COLLEGE to CAREER

Become a Forensic Chemist: Be a part of solving crime!

BY ACS STAFF

A mysterious white powder, a blood smear, and a moldy ham sandwich — completely unrelated items to most. But they could be meaningful for forensic chemists, who analyze physical evidence and samples for clues to solve crimes. Television shows such as *Bones*, *NCIS*, *CSI*, and *Dexter* have glamorized forensic scientists and made the field more popular, so competition can be intense. However, if you have a strong desire to shape the world of justice by using science to solve crime puzzles, then a career in forensic science could be worth pursuing.

Education

A strong background in chemistry and instrumental analysis and a good grounding in criminalistics are vital. An undergraduate degree in forensic science or a natural science is required for work in crime laboratories, with extensive course work in mathematics, chemistry, and biology. More advanced positions, such as lab managers and supervisors, might require a master's degree. A Ph.D. is often *preferred* for advancement to positions such as lab director, but it is *required* for forensic research positions at academic institutions.

Those interested in working with trace evidence, such as glass, hairs, and gunshot residue, should focus on instrumentation skills and take courses in geology, soil chemistry, and materials science. If forensic biology, such as DNA analysis, is preferred, take microbiology, genetics, and biochemistry courses. Those interested in the toxicological aspects of this work, such as obtaining and interpreting toxicology reports, should study physiology, biochemistry, and chemistry.

Work space

About 90% of forensic chemists work in labs associated with a federal, state, or local police department, medical examiner's office, forensic services lab, or branch of the Federal Bureau of Investigation (FBI). There are a few private labs that carry out forensic analyses.

On an average day, forensic chemists apply knowledge from diverse disciplines such as chemistry, biology, materials science, and genetics to analyze evidence found at crime scenes or in the bodies of crime suspects. Forensic chemists often don't know the nature of the sample before they analyze it. As a result, they use criminalistics, the qualitative examination of evidence using microscopy and spot testing, and analytical toxicology that looks for evidence in body fluids through a range of instrumental techniques from optical methods (ultraviolet, infrared, and X-ray spectroscopy) to separations analyses (gas chromatography, high-performance liquid chromatography, and thin-layer chromatography). Mass spectrometry is also frequently used since it provides the strongest evidence in court. The results of their work are used in police investigations and court trials, at which they may be called upon to provide expert testimony and explain their findings to a jury.

THINKSTOCK

Is this career a good fit for you?

Versatility and patience are the most often cited qualities of a forensic chemist. Forensic chemists must be able to spend hours rigorously applying analytical techniques to evidence, meticu-

Quick Facts

- **OPPORTUNITIES —** Job outlook is guardedly optimistic. There's an increasing application of forensic science techniques to examine, solve, and prevent crime.
- **EDUCATION NEEDED —** Requirements vary by employer, but forensic science undergraduate and graduate degrees are recommended.
- **SALARIES —** Median annual wage: $52,840 (Bureau of Labor Statistics, 2012).

lously documenting each step and then defending their work in a court of law. They must also be able to clearly and concisely respond to challenges to their findings. Integrity is an important characteristic because it is not unusual for the different parties in a case to try to influence the forensic chemist's findings. Since they often work with body parts and at crime scenes, an ability to remain unemotional and unaffected is crucial.

Career path

Forensic science technicians receive 6 to 12 months of on-the-job training to learn DNA analysis and receive up to 3 years of training for firearms analysis. In some cases, they must pass a proficiency test before being allowed to handle cases on their own. Throughout their career, they must stay up-to-date on advances in both collection and analysis of evidence.

Most forensic chemists spend their career working at a federal, state, or county lab associated with the medical examiner's office. However, there are different types of careers available, including those in other fields of forensic science, academia, or administration. Chemists can also move up within an organization to a position as the director of a crime lab supervising other forensic scientists rather than being involved in day-to-day analysis. A director is also responsible for case review and general lab management.

Future employment trends

The forensic science field is guardedly optimistic about job prospects as there is greater use of DNA analysis, which is creating more jobs. However, popularity in the media is increasing interest in, and therefore competition for, forensic science careers. Since new forensic labs are rarely created, openings in existing labs caused by promotion or retirement are the main source of positions for new scientists. Increasing pressure on governmental budgets also works to decrease the number of available openings.

A variety of duties

Although government crime labs tend to be structured and very professional environments, forensic chemists' days vary. The majority of the time you're in your lab, but you could go testify in court or assist a Drug Enforcement Agency (DEA) agent in the field. Forensic chemists are sometimes called to investigate clandestine labs — concealed labs that were manufacturing methamphetamines, ecstasy, or other drugs.

Preparing for a career as a forensic chemist has specific educational requirements. Although some forensic chemists at the DEA have upper-level chemistry training, the minimum requirement is a bachelor's degree. Many institutions offer B.S. and advanced degrees in forensic science. Biological chemistry and forensic science training can help as well. Besides the academic requirements, government forensic chemists must undergo a full background check and security clearance, as the specifics of a forensic chemist's work are confidential. All candidates, including candidates for internships, are screened for any criminal record or history of drug use. A strong chemistry background and a clear background check aren't the only preparation you need for a career in forensic chemistry. Particularly true at the DEA, forensic chemistry is a field that includes extensive on-the-job training.

Finding experience

As with all careers, some experience certainly helps. Exposure is the main key, so begin to find ways to get some forensic laboratory experience. The DEA has a Student Career Experience Program designed to let students get an "up close and personal" view of life in a crime lab. Each of the DEA's nine labs has at least one such position. The labs generally develop relationships with local universities that suggest student candidates.

There are also opportunities on local levels. City and state governments run crime labs, and many offer opportunities to shadow local law enforcement officers. Some internships won't be advertised but are still available to interested students who seek them out. If you aren't able to set up any formal experiential learning programs, you could try to contact a forensic chemist and set up an informational interview to discuss his or her job. iC

Lisa M. Balbes *of Balbes Consultants LLC contributed to this article.*

TECHNICAL SKILLS REQUIRED

- Excellent experimental technique and a strong background in instrumentation and quantitative/qualitative analysis are the main technical skills used in this field.
- Being detail-oriented is crucial for a forensic scientist, since the slightest detail can make a huge difference in the interpretation of a sample.
- Critical thinking skills and problem solving skills are required to interpret the results of chemical tests and help determine exactly what happened at the crime scene.
- Forensic scientists often have to explain their findings to other law enforcement officers or provide expert testimony in a court of law, so excellent oral communication skills—even under duress—are required.
- Written communication skills are required for preparation of detailed reports that will stand up to intense scrutiny by both sides of the law.

Chemists in the Real World: Jared Roop

M.S., CHEMISTRY
CRIMINALIST – TOXICOLOGY, MISSOURI STATE HIGHWAY PATROL

PHOTOS COURTESY OF JARED ROOP

During his final year of graduate school, Jared Roop began an internship with the Missouri State Highway Patrol (MSHP) Crime Laboratory. He worked as a lab technician, performing various duties throughout the lab to help make each section run smoothly. About five months into his internship, one of the employees who worked in the Toxicology section resigned. Roop applied for the opening and was hired.

Roop received his M.S. in chemistry with a focus on analytical chemistry (specifically, electrogenerated chemiluminescence) from Missouri State University in May 2012.

What is your major responsibility in your current position?

I test biological fluids (particularly blood and urine) for the presence of alcohol and/or drugs and then write reports of my results that can be used in a court of law. The types of cases I work include DWI (driving while intoxicated), DUID (driving under the influence of drugs), violent crimes where alcohol or drugs might be a factor (i.e., homicide or sexual assault), and coroner cases involving a deceased individual. I am also occasionally required to attend court in order to report my results in front of a judge and/or jury.

Please describe your typical day on the job.

My days vary widely depending on what tasks I have to accomplish. Most of the experiments I perform take close to a full 8-hour day. After performing an experiment, the following one to three days could be spent analyzing the data, depending on the nature and magnitude of the experiment. After data analysis, I might spend half of a day writing reports for those cases. Every case that is worked is peer-reviewed; the flip side of this is that I spend probably 5–10% of my week peer-reviewing the work of my colleagues. Some days are completely filled with court-related work. This might entail studying the results in a case for which I have been issued a subpoena, as well as traveling to court in a location a few minutes to several hours away.

Typically, how many days each month do you spend away from your workplace on travel?

One to five days, generally related to testifying in court cases.

What apps/software/instrumentation/tools can't you live without?

All of my confirmation experiments are performed on either a headspace gas chromatograph (HS-GC) or a gas chromatograph/mass spectrometer (GC/MS). These are the workhorses of our lab, and so understanding them and their software programs is critical. Also, being comfortable with Microsoft Office is important for the presentations we might give (PowerPoint) and the spreadsheets we keep for various reasons (Excel). Our set of mechanical pipets play a crucial role in the success of toxicology, so familiarity with them is key.

What do you like most about your job?

My job allows me to use the scientific degrees I have in a practical way. Every day I realize why I learned certain things in school — such as performing simple extractions — and I see those concepts applied to a real-world setting. I collaborate with my co-workers, as well as solve problems and complete projects on my own. It's interesting to see how many different processes can be used in presumptive testing [to determine whether a sample is either definitely not a certain substance, such as blood, or could be] and confirmative testing [done to confirm the results of presumptive testing]. I feel that my job matters in the sense that my reports and testimony can bring an unbiased truth to a legal situation that needs to be resolved.

What's the best career advice you've received?

Take advantage of any internship opportunities you have. Prior to interning with the crime lab, I had no idea of the appeal of forensic toxicology. Internships also help in building a professional network, which is also critical to success.

Is there anything else you would like to mention about your career?

Court testimony is a major part of a career in forensic sciences that most people do not think about. Being able to communicate effectively and essentially teach what you do to a judge, jurors, and legal counsel who have little to no training in your field is very important. Scientists who enjoy explaining their work might find forensics more appealing than they originally thought.