Submersibles

Autonomous Underwater Vehicles (AUVs) are robot submarines, which are used to explore the world's oceans and gather data without a pilot or any tether. Before launch from the research ship, the AUV's computers are programmed with instructions of where to go, what to measure and what depths to go to.

https://noc.ac.uk/facilities/marine-autonomous-robotic-systems/autosubs

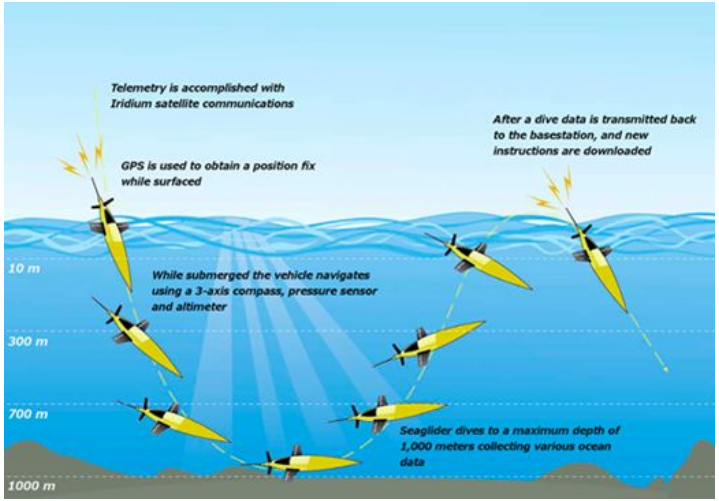
The Thwaites Glacier Programme

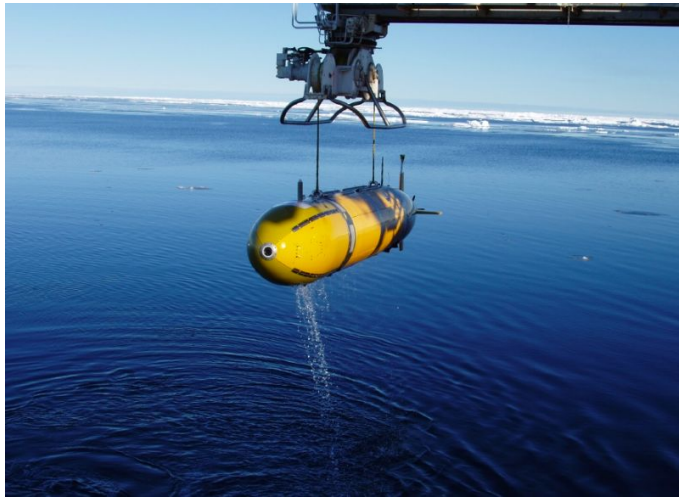
https://nerc.ukri.org/press/releases/2018/52-thwaites/

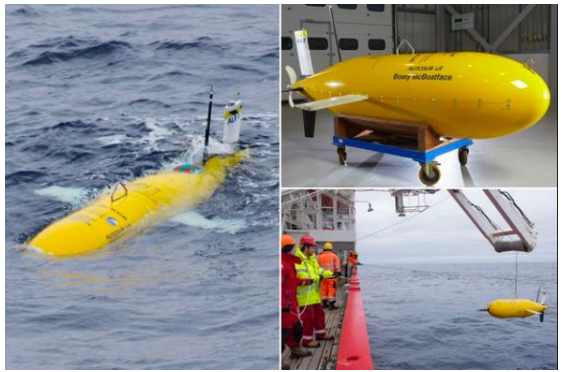
Scientists will deploy ocean gliders and autonomous vehicles to collect data to discover how the glacier interacts with the ocean today.

Tagged Weddell and elephant seals that haul out on nearby islands will capture data about their behaviour and the ocean conditions where they dive.

ROVs


Telemetry is accomplished with Iridium satellite communications
After a dive data is transmitted back to the basestation, and new instructions are downloaded
GPS is used to obtain a position fix while surfaced
While submerged the vehicle navigates using a 3-axis compass, pressure sensor and altimeter
10 m
300 m
700 m
1000 m
Seaglider dives to a maximum depth of 1,000 meters collecting various ocean data





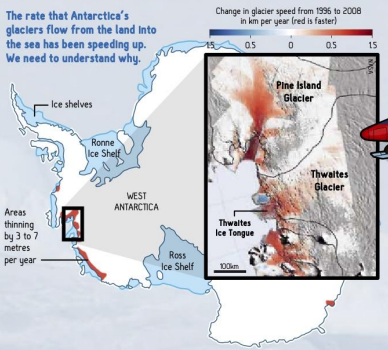
INVESTIGATING THWAITES GLACIER

Thwaites Glacier and Pine Island Glacier are two of the biggest and fastest-retreating in Antarctica. If both collapsed, global sea levels could rise by over a metre. Without them, the entire West Antarctic Ice Sheet could be more likely to collapse, leading global sea levels to rise by over three metres.

A five-year collaboration is investigating what's causing ice loss at Thwaites Glacier and how it will impact global sea levels. This is a joint venture between the U.S. National Science Foundation and the UK's Natural Environment Research Council. The eight projects use a suite of technologies.

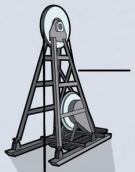
NERC SCIENCE OF THE ENVIRONMENT

The rate that Antarctica's glaciers flow from the land into the sea has been speeding up. We need to understand why.



RADAR

NERC's Twin Otter aircraft will take radar measurements to look deep below the surface of the ice and build a clear picture of how different layers of ice and the bedrock interact. This is crucial in understanding how climate change will affect large ice sheets.



HOT WATER DRILLS

These sample the seabed beneath floating ice shelves and sediments beneath grounded ice. They also take ice cores from the ice shelf, which will show us what the climate was like in the past.

REMOTE STATIONS

Multi-sensor remote autonomous stations will measure weather, ice conditions, ocean currents and temperature from on top of the ice shelf or on sea ice.

SEISMOMETERS

An array of seismometers will measure conditions under the ice and detect changes in movement, in the same way we monitor earthquakes.

SHIPS

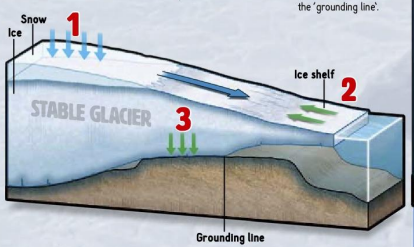
Ships will use sonar to map the seafloor. They will also measure the water's temperature, pressure, density and salinity (saltiness) which tells us about ocean currents.

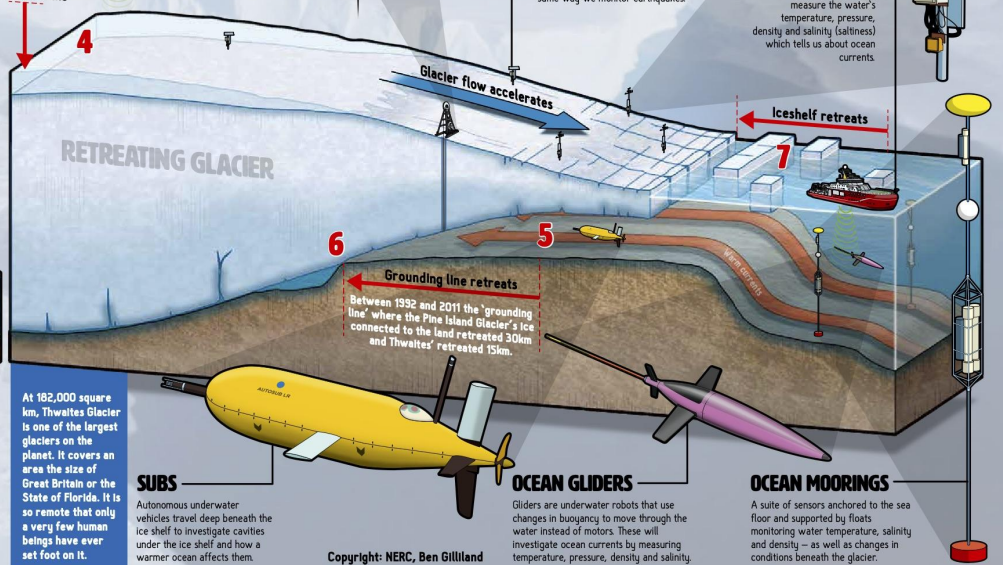
FROM STABLE GLACIER...

1 A stable glacier is in rough equilibrium. Annually, the snow falling on the glacier replaces the ice flowing into the ocean.

2 The floating part of a glacier, the ice shelf, acts like a cork or dam, holding back the ice upstream.

3 Sediments and water beneath the ice affect its speed – as does how much of the glacier is in contact with the land at the 'grounding line'.





...TO RETREATING GLACIER

4 The equilibrium of the stable glacier is lost. There is no longer enough snowfall to replace the increasing ice flow into the ocean. All the lost ice ends up in the ocean, raising global sea level.

5 Warm currents under the ice increase, melting the floating ice shelf and causing more icebergs.

6 The thinning reduces its effectiveness in damming ice flow

7 As more of the glacier begins to float the glacier flows faster.

At 182,000 square km, Thwaites Glacier is one of the largest glaciers on the planet. It covers an area the size of Great Britain or the State of Florida. It is so remote that only a very few human beings have ever set foot on it.

SUBS

Autonomous underwater vehicles travel deep beneath the ice shelf to investigate cavities under the ice shelf and how a warmer ocean affects them.

OCEAN GLIDERS

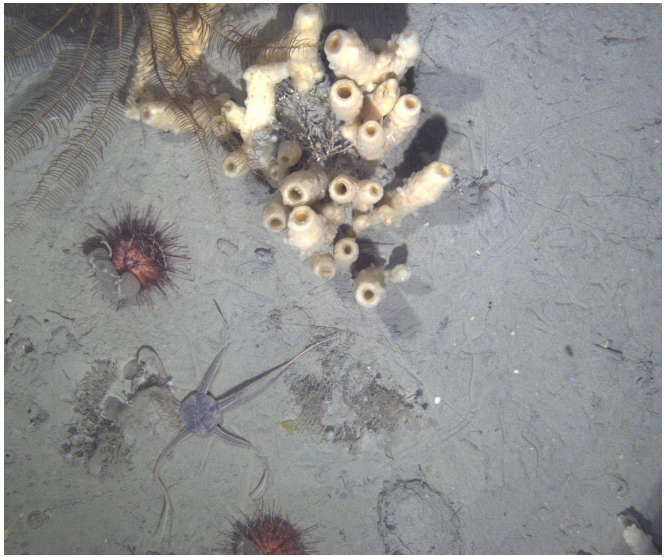
Gliders are underwater robots that use changes in buoyancy to move through the water instead of motors. These will investigate ocean currents by measuring temperature, pressure, density and salinity.

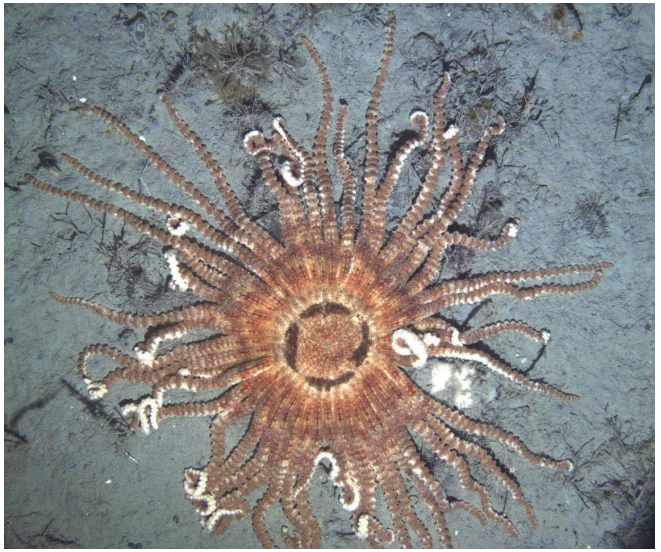
OCEAN MOORINGS

A suite of sensors anchored to the sea floor and supported by floats monitoring water temperature, salinity and density – as well as changes in conditions beneath the glacier.

What do ROVs find in the polar oceans?

http://ocean.si.edu/ocean-videos/rov-video-stunning-creatures

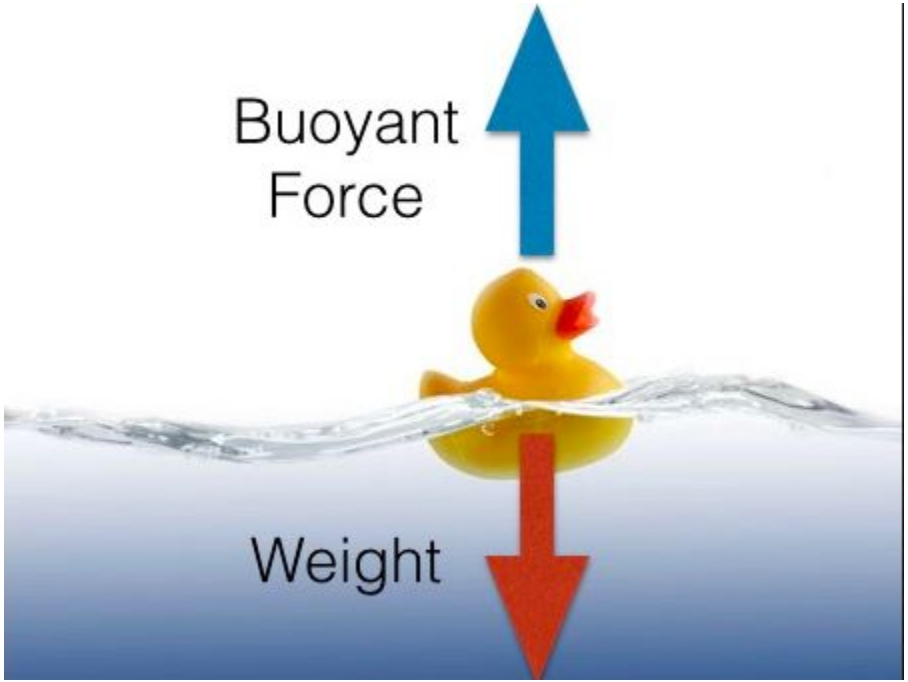




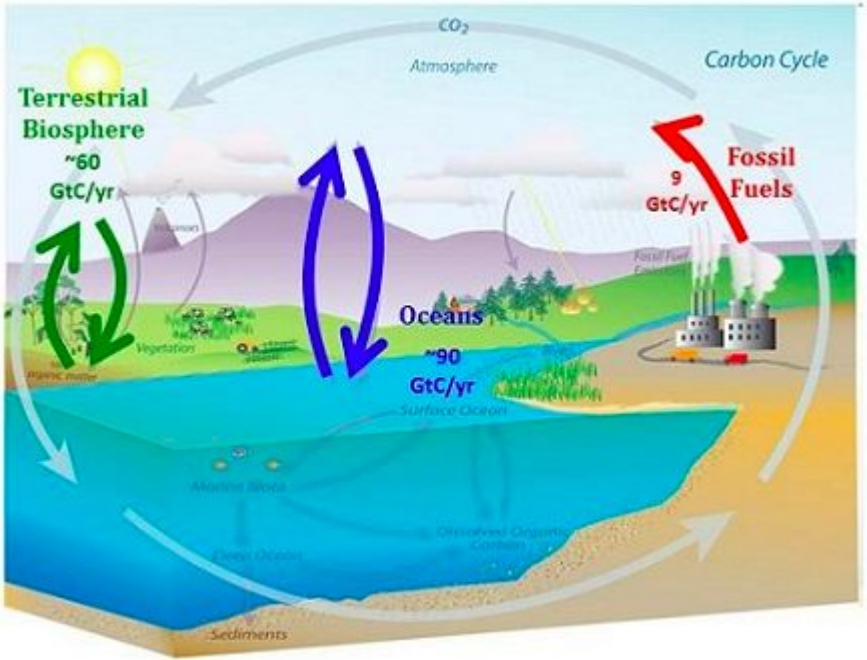
The Ocean Grabber Challenge

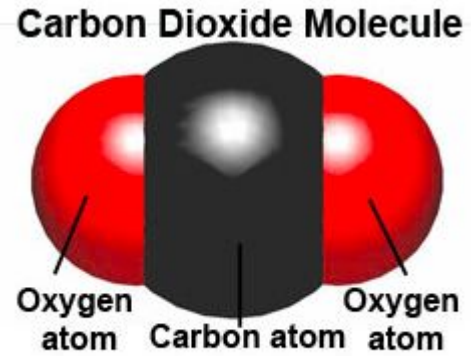
- ORGANISE A TEAM:
  - DESIGNER – TO DESIGN AND DRAW THE ROV
  - SCIENTIST – TO PLAN THE SCIENCE MISSION
  - ENGINEER – TO BUILD AND TEST THE GRABBER ARM
  - PROJECT MANAGER – TO HELP EVERYONE ELSE
- THINK OF A NAME FOR YOUR ROV
- DECIDE ALL THE THINGS THE ROV WILL DO
- BUILD AND TEST THE GRABBER ARM
- MAKE A PRESENTATION TO WIN THE CONTRACT

What is important for a good ship?



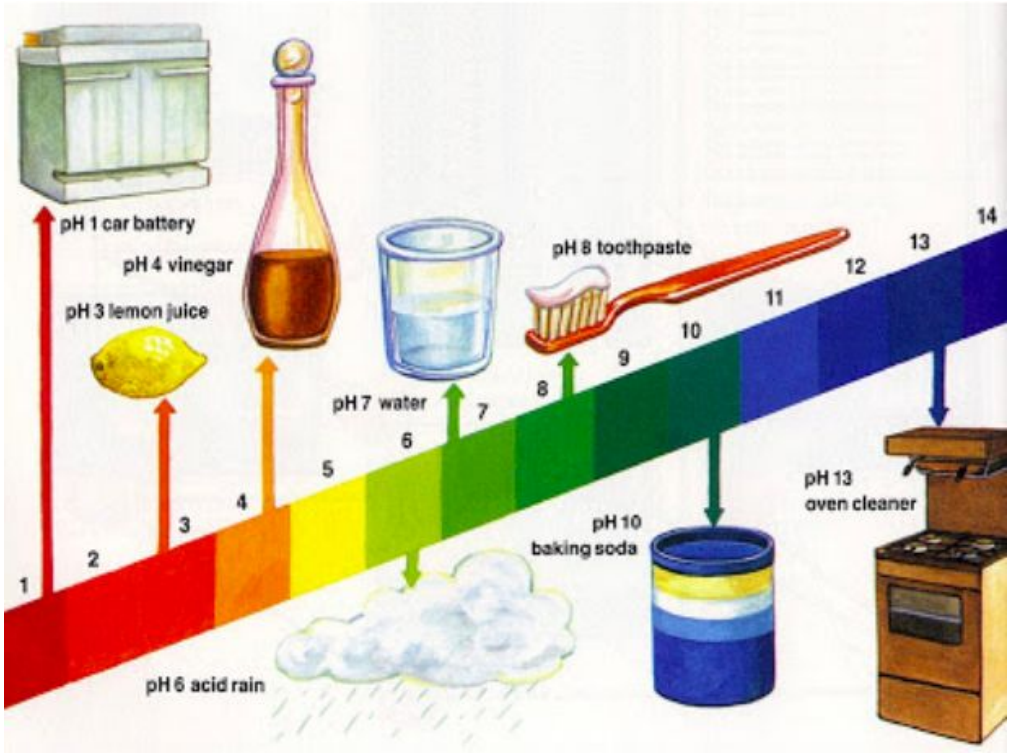

Sir David Attenborough



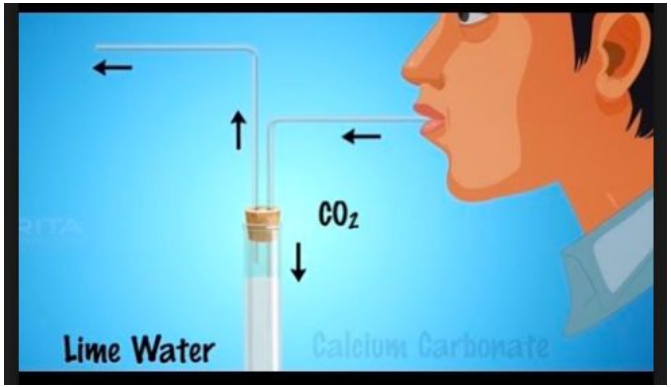


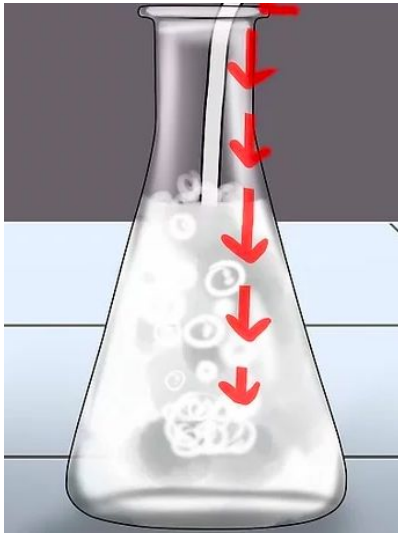
CO_2 in the oceans

Testing acids and alkalis

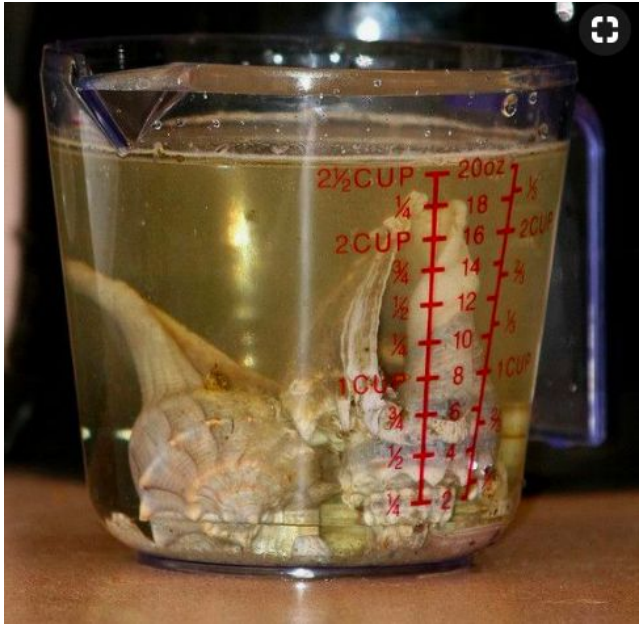


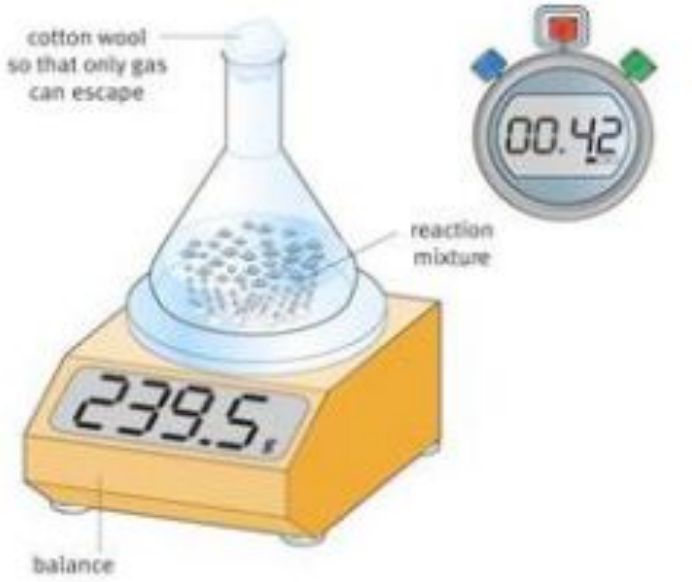
Making CO_2 and testing it

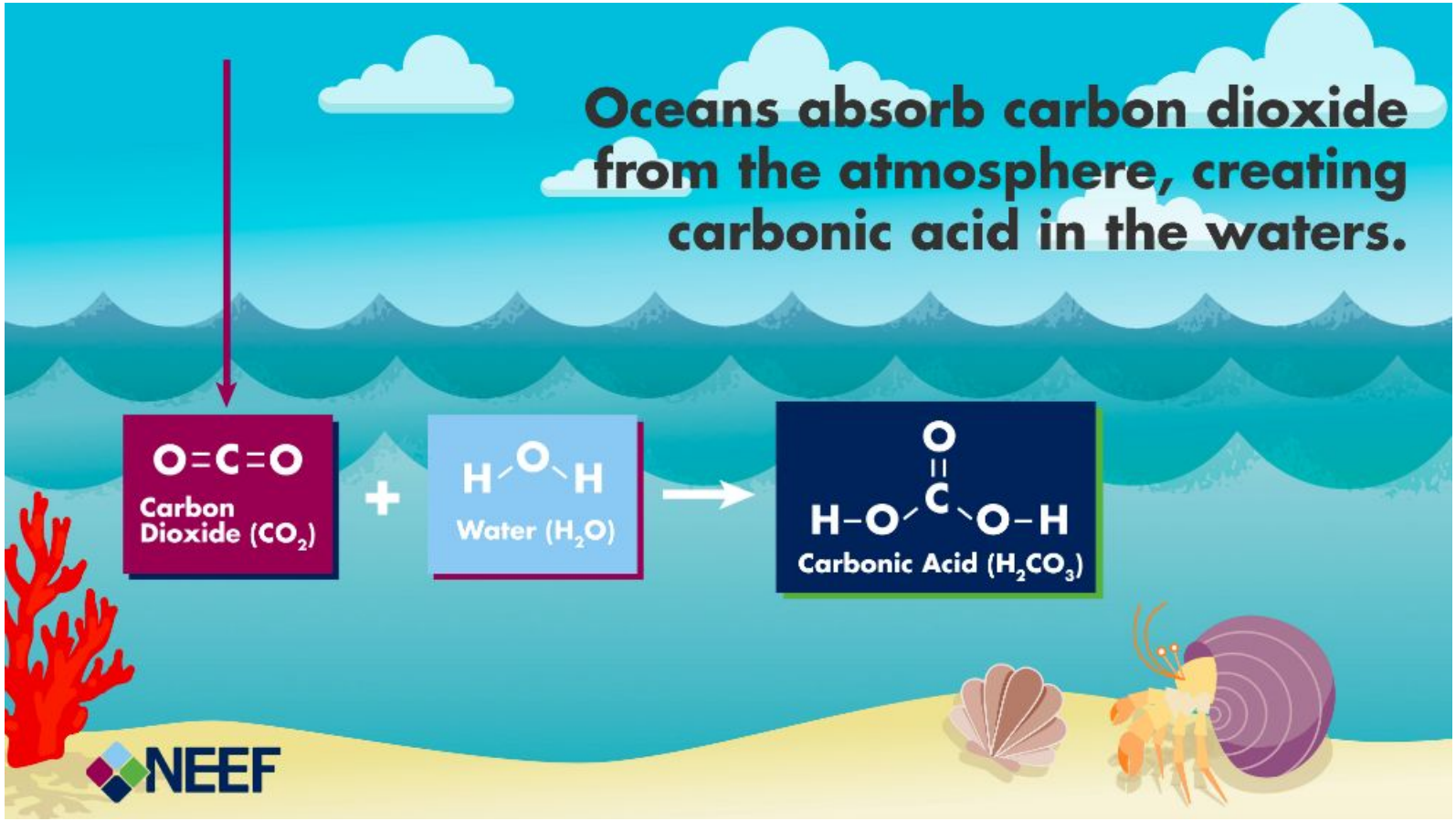




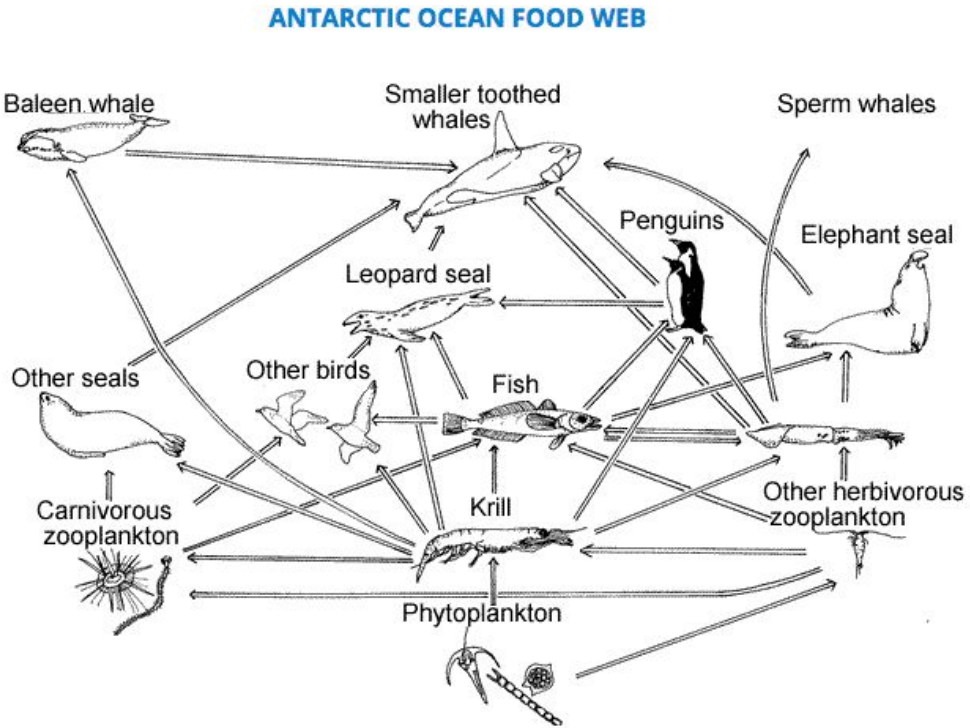
What happens if sea water gets more acidic?

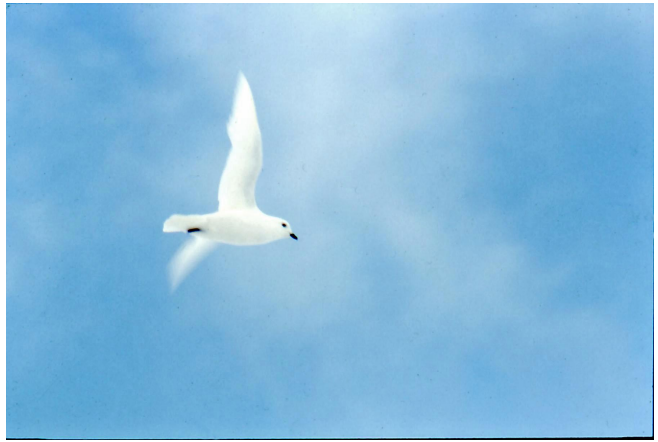




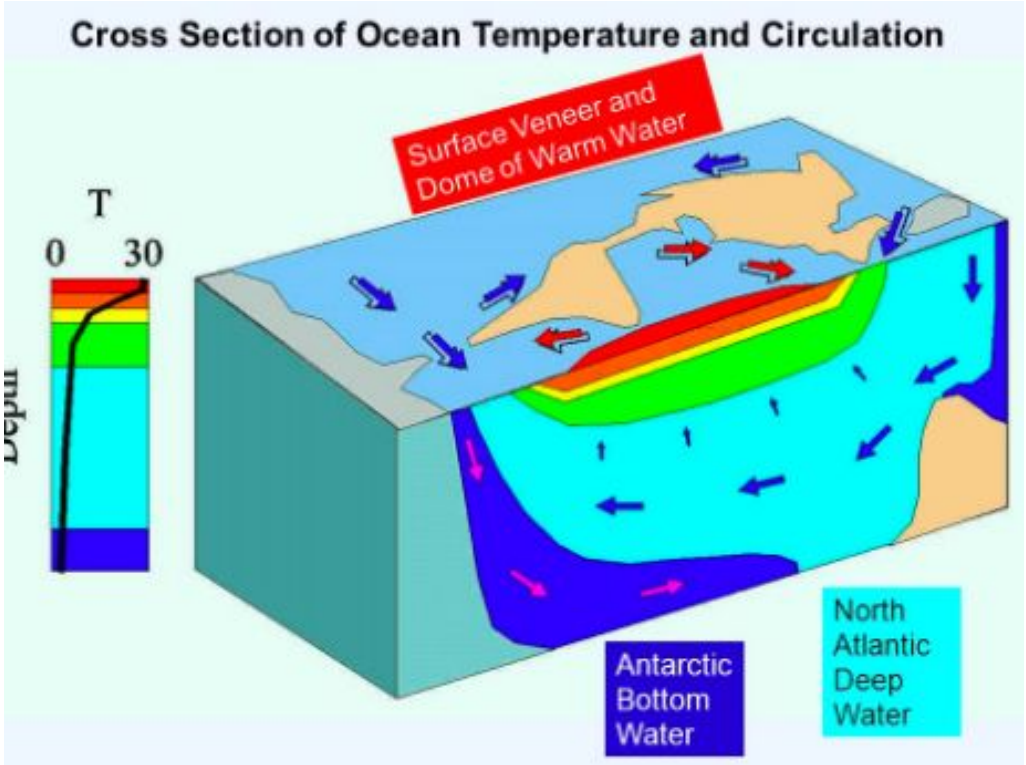

Oceans absorb carbon dioxide from the atmosphere, creating carbonic acid in the waters.
O=C=O
Carbon Dioxide (CO_2)
+
H–O–H
Water (H_2O)
H–O–C(=O)–O–H
Carbonic Acid (H_2CO_3)
NEEF

What could be affected in the polar oceans?

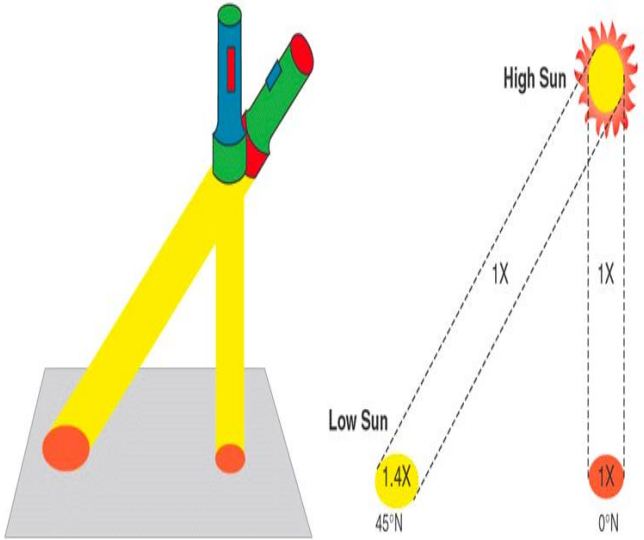


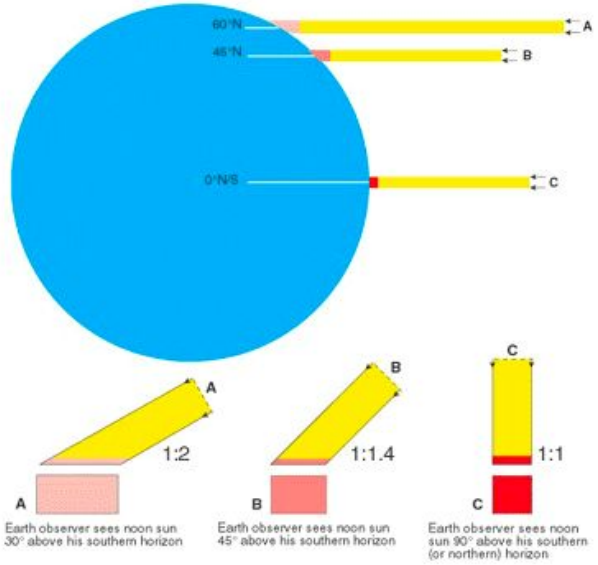


What happens to warm and cold water in the oceans?

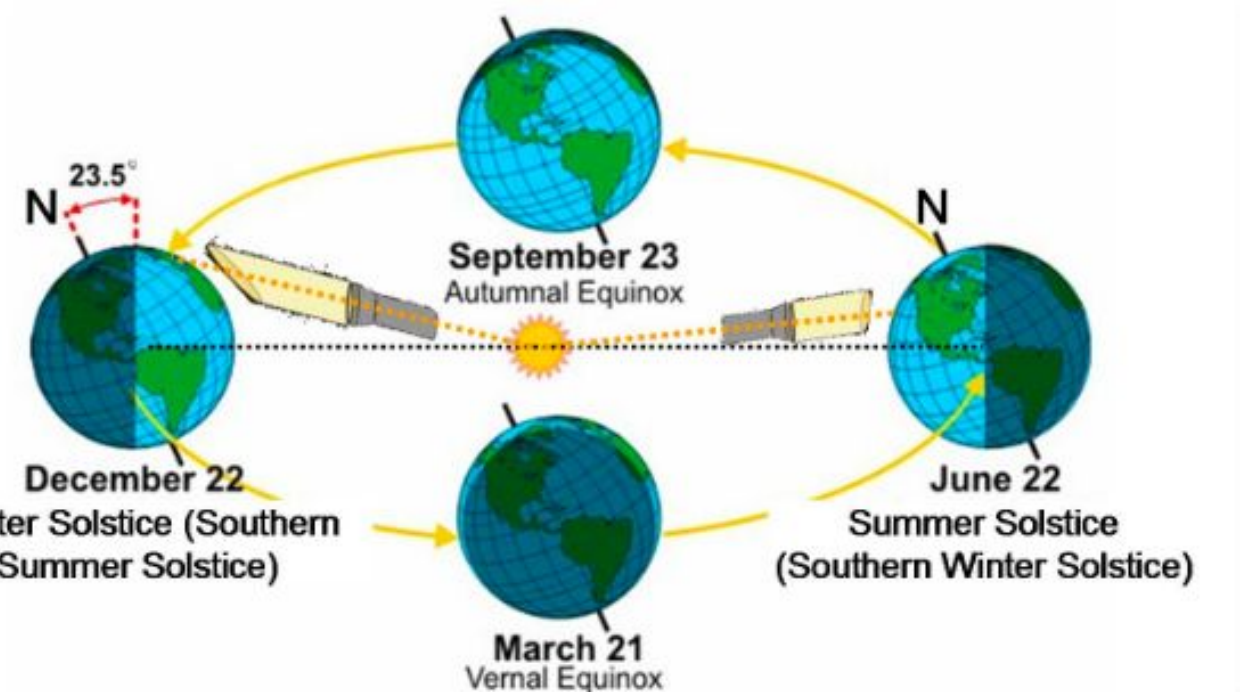


What happens to the Sun's heat energy at different latitudes?

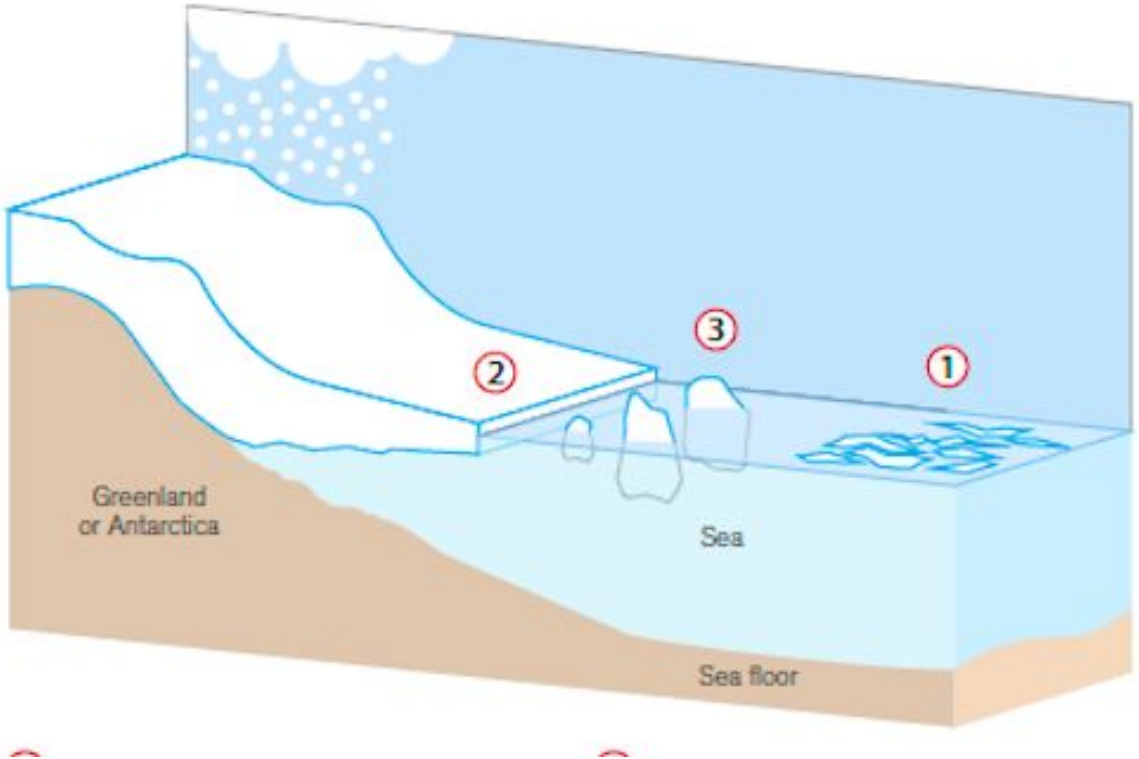




Why are the poles cold?



Sea ice, ice sheets and icebergs




British
Antarctic Survey

JPT/HI Draft List of Activities:

Expedition activity - menu sheets and instructions (Cafe Antarctique menu for Olivier?)
Polar snacks - calculations linked
SEE EXPEDITION FOOD FOLDER

6 Activities:

Teams to be given 1st and 2nd choice in advance (provide some information for them)

Submersibles and ocean grabber (lemonade bottles - coke bottles from home)
Ocean chemistry (JPT gets fizzy drinks)
Food chains/animals/adaptations/penguin huddling/blubber gloves (Holly will get gloves and blubber, lots of ice)
Tents and materials - modelling straws, materials, weights? (Holly has some)
Ocean circulation and climate (Holly will make coloured ice)
Boats - drip tray, Mary Rose boxes, sailing vs power challenge

Draft Programme:
9-9:15 Thameside arrive at Caldecott
9:15 JPT introduces Antarctic Science
9:25 Al Sylvester introduces Antarctic Exploration
9:35 Team building - calculate food and clothing requirements for a day in Antarctica (including Antarctic menu for judging by Olivier Hubert)
10:00 Break with Antarctic snacks
10:20 Training begins - teams (2 from each school) learn the basic activities in 6 locations (support from school staff/ATOM/ASP/Science Ambassadors)
11:15ish review progress - teams begin designing displays
12:15 lunch - Thameside return to school with some supporting staff and Al Sylvester
1:00(?) Teams work on setting up and rehearsing displays
2:45ish Olivier Hubert arrives Caldecott
3pm BOTH schools - introductory talks by either Al or Olivier; parents visit