Dna fingerprinting is 100 percent accurate law general essay

Law

" DNA Fingerprinting is 100% accurate in its use in Criminal Investigations"

DNA printing, originally developed in 1984 by Sir Alec Jeffreys, has revolutionized forensic science, as individuals can now be identified by their respective DNA profiles. This science has allowed for a revolutionized approach of criminal investigations; however the implications and reliability must be considered when determining its accuracy.

Definition of DNA

DNA, or deoxyribonucleic acid, contains all the genetic information about a person. It's the instructions for the body's entire genetic makeup. DNA is unique to each individual person. A person has the same DNA throughout his entire body, and it's located in every cell. Cells are the basic building blocks of all people.

Definition of DNA Fingerprinting

DNA fingerprinting in its essence, also known as DNA profiling, testing, DNA typing, or genetic fingerprinting, is " The analysis of DNA from samples of body tissues or fluids in order to identify individuals." It is a technique used

by forensic scientists to contribute to individual identification by their DNA. DNA fingerprinting is the process of identifying a person through their DNA sections which are embedded in every cell, rather than an actual fingerprint, despite its title.

How DNA Fingerprinting is done

The fundamental key of DNA testing is in identifying the differences and similarities in specific DNA sequences that are being compared. There are four DNA Fingerprinting techniques: RFLP analysis, PCR analysis, STR analysis, and AmpFLP. RFLP Analysis, or Restriction fragment length polymorphism, is used in order to identify change in the genetic sequence that may have occurred where a restriction enzyme, which is an enzyme that functions to protect the organism by attacking foreign DNA, cuts. RFLPs can be used to trace inheritance patterns, identify specific mutations, and for other molecular genetic techniques. Restriction enzymes are proteins isolated from bacteria that recognize specific short sequences of DNA and cut the DNA at those sites. During this procedure, the restriction enzyme is added to the DNA being analyzed and is incubated for several hours, allowing the restriction enzyme to cut. The DNA is then run through a gel, which separates the DNA fragments according to size. Image showing Restriction Enzyme cuts during RFLP AnalysisThe Second technique, PCR or polymerase chain reaction, has essentially replaced RFLP Analysis as it has now become a technique of the past. PCR applies to a wide variety of t DNA tests that differ in reliability and effectiveness. Each test’s reliability requires independent verification however as not all are as reliable as others. PCR itself is not a DNA fingerprinting technique, but rather increases the amount

of DNA available for typing by reproducing minute sections of DNA which can be done within hours. The image on the left portrays the PCR Analysis process from number 3 onwards (15)Represents just how much more effective PCR Analysis is to RFLP Analysis is (16)STR Analysis, or Short Tandem Repeat, is the third DNA Fingerprinting technique and the most popular. STR is a generic term that describes any short, repeating DNA sequence analysis, and consists of determining the amount of times an individual's DNA of times a small DNA sequence (short tandem repeat unit) is repeated at a specific chromosomal location in order to determine their DNA profile. STR analysis consists of three processes: amplification, electrophoresis, and interpretation. During amplification, extracted DNA is added to chemical reagents and heated, causing the two strands that compose the DNA molecule (they resemble two sides of a " ladder," as seen in the graphic on page 5) to separate. Each of the two strands then can be used as a template to make (or synthesize) a new double-stranded DNA molecule. The reagents in which the DNA is heated contain markers that identify the starting and ending points of the DNA fragment that is duplicated. The markers also are called primers because they prime (or stimulate) the synthesis reaction. Primers are short synthetic pieces of DNA designed to match the regions of human DNA which are highly variable. As the DNA and chemicals begin to cool, the primers attach to the single-stranded DNA. The primers contain fluorescent labels so that they may be detected by lasers later in the testing process. Once the primers have bound to the beginning and end of the segment being copied, individual building blocks of DNA from the reagents fill in the rest of the empty spots on the

single-strand. See diagram supra at page 7 describing the PCR process. The heating and cooling of the DNA is accomplished by a machine called a thermal cycler, in which a tray of capped tubes containing the DNA and chemical reagents are placed. The thermal cycler can be programmed to heat and cool repeatedly for specific amounts of time. At the end of many repetitions, millions of copies of the original DNA section are created. After the DNA has been amplified, the newly formed DNA fragments are sorted according to length using electrophoresis, which is performed by adding DNA to one end of a piece of gelatinous material which contains tiny holes that allows the material to function as a molecular sieve. An electric current is applied across the material, causing the smaller DNA fragments to move resulting in the DNA fragments being sorted by size. The size of the DNA fragments is determined by comparing the distance each fragment moved to the distances moved by the fragments of known size. Another form of electrophoresis is capillary electrophoresis with its distinguishing characteristic being that the electrophoresis occurs inside a capillary tube (a very thin glass tube, comparable to a human hair) with a sieving material inside, rather than on a piece of gelatinous material. Capillary electrophoresis is an automated process that analyzes many DNA samples and requires minimal involvement by DNA scientists after the initial set-up procedures are completed. These procedures include cleaning and rectifying the electrophoresis machine and preparing the amplified DNA for analysis. The fourth technique is ampFLP, or Amplified fragment length polymorph, which relies on variable number tandem, repeats (VNTR) to distinguish alleles, which are different forms of a gene. PCR is used to amplify DNA

samples that are then run on a polyacrylamide gel to separate alleles, instead of by size like other tests do. This particular test is highly automated and low-cost, so it is fairly popular in lower-income countries. Image portraying ampFLP process (17)

Use of DNA fingerprinting in Criminal Investigations

Because all of the DNA sections are contained in every cell, any piece of a person's body, from a strand of hair to a skin follicle to a drop of blood, may be used to identify them using DNA fingerprinting. This is useful in the case of identifying a criminal, because even a drop of blood or skin left at the crime scene may be enough to establish innocence or guilt, and it is virtually impossible to remove all physical trace of one's presence. DNA fingerprinting is useful in the case of identifying victims because even in cases where the body may be disfigured past identification, and teeth or other identifying features may be destroyed, all it takes is a single cell for positive identification. One very important use of DNA fingerprinting involves the field of forensics where DNA fingerprinting is used as a tool for solving criminal justice cases. Many high profile murder cases have been solved using DNA evidence. The FBI and police force highly recommend a DNA fingerprint test of a crime scene, victims and suspects. Biological evidence can be proved by extracting DNA from bloodstains, semen, hair or skin that can provide clues to solve the original crime. This technique is also used significantly to prove the paternity in child support proceedings. This technique of identifying people with their fingerprints came into existence from the 1930's. The latest finding in the forensic labs is the DNA fingerprint that is not similar to the traditional fingerprint that can be surgically changed. DNA fingerprints

cannot be in any way distorted by any technology or science because the DNA present in the cells, tissues and organs of an individual is the same. The use of DNA evidence in criminal investigations has grown in recent years. DNA testing has helped law enforcement identify criminals and solve difficult crimes. On the other hand, DNA evidence has helped prove that many convicted people are actually innocent.

Where Can DNA Be Found at a Crime Scene?

Since a person's DNA is located throughout his entire body, any materials left from his body at a crime scene will contain his DNA. Some examples of bodily materials that contain DNA evidence include: BloodSalivaPerspirationHairTeethMucusFingernailsSemenImage Reference CSI Crime Scene (20)

Places where DNA evidence may be found include:

CigarettesClothesStampsBite marksWeaponsCupsTissuesImage (21)

How Is DNA Collected at a Crime Scene?

DNA evidence can be easily contaminated during collection and storage. Contamination can occur when DNA evidence mixes with the DNA of another person. Law enforcement must make sure they take all precautions to not compromise the evidence. Examples of precautions that officers should take include: Wearing glovesAvoiding coughing or sneezing on the DNA evidencePreventing the storage of DNA evidence in direct sunlight or a warm settingUsing paper bags or envelopes for storage and not plastic bagsDNA evidence usually must be stored at room temperature. Paper bags should be

used because plastic bags will retain moisture that may damage the evidence.

How Is DNA Used in Criminal Investigations?

Since every person has unique DNA, the discovery of particular DNA evidence at a crime scene can help law enforcement determine who was involved in the crime. On the other hand, law enforcement can determine that a particular suspect wasn't involved by the absence of his DNA. The technique used by law enforcement to identify people based on their DNA is called DNA profiling, or genetic fingerprinting. DNA profiling is highly accurate as long as the evidence isn't contaminated. Many of the DNA samples go into the Combined DNA Index System (CODIS), a national DNA database that's funded by the Federal Bureau of Investigation. CODIS can be used to identify possible suspects by matching DNA profiles. This database can help forensic crime laboratories at the local, state and federal levels work together to identify criminals and solve crimes.

Advantages of DNA fingerprinting

Can Help Solve Murders/HomicidesThe major advantage of DNA fingerprinting in the criminal justice system is that it can be useful to help solve murders and homicides. DNA is found in almost every cell and any portion of the human body may be used in order to establish identity. It can be in the form of a single hair strand, a piece of skin, nail, or a droplet of blood. These seemingly minute and irrelevant pieces of matter can actually distinguish guilt or innocence in a case. It is quite impossible to remove all bodily or physical traces of a person's presence therefore, DNA fingerprinting

is very useful in murder or homicide cases where the victim's body has been disfigured, or fingerprints have been burned, or the teeth and other features are destroyed--one single cell is enough for making a positive identification. It may also help prove the wrongly accused innocent. Can Conclusively Prove PaternityDNA fingerprinting can also assist mothers who are seeking alimony from a father who refuses to pay since he is claiming that he did not father the child. In the justice system, willful failure to pay alimony or child support can result in a misdemeanor or in some cases, even a felony conviction. DNA fingerprinting can solve cases wherein mothers have had sexual encounters with more than one man and cannot identify who fathered her child. Men may also suspect the child is not theirs so they may undergo DNA fingerprinting to confirm their paternity. Also, DNA fingerprinting can also be used to establish connections to grandparents in order to legally collect an inheritance, or to claim social security benefits. The advantage of using DNA fingerprinting in this context is that it is over 99 percent reliable in determining paternity or a familial relationship. Useful in Rape CasesThere are also many advantages to using DNA fingerprinting in sexual assault or rape cases. DNA fingerprinting is accurate at identifying a rapist based on evidence left behind on the victim. Detectives can simply match the DNA of the semen found at the crime scene with the DNA of the alleged suspect in order to determine who is guilty of the crime. DNA samples from the alleged rapist can be collected through a vaginal swab from the victim or on other semen found in the scene.

Disadvantages of DNA Fingerprinting

AccuracyWhile most experts consider DNA testing accurate, there is always the risk of human error in the results. The analyst studies fingerprints, examines various patterns and decides if the patterns are from the same person. Fingerprint analysts go through special training, but there is still a risk of making a mistake that could mean the difference of life and death in a criminal case. Cost and TimeA major disadvantage of DNA fingerprinting is the cost. Many local police cannot afford a full time DNA fingerprint analyst. This leads them to outsource the tests to experts in other areas. When these experts are busy with other cases, a time management issue can arise. In addition, the fingerprint analyst spends a lot of time in court and preparing their testimony. This time in court takes away from the time the analyst could spend examining fingerprints. Social ImplicationsTwo major social issues of DNA fingerprinting can lead to eventual pitfalls. One is the issue of an individual's rights and the rights of the government to force suspects to undergo fingerprinting tests. Some people fear that the government may use DNA fingerprinting and the fingerprint national registry to try to track law-abiding citizens. The other concern is that while fingerprint analysis may be accurate, an expert analyst's testimony in court can be extremely confusing for the average juror to follow, a fact that defense attorneys may exploit. SensitivityAlthough DNA fingerprinting is very accurate, it also is very sensitive and can be contaminated easily. According to the Woodrow Wilson Biology Institute, the slightest contamination can affect the test, and it is difficult to keep a sample contaminant-free. Also, if different people or equipment are used to measure the length of the DNA sequences, they

might get different results. As of 2010, there are no standards for labs, nor any kind of licensing requirements. This could lead to poor test quality and reliability.

Criminal Case Studies

Tommie Lee Andrews

Tommie Lee Andrews, the first criminal to be convicted in the U. S. with DNA evidence, was convicted by Assistant State Attorney Tim Berry, as an expert in genetics analysis testified that the DNA ''fingerprint'' of Tommy Lee Andrews' blood matched that of the rapist's semen. It was laboratory tests carried out by Lifecodes Inc. that involved three DNA samples: one from the rapist's semen, one from the victim's blood and one from blood taken from Mr. Andrews after his arrest, that Michael Baird, a senior scientist at Lifecodes, and David Houseman a research biologist at Massachusetts Institute of Technology testifies that the DNA of Mr. Andrews’ blood and the DNA in the semen were a match therefore acknowledging him guilty.

Kirk Bloodsworth

After an anonymous tip and eyewitness testimony placed him near the crime scene, Kirk Bloodsworth was sentenced to death in Maryland for the 1984 sexual assault, and murder of 9-year-old Dawn Hamilton. Bloodsworth insisted on his innocence especially since no physical evidence linked him to the killing. His attorney, Bob Morin, with support from the Innocence Project, a nonprofit legal clinic formed to promote the use of DNA analysis to exonerate innocent prisoners, persuaded officials to compare Bloodsworth's DNA with the DNA of dried sperm found on the victim. The results

exonerated Bloodsworth. He was freed from prison in June 1993—the first death-row prisoner to be exonerated by post-conviction DNA testing. In 2003, after much prodding from Bloodsworth and Innocence Project lawyers, Maryland authorities finally searched their DNA database for a " cold hit" match of the evidence in the Dawn Hamilton case. The search turned up Kimberley Shay Ruffner, a convicted rapist who Bloodsworth had known in prison, who was then tried and found guilty of the Hamilton murder. Bloodsworth's story shows the promise of DNA testing for clearing the innocent and identifying the guilty, and by 2004, 144 prisoners, some on death row, had been exonerated by DNA testing.

OJ Simpson

In the famous case of OJ Simpson, who was charged with murdering his ex-wife Nicole Brown Simpson and Ron Goldman, defense attorneys successfully made a case for cross-contamination of DNA samples due to poor handling procedures. In a nutshell, they argued that because the blood samples collected by the Los Angeles Police Department were taken with wet swatches and left in a hot truck for several hours, resulting in degradation of DNA, it was not suitable for analysis. In addition, the defense also successfully argued that criminologists for the LAPD were, in general, poorly trained when it came to sample handling, and did not follow standard protocol, nor did they take precautionary measures, and made serious errors when collecting samples. However, according to Chris Darden forensic scientist in charge of the DNA samples, he and his team had shown the jury a high wall of physical evidence: blood, hair and fiber from three separate sites, a trail of evidence as conclusive as a video tape of Simpson actually

committing the murders. At South Bundy, he had left his footprints, his cap with his hairs attached to it and at least eight separate drops of his blood. At his home he had dropped a glove that matched the one he left near the bodies, and this one contained Goldman's blood. In his bedroom, his socks were splattered with Nicole's blood. In his Ford Bronco, there were samples of both Nicole's and Goldman's blood. Testing was done at two different laboratories, under strict control, confirming beyond a shadow of a doubt that Simpson was linked to the murders. It was a compelling conclusion. Never in the history of the California legal system had so much blood and DNA evidence been collected and accumulated against one defendant to prove his guilt.

Conclusion

DNA printing has revolutionized forensic science, as well as the approach of criminal investigations. Despite the various disadvantages and implications of DNA fingerprinting, it has successfully contributed to the identification of criminals, as well as exoneration of the wrongly accused; however it is conclusive through analysis of the case studies, that DNA fingerprinting is not always 100% accurate due to mistakes such as human error, contamination and degradation of DNA samples.