Criminology dna forensic science assignment

Law

In order to understand the usefulness and the limitations of DNA in the analysis of physical evidence, it is important to be familiar with the basics principles underlying these diverse disciplines. Besides identical twins, each individual’s DNA is unique. After all it is the genetic material that contains all the information necessary for any organism to develop and function. However, only a one-half percent that is of interest to forensics scientists.

This is the portion that varies greatly between individuals and it is what manifests itself in the individual traits such as eye color, hair color, and blood type. Most often the differences in DNA sequence do not show themselves in hysterical appearance; however, these sequences can only be examined using special laboratory techniques. Forensic scientists use these genetic differences from DNA to distinguish an individual between the individuals in a population. In 1944 Oswald Avery defined the role of the cellular component known as DNA as the vehicle of generational transference of heritable traits.

In 1953, James Watson and Francis Crick elucidated the structure of the DNA molecule as a double helix. Form follows function; the very nature of the molecule provided an explanation for its unique properties (Berg, Autonomy, Setter, Agate ; Agate, 2012). In 1980, David Bittiest and coworkers were the first to exploit the small variations found between people at the genetic level as landmarks to construct a human gene map. In 1984, while searching for disease markers in DNA Aleck Jeffrey discovered the science of personal identification.

He termed this method DNA Fingerprinting, a method to detect loci sequentially (Alberta, Johnson ; et al, 2008). This term is later replaced by DNA typing or DNA profiling, “ Early in the use of DNA, profiles for the purpose of identification were called DNA fingerprints, a term which is now rarely used” (Porter, 2005). The first forensic use of DNA occurred in England, “… A DNA test was performed by Dry. Alex Jeffrey, who had developed DNA fingerprinting” (Porter, 2005).

One of the most significant facts of the case is that an innocent suspect was the first accused of the murder was freed based on the DNA evidence. Perhaps the most significant scientific advance besides the determination of the structure of DNA was in 1986 the polymerase chain reaction (PC). PC multiplies the sample and yields results which were once unobtainable, “ Furthermore, the statistical chances of a random coincidence in DNA of two individuals with the same profile have now cached enormous figures in the billions (Porter, 2005).

Observation of cells and Criminology Dna Forensic Science By Supersonically information is carried on chromosomes, “ thread-like structures in the nucleus of a eukaryotic cell that became visible by light microscopy as the cell begins to divide” (Alberta, Johnson & et al, 2008). As biochemical analysis became possible, chromosomes were found to consist of both DNA and protein. DNA is the name given to a group of molecules that occur in all cells of all living organisms and that carry that organism’s genetic information.

That, is they carry the instructions for asking the chemical compounds, proteins, by which cells stay alive, grow, develop, reproduce, and carry out all the functions that constitute life as we know it. DNA molecules are very large, complex molecules made of only a few simple sugar units combined with a phosphate group and one of four nitrogen bases, adenine A, cytosine C, guanine G, and thymine T (Alberta, Johnson & et al, 2008). The combination of one sugar molecule, one phosphate group and any on nitrogen base is called a nucleotide.

A complete DNA molecule consists of very long chains of thousands of nucleotides Joined together. The DNA molecule is comprised of two strands each wrapped around the other in the form of a double-helix. The bases on each strand are properly aligned in a manner known as complementary-base pairing. As a result, adenine pairs with thymine and guanine pairs with cytosine. Each gene is actually composed of DNA specifically designed to carry the task of controlling the genetic traits of our cells. The position a gene occupies on a chromosome in known as a locus.

Approximately 30, 000 human genes have been identified. DNA duplicates itself prior to cell division. DNA replication begins with the unwinding of the DNA trends of the double helix (Berg, Autonomy, Setter, Agate & Agate, 2012). The two separate strands, now separated, act like a template for the formation of daughter strands. Each strand is now exposed to a collection of free nucleotides that will be used to recreate the double helix using base pairing. The enzyme DNA polymerase catalysts the sequential addition of nucleotides to the growing DNA strands.

The advent of DNA technology has dramatically altered the approach of forensic scientists toward the individualizing of bloodstains and other biological factors as evidence. The high sensitivity of DNA analysis and the subsequent search for DNA evidence has even altered the types of materials collected from crime scenes. (Softening, 2013) Modern methods of obtaining DNA have made it possible to obtain convictions on blood left at the scene, on semen, or even spittle behind on a postage stamp. “ It is surprising how often DNA is left behind, often when the criminal accidental cuts himself at the scene but also numerous other ways.

DNA evidence makes detection of crime more probable” (Porter, 2005). During an investigation, forensic evidence is collected at a crime scene, analyzed in a laboratory ND often presented in court. Each crime scene is unique, and each case presents its own challenges. Complex cases may require the collection, examination and analysis off large amount of evidence. In terms of forensic DNA analysis, there is a variety of possible sources of DNA evidence. The more useful sources include blood, semen, vaginal fluid, nasal secretions and hair with roots.

It is theoretically possible to obtain DNA from evidence such as urine, feces and dead skin cells, though this is often classed as a poor source due to the lack of intact cells and high levels of intimations preventing successful analysis. Prior to analysis, the it will be following simplified steps. The sample cells are lased (broken down) in a buffer solution. Denatured proteins and fats are polluted through centrifugation. The cleared Alyssa is then passed through a column, often containing a positively charged medium that binds

to the DNA. Contaminating proteins, fats and salts are then removed through several washes.

The DNA is recovered in a buffer solution (Rankin, 2005-2013). The use of DNA analysis in forensic science is based on a variety of techniques focusing on polymorphisms. Different sequences are studied in different techniques, including single nucleotide polymorphisms, mini satellites (variable number tandem repeats), micrometeorites (short tandem repeats) and mitochondrial DNA, each different with regards to length and repetition (Rankin, 2005-2013)". The latest method of DNA typing, short tandem repeat (STAR) analysis has emerged as the most successful and widely used DNA profiling procedure.

Generally, " DNA extraction is the first step in forensic DNA analysis for use in human identification, and is essential to generating STAR profiles from forensic biological amplest (Luminously, Could, Miranda, Croon, Haversack, Kimono, Saul & Landers, 2012)". Stars are locations on the chromosome that contain short tandem repeats that repeat themselves within the DNA molecule. They express a high degree of polymorphism, making them of particular use to the forensic scientist. As STAR regions are non-coding, there is no selective pressure against the high mutation rate, resulting in high variation between different people (Softening, 2013).

Though there have been thousands of short tandem repeats found in the human genome, only a small number are utilized in forensic DNA analysis. STAR loci are ideal for use in forensic science for a number of reasons. They represent... " Discrete alleles that are distinguishable from one another, they

show a great power of discrimination, only a small amount of sample is required due to the short length of Stars, PC amplification is robust and multiple PC can be used, and there are low levels of artifact formation during amplification (Rankin, 2005-2013)".

The method of enzyme based produced PC-ready DNA after only 20 minute incubation and requires no centrifugation or sample transfer steps. Implementation of this method into the workflow for forensic asses could reduce sample and DNA preparation time. The enzyme based method allows easy integration for downstream processes, such as PC (Luminously, Could, Miranda, Croon, Haversack, Kimono, Saul ; Landers, 2012). Polymerase chain reaction (PC) is a technique for replicating small quantities of DNA or broken pieces of DNA found at a crime scene, outside a living cell.

Polymerase chain reaction is the outgrowth of knowledge gained from an understanding of how DNA strands naturally replicate within a cell. For the forensic scientist, PC offers a distinct advantage in hat it can amplify minute quantities of DNA many millions of times (Softening, 2013). The PC cycle consists of three primary steps: denomination, annealing and extension. " Denomination, the sample is heated to 94-ICC for about 30 seconds. This separates the double-stranded DNA by breaking hydrogen bonds, allowing primers access.

Annealing, the samples is kept at 50-ICC, depending on the primer sequence, to allow hydrogen bonds to form between the primers and the complementary DNA sequence. Extension is also known as the elongation stage. The sample is heated to ICC for duration depending on the length of

the DNA strand to p the strand. Deoxyribonucleic troposphere are added to the 3′ end of the primer (Rankin, 2005-2013)". Each PC cycle can take only 5 minutes. This procedure can then be repeated as necessary until the original sequence has been amplified a sufficient amount of time, with the amount being doubled with each cycle.

Following PC, the products are separated using electrophoresis. Electrophoresis is essentially a method of separating molecules by their size through the application of an electric field, causing molecules to migrate at a rate and distance dependent on their size. The gel essentially acts as a type of molecular sieve, allowing smaller molecules to travel faster than larger fragments. Following electrophoresis, it may be necessary to visualize these bands using radioactive or fluorescent probes or dyes (Berg, Autonomy, Setter, Agate ; Agate, 2012).

Another type of DNA used for individual characterization is mitochondrial DNA. Mitochondrial DNA (mend) is located outside the cell's nucleus and is inherited from the mother (Softening, 2013). Recent developments in forensic Mrs.. Profiling systems have allowed the simultaneous inference of a variety of human cell types room small amounts of samples. In addition to body fluids such as blood, semen, saliva, menstrual secretion and vaginal mucosa, the presence of skin cells can also be determined.

Since more cell types can be examined, RNA profiling complements the existing detection methods of body fluids which are mainly serology-based and presumptive in nature. In forensic genetic analyses, "… The highest priority often goes to establishing the possible contributor(s) of DNA to an

evidentially trace. As a consequence, RNA profiling is incorporated into a DNA/RNA assessment strategy hat generates both a DNA and an Mrs.. Profile from the same stain (Lindbergh, Mainmast & Sine, 2012)".

Mitochondrial DNA is generally used when other methods such as STAR analysis have failed. This is often in the case of badly degraded bodies, in cases of disaster or accidents where an individual is too badly damaged to identify. The most significant advantage of the use of mitochondrial DNA is the possibility of analyzing even highly degraded samples. If a specimen is severely decomposed to the point that it is not possible to successfully extract a DNA profile using nuclear DNA, it may be possible through mitochondrial DNA.

However the use of mend does have its disadvantages. As mitochondrial DNA is only maternally inherited, this cannot form a full DNA fingerprint of the individual, thus this technique is only beneficial if the DNA profiles of maternal relatives are available, such as the individuals mother or biological siblings (National Institute of Justice, 2012). Possibly the most momentous device to arise from DNA typing is the ability to compare DNA types recovered from crime scene evidence to those of convicted sex offenders and other convicted criminals (Lynch, 2013).

Numerous countries have reduced computerized databases containing DNA profiles to aid in the comparison of DNA fingerprints and the identification of suspects and victims. The first Government DNA database was established in the United Kingdom in April 1995, known as the National DNA Database (AND). As of 2011, there were over 5. 5 million profiles of individuals in the

system. Similarly, the FBI in the US formed their own DNA database, the Combined DNA Index System (COD'S), in 1994, though it was in the handling and analysis of evidence will often also submit their DNA profiles to the database in the case of accidental contamination.

There is the possibility for DNA databases to be shared between countries; however some countries focus on different loci in DNA fingerprinting. Currently, U. S. Crime laboratories have standardized on 13 Stars for entry into a national database (COD'S). Currently, DNA evidence is treated as exceptional, but it also is upheld as a model for other forms of forensic evidence to emulate. Many terms, such as investigation, inquiry, argument, evidence, and fact were established in law well before being associated with science.

However, while legal proof remained qualified by standards f moral certainty, scientific proof attained a reputation for objectivity (Lynch, 2013). Although most forms of legal evidence, including expert evidence, continue to be treated as fallible opinions rather than objective facts, forensic DNA evidence increasingly is being granted an exceptional factual status. It did not always enjoy such status. Two decades ago, the scientific status of forensic DNA evidence was challenged in the scientific literature and in courts of law, but by the late sass it was being granted exceptional legal status.