Electricity
Junior Science

https://thetechreader.com/tech/intelligent-electricity-could-it-be-possible-an-insane-original-theory-that-stretches-your-imagination/

GZ Science Resources

Magnets attract some metals but not others

Some objects attract iron and steel. They are called magnets. **Magnetic materials have the ability to attract some materials but to attract and repel each other**

Only iron, cobalt and nickel and some iron alloys like steel are able to act as magnets. The particles that they consist of are able to align themselves so that all their negative ends are facing the same direction.

Aluminium cans are not magnetic whereas 'tins' are largely made of iron and are magnetic.

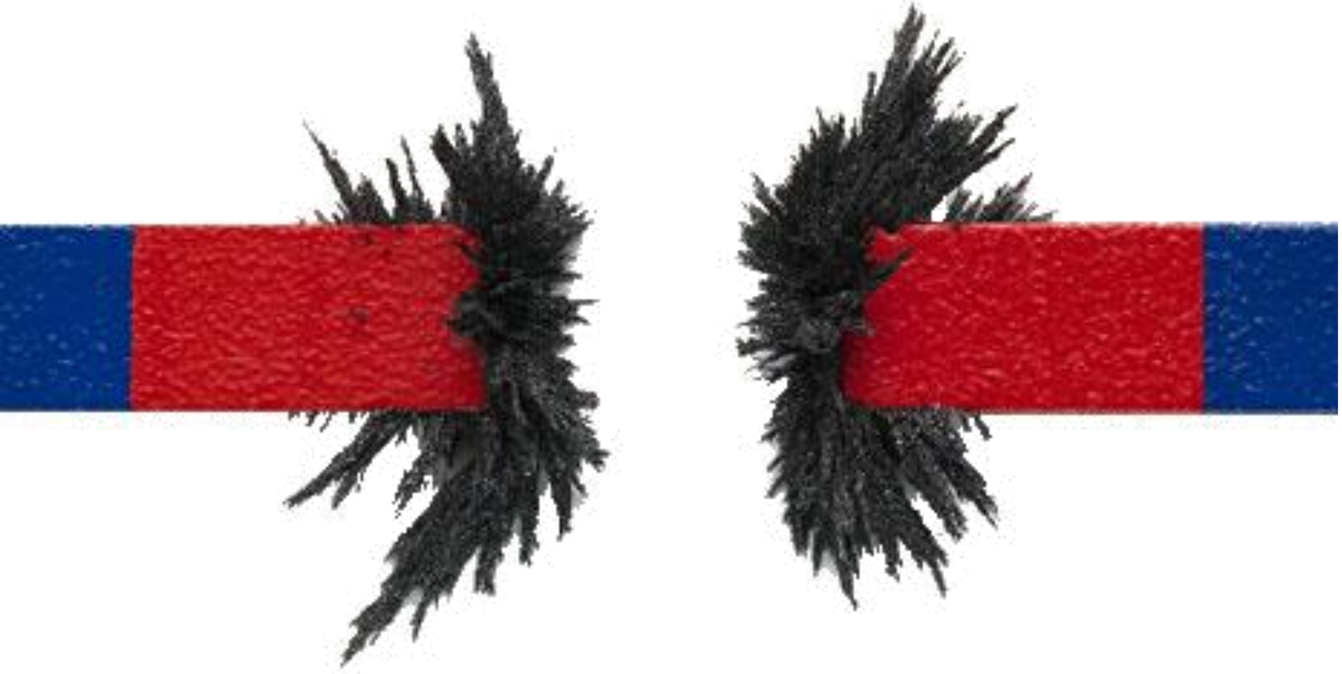
It is sometimes difficult to distinguish between a magnet and a magnetic material. When two magnets are put together there is either attraction or repulsion, but when a magnet and a magnetic material are put together there is just attraction.

The Law of Repulsion and Attraction

A magnet is an object that has a magnetic field around it and attracts objects made of iron.

A **magnetic** field is a region around a magnet where iron objects have a force on them and can be made to move.

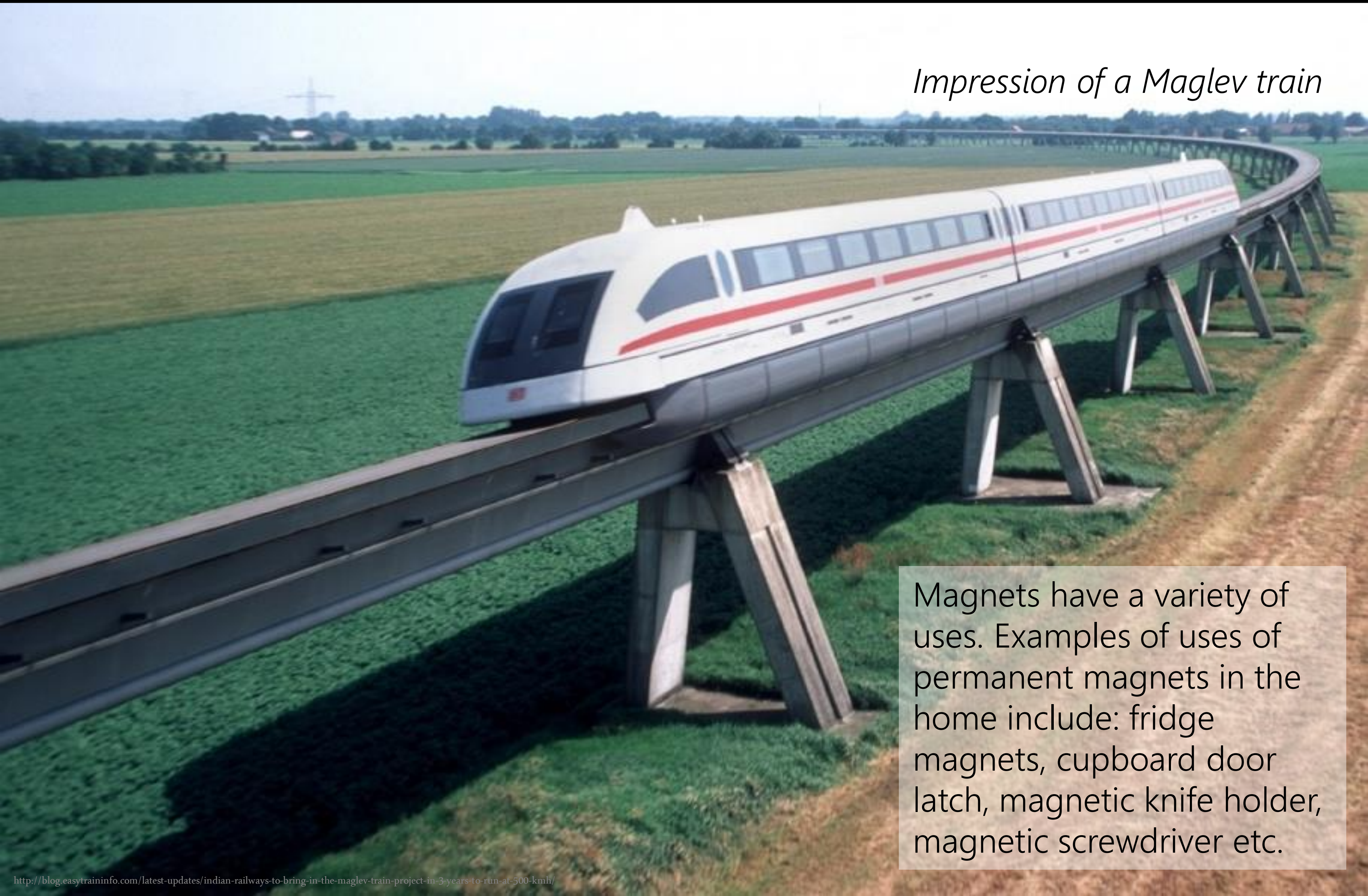
The ends of a magnet are called **poles**, one end is the **N** or **North** pole, the other is the **S** or **South** pole.



Like poles will repel each other. e.g. north and north.

Unlike poles will attract each other. e.g. north and south

Examples of Magnets



Impression of a Maglev train

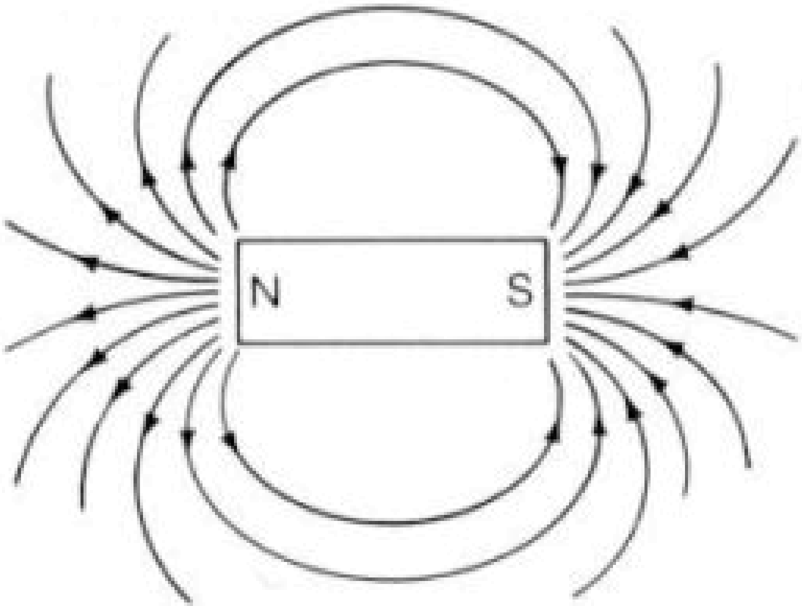
Magnets have a variety of uses. Examples of uses of permanent magnets in the home include: fridge magnets, cupboard door latch, magnetic knife holder, magnetic screwdriver etc.

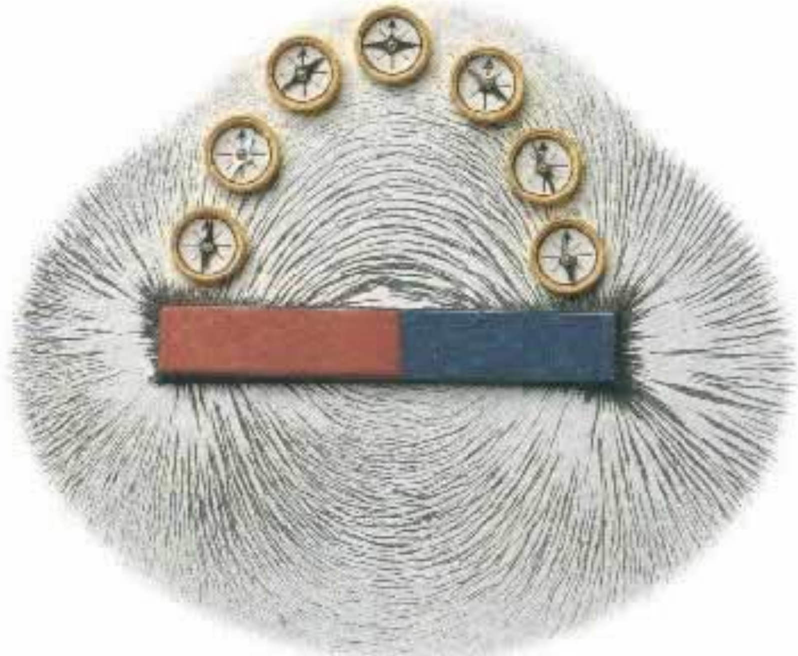
http://blog.easytraininfo.com/latest-updates/indian-railways-to-bring-in-the-maglev-train-project-in-3-years-to-run-at-500-kmh/

Magnetic fields are arranged in fixed patterns

A magnet has a magnetic force field around it. When another magnet or an iron object enters the field it experiences a **force** as either a push or a pull. Field patterns produced by bar magnets can be visualized using iron filings. This is the **magnetic field**. The field lines move out from the N end of a magnet and into the S end.

Compasses, which contain a movable magnet, can also be used to show magnetic fields. The needles will align in the direction of the field.



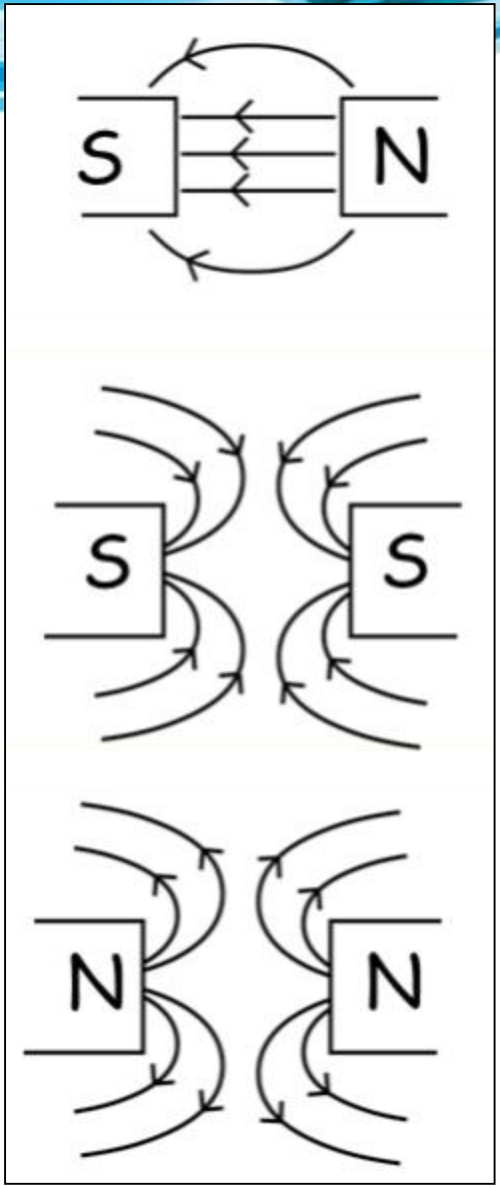


Magnetic field interactions

A strong field is produced between **unlike poles**, moving in the direction between North to South., shown by arrows

Between the middle of **like poles** the net magnetic force is zero due to the fields cancelling out. This is shown by a blank space between.

The field lines move out from a North pole (and into a South pole).

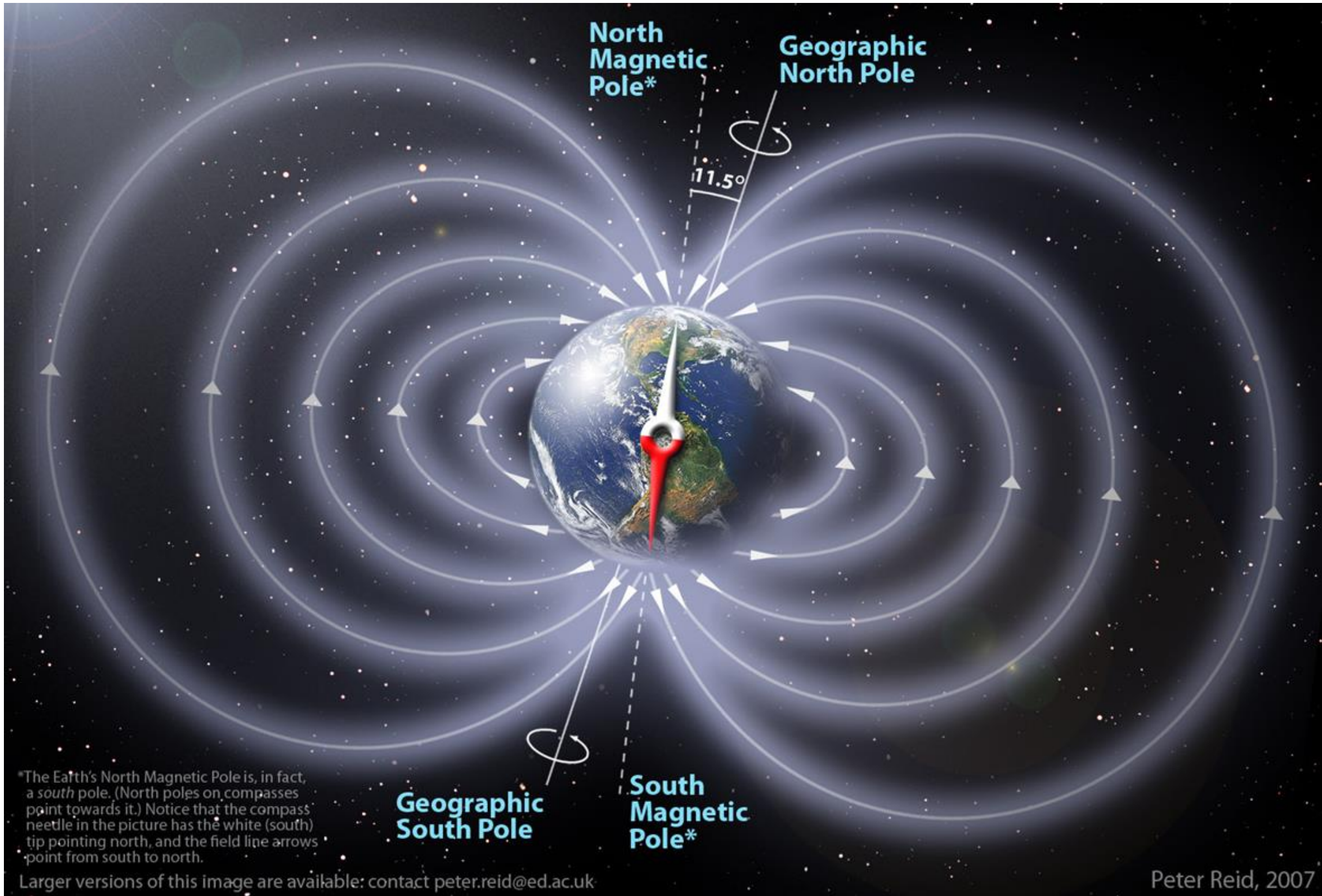


The Earth is surrounded by a magnetic field

extra info

The Earth has a magnetic field. The outer core of the Earth is liquid iron and as heat from the very hot solid iron inner core moves through it then electrical currents are produced. Current Scientific theory suggests that this in turn produces an electric field that stretches far beyond Earth.

This magnetic field produces a North and South Pole, although they are not exactly in the same place as the geographical North and South Pole.
The North of a needle compass is attracted to the South, so the North pole is actually the South Pole!

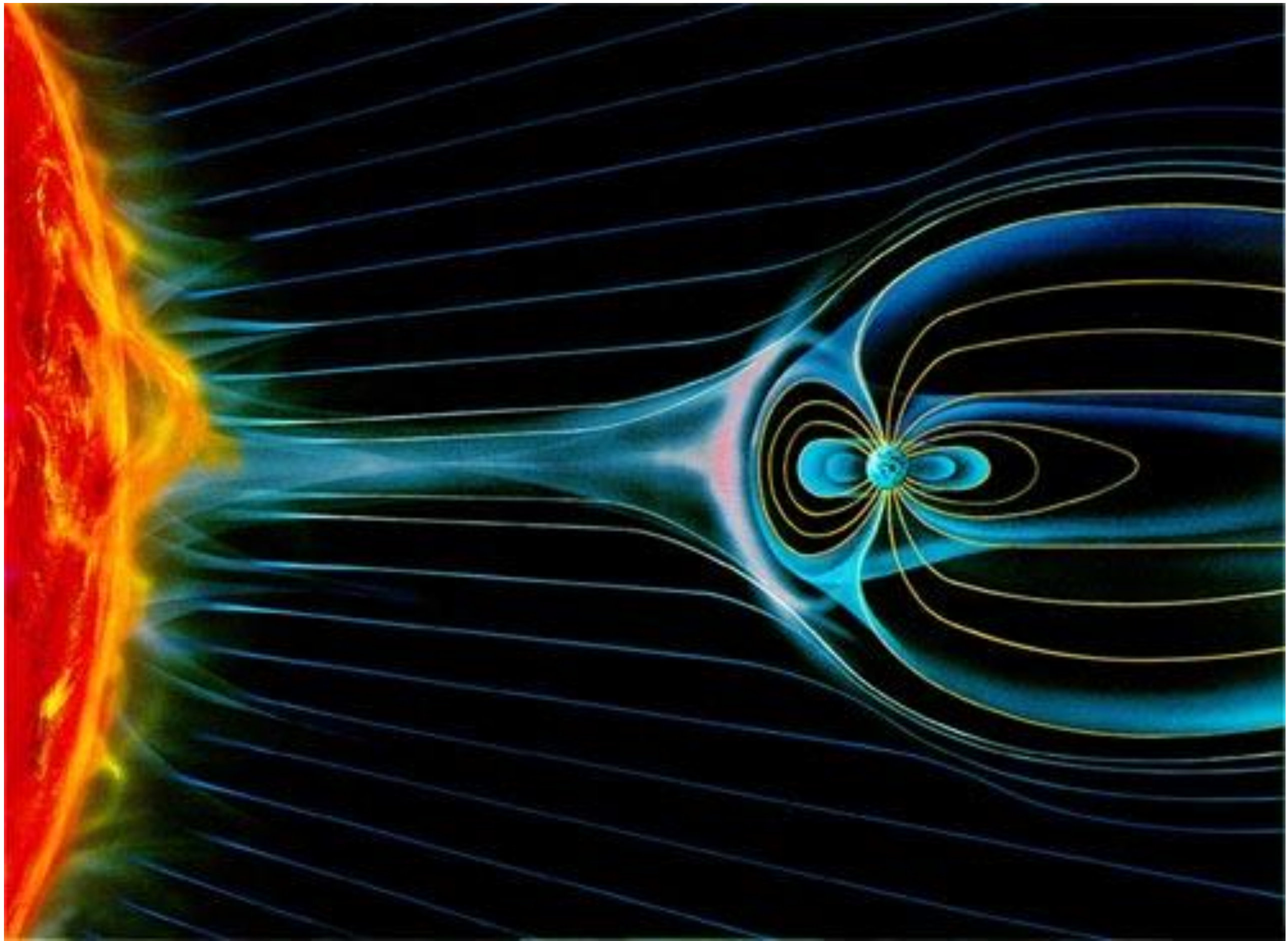


makes

extra info

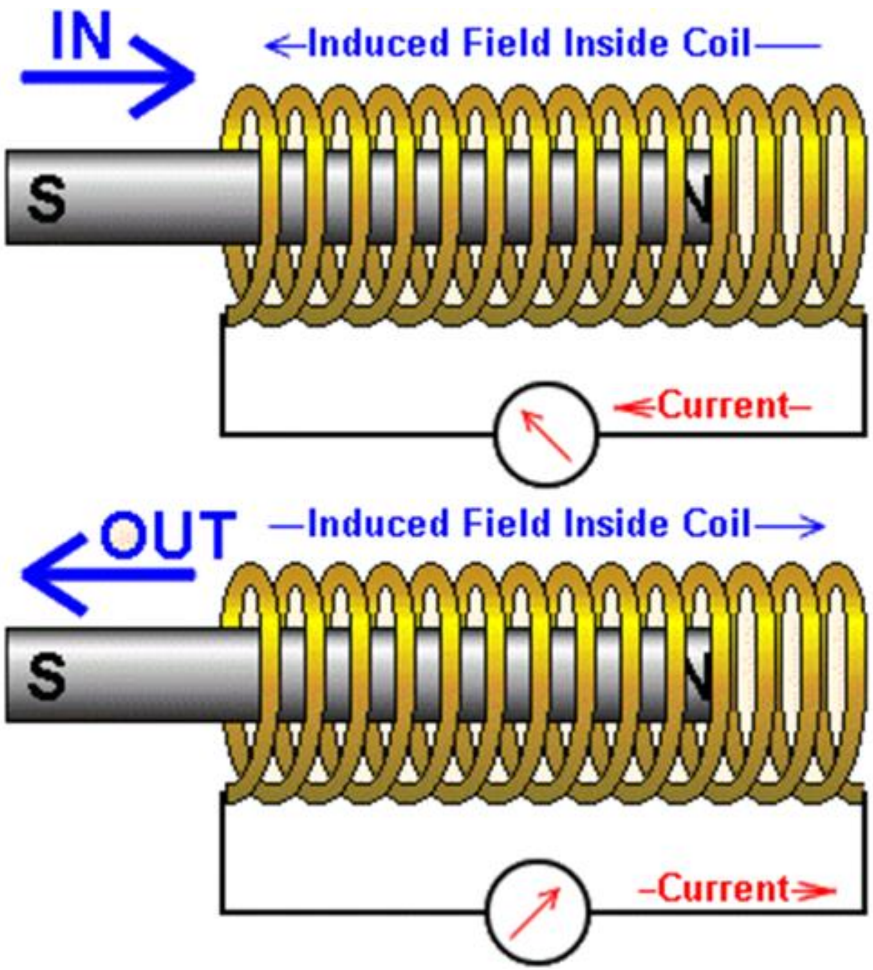
Harmful radiation (which would kill living organisms) emitted from the Sun is deflected by our magnetic field. Small amounts of radiation which enter through the small gaps in the magnetic field lines over the poles interact with the ionosphere layer around Earth and cause beautiful coloured lights in the sky called the Aurora borealis (Northern lights) and Aurora Australis (Southern lights)

The moving inner solid core maybe the cause of the shifting magnetic field. Evidence in ancient rocks shows us that in the past the magnetic field around Earth has switched direction reasonably quickly many times. During these switch overs the Earth may have been left defenceless from dangerous radiation.



An electric current itself has a magnetic field

Electromagnetism describes the relationship between magnetism and electricity. When electrical charges are moving they create or **induce** magnetic fields.
A changing magnetic field will create an electric current and an electric current will induce a magnetic field.
This is called **electromagnetic induction**, it is the principle used to drive generators, motors, transformers, amplifiers and many more electrical devices.

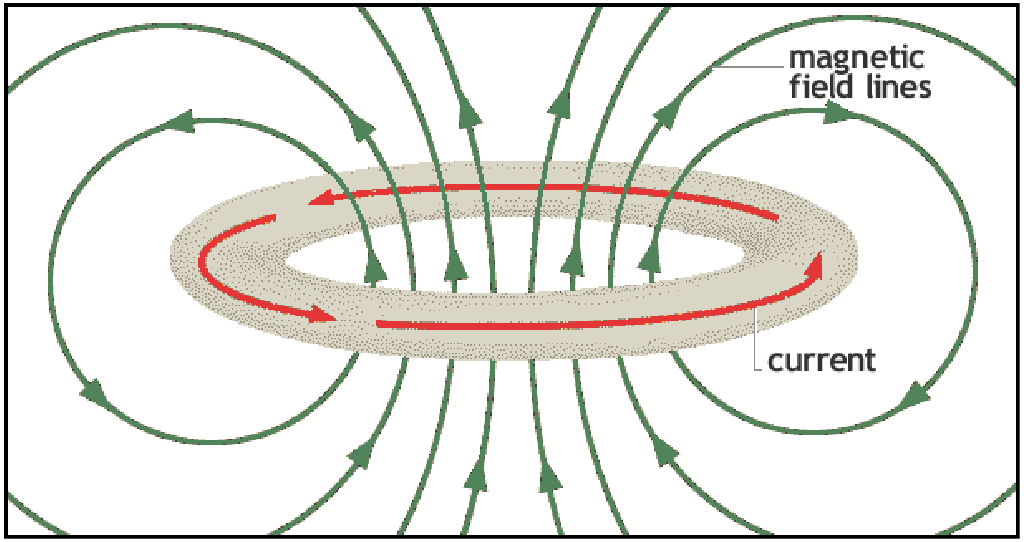


Magnetic fields are arranged in fixed patterns

If a circuit with a wire and battery is set up and a compass placed near the wire, the needle will change direction when the current is on.

When current flows through a conductor it creates a magnetic force field around it – this is called the **electromagnetic effect**. The force field is a circular one running around the wire

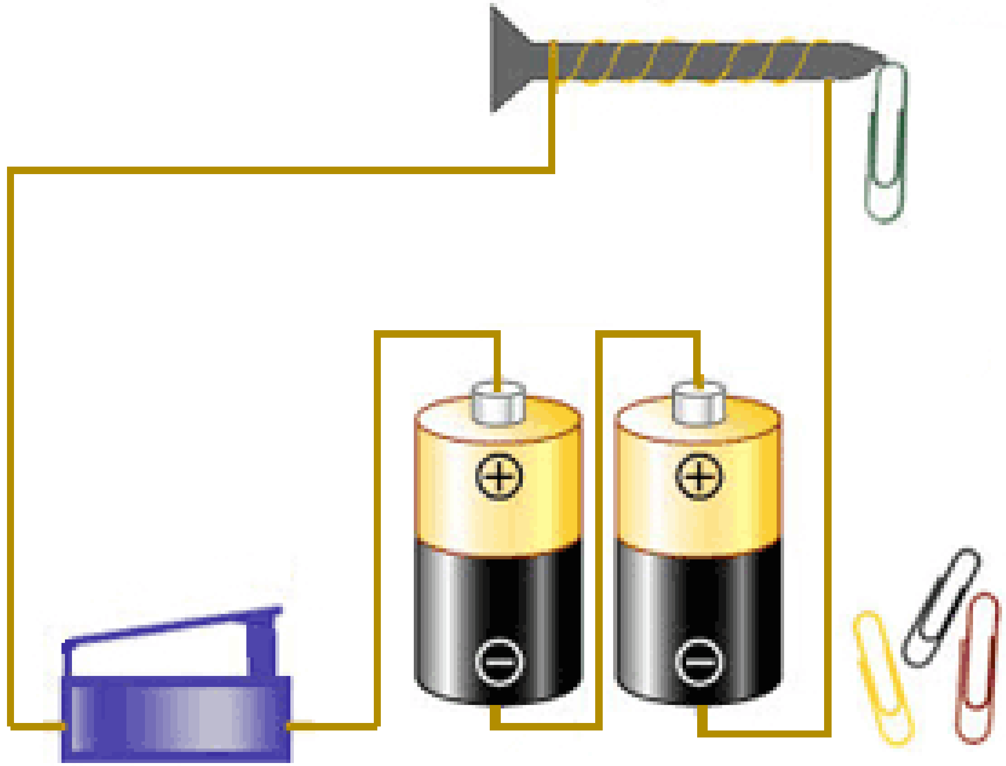
The strength of the magnetic field around a current-carrying wire can be boosted by increasing the current, by looping wire into a coil and by placing an iron bar inside the coil.



Electrical currents moving around a magnet can produce an electromagnet

A magnetic field can be made stronger with a coil of conductive wire wrapped around it and an electric current flowing through the wire. This is called an **electromagnet.** An electromagnet can be made stronger by: increasing the number of turns (how many times the wire is wound) and by increasing the current. A coil of wire is called a solenoid.

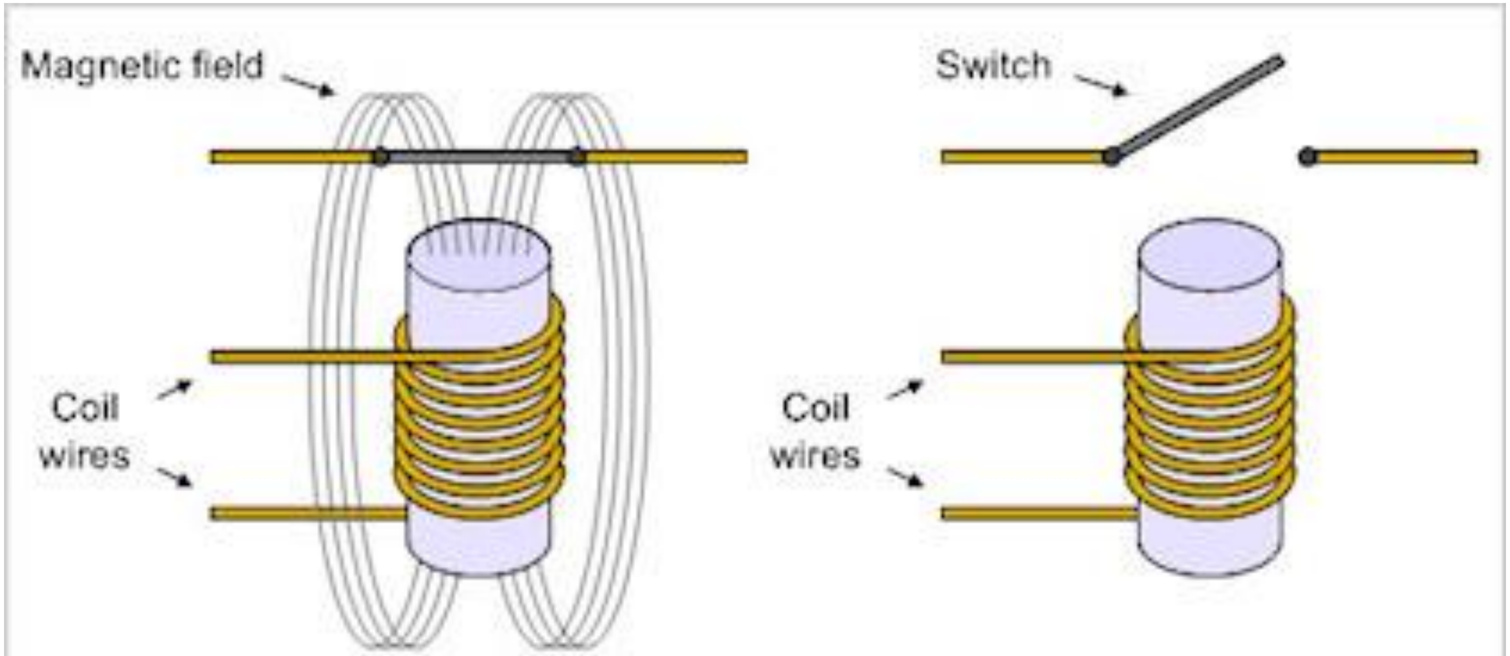
Electromagnets are used when a stronger magnet is required such as for picking up cars at a wreckers and has the advantage of being "switched off" when the current is stopped.



Relays are examples of Electromagnets

extra info

A relay is an electrically operated switch. It works on the principle of a magnet attracting iron when a current is flowing, closing the switch and creating a complete circuit (a) and releasing it when the current is no longer flowing therefore opening the switch (b).



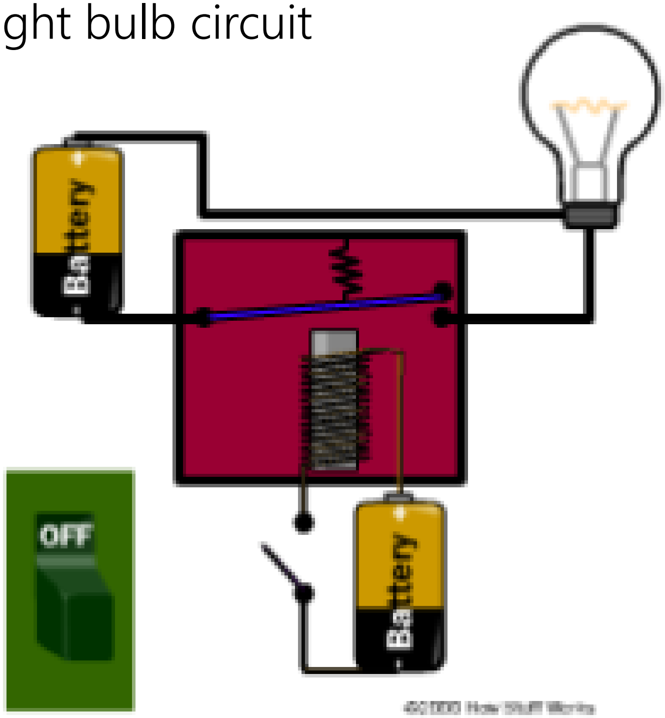
(a) Potential applied to coil [electromagnetic field closes switch]

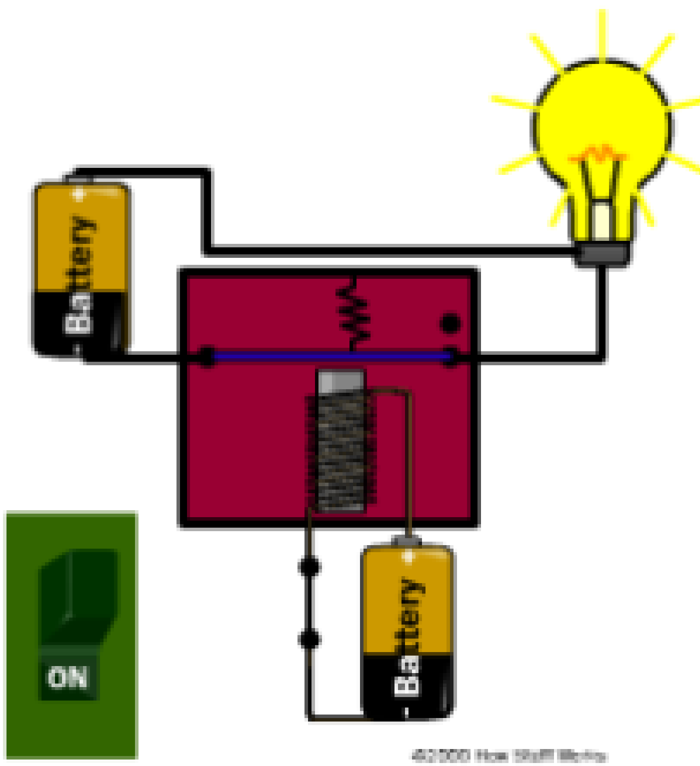
(b) No potential applied to coil [spring (not shown) opens switch]

Using a relay to switch on a light bulb

The relay has a coil containing a sliding iron core to turn on the light bulb

When the current flows, the coil becomes magnetised and pulls soft iron core to the left. The head of the core touches the two metal contacts thereby completing the light bulb circuit



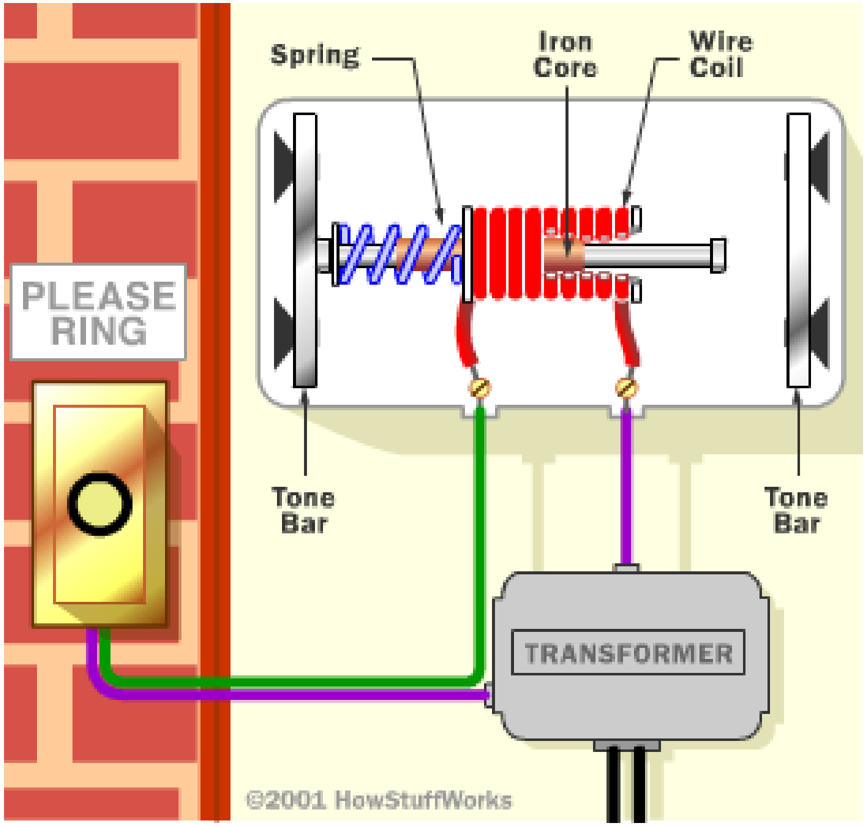


Workings of a chime door bell

extra info

When the solenoid (wire coil) is "switched on" it becomes magnetised and the piston is pulled to the right to hit the right tone bar. When the solenoid is turned off, it becomes non-magnetised and the piston is pulled to the left by the spring to hit the left tone bar

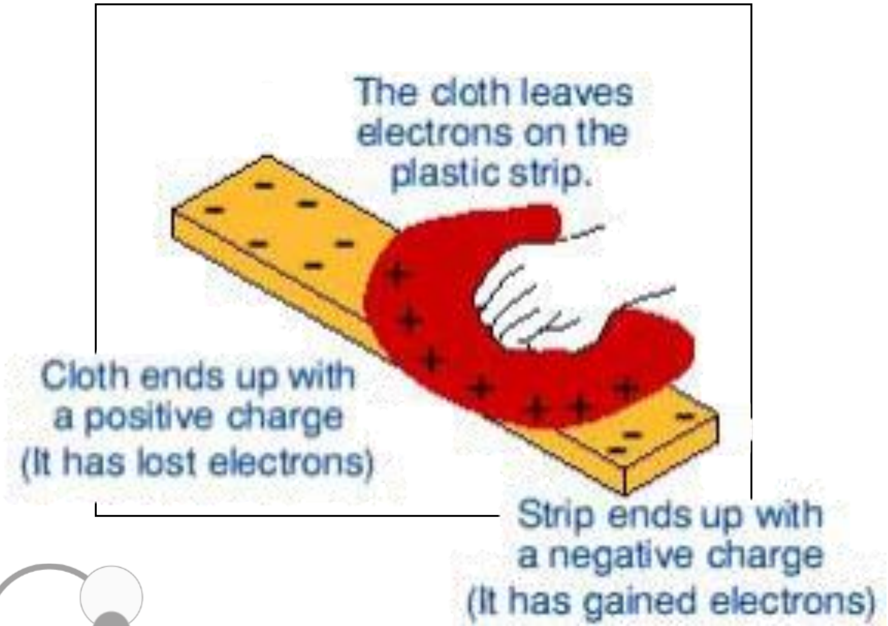
As long as you hold the doorbell button, current will flow through the electromagnet and the piston will remain in this position. But when you release the button, the current will stop flowing through the electromagnet and the magnetic field will collapse. The spring snaps the piston back to the left, where it hits the tone bar on the other side. The second tone bar produces the "dong" sound



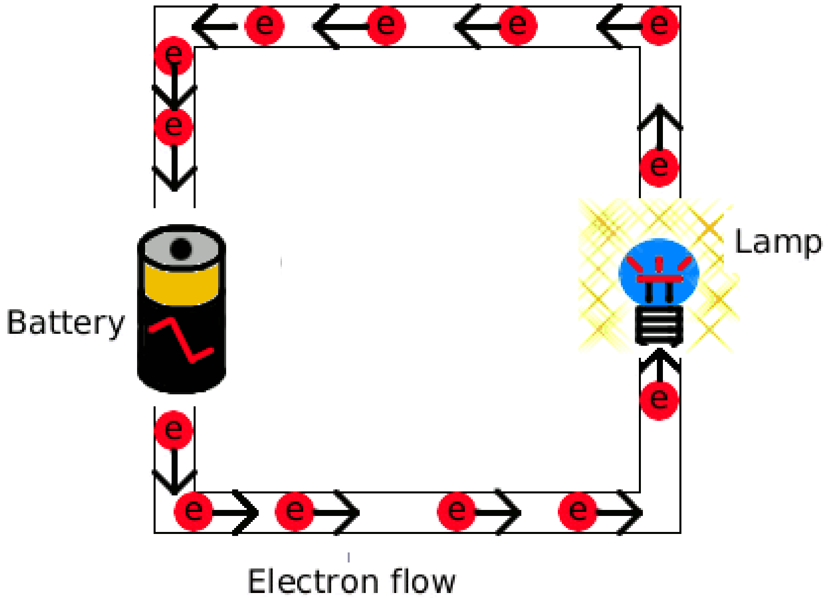
Electric charge produced by friction is the same charge which, moving around a circuit, produces an electric current

There are two types of electricity. **Static electricity** involves charge that is built up on insulators, usually by friction and when there is a large force acting on the charge, the charge will suddenly move. **Current electricity** involves the movement of charge through a conductor and it flows continuously if a pathway is formed.

Static electricity



Current electricity



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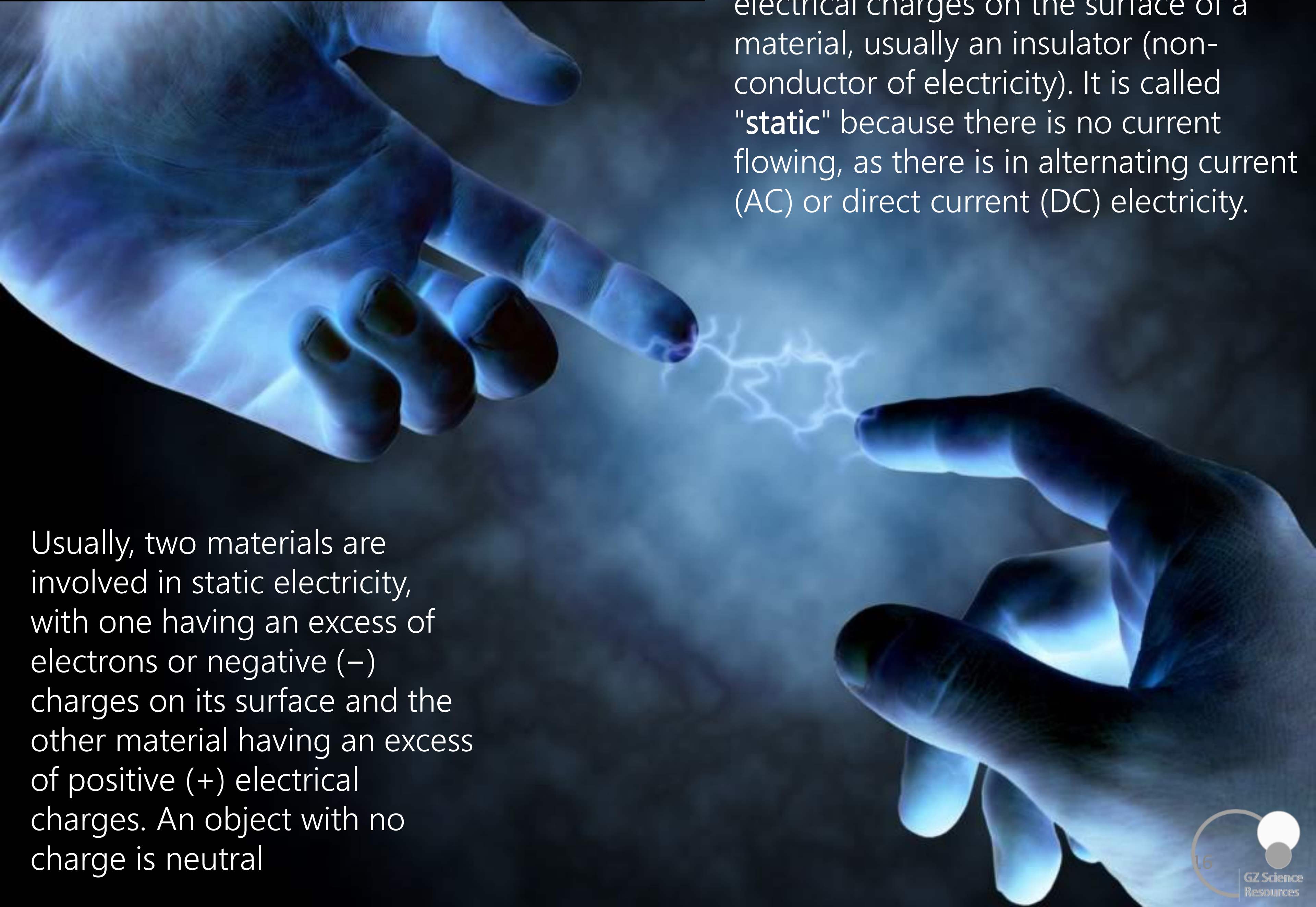
Static Electricity

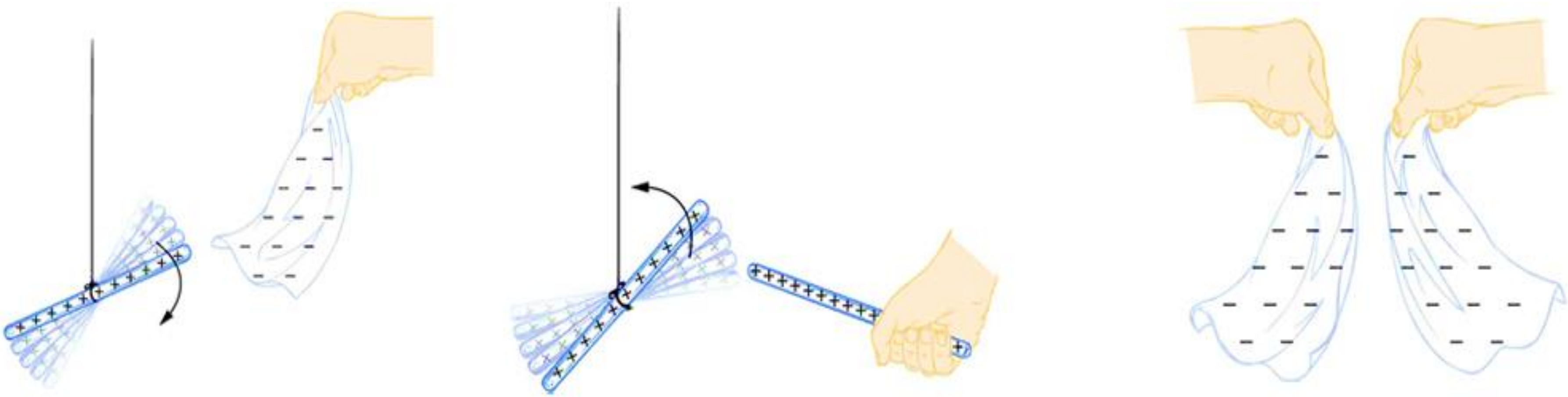
Static electricity is the build up of electrical charges on the surface of a material, usually an insulator (non-conductor of electricity). It is called "**static**" because there is no current flowing, as there is in alternating current (AC) or direct current (DC) electricity.



Usually, two materials are involved in static electricity, with one having an excess of electrons or negative (–) charges on its surface and the other material having an excess of positive (+) electrical charges. An object with no charge is neutral

Attraction or repulsion

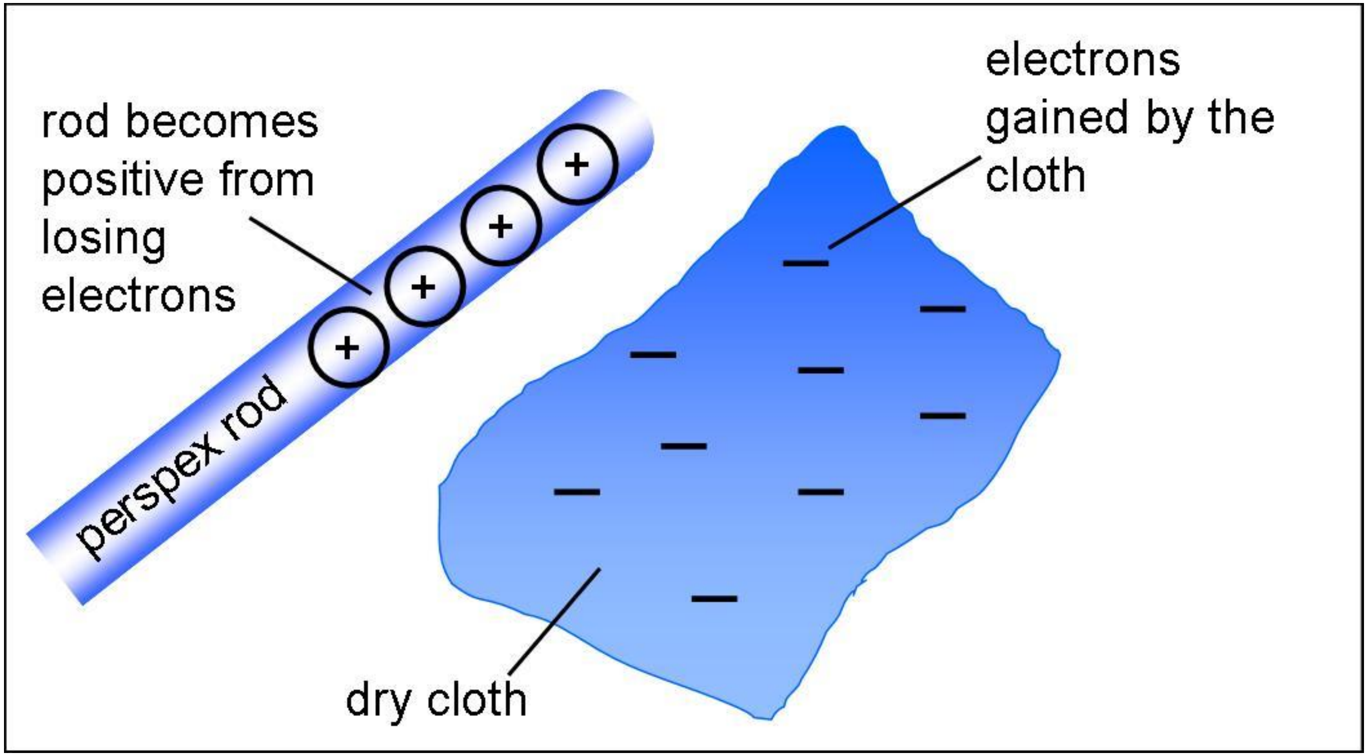
There are only two types of charge, which we call positive and negative. **Like charges repel**, **unlike charges attract**, and there are electric forces between charges. Both positive and negative charges exist in neutral objects but they can be separated by rubbing one object with another. For objects (large enough to be visible), negatively charged means an excess of electrons and positively charged means a depletion of electrons (that have been removed). Charge is measured in coulombs (C)



Law of Conservation of charge

extra info

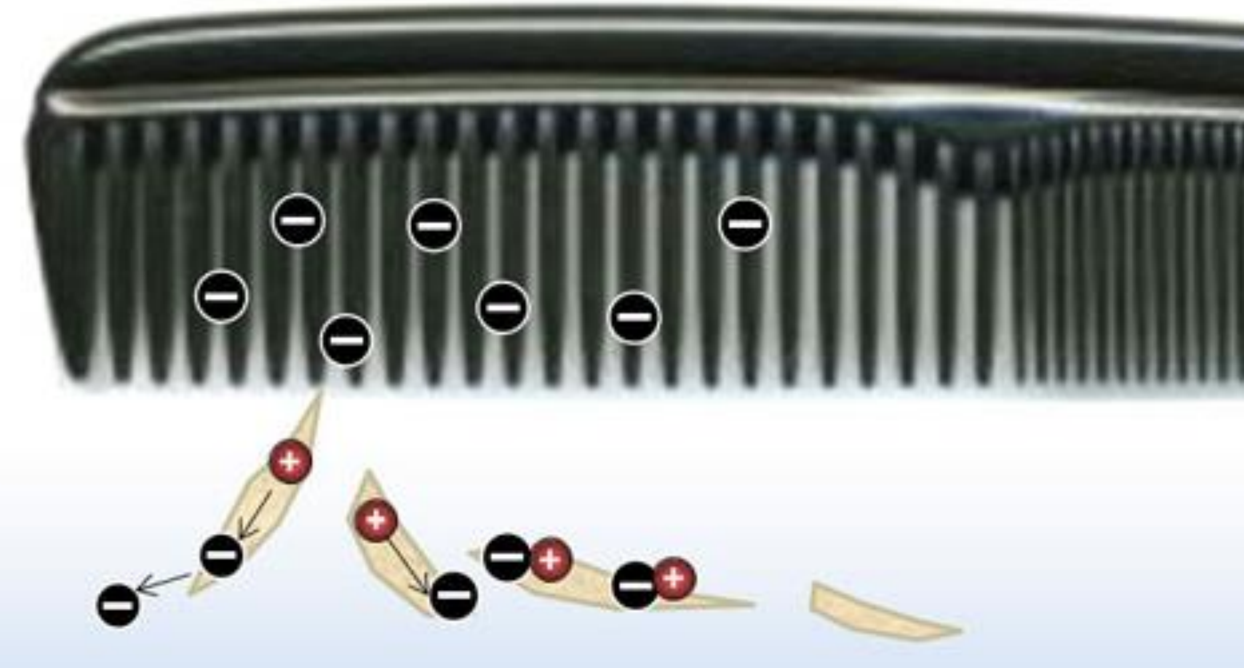
No charge is actually created or destroyed when charges are separated. Instead, existing charges are moved about. In all situations the total amount of charge is always constant. This universally obeyed law of nature is called the **law of conservation of charge.**



Charging by contact

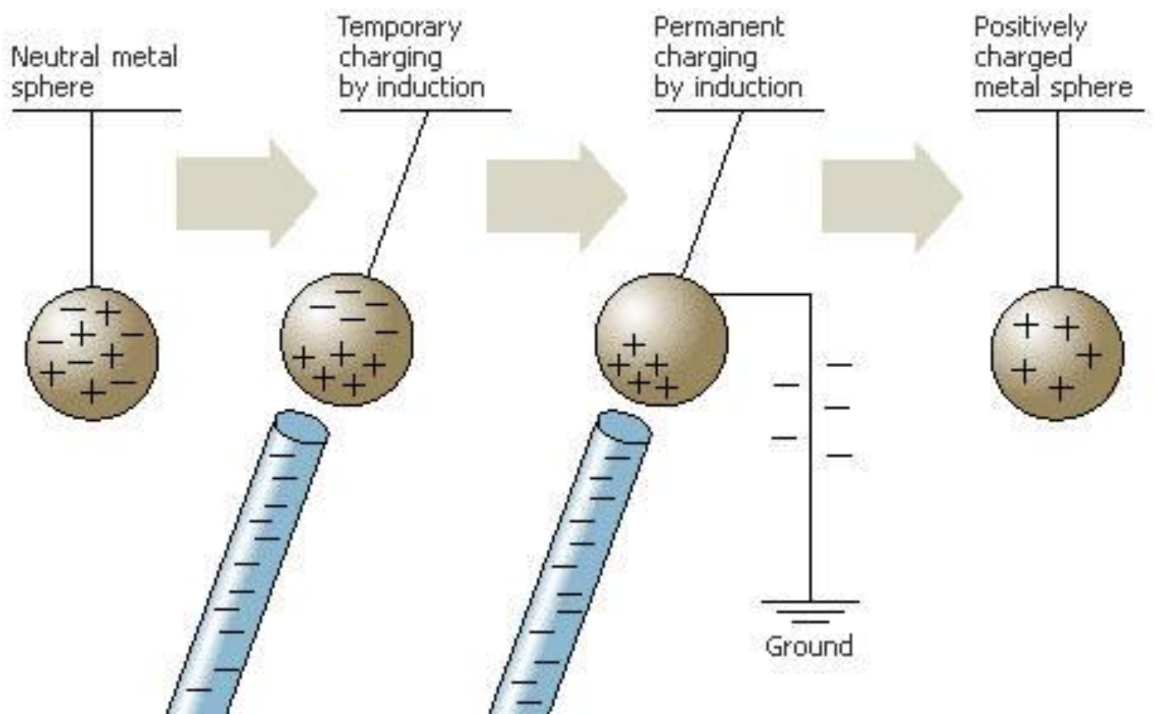
Static electricity involves a build up of charge when two different objects are rubbed together and electrons from one jump across to another. This is called **charging by contact**. Some materials, such as plastic, hold onto electrons better than others and they will become negatively charged. The other object, due to electrons being lost, will become positively charged. The two objects will be attracted to each other due to their positive and negative charges.

Materials that hold electrons well include plastic, silk and glass – these become negative. Objects that lose electrons include metals which become positive.



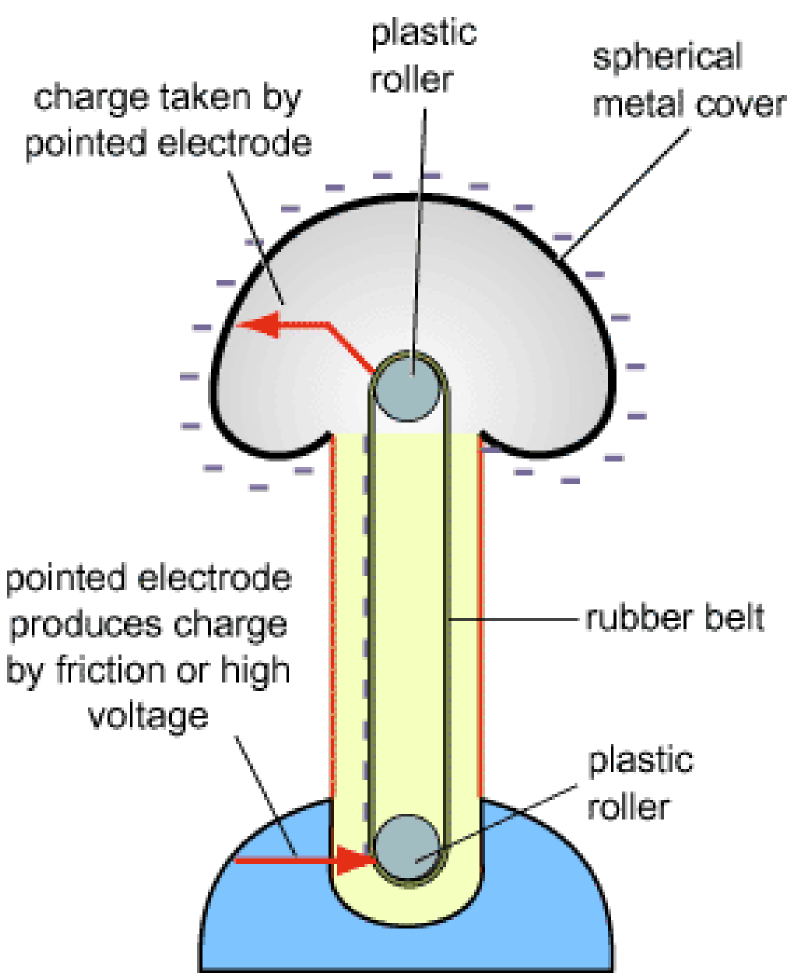
Charging by induction

Objects can also be **charged by induction**. When a negatively charged object is held close to another object but not touching then the negative electrons are repelled and move away (if a path is created which "earths" the object) and the non moving protons cause the object to be positively charged.



If the object being charged is not earthed then as soon as the negatively charged object is moved away then then electrons will just shift back again and neutralise it once more.

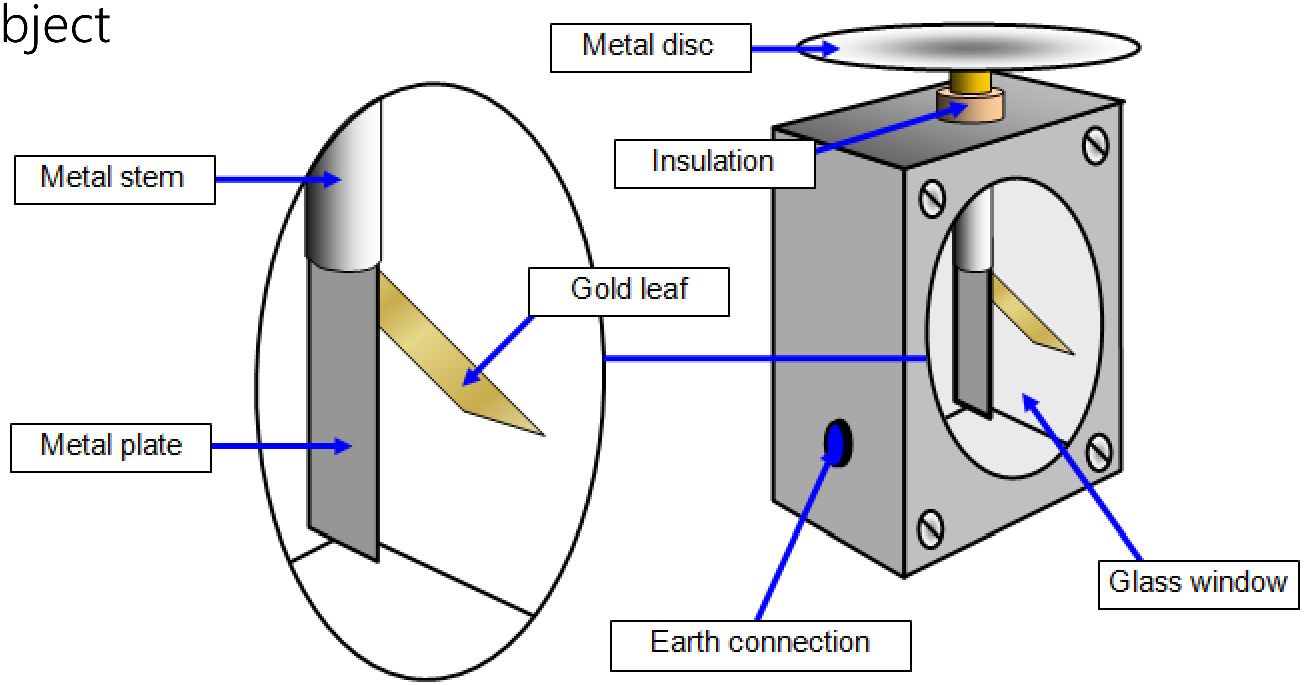
Charge can be **transferred** using a van der Graaf generator



The van der Graaf generator produces and stores charge to create static electricity. A big rubber band move over a piece of felt, which is insulated and creates friction and the negative electrons are "stripped away'. The electrons move up the rubber band to the metal ball and into a person whose hand is placed on the generator. By standing on an insulating surface, the charge cannot go through the body and get to the ground. The repelling electrons, trying to get as far away from each other as possible, cause the person's statically charged hair strands to repel each other and stick up.

Charge can be detected using an electroscope

An electroscope can detect charge by induction or contact. A charged object is placed on or near the metal disc. A negatively charged object will repel negative charge in the insulated electroscope. The negative charge will travel down to the gold leaf and metal plate (some electroscopes have two gold leaves). The negatively charged leaf/plate will then repel each other and move apart. The more they more apart the more the charge held in the original object



Electrical discharge in air

extra info

Electric discharge describes any **flow of electric charge** through a gas, liquid or solid. If there are enough positive (+) electrical charges on one object or material and enough negative (−) charges on the surface of the other object the attraction between the charges may be great enough to cause electrons to jump the air gap between the objects. When charges move we call it a **current**.

Once a few electrons start to move across the gap, they heat up the air, encouraging more electrons to jump across the gap. This heats the air even more. It happens rapidly , and the air gets so hot that it glows for a short time. That is a **spark**.

The same thing happens with lightning, except on a much larger scale, with higher voltages and current.

Lightning is a form of Static Electricity discharge

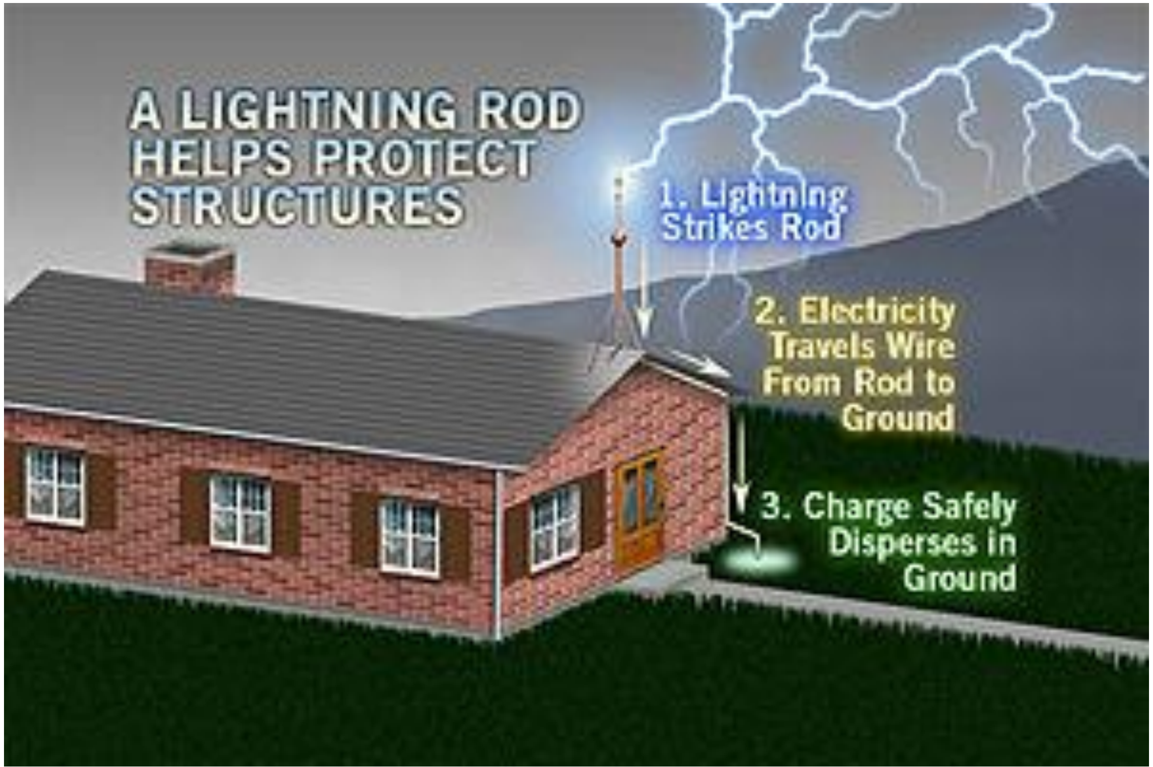
extra info

The build up of charge can be released when the electrons move through the air and make contact with an earthed object. This discharge can be seen as a bright spark. On a larger scale during a storm when particles in clouds rub together the discharge is seen as **lightning**. The lightning will usually make contact with the closest object (the tallest) that is conductive. Some tall buildings have lightning rods on them. These give a path for the lightning to travel down to the ground and prevent the energy of the lightning from damaging and burning the building. Animals and people can be harmed if they are struck by lightning because of the huge amounts of energy being released.

Earthing: how earthing removes excess charges

extra info

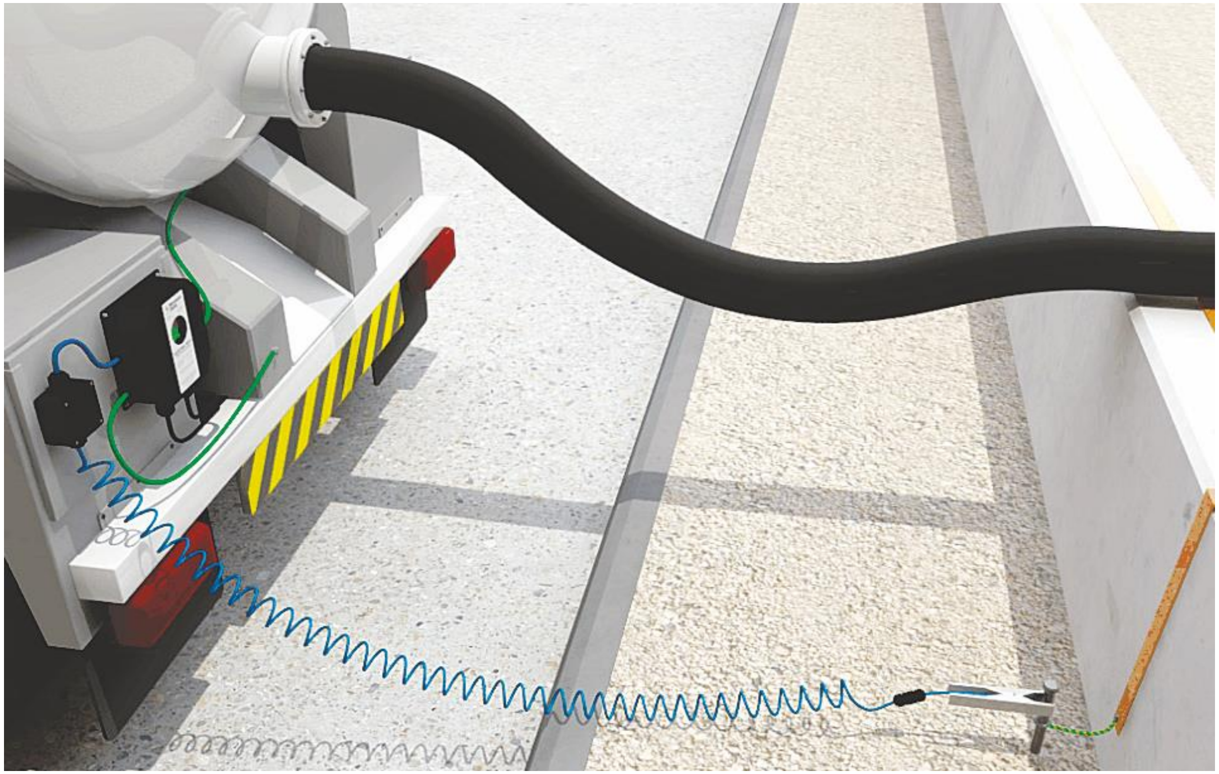
Electrical earthing (or grounding) diverts potentially dangerous electrical current by providing a **conductive** path between the area where static charge has built up and the earth where the charge can spread out. Lightning can be a source of dangerous or damaging charges that can be **dissipated** through a earthing system. Many tall buildings that attract lightning strikes have earthing electrodes (also called **lightning rods**) connected to the building that are sunk into the ground and disperse the excess charge.



The dangers and uses of static charges

A build up of **electrostatic charge** can result in sparks or flashes of light. If this spark occurs near any combustible material then it may cause it to ignite. Fuel trucks often use earthing cables when refuelling tanks to discharge any build up of static electricity that the truck may have gained when travelling.

Air rushing past a moving vehicle drags electrons off the car and leaves it positive causing a build up of charge. This can cause travel sickness for some people. Conducting tails allow the car to pick up electrons from the road surface and lose its charge.



Electrostatic charges are important and useful in photocopying machines and in removing (extracting) dust

Electricity is a form of Energy

Electricity is a type of energy. It can be transformed **from** many other types of energy; kinetic, chemical, nuclear etc.

We make use of electricity by transforming it **into** other types of energy; light, heat, sound, kinetic etc., to run many appliances and machines.

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Energy makes things happen

Any change in speed, size, shape or temperature in an object requires energy.

Energy is the ability to do work.

Work is applying force to an object and making it move in distance.

Kinetic energy is seen when particles, waves or objects move

Light (radiant) Energy	Sound Energy	Mechanical kinetic Energy	Heat (thermal) Energy	Electrical Energy
Energy traveling in waves, with wavelengths that can be seen by humans.	Sound travels in waves of different pressure. This causes movement of particles. Sound cannot travel in a vacuum.	Movement energy. This can be seen when matter changes its position in space	The kinetic energy that atoms contain. The more they move the more heat they contain. Measured by temperature	Energy contained in electrons. This can either be static like lightning or current electricity that moves in a circuit.

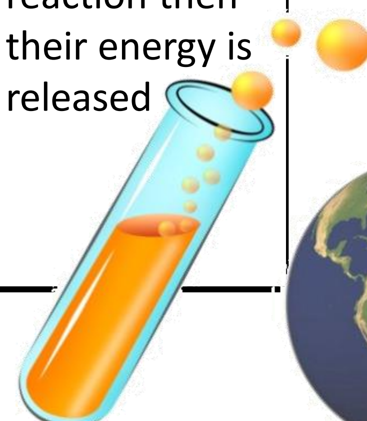
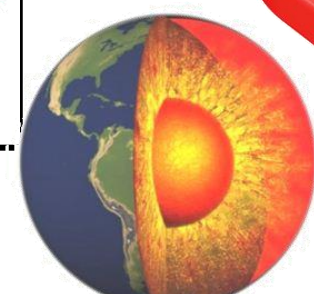
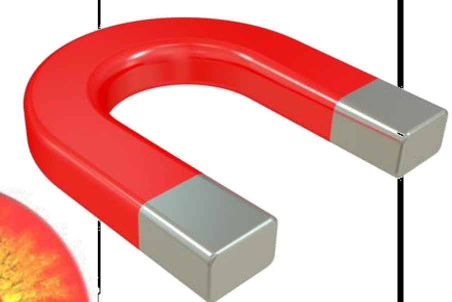




All forms of stored energy are called **potential energy**

Gravitational Energy	Elastic Energy	Nuclear Energy	Chemical Energy	Geothermal Energy	Magnetic Energy
This is the energy contained by an object which pulls it back to Earth. The further up from the ground the more it contains.	Found in springs, rubber bands etc. The more they are compressed the more energy they contain to make them change back to their original shape	The energy contained by the nucleus of an atom which holds the neutrons and protons together. A lot of energy is released when these are separated in a nuclear reaction	The energy contained in the bonds of chemical molecules – i.e.food or battery acid. When these bonds are broken in a chemical reaction then their energy is released	Energy produced by geological processes of the Earth which causes heat and pressure to rise to the surface.	Energy contained by a magnet to either attract or repel other magnetic objects. It can also cause electrical currents.



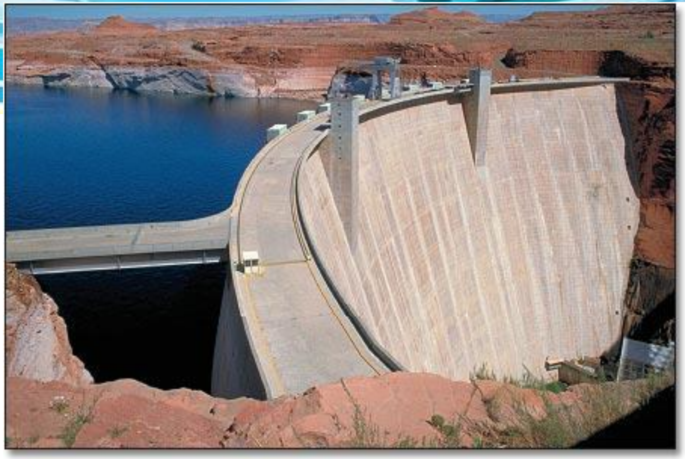
Energy can be transformed from one type to another

Energy can be **transferred** from one object to another. e.g. heat energy from the rocks cooking the food in a hangi. The type of energy does not change.

Energy can also be **transformed** from one type into another. e.g. electrical energy changed into heat and sound energy when boiling a jug.

One type of energy can be transformed into many different types.

The total amount of energy never changes. Energy is able to transform from one type to another. All types of potential energy must be transformed into kinetic energy in order for **work** to be done.

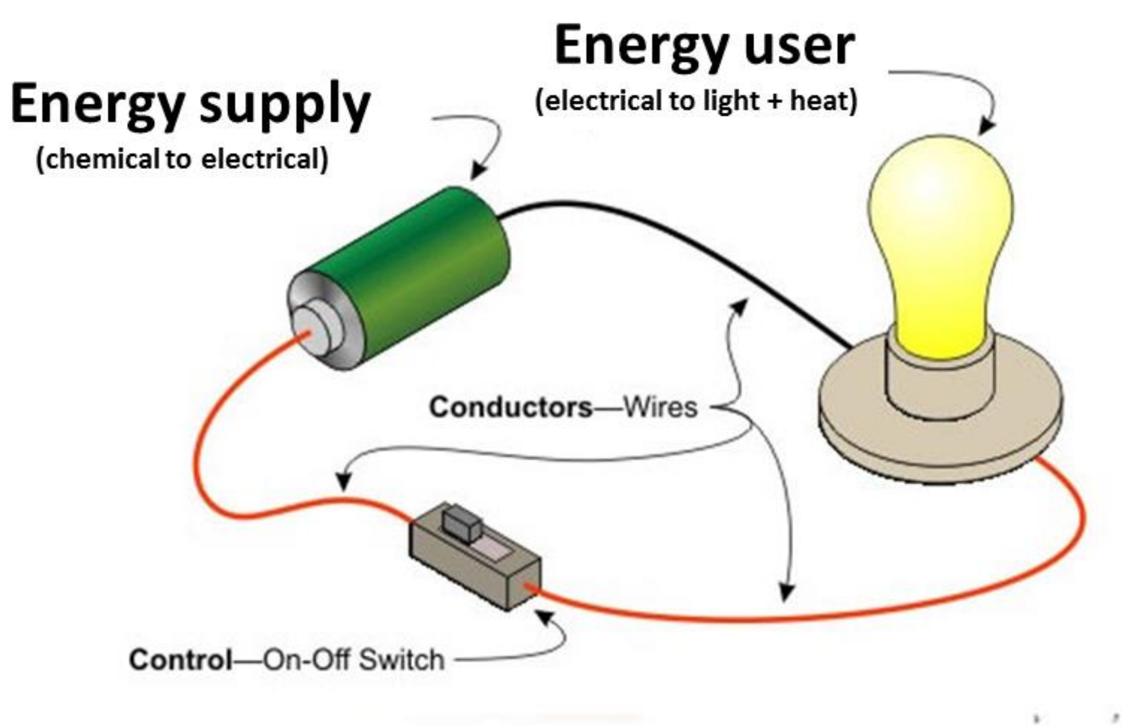


The properties of simple electric circuits

Electrical current occurs when charge moves through a conductor from an area which is negatively charged to an area which is positively charged.

Electrical energy is provided by the battery, cell or **energy supply** and when there is a closed circuit a device, which is the **energy user**, will transform the electrical energy to another type. e.g. The light bulb will transform electrical energy to light and heat energy.

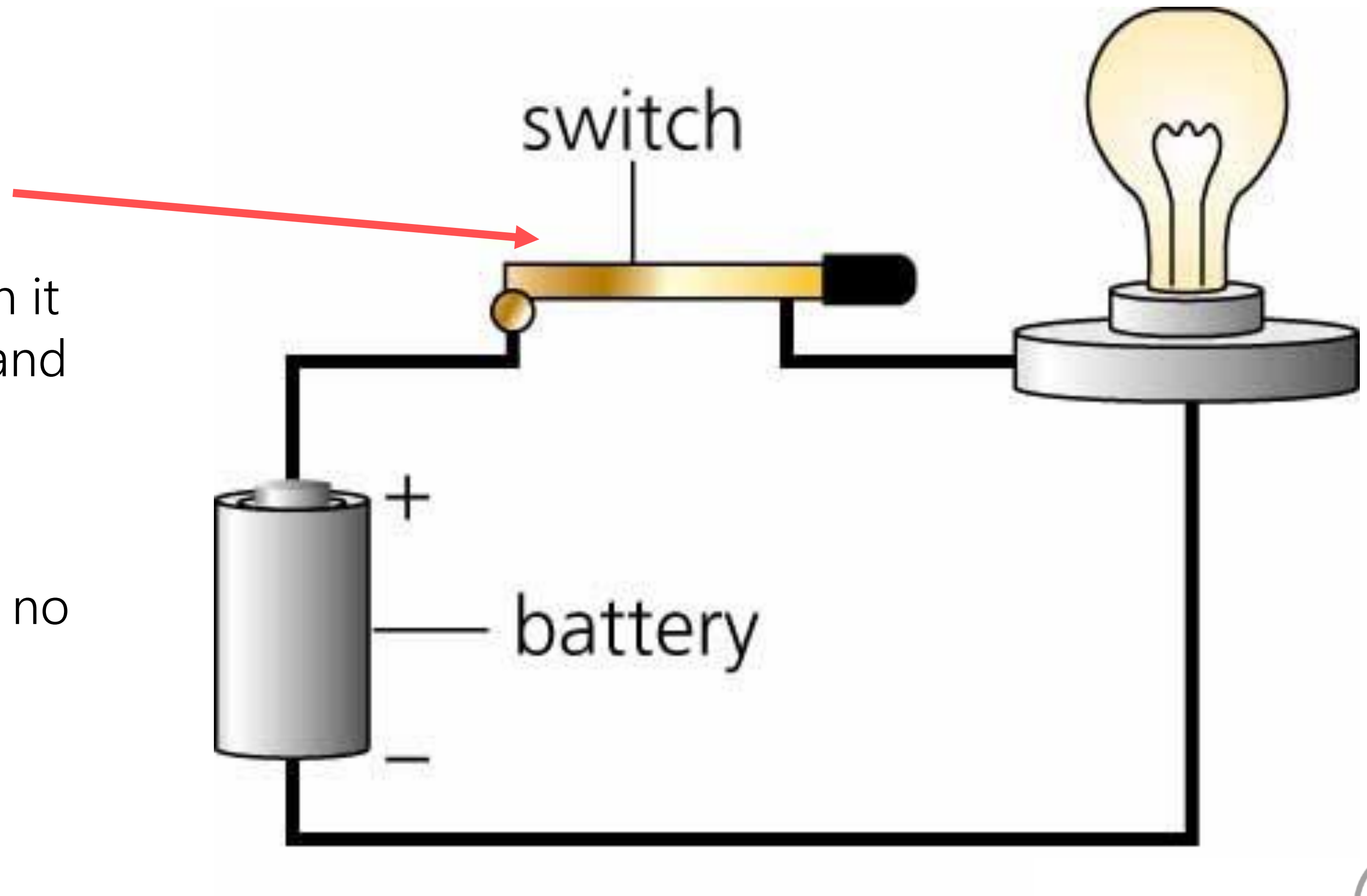
A circuit is a continuous pathway around which the charge carried by electrons can flow.



There is a need for a complete circuit when making use of electricity

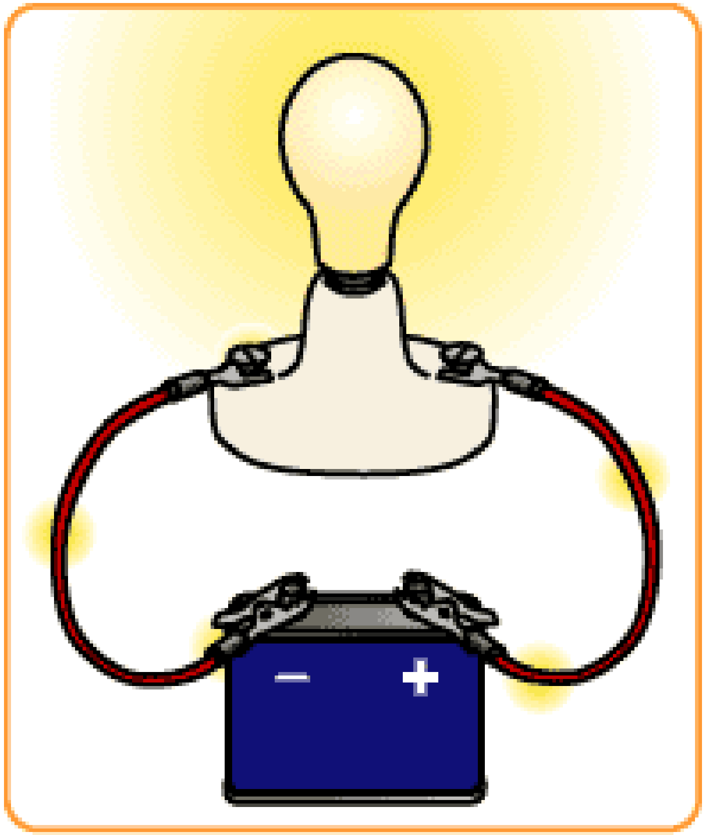
A circuit must be **closed** for the charge to flow and produce a current.

A switch breaks the circuit when it is opened and the flow of electrons stops, resulting in no current.

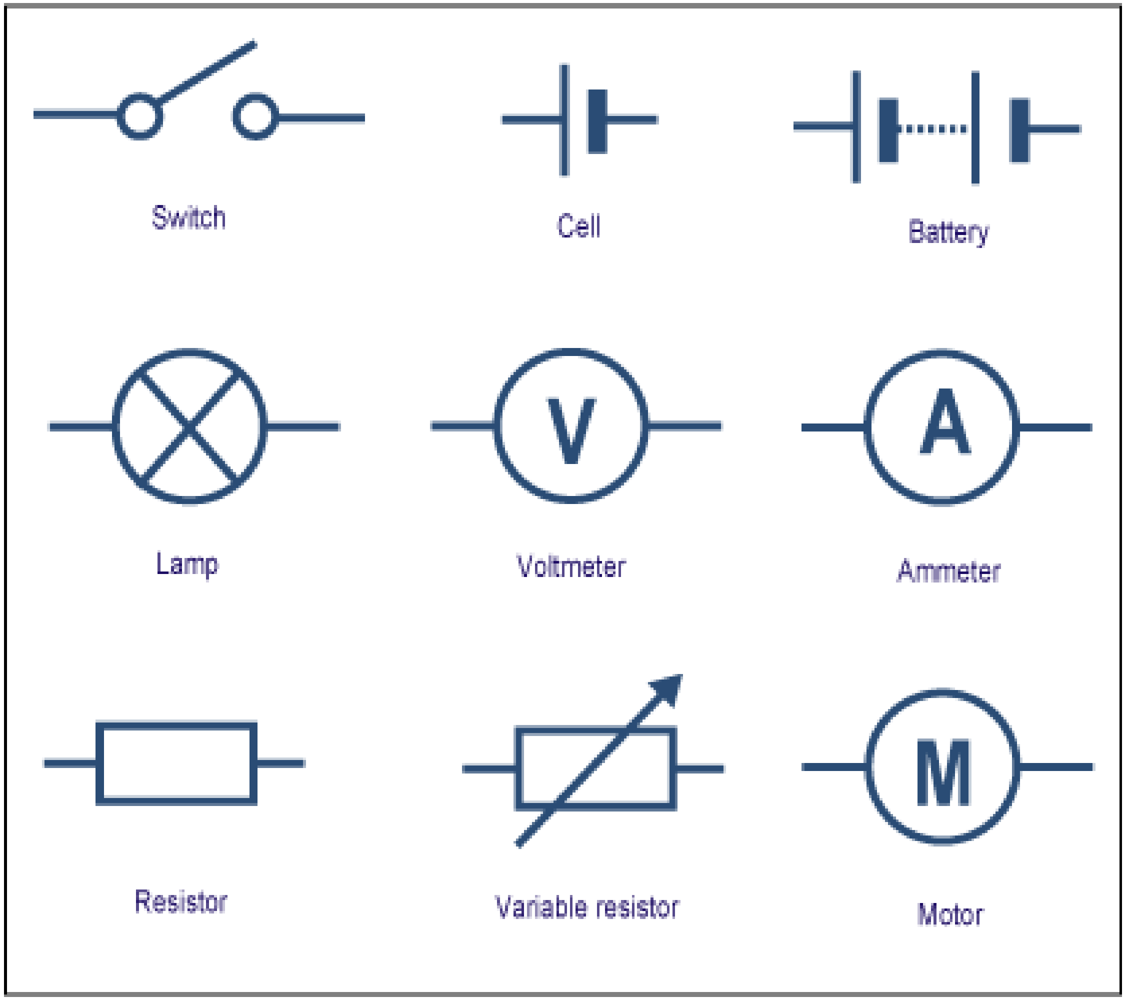


Transforming electrical energy in a circuit

A circuit is made up of electrical components connected together so charge, carried by electrons, moves through the components. A battery or a cell is an energy supply. It supplies energy to the charges. The charges then move around the circuit carrying the energy. When the charges get to a user (or component) of the circuit e.g. a lamp, they have to work to get through the part. The energy is changed into another type of energy (e.g. heat, light, sound, movement). Before the component, the charge has a certain amount of energy and after it has gone through the component it has another amount of energy. So there is a **difference** in energy from one point to another. This is called the **potential difference.**



Draw Circuit diagrams using symbols

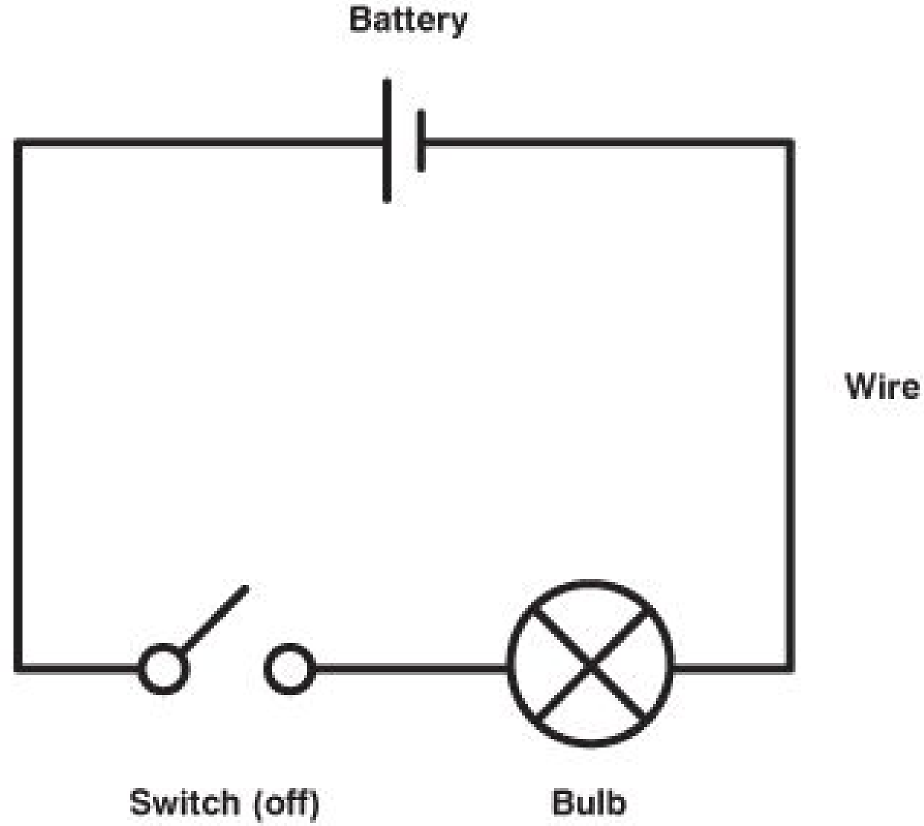


Circuit symbols are used to represent components of an electrical circuit. These symbols can be used universally by electricians and scientists regardless of their different languages to show how different circuits are arranged.

A ruler must be used when drawing circuit diagrams.

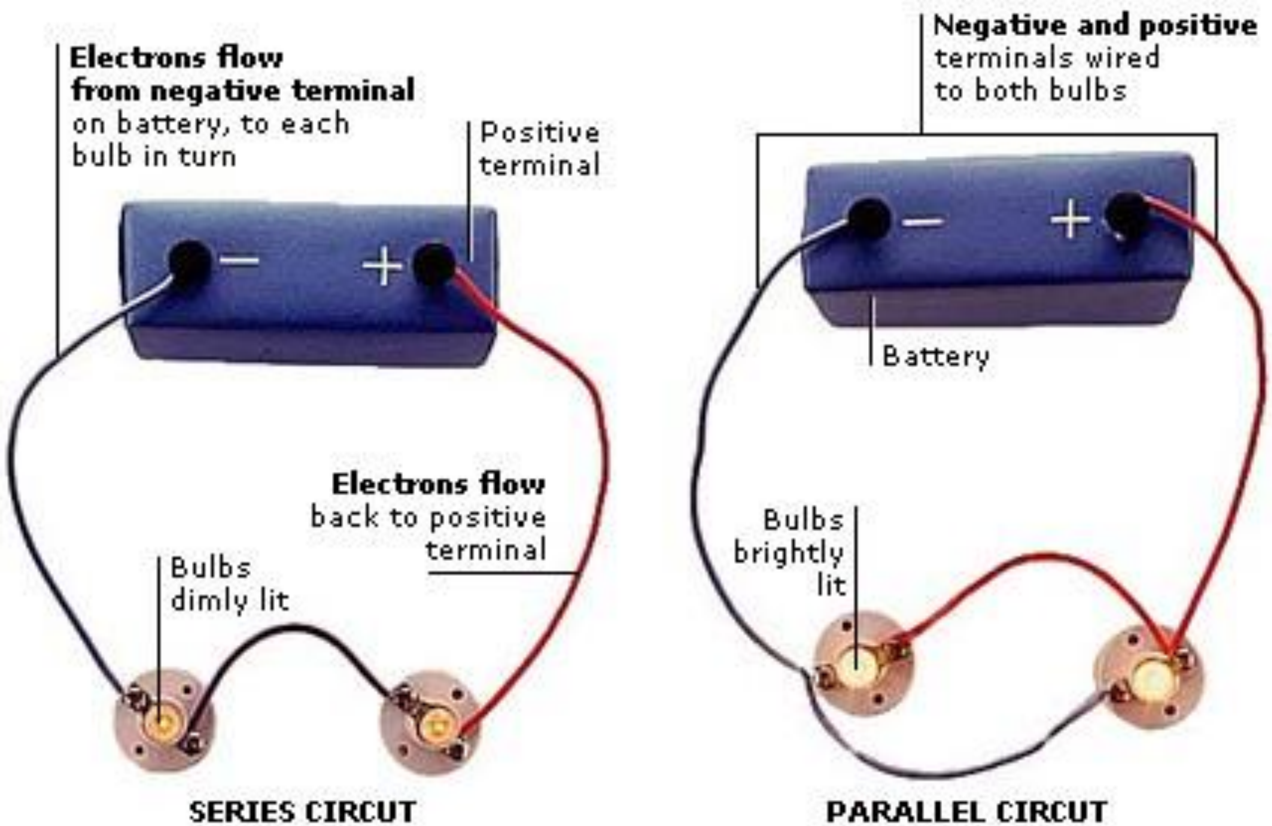
Circuit diagrams use symbols to represent components in a circuit

All circuits will need: a **power source** such as a battery or cell, a **complete circuit** travelling from the positive (larger line) terminal to the negative (smaller line) terminal and one or more **components** (power users) such as a bulb.



Circuits can have one or more pathways for the current to flow

In a Series circuit there is only one pathway for the electricity to flow, and in a Parallel circuit there is more than one pathway for the electricity to flow.



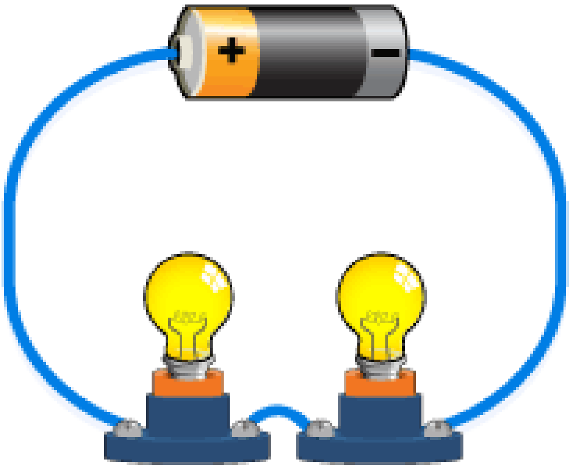
One pathway

More than one pathway

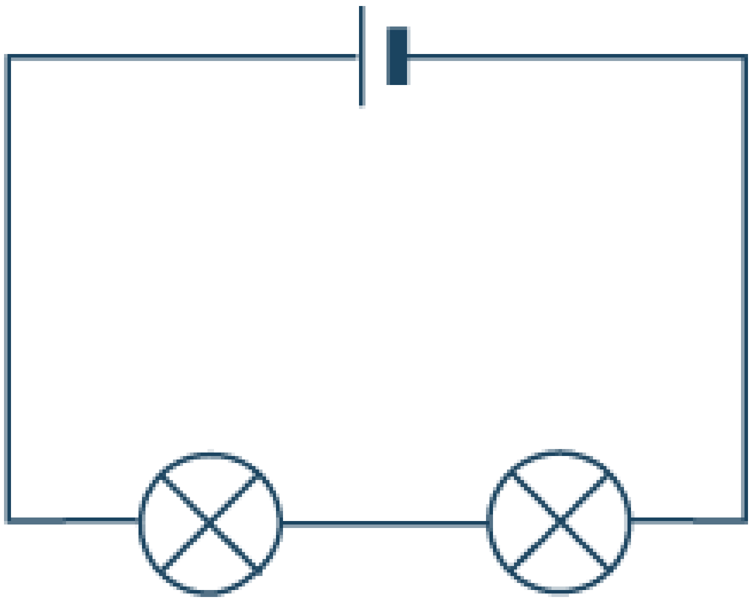
In a series circuit, the charge moves along one path only

The electrical current flows through one component then the next – more lamps added in series cause their brightness to decrease.

Series Circuit



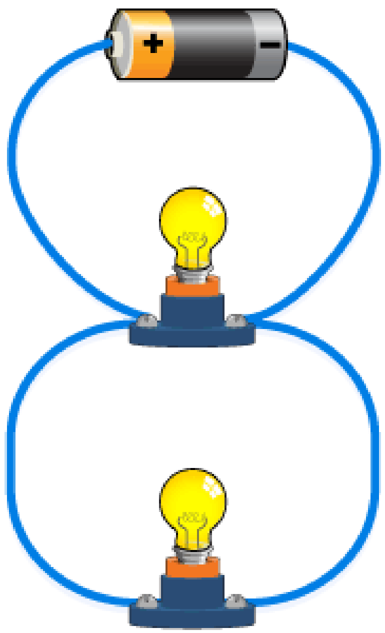
Circuit drawing



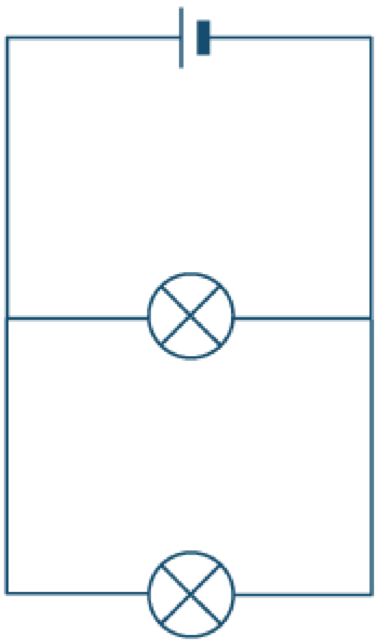
In a parallel circuit, charge moves through two or more pathways.

When more lights added in a parallel circuit this does not effect the brightness of each lamp.

Parallel Circuit



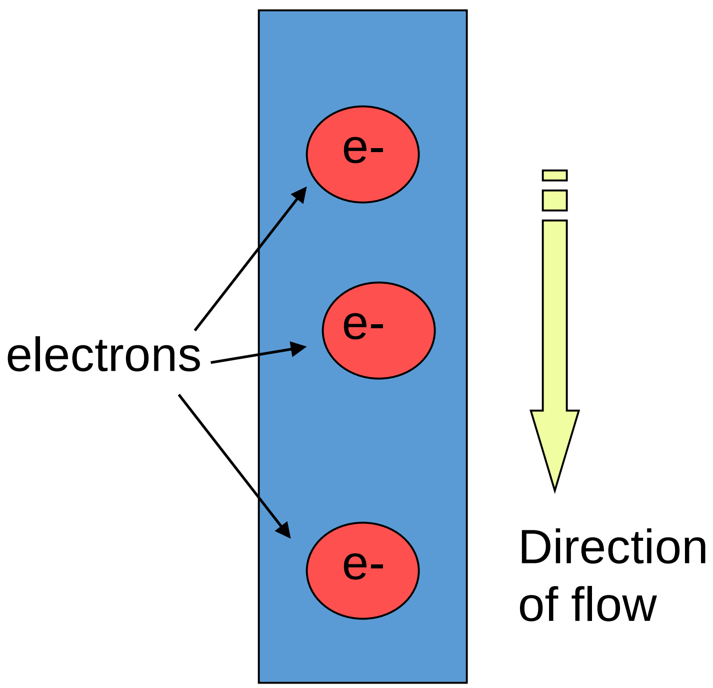
Circuit drawing



The effects and uses of conductors and insulators

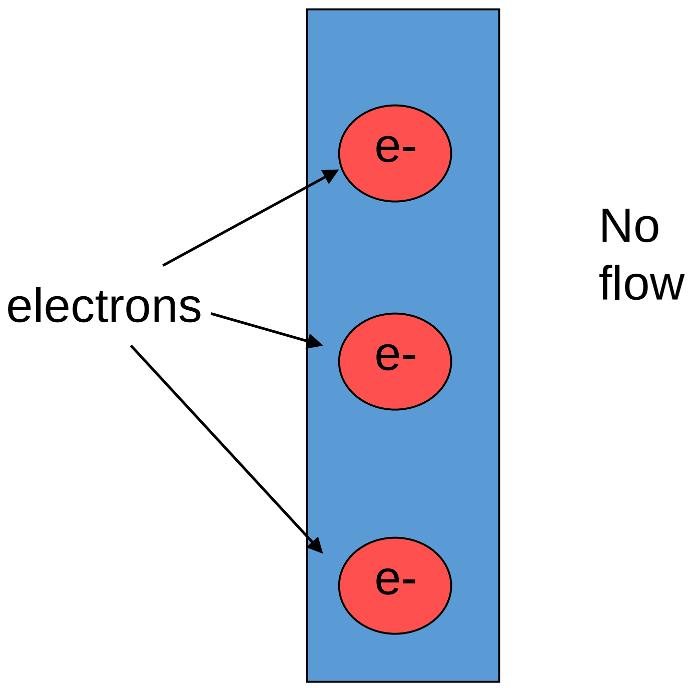
Charge can travel freely in **conductors** such as metal.
Charge can't travel through **insulators** such as plastic.

Conductors



Good conductors have very low resistance

insulators



Insulators have high resistance.

Conductors allow the flow of current through them

Conductors

Copper is considered to be a conductor because it "conducts" the electrical current or flow of charge fairly easily. Most metals are considered to be good conductors of electrical current. Copper is just one of the more popular materials that is used for conductors.

Conductors have **low resistance** since charges move easily

Other materials that are sometimes used as conductors are silver, gold, and aluminium.

Insulators prevent the flow of current through them

Insulators

Insulators are materials that have just the opposite effect on the flow of charge. They do not let electrons flow very easily from one atom to another. Insulators are materials whose atoms have tightly bound electrons. These electrons are not free to roam around and be shared by neighbouring atoms.

Insulators have **high resistance** since there is little to no current flow.

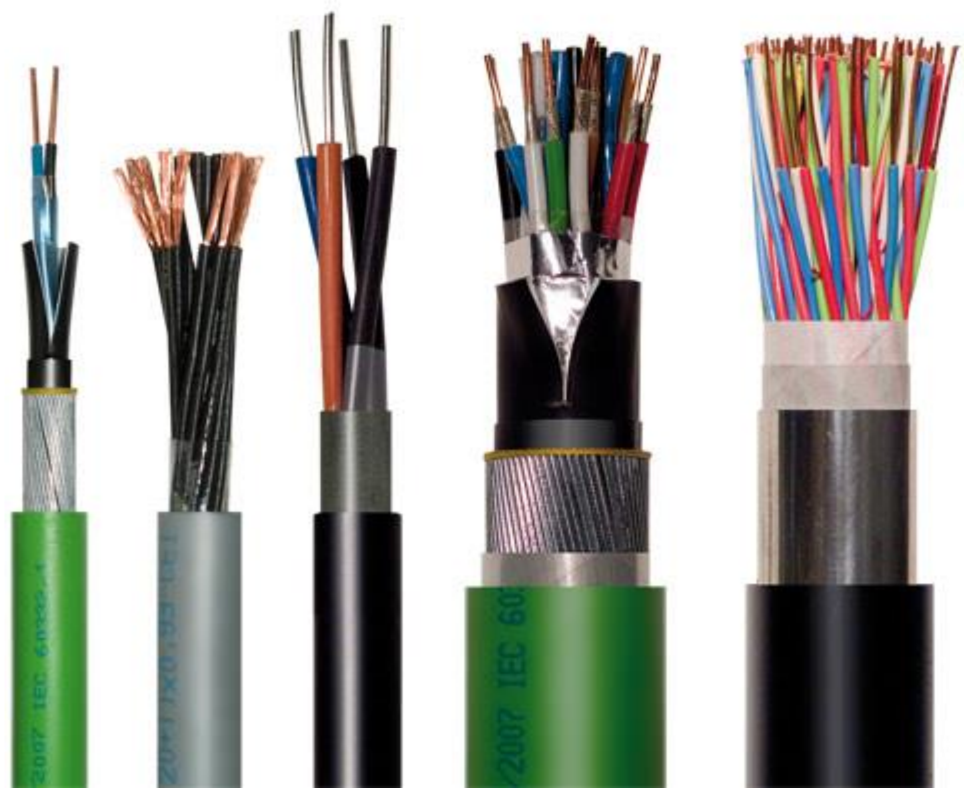
Some common insulator materials are glass, plastic, rubber, air, and wood

extra info

We make use of the conducting and insulating properties of materials in technological applications

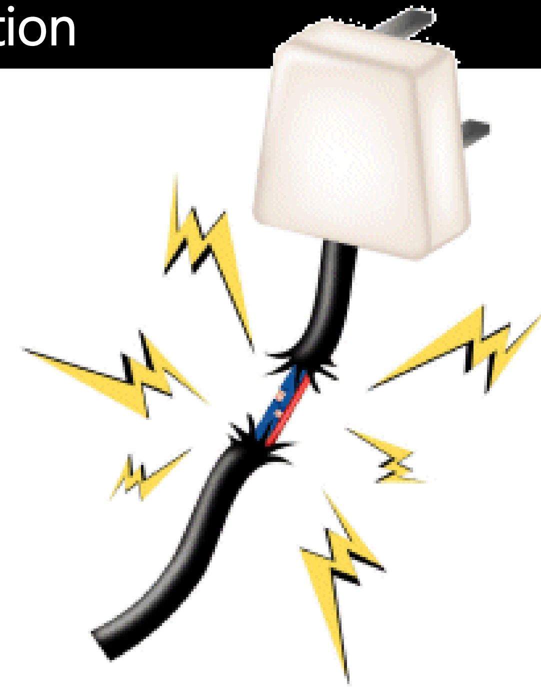
Every day we use materials because of their ability to conduct electricity. The most common product around the home is cables and wiring. Our houses are wired with metals such as copper which carry charge around. The wires are coated in plastic which acts as an insulator to prevent electricity flowing away from the wire.

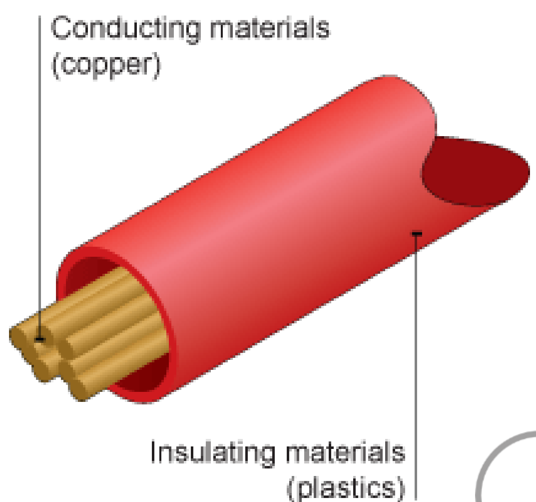
Wires are also used to transport electricity around from where it is generated such as at a hydropower station to towns where it is used. The insulating material around the wire needs to be much thicker and the wires are suspended from pylons by other insulators made from glass or ceramic materials.



The hazards of poor insulation

Machines, wires and appliances that use electricity or have electricity flowing through them must have a insulating material such as plastic surrounding parts that we may come in contact with.
Power lines are usually held off the ground by **wooden** or **concrete** posts and suspended by **glass** or **ceramic** (material that coffee cups are made of) insulators.
Appliances including the cords and plugs usually have **plastic** or **rubber** coverings.
If the coverings become cracked or worn and expose the metal that conducts the electricity then we are in danger of an electric shock if we touch that part.

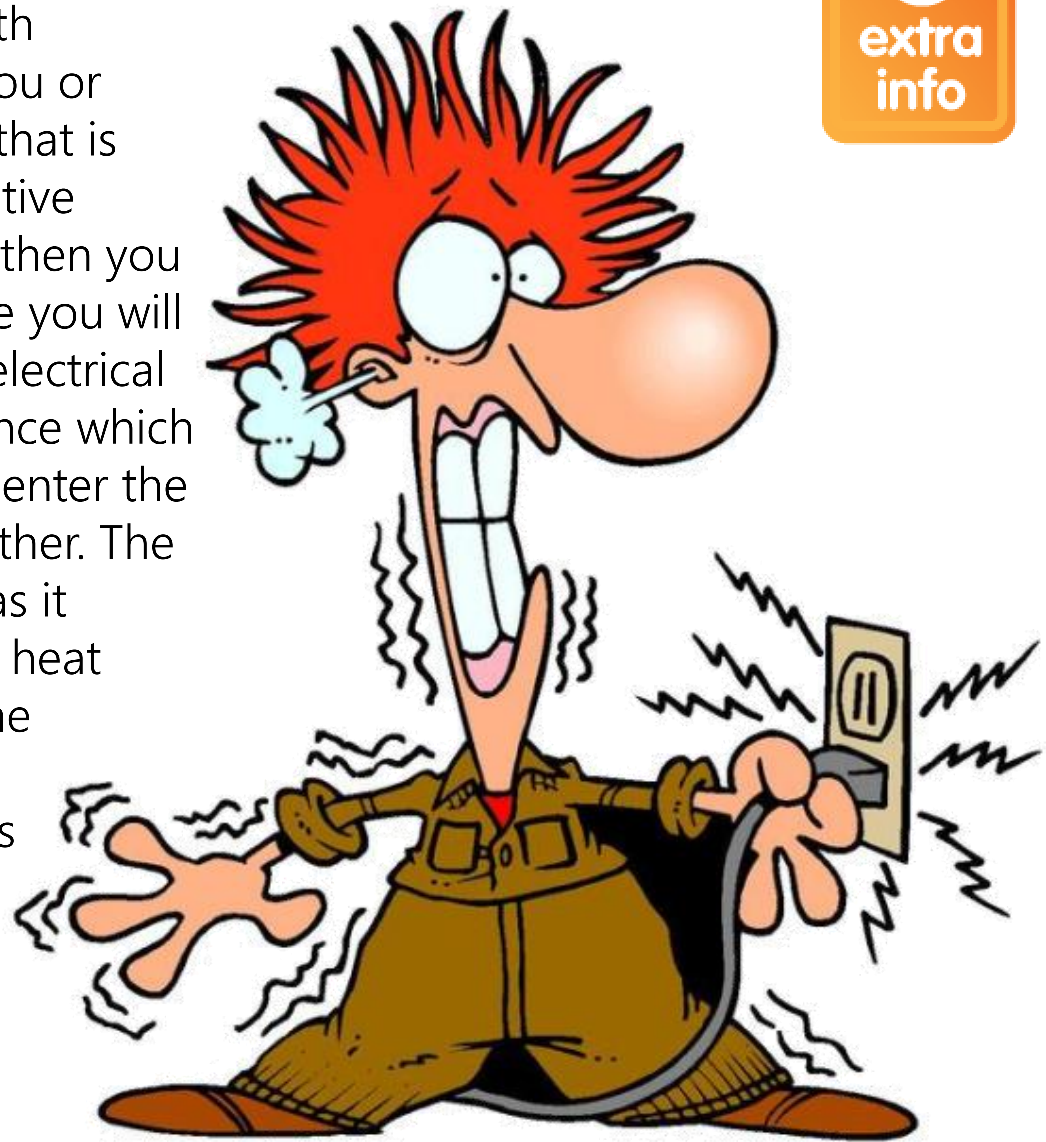




The dangers of electricity and the hazards of poor insulation, overloading and damp conditions

extra info

If electricity flows through your body with enough voltage or current it could kill you or cause damage. If your body is earthed, that is touching the ground or another conductive object that is touching the ground, and then you come in contact with an electrical source you will form a circuit for a current to flow. The electrical current will follow a path of least resistance which may be across your skin but it also may enter the body at one point and exit through another. The electrical current may cause bad burns as it converts some of its electrical energy to heat energy. It may also stop your heart as the electricity interferes with the pacemaker of your heart that sends out small pulses of electricity to keep the heart muscles all contracting and relaxing in rhythm.

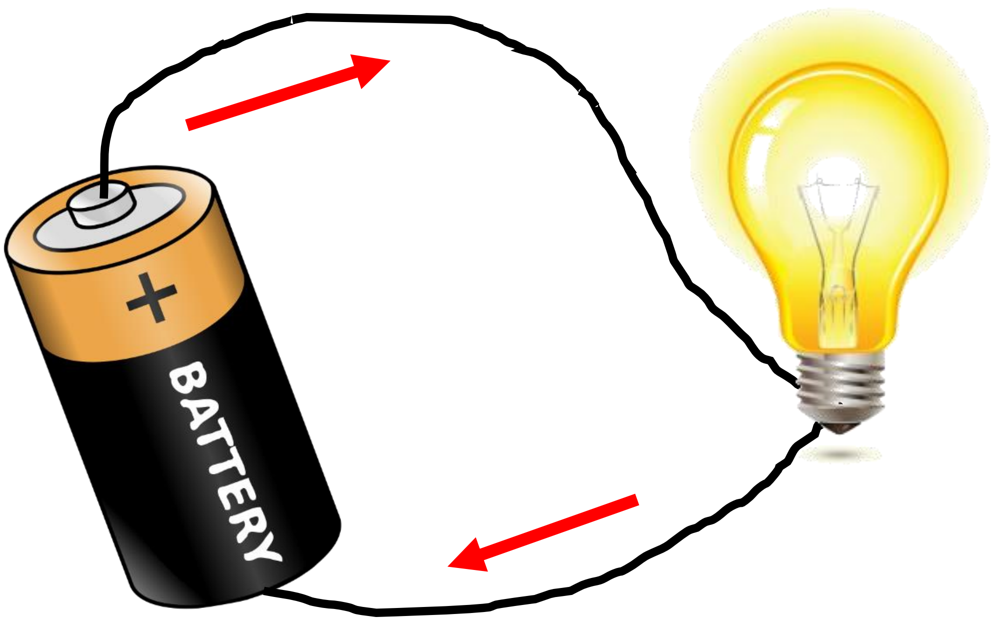


An electric current is a flow of charge

An **electric current** is charge moving from place to place: in a circuit the charge is moving in wires. Electric current measures the rate of flow of electric charge. Particles called electrons carry the electric charge. While some substances called **conductors** conduct very well, e.g. metals, other substances are not able to conduct or nearly conduct no electric current, e.g. glass, called **insulators**. Electric current is nearly as fast as the speed of light. (In an electrolyte charge is carried by ions and in plasma is carried by electrons and ions)

NOTE:
The charge of an electron is negative. Previously people thought that positive particles serve as charge carriers. Due to this error the current flow is moving in the opposite direction of the electrons by convention from the **positive terminal** to the **negative terminal**.

extra info



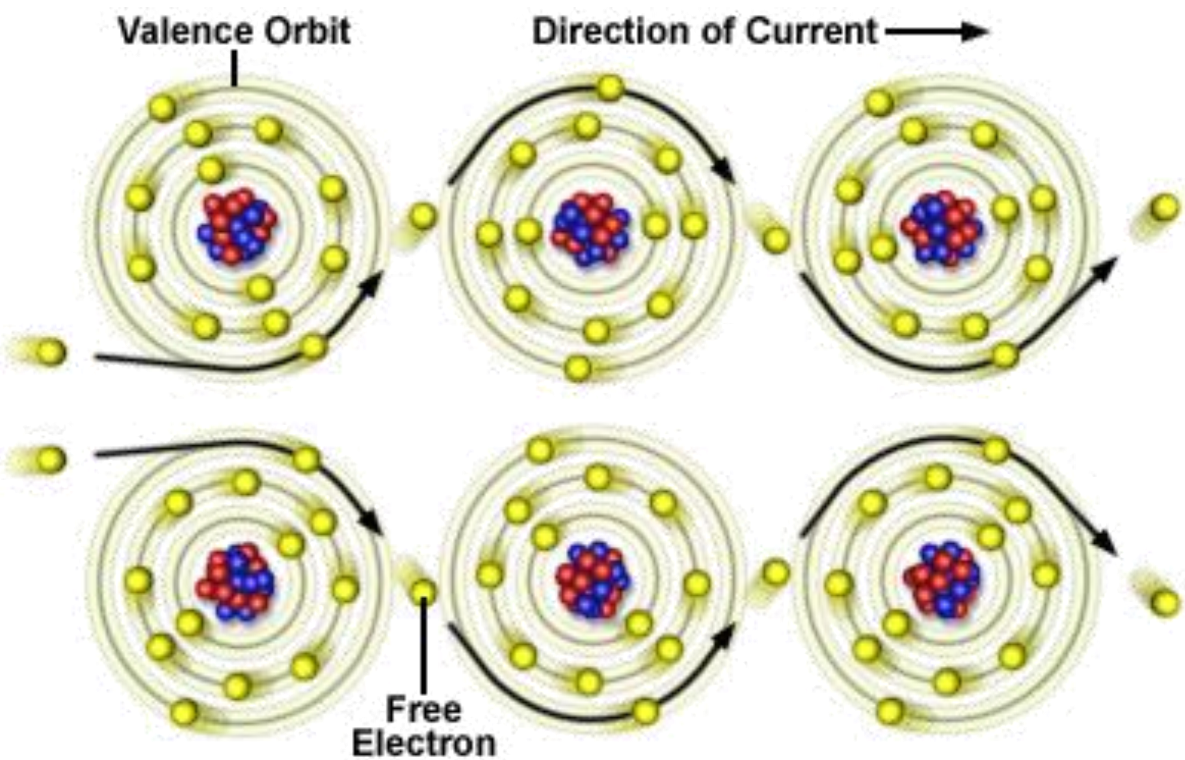
Direction of flow of **current**

Electricity is a form of Energy

extra info

Electricity is all about charge and it's movement. An **electric current** is a flow of electric charge. In electric circuits this charge is often carried by moving electrons in a metal wire. Electrical energy is carried by electrons but it isn't the electrons themselves. Electrons can carry varying amounts of energy. The more energy, the faster they move about. The electrons are "delocalised" as they do not just stay around one nucleus.

All matter is made up of atoms. Atoms consist of protons, neutrons and electrons. Protons have a positive charge, neutrons have no charge and electrons have a negative charge. The charges of protons and electrons are equal and opposite.

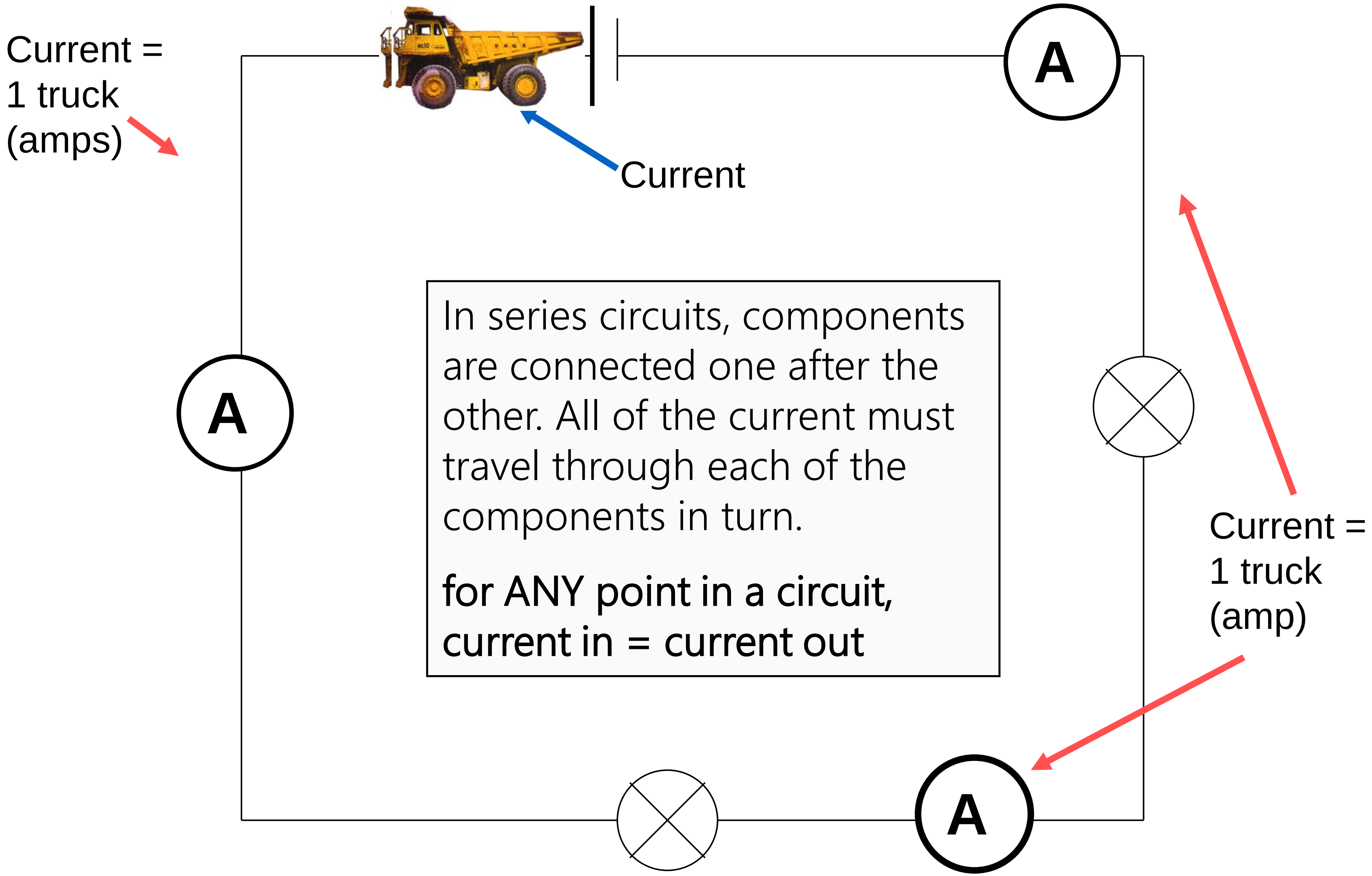


Ammeters are used in circuits to measure Amps

To measure current we need a charge counter which is "in" or is part of the circuit. We can measure the amount of electric current flowing in a circuit with a device called an **ammeter**. The unit of electric current is the Amp - which is often abbreviated to the letter A, especially if it comes after a number. So, for example, 3 Amps can also be written 3A.

To measure the current flowing in a circuit you must connect the ammeter in **series** with the other components

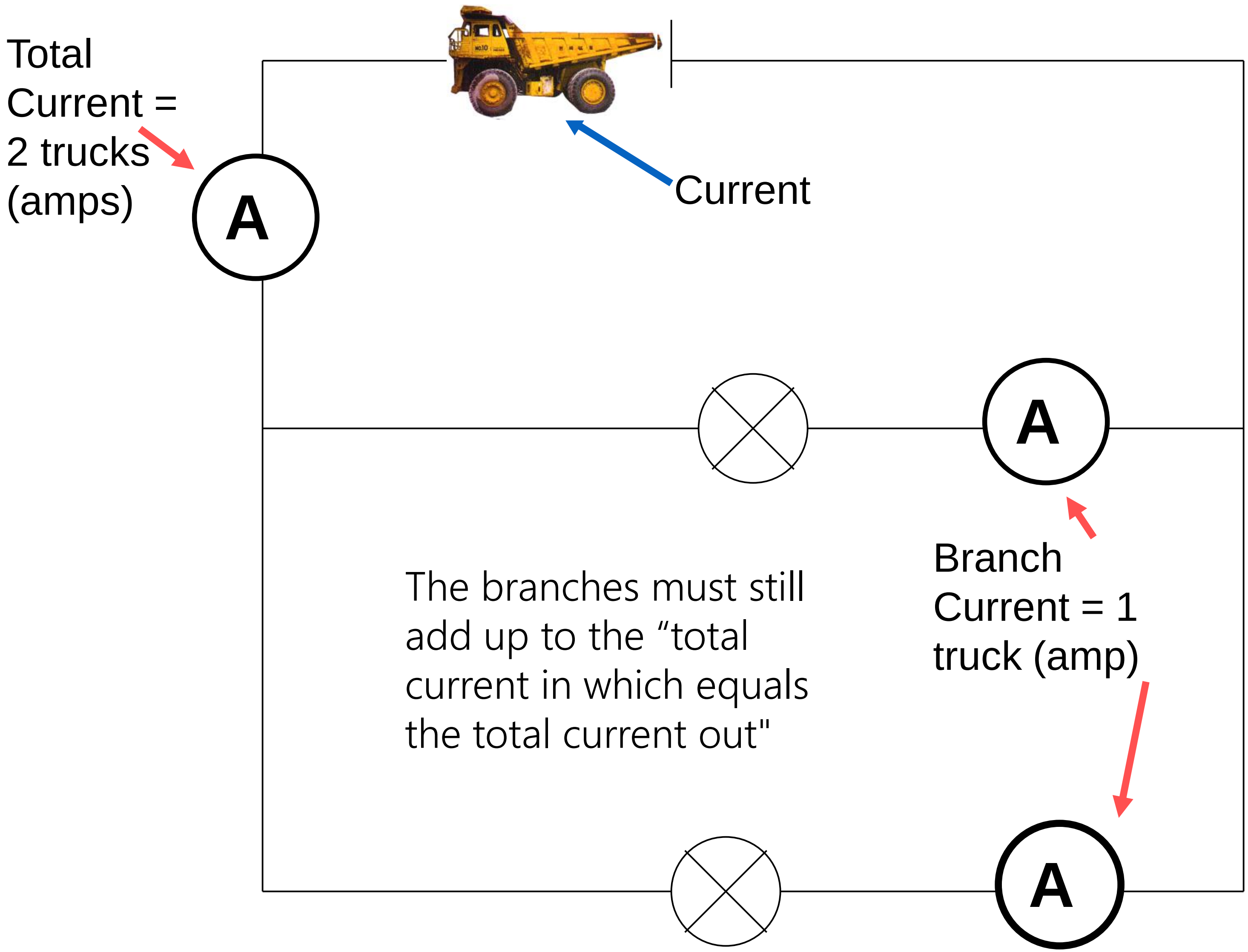
In Series circuits, the current is the same at any point on the circuit



In series circuits, components are connected one after the other. All of the current must travel through each of the components in turn.

for ANY point in a circuit, current in = current out

In parallel circuits, the current is shared out between branches



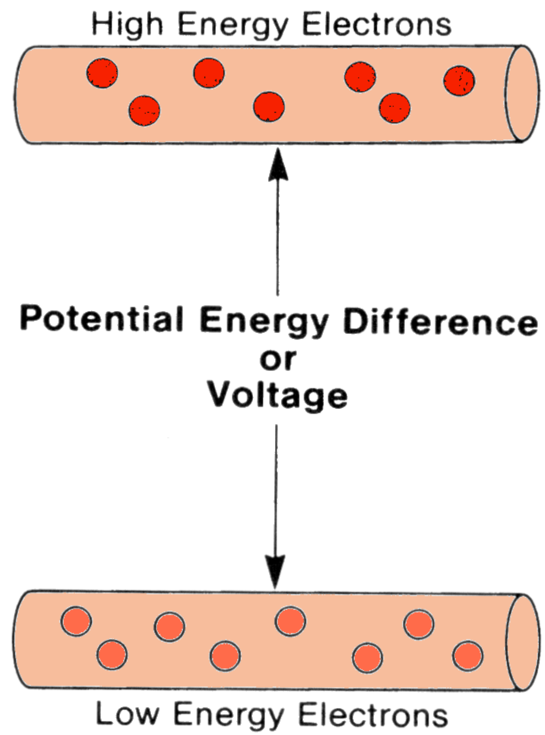
The branches must still add up to the “total current in which equals the total current out"

The 'potential difference' of an electrical supply is a measure of the energy it can transfer from an electrical supply elsewhere

An electric current won't flow through a circuit unless there's a source of energy like a battery or mains electricity to **push** the electric charges along through the wire.

'potential difference' is a measure of how much energy the electric charges have between two points in a circuit.

Potential difference is also known as **voltage**. The more potential difference the more energy is available to be transferred into components attached to a circuit.



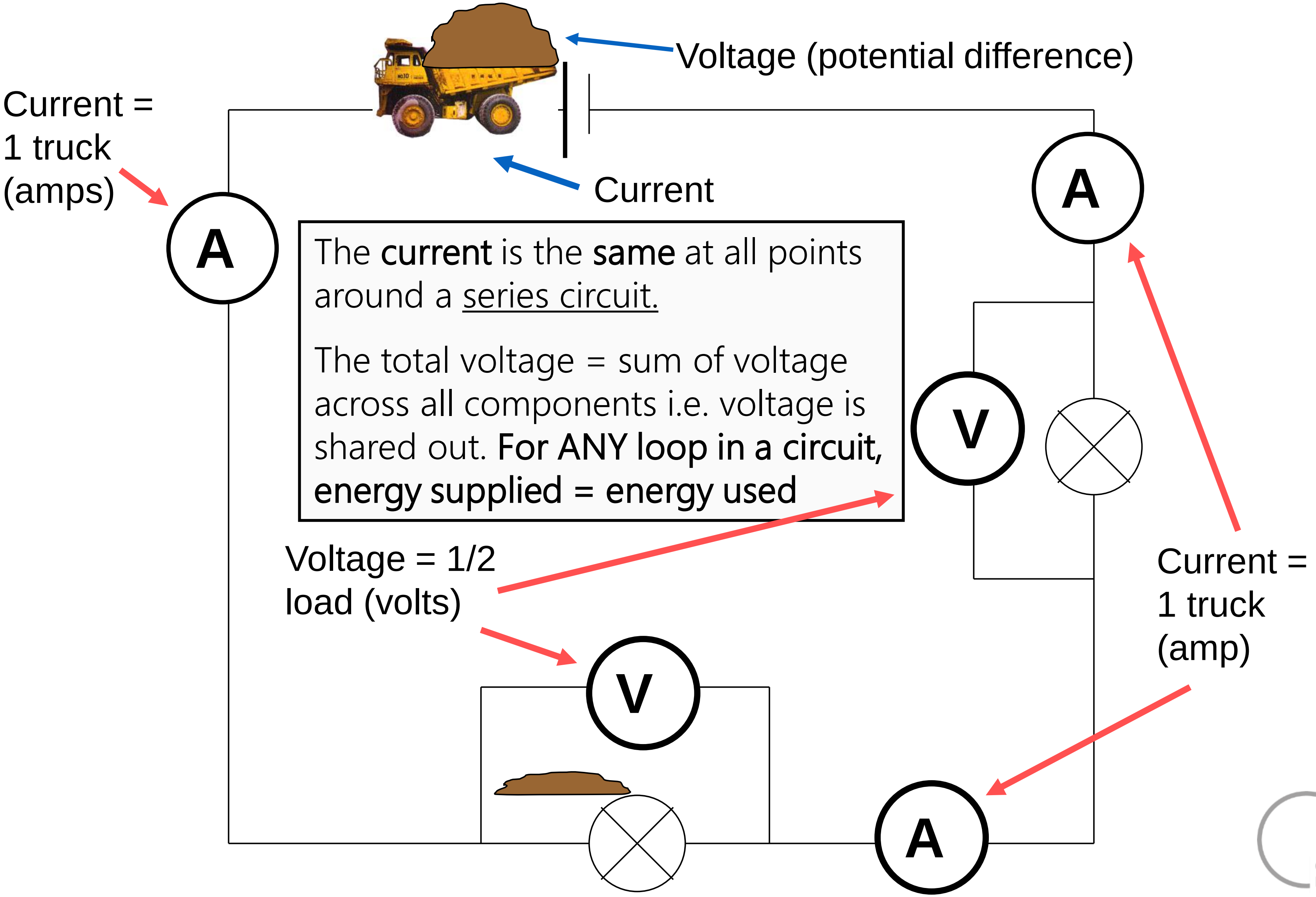
The potential difference between two points is equal to the work done per unit of charge against a static electric field (force) to move the charge between two points and is measured in units of volts
(a joule per coulomb) F=Wd

extra info

Potential difference (voltage) can be measured with a voltmeter

A voltmeter is used to measure **potential difference** (voltage) and is placed in **parallel** to an appliance. **The potential difference** is a difference in energy per amount of charge between two different points of a circuit. We need a device to measure the energies at two points in the circuit and say what the difference is. This is called a **voltmeter** and measures the numbers of volts. The unit is the **volt, V.** We can measure the energy of electric charges in a circuit before they enter a bulb and after they leave it by putting a voltmeter in parallel across the bulb like this:

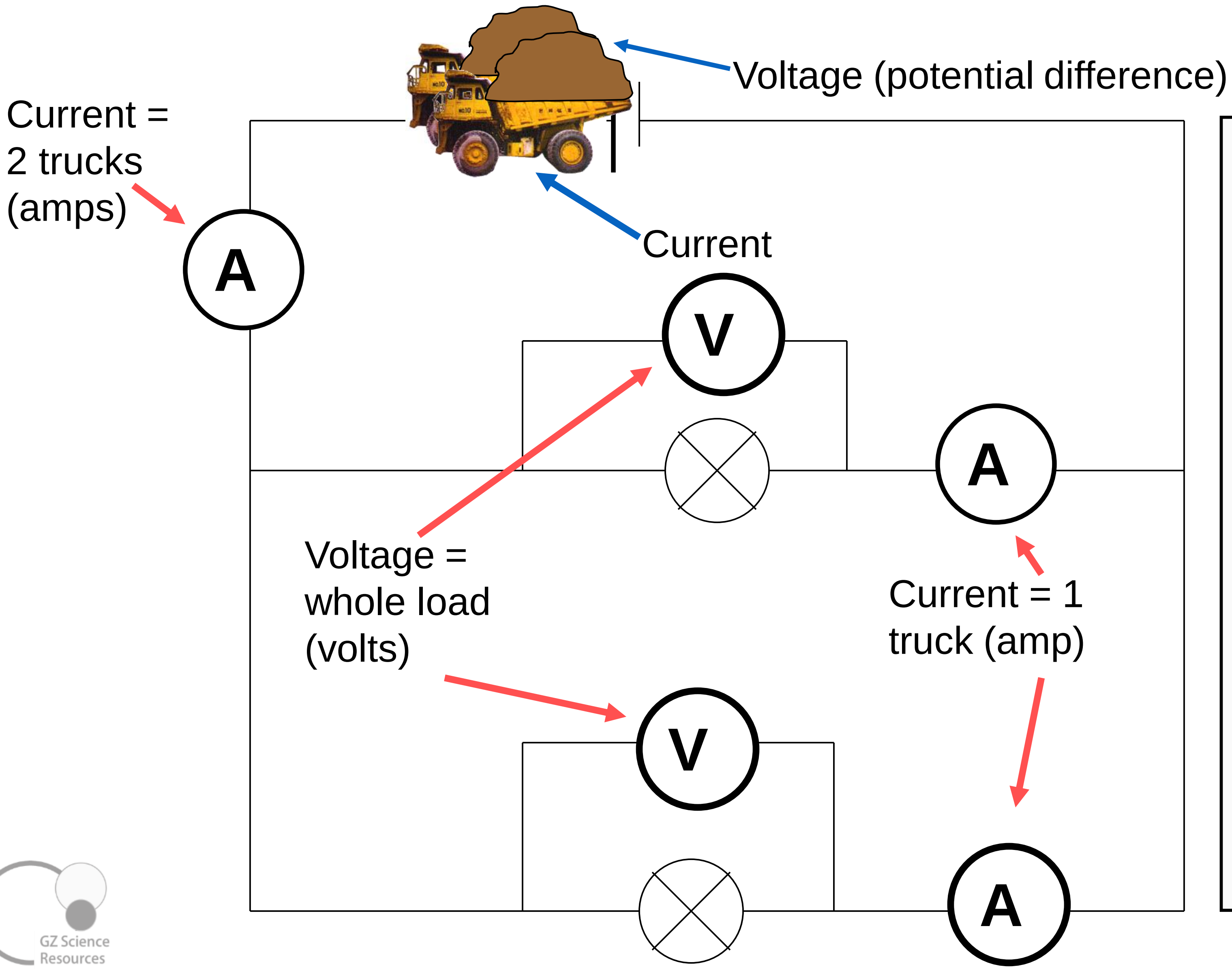
In Series circuits, the potential difference is “shared out” around the circuit



The **current** is the **same** at all points around a series circuit.

The total voltage = sum of voltage across all components i.e. voltage is shared out. **For ANY loop in a circuit, energy supplied = energy used**

In parallel circuits, the potential difference is the same across all branches



The total current in the circuit = sum of the currents i.e. current is shared.

The potential difference is the same across all branches around a parallel circuit.

Current and potential difference in Parallel and Series circuits

extra info

	Current	Potential difference (Voltage)
Series	>Same everywhere in the circuit >Doesn’t increase as more bulbs added	>total potential difference coming out of battery is all used up by components (i.e. bulb) >total potential difference loss is shared between components
Parallel	>total current coming out of battery is shared amongst branches >increases as more bulbs added	>total potential difference loss is the same across all components

Advantages and Disadvantages of Parallel and Series circuits

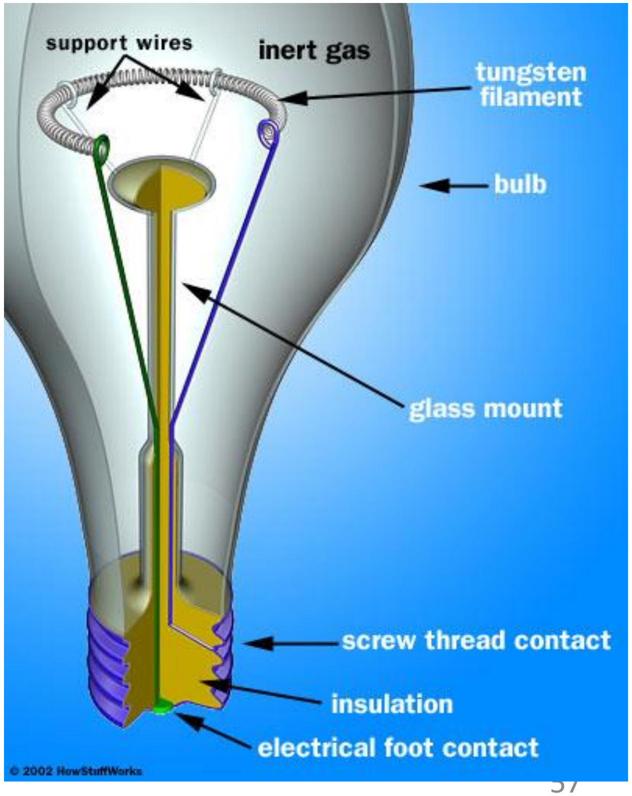
	Advantage	Disadvantage
Wiring done in parallel	Other bulbs remain working if one bulb is blown or removes All bulbs glow brightly	More current is needed when extra bulbs added The battery runs out quicker
Wiring done in series	You can turn off all of the appliances / lights with one switch The wiring is simpler	If one bulb is disconnected the circuit is not complete and all the bulbs will go out Resistance of the circuit is greater if more than one bulb – the other bulbs don't glow as brightly Hard to find the blown bulb

Power = potential difference x current

Power is equal to the rate of energy change
Depends on the current AND the potential difference: for a bulb
The more the energy change **across** it the brighter it will be
The bigger the current **in** it, the brighter it will be.
Power is measured in watts, W.

The **watt** (symbol: W) is equal to one **joule** per second.

A person climbing a flight of stairs is doing work at the rate of about 200 watts; a highly trained athlete can work at up to approximately 2,000 watts for brief periods. An car engine produces 25,000 watts while cruising. A typical household lightbulb uses 40 to 100 watts.



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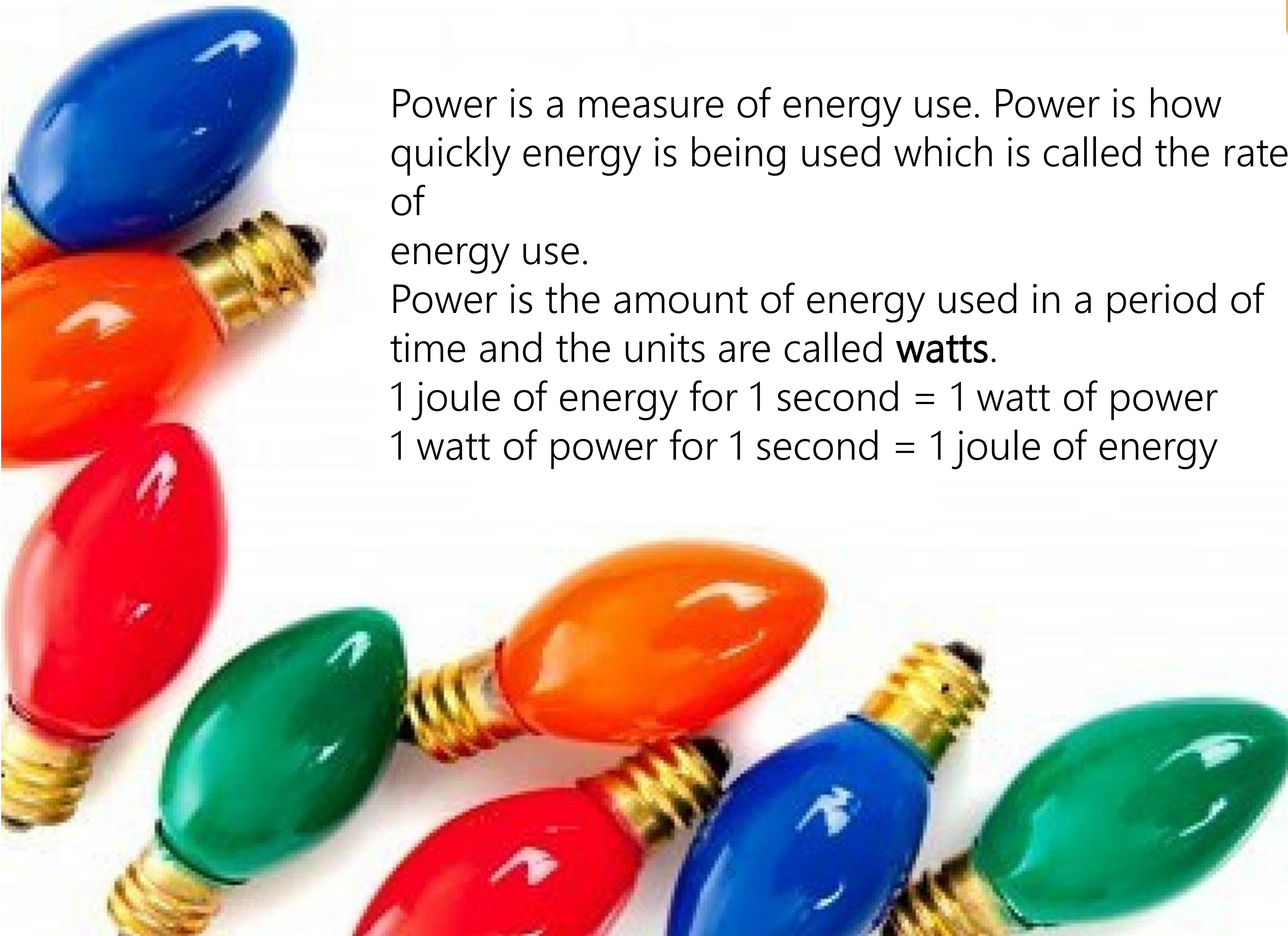
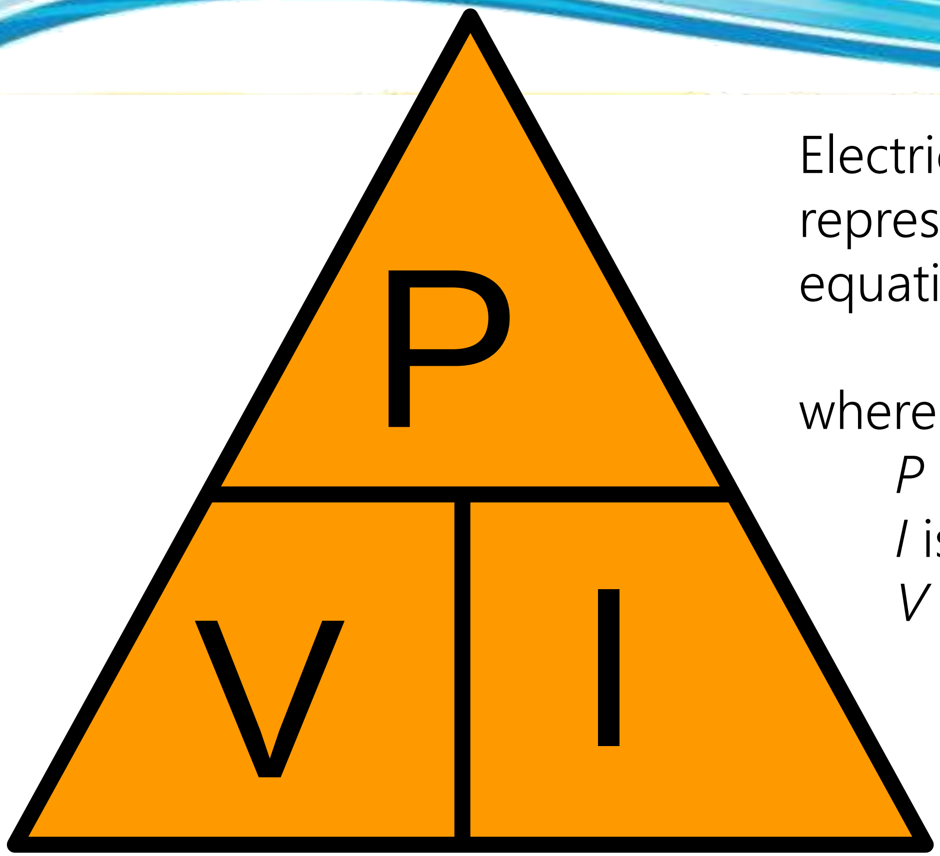
Power is measured in a unit called a watt (W).

extra info

Power is a measure of energy use. Power is how quickly energy is being used which is called the rate of
energy use.
Power is the amount of energy used in a period of time and the units are called **watts**.
1 joule of energy for 1 second = 1 watt of power
1 watt of power for 1 second = 1 joule of energy



Power = potential difference x current



Electric power, like mechanical power, is represented by the letter *P* in electrical equations.

where

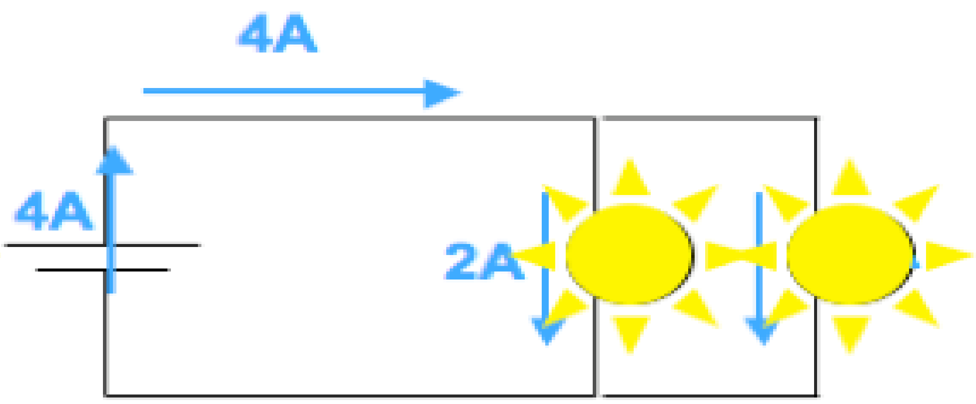
P is the power (**watt** or W)
I is the current (**ampere** or A)
V is the potential difference (**volt** or V)

Power increases if either the current or the potential difference increases.

Predictions of Ammeter and voltmeter readings

Predictions can be made about the current (amps) in both the series and parallel circuits using the rules. In a series circuit if one component reads 2A then all components will read the same. In a Parallel circuit the current reading leaving the power supply must be divided between branches.
Predictions can also be made about potential difference (voltage) readings with the total potential difference across the power supply shared out to components in a series circuit and equal to the potential difference in each branch of a parallel circuit.
Predictions can be tested by setting up each circuit and taking multiple voltage and current readings

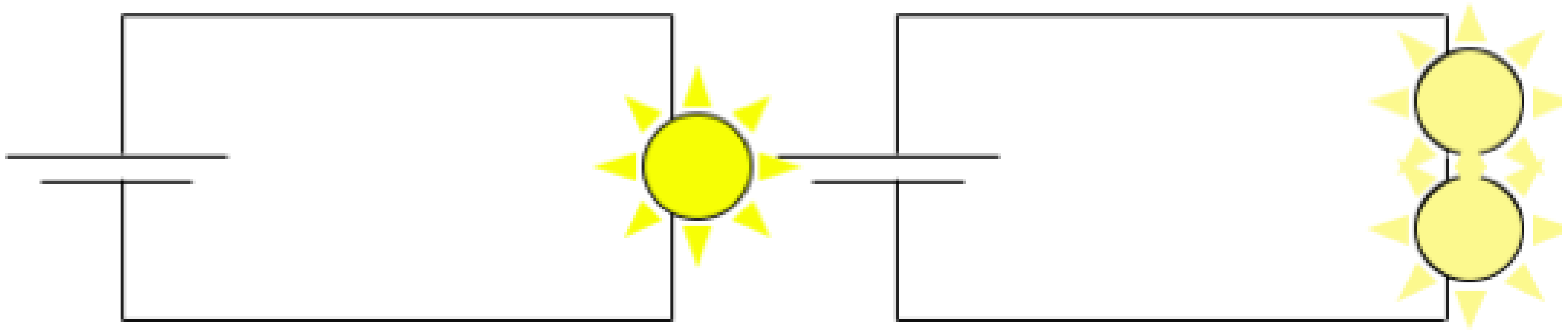
Series



Parallel

Investigating the brightness of adding bulbs in series and parallel circuits

An Investigation will show that the more bulbs that are added to a **series** circuit the dimmer they will collectively be.
In a **parallel** circuit if each bulb has its own circuit then the brightness of the bulbs will not be affected.

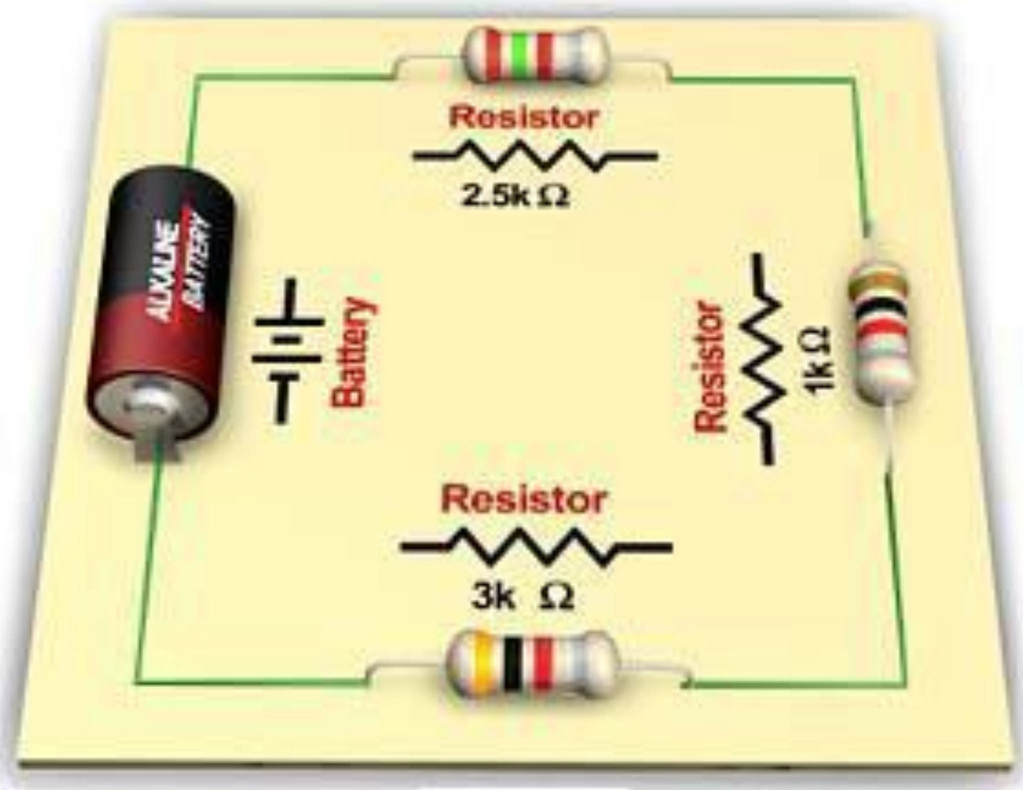


Series

Electrical resistance

Resistance (symbol R) measures how difficult it is for current to move through a component. Resistance is measured in ohms (symbol Ω)

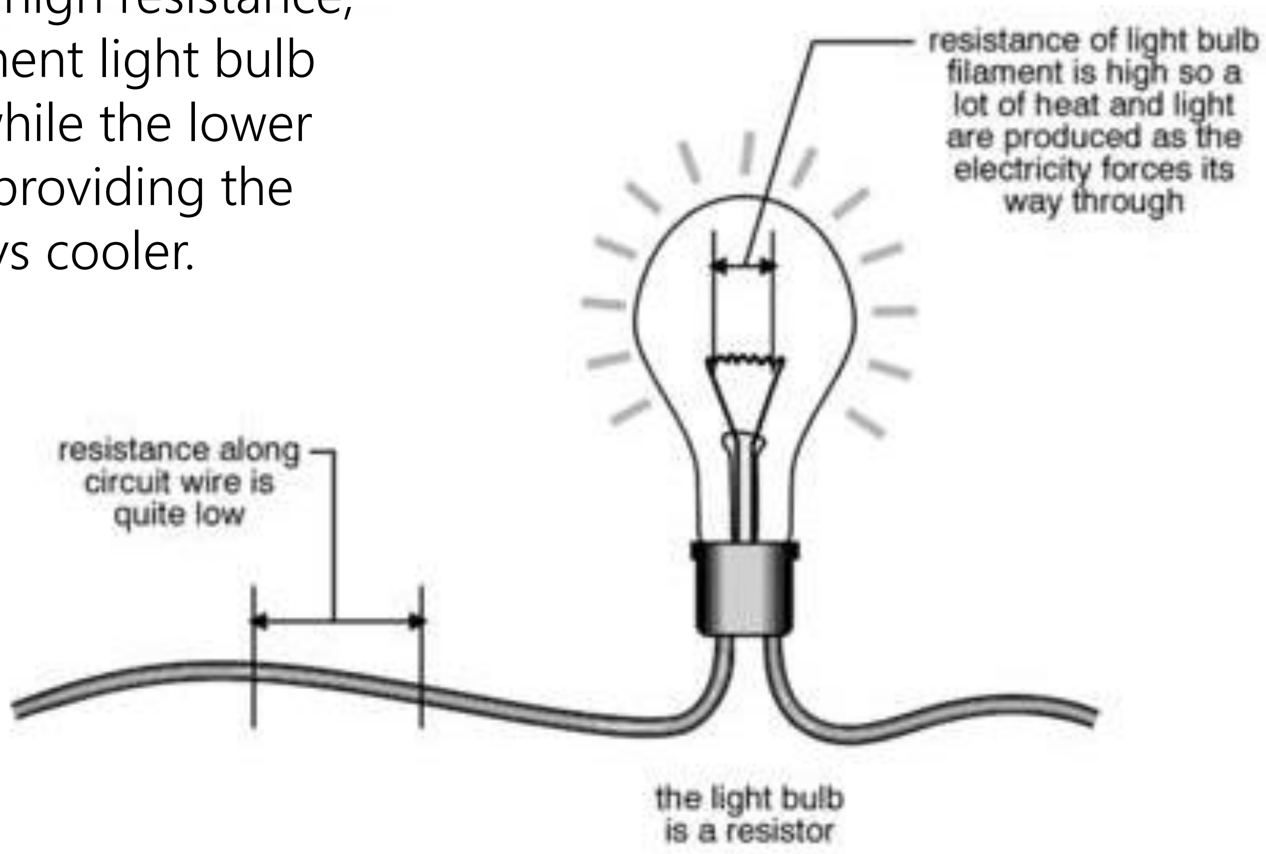
Resisters will reduce the current that flows through a circuit. Components that add resistance to a circuit can often transform electrical energy in light, sound or heat energy, such as the thin wire in a light bulb.



Electrical resistance

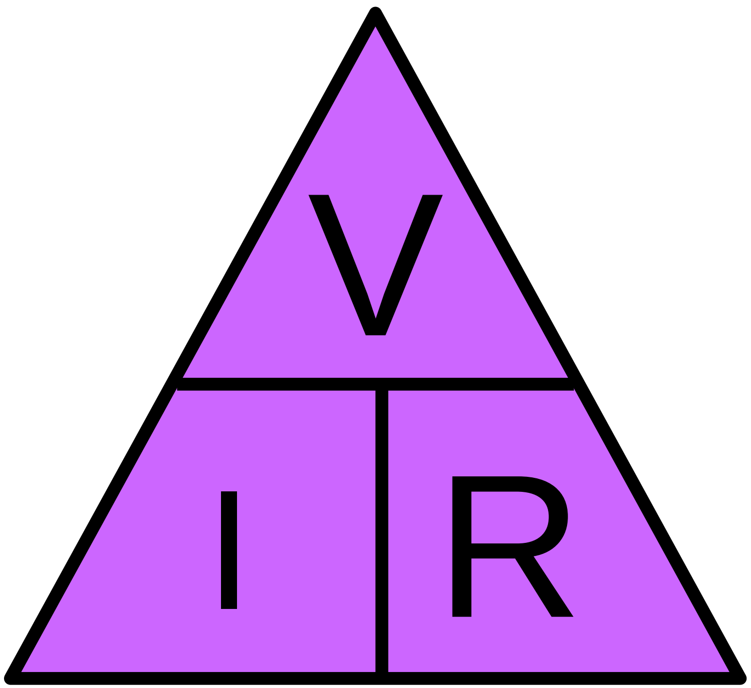
extra info

Parts of a circuit which offer high resistance transform a greater amount of electrical energy into light and heat energy. This is why the high resistance, very thin wire of a filament light bulb glows hot and bright while the lower resistance thicker wire providing the current to the bulb stays cooler.



The resistance of a component (in ohms) = potential difference across component / current through component

Resistance is calculated using R = V/I



The higher the resistance the less the current.

The resistance of an object determines the amount of current through the object for a given voltage across the object.

where

- R is the resistance of the object, usually measured in **ohms**
- V is the potential difference across the object, usually measured in **volts**
- I is the current through the object, usually measured in **amperes**