

The buoyant force of a liquid depends on its **density**, which equals its weight per unit volume. The Buoyant Force is a very characteristic force that acts upon all submerged bodies. This is how Archimedes' Principle explains buoyancy:

**A body immersed in a liquid, either wholly or partially, is buoyed up by a force equal to the weight of the liquid displaced by the body.**

The following mathematical equation can be derived from Archimedes' Principle:

the buoyancy of a submerged body = weight of displaced liquid – weight of the body. Therefore, we may conclude that:

- 1 **The body will float** if the buoyancy is positive  
(body weight < weight of displaced liquid).
- 2 **The body will be suspended** if the buoyancy is neutral  
(body weight = weight of displaced liquid).
- 3 **The body will sink** if the buoyancy is negative  
(body weight > weight of displaced liquid).

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The density of fresh water is 62.4 pounds per cubic foot (28.3 kg/ 0.03 m<sup>3</sup>).

Seawater, however, is denser: 64 pounds per cubic foot (29 kg/0.03 m<sup>3</sup>).

A body immersed in seawater will, therefore, be buoyed up by a greater force than a body immersed in fresh water, so it is easier to float in seawater than in fresh water. weight per unit volume.

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## Effects of breathing high pressure gas!

### Decompression sickness

The diver must avoid the formation of gas bubbles in the body, called [decompression sickness](#)<sup>[3]</sup> or 'the bends', by releasing the water pressure on the body slowly at the end of the dive and allowing gases trapped in the bloodstream to gradually break solution and leave the body, called "off-gassing." This is done by making safety stops or [decompression stops](#) and ascending slowly. Decompression sickness must be treated promptly, typically in a [recompression chamber](#). Administering enriched-oxygen breathing gas or pure [oxygen](#) to a decompression sickness stricken diver on the surface is a good form of [first aid](#) for decompression sickness, although fatality or permanent disability may still occur.

### Nitrogen narcosis

[Nitrogen narcosis](#) or inert gas narcosis is a reversible alteration in consciousness producing a state similar to alcohol intoxication in divers who breathe high pressure gas at depth.<sup>[3]</sup> The mechanism is similar to that of nitrous oxide, or "laughing gas," administered as anesthesia. Being "narced" can impair judgment and make diving very dangerous. Narcosis starts to affect some divers at 66 feet (20 meters). At 66 feet (20 m), Narcosis manifests itself as slight giddiness. The effects increase drastically with the increase in depth, [Jacques Cousteau](#) famously described it as the "rapture of the deep."

### Oxygen toxicity

Oxygen toxicity occurs when oxygen in the body exceeds a safe "[partial pressure](#)" (PPO<sub>2</sub>).<sup>[3]</sup> In extreme cases it affects the central nervous system and causes a [seizure](#), which can result in the diver spitting out his regulator and drowning. Oxygen toxicity is preventable provided one never exceeds the established maximum depth of a given breathing gas. For deep dives, (generally past 180 feet / 55 meters) "hypoxic blends" containing a lower percentage of oxygen than atmospheric air are used.

The Hyperbaric Recompression Chamber is used for the treatment of decompression illness (The Bends), Hyperbaric Oxygen Therapy (HBOT) for carbon monoxide poisoning, and used to help heal other wounds and infections.



### **Hydrostatic Pressure. The water on the surface pushes down on the water below**

and so on down to the bottom where, at the greatest depths of the ocean (approximately 36,000 fsw), the pressure is more than 8 tons per square inch (1,100 ata). The pressure due to the weight of a water column is referred to as hydrostatic pressure.

A gas will compress proportionately to the amount of pressure exerted on it. For example, if you have a 1 cubic foot balloon and double the pressure on it, it will be compressed to 1/2 cubic foot. Increase the pressure by 4, and the volume will drop to 1/4 the size etc. This theory was discovered by Sir Robert Boyle, a 17th century scientist. The theory known as Boyle's Law states: *If the temperature remains constant, the volume of a given mass of gas is inversely proportional to the absolute pressure.*

### **Let's follow an example...**

Suppose you had a balloon measuring one cubic foot at the surface of the water. This balloon is under 1 ATM (**Atmosphere**) (14.7 psi) of pressure. If we push the balloon underwater, and take it to a depth of 33 feet, it is now under 2 ATM of pressure (29.4 lbs) - 1 ATM of pressure from the air, 1 ATM of pressure from the water. Boyle's Law then tells us that since we have twice the absolute pressure, the volume of the balloon will be decreased to one half. It follows then, that taking the balloon to 66 feet, the pressure would compress the balloon to one third its original size, 99 feet would make it 1/4 etc.

The change in pressure with depth is so pronounced that the feet of a 6-foot tall person standing underwater is exposed to pressure that is almost 3 pounds per square inch greater than that exerted at his head.

# Mythbusters - Compressed Diver \*Gory\*



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