



MAKING A HOMEMADE SPECTROPHOTOMETER

Name: _____

Date: _____

Course/Grade: _____

A spectrophotometer measures how much light a solution absorbs at different wavelengths. In this experiment, you will build a simple spectrophotometer using a smartphone, a diffraction grating, and basic materials.



OBJECTIVE

Build a homemade spectrophotometer and use it to measure the absorbance of colored solutions.

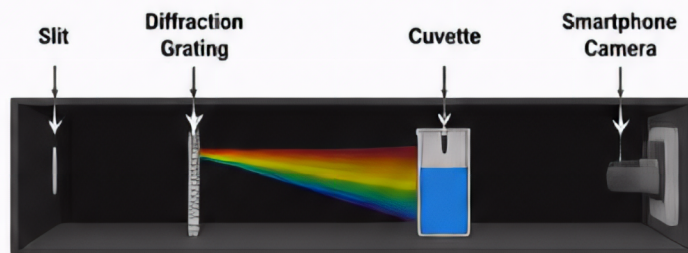


MATERIALS

- Smartphone with camera
- Diffraction grating (1000 lines/mm preferred)
- Cardboard (shoe box or similar)
- Razor blade or sharp craft knife
- Black tape
- Small cuvettes or clear plastic vials (1 cm path length ideal)
- Colored solutions (food coloring works well)
- White LED or CFL lamp
- Battery pack or USB power bank (for the light)
- Ruler
- Computer with spreadsheet program (optional)

BUILD YOUR SPECTROPHOTOMETER

1. **Slit:** Cut a narrow vertical slit (about 1–2 mm wide and 1 cm tall) in one end of the cardboard box.
2. **Collimator:** Place the LED light so it shines through the slit from the outside into the box.
3. **Diffraction Grating:** Tape the diffraction grating inside the box, a few cm behind the slit, with the lines vertical.
4. **Cuvette Holder:** Cut a window in the top of the box and position the cuvette holder so light from the grating passes horizontally through the cuvette.
5. **Detector (Smartphone):** At the far end of the box, cut a viewing window. Place the smartphone camera against the window. Seal all seams with black tape to keep light out.



PROCEDURE

1. Turn on the light and open your smartphone camera app.
2. Point the spectrophotometer at a blank cuvette filled with your solvent (e.g., water). Adjust exposure if needed so the spectrum is bright but not saturated.
3. Take a photo of the blank. This will be your reference (I_0).
4. Replace the blank with a colored solution.
5. Take a photo of the sample under the same conditions. This is your transmitted light (I).
6. Repeat for different colors or concentrations.
7. Transfer the photos to your computer for analysis.



EXPERIMENT IDEAS

- Compare the spectra of different food colorings.
- Investigate how concentration affects absorbance.
- Test unknown solutions and identify them by their spectra.
- Study how pH or temperature changes affect absorbance (if applicable)

DATA ANALYSIS

1. Use image analysis software or a spreadsheet to record the intensity (I) at each wavelength (pixel position) for both the sample and the blank.
2. Calculate transmittance: $T = \frac{I}{I_0}$
3. Calculate absorbance: $A = -\log_{10}(T)$
4. Plot absorbance (A) vs. wavelength. Identify the wavelength(s) of maximum absorbance (λ_{max}).

SAFETY NOTES



- Do not look directly at bright lights.
- Use caution when cutting cardboard.
- Keep liquids away from electronics.

OBSERVATIONS / QUESTIONS
