THE IMPORTANCE OF DNA AS AN INVESTIGATION TOOL

By

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DECLARATION

Student number: 7593821

I, **UDESH MAHARAJ**, declare that "**The importance of DNA as an investigation tool**" is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

(U Maharaj) 23 July 2013

SIGNATURE DATE

PREFACE

This study has a twofold purpose in that it attempts to identify how knowledgeable investigators are about the collection and use of DNA in relation to the building of a criminal case, and to establish how optimally DNA as evidence is utilised. The study has revealed several shortcomings which render the use of DNA evidence inadmissible in criminal proceedings. The researcher also analysed other aspects relating to DNA evidence, namely: identification, individualisation, criminal investigation, forensic investigation, and objectives of criminal investigation.

For criminal investigators to be successful in their investigation of cases involving DNA, it is imperative for them to have a clear understanding of the basic concepts surrounding DNA investigations and the value of DNA evidence. It is submitted that, because of a lack of knowledge in DNA-related investigations by detectives, a lack of training in DNA-related cases and delays in the collection of DNA evidence, valuable evidence is often lost and/or contaminated. This causes such evidence to become inadmissible in criminal proceedings, and has a negative impact on the conviction rate for such crimes.

VOORWOORD

Hierdie studie het ’n tweevoudige doel in die poging om te identifiseer hoe kundig ondersoekers is aangaande die insameling en gebruik van DNA in terme van die bou van ’n kriminele saak en die vasstel van hoe DNA optimal as bewys gebruik kan word. Die studie het getoon dat daar verskeie tekortkominge is wat teweeg gebring het dat die gebruik van DNA bewys onaanvaarbaar was in kriminele prosedure. Die navorser het ook ander aspekte geanaliseer aangaande DNA bewyse, naamlik: identifikasie, individualisering van onderwerpe tydens ondersoek, kriminele ondersoek, forensiese ondersoek, en die aspekte van kriminele ondersoeke.

Vir die kriminele ondersoekers om suksesvol te wees in hulle ondersoek van sake waarby DNA betrokke is, is dit vir hulle van kardinale belang om ’n suiwere begrip van die basiese konsep rondom DNA ondersoeke en die waarde van DNA bewyse te hê. Dit is voortgebring dat, as gevolg van die tekort aan kennis in DNA ondersoeke, asook opleiding van DNA-sake by die speurders, en vertraging in die versameling van DNA bewysstukke, waardevolle bewyse is telkens verlore of gekontamineer. Dit veroorsaak dat sulke bewyse verwerp word in kriminele prosesse, en het ’n negatiewe impak op die vonnis statestieke vir sulke misdade.

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GENERAL ORIENTATION

1.1 PROBLEM STATEMENT

According to Watson (1998:8), Deoxyribonucleic acid (DNA) is a unique genetic data which is more useful and effective than fingerprint data and which could revolutionise South Africa's crime-fighting efforts. The importance of a proper and effective approach to processing a crime scene for clues should never be taken for granted. Over the past two decades there have been fundamental changes in the laboratory examination of physical evidence in the field of forensic investigation (Watson, 1998:8). One such technological advancement has been the use of DNA profiling as an investigative tool.

DNA methods are an established part of the South African law enforcement and criminal justice systems. It is hard to believe that the technologies were developed as recently as the mid-1980s, and that the database of law enforcement profiles was established in the 1990s (Rothstein & Talbott, 2006:153).

The researcher has eighteen years of experience in conducting crime scene investigations in the South African Police Service (SAPS), and, from his observation, a problem exists when it comes to the use of DNA during preliminary investigations at a crime scene. The researcher had often experienced late arrival of forensic officials at crime scenes, and untrained detectives being used on call duty to attend serious cases such as murder, robbery and hijackings. These experts often have to rush through their work, as they have other crime scenes to attend to, and this, in the researcher's opinion, has a detrimental impact on the quality of their work.

In crimes involving DNA, it is possible to obtain a conviction if DNA evidence is acted upon quickly, and if a crime scene is handled in the proper manner. Suspects can be identified from the analysis of DNA, and others eliminated, to narrow the list. (This will be discussed in the forthcoming chapters.) According to Participant 26, a senior advocate in the High Court, it occurs on an unfortunately frequent basis that courts declare DNA evidence inadmissible because

it is contaminated, or the scene disturbed, or not even preserved, or that there is no proper chain of evidence from the time when (or if) the DNA evidence is collected. Marais (1992:48) mentions that a crime scene is the primary source of physical evidence, and that preliminary investigations involve the collection and thorough analysis of evidence before a theory is formulated. DNA evidence that is incorrectly gathered could lose its integrity and/or evidential value, causing this type of physical evidence to be declared inadmissible in criminal proceedings. Alternatively, DNA evidence might not be gathered at all, and this could have a detrimental effect on the outcome of the result of a trial.

The researcher conducted an investigation into whether the detectives at the identified police station are aware of how to use DNA optimally for those cases where it can be a source of evidence in the investigation process. The SAP 6 is a statistical tool used by the SAPS, which indicates how many cases were reported, and how many cases were either solved (convictions obtained), sent to court, and closed as false, withdrawn, filed, or undetected. Perusal of the SAP 6 showed that the conviction rate in DNA-related cases amounted to three percent – a poor solving rate on the part of the Rape Statistics – South Africa & Worldwide 2011. With this low conviction rate, the researcher will prove that there is a problem regarding the investigation of DNA-related cases.

The SAPS curriculum was perused with respect to both the detective course and training offered to learner detectives, as well as the comprehensive training in the investigation of DNA-related cases, so that an attempt might be made to improve the ability of investigators to conduct DNA-related investigations. It was found that detectives on the detective courses were given training in the collection and preservation of evidence; however, the department was not at the level where one could now refer to the detectives completing the course as experts in the field of evidence collection.

1.2 AIM OF THE RESEARCH

The aim of a research study is to establish facts, gather new data, and determine whether there are interesting patterns in the data (Mouton, 1996:103). The aims of this research are to –

- discuss what DNA is.
- establish the importance of DNA evidence is as an investigation tool.

1.3 PURPOSE OF THE RESEARCH

According to Denscombe (2002:26–28), there are different purposes for doing research. This study will focus on the following purposes as described by Denscombe (2002:28):

- The researcher intended to evaluate the existing procedures that investigators are taught when they receive training during their detective course, with respect to identifying and collecting DNA evidence at a crime scene. The researcher's intention was to determine how this training can be improved. The effectiveness of the training will be evaluated by also analysing cases to establish how the guidelines that were given in this training were applied.
- The researcher wanted to apply the new knowledge of international practice to the development of good practice in South Africa. This would be achieved by recommending new procedures to enhance performance and to improve the conviction rate in court cases.
- The researcher wanted to empower himself and other investigators with the new information. The researcher intends to give lectures, to write an article on the importance of the use of DNA for investigation purposes, and to make the information available for training.

1.4 RESEARCH QUESTIONS

Research questions specify exactly what is to be investigated in the research (Denscombe, 2002:31). In addressing the research problem, the following two primary research questions were formulated:

- What is DNA?
- What is the importance of DNA evidence as an investigative tool?

1.5 KEY THEORETICAL CONCEPTS

De Beer (1999:15) comments that definitions concretise the intended meaning of a concept in relation to a particular study. There are a number of concepts that are vital in understanding the research, as these concepts are used throughout the study and need to be clarified. The definitions provided below present a clear understanding of the meaning of these concepts:

- **DNA (Deoxyribonucleic Acid):** This refers to a chemical structure that forms chromosomes. A piece of a chromosome that dictates a particular trait is called a "gene" (Clegg & Macken, 1998:187).
- **Crime:** This refers to an act that is deemed by statute or by common law to be a public wrong, and is therefore punishable by the state in criminal proceedings (Swanepoel, 2000:25).
- **Crime scene:** This is s a location at which a suspected criminal offence has occurred (Gilbert, 2004:490).
- **Physical integrity:** This is explained by Marais and Van Rooyen (1994:59) as being evidence reaching the laboratory in more or less the same condition as it was found.
- **Admissibility:** This is explained by Joubert (2001:332) as being relevant evidence that is accepted by the court.

1.6 RESEARCH APPROACH AND DESIGN

1.6.1 Research design

A research design is an attack or strategy on a research problem (Leedy & Ormrod, 2001:188). The research design for this research is empirical. The researcher used this design, since it involves going into the field and focusing on the personal experience of the participants in the study (Mouton, 2001:150). An empirical research is the "production of knowledge, based on experience or observation" (Maxfield & Babbie, 1995:4). For this reason the researcher interviewed participants who investigate DNA-related cases, with a view to illustrating the aim of the research. An empirical design provides in-depth insights. The design's limitations are that results cannot be generalised, since they

constitute the views of individuals, measurements cannot be standardised, and the collection of data and analysis of data may be time consuming (Mouton, 2001:150). The researcher addressed the limitations through an in-depth literature study on the topic. The empirical design for this study included a thorough literature study, as well as face-to-face interviews with detectives investigating DNA-related cases which are criminal cases wherein DNA evidence forms part of the investigation, in order to investigate the research problem, as well as prosecutors who have prosecuted in DNA-related cases, as described by Mouton (2001:56).

Empirical research involves the idea of going into the field and purposefully seeking the necessary information (Denscombe, 1998:6). The researcher considered this design to be the most useful, under the circumstances, for finding information. This required the researcher to visit certain police stations and interview investigators who are investigating cases which involve the use of DNA evidence. This comes down to what Denscombe (2002:6) states about empirical research – that it involves the idea of getting out of the chair, going out of the office and purposefully seeking the necessary information. The researcher conducted face-to-face interviews, and recorded the responses of the samples by using one instrument. For this reason the researcher considered the empirical design to be suitable for this research.

1.6.2 Research approach

The researcher used a qualitative research approach. Qualitative research focuses on phenomena that occur in natural settings, which is the real world, and involves studying those phenomena in all their complexity (Leedy & Ormrod, 2005:133). To meet this requirement, the researcher interviewed experienced, expert investigators and prosecutors in practice, to obtain a real understanding of the problem. Qualitative research involves the study, use and collection of a variety of empirical materials (Creswell, 1998:15). The researcher used his personal experience, decided court cases, and the conducting of interviews, as instruments for collecting data. This led to the interviewing of detectives and experts in practice, to obtain a good understanding of the problem.

Schloss and Smith (1999:86) are of the view that a qualitative research approach is best suited for trying to better understand complex and interactive phenomena, and because these phenomena are often unique, qualitative research does not seek to generalise findings. Qualitative research allows participants in a setting to tell their stories in their own words. This allows a true reflection of what the participants said to be recorded, and it also allows the participants to say what they want to say, and not specifically what the researcher wants to hear. The procedures used provide outsiders with maximum insight into the situation.

The main strength of this approach is that it leads to in-depth insight into the research topic (Mouton, 2001:150), which is important for developing an understanding of the investigative discipline explored in the research. A qualitative approach is also multi-method in focus (Creswell, 1998:15), which assists researchers in arriving at the best results.

1.6.3 Population and sampling procedures

Babbie and Mouton (2001:174) state that a population is that aggregation of elements from which the sample is actually selected. The population chosen for this research was the investigators of the SAPS, expert from the SAPS who is attached to the Forensic Science Laboratory (FSL), and the prosecutors of the National Prosecuting Authority (NPA). This was due to the fact that the investigators of the SAPS are responsible for investigating DNA-related cases. The expert is responsible for the analysing and producing of DNA-related reports which can be used in court as evidence, and the prosecutors are responsible for the prosecution of DNA-related cases in South African criminal courts. Permission was obtained in writing from the SAPS and prosecutors from the NPA. The population of investigators within the SAPS and the prosecutors within the NPA constituted too large a group to be considered as a sample, so the researcher decided to use a target population.

Welman and Kruger (1994:119) explain a target population as the population to which researchers would ideally like to generalise their results. In this research, the target population was police investigators of the five police stations of the Midlands policing area, namely: Detectives from Family violence, Children

Protection and Sexual offences Unit falling under SAPS Mountain Rise, Pietermaritzburg, Alexandra Road, Townhill and Howick. This added up to a total of 112 investigators. The reason for choosing these stations was that the researcher lives in this policing area, and has worked in this policing area for nearly fifteen years. It therefore also proved cost effective. The researcher did not consider the target population to be representative of the population, because it was not selected scientifically but was the researcher's own choice. Investigators from these police stations investigate the largest number of DNA-related cases within the Midlands policing area. The researcher obtained permission from both the SAPS National and Provincial Commissioner's office to conduct the research.

Bailey (1987:82) defines a sample as a subset or portion of the total population. To obtain a sample of 25 investigators (Sample A) from the 112 target population investigators of this research, the researcher used the simple random sampling technique in their selection. The police stations were in separate vicinities and the selection was done for each station. The researcher obtained a name list of all the detectives at the stations from the branch commanders of the respective stations, where the number of years of service of each detective was stipulated. To obtain five participants at each police station, a name list of the detectives was written down in order of service within the SAPS.

The detectives were then placed into five different categories, in terms of years of service: 1–3 years, 4–6 years, 7–10 years, 11–15 years, and 16 years and over. The researcher then numbered the names according to the category they fell in, placed all the names in a hat, and drew one name from the hat from each category. This was done at each station. It also allowed for the sample to be representative of the population for the interview. The selection process was done by category, so as to ensure that the researcher covered each year of service equally.

According to Welman and Kruger (1994:48), in probability sampling one can determine the probability that any element or member of the population will be included in the sample, but in non-probability sampling, by contrast, one cannot specify this probability. Thus, some elements have no chance of being included

in some examples of non-probability samples. Thus, the researcher used probability sampling for this research.

The target population of prosecutors was the Pietermaritzburg High Court and regional courts, of which there were 17 prosecutors dealing with all DNA-related cases for the five police stations. These courts were selected because they serviced the five police station involved in the research. In selecting the sample of three prosecutors, all 17 names were written separately on pieces of paper and placed in a hat, and the first three names selected were taken as sample B to be interviewed. The simple random sampling method was chosen as the sampling method in this case. Leedy and Ormrod (2005:201) state that simple random sampling is easy when the population is small and all of its members are known. In probability sampling, the researcher may specify in advance that each segment of the population will be represented in the sample. This is the distinguishing characteristic that sets it apart from non-probability sampling (Leedy & Ormrod, 2005:211). Representativeness depends on the selection technique used. The researcher used the simple random sampling selection technique; as a probability sampling technique it gives each member of the target population an equal opportunity of being selected.

In random sampling, each person in the universe has an equal probability of being chosen for the sample, and every collection of persons of the same size has an equal probability of becoming the actual sample, as long as they are members of the same universe. All that is required to conduct a random sample, after an adequate sampling frame has been constructed, is to select persons without showing bias for any personal characteristics (Bailey, 1987:87). Random sampling has the advantage of cancelling bias and providing a statistical means of estimating sampling errors (Bailey, 1987:87). The resulting sample is likely to provide a representative cross section of the whole. When such a random sample has been selected, the researcher can assume that the characteristics of the sample approximate the characteristics of the total population (Leedy & Ormrod, 2005:211).

Probability samples the probability that selection of each participant is known. In probability sampling, the researcher can specify in advance that each segment

of the population be represented in the sample. Generally, the components of the sample are chosen from the larger population by a process known as random selection (Leedy & Ormrod, 2005:199). With regard to the sampling techniques used, namely, the simple random sampling selection technique, and the probability sampling technique, each sample of the target population has an equal opportunity of selection.

The researcher used another sampling method – the purposive sampling method to select the expert sample C for this research. According to Leedy and Ormrod (2005:206), purposive sampling is intended for particular purposes, where people or other units are chosen who are “typical” of a group, or those who represent a diverse perspective on an issue. Leedy and Ormrod (2005:206) further elucidate that purposive sampling is most appropriate for certain research problems, and that the researcher must always provide a rational explanation for choosing this sampling. The researcher included one DNA forensic expert from the FSL (Sample C) for the purpose of this research – namely, Superintendent Thompson; however, purposive sampling does not deliver a representative sample. The reason for the inclusion of the expert is due to her expertise, qualifications, training and experience in DNA-related investigation. Superintendent Thompson is a manager, attached to the Forensic Division in Pretoria, South Africa, who has dealt with, and given guidance to many DNA analysts and investigators over the years, and who has also attended several courses and workshops pertaining to DNA-related cases. Superintendent Thompson is a chief forensic analyst with 20 years' experience in forensic biology, and has investigated hundreds of DNA-related cases. Supt. Thompson has a BSc degree, with biochemistry as one of her major subjects.

However, it must be stated that sample C cannot be considered representative of the sample, as she was not randomly selected. Sample C was referred to the researcher by her commander for participation in the interview, and she indicated her willingness to participate.

1.7 DATA COLLECTION

Data collection forms part of the qualitative approach that was decided on for this research. Leedy and Ormrod (2005:96) propose that qualitative research is often described as being the research instrument, because the bulk of the data collection is dependent on their personal endorsements (interviews and observation) in the settings. According to Welman and Kruger (2001:127), one has to consider which data collection method is the most appropriate for the particular population in question. Clarke (1999:67) believes that the most common qualitative research techniques are questionnaires, interviews, observation, and documentary sources. In this research, the researcher decided on interviews and a study of applicable literature as the most appropriate techniques for the research.

"Triangulation" refers to the use of a combination of methods to explore one set of research questions (Mason, 1998:148). In line with the definition of triangulation, the researcher did as follows:

- The topic was broken down into key concepts, and a list of questions was drawn up in conjunction with the topic, thus allowing the participants to first actively participate, and then impart their knowledge about the topic.
- An interview schedule compiled prior to the interviews conducted by the researcher was used. The questions were based on key concepts and the research questions of the topic.
- The interview schedule ensured that the same questions were posed to each participant in the interview (Denscombe, 2002:100).
- Each participant provided answers from their personal experience and knowledge as investigators.
- Their answers were discussed with them by the researcher, which ensured that their answers were clearly understood by the researcher.

1.7.1 Interviews

Interviews are an effective and accepted data-collection method. Both Welman and Kruger (1994:166) and Mouton, (2001:105) support the view that interviews are an effective and accepted data collection method. The advantage of using a standard schedule in conducting interviews is that it minimises variability from

one interviewee to another, and the data collected can be more easily compared (Robson, 2000:91). Interviews were carried out face to face on a one-on-one basis between the interviewer and the interviewees. All interviews took place in private, in a face-to-face manner, and each participant gave their verbal consent to participate in the interview. During the interview, the researcher wrote down each participant's response verbatim. Structured and semi-structured interviews were used, due to the fact that this combination enabled the researcher to identify questions in advance, and also allowed the researcher to ask more questions to clarify points touched on by any of the participants during the interview as discussed in Leedy and Ormod (2005: 147-149).

Interviews were conducted using an interview schedule with open-ended questions (Robson, 2000:88). The interview schedule consisted of a number of predetermined, open-ended questions which explored various areas of the research topic. Mouton (2001:53) states that the purpose of formulating research questions is to focus on the research problem by breaking it down into questions. Following this concept by Mouton, the questions were formulated by the researcher, based upon the area to be addressed by the research problem.

To test the questions for relevancy and accuracy, as well as to establish whether the questions could be understood clearly, the researcher distributed the interview schedule to six different members, to complete. These members were not part of the population but are trained investigators. The researcher did not receive feedback from any of the six members with respect to the clarity of the questions, thus the questions were left as they were. The interview schedule was sent to the research supervisor who commented on it, and after it was rectified, the schedule was approved. The same interview schedule was used to interview all the samples and to interview prosecutors who had prosecuted DNA related cases and the questions were of a relatively generic purpose. The interviews were conducted in private. Making use of the standard question schedule, each subject was asked a series of questions, the answers to which were written down by the researcher, and confirmed with the subject at the end of the interview.

Leedy and Ormrod (2005:147) provide guidelines that should be followed in conducting a productive interview. The steps taken by the researcher in following these guidelines are as follows:

- **Identify some questions in advance**

  The research questions were taken into consideration, and further questions that supported the main questions were asked.

- **Make sure your interviews are representative of the group**

  According to Welman and Kruger (1994:49), representativeness implies that the sample has the exact properties in the exact same population from which it was drawn. Consequently, a representative sample is a miniature image or likeness of the population. The researcher numbered the names according to the category they fell in, placed all the names in a hat, and drew one name from the hat from each category. This was done at each station, and it allowed the sample to be representative for the interview. Samples used in the research were Sample A – detective members responsible for the investigation of DNA related cases, Sample B – prosecutors who had prosecuted in DNA-related cases, and Sample C was purposively selected. Sample C is a police officer from the FSL in Pretoria, and an expert in the field of DNA analysis but was not representative of sample A. All DNA databases and Forensic Database Management section is at the FSL in Pretoria thus information that was required for the research was obtained from FSL in Pretoria. Also all processing of DNA evidence for DNA related cases from any Family violence, child protection and sexual offences unit (FCS) of the SAPS is processed at the FSL in Pretoria. Therefore the researcher used the FSL in Pretoria as part of the research.

- **Find a suitable location**

  The participants all agreed to be interviewed at their place of employment.

- **Obtain written permission**

  Permission was obtained from the office of the National and Provincial Commissioners of the SAPS, and from the court, to permit the researcher to

conduct the interviews at the relevant stations, and with the relevant prosecutors. Permission was obtained from the NPA, for the prosecutors to take part in the interviews. Consent was also obtained from all the participants before the researcher interviewed them. The participants signed the interview schedule as an acknowledgement of their participation in the interview.

- **Establish and maintain rapport**

  The interviews were held in a very informal way. The researcher explained the reason for the interview, and asked the participants on a regular basis whether they were comfortable – which seemed to put the participants at ease during the interview. When answers were given, the researcher showed compassion for those answers, and encouraged the participants to continue.

  The participants were encouraged to discuss actual cases they had attended, where DNA had played a vital role as evidence in the investigation of the cases. This seemed to change the interaction, and brought out a passion for investigation from the participants.

  Samples A, B, and C were used for the interviews. These were members of the police, prosecutors and an expert in the field of DNA. All were asked the same questions as in the interview schedule. No deviations were made from this, as the researcher wanted all the samples to answer the same schedule questions.

1.7.2 Literature

Mouton (2001:88) states that the purpose of a literature study is to establish what has been done in one's field of study. In this study, the researcher collected data from existing literature, journal articles and the Internet, which fell in the field of law, criminal law, and forensic science. No literature was found that dealt directly with the exact topic. In seeking relevant literature, extensive use was made of libraries, and the Internet, in an attempt to identify any literature specifically relating to the research topic. Areas that were explored included policing and law enforcement, the law of evidence, and crime scenes. The researcher could only identify one published resource on the Internet which specifically dealt with the topic in question (www.ncjrs). This source did not

constitute an extensive academic study, but was a collection of practical experiences on the part of the detective members from the five police stations.

The researcher used decided cases, and conducted an extensive search of South African criminal cases within the focus area of the study, to identify relevant court cases that outlined the use of DNA as an investigative tool. The search revealed significant cases that could be used in this research. This included the consultation of relevant literature that contained reported and decided cases where DNA evidence played a pivotal role in the investigation of criminal cases which involved DNA-related issues/evidence. Superintendent Thompson was also consulted for her relevant and vital input regarding DNA, which appears in the forthcoming chapters of this report.

To expand the literature study, the research topic was then broken down into concepts and subject areas, including the law of evidence (profile of DNA exculpatory cases) and criminal law. This led to a number of published literature sources which benefited the research process. The researcher perused the literature to gain a better understanding of how DNA is used as a tool in investigation, internationally. This was achieved by consulting literature at the Pietermaritzburg research library, and also Internet sources that were posted up as electronic literature on the Internet. The researcher identified the following concepts:

- DNA
- DNA and criminal investigation
- Similarity of DNA
- The origin of DNA profiling
- DNA and evidence
- DNA databases
- DNA an investigative tool
- South African legislation on DNA
- Limitations of DNA

When reading through the literature, the researcher looked for information he could use to address the research questions. The researcher did a study of decided cases as well, to support the research.

1.8 DATA ANALYSIS

In an attempt to organise and analyse the data from qualitative studies, Leedy and Ormrod (2005:150–151) state that Creswell (1998) has described the data analysis spiral which is equally applicable to a wide variety of qualitative studies. Leedy and Ormrod further comment that in the use of such an approach, one goes through the data several times.

Data collection forms part of the qualitative approach that was decided on for this research. The data that the researcher used was primary data, because all the data was collected personally by the researcher from the respective sources. Primary information sources refer to one's data, whether one has to collect it oneself, or whether it exists in one or other form. It is usually available in one of two forms: textual information, or numeric information or data (Mouton, 2001:69). The sources used to collect the data consisted of available literature, the Internet, structured interviews and South African-decided court cases that have been already finalised in court.

Once all the data had been collected, the researcher obtained a holistic picture of all the data, and analysed it accordingly. The researcher used the process as specified by Mouton (2001:198) for the analysis of the data collected:

- Data from the different data-collecting methods (interviews, literature, interviews with experts) was sorted accordingly and then categorised according to the research questions.
- Information was then compared within the different categories, in order to identify variation and similar meanings.
- The similar data was categorised together (all similar responses).
- Variations in the data were categorised together.
- Information that had no substance or bearing was eliminated.
- Where information was still needed, it was easily identified, obtained, and, once obtained, categorised.
- After the researcher had conducted each interview, the answers given by the participants were read by the researcher to ensure that they were clearly understood.

- Findings on the literature were shared with members from the SAPS, to discuss, and to obtain an in-depth understanding.

The purpose of the above points was to analyse the collected data, and to put together what belonged together, to enable the researcher to form a clear picture of what information was gathered. This approach assisted the researcher in determining in which areas investigators might need assistance, from a training perspective, in order to enhance their knowledge of the topic. The researcher also used the interview schedule to obtain a historical understanding of the sample's career background, and also the number of DNA-related cases the sample had investigated. There were 25 participants in Sample A, all of whom were asked the same historical questions. All these participants were employed by the SAPS as investigators attached to the detective branches of the relevant police stations. All 25 participants had investigated DNA-related cases, and all participants had attended the detective course presented by the SAPS training division. The three prosecutors who were used as samples were experienced prosecutors who had prosecuted in DNA related cases.

1.9 VALIDITY

"Validity" refers to the extent to which a measure adequately reflects the meaning of the concept under consideration (Maxfield & Babbie, 1995:108). In order to ensure validity, as described by Mouton (2001:100), the researcher used different sources of data, such as literature and interviews. Literature was consulted and gathered, specifically relating to the subject of DNA, to ensure that all information was thus taken from a reliable source. To ensure the latter, the researcher used accredited sources and resources. An interview schedule with previously tested questions, based on the key concepts and research questions of the study, was used in each interview. Structured interviews were used for collecting data for the research. The data analysis was conducted by following the process as illustrated by Mouton (2001:198). Using this process, the researcher was able to approach the research questions from different angles and from a rounded and multi-faceted way. This enhanced the validity of the research.

Validity concerns the accuracy of the questions asked, the data collected, and the explanation offered. Generally it relates to the data and the analysis used in the research (Denscombe, 2002:100):

- Data and information that was obtained from literature, interviews and case law, was used in a combined fashion to establish patterns and trends, to ensure the trustworthiness and validity of the data, as described by Bouma (1993:47).
- In order to ensure validity (Mouton (2001:100), numerous sources of information (literature, interviews and case law) were used by the researcher. To ensure that the information came from a reliable source, the researcher used accredited sources and resources. Information was gathered from specific books, journals, case law and Internet sites, on this topic, to ensure that information was gathered from reliable and valid sources.
- The set of interview questions was based on the research questions, which ensured that they could measure what they intended to measure, as accurately as possible (Miller & Whitehead, 1996:183).
- The literature can be considered valid, because the literature used was from valid sources (Mouton, 2001:110). The researcher also used a valid interview schedule, and both the sampling procedure and the analysis of the data were valid as discussed in Robson (2000:88). Sample A consisted of police officials who are police investigators of DNA-related cases which are criminal cases wherein DNA evidence formed part of the investigation. Sample B consisted of prosecutors who prosecute DNA-related cases while sample C is an expert on DNA-related matters. All interpretations, analyses and conclusions were made on the basis of the data gathered from the interviews, literature and case law, as discussed in Mouton (2001:110).
- "Triangulation" refers to the use of a combination of methods, which is a combination of different data methods – namely, interviews and the literature study, to explore one set of research questions (Mason, 1998:148). The researcher believes that the selection was valid, because he used a tested sampling procedure – namely, the simple random sampling selection method. The combination of methods is outlined as follows:

- The topic was broken down into key concepts and a list of questions drawn up in conjunction with the topic, thus allowing the participants to firstly actively participate, and then impart their knowledge about the topic.
- An interview schedule compiled prior to the interviews conducted by the researcher was used. The questions were based on key concepts and the research questions of the topic.
- The interview schedule ensured that the same questions were asked of every participant in the interview (Denscombe, 2002:100).
- All the participants provided answers from their personal experience and knowledge as investigators.
- Their answers were discussed with them by the researcher, which ensured that the answers were understood clearly by the researcher.

1.10 RELIABILITY

According to Welman and Kruger (1994:143), reliability in the research process is the consistency of measurement, and the extent to which the observations made by the researcher could be replicated by another independent researcher.

The literature relates to the topic being researched, and is thus reliable. The literature is also considered reliable by virtue of the fact that the South African literature used is being prescribed reading for various tertiary academic institutions in South Africa. The literature from the United States and the United Kingdom is considered reliable, by virtue of the fact that it is recommended reading by professional associations. The sample used for the research is also considered to be reliable, by virtue of the fact that it represents the major South African investigating agency, the SAPS. The use of the simple random sampling technique also contributes to ensuring reliability. Reliability is also addressed through the use of a uniform structured interview schedule for all interviews conducted with the sample. The input from the experts consulted by the researcher, are considered reliable, as their input and experience are relevant to the topics being researched.

1.11 ETHICAL CONSIDERATIONS

The researcher personally approached the participants, as a mark of respect for his professional colleagues, and informed them of the purpose for which they were asked to be interviewed. He also ensured that the participants understood that they were not obliged to participate in an interview, but could do so voluntarily. He also informed them that whatever they said during the interview would be written down verbatim, and that the confidentiality of what they revealed to the researcher would be guaranteed, thus preventing any harm to the participants.

Most ethical issues in research fall into one of four categories: protection from harm, informed consent, right to privacy, and honesty with professional colleagues (Leedy & Ormrod, 2005:101). These issues are elaborated on as follows, in relation to the current study:

- **Protection from harm**

  The participants were never subjected to any physical or psychological harm. The participants were never physically at risk at any given stage of the interview, or subjected to any psychological harm or discomfort. From the outset, the researcher informed them that their participation was voluntary, and he explained the process of the interview – to which there were never any objections. In order to protect the participants, the researcher allocated a number to each one, instead of using their names, and the researcher used the number whenever referring to a participant.

- **Informed consent**

  The participants were informed that they could take part in the interview freely and voluntarily. They were informed that their participation was subject to their approval. They were also informed of the process from the outset, as to what the interview was about and what it would entail. The interview schedule was signed by the participants after the interview was conducted.

- **Right to privacy**

  The participants were informed that their names or responses would not be used or contained in the research. For this reason, the researcher referred to them as “Participant 1”, “Participant 2” and so on.

- **Honesty with professional colleagues**

  All reporting that was carried out in the research, was completed in an honest and professional manner. Nothing that appeared in the research was a misrepresentation or fabrication of any of the responses from the participants. All sources used were referenced accordingly. All responses were interpreted completely, and no subjective conclusions were drawn from the participants’ responses. Each answer was discussed, to ensure that their answers were correctly interpreted by the researcher.

1.12 CHAPTER LAYOUT

- **Chapter 1: General orientation**

- **Chapter 2: DNA**
  This chapter discusses what DNA is, from a scientific point of view.

- **Chapter 3: The importance of DNA as an investigation tool**
  In this chapter, the researcher shows in what cases DNA can be identified for evidence, and be used as an investigative tool in the process of investigation.

- **Chapter 4: Findings and recommendations**
  In this chapter, the final findings and conclusions of each previous chapters are discussed.

CHAPTER 2

DEOXYRIBONUCLEIC ACID (DNA)

2.1 INTRODUCTION

According to Prinsloo (1996:39), criminalistics is the scientific application of various methods and techniques through which the perpetration of criminal actions are uncovered and resolved, and it has to rely on highly sophisticated techniques and keep abreast of any technological advances made in this field. Many clues manifest themselves in a combination of objective and subjective sources, in that the victim, perpetrator and surroundings are reciprocally contaminated with the particles of objective proof, as a result of their transfer during the contact made in the course of the illegal act. Forensic experts, in collaboration with criminalistics, are able to facilitate significant biological breakthroughs in the individualisation of perpetrators of, particularly, crimes of violence, by means of DNA technology (Prinsloo, 1996:39).

In this chapter the researcher discusses what criminal investigation is, and how the use of DNA evidence in criminal cases becomes the systematic search for the truth. Linked to this, the objectives of criminal investigation are also discussed, which is important to show how the initial investigation starts, up to the time that it is finalised in court – which makes the criminal investigation process and objective one and the same.

DNA is part of investigation, as blood, semen, sweat, and so on, is evidence found at crime scenes and on possible exhibits and suspects. This evidence is identified, collected and retrieved as evidence at a crime scene, in the form of objects such as clothing from a possible suspect, or the taking of blood, for example, from a suspect, for comparison in a possible murder or rape case.

Positive identification of any person involved in a crime, is an indispensable requirement for the individualisation of a crime. The researcher discusses how identification positively assists investigators in their investigations. Evidence obtained through the identification process can be linked through a process of

individualisation, so the difference between identification and individualisation is also discussed (Prinsloo, 1996:39).

DNA is a powerful and reliable tool in a forensic scientist's human identification armoury. Understanding DNA is also discussed, to create an understanding of the dynamics of DNA and its interlinking with the concept of investigation.

2.2 CRIMINAL INVESTIGATION

Van Rooyen (2004:6) confirms the viewpoint of Van Heerden (1986:188), who states that criminal investigation is a systematic search for the truth, primarily to resolve the criminal incident with the help of objective and subjective leads, and explains that "objective leads" refer to exhibits and their analysis, as well as to circumstantial evidence (Van Heerden, 1986:188). Van Heerden (1986:188) explains that "subjective leads" refer to evidence from people (victims, complainants, eyewitnesses and suspects) who are directly or indirectly involved in the incident. With DNA evidence, its value or outcome will remain constant, so if the initial analysis and report indicate that the DNA belongs to suspect "A", that fact will never change. It will always belong to suspect A. This, in essence, means that even with time, the fact that the analysis and report indicate that the DNA belongs to "A" will always stay as such, unlike a witness's testimony that, with time, and due to various reasons, can change from the original statement submitted.

According to Berg and Horgan (1998:6), criminal investigation is the lawful search for people and things to reconstruct the circumstances of an illegal act, apprehend or determine the guilty party, and aid in the state's prosecution of the offender. The authors propose that investigators sift through all available information, and determine which pieces can be linked together to accomplish the goal of punishing the criminal responsible for the crime. Berg and Horgan (1998:7) argue that the criminal investigator therefore needs to utilise and analyse all objective and subjective leads, and that the result of the investigation needs to be based on the balance of these leads.

2.2.1 Objectives of a criminal investigation

According to Bennett and Hess (2004:5), the objectives of a criminal investigation are as follows:

- **Identification of the crime:** This concerns situation identification, in which the crime is identified both by judicial elements and observation of the crime scene.
- **Gathering of evidence:** This is the gathering of information that is presented in court to make a finding. It includes direct information (people's sensory experience) and indirect information (physical clues).
- **Individualisation of the crime:** This objective involves the establishment, based on probability, of the perpetrator or alleged criminal in the act committed. This is derived from information collected, and links the crime to a specific person.
- **Arresting the criminal:** Once the investigation confirms the identity of the criminal, this criminal is arrested.
- **Recovery of stolen property:** This is twofold – firstly, to reduce the victim's losses to a minimum, and, secondly, to present the recovered property as evidence in court.
- **Involvement in the prosecution process:** This is to assist the prosecutor in the prosecution process.

With reference to the above objectives, DNA can be linked to individualisation of the crime.

An example here is where the rape victim alleges that she has been raped by a particular person, because the victim did not consent to the intercourse, but was forced into having intercourse with the suspect. If a medical examination of the victim confirms the presence of semen in the victim, it will confirm that sexual intercourse did, in fact, take place. The police can thus now investigate a crime of rape, where DNA evidence will play a vital role in the investigation of the case. If the suspect is later arrested and his blood sample is taken, as prescribed, that blood sample will then be forwarded to the FSL for analysis and comparison with the DNA results of the semen of the suspect found on the victim.

According to Sample A, the objectives of criminal investigations are –

- to solve a crime (11 participants).
- to identify and arrest the perpetrator (five participants).
- to place the perpetrator before the court (four participants).
- to collect evidence of a crime (five participants).

Sample C was able to comprehensively state that it is to firstly identify if a crime has, in fact, taken place. Once this has been established, the scene is to be preserved, with the view to gathering evidence that relates to the crime committed. It is also to identify a suspect who may be involved or linked to the crime that has been committed, and, if necessary, to arrest that person (or persons). If an arrest has taken place, then the suspect can be brought before the court for trial.

According to Sample B, an important point made was that finding the perpetrator is often the simplest part of the investigation, but obtaining evidence in support of a conviction may, at times, be more difficult. Some successful investigation does not necessarily mean a conviction, and conversely, some poor-quality investigation may lead to a conviction.

Samples A could not set out all the objectives of criminal investigation, as set out in Bennett and Hess (2004:5). The sample did, however, have a general understanding of the objectives of investigation. Two of the samples mentioned the prevention of crime as an objective, but it was pointed out that the prevention of crime is the purpose of investigation, and not an objective.

2.3 FORENSIC SCIENCE

According to White (2010:1–2), a useful definition of forensic science is “science used for the purpose of law. Consequently, any branch of science used in the resolution of legal disputes is forensic science (White, 2010:1–2). This broad definition covers criminal prosecutions in the widest sense, including consumer and environmental protection, health and safety at work and civil proceedings such as breach of contract and negligence. The recently appointed UK Forensic Science Regulator has further expanded the definition, saying that forensic

science is any scientific and technical knowledge that is applied to the investigation and the evaluation of evidence to assist courts in resolving questions of fact in court (White, 2010:2). However, in the general usage of the term, forensic practice is now being more widely applied to the use of science in the investigation of crime, by the police and the courts, as evidence in resolving an issue in any subsequent trial. Disciplines attached to the forensic science laboratory in Pretoria include the Biology section (that deals with DNA related matters), Ballistics, Chemistry section, Scientific analysis, explosives sections and questioned documents section.

2.4 IDENTIFICATION

Positive identification of all the persons involved in a crime is an indispensable requirement for the individualisation of crime. Identification rests on the theory that everything in the universe is unique in that it has certain distinctive, individual and class characteristics. The view concerning the concepts of identification differs mutually among the various sciences, but generally it is applied by these sciences to place objects into specified groups – that is, to pinpoint an object as belonging to a specific class of objects (Marais, 1992:18).

Thus, identification can be seen as a classification scheme in terms of which objects with similar characteristics are placed in one category, and such a category is given a name (Marais, 1992:19). The term “identity” refers to uniqueness, and stresses the fact that every object or person (individual) can only be itself or himself. According to Marais (1992:19), on the other hand, “identification” involves the placing of an object in a specific class or group with similar characteristics. The general meaning of identification has no value in criminalistics, because it means that an expert would identify an object as a piece of glass, without relating it to the surface of origin (Marais, 1992:19). This form of identification only attains criminalistic significance when the individuality of the object is determined – in other words, when the piece of glass is positively compared with the surface of origin (Marais, 1992:19).

Fisher (2000:6) states that some police investigators believe that every item of physical evidence can be associated with one individual source. This is, how-

ever, not always the case. Fisher further states that most physical evidence may only be associated with a class or group, and therefore this physical evidence has identification value only. Fisher (2004:7) avers that identification means that items with the same properties share a common source, and they can be classified or also placed into groups.

It is the view of Sample A that the term "identification" means –

- to identify physical evidence that can link a suspect to a crime (12 participants)
- pointing out (identification parade) (five participants)
- to identify evidence in order to arrest and prosecute a criminal (five participants)
- the identification of a person's property or a criminal (three participants)

The prosecutors (Sample B) explained the term as a process which utilises the class characteristics of an object or known substance, to compare with evidence collected from a crime scene. The expert (Sample C) responded by saying it is the identification of an object to establish the object as part of a bigger group or class. This, for example, means that if blood is found at a crime scene, the analysis thereof could firstly identify if it was human or animal blood, and further analysis of the blood would yield a DNA result. This result could then lead to the identification of a specific individual. This is very similar to the explanation given in the literature.

The responses of the samples showed that they were unable to explain what identification is, as explained in Fisher (2004:7), who states that identification means that items with the same properties share a common source, and they can be classified or also placed into groups.

2.4.1 Categories of identification

According to Van Heerden (1986:195) the important categories of identification used in criminalistics are as follows:

- **Situation identification** – relates to the crime situation and individualisation of the unlawful nature of the situation. In a murder scene involving a

female, there might be a condom containing the sperm of a suspect, which could indicate that the deceased could have been raped and murdered.

- **Victim identification** – concerns, in particular, the identification of the dead victim. DNA can play a vital role in victim identification – that is, in the identification of a deceased body that perhaps cannot be identified because of decomposition, for example. The comparison can be made with previous medical reports, blood reports and medical tests that could have been conducted on the deceased. In some instances, a fingerprint imprint may contain sweat, which can also be used for DNA analysis.

- **Imprint identification** – attempts to achieve individualisation by comparing a disputed imprint with a control imprint of the alleged object.

- **Origin identification** – is mainly concerned with the analysis of organic and inorganic solids and fluids, to determine whether the disputed sample and the exemplar have a common origin. In a rape case, the investigator should identify body material or solids such as blood, semen and hair that can be analysed with a view to individualising them and determining their origin, so that a suspect or suspects can be linked to those body materials.

- **Culprit identification** – is concerned with the positive identification of the offender as a person, rather than the identification of his unlawful conduct. In culprit identification, DNA can be used to identify and individualise a person as a suspect, by virtue of bodily fluids such as semen, blood, urine, sweat, and even hair. The positive identification of the suspect involved in a crime is of vital importance (Marais, 1992:18). The scientific comparison and classification according to fingerprints, is the most reliable method of identity (Marais, 1992:25). Marais (1992:24) also states that the most common and ordinary methods of identifying a suspect are through visual documentation, photos and unique personal qualities – DNA, for example.

- **Cumulative identification** – is where contributions of different specialists are collectively considered within the framework of the history and relevant circumstances of the crime situation as a whole. With reference to this, DNA can play an important role. Forensic analysts submit expert evidence, as

witnesses, in the form of an affidavit in court for a criminal trial. Also, in cumulative identification, a multidisciplinary approach can be used in the investigation – for example, the use of a forensic expert at a crime scene to identify, mark, tag, preserve and forward evidence to the FSL for analysis by the forensic analyst who produces a final report which is admissible in court.

When asked the question, "What are the different categories of identification linked specifically to DNA?", Sample A responded as follows:

- situation identification (6 of 25)
- culprit identification (5 of 25)
- victim and imprint identification (10 of 25)
- witness identification (2 of 25)
- origin identification (2 of 25)

Sample B only identified three categories as given by Van Heerden (1986:194), namely: witness, culprit and victim identification. Sample C' was able to list all five categories of identification as given by the abovementioned author. The participants therefore understood the categories of identification.

2.5 INDIVIDUALISATION

According to Bell (2004:180), the term "individualisation" means the process of linking physical evidence to a common source. The author states further that individualisation is a process which starts with identification, progresses to classification, and leads, if possible, to assigning a unique source to a given piece of physical evidence. According to Van Heerden (1985:11–12), the process of individualisation takes place to determine individuality. He adds that the process usually consists of a series of identifications and comparisons.

As discussed above, an object is identified as belonging to a specific class or group. With individualisation, forensic scientists will continue with their analysis to determine if a particular sample is unique, even among other members of the same class (Lee, Palmbach & Miller, 2001:184).

According to Sample A, the term “individualisation” means –

- linking a suspect to a crime or a bullet to a weapon (8 of 25).
- proving that a piece of evidence came from somewhere (4 of 25).
- the undisputed evidence that convicts an accused of a crime (8 of 25).
- a process that the laboratory follows (3 of 25).
- that, for example, if fingerprints are found at a scene, and if there is an alleged suspect, that suspect can be linked if the fingerprints match (2 of 25).

When the researcher compares the responses from Sample A, it is clear that they had a good understanding of the concept of individualisation. Sample B responded by saying that it involves a comparison of a crime and that of a specific person, to link the person to the crime, while Sample C described individualisation as where forensic science will analyse a sample to determine if the sample is unique.

All samples gave an explanation which indicated that they were able to explain the general meaning of individualisation, as given by Van Heerden (1985:11–12), where he states that the process of individualisation takes place to determine individuality, and which process usually consists of a series of identifications and comparisons.

2.6 DIFFERENCE BETWEEN IDENTIFICATION AND INDIVIDUALISATION

Van Rooyen (2004:11) emphasises that identification and individualisation are concepts that are inseparable or inalienable, and that they complement each other. There is an important difference between identification and individualisation. This distinction is of great importance to criminal investigation. Van Heerden (1985:11–12) declares that identification is merely concerned with the identification of something or somebody as belonging to a specific category. In other words, “A is simply A”, and a hair is simply a hair. No comparisons are drawn. Individualisation, on the other hand, involves comparison, usually of the disputed object found at the crime scene, with one of known origin obtained, for example, from the suspected criminal. An example is a fingerprint found at a

murder scene (print in dispute), which is compared with the fingerprints of a known criminal (fingerprints of known origin). A comparison is thus made to determine whether the print in dispute at the scene of the murder, is that of a known criminal with previous convictions, whose fingerprints are on record.

If the concept individualisation" is compared to "identification", one finds that individualisation goes well beyond identification, since individualisation implies that physical evidence, such as semen, found at a crime scene, comes from one source. In other words, the physical evidence can be individualised to one unique source (a single person). According to Van Heerden (1985:11–12), the process of individualisation takes place to determine individuality. The process normally consists of a series of identifications and comparisons, which have a twofold aim:

- to individualise positively the various objects in dispute.
- to determine, conclusively, the criminal involvement of the object or person providing the standard of comparison.

Table 1: Difference between Identification and Individualisation

Identification	**Individualisation**
1. According to Bell (2004:8), identification does not need a comparison; for example, a fingerprint is simply a fingerprint – no comparisons are drawn.	1. According to Bell (2004:8), Individualisation requires comparison; for example, a fingerprint identified needs to be compared to the alleged suspect's print, to make a comparison.
2. In Van Heerden (1985:11–12), "the aim of identification is merely concerned with the identification of something or somebody belonging to a group or category".	2. In Van Heerden (1985:11–12), "the aim of individualisation is to individualise the crime as the act of a particular person or persons".
3. Bell (2004:64) explains that identification encompasses the class characteristics of evidence, which are assigned to a group or category.	3. Bell (2004:64) explains that individualisation of evidence looks at the characteristics of evidence that make it unique.

4. According to Bell (2004:8), identification requires visual examination and chemical tests.	4. According to Bell (2004:64), individualisation requires analysis.

(**Source:** Bell, 2004:8, 64; Van Heerden, 1985:11–12)

According to the researcher, from the above table, if there is blood that is identified at a crime scene and such blood is needed for evidential purposes, it will have no value on its own, unless it is analysed for DNA purposes so that it can be linked to a victim or suspect. The table corroborates what Van Heerden (1985:11–12) states, in that identification without eventual individualisation has no evidential value.

It is evident from the viewpoints of Van Heerden (1985:11–12) and Bell (2004:8, 64), that there are differences between identification and individualisation.

2.7 UNDERSTANDING DNA

According to Erzinclioglu (2006:100), DNA fingerprinting is a technique which is seen as being the most powerful and reliable tool in the forensic scientist's human identification armoury. DNA is the genetic material of a cell, and largely determines human physical characteristics. Much will also depend on how environmental factors affect the way in which genes are expressed in an individual. DNA is the shortened form of the term 'deoxyribonucleic acid', and is present in both the cell nucleus and the extra-nuclear organelles of the cell, known as mitochondria. Humans inherit one half of their nuclear DNA from their fathers, and the other half from their mothers (Erzinclioglu, 2006:100). According to this author, nuclear DNA can thus yield information about paternal and maternal relations, while mtDNA can shed light only on the matrilineal descent (Erzinclioglu, 2006:100).

According to Erzinclioglu (2006:100) the basic idea is that certain stretches of DNA are believed to be unique to an individual. No one else will have the same DNA along those particular stretches, unless they are identical twins from a single individual. When a sample of tissue, be it blood, semen, skin, or other, is found at the scene, it can be collected and used as a source of DNA. Once the

DNA is extracted, it is cut into little pieces by certain enzymes that act as a chemical scissors. This mixture of DNA pieces is placed on a plate in a gel through which an electric current is passed. The different pieces will separate from one another as they move along the gel – the larger ones moving faster and further than the smaller ones. The result is still invisible to the human eye, so radioactively labelled pieces of DNA are added; these adhere to the pieces already separated. The radioactivity makes the pieces visible when an X-ray of the gel is made. In this way, a "picture" of the DNA can be made, and compared with a similarly prepared "picture" of the DNA from the suspect. If the samples match exactly, one has a positive identification (Erzinclioglu, 2006:100–101). The now-famous DNA profile is this picture, which is a series of bands resembling the bar code on supermarket products (Erzinclioglu, 2006:100–101). Gilbert (2004:313) states that DNA or deoxyribonucleic acid is the human genetic blueprint of an individual.

When the researcher asked samples A, B and C, "What do you understand by the term 'DNA'?" they replied as follows:

Samples A responded as follows:

- It was the process of collecting evidence to link the suspect (1 participant).
- It referred to the unique final analysis in the body (1 Participant).
- It is semen, blood, hair, or any part of the body that can be used to determine the identity of an individual person (nine participants).
- It is a scientific forensic term (three participants).
- It is evidence which is admissible in court (seven participants).
- It is a unique composition that is unique to each person (four participants).
- Sample B stated that is was Deoxyribonucleic acid which can be used as evidence.
- Sample C said that it was Deoxyribonucleic acid which is individualised anatomical evidence, that it was unique to each person, and that no two people could have the same DNA. This participant also stated that when a suspect's blood is analysed, a DNA result is obtained, which is used to compare to biological evidence that is found at a crime scene.

The sample's understanding of the concept of DNA was limited, except for sample C, in that they were unaware that it is the genetic material found in all human cells, and that it carries the coded messages of heredity unique to each individual. None of the samples were able to describe DNA in the same way as Erzinclioglu did (2006:100). DNA fingerprinting is a technique which is seen as being the most powerful and reliable tool in the forensic scientist's human identification armoury.

2.8 DNA AS AN INDIVIDUALISATION TECHNIQUE

The term individualisation is the process of linking physical evidence to a common source (Bell, 2004:180). She goes on to say that individualisation is a process which starts with identification processes to classification and leads, if possible, to assigning a unique source to a given piece of physical evidence. According to Van Heerden (1985:137), the blood of every human being is unique, because it is a genetic as well as an environmental product. Genetically, the nature of the blood of every human being is determined at conception, and this genetic uniqueness therefore lies in blood group variations. Van Heerden (1985:137) states as follows: "When we consider that blood is the means of conducting food, fats, acids, etc., we can expect that the uniqueness of blood changes continually and as a short-term characteristic it consequently has limited value in individualisation".

Kirk (1974:184) declares that several diseases, including a venereal disease such as syphilis, have a permanent, long-term effect on the uniqueness of blood. Diseases thus have value in respect of individualisation.

2.8.1 Human individualisation through DNA

New forensic methods and techniques have emerged to address and solve crimes. One such technique is individualisation (Campbell, 2000:94). Gilbert (2004:313) states that DNA is the human genetic blueprint of an individual. Gibbs (2003:60) states that Dr. Alec Jeffreys and his colleagues developed the genetic fingerprint in 1984 by using DNA to positively individualise individuals.

The DNA of identical twins is identical, and therefore individualisation through fingerprinting is still the only effective way to separate them (Genge, 2002:44).

DNA is the building block for the human body, which is inherited from one's parents, and virtually every cell in the human body contains DNA (Genge, 2002: 144). Buckleton (2005:2) agrees with Genge (2002:144), and argues that most human DNA is present in the nucleus of the cell, and each cell consists of 46 chromosomes made up of DNA. The 46 chromosomes of the building blocks of A, G, C and T form the DNA chain (Bennett & Hess, 2001:124). DNA language consists of an alphabet of only four letters, namely T, C, A and G. These letters stand for the four nitrogenous bases found in the DNA: thymine, cytosine, adenine and guanine. Though this alphabet is very short, an enormous array of different sequences of nucleotides can exist in a single strand of DNA, which is normally hundreds of thousands to millions of nucleotides long. DNA is made up of two strands forming a double helix (similar to a spiral staircase in structure). The bases A, G, T and C pair with each other in a specific way, A always pairs with T, and G always pairs with C on opposite strands of the helix (Hazelwood & Burgess, 2001:31). This pairing is called complementary base pairing, and it is the fundamental principle behind all DNA analysis (Hazelwood & Burgess, 2001:31). Gilbert (2004:314) explains that DNA consists of two strands of randomly stacked chemicals that intertwine to form a double helix resembling twisted rope, and it is the particular appearance of the bands that provides the comparative image for positive identification.

2.8.2 DNA criminal intelligence database

The real value of DNA lies in the comparison of questioned samples with DNA profiles kept in a DNA Criminal Intelligence Database (DCID). On a TV programme called Focus (SABC, 2007), it was alleged that the SAPS have established a DCID that contains approximately 25,000 profiles of DNA. De Beer (2006:78) states that during the period 2004 to 2005, 50,969 DNA exhibits were analysed, and 44 467 were finalised. In 256 instances, suspects were linked to another case not related to the one of the initial arrest, by using the DCID. A further 407 cases were linked by means of DNA examination, without any suspects with whom to make comparisons.

From the above discussion it is evident that DNA can be used as an individualisation technique. However, it must be noted that while individualisation is useful, it is limited when there is nothing with which to compare it.

2.9 TYPES OF CASES FOR WHICH DNA ANALYSIS CAN BE USED

Physical evidence covers a large range of possible items and materials from a crime scene; however, only in certain cases can DNA be used to assist in the investigation of an offence. These examples include, but are not limited to, rape cases, murders, assaults, and so on. Ogle (2004:208) states that physical evidence most encountered at crime and rape scenes includes the following: semen, hair, footwear impressions, soil, blood, fingerprinting, clothing, or articles from the suspect or victim, left at the crime scene.

2.9.1 Blood

According to Strydom (1991:243), identification and individualisation of blood is the task of the serologist. Detection, preservation and handling of blood samples, on the other hand, is, for the most part, the task of the criminal investigator, except in cases where detection and collection is possible only with the aid of specialised chemical or other physical methods. In these cases, the expert needs to visit the scene of the crime. It also follows that bloodstains and blood splashes must in other cases be collected, preserved and packaged with the greatest care, to ensure that a suitable sample is obtained, and that the sample reaches its destination safely. If the departmental and legal directives in this regard are not observed, the potential value of serological examinations can be lost.

Blood examinations inevitably also play an important role in cases where the alcohol content in the blood of offenders, and even victims, must be determined. Apart from the example of 'driving under the influence', the importance and essentiality of these types of blood examinations come clearly to the fore in the trial of a crime such as murder. Strydom (1996:245) refers, specifically, to a murder case in which a man shot and killed his wife. Half an hour after the incident, a blood sample was taken from the man because he appeared to be

drunk. It later transpired that he was an alcoholic, and, on account of the alcohol content in his blood, extenuating circumstances were found. In this case, blood was indeed the silent witness.

2.9.2 Semen

According to Kobilinsky, Liotti and Oeser-Sweat (2005:36–39), semen contains spermatozoa in a liquid medium known as seminal plasma. A sterile/sterilised man has little or no spermatozoa in his semen; hence, no DNA profile can be obtained. According to Kobilinsky, Liotti and Oeser-Sweat (2005:36–39), semen may be examined for the following:

- Determining the presence of human spermatozoa/semen.
- Distinguishing between animal and human spermatozoa, such as in cases where bestiality occurs.
- Identifying abnormalities in spermatozoa as an aid in the process of individualisation.
- Classifying semen by means of the recognised methods of blood grouping.
- Determining the presence of seminal fluid.

The above discussion is an attempt to illustrate how DNA analysis and the results thereof can be used to link an individual to a crime, thus showing the use of DNA as an investigative tool.

2.10 THE USE OF DNA AS AN INVESTIGATIVE AID

According to Rothstein and Talbott (2006:153), DNA identification methods are such an established part of the law enforcement and criminal justice systems that it is hard to believe that the technologies were developed as recently as the mid-1980s, and that the databases of law enforcement profiles were established in the 1990s. Although the first databases were limited to the DNA profiles of convicted rapists and murderers, the success of these databases in solving violent crimes provided the impetus for state legislatures to expand the scope of the databases, with little critical examination of each expansion's value to law enforcement or cost to privacy and civil liberties. The world is now entering a new stage of DNA forensics, in which successive database expansions over the

past decade have raised the possibility of creating a population-wide repository (Rothstein & Talbott, 2006:153).

2.10.1 Examples of DNA cases from Beijing

The following are examples from Beijing, of how DNA can be used as an investigative tool (http://www.promega.com):

Case 1:

"In the early hours of May 30, 1999, a multiple murder case took place in the Shijingshan district of Beijing where eight young women were killed. The investigators collected nearly 80 bloodstains at the scene. These bloodstains were compared with the blood of the eight women in several STR loci, and the following conclusions were obtained:

1. Through comparison, they could draw a picture of the blood distribution at the scene and explicitly state what the activity of each victim was when the murders were being perpetrated. This provided the investigator with scientific clues which enabled them to recreate the scene of this case.

2. They collected two footprints covered with blood. One footprint was made by a bloody sock; the other was made by a slipper that belonged to one of the deceased women lying outside the room. The forensic pathologist confirmed that the eight women were stabbed to death by two single-edge knives, but were unsure as to how many murderers/suspects were involved in this case. This information was vital for the investigation in order to successfully solve this case. Through examining the footprints with blood and the slipper left at the scene, it was found that the genotype of the bloodstain inside the slipper was a mixture of four victims, which was different from the bloodstain on the surface of the slipper but was identical with the footprint of the sock. As a result of this information, the investigators were able to deduct that the bloodstain inside the slipper was left by the murderer who wore socks when committing the crime, and after that wore the slippers. This meant that the same suspect left both of the "bloody" footprints, namely the one made with the socks and the other made by the slipper.

3. The 9th genotype was detected in several bloodstains on the scene that were different from the eight victims. This led to the conclusion that the suspect had for some reason bled when the murders were committed. The genotype of the suspect was obtained and provided the only evidence to identify the suspect. This case was solved and it was confirmed that there was only one murderer involved in this case. The 9th genotype found at the scene was found to be the same as the suspect's".

Case 2:

"During the period 10 December 1998 until 13 December 1998, several sacks filled with dismembered body parts were found in different areas of Beijing. The head and some of the guts were not found among these parts. In order to identify the source of the dismembered body parts, DNA methods were used. By using several STR loci, it was found that the genotype of all parts were identical, the Pm value was $3{,}3 \times 10^{-12}$. From this, it was concluded that all these dismembered body parts were from one person".

"Not so long after these body parts were found, somebody reported that a man named Shiwei Gu was missing. In order to determine whether the dismembered body was Shiwei Gu, blood samples were collected from Shiwei Gu's sister, wife and daughter. Next, several STR loci and mtDNA sequence analyses were used to compare the blood sample obtained from Shiwei Gu's daughter. The conclusion was that, based on the possibility of 0.99995, the dismembered body was Shiwei Gu's daughter's biological father. MtDNA analysis follows maternal heredity. The comparison of the dismembered body's sequence with Shiwei Gu's sister, found that the bases and the positions of variation were the same. It confirmed that the dismembered body and the missing man were, indeed, the same person. The identification of the parts provided the investigators with the right direction for the investigation. Four months later, the suspect was found, after the investigators found a bloodstain under the drawer of a writing desk at the suspect's home. STR and DNA sequencing results suggested that the genotype of the bloodstain was different from all the members of this family, and that it was identical with Shiwei Gu's. The Pm value was $2{,}28 \times 10^{-14}$. Thus, it could be concluded that this place was the first scene of the case" (*The role of DNA analysis in crime investigation*: 2009).

According to Olivier (2008) a detective in the East Midlands in South Africa, read about the case and sought Jeffrey's help in solving a vicious murder and rape of two British girls. The prime suspect in the case was a kitchen porter, but he had confessed to only one of the murders. Jeffrey received the semen samples from the murder scene, along with blood samples from the suspect. Jeffrey confirmed that the same person had committed both crimes, but that this was not the suspect the police were holding. In November 1986, the kitchen porter became the first person in the world to have his innocence proven by DNA. The investigation continued with all male residents between the age of 17 and 34 in the Midlands being requested to voluntarily submit a blood sample. The police then received an unexpected tip: a bakery manager chatting in a pub with some of his employees learned that one of his colleagues had convinced another baker to have his blood sample taken instead. The new suspect was arrested, and he confessed. He became the 4 583rd and last man to be tested in the hunt for the Midlands killer. His sample provided a perfect match to the sperm that was found in the two young victims. This was in September 1987, and the case meant that DNA was becoming increasingly accepted as an investigative tool.

DNA can be used to determine paternity and maternity, and for criminal identification. Because people inherit their VNTRs (variable number of tandem repeats) from their parents, VNTR patterns can be used to establish paternity and maternity. The patterns are so specific that a parental VNTR pattern can be reconstructed, even if only the children's patterns are known. Parent-child VNTR pattern analysis has been used to solve standard father-identification cases, as well as more complicated cases of confirming legal nationality, and also in instances of adoption. DNA isolated from blood, hair, skin cells or other genetic evidence left at the crime, can be compared with the DNA of a suspect, to determine guilt or innocence. DNA can also be used to establish the identity of a homicide body. *What every law enforcement officer should know ...*, 03/10/07) states that DNA analysis can point out the direction for detection. It is an important tool which can provide vital evidence to detect and solve cases rapidly and accurately (*The role of DNA analysis ...*, 19/06/2009).

2.10.2 Examples of DNA cases from South Africa

The following are cases from the SAPS FSL: Data Management Section, where DNA evidence played a vital role in the conviction of the perpetrators:

Table 2: List of cases where DNA evidence was used to convict perpetrators, from the SAPS FSL: Data Management Section

Case	Suspects	Sentencing details
Avahatakali Netshisaulu, the son of City Press Editor, Mathaata Tsedu who was murdered.	Three suspects were identified through forensic DNA analysis.	All three accused were given life sentences.
Orange Farm Serial Murders	David Nocela was identified and linked through the forensic DNA database.	Three life sentences
Westonaria Serial Murders	Jack Mogale was linked through forensic DNA to 11 murders and other cases.	Twenty life sentences
Westonaria Serial Rapist	Uria Molefe was linked to 13 sexual assault cases through the forensic DNA database.	Suspect pleaded guilty. Sentencing is pending.
Muldersdrift Serial Rapist	Shvani Phophi linked by forensic DNA database, including the sexual assault of a 10-year-old girl.	Found guilty on 6 counts of rape, 2 counts of theft, and 3 counts of robbery with aggravating circumstances; was sentenced to two life sentences.

(**Source:** SAPS Forensic Science Laboratory: Data Management Section)

Case: Amangwe CAS 18/09/2008 – LAB No 135091/08

The accused in this matter was Sihle Goodpresent Ngubane. The accused attacked arrived at the victim's house and dragged her out of her house. He then assaulted the victim and dragged her through an open field and eventually to his house where he continued to assault her. He then raped the victim. Upon

his arrest, his blood was drawn and forwarded for analysis. The DNA analysis indicated that he was the perpetrator who had raped the victim. He was released on bail in 2008, absconded on 7 February 2011 and fled the area. On 1 August 2011 the accused was traced and arrested at Ladysmith, and was held in custody. The accused's identity as the suspect, who absconded, was confirmed by DNA. The accused was convicted and sentenced to 18 years' imprisonment at Estcourt Regional Court on 12 April 2012.

In response to the question, "How could DNA be used to assist as an aid in law enforcement?" the participants of Sample A replied as follows:

- It empowers the court to ensure that justice is done (ten participants).
- Collection and preservation of evidence (seven participants).
- It supports other evidence and facts (three participants).
- It supports preliminary, secondary and further investigations (three participants).
- It could be used to prove a person innocent or guilty (two participants).

Samples B and C agreed that it can be used to exonerate innocent suspects, it allows for the early identification of suspects, it is a powerful tool for the judicial system to link a suspect to a crime, it increases the conviction rates, it allows for the identification of mass disaster victims, and also assists in the identification of missing persons (in some cases). Sample C from the FSL went on to elaborate that DNA is used for the assistance of investigations – some of the instances and usage of DNA in investigation being as follows:

- Violent and contact crime
- Sexual assault – the victims are taken, in the majority of reported cases, for examination by the medical practitioner. A sexual assault evidence kit containing the samples taken by the medical practitioner, is sent to the FSL.
- Murder – the majority of reported murder cases where DNA samples of evidential value material is found.

According to Sample C, in respect of percentage of reported crime and actual submissions of cases, the FSL Biology Section casework consists of approx 72% sexual assault cases, and 20% murder cases. The rest consists of other

cases. As far as property crime is concerned, it is only in exceptional cases that property crime is examined by the crime scene examiner for trace or touch of DNA exhibit material. Hence, DNA samples are submitted by investigating officers or crime scene examiners in less than 1% of reported property crime. Other crimes make up less than 1%.

Following from the above, the samples were able to state how DNA can be used to assist as an aid in law enforcement.

2.11 THE CRIME SCENE

According to the *Policy on crime scene management* (2005:2), a "crime scene" means a place, including a surrounding area, where an alleged offence was committed, or where items with potential evidential value may be collected. Van Rooyen (2004:94) states that a crime scene is "the actual site, area or location in which an incident took place". A crime scene, according to Van Heerden (1986:217), is "a place or area where a crime has been committed." A crime scene also includes any locality or place where physical evidence concerning the crime could be found (Marais & Van Rooyen, 1990:23).

The samples were asked to define a crime scene. All the samples commented that it refers to a place where a crime was committed. If the researcher compares the responses of the samples with the opinion of Van Heerden (1986:217) and Van Rooyen (2004:94), it is clear that the samples limit the crime scene to include only the place where a crime was committed. As a result, much information and clues might possibly go undetected, since a crime scene also includes a locality or place where physical evidence concerning the crime could be found (Marais & Van Rooyen, 1990:23).

2.11.1 Preservation of the crime scene

According to Lee, Palmbach and Miller (2001:1), investigation of a crime scene is much more than the documentation, processing and packaging of physical evidence. It is the first and most crucial step of any investigation of a possible criminal act. Pepper (2005:13) concurs that thorough and conscientious examination and recording of a scene is vitally important. Pepper further signals a

warning that a crime scene investigator has only one opportunity to recover the evidence that will prove the case. In other words, if that evidence is not recovered, it may be destroyed or contaminated.

According to Becker (2009:31), no matter what the crime or where the location, no two crime scenes can be the same. Each crime scene encompasses not only the geographical area, but also persons and things. Protecting the crime scene area is pointless, if what is contained within it is not also protected. The entrance and exit ways to the crime scene must also be guarded against contamination. All crime scenes contain physical evidence – that is, evidence that can be touched, seen or otherwise perceived, using the unaided senses or forensic techniques. The objective of all criminal investigation is to win convictions, and the key to winning convictions, even where there is a confession or eyewitness testimony, is the quality of evidence obtained at the crime scene. Evidence is of little value if it has been handled, tagged or stored improperly. Evidence should be properly collected, preserved, transported and stored – otherwise, the evidence could become inadmissible in court if the defence discovers any irregularities in this process (Becker, 2009:34).

The samples were asked, “Why do you think that every detective should receive the same in-depth training as the members of the FSL in the preservation of the crime scene?” They answered as follows:

- It is important that all detectives are trained. It often happens that detectives who have not been on any detective training courses are also required to attend crime scenes, and in many cases are entrusted to produce the same effect as a trained detective (16 participants).
- They rather leave it to the members from the Criminal Record Centre, but it often happens that they experience late arrival of these members, owing to manpower constraints (six participants).
- It would be good to have persons trained in proper upliftment and preservation of evidence, who could attend that specific station’s crime scenes that the station's detectives have to attend (three participants).

Sample B mentioned specifically that all detectives should receive the maximum amount of training in this field, as the value of empowering every detective is priceless.

According to Sample C, it is advisable that all detectives be trained at a much more in-depth level, as opposed to the training detectives receive now while on detective courses, in respect of the identification, collection and preservation of DNA. Further, the detectives should continually receive refresher training as long as they are in the detective units. According to Sample C, they do receive a relative amount of training on the detective courses, but the level or standard should be the same as that which the members of the FSL receive, due to the fact that it is relevant evidence, in whatever form, that makes or breaks a case in court. Also, the crime scene evidence needs to be recognised, protected, recorded, collected and packed correctly, properly marked, the integrity protected, and submitted for relevant analysis. The chain of evidence, which is discussed in Chapter 3, must be observed, and the evidence must then be presented in court. When the researcher analysed the detective training curriculum – in particular, the Policy on crime scene management (2005), he found that detectives do receive training in the preservation of the crime scene.

From the above discussion, it is evident that all participants are of the opinion that all investigators should receive the same in-depth training as the members of the FSL, in the preservation of the crime scene.

2.12 SUMMARY

This chapter explored the concept of DNA, in depth. It also dealt with the following: criminal investigation and its objectives and forensic science, DNA as an individualisation technique and as an investigative aid, the DNA criminal intelligence database, and examples of criminal cases in which DNA evidence was used to convict the perpetrator/s of a crime. The concept of DNA was defined, and the way in which it relates to, or interlinks with, the process of criminal investigations through the definition process, was discussed. It is important that this concept be understood by detectives, so that they can create hallmarks in their minds when they attend crime scenes, and so that they are

well-informed in respect of DNA. DNA is an important source of evidence in criminal investigations. It can withstand the harshness of defence attorneys, because it constitutes scientific proof. It is clear from the responses of the investigators from the SAPS, that this is a concept that needs to be further dealt with. The experts and prosecutors have a clear understanding of this concept and the integral role it plays as in a criminal trial. DNA forms part of vital evidence, which will be dealt with in the next chapter.

CHAPTER 3

DNA EVIDENCE AS AN INVESTIGATIVE TOOL

3.1 INTRODUCTION

The identification of evidence starts immediately when the first officer arrives at any crime scene, or when the police officer arrests a suspect – or even during the interview of a witness. It is at this crucial stage in an investigation, that investigators must apply their minds immediately to identify anything that could become evidence in the investigation.

Investigation is all about proof, and to prove a case an investigator needs evidence. DNA analysis involves the examination of the genetic material of humans or animals in order to use the uniqueness of each individual in solving crimes. This form of proof is what can assist the investigating officer to prove the case in court. It often happens that this type of proof is overlooked or ignored at crime scenes – in many instances because of the lack of insight and/or training of the investigator who visits the scene. Investigators usually have one chance (in many cases, the first time they visit the crime scene) to optimally gather as much evidence as possible. Later, the evidence may not be there, as it could be lost, destroyed or even purposefully moved.

According to *Rape Statistics* (2011), it is estimated that a woman born in South Africa has a greater chance of being raped than learning how to read. One in three of the 4,000 women questioned by the Community of Information, Empowerment and Transparency said they had been raped in the past year. A survey conducted among 1,500 school children in the Soweto township showed that a quarter of all the boys interviewed said that 'jack-rolling', a term for gang rape, was fun. More than 25% of South African men questioned in a survey admitted to raping someone. Of those, nearly half said they had raped more than one person, according to a new study conducted by the Medical Research Council (MRC). It is estimated that 500 000 rapes are committed annually in South Africa. A 2010 study led by the government-funded Medical Research Foundation revealed that in the province of Gauteng, home to South Africa's

most populous city of Johannesburg, more than 37% of men said they had raped a woman. Nearly 7% of the 487 men surveyed said they had participated in a gang rape. Between 2008 and 2010, over 138 846 people reported as persons who had been raped in South Africa (*Rape Statistics* (2011)).

This chapter illustrates the understanding of investigators regarding the knowledge they have, to apply their thoughts analytically with regard to DNA evidence as an investigative tool.

3.2 EVIDENCE

According to Schmidt and Zeffert (1996:311), evidence is all information that is given in a legal investigation to establish the fact in question. For Buckwalter (1984:26), evidence is all relevant information that, if admissible in court, can be presented. Hails (2005:2) defines evidence as something that proves or disproves allegations and assertions, and confirms that evidence, in the legal sense, includes only what is introduced at a trial, and that the key to evidence is that it must be presented. If it has not been presented during the trial, then it cannot be classified as evidence, yet.

During the interview the samples were asked what evidence is. The results were as follows:

Twenty-two participants from Sample A stated that evidence is given in court, and either proves or disproves a fact in question. Three of the participants from Sample A stated that evidence is what builds a case that is being investigated, with a view of taking that case to court. This evidence is then presented in court by the public prosecutor. Sample C, the expert from the FSL, and Sample B, the prosecutors, defined it as oral or physical or documentary information which is relevant to a case presented in court. It is clear that all the participants had an understanding of what evidence is, as according to the literature. Samples B and C had a clear understanding of what evidence is; however, not all participants from Sample A were able to clearly explain what evidence is, as mentioned by Schmidt and Zeffert (1996:311).

3.3 THE LEGALITY OF THE USE OF DNA IN CRIMINAL CASES

According to Marais (1992:118), DNA prints satisfy all the requirements with which fingerprints, as an individualising medium, have to comply. These are uniqueness, individuality, invariability, ability to be classified, universality, and the ability to be reproduced. Crime can only be positively solved with the help of objective and subjective clues. Objective clues can be described as factual proof and the objective explanation of them. Subjective clues are defined as the evidence from people who are directly or indirectly involved in the crime (Van Heerden, 1986: 188). Collecting evidence or facts is, according to this definition, the fundamental characteristic of criminal investigation.

In the law of evidence, according to Zeffert, Paizes and Skeen (2003:219), relevance is regarded as the basic criterion for admissibility. This criterion is applied in both a positive and a negative form. The authors add that all relevant evidence is generally admissible, and all irrelevant evidence is generally inadmissible. In explaining the concept of relevance, they state that relevance is essentially a matter of reason and common sense, according to everyday standards of reason prevailing at the time of a particular case, and that much depends on the experience of the judicial officer.

In the commentary on the South Africa Criminal Procedure Act 51 of 1977, revision service 31 (2004:2/12), the meaning of “relevance” is defined as the logical tendency to show or indicate the material fact for which the evidence is offered. If evidence does not logically show or indicate the fact sought to be proved, it is inadmissible. It takes matters no further, and is said to be logically irrelevant. A finding that evidence is logically relevant, on the other hand, does not end the enquiry. It must still be asked whether the evidence is sufficiently relevant to be received.

During the interviews, the participants were asked about the relevance of DNA evidence in criminal investigations. Sample A responded as follows:

- evidence had to be relevant to be admissible (12 of 25).
- the evidence had to be reliable and relevant to be admissible (7 of 25).
- the public prosecutor would decide which evidence was admissible and which evidence would be introduced during the trial (6 of 25).

Sample B indicated that the evidence must be credible, the chain of evidence must be followed, and it must pertain to the case in question and be relevant to the case.

Sample C, the participant from the FSL, referred to the Randitshene case – FSL Lab 115305/04, Modimolle CAS 178/07/04, where the accused was convicted and sentenced to sixteen life imprisonments, plus 220 years for a series of murders, rapes and kidnappings he committed between 2004 and 2008. The suspect was arrested after an intensive police investigation, during which over 550 DNA samples were tested, before a police forensic expert identified the suspect. This DNA evidence was admitted as evidence in the Modimolle Circuit High Court, and played an important role as part of the evidence that allowed Judge Claassen to convict the suspect, David Randitshene.

Sample A answered the question in general but did not refer to DNA evidence or give examples as cited by sample C and were unable to give an explanation of the relevance of DNA evidence in criminal investigation, as discussed by Zeffert et al. (2003:19).

According to section 210 of the Criminal Procedure Act 51 of 1977, “no evidence as to any fact, matter or thing shall be admissible which is irrelevant or immaterial and which is irrelevant or immaterial and which cannot conduce or prove any point or fact at issue in criminal proceedings”.

Blood will be admissible as evidence, if it is relevant as evidence to prove cases at court. In South Africa, the taking of blood from an accused or suspect is governed by legal requirements. The taking of blood samples is administrated by section 37 of the Criminal Procedure Act 51 of 1977. Section 37(2) reads as follows:

Powers in respect of prints and bodily appearance of accused

(1) Any police official may

(*a*) take the finger-prints, palm-prints or foot-prints or may cause any such prints to be taken-

(i) of any person arrested upon any charge;

(ii) of any such person released on bail or on warning under section 72;

(iii) of any person arrested in respect of any matter referred to in paragraph (*n*), (*o*) or (*p*) of section 40 (1) of Act 51 0f 1977;

(iv) of any person upon whom a summons has been served in respect of any offence referred to in Schedule 1 or any offence with reference to which the suspension, cancellation or endorsement of any licence or permit or the disqualification in respect of any licence or permit is permissible or prescribed; or

(v) of any person convicted by a court or deemed under section 57 (6) to have been convicted in respect of any offence which the Minister has by notice in the *Gazette* declared to be an offence for the purposes of this subparagraph;

(*b*) make a person referred to in paragraph (*a*) (i) or (ii) available or cause such person to be made available for identification in such condition, position or apparel as the police official may determine;

(*c*) take such steps as he may deem necessary in order to ascertain whether the body of any person referred to in paragraph (*a*) (i) or (ii) has any mark, characteristic or distinguishing feature or shows any condition or appearance: Provided that no police official shall take any blood sample of the person concerned nor shall a police official make any examination of the body of the person concerned where that person is a female and the police official concerned is not a female;

(*d*) take a photograph or may cause a photograph to be taken of a person referred to in paragraph (*a*) (i) or (ii).

(2) (*a*) "Any medical officer of any prison or any district surgeon or, if requested thereto by any police official, any registered medical practitioner or registered nurse may take such steps, including the taking of a blood sample, as may be deemed necessary in order to ascertain whether the body of any person referred to in paragraph (a) (i) or (ii) of subsection (1) has any mark, characteristic or distinguishing feature or shows any condition or appearance".

(b) "If any registered medical practitioner attached to any hospital is on reasonable grounds of the opinion that the contents of the blood of any person admitted to such hospital for medical attention or treatment may be relevant at any later criminal proceedings, such medical practitioner may take a blood sample of such person or cause such sample to be taken."

The deduction to be made from the above explanation is that if blood is drawn from a suspect for the purpose of analysis, and the result of such analysis is used in court, then the drawing of the suspect's blood, if legally done as required by section 37 of the Criminal Procedure Act, then the analysis of the blood and the result thereof will make the evidence admissible in court. However, the evidence must be relevant to the fact in question; otherwise the evidence cannot be used to prove a case before a court of law. It must be also noted that even if Section 37 is complied with but the chain of evidence is broken, the evidence might not necessarily be admissible in court.

The participants were asked, "What are the requirements for DNA evidence to be admissible at court?" Sample A responded as follows:

- Evidence had to be relevant to be admissible (twelve samples).
- Evidence had to be reliable and relevant to be admissible (seven samples).
- The public prosecutor would decide if the evidence was admissible (six samples).

Samples B and C responded by saying that the evidence must be relevant to the fact in question, and that any evidence which is not relevant and which cannot prove a point or issue in question is not admissible.

Although the samples had answered the question by referring to evidence in general but not specifically to DNA however, none of the participants were able to give an explanation as cited in section 37 of the Criminal Procedure Act.

In the case of *S v Maqhina* 2001 (1) SACR 241 (T), it was decided that where the state's proof of the accused's guilt depended on the results of scientific analyses, the testing process, including the control measures applied, had to be executed and recorded with such care that at any time later it could be verified

by any objective scientist. In *S v R and Others* 2000 (1) SACR 33 (W), it was held that the fundamental test for the admissibility of evidence was its relevance, and that the evidence must be obtained constitutionally. According to Zeffert et al. (2003:712–713), the results obtained as a result of the taking of blood may be used in criminal cases and civil litigation. Section 37 (2) of the Criminal Procedure Act gives the police official powers in respect of the taking of fingerprints, palm prints or footprints which may result in real evidence. The test is apparently a complex one, and there is consequently room for error. The results of DNA tests can be used for individualisation of a person, to place a suspect at a crime scene, show innocence, and prove relationships. Where the proof of guilt depends on the result of such a test, the process must be executed and recorded with sufficient care to enable it to be verified subsequently by any objective scientist and, eventually, the trial court (Zeffert et al., 2003:713–714).

When asked the question, "How can DNA evidence assists in a criminal investigation when such case is before a court of law, Sample A responded as follows:

- To scientifically link a suspect through comparison of, for example, DNA found on a rape victim and that of the suspect arrested (16 participants).
- To place a suspect at a crime scene (six participants).
- As an investigation aid for forensic investigators (two participants).
- To confirm that an incident did take place (one participant).

According to Sample C, the participant stated that DNA evidence can be used to either place a suspected criminal at a crime scene, or to verify a possible fact in question. The suspect could also be convicted in a criminal court of law, based on DNA evidence. According to Sample B, DNA evidence can be used to convict a criminal in a court of law by providing conclusive proof that the suspect had committed the offence, by linking his DNA to the crime scene or the victim. DNA evidence can also place a person at a crime scene – for example, in a rape case, the semen that was taken as an exhibit from a victim will reveal a DNA profile. It must be noted that all participants had a very good understanding of the use of DNA as evidence and how it could assist in the investigation of crime. By this the participants, specifically sample A, illustrated an understanding of **the importance of DNA as an investigation tool**.

3.4 FORMS OF EVIDENCE

According to Buckles (2003:62) and Palmiotto (2004:59), all evidence is classified by type and form, and the authors distinguish between direct evidence and circumstantial evidence – which is explained as follows:

3.4.1 Direct evidence

According to Buckles (2003:62) and Palmiotto (2004:59), direct evidence is based on personal knowledge or observation of the person testifying. It is evidence that proves or disproves a disputed fact directly, relies on the senses and perception of the eyewitness, and does not require any intervening or indirect fact to be proven first. If the testimony is believed, the fact it relates to is conclusively established. Direct information or original evidence is an actual sensory observation or experience. Direct sources of information include –

- victims and complainants
- witnesses directly involved in the event
- persons involved in the event, but not present (informers)
- accomplices and suspects

According to James and Nordby (2005:650), direct evidence is the information that establishes directly, without the need for further inference, the fact for which the information is offered. A clear example would be the eyewitness testimony that the defendant fired the fatal shot, in a murder prosecution. All forensic evidence is primarily offered as circumstantial evidence of a material fact required for a conviction. Evidence obtained through forensic anthropology, forensic entomology, forensic geology, DNA, fingerprints, hair fibres, footwear and tyre impressions, as well as other numerous types of information generated by the body of forensic sciences, serves the vital function of bringing to light important inculpatory or exculpatory facts (James & Nordby, 2005:650). Thus it can be said that DNA is real evidence. It is important to understand that forensic evidence is subsumed under the general evidence category of circumstantial evidence. Circumstantial evidence, which includes the majority of evidentiary offerings in US courts, allows the trier of fact to accept, as proven, a fact for which direct evidence is unavailable, by inference from a fact that is directly proven.

Examples would be the linking of a crime scene, DNA, hairs, fibres, glass, footprints, fingerprints, and bullets or shell casings linked in some fashion to the defendant, which is offered to infer the defendant's presence at the crime scene and thus inferentially connect him to that crime scene (James & Nordby, 2005:650).

3.4.2 Circumstantial evidence

Circumstantial evidence proves or disproves a fact indirectly, by first proving another fact from which an inference may be drawn as to the original disputed fact. It requires the trier of fact to use an inference or presumption in order to conclude that the fact does exist – for example, a witness placing the accused at the scene, with no other possible suspect present, or physical evidence which, in itself, does not prove or disprove the guilt of the perpetrator.

The viewpoints of Buckles (2003), Palmiotto (2004) and Hails (2005) are confirmed in the South African law of evidence, when Zeffert et al. (2003:93) argue that "all evidence require the trier of fact to engage in inferential reasoning." Zeffert et al. further state that evidence which involves only the first tier is called direct evidence, while evidence that asks a trier of fact to consider the second tier of inferential reasoning in addition to the first, is referred to as "circumstantial evidence". They explain this by suggesting that direct evidence generally concerns the assertion of a fact by persons who claim to have perceived it with their own senses, and that circumstantial evidence ultimately depends on facts which are proved by direct evidence.

Four forms of evidence, namely testimonials, physical/real, documentary and demonstrative evidence, could be presented:

3.4.2.1 Testimonial/oral evidence

According to Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), testimonial evidence is oral evidence presented by witnesses at the trial, under oath. Expert evidence on crime scene evidence such as bloody clothing, fingerprints and exhibits found at the scene, is also introduced by the testimony of the witnesses who have gathered this evidence at the scene of the crime.

3.4.2.2 Documentary evidence

In Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), documentary evidence is evidence that consists of "writing" – for example, affidavits, letters, typewriting, notes, printings and pictures. As with physical evidence, a proper foundation must be presented through a witness who can testify as to the documentary evidence's authenticity.

3.4.2.3 Demonstrative evidence

In Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), demonstrative evidence is evidence that "demonstrates", illustrates or recreates evidence that has already been presented – for example, a sketch, photograph or sketch of the crime scene.

3.4.2.4 Other probative material

According to Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), this constitutes the circumstances and rules that play a role in the giving of evidence, such as presumptions and judicial notice – which are explained as follows:

3.4.3 Presumption

For Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), a presumption is an inference which the court draws, and which does not need to be proved by evidence because it reflects the normal course of events – for instance, that a child under the age of ten cannot commit a crime. This is an irrefutable presumption because evidence cannot be presented to prove the contrary. On the other hand, refutable presumptions are found where the court's inference can be rebutted by evidence to the contrary. An example is where a woman's husband is presumed to be the father of her child. Although the court can make the presumption, the husband can give evidence to the contrary.

3.4.4 Judicial notice

According to Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321), a judicial notice is made when the court accepts some-

thing as a fact because it is so well known that it would be unnecessary and absurd to require it to be proved. An example is the fact that a woman's pregnancy lasts more or less nine months.

The samples were asked to name the four forms of evidence. None of the participants from Sample A were able to name all four forms of evidence as cited in Kleyn and Viljoen (2002:182–185), Buckles (2003:63), Hails (2005:3) and Blake (2005:321). Samples B and C were able to list all four forms of evidence.

3.4.5 Physical/real evidence

Palmiotto (2004:156) engages the discussion by writing that physical evidence is generally defined as any unspoken evidence: a thing, an object, a substance, or a visible or invisible gas, which has some connection with a crime under investigation, and which can prove an element of the crime or the theory of a case. The author explains that physical evidence falls into two classifications: evidence with individual identifying characteristics, and evidence with class characteristics only. Evidence with individual characteristics is evidence that can be identified as coming from specific sources or people, because it contains enough identification characteristics, markings, or microscopic evidence such as handwriting, fingerprints and tool marks. In contrast, evidence with class characteristics is evidence that can never be definitely identified, since there is more than one possible source of it, such as blood, soil, hairs, fibre, glass fragments, shoeprints and tool marks, with not enough markings for positive individual identification.

In Zeffert et al. (2003:703), the reference to physical evidence as real evidence is highlighted, which suggests that real evidence can be seen as things which, when examined by the courts as proof, through proper identification become evidence. Physical evidence is evidence that can be tangibly perceived by the trier of fact. It is evidence that "speaks for itself", and includes exhibits found – such as murder weapons, fingerprints or bloodstains. O'Hara and O'Hara (2003:81) state that physical evidence can serve several investigative purposes, and can be divided into the categories of "*corpus delicti*" evidence, associative evidence, identifying evidence and tracing evidence. According to Marais (1992:6), "physical evidence" is also referred to as "real evidence". He states that physical evi-

dence is real evidence, which is visible and recognisable as a liquid, object, print or instrument.

According to James and Nordby (2005:650), discussions of the use of science in criminal law typically revolve around the subject of forensic evidence – that is, facts or opinions generated or supported by the use of one (or typically more than one) of the forensic sciences routinely used in criminal prosecutions.

The central concept in the use of the findings of forensic science, is the crime scene. While a crime scene can be a basement of a counterfeit operation, or the broken back door of a supermarket, the term often refers to the scene of a violent crime such as a sexual assault or a homicide. The identification, collection and testing of crime scene evidence are the focus of the training of forensic scientists, and they are also the central source and reference point for analysis of many legal issues involved directly or indirectly in the field of forensic evidence (James & Nordby, 2005:650).

According to Sample A, physical evidence can be described as –

- indirect evidence that is used against a suspect (three participants)
- evidence that links a suspect to a crime or crime scene (ten samples)
- something you can see or touch (four samples)
- exhibits collected from the crime scene (eight samples)

None of the participants from the police, Sample A, concluded that physical evidence is real evidence. Samples B and C were able to describe physical evidence and state that it is also real evidence, which may include anything, person or place which is observed by the court, in order that a conclusion may be drawn as to any fact in issue.

3.5 IDENTFYING DNA EVIDENCE

DNA profiling is a powerful technique whereby the possible location of a biological sample, such as blood or semen, can be analysed and eventually give a bearing as to the exact origins of the sample (*What every law enforcement officer should know ...*, 03/10/07). DNA profiling can ultimately direct investigators to a specific individual. DNA keeps its integrity in dried specimens for long

periods, and can consequently help in resolving unsolved cases. A few cells only are sufficient for obtaining useful DNA information The list below, adapted from *(What every law enforcement officer should know ...*, 03/10/07), will assist an investigator in this regard:

Table 3: The possible location and source of DNA evidence

Evidence	Possible location of DNA on the evidence	Source of DNA
baseball bat or similar weapon	handle, end	sweat, skin, blood
hat, bandanna or mask	Inside	sweat, hair, dandruff
Eyeglasses	nose- or earpieces, lens	sweat, skin
facial tissue, cotton swab	surface area	mucus, blood, sweat, semen, ear wax
dirty laundry	surface area	blood, sweat, semen
Toothpick	Tips	saliva
used cigarette	cigarette butt	saliva
stamp or envelope	licked area	saliva
tape or ligature	inside/outside surface	skin, sweat
bottle, can or glass	sides, mouthpiece	saliva, sweat
used condom	inside/outside surface	semen, vaginal or rectal cells
blanket, pillow, sheet	surface area	sweat, hair, semen, urine, saliva
“through and through” bullet	outside surface	blood, tissue
bite mark	person’s skin or clothing	saliva
fingernail, partial fingernail	Scrapings	blood, sweat, tissue

(**Source:** What every law enforcement officer should know about DNA evidence, 03/10/07)

From the above, it is clear that DNA can be extracted from a host of evidence; however, one should bear in mind that there are important issues pertaining to its identification, collection, transportation and storage. It is extremely important that a crime scene investigator (expert) collects evidence in a methodical manner, so that such evidence can be preserved and well documented. Note taking is therefore vital in this regard *(What every law enforcement officer should know ...*, 03/10/07). As soon as the scene has been documented and the locations of the evidence noted, the collection phase can begin.

The most fragile or easily lost evidence should be dealt with first; essentially, each item should be photographed before it is removed. DNA evidence can be collected in clean, unused paper containers such as packets, envelopes and bags, while moist or wet biological evidence, such as blood or semen, can be collected in clean, unused plastic containers and transported immediately to the laboratory to prevent contamination of other evidence. Once in a secure location, wet evidence must be removed and allowed to air dry, as moisture can destroy or alter DNA evidence. This is done by the crime scene investigator (expert) (*What every law enforcement officer should know*, 03/10/07).

3.6 COLLECTION OF DNA EVIDENCE

According to Van Rooyen (2004:95) and Marais (1988:28), this is the stage in which the methods, techniques and procedures are used in retrieving evidence. Patience and care are very important at crime scenes, and investigators should take the proper time and care in processing the scene, even if the work is tedious and time consuming. All identified and documented evidence must be gathered and packed, so as to ensure the integrity of the evidence. This means that the evidence must reach the laboratory uncontaminated, for analysis. Contamination of evidence will influence the accuracy of results and the ability of the laboratory to analyse the evidence. Identification marks should always be brought on evidence, for further reference. The continuous possession of the evidence is preserved in court through the chain of evidence. The investigator has to prove that the evidence has not been tampered with, or altered in any way, while being handled and analysed, up to receiving the results back from the laboratory. The integrity of the investigator plays a large role in this phase.

The number of people handling evidence should therefore be minimised (Van Rooyen, 2004:95; Marais 1988:28).

Berg and Horgan (1998:40) and Van Rooyen (2004:95) agree with Marais (1988:28), that evidence may be found at the scene of the crime, or on the victim, or may be taken from the suspect's environment. They add that the way in which the evidence is protected, collected, secured and transported, will affect its later usefulness when introduced in a criminal case during the trial, and that the obtaining of evidence is a continuous process in crime investigation.

Inman and Rudin (2001:196) conclude the discussion on the crime scene by stating that the ultimate purpose of a crime scene investigation is to seek information to solve the commission of a crime – which falls under the umbrella of six questions:

- What happened?
- When did it happen?
- Where did it happen?
- Who was involved?
- How was it done?
- Why was it done?

When asked the question, "What training did you receive on collection of DNA evidence in any course or training programme?", 22 participants replied that they had never received any formalised training, as this training had not been part of any detective course they had attended, while three participants responded by saying that they had not received any formal training, but would be able to identify what needed to be collected at the crime, but not be able to uplift the exhibit or collect it, as they had never received any formal training regarding this procedure. Sample B indicated that they had not received any training in the physical collection of DNA evidence, but understood the concept, as the chain of evidence plays a vital role in the prosecution process. Sample C indicated that she had received comprehensive training in the collection of DNA evidence, due to the fact that such training was part of her job development as a member of the FSL.

3.7 CHAIN OF EVIDENCE

Buckles (2003:81) defines the chain of evidence as the means for verifying the authenticity and legal integrity of evidence, by establishing where the evidence has been and who has handled it prior to the trial. The concept of "chain of evidence" has the same meaning as "chain of custody". Due to the fact that a chain is as strong as its weakest link, the chain of evidence is vulnerable to attack from the defence if the evidence has been tampered with, found to be missing, or cannot be accounted for during any period.

Van Rooyen (2004:12) states that when a question arises as to the authenticity of an item offered as evidence, or its possible alteration or contamination, the location and the condition of the article from the time of its discovery, must be proved. It is of vital importance that there is an account in respect of the chain of any evidence from the time it is identified to the end, if one wants that evidence to have credibility. According to Van Rooyen (2004:12), proof of "chain of custody" demonstrates that –

- the evidence offered is the same evidence found at the scene. In other words, if a blood sample was uplifted at a crime scene, it is the same blood sample that must be sent for analysis for a DNA result.
- there has been no opportunity to replace or improperly alter the evidence. The chain of custody must be maintained at all times, to ensure that it was the same sample that was uplifted at the crime scene, up to the point that it was analysed and a result obtained.
- any change in the condition of the evidence can be explained – for example, when evidence has been destroyed through laboratory analysis. Thus, the blood no longer exists, but merely a report that was generated through the analysis of the blood.

When all the participants were asked what "chain of evidence" meant, they responded as follows:

- The chain of evidence is a chronological chain of events that follow each other with reference to exhibits – that is, from the time it is found until the end result, and such evidence can be introduced in a trial (twenty participants).

- It indicates the step-by-step order in which an investigation has taken place (five participants).
- It refers to the step-by-step processing or handing of the evidence in a criminal case being investigated, which could also affect the credibility of the evidence introduced in a trial (four participants).

All the participants were able to explain the concept with regard to the chain of evidence, but none of them was able to explain the chain of evidence as cited in Van Rooyen (2004:12), which pays special attention to the custody of the evidence which leads to the credibility of the evidence as well.

3.8 THE USE OF DNA AS INVESTIGATIVE TOOL IN SOUTH AFRICA

The following cases are actual South African cases that were investigated by the SAPS FSL. The content of these cases was supplied to the researcher by the FSL Data Management Section in Pretoria:

- NEWCASTLE CAS 156/09/08 (FSL LAB 136400/08; 2008062827)

  A mother and her daughter were attacked in their home. The mother was strangled and daughter (ten years old) was raped and then hanged by the perpetrators. Two suspects were arrested, and appeared before court for the murder and rape of the two victims. DNA evidence presented incriminated the one accused. DNA evidence indicated that the one suspect ("Nkosi") had, in fact, raped the daughter. When confronted with the DNA evidence, both suspects pleaded guilty. On 28 January 2010, one suspect was sentenced to life imprisonment for rape and murder, and the other was sentenced to life imprisonment for murder.

- PRETORIA SERIAL RAPIST (VARIOUS PRETORIA CENTRAL, PRETORIA WEST & THABA TSHWANE) – FSL LAB 102719/07, FSL LAB 145083/07, FSL LAB 7506/07, FSL LAB 10543/08, FSL LAB 29629/08, FSL LAB 29980/08, FSL LAB 44917/08, FSL LAB 51424/08 & FSL LAB 180185/06)

  Due to DNA analysis and comparison, the suspect ("DUBE J", 06D3AA2815XX) was linked to nine cases. Victims of the rape were exam-

ined, and swabs taken and forwarded to the FSL for analysis. When compared, the suspect was linked to nine cases. The suspect was sentenced to 54 years' imprisonment.

- Edenville: CAS: 01/07/07 FSL: Lab: 105318/07

  Two suspects were accused of raping one female victim. Suspect 2 was linked via DNA, and Suspect 1 was excluded. During the court proceedings, the investigating officer, Sergeant Swasti Gurie, was asked to explain if it is possible for a victim to be raped and for no DNA of the suspect to be found. He explained that this is possible if a suspect wore a condom, did not ejaculate, or ejaculated outside the victim's body. The magistrate said that Sergeant Gurie's testimony corroborated the victim's version of events, in that one suspect wore a condom (Suspect 1 – M.I. Khumalo) and the other suspect didn't (Suspect 2). Suspect 2 was sentenced to 15 years' imprisonment for rape.

The following are confirmed cases from the FSL in South Africa, where DNA led to the successful prosecution of the alleged perpetrators:

- FSL LAB 26262/98 – Umlazi CAS 348/12/97 – the accused was a lawyer. He raped his assistant's child. Sentenced to 14 years and his appeal was denied. DNA from the semen matched the DNA found in the suspect's blood.

- FSL LAB 64838/00 Bloemspruit CAS 150/10/99 – Gang rape. DNA helped to link the accused, for which there was little other evidence. Suspects got six life sentences and 446 years of further imprisonment. DNA from the semen matched the DNA found in all the suspects' blood.

- FSL LAB 58498/00 Delmas CAS 180/07/00 – father accused of repeated incest. The child was retarded. DNA was used to prove that his grandchildren were also his children. Sentenced to three years (suspended for five). DNA evidence through a paternity test proved that he was the father of the child to whom the retarded child had given birth.

- FSL LAB 3994/01 Garankuwa CAS 68/12/00 – Rape of a 13 year-old girl. The rape led to the mother becoming pregnant, and a child was born. DNA evidence through a paternity test proved that the child was that of the rapist. 15 years.

- Mountain Rise Serial (13 cases) – DNA pivotal in sentencing: 8 × life + 290 years. The suspect raped as well as killed victims he had raped. The victims were examined for semen. The DNA from the semen matched the DNA found in the suspect's blood.

- FSL LAB 16133/06 Boschkop CAS 216/12/05 – the suspect killed his step-daughter – only way he could be linked was her DNA on his helmet visor. Committed suicide before sentencing.

- FSL LAB 64611/06 Mamelodi rapes and murders – schoolgirls hog-tied, raped and strangled. Both accused got four life sentences. After analysing the DNA from the semen and the blood of both accused, it was found that the DNA from the suspects' semen matched the DNA result found in the suspects' blood.

It is clear from the above cases, that DNA played a pivotal role in the conviction of persons in such serious criminal cases. The above examples indicate that the conclusive result was as a result of DNA evidence. It also played a role as a source of information, in that the person who had been arrested for the offence was, in fact, the correct person being sought. Such evidence did not rely on the evidence of a witness, as it was direct evidence in a court of law. In essence, it can be clearly seen from the discussion and cases that were discussed, that DNA could be used as an investigative tool in South Africa.

When asked the question, "Could DNA be used as an investigative tool in South Africa?" all the samples answered 'yes, it could'. All the samples understood that DNA could be an investigative tool for their investigation of DNA-related cases. The answer to this question and the examples of cases from the practice in South Africa is proof that investigators realise **the importance of DNA as an investigation tool**.

3.9 SUMMARY

During an investigation, an investigating officer can have all the information that link the suspect to the crime within his reach. One of the critical issues in the process of investigation is that the investigating officer must be analytical, and be able to turn the information at his disposal into evidence that can be accepted in any court of law. This means that if investigators want to be effective in their fight against crime, be it investigation or prevention, they have to raise their awareness, and improve their knowledge of investigation methods and techniques such as DNA. Coupled with this knowledge, the analytical ability to apply and convert information obtained at crime scenes, and information obtained from witnesses, into evidence, is essential. If one is striving towards achieving a police investigative service that is world class, then investigators need to be empowered as if they were a “one stop shop” investigation service that has been given the task of investigating crime in South Africa.

What is realised from the findings presented in this chapter is that police officers leave the collection of DNA evidence to the “experts”. This means that they are not exposed to the collection of DNA evidence – which also leads to the fact that, if valuable evidence is lost due to aspects such as bad weather and delays by experts attending the crime scenes, then they find themselves helpless to collect essential evidence. Thus, hundreds of cases are lost.

CHAPTER 4

FINDINGS AND RECOMMENDATIONS

4.1 INTRODUCTION

The aim of the research was to establish the importance of DNA as an investigation tool. To address the research problem, the following research questions were asked:

- What is DNA?
- What is the importance of DNA evidence as an investigative tool?

4.2 PRIMARY FINDINGS

The following findings are based on the research questions:

4.2.1 Research question one: What is DNA?

In this research it was established, based on the literature research and interviews conducted, that –

- DNA is the genetic material found in all human cells, and carries the coded messages of heredity unique to each individual. DNA governs the inheritance of eye colour, hair, stature, bone density and many other human and animal traits. One can say it is the fundamental building block of an individual's entire genetic makeup (http://www.ncjrs.org).
- With reference to the participants, 21 of 29 participants could not give a precise account of what DNA is. It is clear that the participants lacked the knowledge of the proper definition of DNA.

4.2.2 Research question two: What is the importance of DNA evidence as an investigative tool?

In this research it was established that –

- DNA profiling is a powerful technique, whereby the possible location of a biological sample, such as blood or semen, can be analysed, and eventual-

ly give a bearing as to the exact origins of the sample. This can ultimately direct investigators to a specific individual.

- DNA keeps its integrity in dried specimens for long periods, and can consequently help to solve unsolved cases. Only a few cells are sufficient to obtain useful DNA information.
- DNA can be extracted from a host of evidence, such as hair, blood, semen, mucus, ear wax, sweat, saliva and urine. However, one should bear in mind that there are important issues pertaining to the identification, collection, transportation and storage of such DNA evidence. It is, firstly, extremely important that an investigator collects evidence in a methodical manner, and that such evidence is preserved and well documented. It is vital that the investigator takes notes during this process.

This research proves that DNA is an important investigation tool! It was established from the discussion that DNA could be used:

- To scientifically link a suspect through comparison of, for example, DNA found on a rape victim and that of the suspect arrested,
- To place a suspect at a crime scene,
- As an investigation aid for forensic investigators,
- To confirm that an incident did take place,
- To determine paternity and maternity,
- For criminal identification,
- To recreate crime scenes,
- DNA can be used as linkage evidence,
- DNA can be used to individualise in all identification categories,

4.3 SECONDARY FINDINGS

In light of the literature study and interviews conducted, the researcher's secondary findings were as follows.

4.3.1 Objectives of investigation

From the literature it was established that the objectives of investigation are –

- identification of crime
- gathering of evidence
- individualisation of the crime
- arresting of the criminal
- recovery of stolen property
- involvement in the prosecution process

The sample group had a good understanding of the objectives of investigation. However, none of them could set out all the objectives of investigation as set out in the literature.

4.3.2 What is evidence?

From the literature it was established that evidence is all information that is given in a legal investigation to establish the fact in question. For evidence to be admissible in court, it must be relevant and constitutionally obtained.

The participants had a basic knowledge of what evidence is; however, none of them mentioned that evidence is all information that is given in a legal investigation, to establish the fact in question.

4.3.3 Identification

From the literature study, it was established that identification is a process that utilises the class characteristics of an object or known substance, for comparison with evidence from a crime scene. Nineteen of 29 had an understanding of what 'identification' means, and ten of 29 did not have a clear understanding of the term.

4.3.4 Individualisation

According to the literature, individualisation is a process of linking physical evidence to a common source. Some of the participants (19 of 29) had an understanding of what individualisation means, and (10 of 29) did not have a clear understanding of the term.

4.3.5 Understanding DNA

According to the literature, DNA is an abbreviation for the term 'deoxyribonucleic acid', and DNA fingerprinting is a technique which is seen as being the most powerful and reliable tool in the forensic scientist's human identification armoury. Some of the samples (25 of 29) were unable to describe what DNA is according to the literature. The samples need to be enlightened on this term.

4.3.6 Crime scene

According to the literature, a crime scene is a place, including a surrounding area, where an alleged offence was committed, or where items with potential evidential value may be collected. The samples had a good understanding of what a crime scene are (27 of 29). Some samples limited the crime scene to include only the place where the crime was committed. All participants were able to state in which cases DNA can be used.

4.3.7 Training

Training was received in the preservation of a crime scene, while on in-service training courses offered by their employer, SAPS. However, only 1 of 29 received the in-depth training received by members of the FSL.

All the participants agreed that every detective should receive the same in-depth training as the members of the FSL, in the preservation of a crime scene.

4.3.8 Evidence

According to the literature, evidence is all information that is given in a legal investigation, to establish the fact in question. It was also established that in order for evidence to be admissible in court, the evidence must be relevant and constitutionally obtained. All the respondents were able to explain these two concepts adequately. In the study decided cases and case laws have proved to illustrate the fact that DNA evidence has assisted in the conviction of perpetrators of DNA related crimes, thus illustrating the point that DNA can be effectively used as an investigation tool.

4.3.9 Forms of evidence

From the literature, it was discovered that there are different forms of evidence that can be found at a crime scene, namely:

- Impressions – including fingerprints, tool marks, footwear, fabric impressions, tyre marks and bite marks.
- Forensic biology – including blood, semen, body fluids, hair, nail scrapings and bloodstain patterns.
- Trace evidence – including gunshot residue, arson accelerant, paint, glass and fibres.
- Firearms – including weapons, gunpowder patterns, casings, projectiles, fragments, pellets, wadding and cartridges.
- Questioned documents – including forged documents, disputed contracts, and fake signature documents.

The participants could not name the four forms of evidence. They need to be enlightened on all four forms of evidence.

4.4 RECOMMENDATIONS

The researcher recommends the following aspects which will assist investigators to successfully understand the use of DNA as an investigative tool. An on-going training programme that incorporates the following concepts into the current training curricula:

- Objectives of criminal investigation
- Identification
- Individualisation
- Training in preservation of DNA evidence at a crime scene
- Evidence
- Relevance and admissibility of DNA evidence
- Forms of evidence

Owing to the lack of available literature which specifically deals with this topic, the researcher recommends that further research be conducted on the following:

- Collection, preservation and processing of DNA for evidence
- Admissibility of DNA evidence in criminal proceedings

4.5 CONCLUSION

During the research, many concepts were defined, many suggestions made and many opinions analysed. This was carried out in order to gain a better understanding of DNA and to achieve the research aim – which was to illustrate the importance of DNA as an investigative tool. In Chapter 2, the researcher presented a detailed discussion on DNA. This discussion provided the background needed for dealing with the concepts discussed in Chapter 3, which dealt with aspects of the concept of DNA as an investigative tool.

The researcher has empowered himself with the knowledge gained from this research. He anticipates that this research will provide investigators with a deeper understanding and knowledge, so that they can perform their duties more effectively when it comes to DNA-related cases and investigation.

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Umlazi CAS 348/12/97

Wonderboompoort CAS 15/01/99: FSL LAB No 347/99

Yeoville CAS 30/01/97

ANNEXURE A

INTERVIEW SCHEDULE

TOPIC: The importance of DNA as an investigation tool

My name is Udesh Maharaj. I am employed as a forensic investigator by the Special Investigating Unit (SIU). I am conducting research towards my dissertation in MTech: Forensic Investigation, at Unisa. My topic is: "**The importance of DNA as an investigation tool**".

You are being requested to participate in an interview regarding this study. The reason for interviewing you is because of your field being in investigations and having to gather evidence in support of your investigations. The aim of the research is to establish the importance of DNA as an investigation tool.

The purpose of this research is as follows:

- The researcher wants to evaluate the existing procedures that investigators use when identifying and collecting DNA evidence at a crime scene, with the intention of determining their strengths and weaknesses and considering how these procedures can be improved.
- Secondly, the researcher wants to explore how investigators, internationally, process DNA at a crime scene. To accomplish this, the researcher will read extensively in an attempt to explore the field.
- The researcher wants to apply the new knowledge of international practice to develop good practice in South Africa. This will be done by recommending new procedures to enhance performance and to improve the conviction rate in court cases.
- The researcher wants to empower himself and other investigators with the new information. The researcher intends to give lectures, write an article, and make the information available for training.

If you agree to participate, you will be asked questions based on the above topic, and your answers will be recorded in writing. Your participation is voluntary. If at any time during the study you wish to withdraw your participation, you are free to do so, without prejudice. You are free to ask any questions prior to or

during the interview. The interview should take about 30 minutes. You will not incur any cost as a result of your participation in this research. The participants' rights to privacy will be protected. Anonymity and confidentiality are the inherent right of all the participants, and is both respected and maintained.

The participants will be afforded the right to full disclosure about the research (Babbie & Mouton, 2001:238–246). No participant will be subjected to any form of harm. The right to decide whether to remain anonymous or not, lies with you, the participant. The researcher intends to publish his findings in a complete and honest manner (Leedy & Ormrod, 2001:107–108).

Participant's name: _____

Participant's signature: _____ Date: _____

Researcher's signature: _____ Date: _____

A) HISTORICAL INFORMATION

1. In which organisation are you employed?
2. What is your position in the organisation?
3. How many years' service do you have in the organisation?
4. Give details of the investigation experience you possess?
5. What courses have you successfully completed pertaining to investigation?
6. Have you investigated criminal cases which involved DNA evidence?
7. If you answered 'yes' to question 6, please indicate how many DNA cases you have investigated.

Number of DNA related cases investigated – select one of the following:	**Number of successes you have had in cases where DNA played a vital role in the conviction of the accused? Select one of the following**
01–10	01–10
11–20	11–20
21–30	21–30
31–40	31–40
41–60+	41–60+

B) DNA

1. What are the objectives of criminal investigation?
2. What does the term ‘identification’ mean?
3. What are the different categories of identification?
4. What does ‘individualisation’ mean?
5. What do you understand by the term ‘DNA’?
6. How could DNA be used to assist as an aid in law enforcement?
7. How would you define a ‘crime scene’?
8. Why do you think that every detective should receive the same training as the members of FSL, in the preservation of a crime scene?

C) DNA AS AN INVESTIGATIVE TOOL

1. What is evidence?
2. What is the relevance of DNA evidence in a criminal investigation?
3. What are the requirements for DNA evidence to be admissible in court?
4. How can DNA assist in a criminal case when such a case is before a court of law?
5. List four forms of evidence found at a crime scene.
6. What is physical evidence?
7. What training did you receive in the collection of DNA evidence on any course or training programme?
8. What does ‘chain of evidence’ mean?
9. Could DNA be used as an investigative tool in South Africa?

G.P.S 002-0222 SAP 21

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The Provincial Commissioner
Die Provinsiale Kommissaris
KwaZulu-Natal

2007-09-20

Mr. U Maharaj
P. O. Box 8212
Cumberwood
3235

PERMISSION TO CONDUCT RESEARCH: TOPIC: THE IMPORTANCE OF DNA AS AN INVESTIGATION TOOL: M-TECH , UNISA: STUDENT: MR U MAHARAJ

1. Your request to conduct research in respect of the above mentioned topic is herewith approved. See also attached National Head Office letter reference 3/34/2 dated 2007/08/31 in this regard.

2. Approval is however subjected to the agreement and signing of the attachment annexure marked **"AGREEMENT TO RESEARCH CONDITIONS"**

3. Thank you.

PROVINCIAL COMMISSIONER: KWAZULU - NATAL
M HLNGIDI