SeaPerch Math Challenge

Grade Level: 8th-10th

Length of Lesson: 1 or 2 45-minute class periods

Goals:

- Practice mathematical skills as they relate to the SeaPerch ROV
- Practice basic algebra, addition, subtraction, and multiplication
- Use equations to find velocity
- Use equations to find density and buoyancy
- Solve story problems

Core Academic Standards:

- AI.L.3: Represent real-world and other mathematical problems using an algebraic proportion
- AI.L.5: Represent real-world problems that can be modeled with a linear function

Materials:

- SeaPerch Math Challenge Worksheet (below)
- Pencils (1 per student or team)
- Basic calculators (1 per student or team)

Background

SeaPerch focuses heavily on engineering, and it is important to note that much of engineering is based heavily on mathematical modeling and other related skills. Students should be able to see connections between the math skills they are learning in school, and the SeaPerch ROVs they are building. This math challenge relates SeaPerch activities such as building the ROV and maintaining buoyancy, with specific, age-related mathematical skills.

Lesson: LAUNCH

1. You may wish to go over basic mathematical skills such as the creation of simple algebraic equations to solve a story problem with your students before you begin this lesson.

2. If necessary, assess the mathematical ability of your students so that you can make groupings of approximately even skill levels.

3. Group your students into teams of two or three.

Lesson: INVESTIGATE

1. Inform students that this will be a timed challenge. Each team will work together to complete the mathematical challenge. The first team to bring a completed and entirely correct worksheet to the teacher will win the challenge. You may wish to provide a small prize to the winning team.

2. As the students are working, walk around the classroom to ensure that all students are participating in each team.

3. After the challenge, discuss why having a good grasp of math skills is so important when engaging in activities such as SeaPerch, and for all engineers.

Lesson: PRACTICE

1. If desired, this optional activity can be completed after the SeaPerch math challenge:

2. Ask each team to create a story problem based on SeaPerch that incorporates some kind of mathematical skill. Give the teams at least 15-20 minutes to come up with their problem. You may want to look over rough drafts to help guide the students.

3. After each team has completed their problem, have students trade with a fellow group and complete each others' SeaPerch story problems.

Special thanks to Jarvis Huck for standards alignment, and to Beth Mutch and the United States Naval SeaPerch Program for challenge questions and lesson guide

SeaPerch Math Challenge Worksheet

Team Member Names:_____

1. When you begin to build your SeaPerch, you must cut length of PVC pipe to the correct sizes. You are given 5 (five) 12" (30.5 cm) pieces of pipe and must cut these to make the following:
   - Two pieces – 2 1/2" or 6.4 cm long
   - Two pieces – 4" or 10.2 cm long
   - Two pieces – 4 1/2" or 11.4 cm long
   - Four pieces – 1 1/2" or 3.8 cm long
   - Four pieces – 5" or 12.7 cm long

   After cutting the new lengths of pipe, how much pipe will you have left over? Write your answer in both inches and centimeters.

2. How many 12" (30.5 cm) sections do you need to build 45 kits?

3. You have to purchase motors for your kit, as well as plastic canisters to house the motors. Three motors and one canister cost $6, while three motors plus three canisters cost $7.20. How much does one motor cost?

4. When the motors spin, the propellers rotate quickly enough to propel the SeaPerch through the water. Your SeaPerch can travel back and forth across the tow tank (12 feet in width) in 30 seconds. What is the velocity (distance/time) achieved by your SeaPerch?

5. You need to make your SeaPerch neutrally buoyant so it will not float or sink in the water, but just hover below the water line.
    - When an object is submerged in a fluid, there is an upward force on the object that is equal to the weight of the fluid displaced by the object. When the density of the object is less than that of the fluid, the net force will be upwards and the object will float. If the density is greater, the object will sink.
    - The density of water is 1 g/cm^3. Given a barge (a shallow, rectangular boat) that is 1" high on each side and 4" by 10" on the bottom, when cargo (mass) is added to the boat, it will settle into the water until it displaces an amount of water whose mass equals the cargo mass.
    - How much mass in grams can be added to the boat before it sinks? Assume the mass of the boat is small enough to be negligible. Remember that 1 $in^3 = (2.54\ cm)^3$