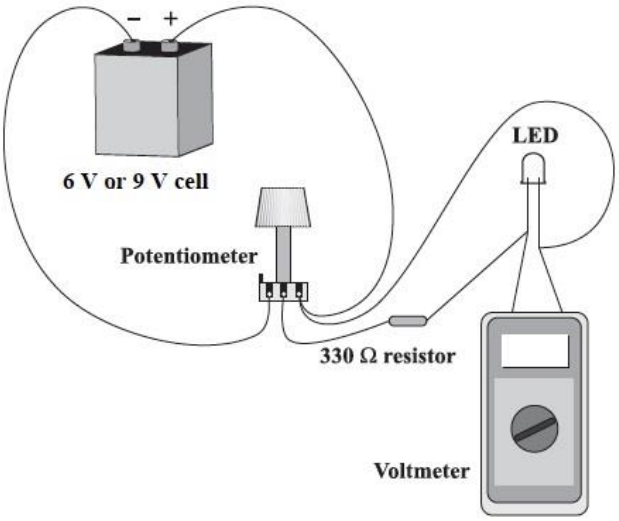
Student Activity Sheet

Measuring Planck's Constant

Key Equations

$E = hf$; $E = eV$; $e\Delta V = hf$;

$e = 1.602 \times 10^{-19}\,\text{J}$; $h = 6.636 \times 10^{-34}\,\text{J}\cdot\text{s}$



Materials

- Set of 5 LEDs of different, known frequencies
- 6 V or 9 V cell
- 1 kΩ potentiometer
- 330 Ω resistor
- voltmeter
- 5 connecting wires

CAUTION: Do not stare *directly* at a *brightly* lit LED.

Procedure

1. Orient the potentiometer so that the terminals are pointing toward you. Turn the knob fully clockwise. Connect the negative terminal of the battery to the left-hand terminal of the potentiometer and the positive terminal of the battery to the right-hand terminal of the potentiometer, as shown in the diagram.
2. Connect one of the LEDs to the 330 Ω resistor using a wire. Connect both of these components to the central and right-hand terminals of the potentiometer, with the *longer* wire of the LED attached to the *right-hand* terminal, as shown in the diagram.
3. Connect the voltmeter across the LED.
4. Slowly increase the potential difference across the LED by turning the potentiometer knob counterclockwise until the LED *just begins* to glow. It is recommended to darken the room when attempting to measure the LED brightness. Record the potential difference at which this happens. Go backwards and forwards past the point at which the LED just begins to glow a few times to locate it as accurately as possible.
5. Repeat Step 4 for all the other LEDs. Always turn the potentiometer knob fully clockwise before changing LEDs so the initial voltage across each LED is 0 V.
6. Summarize your results in a table similar to the table below:

Colour of LED	**Red**	**Amber**	**Yellow**	**Green**	**Blue**
Frequency ($\times 10^{14}$ Hz)	4.54	5.00	5.08	5.31	6.38
Potential difference (V)					

Analysis

1. Plot a graph of potential difference (*y*-axis) versus frequency (*x*-axis).
2. Draw the line of best fit and measure its slope. Use this slope to calculate Planck's constant using the equation $e\Delta V = hf$.

Questions

1. The accepted value for Planck's constant, *h*, is 6.636×10^{-34} J·s. What is the percentage error in your calculated value for Planck's constant?
2. A green laser pointer produces 530 nm light with a power rating of 1.0 mW. How many photons does the laser produce each second?
3. Weather reports monitor ultraviolet (UV) light levels. Why is UV light a concern?