

## The concepts of physics can be used to help an athlete increase their chance of winning a medal!

The athlete needs to use skill and tactics to maximise the **thrust force** and minimise the **drag force** while making their way around the course in the changing wind.

### Newton's third law

For every action there is an equal and opposite reaction.

### The forces involved:

- weight force downwards
- lift force upwards
- thrust force (push)
- drag force (opposing motion).

Both the sail and the hydrofoil work just like an aeroplane wing, providing the lift and thrust forces.

### Unbalanced forces

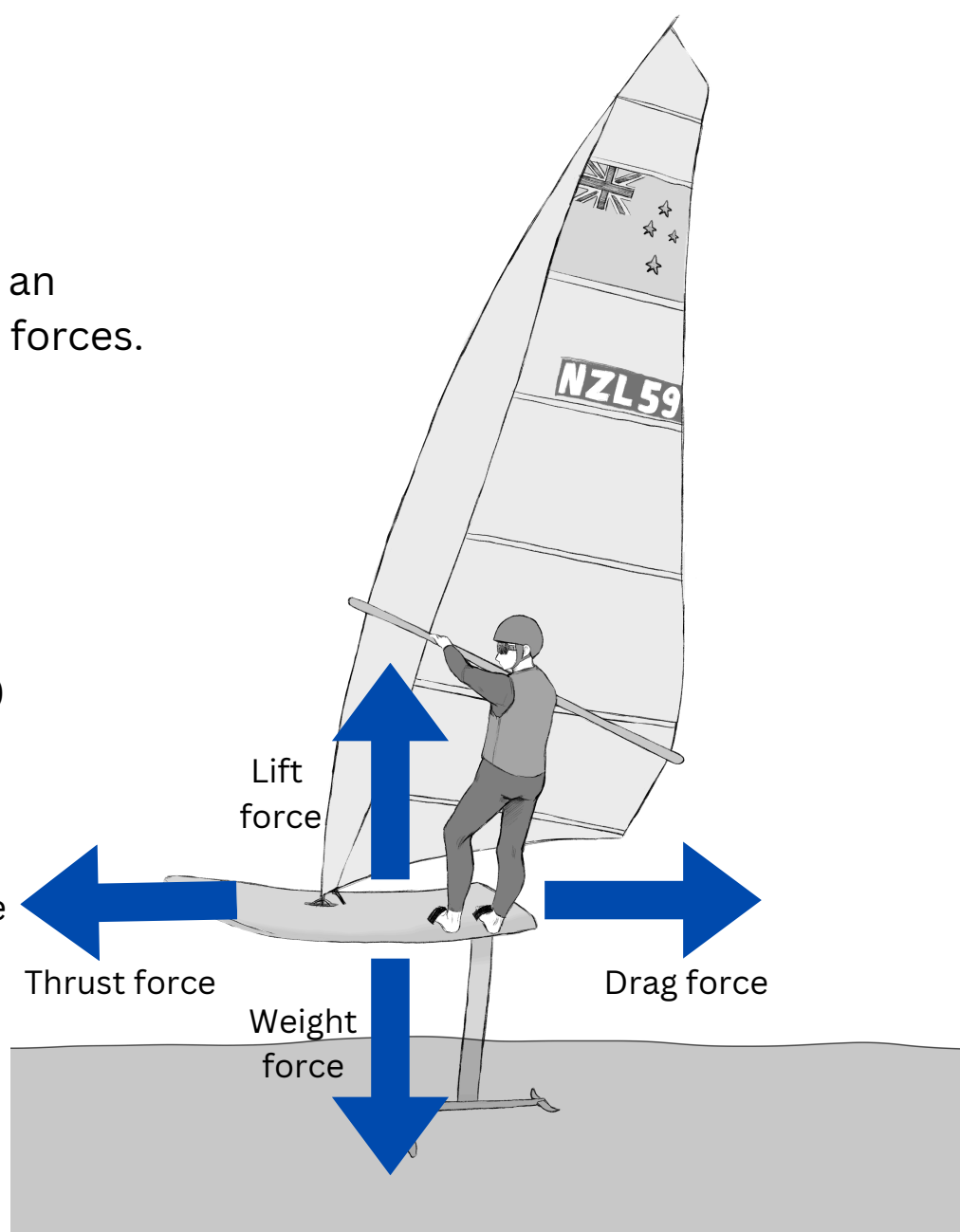
When the **lift force** is **greater than** the **weight force** the board accelerates upwards, rising out of the water.

When the **thrust force** is **greater than** the **drag force** the windsurfer increases speed (accelerates) in the direction of the thrust force.

### Balanced forces

When the **lift force** is **equal to** the **weight force** the board will not accelerate upwards or downwards. It could be rising or falling at a steady rate, or remain at a constant height out of the water.

When the **thrust force** is **equal to** the **drag force** the windsurfer's speed is constant.



Simplified force diagram of a hydrofoiling windsurfer

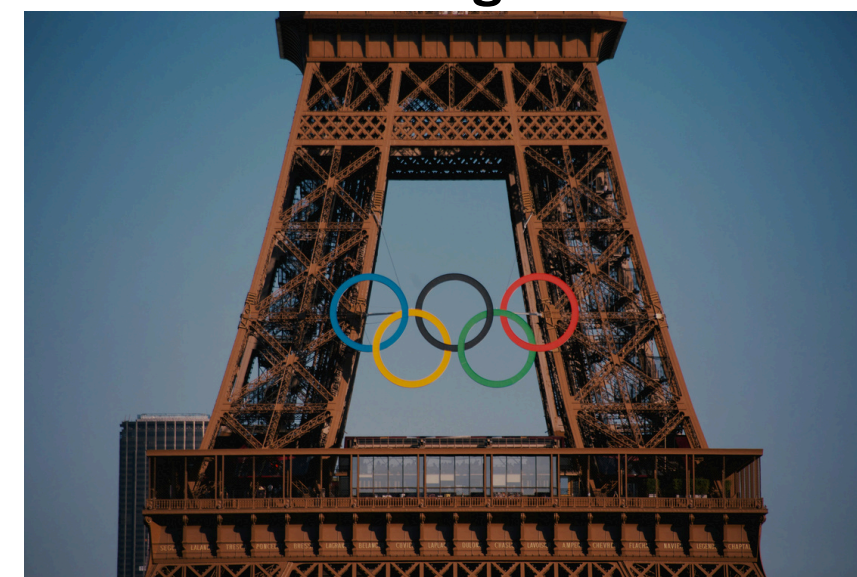


Photo by Bo Zhang on Unsplash

In wind speeds of only 14 knots (7.2m/s) it is amazing how the windsurfers reached speeds of 24 knots (12.3m/s). Equally amazing is how the foiling windsurfers in the Olympic games seem to defy gravity travelling in the air with only a small part of the hydrofoil in the water.

### Key words

**Force-** An interaction between two objects that exerts a push, pull .

**Weight force-** Often termed the force due to gravity it is an interaction between the athlete, equipment and the earth's gravitational field.

**Lift force** -The force upward on the hydrofoil. It is the interaction between the hydrofoil and the water.

**Thrust force-** Thrust is the force in the direction of motion. It is an interaction between the sail and the air.

**Drag force-**The force opposing the motion of the windsurfer is drag. It is an interaction between the parts of the board in the water and the water. When hydrofoiling there is less contact between the board and water therefore decreasing drag force.

### References and useful sources:

<https://www.sciencelearn.org.nz/concepts/energy>

<https://www.sciencelearn.org.nz/resources/313-aerofoils-and-paper-planes>