Glossary

A

Accelaration — The rate at which speed increases.
If a car is accelerating it is moving faster.

Average speed — The average rate at which an object moves.
Average speed can be calculated using this formula:

$$\text{Average speed} = \frac{\text{Distance}}{\text{Time}}$$

Axle — A rod through the center 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. See also Equilibrium.

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

Cams — A non-circular wheel that rotates and moves a follower. It converts the rotary movement of the cam into reciprocating or oscillating movement of the follower. Sometimes a circular wheel mounted off-center 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 a gear from turning the wrong way.

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

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

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

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.

Engineering design — A systematic and creative design process integrating the principles of science, technology and mathematics.

Equilibrium — A stable situation in which all acting forces cancel one another and thus are in balance.

F

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

Fall — Any weight line e.g. cable or rope which is attached to the load or pulley system.

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 — The point around which something turns or rotates, such as the fulcrum of a lever.

G

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

Gear, bevel — 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°.

Gearing, compound — 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.

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.

Gear ratio — A number that indicates how many revolutions a driven gear makes with one complete turn of the drive gear. The gear ratio is determined by dividing the number of teeth on the driven gear by the number of teeth on the drive gear. A ratio of 1:4 means the driven gear turns four times for every one turn of the drive gear.

	Gearing down	A small drive gear turns a larger driven gear and amplifies the force from the effort. But the driven gear turns more slowly.
	Gearing up	A large drive gear turns a smaller driven gear and reduces the force from the effort. But the driven gear turns more quickly.
I	**Idler**	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.
	Inclined plane	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.
J	**Jib**	The lifting arm of a crane from which the weight line is suspended.
K	**Kinetic energy**	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.
L	**Lever**	A bar that turn about a fixed point (fulcrum) when an effort is applied to it.
	Lever, first class	The fulcrum is between the effort and the load. A long effort arm and short load arm amplifies the force at the load arm.
	Lever, second class	The load is between the effort and the fulcrum. This lever amplifies the force from the effort to make lifting the load easier.
	Lever, third class	The effort is between the load and the fulcrum. This lever amplifies the speed and distance the load moves compared to the effort.
	Linkages	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.
	Load	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.
M	**Machine**	A device that makes work either easier or faster to do. It usually contains mechanisms.
	Mass	Mass is the quantity of matter in an object. On Earth, gravitational force pulling your matter makes you weigh, for example 70 kg. In orbit, you feel weightless – but you still have a mass of 70 kg. Often confused with weight.
	Mechanical advantage	The ratio by which an effort is multiplied, resulting in an advantage in force, speed or distance.
	Mechanical advantage, ideal	The measure of performance of an ideal machine under ideal circumstances. Variables like friction are not taken into account when calculating Ideal Mechanical Advantage.

	Mechanical advantage, actual	The measure of performance of a real machine. All variables like friction are taken into account when calculating actual Mechanical Advantage.
	Member	The name given to individual parts of a structure, e.g. a door frame is made from two upright members and one cross member.
	Momentum	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.
P	**Pawl and Ratchet**	An arrangement of a lever or wedge (pawl) and a gear wheel (ratchet) that lets the gear turn in one direction only.
	Pinion	Another name for a gear that meshes with a gear rack or worm gear.
	Pitch	The distance moved by a screw when the screw is turned through one complete turn (360°).
	Potential energy	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.
	Power	The rate at which a machine does work (work divided by time). See also work.
	Pulley	A wheel with a grooved rim used with a belt, chain or rope.
	Pulley, block and tackle	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 effort needed to lift the load.
	Pulley, fixed	Changes the direction of the effort. A fixed pulley does not move with the load.
	Pulley, movable	Changes the amount of effort needed to lift the load. A movable pulley moves with the load.
R	**Rack (gear rack)**	A specialized gear in the shape of a flat bar with teeth.
	Rigid	A rigid material does not easily stretch or bend and does not deform under load.
	RPM	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).
S	**Sheave**	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.
	Slip	A belt or rope slipping, usually on a pulley wheel as a safety feature.
	Speed	See velocity.
	Simple machine	The six basic mechanical devices that form the basis for practically all machines.
	Strut	A member of a structure that is in compression. Struts prevent parts of structures from moving towards each other.

T

Tensile forces Forces in a structure that pull in opposite directions trying to stretch the structure.

Tie A member of a structure that is in tension. Ties prevent parts of structures from moving apart, i.e. they 'tie' them together.

Transmission A system of gears or pulleys with an input and one or more outputs. A gearbox contains a transmission, and so does a clock.

U

Unbalanced force 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.

V

Velocity The speed in a particular direction. To calculate the speed of a vehicle, we divide the distance travelled by the time taken.

Variable, controlled A variable that serves as a standard in an experiment.

Variable, dependent A variable that is observed and measured in response to the independent variable. The dependent variable will change as a result of changes in the independent variable.

Variable, independent A variable which can be manipulated and changed on purpose in an experiment to affect or cause fluctuation in the value of the dependent variable.

W

Work 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.