eDynamicLearning

Discovery Forensic Science

What is a Forensic Scientist?

Be in love with the science not in awe of the headlines. Truly understand and live your subject from the core.

Professor Sue Black
Director, Centre for Anatomy & Human Identification, Dundee University

When most people hear 'forensic science' they think of TV shows and movies focused on crime scene investigation—CSI or NCIS ring a bell? And while these shows do highlight some of the basics of forensic science, they are definitely more 'made for entertainment' than based entirely on fact.

So what's a more complete definition of forensic science? Let's try this: any science used for the purposes of the law is a forensic science. This

means that forensic sciences are regularly used to help solve civil disputes, enforce criminal laws and government regulations, and even protect public health.

this field is an objective and unbiased practice that can apply to either side of a criminal, civil, or other legal matter

A forensic scientist may be called whenever an objective, scientific analysis is needed to uncover the truth and seek justice in any kind of legal proceeding. But it is important to remember that forensic scientists are not one-sided professionals. In other words, they do not only seek to punish the "bad guys." Instead, this field is an objective and unbiased practice that can apply to either side of a criminal, civil, or other legal matter.

And, much of what you see on television and in films relates more to crime scene investigators. In contrast, forensic scientists actually perform much of their work in a lab. Occasionally a forensic scientist may be called to the scene of a crime to assist in the examination and collection of evidence before it heads to the lab. But more often, the crime scene investigators handle this. They then pass the collected evidence onto the forensic scientists.

Snapshot: Becoming a Forensic Scientist

The work done by a forensic scientist is often used in court or legal proceedings. This means it must be accurate, detailed, and most importantly, unbiased. These are all obviously good qualities for you to possess if you are considering a job in the field.

Are you cut-out to work in the field of forensic science?

Of course, the road to becoming a forensic scientist includes years of training and education. But if you are already a detail-oriented person who enjoys keeping precise notes, you are off to a good start!

Training, education, and skills required for a career as a forensic scientist include the following:

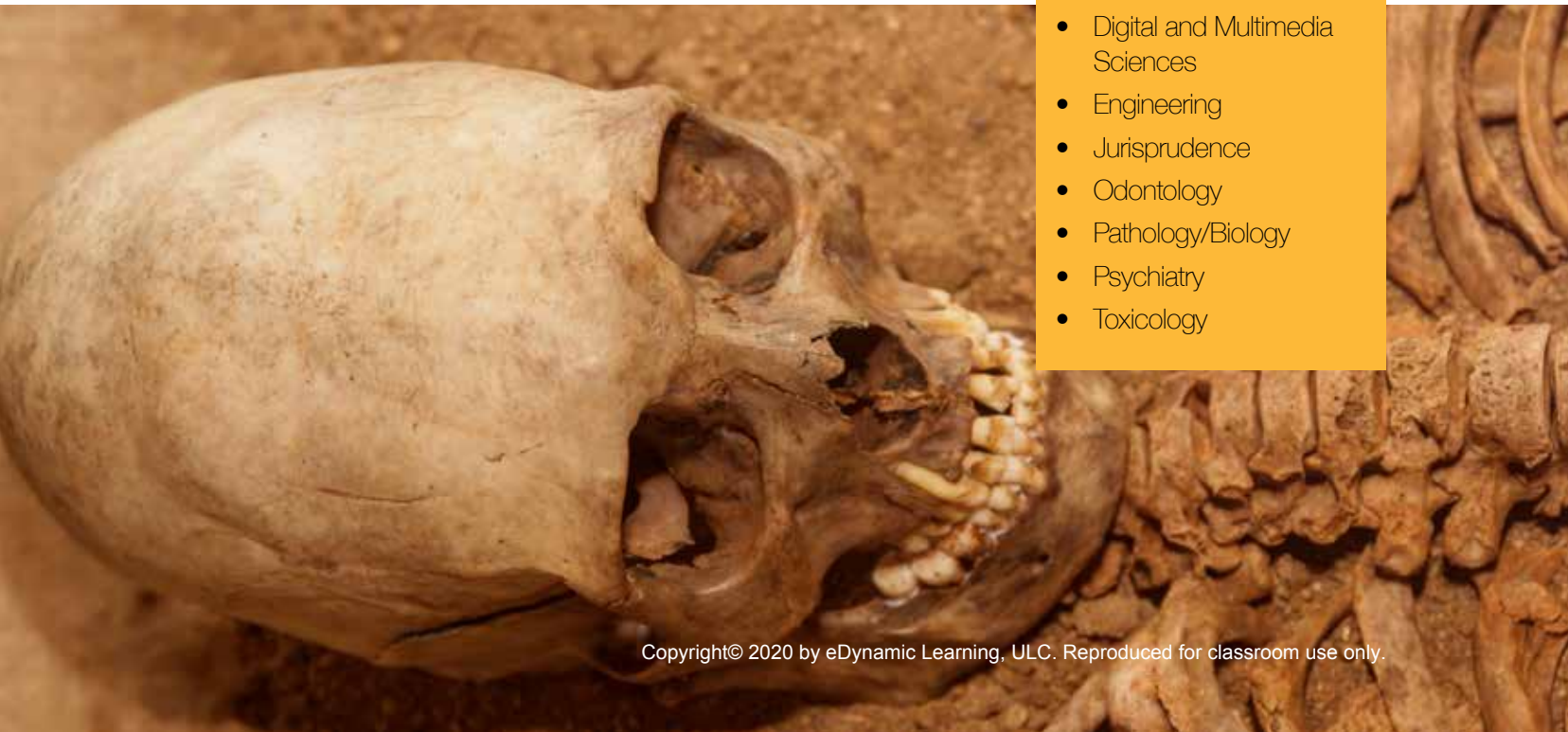
- A bachelor's degree: Though you should get a degree in science (chemistry, biology, physics, etc.), also take courses in math, statistics, and writing skills.
- An advanced degree: Some specialty fields, such as psychiatrist, anthropologist, or pathologist, require advanced degrees and specialized training like a master's or PhD.
- Other skills: Good speaking, notetaking, and observation skills are important. The ability to be unbiased and write an understandable scientific report is also key.

Did you know that there are many different industries that you can work in as a forensic scientist?

Most people picture a forensic scientist working on evidence retrieved from a bloody, murder-related crime scene. But there are many other industries and specialties that you can work in. Keep in mind, though, that some of these special forensic fields require more education and/or training.

Several specialty fields that forensic scientists work in include (but are not limited to):

- Anthropology
- Digital and Multimedia Sciences
- Engineering
- Jurisprudence
- Odontology
- Pathology/Biology
- Psychiatry
- Toxicology



The forensic investigation, including fingerprinting, testing for blood and removing evidence, would be expected to disrupt the scene.

- Lynn Martenstein

The Crime Scene

Let's go ahead and imagine that you are a forensic scientist working in Islamorada, Florida. The phone rings. There has been a crime in your town, and you will be part of the team processing the scene.

Law enforcement and first responders have arrived on the scene. They start by making sure the scene is safe by handling any dangerous situations, caring for any injuries, and arresting any criminals that may still be on the scene. Meanwhile, you gather your tools and head over to the scene.

Some of the most important items in your toolkit include:

- Your camera
- Notebook and pen
- Audio recording device
- Flashlight
- Evidence bags and seals
- Personal protective equipment (gloves, booties, face mask, etc.)
- Latent print kit (fingerprint kit)
- Bodily fluid collection kit (sterile swabs, presumptive tests)
- Laser trajectory kit
- Footwear casting materials
- Biohazard bags

When you pull up to the scene, you learn that the suspect has escaped. The area has been roped off and secured. You have been given the green light to cross the yellow taped-line.

What do you do first? Where do you begin?

A large part of the forensic scientist's job is careful observation. So you begin by simply looking over the entire scene. You see one deceased male laying in the kitchen area. There is a pool of blood around his head. There appears to be a gunshot wound, but you can't be sure until you get a bit closer. You see blood splatter on the wall behind him and a broken window next to the front door. There is also dirt tracked on the carpet and several home items knocked over.

After observing the scene from the sidelines, you enter the house and begin to carefully take photographs. You snap everything from overview shots of the entire crime to photographs that focus on specific evidence while also capturing the surrounding area. You wait to take close-up photographs of specific pieces of evidence until you actually start collecting the evidence, which is the next step.

Let's learn a bit about physical evidence before continuing with our (imaginary) scenario...

The Crime Scene in the Real World:

The O.J. Simpson Trial

Just in case you're not familiar with the case, the O.J. Simpson murder case (officially People of the State of California v. Orenthal James Simpson) was a criminal trial involving former NFL player, broadcaster, and actor O.J. Simpson. Simpson was tried on two counts of murder for the deaths of his ex-wife, Nicole Brown Simpson, and her friend Ron Goldman.

On the morning of June 13, 1994, Brown and Goldman were found stabbed to death outside of Brown's Brentwood, California, condo. Because of his relationship with Nicole, Simpson was a person of interest in the case. When he did not turn himself in, a world-famous (95 million viewers) televised low-speed chase took place while Simpson fled the cops in his white Ford Bronco SUV. Simpson was eventually caught, arrested, and tried in an 11-month trial that became one of the most widely publicized trials in American history.

The Brown/Goldman crime scene is the perfect example of a situation where forensic science played an important role in justice—or rather, it *should* have.

According to an article published in the New York Times in 1996,

If ever there was a criminal case in which scientific evidence should have taken center stage, it was the O.J. Simpson case. It was the DNA found in blood at the crime scene and in Mr. Simpson's home and Ford Bronco that carried prosecutors beyond motive, means and opportunity to the point where they could say they had direct physical proof that he was the killer.

Spoiler alert: O.J. Simpson was found NOT guilty.

But how could this happen if the forensic evidence clearly linked O.J. to the crime scene?

Well, no matter how airtight the evidence from a crime scene is, if it is handled improperly or the chain of custody is broken, that evidence becomes questionable. And that is exactly what happened in the O.J. Simpson trial.

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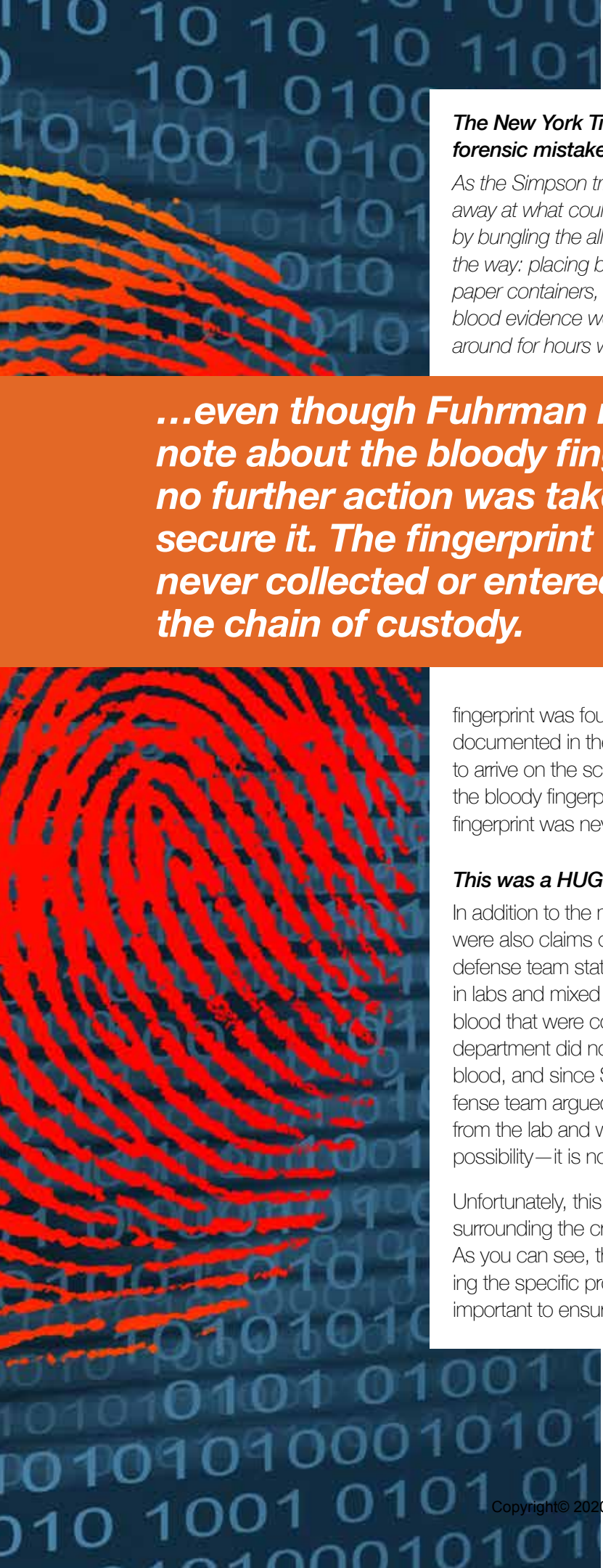


The New York Times article further explains this unfortunate forensic mistake:

As the Simpson trial made clear, the police themselves chipped away at what could have been the bedrock of the prosecution's case by bungling the all-important chain of evidence handling all along the way: placing blood evidence swatches inside plastic, instead of paper containers, where their DNA could degrade; collecting some blood evidence weeks after the crimes had been committed; walking around for hours with a vial of blood evidence instead of delivering it immediately to a laboratory for preservation, packaging and storing, and spilling Mr. Simpson's blood in the very laboratory where, shortly after, other samples would be tested.

…even though Fuhrman made a note about the bloody fingerprint, no further action was taken to secure it. The fingerprint was never collected or entered into the chain of custody.

There were a lot of problems with how the crime scene was handled and how evidence was collected. For example, a bloody fingerprint was found on the gateway at Nicole Brown's house. It was documented in the notes of Detective Mark Fuhrman, one of the first to arrive on the scene. But even though Fuhrman made a note about the bloody fingerprint, no further action was taken to secure it. The fingerprint was never collected or entered into the chain of custody.

This was a HUGE oversight!

In addition to the many claims that the evidence mishandled, there were also claims of evidence being planted at the crime scene! The defense team stated that **EDTA** (a blood fixer or anticoagulant used in labs and mixed with collected blood) was found in the samples of blood that were collected at the crime scene. Because the police department did not have proper collection documents for Simpson's blood, and since Simpson's blood showed traces of EDTA, the defense team argued that all of this showed the blood must have come from the lab and was planted at the scene. However, this is just one possibility—it is not proven fact.

Unfortunately, this is just the tip of the iceberg with the many issues surrounding the crime scene and evidence collection with the case. As you can see, the way that a crime scene is processed, including the specific procedures used to collect evidence, are incredibly important to ensuring that justice is served.

EDTA: a chelating agent or claw-like substance that can grab and stick to other molecules, keeping the blood from clotting, often mixed with collected blood from crime scenes and used in labs

Physical evidence cannot be intimidated. It does not forget. It sits there and waits to be detected, preserved, evaluated, and explained.

-Herbert Leon MacDonell

Physical Evidence

What is Physical Evidence?

Physical evidence can mean many things. But generally, it is any object that can establish that a crime that has been committed or link a victim to a crime. Really, the name kind of says it all: a physical object that serves as evidence

You may be wondering if there is any other kind of evidence other than physical evidence?

Yes!

There is **eyewitness testimony** (spoken evidence given by people who witnessed an event), **digital evidence** (proof from an electronic source, such as emails, hard drives, word processing documents, instant message logs, ATM transactions, etc.), **documentary evidence** (any proof that is in the form of writing like contracts, wills, invoices, etc.), and DNA evidence (often part of physical evidence), to name a few.

And while the various types of evidence come together to tell a story about a crime, physical evidence is one of the most extensive and helpful types of evidence used to understand a crime better. Well, when it is properly collected and examined, of course!

It is also the type of evidence that we will be exploring more in our Islamorada, Florida, crime scene scenario. But before we head back to Florida, let's quickly go over the types of physical evidence that you want to look for and collect at your crime scene.

Physical evidence covers a wide range of items and can include weapons, hair, blood, fibers, or fingerprints. These items are direct evidence of a crime and the people involved. DNA evidence may or may not be present on or within any of the physical evidence that is found at the scene of a crime.

eyewitness testimony: spoken evidence given by people who witnessed an event

digital evidence: proof from an electronic source, such as emails, hard drives, word processing documents, instant message logs, ATM transactions, etc.

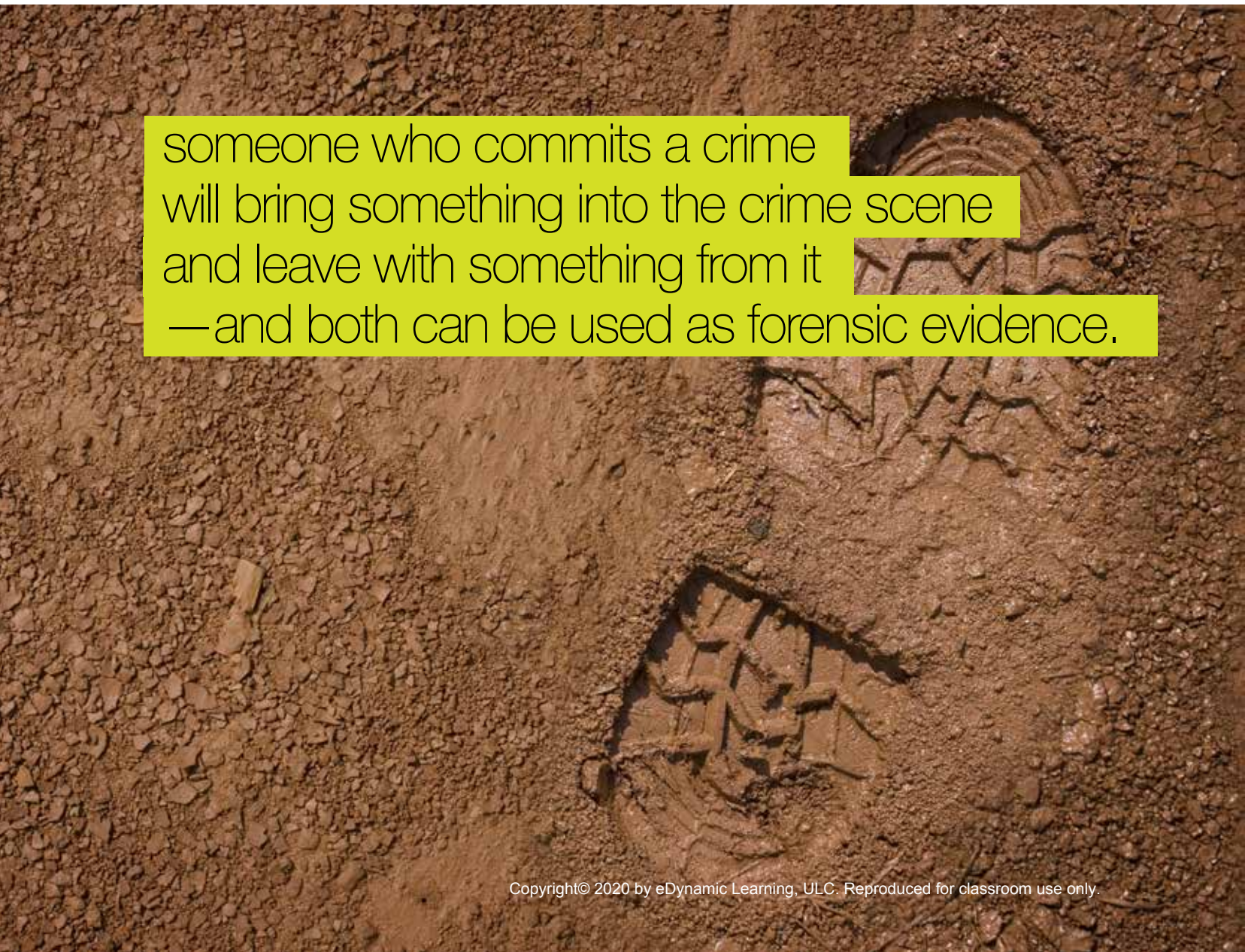
documentary evidence: any proof that is in the form of writing like contracts, wills, invoices, etc.

Some examples of physical evidence that you want to look for at your crime scene include:

- **Biological evidence** (e.g., blood, body fluids, hair and other tissues)
- Latent print evidence (e.g., fingerprints, palm prints, footprints)
- Footwear and tire track evidence
- Trace evidence (e.g., fibers, soil, glass fragments)
- Digital evidence (e.g., cell phone records, Internet logs, email messages)
- Tool and tool mark evidence
- Drug evidence
- Firearm evidence

biological evidence: samples of biological material—such as hair, tissue, bones, teeth, blood, semen, or other bodily fluids—or to evidence items containing biological material

Criminals often think that they can commit a crime and escape the scene without leaving any evidence that they were there. But often, this is not true. In fact, a famous forensic scientist, Dr. Edmond Locard, created a theory about crime scene evidence called Locard's Exchange Principle. The idea of this principle is that someone who commits a crime will bring something into the crime scene and leave with something from it—and both can be used as forensic evidence.



Okay, are you ready to start exploring the physical evidence at your crime scene in Islamorada, Florida? Let's go!

After successfully photographing all parts of the crime scene, you are ready to start collecting physical evidence to bring back to the lab.

Wearing your protective gear, you begin to process the scene using a formal grid search pattern to make sure that nothing is missed. Instead of trying to take notes while you collect and bag evidence, you record verbal notes on your audio recording device:

It appears the point of entry was a broken window near the front door. There are several visible fingerprints on the glass remaining in the window panel. I am lifting these fingerprints for processing.

After lifting the fingerprints, you notice several small hairs stuck in the broken glass. You collect these hairs and a sample of the broken glass. Even though you took numerous photographs when you arrived on the scene, you continue to photograph each piece of physical evidence before removing it from the scene and bagging it.

You work your way through the rest of the scene, photographing and collecting more fingerprints and blood samples from blood splatter on the wall and the pool of blood next to the body. You also collect sand from what look like shoe prints on the rug and clothing that appears to have been ripped off the victim in a struggle.

The most important part of this process is HOW you collect and document this evidence. You make sure to record detailed audio notes so that the **chain of custody**, or the list of all persons who had possession of the evidence during the crime investigation, is never questioned if this case goes to trial.

With the help of other crime scene investigators, you wrap up at the scene and head back to the lab with all of the evidence that was collected. Now what?

chain of custody: in legal contexts, the chronological documentation or paper trail that records the sequence of custody, control, transfer, analysis, and disposition of physical or electronic evidence

Now, the REAL forensic science begins!

You have a list of evidence and a chain of custody for each item. Now you are tasked with testing all of these items using various forensic tests. Because you must remain unbiased, you are not testing these items with the intent of proving anything or 'solving' the crime. You are simply providing factual information about the crime scene for the police, detectives, lawyers, and other involved parties to use in solving the crime.

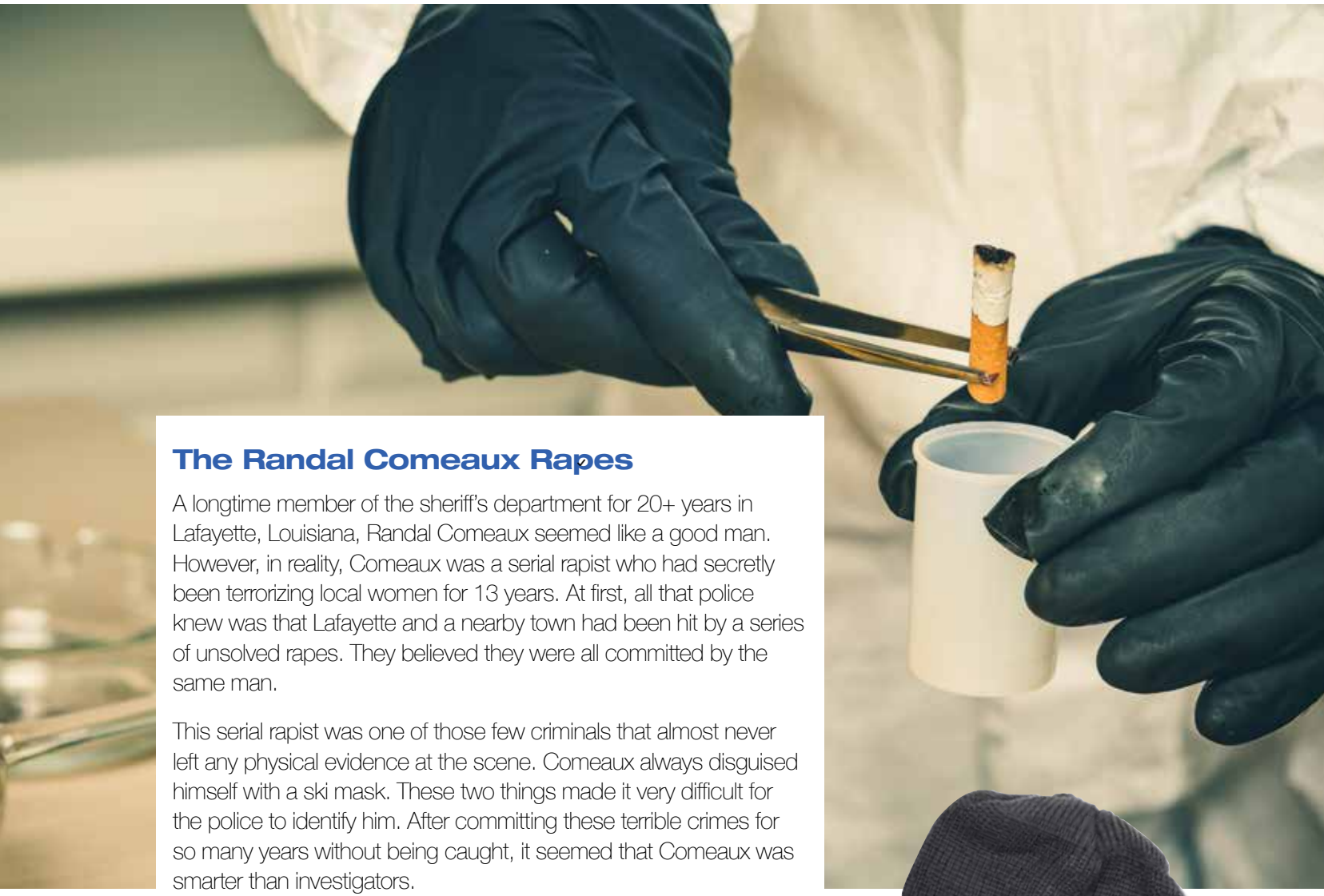
Some common laboratory tests that you might perform include:

- DNA testing
- Latent fingerprint testing
- Bloodstain pattern
- Hair sample testing
- Shoe and tire impressions

Hopefully, the investigators and detectives will be able to piece together enough information to help solve the crime with all of this evidence testing!

Physical Evidence in the Real World

Check out these two real-world examples of cases where physical evidence played an important role:

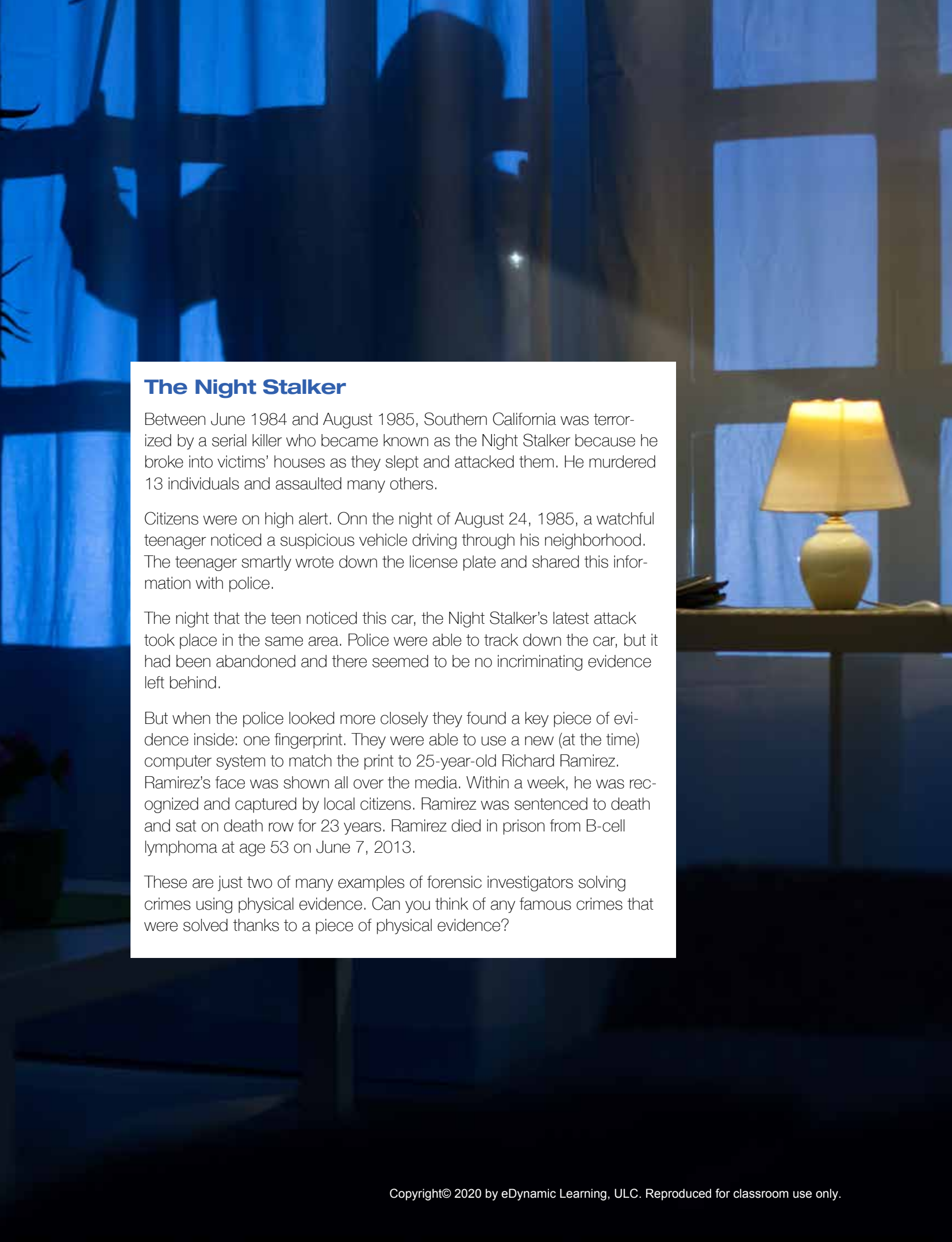


The Randal Comeaux Rapes

A longtime member of the sheriff's department for 20+ years in Lafayette, Louisiana, Randal Comeaux seemed like a good man. However, in reality, Comeaux was a serial rapist who had secretly been terrorizing local women for 13 years. At first, all that police knew was that Lafayette and a nearby town had been hit by a series of unsolved rapes. They believed they were all committed by the same man.

This serial rapist was one of those few criminals that almost never left any physical evidence at the scene. Comeaux always disguised himself with a ski mask. These two things made it very difficult for the police to identify him. After committing these terrible crimes for so many years without being caught, it seemed that Comeaux was smarter than investigators.

But Comeaux made one simple mistake that led to his arrest. While he rarely left evidence at the scene, he often left cigarette butts at the victims' houses. Police were able to take the epithelial cells (tissue cells) from the saliva on the cigarettes and match them to a sample taken from Comeaux. The evidence was undeniable and placed Comeaux at the scene. At first Comeaux pled not guilty by reason of insanity. But later he entered a simple guilty plea and was given three life sentences.



The Night Stalker

Between June 1984 and August 1985, Southern California was terrorized by a serial killer who became known as the Night Stalker because he broke into victims' houses as they slept and attacked them. He murdered 13 individuals and assaulted many others.

Citizens were on high alert. Onn the night of August 24, 1985, a watchful teenager noticed a suspicious vehicle driving through his neighborhood. The teenager smartly wrote down the license plate and shared this information with police.

The night that the teen noticed this car, the Night Stalker's latest attack took place in the same area. Police were able to track down the car, but it had been abandoned and there seemed to be no incriminating evidence left behind.

But when the police looked more closely they found a key piece of evidence inside: one fingerprint. They were able to use a new (at the time) computer system to match the print to 25-year-old Richard Ramirez. Ramirez's face was shown all over the media. Within a week, he was recognized and captured by local citizens. Ramirez was sentenced to death and sat on death row for 23 years. Ramirez died in prison from B-cell lymphoma at age 53 on June 7, 2013.

These are just two of many examples of forensic investigators solving crimes using physical evidence. Can you think of any famous crimes that were solved thanks to a piece of physical evidence?

A dead body tells no tales except those it whispers to the quick ear of the scientific expert, by him to be reported to the proper quarter.

Sir Andrew Douglas Maclagan, British professor of medicine, 1878.

Human Remains

What do you think of when you hear 'human remains'?

Based on what we see on crime television shows or in horror films, you probably picture dead bodies at bloody crime scenes in various stages of decay, waiting to be brought to a morgue. And while these images are sometimes very close to real dead bodies at real crime scenes, TV and film often do not show us the detailed story these human remains can tell us before they are buried.

Human remains often express some basic information about how a person died: a gunshot wound, a stabbing, a fire, etc. These are all causes of death that the average person would likely recognize without any special training or expertise.

However, to a professional forensic pathologist or forensic anthropologist, so many details about the moments leading up to a person's death, the actual death, and even the moments following their death can be learned from the remains. Human remains are like a hidden story just waiting to be discovered, piece by piece to the trained forensic scientist.

When human remains are found at a crime scene, an **autopsy** (postmortem examination) will be performed. One of the first steps of an autopsy is to examine the body closely and collect any evidence that might be on it. The forensic pathologist will explore any bullet holes or knife wounds for evidence that might be inside (like the actual bullet), collect hair samples, examine the skin for needle marks or bruising, and collect samples of anything under the fingernails. Trace evidence, like soil on the victim's clothing, will also be collected. Throughout the autopsy, photographs are taken to document the procedure and the evidence found.

But what do human remains have to do with your case in Islamorada, Florida?

Let's find out!

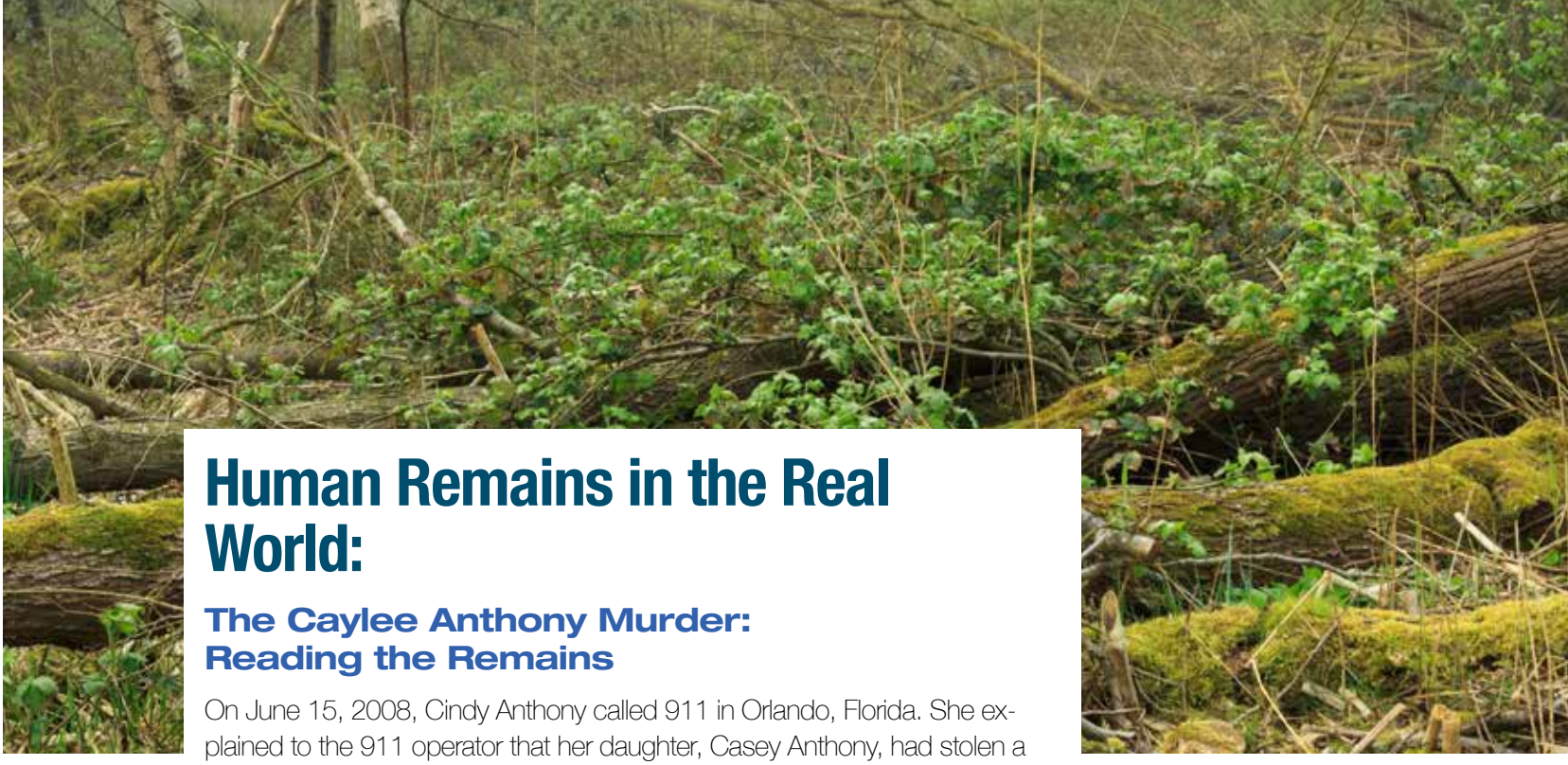
You collected several blood swabs, fibers, and fingerprints from the deceased at the scene, but there is so much more that this body can tell you about the crime and how the person died.

You meet with the forensic pathologist to discuss the **postmortem** (performed after death) examination of the deceased that he performed. The forensic pathologist provides you with body tissues, blood, and other bodily fluids that they collected during the autopsy so that you can analyze them. Hopefully this will help determine the cause, the manner, and the time of death.

The autopsy report includes other important information like the stomach contents, dental records, hair analysis, body temperature, stage of decomposition. Often this will help to find even more details about the time and cause of death and the crime that was committed.

autopsy: a postmortem examination to discover the cause of death or the extent of disease

postmortem: occurring or performed after death



Human Remains in the Real World:

The Caylee Anthony Murder: Reading the Remains

On June 15, 2008, Cindy Anthony called 911 in Orlando, Florida. She explained to the 911 operator that her daughter, Casey Anthony, had stolen a car and some money.

Later, Cindy Anthony called 911 again to report that her granddaughter, two-year-old Caylee Marie Anthony, had been missing for more than a month. After a huge investigation with nationwide coverage, the child's remains were found in December 2008 near the Anthony home.

In June 2011, the murder trial began and was over in a month. Casey Anthony was found not guilty of first-degree murder.

Ten years after a jury acquitted Casey Anthony, several professionals that were involved in the case shared their opinions. One person who had strong opinions on the case was (now retired) chief medical examiner for Orange and Osceola counties, Dr. Jan Garavaglia. One of the most shocking things that she said was, "Science took a backseat on the truth."

There is absolutely no proof this is an accidental death. Sometimes I think science took a backseat on the truth with the Caylee Anthony case.

She explained by saying,

As a medical examiner, we're expected to do a few things: identify the body, come up with a cause of death, why that person died and the manner of death. We don't look at just what the autopsy or just what the body shows—we look at the scene, we look at the circumstances, we look at what's going on preceding the death. And in this case, we have a child that is not reported missing. When the child is reported missing by the grandmother, there is no explanation that's credible of what happened to that child. The body has clearly, clearly been hidden. It has been put in two plastic bags, then put in a canvas bag and then thrown behind a rotting log a couple of blocks from her house….And then we have the duct tape that's still present on the face…Those three things together clearly made this a homicide. It's not changed in my mind. It's not changed in the police's mind. It's not changed in the prosecutor's mind. There is absolutely no proof this is an accidental death. Sometimes I think science took a backseat on the truth with the Caylee Anthony case.

Key Terms

EDTA: a chelating agent or claw-like substance that can grab and stick to other molecules, keeping the blood from clotting, often mixed with collected blood from crime scenes and used in labs

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Thank you for reading! If you want to learn more about this topic, you might be interested in the following courses from eDynamic Learning:

- *Forensic Science 1: Secrets of the Dead*
- *Forensic Science 2: More Secrets from the Dead*
- *Forensics: The Science of Crime*
- *Criminology: Inside the Criminal Mind*

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