HOW DOES THE OCEAN CIRCULATE? PART 2

In our first experiment we looked at how temperature can change the density of water. Salt also changes water density and this is what the experiment is about today! Remember we talked about thermohaline circulation, thermo meaning heat and haline meaning salt. As oceanographers we use the term salinity to describe how much salt is in the water. Think about any time you might have swum in a lake compared to the sea. If you got some lake water on your mouth did you notice that it was similar to tap water? We call this 'fresh water'. Now think of a time you have gone swimming in the sea - it is definitely salty! Let us now see which has the greatest density - fresh or salt water?

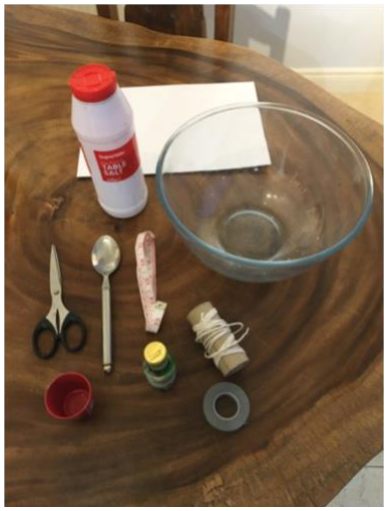
AIM

TODAY WE ARE GOING TO LOOK AT THE HALINE OR SALT PART OF THERMOHALINE CIRCULATION!

STEP 1

Gather the following:

- Large glass or plastic bowl but you must be able to see through it
- Food dye - green works really well and you can get it in the baking isle in the supermarket
- Metal egg cup or small container that can hold around 2.5 tablespoons - do a check first with cold water!
- Table Salt
- A dessertspoon for measuring
- Cold water from the tap
- String
- White sheet
- Ruler or measuring tape
- Scissors
- Sellotape or tape



Equipment needed

Remember experiments sometimes have to be repeated before they work so keep trying until it works!

STEP 2

To allow the small cup to be lowered easily into the large bowl of water cut 2 pieces of string 40cm long using the ruler and the scissors.

Put one piece of the string around the top of the small cup. As you will see there is a lip on container I have used – try and find something similar at home but remember it must be small!

Adding the string to the cup

STEP 3

Add the second string and tie it on the opposite side of the cup. Using a bit of Sellotape or tape secure the knots onto the cup (left image). It very important that when you hold the strings the cup is level (right image).

Secure the knots onto the side of the cup

Knots secured and easy to lift evenly

STEP 4

Fill the glass bowl with cold water from the tap. Add 2 dessertspoons of salt to the water and stir until it has dissolved.

STEP 5

Put a few drops of green dye into your small cup and fill to the top with cold water from the tap.

STEP 6

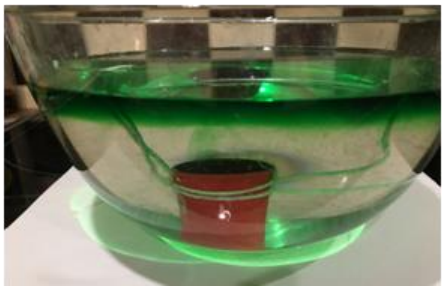
How to hold the cup with water and dye

Pick up the container using the strings.

It is best to hold the strings close to the knots as it's less likely to swing and spill.

STEP 7

Start to lower the cup of cold green tap water (fresh water) slowly into the bowl of cold salty water.



It is important **to lower it slowly and gently to the bottom**.

As it goes in see how the green fresh water comes out of the cup and sits on top of the cold salty water. The place where the green fresh water meets the salt water is called the halocline – the place where there is a large change in salinity or salt content.

WHAT IF IT DOESN'T WORK FIRST TIME?

Make sure you lower the small cup slowly and carefully into the bowl

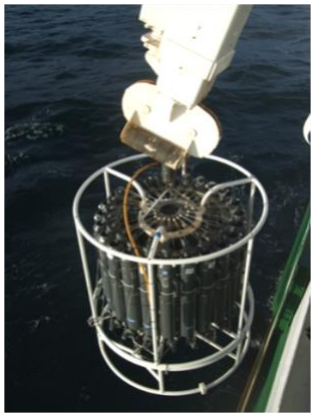
WHY DOES THIS HAPPEN?

This is how our oceans behave with salinity (amount of salt). The 'fresh water' (tap water) is **less dense** so it rises to the surface above the **more dense** salt water which stays at the bottom of the bowl. Now that you have carried out both experiments on how temperature and salt changes water density lets start to imagine how this density works in our oceans.

Let us take an example. We get into a boat and sail out to sea. There is a river with lots of water coming into the bay where we are and we decide to anchor our boat. We anchor in 20m of water. There isn't just one layer of water between the boat and the seabed. Remember what we saw in each of the experiments - **density determines which water layer sits over which**. This is very easy to see when a river enters the ocean, the river water is colder and has less salt than the ocean and therefore less dense so it sits on top of the ocean water.

It is the same when we go further out to sea and the ocean gets deeper and deeper. If we stopped again in our boat there won't be just one layer of water underneath us there will be multiple layers that have organised themselves into density layers. As oceanographers we sample these layers using instruments from research boats. We put instruments off the side of the boats to measure the

temperature and salinity of the water and drop them all the way to the bottom-which sometimes can be over 3km and then bring them back onboard. Below is a picture of a CTD (Conductivity, Temperature, Depth) recorder going off the R.V. Celtic Explorer. Can you see all the long grey tubes? These are the water sampling bottles and we can choose which ones to close when we are in different density layers. This allows us to get water from many different layers. The instrument that measures and records temperature and salinity is underneath the grey tubes and it gives us valuable information on our oceans. When this instrument comes back up onto the boat we take samples from each water bottle. These samples are taken to the lab and analysed for a number of different properties like oxygen, nutrients, dissolved substances to name a few! Hopefully this has started your interest in Oceanography - why not go online and learn more about or oceans! There are some good videos on https://oceanservice.noaa.gov/kids/



CTD System onboard the R.V. Celtic Explorer Credit: Sheena Fennell

COUPLE OF INTERESTING FACTS:

- The Gulf Stream is a part of the Global thermohaline circulation and it flows on the east coast of America. In the fastest part a parcel of water is transported 216km a day[1], that's from Galway to the outskirts of Dublin city in one day!
- Winds and tides as well as density drive ocean currents
- The deepest part of our ocean is the Mariana Trench and is 11km deep[2]

CREDITS

This experiment is brought to you by Sheena Fennell, an oceanographer in Earth and Ocean Sciences at NUI Galway.

Part of a Nature Series by the Ryan Institute during #LockDownIreland

Ryan Institute

NUI Galway
OÉ Gaillimh

[1] https://oceanservice.noaa.gov/facts/gulfstreamspeed.html
[2] https://geology.com/records/deepest-part-of-the-ocean.shtml