Chapter 1

Understanding the World of Forensics

In This Chapter

- Defining forensic science and checking out its origins
- Understanding why the principle of evidence exchange is important
- Unveiling how forensic science is organized
- Revealing what services a crime lab offers

Turn on the TV any night of the week, and you'll find crime scene investigators, or *criminalists,* tracking down criminals, crime lab technicians evaluating evidence, and even forensic pathologists conducting autopsies on shows detailing cases real or imagined. I don't think this newfound interest in all things forensic stems from some macabre fascination with death or a guilty enchantment with the criminal world. If you ask me, people simply are curious by nature and have a strong appetite for scientific knowledge. Remember everyone's fascination with the space program not too many years ago? The cool tools and magical feats of forensic science — making fingerprints appear out of nowhere, identifying suspects by their shoeprints, sniffing out a forger by the unique signature of a laser printer — are proving equally fascinating.

In this chapter, you get your feet wet with the basic definitions and organizational elements of the field of forensic science. Most of the topics that I touch on here are explored further in the chapters that follow.

Defining Forensics: The Science of Catching Criminals

If you lived in ancient Rome, you'd head to the forum when you wanted to discuss the news of the day. The town *forum* was a community meeting place for merchants, politicians, scholars, and citizens that doubled as a center for public justice. Steal your neighbor's toga, and the case would be tried at the forum.

REMEMBER

The term *forensic* stems from the Latin word *forum* and applies to anything that relates to law. *Forensic science,* or criminalistics, is the application of scientific disciplines to the law.

The same tools and principles that drive scientific research in universities and identify cures in hospitals are used by forensic scientists to find out how a victim died and, ideally, who was responsible. In the same way modern hospital laboratories employ professionals to deal with pathology (the study of diseases of the human body), toxicology (the study of drugs and poisons), and serology (the study of blood), modern forensic laboratories employ experts in forensic pathology, forensic toxicology, and forensic serology, all of whom use the principles and testing procedures of their medical specialties to help resolve legal issues and answer questions like:

- When and how did the victim die?
- Does the suspect's blood match the blood found at the crime scene?
- Was a suspect's unusual behavior caused by drug use?

Integrating science into the practice of law

Not long ago identifying, capturing, and convicting criminals depended primarily upon eyewitnesses and confessions. The world was a small place, communities were close-knit, and the extent of travel basically was only as far as you could walk. Whenever anyone witnessed a crime, he or she likely knew the perpetrator. Case closed.

Trains, planes, and automobiles changed all that. Criminals can now rapidly travel far and wide, and with this newfound mobility they are less and less likely to be recognized by an eyewitness. Besides, eyewitness evidence these days frequently is proven to be unreliable (see Chapter 3).

For law enforcement to keep pace with criminal advancements, other techniques for identifying criminals had to be developed. Science came to the rescue with methods that depend less on eyewitnesses to identify perpetrators or at least link them to their victims or crime scenes. Fingerprinting (Chapter 5), firearms identification and gunshot residue analysis (Chapter 18), hair and fiber studies (Chapter 17), blood typing (Chapter 14), DNA analysis (Chapter 15), and many other scientific techniques have solved crimes that would've remained unsolved in the past.

The marriage of science and law hasn't been without its setbacks. Many scientific breakthroughs are viewed with suspicion, if not downright hostility, until they become widely accepted. And before a science can ever enter the courtroom, it must be widely accepted. It should come as no surprise that before forensic science could develop, science in general had to reach a certain level of maturity.

Drawing from other sciences

The development of modern forensic science parallels general advancements in science, particularly the physical and biological sciences. Take a look at how a few milestones in science pushed forensics several steps forward:

- The invention of the microscope enabled criminalists to analyze even the smallest bits of evidence and to see details in evidence that never before were imagined.
- The development of photography gave criminalists a crystal-clear representation of the crime scene without relying on memory or the slow process (and far less detailed results) of making drawings.
- The understanding of the physics of ballistic trajectories gave criminalists a much clearer idea of where a bullet may have come from, which, in turn, made crime-scene reconstruction more accurate.
- The discovery of blood typing and DNA analysis made matching suspect to crime scene far more exact.

Getting the Big Picture: Forensics in Action

You witness a burglar sneaking away from a store late at night. You call the police, and when they arrive, you identify the thief as someone you know. That person is arrested. However, fingerprints from the store's broken window, cracked safe, and tools used to open the safe don't match up with those of the person you've fingered. Instead, they match the fingerprints of a known safecracker. What do you think police, prosecutors, and more important, the jury are going to believe? After all, it was dark and raining, you were 100 feet away, you caught only a glimpse of the thief, and you'd just left a bar where you'd had a couple of drinks with friends. The fingerprints, on the other hand, match those of a known thief in each and every detail, meaning they came from him and only him. Which bit of evidence, the fingerprints or your eyewitness account, is more reliable?

This scenario represents what forensics does or at least attempts to do. Each and every forensic technique that you discover in this book is designed to either identify a perpetrator or connect him or her to the crime.

Starting out small: Basic forensic services

Properly identifying, collecting, documenting, and storing evidence are at the heart of the forensic services offered by virtually all law enforcement agencies, from village cop to major metropolitan police department. They need the basic services in the list that follows to be able to investigate and solve crimes and to convict the criminals who commit them:

- **Evidence collection unit:** This c*rime-scene investigation unit* collects and preserves evidence from the crime scene and transports it to the lab. Regardless of whether they're individual police officers or highly trained professionals, members of this unit expose and lift latent fingerprints, (Chapter 5) collect hair and fibers (Chapter 3), and gather any other articles of evidence at the scene.
- **Photography unit:** The *photography unit* takes pictures of the crime scene, all evidence, and the body (whenever one is present). These photos are crucial, serving as blueprints for crime-scene reconstruction and an excellent format for presenting evidence in the courtroom. Turn to Chapter 3 to find out more about photographing a crime scene.
- **Evidence storage:** A secure place for storing and preserving the evidence is essential. Evidence usually is stored in a locked room with restricted access that is housed at your local police station or sheriff's department. Evidentiary materials are kept in storage for years or even decades, and the chain of custody (see Chapter 3) must remain unbroken throughout that time, or the evidence can be compromised, losing its value.

Finding out about physical forensic science

Tracking down trace evidence, checking the ballistics of bullets fired from a gun, examining the penmanship of a signature on an important document, and checking out the swirling ridges of fingerprints under a microscope all are part of the physical side of forensic science.

- **Trace evidence:** Any small item of evidence — hair, fiber, paint, glass, or soil, for example — that places the suspect at the scene of the crime or in direct contact with the victim is considered *trace evidence.* Matching glass fragments found on the victim of a hit-and-run motor-vehicle accident to glass from the broken headlamp of the suspect's car is a prime example. Find out more in Chapter 17.
- **Firearms identification:** *Firearms identification* deals with the examination of weapons and the projectiles they fire, including ammunition, fired bullets, shell casings, and shotgun shells. Firearms experts use a microscope and various types of chemical analysis to identify the type of weapon used to commit a crime and match any bullets fired from that weapon or shell casings to a suspect weapon. I cover firearms identification in Chapter 18.
- **Document examination:** Whenever an important written document's age or authenticity is in doubt, a *document examiner* uses handwriting analysis to match handwriting samples to questioned documents or signatures. Document examination also may include analyzing the physical and chemical properties of papers and inks or exposing *indented writing* (the impressions made on the page beneath one that was written on). Typewritten or photocopied documents that may have been altered also fall under the document examiner's area of expertise. Check out Chapter 19 for the details.
- **Fingerprint examination:** *Fingerprint examiners* match prints to the fingers, palms, or soles of the people who left them at the crime scene. A print found at a crime scene can be compared with another taken from a database or from a suspect, victim, or bystander. Chapter 5 tells you all about fingerprint examination.

Delving into biological forensic science

Forensics deals not only with physical evidence but also with biological evidence, which may take the form of a corpse, skeletal remains, drugs and poisons, teeth, bite marks, insects, and plant materials, to name a few. It also includes analysis of the criminal mind. Biological evidence is often what makes or breaks a case.

For example, an *autopsy* (postmortem examination of the body — see Chapter 9) may reveal the nature and cause of any injuries, the presence of any poisons, and ultimately why and how the victim died. These findings alone may lead to the perpetrator. Blood and DNA analysis can positively identify a suspect and link him or her to a crime. DNA and dental pattern records can be used to identify an unidentified corpse, and plant and insect evidence can reveal the time of death and link a suspect to the crime scene. Find out more about these sciences and the people who conduct them in Chapter 2.

Investigating the Crime Lab

Although they use much of the same equipment and follow similar research procedures, a forensics (crime) lab is quite different from a medical (clinical) lab. The latter deals with the living by carrying out testing aimed at diagnosing and treating the sick. On the other hand, a forensics lab is geared toward testing evidence with the hope of establishing links between a suspect and a crime.

Creating the first crime lab

The United States' first forensic laboratory was established in 1923 by August Volmer in the Los Angeles Police Department. Shortly thereafter, the first private forensic lab was created in Chicago in 1929 as a result of the investigation of Chicago's infamous St. Valentine's Day Massacre (see nearby sidebar). This case involved the expertise of Calvin Goddard, then America's leading firearms identification expert, who was able to link the killings to Al "Scarface" Capone. Two businessmen who served on the coroner's inquest jury were so impressed with Goddard and his scientific use of firearms identification that they funded the development of a crime lab at Northwestern University. The lab brought together the disciplines of firearms identification, blood analysis, fingerprinting, and trace evidence analysis and served as a prototype for other labs.

The St. Valentine's Day Massacre

During the height of Prohibition, gang warfare raged over control of the illegal alcohol trade that sprang up in many U.S. cities. None was bloodier than the war between Chicago rivals Al "Scarface" Capone and George "Bugs" Moran.

On the night of February 14, 1929, seven of Moran's men were waiting for a shipment of hijacked liquor in a warehouse on Chicago's Clark Street. Unbeknownst to them, the shipment was a setup orchestrated by Capone in an attempt to kill his chief rival, Bugs Moran. Moran was supposed to be at the warehouse, but he arrived late. When he got there, he saw a police car pull up and five officers enter the warehouse. Moran retreated and heard machine gun fire, then saw the five cops come out and drive away.

The real police arrived and found that each of the seven men had been shot numerous times. They recovered 70 shell casings. Bullets later were recovered from the victims. Cardiologist Dr. Calvin Goddard, who became famous during the Sacco and Vanzetti case (see Chapter 20), was called in because of his expertise in firearms identification. He determined that the shell casings were from Thomson submachine guns. Using the newly developed comparison microscope, he tested casings from Thomsons belonging to police and determined that none of them were the murder weapons. Goddard's findings meant that the killers had impersonated police officers. Suspicion fell on Capone. Police raided the home of one of Capone's hit men, finding two Thomsons that later were identified as two of the murder weapons.

In 1932, Goddard helped the Federal Bureau of Investigation (FBI) establish a national forensics laboratory that offered virtually every forensic service known to law enforcement across the United States. It too served as a model for all future state and local labs. Now many states have networks of regional and local labs that support law enforcement at all levels.

Identifying common procedures

Scientific services offered by modern crime labs and medical examiners' offices are varied and complex. The number of services supplied by a particular laboratory depends on its size and budget. State and regional labs may provide a wide array of services, and local labs may provide only basic testing. These smaller labs typically outsource more sophisticated testing to larger regional labs. In addition, the FBI's National Crime Lab offers services to law enforcement throughout the country. Not only does the FBI lab perform virtually every type of test, it also possesses or has access to databases on everything from fingerprints and tire-track impressions to postage stamps.

Larger labs may feature separate departments for each discipline, while smaller labs tend to combine services, perhaps even relying on a single technician to do all the work. Obviously, in this circumstance, a great deal of the work must be sent to larger reference labs.

From fiction to fact: Forensic scientists through the years

The first forensic scientist came not from the world of science but from the world of fiction. Sir Arthur Conan Doyle's character Sherlock Holmes frequently used the sciences of fingerprinting, document examination, and blood analysis to solve the crimes he investigated. In fact, in the first Sherlock Holmes' novel, *A Study in Scarlet,* Holmes developed a chemical that determined whether a stain was blood.

The first real-life forensic scientist was Hans Gross. In 1893, he published the first treatise on the use of scientific knowledge and procedures in criminal investigations. Others soon followed.

In 1901, Karl Landsteiner discovered that human blood could be grouped and devised the ABO blood groups that still are in use today. In 1915, Leone Lattes developed a simple method for determining the ABO group of a dried bloodstain and immediately began using it in criminal investigations. Today, ABO typing is used to identify suspects and exonerate the innocent, to determine paternity, and to reconstruct crime scenes.

Early in the twentieth century, Calvin Goddard perfected a system for comparing bullets under a comparison microscope to determine whether they came from the same weapon. And, Albert Osborn laid down the principles of document examination in his book, *Questioned Documents,* which still is used today.

Common procedures conducted in a crime lab include:

- Fingerprint analysis (Chapter 5)
- Tool mark and impression analysis (Chapter 7)
- Blood analysis (Chapter 14)
- DNA analysis (Chapter 15)
- Toxicological testing (Chapter 16)
- Trace evidence evaluation (Chapter 17)
- Ballistic evaluations (Chapter 18)

Digging into the Criminalist's Toolbox

Crime-scene investigators are charged with the duties of finding, collecting, protecting, and transporting all types of evidence to the crime lab. Although each person or team may have different ways of doing things, typical equipment and supplies they take to the scene include the following:

- Crime-scene tape to demarcate and secure the scene
- Camera and film to photograph the scene and evidence
- Sketchpad and pens for scene sketches
- Disposable protective clothing, masks, and gloves
- Flashlight
- Alternative light sources such as laser, ultraviolet, and infrared lighting for exposing certain types of evidence
- Magnifying glass for finding trace evidence
- Tweezers and cotton swabs for collecting hair, fiber, and fluid evidence
- Paper and plastic evidence bags and glass tubes to collect and transport evidence
- Fingerprint supplies, which include ink, print cards, lifting tape, and various dusting powders and exposing reagents such as Luminol
- Casting kit for making casts of tires, footwear, and tool-mark impressions
- Serology kit for collecting blood and other bodily fluids
- Entomology kit for collecting and preserving insect evidence
- Hazmat kit for handling hazardous materials
- Sexual assault kit for collecting evidence in rape or assault cases

The Cornerstone of Forensics: Locard's Exchange Principle

REMEMBER

Every contact you make with another person, place, or object results in an exchange of physical materials. If you own a pet, this exchange of materials is well known to you. Look at your clothes and you're likely to see cat or dog hair clinging to the fabric — a pain in the behind if you want to keep your clothes looking sharp, but an incredible boon for forensic science. You may also find that you transfer these hairs to your car, your office, and any other places you frequent.

Known as the *Locard Exchange Principle,* after Dr. Edmond Locard, the French police officer who first noticed it, the exchange of materials is the basis of modern forensic investigation. Using this principle, forensic scientists can determine where a suspect has been by analyzing *trace evidence* (any small piece of evidence) — fibers on clothing, hair in a car, or gunk on the soles of shoes.

Looking at Locard's principle in action

As an example, say that you have two children and a cat. You run out to take care of some errands that include stopping at a furniture store, the laundry, and the house of a friend who has one child and a dog. From a forensics standpoint, this sequence of events can provide a gold mine of information.

You leave behind a little bit of yourself at each stop, including

- Hair from yourself, your children, and your cat.
- Fibers from your clothing and the carpets and furniture in your home and car.
- Fingerprints and shoeprints.
- Dirt and plant matter from your shoes.
- Biological materials, if you accidentally cut yourself and leave a drop on the floor or sneeze into a tissue then drop it in a trash can.

But that's not all. You also pick up similar materials everywhere you go:

- Fibers from each sofa or chair you sat on at the furniture store ride away on your clothes, as do hair and fibers left behind by customers who sat there before you.
- Fibers of all types flow through the air and ventilation system and settle on each customer at the laundry.

- Hair from your friend, her child, and her dog latch on to you as you walk away. You also collect fibers from your friend's carpet and furniture.
- Fibers and hairs that have fallen to the floor attach to your shoes and pants at each stop.
- Dirt, dust, plant material, and gravel are collected by your shoes everywhere you set foot.

In short, by merely running errands, you become a walking trace evidence factory.

Reading the trace evidence

An examination of your clothes after the expedition detailed above reveals all sorts of fibers and foreign hairs and essentially provides a travelogue for your errands. If someone robbed your friend's house that evening while your friend was away, criminalists would find your fingerprints, your hair (as well as that of your children and your cat), and fibers from the carpets in your house and car. They could place you at the scene of the crime.

Of course, you'd have an alibi (I hope) and a legitimate reason why your trace evidence was found at the scene. The thief would not be able to offer a legitimate reason for his trace evidence being at the scene, which means the presence of his prints, hair, and carpet fibers would need an explanation.

Determining who did what where

REMEMBER

Placing a suspect at the scene of a crime is one of the basic functions of forensic science. The analysis of fingerprints, blood, DNA, fibers, dirt, plant materials, paint, glass, shoe and tire impressions, and indeed every test done by the crime lab is performed to create an association between the perpetrator and the crime.

In many cases, the mere fact that a suspect can be placed at the scene is an indication of guilt. A fingerprint on the faceplate of a cracked bank vault, semen obtained from a rape victim, or paint from the fender of a car involved in a hit-and-run accident connects suspects to crime scenes where they have no innocent reason for being.