (5) points upon successful completion of this task.





Real-World Inspiration

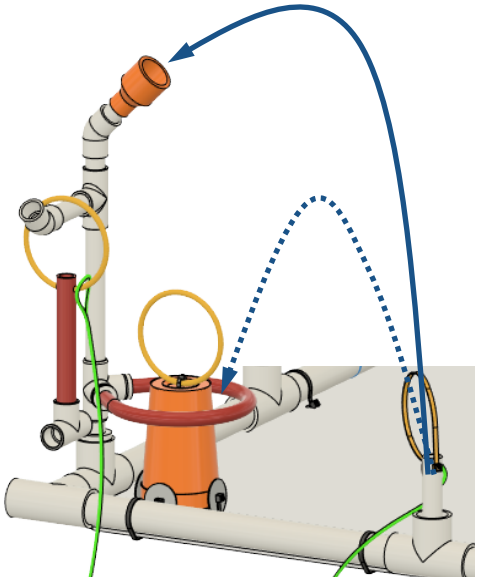
A lander is a mechanical platform used to carry payloads from the bottom of the sea to the researchers on the surface ("underwater elevator"). A lander makes the transit to the surface for an ROV and allows the vehicle to spend more time exploring the seafloor. This task represents preparing the lander to transport samples from the seafloor to the water's surface.

2.5.4. Temperature Sensor (Task 2)

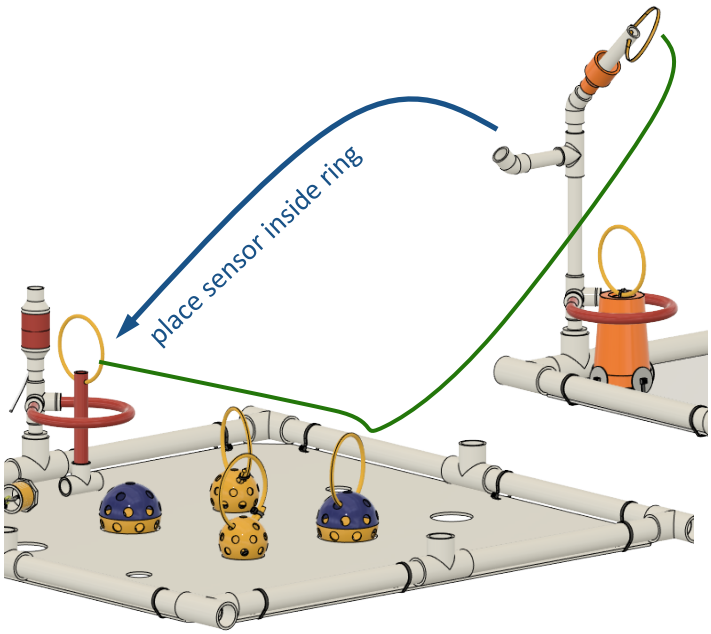
The ROV must retrieve the temperature sensor connector, deposit the temperature sensor connector, and then place the temperature sensor inside the hydrothermal vent ring.

Teams may select one of two options for depositing the temperature sensor connector:

- **Option A**: Plug the connector into the connector port (shown with the blue **solid line** below; higher difficulty)
- **Option B**: If teams are unable to plug the connector into the port, the connector may be placed in the holding ring below it (shown with the blue **dashed line** below; lower difficulty)



Temperature Sensor Connector Placement
Option A (**solid**) – Option B (**dashed**)



Temperature Sensor Placement

At the start of the run, the temperature sensor will be located on the Elevator Platform and must be moved to the temperature sensor measurement area on the Ocean Bottom Platform. The connector port and holding ring are both located on the Elevator Platform.

Scoring
A maximum of 30 points can be earned in this task. This is a multi-step task and teams will earn points for completing each step of the task, including:

- For retrieving and depositing the temperature sensor connector teams will earn:
  - Twenty (20) points for placing temperature sensor inside the connector port OR
  - Five (5) points for leaving the temperature sensor in the holding ring.
- Teams will receive ten (10) points for placing the temperature sensor inside the hydrothermal vent ring.

Real-World Inspiration
Temperatures near hydrothermal vents can reach up to 750°F (400°C), hot enough to melt some ROV parts. Measuring temperature is essential to helping scientists understand the formation, structure, and evolution of these unique habitats. Biologists use temperature data to learn about the animals' living environments and the range of temperatures they can tolerate. Chemists use it to make sure they are collecting the hottest fluid from a vent as well as to explain the vent's chemical composition deep below the surface.

2.5.5. Fluid Collection (Task 3)

The ROV must close the end cap on the water sample collector by lifting the collector by the attached rope loop. The ROV must then retrieve the water sample collector from the Ocean Bottom Platform and transport it to the storage basket on the Elevator Platform.

Water Sample Collector Closure and Placement

Scoring

A maximum of ten (10) points can be earned in this task. This is a multi-step task and teams will earn points for completing each step of the task. Teams will receive:

- Five (5) points for closing the water sample collector. Points will be earned by lifting the collector by the rope loop even if the caps do not fully close.
- Five (5) points for transporting the water sample collector and placing in the collection basket.

Real-World Inspiration

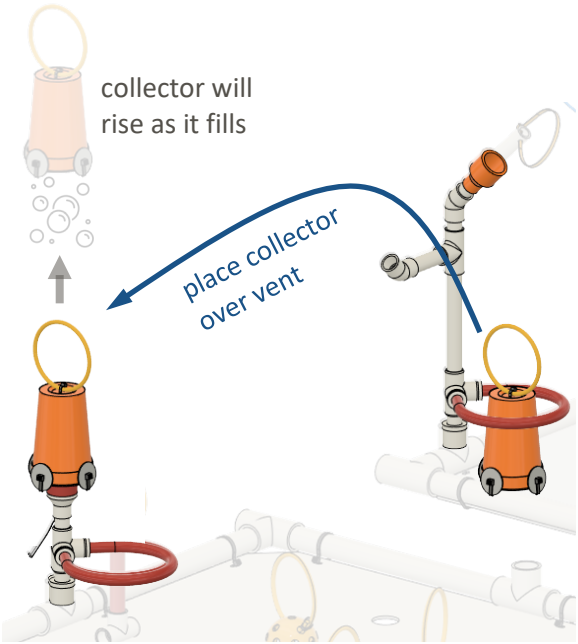
Hydrothermal fluid can contain dissolved sulfur, copper, zinc, gold, iron, helium and other chemicals from deep beneath the ocean floor. When it combines with near-freezing, oxygen-rich seawater, rapid chemical reactions are triggered that cause sulfides and other minerals to precipitate (rapidly transition from dissolved to solid).

The seafloor surrounding hydrothermal vents is a dense oasis of life, teeming with microorganisms such as bacteria and archaea that use the chemical-rich fluids as a source of energy (chemosynthesis) much like plants use sunlight and carbon dioxide (photosynthesis) in the surface ocean and on land. These microbes are the basis of a food web that includes remarkable life forms such as tubeworms, shrimp, clams, fish, crabs, and octopods.

Analyses of the fluids collected by ROVs around hydrothermal vents provide chemical and microbiological data that helps scientists understand the fluid-rock interactions beneath the surface and often leads to the discovery of never seen before species.

2.5.6. Gas Collection (Task 4)

The ROV must retrieve the gas collector from the Elevator Platform and place it over the hydrothermal vent on the Ocean Bottom Platform to collect a gas sample. The hydrothermal vent will be releasing small bubbles that will be visible on the surface of the pool, simulating the presence of a hydrothermal vent below. As the ROV holds the gas collector above the vent, the collector will fill with gas and rise to the surface. The ROV must hold the collector above the vent and may not release the gas collector until it begins to float upward.



Gas Collector Placement

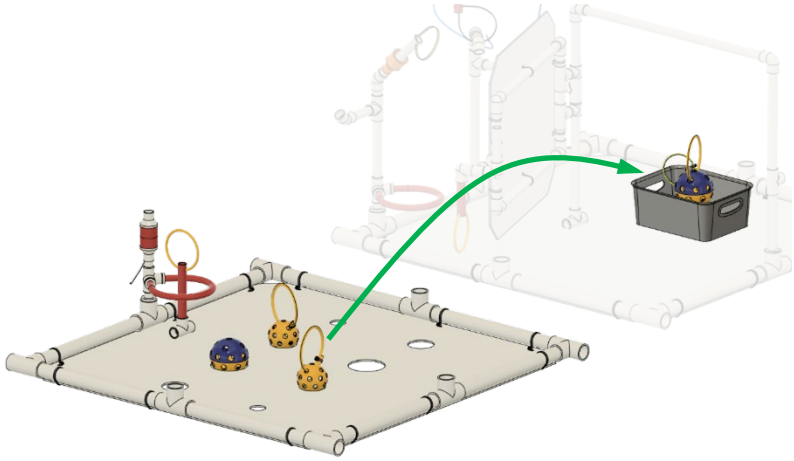
Scoring
A maximum of 15 points can be earned in this task. This is a multi-step task and teams will earn points for completing each step of the task. Teams will receive:

- Five (5) points for removing the gas collector from the ring on the Elevator Platform
- Ten (10) points for filling the collector with gas until the collector fills and floats. Once the collector begins to rise teams will earn the allotted points even if the collector flips and/or sinks.

Real-World Inspiration
Gases collected near hydrothermal vents are analyzed for, among other things, helium and carbon isotopes, which provide valuable information about the age and development of the vents as well as the origins of the gases in the crust and mantle.

2.5.7. Rock Collection (Task 5)

The ROV must retrieve rock samples from the Ocean Bottom Platform and transport them to the collection basket on the Elevator Platform.



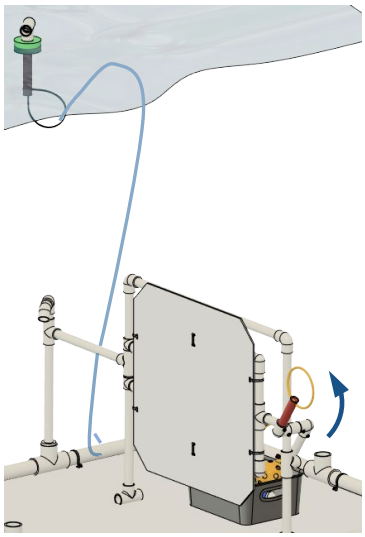
Scoring
A maximum of 25 points can be earned on this task. This is a multi-step task and teams will earn points for completing each step of the task. Teams will receive:

- Five (5) points for the successful retrieval of rocks with loops that are placed in basket (3 rocks available)
- Ten (10) points for the successful retrieval of the rock without loop that is placed in basket (1 rock available)

Real-World Inspiration
Rocks and life near hydrothermal vents are intertwined; life thrives on the surfaces of the underlying crust and within the vent chimneys. Samples are cataloged, extensively imaged and described, and then stored in a variety of ways for geochemical and biological analyses by researchers on shore.

2.5.8. Elevator Recovery (Task 6)

The ROV must close the door and lock the latch on the Sample Return Elevator so that samples are secured during the trip back to the surface. The ROV must then release the elevator marker float to make the sample return elevator visible to and recoverable by the researchers waiting for it on the ship.



Scoring
A maximum of 15 points can be earned on this task. This is a multi-step task and teams will earn points for completing each step of the task. Teams will receive:

- Ten (10) points for closing and latching the elevator door
- Five (5) points for releasing the elevator marker float

Real-World Inspiration

Although the ROV could carry samples back to the ship, it has limited carrying capacity and space. In addition, the ROV receives power from the ship via its tether, so it can stay submerged for days at a time. Instead of recovering the ROV to collect a relatively small number of samples each time, the Sample Return Elevator brings samples to the surface independent of the ROV. Engineers on the ship can then send a new elevator down for additional samples to continue the mission.

2.6. General Pool Event Rules

2.6.1. ROV, Spare Parts, and Adjustments

1. The team must use the same ROV that was presented at compliance for both pool events.
2. Each team must have their own ROV – teams are not allowed to share an ROV.
3. Teams are not allowed to share ROV attachments or devices.
4. Spare parts are allowed; however, spare ROVs are not allowed.
5. Any design or structural modifications made to the ROV after a compliance check requires the team to re-submit the ROV for a compliance check.
6. No parts or materials, except as noted in this section, may be added to or removed from the ROV between pool events. The ROV must compete in both pool events with the same attachments and parts connected. Violations will result in disqualification.
7. Attachments and parts may be *repositioned* (I.e., rotated or swiveled) between the two pool events. Attachments or parts may not be disconnected and relocated; they must remain connected to the same point on the ROV when they are repositioned.
8. The ROV may be worked on or adjusted during competition. This may include adjusting buoyancy by adding or removing buoyancy materials or adding materials like tape or cable ties necessary to secure parts. However, the run timer will continue.
9. Replacement of failed or damaged parts is permitted. Teams replacing failed or damaged parts must re-submit their ROV for a compliance check conducted by staff at the Triage or ROV Poolside First Aid Station.
10. Passing compliance checks does not guarantee the right to compete. Lead judges in the competition area have the final say on safety and compliance issues and may require teams that have already passed the compliance check to fix issues prior to competing.

2.6.2. Auxiliary Equipment, Batteries, and Power Supplies

1. 12-volt direct current (VDC) power connections for the standard SeaPerch power cable alligator clips will be supplied for each competition lane. This power connection is for the ROV only; no auxiliary equipment may be connected to this power connection.
2. Teams may provide their own battery for the ROV.
3. Teams may provide an additional battery for auxiliary equipment such as cameras, advanced controllers, and electromechanical ROV attachments.
4. Team supplied batteries must not be larger than 6.5” long x 3” wide x 4” high and must be 12 VDC maximum with a 9-amp hour maximum rating.
5. Teams may not bring anything to the pool deck that requires 110-volt or any other alternating current (AC) power. Laptop computers are allowed if they are battery powered and do not need to be plugged into 110-volt power.

2.6.3. Diver Assistance and ROV Tether Handling

1. The ROV must move only under its own power. The tether may not be pulled to expedite the ROV’s navigation of the course.

2. If the ROV or tether becomes tangled on the course structure or is otherwise unable to move on its own power, a team member must notify the judge that they would like to try to free the ROV by pulling on the tether. Under this circumstance teams may gently pull on the tether; however, the run timer will continue. If the ROV is pulled by the tether, the ROV must be returned to the location that it was moved from before it may continue competing.
3. The team may ask the judge for diver assistance. If diver assistance is requested the judge will pause the run timer. The judge will restart the run timer when the diver arrives at the lane and begins assisting. There is no longer a two-minute diver assistance penalty. If the ROV is moved, it must be returned to the location that it was moved from before it may continue competing.

2.6.4. On Deck

1. Prior arrangements are required for waivers to any of the following rules to accommodate students' special needs. Any special accommodations must be made in advance of the starting date of the International SeaPerch Challenge by contacting seaperch@robonation.org.
2. All team members and spectators are expected to be respectful of other competitors, spectators, volunteers, judges, and staff.
3. Instructions from judges, volunteers, and event staff must be followed at all times on the pool deck. Those not complying with instructions from judges, volunteers, or event staff will be asked to leave the pool area and may risk disqualification of their team from the event.
4. Pool passes are required to enter the pool area.
5. A maximum of six (6) pool passes will be issued for each team. Any team with more than six members in the pool area without special accommodations risks disqualification from the event.
6. Only four (4) student team members are allowed at the competition lane. Only two (2) team members are allowed at the active course lane. The two (2) team members at the active course are considered the competing team members. The two (2) team members at the inactive course are considered non-competing.
7. Only competing team members are allowed to communicate with the judges.
8. The four team members at the competition lane may switch drivers at any time and as many times as they choose. The lane judge will not stop the timers.
9. The remaining two passes are for pool area spectators and can be used by other students (competing later in either the obstacle or mission course), parents, coaches, teachers, or chaperones.
10. Once a pool event run starts the pool area team spectator may not enter the competition lane.
11. The pool area team spectators must sit or stand behind the designated barrier ribbon.
12. Any student team members who are pool area team spectators may switch with the team members at the competition lane between the pool event runs (obstacle and mission course).
13. All team members must wear shoes with rubber soles while on the pool deck.
14. All team members may help with setup but must exit to their assigned spots before the course run starts. During this set-up period, teams should adjust the ROV's buoyancy and make any other necessary adjustments.

2.6.5. Equipment Failure

1. In the event of equipment failure between pool events, a team will be allowed to work on their ROV at an ROV First Aid Station or at Triage.
    a. The ROV First Aid Station is intended for *quick repairs* that can be accomplished in 15 minutes or less. The station will not be equipped with electrical power, so soldering is not allowed.
    b. After successful repairs, the team will reenter the competition queue in the front of the line.
    c. If repairs are not accomplished within the 15-minute time limit, the team must proceed to the pool check-in station and notify the staff that they require Triage. Teams completing repairs in

Triage will check-in at the pool check-in station and enter the staging area.

2. While competition staff will attempt to accommodate all participants, teams not completing repairs by the last pool event time slots may not be able to compete.
3. If an ROV or equipment malfunctions before attempting the first mission task or passing the first obstacle course hoop, the team may elect to stop their run without incurring a time penalty. The team will be allowed to make repairs as described in item 1 of this section.
4. If an ROV or equipment malfunctions after attempting the first mission task or passing through the first obstacle course hoop, the team may elect to stop their run. The judge will record the current run time and notify the lead judge. The lead judge or technical director will evaluate the issue and decide a course of action. If the team is allowed to make repairs and restart their run, they may incur a time penalty equal to their initial run time at the time they stopped their initial run.

2.6.6. Disputes, Challenges, and Redress Request

1. Sportsmanship is always expected.
2. Team members and advisors are responsible for the conduct of all members and adults accompanying the team. Unsportsmanlike conduct of registered student team members or chaperones is grounds for the disqualification of a team.
3. Teams may not raise questions concerning other competing vehicles or other teams' scores.
4. Only the two competing team members may approach or speak to lane judges. Exceptions to this rule are only allowed if prior arrangements have been made to accommodate special needs.
5. Team members, chaperones, or spectators may not speak to the divers.
6. Team members will verify the time on the scoresheet reflects the time on the stopwatch. If there is a discrepancy, a team member may ask the lane judge for a second opinion. Timing disputes such as a team member claiming the judge did not start or stop the stopwatch at the correct time are not allowable disputes.
7. Disputes should be resolved at the time the alleged grievance occurs. However, if students are not able to articulate the alleged grievance, they may ask to speak to the lead course judge. The lead course judge will provide a redress request card that will allow the student and adult team members to meet with the technical director or lead judge to resolve the dispute. *Decisions of the technical director or lead judge are final, and the same dispute will not be heard again.*
8. If an ROV or the course is inadvertently interfered with during the competition, the competing team members should alert the lane judge and ask for a ruling by the lead judge or technical director. These situations will be addressed on a case-by-case basis.