Suitable for primary aged children

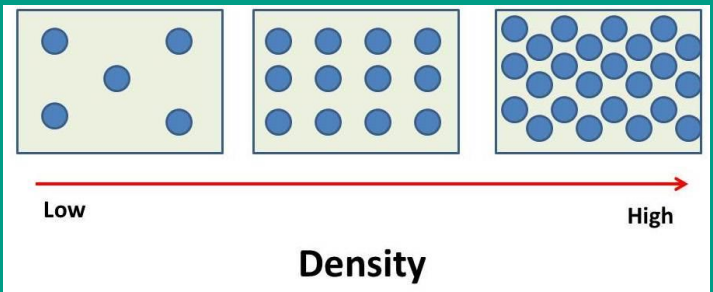
Density Layers

Our oceans are constantly moving- from the surface currents to the greatest depths. Ocean currents help to distribute nutrients and oxygen around the globe and without them life would not be possible in many parts of the ocean. Currents are caused by many different forces, such as: the rotation of the Earth, the effects of wind and temperature differences. Density is also very important to oceanic circulation - or how water moves around in the oceans.

The density of sea water is affected by how salty it is and its temperature.

Making density layers is a good way to explore the differing densities of common liquids and to demonstrate how this physical property of liquids can affect ocean currents.

Definition:
Density is a measure of how much mass there is per unit volume of a substance; or in other words how compact a substance is - how much stuff (molecules or particles) is packed into a given space.



What you will need:

A tall see-through container- a cylindrical vase or tall glass would be a good example
Water
Food colouring (optional)
Vegetable oil
Honey or syrup
Items to float/sink (optional)
3 cups for easy pouring
Spoon if adding food colouring to water
Paper towels

DO:

Assemble your ingredients and equipment.

Pour a sample of each of the 3 liquids into cups and discuss how these liquids flow and move, how do they react if you poke them and how do they feel between your fingers?

Pour a few centimetres of honey or syrup into the bottom of your transparent container. The amount can vary depending on the size of your container but aim to fill no more than 1/3 of the space with this layer.

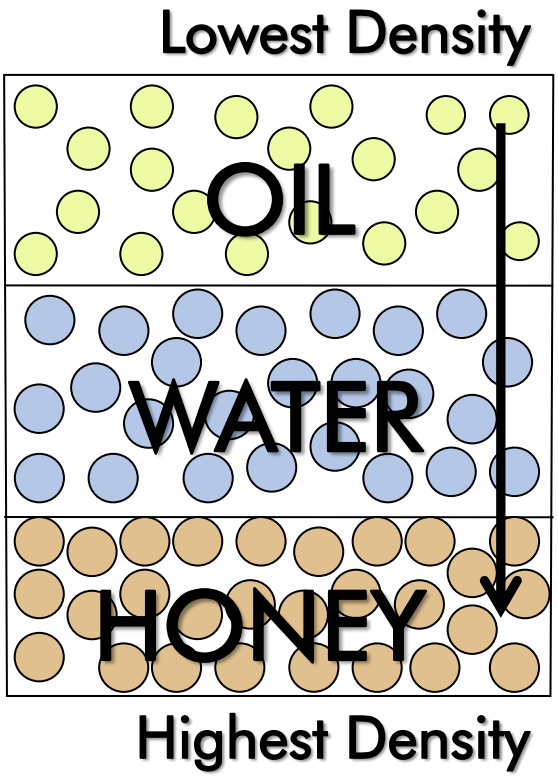
If using food colouring add some into your water and stir to mix.

Next, we are going to add the water. Discuss what could happen when you pour the water in with the honey/syrup. Will they mix together? Make some predictions.

Carefully pour the water into the container, again the amount will vary, but fill no more than 1/3 of the total volume with water.

Discuss what happened? The water floats on top of the syrup/honey! Why could that be?

It is because the honey or syrup is **more dense**! The particles (molecules, bits, however, you want to describe them) of honey are packed in much closer than the particles of water, so the water floats on top. You can relate this to how the honey flows, it's thick and viscous as they particles are all packed in close together so it's harder for it to move. Think also about doing swimming arms through the air versus water, water is more dense, so much harder to move through. Imagine what it would be like to swim through honey!



Next, chat about what you think will happen when you add in the oil and make a prediction. Once you have a prediction you can test your theory by adding the oil to the top. Again, no more than 1/3 of your container's volume.

The oil should separate out, after briefly mixing with the water. This is because the oil is **less dense** than the water.

Follow-up

Now that you have made beautiful density layers you can have some fun with them!

Find some items that you can drop into your container and predict where they will come to rest and then test out your predictions, or hypotheses.
You could even make a table to record your results like the one below with some suggestion of items to test.

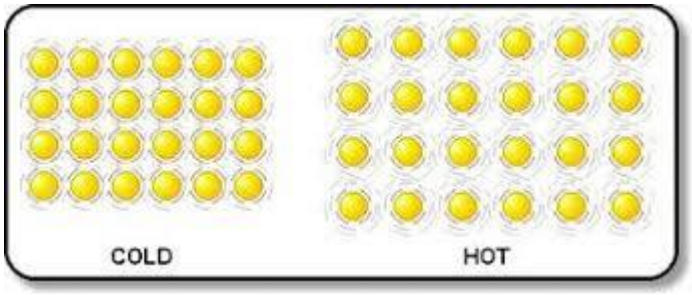
Item	Layer		
Coin	Oil	Water	Honey/Syrup
Prediction			
Result			
Plastic bead	Oil	Water	Honey/Syrup
Prediction			
Result			
Paper clip	Oil	Water	Honey/Syrup
Prediction			
Result			
Rice grains	Oil	Water	Honey/Syrup
Prediction			
Result			
Dried bean/pea	Oil	Water	Honey/Syrup
Prediction			
Result			
Small toy	Oil	Water	Honey/Syrup
Prediction			
Result			

What was the most dense item you tested?

What was the least?

Sinking Cold

Temperature affects the density of a substance. Think of heat as energy. The more energy a substance has the more its molecules or particles can move around or vibrate.



Imagine all of the little dots as people dancing and by adding heat it's like you are playing the music louder and the dancing gets crazier so the people have to space out or they will crash into each other! The more heat, the faster they move so the more spaced out they become. As the particles space out, the substance becomes less dense.

This is why paper lanterns and hot air balloon rise; heat makes the air less dense and the lanterns and balloons rise in the cooler air around them. As things cool down, the air loses some of the energy and becomes more dense, so starts to sink taking the balloon or lantern with it.

What you will need:

Ice cube tray

Water

Food colouring

Glass

DO:

The day before your experiment make some ice from coloured water. You want the water you are using to be well coloured so use a dark food colour and lots of it. You only need one ice cube for the experiment, but you might want to do it a few times so make a few spare.

Once your ice is made you are ready to begin.

Fill a clear glass 3/4 full of room temperature or cool water, you don't want it to be too warm or your ice cube will melt too fast. Then pop a coloured ice cube in and watch density in action!

You will see the cold, coloured water sink down to the bottom of the glass as its more dense than the surrounding water.

If you leave the glass long enough, eventually the food colouring will become uniformly mixed as the temperature throughout the water becomes the same.

What does this have to do with the sea?

Hopefully you noticed that the most dense items and liquids sank to the bottom.

This is exactly what happens in the oceans, the most dense seawater sinks, but this happen on a very large scale. Warm water flows along the surface towards the poles and cools as it moves north and south. Once the water gets close to the poles it sinks. The sinking water pushes the water at the bottom of the sea out of the way, setting up deep water currents. Eventually these deep currents crash into land masses and have nowhere to go but up. These upwellings of cold nutrient rich water are very important to coastal communities and are one of the reasons why we have such a diversity of marine life in the Moray Firth.

This large-scale ocean circulation is called the global conveyor belt current and it is vitally important in regulating our climate as it distributes heat from the equator to the poles and cycles cold nutrient and oxygen rich water back towards the equatorial regions.

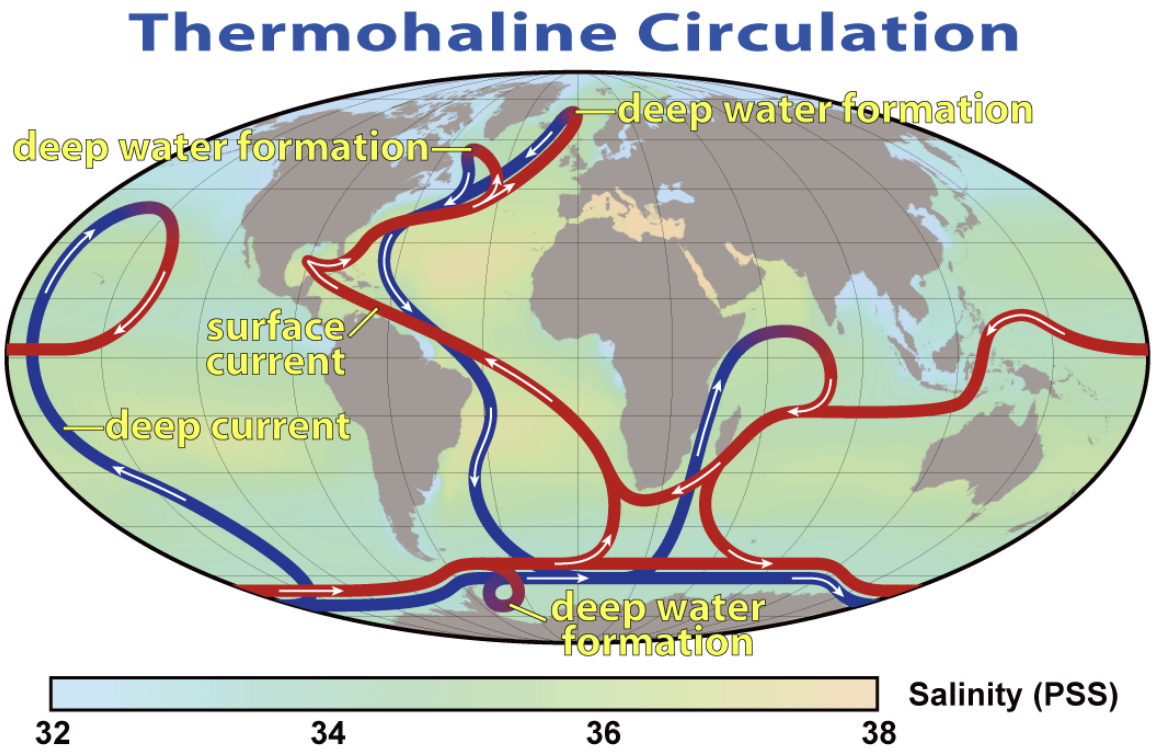


Diagram to show the global conveyor belt current