

## **Laser-Based Liquid Prism Sucrosemeter**

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### **Practical:**

**Summary:** In this experiment students construct their own sucrosemeter using a He-Ne laser and hollow equilateral prism. Sugar solutions are placed in the prism and the diffraction of a laser beam through these solutions can be monitored as a function of concentration, enabling determination of 'real' unknown solutions (cordial, soft drinks etc.). If available, a commercial refractometer is an ideal addition to the experiment as students can compare the results of their constructed sucrosemeter to the commercial one.

The benefits to student learning in this experiment are more of a general nature than specific to concepts presented by lectures. The fact that real samples are analysed is always a plus to student learning. Technical skills in making standard solutions and drawing results from calibration curves expose the student to core analytical skills.

Constructing their own apparatus which is simple yet yields accurate results reinforces in students that instrumentation and design does not always need to be complicated or expensive. With continued advances in the technology of instrumentation as well as interfaced data acquisition software, it is easy for students to simply 'press a button' to obtain results without considering the chemistry that occurs within a fully enclosed instrument. The simplicity of the experimental set-up as well as the transparency of the response signal (visible laser beam diffraction) in this experiment encourages students to consider 'cause and effect' components of instrumentation. Students critically analyse experimental design by probing both strengths (reliable determination of refractive indices and sucrose concentrations) and limitations of their experimental set-up (analysis of dilute samples and samples of complementary colour to the laser beam cannot be reliably made without modifications to the design and/or sampling). Comparison of direct readings of diffraction angles to calculated angles also encourages students to assess accuracy over simplicity when considering data collection methods (for this experiment, direct readings of deflection angles gives poor accuracy, whereas calculated angles yield great accuracy due to relatively small error propagation).

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**Publisher:** Australian Physical Chemistry Enhanced Laboratory Learning Project

**Date:** Published by LTSN Dec 2003

**Reference:** [http://www.apcell.org/apcell\\_main.htm](http://www.apcell.org/apcell_main.htm)

## **Discipline:**Chemistry

### **Abstract**

This experiment has little direct linkage to general course material in Physical Chemistry, unless a component regarding refraction of light through prisms / solutions, Snell's Law, simple laser chemistry etc. is incorporated. Indirectly, this experiment can enhance a student's confidence in their own ability to simplify and comprehend new concepts they are taught in Physical Chemistry. (New concepts in Physical Chemistry can be difficult for students to grasp if the language and mathematical relationships overwhelm them - this experiment is easily understood, and the associated mathematics is easily applied.)

Minimal prior knowledge is required by students to successfully conclude this experiment. Advantageous skills to have are competency in using volumetric techniques / glassware, basic knowledge of light refraction trends and adeptness in constructing and applying calibration curves.

The experiment as presented here is undertaken by our second year students, however I feel that it is simple enough to be adapted as a first year practical.

### **Duration**

Prior to Lab      30 min - 1 hr (reading)

In Laboratory    2 - 3 hrs

After Laboratory 2 - 3 hrs (plotting data, analysing results, calculations, report

### **Further comments**

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