

DNA: Everything you know you learned from CSI

Anjali R. Swinton, MFS, JD

Director of Outreach

National Clearinghouse for Science, Technology
and the Law



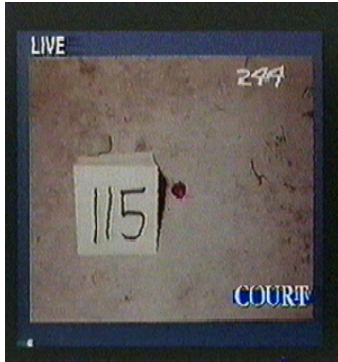
DNA/CSI Quiz

True or false:

- DNA results take 8 minutes
- DNA results can tell investigators what a suspect looks like
- DNA results can determine guilt or innocence
- CSIs are all ridiculously good looking and solve crimes wearing Armani
- All CSI drive Hummers, especially in Florida



Importance of Forensic Evidence



- An extremely strong link between the victim and suspect
- Correct scientific evidence is extremely difficult to dispute by the defense
- It may help not only the immediate case, but other possible connected cases

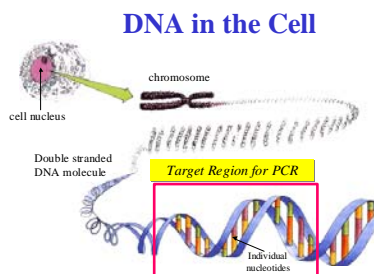
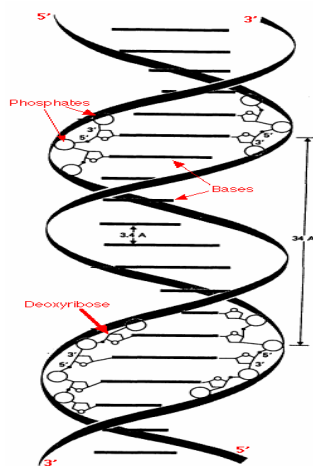
DNA can be found in a variety of places

Sources of Biological Evidence

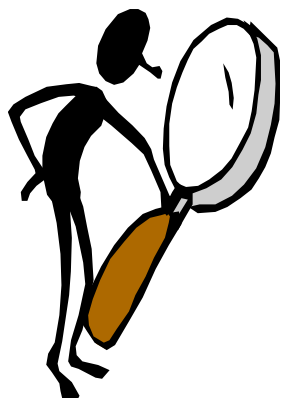
- Blood
- Semen
- Saliva
- Urine
- Hair
- Teeth
- Bone
- Tissue



Structure of DNA



Importance of Proper Collection



- Prevents loss of evidence
- Prevents contamination of the evidence
- Provides documentation to support testimony in a court of law

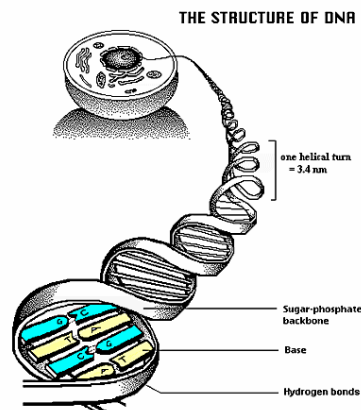
Contamination - Issue or not

- One piece of DNA is copied 3 billion times in the PCR process
- Laboratory analyzes only 2 ng of DNA in PCR reactions
- **Definitely an issue!**



Forensic DNA Analysis

- DNA is an extremely robust chemical molecule
- High degree of probability
 - Statistics of 1 person in 2 quadrillion Forensic databases
 - National comparison of profiles



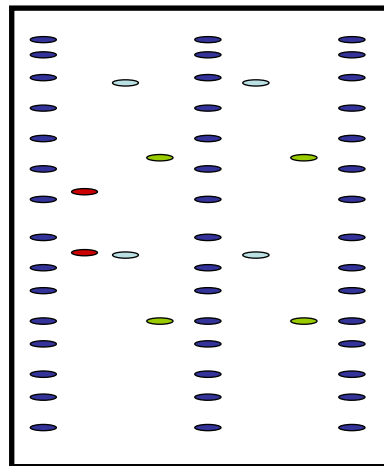
How DNA is used to identify individuals

DNA molecule is ideally suited to forensic typing because of its polymorphic nature (different forms of the same structure, variations of base pair sequences within the DNA molecule)

Variable number of tandem repeats (VNTRs)

Statistical Determination

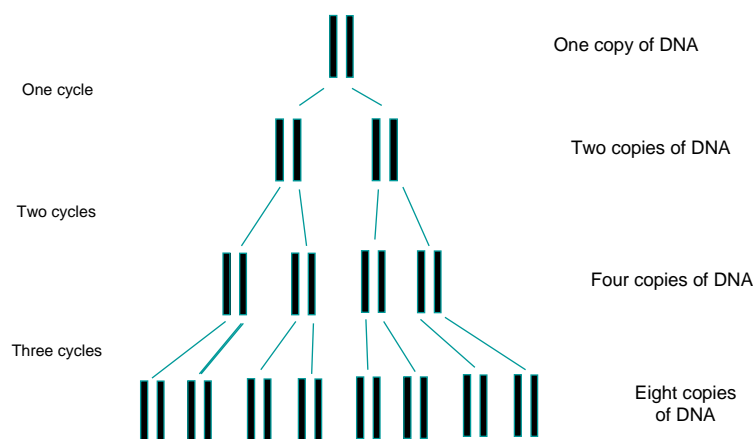
- Match at 1st genetic locus = 1 person/100
- Match at 2nd locus = 1 person/50
- Multiply each together = 1 person/5000
- 5 loci gives statistics of 1 person/5 million



Polymerase Chain Reaction (PCR)

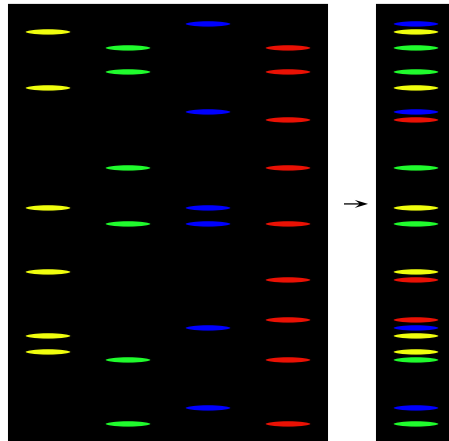
- Allows us to analyze extremely small samples
 - semen from vasectomized males, saliva from bite marks, etc.
- Quicker turn around times on results
- Used on most DNA testing conducted by forensic laboratories
- Limited amount does not mean miracles

Polymerase Chain Reaction (PCR)



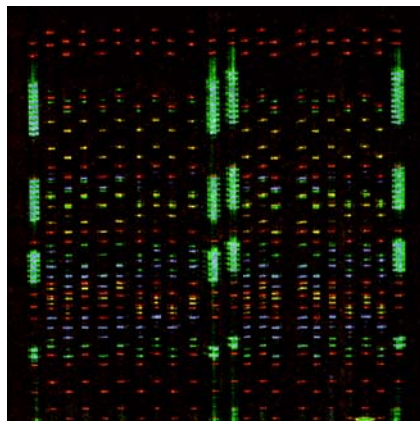
PCR-STR DNA Technique

- Attach to each piece of DNA a different color tag
- Analyze four colors at the same time
- Nine different loci with the degree of discrimination in the quadrillions

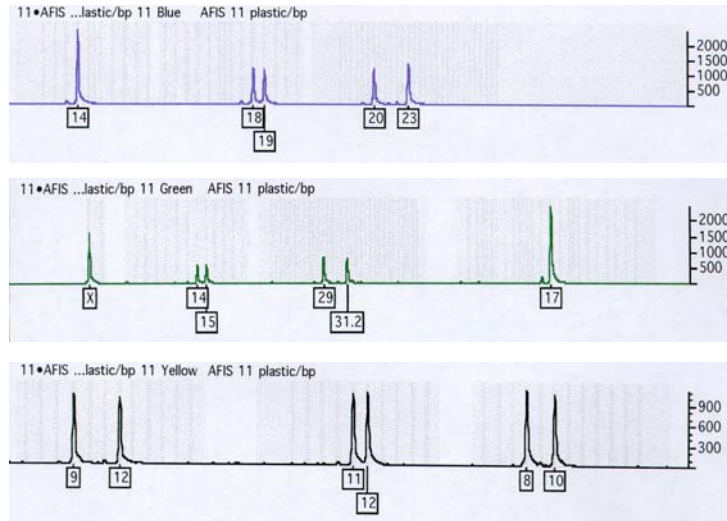


PCR-STR DNA Technique

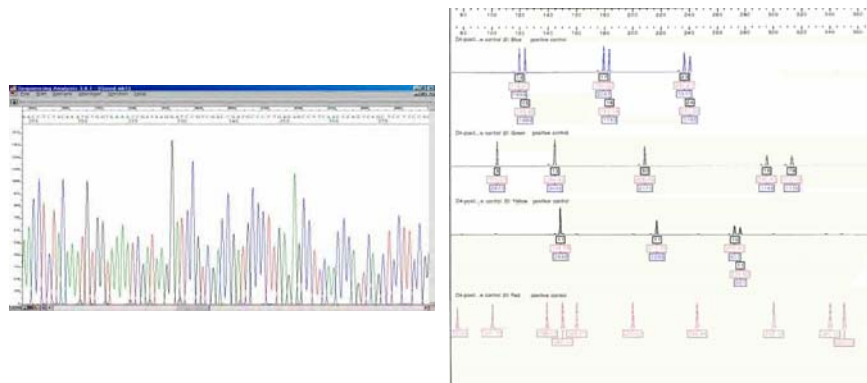
- Latest technology used by all laboratories
- Automated
- Allows you to analyze up to 16 different genetic loci simultaneously



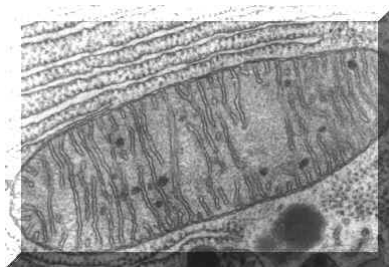
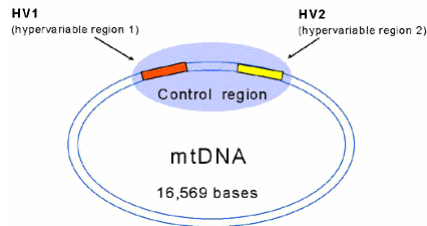
Techniques are rapidly advancing.



Multiplex STR

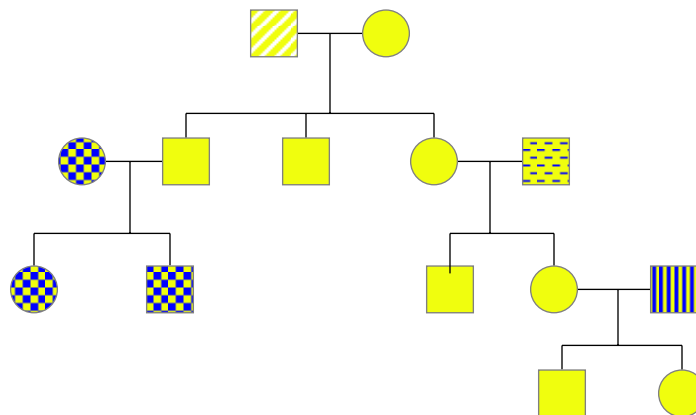


Mitochondrial DNA Analysis



- Highly specialized analysis
- Good for bones and hair shafts
- Only a few laboratories perform the analysis -FBI, Armed Forces laboratory, and a few private labs.
- Cost - \$2000

Maternal Inheritance



Y STRs

- Y Chromosome only
- Can resolve multiple male mixtures
- Can identify DNA from male contributor even in absence of sperm

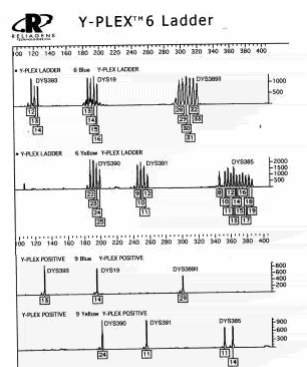


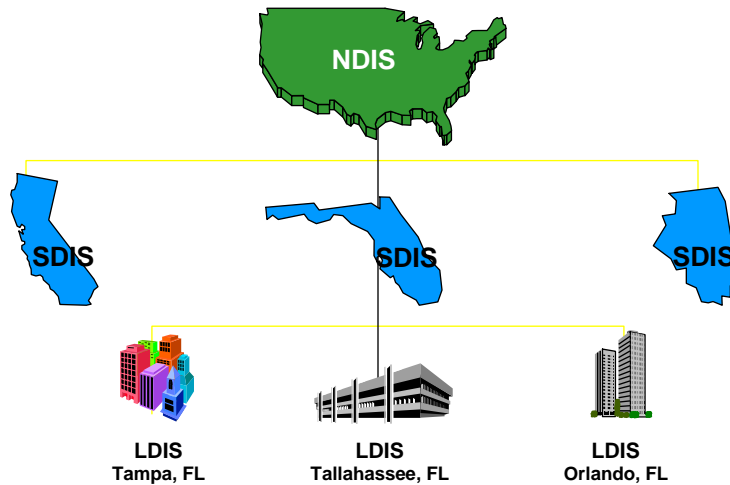
Figure 5.14 A Y-STR allelic ladder and sample. The Y chromosome of males contains STR loci that can be analyzed in the same fashion as STR loci on the autosomal chromosomes. Because the Y chromosome has no homologues, these loci show only one peak per male sample. The Biogen Y-STR™ 6 kit uses six different Y-STR loci. The top two panels contain the allelic ladders, similar to those explained in Figure 5.11. The bottom two panels contain a sample from one person. (courtesy of Biogen Technologies, Inc.)

How DNA helps solve crimes

National (and International) searchable Database (CODIS)

Often casually mentioned on TV shows like CSI

CODIS Architecture



How does it work?

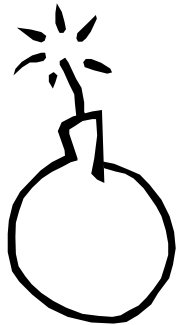
- DNA profile is developed from the semen sample
- Profile is placed in the CASEWORK database

Search is performed to see if any samples with in the database match

Case work database

Contains DNA profiles generated from case analysis. These samples are from "unknown" samples

Match between 2 casework samples



- Unsolved case to unsolved case
- Unsolved case to solved case
- Date rape cases



How does it work?

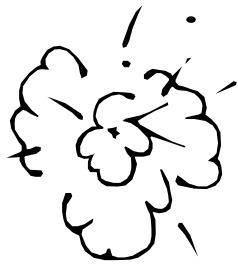
- DNA profile is developed from sample collected from a convicted offender
- Profile is placed in the OFFENDER database

Search is performed to see if any unknown samples with in the database match

Offender database

Contains DNA profiles taken from persons convicted of specific criminal offenses

Match between casework and offender



- Clear a case by developing a suspect



Myth vs. Reality

CSI:
State of the art equip
Unrealistic turn around
times
Unlimited staff
All crimes solved in 42
mins



CSI Effect

Pro:

Increased public awareness and interest in forensic science

Con:

Unrealistic juror expectations of what forensic science can do



THANK YOU!!

Any questions?

Contact:

Anjali R. Swinton
Director of Outreach
National Clearinghouse for
Science, Technology and
the Law
SciLawForensics, Ltd.
301-528-5050
aswinton@scilawforensics.com

