Pressure in the Deep

Recommended style of activity	
Public engagement: Family drop-in activity, group demonstration, demonstration in ATLAS scripted show	**Schools:** Teacher demonstration followed by class activity
Suggested age range: 8-15 years	
Approximate time : 5 minutes demonstration; 5 minutes class/group activity	

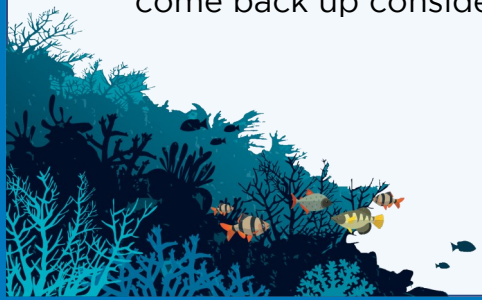
Background Science

The deeper you go in the ocean, the more you feel the weight of the water above you: this is increasing water pressure. You can feel this effect at the bottom of a swimming pool in your ears. The ATLAS research project is looking at areas of the deep sea at depths between 200-2000m. At 2000m depth, the water pressure is about 200 kg/cm^2. That's like a Giant Panda standing on a 20p!

Creatures that live at these depths, or ones which dive down, have special adaptions to allow them to survive these conditions. When humans venture down, they need special equipment for protection from the pressure such as submarines or 'submersibles'. These need to be made of very strong materials.

The following two activities demonstrate the squashing or compressing effect of increasing air pressure, which can be compared with the same effect underwater. In the air and water balloon experiment, the air filled balloon is squashed and shrinks as you increase the air pressure but the water-filled balloon doesn't change — it's much harder to compress (or squash) a liquid. This is why many creatures in the deep have fluid-filled bodies with very little air in them — it helps them cope with the crushing pressure.

In the marshmallow and syringe experiment, the air spaces inside the marshmallow are compressed, making the whole marshmallow shrink. For scientists at sea, a bit of fun can be had by decorating then lowering polystyrene cups into the deep. Just like the marshmallows, the cups are compressed and come back up considerably smaller!



Scottish Curriculum links (CfE):

I can distinguish between living and non living things. I can sort living things into groups and explain my decisions. **SCN 1-01a**

I can identify and classify examples of living things, past and present, to help me appreciate their diversity. I can relate physical and behavioural characteristics to their survival or extinction. **SCN 2-01a**

By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. **SCN 2-15a**

I can extend my knowledge and understanding of engineering disciplines to create solutions. **TCH 2-12a**

Kit List:

For the marshmallow experiment

- Mini marshmallows
- 10-15ml plastic disposable feeding/pet syringes— available on Amazon— Plastic-Syringe-10ml-5-Pack
- Fine-line pens

For the bottle & balloons experiment

- 'Rokit Kit' including bottle, valve and pump connection (available from toy shops & online https://www.rokit.com/the-product/)
- Two round, uninflated balloons
- A bike pump with a pressure gauge (e.g. https://www.argos.co.uk/product/8434599)
- Two pairs of safety goggles

If running this as a Public Engagement Activity, you can also use the explanatory activity sheets—available online in the ATLAS Outreach Portfolio.

Marshmallow Experiment

- Draw a face on the long side of the marshmallow using the fine-line pens. This makes the shrinkage easier to see!

- Put a marshmallow into a syringe and let it fall down to the tip (the opposite end to the plunger). DO NOT SQUASH the marshmallow!
- Make sure that the plunger is at the top, away from the marshmallow.

Marshmallow experiment (ctnd)

- Make sure that the plunger is at the top, away from the marshmallow.
- Holding your finger tightly over the end of the syringe, slowly push down the plunger and watch what happens to the marshmallow!

Bottle and Balloons Experiment:

To be completed by demonstrator/teacher in advance:

- Push one uninflated balloon into the bottle with the neck sticking out, you should then be able to fill the balloon with water, tie it off and then let it drop to the bottom of the bottle. Tip: a tap with higher water pressure will help you fill the balloon. You will probably struggle to fill it beyond golf-ball sized so don't worry if it's not very big!
- Repeat with the other balloon but use the bike pump (or a balloon pump if you have one) to fill it with air. Inflate as large as you can in the bottle while still being able to tie it off.
- You should now have two balloons in the bottle, one filled with air and the other with water.
- Assemble the Rokit bottle top and pipe connection as shown in the kit instructions.
- Screw the bottle top onto the top of the bottle and ensure a tight fit of the pipe connection and valve. It should be quite hard to get the connection into the rubber top!

Safety Tip:

There is a very small risk of the bottle exploding and a medium risk of the valve popping out at high speeds. The Rokit Kit valve is designed to pop-out at 25 psi and the bottle should withstand much greater pressures than this. Use the bike pump gauge to check the pressure and we advise to not pump beyond 20 psi (make a mark on the gauge). Ensure there is clear space around the experiment and wear goggles as instructed.

Bottle and balloons experiment (ctnd)

Demonstration in action:

- The demonstrator/teacher should put on a pair of safety goggles and keep a hold of the valve top to ensure it doesn't pop out before the experiment is completed or to release it if the pressure gets too high.
- Ensure there are no other people within 1m of the experiment.
- If using a volunteer to pump, make sure they are also wearing goggles and know not to pump beyond 20psi.
- Use the pump to increase the pressure in the bottle. The air-filled balloon should visibly shrink while the water-filled one will remain the same size.
- You can slowly release the valve and watch the air-filled balloon expand again.

Public Engagement tip: If running this experiment with a larger audience (e.g. in the show) you can hold the bottle horizontally in front of a laptop web-cam connected to a projector or larger screen to ensure that the audience can all see the change.

For more oceans-themed activities and experiments, please visit https://www.eu-atlas.org/education/education-packs

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