2: MAKE A 'BREADBOARD'

Goal:	To understand how an electrical breadboard works and how electricity flows around it.
Objectives:	Simulate a breadboard using cardboard and copper tape Identify positive and negative terminals on an LED Wire a breadboard with a battery pack, LED, and resistor

What to Do

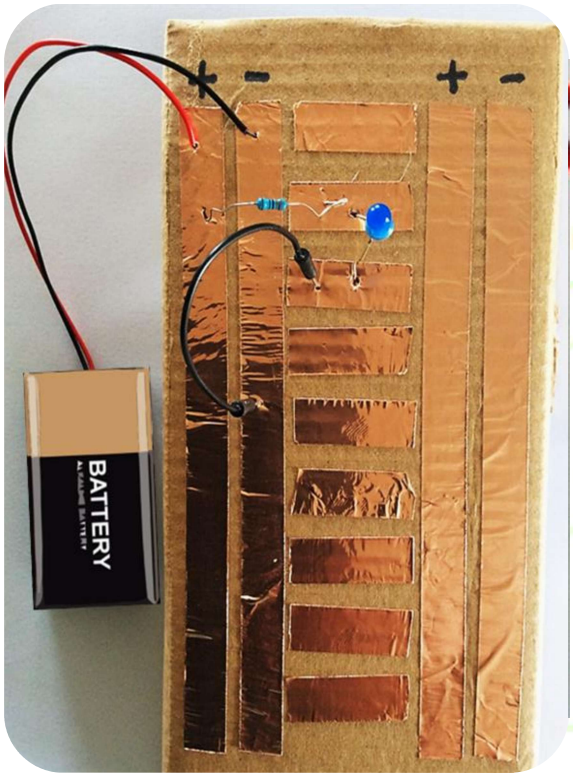
1. PARTS NEEDED:

- ☐ A cardboard rectangle
- ☐ Copper tape
- ☐ 2 LEDs (any colour)
- ☐ 330Ω Resistor - Orange, Orange, Black (3 bands) or Orange, Orange, Black, Black (4 bands) to limit the current flowing through the LED
  - Check that you have the correct resistor
  - > *Students will learn more about resistors in the next lesson*
- ☐ Connecting wires
- ☐ Battery pack
- ☐ Sticky tape

2. BUILD THE CIRCUIT

NB. *If the card you are using is corrugated, as shown, you might find it helpful to push 2-3mm of the legs of the components/wires through the copper tape into the cardboard, before bending over and taping. A drawing pin is useful for making holes. On plain card, simply taping the components down is the best method.*

STICK COPPER TAPE TO THE CARDBOARD AND LABEL IT AS IN THE DIAGRAM.

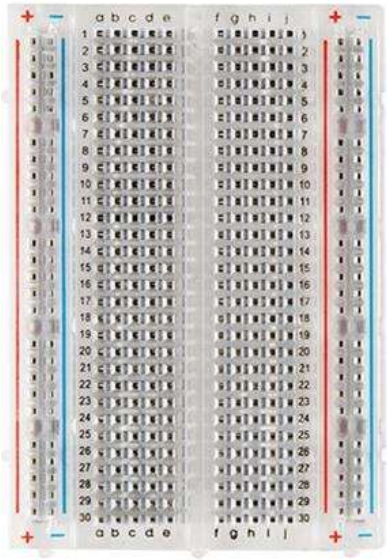


- Label the long vertical rails on each side with 'positive' and 'negative'. Note that the negative connection is usually referred to as 'Ground'. *If you're short of space, only one set of the +/- columns is absolutely necessary.*
- Sticky tape the resistor between the positive rail and one horizontal band. The direction of the resistor does not matter.
- Sticky tape the positive lead (the longest one) of the LED to the same band as the resistor, sticky tape the other (negative) lead to a different horizontal band.
- Sticky tape a wire from the negative band of the LED to one of the Ground vertical rails.
- Sticky tape the red wire from the battery pack to the positive rail, and the black wire to the negative rail.
- The LED should light up. You may have to press down on the wires to form a tight connection.

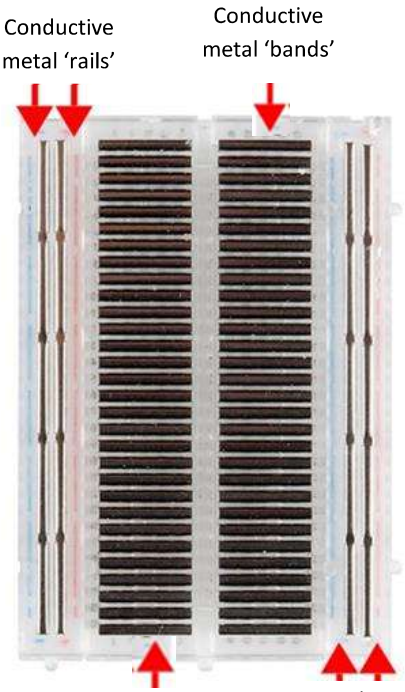
Notice that the copper tape is stuck down as individual strips, they never touch - that would cause a short circuit.

NOW COMPARE YOUR CARDBOARD BREADBOARD WITH THE REAL BREADBOARD.

Outside breadboard



Inside breadboard



Your breadboard

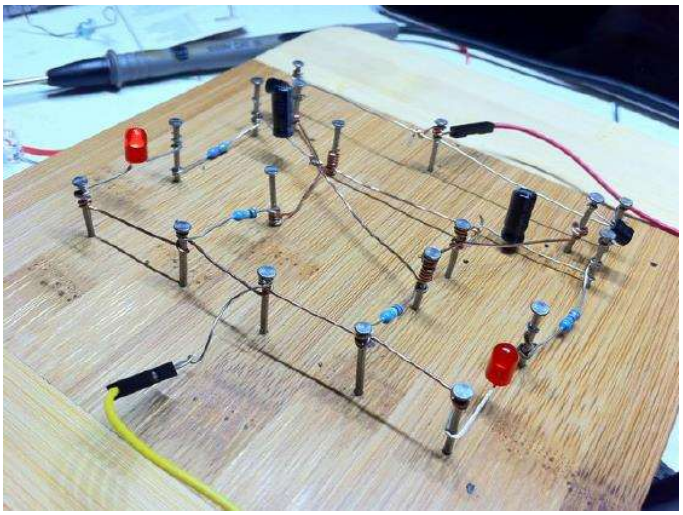
What else could we try?

- Can you make two LEDs work in the circuit?

Don't leave this circuit 'on', it could start a fire!

Disconnect the battery leads from the breadboard and remove the connector from the battery.

2: MAKE A BREADBOARD TEACHER NOTES



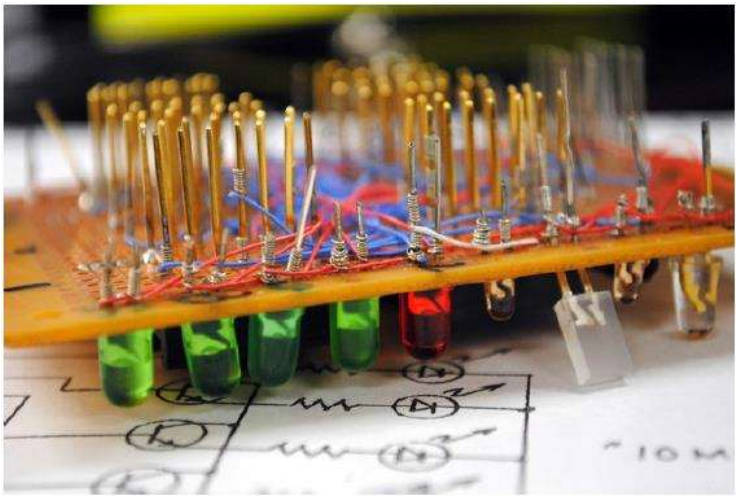
When we're experimenting with electronic circuits, we don't want to solder components together, or connect the clips, it's too messy and cumbersome.

So, in the early days of electronics, some bright spark (☺) decided to bang some nails into a piece of wood and connect the components by wrapping wires around the nails.

And thus, the 'breadboard' was invented.

It proved quite useful but, as you can imagine, it became rather unwieldy and impractical as electronics progressed and circuits became more complex and larger.

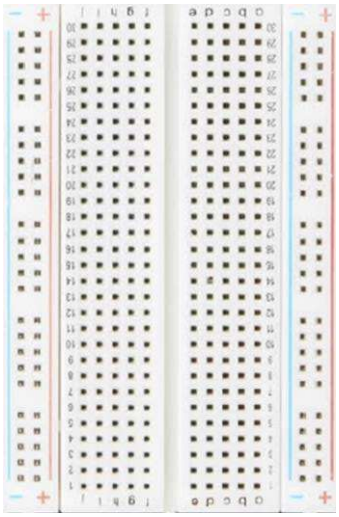
For a while in the 1960s, '70s and '80s, engineers and makers used techniques like wire-wrapping which solved the 'complex circuits' issue but was still semi-permanent. It also required a fairly expensive wire-wrap board or the use of wire-wrap pins and sockets. With practice, wire-wrap prototyping could be fast but took a while to get used to and look at that mess!!



And then in the early 1970's an awesome thing occurred. Ronald J Portugal came up with this brilliant invention:

BREADBOARD FOR ELECTRONIC COMPONENTS

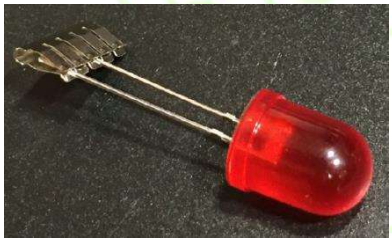
It was quickly called the "Solder-less" Breadboard because no soldering is required to use it, and then shortened to plain Breadboard since nobody uses a "solder-full" breadboard.



And that's how the breadboard got its name!

It's a piece of plastic with a lot of holes in it and, although you can't see it, under each row of 5 holes, is a metal strip with a little individual 'tooth' under each hole. These little teeth grip the leads on the electronic parts, so that when a part is pushed into the breadboard, the clip is pushed open and 'grabs' the metal leg.

Any component or wire that you push into a hole will be electrically connected to any other component or wire you push into a hole in same row of 5 holes.



The power and ground columns (known as 'rails') have a single, continuous strip under each one.

COMPARE THE TWO IDENTICAL CIRCUITS:

Despite having only three connections, wiring with alligator clips makes for a large tangle of wires which would be difficult to change if we wanted to add or remove components. Compare with how neat and organised it is with a breadboard! No long wires, and it's easy to swap in a different resistor or LED (or anything else) when you want to.