ANTENNA

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Greetings Science enthusiasts, summer is upon us and holidays not far away. What to do with tis time? Well I'm a certified SCUBA diver and will be spending my time swimming with the fishes. For this issue I'll go into what is required so swim beneath the waves. To see another world, to interact with other species on their turf – so to speak.

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SCUBA is an acronym that is: **S**elf **C**ontained **U**nderwater **B**reathing **A**pparatus. Basically it is a set of equipment that will allow someone to survive underwater for an extended time – Primarily breathing underwater.

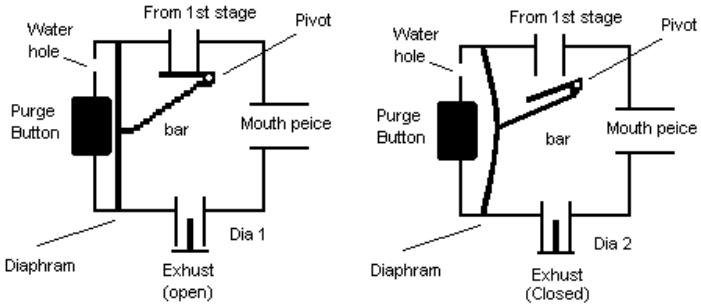
What do you need? The minimum equipment list is:

- A tank of air
- BCD. Buoyancy Compensation Device
- Regulator
- Weights – often as a belt.
- Fins
- Mask
- Wetsuit

The air is for breathing, no big secret about that. The tank is attached to the BCD, the regulator is attached to the tank and the BCD. The weights are and the BCD are for making the diver Neutrally buoyant once the diver gets to the desired diving depth. Fins are to move, and the mask is so you can see underwater.

To have enough air to use for diving it must be compressed, fortunately air is a gas, and like all gasses is compressible so that a great amount of air can be carried in a small container. The average scuba cylinder will hold around 2,300 litres of air. Now this is under great pressure, so to get it to a pressure that we can safely use a regulator is used. A scuba regulator is in 2 stages both work on the same principles.

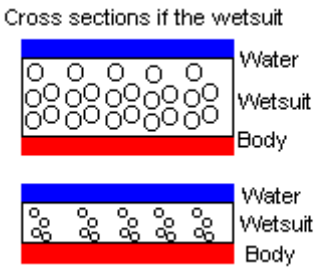
Using picture 1, you can see that water freely enters to the diaphragm, as you go deeper the water will push the diaphragm onto the bar. The bar is on a pivot so when pushed will open the port from the first stage and allow air into the chamber, once the pressure in the chamber is greater then the water pressure the diaphragm is pushed back and the port is closed. This keeps the pressure equalised in the chamber so air is not free flowing until needed. When a diver breaths in, (Dia 2) causes the pressure to drop, diaphragm (assisted by water pressure) is forced in, airflows into regulator and the diver can breathe in. As soon as the diver stops breathing in the pressure equalises and the airflow will stop.



When the diver breathes out, (Dia 1) the pressure in the chamber increases and the flap over the exhaust port opens to allow the air out. As soon as the dive stops breathing out the water pressure will push against the flap and close off the chamber to the water.

Sometime a diver will not have the mouthpiece/2nd stage (it is one in the same unit) and water will get into the chamber, this is where the purge button comes in. The diver puts the mouthpiece into their mouth and puts their tongue over the hole, then presses the purge button, which pushes the diaphragm which pushes on the bar and opens the port allowing air into the chamber, since the diver is stopping the water from going past the mouth piece the water goes out of the exhaust port. The dive can then inhale and get some air. The process only takes a few seconds.

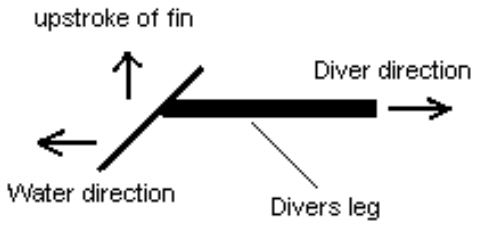
A body is less dense then water so is the wetsuit. So a weight belt is needed to get the diver to decent into the water. Ideally the weight should be just enough to counter the body and wetsuits buoyancy, and allow the diver to go down. A wetsuit is made up of a rubber like material that is full of bubbles. As such a wetsuit will float



As soon as a diver starts their decent the bubbles start to compress as a result they get smaller and the wetsuit become less buoyant. The weight belt, which was JUST enough to get the diver to descend, now becomes a weight greatly more then is needed, that's where a BCD comes in.

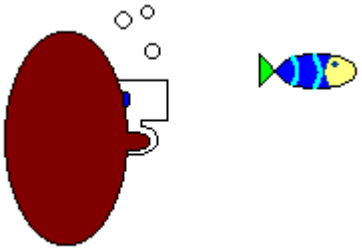
The BCD is connected to the tank so air can be put in. There is a valve to let air out as needed. The BCD is a vest like and is designed to hold the tank, is often has pockets and clips for holding other items. The main function of a BSD is to make a diver neutrally buoyant, that is neither going up or down. This is done by adding or venting air from the vest until the correct buoyancy is achieved.

The fins help propel the diver in the desired direction, as the diver moves the fin up or down the angled surface forces water away from the diver, and as a result move the diver forward. The image is not fully correct, due to the joints in the foot there is almost no real forward motion on the upstroke, most of the forward motion is from the downstroke of the fin.



Ok we are underwater neutrally buoyant and moving – into everything, as we cannot see clearly, the eye is designed to view through clear gasses, fortunately air is clear but we need a way of taking a bubble of ait with us – The mask is ideal. Provided the eyes have a bit of air in front of them the diver can see underwater.

But why a mask and not swimming goggles? Because we are dealing with pressure we need a way of equalising pressure in the mask, so it is the same as the water pressure outside. Enter the nose, by exhaling through the nose, air is forced into the mask and will equalise pressure. Excess air will be forced past the area where the mask edge is against the face. All diving masks have a soft area where the nose is. This is so the diver can squeeze their nose during decent and equalise the area around the eardrum by gently blowing into their nose. This causes some air to be forced into the inner ear and the ears to 'pop', which indicates the pressure is equalised, if a diver doesn't do this it quickly becomes painful. Many people have had a similar experience when driving up large hills, as they go up the air pressure decreases and sometimes they will hear there ears pop, this is the eardrum equalising pressure between both sides of the eardrum.



Congratulations your now underwater, breathing air and neutrally buoyant, moving and can see. Now we can look at the underwater world. Many have always wanted to be astronauts, diving is the same if you think about it – the need for protective clothing, and an air source. Your now and aquanaut, your weightless and have many more things to see that are equally alien to many as a visitor from beyond the earth.

http://www.howstuffworks.com/scuba.htm has moving pictures of regulators if you wish to have a look.

Why cant I breath underwater?

One thing about chemicals is that, once they react in certain ways, they form compounds that are nothing like the original elements. For example, if you react carbon, hydrogen and oxygen together one way you get glucose ($C_6H_{12}O_6$. If you react them together another way you get vinegar ($C_2H_4O_2$). If you react them yet another way you get ethanol (C_2H_5OH). Glucose, ethanol and vinegar are nothing like each other, but they are all made from the same elements. So once Hydrogen and Oxygen combine it is no longer useful for breathing, I does though provide a refreshing drink when chilled.

A final Farwell for the year

I wish you all a great Christmas, thank you for taking the time to read the newsletters over the past year.

If you have any suggestions, comments or articles please send to me at pjt2@ihug.com.au

Take care and I'll see you in the New Year - Peter