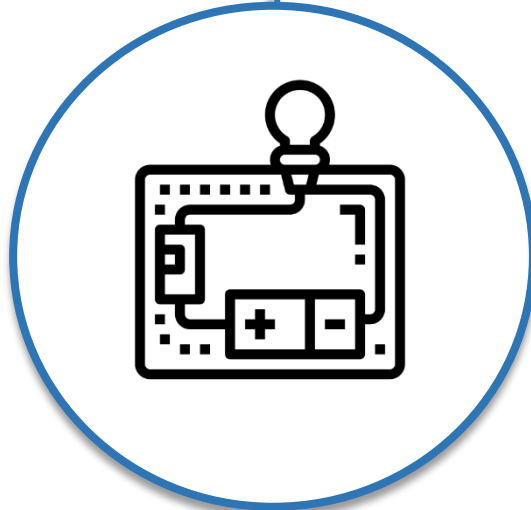


**YEAR 8
PHYSICS
UNIT 2**



In this topic you will discover some of key ideas in Physics about electricity and magnetism. You will learn how electrical circuits work and measure the movement of charged particles and how much energy they transfer. You will learn about magnetism and electromagnetism, and electrostatics.

This will build on ideas covered in Y7 about energy transferred electrically and energy transferred by non-contact forces magnetic and electrostatic. This will also build on ideas about Electricity and Magnets covered in Y5 and Y6.

This will help you prepare for the GCSE Physics topics Electricity and Electromagnetism as well as learning about the uses of Physics in the world.

Name:

Class:

Teacher:

Expected Performance Level:

**ACTIVATE KNOWLEDGE**

In Y7 we were introduced to the eight ways in which energy can be stored and how energy is transferred between those stores. One energy transfer that we looked at was energy transferred electrically. Energy can be transferred electrically by the movement of tiny charged particles called electrons. When electrons move, energy is transferred. We then looked at how we can measure the amount of charged particles that flow in a circuit. This is called electrical current. We used a piece of equipment called an ammeter to measure the amount of electrical current in Amps (A). We then looked at the materials that are needed to transfer energy electrically. The materials that are good at transferring energy electrically need to contain electrons that are free to move. These materials are called conductors. Materials that are bad at transferring energy electrically are called insulators. These materials do not contain electrons that are free to move. We will start this topic by building on our ideas from Y7 and applying them to building circuits.

**STORIES IN SCIENCE**

You're using electricity all the time, even when you're not thinking about it. If you turn on lights in your house, if you turn the heating on, or charge your phone or play on your game console or watch TV, then you are using electricity.

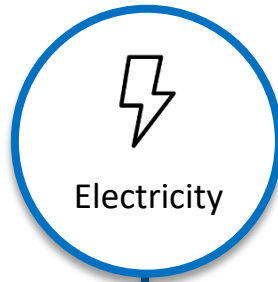
Electricity is the flow of charged particles which transfer energy. We make use of this energy transfer in almost every aspect of our lives. However, electricity was not always something that humans used the way we do today. Someone had to discover electricity, and that person was Benjamin Franklin.

Benjamin Franklin decided to do a little experiment with lightning back in 1752. He thought that lightning was interesting and wanted to find out more about it. So Mr. Franklin did something very dangerous, that none of us should try. He took a kite outside during a thunderstorm, got the string of the kite wet, put a metal key at the end and then let the kite float up into the storm. What he discovered was that the electricity from the storm clouds came down the string, and he received an electrical shock.

Benjamin Franklin was lucky he only received a shock. That dangerous experiment, however, was the starting point for more scientists to experiment with electricity over the next hundred years. These scientists and inventors wanted to discover what could be done with the electricity that Benjamin Franklin found through his experiment.



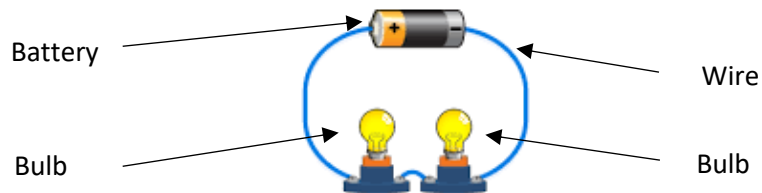
CONTENT



Electricity is the **movement of charged particles** called electrons.
The electrons **transfer energy** as they move.

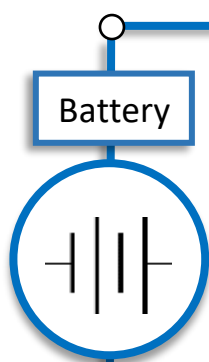
A loop/path that allows the charged particles to move is called a **circuit**.

This is an example of a simple circuit:

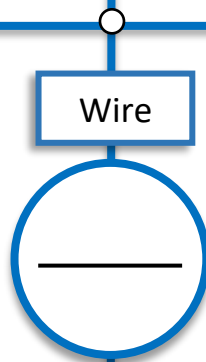


The parts of a circuit are called **components**.

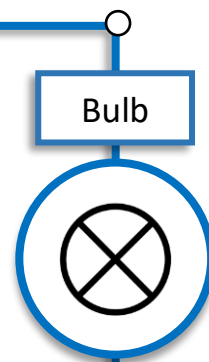
Components have a different job in a circuit. When we draw components, we draw them using a circuit symbol which represents what it is.



Part of the circuit that supplies the energy from its chemical energy store.



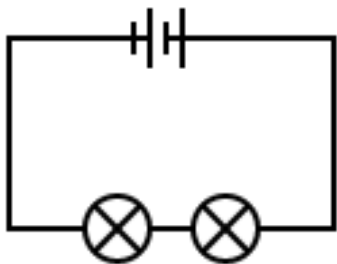
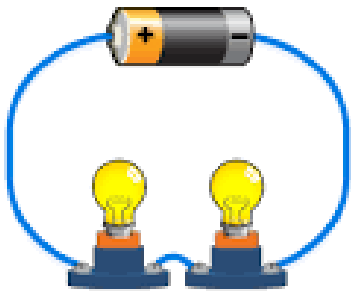
Part of the circuit which contains electrons that can move to transfer energy electrically.



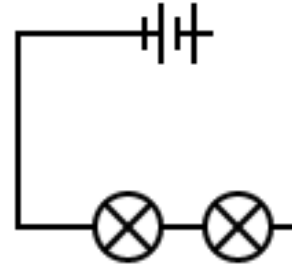
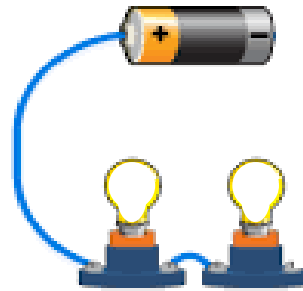
Part of the circuit which transfers energy as light waves.

A **complete circuit** is needed for charged particles to move.

A **complete circuit** is an unbroken loop between components made up of conductors which lets electrons move and transfer energy.



An **incomplete circuit** is a broken loop between components which may be disconnected or made up of an insulator which doesn't let electrons move and transfer energy.



Components can be used to make a complete or incomplete circuit.

A **closed switch** can be used to make a complete circuit.



An **open switch** can be used to make an incomplete circuit.





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What are the charged particles called that transfer energy electrically?		
2	What do the charged particles transfer as they move?		
3	What is a loop/path that allows charged particles to move called?		
4	What type of materials must components be made from?		
5	What are materials called that don't let charged particles flow through them?		
6	Which part of the circuit contains charged particles that move?		
7	Which part of the circuit supplies the energy to be transferred?		
8	Which part of the circuit transfers the energy as light?		
9	What is a circuit called which is made up of a loop with no gaps?		
10	What is a circuit called which is made up of a loop with gaps or insulators?		
Score			



STORIES IN SCIENCE

Thomas Edison was the first recorded inventor to produce a long-lasting electric light bulb, which he created in his laboratory in 1879. He developed a light bulb which was lit by a glowing, electrified filament made of paper. This unfortunately burnt out rather quickly. Lewis Latimer created a light bulb with a filament made of the much more durable carbon in 1881. Throughout his life, Latimer came up with his own inventions. He invented a bathroom for railroad cars and the threaded socket, which allows a light bulb to be screwed into a fixture. In 1890 Lewis Latimer published a book about electricity. He was one of a small group of scientists who formed the Edison Pioneers in 1918.





ACTIVATE KNOWLEDGE

Draw circuit symbols for the following:

Battery

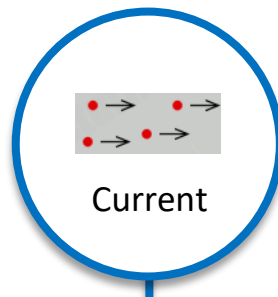
Wire

Bulb

What is the name given to a circuit which is made up of a loop with no gaps that allows charges to move?



CONTENT



Current is the **flow of charge**.

Current measures how fast charged particles (electrons) move through a circuit.

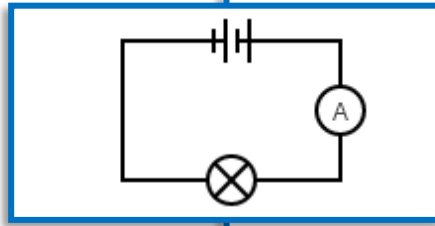
The **faster** the charges flow,
the **bigger** the current.

The **slower** the charges flow,
the **smaller** the current.

Current is measured using an ammeter.
The unit we measure current in is Amps (A).
The circuit symbol for an ammeter is:



METHOD TO MEASURE CURRENT IN A SIMPLE CIRCUIT



Plug in the power supply, turn on and turn to 12V.

1

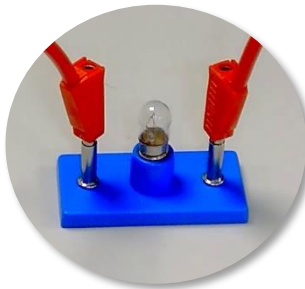
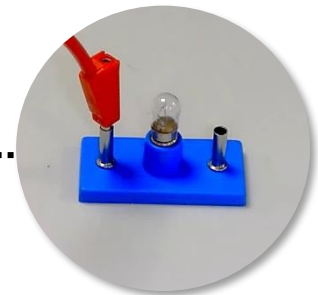


Plug a wire into the red terminal of the power pack.

2

Plug the other end of this wire into a bulb.

3



Plug a second wire into the other side of the bulb.

4

Plug the other end of this wire into the red terminal of the ammeter.

5



Plug a third wire into the black terminal of the ammeter.

6

Plug the other end of this wire into the black terminal of the power pack.

7








Turn on the ammeter and measure the current.

8



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What are the charged particles called that transfer energy electrically?		
2	What do the charged particles transfer as they move?		
3	What is the flow of charges in a circuit called?		
4	What type of materials must components in a circuit be made from?		
5	What is the following circuit symbol? 		
6	What is the following circuit symbol? 		
7	What is the following circuit symbol? 		
8	What is the following circuit symbol? 		
9	What part of a circuit contains charged particles that move?		
10	What is the following circuit symbol? 		
Score			



ACTIVATE KNOWLEDGE

What is current?

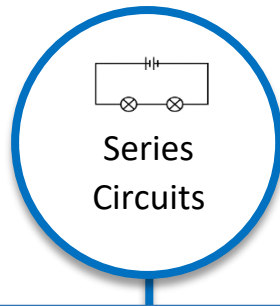
What piece of equipment is used to measure current?

Write each number to one decimal place:

a) 0.44 b) 4.82 c) 2.38 d) 3.87 e) 1.45 f) 6.98



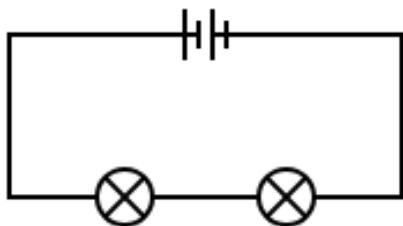
CONTENT



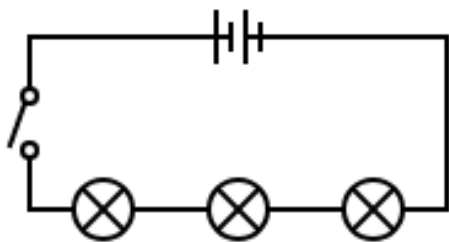
A series circuit is a circuit that has **one loop**.

This means that there is only **one route** for the current to flow.

Examples



A series circuit with a battery and two bulbs.



A series circuit with a battery, an open switch and three bulbs.

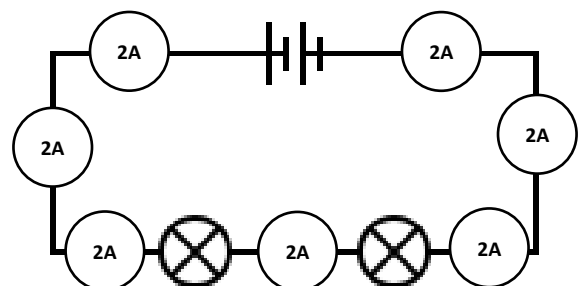
Current in a Series Circuit

Series circuits are **one loop**.

This means that the charges move at the **same speed** around the circuit.





This means the **current is the same at all points** in a series circuit.

The current (flow of charge) is the same at all points which means ammeter readings will be the same at all points in a series circuit.





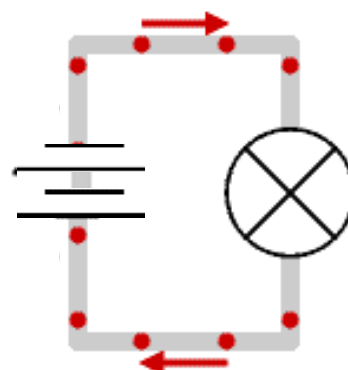
RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the flow of charge in a circuit called?		
2	What is current like at all points in a series circuit?		
3	What is a circuit called that is made up of one loop?		
4	What is the following circuit symbol? 		
5	What is the following circuit symbol? 		
6	What is the following circuit symbol? 		
7	What is the following circuit symbol? 		
8	Draw the symbol for an ammeter.		
9	What are the units used to measure current?		
10	What piece of equipment is used to measure current in a circuit?		
Score			



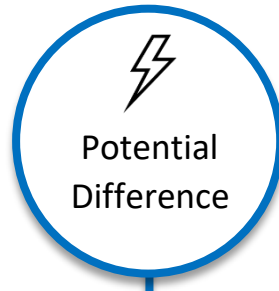
ACTIVATE KNOWLEDGE

How is energy transferred from a battery to a bulb?





CONTENT



Potential Difference is the amount of **energy transferred per charge** in a circuit.
Potential difference measures how much energy the electrons transfer in a circuit.

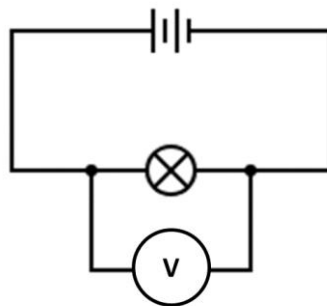
The **more** energy transferred,
the **bigger** the potential difference.

The **less** energy transferred,
the **smaller** the potential difference.

Potential Difference is measured using a voltmeter.
The unit we measure potential difference in is Volts (V).
The circuit symbol for a voltmeter is:



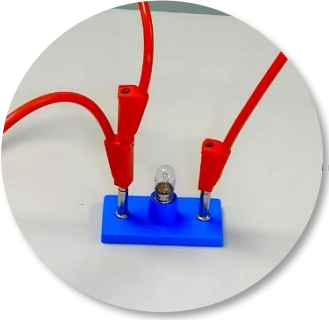
A voltmeter is connected into the circuit in an **extra loop**.
This is called connected in **parallel**.



METHOD TO SET UP A VOLTMETER

Plug a wire into the red terminal of the voltmeter.

1



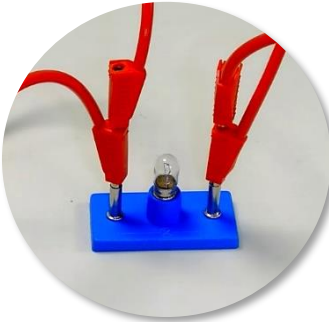
2

Plug the other end of that wire into one of the component's wires.



Plug another wire into the black terminal of the voltmeter.

3







4

Plug the other end of that wire into the other of the component's wires.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the flow of charge in a circuit called?		
2	What is current like at all points in a series circuit?		
3	What is a circuit called that is made up of one loop?		
4	What is the following circuit symbol? 		
5	What is the following circuit symbol? 		
6	What is the following circuit symbol? 		
7	What is the following circuit symbol? 		
8	Draw the symbol for an ammeter.		
9	What are the units used to measure current?		
10	What piece of equipment is used to measure current in a circuit?		
Score			



ACTIVATE KNOWLEDGE

What is potential difference?

What equipment is used to measure potential difference?

How do you set up a voltmeter in a circuit?



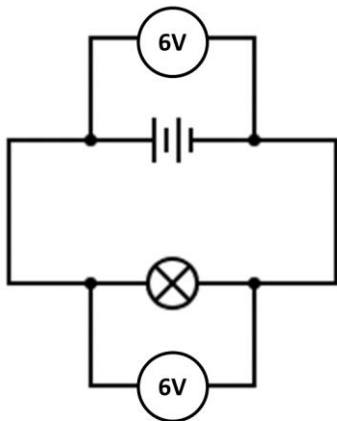
CONTENT

Potential Difference in a Series Circuit

Series circuits are **one loop**.

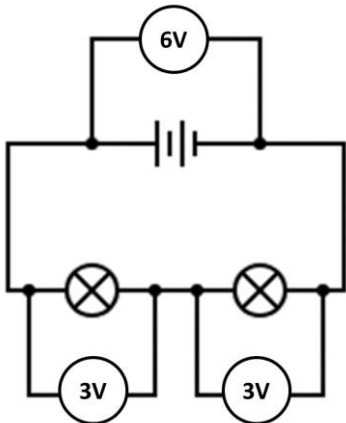
This means that the energy transferred from the battery is **shared between components**.

This means that the **total potential difference** from a battery is **shared between components in a series circuit**.



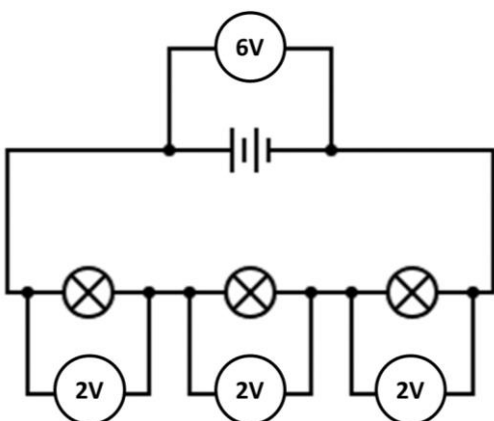
← The total potential difference of the battery is 6V.

← There is one component so potential difference of the bulb is 6V.



← The total potential difference of the battery is 6V.

← There are two components so the potential difference is split between the bulbs and they are 3V each.



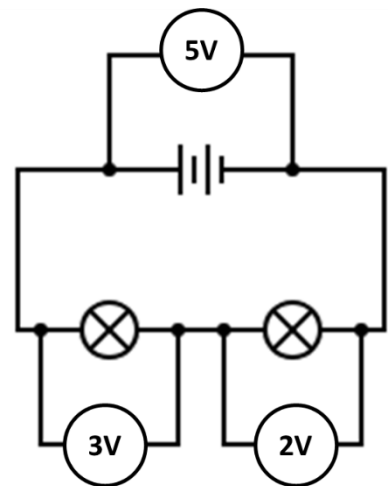
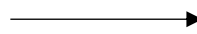
← The total potential difference of the battery is 6V.

← There are three components so the potential difference is split between the bulbs and they are 2V each.

The potential difference **does not always split equally**.

If the components are not the same, the potential difference will not split equally.

The total potential difference of components is always equal to the potential difference of the battery.





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the flow of charge in a circuit called?		
2	What is the energy transferred per charge called?		
3	What piece of equipment is used to measure current?		
4	What piece of equipment is used to measure potential difference?		
5	What are the units used to measure current?		
6	What are the units used to measure potential difference?		
7	What is the circuit called that is made up of one loop?		
8	What is current like at all points in a series circuit?		
9	What happens to the total potential difference in a series circuit?		
10	What is the name of the charged particles that transfer energy?		
Score			



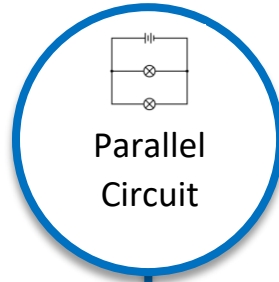
ACTIVATE KNOWLEDGE

What is a series circuit?

Draw a series circuit with a battery, open switch and two bulbs.



CONTENT



A parallel circuit has **more than one loop**.

This means that there is **more than one route** for the charged particles to move around.

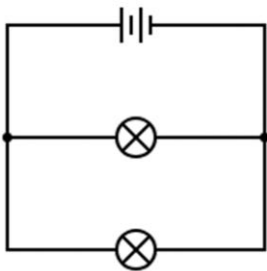


A series circuit with a battery and two bulbs.

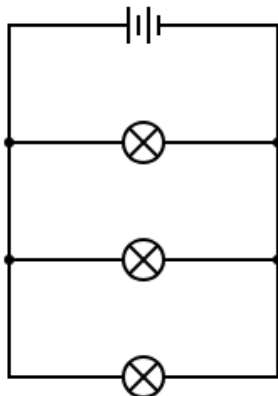


A parallel circuit with a battery and two bulbs.

Examples



Two bulbs in parallel with a battery.

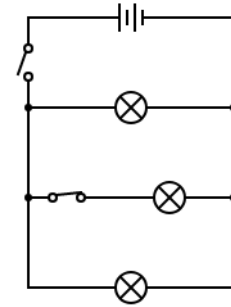


Three bulbs in parallel with a battery.

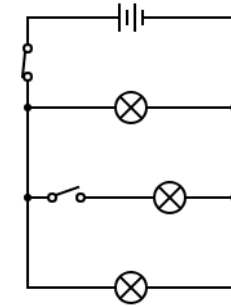
Switches are used to let charges flow through some components but not others:

Examples

No bulbs will light as the switch is open and there is not a complete circuit.



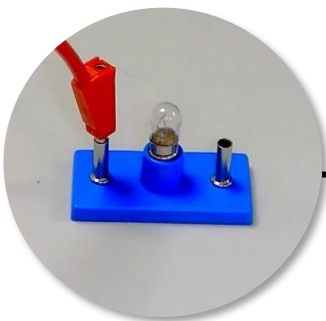
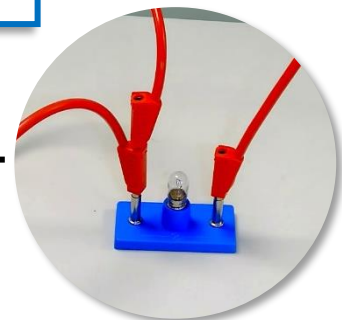
The top and bottom bulbs will light as one switch is closed so they have a complete circuit.



METHOD TO SET UP A PARALLEL CIRCUIT

Plug a wire into one of the component's wires.

1

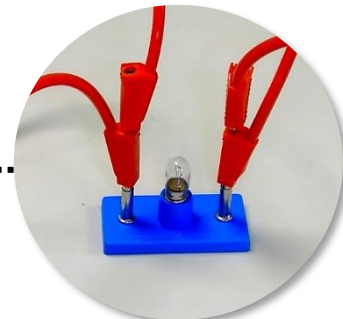


2

Plug the other end of that wire into the parallel component.

Plug a second wire into the component's other wire.

3



4

Plug the other end of that wire into the other end of the parallel component.



**RETRIEVAL ACTIVITY**

	Question	Answer	Mark
1	How many loops do series circuits have?		
2	How many loops do parallel circuits have?		
3	How many routes does current have in a series circuit?		
4	Which component is used to measure current in a circuit?		
5	Which component is used to measure potential difference in a circuit?		
6	What are the units of current?		
7	What are the units of potential difference?		
8	What is the name of materials that are good at transferring energy electrically?		
9	What is the name of materials that are bad at transferring energy electrically?		
10	Draw the circuit symbol for an open switch.		
Score			

**ACTIVATE KNOWLEDGE**

What is a parallel circuit?

What does current measure?

What component is used to measure current?



CONTENT

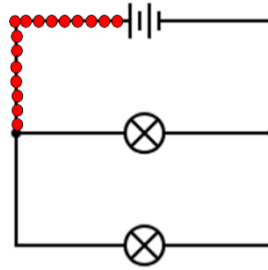
Current in a Parallel Circuit

A parallel circuit has **more than one loop**.

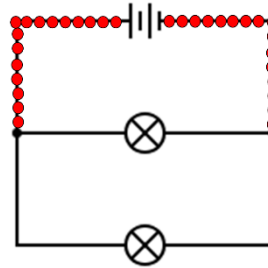
This means that there is **more than one route** for the current to flow.

This means that **current splits at a junction in a parallel circuit** to take different routes.

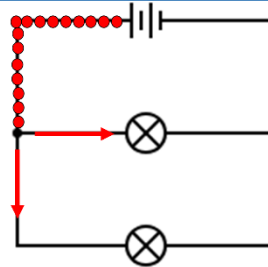
When this wire is connected to the battery these charges will move around the circuit. This is the current.



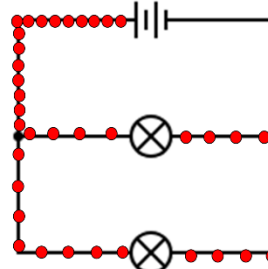
The total current flows through the battery.



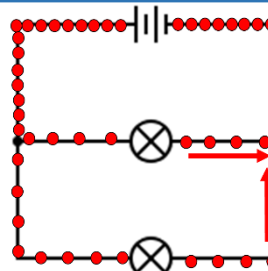
When the charges reach a junction, the current will split to take different routes.



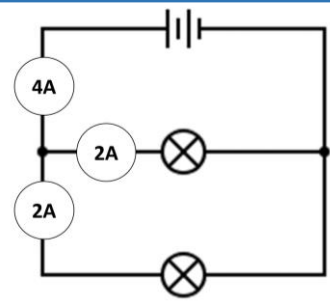
The current will then continue to flow through the loops.



When the current from the two loops reaches the junction, the current will add together.



Ammeter readings show us what happens to the current in a parallel circuit.





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What do charges transfer in a circuit?		
2	What are the charges that move in a circuit called?		
3	What does an ammeter measure?		
4	What does a voltmeter measure?		
5	What is a series circuit?		
6	What is a parallel circuit?		
7	Draw the circuit symbol for an ammeter.		
8	Draw the circuit symbol for a voltmeter.		
9	What is the name of materials that are bad at transferring energy electrically?		
10	What is the name of materials that are good at transferring energy electrically?		
Score			



ACTIVATE KNOWLEDGE

What is a parallel circuit?

What does potential difference measure?

What component is used to measure current?



CONTENT

Potential Difference in a Parallel Circuit

A parallel circuit has **more than one loop**.

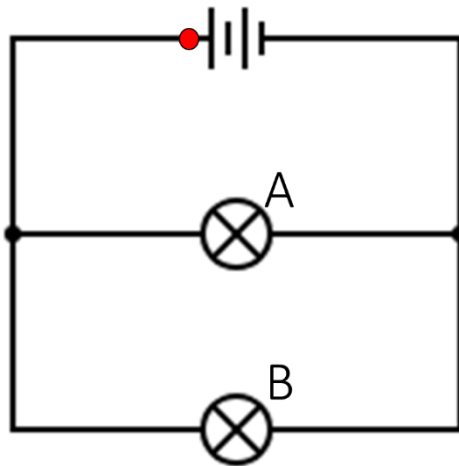
This means that there is **more than one route** for the charged particles to move around.

This means that **charged particles transfer ALL of their energy to the component** they flow through in that route.

This means that the potential difference is **the same across each loop** in a parallel circuit.

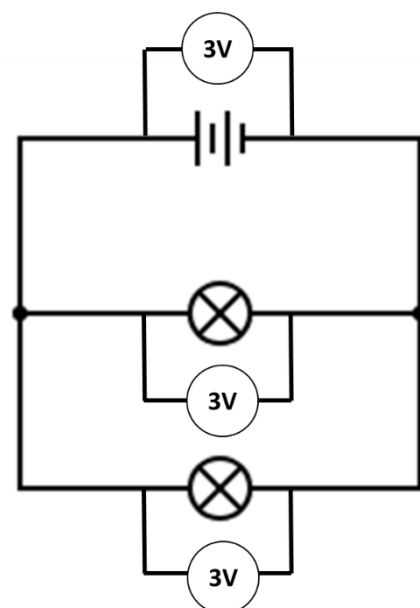
Each charge transfers energy from the battery.

In a parallel circuit, the charge can transfer ALL of its energy to only one bulb e.g. A or B.



This means that the potential difference of the bulbs are equal to the potential difference of the battery.

In a parallel circuit, the potential difference across each loop is equal to the potential difference of the battery. This means that the voltmeter readings will be the same.





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What are the charges that move in a circuit called?		
2	What part of a circuit supplies energy from its chemical energy store?		
3	What part of a circuit contains electrons that are free to move?		
4	What part of a circuit transfers energy as light waves?		
5	What part of a circuit is used to measure potential difference?		
6	What part of a circuit is used to measure current?		
7	Draw the electrical symbol for an open switch.		
8	Draw the electrical symbol for a closed switch.		
9	What is the name of materials that are good at transferring energy electrically?		
10	When charges move faster in a circuit, what has happened to current?		
Score			



STORIES IN SCIENCE

A team of researchers from the University of Singapore have developed a piece of technology called ‘Spoon+’. This device applies weak current pulses to a person’s tongue which causes them to experience different tastes. They report that different tastes require different amounts of currents e.g. sour requires a current of 0.00000012 A. The team have also created a ‘digital lollipop’. This is a device that can be placed on the tongue to simulate a range of tastes through the application of different currents. The possible applications for the digital lollipop are many. If the device can be reduced to the size of a lollipop someone trying to avoid sugar for dieting reasons might use it to simulate the taste of sweetness. Cancer patients undergoing chemotherapy might use it to improve their sense of taste while undergoing treatment. For gamers, the device might let you taste the various objects/foods in a virtual world.



ACTIVATE KNOWLEDGE

What are conductors?

Why are conductors needed in a circuit?

What materials are good conductors?

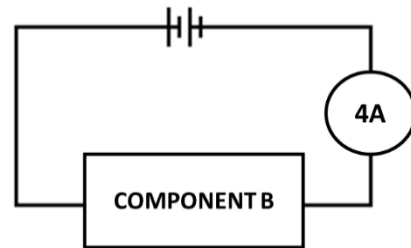
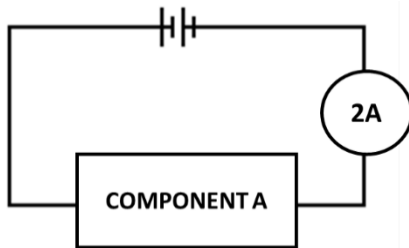


CONTENT

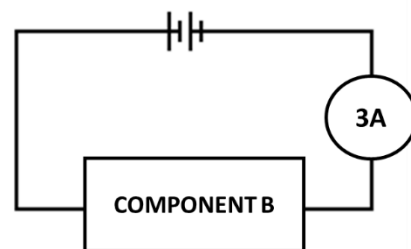
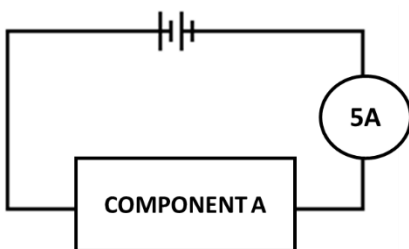
Some materials are **better conductors** than others.

Some materials let **more current** flow through them.

Examples



Component B would be the **best conductor** because it has the **most current** flowing through it.

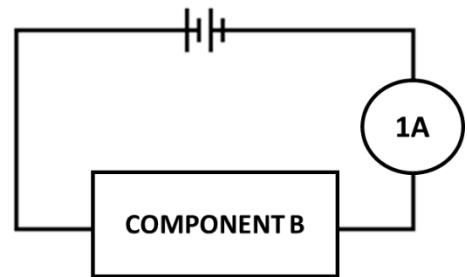
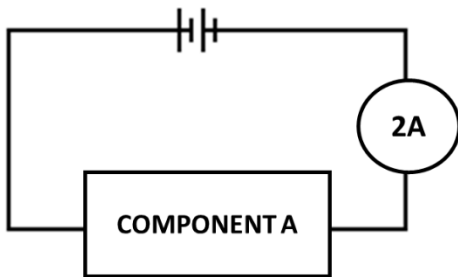


Component B would be the **worst conductor** because it has the **least current** flowing through it.

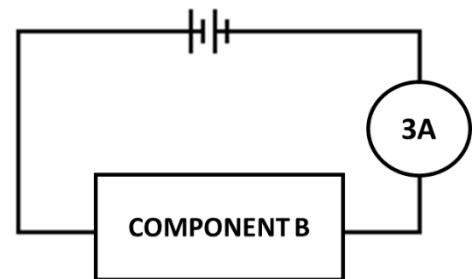
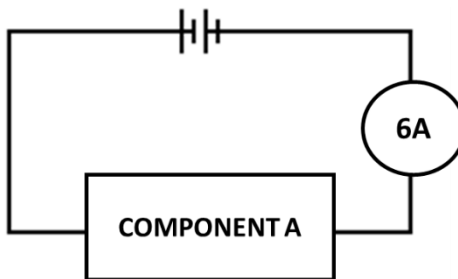


Resistance is a **measure of how hard it is for current to flow** through a component.
A **bad conductor has a high resistance** as it is harder for current to flow through it.

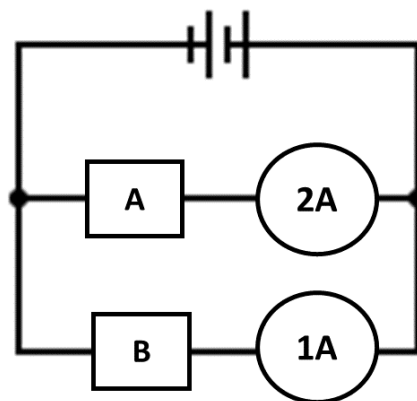
Examples



In this example, Component B would have the **highest resistance** as it has the **smallest current** flowing through it.



In this example, Component A would have the **smallest resistance** as it has the **highest current** flowing through it.

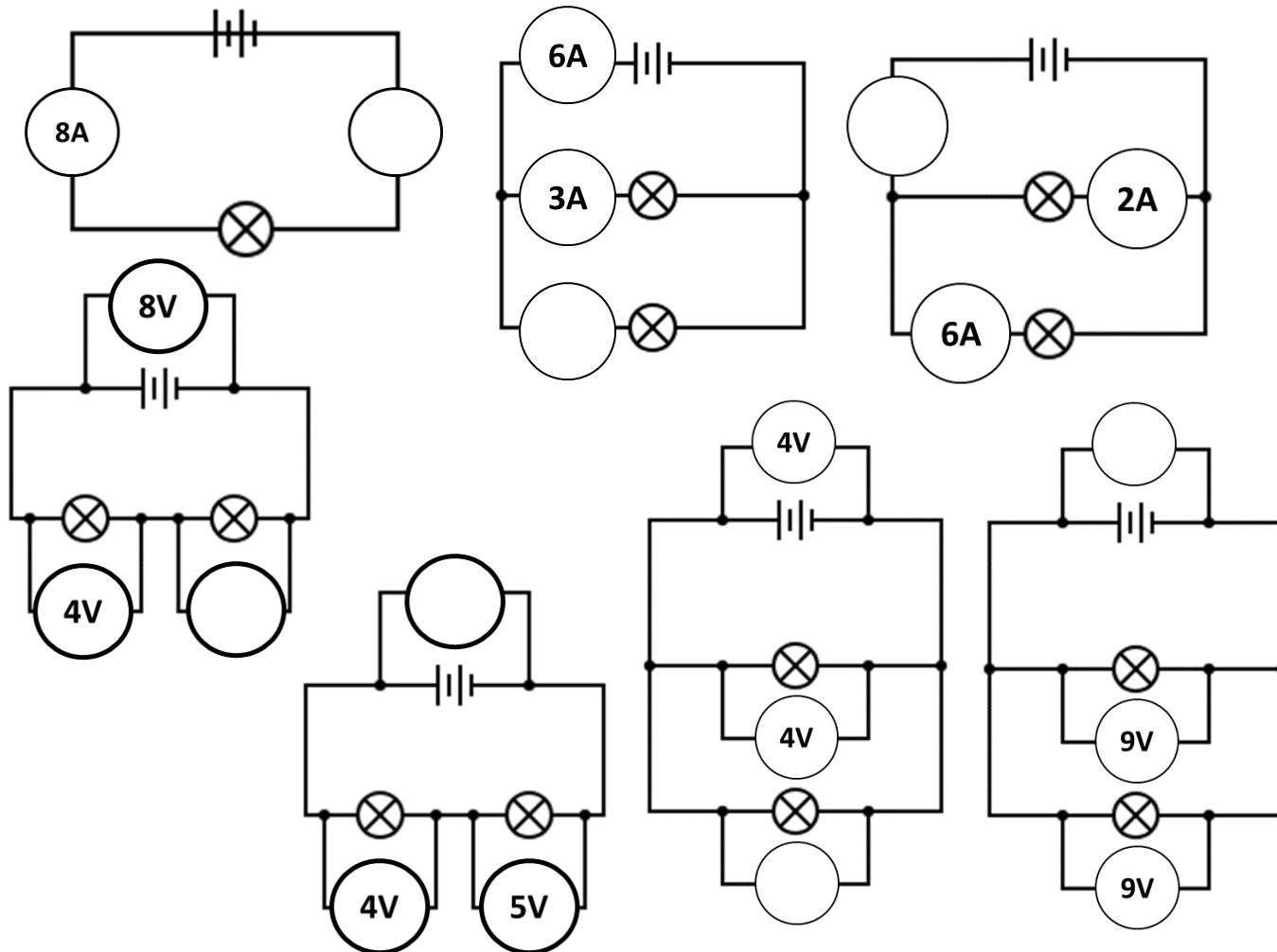


In this example, Component B would have the **highest resistance** as it has the **lowest current** flowing through it.



RETRIEVAL ACTIVITY

Identify the missing ammeter and voltmeter readings.



Score / 7



ACTIVATE KNOWLEDGE

What is current?

What is potential difference?

What is resistance?



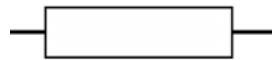
CONTENT



Resistance is **a measure of how hard it is for current to flow** through a component.
A **bad conductor has a high resistance** as it is harder for current to flow through it.

Resistors are components that can be added to a circuit to add resistance to a circuit.

The circuit symbol for a resistor is:



The resistance of a component can be calculated using the following equation:

$$\text{Resistance} = \text{Potential difference} \div \text{Current}$$

The units we use to measure Resistance are Ohms (Ω)

The units we use to measure Potential Difference are Volts (V)

The units we use to measure Current are Amps (A)



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What are the charged particles called that move in a circuit?		
2	What are materials called that are good at transferring energy electrically?		
3	What are materials called that are bad at transferring energy electrically?		
4	What type of circuit has one loop?		
5	What type of circuit has more than one loop?		
6	Complete the equation: Resistance =	Potential Difference ÷	
7	What units do we measure resistance in?		
8	Draw the circuit symbol for a resistor.		
9	What piece of equipment is used to measure current?		
10	What piece of equipment is used to measure potential difference?		
Score			



STORIES IN SCIENCE

The BBC website reports the story of an Australian man, Frank Clewer, who went to a job interview wearing a nylon jacket and a woollen shirt. Nylon and wool are both insulators. When rubbed together, insulators build up a potential difference. His clothes built up a potential difference measured by firemen to be around 40,000 V. That caused a spark which caused the carpet, and then the office, to set on fire. The office was evacuated and a member of the fire service reported that: “There were several scorch marks in the carpet, and we could hear a cracking noise – a bit like a whip – both inside and outside the building.” The website does not record whether Mr Clewer’s interview was successful.



ACTIVATE KNOWLEDGE

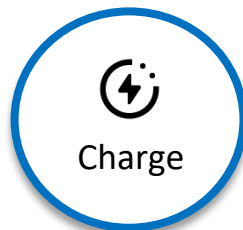
What is an insulator?

Why don't insulators conduct electricity?

What materials are examples of insulators?



CONTENT

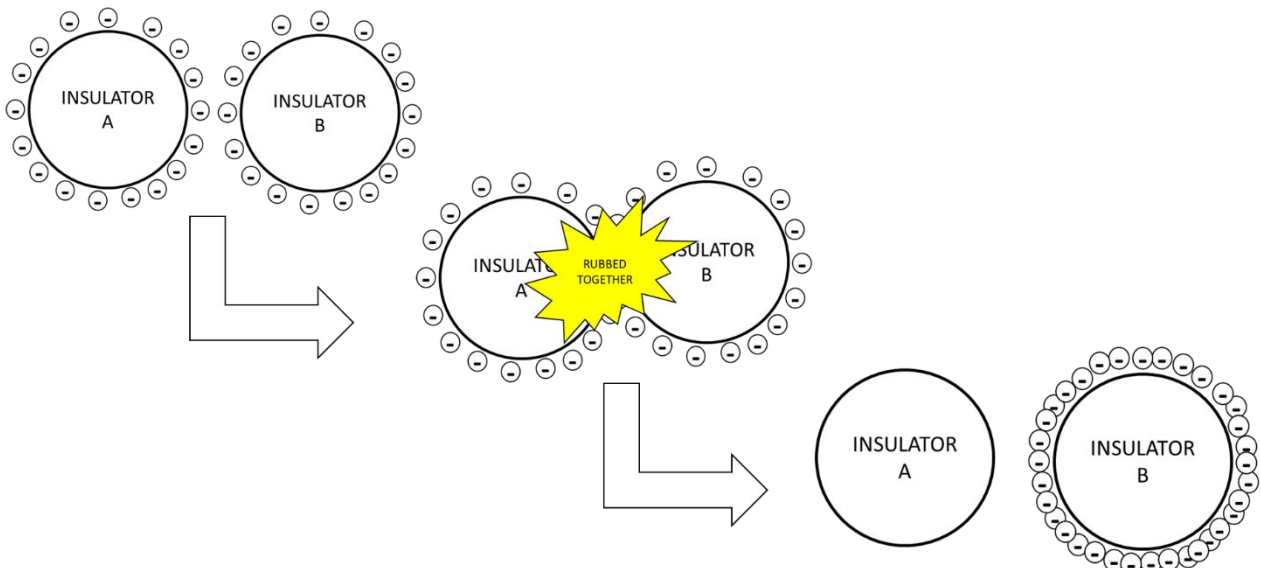


Electrons are charged particles found in all materials.

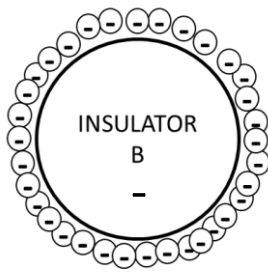
Electrons have a **negative charge (-)**.

Materials that **gain extra electrons** have an **overall negative charge**.

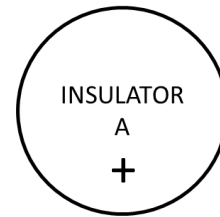
When two **insulators** are **rubbed together**, **electrons are transferred** from one insulator to another.



Materials that **gain electrons** have an overall **negative charge**.



Materials that **lose electrons** have an overall **positive charge**.



Only insulators build up a charge. Insulators are materials that don't let electrons move through them. So, a material that gains electrons keeps the electrons.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What charge does an electron have?		
2	What is the overall charge of materials that gain electrons?		
3	What is the overall charge of materials that lose electrons?		
4	What do you have to do to insulators to cause electrons to be transferred?		
5	What do electrons transfer as they move around a circuit?		
6	Complete the equation: Resistance =	÷	
7	Draw the circuit symbol for a battery		
8	Draw the circuit symbol for a resistor.		
9	Draw the component that measures current.		
10	Draw the component that measures potential difference.		
Score			



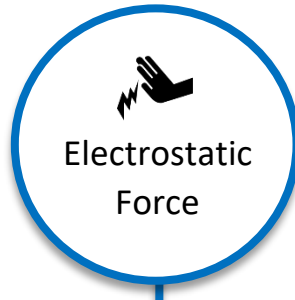
ACTIVATE KNOWLEDGE

What is a non-contact force?

What are the three non-contact forces?



CONTENT

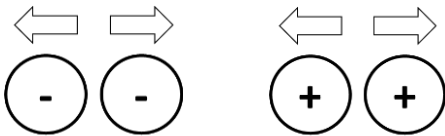


Electrostatic Force

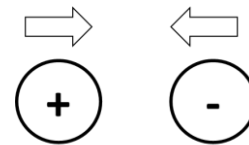
When charges are brought close to each other they feel a **force**.

The force caused by charges is called **Electrostatic force**.

When two of the **same charge** are brought together the charges **repel** (push apart).

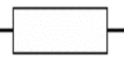


When two **opposite charges** are brought together the charges **attract** (pull together).





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What charge does an electron have?		
2	What is the overall charge of materials that gain electrons?		
3	What is the overall charge of materials that lose electrons?		
4	What is the name of the force that acts on charged particles?		
5	What will happen when a positive and positive charge are brought together?		
6	What will happen when a positive and negative charge are brought together?		
7	What will happen when a negative and negative charge are brought together?		
8	What is this component? 		
9	What is a circuit with one loop called?		
10	What is a circuit with more than one loop called?		
Score			



ACTIVATE KNOWLEDGE

What is the name given to the following force descriptions?

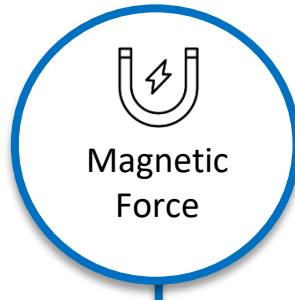
Materials push apart:

Materials pull together:

What are the three non-contact forces?



CONTENT



Magnetic Force

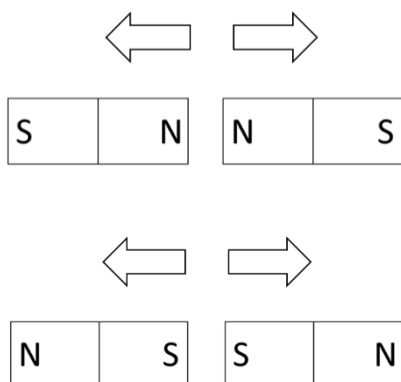
Magnets are made from **magnetic elements**.
The three magnetic elements are **iron, cobalt and nickel**.

When magnets are brought close to each other they feel a force.
The force caused by magnets is called **Magnetic force**.

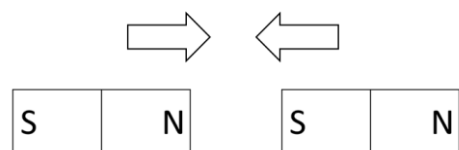
The magnetic force is **strongest at the poles** (ends) of a magnet.



When two of the **same pole** are brought together the poles **repel** (push apart).



When two **opposite poles** are brought together the poles **attract** (pull together).



**RETRIEVAL ACTIVITY**

	Question	Answer	Mark
1	What are the poles of a magnet called?		
2	What are the three magnetic elements?		
3	What is the name of the force that acts on magnets?		
4	What will happen when a North and North pole are brought together?		
5	What will happen when a North and South pole are brought together?		
6	What will happen when a South and South pole are brought together?		
7	What is the name of the force that acts on charged particles?		
8	What will happen when a positive and positive charge are brought together?		
9	What will happen when a positive and negative charge are brought together?		
10	What particles are transferred when insulators are rubbed together?		
Score			

**ACTIVATE KNOWLEDGE**

What flows in a complete circuit?

What is current?

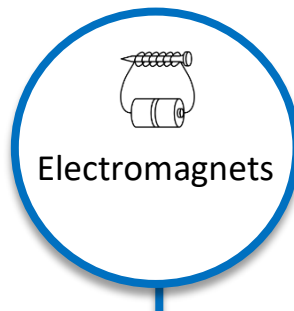


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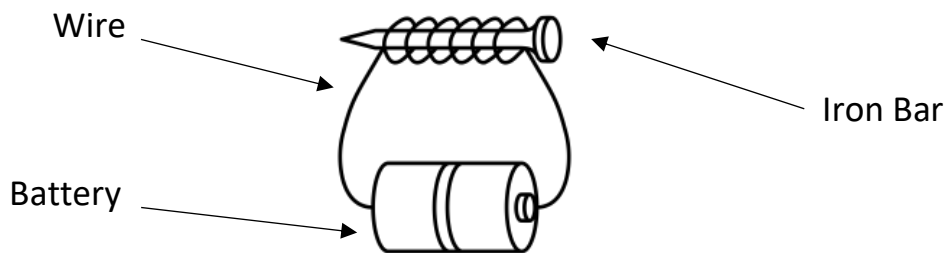
The movement of electrons can cause a wire to become magnetic.

Therefore, **when current flows through a wire, the wire becomes magnetic.**

If we wrap a current carrying wire around an iron bar, the iron bar becomes magnetic.



An electromagnet is current carrying wire coil wrapped around an iron bar.



Electromagnets can be switched on and off easily by using a switch to turn the current on and off. When there is no current, the iron bar stops being magnetic.

We can change the strength of the magnetic force of an electromagnet by:

Changing the size of the current

Increasing the current increases the strength

Changing the number of turns of wire

Increasing the number of turns increases the strength