SCIENCE BEHIND THE CONCEPTS

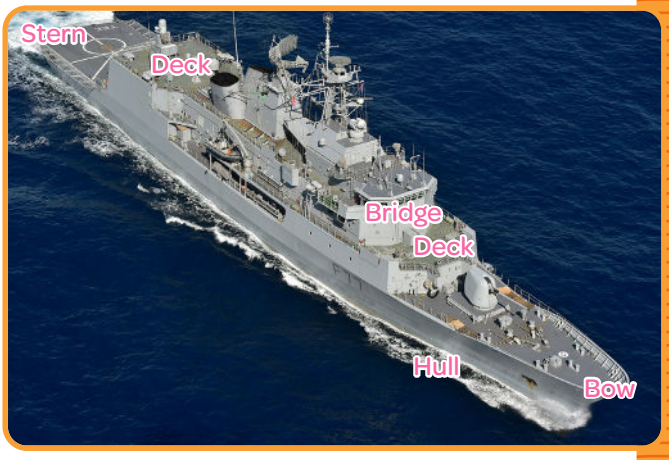
TORPEDO BAY
NAVY MUSEUM

The Science of Buoyancy and Hull Design

BUOYANCY

Buoyancy is all about whether a ship can or can't float in water. Things that float are buoyant.

Whether a ship floats depends on two things; the **weight** of the ship, also called its **displacement**, and the **density** of the ship.

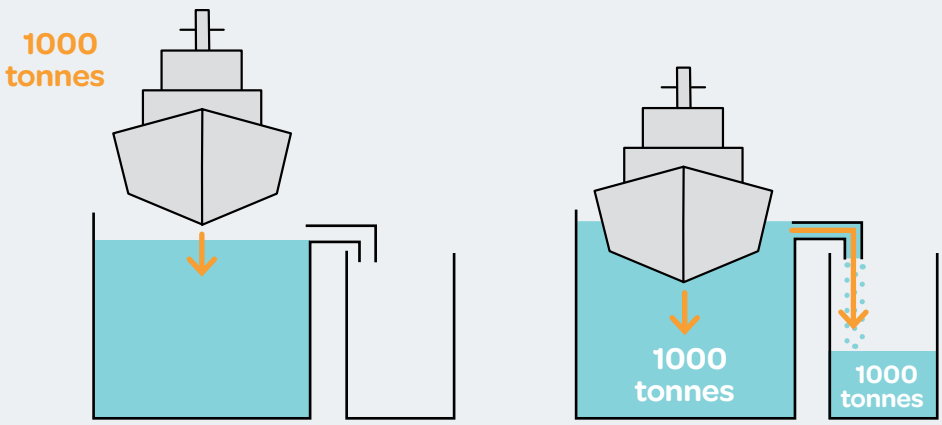


The weight of the ship is due to its **mass** and the **force** pushing down on it due to **gravity**. As the force due to gravity pushes the ship down it pushes aside the water to make room for the ship, this is called its **displacement** or **weight**. Navy ships are made from steel metal which is very heavy so they have a large weight/displacement.

The **density** of the ship is how much matter (stuff) is packed into its volume (size).

If the ship is less dense than the water it is in then it will float. This is because even though it is made from heavy metal, it is shaped so that it is mostly full of air.

Displacement



SCIENCE BEHIND THE CONCEPTS

TORPEDO BAY
NAVY MUSEUM

The Science of Buoyancy and Hull Design

The shape of a ship's hull will determine how stable it is. Stability is the ships' ability to stay upright in the water. This is caused by two **forces** interacting. A **force** is a push or a pull on an object that causes it to speed up, slow down or stay in one place. The two forces interacting when a ship is afloat are the **weight force** due to **gravity** and the **buoyancy force**.

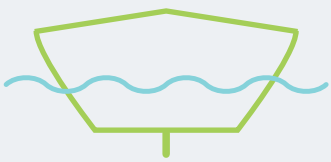
Buoyancy force is the upwards force pushing up on the ship's hull. The strength of the force is equal to the weight or displacement of the ship.

A ship's **stability** is dependent on many things. The distribution of weight on board is very important. If the weight is evenly distributed it is more likely to stay balanced and stable in the water. When taking on supplies this needs to be taken into account as the load needs to be evenly distributed so that the ship stays afloat.

HULL SHAPES

There are many different hull shapes. These are the three simplest:

Flat bottom



The flat bottom hull gives a greater surface area of contact between the ship and the water. This causes a greater displacement of water and leads to a stronger buoyancy force acting on the ship and therefore means it can take a bigger load. However, a flat bottom ship is less stable in large waves as it causes the boat to travel on top of the waves, instead of going through them.

V-shaped

A v-shaped hull decreases the surface area of water in contact with the ship. This decreases the buoyancy force acting on the ship. It also reduces the friction, or water resistance, so the ship can go faster through the water. A v-shaped hull causes the bow of the ship to pierce through the waves rather than go over them so increases stability in rough water. Navy ships have a v-shaped hull.

Round bottom

A round bottom hull is smooth and has less surface area in contact with the water than a flat bottom. Therefore, the buoyancy force is less so it can only take a small load, but it has low water resistance so it can go faster. Round bottom hulls are more unstable so they are prone to rocking and capsizing.