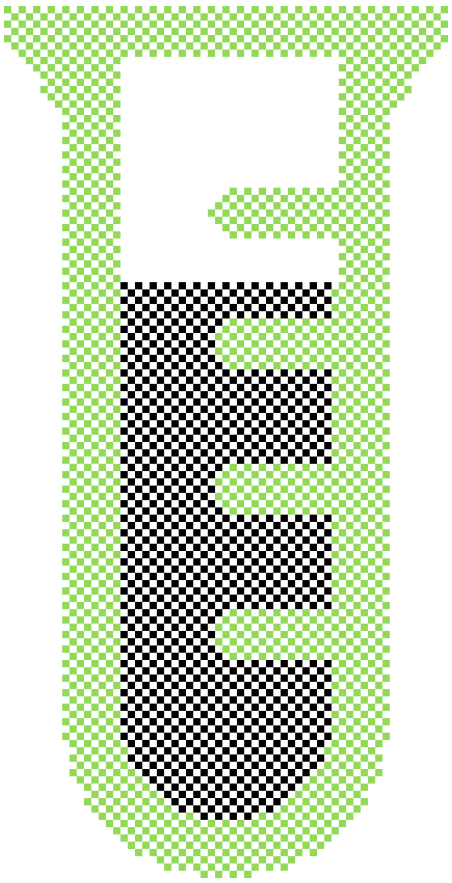
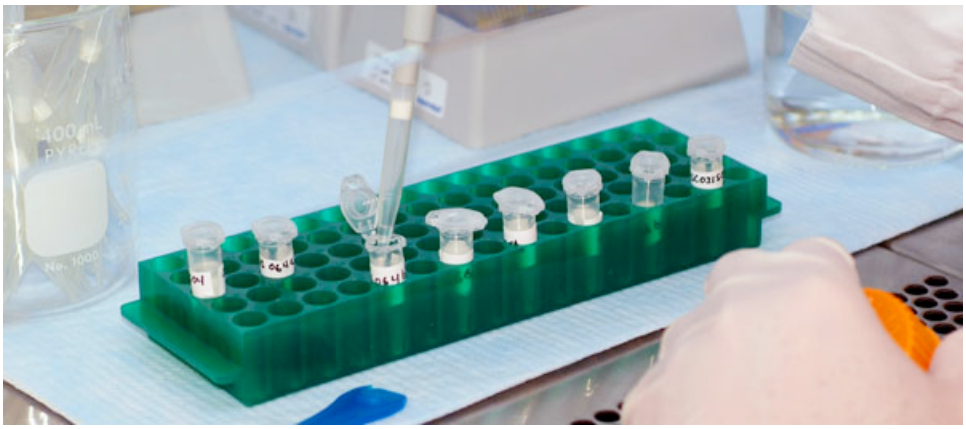


A Simplified Guide To DNA Evidence

Introduction

The establishment of DNA analysis within the criminal justice system in the mid-1980s revolutionized the field of forensic science. With subsequent refinement of DNA analysis methods in crime laboratories, even minute amounts of blood, saliva, semen, skin cells or other biological material may be used to develop investigative leads, link a perpetrator or victim to a crime scene, or confirm or disprove an account of the crime.

Because of the accuracy and reliability of forensic DNA analysis, this evidence has also become an invaluable tool for exonerating individuals who have been wrongfully convicted.



The successes of DNA evidence in criminal trials has captured more than headlines, however—it has captured the public's imagination as well. Jurors now increasingly expect DNA evidence to be presented in a wider array of cases, even when other types of evidence may be more valuable to the investigation.

Principles of DNA Evidence

DNA is sometimes referred to as a "genetic blueprint" because it contains the instructions that govern the development of an organism. Characteristics such as hair color, eye color, height and other physical features are all determined by genes that reside in just 2% of human DNA. This portion is called the coding region because it provides the instructions for proteins to create these features. The other 98% of human DNA is considered non-coding and the scientific community has only recently begun to identify its functions.

Forensic scientists, however, use this non-coding DNA in criminal investigations. Inside this region of DNA are unique repeating patterns that

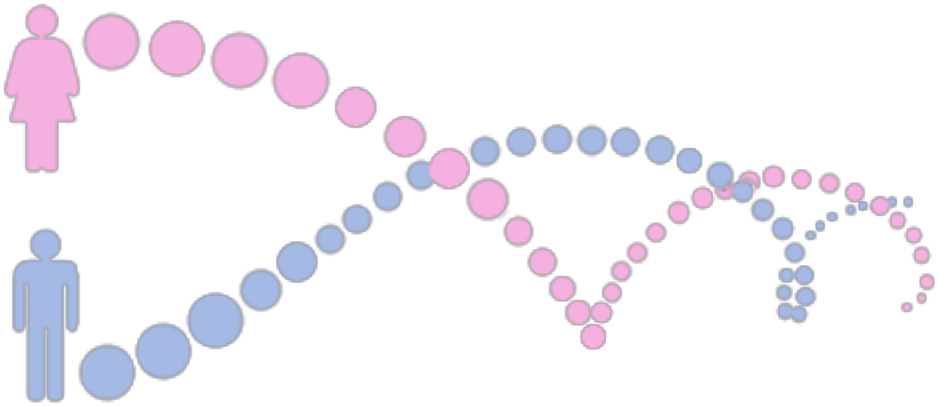
can be used to differentiate one person from another. These patterns, known as short-tandem repeats (STRs), can be measured to define the DNA profile of an individual.

All cells, except mature red blood cells, contain DNA. Any sweat, semen, body fluids or skin cells left behind at a crime scene can be examined for their unique STR signature to possibly link a person to the sample. While thousands of people may share several markers of their STR signature, there has been no case to date where two people have been found to have matching STR markers in all 13 areas used for comparison (except identical twins).

Different DNA, Different Uses

DNA can be found in either the nucleus of the cell (the center of the cell), or the mitochondria outside of the nucleus. Inside the nucleus, there are two types of DNA: DNA can reside in either the autosomal chromosomes or the sex-determining chromosomes. Autosomal DNA is primarily used in criminal investigations because, with the exception of identical twins, no two people have the same autosomal DNA.

However, for certain cases, such as sexual assault, examining DNA residing in sex-determining chromosomes can be very helpful during analysis. If the suspect in a sexual assault case is a male (has Y chromosomes) and the victim is female (has X chromosomes), conducting an analysis of the STR patterns in cells with Y chromosomes (referred to as Y-STR) can eliminate from the analysis the cells belonging to the female. Y chromosomes are passed through the paternal line—a brother, father and male children will exhibit the same Y chromosome.

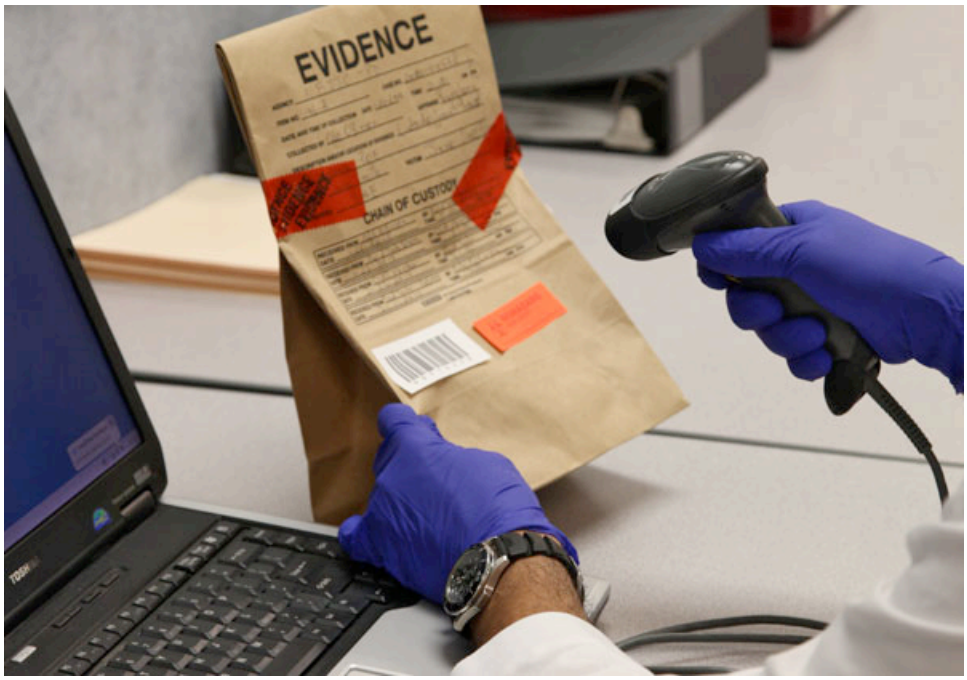


Mitochondrial DNA (mtDNA), on the other hand, is inherited from the biological mother, so all persons related maternally have the same mtDNA (although there is a slight chance that a change in mtDNA from parent to

offspring could exist). Because mtDNA is present in much higher quantities than nuclear DNA and doesn't degrade as quickly as autosomal DNA, mtDNA is useful for identifying missing persons or unidentified remains.

Why and when is DNA evidence examined?

DNA evidence is especially valuable for investigating violent crimes such as homicides or sexual assaults because blood, semen or saliva may be left behind by the perpetrator or victim. If the blood found in a suspect's car contains the victim's DNA, this is a powerful piece of physical evidence possibly linking the victim to that vehicle. If a perpetrator leaves behind a mask, cigarette butt or empty soda can at the scene, samples of sweat, skin cells or saliva can be collected and the resulting DNA profile compared to samples from the parties in question.



Biological evidence may also be discovered and collected in less violent crime scenes such as vehicle break-ins, but because laboratory resources are limited, the analysis and comparison of DNA evidence is typically conducted in the following types of cases:

- sexual assaults
- homicides
- robberies
- missing and unidentified persons

DNA analysis has also been used to help exonerate those convicted of crimes they did not commit. These post-conviction investigations often hinge on DNA evidence as the key information that confirms the innocence of the individual or the guilt of someone else. Many such cases have been successful because the use of DNA analysis was either non-existent or rudimentary at the time of the conviction.

The widespread awareness of the power of DNA analysis and the influence of courtroom television dramas has increased the number of jurors who expect to see DNA evidence in every criminal trial. According to a 2008 study, 22% of jurors expected DNA evidence to be presented in every criminal case [Shelton, **NIJ JOURNAL**]. In fact, when DNA analysis is not presented, trial lawyers often must present the reasons why it is not presented or why it was not collected or tested. For example, if a family member assaults another family member within their home, DNA of both parties will be found all over the home because they both live there, so DNA may not be helpful in determining guilt as some other form of evidence.

Developing Leads Using DNA

If a case has no suspects to compare the DNA evidence to, the profile of DNA collected at the scene can be entered into the FBI's Combined DNA Index System (CODIS) so that it can be compared to existing DNA records at the local, state or national level. By doing this, investigators may find a positive match to someone whose DNA profile is in CODIS and thereby identify a person of interest. Investigators can also search other countries' databases through INTERPOL, an international police organization. This could be beneficial if the investigator has reason to believe the perpetrator was from another country.

How It's Done

Sources of DNA Evidence

The biological material used to determine a DNA profile include blood, semen, saliva, urine, feces, hair, teeth, bone, tissue and cells.

Samples that May be Used

Investigators collect items that could have been touched or worn by persons involved in a crime. The following items may contain DNA material:

- Masks
- Hats
- Gloves
- Clothing

- Tools
- Weapons
- Sexual assault evidence kits
- Underclothes
- Bedding
- Dirty laundry
- Fingernail scrapings
- Cups/bottles
- Cigarettes
- Toothpicks
- Toothbrush
- Facial tissue
- Hairbrush
- Eyeglasses
- Condoms
- Tape
- Ligatures (rope, wire, cords)
- Stamps or envelopes

The best evidence occurs when a person's DNA is found where it is not supposed to be. For example, consider a breaking-and-entering that occurred in a residential area. Near the point of forced entry, a knit cap was found which the homeowners confirm was not theirs. Several head hairs were recovered from the inside, one of which had a root with tissue attached, which made it possible to obtain a DNA profile. The DNA profile was used to identify the perpetrator.

A crime scene investigator uses a swab to collect blood from a crime scene. (Courtesy of NFSTC)

A cigarette butt found at a crime scene may contain valuable DNA material in the dried saliva. (Courtesy of NFSTC)

DNA evidence from both the victim's blood and the perpetrator's skin cells may be available from this hammer. (Courtesy of NFSTC)

As technology advances, forensic scientists are able to analyze smaller and smaller biological samples to develop a DNA profile. For example, if a person touched an object or weapon, skin cells may have been left behind. This **low-level DNA** is sometimes referred to as "touch DNA". It can even be collected

from a victim's skin or bruises where they were handled roughly. Low-level DNA samples may be helpful when examining evidence where it would be difficult to retrieve fingerprints—such as textured surfaces on gun handles or automobile dashboards. However, not all jurisdictions have the capability to process this evidence.

To compare the victim's or suspect's DNA profile to the recovered crime-scene DNA, the laboratory will need to have their known biological samples available for a side-by-side comparison. These known samples are called **reference samples**. In some jurisdictions, a DNA sample is routinely taken from an arrestee during the process of booking and fingerprinting. However, this is an evolving area of law and states vary in their laws governing the collection of DNA from arrestees. Sometimes a court order is required to retrieve a reference from a person of interest. Reference samples are always collected from victims unless they choose not to cooperate with the investigation; in that case, a court order might be required.

Reference samples are often collected by swabbing the inside of the cheek.

In addition to unknown and reference samples, **elimination samples** are often collected from consensual sex partners and others, such as first responders, crime scene personnel and analysts working the case so they can be excluded from the investigation.

It is important that biological evidence be properly collected and preserved as it can easily degrade when exposed to heat or humidity. Storing evidence in cool environments is preferred; however, research has shown that room temperature conditions are suitable for storing dried stains as long as the humidity is controlled. Liquid samples should be transported in refrigerated or insulated containers.

Who Conducts DNA Analysis

DNA analysts working in laboratories that participate in the FBI's National DNA Index System (NDIS) and/or are accredited by a recognized organization must meet specific educational and training requirements. At a minimum, a bachelor's degree in biology, chemistry, or a forensic science-related area is required. In addition, the analyst should have successfully completed nine hours of coursework at the undergraduate or graduate level covering the following subject areas: biochemistry, genetics, molecular biology, as well as coursework or training in statistics and/or population genetics, as it applies to forensic DNA analysis.

To ensure analysts' skills are kept up to date, analysts who are actively employed at a crime laboratory are also required to meet continuing education requirements. These requirements are stipulated by the FBI's Quality Assurance Standards (QAS) (**http://www.fbi.gov/about-us/lab/codis/qas_testlabs**).

The specialists who conduct DNA analysis in the laboratory are referred to by several different titles, including: Crime Laboratory Analyst, Forensic Examiner, Forensic Scientist and Forensic Laboratory Analyst.

How and Where DNA Testing is Performed

DNA testing must be conducted in a laboratory with dedicated facilities and equipment that meet the FBI's stringent QAS requirements (**http://www.fbi.gov/about-us/lab/codis/qas_testlabs**). Most publicly funded DNA crime laboratories in the United States are part of state, regional or municipal law enforcement agencies and accept submissions from multiple agencies.

Prior to performing DNA analysis at the laboratory, initial testing is often conducted at the crime scene to determine the type of biological material in question. Screening for the presence of biological materials may also be conducted in the laboratory to determine if a specific biological fluid may be present. Most biological screening tests are presumptive in nature and do not specifically identify a bodily fluid.

To determine who deposited biological material at a crime scene, unknown samples are collected and then compared to known samples taken directly from a suspect or victim.

Most DNA samples submitted to a laboratory undergo the following process:

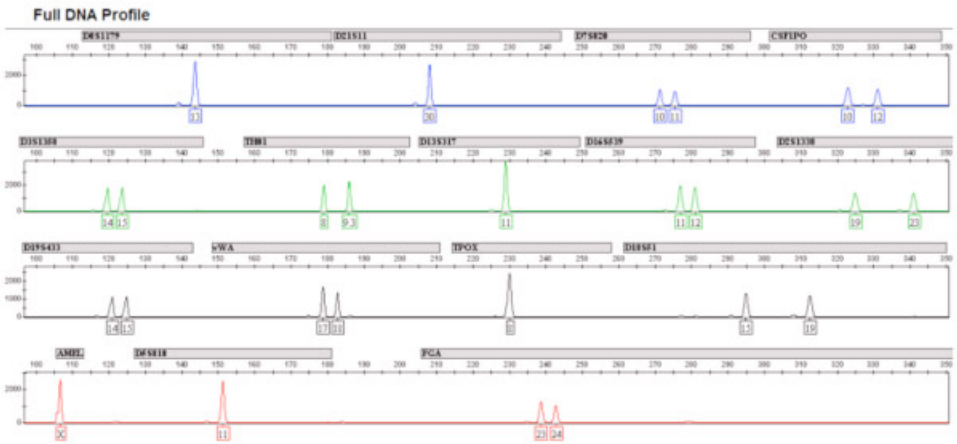
1. Extraction is the process of releasing the DNA from the cell.

2. Quantitation is the process of determining how much DNA you have.
3. Amplification is the process of producing multiple copies of the DNA in order to characterize it.
4. Separation is the process of separating amplified DNA product to permit subsequent identification.
5. Analysis & Interpretation is the process of quantitatively and qualitatively comparing DNA evidence samples to known DNA profiles.
6. Quality Assurance is the process of reviewing analyst reports for technical accuracy.

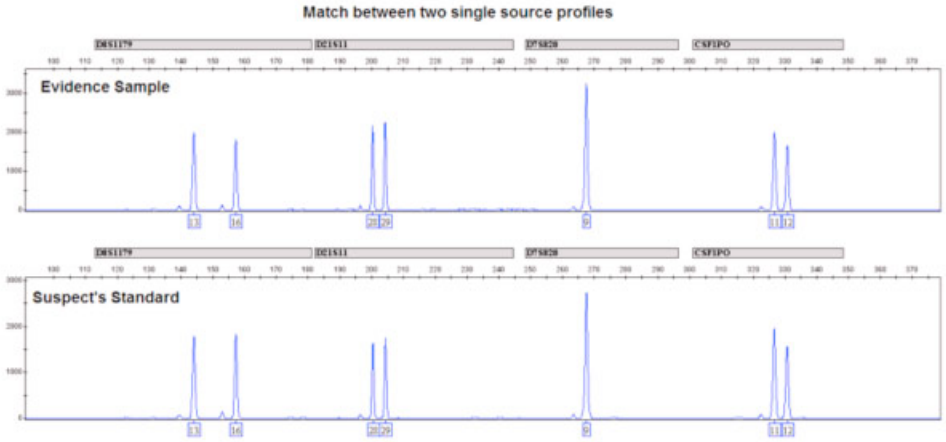
During extraction, a centrifuge is used to concentrate the sample to the base of the tube.

How the Results are Interpreted

The DNA analysis process provides the analyst with a chart called an electropherogram, which displays the genetic material present at each loci tested (each of the gray bars on the graph below, except for the last one, correspond to a locus; the final gray area is used to indicate the gender of the individual). In a complete profile, each person will exhibit either one or two peaks (alleles) at each locus. The following electropherogram is an example of a profile from a single individual (i.e., a “single-source” profile):



Loci that display only one allele indicate that the individual inherited the same marker from both parents at this locus. Where two alleles are displayed, the individual inherited different markers.

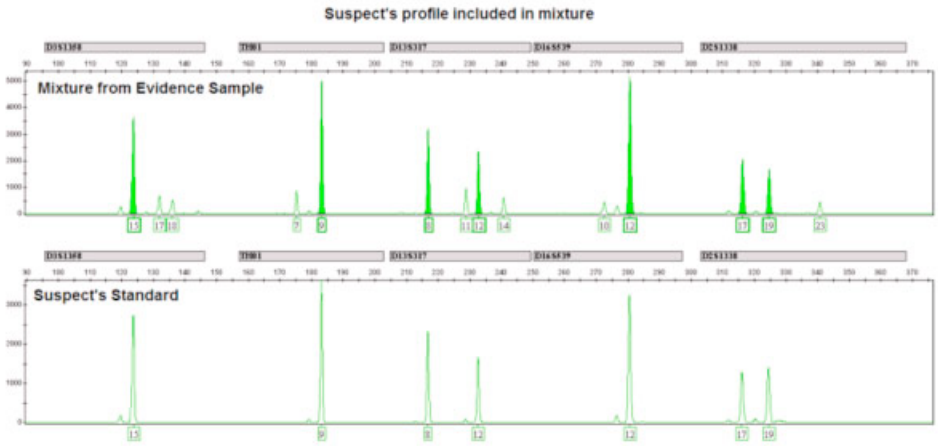


This image shows that the first four loci from the unknown evidence sample collected at the scene match the sample collected from the suspect. (This process would be repeated for all 13 loci.)

Note: The height of each peak must exceed a predetermined quantity threshold to be used in the analysis.

Is the suspect included?

In practice, evidence often contains a mixture of DNA from more than one person. These mixtures can be very challenging to analyze and interpret. In the following example, each marker from the suspect sample is included in the mixture profile collected from the evidence.



Partial Profiles:

If any locus is missing an allele, this is considered a partial profile. Partial profiles can happen for a variety of reasons, such as when a sample is degraded. If a sample has peaks at every locus, but any of them fall below a predetermined threshold, this would also be considered a partial profile.

The partial DNA profile displayed above is missing peaks at two loci. Click image to view larger.

Comparing Profiles Against a Central Database

To enable profiles to be searched against a large, national database, the FBI created the National DNA Index System (NDIS) in 1998. This national database is part of the Combined DNA Index System (CODIS) that enables law enforcement agencies throughout the nation to share and compare DNA profiles to help investigate cases. As of 2012, there are more than 10 million

DNA profiles in the system and CODIS has produced leads that have assisted in almost 170,000 investigations (**http://www.fbi.gov/about-us/lab/codis/ndis-statistics**).

Once a laboratory enters a case into CODIS, a weekly search is conducted of the DNA profiles in NDIS, and resulting matches are automatically returned to the laboratory that originally submitted the DNA profile. CODIS has three levels of operation:

- Local DNA Index System(LDIS)
- State DNA Index System (SDIS)
- National DNA Index System (NDIS)

The NDIS databases contain DNA profiles from:

- Convicted Offenders - DNA profiles of individuals convicted of crimes
- Arrestees - profiles of arrested persons (if state law permits the collection of arrestee samples)
- Forensic unknowns - DNA profiles of unknown individuals developed from crime scene evidence, such as semen stains or blood
- Missing Persons - contains DNA reference profiles from missing persons
- Biological Relatives of Missing Persons - contains DNA profiles voluntarily contributed from relatives of missing persons
- Unidentified Humans (Remains) - contains DNA profiles developed from unidentified human remains

Each database has its own rules regarding the number of STR markers that must be present for the profile to be uploaded. The National DNA Index System (NDIS) requires that 13 autosomal STR markers be tested (with more loci expected in the future), and the profile must contain information for at least 10 loci. The requirements are less stringent for state and local databases. States require the profile to have information for seven or more loci, and the local database requires at least four loci to be present to be uploaded.

FAQs

What kind of results can be expected from DNA analysis?

Biological material that was recently deposited at a crime scene will typically yield a full profile that contains results for all STR markers tested; this can be used for comparing to reference samples. However, some samples can prove difficult to analyze such as samples from a crime scene

that contain DNA from more than one individual. This is especially true for low-level DNA samples retrieved from items such as firearms.

Typically there are three possible laboratory outcomes:

1. If the DNA profiles from the evidentiary and known samples are consistent at each locus, laboratory analysts can interpret this finding as a "match," "inclusion," or "failure to exclude."
2. If the two profiles are not consistent at each locus, the finding can be interpreted as a "nonmatch" or "exclusion."
3. If there are insufficient data to support a conclusion, the finding is often referred to as "inconclusive."

What information does the report contain?

A DNA laboratory report typically includes the following information:

- Administrative information on the case, such as agency, file number, evidence item numbers, victim name and suspect name
- Date of the report and the name and signature of the reporting analyst
- Listing of all items of evidence examined, and type of methodology or technique used
- Listing of loci tested or amplification kit used
- Results of the examination and/or conclusions
- Interpretation of the resultant data
- Statements regarding the disposition of evidence (e.g., "after analysis, the evidence is stored in the laboratory").

Reports will contain an interpretive statement which addresses whether DNA profiles from evidence samples could be associated with or excluded from:

- A known individual (suspect, victim, third party)
- Other evidence samples (scene samples, sexual assault evidence)
- Database samples (offenders, forensic unknowns, or missing persons)

If one or more of the known samples is consistent with any of the evidence samples (a match or inclusion), a statistic will be provided indicating the rarity of the evidentiary profile. A statistic is also provided if all loci of a partial profile match the known sample, but this is obviously not as strong as two full-profile matches.

Based on the statistic, the jury will determine the value of the evidence. A match at all 13 loci between an evidentiary sample and a known sample is strong evidence that the known individual deposited the evidentiary

biological sample. If there is a match at only a few of the loci, the evidence is considerably weaker.

What are the limitations of DNA testing?

No-suspect Cases: Being able to collect and analyze a full DNA profile is powerful evidence, but it's not always going to lead investigators to the perpetrator. There must be a matching profile available to compare it to—either in a database or from a known sample. There is no master database that contains everyone's DNA information.

Partial Profiles: In cases where samples have very low quantities of DNA, are exposed to extreme environmental conditions or are not properly preserved, it may be difficult to obtain a full DNA profile and the test may only yield a partial profile. However, partial profiles may still be helpful in determining if an individual could be included or excluded in the investigation.

How is quality control and quality assurance achieved?

To ensure the most accurate analysis of evidence, the management of forensic laboratories puts in place policies and procedures that govern facilities and equipment, methods and procedures, and analyst qualifications and training. Depending on the state in which it operates, a crime laboratory may be required to achieve accreditation to verify that it meets quality standards. There are two internationally recognized accrediting programs focused on forensic laboratories: The American Society of Crime Laboratory Directors Laboratory Accreditation Board (**http://www.ascld-lab.org/**) and ANSI-ASQ National Accreditation Board / FQS (**http://www.forquality.org/**).

In addition to these quality guidelines, laboratories submitting data to the National DNA Index System (NDIS) must adhere to the FBI Quality Assurance Standards (QAS) (**http://www.fbi.gov/about-us/lab/codis/qas_testlabs**). These standards stipulate that all DNA casework be reviewed by a separate analyst, called a technical reviewer. This is then followed by an administrative review of the final report. Laboratories must undergo an external audit every two years to ensure their processes meet the FBI's QAS.

The Scientific Working Group on DNA Analysis Methods (**http://www.swgdam.org/**) provides input to the FBI on the QAS and publishes other guidance, such as interpretation guidelines, to assist laboratories.

Are there any misconceptions or anything else about DNA evidence that might be important to the non-scientist?

Due to the popularity of television crime dramas, several misconceptions may exist regarding the use of DNA evidence. For instance, when a fictional investigator on TV finds a matching DNA profile in a database, she will often be presented with a picture of the person's driver's license. In real life, CODIS does not contain or provide any personal information. To continue the investigation, she must coordinate with the agency that analyzed and uploaded the sample to obtain these details.

In addition, DNA analysis takes time to be done properly and every test must be reviewed for accuracy prior to release. In a busy crime laboratory, laboratories often have a goal of providing an analysis report within 30 days. However, this turnaround time will vary widely depending on numerous factors including number of other cases waiting to be analyzed; the number of laboratory personnel available; the type and amount of biological material submitted; the laboratory's equipment and other factors.

To compare a profile to those in a state databank will typically take several weeks to process. Once entered into the database, profiles are continuously searched against new profiles as they are entered to see if they match.

Additionally, while the technology exists to analyze samples with only trace amounts of DNA, these samples may often not meet the requirements to be entered into the national level of CODIS. Finally, while DNA evidence can prove extremely valuable to an investigation, in some cases, other, more traditional forms of evidence can be even more valuable to solving and litigating a case.

Common Terms

The following glossary of common terms has been culled from the *Common Terms* page of the DNA Initiative. Comprehensive glossaries are available at: the FBI (**http://www.fbi.gov/about-us/lab/codis/qas_testlabs**) and The National Human Genome Research Institute (**http://www.genome.gov/glossary/index.cfm**).

Allele - The characteristics of a single copy of a specific gene, or of a single copy of a specific location on a chromosome.

Autosomal DNA - DNA found in chromosomes which are not sex chromosomes.

Chromosome - The biological structure by which hereditary information is physically transmitted from one generation to the next; located in the cell nucleus, it consists of a tightly coiled thread of DNA with associated proteins and RNA; the genes are arranged in linear order along the DNA.

Combined DNA Index System (CODIS) - The generic term used to describe the FBI's program of support for criminal justice DNA databases as well as the software used to run National DNA Index System (NDIS) databases; CODIS is made up of the National DNA Index System (NDIS), the State DNA Index System (SDIS) and Local DNA Index Systems (LDIS).

DNA (Deoxyribonucleic acid) - Often referred to as the "blueprint of life;" genetic material present in the nucleus of cells which is inherited from each biological parent that determines each person's individual characteristics. An individual's DNA is unique except in cases of identical twins.

DNA Profiling - The result of determining the relative positions of DNA sequences at several locations on the molecule; each person (except identical twins) has a unique DNA profile when used in the context of the CODIS database, which evaluates 13 specific DNA locations.

DNA Fingerprinting - Analyses of the lengths of the fragments reveal that when looking at multiple VNTRs (variable number of tandem repeats) within and between individuals, no two people have the same assortment of lengths, except identical twins; this technique became known to the public as "DNA fingerprinting" because of its powerful ability to discriminate between unrelated individuals.

Epithelial cells - Cells that cover the inner and outer linings of body cavities.

Forensic DNA Analysis - The process of identifying and evaluating biological evidence in criminal matters using DNA technologies.

Genotype - The genetic constitution of an organism, as distinguished from its physical appearance (its phenotype); the designation of two alleles at a particular locus is a genotype.

Locus - The specific physical location of a gene on a chromosome; the plural form is loci.

Low Copy Number Analysis - The analysis of samples containing a small amount of DNA (approximately 30 cells or less); analysis of samples falling into this category often requires enhanced analysis methods to increase the sensitivity of detection.

Mitochondrial DNA (mtDNA) - DNA located in the mitochondria found in each cell of a body; sequencing of mitochondrial DNA can link individuals descended from a common female ancestor.

National DNA Index System (NDIS) - Authorized by the DNA Identification Act of 1994, the FBI administers this national index. NDIS enables comparison of DNA profiles associated with a crime scene to DNA profiles collected from known convicted offenders, as well as to other crime scene profiles. DNA profiles uploaded to NDIS are searched against the other DNA profiles submitted by other participating states.

Nuclear DNA - DNA located in the nucleus of a cell.

Partial DNA Profile - DNA evidence that does not yield identifiable results in all 13 core loci.

Quality Assurance Standards (QAS) - Quality assurance methods developed by the Scientific Working Group of DNA Analysis and Methods (SWGDAM). QAS provides guidelines to ensure the quality and integrity of data generated by the laboratory and uploaded into the CODIS database(s); published by the FBI.

Reference Samples - Material of a verifiable/documented source which, when compared with evidence of an unknown source, shows an association or linkage between an offender, crime scene, and/or victim.

Short tandem repeat (STR) - Multiple copies of a short identical DNA sequence arranged in direct succession in particular regions of chromosomes.

Y-STR - STR located on the Y chromosome; often examined when investigating sexual assaults involving male suspects.

Resources & References

You can learn more about this topic at the websites and publications listed below.

Resources

CODIS Program and the National DNA Index System FAQs (**http://www.fbi.gov/about-us/lab/codis/codis-and-ndis-fact-sheet**)

The DNA Initiative (**http://www.dna.gov/**)

Principles of Forensic DNA for Officers of the Court (**http://projects.nfstc.org/otc/**) (Online training resource funded by NIJ)

Collecting DNA Evidence at Property Crime Scenes (**http://projects.nfstc.org/property_crimes/index.htm**) (Online training resource funded by NIJ)

Forensic DNA Education For Law Enforcement Decision Makers (**http://projects.nfstc.org/fse/**)

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Federal Bureau of Investigations, Laboratory Services, CODIS—NDIS Statistics. **http://www.fbi.gov/about-us/lab/codis/ndis-statistics** (accessed June 21, 2012).

Ritter, Nancy. "DNA Solves Property Crimes (But Are We Ready for That?)", **NIJ JOURNAL** [online] 2008, 261. **http://www.nij.gov/nij/journals/261/dna-solves-property-crimes.htm** (accessed June 21, 2012).

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Forensic Evidence Admissibility and Expert Witnesses

How or why some scientific evidence or expert witnesses are allowed to be presented in court and some are not can be confusing to the casual observer or a layperson reading about a case in the media. However, there is significant precedent that guides the way these decisions are made. Our discussion here will briefly outline the three major sources that currently guide evidence and testimony admissibility.

The *Frye* Standard - Scientific Evidence and the Principle of General Acceptance

In 1923, in *Frye v. United States*[1], the District of Columbia Court rejected the scientific validity of the lie detector (polygraph) because the technology did not have significant general acceptance at that time. The court gave a guideline for determining the admissibility of scientific examinations:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while the courts will go a long way in admitting experimental testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be **sufficiently established to have gained general acceptance** *in the particular field in which it belongs.*

Essentially, to apply the "*Frye* Standard" a court had to decide if the procedure, technique or principles in question were generally accepted by a meaningful proportion of the relevant scientific community. This standard prevailed in the federal courts and some states for many years.

Federal Rules of Evidence, Rule 702

In 1975, more than a half-century after *Frye* was decided, the Federal Rules of Evidence were adopted for litigation in federal courts. They included rules on expert testimony. Their alternative to the *Frye* Standard came to be used more broadly because it did not strictly require general acceptance and was seen to be more flexible.

[1] **293 Fed. 1013** (1923)

The first version of Federal Rule of Evidence 702 provided that a witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

a. the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
b. the testimony is based on sufficient facts or data;
c. the testimony is the product of reliable principles and methods; and
d. the expert has reliably applied the principles and methods to the facts of the case.

While the states are allowed to adopt their own rules, most have adopted or modified the Federal rules, including those covering expert testimony.

In a 1993 case, *Daubert v. Merrell Dow Pharmaceuticals, Inc.,* the United States Supreme Court held that the Federal Rules of Evidence, and in particular Fed. R. Evid. 702, superseded *Frye's* "general acceptance" test.

The *Daubert* Standard - Court Acceptance of Expert Testimony

In *Daubert* and later cases[2], the Court explained that the federal standard includes general acceptance, but also looks at the science and its application. Trial judges are the final arbiter or "gatekeeper" on admissibility of evidence and acceptance of a witness as an expert within their own courtrooms.

In deciding if the science and the expert in question should be permitted, the judge should consider:

- What is the basic theory and has it been tested?
- Are there standards controlling the technique?
- Has the theory or technique been subjected to peer review and publication?
- What is the known or potential error rate?
- Is there general acceptance of the theory?
- Has the expert adequately accounted for alternative explanations?
- Has the expert unjustifiably extrapolated from an accepted premise to an unfounded conclusion?

The *Daubert* Court also observed that concerns over shaky evidence could be handled through vigorous cross-examination, presentation of contrary evidence and careful instruction on the burden of proof.

In many states, scientific expert testimony is now subject to this *Daubert* standard. But some states still use a modification of the *Frye* standard.

[2] The "Daubert Trilogy" of cases is: **DAUBERT V. MERRELL DOW PHARMACEUTICALS**, **GENERAL ELECTRIC CO. V. JOINER** and **KUMHO TIRE CO. V. CARMICHAEL**.

Who can serve as an expert forensic science witness at court?

Over the years, evidence presented at trial has grown increasingly difficult for the average juror to understand. By calling on an expert witness who can discuss complex evidence or testing in an easy-to-understand manner, trial lawyers can better present their cases and jurors can be better equipped to weigh the evidence. But this brings up additional difficult questions. How does the court define whether a person is an expert? What qualifications must they meet to provide their opinion in a court of law?

These questions, too, are addressed in **Fed. R. Evid. 702**. It only allows experts "qualified ... by knowledge, skill, experience, training, or education." To be considered a true expert in any field generally requires a significant level of training and experience. The various forensic disciplines follow different training plans, but most include in-house training, assessments and practical exams, and continuing education. Oral presentation practice, including moot court experience (simulated courtroom proceeding), is very helpful in preparing examiners for questioning in a trial.

Normally, the individual that issued the laboratory report would serve as the expert at court. By issuing a report, that individual takes responsibility for the analysis. This person could be a supervisor or technical leader, but doesn't necessarily need to be the one who did the analysis. The opposition may also call in experts to refute this testimony, and both witnesses are subject to the standard in use by that court (*Frye, Daubert*, Fed. R. Evid 702) regarding their expertise.

Each court can accept any person as an expert, and there have been instances where individuals who lack proper training and background have been declared experts. When necessary, the opponent can question potential witnesses in an attempt to show that they do not have applicable expertise and are not qualified to testify on the topic. The admissibility decision is left to the judge.

Additional Resources

Publications:

Saferstein, Richard. **CRIMINALISTICS: AN INTRODUCTION TO FORENSIC SCIENCE**, Pearson Education, Inc., Upper Saddle River, NJ (2007).

McClure, David. Report: Focus Group on Scientific and Forensic Evidence in the Courtroom (online), 2007,

https://www.ncjrs.gov/pdffiles1/nij/grants/220692.pdf (accessed July 19, 2012)

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