

Build a Submarine Part 3	Grade 8 – Fluids
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Lesson Plan

Assessment	AFL, model, worksheet
Cross-curricular	

Big Ideas

- Fluids are an important component of many systems.
- Fluids have different properties that determine how they can be used.

Learning Goals

- Build a simple submarine.
- Be able to raise and lower the submarine and understand how that works.
- Understand pressure as a function of depth.

Specific Expectations:

- 2.1** follow established safety practices for using apparatus, tools, and materials
- 2.7** use appropriate science and technology vocabulary

Description:

This is **lesson three** in a five-lesson unit on fluids. The unit uses submarines as a framework on which to build knowledge and conduct experiments. This lesson focuses on building a simple submarine that can be raised and lowered by adjusting the amount of air in it.

Materials/Resources:

Build a Submarine Part 3 Experiment Worksheet
 Aquarium airline tubing (about 30 cm per group)
 or 3 straws per group.
 Waterproof tape (tuck tape works best, but duct tape is fine too or even packing tape)
 2L pop bottles (keep the caps for Day 4)

Scissors
 Two butter knives per group (or similar object that can be used as a weight)
 Optional: rubber bands and washers or coins

Safety Notes:

Be careful while cutting.

Introduction

- Today we will build a submarine out of simple materials and test it. Our submarine today will be able to go up and down.
- Let's remind ourselves: How do submarines go up and down?
 - Use ballast tanks to adjust weight of submarine. When they are empty it floats. When they are full the submarine sinks.
 - This works because things with an average higher density than a surrounding liquid will descend to the bottom of it. Things with an average lower density will rise above it.

Action

Build a Submarine

This is a simple submarine that is made out of a pop bottle. It can be tested in any basin that is at least as deep as the bottle's size on its side. See reference images below.

- Make **three holes in the bottle**, all in a row. They should be evenly spaced (bottom, middle, and top just before neck starts getting narrower).
 - The safest way to do this is to pinch the bottle and make a cut with the scissors. Then insert scissors into cut and cut out a hole.
 - Each hole should be about the size of a quarter or less.
- Push **two knives through one of the holes** into the bottle. They will provide the weight to sink the sub.
- Cut a piece of tubing to about 30 cm length OR tape together three straws (that can be bent)
- **Insert the tubing/straws** through the bottle's regular opening.
 - Insert until the tube reaches about to the middle of the bottle.
 - Turn the tubing so the opening faces AWAY from the three holes you cut earlier. If using a straw bend the straw's shorter end up so you can again aim away from the three holes. This will ensure that when the sub sinks you can suck out all the air before water enters the tubing.
- **Tape the tubing** in place around the bottles opening so it is pretty watertight.
- Testing the sub in a basin:
 - Place the sub with the three holes facing down in the basin. It should float.
 - Now slowly suck on the end of the tubing to remove the air. The sub should fill with water and sink.
 - Once you have sucked out all of the air (or as much as you can) you can blow air back into it to make it come up.
 - Repeat for fun!

Consolidation/Extension

How it works:

- This sub doesn't have separate ballast tanks. But it works just like that. When you suck out the air the sub fills with water, allowing it to sink.
- When you blow air back into it, the sub rises up.
- In a real sub the air that fills the ballast tanks back up comes from pressurized cylinders, not the surface, but otherwise this is exactly how it works in real life.

- Water is about 1,000 times denser than air. Therefore, when we let it enter the submarine it will sink. When we blow air into the sub it rises above the denser water. This only works because we have gravity. The force of gravity from the Earth pulls the denser material down to rest below the less dense material.
- This is just like when you take a big breath in the swimming pool and hold it. You will notice that you float much more easily. When you exhale all the air you will easily sink below the surface of the water.

Extensions:

- You may notice that the submarine surfaces on one side before the other. This is due to uneven weight distribution. Try attaching weights to the outside of the bottle (e.g. small stacks of washers held on with rubber bands) to balance the sub better so it rises evenly.
- Discuss increasing water pressure with depth.
 - If you could take your pop bottle submarine into deeper water what might happen to it? (It would get crushed by the water)
 - How do real submarines deal with this? (Very strong hulls)
 - We can't take our submarine to greater depth but here is a fun video showing a diver doing exactly this:
 - https://www.youtube.com/watch?v=cHf9eWRd_bc
 - And a video showing the impact of pressure on the human body: <https://www.youtube.com/watch?v=0B0EhuxJsts>