Print

Looking for Climate Change : Pressure and Density

Objective:

To learn about pressure and density the EII class at the Bridgeview Montessori School is sending Styrofoam cups to the bottom of the ocean.

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The styrofoam cups lying on top of the shipping container to be sent to the R/V Melville in Australia.

Definitions:

Density: the mass of an object compared to its volume

Pressure: the amount force applied to an area

Units: Most Americans think in English units (1bs, tons, ft, inches, miles etc.), but in oceanography, as in most science disciplines and much of the rest of the world, we work in metric units (kg, tonnes, m, cm, km etc.). Within this text, where it makes sense, we will make some attempt to include both.

- Density: the units of density we will use are kilograms per cubic meter (kg/m3)
- Pressure: There are many units for pressure. Some that we will use here are: pascals (pa), pounds per square inch (psi), atmospheres (atm), millibars (mbar) and decibars (dbar).

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The shipping container used to send the cups to Australia ready to be mailed.

Background:

We have as much as 76 miles of atmosphere above us, so although air is extremely light compared to most things, the whole atmosphere weighs a lot: some 5.5 quadrillion (5,500,000,000,000 = 55 hundred billion) tons or 5 quadrillion tonnes (metric tons). The weight of the atmosphere exerts a pressure on all of us which is roughly equal to:

1 atm = 14.7 psi = 100,000 pa = 1000 mbar = 10 dbar.

That is, if one could separate out a square column of the atmosphere that was 1 inch long by 1 inch wide, it would weigh 14.7 lbs (about the same as three 5 lb bags of sugar).

We are so used to the pressure of the atmosphere that most of the time we don't even notice it. Can you think of a time when you do?

Water is denser than air. Compare the weight of an 'empty' gallon milk jug which is actually full of air to one which is full of water. The great density of water means that one only has to go down about 10 meters (30 ft) in the ocean feel another 14.7 psi (10 dbar) of pressure.

Because every meter (3 ft) of water exerts about 1 dbar of pressure, oceanographers often use dbars and meters interchangeably.

Styrofoam cups are light. They are about the same size as coffee mugs, but they weigh less. This is because Styrofoam is less dense than ceramic. That is, there is more space between the molecules of a Styrofoam cup than there is between the molecules of a ceramic cup. If we remove some of the space between the Styrofoam molecules, although their weight won't change, they won't take up as much room and the Styrofoam will be denser.

Good day Alison

Further to the below, please note we received the b/m container in our office today, under FedEx AWB 6912 8722 7798.

Best Regards,

Vessel Operations - Brisbane,
Inchcape Shipping Services Pty Ltd.

Enlarge Image

The cups decorated by the Bridgeview students have arrived in Australia.

Hypothesis:

What do you think will happen to the Styrofoam cups when they are sent to the bottom of the ocean?

What we need to perform the experiment:

1. Styrofoam cups
2. Permanent markers

3. Mesh laundry bag(s)
4. Plastic ties
5. A ship going out to sea
6. Somebody on the ship willing to perform the experiment (we will use graduate students).
7. A method of sending the cups to the bottom – in our case, the cups will be attached to the frame holding our instruments which will be dropped off the side of the ship on wire and lowered by a winch. It is gravity that allows the instrumentation to fall to the bottom, and the winch operator who pulls it back up again.

The steps to the experiment:

1. October 21, 2009: Decorate the cups using the permanent markers. Include your name, so you get your own cup back at the end of the experiment. Leave some space on the cup for the location and depth of the ocean to be recorded.
    - The BV EII kids were told not take make pictures with too many details. Do you think this was necessary? Why?
2. October 22, 2009: Send the cups to the ship. The R/V Melville starts its journey in Brisbane, Australia. So Chief Scientist, Alison Macdonald, packed the cups along with other items being air freighted to Brisbane.
    - How high do you think these cups will go on their way to Australia?
    - Which distance is greater, the height at which an airplane crosses the ocean or the depth of the ocean?
    - What do you think the temperature is at the height that the airplane flies?
    - What do you think the water temperature will be at the bottom of the ocean?
    - We received notification from our shipping agent in Brisbane that the package had arrived safely on October 28, 2009.
3. We will unpack the boxes when we meet the ship in Australia.
4. Let's send a cup down at one of our shallow stations (about 100 m).
    - What is the pressure at the bottom?
    - How does it compare to atmospheric pressure?
5. We'll send the other cups down when the bottom depth is greater than 5000 m.
    - Can you tell by looking at the map where that will be?
6. Results:

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