

Magnetic Connections

Primary Electricity Set

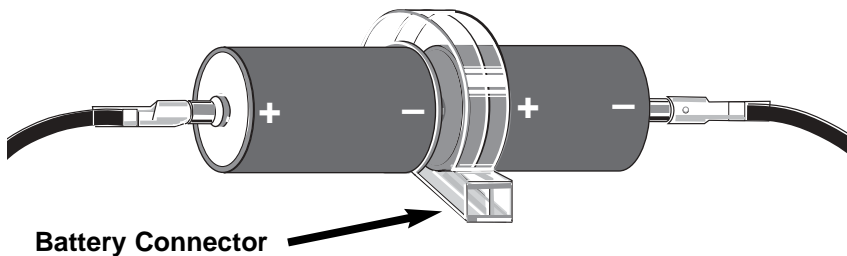
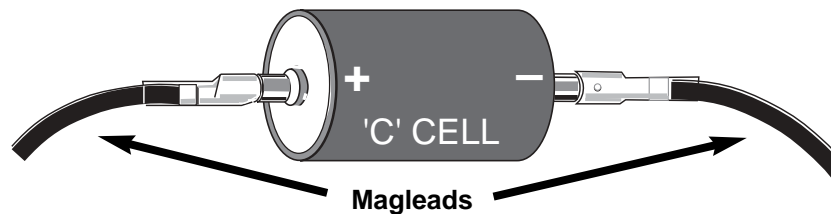
Thank you for purchasing the 'Magnetic Connections Primary Electricity Set'.

Making circuits quickly and reliably . . .

Making circuits with the 'Magnetic Connections Primary Electricity Set' could not be easier. Using Magleads, connections are made by simply putting the end of the lead into the component bases' metal connectors. Connection is ensured by the powerful connecting action of the tiny Neodymium magnet at the end of the clear wire. Clear wire is used so that children can see that it is the metal core of the wire that transports the electric current around the circuit.

Making Circuits

Magleads will connect straight onto a battery because battery cases are made from mild steel which is magnetic.



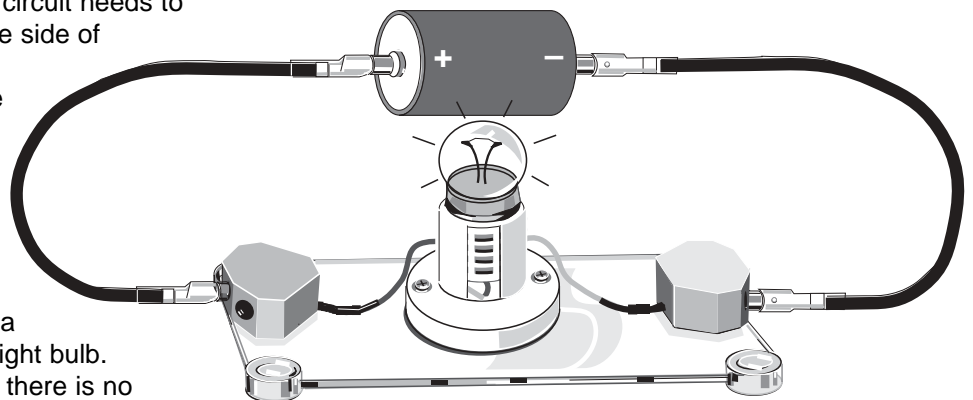
This is helpful where a single battery is being used, but if you need to connect several together to gain more power, then you will find a special battery connecting component in the kit.

NOTE: The battery connector component is designed to be used with 'C' cells.

Simplest 'Closed' Circuit

For electricity to flow a complete circuit needs to be made with a connection to one side of the battery to a component and then back to the other side of the battery. In this situation the current will flow around the circuit and the circuit will work.

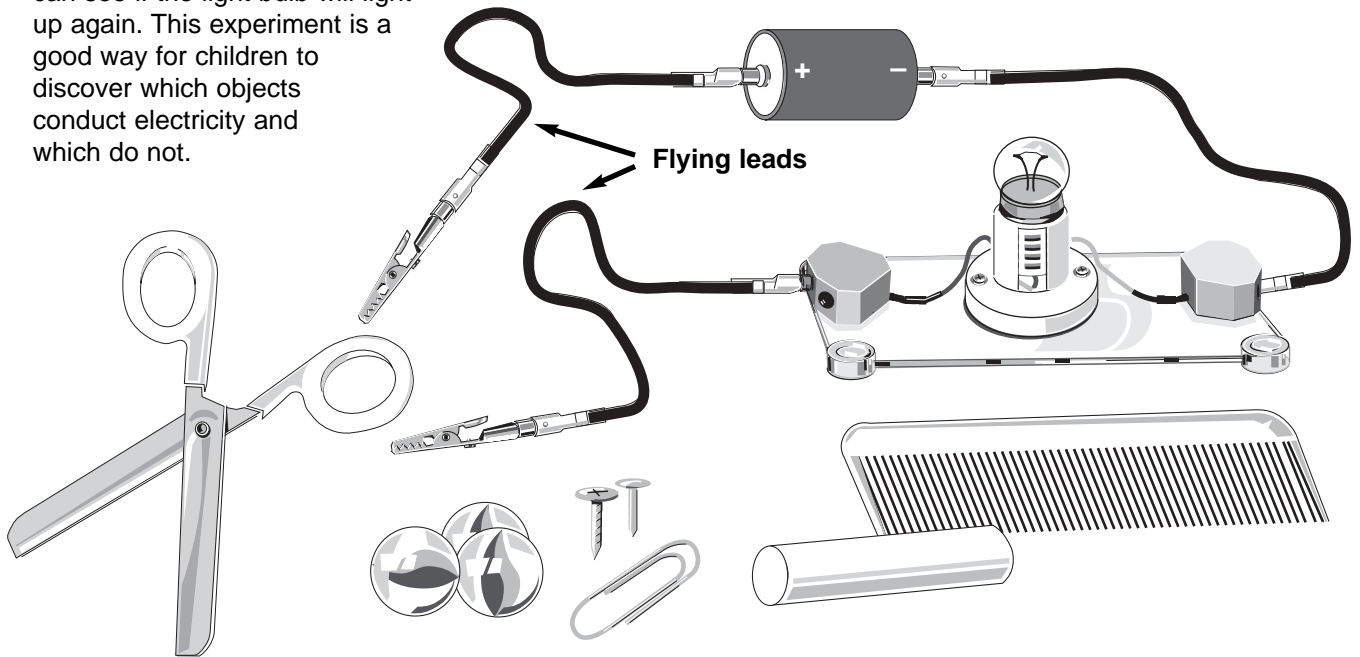
The bases in the kit enable numerous simple circuits to be made with ease. The simplest is a circuit from a battery to a single light bulb. This is called a 'closed' circuit as there is no switch. Closed circuits allow the flow of electricity to move around the circuit without interruption.



Simplest closed circuit

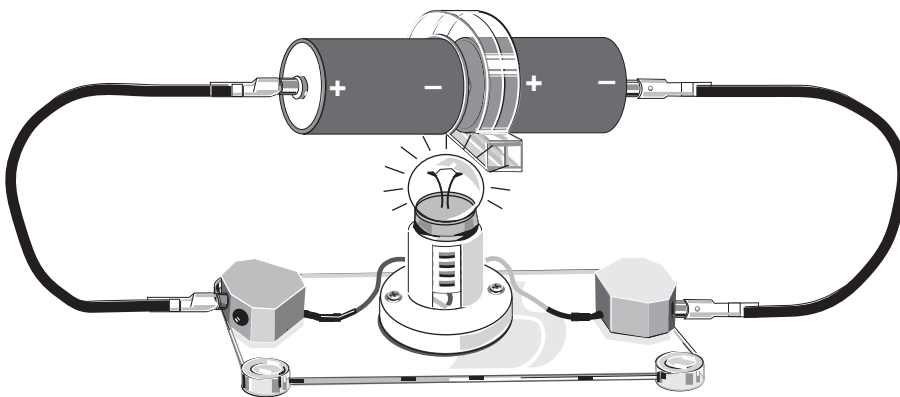
Conduction

If you break open this circuit by disconnecting a Maglead and hold it slightly away from its connection, even with a tiny air gap you will see that the light bulb goes out. If you place items or objects into this gap you can see if the light bulb will light up again. This experiment is a good way for children to discover which objects conduct electricity and which do not.



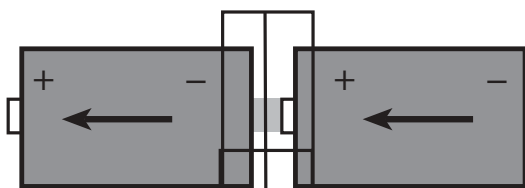
More Power

Adding another battery will increase the voltage in the circuit and will make the bulb glow brighter. To connect batteries together, the Connections Electricity Kit uses a special clear battery connector component which employs a tiny Neodymium magnet to pull the ends of the battery into contact.

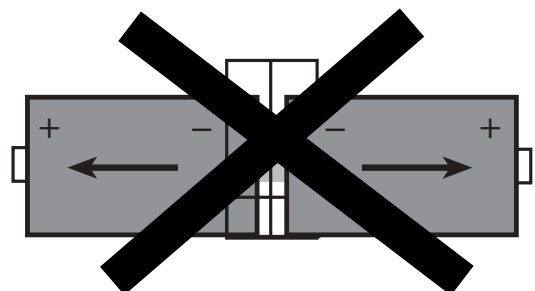


Remember when connecting batteries together they all need to face the same way. To increase voltage the + of one battery connects to the - of the other battery and so on (see the diagram). Let children experiment by putting the batteries the wrong way round to see what happens.

Two batteries give greater power and the bulb glows more brightly



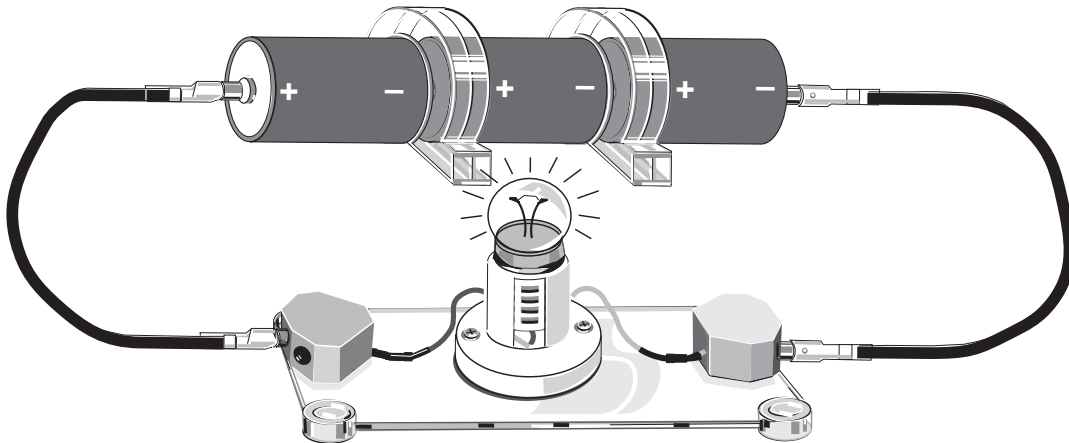
**Adding battery power together.
Both batteries face the same way.**



**WRONG!
Batteries facing in opposite directions**

Even More Power

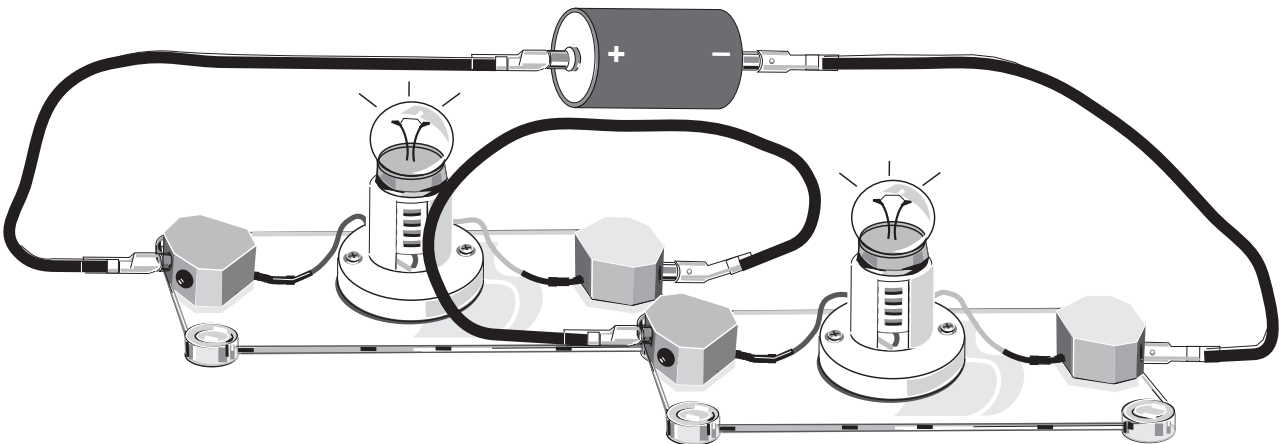
The light bulbs in this set are rated at 2.5 volts. They will glow if connected to a 1.5 volt battery and will glow very brightly but will not burn out* if used with 3 batteries connected together (with a combined voltage of 4.5 volts).



***NOTE:** The life expectancy of a bulb will be shortened by adding too much power, so try to use the correct voltage. Two 'C' Cell batteries (1.5 volts + 1.5 volts = 3 volts) for each bulb (rated at 2.5 volts) are ideal.

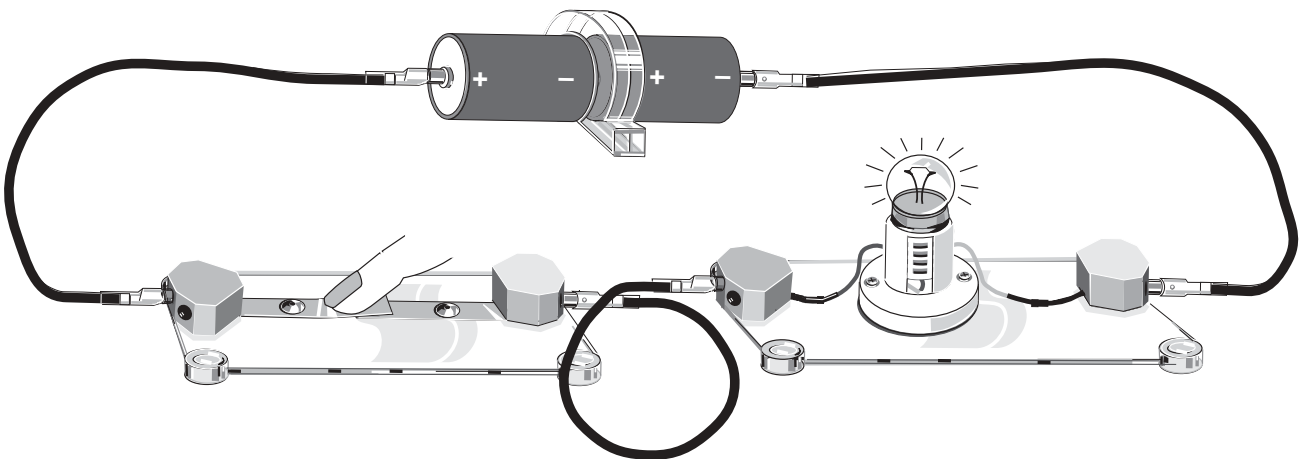
More bulbs, less bright?

If you add another bulb into the loop of your circuit, the voltage is shared and the bulbs will glow more dimly because the voltage is shared between them.



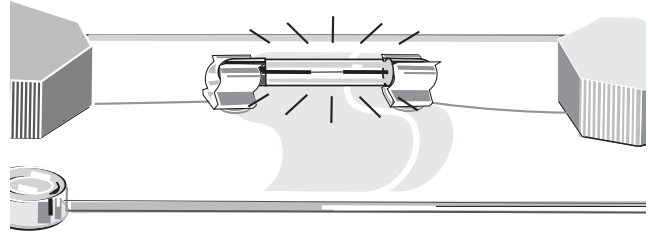
Control

Adding a switch gives an element of control over the circuit. It is not possible to get an electric shock from the switch.



Festoon Bulb

The Festoon bulb is like a normal light bulb, but with the element laid out in a straight line. This helps children to see the tiny metal element very clearly and because it is in line with the circuit it provides a clear explanation about the current squeezing through a tiny piece of metal wire (filament) and that the process causes the wire to heat up.



NOTE: The Festoon bulb is rated at 12 volts so by using one or two batteries together it will just make it glow without it getting too bright. Children can observe it getting hot and glowing inside its glass tube. They can use a magnifying glass or microscope to see the coil of wire glowing red hot more clearly.

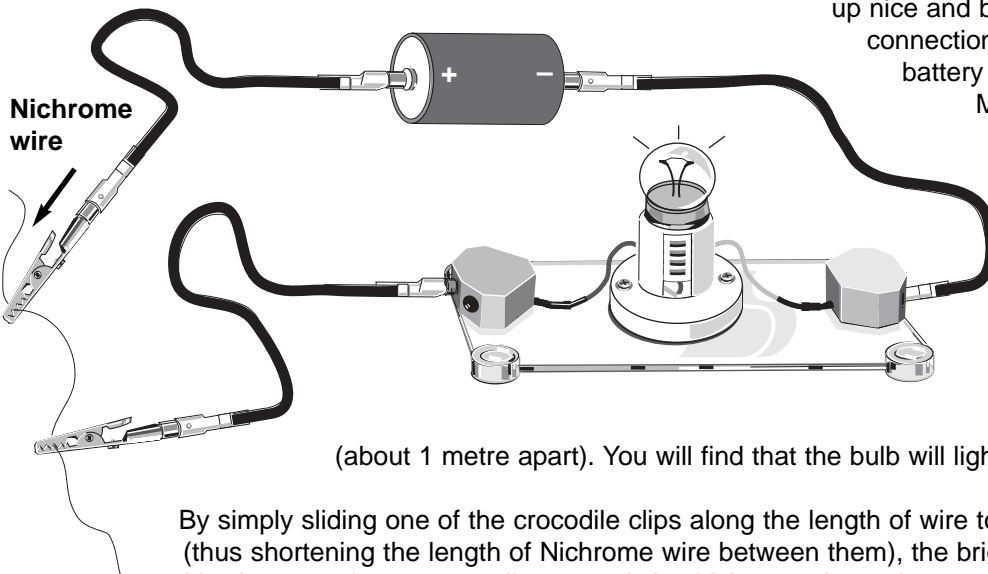
Interestingly, the finer the wire the more resistance it has because the current struggles to squeeze through a small space; conversely, the larger the piece of metal the greater the conductivity. If you were to connect the open ends of this circuit to a blacksmith's anvil for example (a huge piece of metal) the bulb would glow brightly because it is so large and thus there is less resistance to the flow of electrons.

NOTE: Make sure if you are doing this experiment, that you place the connections on to the metal surface of the object. A painted surface will not work because paint is plastic, which is a good insulator, that is why plastic is used as the sheath for electrical wires!

Dimmer circuit

You will find a length of Nichrome wire in the kit which only has a low conductivity. Find the wire, unravel it, and lay it out flat or fix it with sticky tape along the front face of a metre ruler.

Make a 'closed' circuit with two batteries and a light bulb to test that the bulb lights up nice and brightly. Pull the Maglead connection off one side of the battery and add another



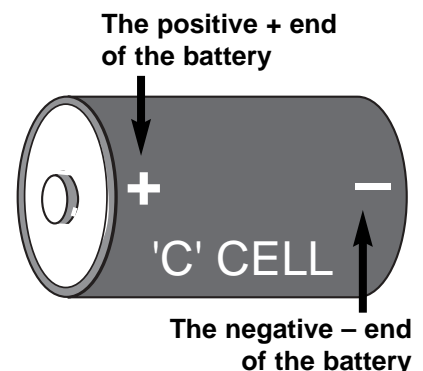
Maglead to the battery to create two separate 'flying leads'. Touch them together to check that the bulb still glows. Fit the crocodile clips onto the ends of the wires and try connecting them to the ends of the Nichrome wire

(about 1 metre apart). You will find that the bulb will light up, but very dimly.

By simply sliding one of the crocodile clips along the length of wire towards the other one, (thus shortening the length of Nichrome wire between them), the brighter the bulb will glow. You have made your own dimmer switch which uses the resistance of the Nichrome wire.

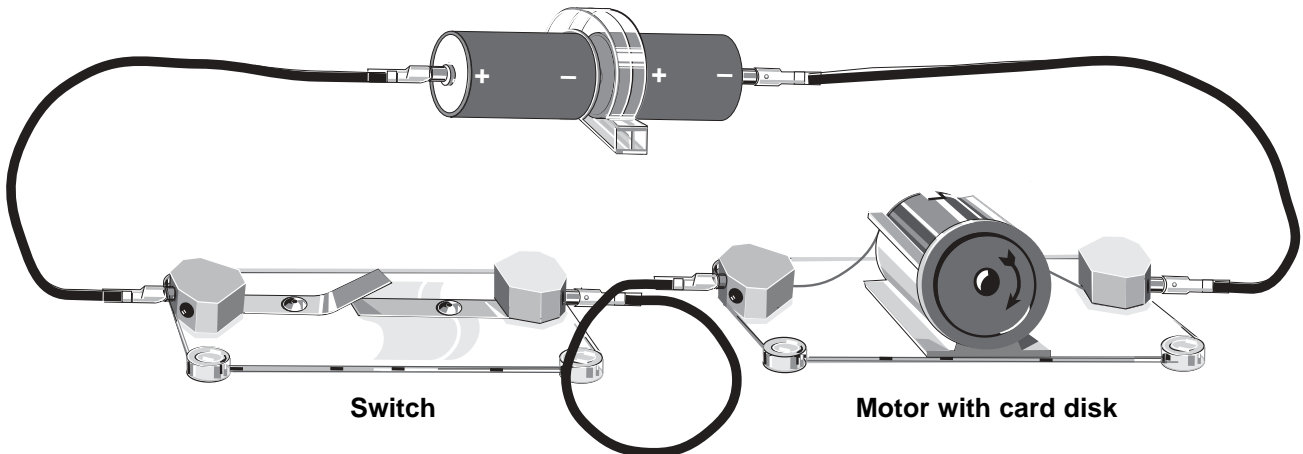
Polarity

So far we have made circuits where the polarity of the circuit has no effect, they all work well. The polarity is the way in which the battery faces in the circuit. In conventional circuits, the current flows from the positive (+) to the negative (-) side of the battery but a light bulb will still light up whichever way round it is connected. However, with some components the polarity is more important. With a motor, changing the polarity will change the direction that the motor spindle will rotate and a buzzer will only work if connected the right way round.



Motor Power

Add a small (2cm) card disk to the front face of the motor spindle using sticky tape. The motor spins so quickly that this will help to show the direction that the spindle is turning when power is applied. Build a circuit with a motor, battery and switch (as shown). Press the switch and see which way the motor rotates.

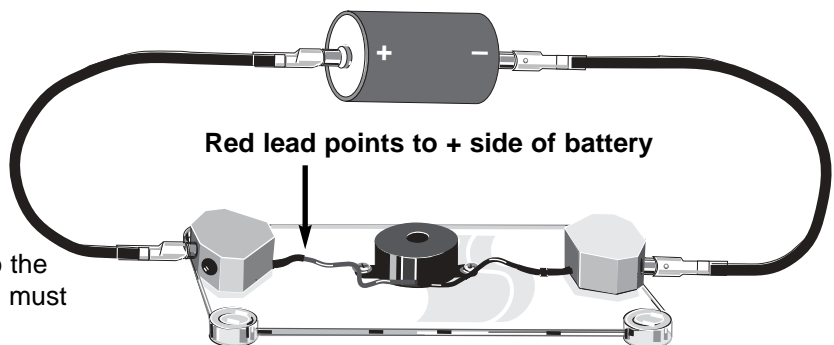


Now remove the Magleads from the battery and connect them the other way round, i.e. the lead that was connected to the + should now be connected to the – and visa versa.

You will find that the motor spindle now rotates the other way. This is a good example of seeing something happen as a direct result of changing the polarity which makes the current flow the opposite way.

Making noise

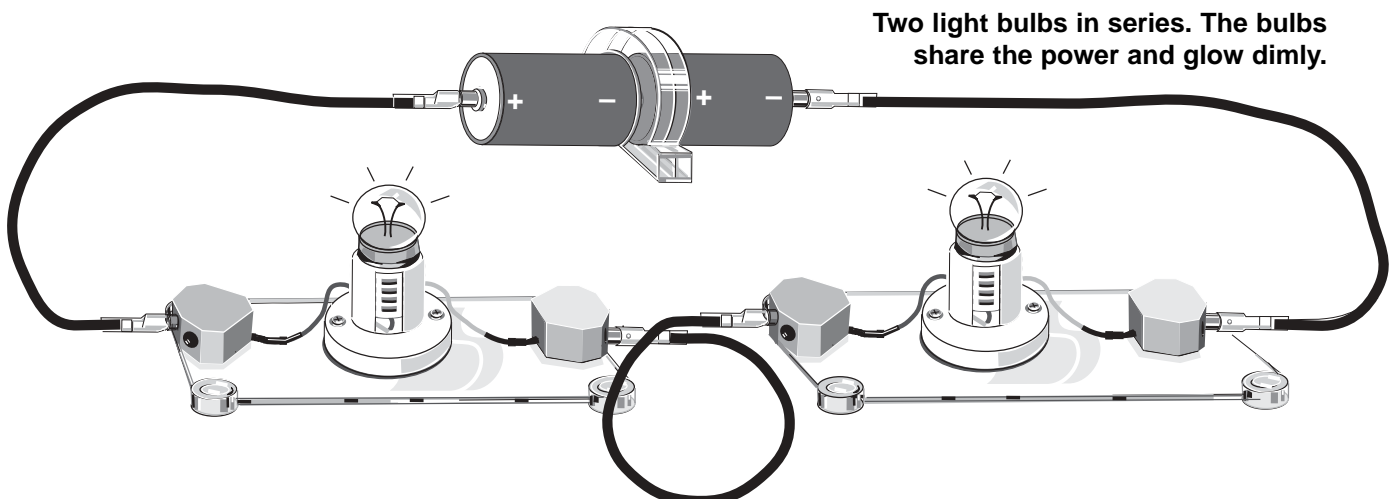
The buzzer has a tiny electrical circuit inside the case and will only sound if it is connected the right way round. Look carefully at the clear plastic base which holds the buzzer and you will see that it has a red and black lead coming from it, the red must connect to the + side of the battery and the black lead must connect to the – side of the battery.



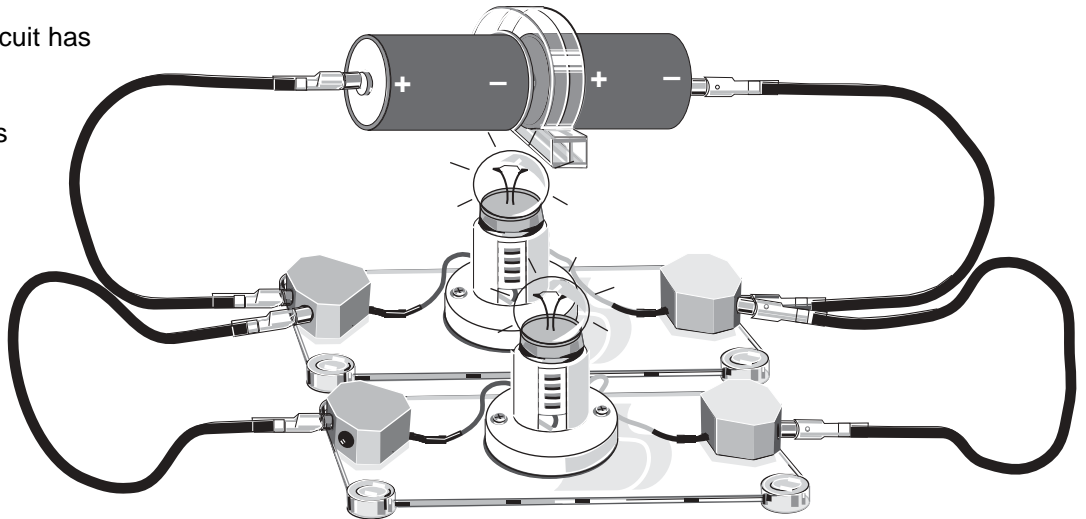
With this component, the polarity must be the right way round for it to work.

Series and Parallel

Series – A series circuit is one where all of the power flows around a single loop and through all of the components. In a series circuit the components share the available power between them. Two light bulbs in a series circuit will glow more dimly; three light bulbs will be even dimmer!



Parallel – A parallel circuit has several loops or routes through which the electricity can flow. This means that each component will receive all of the available power. In a parallel circuit with 2 bulbs they will each shine as brightly as if they were connected individually. Try connecting 3 bulbs in parallel and see what happens.



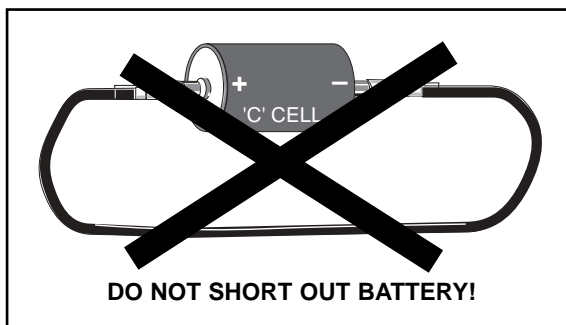
Two light bulbs in parallel. The bulbs glow brightly because they both get the same power.

General Information

Anyone who has taught very young children about the fundamentals of understanding electricity will know that they learn best when they are making the circuits themselves using individual components. This 'hands on' approach is essential and there are no short cuts to this process or indeed any better way for children to learn.

This set is based upon this principle and children should be encouraged to try things out for themselves without any fear of electric shock or making a short circuit. The components are matched so that they and the children can come to no harm*.

*Having said that there are two things that children should be told not to do:



- 1) DO NOT connect a Maglead from one side of a battery to the other side thus connecting both poles together. This shorts out the battery and will quickly remove all of its power. It could also heat up the lead because there is very little resistance in the leads and so the current flows around the circuit very quickly. This is especially the case with Alkaline batteries and Rechargeable cells. For this reason, we strongly advise that Rechargeable cells are not used with this kit.

- 2) Be careful with the bulbs as they are made from glass. They are in fact very robust and even dropping them onto a hard floor should not ordinarily break them, but glass is brittle and sharp if broken so take care.

Apart from that, there is very little to go wrong with these components, but don't forget as part of the learning process, things that don't work are just as important if not more important than things that work correctly! So let children experiment and make mistakes too!

One final point is that to get the most benefit from this set, children should be encouraged to do their own fault finding.

Here are some fault finding tips to give to children:

- If the circuit isn't working, check all of the connections carefully, wiggle them around to make sure there is a good contact.
- Check that the battery is connected correctly, with the Maglead connected to the raised part of the + and the middle of the – side of the battery.
- If you have added batteries together make sure they are connected the right way round. To add power they need to be connected with the + of one battery connecting to the – of the next one and so on.
- If you have a buzzer in the circuit check that the red lead faces towards the + side of the battery.
- Any circuit with a switch in it will not work unless the switch is pressed down.

HAVE FUN!

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