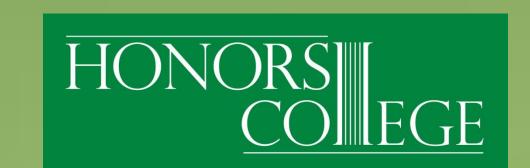


# DNA Profiling--Forensics' Secret Weapon: A Work in Progress

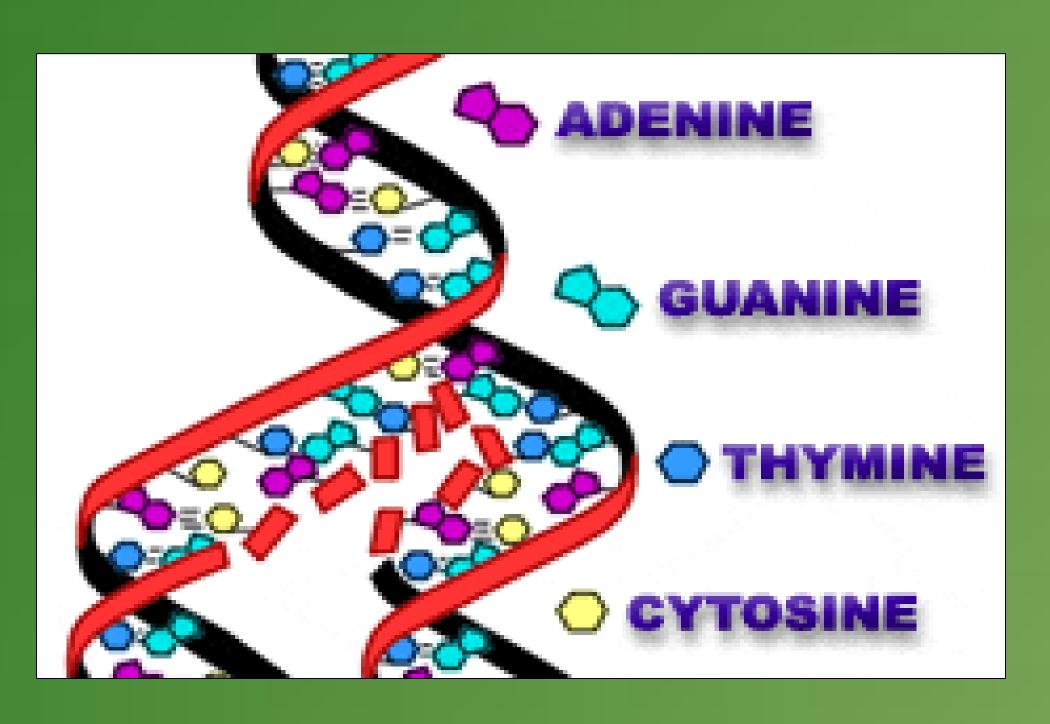
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**ABSTRACT** 

Forensic science is the application of science to the legal system. Within forensics, the use of DNA is very important in inspecting profiles and solving crimes. In crime scene investigation, biological samples, such as blood and semen, do not usually contain enough DNA to perform the tests needed to 3.00reate a biological profile. The purpose of this research is to compare the processes used in DNA testing to determine which is best for the criminal justice and forensics fields. For my methodology, I will study at least ten court cases to look at the use of DNA over time. I am hoping to find a correlation between the use of DNA to convict criminals and the use of other corroborating evidence; by doing this, I will learn if courts are convicting criminals based solely on DNA evidence or if they need other evidence as well.



# BACKGROUND

In the forensic science field, scientists are constantly dealing with DNA (deoxyribose nucleic acid) in order to examine profiles and solve crimes. Sometimes, obstacles arise in which the DNA cannot be processed because there is not enough of the DNA or the DNA is contaminated or degraded. Because of this, several processes have been developed to work through these obstacles, or at least make them as reliable and effective as possible.

One process, called the polymerase chain reaction (PCR), is used to increase the amount of DNA but it does not accomplish DNA testing. This process uses unchanging regions of the DNA to prime the variable regions of the sequence, and primers are used as the starting points for copying of the DNA (Riley 2005, 4). There are several problems with PCR. One is that this process will not work if the DNA is degraded or contaminated – the DNA must be in good condition. Also, this process requires extreme care, because any slight change in the process can yield completely different results. By using PCR, the number of loci can be coamplified, which increases the degree of certainty of a match between two individuals (Sullivan 2008, 392). This process is very useful for crime scene evidence, because blood, sperm, and other biological samples can be amplified successfully to use the evidence in many processes used to identify the culprit.

Ninety-nine% of the human genome is identical among individuals and the remaining .1% is the site of genetic diversity (Oberacher 2008, 137). Within DNA, there are many different segments called Restriction Fragment Length Polymorphisms (RFLP), which include Short Tandem Repeats (STRs) and Variable Number Tandem Repeats (VNTRs), used to identify a person through their profile. This type of forensic testing requires a large amount of undegraded DNA, which is hard to come by using crime scene evidence (Riley 2005, 2). In this process, DNA is cut with a restriction enzyme, which recognizes a specific sequence that occurs many times in a person's DNA. After being cut, the DNA is sorted through a gel, which acts like a sieve allowing small DNA fragments to move more rapidly than larger ones (Riley 2005, 3).

At this time, most scientists like to use the PCR technique to amplify the amount of DNA, because it makes it possible to use more tests to identify the culprit. RFLP are very important in identifying people through genomic profiles because of the genetic variability that exists between people. DNA profiling is a very valuable tool for most scientists around the world.

# LITERATURE REVIEW

In order to compare the processes used in DNA testing, the following sections explain the preexisting data about DNA typing.

- Variable Number Tandem Repeats (VNTRs) and Short Tandem Repeats (STRs)

  ❖ Variable Number Tandem Repeats (VNTRs) are sequence motifs that are tandemly repeated at a certain locus, which vary considerably between individuals (Sullivan 2008, 384).
  - ❖ After VNTRs were discovered, Short Tandem Repeats (STRs) were determined, which are short sequences of 2-7 nucleotides that are used the most frequently in current forensic tests.
  - \*STRs are usually the first choice for forensic typing, because they are easily amplified. Also, they are a shorter length than VNTRs, which permits multiplexing, the simultaneous amplification of two or more regions of DNA (Wong 2006, 192).
- A core set of STR markers was compiled into a nationwide FBI database, called CODIS (Combined DNA Index System); by using this database, the probability of a match between two unrelated individuals is one in a trillion when all thirteen markers are tested (Wong 2006, 193).

### Probes

- ❖ A single-locus probe (SLP) is used to detect a single locus in a genome by yielding two bands in DNA fragments; each band responds to a specific allele at a locus of a chromosome.
- ❖ A greater degree of sensitivity enables a profile to be obtained with less DNA and even partially degraded DNA.
- ❖ Multi-locus probes (MLP) simultaneously detect several loci that have similar sequences and are widely used to detect 3-40 tandem repeats.
- ❖ One advantage of using a MLP is that it yields a large amount of information in a single test with as many as 20 resolvable alleles being detected by a single probe.
- There are several disadvantages as well, which include having a minimum amount of DNA, which can be a considerable obstacle in crime scene investigation, and the fact that fluctuations can result in the loss or gain of some bands.

## Mitochondrial DNA sequence analysis

- \*When chromosomal DNA typing is not an option or attempted typing is unsuccessful, the use of mitochondrial DNA (mtDNA) can be helpful.
- \*Because mitochondrial DNA comes from the egg (maternal side) only, mtDNA can reveal ancient ancestral history as well as human evolution for anthropological investigations (Wong 2006, 193).
- ❖ This type of analysis gives scientists another opportunity to identify criminals if attempts with other processes, such as RFLP, are unsuccessful.

## Forensic identification

- ❖ DNA profiling has made the leap to generating evidence of positive identification, so individuals can be identified with a high degree of certainty.
- ❖ In earlier cases, scientists used multi-locus profiling analysis to match up samples by side-to-side analysis. There are a number of the same bands of similar intensities in identical positions in each sample; the number of bands in the best-resolved part of the gel is counted (Sullivan 2008, 390).
- ❖ Along with the amount of DNA, environmental factors, such as sunlight and moisture, also play a role in the utilization of DNA for crime scene purposes. Sometimes, DNA cannot last for more than a few weeks or a month because of the amount of environmental exposure DNA has received. Once DNA has been dried, it can last from a year up to a decade (Lachter 1997, 1).

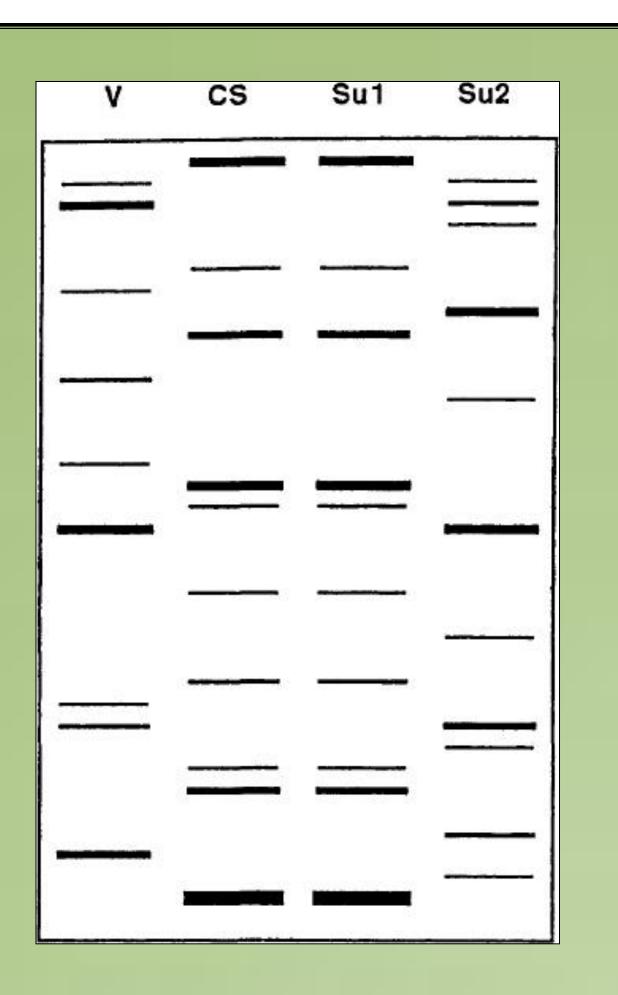
  \*\*Implications of DNA profiling\*\*
  - ❖ DNA profiling is still only used selectively, because the equipment is not available to local prosecutors, it takes too much time to create a profile, and to use the technology in a private laboratory is too costly (Lachter 1997, 1).
  - ❖ Also, there are questions about how DNA profiling can basically convict a suspect of a crime and how that might violate the suspect's right to a fair trial.
- ❖ Because there are so many issues at this time with DNA profiling in court cases, DNA is admitted or excluded on a case-by-case basis, determined by the quality of the evidence and the circumstances of the case (Lachter 1997, 2).

# METHODOLOGY

For my methodology, I will study at least ten court cases to look at the use of DNA over time. I am hoping to find a correlation between the use of DNA to convict criminals and the use of other corroborating evidence; by doing this, I will learn if courts are convicting criminals based solely on DNA evidence or if they need other evidence as well. Also, I will look at court cases from varying years to learn if DNA is used more or less at this time; hopefully, I will see that DNA is used more, because of the development of new technology that aids in DNA profiling.

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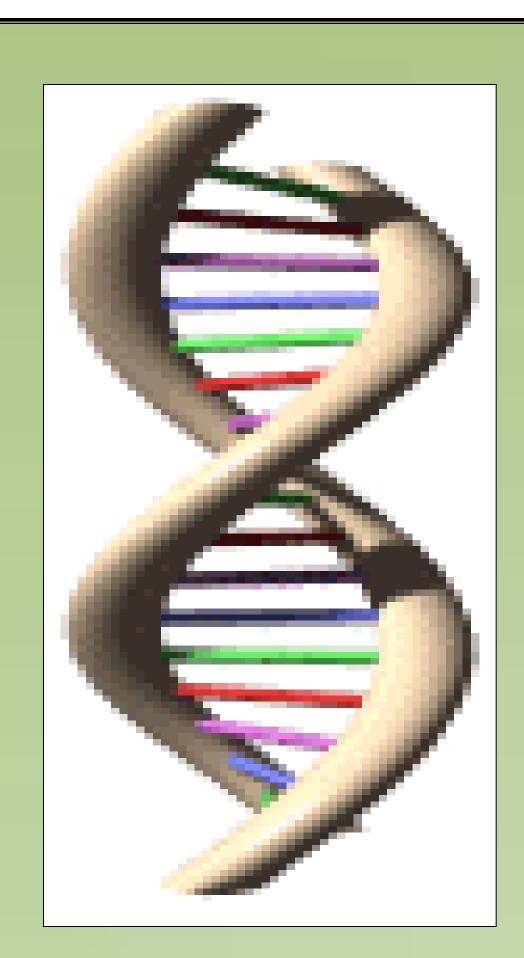


Fig. 4. The schematic shows a typical set of forensic multilocus DNA tests, with the DNA samples of the victim (V), crime sample (CS), and suspects 1 and 2 (Sul and Su2) being tested contemporaneously. All bands in the crime sample are matched in size and intensity by the bands present in the DNA profile of suspect 1, who has a high probability of being the source of the crime sample DNA. Suspect 2 can clearly be eliminated as a potential source of the DNA in the forensic sample.

## PICTURE ACKNOWLEDGEMENTS

- "Free Gifs and Animations" <a href="http://www.fg-a.com">http://www.fg-a.com</a>
  <a href="http://www.fg-a.com">www.123gifs.edu</a>
- "The Basics of DNA" <a href="http://www.youtube.com/watch?v=SrUV2InfxIo">http://www.youtube.com/watch?v=SrUV2InfxIo</a>

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