

Dudesville: A crime scene under the microscope



QUT Extreme Science



Glossary

DNA	(Deoxyribonucleic acid) an extremely long macromolecule that is the main component of chromosomes and is the material that transfers genetic characteristics in all life forms
Chromatography	The separation of mixtures into their individual components by adsorption by a solid, such as a strip of filter paper (paper chromatography)
Forensic Science	The use or application of science in courts or legal proceedings
Locard's Principle	When two objects come in contact with each other they exchange evidence or it states that anywhere we go we take evidence and leave evidence.

Objectives of workshop

- Learn to compare pieces of evidence to identify any samples from suspects that match samples from crime scenes
- Identify and describe patterns or relationships in observations in order to conclude who committed the crime in question
- Learn to summarise data and explain why you reached your conclusions using scientific understanding
- Understand Locard's principle and how it is used as a basis for forensic investigation

Equipment list

- 12 stereo microscopes
- Power boards and extension leads
- Box of Dudesville items:
 - Hair samples and instructions (x2)
 - Fibre samples and instructions (x3)
 - Poppy seed samples and instructions (x3)
 - Soil samples and instructions (x3)
 - Paint samples and instructions (x3)
 - Set of fingerprint pictures and instructions (x 2)
 - Set of pollen samples pictures and instructions (x2)
 - DNA pictures and instructions (x 1)
 - Dye analysis pictures and instructions (x1)

Safety notes

- Electrical extension cords and powerboards are used in this workshop
- Students should be careful not to trip on any exposed cords
- Students should not touch the powerboards
- Only the student using the microscope should adjust any of the settings



Background

Forensic science means the use or application of science in courts or legal proceedings. Thus any form of science such as medicine, pathology, odontology, biology, chemistry and engineering can, if presented in evidence by a qualified person merit the title 'forensic'. It is obvious that forensic science is not a discipline or branch of science, but is a catch-all for many distinct disciplines that may be used to help in the determination of a court case, either civil or criminal.

While forensic science is often seen as focusing exclusively on law enforcement, forensic science can be applied in many areas of the community and industry where the skills of a scientist needs to be applied to a problem and the outcome may be presented in a court of law. For instance a forensic chemist may need to investigate the source of an oil spill or trace a food contamination either of which may result in presenting their results in a court of law.

Unlike the fictional television characters, the forensic scientist is confined to a particular discipline and often to a specialty within that discipline. Although at times a scientist may contribute the major piece of evidence in a particular case, generally their evidence is contributory, a piece in the jigsaw that comprises the total evidence presented to the court from other witnesses, including police investigators. To assist in conviction of offenders is not the function of the scientist. In many instances the scientific examinations help to eliminate suspects and establish innocence. The scientist must be impartial and not an advocate for the defence or prosecution.

Field sciences will include for example crime scene investigation which incorporates not only investigation of crimes against the person, such as murder and assaults, but other crimes such as fires and explosions.

Scene investigation involves recording details of the scene using still and video cameras, collecting evidence such as fingerprints and shoeprints, locating and collecting relevant items of physical evidence such as blood stains and stained garments, and analyzing the crime scene in order to ascertain the likely cause and progression of a fire or reconstructing the sequence of events surrounding a shooting. Crime scene investigators take great care to ensure that crime scenes are secure, that trace evidence does not get inadvertently transferred from one item to another, and that all relevant detail at a scene is recorded.

In many States and the Northern Territory crime scene examiners are recruited from serving Police members, whilst in others graduates are recruited.

There are two distinct disciplines of forensic science: medical and laboratory sciences.

Medical disciplines include pathology, psychiatry, psychology, forensic medicine and odontology (dentistry).

- Pathology involves post mortem examinations and determinations such as time and cause of death and wound interpretation.



- Psychiatry and psychology is concerned with whether a mental state may be a mitigating circumstance in the commission of an alleged crime, whether a person is mentally fit to stand trial and treating those convicted of crimes who are mentally ill.
- Those involved in forensic medicine examine victims of crime and suspects who may have sustained an injury while allegedly committing a crime. They give interpretations of their findings such as possible causes and timing of wounds.
- The role of the odontologist is to identify bodies and skeletal remains from dental records, reconstruct faces from skulls and where possible, interpret bite marks.

Appropriate qualifications (minimum):

- Pathology, psychiatry and forensic medicine: medical degree with appropriate post-graduate qualifications
- Psychology: degree in Psychology (clinical)
- Odontology: Degree in Dentistry.

Laboratory sciences will include, for example, chemistry, biology, toxicology, firearm examination, fingerprint examination, questioned document examination and the examination of marks and impressions.

- The role of the forensic chemist can vary enormously. There are a number of different areas in which they are involved. These include the detection and identification of:
 - Illicit drugs and manufacture of them at 'clandestine laboratories';
 - Accelerants used in arson cases;
 - Explosive and gunshot residues;
 - Trace evidence, including paint, glass, polymers and fibres.
- Biology includes DNA profiling where it is possible to distinguish between individuals because of differences in their DNA. Samples used include blood, saliva, semen and hair. It is also possible to distinguish between individuals by looking at other characteristics of hair. Other examinations include the detection of biological material and the interpretation of the manner in which the material was deposited.
- Toxicology involves the detection and identification of illicit and pharmaceutical drugs and poisons in the body, interpreting toxicity levels and the effects on the functions of the body.
- Firearm examination is the study of firearms and ammunition and the identification of particular firearms from fired cartridge cases and projectiles. It also involves the determination of the angle and distance a gun was fired from to hit a specific target.
- Fingerprint examination is perhaps the best known of the forensic sciences. It involves the detection of fingerprints on a vast range of different surfaces using a variety of detection techniques. It also involves the identification of fingerprints and their ability to categorically link suspects to or exclude suspects from a crime scene. In Australia, some States are recruiting Police members, whilst others recruit graduates.
- The discipline of questioned document examination incorporates examination and identification of handwriting and handwriting impressions, and machine generated documents (e.g. from typewriters, printers, fax machines etc) in an attempt to determine the origin and of materials such as paper, inks and toners. There is a significant amount of



forensic document examination taking place outside traditional law enforcement laboratories, such as in private companies, financial institutions, and government agencies such as the Department for Immigration, Multicultural and Indigenous Affairs.

- Marks and impressions are left at scenes by implements such as bars and screwdrivers and by shoe soles and vehicle tyres. Detection and identification of these marks and impressions is another discipline within forensic science.

With the emergence of e-business has arisen an increase in fraud and identity theft. IT specialists are increasingly being called upon to examine computer hardware and software to investigate these crimes. IT specialists are also called upon to recover evidence from mobile telephones and to investigate criminal misuse of the internet.

Appropriate qualifications (minimum):

- Chemistry: Bachelor of Science in chemistry
- Biology: Bachelor of Science
- Firearm marks and impression examination: Diploma of Public Safety; Degree in forensic investigation
- Fingerprints: Bachelor of Science; Diploma in forensic investigation (fingerprints); Degree in forensic investigation
- Questioned documents: Bachelor of Science; Diploma in forensic investigation (document examination); Degree in forensic investigation¹

¹ <http://www.nifs.com.au/home.html>

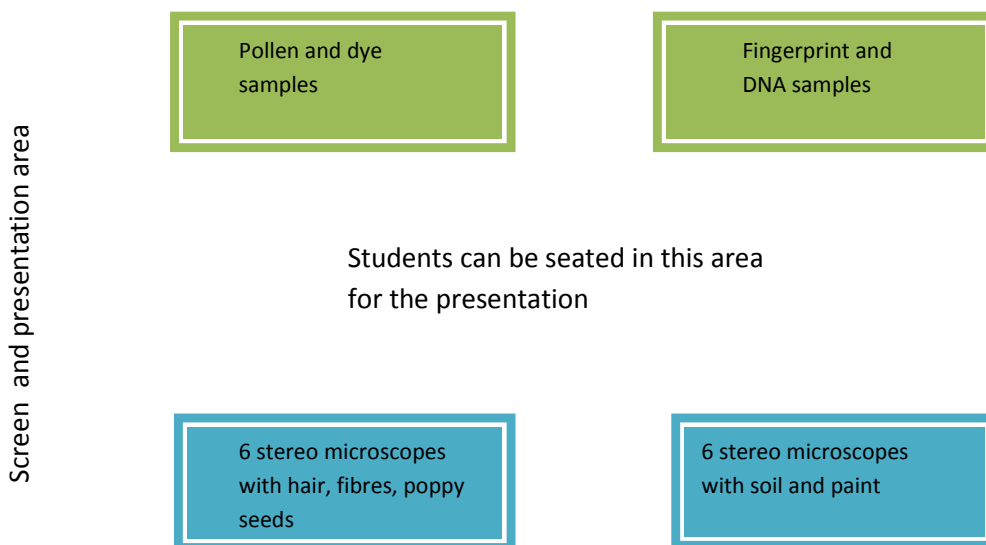
Workshop activities

In this workshop there are 9 sets of samples for the students to examine – 5 under microscopes and 4 on instruction sheets using photos and diagrams. This is a self-directed workshop, where the students work at their own pace, in groups of 2-3 or on working alone if they wish. For grades 5 and 6 and for short sessions, it is best to have the microscopes focused and ready to go so the students don't need to adjust the microscopes. This is not as important for older students, when clear instructions on how to use the microscope are given.

Rundown of workshop

Time	Activities
0-15	Presentation, run through sample types, microscopes etc
15-40	Students work through evidence samples, fill out worksheet
40-50	Go through the worksheet, answer questions

An example of a good setup for this workshop is illustrated below. The best setup will change depending on the location of the power points in the room, how many tables you're given, and how big they are. Make sure you leave space for the class to come in that is clear from power cords, and also that you leave a space for the class to sit. Do your best to keep all power cords and power boards out of the way of the students.



The following table is a guide for setting up the microscopes for each type of evidence so that they are easy for the students to analyse.



Evidence	Magnification	No. microscopes	Microscope lights
Hair and fibres	8x	3	Top only
Poppy seeds	16x	3	Top only
Soil	8x	3	Top only
Paint	20x	3	Top only

Things to tell the students before they start work

1. Using the microscopes, identify any matches between the samples from the crime scene and the suspect samples – there may be more than one match for each type of evidence!
2. The fingerprints must be EXACT matches – use the magnifying glass if needed
3. Use the crime scene DNA profile to match it to a suspect by placing it over the top – this also must also be an exact match
4. When a match is identified, it should be marked on the worksheet using a tick or a cross
5. Once the table of evidence has been completed, identify which suspect you think is the most likely to have committed the crime, based on all of your observations.

Script

A PowerPoint presentation is used for this workshop, so please use this as your script.

Worksheet

The worksheet for this workshop is found on the following page.

Acknowledgements

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The Case of the Dudesville Robbery

You are a forensic scientist employed by the Police Department. The police have gathered evidence in the case of the Dudesville bank robbery and asked you to analyse it. As you process each piece of evidence, keep a summary of your conclusions by completing the table below. If the evidence connects the suspect to the crime, tick the relevant box.

	DNA	Finger-prints	Soil	Seeds	Paint	Hair	Fibres	Pollen	Dye
Suspect 1: Moneybags									
Suspect 2: Criminal									
Suspect 3: Getaway									

Who should the police arrest? Why? _____

Did any other suspects have poppy seeds caught in their clothing? How do you explain this? _____

How do you explain the presence of the DNA profile that was found at the bank? _____

Whose fingerprints did you find in the bank? What does this mean? _____

What did the soil evidence indicate? _____

How do you explain the pollen results? _____
