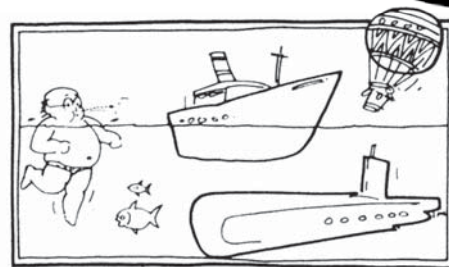


When you walk into the water at a swimming pool or at the beach, do you feel lighter or heavier?

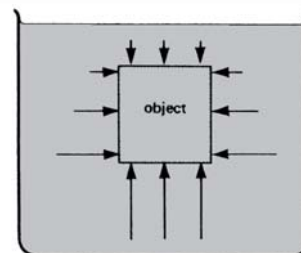
If you walk in deep enough (up to your chin), your feet come off the ground and you start to float. This is because the water is exerting on you a force called **upthrust**.



Upthrust and pressure

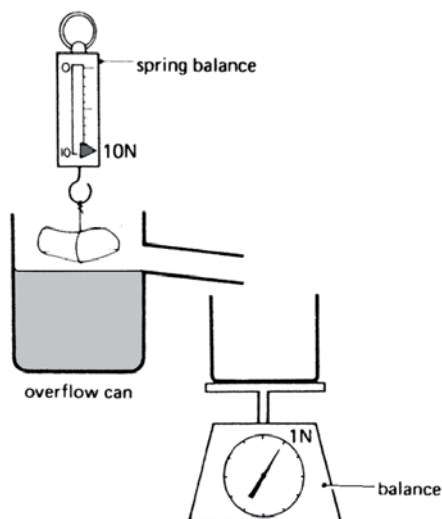
All liquids exert an upthrust like this because the pressure inside the liquid increases as you go deeper (see page 78).

This means that the pressure on the bottom of an object is greater than on the top, and so there is a resultant force upwards :

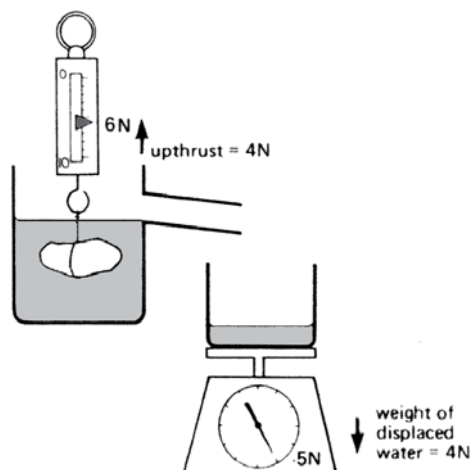


Experiment Archimedes' Principle

Use this apparatus, in 2 steps, to investigate how the **upthrust** depends on **the weight of liquid displaced** by the object.



Step 1 : Weigh the object in air



Step 2 : Weigh it in water

Notice that (in this example) : Upthrust = 4 N
Weight of displaced water = 4 N

This is Archimedes' Principle:

When an object displaces a fluid (a liquid or a gas),

$$\text{Upthrust} = \text{weight of fluid displaced}$$

Because it applies to any fluid (gases as well as liquids), this also explains why hot-air balloons float, and hot air rises.

Long ago Archimedes did shout,
"I have found what it is, without doubt,
The Upthrust (or force),
Is equal (of course),
To the Weight of the fluid pushed out."

In the special case of an object floating, like a ship,

Upthrust = weight of floating object (see diagrams on page 81, 90), so:

Principle of Flotation: Weight of fluid displaced = weight of floating object

If a ship weighs 100 million newton, then it must sink into the water until it displaces 100 million newton of water. If a cargo weighing 1000 N is put on board then the ship will sink until an extra 1000 N of water is displaced.

An object always floats if its density is less than the density of the liquid.