

Glossary: The Imagination Factory Toolbox

acceleration	<p>Describes how quickly an object's velocity changes over time.</p> <p><i>A rock that is released from a building increases its speed of falling and therefore is accelerating.</i></p> <p><i>When the rock reaches maximum velocity (therefore its velocity is constant) is not accelerating.</i></p> <p><i>When the rock impacts the ground, its velocity changes and therefore it is accelerating (or decelerating).</i></p>
axle	<p>The rod or shaft attached to the centre of a wheel. The wheel turns and places force on the axle.</p>
belt drive pulleys	<p>Two fixed pulleys of different sizes are connected together with a looped belt. One pulley wheel turns, so the looped belt also turns and drives the second pulley wheel. Things attached to the pulleys can also spin, such as LP record players and washing machine tubs.</p>
bevel gear	<p>Two gears facing each other at right angles, such as those found on egg beaters.</p>
block and tackle	<p>When many pulleys are connected via a rope, it is often called a block and tackle pulley system. The block is the frame around the pulleys. The tackle is the rope or cable connecting the pulleys and the load.</p> <p>A block and tackle is used in garages to lift engines from cars. You will also find these pulley systems on cranes, wharves and ships.</p>
cam	<p>A disc that is usually oval or egg-shaped, but can be any roundish-bumpy shape. As the cam disc spins, it pushes against a rod along its edge. As the rod moves over the cam, it may open or close an attached valve. The cam spins around, but it pushes rods or pistons in a straight line, so round movement becomes linear or straight movement.</p>
camshaft	<p>When many cam discs are threaded onto a rod or shaft, the whole piece is called a camshaft. As the camshaft turns, the cam discs are able to push a series of rods or pistons up and down in a pattern.</p>
crankshaft	<p>Cranks are similar to cams, except the cranks can pivot more and have more of a pushing effect on the crankshaft to turn it around. Crankshafts are normally found at the base of an engine's pistons. As the piston shoots down, it pushes the crankshaft down and around. The crankshaft continues to turn and pushes the piston back up the cylinder and the cycle repeats.</p>
cylinders	<p>A round pipe that contains a moving piston. In an engine, a mixture of fuel and oxygen explodes inside the cylinder, so the piston inside is forced down and pushes a crankshaft around.</p>
displacement	<p>How far an object has moved from its original position.</p> <p><i>A bus that travels 5 km to a school then 5 km back to its original spot has been displaced by 0 km by the end of the trip.</i></p>
distance	<p>How far an object moves on its travels from an original position.</p> <p><i>A bus that travels 5 km to a school then 5 km back to its original spot has travelled a distance of 10 km by the end of the trip.</i></p>



Background Support Notes



eccentric cam	When a cam or a wheel is attached off-centre to a camshaft or axle, it is called an eccentric cam or wheel.
efficiency	<p>Efficiency measures how much work is achieved from the effort or force that is applied to a machine. Efficiency is usually shown as a percentage (%) and can be calculated using the formula:</p> $\text{Efficiency} = (\text{work output in joules} \div \text{work input in joules}) \times 100$ <p>A machine's efficiency can never be 100%. This is because when parts of a machine move against each other, they generate friction (which in turn causes heat energy to be released and the machinery parts to wear away). Modern petrol engines tend to have an efficiency of about 30%.</p>
effort	The force you place on a machine so it does work such as lifting a load, travelling further forward, spinning something faster, etc.
engine	A combination of simple machines that changes fuel (chemical) energy into mechanical and kinetic energy.
force	<p>An influence that causes an object to accelerate. Force is measured in newtons (N). <i>Forces can be pushes, pulls or lifts.</i> A push or a pull can make something change direction, come to a stop or start moving.</p> <p>Force in machines such as pneumatic or hydraulic pistons can be calculated by:</p> $\text{Force} = \text{area} \times \text{pressure}$
friction	A force that occurs when two surfaces rub against each other, which generates heat energy. Mechanical energy is usually lost as heat energy because of friction.
fulcrum	<p>The point where the lever arm pivots. The fulcrum is located in different spots, depending on the type of lever being used (first, second or third-class levers).</p> <p>The position of the fulcrum near the load can also change how much effort is needed to move the load.</p>
gear	<p>Wheels that have bumpy edges or teeth are called gears. Usually the teeth of one gear interlock with the teeth of another gear. When one gear turns, its teeth push on the neighbouring gear's teeth.</p> <p>The number of teeth on gears can be used to calculate how they will push on other gears including how fast they will spin and how much force they will generate.</p>
hydraulic	The study of pressure and flow in liquids. A hydraulic jack uses oil under high pressure to lift large objects more easily.
inclined plane	Inclined planes are like ramps. They can be used to lift something heavy (such as pushing something up a ramp). Longer ramps are less steep (more shallow angle), making it easier to raise a load, but you need to push the load over a longer distance (which means more friction).
input force	How much force (in newtons) is being applied to a simple machine. Some input energy is lost as heat and friction, so total output force can never be equal to or more than the total input force.
joule	One joule is defined as the work done by a constant force of 1 newton when the object being worked on has moved 1 metre.

lever arm	The part of a lever bar between the place where effort is being applied and the position of the fulcrum. The length of the lever arm determines how much effort is needed to shift the load and far (distance) the load can be moved.
load	The thing being lifted, pushed or pulled by a simple machine. Loads usually offer resistance against the machine's movement and the machine needs to overcome this resistance.
magnification of force	Force magnifiers increase the strength or force of moving something. You would find it very difficult to use your bare hands to remove a nail that has been hammered into a piece of wood. Instead, you'd use a pair of pliers or a crowbar (both types of levers). When you squeeze the pliers' handles, they will give you greater force at the jaws to grip and pull out the nail.
magnification of movement	Bike gears and pedals propel you forward much further than if you were simply walking. You may only push a bike's pedal around slightly, but you bike will roll forward about 3 metres—much further than you could step forward.
master cylinder or piston	The piston being pushed and placed directly under pressure to cause a second (slave) piston to move and perform work. The master cylinder drives the slave cylinder.
mechanical advantage	How much force a machine exerts, depending on how much force is applied to the machine and how the simple machine is constructed (e.g., the size of the parts, how far you have to move the parts or distance). No machine can magnify both force AND movement. If you did, you would get more work out of the machine than you put into it, which just isn't possible! Work = force x distance moved So if a machine <i>increases force</i> , it must <i>decrease distance</i> moved. If a machine <i>increases distance</i> moved, it must <i>decrease force</i> .
newton	A unit of force. One newton is the amount of force required to give a 1-kg mass an acceleration of 1 m/s ² .
output force	The work done (usually measured in newtons) by a machine. Some energy is lost as heat and friction, so total output force can never be more than total input force. A machine may apply more force to lift a load than you could use with your bare hands (due to mechanical advantage), but you cannot get more work out of a machine than you put into it.
pascal (Pa)	A unit of pressure recognised by System Internationale (SI) or International System of Units http://www.bipm.org/en/si/si_brochure/general.html
Pascal's Principle/Law	Pressure spreads equally in all directions throughout a fluid (e.g., oil, water, air) in a confined container.
pawl	Pawls are usually found on the end of a pendulum and they stick out at right angles to the pendulum. So as the pendulum swings, the pawl clicks into place on a ratchet wheel's teeth.
pendulum	Pendulums usually have a rod or a string with a mass attached at one end (closest to the ground). As a pendulum swings from side to side, it may control the movement of other machines (such as a ratchet wheel). The length of the rod determines the timing of a pendulum's swing, rather than the weight of the mass at the end of the pendulum.



Background Support Notes



pinion (and rack)	A round gear wheel (pinion) can push a kind of 'flattened' out gear (rack). Rack and pinion gears let you turn a gear to push or pull something else in a straight line. A bottle opener uses rack and pinion gears to pull a cork straight out of a wine bottle.
pistons	The moving rod inside a cylinder. Engine pistons move up and down after fuel explodes inside the cylinder.
pneumatic pistons/cylinders	Pneumatics is the study of pressure and flow in gases. Pneumatic pistons use compressed air (air under pressure) to move loads or other machinery. Hydraulic pistons use liquids such as oil or water.
power	The rate at which work is done. The more power, the <u>faster</u> the work is done (but you cannot get more work out of a machine than you put in). Power = work done ÷ time taken <i>A weightlifter who lifts a bar in 5 seconds has used twice the power of a weightlifter who lifts a bar in 10 seconds.</i> Power (the rate of doing work) can be measured in watts (W), kilowatts (kW or 1000 watts) and megawatts (MW or 1 000 000 watts).
pressure	How much force is applied over an area. This is particularly important in pneumatic and hydraulic pistons, as larger and smaller pistons have larger or smaller area in contact with pressurised fluids.
pulley	A wheel with a grooved outer edge and a rope or string looped around it. Two or more pulley wheels usually have ropes connecting them together to allow the rope to be pulled through.
rack (and pinion)	A round gear wheel (pinion) can push a kind of 'flattened' out gear (rack). Rack and pinion gears let you turn a gear to push or pull something else in a straight line. A bottle opener uses rack and pinion gears to pull a cork straight out of a wine bottle.
ratchet or escapement wheel	Usually found in grandfather clocks, ratchet or escapement wheels have notches or teeth around the edge of the wheel that turn with the action of a swinging pendulum. As the pendulum swings its top bar (pawl) clicks into each tooth on the wheel and stops it continuing to turn forwards or backwards. The wheel turns a sprocket wheel and chain in measured amounts.
screw	A screw is like an inclined plane or a wedge wrapped up around a cylinder. Screws can take a rotating force and change it into a much larger straight-line force.
slave cylinder or piston	The piston that moves and performs work if it is connected to a master cylinder which creates pressure through the system.
speed	Describes how quickly an object moves. <i>A rock that is thrown in the air is travelling at 5 m/s.</i>
sprockets	Sprocket wheels have teeth (or sprockets) around their edges, similar to gears. The sprocket wheels are connected together by a loop of linked chain. The sprockets or teeth are inserted between the chain links and pull the chain along as the sprocket wheels turn.

torque	<p>Torque is a force that twists or changes the rotation of things. Torque is influenced by two factors: the length of the arm that's being rotated, and the strength of the force that is acting on the arm from a direction that is perpendicular to the arm.</p> <p>Torque (causing rotation) = lever arm distance (m) x perpendicular force (N).</p> <p>As the length of the arm increases, torque increases OR you can increase torque by increasing the force. This is true for all three classes of levers.</p> <p>Spanners use torque to twist and unscrew bolts. Longer spanners (a longer lever arm) can unscrew bolts with less force than shorter spanners (shorter lever arms).</p> <p>Wheels are curved levers and they use also torque to do their work. In a wheel, the lever arm distance is the wheel's radius (or the distance between the axle and where force is being applied at the outer edge or rim of the wheel).</p>
valve	<p>A mechanism which controls the flow of fuels (liquid or gas) into a piston cylinder. Valves are usually located at the top of piston cylinders and they are moved up and down by camshafts.</p>
velocity	<p>Describes how quickly an object moves in a particular direction. Velocity is speed with direction.</p> <p><i>A rock that is thrown in the air is travelling at 5 m/s upwards.</i></p>
wedge	<p>A simple machine consisting of a triangular shaped block that can be forced into a gap, giving a greatly increased force.</p>
weight	<p>The force of gravity acting upon a body. It's usually measured in newtons, but in everyday language, we tend to talk about weight in grams or kilograms.</p>
wheel and axle	<p>Wheels are usually round in shape and a rod called an axle is threaded through their centre. As the wheel turns, it places force on the axle and the axle is able to do work.</p> <p>Wheels and axles are like levers that have been bent around in a circle, because the outside of the wheel is where effort is applied, the wheel's axle is its fulcrum. Depending on how the wheel is used (i.e., whether it's a flywheel or steering wheel), it relies on rotational inertia and torque to do its work.</p>
work	<p>Work is equal to the force applied to an object multiplied by the displacement of an object where the object's movement is in the direction you apply the force. The units of work are measured in joules (J).</p> <p><i>A teacher who pushes a table and moves it one metre has done work.</i></p> <p><i>A teacher who pushes a wall without causing it to move has done no work.</i></p>
worm gear	<p>A long, screw or spiral-shaped gear that interlocks with a round gear wheel. As the worm gear turns, it pushes and turns the round gear.</p>