

# Forces in Motion

## Forces

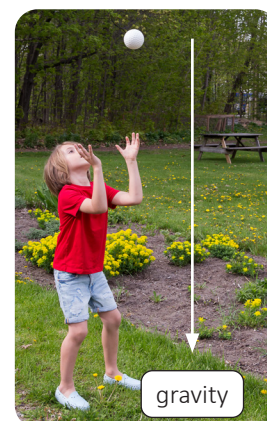
A force is a push or a pull that makes something move, change speed or change shape. A force can be either a contact force or a non-contact force. Friction, air resistance and water resistance are examples of contact forces. Magnetism and gravity are examples of non-contact forces.



## Gravitational force or gravity

All objects have gravity because all objects have mass. Usually, the gravitational force between two objects is very weak because the objects are small. Gravitational force becomes larger as an object's mass increases. Gravity gives an object weight.

Earth's gravity pulls objects towards its centre. Earth's gravitational force is strong because Earth has a large mass. Gravity keeps objects on the surface of the Earth and pulls all unsupported objects to the ground.



## Frictional forces

Friction is in all places where two surfaces meet. It acts in the opposite direction to movement and always slows an object down. The amount of friction depends on the materials from which the surfaces are made. The rougher the materials, the greater the frictional force; the smoother the materials, the smaller the frictional force. Friction can be reduced through streamlining or the use of lubricants, such as water or oil, between surfaces or by using materials with different properties.



## Air resistance

Air resistance is a type of friction. It acts when an object moves through air. The air particles push against the object and slow its movement.

The larger the surface area of an object, the greater the air resistance it will have when it moves. This is because objects with a larger surface area collide with more air particles, causing them to slow down more. Designing objects to have a smaller surface area and streamlined shape decreases air resistance and allows them to move more quickly.



## Water resistance

Water resistance is another type of friction that always acts against the direction of movement. It is caused by water particles hitting an object and slowing it down.

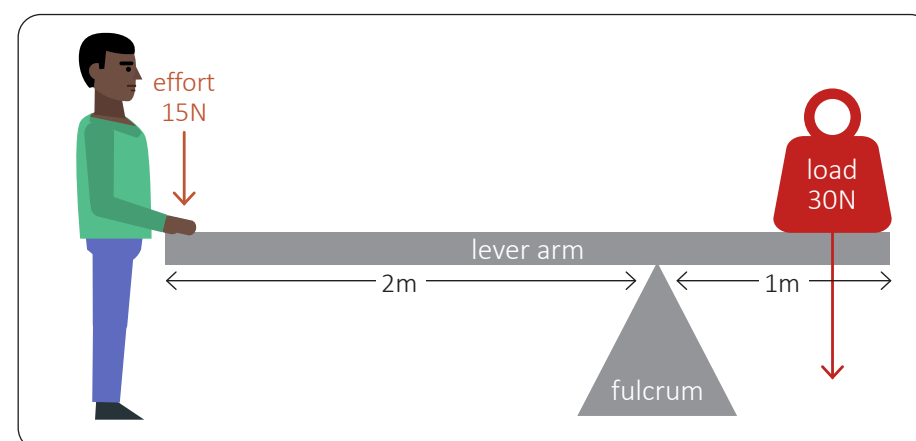
Objects with a large surface area will hit more particles and, therefore, have more water resistance than objects with a smaller surface area.

The larger the surface area of an object, the greater the water resistance it will have when it moves. This will slow it down. Designing objects to have a smaller surface area and streamlined shape decreases water resistance and allows them to move more quickly.



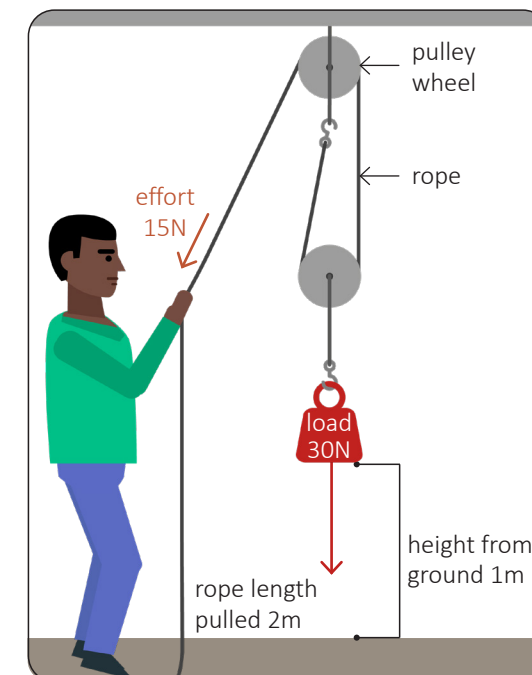
## Levers

Levers are simple machines that can be used to provide a mechanical advantage, so a smaller force can have a greater effect. They consist of a lever arm, a fulcrum, a load to lift and an effort force. Levers make it easier to lift a load. For example if the distance between the fulcrum and the effort is double the distance between the fulcrum and the load, the effort needed will be halved.



## Pulleys

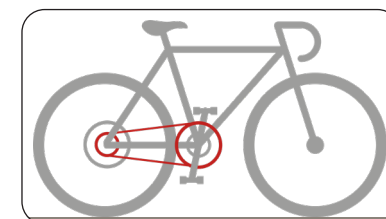
Pulleys are simple machines that can be used to provide a mechanical advantage. They consist of one or more grooved wheels and a rope. Pulleys make it easier to lift a load. For example, when two wheels are used in a pulley, the force needed to lift the load halves. At the same time, the length of rope needed to lift the load 1m off the ground doubles to 2m.



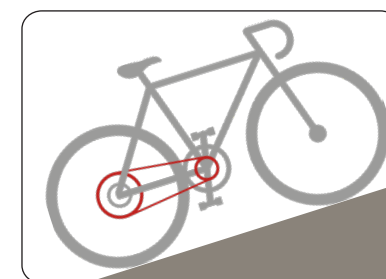
## Gears

Gears are wheels with teeth around their edge. They can be connected directly together, so their teeth mesh and they turn in opposite directions. They can also be connected by a chain to turn in the same direction. Gears of different sizes with different numbers of teeth can create a mechanical advantage. For example, in a mechanism made with a large gear with 12 teeth and a small gear with 6 teeth, the small gear will rotate twice as fast as the large gear but with half the amount of force. Bicycles have different gears. Choosing the right combination of gears can provide a mechanical advantage for the cyclist.

A cyclist can go faster on the flat by using a large gear to pedal slowly attached to a smaller gear at the back, which turns the back wheel quickly.



A cyclist can ride up a hill by using a small gear that is easier to pedal attached to a larger gear, which turns the back wheel slowly but with more force.



Using gears of the same size with the same number of teeth does not give a mechanical advantage because both gears turn with the same force and at the same speed.

