

SCIENCE NOTES

This page reveals some of the science behind boat design

How do boats float?

For your solar boat to float it's hull must displace water to create an upward buoyant force equal to the weight of the boat.

Archimedes principle: A force equal to the weight of the fluid it displaces buoys up a floating or immersed object.

From this we can see that the boat must displace a weight of water equal to its own weight.

Stability

The boat must be stable in the water to reduce the danger of capsizing.

Centre of gravity:

The weight of the boat can be conceived as a downward force at the centre of gravity.

The position of the centre of gravity depends on distribution of mass in the materials that make up the boat.

Centre of buoyancy:

The counterbalancing upward force acts at the centre of buoyancy which is at the centre of gravity of the volume of water displaced by the hull. The position of the centre of buoyancy depends on the shape of the hull.

Drag

Drag from the substance through which an object is traveling tends to slow it down.

Your boat will be moving through two substances:

Water drag

Water is much thicker than air (nearly 800 times) so a boat experiences most of its drag from the water. If there are no water currents then water-drag on the boat will vary only with the speed of the boat.

Generally, the greater the formation of water turbulence by the hull moving through it the greater the drag. A smooth hull with a clean entry and exit line experiences less drag than one which produces a big wake or a lot of turbulence.

A lighter boat will displace less water than a heavier boat so there will be less drag from the water as the boat travels along the course.

Air drag

If the air were perfectly still then the air drag on your solar boat would be much less than the water drag. Air is much thinner than water but it still has mass and density so if the air is moving (as it surely will be) it may exert a significant force on the boat (the principle behind a sail boat). Wind assistance is not allowed in the solar boat race. Try to design the shape of your boat so it is affected as little as possible by wind direction.

Propulsion

A boat must be forced against the drag it experiences for it to move through the water & air. On your solar boat this is the job of the propeller, which will be powered by the solar cells & motor/s. A spinning propeller forces water backwards, which creates reaction force pushing the boat forwards.