

***ALL YOU EVER WANTED TO KNOW ABOUT
FORENSIC SCIENCE IN CANADA BUT DIDN'T
KNOW WHO TO ASK!***



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INTRODUCTION

Many people are becoming interested in the field of forensic science. This is, in part, due to the mass proliferation of television shows which feature forensic science and scientists. Such shows are intended as entertainment only and are not designed to educate the public about the science itself or the genuine careers available in the field. However, whether accurate or not, many of us derive a great deal of information and ‘common knowledge’ from television and it is clear from discussions with people of all ages that there are a tremendous number of misconceptions concerning the field of forensic science.

This small booklet is intended to assist people who are genuinely considering a career in the broad field of forensic science in Canada. It is no way designed to be all encompassing but will describe the major career paths within forensic science in Canada together with the training required to enter these fields. As science is always advancing and expanding, so new areas will open with new career opportunities. This booklet is aimed at forensic science in Canada but, with some exceptions, should be relatively applicable in most areas.

This booklet is an edited compilation of information from a large number of experts in the field.

WHAT IS FORENSIC SCIENCE?

Forensic science is the application of science to law. Any science can be applied into a legal situation, but some of the commonest forensic sciences include forensic biology, forensic chemistry, and forensic toxicology. The word forensic in today’s world simply means the application of something to a legal situation. Therefore, on it’s own, the word forensic means very little. When used in the term “forensic science” it means applying a SCIENCE into a legal setting. The important word here is SCIENCE. Therefore, you CANNOT be a forensic scientist without first being a scientist, and a very good and well educated scientist as you will not only be analyzing and interpreting evidence which could be responsible for setting a person free or imprisoning them for life, but also you will and should be challenged to the utmost during cross-examination in court. Therefore, the science must come first. If you wish to be, for instance, a forensic chemist, you must be a top of the line chemist first. Then you will be trained to apply your knowledge of chemistry into a legal setting. In most cases, forensic science is little different from other branches of science. We just use our expertise to help solve crimes.

Although on television we see supposed ‘forensic scientists’ doing a multitude of jobs from crime scene analysis to shooting the bad guy, forensic science in real life is quite different. Television and fictional books suggest that one person is frequently an expert in many aspects of science. In reality, each area is a distinct specialty with many years of education and training required before a person can enter the field. If television heroes really had all the education required to be an expert in several fields, they would be well into their eighties before they even began their career.

There are several career options in the area of forensic science. Some of these positions are only available to sworn police officers, but many others are open to civilians. Many positions are full-time, while others are consultant positions. Forensic science careers exist in several areas including :-

1. ***The Forensic Lab.*** There are many crime labs or forensic laboratories across Canada which employ civilian scientists to analyze evidence recovered from a crime scene.
2. ***Crime Scene Investigation.*** Crime scenes are analyzed by police officers in Canada, not civilians. These officers are highly trained and specialized Identification officers whose sole duty is to investigate and process crime scenes.
3. ***Death Scenes in general.*** Death scenes, with few exceptions, are attended by Coroners, Medical Examiners, or their trained death investigators, depending on Province. These people are civilians and work for their individual province, acting as an ombudsperson for the dead. If the death is suspicious, it is also attended and the scene processed by Identification (police) Officers.
4. ***Forensic Pathology.*** Forensic pathologists are specialized medical doctors who analyze the body, performing autopsies and determining such factors as cause of death.
5. ***Other Forensic Specialists.*** There are many other forensic specialists including forensic anthropologists, entomologists, odontologists, engineers, botanists, artists, nurses, psychologists, psychiatrists, profilers and wildlife specialists, to name just a few.

The following is intended to describe some of the more common forensic positions.

THE FORENSIC LABORATORY

There are many crime or forensic laboratories in Canada. These include Police labs such as the Royal Canadian Mounted Police (RCMP) Forensic Laboratory Service (FLS), and Provincial labs such as those found in Quebec and Ontario, and some private labs. Scientists who work in these labs are civilians and are unbiased professionals. They analyze forensic trace evidence in the lab and testify as expert witnesses in court, explaining their science and the results of their analyses, to the triers of fact. Sciences analyzed include forensic biology, forensic chemistry, forensic toxicology, questioned documents and firearms and toolmark examination. Most areas employ both specialists and technologists.

The RCMP FLS is responsible for conducting analyses and examinations of physical evidence in connection with police investigations anywhere in Canada. Its services are primarily available to police agencies, courts and government agencies in most provinces (Ontario and Quebec have their own provincial forensic laboratories). FLS consists of approximately 380 forensic scientists, technologists, and administrative personnel. Based on the results of their work, members of the Forensic Laboratory Services issue case reports and provide expert forensic testimony to the courts. In certain cases, the laboratory staff can—on request—provide advice and opinion to interpret evidence in situations where a hypothetical scenario may have been established, but laboratory examinations have not been requested. The Forensic Laboratory Services complements the work of the National DNA Data Bank, which unlike the FLS, is responsible specifically for the analysis of convicted offender samples and the maintenance of the Convicted Offender and Crime Scene Indices.

The Forensic Laboratory Services employs civilian staff as specialists and technologists in positions requiring various levels of post-secondary academic training and

experience. More information on the RCMP and the Forensic Laboratory Services is available at www.rcmp-grc.ca. The RCMP labs are located in Vancouver, Edmonton, Regina, Winnipeg, Ottawa and Halifax (http://www.rcmp.ca/fls/home_e.htm). Due to recent restructuring, areas of specialization have been created to consolidate expensive equipment such as gas and high performance liquid chromatography instruments and to align specialties such as Evidence Recovery (Exhibit search) to Biology Analytical (the extraction of DNA and generation of DNA profiles). As a result, these laboratories do not offer full services at any given location but as a Laboratory Service Directorate with six service delivery sites, all major services (Biology, Toxicology, Chemistry, Documents and Firearms and Tool Mark Examination) remain accessible to investigators across Canada. In other words, if one is interested in becoming a Firearms and Tool Marks examiner, they will be limited to the Vancouver, Regina and Halifax laboratories, while entry level positions in the Biology discipline are located in Ottawa and Vancouver only. Those considering a career with the RCMP Laboratory Services Directorate should be very flexible and be willing to move to a new city to accept a position.

The Provinces of Ontario and Quebec each have their own laboratory system that serves their respective provincial Police Services. The Centre of Forensic Sciences (CFS) has two sites: the central laboratory, located in Toronto, and a smaller regional laboratory in Sault Ste. Marie. As a branch of the Ontario Ministry of Community Safety and Correctional Services, the two laboratories conduct scientific investigations in cases involving injury or death in unusual circumstances, and in crimes against persons or property. This service is provided to law enforcement officers, crown attorneys, defence counsel, coroners, pathologists, and other official investigative agencies in criminal cases, and to counsel in some civil cases. More detailed information can be obtained on-line at: http://www.mpss.jus.gov.on.ca/english/pub_safety/centre_forensic/about/intro.html

Submissions to the CFS are delivered to the Centre Receiving Office where they are directed to the appropriate section for examination: Biology, Chemistry, Documents and Photoanalysis, Electronics, Firearms and Toolmarks, and Toxicology.

In Québec, the Provincial Forensic Laboratory, Laboratoire de sciences judiciaires et de médecine légale du Québec is located in Montreal. Information can be obtained at <http://www.msp.gouv.qc.ca/labo/>. It goes without saying that an excellent command of French would be required in addition to all scientific training. This laboratory, established in 1914, was the first forensic laboratory in North America and presently employs 125 personnel.

The following will describe the major areas of science found in forensic labs:

Case Receipt Unit

Evidence collected from a crime scene first enters the forensic lab in the Case Receipt Unit. All exhibits are tagged with a computerized monitoring system so their location and status can be followed by computer throughout the lab system. Any piece of evidence may require examination by several specialists. For instance, a firearm with a fingerprint in blood will require examination by Evidence Recovery, Biology, Firearms and by Identification officers. Therefore, the coding system allows for the tracking of this exhibit throughout the

entire system so that it's whereabouts and security is known at all times, as well as how far through the system it has been processed.

Evidence Recovery

Evidence Recovery is the process by which trained and qualified scientists search, identify, and recover forensically significant trace evidence material from exhibits¹ submitted as part of a criminal investigation. In the context of the forensic laboratory, Evidence Recovery is the first step in a process that ultimately attempts to establish a particular association: between two (or more) persons (e.g. suspect and victim), a person and a place (e.g. suspect and crime scene), and/or a person and an object (i.e. suspect and weapon).



Microscopes are one of the most important tools for a search technologist

Once the search, identification, and recovery of the evidence is complete, it can then be analyzed, compared, and interpreted by other qualified forensic scientists. All of the work in Evidence Recovery is performed by using established and accredited scientific methodology in fields such as Biology and Chemistry. Although the Evidence Recovery Unit of the RCMP Forensic Laboratory System is described here, other laboratories across the country perform the same work, albeit sometimes under different titles and in different sections. Other laboratories may have slight differences in their structure; for instance, in which individual is responsible for each step in the processing of the evidence. Contact individual laboratories for details.

¹ an *exhibit* is any such article that is considered in itself to be evidentiary material, or that may contain evidentiary material (e.g. a handgun, a swab, a bloodstained shirt, etc.)

Education and Further Training for a Search Technologist

Prospective understudies must have a minimum of a four year Bachelor of Science degree with Honours standing (or equivalent), from a recognized institute, in one of the following: biology, biochemistry, chemistry, medical laboratory science, or a forensic science related area. Although not required, work experience in a laboratory setting is strongly preferred.

In the Royal Canadian Mounted Police, a Search Technologist (ST) is the individual responsible for recovering all the different types of trace evidence that may be encountered during the examination of exhibit material in an investigation. In the Laboratoire de sciences judiciaires et de médecine légale, in Quebec, the forensic specialists do the evidence recovery themselves and technologists are going to be trained for this in the future.

Search Technologists undergo an understudy program upon engagement, consisting of an extensive review of scientific literature dealing in all aspects of evidence search, identification, and recovery. They are also required to work under the supervision of qualified senior examiners in the examination of ongoing investigations, where they have the opportunity to acquire all of the tools necessary to properly search evidentiary material.

Towards the end of their understudy period, understudies are required to successfully complete a number of written, oral, and practical examinations before they are deemed qualified, and can conduct their own work on cases submitted to the laboratory.

As a Search Technologist...

A technologist specialized in Evidence Recovery (such as a Search Technologist) typically will spend most of his/her day at the bench, performing the identification and recovery of specific biological evidence, such as semen, blood, saliva, hair, and trace DNA, as well as non-biological trace evidence, such as paint, glass and fibres, as the case may dictate.

As primary examiners in the forensic process, STs hold a great deal of responsibility in that their examinations and decisions in a case will have a great effect in the subsequent analysis and interpretation of the evidence.

Search Technologists are required to keep an accurate description of their examinations and results, and are also responsible for the continuity² of the evidence they examine. They also regularly interact with other members of the laboratory in order to obtain the necessary information to proceed with an examination, or to obtain the assistance needed to perform a specialized analysis.

Search Technologists are primarily “bench scientists”, but on rare occasions are called out to assist in the examination of crime scenes, where they mainly act in an advisory role to police investigators.

One of the most challenging and unique aspects of an ST’s role (and for any kind of forensic scientist) is having to defend the results of his/her examinations in a court of law. As technologists, STs are only called to defend the actual results of their examinations (they

² *continuity* is a term that accounts for the complete history of a particular piece of evidence, from the time of its collection, through examination, and up to its eventual disposal

generally do not *interpret* the results) and are not required to attend court as often as forensic specialists, who are mainly responsible for the interpretation and reporting of evidence.

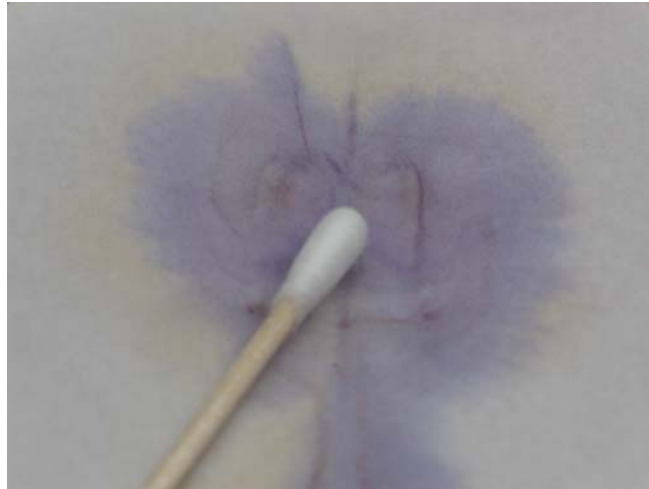
Searching for Evidence

The R.C.M.P. Forensic Laboratory Services (FLS) plays a very important role in assisting police personnel in criminal investigations. The majority of the cases that the FLS examines can be classified as primary offenses, such as assaults (including aggravated and sexual assaults), break and enter type offenses, and homicides. The FLS also regularly assists in missing person type investigations.

As such, the type of evidence that is most commonly encountered in Evidence Recovery is biological in nature, and is mainly focused on establishing a forensic association using DNA profiling. DNA can be readily obtained from body fluids often present as evidence in criminal cases, such as semen, blood, and saliva. DNA can also be recovered from hairs, and from the sloughing of epithelial cells.

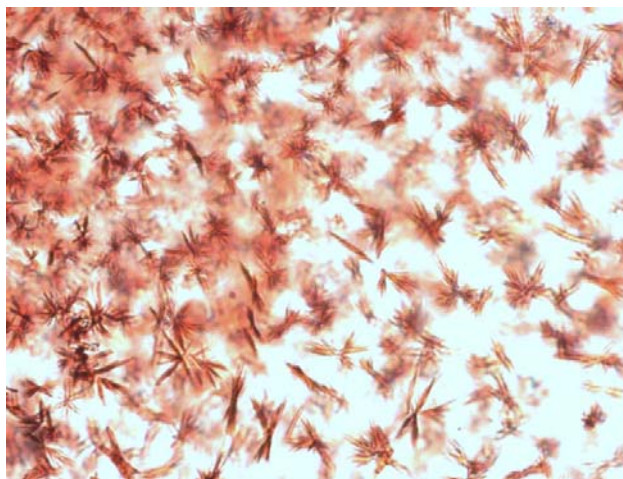
Search Technologists are trained to be able to identify body fluids such as semen and blood, for example, by performing a series of biochemical and microscopic tests that can either *indicate* the presence of a body fluid, or can positively *identify* the target body fluid.

For example, a positive result with the *Fast Blue* test, a biochemical test that assays for the enzyme acid phosphatase tells the examiner that semen *may* be present on a particular stain.



A positive Fast Blue Test

In contrast, the *Haemochromogen* test, used in blood identification, is specific since it crystallizes the iron core of haemoglobin, a molecule found only in blood. A positive result with Haemochromogen tells the examiner that the presence of blood is *confirmed* on a particular stain.



A haemochromagen positive result

A solid foundation in the biological sciences and chemistry are a must for an Evidence Recovery technologist. Since the bulk of forensic examinations involves the use of various specialized microscopes, microscopy is also an essential skill required in Evidence Recovery.

Equally as important to the job is the ability to analyze challenging situations, and to make critical decisions. Good communication and organizational skills are also key elements of the position.

Career Opportunities as a Search Technologist

In the RCMP FLS, Search Technologists can be cross-trained as Biology Analytical Officers, technologists who perform the *analysis* of biological samples in order to develop DNA profiles. This would require a minimum of a B.Sc. Honours degree.

They can also aspire to become forensic specialists, as either Search Coordinators in Evidence Recovery or as Biology Reporting Officers. Specialists receive further training that allows them to be able to *interpret* forensic evidence, and any results gathered from its examination.

Search Coordinators are able to perform the same duties as do Search Technologists, and receive further training that allows them to perform specialized examinations. They are also responsible for directing and assisting Search Technologists, and report the results of their examinations to police investigators.

Biology Reporting Officers are highly trained scientists whose main role is to evaluate, compare, and interpret the DNA profiles obtained after analysis is complete. They are responsible for writing forensic reports that outline both the results of biological evidence, and their *significance*. Reporting Officers are the individuals who are most often required to give evidence in court.

Further Information on Evidence Recovery

For more information on a career in forensic science, and more specifically Evidence Recovery and the RCMP Forensic Laboratory Services, please visit: http://www.rcmp-grc.gc.ca/fls/home_e.htm.

Forensic Biology

Forensic Biology involves the examination of exhibit material to recover sources of DNA for subsequent DNA profiling. There is a three-way division of labour in the Biology section in the RCMP:

1. Evidence Recovery Unit (searching of exhibits). See above.
2. Biology Analytical (extraction, quantitation, amplification of DNA) and
3. Biology Reporting (application of DNA profiling software, comparison of generated profiles and statistical interpretation of any matches obtained).

In the Biology Discipline, assault cases are the majority of cases that are examined. They sub-classify into the various degrees of sexual and aggravated assault and, the most ultimate of assaults: homicide. With the introduction of Bill C-13, virtually all types of property crimes will now also be examined. Again, different labs may use different terminology and titles, although the job itself remains the same.

Educational and Further Training for a Forensic Biologist

Forensic Biologists are usually either technologists or specialists. The basic requirement for entry level Technologist positions in Biology (Evidence Recovery Unit and Biology Analytical) is a three year diploma from a technical institute such as the British Columbia Institute of Technology (BCIT) but the reality is that individuals with Honours level Bachelor degrees and Master's degrees (in a variety of fields such as Biochemistry, Genetics, Molecular Biology, Microbiology, to name but a few) are constantly applying. It is very valuable to have such degrees as they satisfy the requirements for Specialist level positions (Biology Reporting) which are usually filled as promotions from the Technologist positions. Any sort of experience with Molecular Biology is an asset. Also, graduates from programs offering technical diplomas or degrees in Laboratory Medicine are also highly suited to positions in the Evidence Recovery Unit. A minimum of a three year BSc is required in Quebec at the Laboratoire de sciences judiciaires et de médecine légale.

In addition to any scientific training, ideal candidates must have excellent written and, especially, oral communication skills as a large proportion of our services deal with the education of the Court and Investigators in the analyses that we perform. A forensic scientist must be able to effectively explain complex technical terms and concepts in layman's terms without boring their audience. This cannot be overemphasized for all forensic scientists, and indeed, for most scientists. It is vital to be able to communicate your science to people who are not trained in these fields, such as the jury. Even if a person is a brilliant scientist, if they cannot communicate their information in a clear and understandable fashion, then they cannot be a forensic scientist. Any courses and experiences that increase a person's verbal and written skills will prove very valuable.

Career Opportunities in Biology

In the Biology Section, the available careers range from general duty technologist (prepares reagents, order supplies, assists Biology Analytical and Reporting staff), to Biology PCR Analyst, to Biology Reporting Officer. Management level positions usually arise as a result of retirement or relocation but once an individual reaches this level, they become more

of an administrator than a scientist. The Biology Discipline does have a Technical Leader (position is in Ottawa) to deal with scientific issues and a Program Manager (also in Ottawa) to deal with administrative issues. Ninety to ninety-five percent of the work is done in the lab and at the bench with the remainder essentially reserved for giving testimony in Court (either in person or via videoconference). All work has to be peer-reviewed, something that the gang at CSI must do during the commercials. Files frequently take several hours to a few days to be peer reviewed. This is never shown on television but is a vital part of credibility. Field work is extremely rare and usually long after (months and even years) the crime has occurred. Forensic biologists do not ‘wax poetic’ with a Pathologist over a corpse in the morgue as seen on television, but rather are bench scientists working in laboratories. The hours are Monday to Friday with schedule flexibility in place to compress one’s work week if so desired. Occasionally, there are opportunities to work overtime. The work is almost entirely in the lab, with excursions to testify in court.

Salaries vary with qualifications and over time but a general guide (2005) RCMP is

Technologist I (General Duty Tech) – 40 to 50 K (over 6 years) + benefits (ext. medical / 90% dental, pension + more)

Technologist II – entry level scientist – 52 to 62K (over 6 years) + benefits

Technologist III – senior technologist – 53 to 72K (over 6 years) + benefits

Specialist II – bench specialist – 55 to 75K (over 11 years) + benefits

Specialist III – section manager or technical leader – 76 to 84K (over 5 years) + benefits

Specialist IV – lab manager or program manager (Ottawa) – 85K to 94K (over 5 years) +benefits

Salaries will vary between sections, departments and organizations and over time so these must be taken as a rough guide only. Please check with the appropriate departments for updates.

Further Information on Forensic Biology

Association of Forensic DNA Analysts and Administrators <http://www.afdaa.org/>
<http://www.cstl.nist.gov/biotech/strbase/index.htm>
http://www.miraibio.com/products/cat_liquidarrays/view_luminex/sub_technology/index.html

Forensic Chemistry

Forensic chemistry in Canada refers to the chemical analysis of materials in support of the Justice System. This includes the analysis of fire debris for ignitable liquids, Gun Shot Residue (GSR), paint, glass, fibres, explosives, building materials and soil.

The minimum education requirement is an honours B.Sc. in a natural science though the majority of the scientists have graduate degrees. Most of these will be degrees specializing in chemistry, or having a very strong chemistry component. Once a person is hired by a forensic laboratory, they then undergo in-house training which typically lasts 12 to 18 months. This training is a combination of technical, court, policy and evidence handling training. During this time period the trainee will work on cases under the supervision of an experienced examiner. This allows the trainee to gain experience in all aspects of casework.

Forensic chemists analyze any trace evidence that is not a body fluid. They examine all sorts of materials which are found in our everyday life such as drywall, paint, adhesive, rubber, glass, fibres *etc.* These are normal, everyday products which we don't normally think of in relation to crimes. But crimes occur in everyday places such as houses, offices, gardens, streets and sidewalks. So these 'everyday' materials are frequently of interest at a crime scene due to the potential transfer from offender to victim and victim to offender. This exchange of materials is known as Locard's Exchange Principle, stating that every contact leaves a trace. For instance, in a hit and run accident where a man driving a yellow 2001 Honda Civic shoots a red light and strikes and kills a pedestrian and then he drives away, paint fragments as well as small particles of glass, may be found on the victim's clothing. Most car manufacturers use slightly different colours from other manufacturers and may also use different colours in different years. So a yellow 2001 Honda Civic would likely be a different shade of yellow from a 2001 Toyota Corolla. Analysis of the paint chips and reference to the known database of car paint colours and layers will include the 2001 yellow Honda Civic. Similarly, the glass fragments can be classified as to the type of glass used, whether it is from a headlight, windshield or rear window of a car. These are known as class characteristics as they identify a group, such as yellow 2001 Honda Civics, rather than to an individual Honda Civic. There are, of course, many 2001 yellow Honda Civics in town but if paint is recovered, the scientist can be sure that the offending vehicle is damaged. Depending on how much paint, glass or parts are found they may be able to indicate just how badly damaged the car is. If the car is located, an examination may reveal the presence of tiny clothing fibres in the damaged area of the vehicle. These can then be compared to the clothing the victim was wearing. Forensic chemistry is rarely individualizing, in contrast with evidence such as DNA or dental evidence. Chemistry, on the other hand, deals with probabilities, but when several independent materials transfer from one person or object to another the evidence can be extremely valuable.



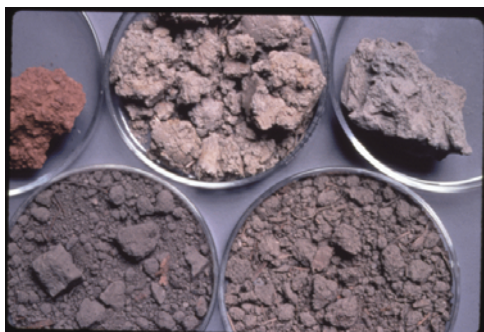
Forensic chemists spend much of their time at a lab bench examining case items for materials which are then compared physically and chemically to materials collected from another location to determine whether or not they have originated from the same source. For instance, did the clothing fibres on the car match those from the victim's jacket? Court testimony is a critical part of the job of a forensic chemist even though a small percentage of the time is spent this way. In an emergency a scientist may be called upon to assist with a scene or provide advice to an investigator. This is very rare and for the most part the hours are normal working hours Monday to Friday in the laboratory. The scientists will also do lecturing and presentations for clients. This requires public speaking skills.

The types of cases that a forensic chemist will analyze include:

- Fire debris analysis – examining fire debris, suspect clothing and items from the deceased, for ignitable liquids.
- Gun Shot Residue – GSR is the micron sized particles containing barium, antimony and lead, from a fired weapon. If these particles are found on a person or in a location it can be confirmed that contact has been made with a fired weapon.



- Paint, glass, soil and fibres – trace evidence – involves the examination of the material to discriminate different sources. This usually is done visually, microscopically and then chemically.



- Explosives – materials suspected to be explosives may be analyzed (pre-blast) and residues and debris after an explosion may be analyzed for explosives residues (post-blast).



- Chemical identification – analysis of materials to determine their chemical composition and possible source.

Openings in the field of forensic chemistry are limited. There are fewer than one hundred positions in all of Canada.

Further Information on Forensic Chemistry

http://www.mpss.jus.gov.on.ca/english/pub_safety/centre_forensic/about/intro.html

http://www.rcmp.ca/fls/home_e.htm

http://www.msp.gouv.qc.ca/labo/index_en.asp

<http://www.geocities.com/CapeCanaveral/4329/>

Forensic Toxicology

Forensic toxicology is quite different from forensic chemistry. Whereas a forensic chemist performs chemical analyses of a myriad of everyday materials, forensic toxicologists concentrate on the chemicals found in body fluids, primarily drugs, alcohol, and poisons and with chemicals related to the making and using of drugs such as methamphetamine labs, needles and spoons. Forensic toxicologists also provide an interpretation of these findings for investigatory and court purposes.



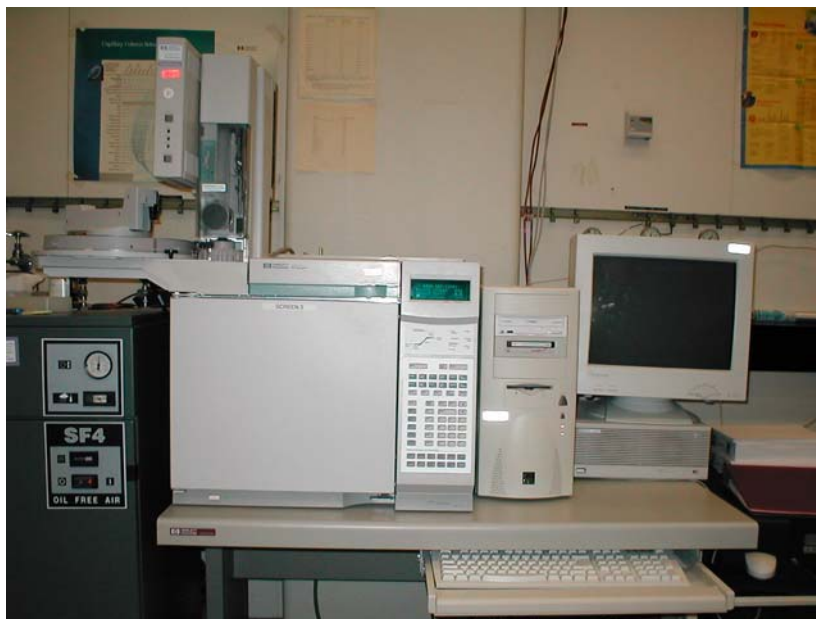
Illicitly produced methylenedioxymethamphetamine (Ecstasy) Tablets

A forensic toxicologist can find himself or herself involved in a wide variety of cases from unexplained (but not suspicious) deaths (coroner's investigations) to impaired driving to homicide. Much of the time, laboratory work deals with postmortem toxicology and helping to unravel a cause of death but forensic toxicologists are often called to do casework that deals with the effects of drugs on living individuals. In fact some of the most complex and interesting cases and analyses don't involve deaths but deal with a drug's ability to incapacitate victims or alter their behaviours. Because of the great diversity of work in the area of forensic toxicology there are several different laboratories where a person may find employment. Some, like the RCMP laboratories, are geared towards the production of evidence for criminal investigations. Others produce toxicology analyses for Coroners and Medical Examiners and some labs, such as the Centre of Forensic Sciences are responsible for both types of casework.



A Headspace Gas Chromatograph used for alcohol analyses

Forensic toxicology scientists are minimally required to have a B.Sc.(Hons) in an academic discipline such as toxicology, pharmacology, pharmacy, physiology, chemistry, or biochemistry. Many toxicologists, however, have training at a graduate level (M.Sc. or Ph.D.) and such training is often an asset since toxicology is a constantly and rapidly changing area that frequently requires research skills that have been acquired during graduate work. Most laboratories will have an in-house training program that will vary according to the guidelines of the jurisdiction. It is not unusual to have at least a two-year training period during which time the trainee will be familiarized with analytical instruments or procedures used to screen for, identify and measure drug concentrations in body tissues and fluids as well as in non-biological material such as tablets, powders and liquids. This training will include the use of gas and liquid chromatography, immunoassays and mass spectrometry and how to interpret the data that are produced.



A Gas Chromatograph used for drug/poison analyses

Most forensic toxicology laboratories employ both scientists and technologists. While historically most of the “bench work” that goes into producing the case findings were done by scientists, the reality of today’s fast paced system is that the scientist no longer spends as much time in the laboratory. Rather the scientist is in many ways a “scientific case manager”. On any given day the toxicologist will employ their skills to determine the type of analysis that is required in a case, what samples to use in that analysis and how to interpret the findings in a manner in which both the lay public (police, jurors *etc.*) and professionals (coroners, pathologists *etc.*) can understand. The forensic toxicologist will also be expected to attend court to give evidence on a regular basis. This part of the career is that of the expert witness and as such the toxicologist may often be called to give opinions on evidence that they did not produce. Most forensic toxicology labs doing criminal casework offer expert support to the police services in their jurisdiction in the area of breath testing for impaired driving. Other aspects of the job include teaching and research. Often a toxicologist will be expected to offer lectures to a variety of client groups. For example, training police officers to use a breath testing instrument or training Crown Attorneys in how to best utilize toxicology evidence in murder or sexual assault trials. Research in forensic toxicology tends to be applied and driven by case-related questions and new needs in the laboratory and as such often has much more immediately apparent impact than purely academic research.



An Intoxilyzer 5000C – one of the approved instruments used in Canada for breath alcohol testing

The salary ranges of each individual laboratory can vary according to the employer but it would not be unusual for a fully qualified and experienced forensic scientist in toxicology to have an annual salary in the range of 60 to 70K+ while technologists salaries can range from 40 to 60K depending on experience. The work week in most labs is usually set at slightly less than 40 hours but having said that most toxicologists are dedicated to their science and really don't watch the clock when there is an important case in the offing. The job rarely involves attending crime scenes or autopsies but this cannot be ruled out as a possibility. This is most likely in the case of clandestine labs, where the presence of a toxicologist may be valuable in advising police personnel about what is likely to be valuable evidence, and what is likely to be dangerous to handle.

One area of the work of a Forensic Toxicologist that diverges from many other forensic disciplines is the number of times they are required to give strictly “opinion evidence”. This is evidence that is based on data not produced by their laboratory and may be entirely hypothetical. Many of the opinion cases revolve around impaired driving and the scientific technicalities that surround that aspect of the law but often the opinion of a toxicologist is key in explaining to a jury the effects of drugs and alcohol on either the complainant, accused or deceased. Courtroom toxicology testimony is seldom accepted without any challenge and forensic toxicologists are often cross-examined vigorously by the opposing counsel in hearings but that's what keeps it interesting!

Further Information on Forensic Toxicology

International Association of Forensic Toxicologists - <http://www.tiaft.org/>

American Board of Forensic Toxicology - <http://www.abft.org/>

Society of Forensic Toxicologists - <http://www.soft-tox.org/>

WWW Virtual Library: Forensic Toxicology –
<http://home.lightspeed.net/~abarbour/vlibft.html>

Questioned Documents

Documents are part of everyday life and on occasion are subject to question or dispute. Attempting to answer such questions from the scientific examination of documents is the work conducted by questioned document examiners. In the descriptions that follow the terms questioned document examiner (QDE) and forensic document examiner (FDE) are used interchangeably. Linked with Questioned Documents is the discipline of counterfeits in which suspect travel documents such as passports and visas as well as credit cards and currency are examined to determine whether they have been altered or counterfeited

The work of the FDE is varied and requires knowledge of many aspects of how documents are made, what materials they are made with, and how documents may be subjected to changes by physical and/or chemical means. Not only must the FDE have knowledge of current materials, methods, and procedures for documents they must also have historical knowledge of such matters. Essentially any instrument or material used in the preparation of documents may play a part of an examination at a much later time.

FDEs work primarily on cases involving criminal, civil, or regulatory matters. However, in some instances examinations may involve documents from historical or other non-judicial settings. As with any other forensic science not all questions posed to the FDE can be answered due to scientific limitations or from a lack of data available in the comparison processes described below.

Historically, the field of questioned documents grew out of a need for the courts to settle matters under dispute involving signatures and handwriting. In North America, Albert S. Osborn is credited with establishing the foundation of the field with his book *Questioned Documents* first published in 1910. From these early beginnings, the field grew from examiners mostly in private practice to expand into government forensic laboratories. In fact, questioned documents was one of the earliest forensic sciences to be part of government forensic laboratories in the 1930s.

Common Questions asked of Forensic Document Examiners

The following are examples of some of the common questions which are posed to Forensic document examiners.

1. **Signature verification, was the signature written by the person who was supposed to have written it?** The examination of questioned signatures requires an adequate quantity of specimen (exemplar) signatures for comparison purposes. This is due to the range of variation in genuine signatures. It is often thought that this variation is such that comparisons would not be possible. However, within this range of variation, the habits of writing the signatures are observed and a meaningful comparison with questioned signatures can be conducted. The signatures to be compared should also be contemporaneous, *i.e.* of approximately the same date. Signatures are subject to some change over time, especially when first learning to write and in later years if an illness causes changes to the writer's signature.
2. **Who wrote the handwritten/handprinted entries on the documents?** To answer this question, handwritten/handprinted material of a similar type known to have been written by a particular writer is required to compare with the questioned entries.

Similar requirements for the specimen material used for signature comparisons are applicable for handwriting examinations. However, it is important to note that signatures cannot generally be compared with handwriting in most situations.

3. **Did a particular office machine produce a questioned document?** This applies to any type of office machine that may have been used to produce a questioned document in whole or in part. This includes typewriters, dot matrix printers, facsimile machines, ink-jet printers, laser printers, photocopiers, cheque writers, rubber stamps, and nearly any other device that could be used in the production of a document. Common examinations involve the determination of whether or not a particular device was used in the making of a questioned document. Notwithstanding the changes in modern communications, there is no shortage of work for the modern FDE. If anything, the production of and the reliance upon documents produced by office machines is greater than ever before. Modern office equipment is capable of producing large quantities of documents. Even if only a few of such a large quantity are subject to question the number of examinations for the FDE may be extensive.
4. **Is the date on the questioned document plausible?** There are two types of date problems, the first being absolute date. Absolute date meaning were the materials used to produce the document available at the purported date. For example, a handwritten document bearing a date of 1900 could not have been written in 1900 with a ballpoint pen. Nor could a manuscript bearing a date of 1935 been typed on a Selectric typewriter. These types of examinations include the paper; watermarks used to produce a document may not have existed when purported. The second type of problem involves relative dating which arises when the purported sequence of events in a document's preparation are questioned. For example, the substitution of one or more pages in a multiple page document such as a contract. The substituted page may bear evidence of being produced at a different time.
5. **Examination of documents for alleged changes, interlineations, and alterations.** Documents may have been subject to changes that may be visible to the unaided eye, but in some instances the observation of any changes would require the assistance of specialized equipment. This specialized equipment may include microscopes, specialized illumination, cameras, and other instrumentation.

Education and Further Training for a Forensic Document Examiner

The minimum educational requirements for an FDE in government laboratories is an honours bachelor's degree in science. Once hired, further training in document examination is undertaken through an apprenticeship style of program under the guidance of another trained, senior FDE. It requires a minimum of two years of full time training under such a program to become qualified in most government agencies. Training programs are increasing in length due to the changes in technology and further research into the traditional aspects of document examination. Currently there is no recognized program at a university that will provide all of the basic training required to substitute for an apprenticeship.

Forensic document examiners apply the theory and practice of the scientific training received in their undergraduate education, *e.g.* chemistry, mathematics, biology, physics, psychology, computer science, *etc.* to their analyses. Furthermore the multi-disciplinary nature of document examination necessitates learning about other sciences and consulting with other scientists who have specialized knowledge which may assist in answering some

questioned document problems. Document examination is a full time occupation and requires a willingness to learn and apply such knowledge to cases. It also requires a willingness to consider research when needed to solve problems. As well excellent visual skills are required and word blindness and other visual tests will be conducted on prospective candidates.

In order to keep abreast of current developments and research, FDEs must participate in continuing education. Such continuing education may take many different forms including attendance at professional conferences, ongoing research, giving lectures to interested parties, writing articles or books, or nearly any other educational practice on document examination. Certification in North America is available from the American Board of Forensic Document Examiners (ABFDE). A candidate must successfully complete tests of theory and practical cases in order to obtain certification. There are several other professional associations such as: the American Society of Questioned Document Examiners (ASQDE), The American Academy of Forensic Sciences (AAFS), and the Canadian Society of Forensic Sciences (CSFS). Although it is not legally required, most FDEs in Canada belong to one or more of these professional organizations.

Work Setting for the Questioned Documents Examiner

Forensic document examiners conduct most work in a laboratory setting. The laboratory will be equipped with a variety of optical, chemical, and electrical instrumentation depending on the types of examinations conducted. Most working conditions will be in comfortable laboratory conditions except for some submitted documents which may require special handling procedures due to contamination, fragile state, or physical size. For some cases, work is conducted "in the field", this may involve the examination of documents which cannot be sent to the laboratory due to legal or technical reasons. For these instances some portable laboratory equipment is taken to the site.

Career Opportunities in Questioned Documents

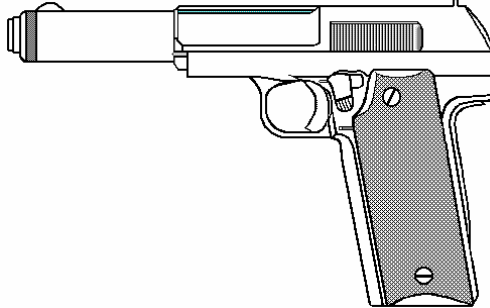
There are currently a limited number of FDEs working in Canada. The number is less than 50 including federal laboratories, provincial laboratories (Ontario and Québec), and examiners working in private practice. Many examiners in private practice were previously employed by a government laboratory and either entered private practice after retirement or entered private practice as an alternative to being in a public laboratory. The limited number of positions is not due to a shortage of work. It may be partially the result of the long training time required as laboratories must be willing to commit to the long training period. The allocation of such training resources may be scarce in the current environment in government laboratories. No formal statistics are immediately available on the average age of practising examiners in Canada, but many practising examiners are less than 10 years away from retirement and the opportunities for those wanting to enter the field should be increasing.

Further Information on Questioned Documents

American Society of Questioned Documents Examiners – <http://www.asqde.org/>
American Board of Questioned Documents Examiners
<http://www.asqde.org/abfde.htm>

Firearms and Toolmark Examinations

A Firearms and Toolmark Examiner's prime work involves the microscopic matching of the 'toolmarks' made on bullets and cartridge cases upon firing. This aspect is actually pattern matching based on established scientific and statistical principles.



Astra semi-automatic pistol

Some serious criminal cases also involve an estimation of the distance of a firearm from a target based on the discharge residues at the projectile holes and based on the damage created in the target. Some examinations are visual and some are microscopic. Often the target materials are garments and sometimes human skin. Attendance at autopsies or major crime scenes is also a necessary but somewhat infrequent part of the job.

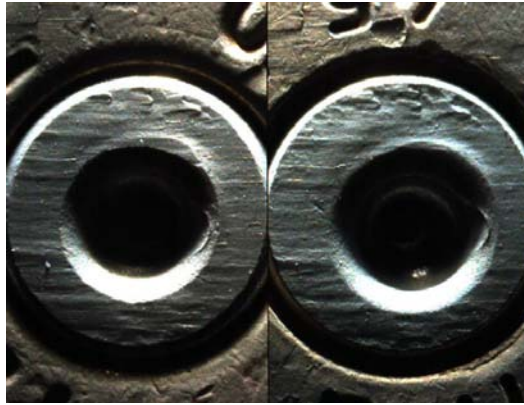
Much of the casework also involves determining whether a firearm is working properly and determining the legal category into which it belongs. Restoration of firearm serial numbers that have been effaced comprise another of the examiner's duties.

A less frequent but equally important type of criminal case involves the matching of items of evidence to the toolmarks they produced in some softer substance. In some instances broken or severed items are matched and identified as having been a single item or attached previously.

The types of cases which an examiner will expect to see range from serious crimes such as multiple murders, arson, robbery, and other personal injury crimes to lesser technical or regulatory infractions such as unsafe storage of firearms and unregistered firearms.

Detailed notes and photos or diagrams are made at each stage of the examination and a written report is created for the investigator and the courts. Court testimony is part of the job and the examiner is required to testify as an expert witness under oath, and provide information about observations made and conclusions formulated. Those conclusions and the lab procedures used to arrive at them may be challenged in a very vigorous cross examination.

The term 'Ballistic Expert' often used inaccurately on television to label the 'Firearms and Toolmark Examiner' is misleading. A true ballistic expert is concerned with projectile trajectories and likely to be employed by the military or by arms and munitions manufacturers.



Match of breechface markings on a crime scene cartridge case to a test from the suspect firearm, as seen through the comparison microscope

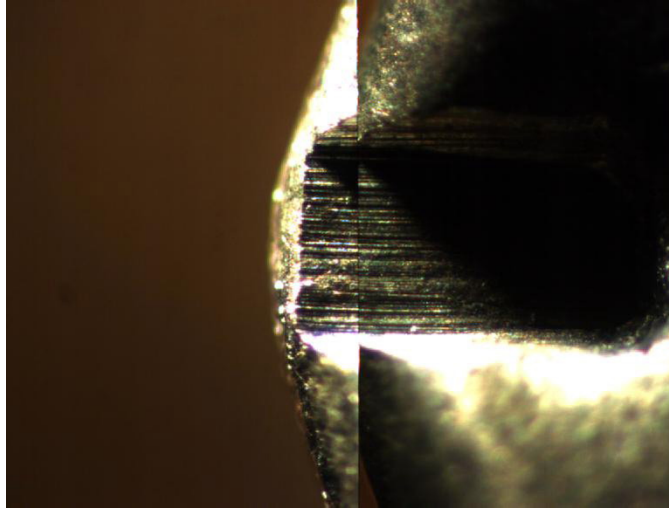
Education and Further Training for a Firearms and Toolmarks Examiner

Candidates for this discipline are required to have an honours Science degree with university level courses in Chemistry and Physics. Some candidates also have engineering backgrounds. Certain skills (as listed below) are necessary for this profession. The candidate is likely to be asked about them in a hiring interview and may be required to demonstrate some of them in practical exercises during a technical assessment for hiring.

Required Skills

1. Some basic knowledge of and interest in firearms and their mechanisms is a desirable asset.
2. Chemical spot tests require normal colour vision.
3. Observational skills are necessary for the job, as pattern matching is the primary work. For most people these skills are enhanced during training.
4. A mechanical aptitude is essential for the disassembly and reassembly of the complex firearms mechanisms and an understanding of how moving parts interact with each other.
5. The examiner must also be capable of writing lucid and accurate technical reports using word processing computer programs.
6. Problem solving and the ability to organize and prioritize work are needed as the firearms examiner works independently much of the time. Some cases and projects however require teamwork with other members of the laboratory, police and other professionals, so co-operation and meaningful contributions to a team are needed as well.
7. Autopsies, crime scene attendance and dealing with skin and bloody garments from victims of gunshots require that the examiner can handle some real life situations that are not for the squeamish.
8. A safety conscious attitude in the handling of firearms is a must in a lab where all types of firearms of varied states of repair are examined in close proximity to other examiners – a mistake can be fatal!
9. The ability to deal with the recoil of large caliber rifles, shotguns and handguns is also required.
10. Court testimony requires that the examiner be scrupulously honest and unbiased despite the pressures of being examined by lawyers each of whom wishes to present a single side of the case. Articulating clearly the complexities of technical procedures

while keeping the explanations understandable for untrained judges and juries requires that the expert witness be able to teach without using the technical terminology of his or her specialty or appearing to be snobbish.

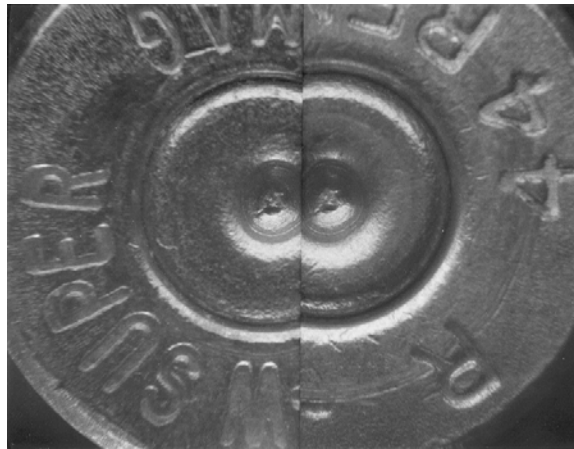


Match of a rimfire firing pin mark on a crime scene cartridge case to a test from the suspect firearm, as seen through the comparison microscope

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The science degree only provides the basis for the specialized training. The training provided by the employer is apprentice-like and under the tutelage of experienced examiners. It involves writing a series of researched papers on topics related to the job, practical exercises, written and/or oral exams and mock trials. This training is usually given in modules with some being prerequisites for others. The training period can be up to two years in length depending on the student and his or her previous knowledge of firearms.

Once the training is completed and an authorization is given to work on cases, the newly trained examiner will be under the oversight of a senior examiner for a trial period. This is both to assure that these cases are completed properly and for the newly trained examiner to continue to benefit from the experienced eye of the senior examiner.



Match of a centrefire firing pin mark on a crime scene cartridge case to a test from the suspect firearm, as seen through the comparison microscope

Work Setting for a Firearms and Toolmarks Examiner

Commonly, Firearms and Toolmark Examiners work a 40 hour work week with weekends off. Exceptions occur occasionally when court, training, conference travel or special projects require additional time which is usually compensated with overtime pay or rescheduled time off.

Most of the typical work day will be spent on a specific case that the examiner is completing. Making notes and photos about the exhibits, firing guns to recover test bullets or cartridge cases and visual or microscopic examinations consumes much of the day. Writing the report, entering statistical and exhibit transfer information into a computer as well as preparing exhibits for return to the investigator are part of the process. Communications with members of other lab disciplines, investigators and prosecutors about specific exhibits, cases or court dates also consumes some portions of the day.

Career Opportunities in Firearms and Toolmark Examination

The normal career path move for an examiner in this profession with some years of experience is to compete for positions within the discipline such as Senior Technical Advisor, Section Head, and Discipline/Program Manager or equivalent. These positions will vary in name and availability with the employer.

Further steps once supervisory and administrative experience has been gained could involve competing for management positions in a laboratory or laboratory system.

Further Information on Firearms and Toolmark Examinations

The primary professional association which connects Firearm and Toolmark Examiners around the world is ‘The Association of Firearm and Tool Mark Examiners’ (AFTE). It has a website and journal, and has a yearly business meeting and training seminar style conference in the United States or Canada. The best web pages to provide additional information are those by AFTE (<http://www.afte.org>) and Firearms ID (<http://www.firearmsid.com>). Much of the AFTE site is available only to members, and some portions of the Firearms ID site are available only to law enforcement personnel. However, the Firearms ID site has a high quality virtual comparison microscope with exercises in matching of bullets and cartridge cases that can be completed by anyone. This site also provides a wealth of information concerning firearms examinations as well as 3D images of firearms.

Employment Opportunities in Major Forensic Labs

Jobs are limited as there are only a few major forensic laboratories in Canada. However, positions do become available and those interested should contact the labs directly or watch out for advertised positions. Also, you should regularly check their websites.

RCMP FLS

Prospective candidates must have excellent writing and oral skills as well as a high level of interest, self-reliance and analytical ability (www.rcmp.ca/fls/careers_general_e.htm). Candidates will be assessed in eight core areas including leadership, client-centred service, thinking skills, personal effectiveness and flexibility, planning and organizing, interpersonal skills, communication and continuous learning (www.rcmp.ca/fls/careers_general_e.htm). Specialists must be prepared to travel and to testify in legal proceedings and are subject to transfer to any of the six RCMP labs at any point during their career. Employment opportunities occur to suit the operational requirements of the RCMP. Positions are rarely posted on external sites however those who are interested in positions with the RCMP should send their C.V. via e-mail to lab-cv@rcmp-grc.gc.ca. Applications and enquiries can also be sent to

Human Resources
Forensic Laboratory Services
NPS Building, Lab Tower, Rm. 262
PO Box 8885
Ottawa, ON K1G 3M8

The RCMP hires only Canadian citizens.

Centre Of Forensic Sciences

The CFS has a brochure describing its activities available from the Training Unit at 25 Grosvenor St., 15th fl., Toronto, ON M7A 2G8, telephone (416) 314-3654. Prospective candidates must have excellent written and oral communication skills as well as a high level of personal integrity, self-confidence, analytical ability, and interpersonal skills. Candidates for scientist positions must demonstrate academic knowledge and relevant experience, the ability to perform scientific research, and the ability to present complex scientific evidence to a variety of audiences. Some positions require excellent colour vision and manual dexterity. Scientists must be prepared to travel within the province of Ontario to testify in legal proceedings and provide client education and training. Positions are posted on the Ontario government web-site <http://www.gojobs.gov.on.ca/mbs/gojobs/gojobs.nsf>

Laboratoire De Sciences Judiciaires Et De Médecine Légale Du Québec

The laboratory can be contacted at LSJML.SPPAR11@msp.gouv.qc.ca. Job opportunities are advertised at the site of Conseil du trésor: http://www.tresor.gouv.qc.ca/fr/ress_humaine/emplois/liste_emplois/liste.asp where all government positions are posted. The minimum academic requirements are listed below:

Appareils de jeux	Ingénieur	Diplôme universitaire de 1er cycle Génie avec spécialisation en électronique Génie avec spécialisation en informatique appliquée Être titularisé ingénieur et membre de l'Ordre des ingénieurs du Québec
	Technicien	DEC en électrotechnique DEC en systèmes ordinés
Balistique*	Professionnel	Bac. en sciences, spécialité physique
	Technicien	DEC en sciences
Biologie	Professionnel	Bac. en biochimie ou l'équivalent
	Technicien	DEC en chimie-biologie DEC en techniques de laboratoire medical
Chimie judiciaire	Professionnel	Bac. en chimie, BSc. Minimum plus member de L'Ordre des Chimistes du Quebec Maîtrise en chimie Doctorat en chimie
	Technicien	DEC en chimie analytique
Documents*	Professionnel	Bac. en sciences
Médecine légale	Médecin	Médecin spécialiste en pathologie
	Assistant-pathologiste	SEC. V et 6 ans d'expérience pertinente DEC en thanatologie
	Technicien/histologie	DEC en techniques de laboratoire médical
Toxicologie	Professionnel	Bac. en chimie Bac. en biochimie Diplôme d'études supérieures en toxicology (souhaitable)
	Spécialiste - spectrométrie de masse	Diplôme en spectrométrie de masse (M.Sc. ou Ph.D.) Membre de L'Ordre des Chemistes du Quebec
	Technicien	DEC en chimie analytique DEC en techniques de chimie-biologie

Private forensic laboratories also exist, frequently handling work such as immigration and paternity cases.

CRIME SCENE INVESTIGATION

The true Crime Scene Investigators or “CSI” in Canada are not civilians, as is so often portrayed on television, but rather, highly trained police officers. These police officers are usually called Identification Officers or Ident Officers. In some municipal or Provincial forces, the police officers who analyze a crime scene may be in the Detective or Major Crime Sections, but the qualifications, training and job are very similar. Ident officers used to require at least 7 years service in the police force, before entering the training and understudy period in Ident. Very recently, this has changed and some forces now allow police officers to enter the Ident section after only 3 years of police service. However, in such cases, the understudy period is lengthened from two years to four years. The training is intense and involves course work, research and extensive oral and written examinations. Ident officers are trained in all aspects of crime scene analysis from photography, fingerprinting and DNA collection to blood spatter pattern analysis (only a select few). The Ident team handles the crime scenes and is not responsible for other aspects of the investigation. Their duty is to the scene and the analysis of some of the evidence. Other police officers are involved in such things as interviewing suspects and following up leads. The Ident team will correctly collect the evidence, and submit it to the forensic scientists at the lab, who will then perform the analyses and submit reports to the Investigating Officers. The Ident officer, however, is responsible for the actual individualization of fingerprints and the analysis of blood spatter pattern. Quality control is extremely important in Ident so NO mistakes are allowed. If an Ident officer makes an incorrect individualization of a fingerprint and wrongly identifies a person, then they are immediately removed from the Ident section. This can occur from their first training exercise to the last print they individualize before they retire. If they make a mistake, they are out of the section. Therefore, every Ident specialist in Canada can state in court, that they have NEVER mis-identified anyone.

If you wish to become a crime scene specialist in Canada, you must first become a police officer and complete basic training and the first several years as a general duty officer before you can apply to enter Ident. If you are not interested in becoming a police officer in general, you should not enter the police force with the express intent of entering Ident as many people are interested in this field, so not every police officer who applies to Ident will get in. In some other countries, there also civilian Scene of Crime Officers (SOCO’s). In some of these areas, SOCO’s are highly trained civilian members of police forces, and in others they simply assist the Ident team. In Canada, in some provinces, limited SOCO positions are available to assist Ident officers. The following relates to RCMP Ident officers but is similar for most Canadian Police Agencies.

Educational and police background required to enter the Forensic Identification Section

This is a list of many of the steps involved in becoming a member of the RCMP Forensic Identification Section, (FIS). If a person wishes to attend and examine crime scenes during active criminal investigations, they must be a member of the Forensic Identification Section. In Canada, this would hold true for the RCMP as well as other Police Agencies.

RCMP process to become a Forensic Identification Specialist

- 1) Regular member (min of 3 years)
- 2) Answer job advertisement
- 3) Supply resumé (all experience before and during RCMP. This includes all education and specific forensic courses)
- 4) Physical comparison abilities test, (PCAT)
- 5) Rated on a national list for Identification vacancies
- 6) Candidate is identified, and placed into a 3 week assessment at a Forensic Identification Section
- 7) If successful and found suitable, a place is reserved on the FIS course at the Canadian Police College in Ottawa, Ontario. 8 weeks in duration.
- 8) If successful, go to posting anywhere in Canada.
- 9) Begin the 4 year FIS Apprenticeship training program
 - 1st year to 18 months must complete all required apprenticeship benchmarks
 - Must successfully complete a Certification Board.
 - During the next 3 years, on going case work and mandatory benchmarks, training courses, and technical review of certain cases.
 - At the end of the 4 years, may be designated as a Forensic Identification Specialist.
 - Continue working in the Forensic Identification Discipline.
- 10) Bi annual re certification within the fingerprint discipline

Description:

- 1) The FIS candidate must be a full member of the RCMP with a minimum of 3 years experience. This threshold has fluctuated over the years due to a continuous demand for seeking out the best people for the job. Currently, our Force is undergoing a tremendous exodus of older Members. It is necessary to maintain and replace this knowledge base. A requirement that does not change is a desire to attract the Member with the most interest, ability, and potential to the Discipline. Areas which might be considered would include, but not be limited to a wide variety of general duty police work. In many cases this kind of experience is found by Members who have been posted to more than one location and as a result, exposed to a variety of policing issues and people. The Member who has taken it upon him or herself to expose themselves to the work of the FIS during case examinations will become familiar with some of the issues of the work, and ascertain whether or not it is something that might be worth pursuing as a career.
- 2) The Member must be aware of internal processes within the Organization which will advertise vacancies within the Forensic Identification Section.
- 3) A successful candidate will have prepared in advance a professional resumé. This document must include education before and after entry into the Force. Courses that are specific to Forensics are now available at many post secondary institutions. This type of knowledge is desirable but may not be absolutely necessary for a successful candidate. The resumé should also include work related experiences associated to the Forensic Identification

Field. An example might be investigations where the general duty Constable has worked with a Specialist, or observed crime scene processes during the examination of a crime scene.

4) Physical Comparison Abilities Test, (PCAT). This is a test which looks for an ability to recognize shapes and patterns. The test may be retaken once, with one year separating each test.

5) The Forensic Identification Section is administered as a National Program. As a result, all candidates who have completed and passed the PCAT are placed onto a National List. The list is used to identify potential candidates for the next phase of the process.

6) A candidate is chosen to participate in an assessment period which lasts approximately 3 weeks. This is usually done at the candidates local Identification Section. Experienced Forensic Identification Specialists have an opportunity to monitor and evaluate a candidate's ability and potential ability, regarding crime scene analysis and all other related areas of interest within the discipline. The Forensic Identification Specialist will have the authority to pass the candidate, or to terminate the candidate's application to the Section.

7) If successful, the candidate is placed onto a National List for the 8 week Canadian Police College's Forensic Identification Training and Techniques Course. This course is offered twice per year. The Canadian Police College is recognized nationally and internationally as a Centre of Excellence for Police Studies. The RCMP, other Police Agencies from Canada, and around the world, place candidates at the CPC for these reasons.

Successful Candidates will have been taught Forensic Identification Techniques from qualified, experienced, and active Specialists. Instruction on various techniques and methods will assist the candidate to begin a career within the FIS community.

8) On successful completion of the CPC course, the member is transferred to his or her Forensic Identification Section. (May be anywhere in Canada. The member has usually agreed to the location prior to beginning the process)

9) The RCMP requires the Candidates to complete a 4 year Apprenticeship Program. The Member must complete a large amount of extra work and additional training, prior to becoming a Specialist. The program is done while the Candidate is working full time, taking a full case load, and under the direct supervision of a qualified Specialist within the Section. The first year to 18 months is often called "the year from hell" by many candidates. It is within this first year that all extra duties and educational requirements must be completed. A Course Training Standard is used to guide and direct the candidate. At the end of the first year the candidate must present him or herself to the Board. The Board consists of three experienced qualified Forensic Identification Specialists. A case must be presented and defended that he or she was directly involved in, as if it were a real case at trial. The Board acts as Officers of the Court and cross examines the candidate on all aspects of the Forensic Examination of case. If the candidate presents and defends the case successfully he or she is considered to have passed the Board. The candidate will be able to return to the FIS and continue to work through the remaining 3 years of the Apprenticeship Program. Benchmarks, required courses, and technical reviews must all be completed during this period.

Once the 4 year Apprenticeship Program has been successfully completed, the candidate may be advanced to the Forensic Identification Specialist level.

10) A bi annual assessment of the FIS member's abilities is required. This takes the form of the Advanced Fingerprint Identification Course. Each member must participate at least once every two years.

How many Forensic Identification Officers are in Canada?

The RCMP has approximately 250 Forensic Identification Specialists from Coast to Coast. Most are stationed in larger centers. Municipal Forces and other Police Agencies also have Identification Sections which investigate crime scenes within their jurisdictions.

What is Regional Forensic Identification Support Service?

The RFISS Section is a specialized Forensic Unit within the larger National Forensic Identification Program. The section was created in the early 1980's after three Identification Specialists attended a Bloodstain Pattern Recognition Course held in Corning, New York, taught by Mr. Herbert Leon MacDonnell. The RCMP observed the benefit of this specialized technique and took steps to introduce the study of bloodstain patterns into the crime scene approach.

RFISS members come from the community of Forensic Identification Specialists within the RCMP. The Force has 4 RFISS Units. One four person section is located in Vancouver. This unit covers all of British Columbia and the Yukon. One three person section is located in Edmonton. It covers all of Alberta, the Western Territories, and parts of Saskatchewan. One two person section is located in Winnipeg, and administered from Edmonton. The two Winnipeg RFISS members cover Manitoba, the Eastern Territories, and parts of Saskatchewan. One three person section is located in Halifax. These Members cover all of the East Coast, and have occasionally been called to assist in the Caribbean. The 12 members within RFISS are Staff Sergeants and Sergeants and are responsible for assisting all Forensic Identification Specialists within the RCMP. They will respond to other authorized Police Agencies in Canada, or abroad.

The main objective of the RCMP in creating RFISS was to provide assistance to Identification Sections when investigating serious cases, usually involving Homicide. Its members bring a certain amount of crime scene experience and training which would not normally be available within a local Identification Section. An example of this would be the ability to perform Bloodstain Pattern Analysis and provide Expert testimony at all levels of Court about that analysis. Canadian and other Courts have accepted Bloodstain Pattern Analysis as a valuable tool available to the crime scene analyst. If an investigator finds blood at a crime scene and feels it may become an issue later in the investigation, a qualified Bloodstain Pattern Analyst must be used to interpret the patterns, and prepare a report on his or her findings. Members of the RFISS units are positioned within the National Police Services Forensic Laboratories. While in these locations, they are able to liaise between the world of Crime Scene Analysis, Police Investigators, and the Forensic Laboratories.

What does a Certified Forensic Identification Expert do?



photo by Cst. D. Holmes

Bloodstain Pattern Analysis Photograph

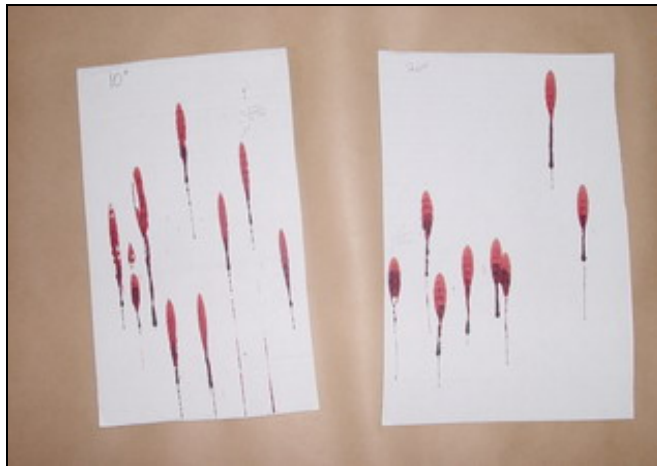


Figure 1 Bloodstains created during experimentation by Sgt. J.L. Hignell (RCMP)

Further Information on Identification

Web Sites available include the International Association of Identification, (IAI), the Canadian Identification Society, (CIS), the Canadian Society of Forensic Science, (CSFS), and the International Association of Bloodstain Pattern Analysts, (IABPA). The Surrey RCMP has created a website which describes some of the duties and responsibilities of the Forensic Identification Specialist. It is located at <http://www.rcmp-grc.gc.ca/bc/lmd/surrey>

Canadian Identification Society - <http://www.cis-sci.ca/>

International Association for Identification - <http://www.theiai.org/>

MEDICO-LEGAL DEATH INVESTIGATORS

Coroner and Medical Examiner

The Coroner or Medical Examiner is the Ombudsperson for the dead. Any death that does not occur in a hospital or under the care of a physician, whether natural or otherwise, will be investigated by a Coroner or Medical Examiner, depending on Province or Territory. The only exceptions to this are when a person dies in the care of a doctor. For instance, if an elderly person was known to have cancer, which was in its terminal stages and the person dies in their bed, it would be usually presumed that they died of the cancer, unless circumstance indicated otherwise. In all other cases, the death will be investigated. Any homicide or suspicious death will, of course, be investigated, but even those deaths that appear to be non-homicides will still be examined. An obvious reason for such a death investigation is to determine whether it really is a non-homicide, or if a crime has taken place. As well, understanding why a loved one died is very important for closure for the grieving family. This is especially true when the death was unexpected. When a fit young man collapses and dies while walking down the street, it is extremely important to determine why that death occurred. Perhaps he had some contagious and rapidly acting disease that the public must be warned about, or maybe he was exposed to something very toxic at work that must be rectified, or perhaps he had a congenital heart condition that no-one knew anything about. Also, of course, there may be legal questions to answer, such as insurance or civil liabilities. Often such things can only be resolved by determining the identify of the decedent, the time of death, the cause of death, the mode of death and the manner of death.

When a death appears suspicious, the police will, naturally, investigate. However, the death also falls under the Coroner or Medical Examiner's Act of that Province or Territory and will also be investigated by the Coroner or Medical Examiner.

The Coroners system dates back to 900 AD in Britain when Coroners were appointed, usually by the King. Hence they were called CROWNERS because of their relationship to the monarchy. This word Crowner has changed over the centuries to become Coroner, the term we and other countries use today. Some Provinces still have Coroners, whereas others have developed a Medical Examiner System. However, whichever system is in place, it is the duty of the Coroner or Medical Examiner to determine:

- WHO died? - what is the identity of the decedent?
- WHERE did they die? - was it here or somewhere else?
- WHEN did they die? – what was the time and date of death?
- WHY did they die? - what was the medical cause of death?
- HOW did they die? - what was the manner of death? Accidental, natural, suicide, homicide, or undetermined.

Coroner

In Provinces with Coroners Systems, the Coroner is responsible for the investigation of all unnatural, sudden, unexpected, unexplained or unattended deaths. Coroners are governed by the Coroners Act for that Province. The B.C. Coroners Act can be viewed at www.qp.gov.bc.ca/statreg/stat/C/96072_01.htm. The Coroners System is in place in B.C, Saskatchewan, Ontario, Québec, New Brunswick, Prince Edward Island and Yukon, Nunavut and Northwest Territories. In the US, 28 States have Coroners Systems, and 22 plus DC have Medical Examiner Systems.

Much of the following information comes from the BC Coroners Service web page - www.pssg.gov.bc.ca/coroners/index.htm. A Coroner is a medical-legal death investigator. They are appointed by the Lieutenant Governor in Council upon the recommendation of the Attorney General. The position is judicially independent.

The Coroner will determine the identification of the deceased, and how, when, where and by what means they met their death. The Coroner will classify the manner of death as natural, homicide, suicide, accident or undetermined. The Coroners Service is a fact-finding rather than a fault finding organization and serves the deceased, the family and friends of the deceased, and society at large. Coroners have a quasi-judicial role and hold and preside over inquiries and inquests into deaths. By investigating a death, the coroner not only helps to answer the questions of the identity of the decedent, and how, when, where and by what means they met their death, but also provides recommendations to help prevent similar deaths. For instance, if a death of a pedestrian at a particular road site is investigated and it is found that several similar accidents have occurred at that site, the Coroner may recommend that a pedestrian light is installed in this area, or barricades are erected, to prevent similar fatalities.

The majority of Coroners are fee-for-service, although some positions are full-time. For instance, in B.C., there are approximately 21 full-time Coroners and 120 community or fee-for-service Coroners. Each Province is also divided into Regions and each region is headed by a Regional Coroner, who is full-time. The Coroners Service in each Province is headed by the Chief Coroner. Coroners are on duty and on call 24 hours a day and provide services to local and sometimes very remote communities. Community Coroners are called when needed and are paid based on the number of hours they work. This is not a full-time job and most Coroners also have other part time employment.

Coroners attend and investigate death scenes so must be able to deal with grieving families as well as investigate all aspects of the death including examining the body, the death scene and the history of the decedent.

Coroners do not perform autopsies. When a medico-legal autopsy is required, the Coroner will request that an autopsy be performed by a Forensic Pathologist.

Career Opportunities for Coroners

Coroners come from all walks of life with a wide variety of backgrounds including but not limited to: medical, legal, investigative, policing and business. In most Provinces with Coroners systems, a Coroner does not have to have a medical degree. The exceptions to this are Ontario and Prince Edward Island, where a Coroners system is in place, but all Coroners must be medical doctors. Although a medical degree is not required in other Provinces, an understanding of medical terminology is a great asset. The Coroners Service

looks for individuals who are intelligent, upstanding, concerned and honest members of the local community. Although Coroners can have a wide variety of backgrounds, the Coroners Service gives preference to people with legal, medical or investigative backgrounds. Life experiences are valuable and a Coroner should be a dedicated person who has a strong concern for public and community safety. They must be sensitive and supportive in order to work with grieving relatives and friends of the deceased and be able to communicate effectively with a variety of people, including law enforcement, the public, the medical community and other agencies. They should also have strong leadership and team skills in order to coordinate death scene investigations (www.pssg.gov.bc.ca/coroners/index.htm).

Further Information on Coroners

British Columbia www.pssg.gov.bc.ca/coroners/index.htm

Ontario

http://www.mpss.jus.gov.on.ca/english/pub_safety/office_coroner/about_coroner.html

Quebec <http://www.msp.gouv.qc.ca/coroner/index.asp>

Saskatchewan <http://www.saskjustice.gov.sk.ca/coronersoffice/>

Yukon Territory <http://www.justice.gov.yk.ca/prog/cjps/crn/>

Northwest Territories <http://www.justice.gov.nt.ca/Coroner/coroner.htm>

Prince Edward Island www.gov.pe.ca/infopei/index/php3?number=52651&lang=e

New Brunswick http://www.cdc.gov/epo/dphsi/mecisp/new_brunswick.htm

Nunavut Territory Office of the Chief Coroner, Box 1000, Stn. 590, Iqaluit, Nunavut,
X0A 0H0

Medical Examiner

Medical Examiners like Coroners, are responsible for overseeing investigations into unexplained natural deaths or unnatural deaths, but are different from Coroners in two respects. First, whereas a Coroner does not necessarily have to be a physician (although in some jurisdictions, like Ontario, they are), a Medical Examiner by definition must be a physician. Second, Medical Examiners investigate deaths, but do not have any of the quasi-judicial inquisitional powers of a Coroner. In many Canadian provinces and territories, a Coroner can call and preside over an Inquest into the circumstances of a death he/she has investigated. A Medical Examiner does not have the power to order such a proceeding to take place and would likely be called to appear as a witness at one, rather than preside over it. Such an inquiry is held before a judge. In such an inquiry, the judge can still not appoint blame, but again makes recommendations in order to prevent similar deaths from occurring in the future.

The Medical Examiner system of death investigation originated in Boston in 1877, and has spread to many parts of the United States and Canada. Currently Alberta, Manitoba, Nova Scotia, and Newfoundland are the four Canadian provinces that have Medical Examiner systems in place. As previously mentioned, a Medical Examiner must be a physician, but this does not necessarily mean that a Medical Examiner is a Forensic Pathologist (or even a Pathologist). The administrative head of each of the four Canadian Medical Examiner provinces (referred to as the Chief Medical Examiner) is a Forensic Pathologist by training. Depending on the size of the province and available resources, there may be other Forensic Pathologists who work as Medical Examiners with the Chief Medical Examiner. Beyond that, the remaining Medical Examiners in each of these jurisdictions are generally Family Physicians who are hired on a part-time fee-for-service basis to conduct death investigations.

Working with police, the Medical Examiner determines the circumstances surrounding a death and either attends the scene of death or ensures that the scene is attended and documented by police. If the Medical Examiner decides that an autopsy is necessary to complete the investigation, they will have the autopsy done either by a local hospital Pathologist or by one of the full-time Medical Examiner/Forensic Pathologists employed by the Medical Examiner's Office. If an autopsy is not necessary, the Medical Examiner will conduct and document an external examination of the body and collect appropriate specimens for toxicology. As with a Coroner, the Medical Examiner is responsible for proper identification of the decedent and for establishing the circumstances of the death, the medical cause of death, and the manner of death (i.e. whether the death was due to natural disease or whether it was an accident, homicide, suicide, or undetermined).

Further Information on Medical Examiners

Alberta <http://www.justice.gov.ab.ca/ocme/default.aspx>

Manitoba <http://www.gov.mb.ca/justice/about/chief.html>

Nova Scotia <http://www.gov.ns.ca/just/cme.htm>

Newfoundland <http://www.justice.gov.nl.ca/just/medical%20examiner.htm>

Forensic Pathology

Forensic pathology is a unique, challenging and rewarding career that combines medical expertise with many other diverse fields of study. It is the application of medical science (study of the human body and its injuries and diseases) to legal problems. Forensic pathologists (FPs) are physicians with particular expertise in injury interpretation and death investigation, including determination of cause and manner of death. They are trained to perform autopsy examinations and this comprises the majority of their workload. They are also called upon to give expert testimony in court. Less commonly, they may be consulted in evaluation of living patients to assist in interpretation of injury patterns, e.g. motor vehicle collisions, or suspected child abuse. Finally, FPs make valuable contributions to public safety, e.g. identifying unsuspected life-threatening communicable diseases, and providing information regarding motor vehicle safety and electrical or choking hazards.

Forensic Pathology as a Medical Specialty

It is important to understand how forensic pathology relates to the practice of medicine in general and pathology in particular. Pathology (literally “study of disease”) is a subspecialty of medicine that involves the examination of body fluids and/or tissues in order to provide information about or diagnose a patient’s medical condition. Pathologists, also called “laboratory physicians”, are medical doctors who have completed specific postgraduate medical training, just as surgeons, pediatricians or cardiologists have obtained additional specialized training in their areas of expertise. Pathologists provide critical information to other doctors so they can diagnose and treat their patients.

Within the field of pathology, there are several subspecialty areas, including:

- Anatomical pathology
- Medical Biochemistry
- Medical Microbiology
- Hematopathology

Many pathologists practice in more than one of these areas (i.e. general pathologists). Forensic pathology is generally considered to be a subspecialty in anatomical pathology (involving the direct visual examination of body fluids, tissues and organs). However, FPs frequently draw from expertise in more than one of these specialty areas in the investigation of a particular case.

Education for Forensic Pathology

All FPs will have completed medical school (usually four years) and an additional postgraduate training program in Laboratory Medicine (five years). After this, specific expertise in forensic pathology is obtained through a one-year fellowship, during which the pathologist participates directly in death investigation, performing forensic autopsies and testifying in court about his or her findings. In addition to medical training, FPs are required to become familiar with other areas, such as wound ballistics and trace evidence. Most Canadian FPs have obtained fellowship training at a medical examiner’s office in the United States. This training (and subsequent examination) allows for qualification in forensic pathology by the American Board of Pathology. At the time of this writing, the Royal College of Physicians and Surgeons of Canada is in the process of recognizing and developing subspecialty certification requirements for forensic pathology in Canada.

Employment in Forensic Pathology

After receiving the necessary training and qualifications, FPs in Canada typically find work with either a Coroner's Office or Medical Examiner's Office. These offices operate on a provincial or territorial level, and are defined by statute. Most jurisdictions in Canada have a coroner system, in which death investigation is the responsibility of lay-persons or non-pathologist physicians. The Coroners Service then employs or contracts with FPs to perform autopsies as necessary to determine the identity of the deceased, and how, when, where, and by what means he or she died. This is in contrast to a medical examiner system in which the FP (i.e. medical examiner) takes direct responsibility for the overall death investigation system, including not only the performance of autopsies, but also the investigation of the scene and circumstances of death. Both systems share the same goals of accurate identification of cause and manner of death, and promotion of public health and safety.

Full-time forensic pathologists are employed in only 10-15 cities in Canada. Outside of the major population centres, many pathologists participate in forensic work part-time, in addition to their other hospital duties.

Expertise and Scope of Practice of Forensic Pathology

FPs are trained to determine cause of death (e.g., ruptured aneurysm, hanging, or gunshot wound of the head), and manner of death, which is a one-word statement summarizing the circumstances under which death occurred: natural, accident, suicide, homicide or undetermined.

Interpretation of injury patterns and reconstruction of injury events are areas of expertise which differentiate FPs from other pathologists. Application of these skills is useful in determination of not only cause of death, but also manner of death. For example, wounds caused by a knife will tend to show different patterns in homicidal vs. self-inflicted injuries.

The FP's expertise will be applicable to more than just cause and manner of death. Examples of other questions that an FP might address include the following:

- What type of weapon caused this injury?
- How long could this person survive with these injuries?
- When did death occur?
- Does this deceased person have a hereditary medical condition that may affect others in his family?
- What role did drug use play in the death of this person?
- Is this child the victim of physical or sexual abuse?
- In a motor vehicle collision, was this person a driver, or a passenger?
- Are there any pathologic findings that might assist with identification of these decomposed remains?

A major tool for answering these questions is the autopsy examination. This is a postmortem examination with multiple components: examination of the clothing and other paraphernalia; external examination documenting overall condition of the body, any identifying marks or scars, injuries and evidence of disease; collection of toxicology samples; and examination of the internal organs, including microscopic examination, for evidence of injury, disease or poisoning. Photographic documentation, x-rays and other procedures (e.g. cultures of body fluids or tissues) are performed as appropriate. The examination also

includes collection of other forensic evidence, such as retained bullets, hair or fiber evidence, clippings or swabs for DNA analysis, and documentation of sexual assault. These materials are typically turned over to a forensic scientist (criminalist) in a forensic laboratory for further examination.

The average FP performs between 150 and 350 autopsies each year. Approximately one-third to one-half of these are natural deaths. Typically, these are deaths which have occurred suddenly and unexpectedly, in people with no previous symptoms or medical history to explain how death occurred. A much smaller proportion of cases (5-15%) are homicides, and the remainder are suicides or accidents, including motor vehicle fatalities, drug overdoses, drownings, workplace accidents, and others. The majority of the FP's average workday is spent in performing autopsy dissections, documenting findings and preparing reports of these examinations. The autopsies are typically performed in a hospital morgue or designated coroner or medical examiner facility, with a pathologist assistant or morgue technician to aid with dissection and moving the body. An average autopsy examination will take one or two hours to perform, but more complex cases may require much more time, even days. The FP may consult with other experts (e.g. toxicologist, neuropathologist, microbiologist) to obtain additional specialized testing. Toxicology testing is particularly important, both because drug overdose deaths are common, and because such cases usually show no definitive findings at autopsy.

It is important to recognize that the autopsy findings and the findings of any other ancillary studies must be interpreted in the light of other information about the scene and circumstances of death. An autopsy is not a substitute for good investigation, and will not provide all of the answers by itself. Before starting any autopsy examination, the FP will obtain as much information as possible about the case, including medical records and scene findings. This information may be just as important as the autopsy itself in determining the cause of death. The autopsy, scene findings and circumstances of death will complement each other. Forensic pathologists are trained to evaluate all of the available information in coming to a conclusion about the cause and manner of death.

In Canada (and most if not all jurisdictions in North America), the FP infrequently attends the scene of death. Scene investigation is typically performed by police and trained coroner or medical examiner investigators. The pathologist's attendance may be requested in homicide cases, or if findings at the scene are particularly difficult to interpret. If necessary, in cases where he or she has not attended the scene, the pathologist may request scene photographs to review. The FP may be called upon to describe his or her findings in court, most commonly in criminal cases (i.e. murder), but also occasionally in civil proceedings or coroner's inquests. The pathologist is an expert witness, able to give opinion evidence in the field of forensic pathology. It is important that an FP be able to express complex medical concepts and terminology in a way that jurors and judges can understand. Although the FP is usually called to testify by the prosecutor, he or she is not testifying "for" the prosecution or the defense, but rather is an impartial witness representing the deceased.

Further Information on Forensic Pathology

American Board of Pathology - <http://www.abpath.org/>

National Association of Medical Examiners - www.thename.org

<http://www.forensiconline.com/generallink.htm>

<http://www-medlib.med.utah.edu/WebPath/FORHTML/FORIDX.html>

OTHER FORENSIC SPECIALISTS

There are many other forensic disciplines that are separate from the crime lab and the police force. Some scientists within these disciplines are employed full-time in the forensic field, whereas many others are employed full-time in other areas, such as university professors and museum curators, and are on-call for police, coroner or medical examiner as consultants when a case requires their services. Depending on their science, they may be called many times in a year, or only once or twice. Most are required to have a minimum of a Ph.D. in their science and a strong academic and research background.

Forensic Odontologist

Forensic dentists or odontologists are professionals whose added forensic training helps identify victims of crime or accident, but can also help to solve rapes, catch child molesters and even catch killers. There are many ways forensic dentistry can help in an investigation. The public's first exposure to forensic dentistry also known as forensic odontology is usually via the media when we hear or read that some victims will be identified "by dental records" but the public seldom realizes just how vital dental records are for victim identification.

A multi-disciplinary approach is the only way a proper investigation can be completed to the satisfaction of the victim; the criminal; the victim & criminal's families, and the investigators. The unique knowledge and manual skills of a forensic dentist bring an important resource to the multi-disciplinary investigative team. Forensic dentists are involved in several areas of investigation: victim identification (most common), bite mark investigation, abuse recognition (on victims of all ages), mass disaster response teams and civil litigation.

Importance of Dental Evidence in Identification

Approximately 95% of forensic dentistry cases involve victim identification. This may be the identification of a single individual whose remains are beyond recognition due to decomposition, burns or severe trauma or the identification of a large number of individuals in a mass disaster.

The human dentition is considered to be highly individualizing. If one examines the human mouth, every tooth can be considered as a box on a table with five (5) surfaces; four side walls --- the front (mesial) and back (distal) walls; the tongue (lingual) side and the cheek (buccal) side. The fifth 'wall' is the top or biting (occlusal) surface. The human adult dentition normally has thirty-two (32) teeth and with each tooth having five surfaces, there are a total of 160 (5 x 32) surfaces to check. With approximately sixteen different ways to restore a single tooth, the compounded combinations for the forensic team are enormous.

The human dentition is particularly valuable in victim identification because of the survivability of dental structures. Enamel is the hardest substance in the human body, followed by dentine and thirdly by bone. A tooth therefore, is resistant to changes associated with time, water, decomposition, drying, and temperature. Dental fillings used to repair & replace teeth are also resistant to many of the same common factors, making them easily identifiable as well. Restorations are stable to all the same factors as teeth, and some can even resist temperatures in cremation of anatomical remains.

All this makes dentistry a valuable source of ante-mortem (ante means ‘before’ and mortem means ‘death’) information useful in identifying a patient should the need arise. Dental records of patients in any practice, for the forensic dental professional, are called ante-mortem records. Dental records taken on the remains of a victim of crime or accident are called post-mortem records (post means ‘after’).

Since almost every dental patient has had radiographs (X-rays) taken, ante-mortem records of dental structures are very common.



A considerable amount of dental evidence is present in a mouth such as this which allows forensic dentists to identify the decedent once ante-mortem dental records are available (Courtesy of American Board of Forensic Odontology).

A forensic dental professional requires a basic working knowledge of other forensic modalities such as: anthropology, criminalistics, engineering, general sciences, jurisprudence, (odontology), pathology-biology, questioned documents and toxicology. The scope of forensic dentistry also requires the forensic dental professional to have many primary qualifications, starting with a broad background in general dentistry; basic (unique) knowledge of head & neck anatomy; of radiographs (x-rays) & oral pathology; and of the various types and forms of restorative procedures. In cases of mass fatalities, such as hotel fires, plane crashes, 9/11 and Hurricane Katrina, forensic odontologists are particularly important in identifying the dead.

Bite Marks

Biting is a common aggressive act especially during sexual encounters and like finger prints, can put a suspect at the crime scene. Bite marks can be both offensive and defensive. Offensive biting by the attacker is used to gain control of victims by inflicting pain. Defensive bite marks are done by victims to fend off an attack; to leave evidence behind; or can be self-inflicted to mask other trauma from an attack.

Bite marks have unique bruising patterns and may suggest various scenarios. They can be single or double, oval shaped bruises, located anywhere on a body/victim. They can be multiple and from a single or multiple biters. They can also be self-inflicted. Proper examination by a dental professional can determine if they are a result of a single attack or multiple attacks over a period of time. Unfortunately, biting is very common in child (and all victim) sexual abuse situations, where the attacker bites the victim.



Human adult bite mark on buttock of a 2-year old child (F. Stechey).

One very important aspect of any bite mark is that bite marks put a biter at the crime scene, the crime scene being the victim's body. Let's examine an actual bite mark case. For orientation, let's first become familiar with the appearance of bite marks on human skin. Most bite marks are oval in shape with one arch of the oval being more heavily bruised than the opposite arch. The heavier bruising generally is from the lower (mandibular) arch and is due to the strength and power of the mandible and muscles of mastication. The upper arch stabilizes the tissue and generally has less power, therefore less bruising.

Case Example. In the following bite mark photograph of another bite mark, the oval appearance and the heaviness of one arch to the other is apparent. Studying the bite mark more closely, one can see three distinct bite marks on the upper arch and two for the heavier bruised lower arch. This gives the analyser an orientation of the biter's position on the victim. In this case, the bite mark can be orientated to the biter's right & left hand side; upper and lower arch. As one carefully studies the lower arch, a "profiling" of the bite shows the two lower central incisors displaced more buccally (to the lip side) and the two lateral incisors displaced more to the lingual (tongue side). It can be assumed from this alone that the actual biter would have the same arrangement with his lower anterior teeth.



Case example bite mark (Photo by Dr. Richard Souviron, Dade County Florida)

This bite mark was found on the body of a homicide victim and made available by forensic dentist Dr. Richard Souviron of Dade County, Florida. Dr. Souviron profiled the bite mark and once a suspect was detained by Dade County police officials, the profile proved to be correct.

The next photograph shows the actual dentition of the primary suspect in this case, a serial killer proven to be at the crime scene of this homicide because he left his bite mark on the victim. The bite mark was the only *objective* evidence that put the biter at the homicide scene.



Dentition in suspect in previous bite mark photo (Photo by Dr. Richard Souviron, Dade County Florida)

Dr. Richard Souviron was able to compare bite marks of the serial killer's last three victims as being from the same person; the same biter, and in Court, able to state with reasonable medical-dental certainty, that the biter was in fact, --- Ted Bundy. Based on this objective evidence, the jury convicted Ted Bundy of the homicides and in Florida, Ted Bundy was electrocuted for these killings.

Educational Requirements for Forensic Odontology

Forensic Odontologists are first and foremost, dentists. To become a dentist, you will require either a basic Bachelor of Arts (with science options) or a Bachelor of Sciences undergraduate degree to qualify for entrance into a Faculty of Dentistry. A manual dexterity entrance exam will then determine your manual skills for the profession. Passing this will then have admissions people place attention on your BA or BSc marks overall. The higher the marks the better, because as the saying goes, many may apply but few are chosen. Dental school admission is a prime example.

For a dental assistant or hygienist, the same basic schooling in those specific fields is required, and the higher the marks the better.

Experience in the vocation is your next priority, and many forensic agencies will require a minimum of five (5) years experience in the regular workplace. During this time, it is important to take extra courses in the forensic areas. One of the primary and best introductory programs can be found with the Armed Forces Institute of Pathology in Washington, D.C. Their website contains all the information:

www.afip.org

Further Information on Forensic Odontology

The best information can be received by getting a copy of the ‘Manual of Forensic Odontology’ from the American Society of Forensic Odontology (see website below).

American Society of Forensic Odontology: <http://www.asfo.org/>

American Board of Forensic Odontology - <http://www.abfo.org/>

British Association for Forensic Dentistry <http://www.bafo.org.uk/>

Australia Society of Forensic Dentistry <http://www.uq.edu.au/asfd/>

Forensic Anthropologist

Forensic anthropologists are consultants who provide scientific expertise in legal contexts on an irregular basis. Most have full-time jobs as university professors or museum curators in the broader discipline of physical anthropology. Their scientific expertise lies in knowledge of human anatomy, specifically the skeleton and of individual bones and teeth. To many researchers in the field of physical anthropology the discipline is now known as “biological anthropology” to show consideration for the study of genetics within anthropology and emphasize the relationship between biology and anthropology. Many practitioners are also qualified in the study of taphonomy, the science of what happens to a body after death and before it is found, depending upon different environmental influences (a “sister” discipline called forensic archaeology). Forensic anthropology and archaeology are the disciplines that interconnect these techniques of anthropology to the law. Forensic anthropologists are specialists in the documentation of trauma to the body, its time of occurrence (before, during, or after death), postmortem alteration of bone, and construction of biological profiles of unknown individuals especially after cremation and in certain burial environments, where DNA can not survive and is useless in identification of the deceased.

Physical anthropologists are experienced in the study of skeletal remains excavated from archaeological sites, which is knowledge that is useful when applied to the modern crime scene. Because of today’s spotlight on forensic science, there is a greater emphasis for anthropologists to be trained in aspects which directly apply to the criminal investigation of death. In addition to graduate degree programs in biological anthropology which may offer specialization in forensic anthropology, several Canadian universities offer forensic science degree programs which include training in anthropology. Forensic anthropologists will usually hold Ph.D.s in physical or biological anthropology, conduct research involving modern forensic data, and attend national and international conferences to maintain their qualifications. Local and regional seminars and workshops, as well as short refresher courses at accredited institutions further help to hone the anthropologist’s skills. Though no equivalent program yet exists in Canada, certification through the American Board of Forensic Anthropology is an important consideration for being an expert witness in a court of law.

The casework of a forensic anthropologist is varied. Most of the time, they are called upon to identify unknown skeletal remains (See following figures). The remains can range in completeness from isolated bones or fragments to full skeletons.



Examples of the variations in burned human bone from several individuals. O.C.M.E. Edmonton

For each case the forensic anthropologist examines there are 11 questions they attempt to answer: (1.) is it bone? (2.) is it animal or human bone? (3.) how many individuals are represented? (4.) evidence for time since death, (5.) sex of the individual, (6.) age at death, (7.) ancestry (“racial” origin), (8.) stature (height) of the individual, (9.) evidence of trauma that may assist in determining cause (the exact reason someone died) or manner of death (homicide, suicide, accidental, natural or unknown), (10.) any individualizing features such as evidence of medical devices; bone anomalies; bone pathologies (disease processes), old fractures, fingerprints, amputations, etc., and finally, (11.) identity of the deceased. Besides creating a biological profile of an individual, the forensic anthropologist attempts to create an “osteobiography”. An osteobiography is a reconstruction of the ante-mortem biological profile which includes attempting a reconstruction of a victim’s way of life up to the time of death. The more comprehensive the information gained from the remains, the better is the chance of matching them to a list of missing persons or confirming their identity when other records become available. Anthropologists are trained to recognize human skeletal variation, especially in cases where the body is unrecognizable. For example in cases of trauma (body dismemberment), cases of burning (house fires), and cases of high body fragmentation (bombings or airplane crashes).



A forensic anthropologist examining human remains.

A forensic anthropologist may be asked to give an opinion on the source of a break in a bone and whether the damage occurred before, after, or around the time of death. This may help to establish how the person died and whether there was a crime involved. Taphonomy may help to determine whether the damage was the result of, or could have been masked by the effects of scavenging animals. On the other hand, marks in bones, such as saw bones, may be distinctive enough to help identify the class of tool that a criminal could have used to inflict damage on a living or deceased person.

A common question put to the anthropologist when skeletal remains are found is how old they are. Post-mortem interval is an important consideration also in the case of partly decomposed remains, and the anthropologist will work closely with the pathologist to determine time since death. The anthropologist may assist at the hospital/morgue autopsy, study remains in the university or museum laboratory, or lend expertise at the scene of discovery. They are usually called by the police when needed but they may also be called by the forensic pathologist/coroner or the chief/deputy medical examiner, depending on the province or territories death investigation system when remains are found.

In the past, most forensic anthropology cases were individual cases presented by law enforcement agencies. More recently, forensic anthropologists have come to the fore in world wide cases of genocide investigations and documentation for future generations of war crimes and crimes against humanity, and closer to home, in serial homicide investigations in Canada. Most positions involve contracts of varying lengths and are rarely permanent.

Further Information on Forensic Anthropology

Currently, there are approximately 20 forensic anthropologists on call in Canada. Job openings are limited and most often entail university academic positions. More information may be obtained from the following world wide web sites:

<http://www.forensicanthro.com/>

American Board of Forensic Anthropology (ABFA)

<http://www.csuchico.edu/anth/ABFA/>

Canadian Association for Physical Anthropology -

<http://www.utoronto.ca/~chan/capa/index.html>

American Association of Physical Anthropologists (AAPA)

<http://physanth.org/>

C.A. Pound Human Identification Laboratory

<http://web.anthro.ufl.edu/capoundlab.shtml>

Forensic Artist

Forensic art can best be described as any art that assists in the identification, apprehension or conviction of offenders, or that aids in location of victims or the identification of unknown deceased persons.

Forensic art can be categorized as follows;

- ***Composite imagery***
Used to produce a near likeness of a suspect based on a witness description
- ***Image modification and image identification***
Manipulation, enhancement and comparison of photographic images.
- ***Reconstruction and postmortem identification aids***
Techniques used to assist in the identification of human remains in various stages of decomposition

The majority of Canadian police agencies have a fully qualified forensic artist on staff. These forensic artists are either sworn police officers or civilian staff members. Forensic art services are usually provided in addition to regular duties.

Education and training for forensic art is limited in Canada. The majority of Forensic artists have learned their craft in the United States. Various forensic art courses can be found on the internet. The Scottsdale artist school provides some of the best training to both police and civilian artists. The FBI academy provides in depth training to police artists.

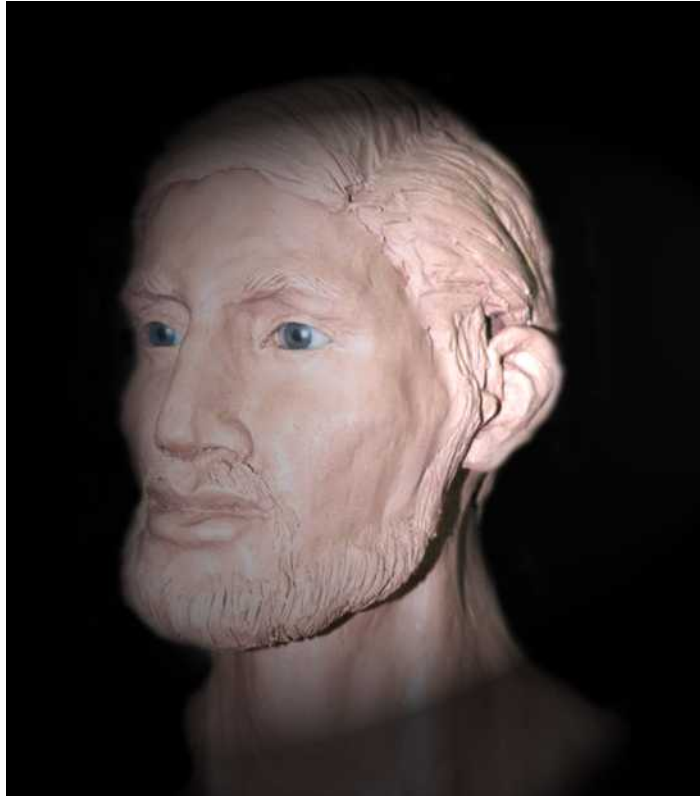


An example of composite art.

The majority of forensic artists provide composite art services. The artist will work closely with a witness to obtain a near likeness of a suspect. The composite image is used to

help in suspect identification, elimination and witness corroboration. The number and types of cases the artist will be involved in varies from agency to agency.

Very few artists in Canada are fully trained in reconstruction and postmortem aids. These techniques are used to aid in the identification of unknown deceased persons. Postmortem aids are used with remains in a certain state of decomposition. Reconstruction techniques are used with skeletal remains.



An example of a facial reconstruction.

Further Information on Forensic Art

www.karentaylor.com

www.forensicartist.com

Criminal Investigative Analyst (Behavioural or Criminal Profiler)

Criminal Investigative Analysis or Criminal Profiling as it is referred to in popular media, is best described as the analysis and interpretation of an offender's behaviour as exhibited through the crime/crime scene. The analysis of criminal behaviour as an investigative tool was originally borne out of the work completed by a select number of highly skilled investigators assigned to the Behavioural Sciences Unit (BSU) of the Federal Bureau of Investigations (FBI) at Quantico, Virginia. Though the idea of inferring a suspect's personality and characteristics was not new, it was the BSU who was responsible for first developing a specialized training protocol based on experience, education and research for investigators in the field. This protocol helped to ensure the integrity of the technique as well as the competency of the analyst. In 1992 with the suspension of the FBI's program, the International Criminal Investigative Analysis Fellowship (ICIAF) became the training and accreditation authority for the certification of Criminal Investigative Analysts. The ICIAF is now responsible to ensure that future analysts are certified to meet a minimum standard of competency prior to offering their opinions as "Criminal Investigative Analysts" to police agencies or the courts. Certification for all analysts can only be acquired through the successful completion of the ICIAF Understudy program. The understudy program is essentially a 2 -3 year program wherein the potential analyst "apprentices" under the direct supervision of an ICIAF member. Upon completion the candidate must successfully complete both a written exam as well as an oral board examination.

Candidates who wish to be considered for the ICIAF Understudy program must meet the following general criteria, in addition to other criteria relating to their sponsoring agency:

- Sworn law enforcement officer
- Recommended 10 years law enforcement experience
- Minimum of three years recent experience investigating crimes of interpersonal violence, specifically homicide, sexual assault and/or other serial violent crime
- Superior level of investigative skill in the area of interpersonal violence and must be able to provide written documentation of their skill
- Superior communication skills, both orally and in writing
- Must be approved and sponsored by an ICIAF member in good standing
- Recommended post secondary education in criminology, psychology

Criminal Investigative Analysts receive specialized training in 18 separate areas of expertise including but not limited to: sexual assault offenders and typologies, sexual homicide, forensic pathology, crime scene reconstruction homicide investigation, equivocal death analysis, child abduction and molestation, interview and interrogation strategies, threat assessment, normal and abnormal behaviour and media strategies.

Upon certification, Criminal Investigative Analyst's are typically called upon to complete but are not limited to the following analyses:

Profile of the Unknown Offender

This service is designed to assist the investigative team in identifying and prioritizing potential suspects. Investigators typically receive a written or verbal report detailing a variety of analytical opinions and the reasons for those opinions. Also included is a personality description of the type of person who most likely committed the crime. Investigative suggestions are offered to assist investigators in applying the analysis operationally. This service requires an in-depth analysis of the crime(s) involved.

Indirect Personality Assessment

This service involves the analysis and interpretation of the personality, habits, and behaviour of a known individual, based on information furnished by people other than the suspect. Interview / interrogation strategies, undercover approaches / scenarios, and/or intervention strategies (in the case of threats and stalkers) can flow from this service.

Threat Assessment

This service involves the analysis of threats made against any individual or corporation. An assessment of potential risk may assist in developing operational plans, allocating resources or making strategic decisions in managing a perceived level of risk. Again a written or verbal report is provided outlining an assessment of the potential for violence based on the information known at the time. The reasons for that assessment are provided, along with investigative and intervention suggestions. Threat assessments have been provided in cases of domestic violence, stalking, threats against police officers, threats of school violence, threats against judges or politicians, high risk offenders being released on warrant expiry, high risk offenders living in the community, anonymous threats, and product tampering.

Equivocal Death Analysis

This service provides a written opinion as to the most likely manner of death (accident, suicide or homicide), based on a thorough analysis of all the information known about the victim and the circumstances of the death including reconstructions and evaluation of suicide risks.

Early-Stage Investigative Consultation

On-site or telephone consultation, in the early stages of an investigation providing a behavioural interpretation of the facts as they are known at the time. This process is less than a full profile or personality assessment, and may change as more information becomes known. This service can be useful in generating early leads, identifying the significance of existing information or interpreting the crime scene.

Career Information

There are approximately 75 certified Criminal Investigative Analysts world wide. In Canada there are currently 8 certified Criminal Investigative Analysts and 5 understudies. In addition to the approximate 3 year commitment in the understudy program, understudies are also required to make a minimum 3 year commitment to work as a Criminal Investigative Analyst as a primary role, upon certification.

Further Information on Criminal Investigative Analysis

Academy of Behavioral Profiling - <http://www.profiling.org/>
FBI – <http://www.fbi.gov>

Forensic Psychologist

There are several specialties involved under the heading of forensic psychology, or more correctly, psychology and law. It is a broad area involving the application of scientific and professional aspects of psychology to issues and questions relating to law and the criminal justice system. The following information is derived from www.ap-ls.org and an excellent paper entitled Careers in Psychology and the Law: A Guide For Prospective Students - www.ap-ls.org/students/careers%20in%20psychology.pdf. Much more detailed information can be found at that site, including extensive interviews with forensic psychologists.

The main subspecialties of forensic psychology include Clinical-Forensic Psychology, Developmental Psychology, Social Psychology, Cognitive Psychology, and Community Psychology.

Clinical Psychology:-

Clinical Psychologists are concerned with the assessment and treatment of persons with mental disorders who are in conflict with the law. They practice mostly in prisons, secure forensic units, court services units or in private practice, consulting in forensic assessments and treatment where it relates to legal issues. They may also be involved in research in areas such as violence risk assessment and treatment needs and responses. Clinical psychologists do provide assessments of individuals for the courts and criminal justice system, such as testifying as to whether a person is not criminally responsible by reason of mental illness, or whether, if paroled, a person would be a risk to society. It should be noted, that despite television portrayals, clinical psychologists are not forensic profilers. “Profilers” or Criminal Investigative Analysts in real life are almost all sworn police officers.

Developmental Psychology:-

Developmental psychologists concentrate on psychological issues involved in human development from birth to death. They are often involved in consultation and research that relates to children and adolescents involved in legal issues, such as child testimony, child competence, needs of children in family disputes, children’s knowledge and decision making abilities when in conflict with the law, as well as policy development regarding children and adolescents. If they testify in court, it is usually more to do with general issues related to child development rather than on individual assessments. They may be asked to give expert evidence in such issues as whether a child or elderly person is competent to make decisions about their lives.

Cognitive or Social Psychology:-

Cognitive or social psychologists are primarily researchers and lecturers in human perception and memory. They focus on how humans think, reason and remember. Their legal work relates to such issues as eyewitness testimony, accuracy of memory and detecting deception. They are often involved in research relating to how juries think and make decisions. Most are academics.

Community Psychologists:-

Community psychologists work in academia as well as in the community in such areas as government agencies, non-profit agencies, foundations and community based advocacy settings. They focus on how the social forces in the outside world affect people, families and communities.

Training and Education in Forensic Psychology

Practicing forensic psychologists will have a minimum of a BA in Psychology, followed by graduate work in their specialty. In almost all cases, a Ph.D. is required, although some positions in advocacy and in assisting practicing psychologists exist for those with MA's. There are now a number of universities that offer Ph.D. programs in Psychology and law including Simon Fraser University. In 1978, the American Board of Forensic Psychology was established.

Clinical Psychologists require a doctoral degree (Ph.D. or Psy.D) in clinical psychology and licensure as a psychologist. Developmental psychologists require graduate training, usually to the Ph.D. level, in developmental psychology and may also have some formal legal training. No internship or licensure is required. Cognitive and social psychologists have graduate training in traditional social or cognitive psychology which may also include a focus on law. Those trained only in social or cognitive psychology may receive training in the law at the post-doctoral level, although this is not necessary. Community Psychologists receive their graduate training in community psychology programs with emphasis on law or policy.

Some forensic psychologists may go beyond their Ph.D. in Psychology and Law and obtain a Juris Doctorate (JD) or Masters of Legal Studies (MLS). Psychologists who are primarily researchers, educators or court consultants, certification is not necessary although it would still be valuable. Such psychologists do not present a forensic assessment on a given individual. However, psychologists who do testify to forensic assessments of individuals or treatment services, should be further trained in the delivery of applied services such as clinical and counselling psychology, in the delivery of forensic services and should be licensed. Psychologists wishing to specialize in clinical forensic practice, should be board certified by the American Board of Forensic Psychology.

Further Information on forensic Psychology

American Psychology and Law Society - www.ap-ls.org
www.ap-ls.org/students/careers%20in%20psychology.pdf

American Academy of Forensic Psychology and American Board of Forensic Psychology <http://www.abfp.com/>

Forensic Botanist

Forensic botany is the application of plant science to legal cases. Botany is one of the biological sciences, and a forensic botanist must be a trained scientist with a solid grounding in the methods of scientific inquiry. Some forensic laboratories carry out certain botanical analyses in house, such as the identification or genetic analysis of *Cannabis* samples. However, the vast majority of police investigations involving the identification and interpretation of botanical evidence rely on a botanical consultant to conduct the analyses and provide a report to the investigating authority.

Forensic botany is an underutilized forensic tool, considering that plant parts such as leaves, seeds, wood and microscopic pollen and spores are found virtually everywhere, and can be collected and used to assist investigators. Much plant evidence falls into the category of trace evidence, and can be used to link a suspect, a victim, or an object like a car to the scene of a crime. Such associative evidence has been used to help identify a murder location, to determine if a body has been moved or not, or to challenge a suspect's alibi. A murder case in the USA involved testing a suspect's claim that he had not been near a farm where the farmer was killed and his truck stolen. Examination of the hair and clothes of the suspect revealed large quantities of corn pollen that linked him to a flowering cornfield and assisted in gaining a conviction. Every case has its own unique aspects, and the botanist must be broadly trained to understand and interpret different aspects of plant anatomy, chemistry, taxonomy, and ecology.

Many different aspects of plant science can be applied to certain forensic cases. The fact that woody plant stems and roots produce annual growth rings can be very useful in establishing time since death in gravesites. Disturbances of the soil and the presence of a decomposing body can alter the growth ring patterns of roots and small trees and shrubs in the immediate vicinity, and by counting back growth rings, the year and sometimes season of disturbance can be determined. Similarly, disturbances of the soil lead to changes in the vegetation that recolonizes the disturbed area, and this can lead a plant ecologist to identify possible gravesites.

Some botanists with training in plant anatomy are able to identify plant residues from the last meal of a homicide victim, leading to possible associations with certain restaurants or residences where particular fruits, seeds, or vegetables were consumed. Specialized knowledge of microscopic plant tissues is of course needed to make such identifications. Many different variations of such themes occur in reality, and broad training in plant science is necessary to appreciate the potential of various analytical methods.

In the last decade or so, molecular biology is gaining importance in forensic botany, following on the many successes of DNA analysis and "fingerprinting" of individuals in humans and other animals. The future of forensic botany will certainly involve the application of techniques such as AFLP (amplified fragment length polymorphisms) analysis of DNA samples. Plant tissues contain 3 kinds of DNA (nuclear, mitochondrial, and chloroplast) so there is no lack of raw material for analysis. There are already several cases in the literature which demonstrate that individual plants can be "fingerprinted" using DNA, and provide solid links between suspects and specific locations where a crime occurred. The DNA databases still need to be constructed for most plant species, but once they are, plant DNA analysis will become a key technique in future criminal investigations.

In order to become a forensic botanist, an advanced degree in plant science is highly desirable. A Master's degree, or ideally a Ph.D. will provide the credibility that is needed when one is called upon to testify in open court, and defend your report, its methods, and its conclusions. This can be a daunting experience, and the more training and experience you can gain, the better.



A forensic botanist examines plant evidence from a crime scene

There are a few independent forensic botanical consultants in North America and elsewhere, but most cases are done “on the side” by academics at universities or colleges, or experts from institutional herbaria (dried plant collections). In Canada, a forensic botanist may receive 1-2 cases a year on average, with a high of 5 cases. There are many people with the qualifications to identify plants and interpret their possible meaning in an investigation, but many individuals do not want to be involved in criminalistics (criminal investigation), and especially not in court proceedings.

Although plants are common in association with crime scenes, they are not often used as part of the investigation. Other techniques are often more familiar and well-tested, so plant evidence tends to be used only for situations where its value is clear, and other techniques are potentially less useful. There are several instances where plant evidence has played a major role in resolving cases, and forensic botany is poised to expand significantly as new molecular techniques and applications such as forensic palynology (pollen and spore analysis) are developed for use in North America.

Further Information on Forensic Botany

<http://myweb.dal.ca/jvandomm/forensicbotany/>

<http://members.fortunecity.com/smashx14/forensics.html>

<http://www.sfu.ca/biology/faculty/kermode/laboratory/forensic-botany.htm>

Coyle, H.M. (Ed). 2005. Forensic Botany, principles and Applications to criminal Casework. CRC Press, FL. USA

Forensic Entomologist

Forensic entomologists study the insects associated with a human body or an animal in order to estimate the minimum elapsed time since death. Entomologists can also determine the timing of dismemberment or decapitation, whether the body has been moved or disturbed after death, the presence and position of wound sites that are no longer visible to the naked eye and are also consulted in cases of human or animal abuse. Insects can also be used as DNA specimens to reveal the DNA of the victim they fed upon. As well, they can be used as toxicological specimens, to determine whether the victim had drugs or their metabolites in their system when they died. Both of these examinations, however, would not be performed by an entomologist but by the forensic biologist or toxicologist respectively.

Forensic entomology is used primarily in cases of homicide, although may also be involved in suicide, accidental and natural deaths if time of death is in question. Carrion insects are attracted to remains from immediately after death until years have elapsed so an understanding of these insects, their ecosystems and their dynamics on the corpse, allow a forensic entomologist to interpret many aspects of the death, most importantly, when death occurred. Medical parameters are extremely valuable in estimating elapsed time since death in the first few days after death, but are not useful after 24-72 h, therefore, forensic entomologists are usually involved from 3 days to a year or more after death, and can be involved in fresh deaths on a case by case basis.

Forensic entomologists attend crime scenes and autopsies to collect insects. They transport this insect evidence back to their own laboratories, usually within a university setting, to rear and analyze the insect evidence. These must be fully secure labs. Forensic entomologists produce a written report and will present this report and their analyzes in a court of law.



Blow fly maggots massing on a pig carcass.

Forensic entomologists usually have a minimum of a Ph.D. in the field of entomology followed by years of experience in the field of entomology. Expertise in medical and

veterinary entomology and ecology is most common, with forensic entomologists having specific expertise in carrion insects, particularly Diptera and Coleoptera. Research, academic publications and regular attendance and contribution at entomological conferences is expected. Board Certification in the American Board of Forensic Entomology requires a Ph.D. in entomology, followed by at least five years of regular and active experience in the field of forensic entomology.

Most forensic entomologists in North America are employed as university professors in entomology and consult to the police when required. They, therefore, have a ‘regular job’ as an academic and are called to crime scenes on a case by case basis. As forensic entomology becomes more well known, some are fortunate enough to be hired into an academic position specifically in forensic entomology. However, especially in Canada, due to the low numbers of homicides and cold and extensive winters in some regions, there is not a great demand for forensic entomologists, with only 10-20 cases per year requiring the services of an entomologist. This may well increase as more police officers and agencies become aware of the value of this evidence.

Further Information on Forensic Entomology

American Board of Forensic Entomology

<http://www.research.missouri.edu/entomology/>

European Association for Forensic Entomology - www.eafe.org

North American Forensic Entomology Association -

<http://www.nafea.net>

<http://www.forensic-entomology.com/>

<http://www.rcmp-learning.org/docs/ecdd0030.htm>

Forensic Engineering

Pure Science vs. Engineering

Engineering (applied science) is not the same as pure science. Science in general uses the empirical method of analysis – that is, scientists usually run many experiments and use a lot of data to make conclusions. This method of decision making is called induction. Engineers, on the other hand, not only perform experiments and make conclusions like other scientists, but are also trained to take empirically obtained results from related but distinct situations, and use those data to make conclusions about situations that may be somewhat different from that studied with any empirical analyses. This method of inference is called deduction, which is quite different from what a scientist usually does.

When it comes to applying the physical sciences like mathematics, physics, or chemistry, engineers are licensed and regulated in their chosen discipline to ensure public safety. For example, engineers and scientists run many tests on steel to determine its properties, strengths, etc. They pull it apart, compress it, heat it, cut it – you name it. They also do this for other materials too. In doing so, they establish data relating to materials and how much they can stretch, or bend, *etc.* before coming apart and failing. However, when a building or bridge is constructed, only one is built. It would be crazy to build twenty or one hundred structures and test them to failure in order to ascertain how much load they can withstand. Instead, licensed engineers apply the science obtained through testing materials to deduce how much material to use, and how strong the structure will be, before it is constructed.

Definition of Engineering

The definition of the engineering profession's role is very broad. It includes the professional application of mathematics, physics, chemistry, metallurgy, electronics or any related applied subject, to report on, advise on, evaluate, design or technically inspect any physical structure, work, process or device used by humanity.

Some of the various traditional categories of engineers together with brief descriptions are listed below:

- Mechanical Engineers – apply science relating to the effects of forces and energy on the motion and deformation of solid and fluid substances;
- Civil Engineers – apply science relating to static structures such as bridges, complex buildings, and urban development;
- Electrical engineers – apply science relating to electricity, electrical systems, and electronics;
- Materials Engineers – apply science relating to strength properties and micro structures of metals and other materials; and
- Chemical Engineers – apply science relating to chemistry, and chemical industrial processes ranging from the production of pharmaceuticals to fuel.

Of course, in reality, the above categories are divided even more finely according to specific areas of a particular engineer's practice. For example, engineers specializing in accident reconstruction are commonly a subset of mechanical engineering, since mechanical

engineering is the traditional category relating most closely to the study of motions, forces, and energy associated with vehicles, vehicle components, pedestrians, and vehicle occupants.

Forensic Engineering

Though engineers can be involved in research or testing, most engineering relates to constructing, manufacturing, or designing things. On the other hand, forensic engineering relates to events that involve something that has already happened, come apart, or been damaged and an investigation is required in anticipation of possible legal proceedings. Physical sciences are applied to determine how these events occurred, and the conclusions are presented in a form suitable for any legal proceedings. In a sense, forensic engineers solve puzzles using the physical sciences.

Any event that can be described and analyzed using the physical sciences is within the realm of forensic engineering. The examples of such cases are boundless, and include motor vehicle accidents of all descriptions, slip and fall accidents, industrial losses, product liability cases and equipment failures. Whenever a building falls down, a car crashes, a building burns down, some machinery fails, or a water pipe unexpectedly bursts, etc., forensic engineers may well be involved in determining the sequence of events that led to the occurrence.

The possibility of attending court and testifying is always real in forensic cases, however more commonly the engineer will investigate an event, gather and preserve data relating to it through documentation, measurements, and photography, and their involvement will end with a report for a lawyer or insurance adjuster. Civil disputes usually resolve before trials start, but criminal cases tend to go to trial requiring any engineers for the crown or defence to be qualified as an “expert” by the court and to testify (and be cross-examined) on their findings.

While structures and designs of traditional engineers are subject to testing by natural laws, forensic engineering reports in general are, by definition, more abstract and usually not directly testable. Forensic engineers routinely have their reports reviewed by other engineers or experts retained by opposing counsel, pursuant to cross-examination. In order to be effective, the engineer must be properly qualified in the area in question and their conclusions must be consistent with all physical laws and data available in relation to events of interest. Forensic engineers must be prepared to vigorously justify and defend their conclusions by way of calculations, documentation, and photography.

Educational Requirements

A minimum of a four-year degree in engineering from an accredited university or the equivalent is required, and licensing as a professional engineer requires an additional four years of on the job training and supervision and the successful completion of exams given by the licensing bodies. With few exceptions, to be an engineer, or to even legally call yourself an engineer, you *must* be a registered member in the professional association in your locale. In Ontario for example, the association is called the Professional Engineers of Ontario. Further training in a specialized area, such as motor vehicle accident reconstruction or fire investigation or electrical fault determination must also be attained through various professional organizations. On-the-job training with other experienced forensic engineers is desirable to gain knowledge of the forensic investigation process and the legal system.

Types of Forensic Engineering

The type of forensic engineering that an engineer may eventually get involved in depends on what type of engineering degree they start out with, and what type of training they receive while working. Forensic engineers from virtually every type of engineering background exist.

However, forensic engineers are often employed full time where losses are large, and in today's society, two areas involving serious injuries and property damage i.e. losses, include motor vehicle collisions and fire losses. Though there are exceptions, mechanical engineers are the ones most often involved with a forensic analysis of these events.

Regardless of the type of loss, in addition to engineering, a good strong background in mathematics and physics assists with any such analysis. For example, though the physics learned in high school may well cover the basic principles of linear momentum and kinematics and thereby assist with the analysis of a motor vehicle collision, other aspects of physics such as angular momentum, energy, kinetic reactions between tires and the roadway, in addition to the particular characteristics of vehicles, photographic evidence, environment and vehicle operators, all must be considered in conjunction with other factors when analyzing and reconstructing a collision. Though some forensic engineering investigations do not require much in the way of calculations, mathematics associated with some analyses involves possible ranges of variables rather than discrete values, thereby complicating the calculations immensely.

Whether an engineer does forensic investigations full time or not depends on their area of expertise as some areas are more sought after than others. Also, lawyers and insurance companies tend to use those forensic engineers that specialize in forensic work, that are used to the scrutiny, and that have demonstrated the investigative skills required.





Examples of the types of accidents that would require the analyses of a forensic engineer.

Further Information on Forensic Engineering

<http://www.nafe.org/> National Academy of Forensic Engineers

<http://www.iifes.org/> - International Institute of Forensic Engineering Sciences, Inc.

www.apegga.org The Association of Professional Engineers, Geologists, and Geophysicists of Alberta

www.catair.net Canadian Association of Technical Accident Investigators and Reconstructionists

www.casterling.com

www.maceng.com

www.aace.ab.ca

Forensic Nursing

Forensic Nursing is a term new to most Canadian healthcare professionals even though the first registered nurses began working in the area of death investigation under the tutelage of Dr. John Butt in Calgary, Alberta in 1975 within the Medical Examiner's Office. Dr. Butt, a Forensic Pathologist found that the registered nurses he hired to work with families and other professionals in death investigation were ideally suited to the role. Their expertise and knowledge in medical conditions, mechanism of injury, medical records and their ability to communicate with families in distress as well as other professionals proved invaluable as investigators. From this beginning on Canadian soil, 21 years later emerged the specialty recognized as Forensic Nursing by the American Nurses Association in 1995.

In Canada, forensic nursing is not recognized formally as a specialty of nursing to date by the Canadian Nurses Association. It however, is recognized as a subspecialty of nursing with increasing numbers of registered nurses working in a variety of roles that come under the umbrella of forensic nursing.

Forensic Nursing is ably described by the "architect" of forensic nursing, Virginia A. Lynch in her book "Forensic Nursing" newly released in July, 2005. She states: "Forensic nursing is the application of the forensic aspects of healthcare combined with the bio/psycho/social/spiritual education of the registered nurse in the scientific investigation and treatment of trauma and/or death of victims and perpetrators of violence, criminal activity and traumatic accidents. The forensic nurse provides direct services to individual clients, consultation services to nursing, medical and law-related agencies, as well as providing expert court testimony in areas dealing with questioned death investigative processes, adequacy of services delivery and specialized diagnoses of specific conditions as related to nursing' (Lynch 1991)

In Canada, forensic nurses work in the areas of sexual assault as nurse examiners, death investigation in the Coroner's Service or Medical Examiner's Office, forensic psychiatric nurses in a variety of settings, forensic correctional/custodial nurses in correctional and/or prison facilities, child maltreatment/abuse nurses in clinics or programs, forensic youth services nurses in youth corrections, domestic and/or interpersonal violence programs as nurse examiners and in legal services as legal nurse consultants. Most recently, the forensic nurse educator is emerging as the demand for education in the principles of forensic nursing and forensic health sciences becomes apparent.

A forensic nurse may be involved in cases such as that of a child who has been physically abused, an elder who has been the victim of violence, an adolescent who has been sexually assaulted, a sudden death being investigated by the coroner's service, a victim of a motor vehicular incident in the emergency department, a youth in a forensic correctional center or any person who is the victim or perpetrator of a crime, violence or trauma.

The highest profile forensic nurse currently is the sexual assault nurse examiner who has changed the manner of health and forensic care provided to victims of sexual assault over the last 13 years in Canada. The sexual assault nurse examiner is a specially trained registered nurse who is able to assess, examine and care for a patient who has been sexually assaulted, but also collect and preserve all manner of forensic evidence, provide a chain of custody and document all findings as well as testify in court regarding those findings.

Canada, to date has not developed any guidelines for the education of the forensic nurse. The practitioners in the field have been utilizing international guidelines for both standards of practice and educational guidelines such as those developed by the International Association of Forensic Nurses. There is an international certification for Sexual Assault Nurse Examiners Adult/Adolescent (SANE-A) which a number of Canadian sexual assault nurse examiners have obtained since its inception in 2002.

Canadian educational programs for forensic nurses are limited to only two educational institutions at this time. Mount Royal College in Calgary, Alberta offers an on line 2 year certificate in Forensic Health Care. In January, 2005 British Columbia Institute of Technology in BC initiated the first classroom format in Canada with an Advanced Specialty Certificate in Forensic Health Sciences as a 2 year part time studies program. Education for forensic nurses has been either “on the job” or as in the case of sexual assault nurse examiners within a specific health care institution.

Job descriptions for forensic nurses are based on the roles they perform within the facility they are employed in. Forensic nurses can work in hospitals, clinics, prisons, correctional facilities, coroner’s offices, medical examiner’s offices, forensic mental health facilities, remand centers, child protection clinics or programs, police services as mental health responders to domestic violence calls as well as being in private practice as an educator or consultant.

The key components of the role of the forensic nurse are:

- Identification of trauma (assessment)
- Investigation
- Documentation (history) pertaining to the incident (intervention)
- Collection of evidence (specimens)
- Post investigative review (evaluation) (Lynch 2005)

The future of the forensic nurse in Canada is just beginning to emerge in health care. Forensic Nursing has been described as “the specialty of the decade” by Kathy Bell, former President of the International Association of Forensic Nurses. The job opportunities for forensic nurses is ever expanding as their experience and credibility become apparent in the judicial system particularly as in the role of sexual assault nurse examiners. Sexual Assault Nurse Examiners are the largest group of self identified forensic nurses with SANE programs in seven of the ten provinces to date. Forensic psychiatric and forensic correctional/custodial nurses are by far the largest population of forensic nurses in Canada. Upon the recognition of the specific role forensic nurses can play in health care, there is an opportunity for every emergency department in the country to employ a forensic nurse to provide their specialized skills to all patients within not only the emergency department but possibly the health care facility as a whole as well.



Forensic Nurse Examiner and Police Officer during evidence transfer in a sexual assault case.

Further Information on Forensic Nursing

International Association of Forensic Nurses - <http://www.forensicnurse.org/>

Sexual Assault Nurse Examiner-Sexual Assault Response Team <http://www.sane-sart.com/>

National Forensic Nursing Institute - <http://www.nationalforensicnursinginstitute.org/>

Forensic Education - www.forensiceducation.com

Forensic Nurse Magazine www.forensicnursemag.com

Forensic Nursing www.forensicnursing.org.uk

Lynch, V.A. 2005. **Forensic Nursing** Elsevier Mosby, ISBN number 0-323-02826-8

Giardino, A.P. *et al.* 2003. **Quick Reference Sexual Assault for Healthcare, Social Services and Law Enforcement Professionals** G.W. Medical Publishing, Inc ISBN number 1-878060-38-4

Crowley, S.1999. **Sexual Assault The Medical-Legal Examination** Appleton and Lange ISBN number 0-8385-8533-7

Fire Investigators

The field of Fire Investigations is really no different than any other investigative area and is a combination of science and experience.

The skills required are very similar, but are adapted to the subject of Fire.

Just like any other Investigator some basic training in the following areas will be required:

- Interviewing
- Note Taking
- Report Writing
- Photography/Video
- Scene Sketching
- Evidence collection
- Court Procedure

But a Fire Investigator also needs training in these areas:

- Fire Behaviour
- Fire Scene Examination (Determining “Area of Origin, Cause and Circumstance)
- Fire Code
- Fire Protection Systems
- Building Construction
- Flammable & Combustible Gases

Then further training in:

- Thermal Imaging Camera
- Vehicle Fires
- Explosives
- Scene Reconstruction

The field of Fire Investigations is a very interesting area and is always challenging. No one scene is ever the same. They can be similar in some ways, but there are so many factors to take into account and then you throw the human factor in there as well.

To be a good Fire Investigator, **a person should have been or still be a Fire fighter**. As a Fire Investigator, a person will have a better understanding of fire behaviour and what a firefighter goes through when they are fighting a fire, if they have already experienced it themselves. A fire scene is different from most scenes because of the heat and smoke. When a firefighter goes into a burning building, it is pitch black, there is lots of heat and the firefighter does not know the layout of the place.

So the firefighter is in there, blind as a bat, adrenalin pumping like crazy and going through the place like a bull in a china shop. They are on their hands and knees, reaching out to feel what’s around them and tossing everything out of their way. Now, as an investigator, not a fire investigator, you come into this house that was once a home and it looks like a bunch of vandals have gone through the place. Everything is upset, in shambles and it looks like someone was on a destruction mission, when in fact, the firefighters were doing what they were taught so that they can rescue anyone that was inside and/or get to the seat of the fire.

A fire investigator arrives at the scene, speaks with the fire crews and then can relate to what they encountered when they were inside the burning building. A good fire investigator, with firefighting experience, can walk into the scene and almost see what the firefighters were doing while they were in there. Police often refer to the firefighters as “The Evidence Eradication Team” as much evidence in a crime scene can be destroyed by firefighters, but in most cases they have no choice, as they are trying to save lives and extinguish the fire. Even in a vehicle fire, there can be lots of evidence originally, but it can either be washed away by the water used to extinguish the fire, or the scene will be disturbed by the crews as they access the vehicle.

As most fire investigators come from the fire floor, they have a good rapport with the crews and are able to train them in scene preservation. This is an ongoing battle, but fire investigators are training firefighters to be more careful when in a fire scene, but some damage is unavoidable. By working with other agencies, like the R.C.M.P. Lab; Canadian Standards Association (CSA); Building & Electrical Inspectors; the local Gas Company and the local Police, fire investigators are able to share information and put training ideas together. Fire investigators also work with local and international organizations not only for training, but to network with each other regarding events and techniques. Such organizations include: The International Association of Arson Investigators (IAAI); The Bureau of Alcohol, Tobacco & Firearms (ATF); The Insurance Bureau of Canada and the Fire Investigation Association of Alberta (FIAA).

In Alberta, for instance, with the implementation of the Safety Codes Legislation, it is the law that all fires must be investigated by an Accredited Agency. This simply means that a fire investigator has to respond to all fires that result in property damage, appear to be suspicious or deliberate and where there is an injury or death. The fire investigator will determine the “Area of Origin”, the cause and the circumstances of the fire. If it is determined or suspected that this fire is criminal in nature, then they will contact the local police. Once at the scene and after speaking with the Fire Crews, owner, occupant and/or witness/s, the fire investigator will examine the scene and in most cases this means that they will be digging and reconstructing the scene.



(Capt. E. Rostalski)



(Capt. E. Rostalski)

After the “On Scene” investigation, the investigator will have the ever pending paper work. This includes filling out the forms for the Fire Commissioners Office so that they can collect their statistics, and a report explaining their findings.

A fire investigator is little different from any other forensic investigator; the basic investigative training is the same; the only difference is that they deal with fire which includes structures, vehicles, explosions, wildland fires and even plane crashes.

To be a good Fire Investigator, a person is always learning and always taking courses to keep current with all the different fire suppression systems and techniques. This means lots of reading and networking with the different agencies and people that are involved in the investigative or forensic field.

The field of fire investigator varies from province to province.

Further Information on Fire Investigation

www.interfire.org

www.ofm.gov.on.ca/english/FireProtection/munguide/04-52-03.asp

Wildlife Forensics

Wildlife crime, including traditional poaching as well as the illegal killing of wildlife for the trade in illegal animal parts, has become a major issue in Canada and the world. World Wildlife Fund recently stated that it was the one of the biggest crimes in the world, profit margin-wise, second only to drug dealing. Animal parts such as bear galls and eagle feathers can be extremely valuable in this trade.

In most cases, wildlife forensic science is no different from regular forensic science in that molecular biology, chemistry, toxicology and crime scene analysis are very similar to that used in human crimes.

However, wildlife forensic scientists concentrate on identifying the species killed. In human cases, this is usually fairly straightforward. However, in a wildlife case, it is crucial to be able to identify the species of animal correctly. One fish species may be perfectly legal to catch and eat but another very similar species may be endangered. Therefore, wildlife forensic specialists are primarily morphologists who identify animal species taxonomically. As more DNA profiles of species become available, DNA identification may become more important, but at the moment, classic morphology is still most used.

Further Information on Wildlife Forensics

US Fish and Wildlife Service National Fish and Wildlife Forensics lab -

<http://www.lab.fws.gov/>

Trent University Wildlife Forensic DNA lab –

<http://www.forensicdna.ca/wildlifeagencies.html>

Canadian Wildlife Service - http://www.cws-scf.ec.gc.ca/birds/gene/foren_e.cfm

<http://www.forensicdna.ca/wildlifeagencies.html> links Federal and Provincial agencies that use forensic DNA analysis in criminal investigations pertaining to wildlife

OTHER USEFUL FORENSIC WEBSITES

We hope this short booklet has been informative and provided information to guide you in your career choices. The following are web sites that will provide further information. Most of the following sites also contain links to further sites.

RCMP Forensic Lab Services - http://www.rcmp.ca/fls/home_e.htm

Centre of Forensic Sciences –

http://www.mpss.jus.gov.on.ca/english/pub_safety/centre_forensic/about/intro.html

Laboratoire de sciences judiciaires et de médecine légale du Québec

http://www.msp.gouv.qc.ca/labo/index_en.asp

FBI Laboratory Division (USA) <http://www.fbi.gov/hq/lab/labhome.htm>

The Forensic Science Service (UK)

http://www.forensic.gov.uk/forensic_t/index.htm

National Institute of Forensic Science (Australia)

<http://www.nifs.com.au/home.html>

Canadian Society of Forensic Science - www.csfs.ca

American Academy of Forensic Sciences - www.aafs.org

Forensic Science Society (UK) <http://www.forensic-science-society.org.uk/>

Australian and New Zealand Forensic Science Society <http://www.anzfss.org.au>

European Network of Forensic Science Institutes <http://www.enfsi.org/>

Association of Universities and Colleges in Canada <http://www.aucc.ca/>

Zeno's Forensic Site - <http://www.forensic.to/forensic.html>

Carpenters Forensic Sci resources - <http://www.tncrimlaw.com/forensic/>

Interactive Investigator –

<http://www.virtualmuseum.ca/Exhibitions/Myst/en/index.html>

National Centre for Forensic Science <http://www.ncfs.org/home.html>

<http://forensics.ca/phpcode/web/> - for post secondary forensic courses, also job postings

American Board of Medicolegal Death Investigators, Inc. –

<http://www.slu.edu/organizations/abmdi/>