Building a Lego® Spectrophotometer

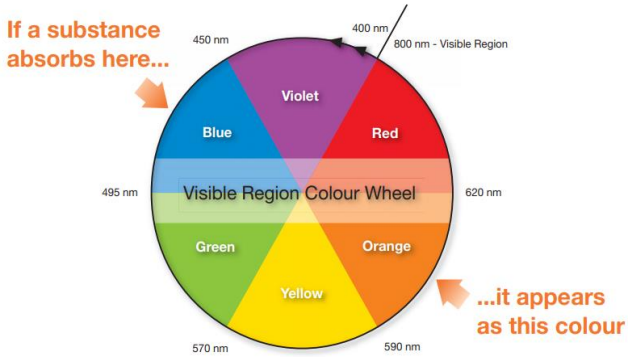
Objectives

- To build a Lego® Spectrophotometer

Building the Lego® Spectrophotometer

Selecting the LED colour:

The colour absorbed by a solution is complementary to the colour it appears so in order to be able to measure absorbance of the solution the LED colour must be complementary to the colour of the dye being used. The complementary colour can be worked out using the colour wheel below. For example, a blue dye requires an orange LED. Specific practical scripts will suggest an appropriate LED.



Colour wheel reproduced from RSC SIAS resource

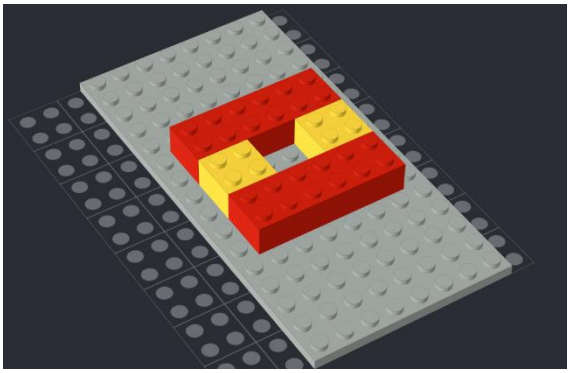
First, identify and test the LEDs. These are clear plastic LEDs with different colours of emission.

- Using a crocodile clip, connect a resistor to the red wire of the battery pack and, using another wire, join the resistor to the long arm of one of your LEDs.
- Connect the shorter arm of the LED to the black wire of the battery pack.

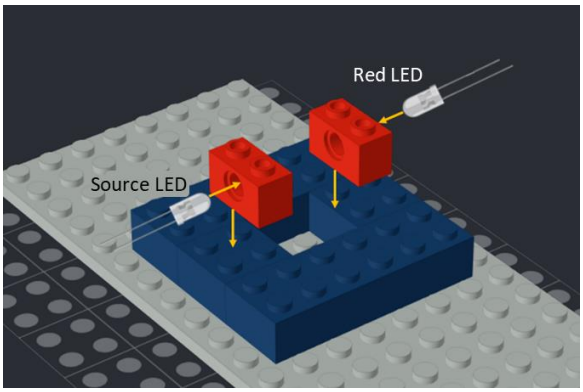
If connected correctly, the LED should light up and you should make a note of the colour of the emitted light. Repeat this for the other LEDs to confirm which is which.

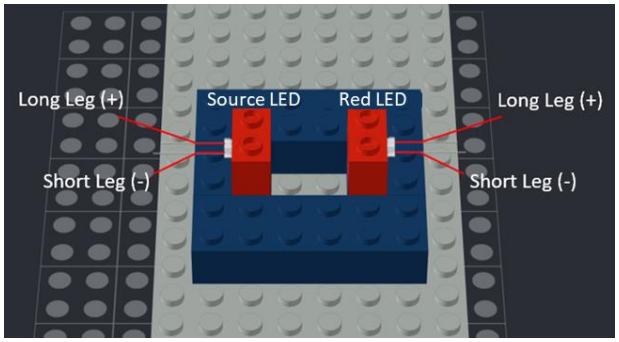
Once you have confirmed that the LEDs are working; their emission colours; and the colour LED you require for your solution, you can start building the spectrophotometer.

Build the base layer of the spectrophotometer.



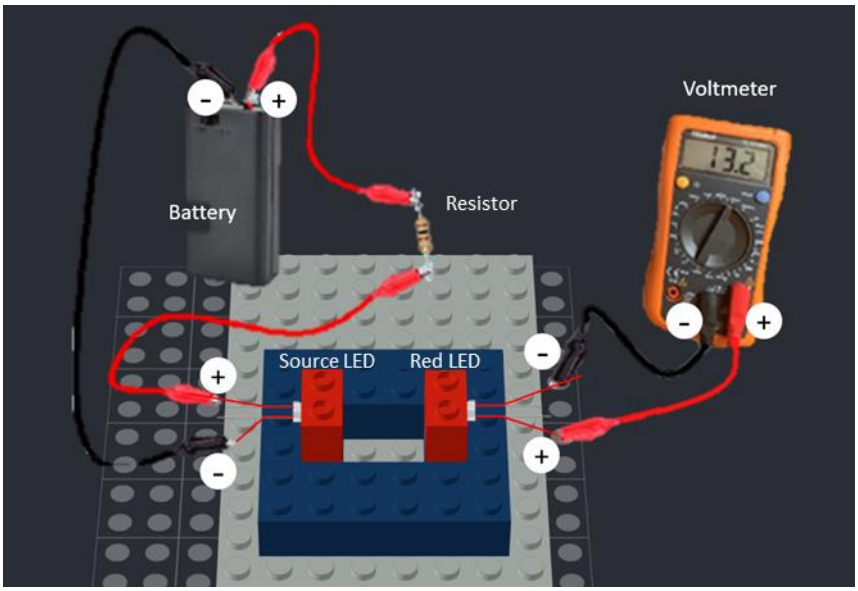
Push the source LED and red, detector, LED into the Lego technic bricks. The LEDs **may be too large** to go completely through the brick, so just push them in as far as you can – do not force them. Then add the LED pieces to the base.





For each LED, make sure you know which of the pins is the longer one. **Separate the legs** of the LEDs to ensure they won't touch and short the circuit.

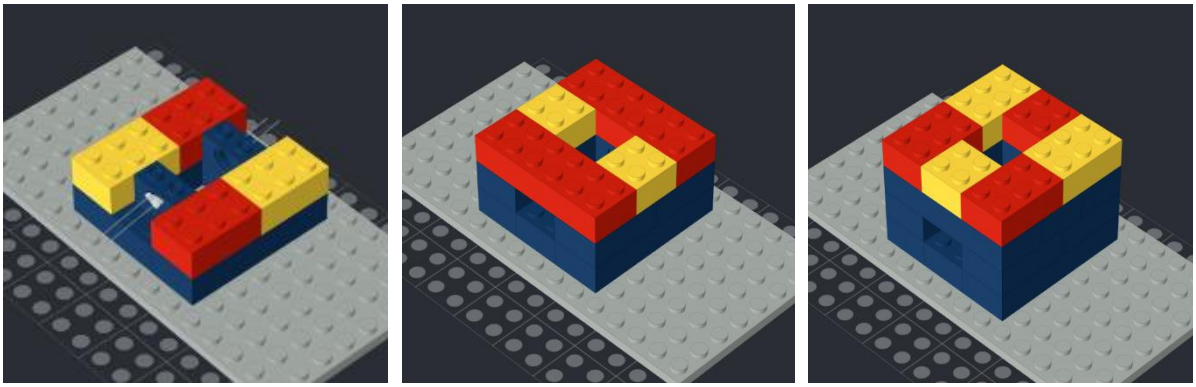
Using crocodile clip wires, construct the two circuits as shown in the diagram below. The red, positive, terminals should be connected to the longer arms of the LEDs. Make sure that the positive arm of the red LED is connected to the V port of the multimeter and the negative arm is connected to the COM port.



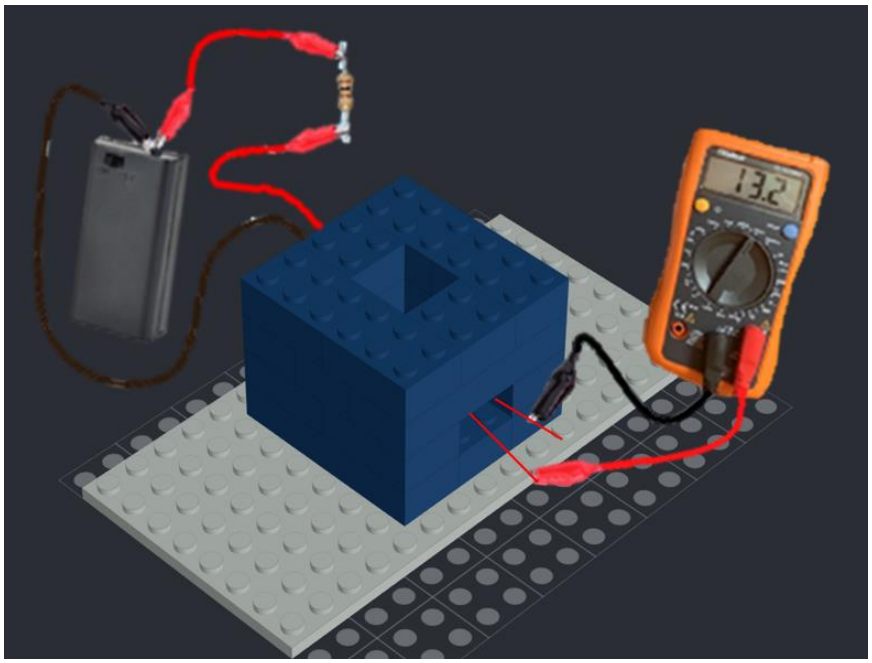
Turn the multimeter to the *2000m* (2000 mV) direct voltage setting. If the source LED is lit up, this should produce a non-zero reading of roughly 600 – 1000 mV. You should also be able to observe that the voltage reading drops if something, such as a finger, is inserted to obstruct the light path between the two LEDs.

Disconnect the source LED from the power supply, when it is not in use.

Finish building the rest of the spectrophotometer in layers, according to the diagrams below.



Your final spectrophotometer and circuit should look like this:



Acknowledgements and copyright

This resource has been authored by members of the Department of Chemistry at the University of Oxford.