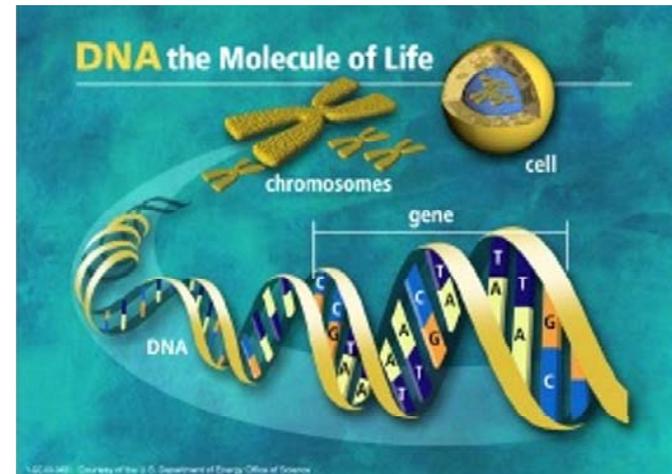


DNA

# What is DNA?

“The Blueprint of Life”



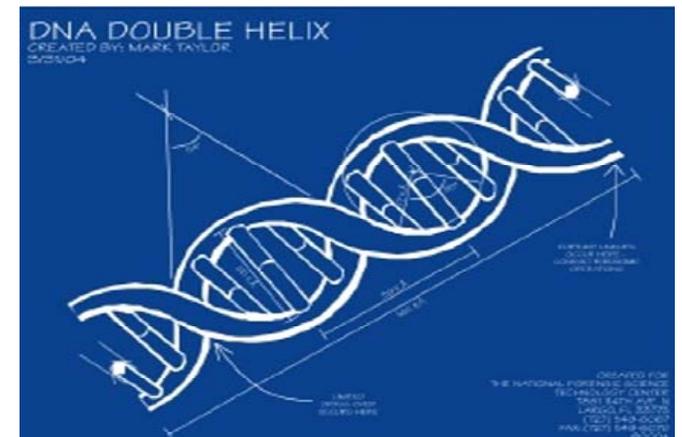
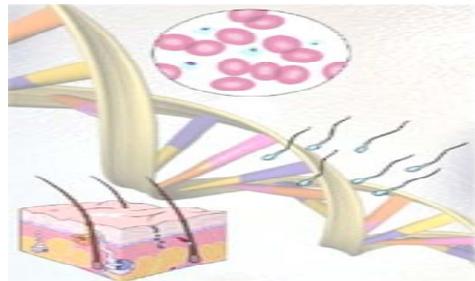
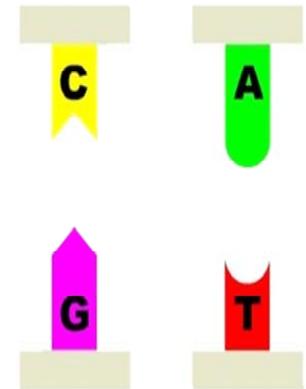
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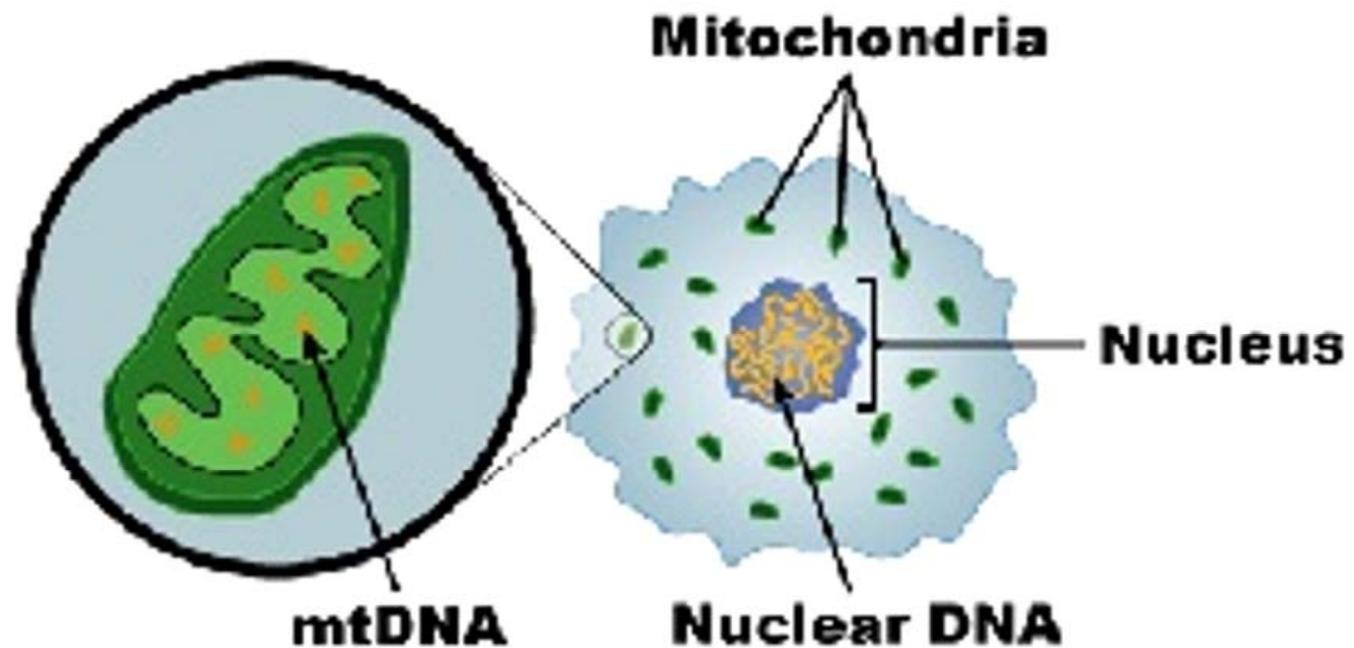
# DNA Structure and Location

- Four bases: A, T, C, G
- Spiral staircase (Double helix)
- Genes and non-coding regions
- All nucleated cells



DNA

# Location of DNA in the Cell



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A diamond-shaped logo with a grid pattern and the word "DNA" in white capital letters.

# Useful DNA Facts

- Inherited
- Same only in identical twins
- Stays the same for life
- Same in every cell
- Stable in dry conditions

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# DNA Analysis

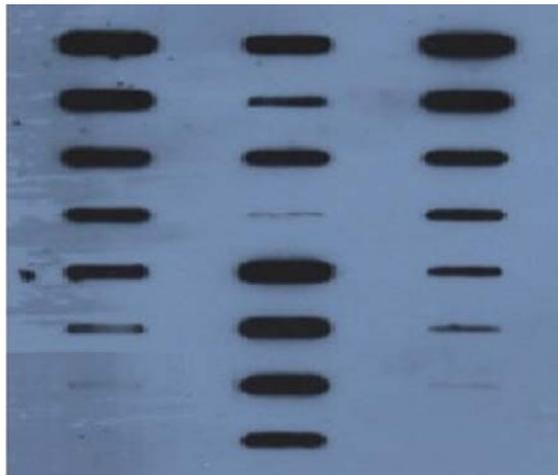
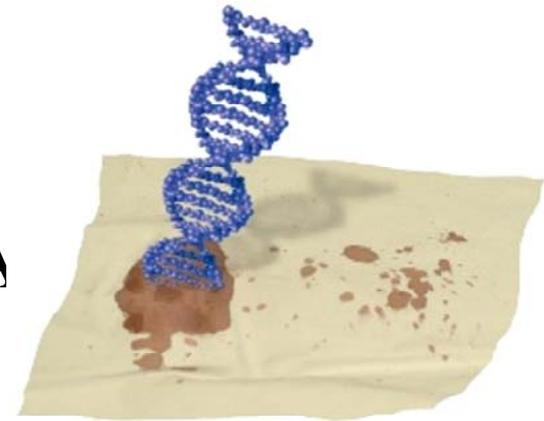
- PCR amplification
  - Copies small amount of DNA
  - Look at 16 different areas of DNA



- STR Typing
  - “1 in 100 million billion”
  - Identity statement

# DNA Analysis

- Step 1
  - Extract and purify DNA



- Step 2
  - Quantitate

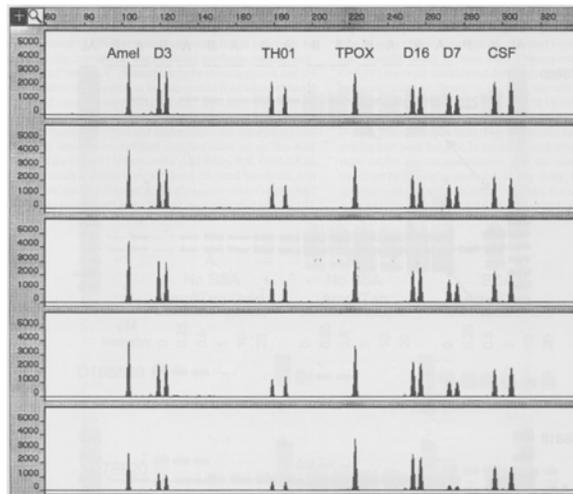
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# DNA Analysis

- Step 3
  - Amplify (make copies)



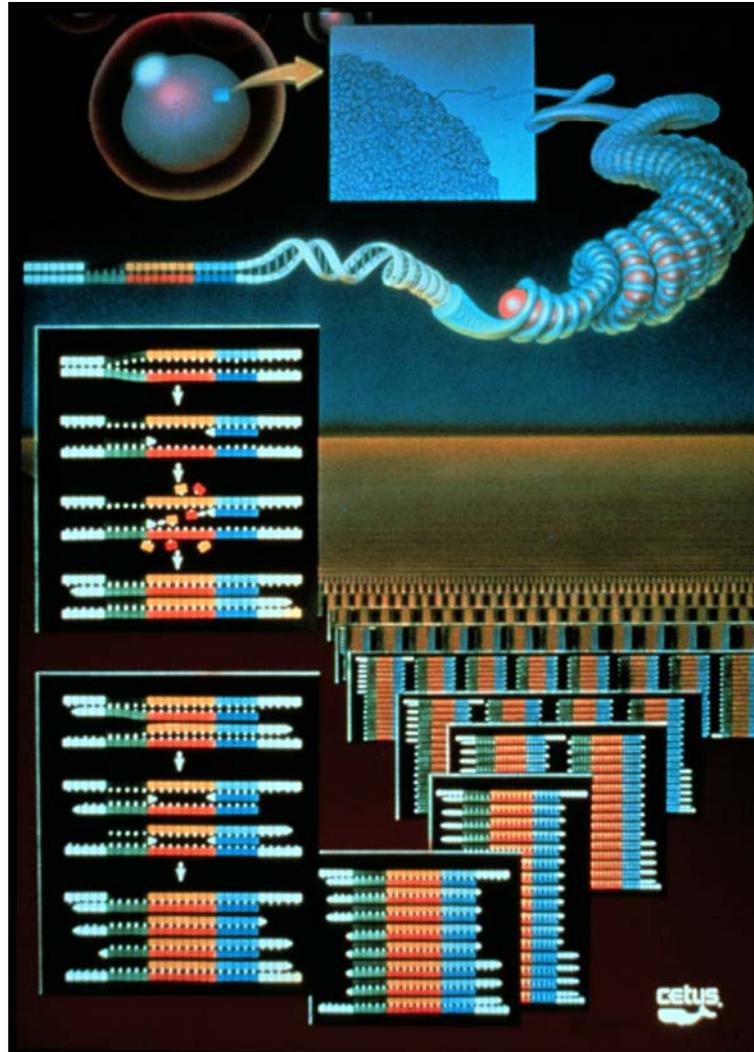
- Step 4
  - Separate and detect

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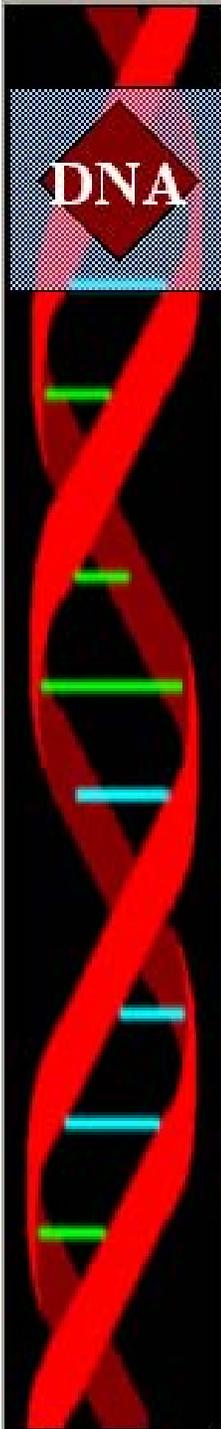
DNA

# PCR Amplification of DNA



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A vertical graphic on the left side of the slide showing a DNA double helix. The two strands are red, and the base pairs are represented by horizontal bars in green, cyan, and blue. At the top, a diamond-shaped box contains the word "DNA" in white text.

DNA

# PCR Advantages

- Requires small sample size
- Old/degraded samples may give results
- Can be automated

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# Future of DNA Testing

- Mitochondrial DNA (mtDNA)
  - Transmitted through maternal line
  - Works on samples without nucleus (hair shafts)

# Future of DNA Testing

- Y Chromosome DNA
  - Transmitted through paternal line
  - Useful in resolving DNA mixtures in sexual assaults

# Future of DNA Testing

- Automation
  - Relieve backlog
  - Process offender samples
- Miniaturization
  - Portable, typing done at scene
  - Direct access to database from scene

# Future of DNA Testing

## **CODIS** (*Combined DNA Index System*)

- Convicted offender profiles
- No suspect cases
- Cold cases

A diamond-shaped logo with a grid pattern and the word "DNA" inside.

# Future of DNA Testing

## **NDIS** (*National DNA Index System*)

- Re-examination of old cases where conviction was based on non-DNA evidence

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# Cold Case Testing

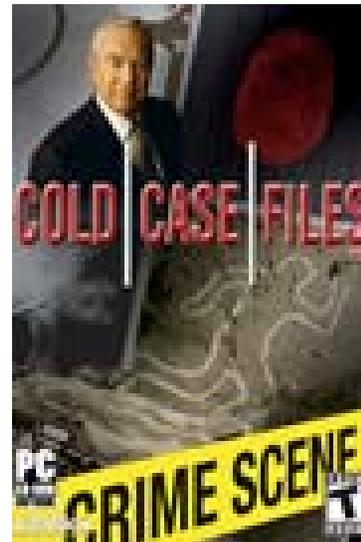
# Cold Case Testing

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# What is a “Cold Case”?

“...cases that other investigators, for whatever reason, could not solve.”



- *Bureau of Justice Assistance Bulletin*

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# Reasons for Cold Cases

- Rising crime rates
- Staff shortages
- Budget restrictions

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# Reasons for Cold Cases

- “Do more with less”
- Changing forensic laboratory policies
- Changing forensic laboratory priority/backlogs

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# Law Enforcement Responsibilities

- Identify cases with remaining biological evidence
- Of these cases, determine if material witnesses or victims are available
- Identify statute of limitation issues

-APRI

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A logo consisting of a red diamond shape with a white grid pattern inside, containing the letters 'DNA' in white. The logo is positioned in the top left corner of the slide, partially overlapping a vertical decorative element.

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# Law Enforcement Responsibilities

- Define categories of cases
- Case review

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A diamond-shaped logo with a grey stippled background and the word "DNA" in white capital letters.

# Cold Cases

- Locate case files
  - Reports
  - Evidence logs
  - Forensic testing reports
  - Previously tested evidence
  - Crime scene evidence containing biological evidence

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# Law Enforcement Responsibilities

Remember

Cold hits begin the investigation rather than end the investigation!

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# Cold Cases

- Evaluate probative DNA evidence & submit appropriate evidence for testing
- Consult with prosecutor & laboratory
- Continue investigative protocol

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# Cold Cases

- Identify witness issues
- Follow agency procedures for submitting DNA profile to CODIS
- Prepare a John Doe warrant if applicable

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# If a “Cold Hit” is Obtained

- Identify other unsolved cases believed to have been committed by the same offender
- Confirm the availability of biological evidence in those cases

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# If a “Cold Hit” is Obtained

- Locate the suspect identified by the hit
- Obtain a confirmation sample
- Interview that suspect
- Complete the investigation

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# Unadjudicated Cold Hits

In the event the crime cannot be adjudicated, it may helpful for:

- Leverage for plea agreements
- Evidence of other crimes/bad acts

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A logo consisting of a red diamond shape with a white border, containing the letters "DNA" in white. The diamond is set against a black background with a white grid pattern.

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# Unadjudicated Cold Hits

In the event the crime cannot be adjudicated, it may helpful for:

- Enhancement of punishment at sentencing hearings
- Information to withhold parole

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# Evaluating Cold Cases for DNA

- Previous case activity
  - No viable suspect(s)
  - No evidence to link developed suspect(s)
- Review the case file
  - Investigative reports
  - Photographs
  - Evidence recovered
  - Forensic reports

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# Evaluating Cold Cases for DNA

Is the original  
investigator of  
assistance?

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# Locating Cold Evidence for DNA

- Locate and document the evidence packages
  - Police storage?
  - Court storage?
  - Laboratory storage?
  - Attics, desks, and vehicles?
  - Destroyed?
- Chain of Custody?



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# Evidence Evaluation

- Evaluate evidence with respect to the forensic laboratory's capabilities
- Use a Forensic Scientist to assist this process!



# Evidence Consumption

- US Supreme Court found that  
*“[i]n general, the destruction or failure to preserve potentially useful evidence does not constitute a violation of the due process clause, unless it can be shown that the police, the prosecutor or the laboratory acted in bad faith.”*
- Arizona v. Youngblood, 488 US 51 (1988)
- Dixon v. State, 275 Ga. 232 (Georgia Supreme Court 2002)

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# Evidence Consumption

- “Half” Rule observed by some laboratories
  - No more than half of the evidence sample may be consumed
  - Repeat testing? Not possible by the original laboratory
- Check with **your** forensic laboratory to determine policy

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# Cold Evidence

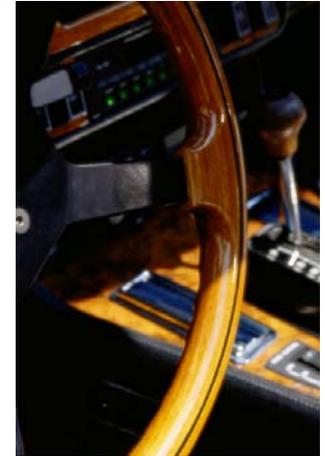
- Each item of evidence has a history – can't go back in time!
- Unintentional historical contamination
  - Police and crime scene personnel
  - Scientists – both DNA and other examiners
  - Jurors, lawyers, and some judges!

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# Overlooked Cold Evidence

- **TOUCH** evidence
  - Handles of weapons, ligatures, etc.
- **WEARER** evidence
  - Items of clothing, masks, etc.
- **ORAL** evidence
  - Bottles, utensils, etc.



# Important DNA Principles To Consider

- DNA continues to degrade over time, although more slowly in cool, dry environment.
- mtDNA may also have been used in these types of cases

# Advantages of Applying DNA to Cold Cases

- Advanced DNA capabilities
  - “*Do more with less*” evidence sample
  - Results are more discriminating
    - » Not to be confused with “accurate”
- Use of DNA Data Bank in the absence or elimination of a suspect
  - State
  - National (NDIS)

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# Post-Conviction Testing

# Post-Conviction Testing

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# Law Enforcement Responsibilities

- Identify which cases
  - Were closed before DNA evidence was available to the jurisdiction
  - Still have biological evidence remaining and the location of that evidence
  - Resulted in a conviction of a person who is still alive

*-APRI*

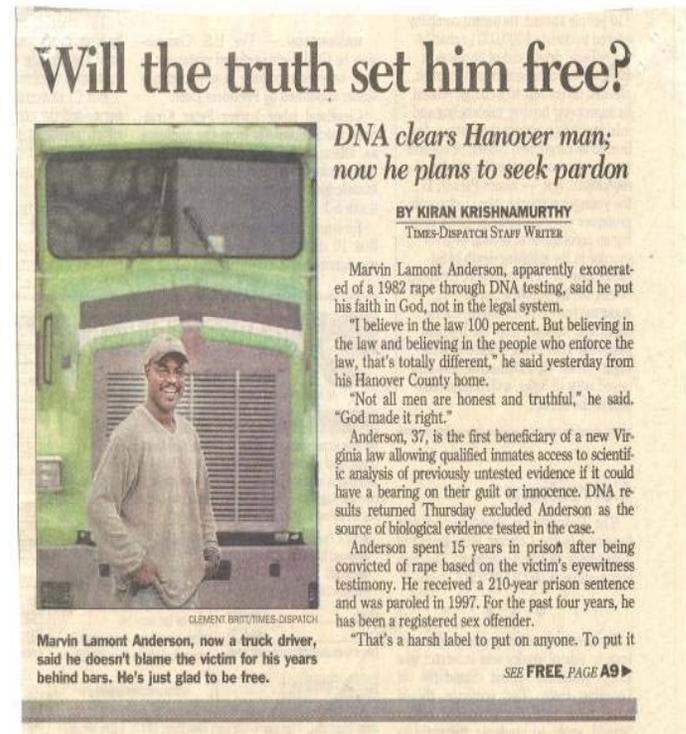
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# Post-Conviction Cases

- Share many of the same evidence issues as cold cases
- Must consider possible contamination by
  - Attorneys
  - Judges
  - Juries from original trial

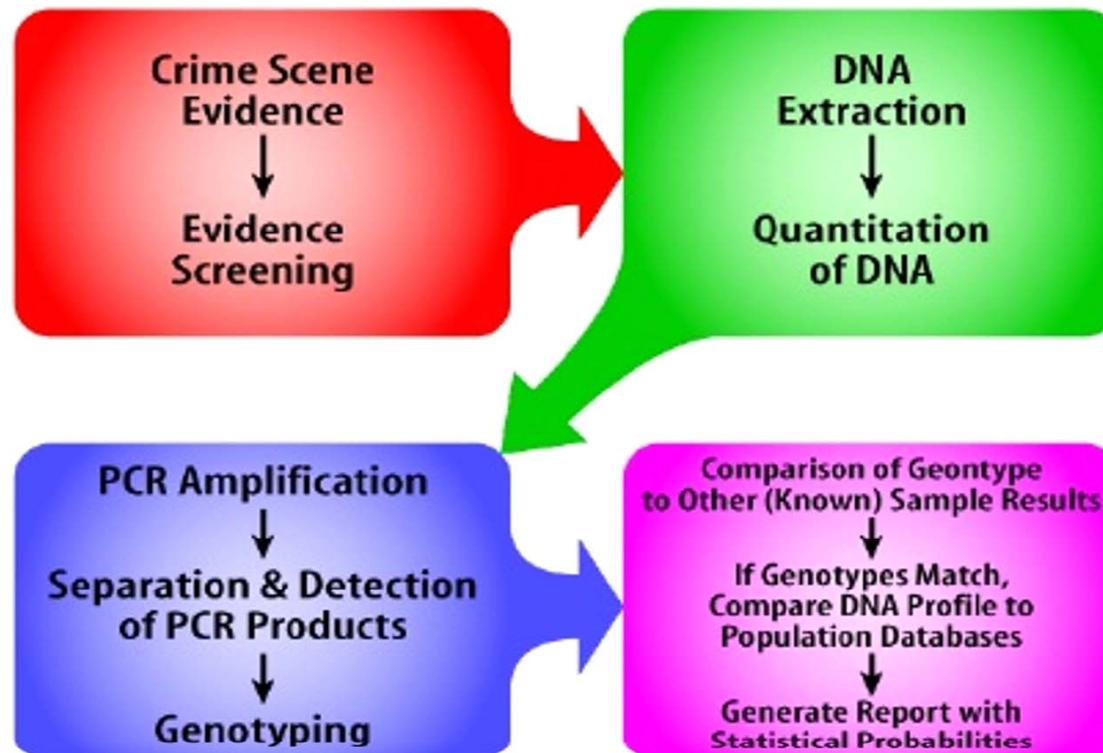


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# How DNA Helps Solve the Crime



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# Cold Case Summary

- Computerization of DNA profiles will enable us to:
  - Solve no suspect cases
  - Connect cases that no one knows were perpetrated by the same individual

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# Cold Case Summary

- It's never too late to revisit cold cases
- We are able to use all parts of a human to solve crimes, from head to toe!

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# CODIS

## Combined DNA Index System

- Enables state & local crime labs to exchange and compare DNA profiles electronically

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# CODIS

Contains two database files:

- Convicted offender file
  - » Contains DNA profiles of offender convicted of a qualifying offense
- Forensic file
  - » Contains DNA profiles developed from crime scene evidence

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# CODIS

- Convicted offender file match
  - Obtain warrant to confirm match
- Forensic file match
  - Investigators from different jurisdictions can exchange information

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# CODIS

- Possible outcomes:
  - Link 2 or more unsolved cases
  - Link a solved case to an unsolved case
  - Link 2 or more solved cases

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# Using Results

## Understanding “Hits” and “Misses”

The “Reality” of DNA evidence in our society.



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# Reality vs. T.V.



- Public perception is influenced by TV.
  - Crime solved and offender brought to justice within an hour
- DNA collection at crime scenes is increasing
  - Technology improving
  - DNA processing takes time!



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# Public Perceptions

- Latent fingerprint technology improving
  - People expect police to locate & collect prints at crime scenes
- With increased knowledge of DNA
  - People expect DNA collection at crime scenes



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# Fingerprint vs. DNA

- “Swabbing” for DNA and “dusting” for fingerprints
  - Overlap conceptually but not practically
  - DNA labs able to perform more tests with less evidence
  - Fingerprint brush can transfer DNA between crimes



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# Who's the Bad Guy?

- Police are taught not to leave fingerprints at a crime scene
- It's nearly impossible NOT to leave your DNA
- Some agencies require fingerprints & DNA profiles of officers entered into databases.



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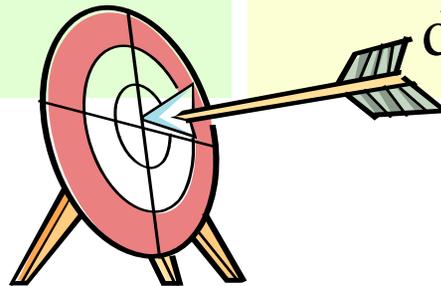
# DNA “Hit” and “Miss”

“**HIT**” = a person’s DNA was left at the scene

- Friends and family leave DNA behind
- “hit” might not be that important.

“**MISS**” = A failure to find evidence.

- Doesn’t mean someone is not responsible for a crime.
- The person’s DNA might not be in the database.



DNA

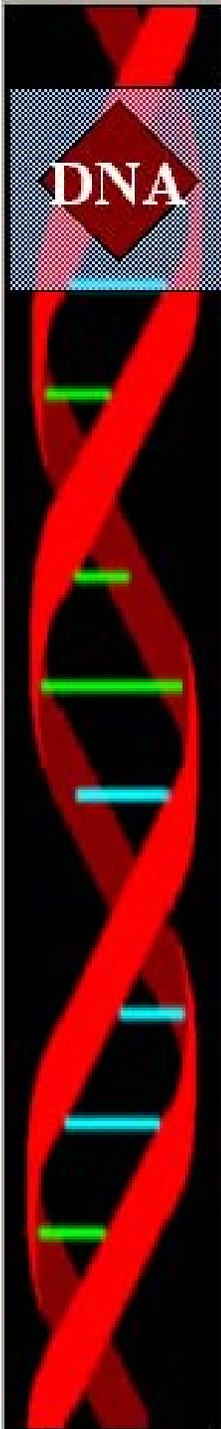
# DNA History



- DNA collection was not possible prior to 1950's.
- The discovery of DNA structure by Watson and Crick
  - Police able to link people to crimes
  - Failure to link a person to a crime by DNA does not mean “not guilty”

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A vertical graphic on the left side of the slide depicts a DNA double helix. The two strands are colored red and are intertwined. Horizontal rungs representing base pairs are shown in green and cyan. At the top of this graphic, the word "DNA" is written in white capital letters inside a dark red diamond shape, which is set against a grey grid background.

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# Strategic Uses for DNA Evidence

- Prove guilt
- Exonerate the Innocent
- Paternity Testing

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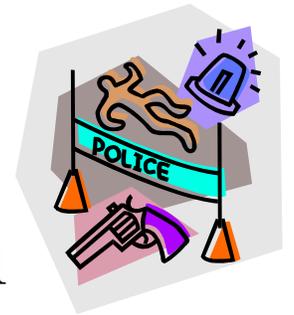
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# Strategic Uses for DNA Evidence

- Determine identity of human remains
- Evolution of human populations
  - National Geographic
- Study inherited disorders

# DNA in the Courtroom

- Circumstantial Evidence
  - Information collected from witnesses
  - Documents pointing an individual as the perpetrator



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# DNA in the Courtroom

- Physical Evidence
  - Information collected from actual objects

•Bodies	•Stains
•Weapons	•Fingerprints
•Body Fluids	•Hairs, Fibers, etc.

# DNA in the Courtroom

- Prosecutor must present evidence to the court
- Must prove an overall “theory” from evidence to jury
- Scientific evidence is precise



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# DNA in the Courtroom

- Evidence can be:
  - Documents
  - Exhibits
  - Facts agreed on by both sides
  - Testimony of witnesses

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# Scientific Evidence Admissibility Standards

- Is the scientific evidence trustworthy?
  - Must demonstrate
    - » accuracy (validity)
    - » consistency (reliability)



- **Frye Rule**
  - U.S. v. Frye (1923)
  - Standard on accepting scientific evidence.
- **People v. Kelly (1976)**
  - Proponent of the evidence must demonstrate the correct use of scientific procedures