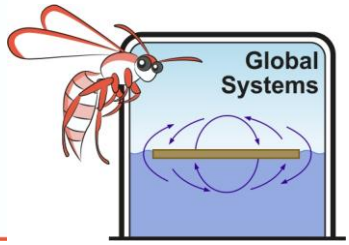


Global Conveyor Belt - Teacher Notes

Factors that drive deep ocean currents - Temperature and density

Four fifths of our planet is covered by sea. Deep ocean currents are more important than marine surface currents or air currents in the atmosphere in the transport of heat around the world. Driven by temperature and salinity they create a "Global Conveyor Belt" which moves vast quantities of heat around the surface of the planet within the oceans. It may move more slowly than air currents but can transport more heat and is absolutely critical to our understanding of the forces that drive climate change.

What do we mean by density? Mass per unit volume

How can a change in temperature result in a change in density. As temperature (kinetic energy) increases, molecules bounce off each other more and move further apart. There is less mass per unit volume. Density decreases. Conversely as temperature decreases density increases.

Does this hold true for water? No. Water is anomalous. Its density increases until 4°C when it freezes and becomes ice. Ice is less dense than water due to weak hydrogen bonding forming an octagonal crystal lattice which has a larger volume than liquid water.

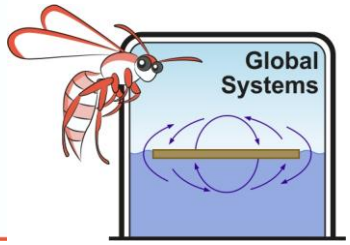
Students may visit: https://ed.ted.com/lessons/why-does-ice-float-in-water-george-zaidan-and-charles-morton for a 3.55minute animation and explanation

The Global Conveyor Belt (GBC) is started as a downward flow of water near the poles.

Aim To demonstrate how cold can initiate a downward flow of water

Materials per group

- A large glass beaker or transparent container almost full of water at room temperature
- A plastic bag with ice cubes
- A clothes peg or grip to hold the bag in position
- A dropper bottle with food dye or a small beaker of food dye and a Pasteur/transfer pipette)



Global Conveyor Belt - Teacher Notes

Method

1. Hang the bag of ice to one side of the transparent container (as above).
2. Leave for two minutes to allow the current to become established.
3. Gently drop food colouring onto the water's surface at the centre of the container. (Teachers of energetic classes may wish to pop round the class and do this part themselves).
4. Observe and note observations.

Results/observations

What did you observe? The dye moved towards the bag of ice cubes and was then swept downwards towards the bottom of the container.

Conclusion

What conclusion do your observations draw you towards? As water temperatures approach freezing downward currents are produced.

Discussion

Explain how chilling water could create a downward current. Liquid water density increases as it cools and it will sink downward through warmer water creating a current.

At our poles, warm seawater comes in contact with frozen ice caps and ice shelves. What effect will this produce? Chilled water will form a downward current drawing more water after it.

How can this activity be improved? Repeat the activity. Control variables such as the volume of ice, size of bag, temperature of water, chemistry of dye etc. Use salt water to represent polar waters instead of fresh.