**TOPIC: FINGERPRINTING, DNA AS INDESPENSIBLE FORENSIC SCIENCE**

**COURSE: ANA 406 INTRODUCTION TO FORENSIC SCIENCE**

**GROUP: V**

**LECTURER: Dr. Enye Linus A.**

**BY:**

ANYANWU COLLINS-KEVIN-16/MHS01/046

MAHMUD ZUBAIRU KAMARU – 16/MHS03/033

OLUDELE DOYINSOLA - 16/MHS01/196

DANIEL CHIAMAKA FAITH - 16/MHS03/009

OKEME SAMUEL - 16/MHS01/177

UMO EMMANUEL OKON - 16/MHS03/022

DIVINE KANU – 16/MHS01/122

AKINJARE TOLUWALASE MATTEW – 16/MHS01/023

FADAIRO ADEGBENGA SAMUEL – 16/MHS03/012

ERIKE CHUKWU -

ERIC OGHENETEGA SAJERE – 16/MHS03/031

**1.1: Fingerprinting**

Friction ridge skin has unique features that persist from before birth until decomposition after death. Upon contact with a surface, the unique features of friction ridge skin may leave an impression of corresponding unique details (Wertheim, 2011). Two impressions can be analyzed, compared, and evaluated, and if sufficient quality and quantity of detail is present (or lacking) in a corresponding area of both impressions, a competent examiner can effect an individualization or exclusion (identify or exclude an individual). The analysis, comparison, evaluation, and verification (ACE-V methodology), combined with the philosophy of quantitative–qualitative examinations, provide the framework for practical application of the friction ridge examination discipline (Wertheim, 2011). Fingerprinting refers to the process of adding fingerprints to an object and recording them, or of identifying and recording fingerprints that are already intrinsic to the object (Wagner, 1983). Fingerprinting is now in wide use, typical examples include:

* Providing biometric security (for example, to control access to secure areas or systems)
* Identifying amnesia victims and unknown deceased (such as victims of major disasters, if their fingerprints are on file)
* Conducting background checks (including applications for government employment, defense security clearance, concealed weapon permits, etc.).
* Forensic analysis of crime scene and conviction of criminal cases

**1.2: Types of fingerprints**

* Arches: The ridges of the finger run continuously from one side of the finger to the other and make no backward turn. Normally, there is no delta in an arch pattern but if it exists, there must be no re-curving ridge that intervenes between the core and delta points (Godden *et al*., 2005).
* Loops: The ridges make a backward turn in loops but they do not twist. This backward turn or loop is distinguished by how the loop flows on the hand and not by how the loop flows on the card where the imprint is taken. This imprint on the fingerprint is similar to the reverse image that we see when we look at ourselves in the mirror. A loop pattern has only one delta (Godden *et al.,* 2005).
* Whorls: Some of the ridges in a whorl make a turn through at least one circuit. Therefore any pattern that contains two or more deltas will be a whorl (Godden *et al*., 2005).

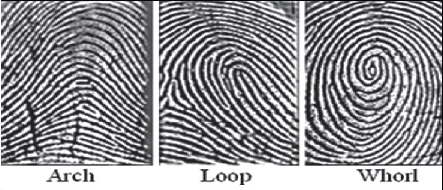


Figure 1.1: Types of fingerprints (Ahmed & Razzak, 2007)

**1.3: Fingerprint development**

The uniqueness of friction ridge skin falls under the larger umbrella of biological uniqueness. No two portions of any living organism are exactly alike. The intrinsic and extrinsic factors that affect the development of any individual organ, such as human skin, are impossible to duplicate, even in very small areas (Wertheim, 2011). The uniqueness of skin can be traced back to the late embryological and early fetal development periods. The primitive epidermis is established at approximately 1 week Embryonic Gestational age EGA, when ectoderm and endoderm are separately defined. A second layer of epidermis forms at about 4–5 weeks EGA. The outermost of the three layers is the periderm. The middle layer, which is the actual epidermis, is composed of basal keratinocytes (named because of the keratins these cells manufacture). At about 8 weeks EGA, the basal cells between the epidermis and the dermis begin to consistently divide and give rise to daughter cells that move vertically to form the first of the intermediate cell layers (Wertheim, 2011). At this point, the embryonic epidermis is three to four cell layers thick, but it is still smooth on its outer and inner surfaces. Keratinocytes are tightly bound to each other by desmosomes, and the cells of the basal layer are attached to the basement membrane by hemi-desmosomes (Wertheim, 2011). At around 10–10.5 weeks EGA, basal cells of the epidermis begin to divide rapidly. As volar epidermal cells divide, shallow “ledges” can be seen on the bottom of the epidermis. These ledges delineate the overall patterns that will become permanently established on the volar surfaces several weeks later. Primary ridges are the first visual evidence of interaction between the dermis and epidermis and are first seen forming as continuous ridges (Wertheim, 2011).

**1.4 Fingerprinting in Forensic Science**

The first characteristic that is critical to fingerprint identification is that fingerprints don’t change over time. That is, everyone’s fingerprints are the same from birth until death. The size of the finger changes, but the fingerprint pattern does not. The second critical characteristic is that no two fingerprints are ever exactly alike in every detail. Interestingly, even identical twins do not have the same fingerprints. The uniqueness of fingerprints makes it possible to use prints from a crime scene to either connect a suspect to the scene or eliminate a suspect from consideration. Latent fingerprints (those left accidentally at the scene of a crime) can be collected from a wide variety of surfaces. Invisible fingerprints, such as those made from skin oils, can be processed to produce visible prints for identification (Page *et al.,* 2011). Even partial, smudged, or otherwise imperfect prints can help detectives make a case against a suspect. In the context of crime scene investigation, the identification of latent fingerprints is the process of analyzing the latent prints against a database of fingerprints to try to find a match. The challenges involved in this task are numerous, particularly if the fingerprint is not clear and complete (Cole, 2009). When a crime is committed, crime scene investigators typically use adhesive powders to find fingerprints (Page *et al.,* 2011). This is often called ‘dusting for fingerprints because investigators use brushes to dust surfaces with powder. The powder sticks to the oils present in fresh fingerprints, making them visible. After locating a print, crime scene investigators photograph the print and lifts it using special lifting tape. They also write a short description of where the fingerprint was found and begin a meticulous record of the individuals who handle or transport the evidence as it makes its way to the forensic laboratory, where fingerprint identification occurs (Page *et al.,* 2011). Forensic scientists who analyze fingerprints in the lab are typically called fingerprint examiners. The fingerprint examiner’s job begins when print arrives at the lab from the scene of the crime. A fingerprint examiner must first carefully mark the distinguishing features of the full or partial print. The next step is to enter the print into a fingerprint identification system such as the Federal Bureau of Investigation’s Integrated Automated Fingerprint Identification System (IAFIS). Finally, the examiner must manually compare latent fingerprints with potential matches obtained by the system in order to make a positive identification. The examiner must thoroughly document every step of the process and write a full report about the identification process and its conclusions (Page *et al.,* 2011). If the fingerprint evidence is used in a case that goes to trial, the examiner may be required to testify in court about the work (Cole, 2009). Fingerprint evidence can be critical in placing a suspect at the scene of the crime, Fingerprint identification techniques continue to evolve with the increased availability and power of modern computers, and this field of forensic science promises to be exciting for years to come (Cole, 2009).

**1.5: Fingerprinting as an Indispensable Forensic tool**

No two people have exactly the same fingerprints. Even identical twins, with identical DNA, have different fingerprints. This uniqueness allows fingerprints to be used in all sorts of ways, including for background checks, biometric security, mass disaster identification, and of course, in criminal situations. Fingerprint analysis has been used to identify suspects and solve crimes for more than 100 years, and it remains an extremely valuable tool for law enforcement. One of the most important uses for fingerprints is to help investigators link one crime scene to another involving the same person. One of the most important uses for fingerprints is to help investigators link one crime scene to another involving the same person. Fingerprint identification also helps investigators to track a criminal's record, their previous arrests and convictions, to aid in sentencing, probation, parole and pardoning decisions.

**2.1: DNA in Forensic Science**

One particular biological tool has revolutionized forensic investigations is the analysis of DNA. As all living things contain DNA, and all DNA exhibits variability both among and within species, any biological material associated with a legal case carries in it information about its source (Jobling & Gill, 2004).

DNA fingerprinting: The DNA revolution began in 1984 with the discovery, by Alec Jeffrey in Leicester, UK, of hypervariable loci known as MINISATELLITES1. These were detected by hybridization of probes to Southern blots of restriction-enzyme-digested genomic DNA. Shared ‘core sequences’ between different minisatellites loci allowed probes to detect many independent minisatellite simultaneously, yielding the hypervariable multi-band patterns known as DNA fingerprints (Jobling & Gill, 2004). At the same time, a method known as DIFFERENTIAL LYSIS was developed that selectively enriched the sperm concentration in vaginal fluid/semen mixtures, thereby avoiding the problem of the victim’s DNA (which is in great excess) masking the rapist’s. This is the only protocol to have remained unchanged throughout the past 20 years (Jobling & Gill, 2004). Although DNA evidence alone is not enough to secure a conviction today, DNA profiling has become the gold standard in forensic science since that first case, the value of DNA typing as an investigative tool is enormous because an extremely large number of genotypes exists in the population, which yields a high probability of finding different patterns in different individuals. A high probability of different patterns in different individuals means a large chance of excluding a falsely accused individual and small chance of a coincidental match between a DNA profile of a suspect and that in an evidentiary sample. Despite being dogged by sample processing delays because of forensic lab backlogs, the technique has gotten progressively faster and more sensitive: Today, investigators can retrieve DNA profiles from skin cells left behind when a criminal merely touches a surface (Chakraborty & Kidd, 1991). This improved sensitivity combined with new data analysis approaches has made it possible for investigators to identify and distinguish multiple individuals from the DNA in a mixed sample. And it’s made possible efforts that are under way to develop user-friendly instruments that can run and analyze samples in less than two hours (Chakraborty & Kidd, 1991).

**2.2: DNA as an Indispensable Forensic Tool**

When doing the DNA testing it is then taken from two sources the cell’s nucleus and the cell’s mitochondria. The use of scientific principles to the art of criminal investigation in forensic science. It is a valuable tool in which jurors tend to rely therefore it calls for accuracy and reliability in order to help prevent wrongful convictions. Some of the crime scene investigations that have been done by the forensics are the hair analysis. DNA is the genetic code for producing proteins made by combining amino acids. Each group of three nucleotides e.g. G-A-G codes for the amino acid called glutamine while C-G-T codes for alanine. Protein is not likely to function well if a nucleotide change and becomes the basis for diseases and health issues. The proteins produced have roles such as enzymes that are meant to speed up the chemical reaction. Cell transport protein is responsible for the association in the movement of materials in the cell.

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