"Any object, wholly or partly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object."

- Archimedes' Principle

Why Ships Float

How could ships weighing thousands of pounds float on water when a small coin sinks right to the bottom? The key was a discovery by a Greek mathematician and inventor named Archimedes.

Archimedes Invents Naval Architecture

The Greek Mathematician and inventor Archimedes lived during the 3rd century BC. According to history, he was in the bath one day when he discovered the principle of **buoyancy** which is the reason why huge Greek ships weighing thousands of pounds could float on water.

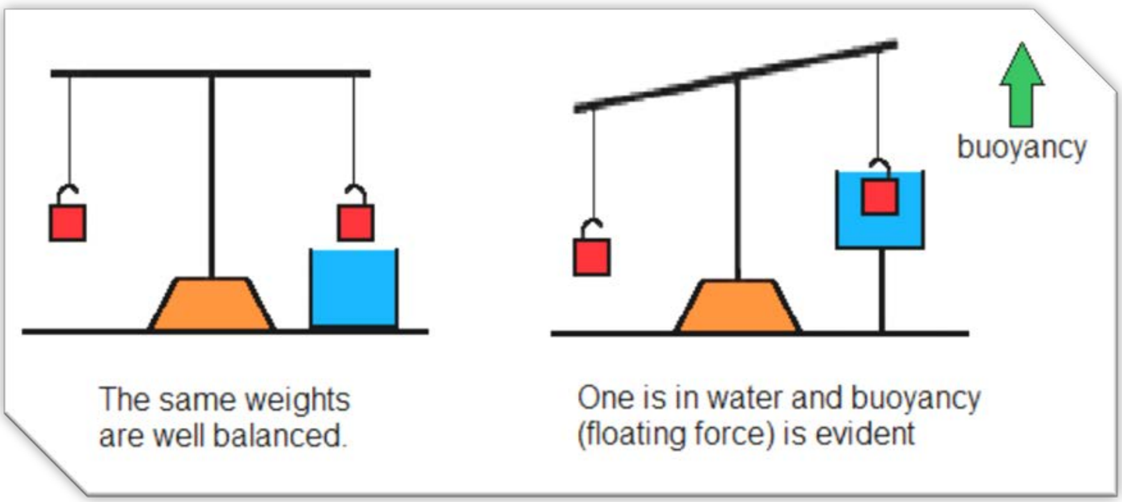
He noticed that as he lowered himself into the bath, the water displaced by his body overflowed the sides and he realised that there was a relationship between his weight and the volume of water displaced.

It is said that he ran naked into the street yelling "heurEka" which is where we get our word "eureka!" (*I found it*) from Greek "heurEka" (*I have found*).

Archimedes' Principle is the foundation on which modern Naval Architecture is built.

The Buoyancy Principle

Archimedes continued to do more experiments and came up with a buoyancy principle that a ship will float when the weight of the water it displaces **equals** the weight of the ship and anything will float if it is shaped to displace its own weight of water before it reaches the point where it will submerge.



Example:

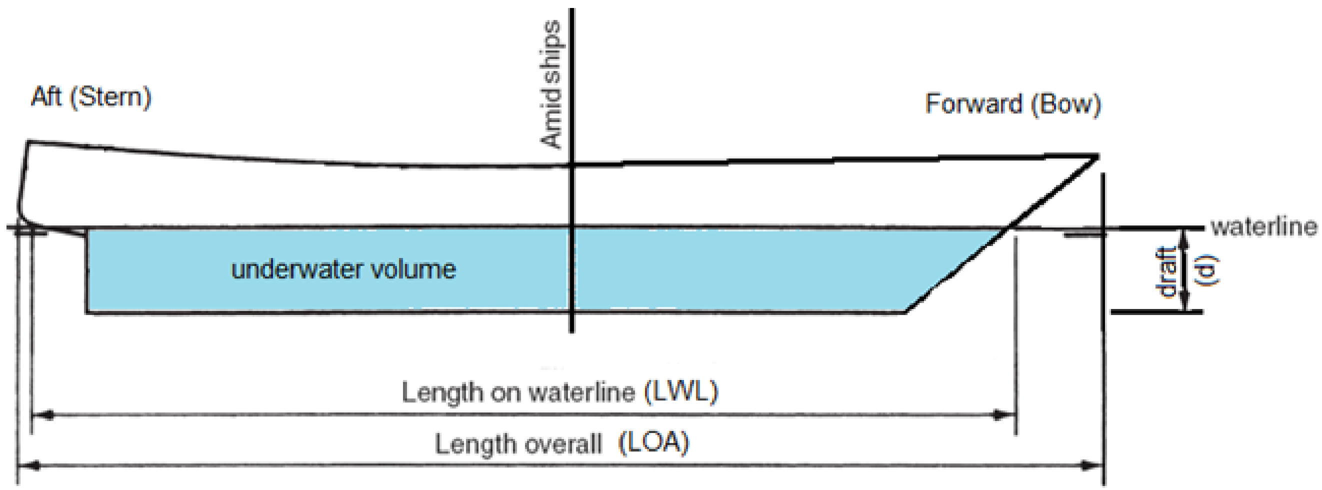
A ship weighs 100 tonnes on dry land. Find the volume of water which will be displaced after the vessel is launched into fresh water.

$$\text{Volume of Displaced Water} = \frac{Weight\ of\ Vessel}{Density\ of\ Fresh\ Water}$$

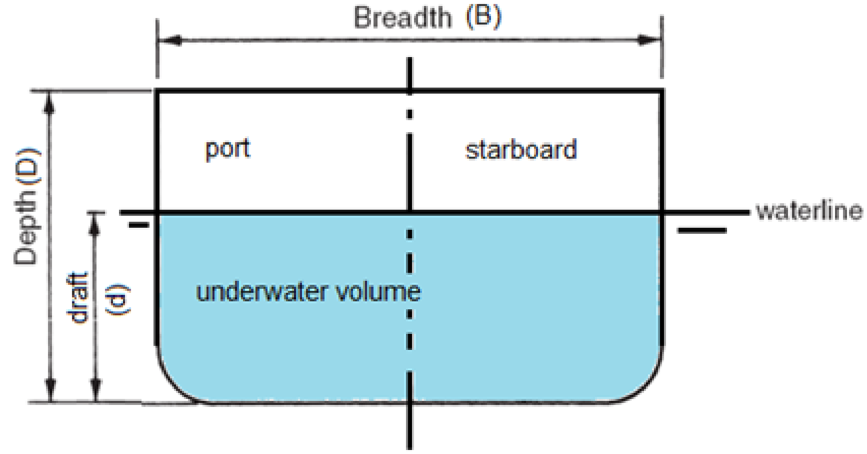
$$= \frac{100\ tonnes}{1.0\ ton\ per\ cubic\ meter}$$

$$= 100\ \text{m}^3$$

Some Common Ship Design Terms



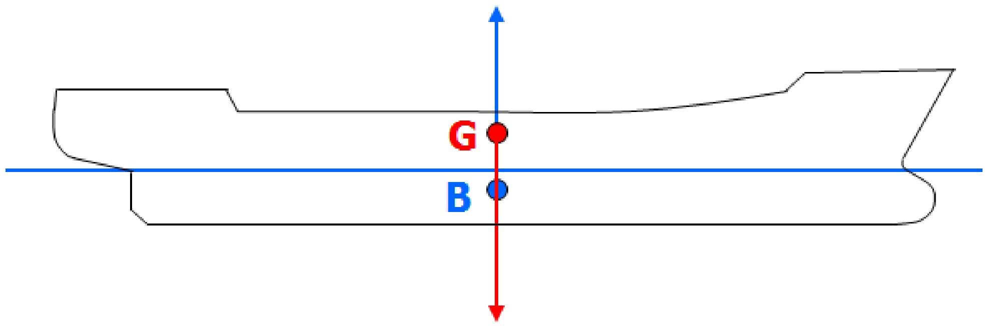
Outboard Profile



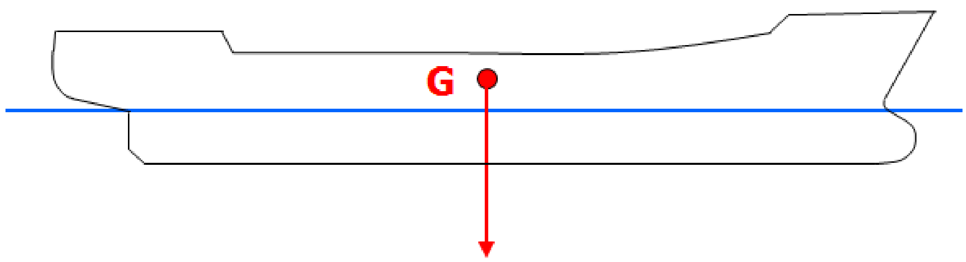
Section at Amidships
Looking Forward

Stability (Why Ships Float)

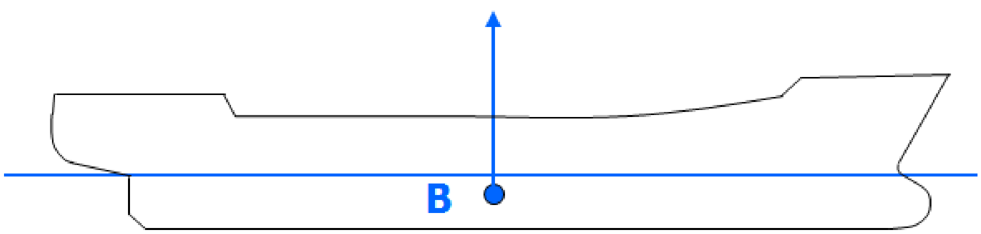
The centres of buoyancy and gravity act together to determine the stability of the vessel. By analysing the relative positions of the centres of gravity and buoyancy, an assessment can be made of the stability of the vessel.



The mass forces trying to **SINK** the ship act through the centre of gravity (G).



The buoyant forces trying to **FLOAT** the ship act through the centre of buoyancy (B).



When the buoyant forces **EQUAL** the mass forces, the vessel floats.

Calculation Worksheet

Include this worksheet as part of your Design Booklet.

School Name: ______________________________ Date Prepared: ________________

Vessel Parameters:

Length on Waterline (LWL): _____________ m

Breadth on Waterline (B): _____________ m

Draft (d): _____________ m

Task 1: **Calculate the approximate *underwater* volume for the vessel.**

Underwater Volume = LWL x B x d

= ______ m x _____ m x _____ m

= __________ m^3

Task 2: **Calculate the approximate weight of the vessel.**

$$\text{Volume of Displaced Water} = \frac{Weight\ of\ Vessel}{Density\ of\ Fresh\ Water}$$

Weight of Vessel = Volume of Displaced Water x Density of FW

= Underwater Volume x Density of FW

= __________ m^3 x 1.0 tons/m^3

= __________ tons x 1016 = __________ kg

Task 3: **Weigh the vessel.**

Measured weight of vessel: ____________ kg

Is there a difference between your calculated weight and your measured weight? If so, why do you think there is a difference?