

**Pool Performance Round 2 Underwater Mission****Seaperch Ninja Warrior**

BELOW IS A FICTIONAL SCENARIO FOR THE SEAPERCH UNDERWATER ROBOT OUTREACH COMPETITION

**Challenge Course**

The course, inspired by “American Ninja Warriors,” tests a team’s SeaPerch design and driver skill by accomplishing a series of challenges. Each team ends the course by punching a big red button to send a 20-foot geyser of water into the air. The capabilities tested include:

- SeaPerch speed
- Navigational accuracy to maintain a straight path towards a small target or avoid obstacles
- Turn in a tight space
- Lifting weight from pool bottom
- Hold position while applying forward thrust
- Navigate through turbulent water
- Maintaining a forward and upward trajectory by coordinating forward upward thrusts

SeaPerches from all lanes can start simultaneously when the lead judge gives the signal to go. Each team is to accomplish each challenge as rapidly as possible. The course will have four cues showing the competitors and audience progress of each SeaPerch. The first cue is a water cannon the SeaPerch triggers by sprinting towards and punching a red 5-inch diameter target. The 20-foot geyser will show all teams and the audience what SeaPerch had the best start. The SeaPerch triggers the second cue by pivoting left as emerges from the “canyon” and rotating a lever to light the beacon. The third cue is at the course mid-point and requires the SeaPerch to push against and hold for several seconds a 5-inch diameter target that releases air into a cylinder to raise a flag above the pool surface while a rush of bubbles flow to the surface. When the lane judge sees that the flag is high enough above the water, the team can take on the next challenge, navigating through a curtain of bubbles. The final cue is a second water cannon, which concludes the course. The first to finish the course is the first to punch the big red button, releasing a geyser and the lane judge records the time.

The qualities of a successful SeaPerch should be:

- Fast forward speed
- Minimized height and width to ease navigation through the “canyon” and “tunnel”
- Minimized surface area to enable navigation through turbulence
- Strong upward thrust to lift weight and rise rapidly to surface
- Ability to pivot

For the driver, the individual challenges were designed to be simple but test his/her navigational and maneuvering skills. Challenges require the SeaPerch to accurately and rapidly traverse a desired path, lift, push, pivot in place, and coordinate forward and rising motions to the surface.

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

- Marking the location of floating waste by lighting a beacon
- Move solid waste trapped in a gyre so it can be collected

- Lifting sunken solid waste to a collection “vault”

### **Ocean Clean Up**

An estimated 8 million metric tons of plastics enter the ocean every year adding to the approximately 150 million metric tons already in the ocean. Plastic waste has been ingested by many different types of aquatic life and can injure or kill them. Many different organizations around the world are involved in cleaning up the oceans and preventing trash from entering the oceans. In the ocean there are large circular currents called gyres. Gyres essentially will concentrate the floating trash. One such gyre in the north central Pacific Ocean is the size of Texas.

Prior to 1990 ships would dispose of their trash at sea. Regulations from the International Maritime Organization has prohibited ships from disposing of plastics at sea. Now most of the plastic trash comes from people who just throw their plastics anywhere. Rainwater will wash the plastic into rivers and the rivers will dump into the ocean.

Whenever operations happen at sea, a ship that is using a remote operating vehicle has to be aware of the weather and ocean conditions. Weather will cause high sea states making ocean cleanup efforts impossible.

### **Mission Components**

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

**A view of the mission components can be viewed on Attachments A, B and C in this document.**

### **“SeaPerch Ninja Warrior” Mission Challenges**

1. The first challenge is to sprint to a 5-inch diameter target, punch the target to release a 20-foot geyser. The first cannon to be released will be triggered by the team with the fastest start.
2. The second challenge is to traverse 3 feet through an 18-inch wide “canyon.” Colliding with the side posts will slow the SeaPerch. This is a test of the operator’s navigational skills.
3. The third challenge is to turn on a beacon. There is an arm attached to a PVC cross. The robot has to pivot at the “canyon” exit to rotate the cross, which will turn on the light. (Note: the beacon is the same that was used last year.)
4. The fourth challenge is to remove a small plastic bottle from the floating ring (gyre). The bottle must be pushed over the top of the rings or pulled below.
5. The fifth challenge is to close the gate on the vault. The robot will pick a weighted rope ring and place it on a hook on the vault gate.

6. The sixth challenge is to raise a flag. The robot will push and hold red button, which will raise a flag above the surface of the water. This action will require the robot to apply constant pressure to the button. The activation will also activate a bubbler.
7. The seventh challenge is to navigate through the bubbler. The bubbles will make it difficult to enter the horizontal "tunnel." However, the robot operator may accept a time penalty and choose to wait until the flag descends. When the flag descends, it will shut off the bubbler.
8. The eighth challenge is to navigate the horizontal tunnel, challenging the operator's navigational skills by maintaining a low horizontal course. Colliding with the posts above or below will slow the SeaPerch.
9. The ninth challenge is to slide the wheel up an inclined pipe past a set mark on the pipe. This requires carefully coordinated applications of forward and upward thrusts.
10. The tenth challenge is to maneuver away from the wheel and push the red course completion button. This will activate the second air cannon releasing a 20-foot geyser signaling time stop.

### **Mission Scoring**

1. Each lane's judge will start his/her stopwatch when the lead judge gives the start signal.
2. On the team's scoresheet, each lane's judge will check the box for each challenge the team completes as the team completes it.
3. Each lane's judge will stop his/her stopwatch the moment the final red button is pushed. That is the uncorrected time.
4. Immediately after each heat, the score sheets will be collected and sent to the master scorer.
5. The master scorer will tally the unchecked boxes and add a 1.5-minute penalty for each unchecked box to the course completion time.
6. The teams with the top six corrected completion times will compete in a special run-off to determine the winner of the "**SeaPerch Ninja Warrior**" trophy.

### **NOTE:**

The leader among teams that tie will be decided by a runoff.

