

Lesson Plan

Assessment	AFL, experiment, 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

- Learn basics of submarines, and as it connects to fluids.
- Pressure increases with depth of fluids.
- Different fluids have different densities and will layer according to those.

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 two** 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 what submarines do. There are experiments on pressure and depth and how fluids of different densities layer on top of each other.

Materials/Resources:

Build a Submarine Part 2 Visuals, Experiment Worksheet

2 litre pop bottle, several holes drilled into the side

Tape or plug for holes in bottle

Plastic cups (seven per group)

Two colours of food colouring

Honey, corn syrup, dish soap, water, vegetable oil, rubbing alcohol, lamp oil (for each group)

Glass cylinders (1 per group)
Turkey basters (optional)

Safety Notes:

Lamp oil is flammable.

Introduction

Submarines

Use Build a Submarine Part 2 Visuals to discuss.

- **Slide 2-4:** What is a submarine? Discuss with class. Show some images.
- How do submarines dive?
 - Take guesses / discuss
 - Here is a video that you can use to supplement:
<https://www.youtube.com/watch?v=yb3e4IegeJ0>
 - **Slide 5:** Basically the submarine has to become DENSER as a whole than the same volume of water would be. There is a lot of air in a sub (less dense than water). It is built with enough air pockets that the heavy steel hull stays afloat. If you fill the ballast tanks with water though then the sub sinks. To rise up again the ballast tanks have to be re-filled with air (pressurized air is pumped into the ballast tanks).
- Other cool submarine facts:
 - May have crews of over 100!
 - Used for exploration, research, salvage, and of course as warships
 - Periscopes are used to peak at the surface from under the water.
 - Nuclear subs can stay under water longer and travel at greater speeds than diesel ones. Nuclear power is so useful because it does not require oxygen to burn so such a motor does not use up the air in the vessel. Some subs can stay underwater for several months!
 - Subs use torpedoes in warfare.
 - The hull of submarines is made of titanium or steel, as it has to resist being crushed by the tremendous pressure of the water as it dives deeper.
 - Submarines have dived to the deepest spots in the ocean such as the Marianas Trench.

Action

Changing Pressure with Depth (Demo)

A submarine has to be able to withstand tremendous pressure. Why is that? Let's find out what happens to water pressure as you increase the depth of it.

- This is a simple demo to show how the pressure increases with depth in a fluid. It can be done as an activity if you wish of course.
- Take a 2L pop bottle (or similar) and drill several small holes into its side at varying depths (e.g. one low, one medium, one high).
- Temporarily plug the holes (e.g. with tape, or just holding a finger on it) and fill up with water.
- Remove plugs from holes and let the water escape (over a basin of some sort!)
- **Observe each water stream. What does it tell you about the pressure?** (The more water is above any hole the farther out the water shoots – showing that it has more pressure).
- Repeat if desired.

Layering of Fluids

Pour liquids of decreasing densities into a clear cylinder so they form layers. This is a fun experiment that takes some patience. It'll work great if students work in groups of 2 or 3 students. The tie-in with submarines is the fact that we change the weight of the submarine to make it go up and down (in essence it's overall density) – so it is the same principle at work as in this experiment.

A nice write-up can be found here: <http://www.stevespanglerscience.com/lab/experiments/seven-layer-density-column/>

See also the Science North video on Fluids included with the lesson plan.

- Pour the same amount of each liquid into plastic cups. Enough that it will make a nice layer once poured into the cylinder.
- Add some food colouring to the corn syrup and rubbing alcohol (optional)
- Carefully pour the following liquids into the cylinder WITHOUT letting them touch the sides:
 - Honey
 - Corn Syrup
 - Dish Soap
- Then carefully add the following liquids with the turkey baster by letting them RUN DOWN the side of the cylinder (or slowly tilt the cylinder slightly and slowly pour each liquid down its side).
 - Water
 - Vegetable oil
 - Rubbing alcohol (wash baster before doing this)
 - Lamp oil (again, wash the baster – be careful, the lamp oil can easily escape from the baster, so keep a finger on the hole)

Consolidation/Extension

Discussion

- How can we explain this experiment?
 - Liquids layer by density. Less dense liquids will stay on top of denser liquids.
 - Let's remember what density is: mass/volume. So if the volume stays the same (e.g. the same amount of each liquid before pouring in) then the MASS will be less for each subsequent liquid. This makes sense because each subsequent liquid has a lower density – meaning the particles making it up are further apart.
- Students can fill in the Experiment Worksheet (see link)
- Extension:
 - You can try dropping small objects into the liquids you find around your classroom. Things like beads (wood and or plastic), a screw, pin, etc. Make a guess which layer it will lie on top of (e.g. you know wood floats on water. Will it also float on vegetable oil?)