SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Build a Submarine Part 5 **Grade 8 – Fluids**

Lesson Plan

Assessment	Rubric, 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

- Story of Archimedes, with understanding of how his experiment worked.
- Get connection between Archimedes principle and subs (when sub floats it displaces as much water in weight as its own weight, when it sinks the water displaces is less than the weight of the sub).
- Able to apply Archimedes principle to complete an experiment.

Specific Expectations:

2.1 follow established safety practices for using apparatus, tools, and materials
2.7 use appropriate science and technology vocabulary
3.2 describe the relationship between mass, volume, and density as a property of matter
3.5 determine the buoyancy of an object, given its density, in a variety of fluids

Description:

This is **lesson five** 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 Archimedes principle and buoyancy.

Materials/Resources:

Build a Submarine Part 5 Visuals, Experiment Worksheet, Assessment of Learning Rubric
Kitchen scales or spring scales for each group
Tupperware containers (large enough for a bottle)
Containers to catch overflowing water (e.g. plant saucers)
Butter knives

Safety Notes:

Introduction

The Story of Archimedes

Talk about Archimedes and what he did. He was an amazing scientist and there are many stories worth mentioning. For a brief summary use the Visuals (see link):

- **Slide 2:** Archimedes, ancient Greek
- **Slide 3:** He made many discoveries and invented a number of things. He could be described as the "Leonardo da Vinci of antiquity"!
- **Slide 4:** Archimedes Principle – the problem of determining of the king's crown was pure gold
- **Slide 5:** Explanation of Archimedes Principle
- **Slide 6:** Archimedes Principle as it applies to floating objects

Buoyant Force (Demo)

- Hang a weight off a spring scale.
- Let students see its weight.
- Submerge the object in water.
    - Notice that the water rises (or overflows if you have the container filled to the brim).
    - Read off the weight reading on the scale now (it will be lower).
- This is buoyancy acting on the object.
- **Extension:** Measure the weight of the displaced water and see that it is equal to the difference between the objects measured weight in air and water.

How it applies to submarines:

- When a submarine floats it has enough buoyancy to balance its weight. It is just like a ship.
- To sink the submarine reduces its buoyancy (by filling ballast tanks).
- A submarine can adjust its buoyancy constantly so it has neutral buoyancy at any depth! Many fish do this too with their swim bladders.

Action

Archimedes Principle Experiment

We can use our bottles as "ships" and figure out the weight of their cargo (butter knives in this case). Students will complete the attached worksheet as they do the experiment.

- Let's now use our submarines as floating objects. We can put something in their belly and figure out how much that weights based on the amount of water displaced.
- Have each student group place a number of knives (from 1 to 5) in their sub through one of the holes. Tape the sub shut so no water can enter.
- Place each sub in a solid plastic bag (so you can't see how many knives are in it). Number the bottles.
- Each group takes turns measuring the weight of the displaced water of each sub and records their measurements.
- Procedure:
    - Fill a container to the brim with water. Place it on something that can catch the overflowing water. For example you can use plastic salad bowls place on large plant saucers.

- Carefully place the bottle on the surface of the water.
    - Note that students can place their bottle in the water upright as long as the balance it (without pushing on it though!) – if the bottles don't fit lying down.
- Pour the water that overflowed into a bowl on a kitchen scale (zeroed with the bowl on it!) and read off how much weight the water has.
    - Or measure weight using a spring scale – the weight of the container that is being hung on the scale has to be subtracted manually in this case.
- Record measurement.
    - We will assume that the bottle's own weight can be ignored. Note the extension below though to correct this!

- Each group does this for each bottle.

Consolidation/Extension

Discussion:

- Discuss how you could figure out the number of knives in each bottle.
- Discuss that if one knife had, for example, been much lighter or heavier you would have noticed the difference in the amount of displaced water. Just like Archimedes was able to tell if the crown was made of pure gold or not.

Extension for advanced students:

- Draw a graph of the number of knives versus the weight of the bottle plus knives (the weights that were recorded in each step above).
- Can you deduce what the weight of the empty bottle is? (Yes – it's the y-intercept on the graph)

Possible extra day:

- Do research on a real submarine (ancient or modern). Present to class or hand in as assignment. Incorporate learning from this unit (for example do research on how your submarine goes up and down, how it is powered, how it is protected from pressure at depth etc.).