How do you make circuits?

When there's an emergency, an ambulance driver turns on the siren and flashing lights. You could make a simple circuit that does same thing.

What would you need and how would you connect it all together?

TERMS

Conductor

Insulator

FOCUS ON

what the different parts of a circuit are.

WRONG!

Electricity can flow out of the end of a wire like liquid.

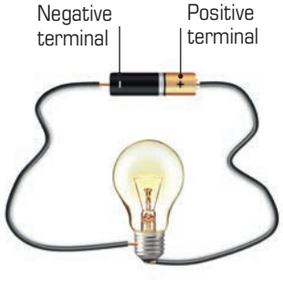
RIGHT!

Electricity can only flow through a complete circuit.

Circuits

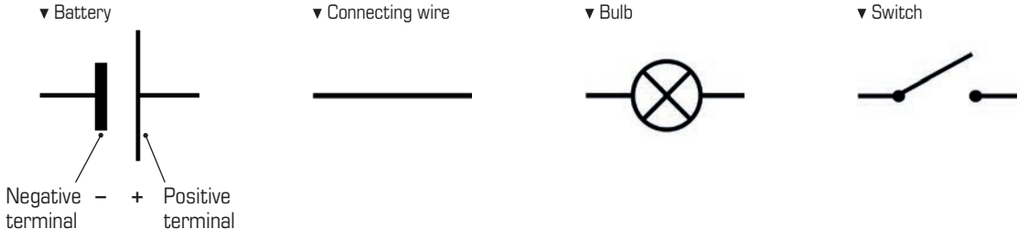
This bulb is not lit. There is no complete path, or **circuit**, for electricity to travel around.

To make a complete circuit, we connect a wire to both terminals of the battery and bulb.

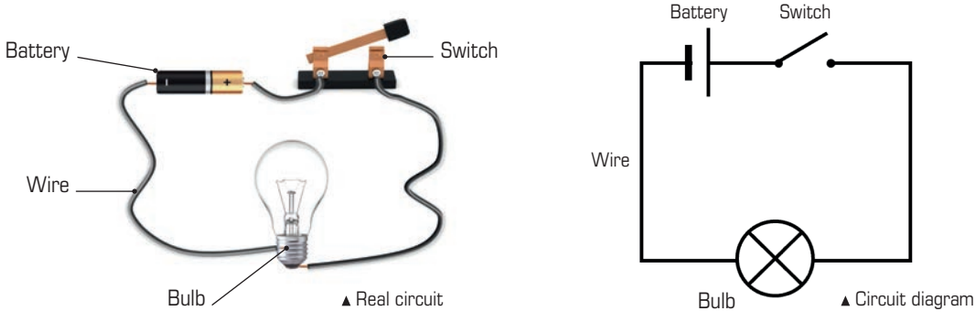


Circuit symbols

Drawing the parts of a circuit can be tricky. Scientists use symbols instead of pictures. Here are some common symbols:



We can use the symbols to turn a picture of a real circuit into a circuit diagram.



Can you draw a circuit with two bulbs?

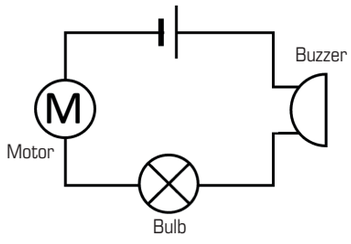
Devices

Devices are things like buzzers, bulbs and motors. They can go anywhere in a circuit and they can usually be connected either way round.

A motor rotates to provide movement.

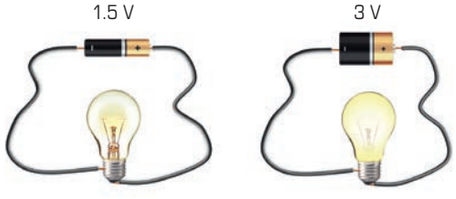
A thin wire inside a bulb gets hot and lights up.

A buzzer has a speaker that produces a sound.



Power source

A battery provides the force to move electricity around. The number on it is called voltage (V). The bigger the voltage, the harder the battery pushes. A 3 V battery makes a bulb brighter, a buzzer louder or a motor faster than a 1.5 V battery.

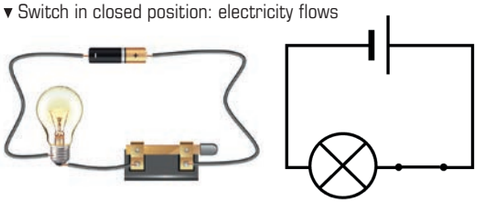


Why is one bulb brighter than the other?

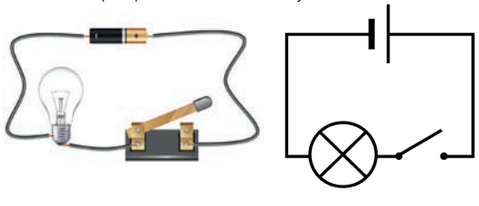
Switch

A switch starts and stops electricity. It has two different positions, closed and open, so it can be used to turn devices on and off.

▾ Switch in closed position: electricity flows

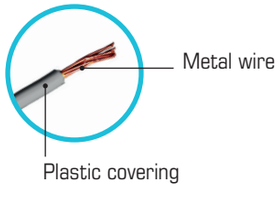


▾ Switch in open position: no electricity flows



Connecting wires

Metal wires connect the parts of a circuit. They're metal because metals are **conductors**. This means electricity passes through the material easily. The wires are covered in plastic. Electricity does not pass easily through plastics. They are **insulators**. Insulated wires stop you getting an electric shock.



What is the difference between a conductor and an insulator?

REVIEW

1. Give the terms for each of the definitions below.

a) A complete path for electricity to move around.

b) A device that makes a noise when electricity goes through it.

c) A power source.

d) They connect the different parts of a circuit.

2. Why doesn't this bulb light up?

3. Copy and complete this table.

Name	Symbol	Function
Bulb		
Switch		
Battery		
Wire		

4. Suki builds a circuit with 2 batteries and 2 bulbs. Draw a circuit diagram of her circuit.

5. You build a circuit with one battery and one bulb. Describe how you could change the circuit to make the bulb brighter.

6. Draw a diagram of a circuit that lights up and makes a noise when you press a switch.

What is electricity?

When you touch a lightstick at both ends, it lights up as if by magic.

How do you think it works?

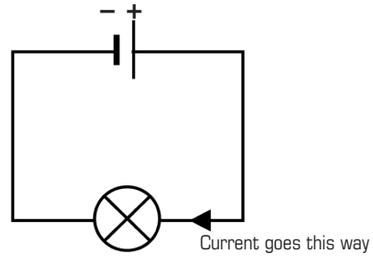
TERMS
Amp
Ammeter

FOCUS ON
how to imagine current like a rope.

Current

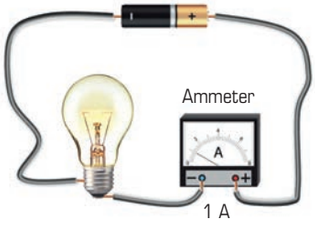
Current is the name for the flow of electricity around a circuit. The voltage from the battery is what makes current flow.

We show current as moving from the positive terminal of the battery to the negative terminal.

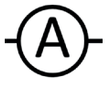


We measure the size of the current with a device called an **ammeter**.

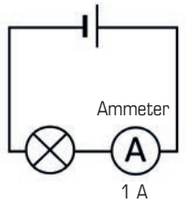
The current here is 1 **Amp**. Amp is short for Ampere, the unit of current. Amp is usually just written as A. So the current here is 1 A.



This is the symbol for an ammeter:



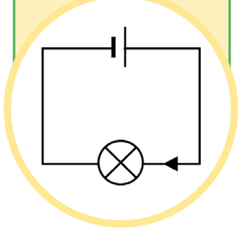
A circuit diagram for measuring current looks like this:



Can you draw a circuit where the ammeter is in between two bulbs?

What does the arrow represent in each drawing?

CURRENT is like **A LOOP OF ROPE**

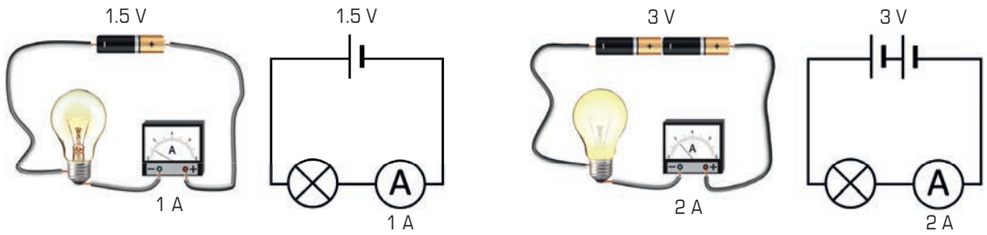


We can understand how current flows with an analogy.

Imagine current is like a loop of rope. Your hands are like a battery. When you give the rope a push (like voltage), you make the rope move around (like current).

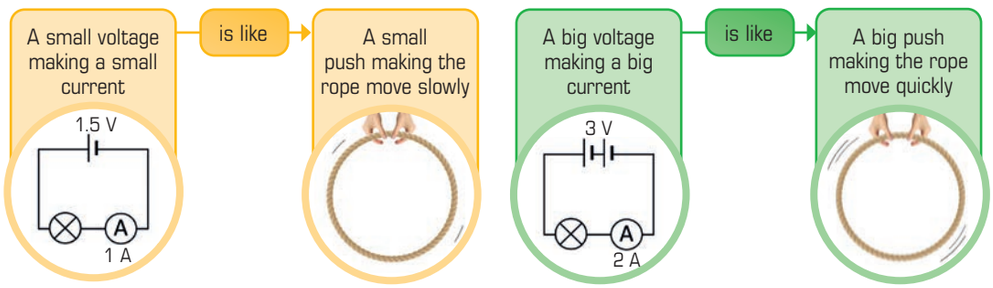
Higher voltage means more current

One way to make more current and a brighter bulb is to use a battery with a higher voltage. Joining several batteries together has the same effect.



What happens when current increases?

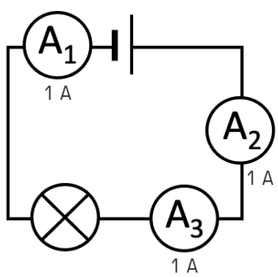
Why does a bigger voltage produce more current? Picture the loop of rope.



Current is the same everywhere

Some people think current is used up. But that's wrong. Look at this circuit. Wherever you put the ammeter, it measures 1 A.

To see why current is the same everywhere, picture it as a loop of rope. There's just one piece of rope, so it all has to move at the same speed. If it didn't, the rope would start to bunch up.



WRONG!
Current gets smaller as it goes around a circuit.

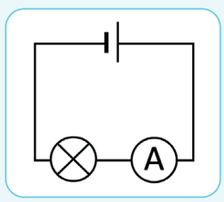
RIGHT!
Current is the same everywhere in a circuit.

REVIEW

1. Describe what current is.

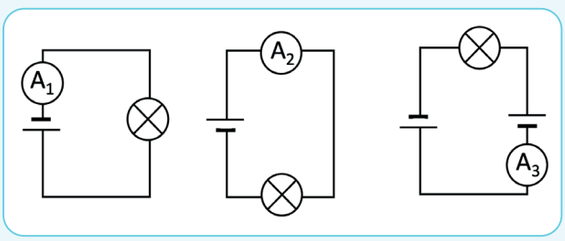
2. True or false?
a) Current is pushed around a circuit by a bulb.
b) The unit for current is the Amp.
c) Current decreases as it goes around a circuit.

3. This diagram shows a simple circuit. Draw and name the part which:
a) Measures current.
b) Varies the amount of current.
c) Turns on when there is a current.

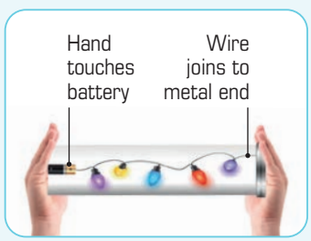


4. Imagine a second pair of hands pushes the rope. This is like adding another battery to a circuit. Use the loop of rope to explain why a second battery has to be the correct way round for current to flow.

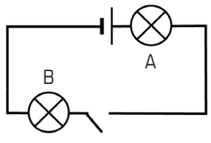
5. In which ammeter (A_1, A_2, or A_3) is the current highest? Give a reason for your answer.



6. This diagram shows what is inside the lightstick.
How does it work?
Hint: Current can flow through your body.



What is current really?



Three students discuss what will happen in this circuit at the instant the switch is closed.

Leo: "Bulb A will light first, because the current starts at the battery."

Keira: "Bulb B will light first, because it's closer to the switch."

Felix: "Both bulbs will light at exactly the same time."

Who is correct and why?

FOCUS ON

imagining the moving electrons inside a wire.

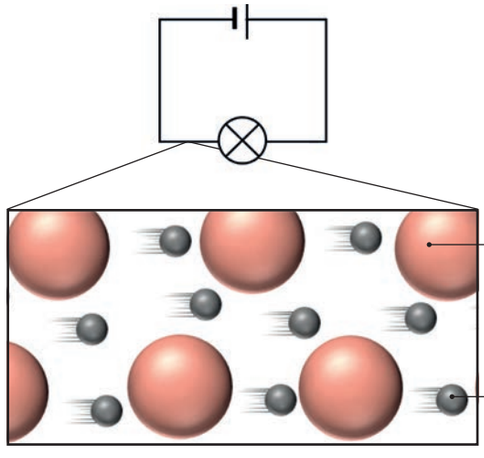
TERMS

Electron

Moving electrons

You know that current means something moving around a circuit. If we could zoom into a wire, we would see what is really moving.

Which part of a wire can move?



The wire is made of microscopic particles called atoms. As the wire is in the solid state, these atoms are unable to move around.

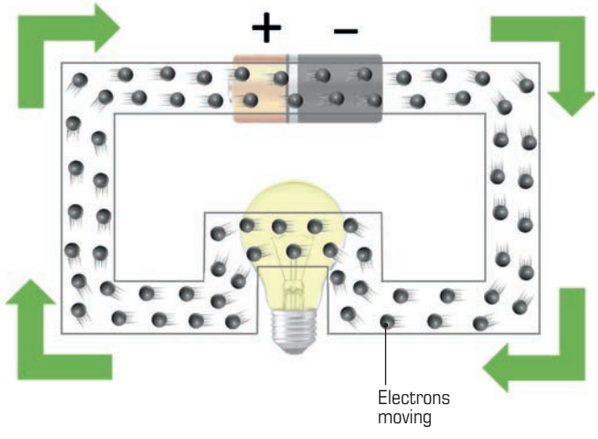
Between the atoms are even tinier particles called **electrons**. The electrons are free to move in any direction.

WRONG!

It takes time for current to reach the bulb.

RIGHT!

Electrons start moving all together so the bulb lights immediately.



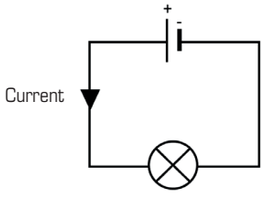
When you connect a battery, it creates electric forces. The negative terminal repels the electrons and the positive terminal attracts the electrons. The forces push all the electrons in the circuit around in the direction of the positive terminal. The electrons all move together like the loop of rope.

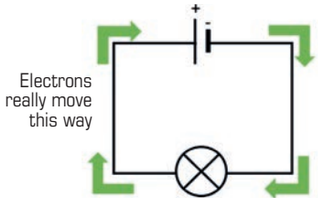
So, current is really a movement of electrons - through the battery, through the wires and through the devices.

The direction of the current

When scientists discovered electricity, they thought current moved from the positive to the negative terminal of the battery. Even through this is wrong, we still show the current going this way.

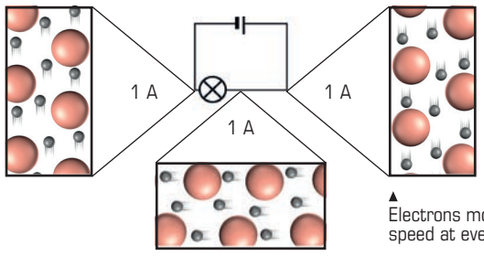
It was only later that scientists discovered that current is made of electrons. Then they realised that the electrons actually move from the negative to the positive terminal.





Why current is the same everywhere

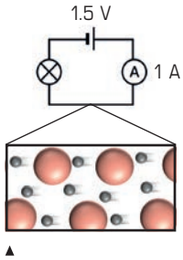
We have seen that current is the same everywhere in a circuit. Now we can explain why. Electrons all around the circuit move at the same speed. They have to. Otherwise, electrons would pile up somewhere.



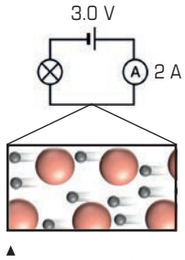
▲ Electrons move at the same speed at every point.

Why higher voltage means more current

We also saw that using a battery with a higher voltage makes more current. We can explain this in terms of electrons. The higher the voltage, the stronger the push on the electrons. When electrons move faster around the circuit, it means there's more current.



▲ Electrons move more slowly - less current



▲ Electrons move faster - more current

What happens to the electrons if a 9 V battery is used?

REVIEW

1. Copy and complete the sentences:

a) Inside wires are tiny _____ that can move.

b) Electrons are pushed around a circuit by the _____.

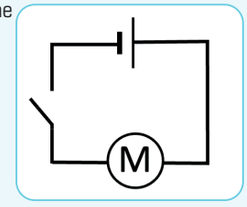
c) Electrons move from the _____ terminal of a battery to the _____ terminal.

2. Rewrite each sentence so it is correct:

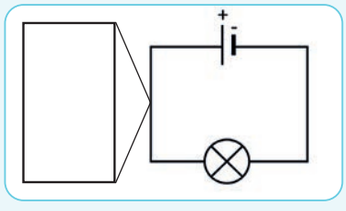
a) Electrons move more slowly when they go through a bulb.

b) The higher the voltage, the greater the number of electrons in the wire.

3. Describe what happens to the electrons in this circuit when the switch is closed.



4. Copy this diagram. Draw the atoms and electrons in the box. Add arrows to show which direction the electrons are moving.



5. Oakley has a wrong idea: 'If you disconnect one of the wires in a circuit, electrons spill out of the end.' Explain what really happens.

6. When the switch is closed, which bulb lights first? Give a reason for your answer.