VCE Chemistry – Analysing Caffeine

Your Mission: Your task is to act as forensic chemists investigating the role and risks of caffeine. You'll decode how it affects the brain, analyse calibration data, and design greener lab methods to measure caffeine in real-world drinks.

Pre-Visit Activity

How Caffeine Works	10 mins	**Watch:** *How does caffeine keep us awake?* Link: https://www.youtube.com/watch?v=foLf5Bi9qXs **Quick response prompts (note sheet):** 1. How does caffeine stop you from feeling sleepy? 2. What effect does caffeine have on the brain chemicals that control mood and focus? 3. What health problems can happen if you have too much caffeine?
Label Detectives	20 mins	**Task:** Compare the caffeine claims of 3–4 drinks (coffee, energy drink, cola, tea). • Find the labelled caffeine content (mg/serving). • Research the average actual caffeine content (use Food Standards ANZ database or quick online search). • Rank them from lowest to highest caffeine per 100 mL. **Discussion:** Which products under-report vs. over-report compared to published values?
Beer's Law Warm-up	15 mins	**Tool:** PhET Beer's Law Lab (https://phet.colorado.edu/sims/html/beers-law-lab/latest/beers-law-lab_en.html) **Mini-task:** • Build a calibration curve (Absorbance vs Concentration). • Explain why we need linearity and how we'll apply this to caffeine HPLC/UV analysis.
Reflection	5 mins	• Why might label values differ from measured values? • What ethical issues arise if energy drinks don't match their claims?

Post-Visit Activity

Calibration Forensics	30 mins	**Teacher provides:** two caffeine calibration datasets (different slopes/R^2 values) + a set of unknown absorbances/peak areas. **Tasks:** 1. Plot both calibration curves. 2. Use each curve to calculate caffeine content in the unknown sample. 3. Decide which curve is **more reliable** (R^2, number of calibration points, fit to origin). 4. List uncertainty sources: pipetting, baseline drift, column performance, glassware. 5. Suggest refinements: matrix matching, internal standard, replicate injections.
Energy Drink Investigation	20 mins	**Scenario:** Your lab is asked to test caffeine in a new **"extra energy" drink**. **Design a method:** • **Sample prep:** filtration, dilution, or SPE (solid-phase extraction) if needed. • **Calibration range:** pick a mg L^{-1} span that covers ~20–200 mg per serving. • **Instrument:** HPLC-UV, GC-MS (if volatile derivatives used), or spectrophotometer with standard additions. • **Controls:** blanks, spike-recovery, duplicate analysis.
Green Chemistry Ethics	15 mins	**Prompt:** Should analytical labs phase out **toxic solvents** like acetonitrile used in HPLC? **Discuss:** • Waste disposal issues. • Health & safety risks. • Alternatives (water/ethanol mobile phases, supercritical CO_2). • Trade-offs: detection limits vs. sustainability.
Caffeine and You	15 mins	**Task:** Create a **poster or infographic** for your peers: • Safe caffeine intake (400 mg/day guideline). • Which drinks are **"**high risk"? • What testing proves label accuracy?