How to choose your motor

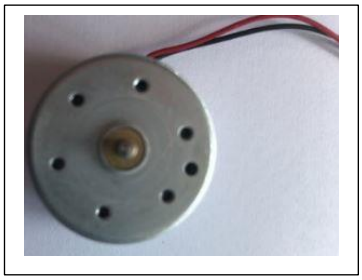
There are three motors you can buy in the shop and you will need to choose the right one for your prototype. Use this sheet to help you but, if you are still not sure which one to choose, ask your challenge leader for advice.

Motor

This is an ordinary motor which will spin constantly around in a circle (360º) when connected. It can move either clockwise or anticlockwise depending on which way you connect the wires to the motor.

You can connect this to a 3V battery pack (2 x AA cells).

Solar motor



This motor is only for use with a solar panel. It does exactly the same as the motor above and spins constantly around in a circle (360º) when connected.

You will need to look at the 'How to use a solar panel' sheet to help you connect it.

Servo motor

This motor can only be used with a servo motor control unit and will need a 6V battery pack (4 x AA cells) with jumper leads attached.

Using the servo motor control until you can either manually turn the dial to make the rotor arm turn clockwise or anticlockwise through 90º or you can make it turn from 0º to 90º and back again automatically.

You will need to use the 'How to use a servo motor control unit' sheet to help you connect it.

Which motor is best for your product design?

How to connect a buzzer or an LED

Some electrical components will only work if you connect them a specific way. Read this sheet if you are not sure which way round you should connect your buzzer or Light Emitting Diode (LED). You should look at the sheet called ‘How to connect a circuit’ if you are not sure what to use to connect your buzzer or LED to the battery pack or other components in your circuit.

Connecting a buzzer

Connect the red wire of the buzzer to the positive terminal (red wire) of the battery pack or solar panel using your chosen type of connection.

Connecting a Light Emitting Diode (LED)

Light emitting diodes (LEDs have one leg slightly longer than the other. Sometimes you have to look carefully to see which one.

Connect the longer leg of the LED to the positive terminal (red wire) of the battery pack or solar panel using your chosen type of connection.

How could you use this in your product design?

How to connect a circuit

Good electronics engineers must connect their electronic components safely and neatly. They do not just twist wires together and hope they stay attached as they know that they often need to get to their connections quickly if there is a problem (a common occurrence!).

There are two ways you can connect a circuit so you need to think carefully about which way is best for your prototype and your budget.

Crocodile leads

These are the easiest but the most expensive way to connect your circuit.

You can use these to clip onto the wires of the components in your circuit.

Making your own connections

To make your own connections you can use insulated wire. Remember it doesn't matter which colour you use as this is just a plastic coating but it can help when connecting other components if you use red for connections to the positive terminal of your battery pack and black to the negative terminal.

To connect the wire to your components you will first need to strip the ends of the wire to expose the conductor (the wire). Use the wire strippers in the Hire Centre. You can then use either terminal blocks or crocodile clips to make connections.

For the terminal blocks you will need to put the stripped ends of the wire into the block and use the screwdriver to tighten up the screw.

For the crocodile clips you will need to put the wire onto the clip so that the stripped end is touching the metal and then use the pliers to pinch (or crimp) the ends onto the insulated part of the wire. (Ask your challenge leader to show you if you are unsure how to do this.)

How could you use this in your product design?

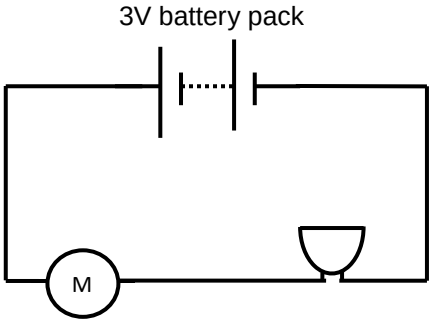
How to make a parallel circuit

If you want to put more than one component in a circuit you may find putting them in series (see the sheet on 'How to make a series circuit' if you are unsure what this is) will not work. You may find bulbs do not light up or are not very bright, motors run slowly or buzzers are quiet. Making a parallel circuit can help.

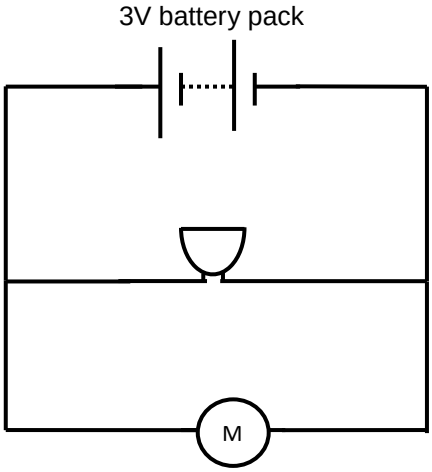
This is all about **RESISTANCE**. Think about your Engineering Apprenticeship and what you learnt about resistance there. In a parallel circuit you give the electricity two routes to flow through rather than just one.

Try this:

1. Connect a circuit which has a buzzer and a motor in series as shown in the diagram below.



2. Now connect them in parallel as shown in the diagram below. Does this make a difference?



How could you use this in your product design?

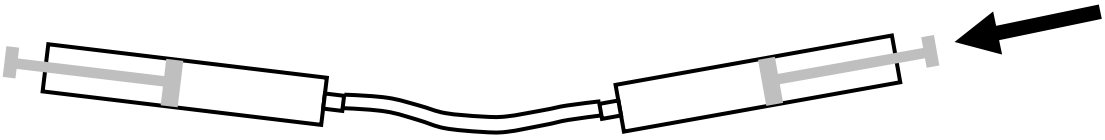
How to make a pneumatic system

In a pneumatic system compressed air can be used to move/lift things. You can make it as shown below:

1. Pull the plunger of each syringe so that it is half way out (around 5ml reading on the scale).

2. Connect the plastic tube onto the ends of both syringes.

3. Push the plunger on one syringe and watch what happens to the other syringe.



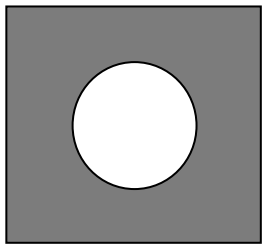
How could you use this in your product design?

How to make a pressure pad

A pressure pad can be used as a switch in your circuit. It works by making a connection between two conductive layers (tin foil) when pressed down and breaking the circuit when something stops pushing it down and the sponge separates the two layers of tin foil.

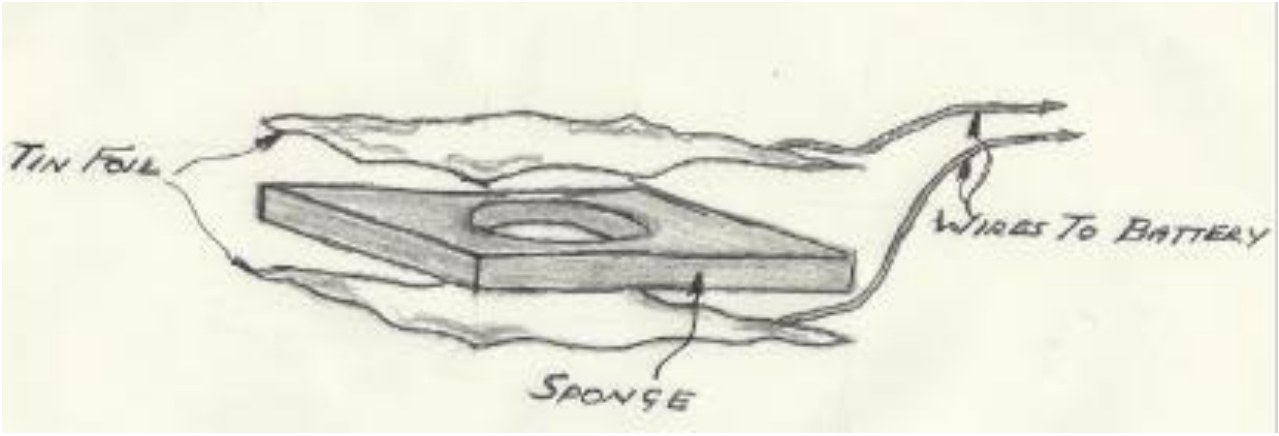
You can make it as shown below.

1. First cut a hole in the sponge.



2. Then cut two pieces of foil the same size as the piece of sponge and tape one on the top and one on the bottom. These **MUST NOT** touch if the sponge is not pressed down but should once it is pressed.

3. Put together the pieces of tin foil and the foam as shown below and attach one circuit connection to the top piece of tin foil and one to the bottom.



4. You can then put it in your circuit just like a switch and press it to make a bulb or LED light up, a buzzer sound or a motor begin working.

How could you use this in your product design?

How to use a Light Dependent Resistor (LDR)

A Light Dependent Resistor (LDR) is a variable resistor. This means it can change the rate of flow of the current in a circuit. We can change the resistance by increasing the light levels.

When the light levels are low, resistance is high and the rate of flow is slower. This means an Light Emitting Diode (LED) will be dimmer or a buzzer will be quieter.

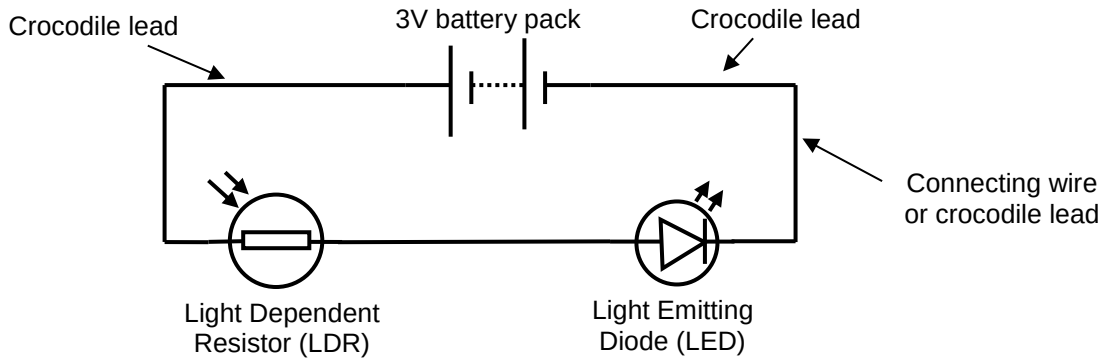
When the light levels are high (such as when you shine a torch on the LDR), the resistance is low the rate of flow is faster. This means an LED will be brighter or a buzzer louder.

<u>Important:</u> The LDRs in the shop will only work with the LEDs or piezo buzzers. They will NOT work with a 2.5V Bulb or a motor.

When you connect an LDR in a circuit it should be placed before the component(s) you want to vary (e.g. buzzers or LEDs), on the positive terminal side of the battery pack (red wire side).

<u>An example</u>

The circuit diagram below gives an example of a circuit with an LDR and a Light Emitting Diode (LED) and reminds you how the components should be connected.



Tips:

- The LDR must be connected to the positive terminal of the battery (red wire).
- The longer leg of the LED must be connected next in the circuit on the positive terminal side of the battery pack.

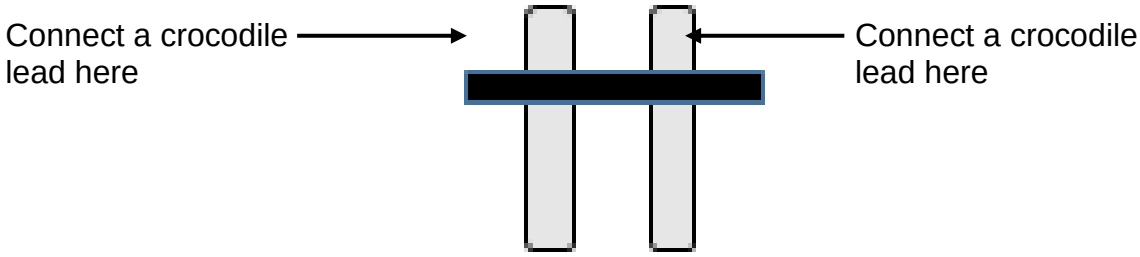
Your LED may light up if you are working in a light room but, if not, try shining a torch on to the LDR. Ask your challenge leader if you do not have one.

Hold your hand over the Light Dependent Resistor (LDR) and watch what happens to the Light Emitting Diode (LED).

How could you use this in your product design?

How to use a moisture sensor

You can use a moisture sensor in your circuit as a simple switch. Connect it by attaching one crocodile lead to the top of one nail and another to the top of the other nail as in the diagram below.



Remember your engineering apprenticeship on **RESISTANCE**? Different materials have different levels of resistance. Good conductors have low resistance, poor conductors have high resistance.

Water is quite a good conductor of electricity so, when you put the two nails into water, it will allow the electrical current to flow through the circuit. This will also work if you put the two nails against any material which conducts electricity.

Try it against different materials. Which materials conduct electricity and which do not?

How could you use this information to make your own switch?

How could you use this in your product design?

How to use a servo motor control unit

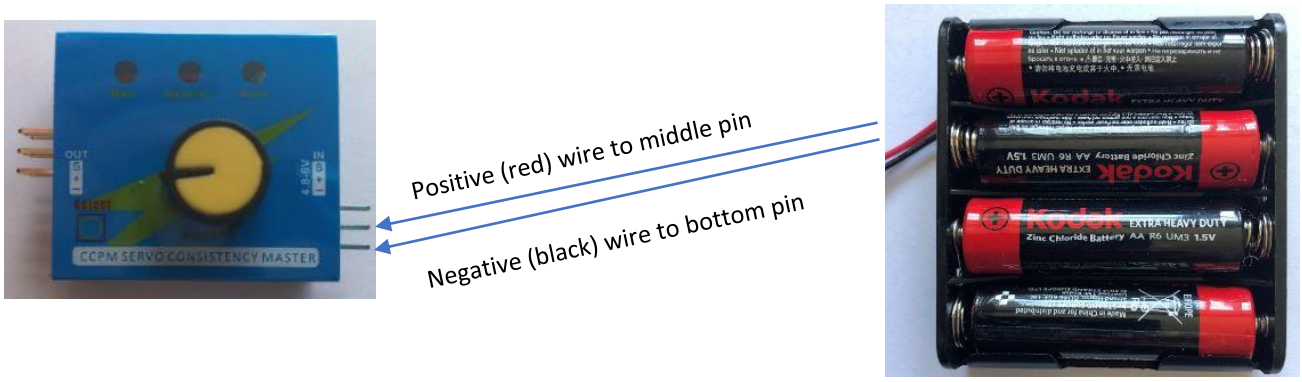
The servo motor control unit can be used **ONLY** with a servo motor, it will not work with anything else.

You will need:

- A 4 x AA battery pack with jumper leads attached
- A servo motor control unit
- A servo motor

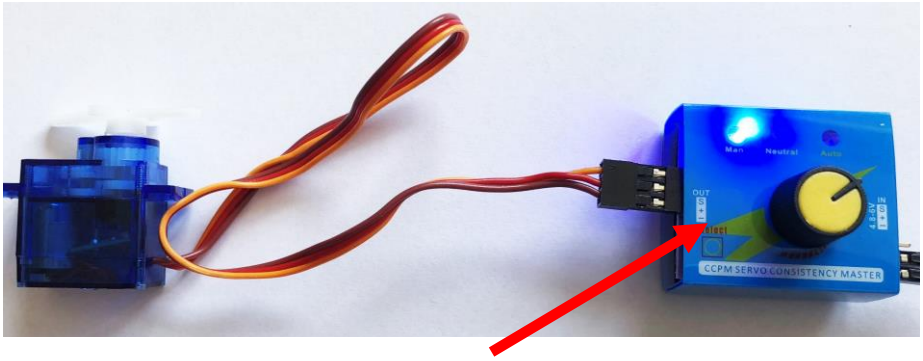
1. First take the battery pack and jumper leads and connect to the servo motor control unit as shown below.

   IMPORTANT: The jumper leads may not be the same colour as the wires leading from the battery pack to the terminal block so you will need to make sure you connect the correct wire.



   If you have done this correctly you will see the light on the servo motor control unit light up.

2. Next get the servo motor and attach to the servo motor control unit as shown below.



NOTE:
The orange wire must be at the top and the brown wire at the bottom.

You can attach up to 3 servo motors if needed.

3. You can now gently click the ‘Select’ button and either operate your servo motor on ‘Man’ (manual), where you need to turn the yellow dial to turn the motor, or ‘Auto’, where the motor will move automatically between two settings.

How to use a solar panel

You can use a solar panel to power electrical components. This **MUST** be used **IN PLACE** of a battery pack and not **AS WELL** as.

You can ONLY use a solar panel to power the following as they do not have sufficient power to make all the components in the shop work:

- A solar motor
- A piezo buzzer
- A light emitting diode (LED)

Solar motors can be connected any way round depending on the direction of rotation you want (e.g. clockwise or anti-clockwise).

Buzzers and LEDs must be connected as you would connect them to a battery pack - the positive (red) wire to the positive side of your component (red wire of a buzzer or long leg of the LED) and negative wire (black) to the negative side of your component (black wire of a buzzer or short leg of the LED).

Solar panels do not store energy so, once you have connected your circuit, you will need to find a bright light source. If it is a sunny day you may be able to use the light coming through the window in our workshop but, if not, use the lamp (or light source) provided by your challenge leader to test your circuit.

How could you use this in your product design?