

# **DNA Fingerprinting**

Chem 210

2/28/00

**There are not many methods for positive  
physical identification in forensics**

- Fingerprinting
- Blood typing

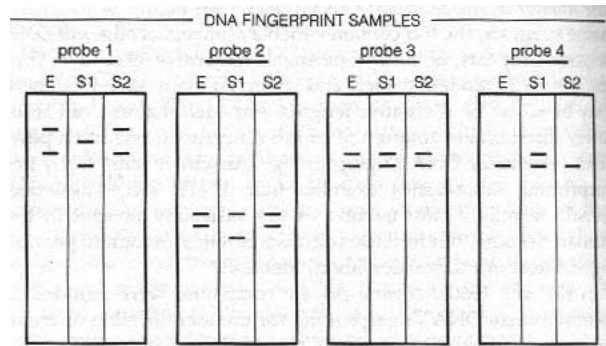
## **DNA based identification could have many applications**

- DNA sequence is unique to a specific individual.
- DNA sequence analysis is fast, requires little sample.
- Applications:
  - Criminal investigations
  - Paternity
  - Random historical investigations/identifications
  - DNA as a “tag” for non-biological systems

## **The most common DNA fingerprinting technique relies on RFLPs**

- Certain sites in the human chromosomes contain variable numbers of adjacent DNA repeats (variable number of tandem repeats, or VNTRs).
- VNTRs are highly polymorphic--some chromosomes contain 30 copies, some 31, etc.
- The number of copies can be assessed by restriction enzyme digest combine with Southern blotting--the number and length of fragments can be used as a fingerprint.

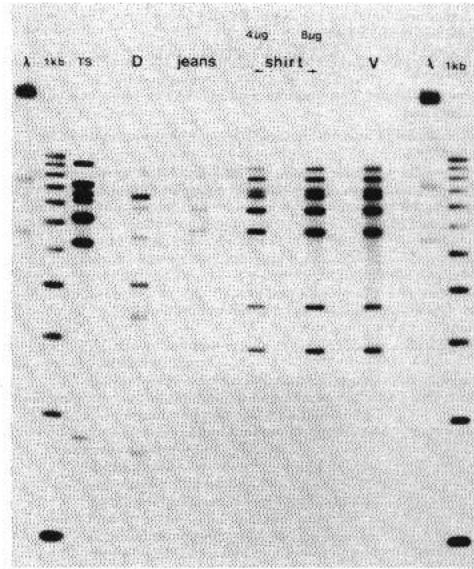
## Identification using RFLPs



## DNA evidence can be introduced in criminal trials

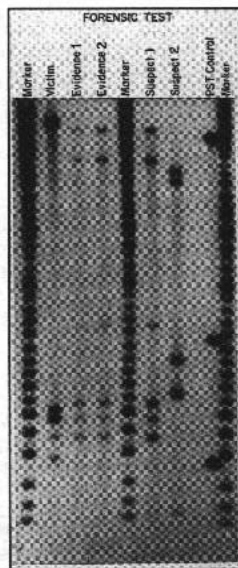
- 1983: Investigation of a rape/murder case in the UK uses DNA testing.
  - DNA taken from crime scene.
  - 4500 men in the small town all give blood samples; none have matching DNA.
  - Later, discovered that one man hadn't given a blood sample--his DNA was a perfect match
- 1988: DNA testing used in rape conviction of Tommy Lee Andrews in Florida.

## Example of DNA evidence in a criminal trial



Autograd courtesy of Cellmark Diagnostics.

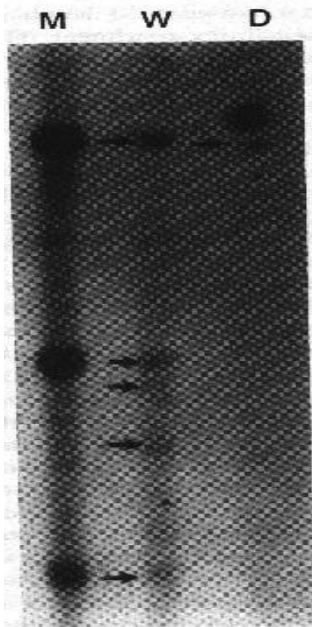
## Example of DNA evidence in a criminal trial



## **The 1989 *Castro* case raised doubts about DNA evidence**

- Vilma Ponce and her 2 year old daughter were found murdered in their apartment in 1987; a janitor in a nearby apartment building, Joe Castro, was accused of the murder.
- Castro had a blood stain on his watch.
- A commercial DNA analysis company (LIFECODES) found that the DNA from the blood sample matched the DNA of the victims.
- Castro's lawyers, Barry Scheck and Peter Neufeld, attacked the DNA evidence as ambiguous and poorly interpreted.

## **Does the DNA from the watch match the victims?**



- What are the two mystery bands?
- LIFECODES says they are contamination; Scheck and Neufeld argue they render the DNA evidence inconclusive.

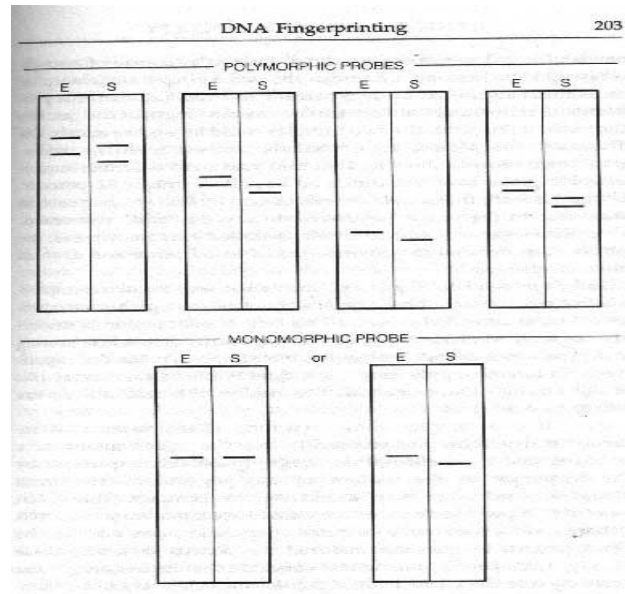
## **What does a match mean?**

- The presence of a match needs to be analyzed by a statistical argument--how likely is it that two individuals would show the exact same RFLP bands?
- This information usually obtained from tables of data gather from random samples--i.e., in a sample of 5,000 individuals, how many show each individual band.
- The frequency of the overall pattern given by multiplying the individual frequencies--assume independence of the alleles.

## **This analysis has a lot of problems**

- How do you define the correct population to compare the results? (usually racial or ethnic categories: white, black, Hispanic--but these are not genetic categories).
- Are the bands really inherited individually? Or should a more complex genetic analysis used?
- Scheck and Neufeld (with support from geneticists) argued that LIFECODES over estimated the quality of a match.

## Another common problem: bandshifting



## How do judges decided about scientific evidence?

- 1923 *Frye* rule: to be admissible as evidence, a scientific procedure or concept must have broad recognition or support within the scientific community.
- 1993 *Daubert vs. Merill Dow Pharamceuticals*: the supreme court ruled that judges must decide whether scientific evidence is admissible--judges, not the scientific community, are the gatekeepers in the court.

## Future of forensic DNA analysis

- DNA testing and analysis are improving: technical problems should decrease.
- DNA evidence is used most often to acquit defendants (lack of a match is very firm evidence).
  - Scheck and Neufeld have recently created the Innocence Project to promote use of DNA testing
- There have been proposals to create DNA libraries of known felons.
  - This raises a lot of civil liberties concerns.

## DNA as a paternity screen is a huge business

