EUREKA!
the national children's museum

AT HOME!
PROJECT NO.13

Cartesian Diver (aka Bob the pen lid)

As family days out are put on hold, we've been thinking how we can make your family days in as much fun as possible.

Eureka! is the UK's only hands-on museum just for children aged 0-11. Full of exhibits to explore, helpful staff to engage with, activities to do and buttons to press. Based in West Yorkshire, we have brought smiles to the faces of over 8 million visitors since 1992. As families can't come to us, we are keen to bring a sample of the Eureka! experience to you.

Our expert staff have come up with a series of experiments that can be done at home, all designed to inspire children to get hands-on, have fun, and learn about themselves and the world around them.

Get experimenting and send us or share your pictures and videos using #EurekaAtHome and we'll share on our social media feeds too.

WE'RE ALL IN THIS TOGETHER!

No.13

CARTESIAN DIVER

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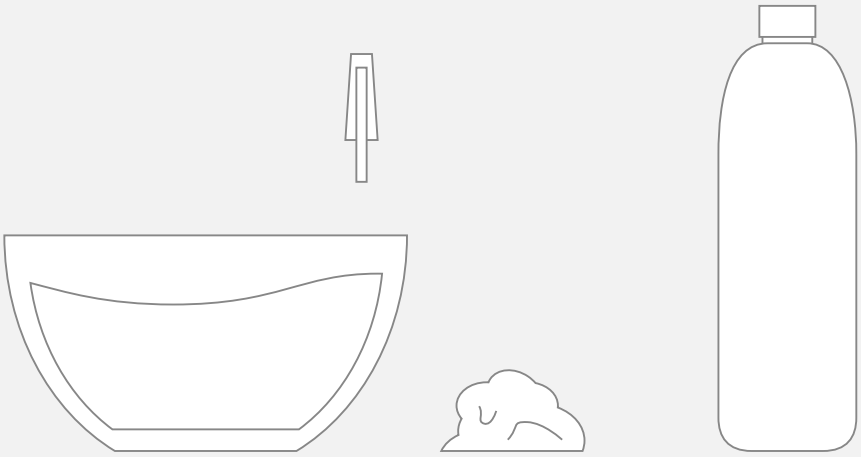
Make your diver (it doesn't have to be called Bob!)

It's amazing how well you can train a pen lid! But first you need to make your pen lid diver and give it a name.

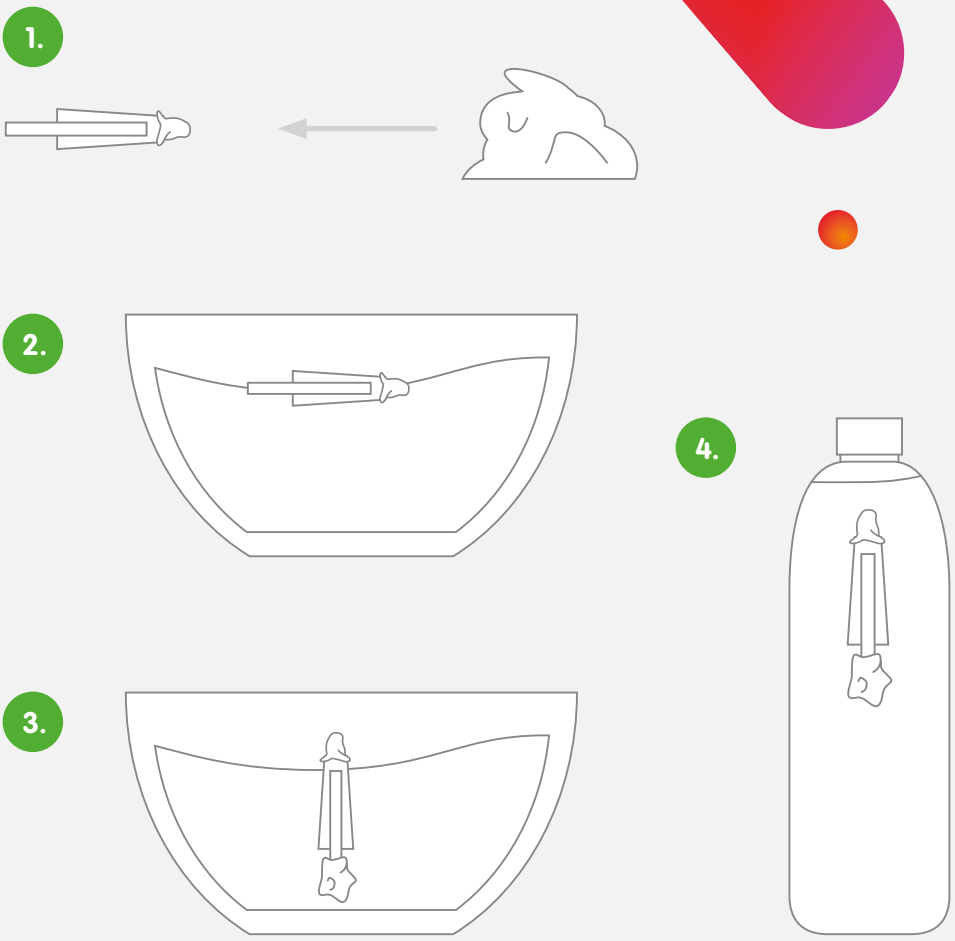


YOU WILL NEED:

- A small bowl of water
- A plastic bottle
- A pen lid
- Some blutac

MAKING YOUR DIVER:

1. Take a small blob of blutac and use it to block the hole in the top of the pen lid
2. Pop the pen lid in the bowl of water, and you will see it floats sideways – perfect for a swimmer, but not good for a diver
3. Using a bigger blob of blutac, add enough to the other end of the pen lid to help it float vertically in the bowl of water. You need to have your diver with their 'head' just above the water – so bobbing about at the top
4. Once your diver floats vertically, fill you plastic bottle with water, and drop in your diver!



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CARTESIAN DIVER

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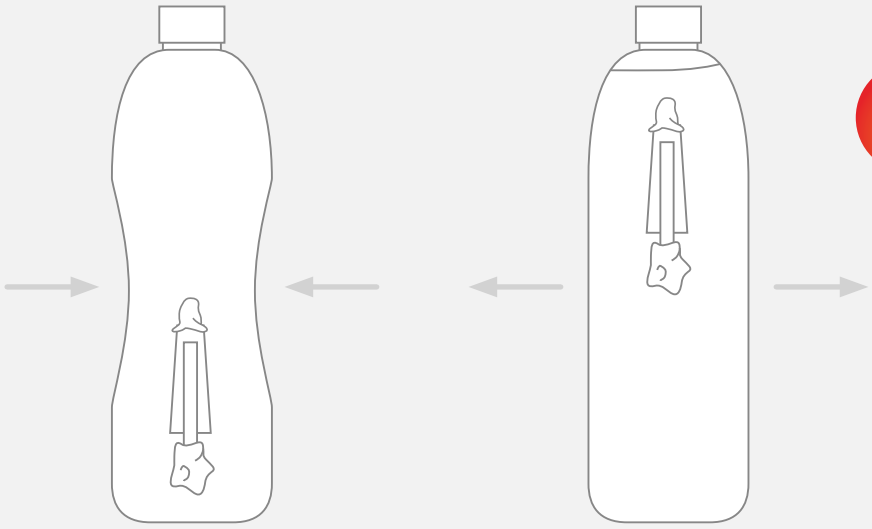
TRAINING YOUR DIVER:

This is easier than you may imagine!

- When you say "Bob, dive!", gently squeeze the bottle, and your diver will dive to the bottom
- When you say "Bob, come up!", release the pressure on the bottle, and your diver will come up to the surface again



Is it magic, good diving training, or is it all to do with the science of buoyancy?

Investigating buoyancy

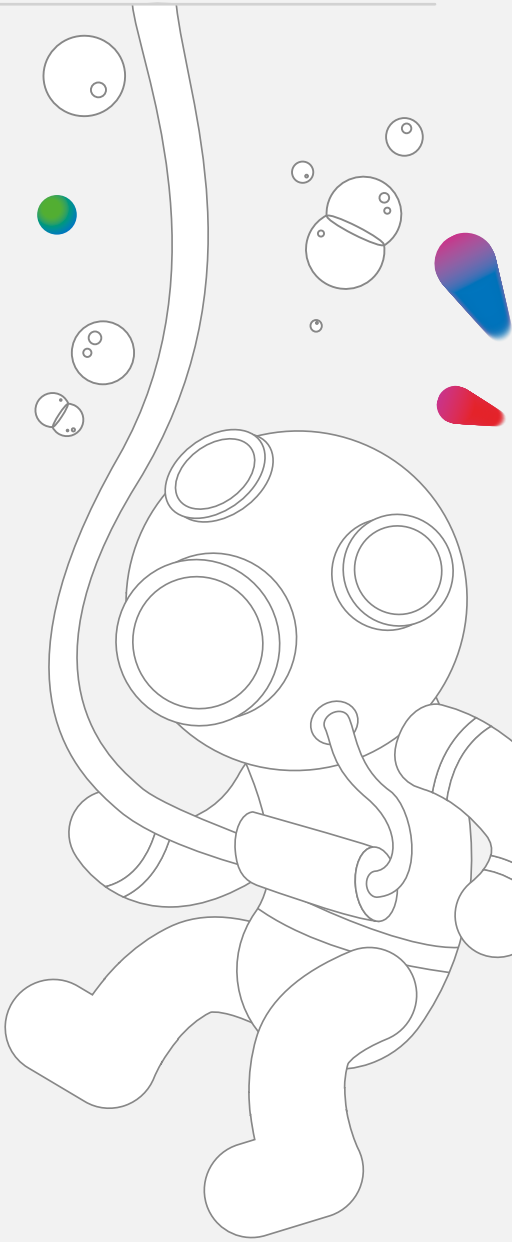
When your pen lid is floating comfortably at the top of the water bottle, it is floating because there is an air bubble trapped inside the pen lid that is large enough to make the lid float. This air bubble makes the pen lid float because air is lighter than water.

When you squeeze the bottle, you push water up into the pen lid, squishing the air bubble into a smaller space. The more water that is inside the pen lid, the less buoyant it becomes and the heavier the pen lid is. Now the pen lid is heavier, it will sink.

When the pressure on the outside of the bottle is released again, the squished air inside the diver expands again, and this pushes some of the water back out of the diver. As the water level inside the pen lid drops, the diver floats back up to the top again.

By controlling when and how hard you squeeze you can control your diver and make it float up and down as you wish.

Can you think how this experiment, and the principles of buoyancy can work for a submarine? It's hard to imagine, but your pen lid diver and a submarine actually work in similar ways. When the submarine is ready to dive, it takes water into its tanks until it is heavy enough to make the submarine sink. The increase in weight caused by the water in the tanks increases the density* of the submarine and it descends. When the submarine wants to come up to the surface again, air is blown into the submarine's tanks, the water is forced out, and the submarine comes back up to the surface.



*Density – How heavy something is compared to the amount of space it takes up