

## Experiment 3: Series and Parallel Circuits

### Goal

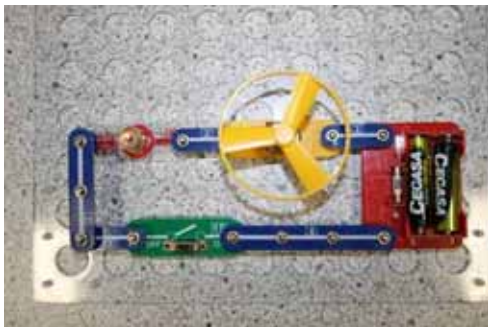
In experiments 1 and 2, we saw one circuit with a lamp, and another circuit with a DC motor. But how can we combine the lamp and the DC motor in the *same* circuit? And will they work in the same way as they did before? The aim of this set of circuits is to see how electricity flows in circuits with more than one component.

### Components

1. All the components we used in circuits 1 and 2- lamp, switch, battery pack, connectors, motor, and fan blade.
2. We'll also be using the Ammeter. The Ammeter is a device which senses the current flowing in the circuit, and gives you an idea of the amount of power that the battery can supply.

### Circuit 1: Lamp and Motor in Series

The first way we will combine the lamp and the motor in the circuit is to simply put one after the other. Build the circuit shown in the first picture below.



We say that the lamp and the motor are “in series”. Switch on the circuit- the lamp will light and the fan blade will turn. The power from the battery is shared between the lamp and the motor. Current flows from the battery, through the motor, through the lamp, and back to the battery again.

It would be useful to know just how much power is available from the battery. To measure this, we can use the Ammeter. Change the circuit to the one on the right, which includes the ammeter. The lamp and the motor are still in series (one after another), but now the meter is connected across the battery. Take a note of the reading from the meter.



What happens if you remove the lamp? The motor will stop turning. And what happens if you remove the motor? The lamp will go out. This tells us that in series connected circuits, if one of the components fails, then the circuit is broken. You might find this with Christmas lights – if one of the bulbs blows, then all the lights on the tree go out. That's because most (older) sets of Christmas lights are all connected in series.

## Circuit 2: Lamp and Motor in Parallel

Another way to connect the lamp and the motor is to put them side by side. Build the circuit shown in the picture below:



We say that the lamp and the motor are “in parallel”. Switch on the circuit- the lamp will light and the fan blade will turn. The power from the battery is shared between the lamp and the motor. Current flows from the battery, through the lamp (lighting it), and back to the battery again. Current *also* flows from the battery, through the motor (turning it), and back to the battery again.

What happens when you remove the motor? The lamp will stay lighting. And if you removed the lamp, the motor would keep turning. That’s because removing the motor does not break the circuit. Current can still flow from the battery, through the lamp (lighting it), and back to the battery again. This is one of the advantages of parallel circuits.



### **Real World**

Some of the electrical connections in your house are in series, and others are in parallel. Try to think of a time when one of the fuses in the house’s fusebox blew. You might have found that some of the wall sockets didn’t work, while the others still worked.

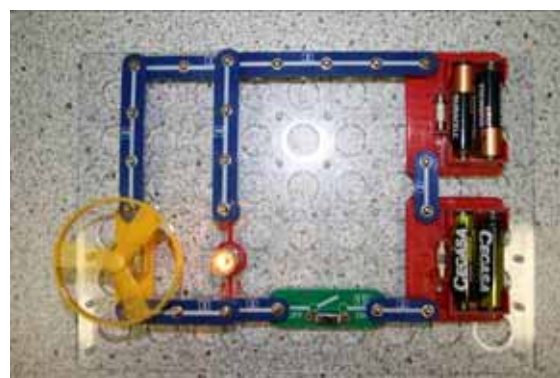
The wall sockets that didn’t work were connected in series by the fuse to the ESB mains.

When the fuse blew, the circuit from the ESB power supply to these sockets was broken. The wall sockets that still worked were connected by fuses in parallel with the one that blew.

Their connection to the ESB supply was not affected by one fuse blowing.

## Circuit 3: More Power!

In the series and parallel circuits, power is shared between the lamp and the motor. You might find that the motor doesn’t spin as fast, or that the lamp doesn’t shine as brightly as before, especially if the batteries are running down. We can fix this by increasing the power to the circuit – let’s add another battery pack like in the circuits below:



We double the power by connecting two battery packs in series. Make sure the + of the battery pack on the bottom is connected to the – of the battery pack on top. The reading on the meter is now twice what it was before. The lamp shines more brightly and the motor spins more quickly (be careful – the fan blade might fly off!).