

11 The Fourth Force of Flight – Weight

What is weight?

Weight is the force generated by the gravitational attraction of the earth on an aeroplane.

The first three forces of flight – lift, thrust and drag – are all controlled in some way by the design of the aeroplane:

- lift by the shape of the wings and fuselage;
- thrust by the engines or force of propulsion; and
- drag by the aerodynamic shape of the aeroplane (it is shaped to reduce resistance to the air).

As well as the lightweight materials used to make the aeroplane, these three things (lift, thrust and drag) help the aeroplane to overcome the fourth force (weight) when it flies.

For a plane to fly it has to overcome the forces from mass, gravity and weight.

- The mass (measured in grams) of a person or an object is the amount of space that they take up. The weight of an object depends on where it is, whereas mass is constant and never changes.
- We can see this when you consider that the force of gravity on the Moon is less than gravity on the Earth. This is because the Earth itself has a greater mass than the Moon, so its gravitational field is greater.
- Gravity acts as a force that interacts with mass to pull it towards the centre of the Earth and so gives us a weight.
- Therefore, while our mass would stay the same on the Moon, our weight would change because the gravitational field is less.
- The mass (measured in grams) of an object does not change, but its weight can vary depending on gravity.
- For convenience, we usually think of gravity as causing objects to fall towards the centre of the Earth. We can see its effect when we drop an object. An object falls to the ground because it is enclosed within the gravitational field of the Earth, which has the effect of pulling an object downwards.
- A plane has a large mass (and therefore a large weight). To keep it in the air we must decrease its weight as much as possible. With less weight the aeroplane requires less thrust to fly. This means it uses less fuel.

Parts of an Aeroplane

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Part of an Aeroplane	Function
fuselage	the body of the plane – holds things together and carries the load
cockpit	area the plane is controlled from
jet engine	generates thrust
wing	generates lift
spoiler	changes lift, drag and roll
flaps	change lift and drag
slats	helps to change the lift
elevator	controls pitch (vertical movement up and down)
rudder	controls yaw (horizontal movement side to side)
aileron	helps control the roll
vertical stabiliser	controls yaw (horizontal movement side to side)
horizontal stabiliser	controls pitch (vertical movement up and down)

Would putting holes in a plane be a good way of reducing weight?

Tape together a bundle of straws and see if you can balance something heavy on it.

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