# 2024 Qualifying SeaPerch Challenge Playbook

Hosted by the Tulsa Regional STEM Alliance
March 30, 2024 - 11 am - 4 pm
Jenks Aquatic Center - 495 N Birch St., Jenks, Ok 74037

A key goal of SeaPerch is to provide meaningful opportunities for students to learn and enhance their knowledge and skills related to robotics and the engineering design process. This year we anticipate we will have 60 teams competing from 20 schools, and the top 2 winners from the middle and high school divisions will have the opportunity to go on to compete at the International SeaPerch Competition May 31 - June 1, 2024 at the University of Maryland.

Our qualifying competition is modeled after the International SeaPerch Challenge, but small changes are made to suit our audience and event parameters. For the teams promoted to the International SeaPerch Competition, teams will be expected to follow the International Handbook.

> The following is meant to guide participants through competition details and challenges. Missing information or have additional questions? Contact rachel.christy@tulsastem.org.

## COMPETITION THEME

The 2024 theme is Deep-Sea Exploration with an emphasis on hydrothermal vents. First discovered in 1977 near the Galápagos Islands off the coast of Ecuador, hydrothermal vents are a critical area of ocean exploration. ROVs are necessary to aid researchers in exploring the harsh environments that surround hydrothermal vents where extreme temperatures and pressures, toxic chemicals, and reduced visibility are the norm.

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. The 2024 International SeaPerch Challenge was inspired by the wealth of information that can be gathered by exploring these deep-sea geysers.

## EVENT DETAILS

**Date & Time:** Saturday, March 30, 2024, 9am - 4pm
**Location:** Jenks Aquatic Center located at 495 N Birch St., Jenks, OK 74037

**Schedule:**

High School Division: 9:00 AM - 11:00 AM*
Middle & Elementary Divisions: 12:00 - 3:00 PM*
*Times are subject to change and any changes will be announced prior to the event.

All teams, coaches, and parents are invited to attend the entirety of the event this year. All spectators will be asked to remain in the Spectator Seating Area on the second-floor of the Aquatic Center overseeing the pool competition area. Teams will only be allowed into the pool competition area during their scheduled competition time. Once teams have concluded all three competition events, teams are welcome to hang around the Jenks Aquatic Center in the spectator or lobby areas, or to leave and return for the Awards Ceremony.

**Awards & Advancement:**

The Awards Ceremony will take place at approximately 3:45 pm on Saturday, March 30. Trophies will be awarded to 1st, 2nd, and 3rd place winners from each of the three divisions.

The first place team from both the Middle and the High School divisions will advance to the International Competition at the University of Maryland, held May 31 - June 1, 2024.

**Competition Layout:**

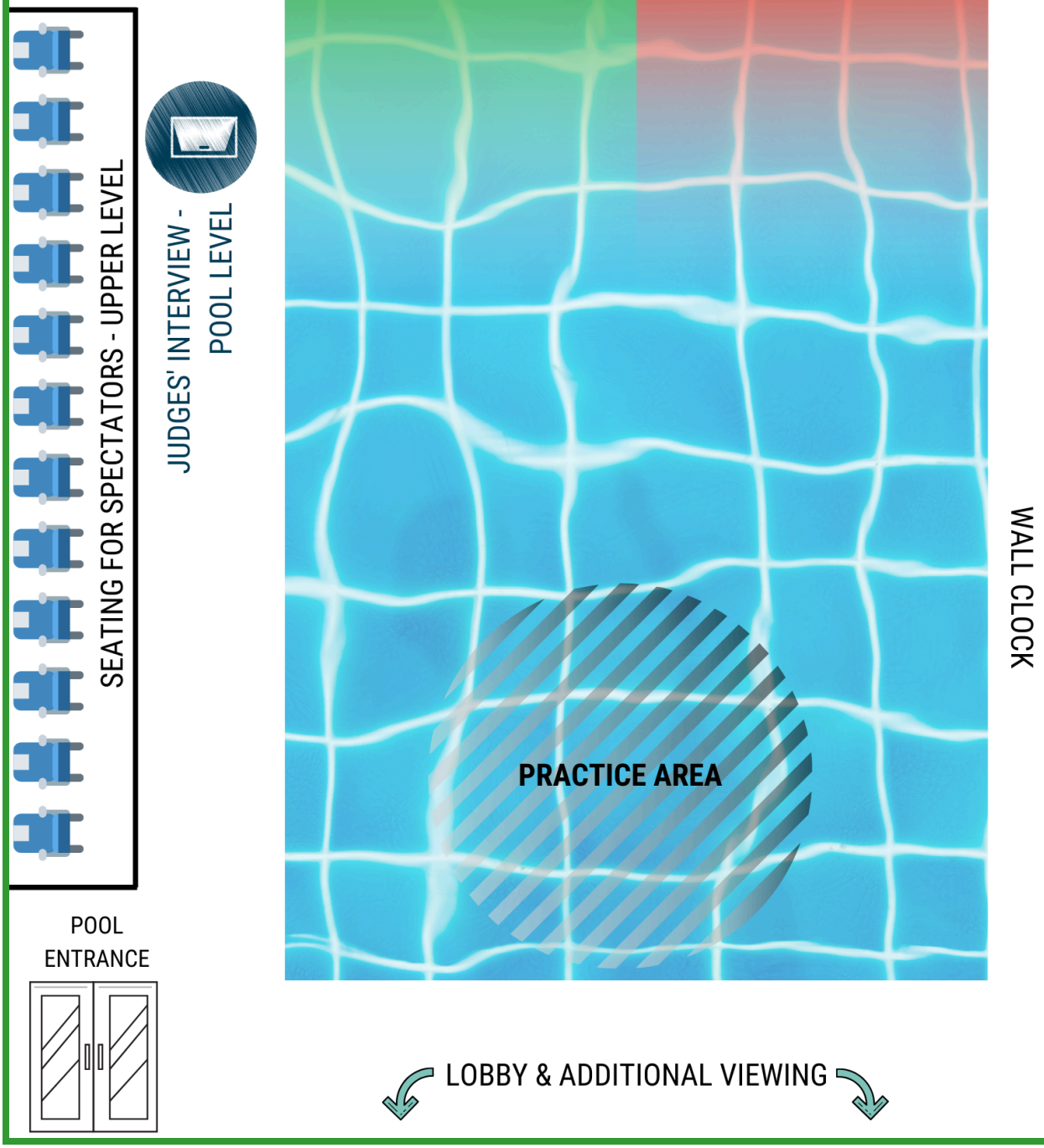
All challenges take place in the mainpool area of the Jenks Aquatic Center. Signage will help indicate which areas of the pool are marked for each pool competition, but the following is a general layout so students can begin to familiarize themselves.

The interview room is attached to the pool area. There will be signage indicating where teams will wait to be interviewed. No events will take place in the smaller pool area or in other locations in the building.

All students are encouraged to stay in the main pool area while competing and up in the upper level stands area while spectating.

# 2023 SEAPERCH CHALLENGE MAP

Jenks Trojan Aquatic Center - Main Pool



## GENERAL POOL EVENT RULES

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 rachel.christy@tulsastem.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. Only two team members are allowed to be present at the pool edge driving the ROV during each pool event. The on-deck team members may switch drivers at any time and as many times as they choose. The lane judge will not stop the timers.
   **Note:** All team members and coaches will be allowed in the competition pool area during their scheduled competition time.
5. All team members must wear shoes with rubber soles while in the pool area.
   **Note:** The pool area can get quite warm, so layers are suggested.
6. 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.

## ROV RULES:

1. Each SeaPerch ROV must be presented for a compliance check during check-in and approved prior to the team competing in the pool events.
2. The same ROV that was presented at compliance must be used for all pool events.
3. 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.
4. ROVs must fit through an 18" diameter hoop.
5. All ROVs must include waterproofed motors.
   **Note:** Teams may only utilize stock SeaPerch motors for propulsion (Jameco Electronics P/N 232022). Additional non-stock motors may be used for non-propulsion purposes.
6. ROVs may include 3D printed or additive manufactured parts.
7. Parts connected to the ROV may be *adjusted* or *repositioned* between the two pool events. However, no parts or materials may be added or removed to the ROV after compliance checks are completed (with the exception of buoyancy).
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.

**Note:** Time will be made available for teams to practice/adjust their ROV prior to beginning their pool events, as well as in between pool events.

9. Replacement of failed or damaged parts is permitted. Teams replacing failed or damaged parts must resubmit their ROV for a compliance check conducted by staff at the Triage or ROV Poolside First Aid Station.
10. The ROV must move only under its own power. Teams are not allowed to pull or otherwise maneuver the ROV by the tether.
11. 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 to request diver assistance to free or retrieve the ROV. Under this circumstance, teams must end their run and will be awarded only the points earned up until the tangling on that event.

## DISPUTES AND CHALLENGES

1. Sportsmanship is always expected. 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. **Sportsmanship is still expected during dispute/challenge conversations.**
2. Teams may not raise questions concerning visibility or water movement within the pool as a result of divers or other ROVs competing at the same time.
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.
   **Note:** 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.
   **Note:** 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.
   **Note:** 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 physically 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.
   **Note:** The loss of visibility due to movement in the water by divers and other ROVs does not count as a physical interference.
   **Note:** A diver swimming near the ROV or course without physically touching the ROV does not count as a physical interference.

## TEAM GUIDELINES

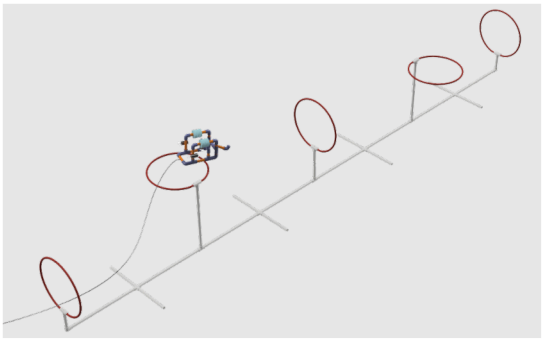
**There are three competition divisions:**

- Elementary division (K-5)
- Middle School division (6-8)
- High School division (9-12)

In instances where teams are comprised of students from more than one grade band, the team should compete in the class of the oldest student on the team. For example, a team of 7th, 8th, and 9th grade students must be registered in the High School Class.

## COMPETITION EVENTS

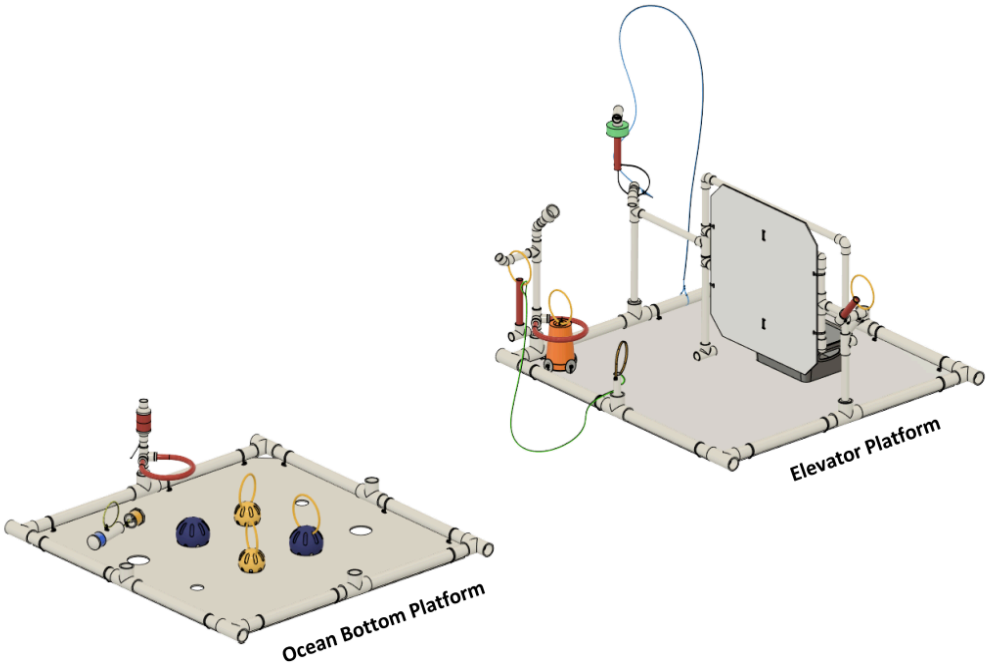
1. Obstacle Course - 100 points possible
    a. The goal of the Obstacle Course is to demonstrate high-speed maneuverability and requires the SeaPerch ROV to navigate the course as quickly as possible.
    b. Teams must navigate their SeaPerch ROV through a series of five 18" hoops as many times as possible in 4 minutes.
    c. **Course Navigation:**
        i. *Start of run:* The ROV must be surfaced, within 6" of the wall, and under its own power (team members may not be touching the ROV).
        ii. 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 last hoop (the hoop furthest from the pool wall). Surfacing is considered complete when any part of the ROV breaks the water surface. The ROV must re-submerge and pass through each of the 5 hoops in reverse order heading back to the pool wall.
        iii. *End of Run:* The run is complete when the allotted time runs out, the ROV has passed through the course 4 times, or the team has aborted the run.
        iv. **Note:** There is no guarantee of the position of the hoops when the course is put in the pool and may not appear as pictured above. 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.
        v. **Note**: This is different from the National competition rules, where teams are only required to navigate their Perch through the hoops twice.

d. **Scoring**: A maximum of one hundred (100) points are possible for this task. Teams will receive five (5) points per hoop the ROV successfully passes through within the four minute time period.

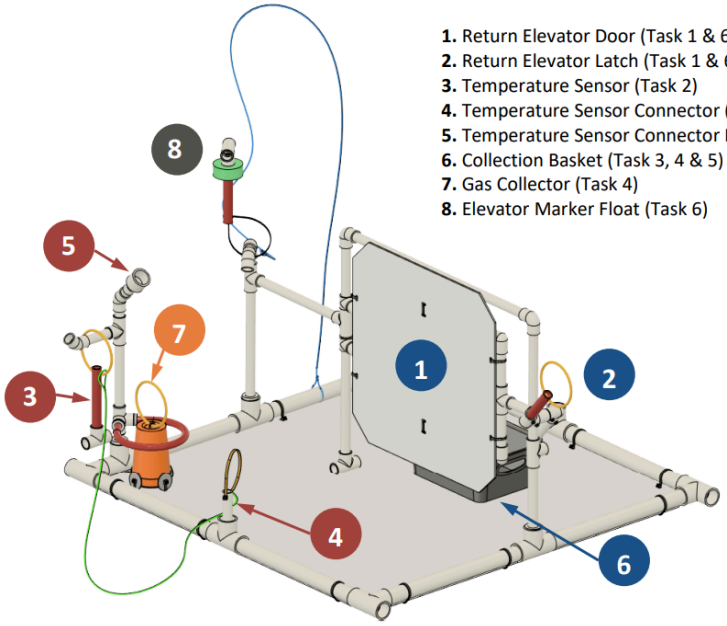
2. Mission Course - 100 points possible
   a. The goal of the mission course is to simulate the tasks and environment that an ROV might encounter while exploring the harsh environments that surround deep sea hydrothermal vents.
   b. Teams must use the SeaPerch ROV to complete as many mission tasks as possible in a 10 minute time period.
   c. The mission course consists of six tasks across two task frames on the pool floor around 6-7 feet below the water surface. (See course layout below.)



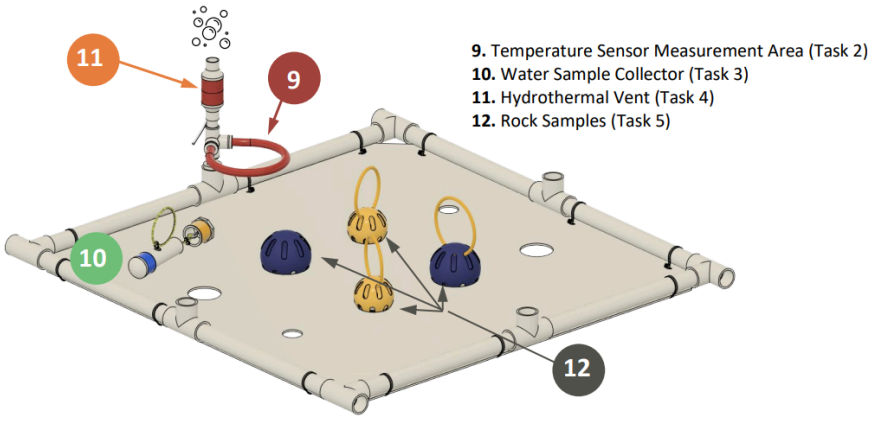

   d. **General Course Rules:**
      i. *Start of run:* The ROV must be surfaced, within 6" of the wall, and under its own power (team members may not be touching the ROV).
      ii. Objects falling past the suspended task frame are out of play and the ROV is not allowed to attempt to retrieve them.
      iii. *End of run:* The run is complete when the allotted time runs out OR when the ROV touches the pool wall while surfaced (any part of the ROV breaks the surface of the water) after completing as much of the course as desired.
      iv. 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.)

v. Tasks may be completed in any order with the following exceptions:
   1. 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.
   2. 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.




Elevator Platform with Task

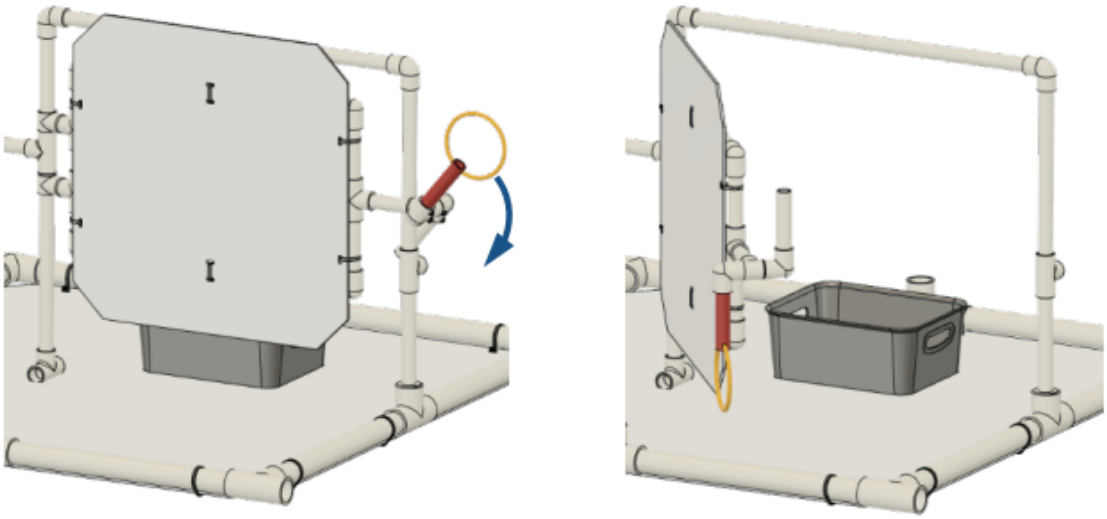



Ocean Bottom Platform with Task Elements

e. **Course Navigation**:

i. Task 1: Elevator Preparation

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 below by a small basket).
2. **Scoring:** Teams will receive five (5) points upon successful completion of this task.

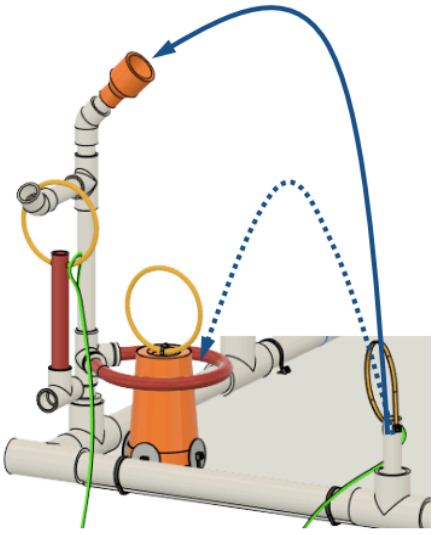


3. **Real-World Inspiration:** A lander is a mechanical platform used to carry payloads from the bottom of the sea to the researchers on the surface ("underwater elevator"). A lander makes the transit to the surface for an ROV and allows the vehicle to spend more time exploring the seafloor. This task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

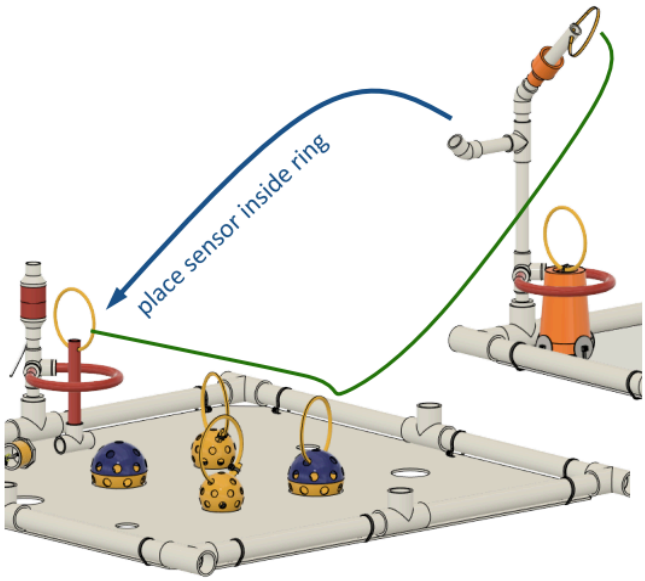
ii. Task 2: Temperature Sensor

1. The ROV must retrieve the temperature sensor connector, deposit the temperature sensor connector, and then place the temperature sensor inside the hydrothermal vent ring.
2. 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)

3. **Note**: 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.
4. **Scoring:** A maximum of thirty (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:
    a. For retrieving and depositing the temperature sensor connector teams will earn:
        i. Twenty (20) points for placing temperature sensor inside the connector port OR
        ii. Five (5) points for leaving the temperature sensor in the holding ring.
    b. Teams will receive ten (10) points for placing the temperature sensor inside the hydrothermal vent ring.



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




Temperature Sensor Placement

5. **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.

iii. Task 3: Fluid Collection

1. The ROV must close the end cap on the water sample collector by lifting the collector by the attached rope loop.
2. 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.
3. **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:
   a. 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.
   b. Five (5) points for transporting the water sample collector and placing in the collection basket.


Water Sample Collector Closure and Placement

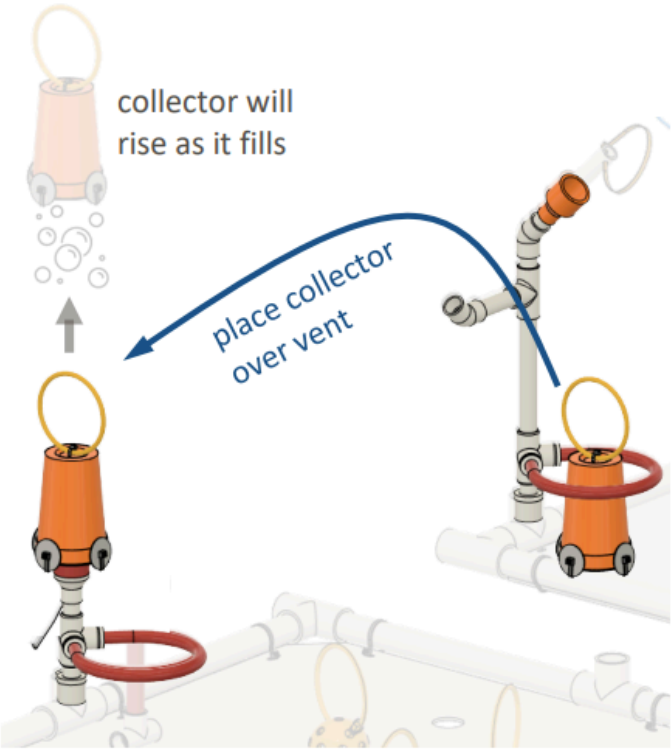
4. **Real-World Inspiration:** Hydrothermal fluid can contain dissolved sulfur, copper, zinc, gold, iron, helium and other chemicals from deep beneath the ocean floor. When it combines with near-freezing, oxygen-rich seawater, rapid chemical reactions are triggered that cause sulfides and other minerals 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

### iv. Task 4: Gas Collection

1. 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.
2. 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.
3. The ROV must hold the collector above the vent and may not release the gas collector until it begins to float upward.

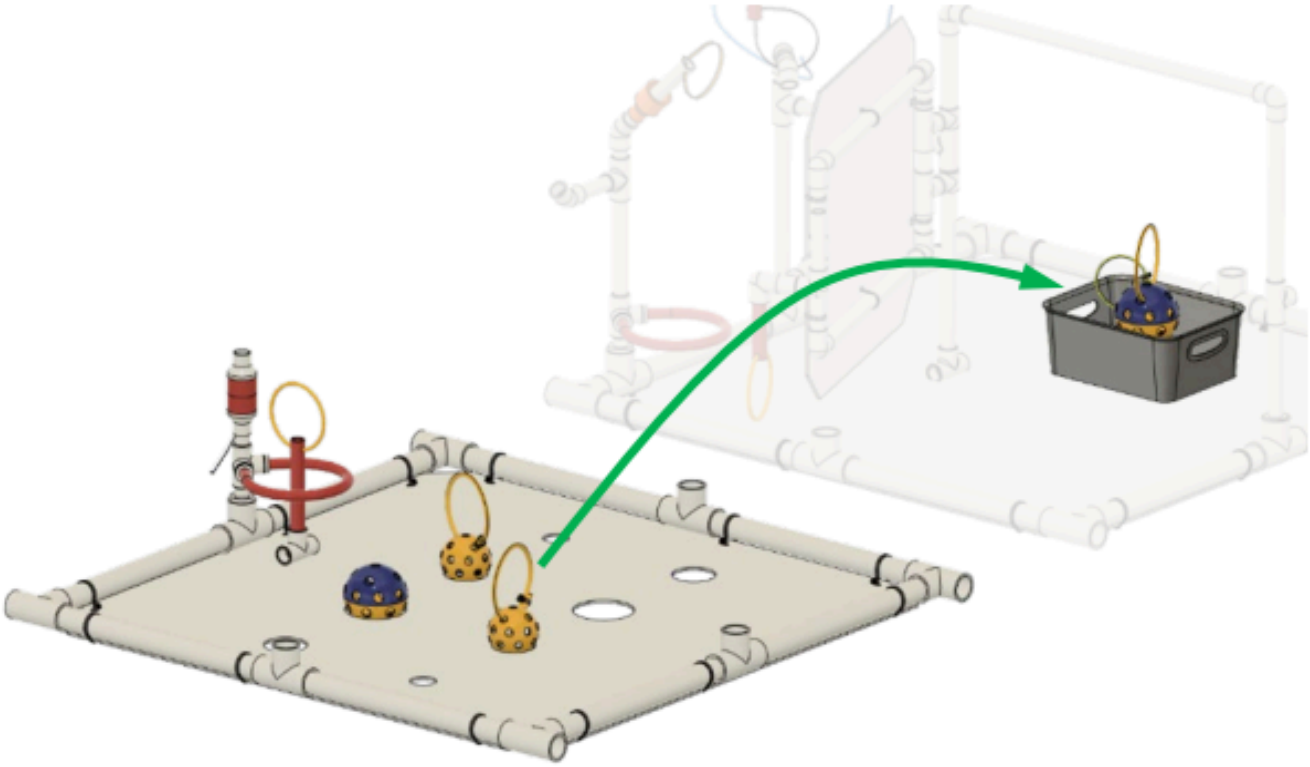


Gas Collector Placement

4. **Scoring:** A maximum of fifteen (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:
   a. Five (5) points for removing the gas collector from the ring on the Elevator Platform
   b. 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
5. **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.

v. Task 5: Rock Collection

1. The ROV must retrieve rock samples from the Ocean Bottom Platform and transport them to the collection basket on the Elevator Platform.
2. **Scoring:** A maximum of twenty-five (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:
   a. Five (5) points for the successful retrieval of rocks with loops that are placed in basket (3 rocks available)
   b. Ten (10) points for the successful retrieval of the rock without loop

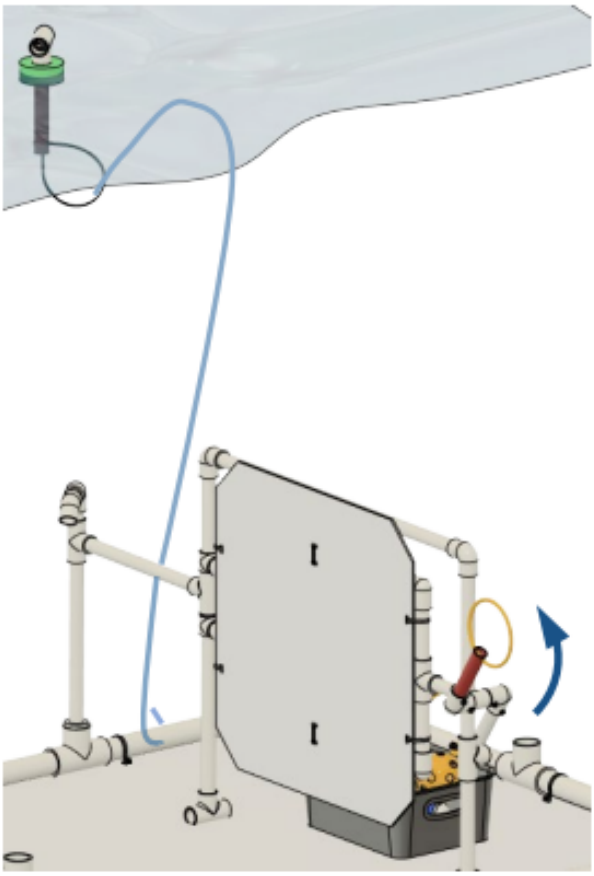


that is placed in basket (1 rock available)

3. **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.

vi. Task 6: Elevator Recovery

1. 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.
2. 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.



3. **Scoring:** A maximum of fifteen (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:
    a. Ten (10) points for closing and latching the elevator door.
    b. Five (5) points for releasing the elevator marker float.
4. **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.

3. Interview - 30% of total score - 100 points possible
    a. The goal of the interview is to demonstrate understanding of the engineering design process.
    b. Teams will answer questions about their strategy, design plans, tests & redesigns, teamwork, & perseverance through the SeaPerch building & competing process.
    c. No design notebooks or technical reports will be collected or reviewed.
    d. **Note:** Teams are encouraged to create an engineering notebook and document the design process not only because it is best practice, but also because a Technical Design Report is required of teams that promote to the International Competition.

e. **Note:** If teams do create an engineering notebook, they may bring the notebook into the interview, but they are not required to do so.
f. **Interview Process:**
    i. Students will meet with a judge to answer questions that demonstrate their understanding of the engineering design process and that provide insight into their teamwork and challenges during the building & competing process.
    ii. Interviews will last approximately 10 minutes.
g. **General Interview Rules:**
    i. Only students on the team are allowed into the interview. Coaches and parents are welcome to wait in the spectator area.
    ii. Students are welcome and encouraged to bring their SeaPerch into the interview for demonstration.
h. **Interview Topics:**
    i. Strategy, Design Plans, Tests & Redesign, Teamwork, and Perseverance
i. **Questions to Think About:**
    i. What was your team's strategy for completing the obstacle and mission courses? What did you want your Perch to be able to do? How would you define the problem needing to be solved?
    ii. How did your strategy for completing the tasks affect your SeaPerch design? What project constraints or parameters did you have to keep in mind?
    iii. Explain your SeaPerch design plans. What are the creative aspects or components of your SeaPerch? Why did you incorporate those aspects/components?
    iv. How did you approach designing your Perch? What things did you consider? How did you work together to come up with your final design?
    v. What tests did your team do in-water or in-simulation, and what were the results?
    vi. How did your test results impact or inspire further designs, modifications, improvements? (include charts, images, figures if able)
    vii. What are your next steps for your Perch OR if you were to build/compete with your Perch again, what would you do differently?
    viii. What did each team member contribute and what impact did each of those contributions have on the team's overall success?
    ix. What challenges did you face (during building and during the competition) and how did you overcome them?
j. **Scoring:** A maximum of one hundred (100) points can be earned through the interview. Teams will be asked approximately five questions covering the Interview Topics listed above. Each question response will be scored on a scale of 1-20 (1-5=beginning, 6-10=developing, 11-15=accomplished, 16-20=exemplary).