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Hooking up LEDs

Batteries:

Most of you have probably just connected LEDs directly up to a 9 Volt battery and been satisfied. Those of you who have tried connecting more than a few this way have found that depending on how you connected them you either got a very short battery life or very little light. That is because 9 Volt battery just does not have much power available.

AA and AAA cells are more suited to most projects. For a large number of LEDs, such as a lighted costume, you may need C cells in order to get a decent battery life. The key is that AAA, AA, C, and D cells will all light a large number of LEDs, but the larger the battery the longer the life. Button cells are really only suitable for blinking LED circuits that are off more than they are on.

Batteries should only be connected in series. That shouldn't be a problem if you just buy commercial battery holders. You must match the number of batteries to your arrangement of LEDs. Of course if you use a kit or prebuilt circuit or tear apart a toy for the electronics, you must use what it was designed for.

If all you want is steady lights, it is really fairly simple once you know the basics of how things work.

LEDs:

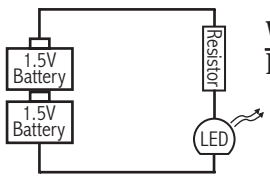
Something important to know is that LEDs have a certain constant voltage dropped across them when they are lit. That means you -must- use a current limiting resistor in series with the LEDs. If you connect an LED directly to batteries that are over it's voltage drop, it will draw massive amounts of current and burn up with a big crack!

The voltage will vary a bit from one type of LED to another, and will vary quite a bit from one color of LED to another. If you are only using one LED, it is pretty simple, you just have to make sure the batteries supply a volt or two more than the voltage drop on the LED and pick a suitable current limiting resistor. In general, adding more batteries will not increase battery life, because the extra voltage and therefore the extra power just gets absorbed by the series resistor. For more battery life, use larger batteries.

- In general:
- Red ~1.7 Volts
 - Yellow ~2 Volts
 - Green ~3 Volts
 - Blue 3 to 5 Volts
 - White 3 to 5 Volts

You may be able to light an LED dimly with a bit less than these voltages, depending on the particular LED. But you will get erratic results. For instance, although a particular Red LED may light from one brand new 1.5 Volt battery, after the battery is only partly discharged the LED will not light to a useful level.

To calculate the series resistor, the LED current should be something between 2mA and 20mA. One mA is 1/1000th of an Amp.



$$\frac{V_{\text{battery}} - V_{\text{LED}}}{\text{LED Current}} = R_{\text{Series}}$$

For a Red LED with Two Batteries: For a Yellow LED with Two Batteries::

$$\frac{3V - 1.7V}{10\text{mA}} = 130 \text{ Ohms}$$

$$\frac{3V - 2V}{10\text{mA}} = 100 \text{ Ohms}$$

This is not very critical so resistors such as 100 to 150 Ohms will work with the first example, and 82 to 120 with the second.