Assessing The Role Of DNA Fingerprinting To The Society And The Law

I. Introduction

An individual's identification is based on physical appearance, characteristics and demographic profile. A source of identification of an individual is his genetic identity, these genetic identity are individually unique from every individual. Through this is the so called DNA, or the genetic blue print of our own systems since it contains instructions to construct other components of the cell. The knowledge of DNA in the field of Science was then revolutionized and creates new important role in the application of living the life. Due to the fact that no other individual may contain the same genetic sequence that act as codes of each and every one of us, DNA Fingerprinting evolved. According to Sir Tomas Menino, [1]"We must be vigilant in our actions towards criminals and innovative in our approach towards solving crime". Science as part of the academe also plays a very important role in the lives of the nation. It was noticeably amazing that the realm of Sciences mainly defines our living, due that, it surrounded us (known or unknown) in our almost everyday activities. Science, [2], was a system of departmental knowledge covering general truths and methods that was reconcile through practice of scientific laws. Through evolution of the society, where in the world we lived in is almost at its risk due to criminalities and resurrections of living, [3] (Philippines: ranked as 69th place with 40.42% crime index), it is very rightful that Sciences helps us in different aspects of solving this undying phenomenon – the criminalities, through the advancement of performing DNA Fingerprinting.

II. Objectives

The purpose of this paper was to assess the science behind DNA fingerprinting technology and to investigate its impact to the society and the law. The document was intended to expound the following statements such as, 1) the relation and 2) the importance of DNA Fingerprinting in the field of Chemistry, 3) the procedural methods of DNA Fingerprinting, and lastly, 4) the importance of DNA Fingerprinting in the society, also to the society of law. With this, information such as, definition of DNA and DNA fingerprinting, types of DNA fingerprinting and its methods, and the roles that had been played by DNA fingerprinting to the society and the judicial system will be the focus of the discussion of this paper. This discussion purposely aimed to help the general public understand the complexity of this technology.

III. Discussion

Chapter I. Dna Definition And Structure

This deals with the definition of Deoxyribonucleic acid (DNA), concerning its function in genetic coding. Also, in this chapter, the DNA structure was explained to further elaborate the start of the discussion regarding DNA Fingerprinting.

In the field of Science, [19-20] DNA is the long polymer of simple units called nucleotides, which are held together by the backbone in the composition of sugar and phosphate groups. In the

backbone is the four types of molecule called bases, and the sequences that it forms is responsible for encoding genetic information. Using the genetic code, the DNA majorly functions in encoding the sequence of amino acids residues in proteins, which mainly helpful in the development of body cell. The four chemical bases are known as the adenine (A), guanine (G), thymine (T) and cytosine (C). Similar to the application of how the letter of the alphabets appears in a certain order to form words and sentences, the order or sequences of these four bases determines the information available for building and maintain an organism. Wherein, with the help of DNA, [4] the body can easily determine the particular structure and function of every cell. Also, DNA holds a very important role in our body, without this, there would be no one to be considered accountable for the responsibility of passing characteristics or traits from our parents to us. Most of DNA is found inside the nucleus of a cell, where it forms the chromosomes. Chromosomes have proteins called histones that bind to DNA. DNA has two strands that twist into the shape of spiral ladder called helix. The four building blocks of DNA are the; adenine (A), thymine (T), guanine (G), and cytosine (C). The attachment of these four bases can form chemical bond called as base pairs, which connect the two DNA strands.

Chapter II. Dna Fingerprinting Definition, History And Types

In this chapter, the discussion regarding DNA Fingerprinting was elaborated through documenting definitions, history and types.

DNA fingerprinting is a [6] “DNA-based identification system that relies on genetic differences among individuals or organisms”. In DNA Fingerprinting, identifying an individual from a sample can be accomplished through looking at the unique pattern that the DNA of that specific individual have. [7] By finding out the length of the DNA, and the number of the DNA sequences, performing DNA fingerprinting would be possible.

In the history of our world, it is factual that DNA Fingerprinting has truly evolved, through the effort of Dr. Alec J. Jeffreys, an English geneticist, DNA fingerprinting technique was known. [7] The said technique was invented in the year of 1984.This is where he found out that in an individual’s DNA, the DNA sequences are multiple replication of each other, and amazingly, the number of repeated sequences are different from any other individual. For the record, DNA fingerprinting was first used in an immigration case. In there, DNA fingerprinting helped in finding out relation between the immigrants with the people they claim as their close relatives. It was a great success and event in the history of DNA fingerprinting.

Year Event

- 1935 Andrei Nikolaevitch Belozersky isolated DNA in its pure from
- 1953 James Watson and Francis Crick explained the double helical structure of DNA
- 1966 Marshall Nirenberg, Heinrich Manthaei and Severo Ochoa demonstrated and explained about the genetic codes in the DNA which consisted of three nucleotides base each of 20 amino acids.

In terms of types, Scientists have developed two main methods to examine differences in DNA. The first is Restriction Fragment Length Polymorphism (RFLP) which is usually used to analyze relatively long VNTRs, and the second is Polymerase Chain Reaction (PCR) which is usually used to analyze relatively short STRs. Each method has advantages and disadvantages.

RFLP type of DNA Fingerprinting

[9] In RFLP as a method of DNA Fingerprinting (also known as Restriction Fragment length Polymorphism was first used in Scotland in 1987, this is where RFLP blooms as a functional method of DNA Fingerprinting. RFLP fingerprinting analyzes the lengths of specific DNA bands excised from the main DNA molecule by cutting with restriction enzymes. The band lengths vary depending on the number of repeating sequences. These repetitions, known as Variable Number Tandem Repeats (VNTRs), can repeat from one to thirty times. RFLP fingerprinting, compared to other techniques, has limitations. The main limitation is the initial amount of DNA needed for analysis (Table 2). This procedure does not amplify the DNA, so if there is not enough DNA present, RFLP fingerprinting cannot be performed. Additionally, RFLP fingerprinting is a slow process. Analysis typically requires about 3-4 weeks of laboratory work under the best circumstances.

In RFLP DNA fingerprinting, [10] the first step to do is the isolation and purification of DNA, second is the PRC amplification and restriction enzyme digestion, third, separation and detection of the digested products via electrophoresis, fourth, analyzation of data to generate the fragment profile for each sample and lastly, clustering analysis based on the profile of sample gathered in step 4.

PCR Type of DNA Fingerprinting

While on the other hand, Polymerase Chain Reaction or PCR type of DNA Fingerprinting main used is the amplification trace amounts of DNA, (amplification is a process of making more identical copies). Wherein, using PCR will lead to a higher probability of determining the identity of the source. Additionally, most doctors would recommend the usage of PCR due that, performing this type can answer different medical questions that may help in diagnosing and treating the patients.

On behalf of the procedures of PCR, Kary Mullis and Micheal Smiths were awarded a Nobel Prize in 1993, after the basic steps in performing PCR was figured out by Mullis in 1983.

[11-12] In performing PCR, there are reagents that must need to be prepared first, those are, 1) the DNA template to be copied, 2) primers, or the short stretches of DNA that initiate the PCR reaction, in getting the primers, one must decide which side of the DNA wants to be copied, 3) DNA nucleotides bases (A-T-C-G), this will be needed in constructing the new strand of DNA, 4) Taq polymerase enzyme, which is useful to add in the new DNA bases, 5) a buffer solution, to ensure the right conditions of the reactions.

On the other hand, [11] its main steps are denaturing, to be followed by annealing and extending. These three steps are the basic steps in performing PCR, which is needed to repeat in at least 20-40 times to double the copies of DNA each time.

Chapter III. Applications Of Dna Fingerprinting

In this chapter, applications of DNA Fingerprinting to the society will be explained, brief backgrounds will be given but the focus will remain in the roles of DNA Fingerprinting to the Forensic Science.

DNA Fingerprinting as the most significant tool of Forensic Science still creates a big impact to the society with a lot more uses, for example are the Paternity Testing and Molecular Archeology.

Paternity Testing

DNA fingerprinting to Paternity Testing is one of the most punctual use of DNA fingerprinting in the current times. Due that, with the use of DNA analysis it would be possible to determine the genetic relationship on an individual (the child) and his/her male parent (the father).Since 1990's, [13] where the use of DNA in Paternity testing was then expanded, the accuracy of the test are getting closer to 99.99% accuracy, this leading probability has created DNA testing a dispute to the remarks of Paternity tests.

Molecular Archeology

Scientists are able to study the evolution of human population also with the use of DNA Fingerprinting. In order to trace migrations, scientists extract DNA samples from skeletons as well as from living people around the world and compare them to show possible migration patterns of different ancient civilizations. To archeologist, [14] DNA was used as tool to link us to the memories of the past.

DNA Forensics

The use of DNA fingerprinting also plays an important role in the field of forensic science. With the use of DNA fingerprinting, forensic analysts have a more accurate way of investigating crimes. According to Girish et. al (2010) with the recent advances on molecular biology, it has revolutionized all aspects of dentistry. With these progresses in technology, identification of individuals is easier. The most reliable source of DNA is inside the teeth, since the DNA is covered by enamel, it provides protection to the DNA sample from factors that might affect it. These genetic makeups that are contained in DNA are used to identify a person's identity. Every individual's DNA makeups have different sequence or have uniqueness that helps in identifying a certain person from another. Although these variations of DNA sequence differentiate one person from another, but could also be used in correlating individuals. The DNA fingerprinting may also be used various studies more specifically in the field of biology.

Since DNA fingerprinting is widely used in the field of forensic science, it has been providing accurate information and analysis on the matter being investigated. According to the Rule on DNA Evidence [16] by the Philippine Supreme Court that all biological samples that exist that are relevant to the case should be tested using a scientifically valid technique. In the light of this, forensic chemists are responsible in analyzing data gathered from crime scenes. Bakar (2015) stated that analytical chemistry plays an important role in the field of forensic science. In addition, he stated that forensic chemistry is an application of analytical chemistry to the law with the analysis of physical traces. Also, analytical chemistry requires you to have strenuous skills in using different substances along with different types of modern instrumentation and analysis skills along with a problem solving approach.

The role of DNA Fingerprinting in solving criminalities around the world is widely accepted. With the help of DNA fingerprinting conviction of innocent individuals accused for crimes that they did not commit would always be in larger possibilities. As stated in Chang and Goldsby 12th Edtion,

Chemisty [18] “Today, DNA Fingerprinting has become an indispensable tool of law enforcement”.

Chapter IV. General Process Of Dna Fingerprinting

In DNA Fingerprinting, everything starts with the extraction of DNA with parts of our body containing one, then, restricting DNA through an enzyme, using gel electrophoresis separate the fragments of DNA. Then, transfer the DNA onto a nylon membrane, add the radioactive probe, set up X-Ray to detect radioactive pattern, obtaining all the processes will lead in knowing the result, whether there is a connection between the two individuals.

IV. Conclusion

Indeed, DNA fingerprinting and Forensic Science can be defined as the intersection of two integral parts in today’s society, the law and science. It is because DNA Fingerprinting was considered as a greatest tool that was widely used in the field of forensic science in today’s generation. Moreover, DNA fingerprinting was one of the most accurate ways to identify organisms, as for DNA is a unique piece of genetic material within biological organisms, that no two persons were exactly alike. In our society, crimes are undeniably spreading until it turns to be a headache not just in our government but also brought fear to everyone. Some of the crimes were given justice for the victims, but unfortunately some cases were not. But because of the technology of DNA fingerprinting arise for forensic science, most of the crimes have been solved and justice has been served. Hence, DNA forensics is one of the greatest tools in piecing together a crime scene.

It is difficult for many to grasp the idea that something so small and invisible to the naked eye like DNA could have such a large role in proving one’s innocence or guilt in the society of law because it cannot easily be altered once it is left at a crime scene or deposited within the body, which makes it a strong forensic tool. Thus, DNA evidence is now one of the most powerful tools used in determining who is responsible for a crime and one of the only true methods to correctly identify an individual.

As time passes by, the method of fingerprinting also revolves into a new one. RFLPs and VNTRs are the traditional methods of fingerprinting DNA, which uses a relatively large sample that uses the method of probe hybridization to detect polymorphisms in the DNA. As of now, STRs are the most used form of DNA fingerprinting, which is PCR based and uses a very small sample of DNA. On the other hand, DNA fingerprinting has many applications that range from criminal rape cases, paternity tests, molecular archeology, sports memorabilia, etc. Although there are still some factors that make it difficult to preserve a good DNA sample, progress will continue to be made in the field of forensic science, which seems to have a limitless future in technology to come.

Therefore, it’s our opinion that DNA fingerprinting is an essential tool in forensic science, as for fighting and solving crimes. This kind of technology should be continuously accepted in the society of law, but with government responsibility to assure that this will be properly used to obtain justice and be used in other fields.