Cells in Series and Parallel

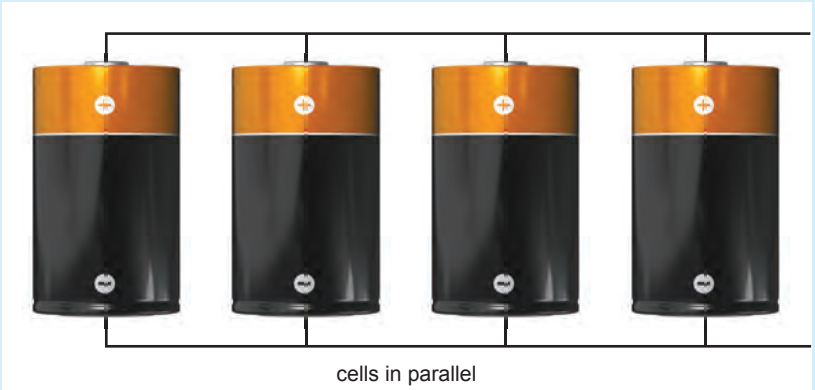
When you open a torch to replace the batteries, you will find that there are two or three separate cells placed end to end, with a spring providing pressure to connect them tightly. If you look at some other electrical devices such as toy trains or remote controlled cars you may find the cells are placed side by side instead. The difference between these two layouts is that one set of cells is in series and the other set is in parallel. The reason for these differences is that by altering the layout of the cells you can alter the output voltage.

When cells are arranged in **series**, each positive terminal is connected to the next cell's negative terminal and so on; they are in a single path which is the same as a series circuit. By connecting cells together this way, it allows a device that needs a large voltage to be powered by several cells of lower voltage. Some devices like a torch need higher voltages to make the lamp glow, so a combination of cells or a battery (remember two or more cells in series makes a battery) working in series provides the necessary voltage . A 9 V battery (like most smoke alarms use) has six individual 1.5 V cells in series inside it as shown in the image opposite.

When you have cells in series, you add the individual voltages to get the total voltage output. Looking at the diagram below, $V = V_1 + V_2 + V_3 + V_4$. So if each cell provides 1.5 V, then the total voltage output would be $1.5 \times 4 = 6$ V.

cells in series

When the cells are connected in **parallel**, all the positive terminals are joined together and all the negative terminals are joined together, as shown in the diagram below. This means that the voltage isn't altered and the voltage output is still equal to one cell. Looking at the diagram below, $V = V_1 = V_2 = V_3 = V_4$. So if each cell provides 1.5 V, then the total voltage output in this case would still be 1.5 V.



cells in parallel

If the total current required is known then each cell in parallel provides a fraction of it. For the diagram shown, each cell would provide a quarter of the total current. If further cells are added in series, then each cell supplies an even smaller fraction of the total current. This means that the more cells there are in parallel, the longer they will all last.

When using multiple cells, the way that they are connected together (series or parallel) is very important because if the voltage supplied is greater than what a component can take, it is likely that the component will be damaged or completely destroyed.