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After apparently the driest May in many years, it has decided to cool down. It of course decided to cool down and RAIN on my birthday. One of my gifts is a Galileo Thermometer, so thought this would be a great subject.

Editor of ANTENNA:
Peter Toomer –antennae@anzaas.org.au

Galileo thermometer

Based on a thermoscope invented by Galileo Galilei in the early 1600s, the thermometer is called a **Galileo thermometer**. A simple, and fairly accurate thermometer, today it is mostly used as a desk decoration. The thermometer consists of a sealed glass tube that is filled with water and several floating bubbles.

The bubbles are glass spheres filled with a colour liquid mixture; often this is water or alcohol with a colouring.

Attached to each bubble is a little metal tag that indicates a certain temperature.

These metal tags are actually counter weights. The weight of each tag is slightly different from the others. Since the bubbles are all hand-blown glass, they aren't exactly the same size and shape, so the bubbles are calibrated by adding a certain amount of liquid to them so that they have the exact same density. After the weighted tags are attached to the bubbles, each differs very slightly in density (the ratio of mass to volume) from the other bubbles, and the density of all of them is very close to the density of the surrounding liquid (water in this case).

As you might know an object immersed in a fluid experiences two major forces: the downward pull of gravity and the upward push of buoyancy. It is the downward force of gravity that makes this thermometer work.

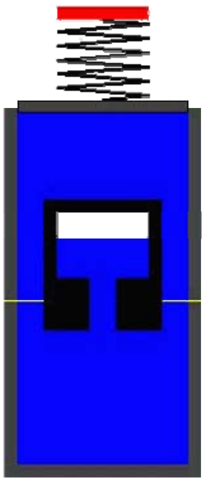
The basic idea is that as the temperature of the air outside the thermometer changes, so does the temperature of the water surrounding the bubbles. As the temperature of the water changes, it either expands or contracts, thereby changing its density. So, at any given density, some of the bubbles will float and others will sink. The bubble is at the bottom of the floating group indicates the current temperature.

Galileo thermometer URL link

http://www.howstuffworks.com/question663.htm

Cartesian diver

A Cartesian diver is an interesting device. It also uses density to work but is implemented using pressure rather then temperature.



The liquid is water, the diver is anything that just floats in the liquid but is open at the bottom. This allows the liquid to enter and lead the diver, this is important. As you can see from the illustration the diver has a bubble of air. The container that the diver is in is a clear plastic bottle. When you press the sides of the bottle the diver will sink, when you let go the diver will rise. But why? It is not temperature, as the movement is too fast. The bubble of air is the clue. As you may know liquids are difficult to compress, whereas a Gas is easy to compress by comparison. So what happens when you press the bottle the liquid being (for the purpose of this experiment) uncompressible, so the only area of give is the bubble of air, as it is compressed more water enters the diver compressing the bubble, thus making it now more dense then the surrounding water. As soon as you stop pressing the pressure on the bubble lowers and the bubble increases in size, thus making the diver less dense, and the diver will rise to the top once again. With careful pressing you can make the diver hover at any point within the bottle.

You can make your own fairly easily. You will need.

- A clear plastic bottle (2 litre soft drink with cap works ok) for the container
- A diver (pen lid works well). Diver must to be able to easily pass through the bottles neck.
- Plasticine or waterproof modelling clay (for plugging holes in diver and providing some weight to diver)
- A bowl of water. Used to calibrate diver

Fill bowl so as the diver can fully float without hitting bottom.

If the diver has a hole at top plug it up so the bubble of air cannot escape. Then weight the bottom of diver so that it floats vertically. The diver should stick out of the water by a little, tip diver so a little water enters but there is still a bubble of air. Check to see if the diver JUST floats at the top . If not allow a bit more water in and try again – More model clay could also be used. Once this is done, fill bottle to the very top, and turn it upside down into the bowl, if all is well only a little air got in. Get your floating diver pull it underwater and put it in the neck of the bottle, it should float to the top of the bottle, if not then a little more air in diver is needed, or less weight from clay. Put cap on bottle (while neck is still underwater) and carefully turn bottle around, diver should ascend to top.

Now slowly press sides of bottle, the diver should descend slowly. Try to make diver float ½ way down bottle also known as Neutral Buoyancy as the dive neither rises or drops. Have fun.

Cartesian diver URL Link. This has a Java Applet you can play with to see how the device works.

http://lectureonline.cl.msu.edu/~mmp/applist/f/f.htm

In SCUBA diving once a diver gets to the diving depth, the inflatable vest they wear, has air added to it so the diver achieves neutral buoyancy. By breathing naturally a diver will ascend / descend slightly but overall the level underwater will remain constant.

The Cartesian diver is based around displacement, as discovered by a chap called Archimedes, you know, the guy who is said to have coined the phrase 'Eureka', after getting into a rather full bath. Well I have a theory about that. It of course cant be proved, but here it is. Archi (as his friends knew him) was very busy and had not taken a bath for a few days – Well people around him kept saying you reeka, go have a bath. The rest they say is history.

Cheers everyone – Peter.