

Cartesian Diver




Control a toy diver. Make it dive to the bottom of a bottle of water and then return to the surface. Or hover half way just like a submarine!

You will need



- Plastic pen top
- BluTack
- Glass of water
- Clear plastic bottle - the taller the better



 *Just so you know. Your diver is named after the famous French scientist and mathematician René Descartes who is believed to have invented this experiment nearly 400 years ago!*

- 1 Most pen tops have a hole in the tip so seal this with a small piece of BluTack



- 2 Add a ball of BluTack to the pen top - you will need a ball about 1 cm in diameter.

- 3 Drop the pen top into a glass of water. Keep adding or removing small amounts of the BluTack from the ball and dropping the pen top back in the water until it floats near the surface of the water. Only the tip should be above the surface.

Now your diver is ready for action!



- 4 Fill the bottle with water right to the top. Drop your diver in and screw the top on tightly.

Gently squeeze the bottle and your diver will sink to the bottom.

Release the pressure and the diver will return to the surface.

By controlling how hard you squeeze the bottle you can make the diver float up and down as you wish. And with a little bit of practice you can keep it floating in one place between the surface and the bottom.



Essential Science

What's going on?

When you drop the diver into the water a small bubble of air is trapped inside the pen top. This makes the diver float at the surface.

When you squeeze the bottle you increase the pressure inside the bottle and force more water inside the pen top and squash the air bubble into a smaller space. This makes the diver slightly heavier (because water is heavier than air) which is enough to make it sink.

When you stop squeezing the pressure is released and the air bubble expands again making the diver lighter so that it floats back to the surface.

Floating and sinking

When an object is placed in water it is pulled down by the force of its weight and it pushes out of the way (displaces) some of the water.

The water pushes back, upwards, with a force that equals the weight of the water that has been displaced. This upwards force is called up-thrust or buoyancy.

If the weight of an object (the downward force) is less than the up-thrust then the object will float.

If the weight of an object is greater than the up-thrust it will sink.

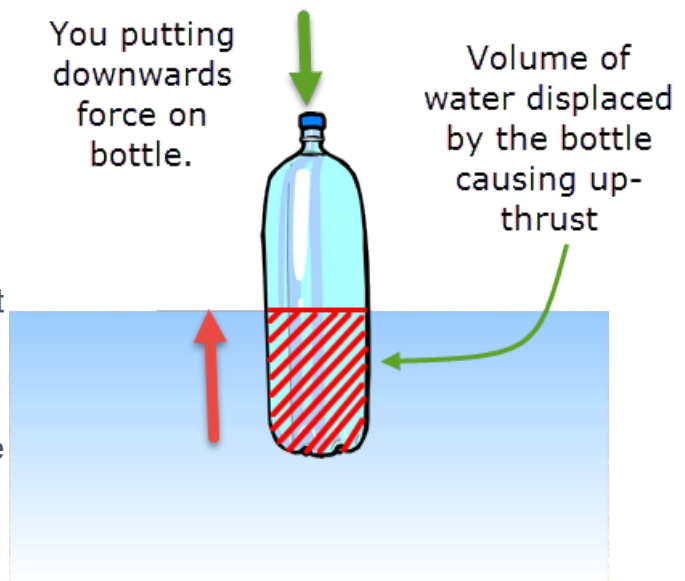
Essential Science

You can feel this up-thrust force with a simple experiment.

You will need a large empty fizzy drink bottle (you can always tell your parents you need to finish the drink as part of an important science experiment!).

Half-fill a sink with water (or better still wait until you are having a bath).

Keep the bottle upright and try pushing it into the water. You will feel the force of the water pushing back. The more you push down the more the water pushes back. This is the force of up-thrust or buoyancy.



Archimedes Principle

The idea of Buoyancy was first understood by Archimedes who was a very clever Greek scientist and mathematician who lived over 2,000 years ago.



So the story goes, he was getting into his bath one day and noticed how the level of the water in the bath rose as he got in.

He shouted Eureka!! (which is Greek for I've found it!!) and was so excited that he jumped out the bath and ran down the street telling everybody.

What he had found was an understanding of buoyancy - why some objects float and some sink.

Why is buoyancy important?

Submarines and fish both use the same science as our diver to help control where they are in the water.

A submarine has tanks that are flooded with water to make it dive under the water. To make it rise again air is pumped into these tanks to push the water out and the submarine floats to the surface.



Many (but not all) fish have an organ inside their body called a swim bladder. They are able to pump air in and out of the swim bladder to make them rise or sink in the water.

Safety first:

The hole in the tip of the pen top is to help prevent small children from choking. So when you have finished your experiment make sure you remove the BluTak from the tip. Just in case!