Spectroscopy in an Envelope, Instructions

This document is a set of basic operating instructions for the "Spectroscopy in an Envelope" colourimeter. For more information, support, helper worksheets, suggested activities, and instructional videos please visit our website, by scanning the QR code or visiting the link at the bottom of the page. However, this sheet is all you'll need to take and process readings.

Step 1: Design, build, and test the colourimeter

- **Design:** Choose an appropriate colour of detector brick. The colour of the brick matches the wavelength of light it is sensitive to (Red = 610 nm, Orange = 570 nm, Yellow = 540 nm, Green = 470 nm, Blue = 420 nm). For more advice and help on choosing a wavelength, see the resources that came with the rest of the kit.
- **Build:** Follow the instructions on the next page to build your spectrometer. Don't bend any of the rigid wires, as they will then become weak and break over time.
- Connect a voltmeter to the two bare wires coming from the detector brick, and set it to the most sensitive voltage possible (usually 0-200 mV).
- Fill a cuvette ¾ high with water. Place the cuvette in the square hole of the colourimeter, with the transparent sides facing the emitter and detector bricks.
- Add two AAA batteries to the battery box. The emitter should light up, and the voltmeter should read a small positive value. If the value is negative, reverse the voltmeter clips. Some detector bricks may read very small values, but anything over about 5 mV is usable.
- **Test:** Check to see if the detector is sensitive to changes in light, by removing the cuvette and using a pen or pencil to block the path of light. Readings should drop close to zero.
- Disconnect batteries until ready to use.

Step 2: Operate the colourimeter

Keeping the emitter lit up for a long period of time will cause a voltage drop, and affect accuracy. Prepare solutions beforehand, and only connect the batteries when taking readings.

- Prepare cuvettes containing each sample you wish to measure, and a water blank.
- Prepare a table of results, with columns for "sample", "I", "*%T*", and "*Abs*". Note down concentrations (or another label) for each of the sample rows.
- Connect the battery and measure the blank. Note this reading as "blank initial".
- Measure each of your samples, noting the millivolt readings under the heading of "I".
- Measure the blank again at the end, and compare both blank readings. If they differ by more than ~5%, then double-check the cuvette position, re-take readings more quickly, or refresh the batteries and repeat the readings.
- Average the two blank readings together, and note this value as "I_o".
- Disconnect the battery until you need to take any more readings.
- Calculate the Transmittance, %T, for each reading, and convert to Absorbance.

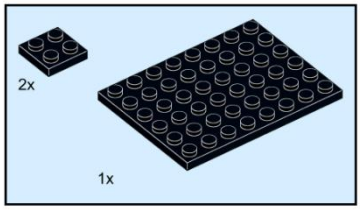
$$\%T = \frac{I}{I_O} \times 100 \qquad \textbf{then} \qquad Abs = 2 - \log(\%T)$$

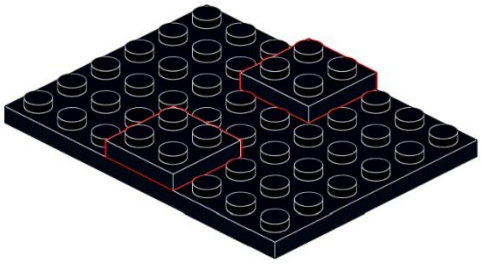
- Absorbance can be calculated directly from "I_o" and "I", if you don't need to plot %T first.

$$Abs = \log\left(\frac{I_O}{I}\right)$$

- Version 0.5, prepared March 2026 at the department of Pure & Applied Chemistry, University of Strathclyde.
- For additional materials, visit https://www.strath.ac.uk/science/chemistry/teachers/SpectroscopyInAnEnvelope

1





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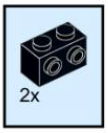

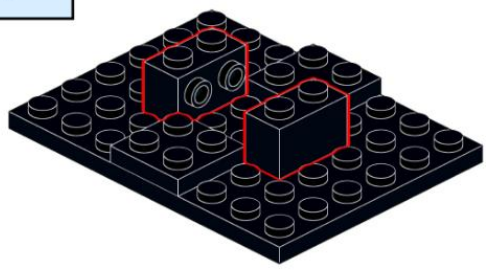

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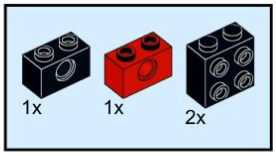
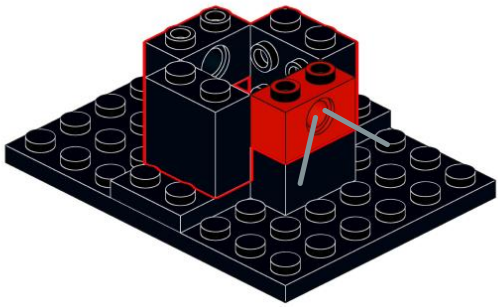


For the black Technic brick, use the emitter (connected to the battery box). Wires face outwards. **Do not bend the rigid wires!**

For the red Technic brick, use any of the coloured detector bricks (two exposed wires, facing outwards, **which should not be bent!**).



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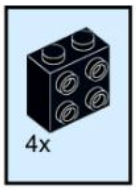

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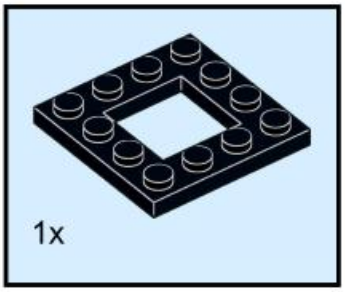

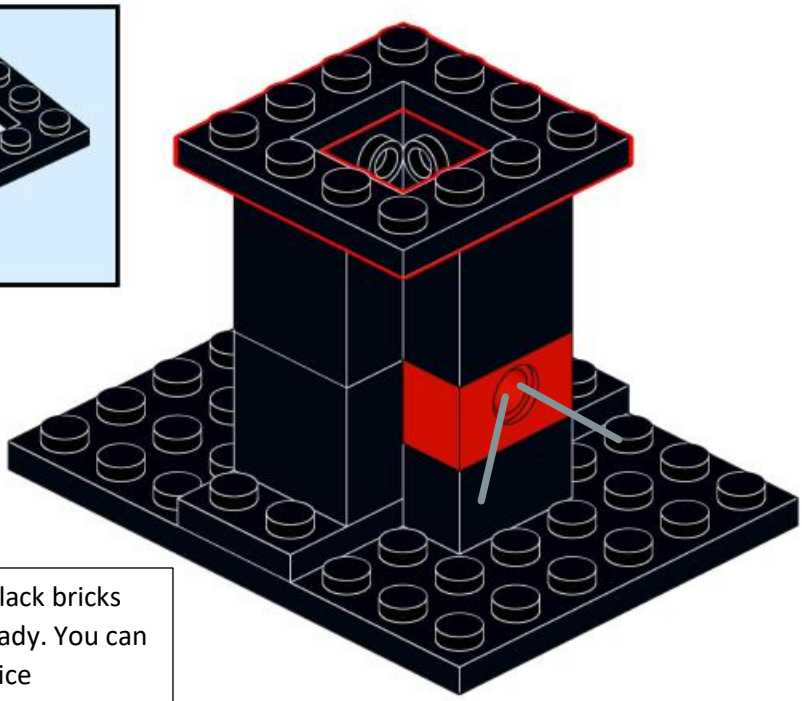

No lid or cover is needed, since the black bricks absorb enough background light already. You can test this yourself by covering the device temporarily while in use; readings won't change.