Professor Brainstorm's
Make A Submarine

Safety First

This experiment uses an effervescent tablet (such as Alka Seltzer). Children should not be left unsupervised with these tablets.
Care should be taken when making the hole in the film canister. (An adult should do this job.)

About this Activity
(Information for Parents and Teachers)

This experiment is about Chemical Change - and also about Sinking and Floating. It is a fun experiment which you will want to repeat again and again!

The experiment is designed for children aged from 8 to11 years (Years 4 to 6).

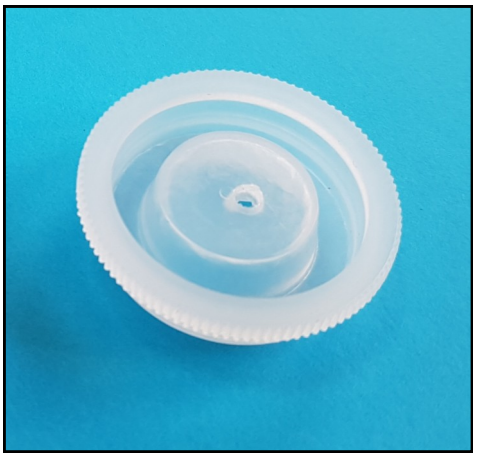
What you Need

The main item that you need for this experiment is a small air-tight container. The ideal thing is an old film canister (see photo on right). You may have one somewhere in the house - or if not you can buy them on eBay. (The clear/white containers are the best ones. You can also get some film canisters which are black with a grey lid. Although these are not airtight, they do still work in this experiment.) If you don't have a film canister, you may be able to find something else which will work - such as a small food container.

The other items you need are:

- An effervescent tablet - such as an Alka Seltzer. (See Safety First warning above.)
- A deep plastic jug.
- Some copper coins - or blu tack. (This is for use as ballast.)

Make A Submarine - Preparation



To make your film canister (or small container) into a submarine, you need to first of all make a small hole in the centre of the lid of the container. If you have a drill, the easiest way to do this is to drill a hole with a 2mm or 3mm drill bit. If not, you will have to make the hole with a skewer or something similar. (Either way this is a job for an adult!)

The next stage is to add some ballast to the container. Place a few coins or some blu tack in the bottom of the container. (2 pence coins are ideal for use in a film canister.) Then place the container in a bowl of water to check that it floats. The idea is to have enough ballast so that the container will just float. (For example, a film canister floats with four 2p coins, but sinks if you add a fifth coin - so I do the experiment with four coins.)

Make A Submarine - Experiment

Now we are ready to do the experiment. The submarine is most impressive if you have a deep transparent jug, for example a 2 litre plastic jug. Fill the jug almost to the top with water.

- Tip the coins (or whatever you are using for ballast) out of the film canister, put an effervescent tablet in the bottom of the canister, then put the coins back in.

The next steps need to be done quite quickly, so read through each of the points below before you start:

- Fill the film canister to the top with water - and clip the lid on firmly.
- Turn the canister upside down (with your finger over the hole) and drop it carefully in to the jug. It should sink to the bottom of the jug - and the canister should remain upside down with the hole at the bottom.
- Keep watching. You should see some bubbles coming out of the bottom of the canister. And then after a few seconds the canister should float back up to the top.
- If you are quick you can retrieve the canister, add some more water - and then drop it back in to the jug again. (You may even manage to do this several times.)

How does it work?

Initially we added some coins (or other ballast) to the film canister so that it just floated. Since the canister also contains some air, we could write:

film canister + coins + air = floats

(Another way to state this is to say that the combined **density** of the film canister plus the coins plus the air is less than the density of water.)

When we fill the film canister with water, what we are doing is replacing the air in the canister with water. And when we do this the canister sinks. So:

film canister + coins + water = sinks

(In other words, the combined **density** of the film canister plus the coins plus the water is greater than the density of water.)

However, when we add water to an effervescent tablet (such as an Alka Seltzer), there is a **chemical reaction** - and a gas is produced. In this case the gas is called carbon dioxide. The bubbles that you saw coming out of the canister when it was in the jug are bubbles of carbon dioxide gas.

So how does the submarine work? When we fill the canister with water, it sinks. But the water also reacts with the effervescent tablet to produce some gas. This gas forces the water out of the canister (through the small hole in the lid). After a few seconds, the gas has forced all of the water out of the canister. We now have a canister which contains only coins and gas. So the canister floats back to the surface.

Now try this ...

What would happen if you dropped the canister into the jug with the hole in the canister at the top? Think about this for a moment and make a prediction. Now try it.

What did happen? You probably saw a nice fountain of bubbles coming up from the container. But the container would have stayed firmly at the bottom of the jug! When the hole is at the top of the container, the gas simply escapes through the hole - rather than forcing the water out. So although lots of gas is produced, the water remains in the container.

