The all-time number one question asked by students is: What jobs can we get with a degree in Analytical Chemistry?

Robin Abel, M.Sc., MCIC

Currently engaged in Ph.D. studies at the University of Alberta, and serving as the Chair of Chemistry for the Canadian Society of Forensic Science since May 2014. Previously employed by the Royal Canadian Mounted Police as a Forensic Specialist.

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Among the many careers available to an analytical chemist is one that has received a great deal of attention in recent years. Forensic science, while not as glamorous as TV shows might suggest, is an excellent career option for the analytical chemist. Forensics offers a combination of daily variety in the examinations performed and materials encountered, as well as important, rewarding work that makes a real impact on the safety and security of us all.

Very early in my university career I became fascinated with forensic science, but information regarding what education and training would lead to a career in forensics was scarce. So, I turned to reading the educational history of any forensic scientist I could find, and discovered a pattern: the vast majority of those in forensics (with few exceptions) had a strong background in the physical sciences, primarily chemistry and physics. While there are some professionals in forensics that do not depend directly on the physical sciences (e.g. forensic psychologists, forensic nurses, forensic sketch artists, etc.) the many other areas of forensics are either based entirely, or depend heavily, upon the tools and techniques provided by chemistry and physics.

In Canada there are presently 3 major publicly funded forensic laboratories (2 provincial labs in Ontario and Quebec and 1 federal) that handle the vast majority of the nation's casework, along with many other public and private labs provide specialized services on police request, and I have had the pleasure of working as a specialist in Trace Evidence Services with the Royal Canadian Mounted Police from 2009 to 2015. Trace evidence (forensic chemistry) primarily involves the recovery, identification, characterization, and comparison of man-made materials for the purpose of associating people (suspects and victims), places (crime scenes and other locations), and things (cars, tools, clothing) with each other to establish their direct contact or proximity. Because of the diversity of materials encountered in forensic examinations, a specialist must be able to operate instrumentation and interpret the data produced from a variety of analytical techniques, all while handling minute quantities of valuable evidence. In my discipline, those techniques include gas chromatography, liquid chromatography, ion chromatography, capillary electrophoresis, laser ablation-inductively coupled plasma (all interfaced with mass spectrometry), infrared and Raman spectroscopy, x-ray fluorescence, x-ray diffraction, scanning electron microscopy-energy dispersive spectroscopy, and numerous types of light microscopy. Prior to the use of any technique, sample recovery, physical examination and preparation for analysis are necessary, requiring a keen eye with attention to detail, a steady hand, a scalpel, a probe, and a variety of different

microscopes. Because of the diversity of techniques used, and the need to adapt them appropriately to each new analyte, a strong grounding in analytical chemistry alongside a thorough understanding of organic and inorganic chemistry is absolutely critical. Even when the specialist has completed both the lab work, and the careful documentation of the analyses and interpretation of those results, the work is not done. Perhaps the most important aspect of forensics is court testimony, where presentation of the work performed and the defense of that work of fact occurs. When the court brings together all of the information surrounding a case in order to render a verdict, it will examine the forensic report and will sometimes call the forensic specialist as an expert witness, especially in cases involving very serious charges or cases where the meaning of the forensic evidence is difficult to understand. When the court calls a forensic specialist, it is important that they be able to explain complex procedures and lines of reasoning to those who are not well versed in science. With a deeper understanding of analytical chemistry, and especially with experience in teaching science, it is easier to quickly formulate accessible explanations of difficult concepts.

My recent shift from forensic casework to the pursuit of a Ph.D. reflects the importance of remaining current in analytical chemistry, as well as maintaining an educational standing sufficient to speak with authority in matters of forensic policy and procedure. Perhaps the most pressing need in forensic chemistry is to implement the many developments in field-portable analytical systems, and the use of chemometrics to determine the significance of forensic comparisons. While forensic chemistry is certainly well established, the relatively small number of scientists actively working in this area coupled with a consistent focus on reducing casework backlogs and providing more immediate answers, has led to a lapse in progress and a heavy reliance on the individual experience of the forensic examiner in determining significance. The techniques currently in use remain valid and reliable in most circumstances, but a lack of global knowledge about the constantly changing chemistry of the world around us has caused forensic experts to reduce the significance they are willing to apply to their findings, even where high significance may be possible. In addition, the willingness of experts to incorporate new analytical techniques has been hampered by a lack of time to establish their practical discriminating power and gain experience in their use, even on familiar samples. New analytical chemists with a solid grounding in their field and its application to forensics are needed to restore the weight of forensic chemistry, ensuring continued provision of physical and chemical information to investigators and the court that cannot be offered by other forensic services.

Forensic chemists provide substantial value to the legal system by associating criminal activity at a crime scene with the suspect responsible for that activity, and can even provide pieces of information critical to reconstructing the series and order of events surrounding a crime. For the analytical chemist, a career in forensic chemistry is a realistic and very rewarding career option that I would highly recommend.