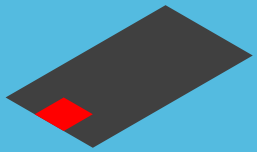
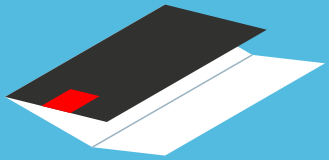
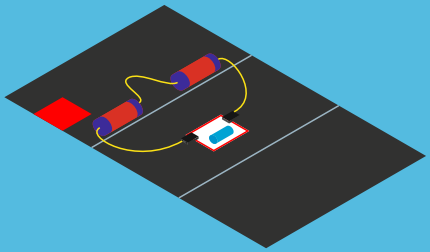
HELLO.

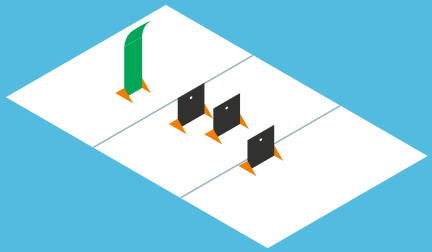
I'm Akosua.

To begin pick out and unfold the worksheet

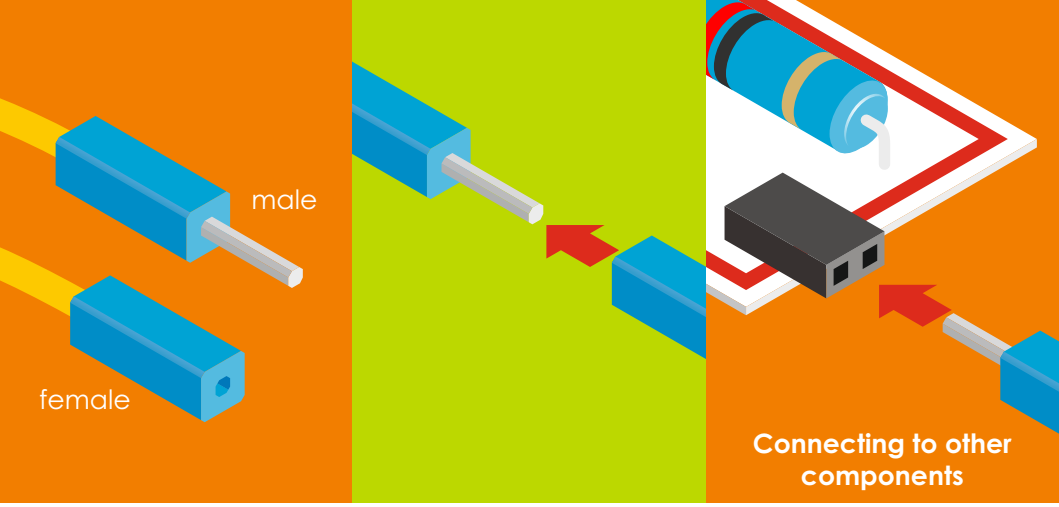








Circuits components and wires are most visible on the black side.
Light experiments are best done on the white side



Making Connections

Connections are made easy using the attachments on your connecting wires. Connecting wires come in male and female wires

All connections are made by gently push the cable unto the leads on the component you want to connect to

Circuit diagrams are drawn using the symbols of the components that will be used for the actual circuit. The components are drawn with lines connecting them, these lines represent connecting wires.

Your first circuit will be a very simple circuit. It will include 2 batteries, a buzzer and connecting wires.
Draw your circuit diagram before you build it

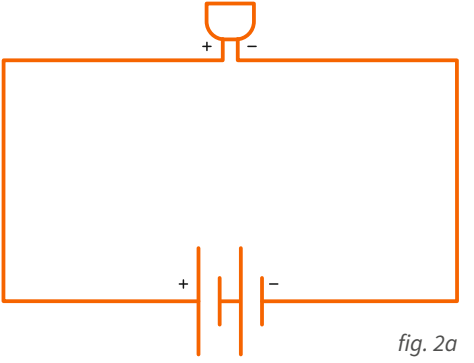
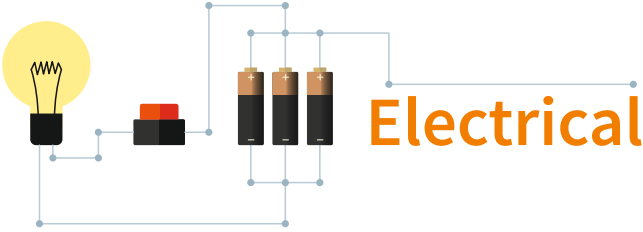


fig. 2a

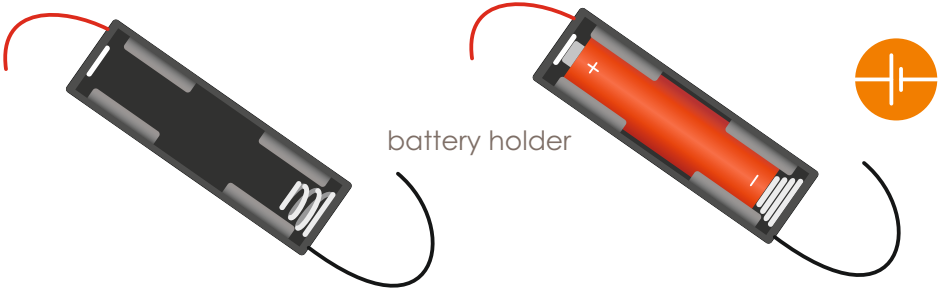
You will find the circuit symbols of new component in orange circles



Electrical Circuits

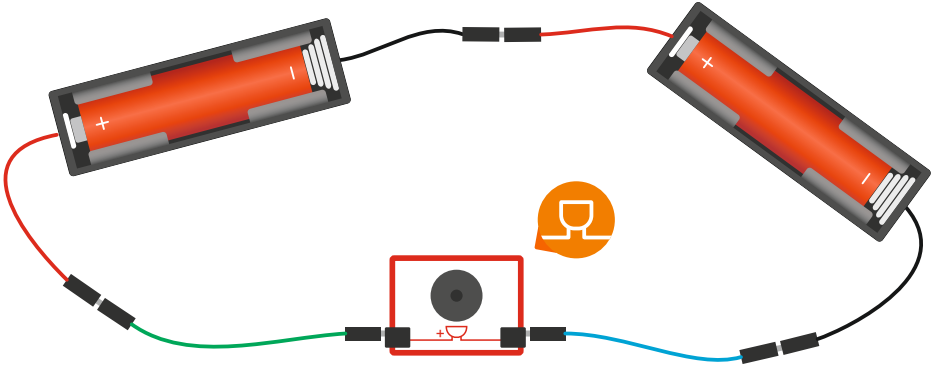
Assemble Your First Circuit

To make connection to your battery, place the battery in one end of the battery holder and gently stretch the other end over the battery.



You have to take note of the + and - signs indicated on the batteries. They show the direction of flow of current

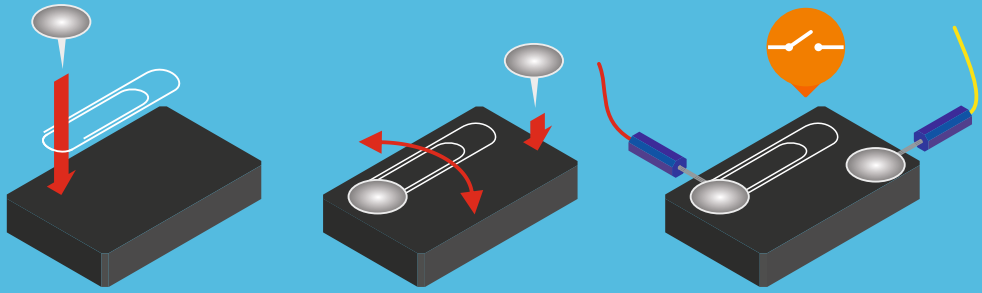
Refer to the first circuit diagram. Connect 2 battery holders together. Connect the battery to a buzzer using your connecting wires as shown below.



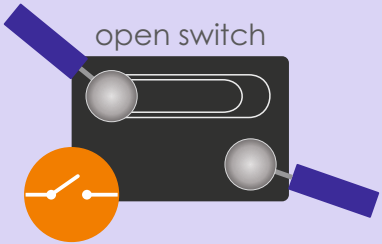
Your buzzer will produce a **loud SOUND**!

We still have to disconnect some wires to open our circuit. How can we turn off our circuit without disconnecting our wires?

In order to open and close our circuit without disconnecting wires we will need a switch

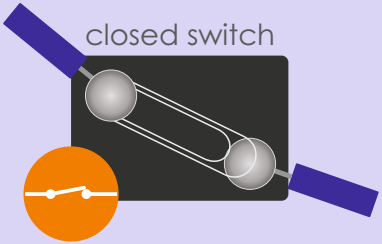


Connect the switch into your circuit. The buzzer should make a sound when close the switch and stop when the switch is open



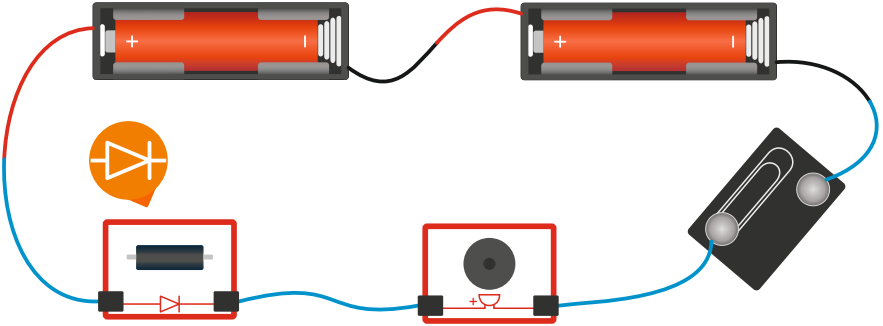
When the pins are not all touching such that current cannot flow, the switch is said to be open

When the pins are all connected, the switch is said to be closed



Diodes

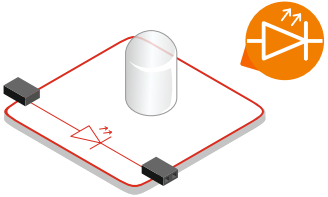
Apart from a switch there are components that allow current to flow depending on how you connect them. A diode allows current to flow in only one direction

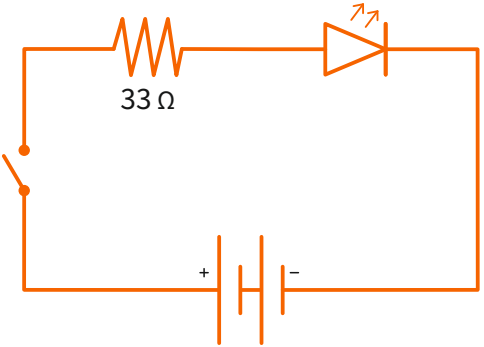


A diode connected such that current flow through it is said to be **forward biased** else is said to be **reversed biased**.
Build the circuit above, ensure the diode is forward biased as in the diagram and close the switch. The buzzer should sound. Reverse the diode several times and observe.

LED (Light Emitting Diode)

There is a special kind of diode that emits light when connected in forward bias. Its know as LED(Light Emitting Diode). There are different LEDs in your set

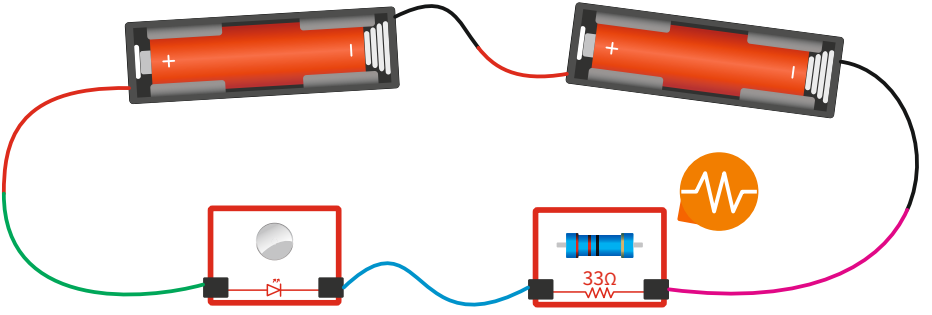


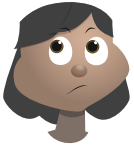


Use your set to build the circuit described in the circuit drawing on the right. It consists of 2 batteries, an LED and a 33Ω resistor (which we will look at next). If we set up our connections correctly the LED should light up

Resistors

Resistors hinder the flow of current. The higher the resistance, the less current will flow through the circuit.



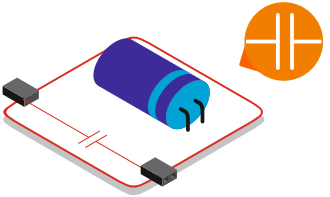


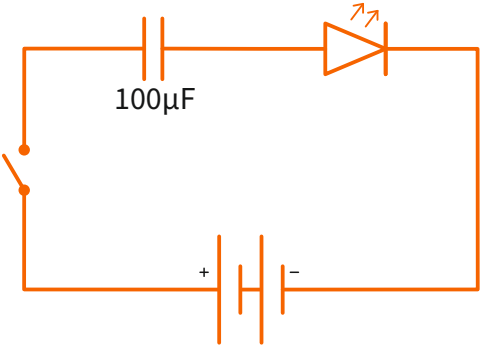
To understand the effect of a resistor replace the 33Ω with the 330Ω, 1kΩ and 10kΩ resistors and observe the LED

What do you think will happen if you do the same thing with the buzzer circuit from earlier. **Why not try it**.

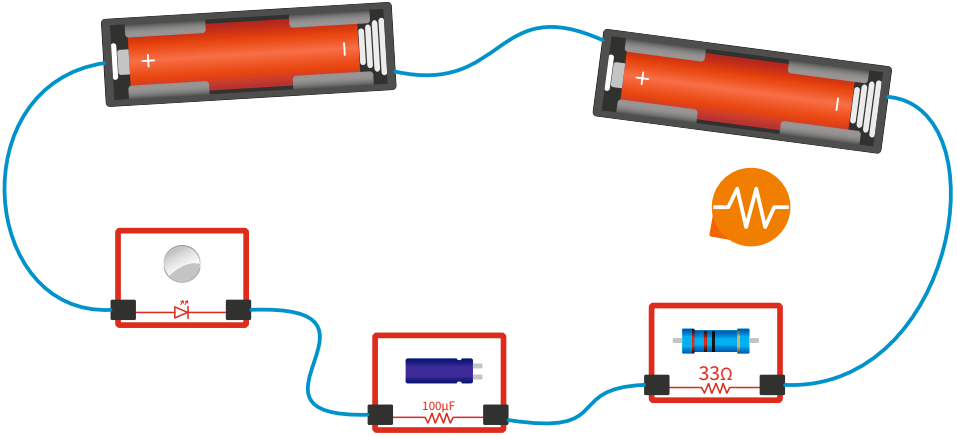
Capacitors

Capacitors can store electrical energy. The Electrolytic capacitor is a one-directional component.





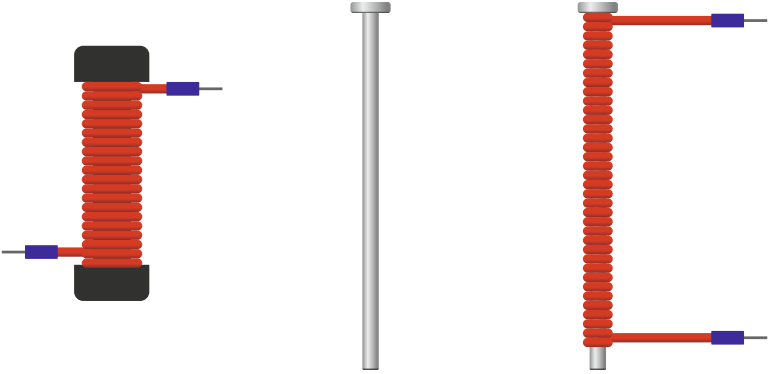
Build the circuit above. Current will flow while the capacitor charges and stop when it is done, hence the LED should be bright, dim, and then go off.



Introduce a 33 resistor into the circuit and observe how long it takes for the LED to go off. Try it again with the 330Ω, 1kΩ, and 10kΩ resistors and observe the LED. What does this say about the flow of current to the capacitor.

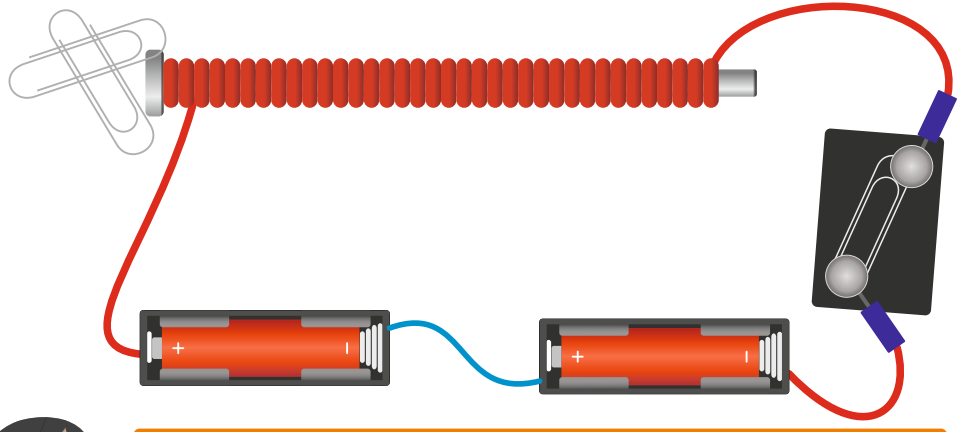
Electromagnetism

An electromagnet is a kind of magnet that is produced by the flow of electric current. We will create this using a solenoid (coil of wire), a nail, and a simple circuit.



To create the solenoid neatly coil the insulated wire around the nail in the same direction until you exhaust the available wire.

An electromagnet is a kind of magnet that is produced by the flow of electric current. We will create this using a solenoid (coil of wire), a nail, and a simple circuit.

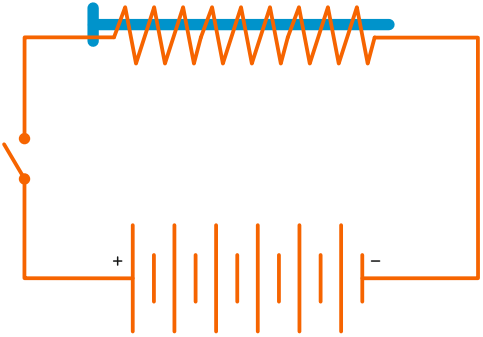


once the switch is closed, the nail should be able to attract paper clips. Do not keep the switch closed too long to prevent draining your batteries

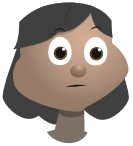
Magnetic Field

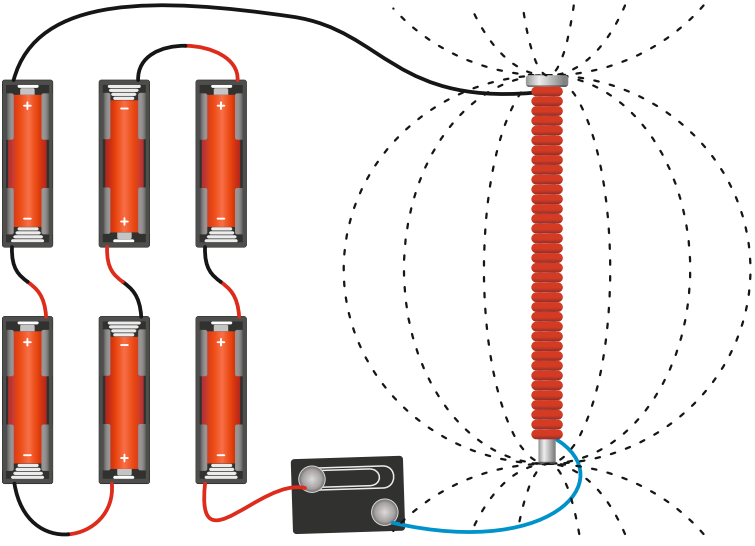
There is a defined area around our electromagnet where the force is felt the strongest. This area is called the magnetic field.

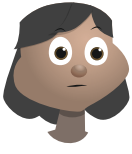
To make a visible magnetic field we will need more current. We need six 1.5 volts dry cells or one 9 volts battery which should be available in your local store. Join with your classmates because it requires at least 4 science sets



Be careful, the electromagnet gets quite warm



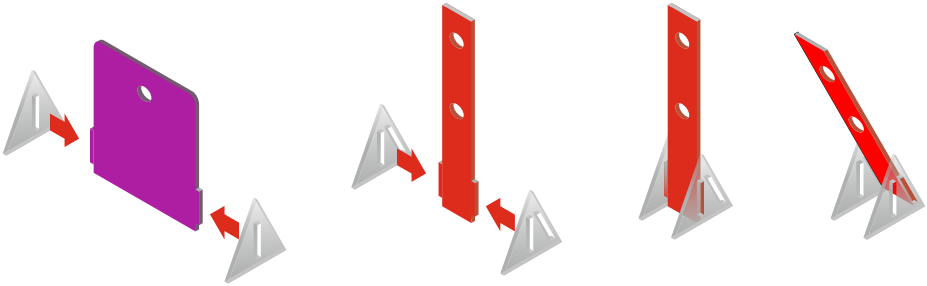




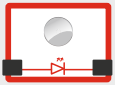
On the white side of your worksheet sprinkle some **iron fillings** evenly and place your electromagnet in the center of the iron fillings. Gently tap the worksheet until the iron fillings draw the **magnetic field**!

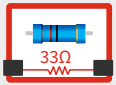
Light

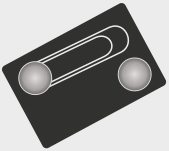
Most of the contraptions in the science set for “Light” studies require setup with triangle stands as shown below



These are the component we will use for out light source



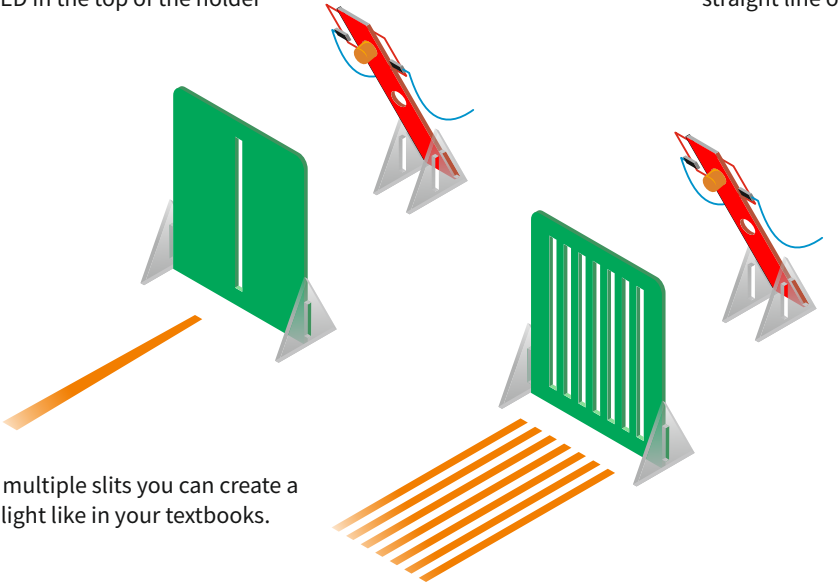




Ray & Beam of light

Using the light circuit from before, put the LED in the top of the holder

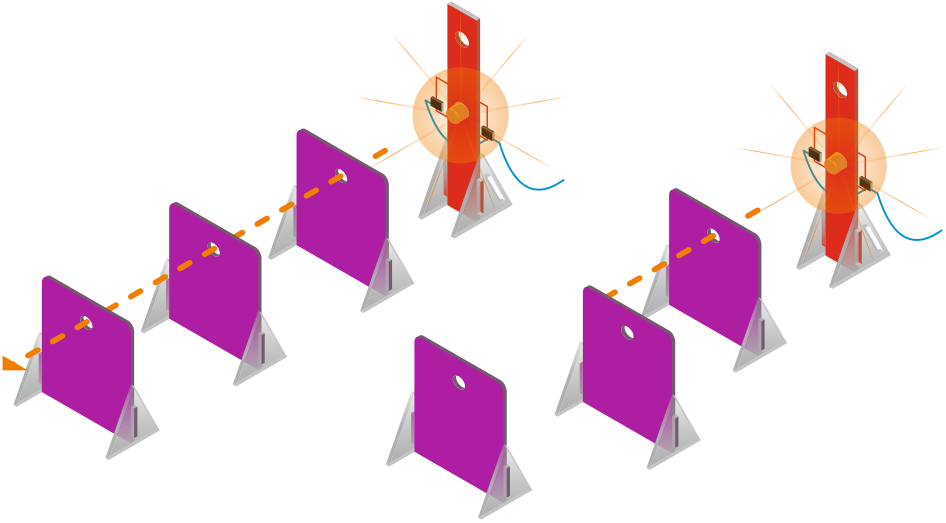
With the single slit you can create one straight line of light



With the multiple slits you can create a BEAM of light like in your textbooks.

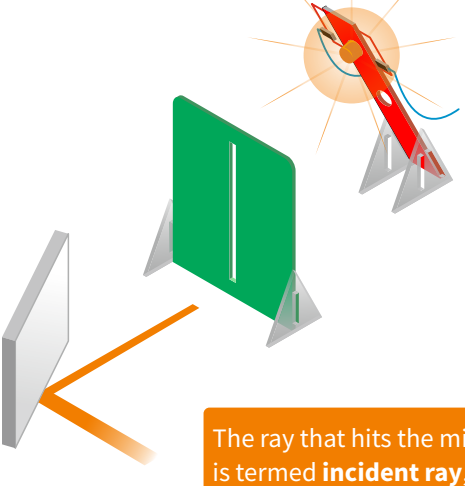
Rectilinear Propagation of light

Put the LED in the lower holder. Using 3 pinhole contraptions as shown below, the light should be visible through to the other end of all 3 pinholes if they are in a straight line. Move 1 pinhole out of alignment and the light will no longer be visible. This is because light travels in straight lines.

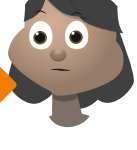


Reflection

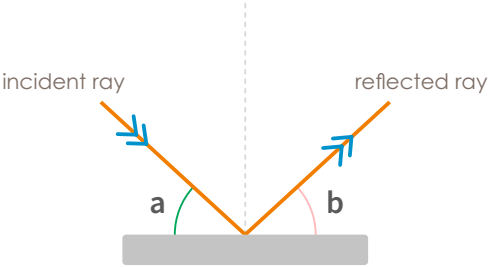
Now that we know how light travels, what will happen if we put a shinny surface like a mirror in its way. Build the contraption shown below. The mirror should reflect the ray. Tilt the mirror and pay close attention to the angle the ray hits the mirror surface and the angle of the reflection



The ray that hits the mirror surface is termed **incident ray**, and the reflected is simply **reflected ray**



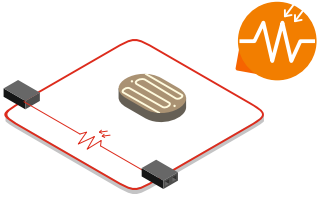
If you look from the top of the mirror, you will observe that the angle the incident ray hits the surface is the same angle the reflected ray leaves the surface.

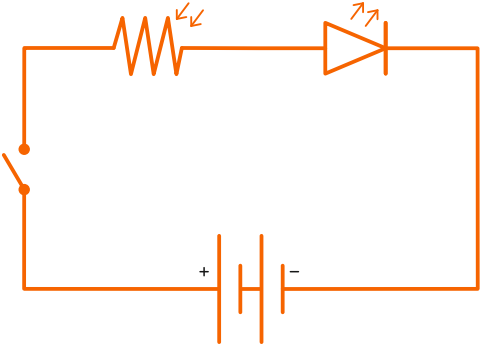


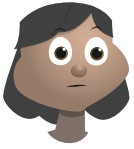
To show this, draw a line for the mirror and a ray with equal incident and reflected angles. Line up your contraptions making sure that the incident ray follows your drawing and the mirror is in the right place. The reflected ray should follow your drawing perfectly.

LDR (Light Dependent Resistor)

The LDR is the first interactive component you get to work with under basic electronics. It is a resistor, but its resistance depends on how much light shines on it



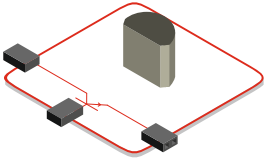




Build the circuit above. When you cover the LDR with your finger the LED should dim very, very slightly. To amplify the effect, we will use a component called a transistor, next.

Transistor

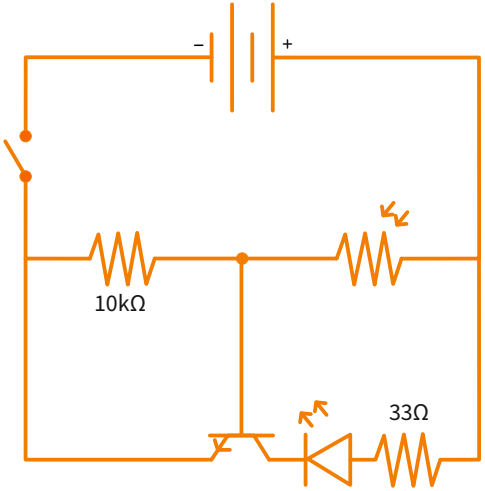
The transistor is an electronic amplifier. It has 3 leads, base, collector and emitter. When you connect a transistor to a circuit, current flows into the collector and out through the emitter, some current also goes through the base.



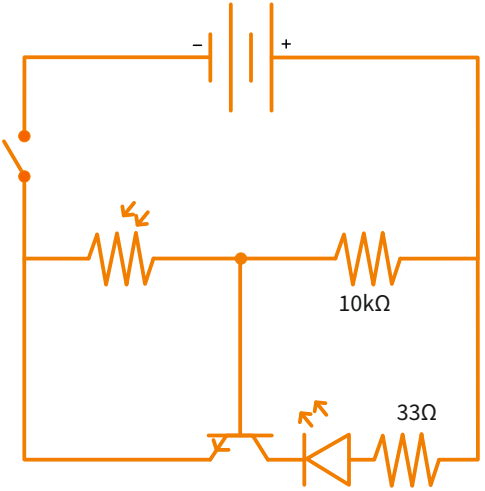
The amount of current flowing through the base is used to control the current from the collector to the emitter.
The most interesting thing about a transistor is that you need a very small current flowing through the base to control a large current passing from the collector to the emitter.

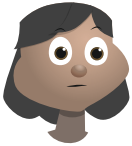
So if we connet our LDR to the base and our LED to the emitter of a transistor, a small change in the resistance of the LDR (current at the base) will cause a greater change in the current going to the LED

Light Detector



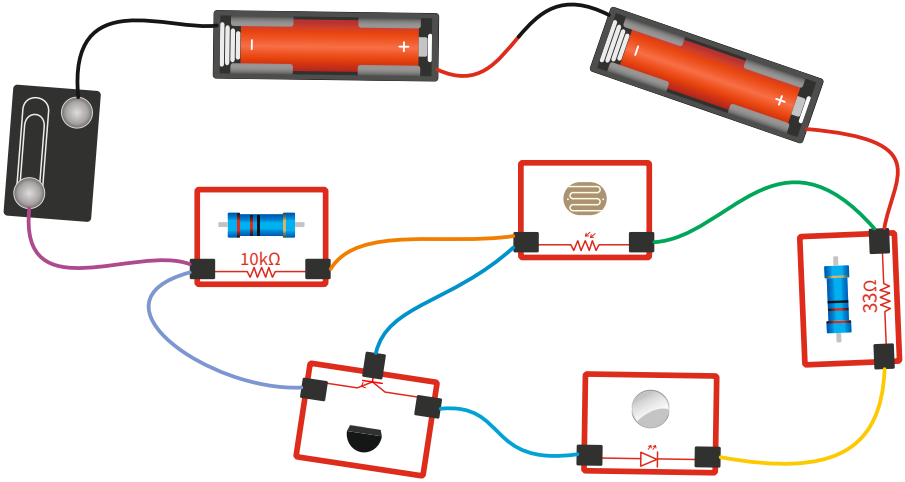
Dark Detector





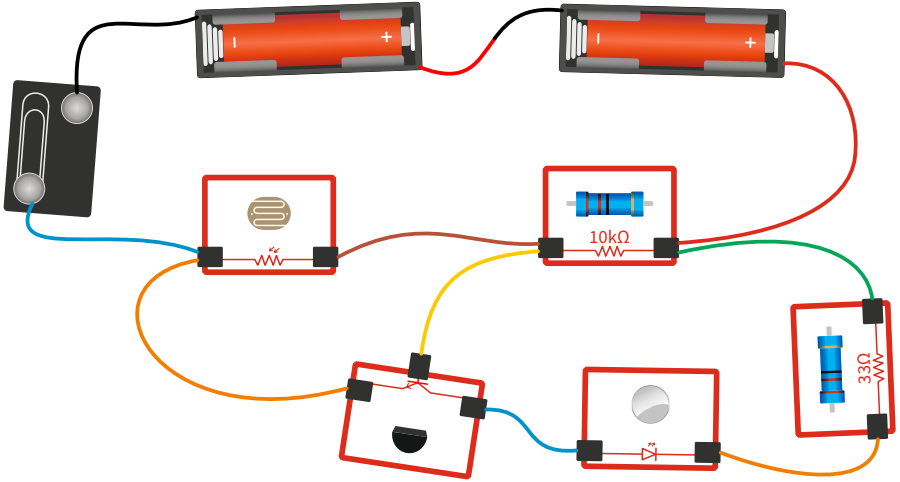
Here are the circuit diagrams to make it easier to understand. Note the placement of the resistor in respect to the transistor

Light Detector



Our LED gets dimmer when there is less light. This is not very useful . A more useful circuit would be one in which the led gets brighter as the room gets darker. Let's go ahead and build our dark detector!

Dark Detector



If you circuit works, **congratulation**! You have just created an automatic light system. When it gets dark, your smart circuit will turn on the light automatically!

CONGRATS

You now have a very good understanding of many core concepts in science and engineering. Experiment more and get ready to live the awesome life of a **scientist** !