

DNA Advances Aid Crime Solving

By Julie Odenbach

Many enjoy watching crime mysteries depicted on Dateline, 48 Hours, and Forensic Files. Even those of us with little or no scientific education about genetics and DNA are fascinated by how new advances in forensic science use DNA to solve complex cold cases.

DNA is deoxyribonucleic acid. DNA defines the hereditary material found in every living organism. Each person has their unique DNA, even identical twins.

DNA consists of four basic building blocks or bases: adenine (A), cytosine (C), guanine (G), and thymine (T). DNA has two long strands joined together in a structure that looks like a ladder twisted together in a spiral double helix shape. Bases on one strand are joined together with bases on the other strand. Those linked bases form the 'rungs' on the DNA ladder. The bases are always paired together so that A is paired with T and C is paired with G. Each base pair is joined together by hydrogen bonds. Human DNA contains approximately 3.2 billion pairs of those bases.¹

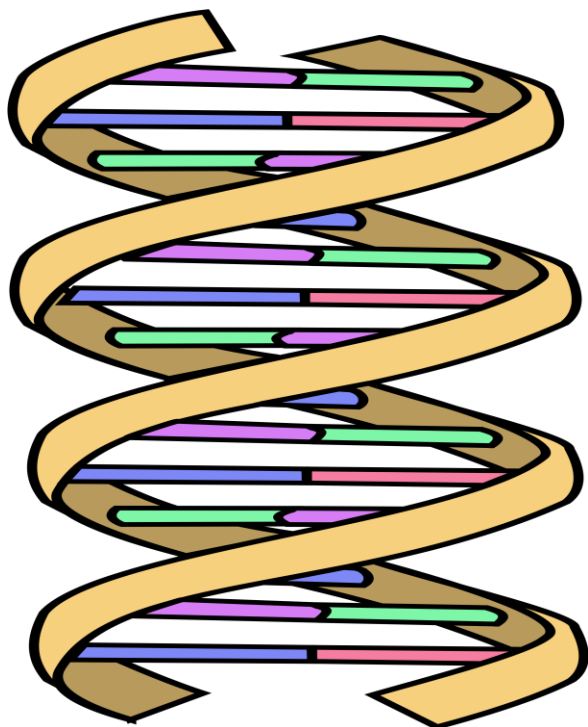


Figure 1 *DNA Double Helix Structure*

¹ What is DNA from <https://www.yourgenome.org/facts/what-is-dna/>

DNA Profiling

DNA profiling links individuals with the blood, saliva, body tissues, hair roots, or semen connected with a crime scene. DNA profiling may also be referred to as DNA fingerprinting or genotyping and can provide indisputable evidence that a given individual was present at the scene of a crime. Of course, the presence of someone's DNA at a crime scene does not tell us how or when the DNA came to be present. The burden of proof remains with law enforcement investigators.

As crucial as DNA is to determine who committed a crime, DNA is equally important in exonerating innocent people. As of 2020, the Innocence Project states that 374 people have been cleared and released from prison, and 21 of those had served time on death row.²

When DNA is extracted from blood evidence, leukocytes are the only blood cells containing a nucleus. Semen collected from rape kits can yield an excellent DNA profile of the offender. Saliva and hair roots found at the crime scene may also provide a good DNA profile.

Once a DNA profile is identified, that information is entered into the CODIS database to check for any matches with previously convicted felons. CODIS stands for the Combined DNA Index System.

Polymerase Chain Reaction (PCR)

In the past, getting a good DNA profile required a reasonably large DNA sample, but the American biochemist Kary Mullis developed PCR (polymerase chain reaction) in 1983. PCR is a technique that produces millions or billions of copies of a segment of DNA. PCR now allows a tiny bit of DNA to be amplified into larger samples, making it easier to get a good DNA profile from minute amounts of DNA evidence. PCR was widely used in many U.S. labs by 1985.

DNA Phenotyping

DNA phenotyping allows genetic researchers to predict a subject's physical appearance and race based on their DNA profile. DNA phenotyping was first used in 2017 in South Carolina to identify the killer of a woman and her young daughter.

Genetic researchers can now specify physical traits such as hair color, eye color, and approximate height. They are currently working on predicting facial features. DNA allows them to make predictions about the racial ancestry of the person. This information may help investigators narrow down their list of suspects, but it also raises concerns about increased racial stereotyping.

Today, two companies in the United States, Parabon NanoLabs and Identitas, have provided DNA phenotyping services to law enforcement.

² Innocence Project: <https://innocenceproject.org/dna-exonerations-in-the-united-states/>

Familial DNA

Familial DNA came to the forefront with the identification of Gary Ridgeway, the Green River Killer who eventually confessed to 48 murders over many years. Genetic researchers at the DNA Doe Project used DNA from a genealogy website to find distant cousins with some matches to the killer. They then re-constructed the family tree from those cousins and used census records and birth certificate records to narrow the family tree until they could find the most likely suspect. In 2001, they linked a saliva sample obtained from Ridgeway in 1987 with semen found on some victims.

Since then, familial DNA has been used in other cases to solve cold cases and identify suspects. According to Tracey Leigh Dowdeswell, a professor of Criminology & Legal Studies, 645 cases as of December 31, 2022, have used familial DNA matches to prosecute homicide cases.³

Touch DNA

Touch DNA only requires tiny samples, so just leaving a few skin cells by simply touching an object can now be used to gather DNA evidence. This means that any object simply touched by an offender could give law enforcement enough DNA to identify the person. However, factors such as sun, rain, heat, or humidity can degrade touch DNA evidence so much that it may be unusable. Also, some people may shed more skin cells than others, so touch DNA evidence is only sometimes found or results in developing a good DNA profile.

DNA Identification of Pets and Plants

DNA identification of pets and plants is also used in criminal prosecutions. A dog's hair has been used to connect a suspect with a crime. After all, it can be hard to explain why your dog's hair was found wrapped up in a homicide victim's clothing. Investigators can also use plant DNA. As seen in one episode of Forensic Files, genetic researchers in the U.K. used leaves from a chestnut tree to connect a man to a murder investigation.

Wrapping It Up

As is often the case, scientific advances offer tremendous advantages while at the same time invading what little is left of our privacy. Indeed, the exoneration of people wrongly convicted is an enormous victory for them and all of society. The ability to solve cold cases that had remained unsolved for thirty or more years is also of great value to the victim's families and the community as a whole. New scientific advances with DNA will hopefully lead to a more just society.

³ Innocence Project: <https://innocenceproject.org/dna-exonerations-in-the-united-states/>