INTRODUCTION

The electromagnetic spectrum ranges from radio waves with wavelengths the size of buildings down to gamma rays, the size of atomic nuclei. White light forms a small part of this spectrum and is composed of a range of different wavelengths which can be dispersed using a prism into its component colours. The colour an object, or a solution, appears will depend on which light is transmitted or reflected in the visible spectrum and which light is absorbed. Using a UV-visible spectrometer and a range of food dyes you will test how the absorbance wavelength value relates to the colour of the solution.

UV-Visible Spectrometer

UV-visible spectrometers can be used to measure the absorbance of ultra violet or visible light by a sample. The spectrum produced is a plot of absorbance versus wavelength (nm) in the UV and visible section of the electromagnetic spectrum. Instruments can be used to measure at a single wavelength or perform a scan over a range in the spectrum. The UV region ranges from 190 to 400 nm and the visible region from 400 to 800 nm. The technique can be used both quantitatively and qualitatively.
**METHOD**

1. Prepare a dilute sample for each colour to be tested using a cuvette and distilled water (approximately 1 drop food colouring to 100 ml distilled water).

2. For each colour sample fill a plastic cuvette and stopper with a lid.

3. Prepare a blank sample cuvette containing distilled water only and stopper with a lid.

4. Use the colour wheel to predict absorbance values for each solution and record your predictions in the table provided.

5. Set up the spectrometer to scan the visible region from 350-800 nm and run each sample. Print out the spectrum and note the wavelength for each of the absorbance peaks. Compare these with your predictions.

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**MATERIALS**

**Chemicals**
- Food colouring samples - Red, yellow, green, blue, pink, black
- De-ionised/distilled water

**Apparatus**
- Disposable plastic cuvettes and stoppers
- Wash bottles x 4
- 100 ml beakers x 10
- 1 box pasteur pipettes and teats (Plastic for younger children)
- Tissues

**Instrument**
- UV-visible Spectrometer (integral printer and paper)
- Laptop (optional)
- Printer (optional)
- Connection cables x 2 (optional)

**Set up for laptop and printer use:**
- Connect UV-vis to laptop via left hand front USB port (Com 5)
- Connect printer to any USB port
- From spectrometer menu Select printer / auto print on / Computer USB / OK
- Open PVC program, set auto print to on or off depending on requirements.
## RESULTS

<table>
<thead>
<tr>
<th>COLOUR</th>
<th>PREDICTED ABSORBANCE VALUE (nm)</th>
<th>ACTUAL ABSORBANCE VALUE (nm)</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>496 - 570</td>
<td>519 &amp; 528</td>
<td>Absorbs Green</td>
</tr>
<tr>
<td>Yellow</td>
<td>380 - 450</td>
<td>428</td>
<td>Absorbs Violet</td>
</tr>
<tr>
<td>Green</td>
<td>620 - 750</td>
<td>427 &amp; 635</td>
<td>Absorbs Red</td>
</tr>
<tr>
<td>Blue</td>
<td>590 - 620</td>
<td>409 &amp; 628</td>
<td>Absorbs Orange</td>
</tr>
<tr>
<td>Pink</td>
<td>496 - 470 570 - 590</td>
<td>510</td>
<td>Absorbs possibly Green/Yellow</td>
</tr>
<tr>
<td>Black</td>
<td>?</td>
<td>519 &amp; 635</td>
<td><strong>Note:</strong> This absorbs both in the Red and Green which are directly opposite, solution appears black</td>
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</tbody>
</table>

**Visible Spectrum**

- **Green**: Wavelength range of 510 - 520 nm
- **Blue**: Wavelength range of 409 - 428 nm
- **Orange**: Wavelength range of 409 - 428 nm
- **Red**: Wavelength range of 519 & 635 nm
- **Violet**: Wavelength range of 496 & 528 nm
- **Yellow**: Wavelength range of 519 & 635 nm

**Higher Frequency**

- UV: Wavelength range of 380 - 450 nm
- IR: Wavelength range of 620 - 750 nm

**Lower Frequency**

- Visible Spectrum: Wavelength range of 400 - 800 nm

*Note:*

- Absorbs Green: Solution appears black.
MODEL SPECTRA

Red: 519 and 528 nm

Yellow: 428 nm
Green: 635 nm

Blue: 628 nm
**Pink: 510 nm**

**Black: 519 and 635 nm**
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![Visible Spectrum Diagram](https://www.rsc.org/)

**Visible Spectrum**

- **Higher Frequency**
  - UV
  - VIOLET
  - BLUE
  - GREEN
  - YELLOW
  - ORANGE
  - RED

- **Lower Frequency**
  - IR

**wavelength (nm)**

- 400
- 500
- 600
- 700
- 800