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.

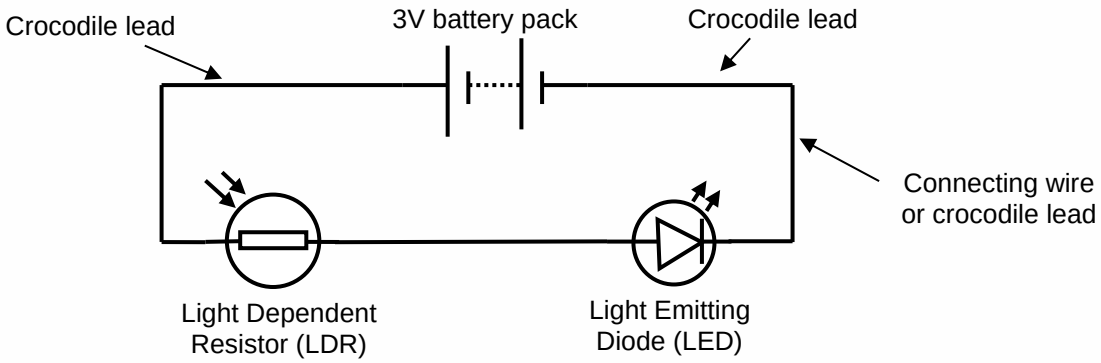
When the light levels are high (such as when you shine a torch on the LDR), the resistance is low the rate of flow is faster. This means an LED will be brighter or a buzzer louder.

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

There are four 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 – 0 to 90º or continuous

Both of these motors 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.

You **MUST** use the 'How to use a servo motor control unit' sheet to help you connect these motors.

Servo motor 0 to 90º - This servo motor will allow you to manually control the position of the rotor arm either clockwise or anticlockwise through 90º. You can also make it do this automatically.

Servo motor continuous – This servo motor will turn automatically through 360^0. You can make it turn both clockwise and anti-clockwise and make it slow down and speed up using the servo motor control unit.

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 servo motor

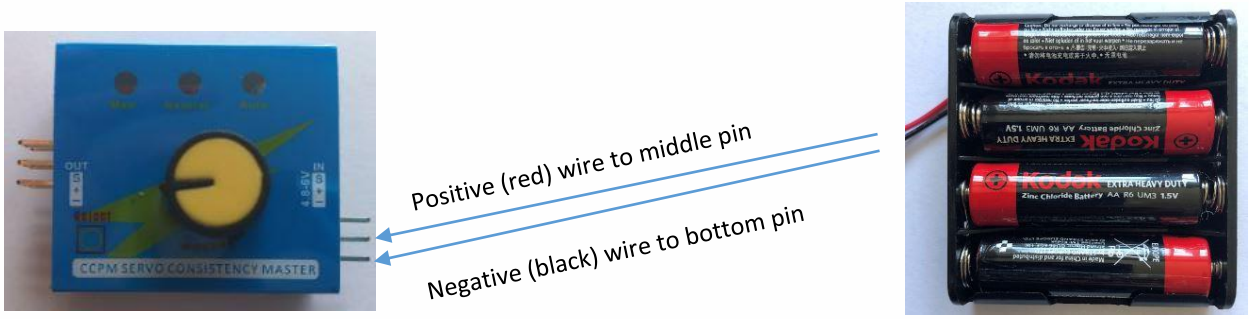
IMPORTANT – READ FIRST:

- The servo motor control unit can be used **ONLY** with a servo motor, it will not work with anything else.
- **DO NOT** leave the servo motor connected to the power all the time or it will burn out and stop working.

You will need:

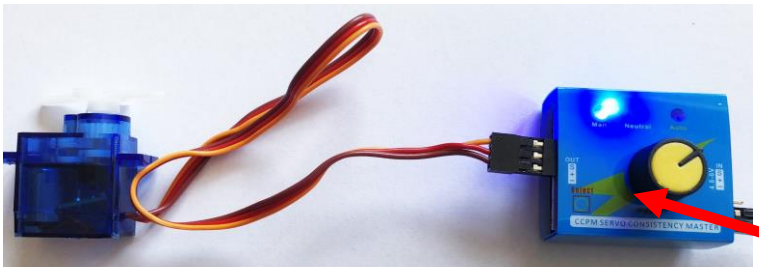
- A 4 x AA battery pack with jumper leads attached
- A servo motor control unit
- A servo motor – either 0 to 90º or continuous (See 'How to choose your motor' sheet)

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. If you are using a **servo motor 0 to 90º**, 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.

   The **continuous** motors will work automatically. You can change direction and speed by turning the dial.

How to make a moisture sensor

You can make a moisture sensor by creating a break in your circuit, like a simple switch.

You will need:

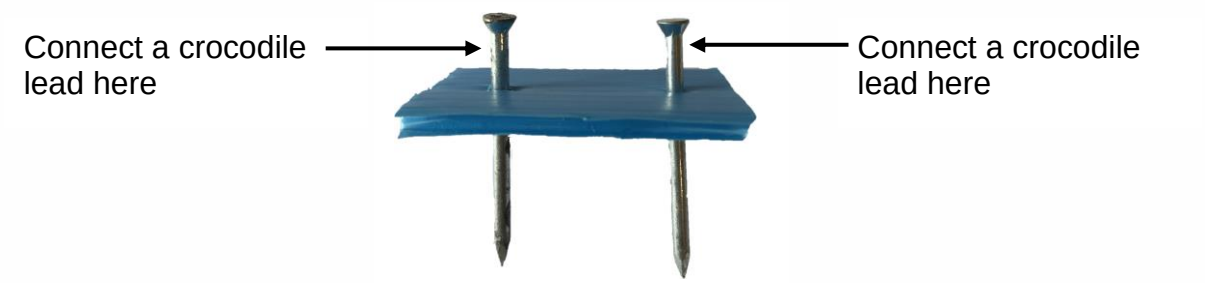
- two pieces of material which conduct electricity (e.g. nails, aluminium foil, paperclips)
- something strong enough to hold the pieces in place (e.g. a piece of correx)

1. Cut a small piece of correx (3cm x 2cm should be plenty large enough).

2. Thread the nail (or whatever conductor you decide to use) through the correx.

3. Make a circuit using a battery pack, two crocodile leads and either a buzzer or an LED. (At this stage don't try to put more than one of these in or it may not work).

4. Now make a break in your circuit and get another crocodile lead. Connect your new moisture sensor 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.



5. Get a pot of shallow water and place the prongs of your nails (or other conductor) in the water. Be careful you do not spill the water over your electrics. What happens?

How does it work?

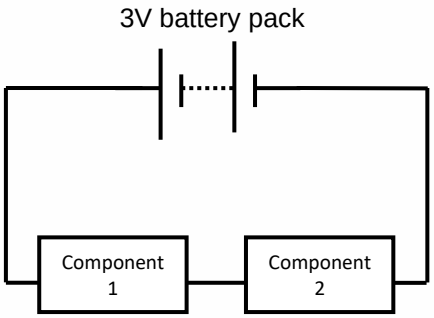
By creating a gap in your circuit you have stopped the flow of electricity so nothing will work. You can fill this gap with anything which conducts electricity. Remember your engineering apprenticeship on **RESISTANCE**? Different materials have different levels of resistance. Good conductors have low resistance, poor conductors have high resistance.

Water is a 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.

However, water is not as good a conductor as metal so you may find it does not work if you use a motor in your circuit or you try to put in more than one component. What could you do to make it work? [**CLUE:** Think about voltage]

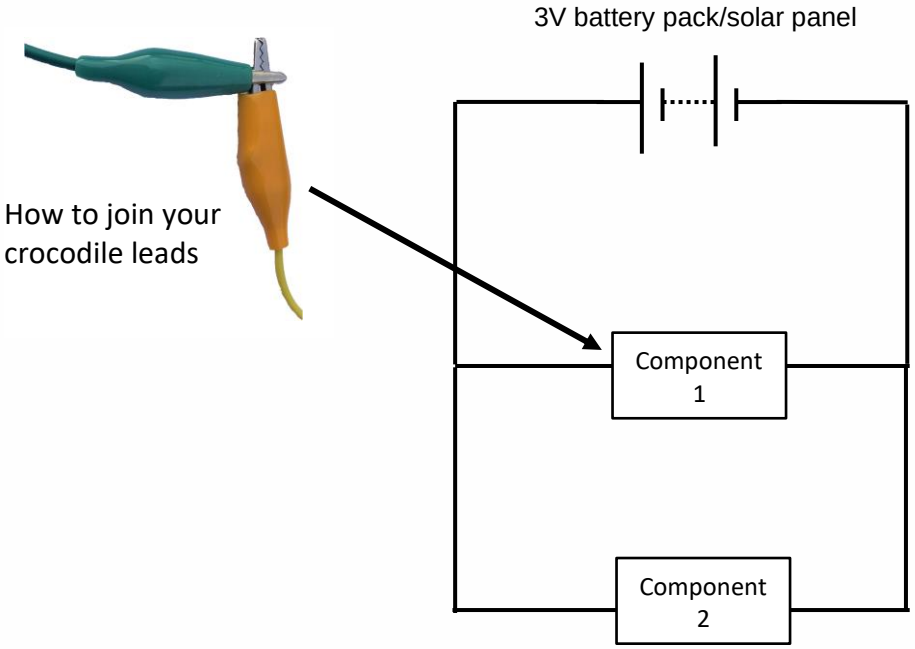
How to make a parallel circuit

If you want to put more than one component in a circuit you will find putting them in a series circuit will not work. (See diagram below with a motor and buzzer in the circuit). You will find bulbs do not light up or are not very bright, motors run slowly or not at all or buzzers are quiet or there is no sound at all.



Making a parallel circuit can help. This is all about **RESISTANCE**. Think about your Engineering Apprenticeship and what you learnt about resistance there.

By connecting your two components (buzzer, LED or motor) in parallel as shown below you give the electricity two paths to flow through, each of which has only one component in it.



How could you use this in your product design?

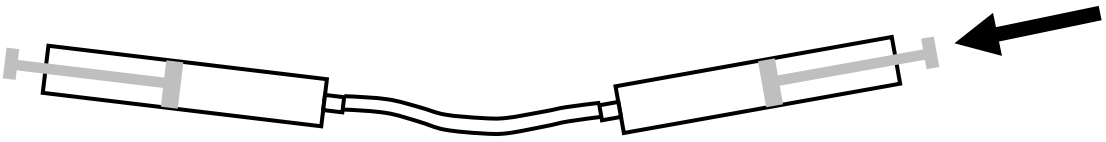
How to make a pneumatic system

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?

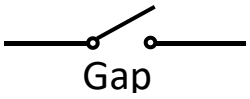
How to make a switch

Our shop only stocks one type of switch, a push to make switch. This works well if you only want something to work when you press down the button, like a doorbell, but you might need a switch which you turn on and it stays on without you holding it. This sheet will help you decide how you could incorporate a homemade switch into your prototype.

What is a switch?

A switch is simply something which you can move to open or close a gap in the circuit like the gap below between the two crocodile leads.

We draw an open switch like this.



When the switch is open the circuit is not complete and the electrical current does not flow. If you close the switch the circuit is complete and the flow of electrical current begins.

What makes a good switch?

A switch must be made of a material which will conduct electricity. In a low voltage circuit, like the 3 Volt ones you will be using, you do not need to have an insulator around it as this level of current will not electrocute us.

Look in the shop to think about the kinds of materials which are good conductors of electricity and would make a good switch. (**Hint:** metals are good conductors.)

How to incorporate a switch.

When you have chosen your conductor for the switch, think about how you might connect it into the circuit.

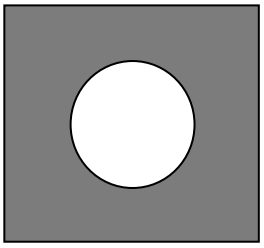
- How do you attach a switch to your prototype?
- How will you make the switch open and close easily without just moving the crocodile leads together?
- Think about where your switch needs to go in the circuit to turn off or on the right component.
- Think about where your switch needs to be in your prototype to allow people to turn it off or on easily.

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. The sponge or polyfoam separates the two layers of tin foil.

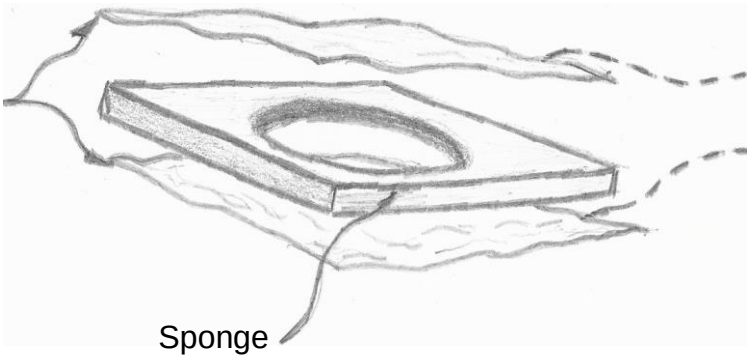
You can make it as shown below.

1. First cut a hole in the sponge or polyfoam.



2. Then cut two pieces of foil the same size as the piece of sponge or polyfoam and tape one on the top and one on the bottom. These **MUST NOT** touch if the sponge or polyfoam 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 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)

You should also note that a solar motor is **NOT** usually strong enough to power a vehicle.

Solar motors can be connected either 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).

IMPORTANT:

Solar panels do not store energy so, once you have connected your circuit, you will need to find a bright light source. Use the lamp (or light source) provided by your Challenge Leader to test your circuit.

How could you use this in your product design?