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CLIMATE THROUGH TIME – 4

Warm Seas; Cold and Temperate Seas; Ocean depths

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Introduction to this Issue

This final issue linked to the *Climate through Time* poster will focus on the three ovals on the poster relating to seas. These are the warm seas, the cold and temperate seas together with the deep oceans. These can also be linked to temperature and sea level curves on the left of the poster and ocean circulation. The activities will include density and salinity which are an inherent part of seas and oceans, together with circulation.

Density in the Seas

Density is the mass of a substance of a given volume (usually expressed as kilograms per cubic metre (Kg m^{-3})).

The density of air increases the nearer to the ground it is. Water on the other hand changes very little throughout its depths. It does not compress like air does.
To show this there is a small experiment you can do. This activity could be done with assistance in lower Key Stage 2 or as a challenge with older children.
Some children may have seen a similar effect before, (found in various toys) but will not know why or how it is happening, thus a discussion can be developed about this.

The Activity:
For this activity you will need a narrow necked bottle and a cork to fit the top tightly. You will also need a plastic pen top, plasticine and water.

- Fill the bottle up to about 1-2cm from the top.
- Attach plasticine to the base of the pen top to hold air in the top. The amount of plasticine you use depends on the mass of the pen top.
- You need to set it up so that the pen top floats just below the surface of the water.
- Push the cork into the top of the bottle. If the cork seals the top it will compress the air in the pen top but will not compress the water.
- The pen top will sink through the water.
- When you pull the cork out the air will expand and the pen top will rise through the water.
- This process can be repeated showing that the water retains its density and air changes its density.
- Discuss what has been happening and why.
- With older children challenge them to find a different method of showing this.
- Ask if it will be the same if salt (sea) water is used – try this and observe and comment on results.
- Does the level of salinity make a difference? This leads into the next activity.

Salinity

The amount of salt dissolved in water is called the salinity. Different bodies of water have different salinities, and these can be expressed in different ways – grams of salts per kilogram of solution; grams of salts per 1000ml; as percentages or as parts per thousand. The table below shows water salinity definitions as both percentages and as parts per thousand.

	Fresh Water	Brackish Water	Saline Water	Brine
As a percentage	< 0.05	0.05 - 3	3 - 5	> 5
As parts per thousand	< 0.5	0.5 - 30	30 - 50	> 50

Different seas around the world have different salinities, usually related to their temperature. Thus (in parts per thousand) the Red Sea ~ 40; The Mediterranean ~ 38; The Black Sea ~ 18; The Baltic Sea ~ 8. The average is 34.7.

Density and Salinity in the Seas

Sea temperature is generally determined by location, especially the sea's latitude. Surface water temperatures are much higher near the equator. When seas are both warm and shallow salinity increases dramatically because of increased rates of evaporation, so these very salty seas are also very dense. An example is the Red Sea which has high evaporation rates due to the very hot climate but no rivers flowing into it.

Activity:

To see how high salinity, or very salty seawater, affects the density of the seas and all that floats in them have a go at this simple activity. Again, this activity could be done with assistance in lower Key Stage 2 or as a challenge with older children.

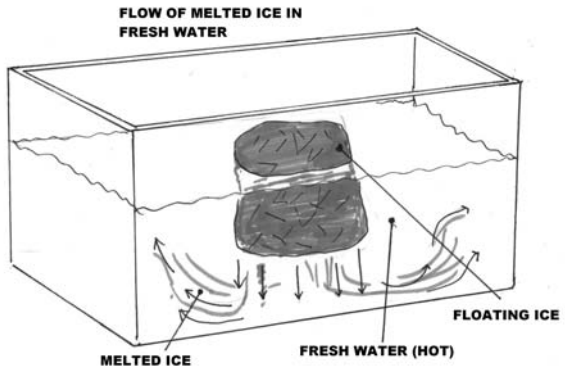
Equipment:
You will need - 3 whole eggs (uncooked), 3 clear jugs or jars.
Note. 1 of each would suffice but the experiment would need repeating three times. Thus, if possible, use three in order that the results can be easily compared and commented on.

1) Fill one jug with cold tap water
2) Fill another with cold tap water then add 10-12 tablespoons of salt, stirring until it dissolves to form brine.
3) Half fill the third and add 5-6 tablespoons of salt, dissolving as before.
4) Carefully place an egg in the jug of cold tap water. Ask the children to comment on what happens and why this might be. The egg will sink to the bottom as it is denser than the water.
5) Place another egg into the full jug of brine. Ask the children to comment on what happens and why this might be, and compare it with jug 1. The egg will float with some of it above the surface.
6) Carefully top up the third jar by slowly and carefully pouring tap water over the brine (tilting the jug containing the brine should help with this).
7) When the water and brine have settled gently place an egg into this jug. Ask the children to comment on what happens and why this might be, compare this with the previous 2 jugs. The egg will sink through the fresh water until it reaches the brine then it will float, suspended midway down through the fluid. (Adding some food colouring to either the brine or tap water, or contrasting colours to both, will help to highlight the boundary between the two fluids).
8) Discuss the links between density and salinity. Older children could research the chemistry behind the observations.

Circulation and Ocean Currents

The oceans are always moving and move in three dimensions. The driving force is heat. Heat from the Sun is the primary source of energy in the oceans just as it is in the atmosphere. Other factors which effect the movement of the oceans include tides and density variations caused by varying concentrations of salt. The vertical movement is caused by variation of density. (The denser water sinks to the bottom, the less dense rises to the top). Water has a maximum density at ~4° C. which is why a pool rarely freezes to the bottom.

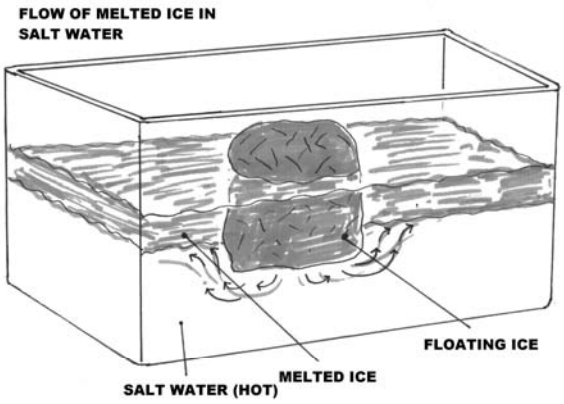
Activity:



An investigation to show the effects of varying temperatures caused by melting ice is easy to carry out in the classroom with a little preparation. Colour some water with food colouring and freeze it into ice cubes. Take a jar or fish tank of hot water and carefully float the ice on the water's surface to represent an iceberg. An alternative to ice cubes is a balloon filled with water, (put the colouring into the balloon first.), wait until it is frozen and then cut the balloon away.

The ice floats because it is less dense than water at any temperature. As it melts and the denser, cold water leaves the ice mass it travels down through the hot water and sinks to the bottom. As it moves down it is heated by the surrounding water and becomes less dense. It then rises to the surface. The food colouring improves the visibility and the movement of the water representing the thermal currents can clearly be seen.

If the same activity is done with a salt solution in the tank a different effect is observed. The fresh water, although cold, is less dense than the salt water. When it is released from the melting ice it does not sink but forms a layer that floats above the salt water. This separation effect would be apparent around areas where large amounts of fresh water meet salt water such as at the mouths of large rivers or the edges of the ice-caps.



These effects would have occurred on a worldwide scale as the icecaps receded at the start of each interglacial period.

Useful Websites:-

http://en.wikipedia.org/wiki/salinity
www.windows2universe.org/earth/Water/salinity.html
www.windows2universe.org/earth/Water/density.html
www.windows2universe.org/earth/Water/ocean_currents.html
www.seafriends.org.nz?oceano/seawater.htm
www.palomar.edu/oceanography/salty_ocean.htm
www.montereyinstitute.org/noaa/lesson08.html

The Seas - Summary

Looking at the globes, on the left side of the poster, showing the changing position of Britain and Ireland through time we can see that the areas of ocean and land have moved and changed over long periods. Likewise, using the temperature and sea level through time graph we can see the changes here too. During all this time there have been oceans of various sizes and types and with these have developed currents, which have changed over time. These currents have all been linked to and driven by the temperature of the oceans; the density of the water; the salinity of the water and how all of these can change with temperature, depth and environment. There are also links here to weather and climate. Older children might investigate our own climate in relation to the Gulf Stream and what might happen if this current moved either north or south.

Conclusion

As you can see from the variety of information within this and the previous three PESTs, Britain and Ireland have been situated in various positions on the globe and have been subjected to a variety of environments and climates. Thus as well as the ideas we have suggested to you, any work on climate change or global warming can make use of the information on the *Climate through Time* poster. It would certainly make a good starting point in a discussion with older children relating to who might be causing the global warming – if indeed it is happening.

We hope that you will devise other uses for the poster, don't forget that it can be downloaded in electronic format from the site below. We would like to thank BGS for suggesting we develop these activities and permission to use the poster to do so.

The *Climate through Time* poster can be downloaded in low or high resolution formats from: www.bgs.ac.uk/education/climate_change/climate_through_time.htm

Forthcoming Events. Full information is available from the respective web sites.

ESTA Primary Team Members will be providing practical workshops, resources and useful information at:-
ESTA Conference Leicester, 17th – 19th September 2010. www.esta-uk.net Primary INSET Saturday 18th – practical workshops on minerals, rocks, soils, rivers and coasts with emphasis on cross curricular themes.
ASE Conference, Reading. 5th – 8th January 2011. Saturday 8th January 2011. Primary Workshop: Sort minerals by devising and discussing criteria. Use this knowledge to work through rock identification at different levels with the ESTA rock kit. Test rock porosity and make your own well. Consider rock erosion and soil formation. Observe differences in porosity/permeability, colour, texture and composition of various soils and link this to their origins. TAKE AWAY TOUR OWN ROCK KIT AND TEACHING PACKS.
GA Conference. Guilford. April 15th – 16th April 2011. Physical Geography related cross curricular workshops.

This issue was devised and written by Geoff Selby-Sly, Stewart Taylor and Niki Whitburn, ESTA Primary Team. Edited by Tracy Atkinson, ESTA Primary Team.

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