DNA ALSO SPELLS "DAN"… (AND "AND")

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DNA EVIDENCE FOR PROSECUTORS

- What is DNA?
- History of Serology / DNA
- DNA Foundations
- Preparing for Trial
- Use of DNA Evidence at Trial
- CODIS
- Defense Issues

FORENSIC DNA TESTING

Forensic DNA testing is designed to highlight the differences in each person's genetic material in order to determine whether an unknown physical sample could have originated from a known person.

3 STEPS OF FORENSIC DNA TESTING

1. Analyst develops DNA profiles from unknown samples at crime scene.
2. Analyst then compares the DNA of the known person(s) and the unknown sample(s) to determine whether or not they are alike. As the # of traits increases, the less likely it is that the combination of traits will appear in more than one given person. Goal = a match.
3. Next step is to put the analyst's findings into context. Goal = really, really high number (the likelihood of a match is 1 in 14 quintillion).

WHAT DNA CANNOT TELL US

- Who committed the crime.
- When the crime was committed or more specifically when the DNA was deposited at that location or on a particular object.
- How the crime was committed – mens rea or whether a defense to the crime exists.

CSI: REAL LIFE

- The Lab can detect minute amounts of DNA.

Approximately
1 nanogram
[one billionth of a gram]

DNA CAN BE RECOVERED FROM MANY THINGS

SOURCES OF DNA

- Blood
- Semen
- Saliva
- Perspiration
- Bones and Teeth
- Hair root
- Tissue / skin cells
- Urine, Fecal material, Vomit

WHOSE DNA?

- A direct sample from anyone who may have contributed DNA material is critical.
- Includes victim, suspect, consensual partner(s), elimination sources (ex., owner of vehicle, business employees).
- Reference samples are necessary for DNA comparison.
- Exception – CODIS entry. However, a reference sample will be needed ultimately for comparison.

REFERENCE COLLECTION

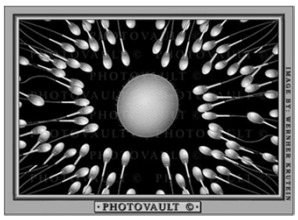
- Liquid blood samples
  - Purple top blood tubes contain the best preservative
- Buccal (Saliva) samples
  - Collected by rubbing the inside of an individual's cheek with a "Q-tip"
- Alternate known samples
  - Items of established origin such as toothbrushes, combs, etc.

A WORD ABOUT NOTICES OF CONSUMPTION

- Not explicitly required by law, but a good practice.
- Have been used so long in Marion County they are considered the norm, if not an actual requirement.
- Gives the defense advance notice that all DNA from that swab/source will be consumed in the testing process.
- We give them 10 days to file a response that they wish to have a defense expert present, otherwise we will proceed with testing.

DNA IS INHERITED

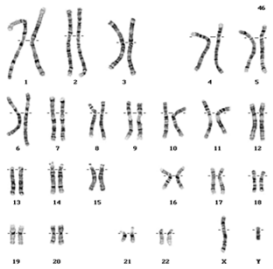
Everyone inherits one copy of DNA from their mother & one from their father



WHAT IS DNA?

- The genetic material that exists in the cells of every living organism.
- DNA is a double stranded molecule shaped like a long twisted ladder.
- Each rung of ladder is made up of 2 bases referred to as a base pair.
- One copy from mother; one from father.
- DNA testing focuses on the areas in human DNA where there is sufficient variation to allow an analyst to develop a unique profile.

DNA CHROMOSOMES



- Human cells contain 46 chromosomes in 23 pairs
- One of these pairs identifies the sex chromosome, X and Y

TYPES OF DNA TESTING

1. DNA from Nucleus of Cell (Nuclear DNA):

- Each cell with a nucleus contains a copy of a person's DNA.
- DNA strand is a double helix (a staircase or ladder).
- Sides of strand are chains of sugars and phosphates.
- Steps of staircase or rungs of ladder are pairs of molecules called "bases."

- 4 bases in the DNA strand
  - A, C, G, T
  - Only C and G bond
  - Only A and T bond
- The human genome is comprised of 3 billion of these base pairs.
- The 3 billion base pairs are grouped in 23 pairs of chromosomes – one from mother and one from father for a total of 46 chromosomes.
- Specific sequences of bases that code for a particular characteristic are called genes.

- Examples of genes – hair color, eye color (none of these are used in forensic DNA testing – too common).
- A gene's position on a chromosome is its locus.
- The possible sequences or variations of a gene are called alleles.
- Because everyone inherits 2 sets of chromosomes from each parent, humans have two alleles at each locus.
- When a DNA sample is analyzed, the results are called profiles. You may have a full profile or a partial profile.

LANGUAGE OF DNA PROFILING

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

The following describes a number of terms used in DNA profiling…

The depiction on the left is of a DNA profile developed at 9 STR locations (plus the Amelogenin location which indicates the gender of the profile), recorded in numeric format.

LANGUAGE OF DNA PROFILING

LOCUS

A specific test site on the DNA

(plural = loci)

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

LANGUAGE OF DNA PROFILING

Amelogenin	XX
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D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

ALLELE

Variant form of DNA

A person has two alleles at each locus, one inherited from their mother, and one from their father

LANGUAGE OF DNA PROFILING

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

GENOTYPE

The combination of alleles found at any given locus

LANGUAGE OF DNA PROFILING

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

GENOTYPE

The combination of alleles found at any given locus

Also extends to describe alleles found at all loci tested

LANGUAGE OF DNA PROFILING

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

HETEROZYGOTE

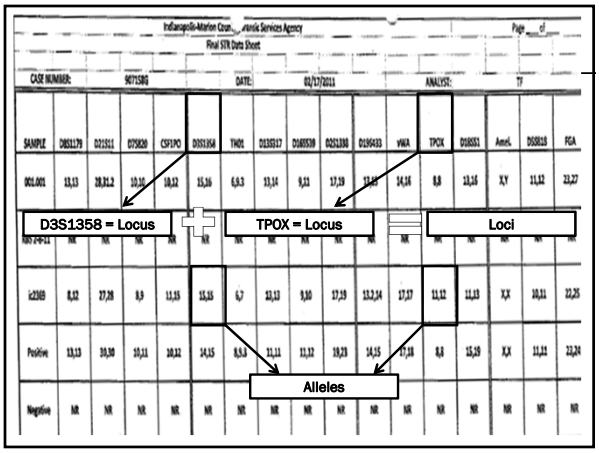
A single-locus genotype with two different alleles

LANGUAGE OF DNA PROFILING

Amelogenin	XX
D3S1358	16, 17
vWA	15, 19
FGA	21, 24
TH01	6, 8
TPOX	8, 11
CSF1PO	9, 12
D5S818	11, 12
D13S317	12, 12
D7S820	8, 11

HOMOZYGOTE

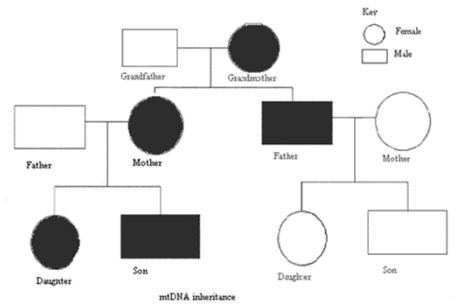
A single-locus genotype with two copies of the same allele



TYPES OF DNA TESTING

2. Mitochondrial DNA Testing (mtDNA):

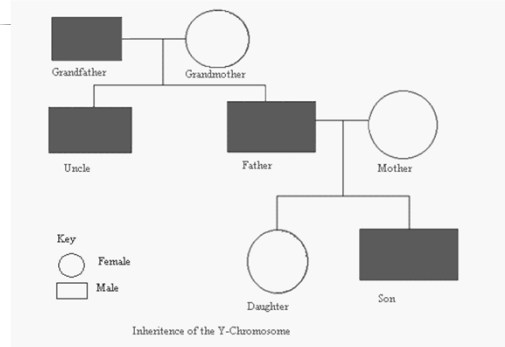
- Instead of DNA from the nucleus of a cell, this DNA comes from the cell's mitochondria. The typical sources for mtDNA are bone and hair.
- Mitochondrial DNA is maternally inherited; that is, mtDNA profiles will be identical for all persons maternally related to the contributor. So under certain circumstances, mtDNA may not be able to eliminate members of the same family.



TYPES OF DNA TESTING

3. Y-STR Testing:

- This type of testing looks at the "Y" chromosome (comes from daddy). It is the opposite of mtDNA in that Y-STR profiles will be identical for all persons paternally related to the contributor. So suspect better be a male.
- Most common for sexual assaults. Or can be used in a major-minor contributor case where the major is female and the minor is male to enhance or highlight the male profile. MCCL lab does not do this testing by request but it is an internal decision based on nature of case and previous results.



HISTORY OF DNA TYPING

- Serological Testing (1920's to 1985)
  - Blood Typing
  - Forensic Protein Profiling
- RFLP (1985-1995)
- DQ-Alpha and PolyMarker (1990-1997)
- PCR/STR (1997 to present)

SEROLOGY

- Serological Testing – Generally
  - Serologic tests are classified as presumptive or confirmatory.
  - A positive presumptive test suggests the presence of a particular body fluid. Due to the possibility of false positive reactions a confirmatory test is highly recommended.
  - The confirmatory test has a higher degree of specificity for the body fluid in question. If you do not have a confirmatory test, you need to find out why: (1) there may be no current available test that can definitively identify that body fluid, (2) your lab may not have validated testing for that fluid, (3) there may be a limited sample size, or (4) lack of resources.

SEROLOGY – PRESUMPTIVE BLOOD

- The common presumptive test for blood is phenolphthalein (Kastle-Meyer or K-M reagent) which cause color changes that indicate the potential presence of blood. These tests are considered presumptive because a number of substances can show a positive reaction – human blood, animal blood, oxidizing agents such as rust and certain plant extracts.
- Luminol is typically used to screen large areas for the presence of blood that is not visibly detectable. In the presence of blood luminol glows in the dark.

SEROLOGY – CONFIRMATORY BLOOD

- Confirmatory tests for the presence of blood include crystal tests and antibody-antigen tests. Crystal tests are specific for hemoglobin, a protein found in blood.
- Blood then can be ABO grouped (A, B, AB, O). 80% of the population is either type A or type O.
- Forensic protein profiling allows for the detection and identification of specific human proteins. This once allowed for slightly better odds than mere blood typing (one in several hundred). Rarely done today because of DNA.

ABO GROUPING

Page 10

LABORATORY EXAMINATION REPORT Date 5-3-90 Case No. 698918-P

RESULTS OF EXAMINATION(S):

Item(s) submitted	Test Results
Item M-16 - Pubic area combings	Seminal fluid detected on hairs and other debris submitted in envelope.
Item 25 - drywall with handprint	Human blood detected. "A", "H" antigen detected. PGM Subtype: No activity detected. EAP: B
Item 31 - Chair	Human blood detected. "B, H" antigens detected. PGM Subtype: 1-1 EAP: B

Conclusion:

The bloodstaining detected on items 8a, 8b (back) ~~8d, 8e, 8f~~, 9, 11, 12, 14, 16, and 6, is consistent with originating from an ABO type O and therefore could have originated from [ ].

"H" blood group substance detected on the vaginal swabs is consistent with an ABO type O and could have originated from [ ].

A,H antigens detected in the bloodstaining on items 8b (right sleeve), 13 (stain) ~~17, 18~~ (scene sample), and ~~25 (wall A~~ piece with handprint) are consistent with originating with ABO type A, however the possibility also exists of a mixture between type A and type O blood. "A" antigen is foreign to [ ] and could not have originated from her.

"A" antigen detected in the bloodstaining on item 13 (stain) is consistent with originating from an ABO type A. "A" antigen is foreign to [ ] and could not have originated from her.

PGM type 2-1 detected from the single hair (6A1) collected from item 6 is different from the PGM type of [ ] demonstrating that this hair did not originate from [ ].

SEROLOGY - SEMEN

- Semen is a mixture of sperm cells (spermatozoa) and seminal fluid. Seminal acid phosphatase (SAP) is an enzyme present in high concentrations in semen and SAP is a presumptive test for semen that causes a color change indicating the potential presence of semen.
- Visual observation of sperm cells under a microscope confirms the presence of semen.
- In DNA testing will break down into sperm fractions and epithelial fractions.

SEROLOGY - OTHER

- Saliva – most common presumptive test involves the detection of alpha-amylase. Currently there is no confirmatory test for the positive identification of saliva.
- Urine – presumptive testing for the presence of urea and/or creatinine (2 substances found in undiluted urine). Currently there is no confirmatory test for the positive identification of urine.
- Epithelial (skin) cells – most forensic labs do not seek to identify the origin of epithelial cells although the microscopic appearance of epithelial cells from different areas of the body can vary. Often referred to as "touch DNA."

EARLY FORENSIC DNA TESTING - RFLP

- Restriction Fragment Length Polymorphism analysis:
  - Uses enzymes to break the long strands of DNA into shorter fragments (restriction fragments) and separates these by length using a process called electrophoresis.
  - 4-6 different loci (each containing a different length polymorphism) are examined. Because the probability of a "matching" pattern at any locus is one in hundreds to one in thousands and because the probability of a match at the various loci are assumed to be statistically independent, the probability of a match at 4 or more loci can be established at 1 in millions.

PROBLEMS WITH RFLP ANALYSIS

- Requires more "significant" amount of substance (about the size of a quarter to a half dollar or scientifically speaking 50-500 ng).
- Not as successful with degraded DNA samples – DNA has to be double-stranded for enzymes to work.
- Non-standardized interpretation guidelines and poor statistical support for assigning weight to the occurrence of a match.
- Time (6-8 weeks as opposed to days).

DQ ALPHA

- Developed for amplifying and typing a sequence polymorphism known as the DQ-Alpha gene. Six distinct alleles of this gene can be identified after amplifying the DNA. This method used PCR (polymerase chain reaction) to "amplify" DNA fragments, producing billions of copies of target fragments of DNA from one or more loci.
- DQ-Alpha is more sensitive than RFLP and allows for more rapid analysis. However, it is a less discriminatory test, detecting only several alleles of a single gene and, therefore, produces lower statistical probabilities.

POLYMARKER

- PolyMarker co-amplified a portion of the DQ-Alpha gene along with five other DNA segments.
- Faster than RFLP and capable of analyzing smaller or degraded samples because used PCR.
- However, while it is a PCR-based test and fairly sensitive, the five additional PolyMarker loci utilizes simple sequence polymorphisms with only two or three alleles possible for each locus.

LIMITATIONS OF EARLY PCR TESTING

- DQ-Alpha and PolyMarker were capable of a power of discrimination in the range of 1 in 10,000 unrelated individuals.
- Not sufficient in differentiating people on a scale large enough to be useful in a national DNA database. They were an improvement over serological testing and over RFLP when dealing with small or degraded samples.
- They were also useful in introducing PCR-based methods into the courtrooms.

PCR

- Polymerase Chain Reaction (PCR) is the most common and current method of analysis.
- PCR is a way to increase the size of a very small or degraded sample of genetic material so that it can be tested.
- PCR is a data reduction tool that looks at only a few discrete regions of DNA (termed STR's)
- Testing method = STR (short tandem repeat).

PCR = A GIGANTIC COPIER

- Polymerase chain reaction based methods provide the capacity to copy and label a specific DNA sequence (or multiple sequences) in order to make that sequence detectable.
- DNA can be either single stranded or double stranded so DNA can be degraded.
- Further can test very small amounts of DNA (0.1 to 1 ng).
- 1-2 days to complete testing.

FACTS ABOUT STRS

- STR = Short Tandem Repeats
- Are not associated with the physical characteristics of an individual.
- The STRs examined are a miniscule fraction of the entire human genome but are at areas that are highly variant.
- STR tests are engineered to give us the most bang for the buck.

STR

- An STR is a DNA locus that contains a certain length polymorphism. At each STR locus, we have 2 alleles that vary in length depending on the number of repetitions of a short core sequence of genetic code. A person with 14, 15 at a locus has one allele with 14 repeating units and another with 15 repeating units.
- In 1997, the FBI identified 13 STR loci that it deemed appropriate for forensic testing.
- Commercial firms developed test kits for automated equipment for typing these STRs. These kits amplify DNA fragments and label the loci with colored dyes.

STR LOCATIONS (THE CODIS "13")

- D3S1358
- vWA
- FGA
- D8S1179
- D21S11
- D18S51
- D5S818
- D13S317
- D7S820
- D16S539
- TH01
- TPOX
- CSF
- (Amelogenin)

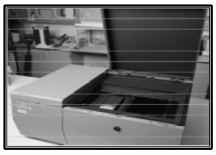
PREPARATION OF DNA CASE

What should I have?

- Laboratory Report(s)
- STR Data Chart(s)
- Electropherograms
- Laboratory Notes
- Understanding of the Statistics

STEPS IN DNA TESTING

- Steps include:
  - Extraction
  - Quantification
  - Amplification
  - Analysis
  - Second reader / administrative review



READING LAB REPORTS

Laboratory Examination Report LAB11-05860 Page 1 of 3

DATE: 01/26/2012 Agency Case #: DP11130180

TO: Indianapolis Metropolitan Police Department

FROM: Tonya Fishburn, Forensic Scientist

EXAMINATION REQUESTED: DNA

MATERIAL SUBMITTED:

Item 003.001.01	Stain card prepared from liquid blood standard of
Item 003.002.01	Sample from vaginal/cervical swab(s)
Item 003.003.01	Sample from external genital swab(s)
Item 003.004.01	Sample from speculum swab(s)
Item 003.008.01	Vaginal wash stain
Item 003.009.01	Sample from dried secretions swab(s) from right ear
Item 003.010.01	Sample from dried secretions swab(s) from left ear
Item 003.011.01	Sample from dried secretions swab(s) from neck
Item 003.012.01	Sample from dried secretions swab(s) from right breast
Item 003.01	
Item 003.01	
Item 003.01	
Item 006.00	
Item 006.00	
Item 006.003	Stain from crotch area of pants
Item 012.001	Sample from penile swab(s)
Item 013.001	Buccal cell standard from
Item 014.001	Buccal cell standard from

DNA analysis was not conducted on items 003.004.01, 003.008.01, 006.002 and 006.003.

RESULTS:

Deoxyribonucleic Acid (DNA) from items 003.001.01, 003.009.01, 003.010.01, 003.011.01, 003.012.01, 003.013.01, 003.016.01, 013.001, 014.001 and the sperm and epithelial fractions of items 003.002.01, 003.003.01, 003.018.01, 006.001 and 012.001 was characterized through the Polymerase Chain Reaction (PCR) at Short Tandem Repeat (STR) genetic loci D8S1179, D21S11, D7S820, CSF1PO, D3S1358, TH01, D13S317, D16S539, D2S1338, D19S433, vWA, TPOX, D18S51, Amelogenin, D5S818 and FGA.

DNA analysis was not conducted on items 003.004.01, 003.008.01, 006.002 and 006.003.

Laboratory Examination Report LAB11-05860 Page 2 of 3

The DNA profile obtained from the epithelial fractions of items 003.002.01, 003.003.01 and 003.018.01 match the DNA profile of 03.001.01. An additional contributor at genetic locus D8S1179 in the epithelial fraction of item 003.003.01 is inconclusive.

The DNA profile obtained from the sperm fraction of item 003.002.01 is a mixture with major and minor contributors. T A profile of (003.001.01). clusive. Results are inconclusive about the (014.001).

The partial DNA profi atches the DNA profile of (014 al at random from the population having the same partial DNA profile matching the sperm fraction of item 003.003.01 is approximately 1 in 157 million in Caucasians, 1 in 290 million in African Americans and 1 in 389 million in Hispanics.

The DNA profiles obtained from the sperm fractions of items 006.001 and 012.001 and the partial DNA profile obtained from the sperm fraction of item 003.018.01 match the DNA profile of (014.001). In the absence of an identical twin (014.001) is the source of the DNA profile obtained from the sperm fraction s obtained from the sperm fraction of item 003.018.01 to a r

The DNA profile obtained from t ixture with major and minor contributors. The DNA pr NA profile of (003.001.01). The partial es the DNA profile of (014.001). In the (014.001) is the source of the minor partial DNA profile obtained from the epithelial fraction of item 006.001 to a reasonable degree of scientific certainty.

The DNA profile obtained from the epithelial fraction of item 012.001 is a mixture with major and minor contributors. The DNA profile of the major contributor matches the DNA profile of (014.001). The DNA profile of the minor contributor matches the DNA profile of (003.001.01). In the absence of an identical twin, Heather Barker (003.001.01) is the source of the minor DNA profile obtained from item the epithelial fraction of item 012.001 to a reasonable degree of scientific certainty.

No DNA profiles were obtained from items 003.009.01, 003.010.01, 003.011.01, 003.012.01 and 003.013.01.

No interpretable DNA profile was obtained from item 003.016.01. 018.01, the m fractions of and could not

(013.001) can be eliminated as being a contributor to the mixed DNA profiles obtained from the sperm fraction of item 003.002.01 and the epithelial fractions of items 006.001 and 012.001.

MIXED SAMPLES

- A sample with DNA from more than one individual present
- Distinguishable Mixtures
  - Contain alleles of distinct contrast in height/intensity
  - Distinct alleles can be attributed to a specific individual
- Indistinguishable Mixtures

Laboratory Examination Report LAB11-05860 Page 1 of 2

DATE: 09/11/2012 Agency Case #: DP11130180

TO: Indianapolis Metropolitan Police Department
FROM: Tonya Fishburn, Forensic Scientist
EXAMINATION REQUESTED: Supplemental DNA Report

MATERIAL SUBMITTED:

Item 076.001.01.01.01	DP11130376	One swab taken from item 076.001.01 (cell phone battery)
Item 076.001.02.01	DP11130376	One swab taken from item 076.001 (cell phone)
Item 076.002.01.01	DP11130376	One swab taken from item 076.002 (driver's license)

The DNA profile obtained from item 076.001.01.01.01 is a mixture with major and minor contributors.

DNA (Deoxyribonucleic Acid) was characterized using the Polymerase Chain reaction (PCR) and the AmpFlSTR Identifiler amplification kit. Amplification was performed at genetic loci D8S1179, D21S11, D7S820, CSF1PO, D3S1358, TH01, D13S317, D16S539, D2S1338, D19S433, vWA, TPOX, D18S51, D5S818, FGA and Amelogenin.

CONCLUSIONS:

The DNA profile obtained from item 076.001.01.01.01 is a mixture with major and minor contributors. The DNA profile of the major contributor matches the DNA profile of Heather Barker (003.001.01). In the absence of an identical twin, [redacted] (003.001.01) is the source of the major DNA profile obtained from item 076.001.01.01.01 to a reasonable degree of scientific certainty. The partial DNA profile of the minor contributor obtained at genetic loci D8S1179, D19S433 and vWA matches the DNA profile of [redacted] (014.001). The probability of selecting an unrelated individual at random from the population having the same partial DNA profile matching the minor contributor in item 076.001.01.01.01 is approximately 1 in 625 thousand in Caucasians, 1 in 94 thousand in African Americans and 1 in 203 thousand in Hispanics. [redacted] (013.001) can be eliminated as a contributor to the mixed sample.

The partial DNA profile obtained from item 076.001.02.01 is a mixture with major and minor contributors. The partial DNA profile of the major contributor matches the DNA profile of [redacted] (003.001.01). In the absence of an identical twin, [redacted] (003.001.01) is the source of the major DNA profile obtained from item 076.001.02.01 to a reasonable degree of scientific certainty. The partial DNA profile of the minor contributor obtained at genetic loci D8S1179, D19S433, vWA and D5S818 matches the DNA profile of [redacted] (014.001). The probability of selecting an unrelated individual at random from the population having the same partial DNA profile matching the minor

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The partial DNA profile obtained from item 076.003.01.01 is inconclusive. The possibility of a mixture cannot be confirmed.

No interpretable DNA profile was obtained from item 076.002.01.01.

The partial DNA profile obtained from item 076.003.01.01 is inconclusive. The possibility of a mixture cannot be confirmed.

The partial DNA profile obtained from item 076.004.01.01 is a mixture with major and minor contributors. The partial DNA profile of the major contributor matches the DNA profile of [redacted] (003.001.01). In the absence of an identical twin, [redacted] (003.001.01) is the source of the partial major DNA profile obtained from item 076.004.01.01 to a reasonable degree of scientific certainty. [redacted] (014.001) cannot be eliminated as a minor contributor to the mixed sample. The probability of an unrelated individual in the population being a contributor to the mixed partial DNA profile is approximately 1 in 80 million in Caucasians, 1 in 442 million in African Americans and 1 in 306 [illegible] sample b[illegible]

[redacted] (014.001) cannot be eliminated as a minor contributor to the mixed sample.

Portions [illegible]

Please see report issued January 26, 2012 by [redacted] for results of previous examinations.

READING STR DATA CHARTS

STR DATA CHART

SAMPLE	D8S1179	D21S11	D7S820	CSF1PO	D3S1358	TH01	D13S317	D16S539	D2S1338	D19S433	vWA	TPOX	D18S51	Amel	D5S818	FGA
M-1	12,13	30,31	8,10	12,12	16,17	6,6	9,13	11,12	20,25	13,14	17,19	8,10	12,14	X,Y	9,12	23,25
18	13,13	28,31.2	10,10	10,12	15,16	6,9.3	13,14	9,11	17,19	13,15	14,16	8,8	13,16	X,Y	11,12	23,27
D-1-1	14,15	28,29	10,11	10,12	15,16	8,9	12,13	9,11	17,25	11,13	15,19	6,8	16,17	X,Y	8,13	23,24
D-1-2	14,15	28,29	10,11	10,12	15,16	8,9	12,13	9,11	17,25	11,13	15,19	6,8	16,17	X,Y	8,13	23,24
D-1-3	14,15	28,29	10,11	10,12	15,16	8,9	12,13	9,11	17,25	11,13	15,19	6,8	16,17	X,Y	8,13	23,24
ICA65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
09JF RBS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
RBS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
ICA52	14,14	29,29	9,11	12,14	16,16	8,9	9,10	9,12	17,22	13,14	18,18	8,10	12,14	X,X	12,13	21,22
Positive	13,13	30,30	10,11	10,12	14,15	8,9.3	11,11	11,12	19,23	14,15	17,18	8,8	15,19	X,X	11,11	23,24
Negative	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE OF RESULTS

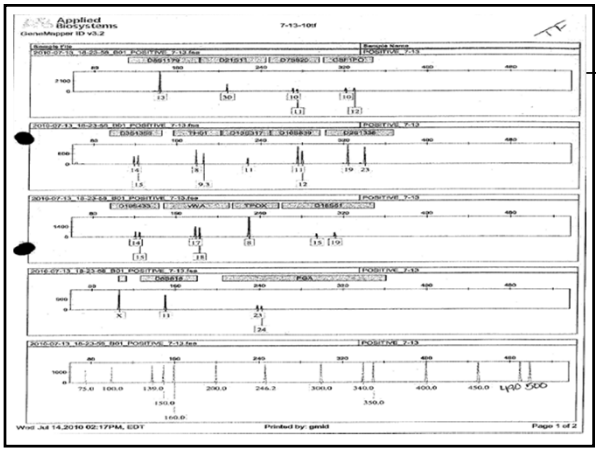
ITEM	DESCRIPTION	D3S1358	vWA	FGA	Amelogenin	D8S 1179	D21S11	D18S51	D5S 818	D13S 317	D7S820
11.1.2	Standard from Maria Espinoza	15,16	16,17	19,24	X,X	12,12	29,30	14,17	11,13	11,13	8,13
12.1.2	Standard from Gado	14,17	16,21	25,29	X,Y	14,14	28,29	17,18	10,11	10,14	10,12
2.1	Wood – display case	15,16	16,17	19,24	X,X	12,12	29,30	14,17	11,13	11,13	8,13
10.1	White T-Shirt	15,16	16,17	19,24	X,X	12,12	29,30	14,17	11,13	11,13	8,13
6.1	Money	15,16<200 14,17	16,21	25,29	X,Y	12 14	28,29	17,18	13<200 10,11	10,14	10,12
4.1.1	Black T-Shirt	15,16	16,17	19,24	X,X	12,12	29, 30	14,17	11,13	11,13	8,13
4.3.1	Grey Underpants	14,17 15,16	15,18 16,17	28<200 19,24	Y X	14 12	28,32.2 29,30	18<200 14,17	10 11,13	10,14 11,13	10<200 8,13

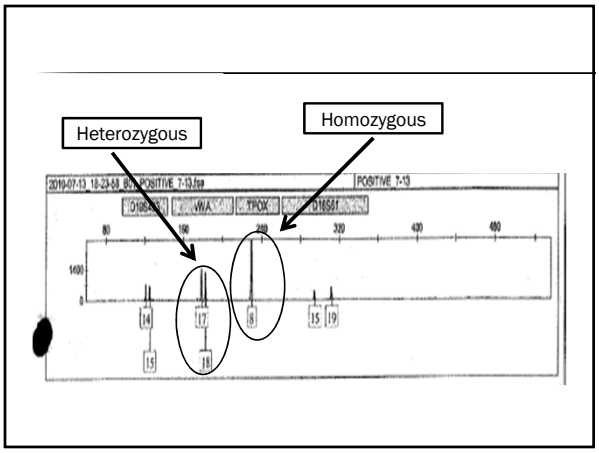
KEY
NA = No Activity
( ) = Weak results for types in parenthesis
> = Greater than
X,Y = Male DNA
< = Less than
[ ] = Alleles in brackets are between 50 and 149 RFU. Because of the low activity of these alleles, it may not be possible to determine all of the genotypes at this locus.

TABLE OF RESULTS

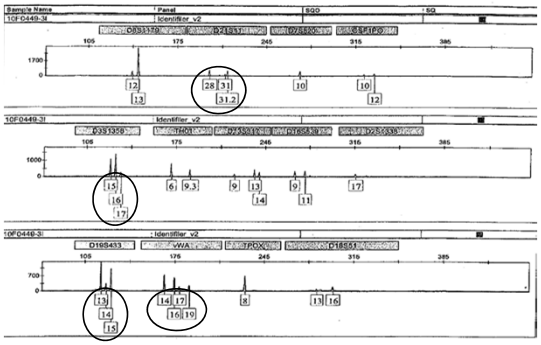
ITEM	DESCRIPTION	D16S 539	THO 1	TPOX	CSF 1PO	CONCLUSION
11.1.2	Standard from Maria Espinoza	11,12	6,7	8,11	11,12	
12.1.2	Standard from Gado	12,12	6,6	8,8	11,12	
2.1	Wood – display case					Matches the DNA profile of Maria Espinoza
10.1	White T-Shirt					Matches the DNA profile of Maria Espinoza
6.1	Money	12,12	6,6	8,8	11,12	Mixture where major contributor matches DNA profile of Nassirou Gado
4.1.1	Black T-Shirt	11,12	6,7	8,11	11,12	Matches the DNA profile of Maria Espinoza to a reasonable degree of scientific certainty
4.3.1	Grey Underpants					Mixture where major contributor matches DNA profile of Maria Espinoza; results are
						inconclusive about contribution by Gado

ELECTROPHEROGRAMS

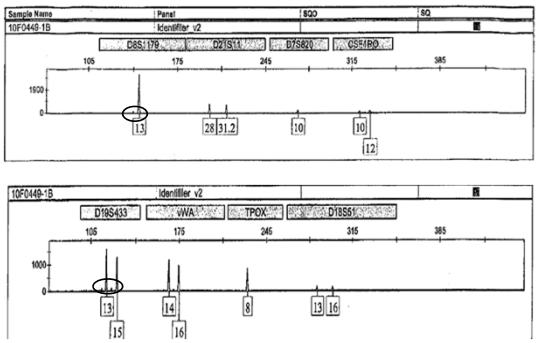




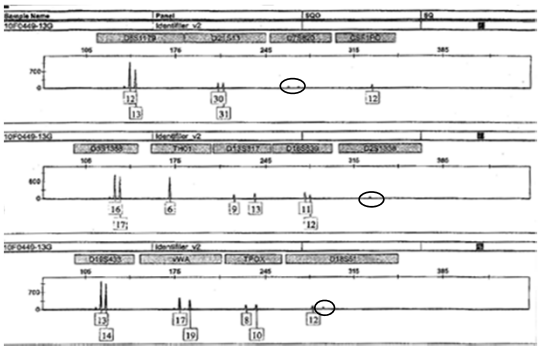
MIXTURES



STUTTER



ALLELIC DROPOUT



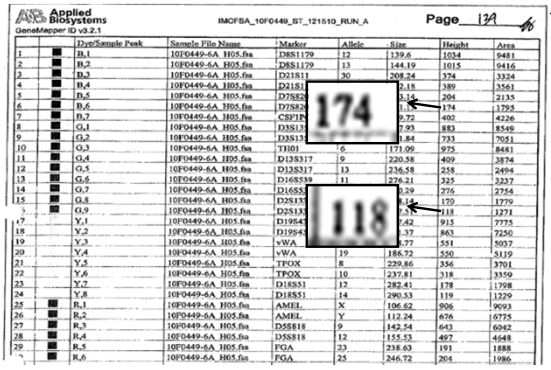
RFU PEAK DETECTION THRESHOLD

- Data produced in the capillary electrophoresis instrument contains baseline "noise" which is reflected on the electropherograms.
- Peak detection thresholds are set below which any data is considered unreliable – to differentiate true PCR product from instrument noise. One example of a common peak detection threshold is 50 RFUs.
- This minimum threshold (so that noise is discounted) is commonly referred to as the peak detection threshold or the analytical threshold.
- To make matters more confusing, however, this is also often referred to as the Peak Amplitude Threshold or PAT.

RFU STOCHASTIC THRESHOLD

- The second threshold used is referred to as the stochastic or match interpretation threshold (MIT).
- The stochastic threshold or MIT is used for match purposes – in other words, the peak height must meet or exceed the stochastic threshold to be counted for match purposes.
- If the peak height is below the stochastic threshold, then there is a probability that the second allele in a truly heterozygous sample has dropped out. If all observed peaks are above the interpretation or stochastic threshold, then there is confidence that all amplified alleles are being detected.

STOCHASTIC OR RFU THRESHOLDS


Applied Biosystems
GeneMapper ID v3.2.1
IMCFSA_10F0449_ST_121510_RUN_A
Page 139

		Dye/Sample Peak	Sample File Name	Marker	Allele	Size	Height	Area
1	■	B,1	10F0449-6A_H05.fsa	D8S1179	12	139.6	1034	9481
2	■	B,2	10F0449-6A_H05.fsa	D8S1179	13	144.19	1015	9416
3	■	B,3	10F0449-6A_H05.fsa	D21S11	30	208.24	374	3324
4	■	B,4	10F0449-6A_H05.fsa	D21S1		2.18	389	3561
5	■	B,5	10F0449-6A_H05.fsa	D7S82		3.14	204	2135
6	■	B,6	10F0449-6A_H05.fsa	D7S82		3.8	174	1795
7	■	B,7	10F0449-6A_H05.fsa	CSF1P		9.72	492	4226
8	■	G,1	10F0449-6A_H05.fsa	D3S13		7.93	883	8549
9	■	G,2	10F0449-6A_H05.fsa	D3S13		1.84	733	7051
10	■	G,3	10F0449-6A_H05.fsa	TH01	6	171.09	975	8481
11	■	G,4	10F0449-6A_H05.fsa	D13S317	9	220.58	409	3874
12	■	G,5	10F0449-6A_H05.fsa	D13S317	13	236.58	258	2494
13	■	G,6	10F0449-6A_H05.fsa	D16S539	11	276.21	325	3237
14	■	G,7	10F0449-6A_H05.fsa	D16S5		9.29	276	2754
15	■	G,8	10F0449-6A_H05.fsa	D2S13		8.14	170	1779
16	■	G,9	10F0449-6A_H05.fsa	D2S13		7.38	118	1271
17		Y,1	10F0449-6A_H05.fsa	D19S4		7.42	915	7775
18		Y,2	10F0449-6A_H05.fsa	D19S4		7.37	863	7250
19		Y,3	10F0449-6A_H05.fsa	vWA		6.77	551	5057
20		Y,4	10F0449-6A_H05.fsa	vWA	19	186.72	550	5119
21		Y,5	10F0449-6A_H05.fsa	TPOX	8	229.86	356	3701
22		Y,6	10F0449-6A_H05.fsa	TPOX	10	237.81	318	3359
23		Y,7	10F0449-6A_H05.fsa	D18S51	12	282.41	178	1798
24		Y,8	10F0449-6A_H05.fsa	D18S51	14	290.53	119	1229
25	■	R,1	10F0449-6A_H05.fsa	AMEL	X	106.62	906	9093
26	■	R,2	10F0449-6A_H05.fsa	AMEL	Y	112.24	676	6775
27	■	R,3	10F0449-6A_H05.fsa	D5S818	9	142.54	643	6042
28	■	R,4	10F0449-6A_H05.fsa	D5S818	12	155.53	497	4648
29	■	R,5	10F0449-6A_H05.fsa	FGA	23	238.63	191	1888
30	■	R,6	10F0449-6A_H05.fsa	FGA	25	246.72	204	1986

INTRODUCTION TO ADMISSIBILITY

Schmerber v. California, 384 U.S. 757; 86 S.Ct. 1826; 16 L.Ed.2d 908 (1966):

- The 4th Amendment applies to removing material from a suspect's body.
- The extent of the intrusion needed to secure the biological sample must be considered. Typically, collecting blood, hair, or swabs will not violate an individual's constitutional rights since the nature of the collection is not substantially invasive.

INTRODUCTION TO ADMISSIBILITY

A person may be "tricked" into giving a DNA sample.

When a person leaves a biological sample on some item in a public place and that item is subsequently seized by law enforcement, there is no invasion of privacy and thus no constitutional right triggered.

California v. Hodari D., 499 U.S. 621, 111 S.Ct. 1547, 113 L.Ed.2d 690 (1991)

CHAIN OF CUSTODY

- Culver v. State, 727 N.E.2d 1062 (Ind. 2000)
- Muex v. State, 800 N.E.2d 249 (Ind.App. 2003)
- Test for Chain of Custody:

An exhibit is admissible if the evidence regarding its chain of custody strongly suggests the whereabouts of the evidence at all times. The State need only give reasonable assurances that the property passed through various hands in an undisturbed condition. The presence of the sealed container in an unaltered condition gives us reasonable assurance….

FROM CULVER V. STATE

- State need not establish a perfect chain of custody; gaps go to weight, not admissibility.
- In this case, State called the person who collected the evidence and the DNA examiner, but not the deliverer to the lab or the receiving clerk. Testimony was heard as to sealing and marking; no indication of tampering.
- Held: there is a presumption of regularity and of due care in the handling of exhibits by public officers and the State established a continuous chain of custody.

CHECKLIST FOR CHAIN OF CUSTODY

- Officer/crime lab person who collected, packaged, and placed item(s) from the crime scene into the property room.
- Serologist who took the item(s) and tested for substance and the cuttings/swabs they took from the item(s) placed into the property room.
- DNA analyst who finally tested the item(s).
- Person who obtained victim standards from autopsy or hospital and took to property room.
- Person who took standard from suspect(s).

FOUNDATIONAL QUESTIONS - EXPERTS

IRE 702

(a) If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

(b) Expert scientific testimony is admissible only if the court is satisfied that the scientific principles upon which the expert testimony rests are reliable.

CONFRONTATION: MELENDEZ-DIAZ (2009)

- Held that the prosecution violated the Confrontation Clause when it introduced forensic laboratory reports into evidence without affording the accused an opportunity to be confronted with the analysts at trial. Using the *Crawford* analysis, the SCOTUS held that the reports were testimonial.
- "A defendant has a constitutional right to confront at the very least the analyst that actually conducts the tests" and there is "no substitute for a jury's first-hand observations of the analyst that performs a given procedure."
- Other state supreme courts and federal courts of appeals have held that the Confrontation Clause prohibits such "surrogate" forensic testimony.

CONFRONTATION: BULLCOMING (2011)

- DWI trial in which the analyst was unavailable (*post-Crawford*, but pre- the *Melendez-Diaz* decision). The State called another analyst to validate the report. The analyst called was familiar with the testing device used in the case and with the laboratory's testing procedures, but had neither participated in nor observed the test on Bullcoming's blood sample
- Held the Confrontation Clause does not permit the prosecution to introduce a forensic laboratory report, made in order to prove a fact at trial, through the in-court testimony of an analyst who did not sign the certification or personally perform or otherwise observe the performance of the test.

CONFRONTATION: WILLIAMS (2012)

- By a 4-4-1 vote, SCOTUS held that a prosecution expert witness from the Illinois State Police Lab could testify regarding the meaning of an outsourced lab report which resulted in matching a defendant's DNA to that found on a rape victim without introducing the report as evidence. The case came from Chicago where police, investigating a 2000 rape, outsourced part of the DNA testing. The outsourcing agency developed DNA profiles on the victim and suspect from submitted samples and issued a report. An ISP analyst, using the DNA profiles, who had tested the actual evidence pertaining to the case and who had read the outsourced report, testified to a match between the rapist's DNA and a standard collected from victim.

WHO TESTIFIES IN COURT

1. Serologist

   The serologist tests the substance to tell us what it is (blood, semen, saliva, potential epithelial).

2. DNA Analyst

   The DNA analyst tests the substance to try and identify or eliminate a source (is our suspect identified, is our suspect eliminated, is there more than one source of DNA present, etc.)

PREPARATION FOR SEROLOGIST

- What was tested/what wasn't tested.
- Presumptive vs. confirmatory testing.
- Items tested should already be in evidence.
- Have serologist bring with him/her the "coin envelopes" – the what???
- Introduce coin envelopes collectively.
- Prep witness to refer to item #s by what they are.

FOUNDATION FOR SEROLOGIST

- Background questions
  - For serologist
  - For the science
- For Serologist
  - How are you employed
  - Education and training
  - Duties as forensic scientist in serology unit
  - Serologist assigned examination of a # of items in Case #_____
  - What is serology?

FOUNDATION FOR SEROLOGIST

- For Serology
  - How can you identify different types of biological material which may be present on a particular item of evidence?
  - How is the possible biological material separated from an item of evidence, for example possible blood from a shirt?
  - What do you do with it upon removal?
  - What specific tests are then used to identify the nature of the biological material? As a side note prep the serologist to be brief when it comes to describing testing that is used.
  - Were those tests used in your analysis of items in Agency Case #_____?

FOUNDATION FOR SEROLOGIST

- For Serology (cont'd)
  - Are the tests you have identified and which were used in this case, commonly relied upon in the field of serology?
  - Have they been subjected to peer review?
  - Have those tests been deemed to be scientifically reliable?

CHAIN OF CUSTODY FOR SEROLOGIST

- Chain of custody questions
  - Was a request made for testing in this case?
  - How was that request made?
  - Did you receive items for testing?
  - How do you receive items?
  - Were they packaged in a certain manner?
  - Were they sealed?
  - How are items stored at the lab if they have biological evidence such as semen?
  - What is the purpose of frozen storage?
  - How does frozen storage maintain the integrity of the sample?
  - Were all items received by you for analysis properly stored and maintained?

COIN ENVELOPE QUESTIONS

- I'm handing you a # of envelopes marked as State's Exhibits ___ through and including ___
- Please take time and review the envelopes
- Brought them with you to court today
- All sealed and have been in your control
- Initials on the seals
- Are each in the same or substantially similar condition as when you conducted the testing on each item in this case?

USING THE REPORT AT TRIAL

- If introducing the serologist's report
  - After receiving and testing items, did you create a document memorializing findings
  - Dated _____; made at or near time of testing
  - Done to document chain of custody and testing
  - Prepared by you in normal course of business
  - Made, reviewed and signed by you
  - Regular practice to make such a report in every case where you conduct serological testing
  - Would use of report assist you in explaining findings to jury and assist jury in understanding?

QUESTIONING AS TO ITEMS ANALYZED

- Ask about items not analyzed
- Go through each coin envelope
- Remember to reference what the item is, not just the item #
- What was your result?
- Have the serologist explain the result and the basis for it
- After making your evaluations as to the items submitted, do you conduct any further testing with respect to those items?
- When items are identified which may be a source for DNA, what is done with those items?
- In this case were there potential sources of DNA and standards forwarded to DNA for further analysis?

PREPARING FOR DNA ANALYST

- Serologist and DNA analyst may be same person or the duties may be split.
- Items tested and coin envelopes should already be in evidence.
- Continue to refer to item #s by what they are.
- Understand the terminology.
- Decide whether you are going to introduce the report or, without introducing the report, have the analyst testify as to his/her results.

FOUNDATION FOR DNA

- Background questions
  - For the analyst
  - For the science
- For DNA Analyst
  - How are you employed
  - Education and training
  - Specialized training in field of DNA
  - Duties as forensic scientist in DNA unit
  - DNA analyst assigned examination of a # of items in Agency Case #_____

FOUNDATION FOR DNA

- For DNA Science
  - What is DNA?
  - Have you developed a presentation to assist you in explaining DNA to the jury and to assist the jury in understanding the basics of DNA?
  - Show State's Exhibit ___, a DVD and State's Exhibit ____, a printout of the presentation
  - Have you reviewed the DVD and the printout?
  - Are they one and the same?
  - Move to admit and move to publish
  - Ask that the witness be allowed to step down and review the presentation with the jury

EXAMPLE

PURPOSE OF DNA COMPARISON

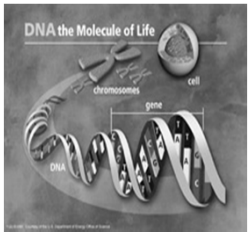
To determine if evidence exists that could link:

- Victim and Suspect
- Victim and Crime Scene
- Suspect and Crime Scene

For Courtroom Purposes

What is DNA?

- Deoxyribonucleic Acid
- The blueprint that tells our body how to develop and function.
- Does not change during our life.
- DNA is the same throughout the body.

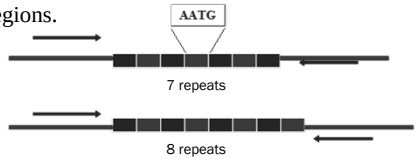


Nuclear DNA

- Found in all cells that have a nucleus
- Packaged into chromosomes
- 23 pairs of chromosomes (46 total)
- 1 copy received from each parent

Short Tandem Repeats (STRs)

- Locations within our DNA where a short sequence is repeated multiple times.
- The number of times the sequence is repeated varies from individual to individual.
- Forensic DNA labs typically look at 13 STR regions.



Developing a DNA Profile

- A DNA profile is a genetic description of a sample based on the repeats (or alleles) at each of the 13 STR regions.
- Four steps involved in developing a DNA profile:
  - Extraction
  - Quantification
  - Amplification
  - Analysis of Results

Extraction

- The DNA is inside the cell.
- The cell is broken open and the DNA is released.
- The non-DNA portion of the cell is removed (cell membrane, proteins).
- The DNA is concentrated into a small volume.

Quantitation

- How much Human DNA is in the sample?
- Necessary to optimize the quantity of DNA for the next step in sample analysis.

Amplification

- Makes millions of copies of the DNA.
- Copy only the 13 STR regions of DNA and gender determining location.
- Amplification allows us to develop a profile from a sample with a very small amount of DNA.

Comparing DNA Profiles

- The DNA profile from evidence items is compared to the DNA profiles from known standards
- Standards are individuals known or believed to be involved in a case (such as victim and suspect)

Possible Results

- Exclusion
  - no match between evidence and standards
- Inclusion (usually accompanied with statistics)
  - match between evidence and standard(s)
- Inconclusive
  - minimal evidence DNA: obtained profile which was unsuitable for comparison to standards
  - insufficient evidence DNA: no profile obtained

FOUNDATION FOR DNA – WHERE WE LEFT OFF

- All items tested were introduced into evidence
- The serologist brought the coin envelopes to trial and they have been marked as exhibits
- The serologist has testified:
  - Coin envelopes were introduced
  - Sources of potential DNA were identified
  - Items were properly packaged and stored for transfer to DNA
  - Chain of custody from serologist to DNA analyst intact

WHERE WE LEFT OFF (CONTINUED)

- We understand the foundational questions needed
- Background questions have been asked:
  - For the analyst
  - For the lab
  - For the science
- Saw a slide presentation that can assist the jury in "understanding" the basics of DNA

DNA FOUNDATIONAL QUESTIONS

- Next review with jury some concepts from the DNA presentation
  - DNA stays the same throughout a person's lifetime
  - Commonly referred to as a "genetic fingerprint"
  - The technology is not new
  - The focus of DNA testing (is also to exclude)
  - Other areas of use for DNA testing besides crimes
  - How DNA is left at the scene of a crime
  - Why DNA might not be left
  - What DNA can tell us
  - What DNA cannot tell us

DNA ANALYSIS ON THIS PARTICULAR CASE

- Were you requested to analyze certain items?
- Were standards submitted?
- Did you use the testing method previously discussed?
- Has this method been empirically tested?
- Has this method been subjected to peer review and publication?
- Has PCR/STR testing gained general acceptance within the scientific community?
- Have you testified previously in court as to this method of DNA testing and the results obtained from such testing?
- Are there standards or controls in place regarding the testing process? Followed in this case?

IF INTRODUCING THE DNA REPORT

- As samples are examined, are there procedures to document the testing as it is completed?
- What are those procedures?
- Are these documents made at or near the time of the testing in a case?
- At the conclusion of the testing are those documents maintained as part of the entire case file?
- At the conclusion of the testing is a lab report and data chart generated by you that memorializes all of your findings with respect to all items tested in this case?
- Were those reports made by you?
- Are the reports kept at the lab in the regular course of business?
- Would use of these reports assist you in explaining your findings to the jury?
- Admit and move to publish with copies for jurors

EXPLAINING FINDINGS TO JURY

- Whether using the report or not, I find it helpful to group items for explanation to the jury.
- Discuss standards first
- Then group either by item, location, or by result
- If by result:
  - Not tested (with explanation)
  - No DNA or interpretable DNA found
  - DNA results inconclusive
  - Partial DNA profiles with lower statistics
  - Identifiable DNA profiles
  - Your “money shot”, if one

CONCLUDING THE DNA ANALYST'S TESTIMONY

- Remember if using statistics to establish the foundation for the statistics and not only have the analyst state the result but what it means
- After your work was completed, was it viewed by a second DNA analyst?
- Is that standard procedure? Is it required before your findings are issued? Why?
- In this case who reviewed your analysis?
- Did that analyst concur with your findings?

A DNA PROFILE FREQUENCY

- It represents the probability of randomly selecting an individual of a defined relationship who has the same DNA type as that obtained from the evidence.
- Generally if the most common general population profile frequency is ≤ 1 in 6 billion, then the identity statement is issued in the report.

STATISTICAL APPROACHES

- RMP = Random Match Probability
- Question: what is the probability of finding a specific DNA profile in a population at large?

- Answer: RMP = $(locus_1)(locus_2)(locus_3)\ldots(locus_{13})$

STATISTICAL APPROACHES

- Adjusted Probability

- Question: what is the probability of finding a specific DNA profile in a population of a specific size (e.g., a database)?
- Answer: (RMP) x (# of persons in database) = Adjusted Probability

POSSIBLE COMBINATIONS OF ALLELES INTO GENOTYPES

Locus	Alleles	Genotypes	Locus	Alleles	Genotypes
D3S1358	10	55	TPOX	7	28
vWA	10	55	Tho1	7	28
FGA	19	190	CSF1PO	11	66
D8S1179	10	55	D16S539	8	36
D21S11	20	210	D2S1338	11	66
D18S51	15	120	D19S433	8	36
D5S818	10	55			
D13S317	8	36			
D7S820	11	66			

13-LOCUS PROFILE POSSIBILITIES

- Using the chart on the previous slide if we combine the possible genotypes into a 13-locus profile
- Works out to 460 septillion possibilities
- A septillion is a 1 followed by 24 zeros
- Million (6), billion (9), trillion (12), quadrillion (15), quintillion (18), sextillion (21)
- There are around 6 billion people on the planet

STATISTICAL TOOLBOX

- Calculations are based on mathematical formulas widely-accepted in all scientific fields
- Referred to as the "Product Rule"
- Databases tell us how often a given allele occurs in a population

PRODUCT RULE

- Each DNA type for a test is independent of the next, so their probabilities may be multiplied together

- Example – the flip of a coin. The second toss is not impacted by the first toss – they are independent events. Probability of heads on one toss = ½. Probability on 2 tosses = ½ x ½ = ¼. If you did this 13x – $(½)^{13}$ = .00012 or 1/8192

CSI: CODIS

- The Combined DNA Indexing System (CODIS) can associate DNA profiles from crime scenes and convicted offenders.

NDIS/CODIS

- NDIS is the National DNA Index System which manages nationwide information in a single repository maintained by the FBI.
- CODIS is the "Combined DNA Index System" which is the software that runs the U.S. national DNA database and connects the labs housing DNA data at the local, state, and national levels.
- There are also state databases (SDIS) and local databases (LDIS).

NDIS/CODIS

- NDIS was launched in October 1998. Today all 50 states participate as well as the FBI Laboratory, US Army Crime Lab, BATF, and Puerto Rico.
- CODIS loci: an established set of 13 STR's required for inclusion of a DNA profile at the national level in CODIS.
- Cold hit: a match made between a crime scene DNA profile and a DNA profile found on a DNA database in the absence of any prior investigative leads.

CODIS – WHAT WE NEED TO KNOW

- CODIS is a presumptive test maintained by ISP.
- What can be discussed in court is limited but there are reasons why it is relevant to discuss it in some context. Atteberry v. State, 911 N.E.2d 601 (Ind.App. 2009) (defendant's DNA was located in a "national database" which led police to him in St. Louis, MO 20+ years later).
- Must have a confirmatory test done by a lab.

HOT OFF THE PRESS! (PART 1)

- Maryland v. King (SCOTUS – decided 6/3/13 – a 5-4 opinion)
- Defendant arrested in 2009 for first and second assault charges. When processed on the arrest, booking personnel used a cheek swab to take a DNA sample. The swab was matched to an unsolved 2003 rape. King moved to suppress arguing the taking of the swab violated the 4th Amendment.
- Held: when officers make an arrest supported by PC to hold for a serious offense, taking and analyzing a cheek swab is like fingerprinting and photographing and is reasonable under the 4th A.

HOT OFF THE PRESS! (PART 2)

- *Speers v. State*, _____ N.E.2d ____ (Ind.App. Decided June 6, 2013)
- Defendant arrested for burglary. A lab tech transferred suspected blood from glass slides to cloths to facilitate DNA testing. The lab tech was not called at trial. The DNA analysis, who was called at trial, testified that the blood on the cloths matched that of the defendant. The defendant argued that the DNA results were erroneously admitted based on the *Williams* case (SCOTUS).
- Held: Ct. of Appeals relied on *Pendergrass*, 913 N.E.2d 705 (Ind. 2009) and held that there was no 6th or 14th A. violations. The lab tech was deemed more of a chain of custody witness and calling her was discretionary with the State.

DEFENSE ISSUES

- The NAS Report
- Errors and Fraud
- Collection
- Packaging and Storage
- Credentials of the DNA Analyst and/or the Lab
- Method of Statistical Evaluation
- Confusion of LCN with "Touch DNA"

THE NAS REPORT (2009)

- A 300+ page report outlining perceived shortcomings in the various fields of forensic science.
- While DNA fares better than other fields such as latent prints, firearms/ballistics, handwriting analysis, hair and fiber comparison, tool marks, etc. certain issues are referenced which can give defense counsel areas for cross-examination of your analyst.
- Defense attorneys may attempt to use the NAS Study in an attempt to invalidate results in specific cases. This despite the fact that the NAS Study itself states that it is not to be used for such a purpose.

ERRORS AND FRAUD

- Potential for human error or contamination in collection and testing.
- Interpreting results can be a subjective process.
- Was the analyst aware of law enforcement's theory of the case when administering DNA tests (expectation bias)? Studies suggest that expectation bias may be particularly relevant in mixture cases. Does your lab / analyst have a protocol in place whereby samples of potential DNA are analyzed and profiles developed before standard profiles are developed?
- Did the analyst follow proper procedures?
- Was the evidence "batch tested" and, if so, what are the implications?

COLLECTION

- Was it inside or outside? Rain? Snow? Time elapse?
- Who had access to it before police arrived?
- Did first responding officer touch/move the evidence?
- Who else had access? Was it an area with potentially a large # of unknowns?
- What is the potential for contamination and/or transfer?

PACKAGING AND STORAGE

- Was evidence allowed to air dry before packaging?
- Was it packaged properly (some items require paper, some plastic)?
- Was it stored properly (some items require refrigeration)?
- Did the crime scene technician/collector wear gloves?
- Were items kept separate at all times?

THE ANALYST AND THE LAB

- Know your analyst's credentials and results of proficiency training
- Know the lab's credentials
- Was the test properly documented? If the analyst follows proper procedure he/she documented everything that happened to the piece of evidence while in his/her custody (bench notes)
- Did the DNA analyst consider whether the defendant is related to victim or to another possible suspect? They may share genetic traits in common (especially important in mitochondrial DNA). Does defendant have an identical twin?

STATISTICAL EVALUATION

- Our analysts do the statistical analysis and they are not statisticians
- So they use established databases – what database was used in your case (FBI, ISP, Marion County)?
- Did the analyst use scientifically reliable and accepted standards to calculate the probabilities of a match?
- Did your analyst calculate the statistical probability of a false positive?

A WORD ABOUT OUTSOURCING

- Often perceived as a cost-saving measure.
- Is that lab accredited? By whom?
- Who is bearing the cost of bringing that analyst to testify?
- If their results were confirmed by your lab, you need additional information:
  - Do the accreditation standards differ?
  - Do the RFU thresholds differ?

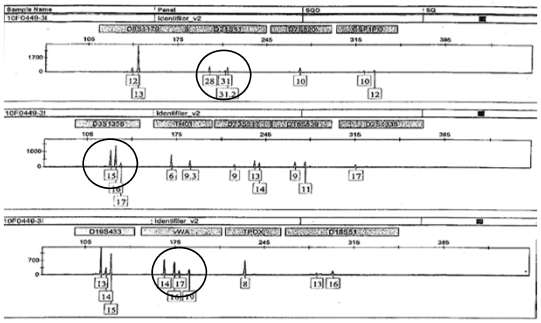
LCN: LOW-COPY NUMBER

- LCN refers to analysis of a small quantity of DNA often by increasing the number of PCR amplification cycles beyond what is commonly accepted by most labs.
- LCN is not the same as low level DNA, "touch" DNA, or degraded DNA although defense counsel may confuse LCN with these terms.
- With low levels of DNA, the analyst can often obtain reliable results without having to boost the PCR cycle number and push the sensitivity of the amplification. This is done by increasing the injection time.

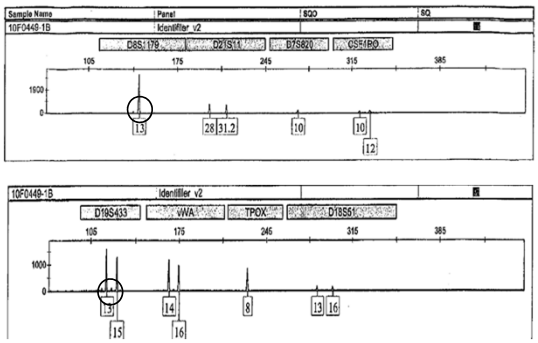
TECHNICAL LAB "ISSUES"

- D***, the defense has actually hired an expert!
  - Misinterpretation of DNA results
  - Technical artifacts
  - Injection cycles

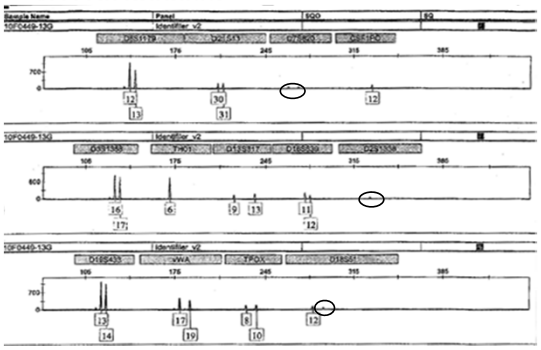
INTERPRETING DNA MIXTURES



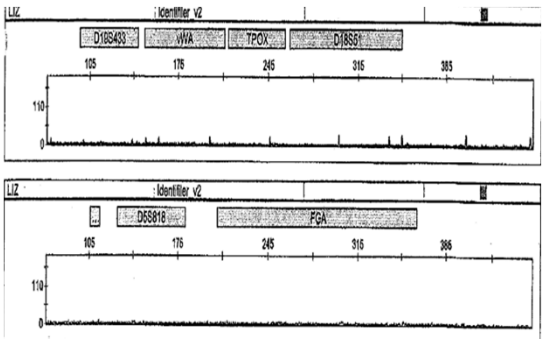
STUTTER



ALLELIC DROPOUT



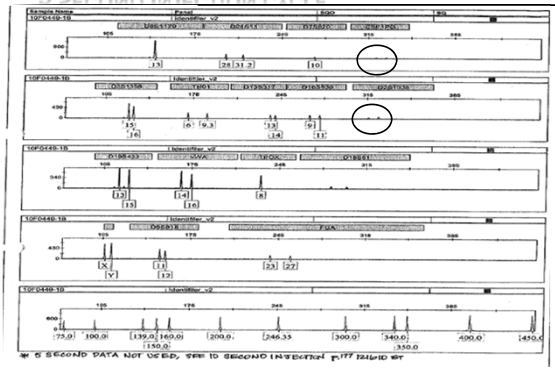
NOISE



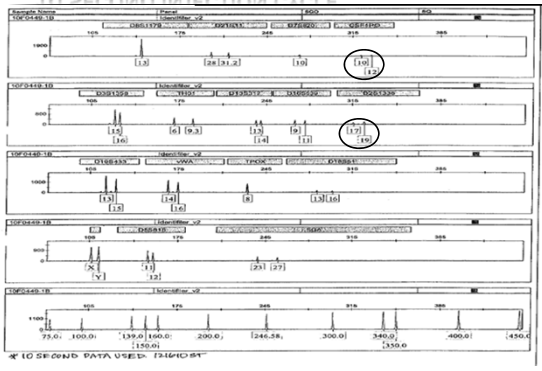
INJECTION CYCLES

- The analyst may run the DNA first at a 5-second injection cycle, then at a 10-second injection cycle.
- This is NOT uncommon.
- However, alleles may be present on the 10-second injection cycle which were not present on the 5-second cycle. The defense may then attack the integrity of the analyst's interpretation of the alleles in the 10-second injection cycle.

5 SECOND INJECTION CYCLE



10 SECOND INJECTION CYCLE



DNA IN THE COURTROOM

- Keep it simple
- Make it vivid
- Understand the science and your data
- Know your audience
- Communicate credibility

WHAT THEY ARE SAYING/NOT SAYING

- They are not saying that _____ is the only person to possess that profile.
- They are saying that they would not expect to find that same DNA profile in a population of *n* individuals. *N* = 6 billion (world population).
- From this they say: "Based on the STR typing results and to a reasonable degree of scientific certainty, _____ is the source of the DNA obtained from Item _____."

USE IN CLOSING ARGUMENT

Match	It's him (with statistics)
Consistent with	It's him (with lesser statistics) or at least it may be him
Cannot be excluded	He's not eliminated
Inconsistent with	It's not him (with explanation)
Excluded	Better have a really good explanation

STATE OF INDIANA	)	IN THE MARION SUPERIOR COURT
	)SS:	CRIMINAL DIVISION, ROOM ____
COUNTY OF MARION	)	
STATE OF INDIANA	)	
	)	
v	)	
	)	
_____	)	CAUSE NUMBER: _____

MOTION TO COMPEL DEFENDANT TO PROVIDE BUCCAL SWAB SAMPLE

The State of Indiana by its Deputy Prosecuting Attorney moves this Court for an Order requiring that _____, defendant in the above-entitled cause, present himself/herself for the taking of a buccal swab sample for the following good and sufficient reasons:

1. The defendant, _____, has been charged with the offenses of _____.
2. As stated in the charging information, the State alleges that on or about _____, 2013, _____ defendant murdered _____.
3. The State incorporates by reference herein the Affidavit for Probable Cause filed in this case.
4. As stated in the Affidavit for Probable Cause filed in this case, the scene and items from the scene were processed, which included the process of swabbing for potential DNA.
5. Known buccal swab samples are needed from the defendant for comparison analysis to be performed with the samples that were recovered from this investigation for comparison and/or elimination purposes.

WHEREFORE, the State of Indiana moves the Court to order production of the defendant's body for obtaining a buccal swab sample from his/her person upon demand of the detective assigned to this case or any other person as designated by the State of Indiana and upon presentation of a signed Order of this Court.

_____
Deputy Prosecuting Attorney

CERTIFICATE OF SERVICE

This is to certify that a copy of the foregoing has been served upon the attorney for the defendant by placing a copy of same in the Public Defender's box in Criminal Court 1 the same date of filing.

_____

Deputy Prosecuting Attorney

STATE OF INDIANA	)	IN THE MARION SUPERIOR COURT
	)SS:	CRIMINAL DIVISION, ROOM ____
COUNTY OF MARION	)	
STATE OF INDIANA	)	
	)	
v	)	
	)	
_____	)	CAUSE NUMBER: _____

ORDER

The State of Indiana having filed its MOTION TO COMPEL DEFENDANT TO PROVIDE BUCCAL SWAB SAMPLE in the proper form and the Court having read and carefully considered same, now finds that said Motion should be GRANTED.

IT IS THEREFORE ORDERED, ADJUDGED and DECREED that defendant, _____, produce himself/herself for the taking of BUCCAL SWAB SAMPLE upon demand of the detective assigned to this case or any other person as designated by the State of Indiana and upon presentation of a signed Order of this Court.

So ordered this _____ day of _____, 2013.

_____
_____, JUDGE
Marion Superior Court
Criminal Division, Room _____

Distribution:

State of Indiana
Attorney for Defendant

STATE OF INDIANA	)	IN THE MARION SUPERIOR COURT
	)SS:	CRIMINAL DIVISION, ROOM _____
COUNTY OF MARION	)	
STATE OF INDIANA	)	CAUSE NO. _____
	)	
v	)	
	)	
_____	)	

NOTICE TO DEFENDANT OF INTENT TO CONSUME

The State of Indiana by its Deputy Prosecuting Attorney, hereby files its Notice to Defendant of Intent to Consume and would show the Court as follows:

1. The prosecution has requested DNA testing of certain evidence recovered in this case. The DNA analyst assigned to this case believes that the following item(s) under DP13-018429 and DP-13-004134 will be consumed during the extraction process of the DNA analysis: Item 10 – one (1) possible DNA swab taken from the outside driver's side door handle; Item 11 – one (1) possible DNA swab taken from the outside passenger side door handle; Item 12 – one (1) possible DNA swab taken from the outside door handle of the rear driver's side; Item 13 - one (1) possible DNA swab taken from the outside door handle of the rear passenger side; Item 14 - one (1) possible DNA swab taken from the inside door handle, gear shift, steering wheel, turn signal and seat belt buckle of the passenger side; Item 15 – one (1) possible DNA swab taken from the inside door handle and seat belt buckle of the passenger side; Item 16 – one (1) possible DNA swab taken from the inside door handle and seat belt buckle of the driver's side rear; Item 17 – one (1) possible DNA swab taken from the inside door handle and seat belt buckle of the passenger side rear; Item 001.001 – one (1) DNA swab taken from the rim of the bottle; Item 007.001 – one (1) DNA swab taken from the rim of the cup; and Item 009.001 – one (1) DNA swab taken from the rim of the bottle.

2. The State hereby informs counsel for the defendant that the Indianapolis Marion County Forensic Services Agency (IMCFSA) will take all reasonable means to preserve evidence.

3. The State hereby requests that the defendant notify the State within ten (10) days of the filing of this motion, whether s/he objects to proceeding with DNA analysis. If the defendant does not notify the State within ten (10) days that s/he objects to this motion the State will notify the IMCFSA (crime lab) to proceed with testing on the above listed items.

Respectfully Submitted,

_____

Deputy Prosecuting Attorney
Marion Co. Prosecutor's Office
251 E. Ohio St., Suite 160
Indianapolis, IN 46204

CERTIFICATE OF SERVICE

I hereby certify that a copy of the above was served upon the attorney for the defendant, on the date of filing as provided in the applicable trial rules.

_____

Deputy Prosecuting Attorney