

Physical Science Submarine Wars Project

Working in a team, your goal is to build a submersible vessel that can:

- Initially float on the surface
- Descend and become fully submerged
- Maintain neutral buoyancy (no part above the water, and not touching the bottom)
- Move forward and backward while submerged
- Return to the surface

You may operate your vehicle with a “tether”, or, better yet, design it to operate autonomously. If you use a tether, it must leave the water at a single point and be fixed to a single location outside the testing tank when you are using it. The tether may not be used to push, pull, or lift the vessel. Your tether may include one 8’ length of pneumatic or surgical tubing, and as many strings or pull cords as you wish but they must all be tied together (loosely if desired) with small loops of string, twisty-ties, or the equivalent.

You must construct your vehicle using only the materials specified in Appendix A, Allowed Materials. You may ask permission in writing to use similar, easily obtainable household items with a total cost of less than \$5; approval of such requests will be the sole decision of MrH. Email is considered “in writing” for this purpose.

Between now and Testing Day, there will be seven class blocks available for work on the project, and the Project Lab will be open most days after school until 3:30PM. You may also take your submarine home to work on it, but before you may do so, you must turn in an Affidavit signed by each team member, and a parent of each team member. This will require advance planning!

In addition to the submarine itself, there are six additional deliverables for the project, each of which makes up a portion of your total project grade as follows.

Deliverable	Due	Points
Design Ideas (3)	Thu 5/29	6
Project Plan	Thu 5/29	4
Design Plan	Wed 6/4	10
“As-Built” Design	Tue 6/10	10
Project Logs	Tue 6/10	10
Submarine	Tue 6/10	up to 95
Project Report	Wed 6/11 3PM	15
Max total		150

Due dates indicated are at the beginning of the class period except for the Design Ideas and Project Plan which must be turned in at the end of the indicated class block, and the Project Report, due at 3PM. Your score for each deliverable will be reduced by 25% for each school day or part of school day later than the due date. Email submissions are permitted prior to the due date, but it is your responsibility to confirm delivery. Detailed requirements for each additional deliverable are attached.

The submarine itself is scored by functional capabilities as shown on the attached Submarine Wars Score Sheet. Note that a slowly sinking bottle with a hole in it will earn 10 points; add a tube tether, blow into it to make it ascend, and earn another 10, which, assuming you earn a perfect score on all the written work, gives you a 74. Earn just 60 of 95 possible points on the submarine itself, and you still have a Level 1 A (again, assuming excellent written work).

On Testing Day, you will have two trials of three minutes each to demonstrate the functional capability of your submarine. Order of competition will be determined by random drawing. The three minute timer will be started one minute after the previous vessel has completed its trial. All vessels will be impounded at the beginning of the lab block; teams may work on their vessel only after they are called for their first trial.

Appendix A: Submarine Wars Allowed Materials

Plastic drink bottles

Household sponges

Latex balloons – 4 per team available on request

PVC pipe

Glue (hot glue, super glue, ...) – hot glue and glue guns available in the lab

Tape (duct, medical, ...) – duct tape available in the lab

Rubber bands – some available in the lab

Waterproof sealant

Propellers

Plastic tubing – 8' pneumatic tubing provided on request

Plastic syringes – 1 large or small syringe provided on request)

Vinegar – small quantities provided on request

Baking soda – small quantities provided on request

Baking powder

Common household items for ballast (batteries, coins, bolts, etc.)

Deliverables

1. Three “Brainstorm” Design Ideas

Three significantly different design ideas, recorded on the [Brainstorm form](#). The sketch must be neat and clear, and labeled to show different materials used. All materials must be listed.

2. Project Plan

A list by person, by day of what each person plans to accomplish leading up to testing day. Use the [Project Plan form](#) on the web. If you plan on working more days outside of the class blocks, you should add rows to the table or attach a second form. Note: each team member should keep a copy for use in their Project Report (see below).

3. Design Plan

A final design you plan to build, including:

- a clean drawing or drawings showing all parts and how they are assembled.
- each part must be labeled on the drawing, and listed in a parts table that also shows how you will obtain it
- a brief written description of the vessel and how it will accomplish all planned functions: descending, ascending, moving forward and backward, and maintaining neutral buoyancy.

It must include enough detail, including measurements, in order to be able to reconstruct your vessel. This document must be typed, although the drawings may be done by hand and scanned in or attached. Note: you will be required to turn in an updated version of this on Testing Day, and each team member should keep a copy for use in their Project Report (see below).

4. “As-Built” Design

This is your Design Plan, updated to show exactly what you delivered on Testing Day. If your actual vessel suffers serious technical difficulties but your As-Built Design is accurate, you may receive partial credit for well-designed functions. This version must also be typed, although again updated drawings may be done by hand and scanned in or attached. Note: each team member should keep a copy for use in their Project Report (see below).

5. Project Log

Using the [Project Log form](#) on the web, this document must specify exactly what each project team member accomplished during every day anyone worked on the project. This Log must be kept up to date, and will be inspected at the end of each class block reserved for project work. When submitted on Testing Day, each team member must sign the Log in order to receive credit for it. Note: each team member should keep a copy for use in their Project Report (see below).

6. Project Report

This report must be prepared INDIVIDUALLY. You may of course discuss the topics below with your team members, but you must write the report yourself. You should not read any of your classmates' reports before completing your own. Any violation of these rules will be considered a serious violation of academic integrity.

The report must be submitted as a shared Google Doc, double spaced. It must include the following:

1. A description of all significant differences between the Design Plan and the As-Built Design, including the reasons the changes were made. (20%)
2. A day-by-day comparison of the Project Plan to the Project Log, including the reasons for any significant differences. (15%)
3. What you would do differently if you had it to do over again. (30%) This includes three separate topics:
 - a. How your team as a whole could have gotten a better score
 - b. How your team as a whole could have spent less time to accomplish what you did
 - c. What you personally could have done to help make (a) and (b) happen
4. Advice you would give to project teams attempting a similar project next year, including advice on:
 - a. the design itself; what specific things worked well for you, and what should they avoid (10%)
 - b. how to work more efficiently and effectively. (10%)
5. (Optional) Your personal assessment of the portion of the effort each team member contributed to the success of the project. If these portions are not equal, explain why. You may request that a specific number of points be taken from one or two team members and reassigned to which others.

In addition to the percentages listed above, 15% of your score for this report will be for Professionalism (neatness, proper English, no typographical errors).

Most students find that it takes 4-5 pages to cover these topics fully, but if you can write crisply and clearly, you may be able to do it in less.

Remember, throughout your report:

- Be specific! “Don’t chat with friends, even for a minute” is much better than “manage your time”.
- Give complete lists, not examples. “The three things we could have done better are...” is much better than “For example, we could have...”
- Address each of the four required topics thoroughly.