WaterSafe AUCKLAND INC. WAI ORA

Building a water safety culture

Teacher Guide
Why lifejackets float

What is a lifejacket?

A lifejacket or personal flotation device (PFD) is designed to keep an individual afloat in the water in the event of an emergency and so is considered life-saving equipment. It will help to keep a person on the water's surface in a relatively upright position but slightly inclined backwards, to allow the person to breathe and not have to tread water (expend energy) to stay afloat.

Why do lifejackets float?

Most lifejackets rely on air or gas to provide buoyancy. Early lifejackets were made of kapok fibre sealed in treated canvas pouches. These pouches could be punctured and so the lifejacket lost its buoyancy. Also, kapok is easily compressed, thus losing its buoyancy.

Today standard PFDs are made of foam and covered in a nylon outer layer. It is the density (see below) of the foam that determines the lifejacket's buoyancy. The foam used is closed cell foam and it was introduced into lifejacket design in the 1970s. This foam is full of tiny individually made air pockets called cells. These pockets are not connected to each other at all. It is these isolated yet tightly packed air-filled pockets that provide the flotation in the foam. Closed cell foam can be punctured over and over again with only a minimal affect on buoyancy.

The latest trend in lifejacket design is the development of the inflatable lifejacket. These lie flat on the body until inflation occurs. Inflation can be spontaneous on immersion into water or manual by pulling a tab. The inflation works by triggering the release of carbon dioxide. However, the lifejacket is not active until the carbon dioxide is activated and released into its cavities.

Remember, ***Lifejackets - They won't work if you don't use them!***

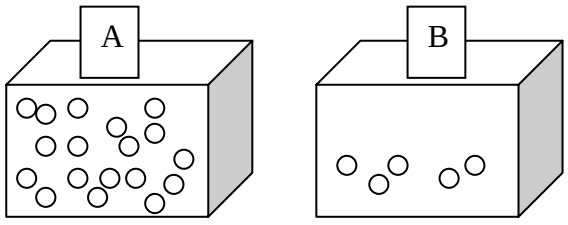
Flotation

Density and displacement are important concepts when considering buoyancy. Materials with a density less than that of water will float. Objects with air trapped in them will tend to float, as will objects that are shaped to include air, such as a boat. Closed cell foam has a density less than that of water.

Density

The density of a body is a measure of how tightly the matter, (stuff it is made from) is packed together. It is the ratio of mass to volume. Mass is in grams and volume per cubic centimetre.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$



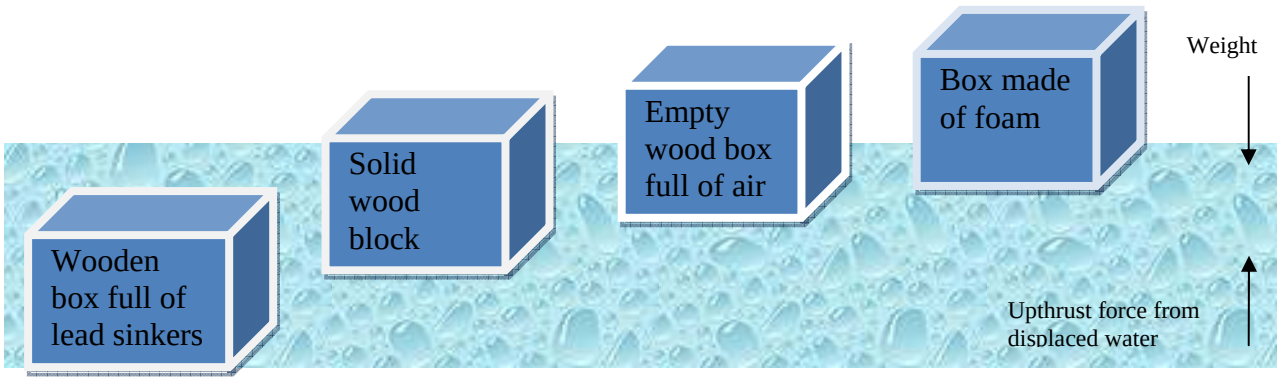
Box A and B are made of the same materials and are the same size. If each round sphere weighed the same, which box would be heavier and why? Answer - The box that has more spheres, box A, as it has more mass per unit of volume. So it has a greater density. The same would apply to a solid wood block and a hollow wooden box of the same size full of air. Air is a gas. All gases have loosely packed particles as in box B.

Different materials have different densities.

	Density g/cm^3
Foam	0.35
Wood	0.85
Water	1.00
Lead	11.3

Displacement

When an object is in water it displaces the water, ie it pushes the water aside. That is why a full cup of water will overflow if an object is placed in it. When you are in water you feel lighter because the water that has been displaced (that is, equal to your volume in the water) is pushing up (upthrust) thus creating buoyancy. For an object to float the weight of the displaced water must be equal to the weight of the object, see diagram below.



The box of lead has sunk because its weight exceeds the upthrust that can be provided by the displaced water.

The solid box floats lower as it has displaced enough water to equal its weight.

The hollow box is lighter, it too has displaced enough water to equal its weight, so it floats higher (less water is displaced).

The box made of foam is so light it hardly displaces any water so it floats even higher than the empty wood box.

A person with air in their lungs will float higher than without air in their lungs. Some people can float on top of the water while others will float lower, and some will even float under the water. However everyone wearing a life jacket will always float on top of the water as both (person and lifejacket) become one unit when the lifejacket is the correct size and fitted correctly.