

## **Submersibles (45 Minutes - Coach Scheduled Event)**

**Description:** Teams will build a device to create neutral buoyancy within a saline water environment using a set of given materials. This event has a building component and a written test.



**Participants per Team:** 2

### **Spirit of the competition:**

- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

### **Safety Requirements:**

#### **Safety glasses labeled ANSI Z87.1+ (impact rated)**

- Glasses must be worn during all practice and test runs.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.

#### **Indirect Vent Goggles**



**ANSI Z87.1-2015 certified and meets CE EN166 & D3 Splash/Droplet standards.  
Eyeglasses and Safety Glasses are not safety rated  
for this event!**

### **Teams Need/May Bring:**

- Sharpened pencils and scissors. Optionally one four-function calculator
- One chart or graph on 8 ½ x 11 paper showing at least 5 experiments to achieve buoyancy in different saline solutions.

### **Materials provided at event:**

Plasticine clay, play dough, or plumbers' putty, paper straws, 25 cm of masking tape, small paper clip, a 30cm to 40cm tall container filled at least ¾ full of a 1% to 10% saline solution.

### **The Competition:**

#### **Part 1-Written Test**

- Teams will take a written test on buoyancy concepts. The questions may relate to fish, submersibles, and underwater exploration. This will account for 25% of the team score. As a part of the test teams will estimate how far they will be from the midway point.

#### **Part 2- Constructing the Submersible**

- Teams will build a Cartesian submersible using the given materials. The submersible will then be placed in the container of saline solution so that it comes to rest at a designated midway point in the container.
- Teams will mark a reference line near the center of their submersible. This Event Supervisor will use this reference line to measure in millimeters the distance between the midway point and the reference point.
- No teams may squeeze the container.
- No teams will test their submersible in the container at any time.

### **Scoring:**

Teams will receive two weighted rankings. These rankings will be added to find the final placements. The team with the lowest sum will place first

- 75% - Teams will be ranked based on their midpoint measurement. Lowest distance to farthest.
- 25% - Teams will be ranked based on their written test score.

Teams will be placed in tiers based on adherence to the challenge instructions. Within each tier, teams will be ranked based on the scoring criteria for the challenge.

- Tier 1: Teams with no violations.
- Tier 2: Teams with a rule or building violation.

#### **Tiebreakers:**

- Tiebreaker No. 1: The closest estimate to the midway point.
- Tiebreaker No. 2: First incorrect answer on the test will rank lower.

#### **Scoring Example:**

**Equation: (written test ranking x 0.25) + (submersible ranking x 0.75) = final ranking**

- Team A ranks 6<sup>th</sup> on the written test. This scores 1.5 ranking points. The team also scores 5<sup>th</sup> on their submersible distance. This scores 3.75 ranking points. The team's final ranking score is 5.25.
- Team B ranks 2<sup>nd</sup> on the written test. This scores 0.5 ranking points. The team also scores 4<sup>th</sup> on their submersible distance. This scores 3.0 ranking points. The team's final ranking score is 3.5.
- Team B places first in the rankings.

#### **Possible Resources:**

Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- [Fluids | Physics library | Science | Khan Academy](#)
- [Mad about Science: Cartesian Diver](#)