Challenging the Evidence: DNA

Is this an acceptable procedure?

DNA is considered the gold-standard of forensics testing against which all other forensic science disciplines are now judged. DNA is the result of scientific study of biology, and all DNA identifications have a biological explanation. Laboratories follow well-specified and scientifically accepted procedures, and testing is done in such a way that the occurrence of false positives, or two people sharing the same DNA profile is relatively low, absent intentional fraud or error in testing or mishandling of the samples. Moreover, DNA analysis can make individual-specific identifications with a high level of accuracy; DNA analysis has a low error rate (absent fraud or contamination), and has been subjected to numerous statistical studies.1

Opinion of the NAS Report (2009)

DNA analysis is “the standard against which many other forensic individualization techniques are judged.” DNA’s usefulness as a forensic tool is the “fortuitous by-product of cutting-edge science.”2

Testing methods

Nuclear DNA analysis (more common, more reliable), three types of nuclear DNA analysis are:

- 13 Core Short Tandem Repeat (STR) polymorphisms (loci) analysis. The 13 loci are chosen to reduce the probability of two people sharing the same STR profile.3
- Y STR analysis.4 This test is considered less accurate and “definitive with respect to identifying a single person.”
- Single Nucleotide Polymorphisms (SNP) analysis.5 No public forensic DNA labs in the United States use this method.

Mitochondrial DNA (mtDNA) analysis.6 This method is considered less discriminating than STR testing because mtDNA analysis cannot make individual-specific identifications. (See “Best way to attack” infra).

2 NAS Report, 5:5.
3 NAS Report, 5:3, 5:5.
4 NAS Report, 5:3; Y STR measurements analyze only the male (Y) chromosome. This method is used in sexual assault cases where there is an insufficient amount of male nuclear DNA available.
5 NAS Report, 5:4; SNP measurements allows for DNA measurements to be made when the testing sample is severely damaged.
6 NAS Report, 5:5; mtDNA is particularly useful in analyzing DNA in hairs, bones, and teeth, which do not contain enough nuclear DNA to allow for STR testing. Because mtDNA is passed down by females, all people
Ways to attack DNA evidence

- Attack how the samples were collected and stored because improper handling can lead to contamination.
- If there was an insufficient testing sample and the sample was amplified to allow for STR testing, attack the amplification as a distortion of the evidence. Amplification is uncommon in the United States.\(^7\)
- Attack the qualifications and experience of the tester.
- If mtDNA is tested, attack the results because:
  - no individual-specific identifications are possible with mtDNA,\(^8\) and
  - only one locus on the genome is compared; as a result mtDNA measurements are less discriminating than STR results.\(^9\)
- If Y STR comparisons are the only method of DNA testing, attack the results as less accurate and definitive than the 13 loci STR testing.\(^10\) (See “Testing methods” section supra, and note 4).

Look for these problems\(^11\)

- Errors (called “interpretational ambiguities”) are possible, they can be caused by samples being “inappropriately processed or contaminated.”
- If testers only have a small amount of genetic material available for testing, limited amounts of information can be gathered, which increases the changes of “misinterpretation.”\(^12\)
- In casework reviews of mtDNA testing, the NAS report indicated that there were a “wide range in the quality of testing results that include contamination, inexperience in interpreting mixtures, and differences in how a test is conducted.”

Qualifications to be a forensic DNA analyst

- **Laboratory guidelines:** Laboratories that conduct DNA testing and enter those results into CODIS\(^13\) must be accredited, must follow specific (standardized) procedures, and must have a technical leader who has met additional training and educational requirements.\(^14\)

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\(^7\) NAS Report, 5:4; If an insufficient amount of DNA evidence is available for STR testing, the sample can either be amplified, which is uncommon in the United States, or mtDNA can be analyzed.

\(^8\) NAS Report, 5:4; mtDNA is unable to make individual-specific identifications because all people within several generations with a common female ancestor have the same mtDNA profile; however, “mtDNA testing has forensic value in its ability to include or exclude an individual as its source.”


\(^10\) NAS Report, 5:3-4.


\(^12\) NAS Report, 5:4.

\(^13\) NAS Report, 5:3; The results of a DNA analysis can be “entered into the Federal Bureau of Investigation’s (FBI’s) Combined DNA Indexing System (CODIS) and are searched against DNA profiles already in one of three databases.”

\(^14\) NAS Report, 5:4.
In general, testing personnel must pass proficiency tests, meet specific educational and training requirements, and have at least a Bachelor of Science degree.\textsuperscript{15}

**Washington State Requirements:** Washington State Patrol Crime Lab requires that all levels of forensic scientists have, at a minimum, a Bachelor of Science degree in either forensic science or a natural science.\textsuperscript{16}

- E.G.: Forensic Scientist 1, minimum requirements:
  - Bachelor of Science degree in forensic science or natural science, including:
    - Minimum of 20 semester/30 quarter hours of chemistry, and
    - Minimum 5 semester/8 quarter hours of physics.
  - Desired qualifications:
    - One year full-time paid technical experience in an analytical, research, or crime laboratory; OR
    - Advanced degree in forensic science or natural science.
- For DNA positions: “[A]pplicants must have successfully completed at least one undergraduate or graduate level course in each of the following subjects: biochemistry, genetics, and molecular biology.”\textsuperscript{17}

**A Good Defense Expert**

**Education and Experience**

- A good expert will exceed the minimum requirements of the state in question or the accrediting entity.

**Proper Reporting Procedures**

- A good expert will have published research or articles about her area of expertise in a peer-reviewed scientific journal.

**Follow proper reporting procedures**

- Properly reported evidence will generally include:
  - a description of the evidence (including its method of collection),
  - a listing of the loci measured,
  - a description of the methodology,
  - the results and conclusions of testing, and
  - an interpretive statement about the inferences that can be drawn from the results.\textsuperscript{18}

**Methodology**

- A good expert will have used the scientific method before reaching conclusions, and will use the most accurate testing methods possible.

\textsuperscript{15} NAS Report, 5:4.


\textsuperscript{17} Job listing Forensic Scientist 3 (found on the WSP website.), http://www.wsp.wa.gov/employment/forenreq.htm (last visited June 3, 2011).

\textsuperscript{18} NAS Report, 5:5.
Additional Resources

- Washington State Patrol Crime Laboratory:  
  http://www.wsp.wa.gov/forensics/crimlabs.htm
- U.S. National Library of Medicine (NLM) and Genetics Home Reference:  
- DNA.gov (The DNA initiative: Advancing Criminal Justice Through DNA Technology):  
  http://www.dna.gov/basics/