



## Glossary

We have tried to make the glossary as understandable and practical as possible without resorting to difficult equations and long explanations.

- A**
- Acceleration** The rate at which speed increases.  
If a car is accelerating it is moving faster.
- Advantage** The ratio of the output force to the input force of a machine.  
Often a measure of how useful it is to us. This is sometimes called mechanical advantage.
- Air resistance** The force that air creates by pushing back on a vehicle or object that is trying to push through it.  
A streamlined shape creates less air resistance.
- Amplify** To make larger. For instance a lever can amplify the force from your arm.
- Axle** A rod through the centre of a wheel, or through different parts of a cam. It transmits force, via a transmission device, from an engine to the wheel in a car or from your arm via the wheel to the axle if you are winding up a bucket on a rope.
- B**
- Balanced force** An object is balanced and does not move when all the forces acting on it are equal and opposite.
- Bearing** Part of a machine which supports moving parts. Most of the holes in LEGO® elements can work as bearings for LEGO axles.  
The special plastic is very low friction, so axles turn easily.
- Belt** A continuous band stretched around two pulley wheels so one can turn the other. It is usually designed to slip if the follower pulley suddenly stops turning.
- C**
- Calibrate** To set up and mark out the units on a scale for a measuring instrument. We can use known values like brass weights to mark a letter balance scale in grams or a stopwatch to mark off our new timer in seconds. This is called calibrating.
- Cams** A non-circular wheel that rotates and moves a follower. It converts the rotary movement of the cam into reciprocating or oscillating the movement of the follower. Sometimes a circular wheel mounted off-centre on a shaft is used as a cam.
- Compression forces** Forces in a structure that push in opposite directions, trying to squash the structure.
- Control mechanism** A mechanism that regulates an action automatically. A ratchet stops an axle from turning the wrong way; an escapement stops a clock from running too fast.

**Counter balance** A force often provided by the weight of an object you use to reduce or remove the effects of another force. A crane uses a large concrete block on the short arm of its jib to counter the unbalancing effect of the load of the other longer arm.

**Crank** An arm or handle connected to a shaft (or axle) at right angles enabling the shaft to be easily turned.

**D** **Driven gear** See Follower.

**Driver** The part of a machine, usually a gear, pulley, lever, crank or axle, where the force first comes into the machine.

**E** **Efficiency** A measure of how much of the force that goes into a machine comes out as useful work. Friction often wastes a lot of energy, reducing the efficiency of a machine.

**Effort** The force or amount of force that you or something else puts into a machine.

**Energy** The capacity to do work.

**Escapement** A control mechanism in a timer that stops energy from, for example, a spring or falling weight escaping too quickly. Usually it ticks!

**F** **Fair testing** Measuring the performance of a machine by comparing its performance under different conditions.

**Flywheel** A wheel that stores moving energy when it is spinning and releases it slowly. The heavier, wider and faster the wheel, the more energy it stores.

**Follower** Usually a gear, pulley or lever driven by another one. It can also be a lever driven by a cam.

**Force** A push or a pull.

**Friction** The resistance met when one surface is sliding over another, e.g. when an axle is turning in a hole or when you rub your hands together.

**Fulcrum** See Pivot.

**G** **Gear** A toothed wheel or cog. The teeth of gears mesh together to transmit movement. Often called a spur gear.

**Gear, crown** Has teeth that stick out on one side looking like a crown. Mesh it with a regular spur gear to turn the angle of motion through 90°.

**Gear, rack** A flat gear with the teeth equally spaced on a straight line that converts rotational motion into linear motion when a spur gear is meshed against it.

**Gear, worm** A gear with one spiral tooth resembling a screw. Mesh it with a pinion to deliver large forces very slowly.

<b>Gear, bevel</b>	Has teeth that are cut at a 45° angle. When two bevel gears mesh, they change the angle of their axles and movement through 90°.
<b>Gearing down</b>	A small driver turns a larger follower and amplifies the force from the effort. But the follower turns more slowly.
<b>Gearing up</b>	A large driver turns a smaller follower and reduces the force from the effort. But the follower turns more quickly.
<b>Gearing, compound</b>	A combination of gears and axles where at least one axle has two gears of different sizes. Compound gearing results in very big changes to the speed or force of the output compared to the input.
<b>Grip</b>	The grip between two surfaces depends on the amount of friction between them. Tyres grip dry road surfaces better than wet road surfaces.
<b>I</b>	
<b>Idler</b>	A gear or pulley that is turned by a driver and then just turns another follower. It does not transform the forces in the machine.
<b>Inclined plane</b>	A slanted surface or ramp generally used to raise an object with less effort than is needed to lift it directly. A cam is a special sort of continuous inclined plane.
<b>K</b>	
<b>Kinetic energy</b>	The energy of an object that is related to its speed. The faster it travels, the more kinetic energy it has. See also potential energy.
<b>L</b>	
<b>Lever</b>	A bar that pivots about a fixed point when an effort is applied to it.
<b>Lever, first class</b>	The pivot is between the effort and the load. A long effort arm and short load arm amplifies the force at the load arm, e.g. when prying the lid off a can of paint.
<b>Lever, second class</b>	The load is between the effort and the pivot. This lever amplifies the force from the effort to make lifting the load easier, e.g. in a wheelbarrow.
<b>Lever, third class</b>	The effort is between the load and the pivot. This lever amplifies the speed and distance the load moves compared to the effort.
<b>Linkages</b>	A mechanical linkage carries movement and forces through a series of rods or beams connected by moving pivot points. Locking pliers, a scissors lift, a sewing machine and a garage door lock all contain linkages.
<b>Load</b>	Any force a structure is calculated to oppose, such as a weight or mass. It can also refer to the amount of resistance placed on a machine.
<b>M</b>	
<b>Machine</b>	A device that makes work either easier or faster to do. It usually contains mechanisms.

<b>Mass</b>	Mass is the quantity of matter in an object. On Earth, gravitational force pulling your matter makes you weigh say 70 kg. In orbit, you feel weightless – but sadly you still have a mass of 70 kg. Often confused with weight.
<b>Member</b>	The name given to individual parts of a structure, e.g. a door frame is made from two upright members and one cross member.
<b>Mechanism</b>	A simple arrangement of components that transforms the size or direction of a force, and the speed of its output. For instance a lever or two gears meshing.
<b>Momentum</b>	The product of the velocity and mass of an object: velocity not speed because direction is important; mass not weight because it isn't dependant on gravity.
<b>N</b>	
<b>Net weight</b>	The weight of a substance after the weight of its container has been taken away.
<b>P</b>	
<b>Pawl and ratchet</b>	An arrangement of a block or wedge (pawl) and a gear wheel (ratchet) that lets the gear turn in one direction only.
<b>Pendulum</b>	A weight hung from a fixed point so that it can swing freely back and forth under the influence of gravity.
<b>Period of swing</b>	The time it takes for a pendulum to complete one swing. For our pendulum, lowering the weight lengthens the pendulum and lengthens the time or period of swing and vice versa.
<b>Pinion</b>	Another name for a gear that meshes with a gear rack or worm gear.
<b>Pitch</b>	The distance moved by a screw when the screw is turned through one complete turn (360°).
<b>Pivot</b>	The point around which something turns or rotates, such as the pivot of a lever.
<b>Potential energy</b>	The energy of an object that is related to its position. The higher up it is, the more potential energy it has. See also Kinetic energy.
<b>Power</b>	The rate at which a machine does work (work divided by time). See also Work.
<b>Pulley</b>	A wheel with a grooved rim used with a belt, chain or rope.
<b>Pulley, fixed</b>	Changes the direction of the applied force. A fixed pulley does not move with the load.
<b>Pulley, movable</b>	Changes the amount of applied force needed to lift the load. A movable pulley moves with the load.
<b>Pulley block</b>	One or more pulleys in a movable frame with ropes or (block and tackle) chains running around them to one or more fixed pulleys. The pulley block moves with the load and reduces the applied force needed to lift the load.

<b>R</b>	<b>Rack (gear rack)</b>	A specialized gear in the shape of a flat bar with teeth.
	<b>Renewable energy</b>	Energy from a renewable source such as sunlight, wind or flowing water.
	<b>Resetting</b>	Turning a pointer on a scale back to zero again.
	<b>Rigid</b>	A rigid material does not easily stretch or bend and does not deform under load.
	<b>RPM</b>	Revolutions or turns per minute. This is usually the measure of speed of a motor. The LEGO® motor turns at about 400 rpm unloaded (when it is not driving a machine).
<b>S</b>	<b>Sequencing</b>	Setting up actions to happen in the right order and at the correct time intervals. Cams are often used for this purpose.
	<b>Sheave</b>	A pulley wheel with a grooved rim. The groove is used to hold a rope, belt or cable so that it does not slip off the wheel.
	<b>Slip</b>	A belt or rope slipping, usually on a pulley wheel as a safety feature.
	<b>Speed</b>	See Velocity.
	<b>Strut</b>	A member of a structure that is in compression. Struts prevent parts of structures from moving towards each other.
<b>T</b>	<b>Tensile forces</b>	Forces in a structure that pull in opposite directions trying to stretch the structure.
	<b>Tie</b>	A member of a structure that is in tension. Ties prevent parts of structures from moving apart, i.e. they 'tie' them together.
	<b>Torque</b>	The turning force coming from an axle.
	<b>Transmission</b>	A system of gears or pulleys with an input and one or more outputs. A gearbox contains a transmission, and so does a clock.
<b>U</b>	<b>Unbalanced force</b>	A force that is not opposed by an equal and opposite force. An object feeling an unbalanced force must begin to move in some way.
<b>V</b>	<b>Velocity</b>	The speed in a particular direction. To calculate the speed of a vehicle, we divide the distance travelled by the time taken.
<b>W</b>	<b>Weight</b>	See Mass.
	<b>Wind resistance</b>	See Air resistance.
	<b>Work</b>	We calculate the work done by multiplying the force needed to move an object by the distance it is moved (force x distance). See also Power.