

Analytical Chemistry Experiments with a Forensic Flavor

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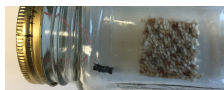
Introduction

A resource for analytical and forensic chemistry professors has been created to facilitate introduction of interesting and practical experiments with a forensic flavor into the undergraduate laboratory curriculum. The experiments closely mimic those that are practiced in today's crime laboratory and have been student-tested for use in the college setting. Background references, procedures, helpful notes, and expected results for each experiment are included in a hardcopy laboratory manual for instructors that is available from the author.

Trace Evidence

Each chapter describes a common type of trace evidence:

Arson evidence



Drugs



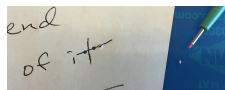
Fibers



Gunshot residue



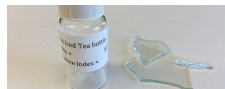
Questioned documents



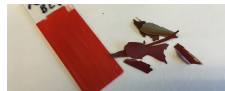
Explosives residue



Glass



Paint



Body fluids (alcohol and drugs)

Instrumental Techniques

Descriptions of the analysis of each piece of evidence by one or more instrumental techniques are given in the manual. With each type of evidence, one of the techniques is common to nearly all undergraduate chemistry laboratories, while additional techniques are included to allow those with more extensive instrument holdings to explore further.

Suggested Techniques

UV-Vis Spectrophotometry
Infrared Spectrophotometry
Optical Microscopy
Atomic Absorption Spec.
Gas Chromatography
GC – Mass Spectrometry

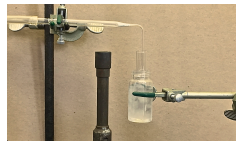
Alternate Techniques

Spectrofluorometry
Raman Spectrophotometry
Scanning Electron Microscopy
Energy Dispersive X-ray Spec.
Liquid Chromatography
LC – Mass Spectrometry

Simplified Equipment and Procedures

Some of the equipment and materials in today's crime laboratory are expensive and unavailable in undergraduate laboratories. The manual describes simple equipment and procedures that can reasonably replace the real thing. Examples are:

Pyrolyzer for paint
(pyrolysis GC-MS)



Microscope hot stage
(R.I. of glass)



Headspace sampling
(ethanol in blood)



One- or Two-Session Experiment

Each experiment fills one or two three-hour laboratory session(s). An example is the analysis of black pen inks from a questioned document. Over the course of one laboratory session, students learn to take microdots from paper, sample the document, extract the ink into acetonitrile with sonication, and record the visible absorption spectra of the inks. A second session can follow in which the same extract is subjected to liquid chromatographic analysis with detection at multiple visible wavelengths.

Experimental procedures are described clearly, but are purposely vague in spots to encourage students to fill in the missing details. Student procedures are provided in editable electronic format, so that instructors can alter the level of detail provided, if desired, one way or the other.

Set of Round-Robin Experiments

Two dozen experiments using 12 different techniques are described in the manual, enough to supply round-robin labs, where several different experiments happen at once and students (usually in pairs) switch to a different experiment each week.

Four- or Five-Session Laboratory Project

A set of experiments can serve as the source of an end-of-semester project laboratory, in which students work as a team to solve a crime. The vehicle tying the experiments together is a crime scenario. Five scenarios, including police reports, list of collected physical evidence, witness and suspect statements, maps and photos, are provided in the manual. A mock trial is suggested as a way of students presenting their work and final results, and supporting documents for the mock trial are given.

The crime scenarios are:

- Case of the Bloodied Bully
- Case of the Olympic Outrage
- Case of the Pilfered Painting
- Case of the Tampered Testament
- Case of the Trampled Teen

