

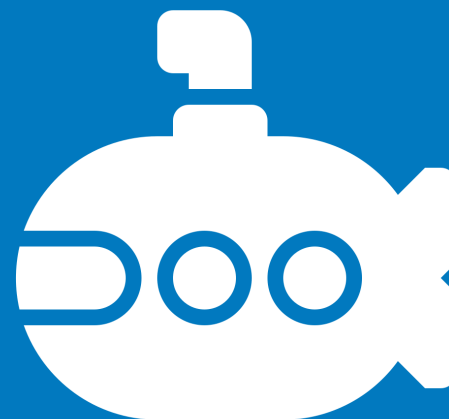
# What makes the ocean so special?

There are lots of clues here to help you appreciate just how important the ocean is to our lives. Have a look through and see if you can work them out! If you get stuck, ask a member of staff.




# Pressure in the deep ocean

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 see the effect of high pressure on a marshmallow by following the instructions.



# Pressure in the deep ocean

- Take a marshmallow out of the pot and draw a face on it. **DO NOT EAT IT!**
- Put one in 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.
- Holding your finger tightly over the end of the syringe, slowly push down the plunger and watch what happens to the marshmallow!



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 1,294kg per square inch. That's like a Black Rhino standing on a 50p!

As you increased the pressure, the air inside the marshmallow is squashed, causing the marshmallow to shrink. Many creatures in the deep have fluid-filled bodies with very little air in them. Liquids are much harder to squash than air so this helps them cope with the crushing pressure.



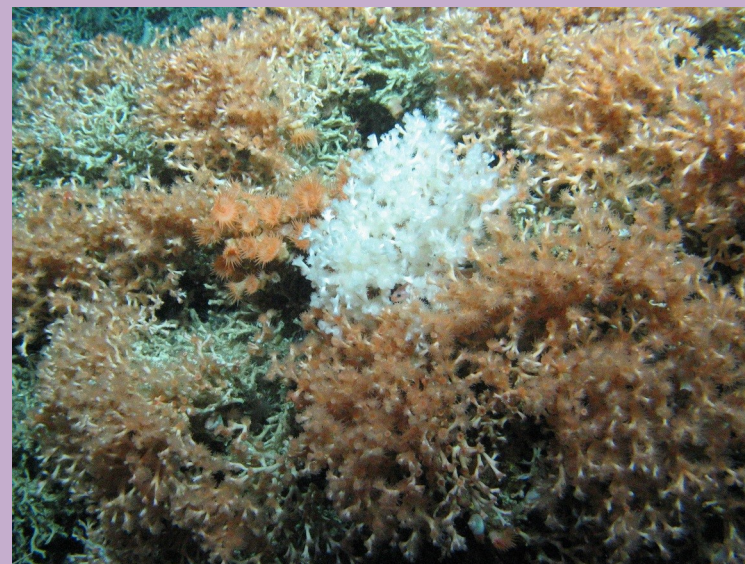
Anemone credit: Formigas Seamount, MEDWAVES(Covadonga Orejas) September 2016



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# Ocean Acidification

The ocean soaks up carbon dioxide ( $\text{CO}_2$ ) gas from the air. Human activities are adding more  $\text{CO}_2$  to our atmosphere, so more is going into the oceans and making it more acidic. This will make life very difficult for some ocean creatures with hard skeletons such as cold-water corals. You can find out more about the effects of this by doing some experiments.



Credit: *Lophelia pertusa* coral, Logachev Mounds, Rockall Bank (Laurence de Clippele) June 2012





# Ocean Acidification

As the oceans soak up more carbon dioxide gas from the air, they get slightly more acidic. This will make it harder for creatures with skeletons made of calcium carbonate (chalk) to get the ingredients they need to build their skeletons from the water. This might make them more likely to get ill or mean they grow more slowly.

A lot of creatures make their home in dead coral 'rubble' and many reefs are built up on the rubble of previous colonies. In a more acidic ocean, the rubble could be in danger of collapsing, causing many creatures to lose their homes or even damaging the whole reef.

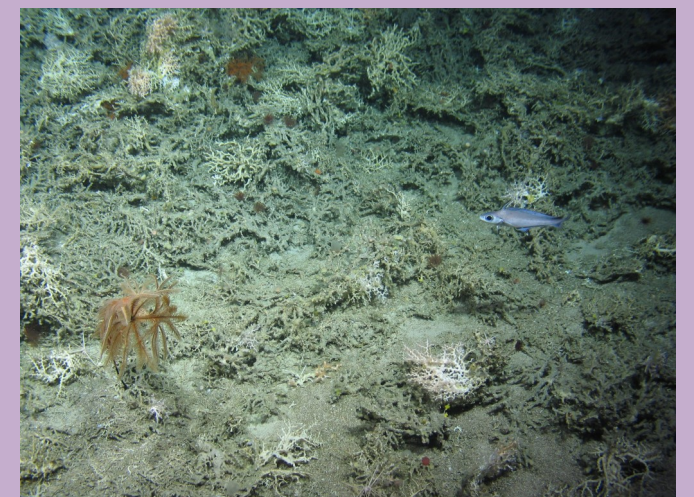
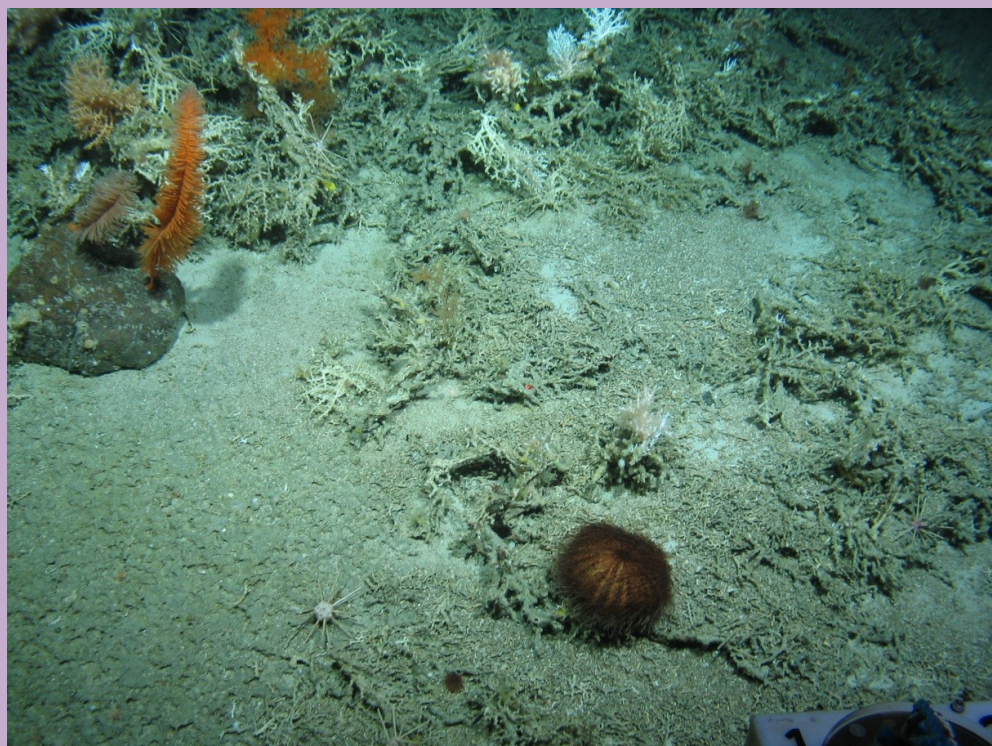


Image Credits: Logachev Mounds,  
Rockall Bank (Laurence de Clippele)  
June 2012

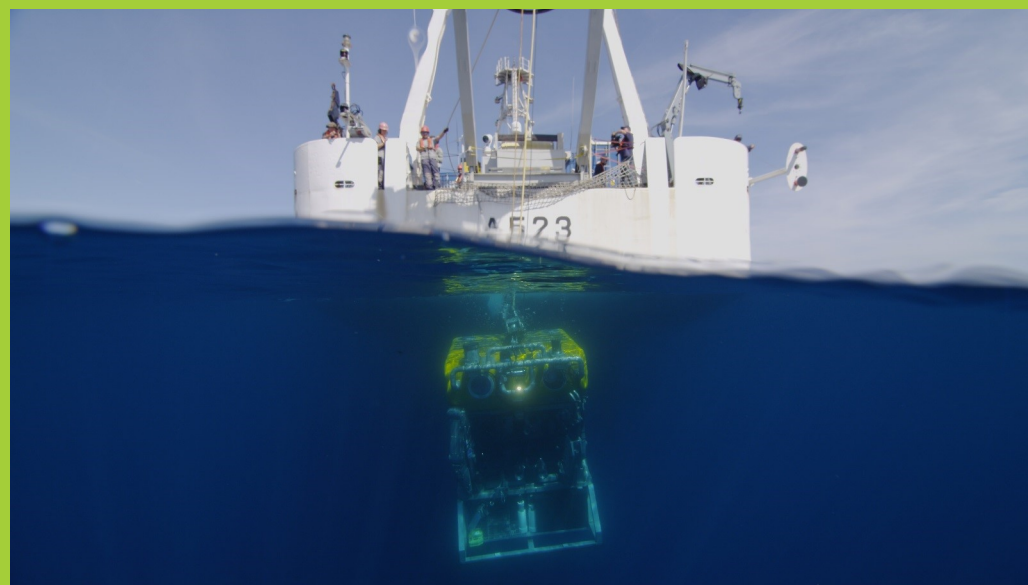


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# Robot Challenge!

ROVs (Remotely Operated Vehicles) are underwater robots that are usually controlled by the crew on board a research ship. They have lots of tools to do their jobs including cameras and lights. Some ROVs have tools such as 'manipulator arms' and 'suction guns' to help them pick up samples. You can have a go at being an ROV pilot and see if you can collect some samples by following the instructions.



ROV LUSO being deployed in the Azores, BlueAzoresExpedition (Telmo Morato), June 2018



# Robot Challenge!

- Find someone to work with — you need to be in a pair for this challenge!
- Choose which person is going to be the ROV (robot) and which person is going to be the pilot (robot controller).
- The ROV pilot needs to take the litter picker — this is your ‘manipulator arm’. Then they need to put on the blindfold!
- The pilot now has to give the ROV instructions to pick up a sample.

Good luck and be careful not to damage anything or hit anyone!



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ROV LUSO tools being used in the Azores, BlueAzoresExpedition (Telmo Morato), June 2018



- Now try the same thing but use the suction gun (also known as a ‘slurp gun’!).

As you can imagine it takes a lot of practice to be a good ROV pilot, especially if there are strong ocean currents which make it hard to keep the ROV still in the water.



# Hydrothermal Vents

Hydrothermal vents are a bit like underwater hot springs. Ask a staff member to show you how to activate your own Hydrothermal Vent!



Hydrothermal vent in the Azores, BlueAzoresExpedition (Telmo Morato), June 2018





# Hydrothermal Vents

Hydrothermal vents often form at areas where tectonic plates meet. Seawater moves down through deep cracks in the seafloor and is heated by molten rock. When it comes back up, the hot water will have lots of interesting minerals picked up from the rocks. These can form tall chimneys that are several metres high. Many interesting creatures are adapted to live in these extreme environments!

In June 2018 scientists from the ATLAS project discovered new Hydrothermal Vents in the middle of the Atlantic Ocean, near the Azores. How many can you spot in this picture?!



Hydrothermal vents in the Azores, BlueAzoresExpedition (Telmo Morato), June 2018



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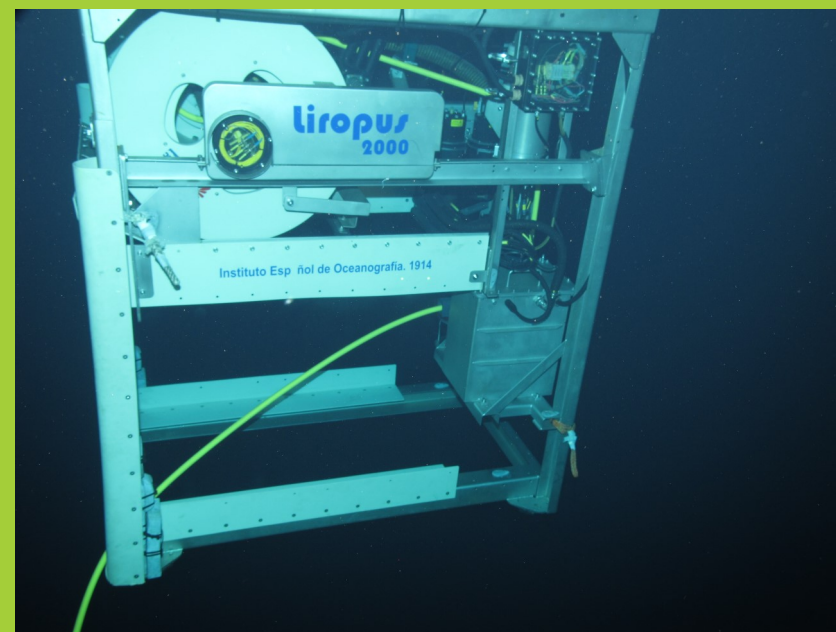
# Design Time!

Humans can't survive underwater without special vehicles like submarines. The deep sea is difficult to explore and scientists can only visit small bits at a time. This makes it impossible to find all of the creatures that might need protecting or discover useful materials. To help solve this problem scientists use technology!

Can you design something which will help scientists find out more about the deep?

**How deep will it go? What can it do? What might it find?**

Look at the cards if you need inspiration.



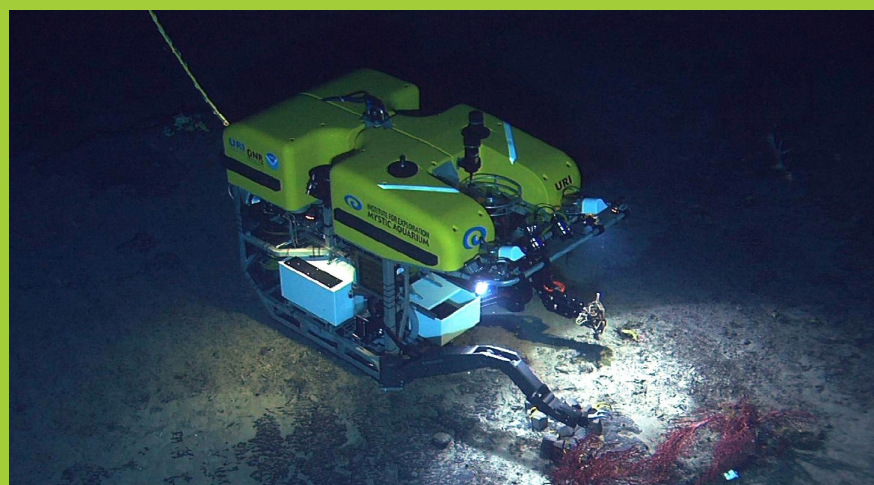
ROV image credit: Formigas Seamount, MEDWAVES(Covadonga Orejas) September 2016





## ROVs

What are they?	A 'Remotely Operated Vehicle' - underwater robots controlled from a ship by a pilot.
What can they do?	Use lights and cameras to take videos and pictures underwater. Pick up rocks or creatures using robot arms or 'suction guns' and put them in special boxes to be brought back up. Collect water or sea-bed samples.
Not so good...	They are attached by a cable so can't go too far from the pilot. Can't be used in very strong currents, especially the smaller ones.



Credit: NOAA photo library, Mountains in the Sea Research Team; the IFE Crew; and NOAA/OAR/OER.



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## Gliders

What are they?	Small robots that 'fly' underwater using their wings.
What can they do?	They can be controlled via a satellite link from anywhere in the world—people don't have to be at sea to use them. Collect information such as water temperatures and saltness. Be at sea for up to seven months at a time!
Not so good...	They are small compared to the ocean so can be hard to find if they stop working or get lost.



Credit: SAMS, Andy Mogg, ATLAS Project



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## CTD

What are they?	CTD = conductivity, temperature and depth. Measuring equipment which can be lowered into the sea.
What can they do?	Collect water at different depths with specially designed bottles that open automatically at different depths. Conductivity can be used to work out the saltiness of the water. Measure the water temperature. The water samples can be taken back to find out what is in them scientists might be looking for bacteria, tiny animals or marine snow!
Not so good...	Has to be lowered from a ship—can't get into the water on it's own. Has to be cleaned each time it's used to make sure nothing gets mixed up.



Credit: Graham Tulloch, BGS, ATLAS Project



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## Submarine/Submersible

What are they?	Underwater vehicles that people can sit in and dive to the deep!
What can they do?	Give scientists a great view of the deep sea. Take some really amazing pictures and videos. Help with exploration and let scientists watch creatures in the sea.
Not so good...	They are expensive to use. Could be scary for people who don't like small spaces or going deep underwater. There aren't very many of them!



Credit: NOAA photo library, Robert Schwemmer, CINMS, NOAA.



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## Landers and Moorings

What are they?	Equipment which can be left on the sea-floor or anchored to it for months to years.
What can they do?	<p>Have sensors for measuring lots of different things like underwater currents, temperature, saltiness, the amount of food in the water.</p> <p>Can have 'hydrophones' to record underwater sound, which can help scientists find marine creatures.</p> <p>Have special floats so that they can be collected and the information they have gathered can be looked at.</p>
Not so good...	<p>Have to be lowered from a ship—can't get into the water on their own.</p> <p>You can't tell if it has worked until you pick it up again!</p>



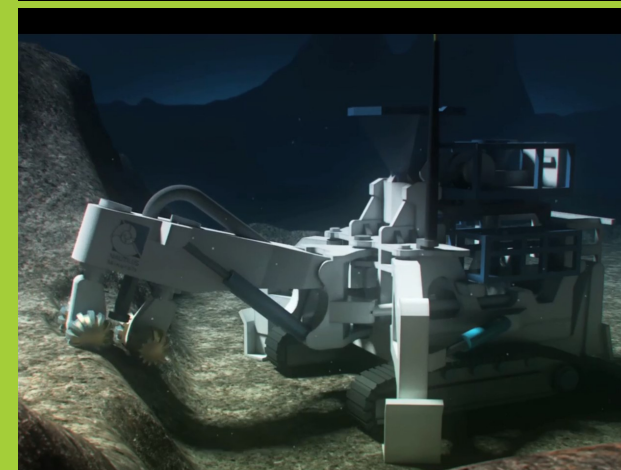
Credit: Graham Tulloch, BGS, ATLAS Project



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## Deep-sea mining vehicle

What are they?	Future technology! Underwater vehicles that people can control and use to mine the deep sea.
What can they do?	<p>Dig up metals and useful materials from hydrothermal vents, deep sea-floors and mid-ocean ridges. These can help us make mobiles and develop new technologies.</p> <p>Get materials which we can't get on land.</p> <p>Get materials which have run out on land.</p>
Not so good...	<p>Could destroy lots of amazing and unique underwater places, leaving many creatures without a home.</p> <p>They could make the water really dirty over a large area.</p>



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