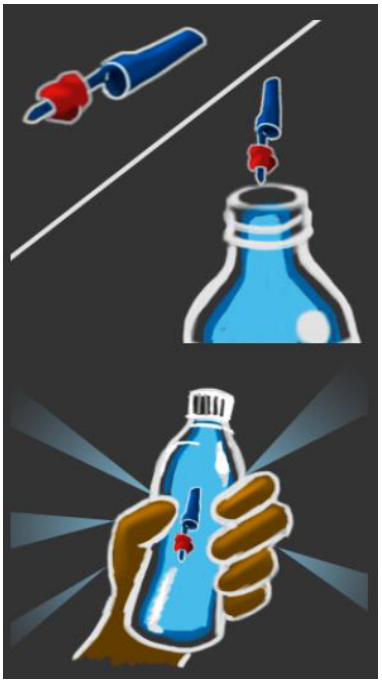
cavendish nuclear

1 HOUR

How Submarines Work – Cartesian Diver

Materials

- Empty bottle
- Pen lid
- Blu Tack (or Playdough)



Activity Overview

- This is a fun activity that uses the Cartesian Diver science experiment to demonstrate the principle of buoyancy
- Create this experiment to help understand how submarines dive and resurface

Activity Plan

- Fill an empty bottle with water
- Find a pen lid and place some blu tack at the end to give it more weight. This will represent a submarine!
- Drop the pen lid into the bottle. The pen lid should float upright at the top of the water.
- If it doesn't stay upright, try adding more blu tack (you might want to practice in a glass of water first)
- Once your pen lid is upright, squeeze the bottle gently and watch the pen lid sink to the bottom. Release the bottle and watch the pen lid rise to the top
- Discuss why the pen lid does this

Learning Objective

- Understand how buoyancy forces allow a submarine to dive and resurface
- Understand how density is important when designing a submarine
- Observe the forces that act on a submarine when it's in water

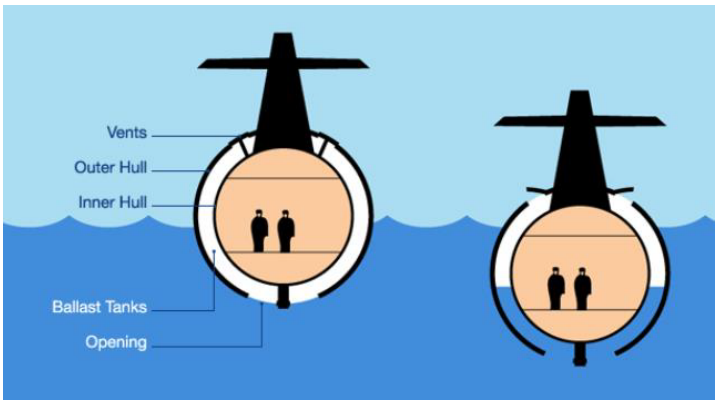
Reflective Questions

- Why does squeezing the bottle make the pen lid sink?
- What happens to your submarine if you add more weight to it and why?
- What do Babcock engineers need to think about when designing submarines? Think about weight, design and materials.

How Submarines Dive and Resurface

An object will float depending on its density (how heavy it is for its size) and if it is buoyant. This is explained further in our Paper Boat Challenge – also on LinkedIn. Unlike a boat, a submarine needs to become denser in order to sink. But how does this happen?

This is achieved with ballast tanks. Ballast tanks are empty sections of the submarine, designed to be filled with water. When a submarine needs to dive the ballast tanks are filled with water, making the submarine heavier. When it needs to resurface, air is blown into the ballast tanks which pushes the water back out. This allows the submarine to become more buoyant. An example of this is placing an empty bottle in water which will float. The more water that is added to the bottle, the more it sinks.



Cartesian Diver Explained

How does using the ballast tanks cause sinking and rising? The Cartesian Diver experiment demonstrates this. When dropped in the water, the pen lid contains enough air inside to float. Squeezing the bottle allows the pen lid to sink, and releasing your hand from the bottle allows the pen lid to rise. But why is this?

When the pen lid is dropped into the water, the air inside allows it to be buoyant. When the bottle is squeezed, water goes into the pen lid and compresses the air inside. As the volume of the pen lid doesn't change, the pen lid therefore becomes denser. The density of the pen lid is now greater than the density of the water, resulting in the pen lid sinking.

An object in water experiences a downward force of gravity, as well as an upwards buoyant force. Pressure of the water increases with depth, causing the upward buoyant force to be greater than the downward force on the object. The buoyant force is equal to the weight of the fluid displaced by the object. Sinking of an object will occur when the object density is greater than the density of the water.