

# Dna testing in the criminal justice system



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## DNA Testing

Provided its uniqueness, DNA has found many uses in the medical and criminal investigation fields. In the medical field, scientists use DNA analysis to determine paternity. In the criminal investigation field, scientists use DNA analysis to identify suspects in criminal investigations. Nonetheless, identification of people using DNA analysis is not foolproof.

DNA testing, also known as DNA profiling, came because of two separate breakthroughs in molecular biology. Kary Mullis invented the Polymerase Chain Reaction in the USA while Professor Sir Alec Jeffreys discovered DNA fingerprinting at the University of Leicester in the UK (Kilpatrick).

Professor Sir Alec Jeffreys was the first to employ DNA analysis in a criminal investigation in 1986. He used DNA fingerprinting techniques in two rape and murder cases that took place in 1983 and 1986 in Leicestershire, UK. Officers from a small local police service approached Professor Jeffreys to assist them in solving two potentially linked rape and murder cases of two young girls. Professor Jeffreys analyzed samples from both girls in the two murder cases and came up with DNA profiles of the culprits in both cases. The DNA profiles were identical, and this led them to the conclusion that they were dealing with one culprit for both cases (Prime, and Newman 12). A mentally challenged porter, 17 years of age, had earlier confessed to commit one of the murders. However, when Professor Jeffreys took his DNA profile and compared it to the DNA profile of the culprit obtained earlier, they did not match.

The police had to find the perpetrator. The police organized the first ever screening project that was carried out for DNA profiling. They obtained blood samples from the close to 5, 000 men living in a small community where the murders had taken place. The samples, unfortunately, did not identify the suspect directly. The suspect, Colin Pitchfork, had asked one of his friends to give a blood sample on his behalf. However, the friend eventually gave in and admitted he had stood in for Pitchfork. Police arrested Pitchfork and his DNA profile obtained from his blood sample. His DNA profile matched the DNA profile obtained by Professor Jeffreys in the two murder cases. The probability of such a match occurring was  $5.8 \times 10^{-8}$ , and this provided credibility to his conclusions. His findings led to the conviction of the culprit, Colin Pitchfork, and the exoneration of the innocent man who was previously the main suspect in the crimes (Prime, and Newman 13).

Though Professor Jeffreys' method was accurate and reproducible, it required large quantities of high quality DNA, which forensic scientists did not always recover during forensic investigations. Further research on DNA analysis led to two major breakthroughs in the 1980s and 1990s. These breakthroughs formed the basis for modern DNA analysis techniques that are in use today.

The concept behind DNA testing is finding the differences in the DNA sequences of two or more samples of DNA. Thus, scientists use two or more sets of DNA in the analysis. In forensics, these samples are samples of DNA from the crime scene compared with DNA samples from suspects. The initial step in testing varies depending on the testing techniques. However, the first step is normally the isolation of a small part of a DNA sequence. Forensic scientists then isolate the DNA fragments and sort them based on size by gel

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electrophoresis (Whiting). The forensic scientists then make a blot of gel, and they release a probe onto the sample, which finds and binds onto a DNA sequence that is similar with that which is associated with the probe (Jones 527).

The common techniques used in DNA analysis include Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction (PCR), Short Tandem Repeats (STR), and Amplified Fragment Length Polymorphism (AmpFLP).

Restriction Fragment Length Polymorphism (RFLP) is a widely used method of isolating DNA. It requires large quantities of undegraded DNA. Because of this, this method is ideal for fresh crime scenes that have a lot of DNA evidence. Once scientists obtain adequate samples, they introduce restriction enzymes to isolate the AATT sequence. Scientists carry out gel electrophoresis on the fragments, make a blot, and probe the sample as mentioned earlier. The scientists analyze the sizes of the DNA fragments that the probe has found. They then compare the results of each DNA sample. Forensic scientists declare a match if the sizes of the two bands (bands of DNA from the crime scene and suspect's DNA) are within five percent of each other.

Polymerase Chain Reaction (PCR) is a method of DNA amplification, which has the ability to use information from minute and degraded DNA samples. This method amplifies specific parts of DNA. The method makes use of two short DNA pieces known as thermostable DNA polymerase and oligonucleotide primers to isolate the part of DNA, which scientists copy. The

scientists carry out gel electrophoresis as with Restriction Fragment Length Polymorphism (RFLP). In Polymerase Chain Reaction, contaminated DNA samples may bring about false results. Therefore, scientists only use uncontaminated samples.

Short Tandem Repeats refer to tiny regions of short repeated sequences. In these regions, DNA varies immensely between people who are not related. In this method, scientists seek to identify these regions in both samples and compare the two regions from the two samples. Scientists can achieve higher accuracy by isolating and testing many short tandem repeats. The amplifying effects of Polymerase Chain Reaction make it the ideal method for isolating short tandem repeats.

The Amplified fragment length polymorphism makes use of the variable number tandem repeats to differentiate alleles. Unlike in other tests where the criterion of separation of DNA sequences is size, scientists use polyacrylamide gel to separate alleles. This method is cheaper than the other methods and is highly automated.

The development of DNA testing has revolutionised the justice system in the US. It has led to close cooperation between forensic services and police services (Prime and Newman 11). DNA testing assists detectives in solving difficult cases where other investigative techniques prove insufficient. DNA testing can help provide clues where no witnesses are forthcoming, and it can drastically reduce wrongful arrests. More importantly, DNA testing makes evidence more reliable. It is interesting that the first use of DNA to solve crimes led to the exoneration of the main suspect of the crimes, who

had earlier confessed to committing one of the crimes (Prime and Newman 13).

DNA testing has helped solve a wide variety of cases ranging from forced entry and homicide to gang crimes, sexual assaults, and murders. A study carried out by the National Institute of Justice in the United States sought to determine the reliability of DNA evidence as a technique of solving crimes. The study involved examining cases and the availability of evidence for DNA profiling. In 55% of the cases that had biological evidence, researchers were able to identify a DNA profile. Of those cases that investigators fed into the DNA database, 41% provided a lead in identifying the suspect (Johns and Rushing). DNA testing in investigations led to two-and-a-half more success rates as compared to traditional investigation methods. The rates of arrest and prosecution were double with DNA testing (Johns and Rushing).

In spring 2003, Holly Jones, a 10-year-old girl, went missing from her neighborhood in Toronto. The days that followed her disappearance, investigators found parts of her mutilated body on the shores of Lake Ontario (Prime and Newman 13). Investigators positively identified these body parts as belonging to Jones through DNA typing. Moreover, the investigators developed a foreign DNA profile, most probably belonging to the perpetrator, from fingernail scratchings they obtained from the body parts.

The investigation of this case posed a great challenge to the Toronto Police Service. The lead investigators had the option of undertaking door-to-door canvassing in order to identify possible sexual offenders, whose number ran into hundreds. They had also received more than 2, 000 tips from the public.

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The huge amount of work awaiting the investigators led them to considering forensics to assist them in solving the case. A trace evidence scientist at the forensic science laboratory examined the victim's tapings, which led the investigators to the clue that the victim had been in touch with a green carpet (Prime and Newman 12). With this lead, police officers went on a door-to-door canvassing. Police officers identified a potential suspect. The suspect, however, declined to give a voluntary DNA sample to assist the police officers in the investigation. Undercover police officers were able to obtain DNA samples from the suspect, which the investigators compared to the DNA samples obtained from the body parts. The DNA profiles matched.

The police officers apprehended the suspect, and they searched his apartment. DNA analysis showed traces of Jones' blood in the suspect's apartment. With the amount of evidence obtained, the suspect entered a guilty plea (Prime and Newman 12).

Today, countries have established DNA databanks to help investigators with information with possible suspects. In Canada, the DNA databank had an almost immediate effect. With the formation of the National DNA databank, investigators reopened a 12-year-old unresolved case, which had involved more than 1, 000 suspects. The police had arrested the culprit on an unrelated crime. When investigators fed the culprit's DNA profile into the databank, the investigators found important leads that guided them to solving the 12-year-old case.

The future of DNA profiling will test the delicate balance between law enforcement needs and the public's right to privacy. Scientists are

developing techniques to predict a person's physical traits through DNA analysis. This will provide investigators with a genetic "eyewitness" (Prime and Newman 13). In addition, technology on identifying culprits through kinship relationships is under research. The future of DNA testing is both delicate and fascinating, and it will require a cautious approach. DNA testing, when used properly, has great benefits to crime investigators and the society in general.

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