

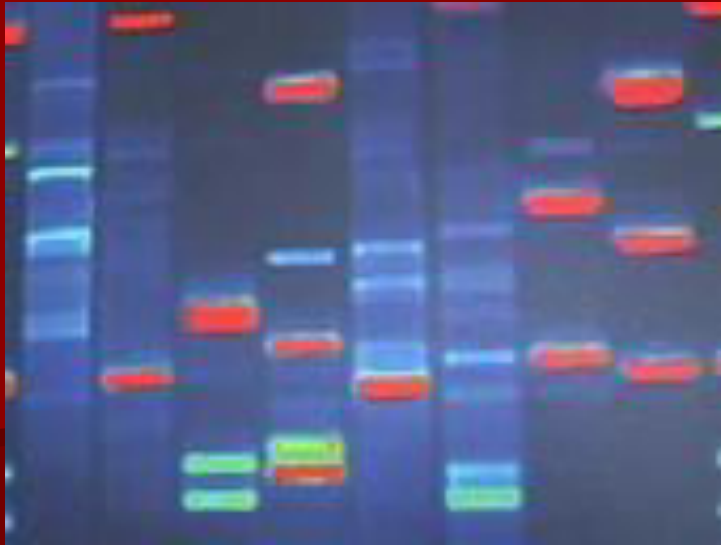


FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

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DNA Fingerprinting



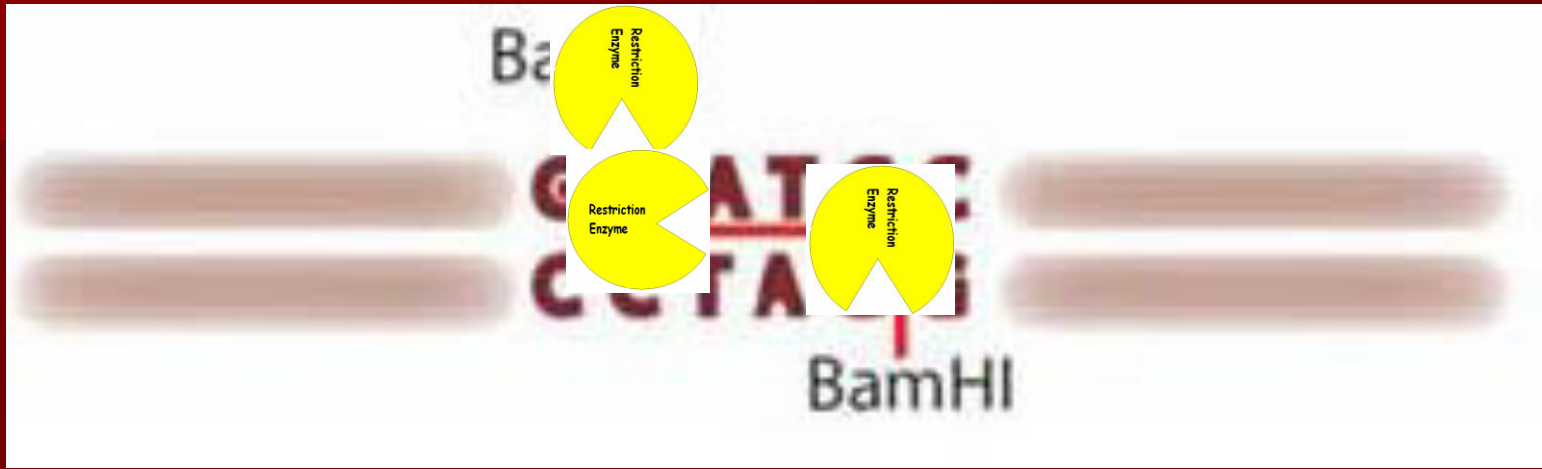
Why Use DNA Fingerprinting?

- DNA fingerprinting is a way of telling individuals of the same species apart
- DNA sequences are variable and can therefore be used as identifying characteristics.
- DNA fingerprinting has advantages over other sources of evidence (fingerprints, blood type, etc.):
 - Highly accurate.
 - Can be gathered from trace crime scene evidence.

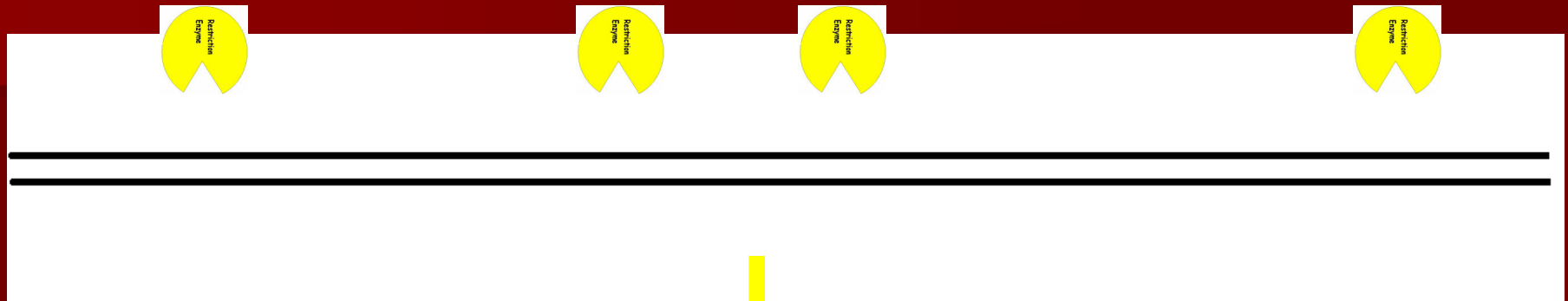
How do you take a DNA fingerprint?

- One way: Restriction Fragment Length Polymorphisms (huh?) → aka RFLP
- Restriction enzymes are molecules that can cut DNA into pieces --> each enzyme cuts at a very specific DNA sequence
- While all human beings share roughly the same DNA sequence, there are in fact a small number of differences → these differences can be seen by restriction enzymes

RFLP Animation



Individual 1



DNA

A

B

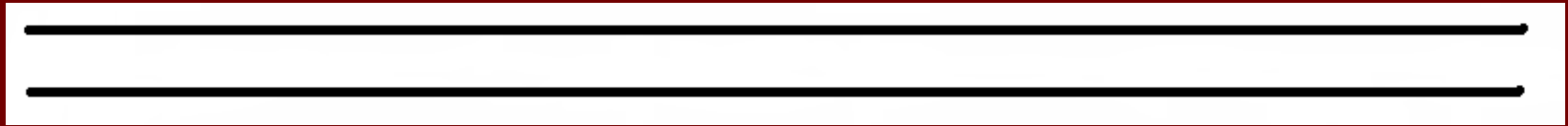
C

D

E



Individual 2



A

B

C

D



Individual 1 vs. Individual 2

Individual 1

A **B** **C** **D** **E**



Individual 2

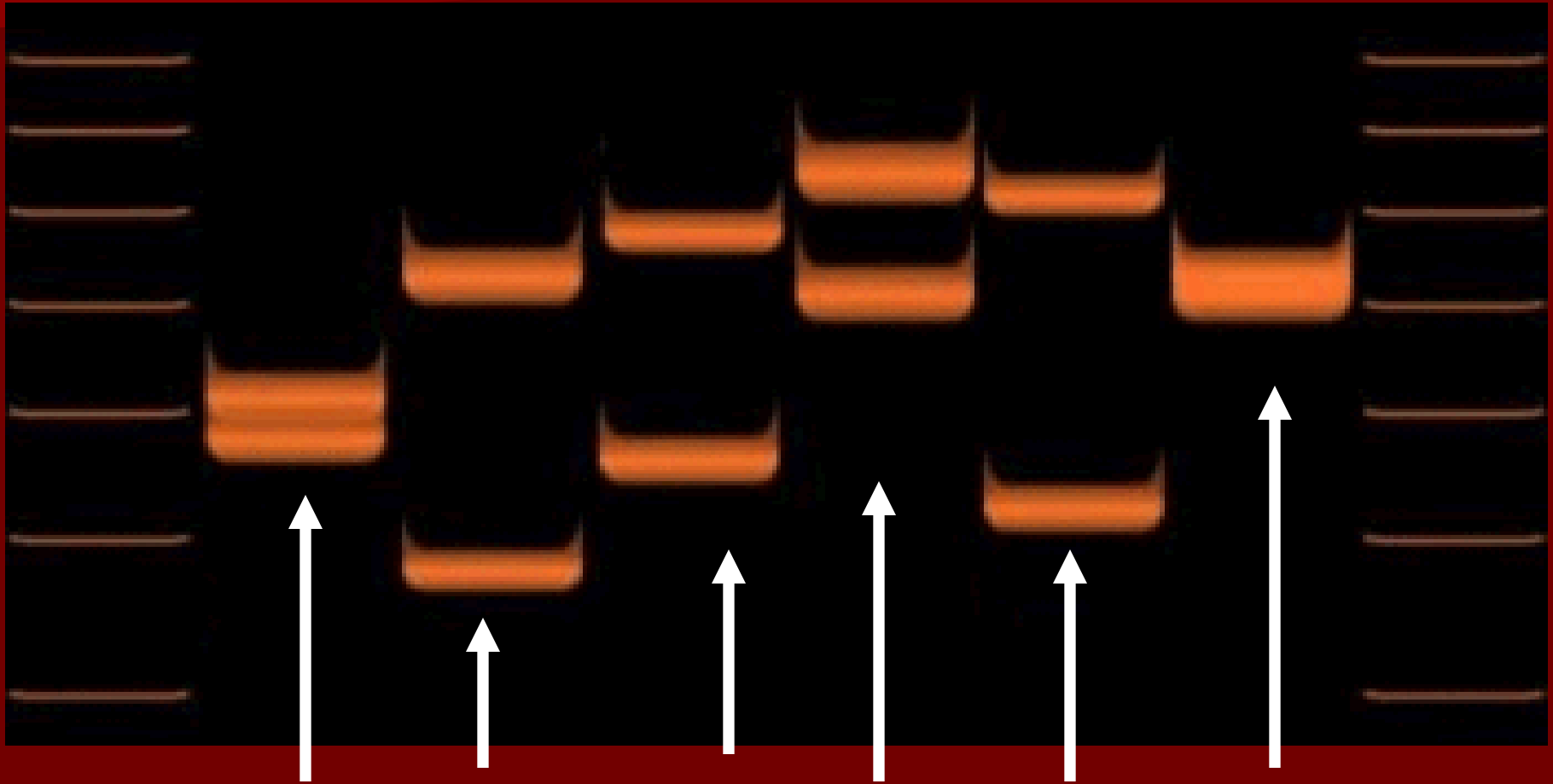
A **B** **C** **D**



Summary

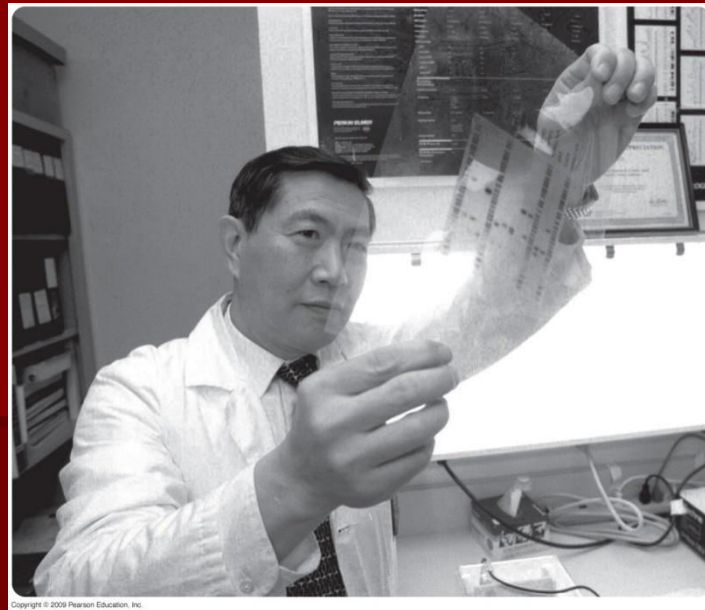
- Essentially, once the DNA has been cut by the enzymes, we will have DNA fragments of various sizes
- Each individual's banding patterns should be different because the restriction enzymes will cut each person's DNA at different points
- Fragments of different sizes will travel different distances along a gel when an electric current is passed through it

Agarose Gel Electrophoresis



Different banding patterns from different individuals

DNA Fingerprinting and Forensic Analysis

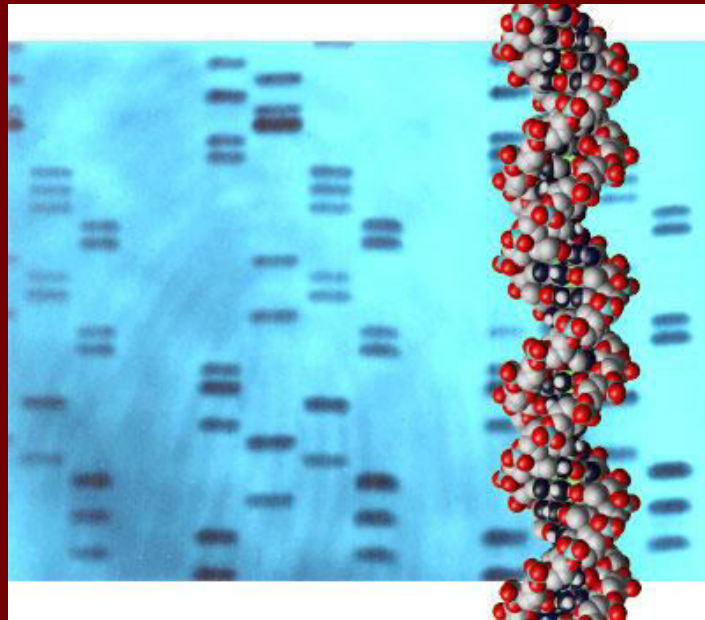


Introduction to DNA Fingerprinting and Forensics

- ❖ Forensic science can be defined as the intersection of law and science
- ❖ First photography-then fingerprint- then, in 1985, DNA Fingerprinting

DNA Fingerprint

- ❖ DNA fragments show unique patterns from one person to the next.
- ❖ Used in paternity disputes and as forensic evidence.

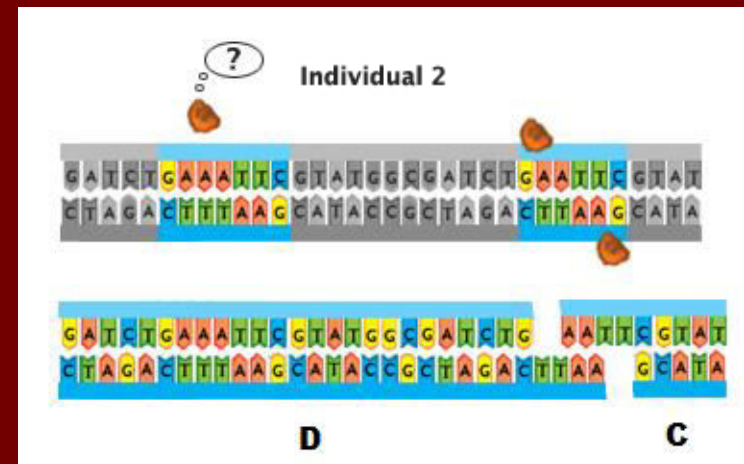
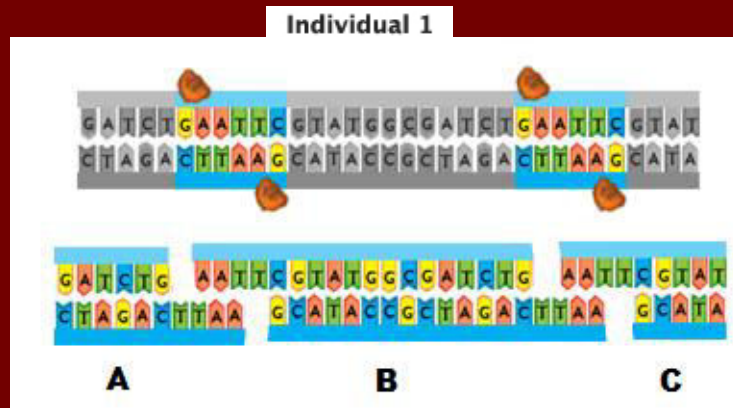


Preparing a DNA Fingerprint

- ❖ Specimen Collection- Could be a licked envelope, dirty laundry, a cigarette butt, saliva
 - Special precautions in handling specimens: gloves, disposable instruments, avoid talking and sneezing, avoid touching sample with your skin, air-dry the evidence before packaging so mold does not grow
 - Enemies of evidence: sunlight, high temperatures, bacteria, moisture
 - Ideal sample: 1 mL of fresh, whole blood (white blood cells) treated with EDTA

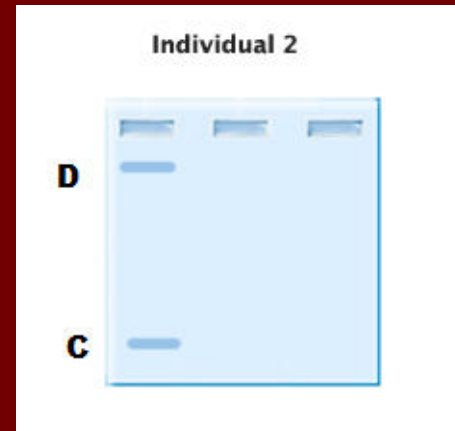
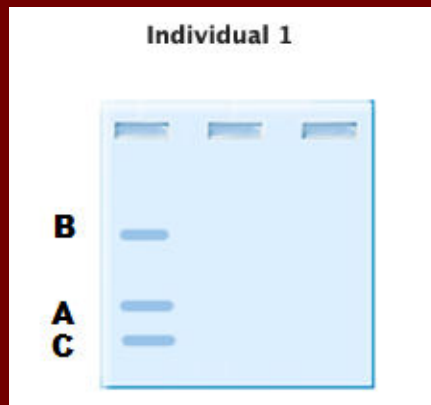
RFLP

- ❖ Restriction Fragment Length Polymorphism (RFLP)
 - Nucleotide sequence variations in a region of DNA that generates fragment length differences according to the presence or absence of restriction enzyme recognition sites.

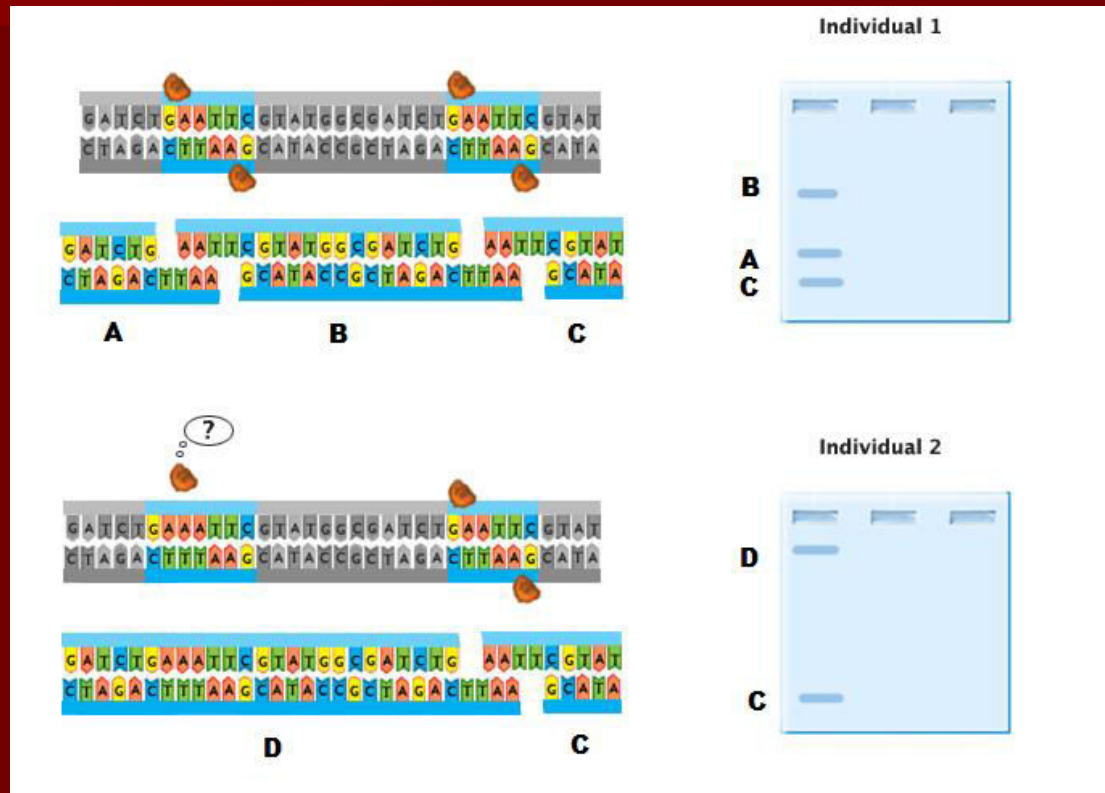


RFLP

- ❖ The RFLP fragments can be separated by gel electrophoresis.



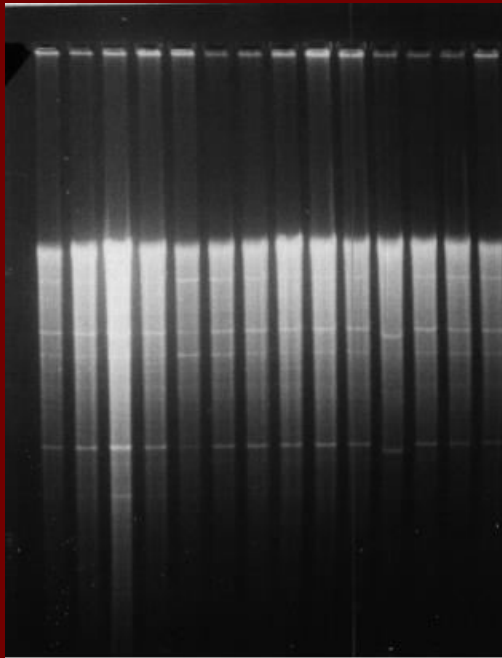
RFLP



RFLP animation

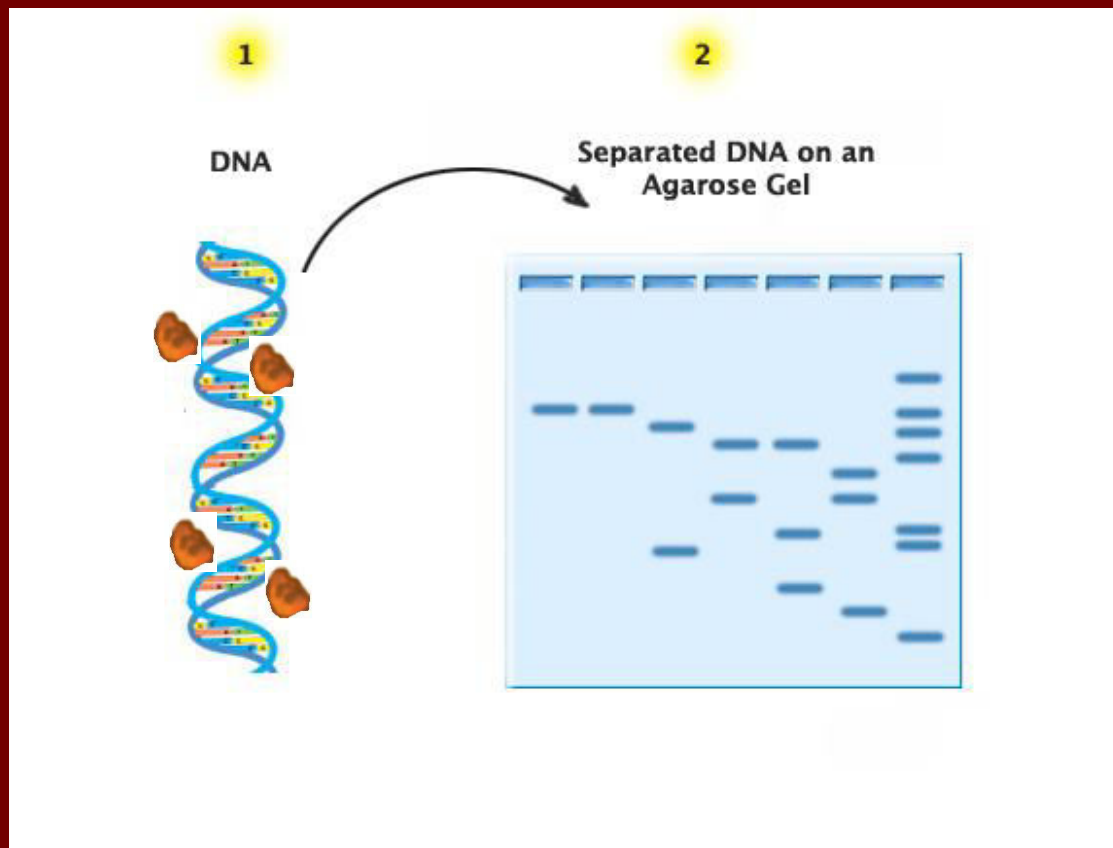
Southern Blot

- ❖ Molecular technique where DNA is transferred onto a membrane from an agarose gel and a probe is hybridized.



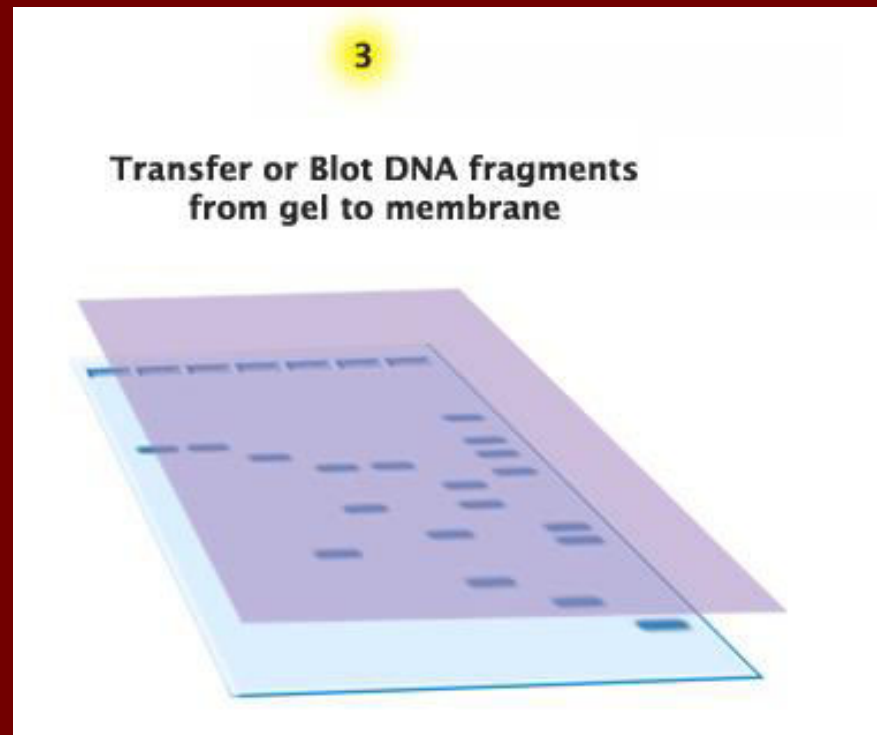
Southern Blot

- ❖ The first step in preparing a Southern Blot is to cut genomic DNA and run on an agarose gel.



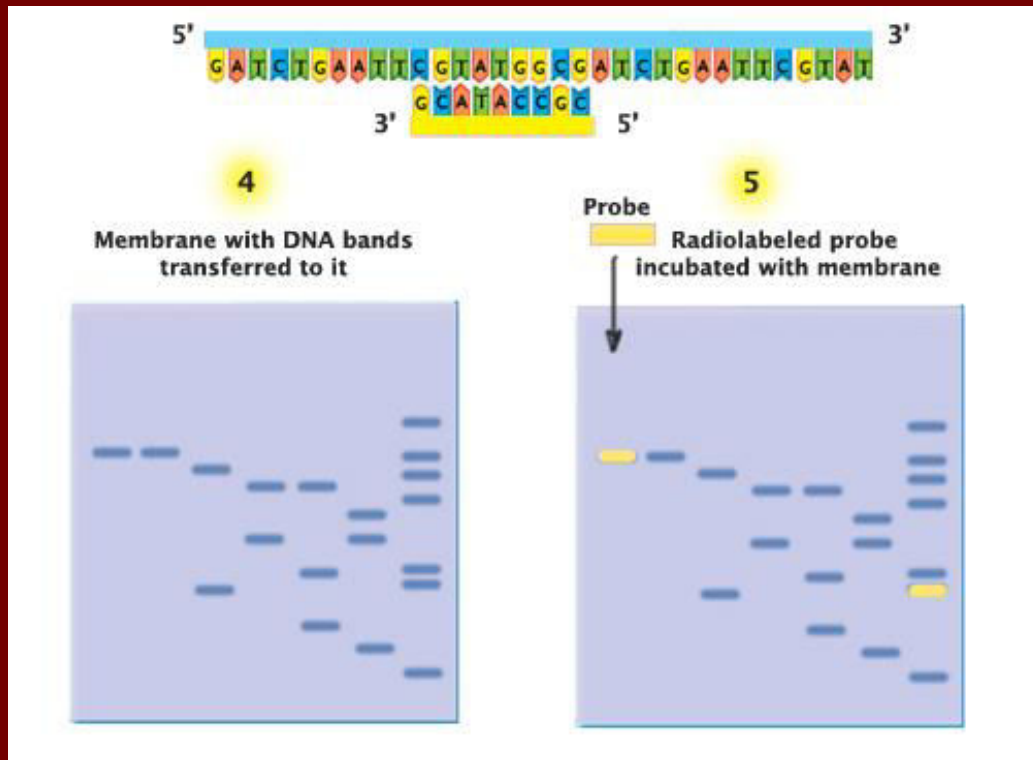
Southern Blot

- ❖ The next step is to blot or transfer single stranded DNA fragments on to a nylon membrane.



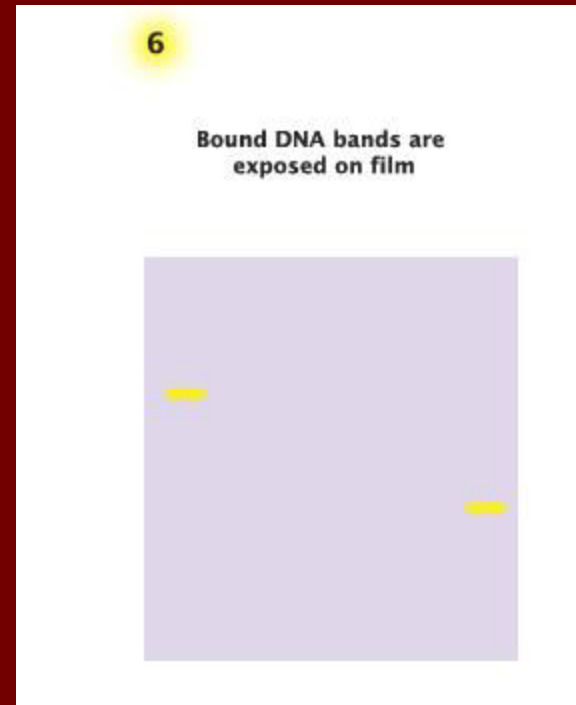
Southern Blot

- ❖ The next step is to hybridize a radioactively labeled DNA probe to specific sequences on the membrane.

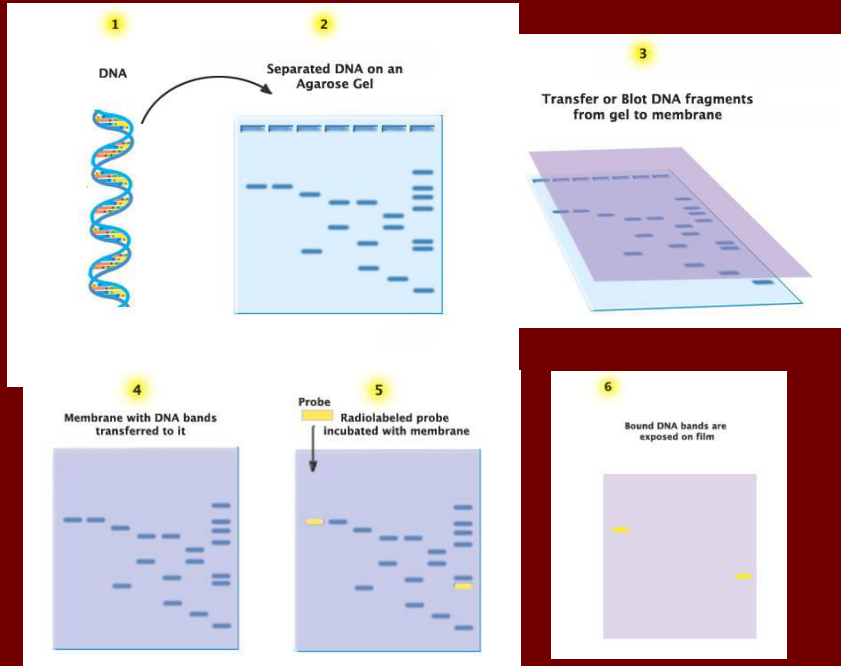


Southern Blot

- ❖ The last step is to expose the radioactively labeled membrane to a large sheet of film.
- ❖ You will only visualize bands where the probe hybridized to the DNA.



Southern Blot



Southern Blot Animation

VNTR

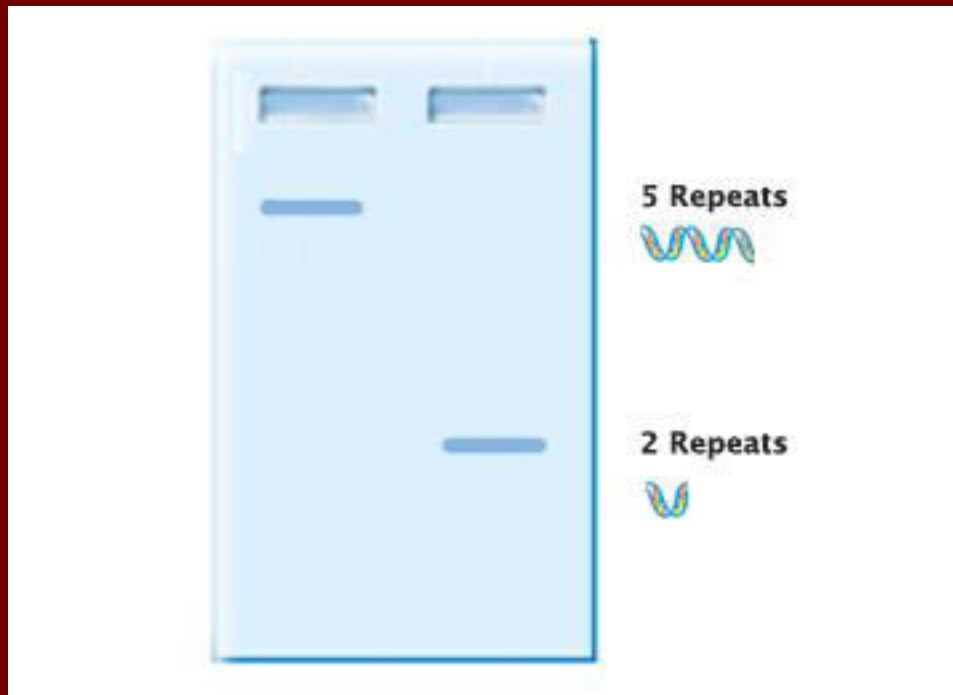
❖ Variable Number Tandem Repeat (VNTR)

- sequences that are repeated multiple times and the number of repeats varies from person to person.



VNTR

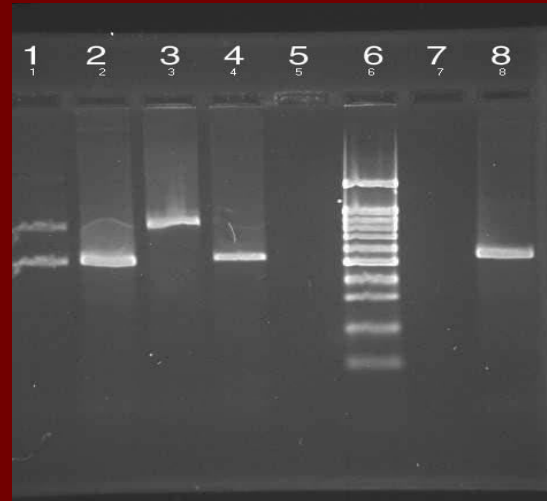
- ❖ VNTRs usually occur in introns
- ❖ VNTRs can be amplified by **PCR** and run on agarose gels to produce unique DNA fingerprints



PCR

❖ Polymerase chain reaction (PCR)

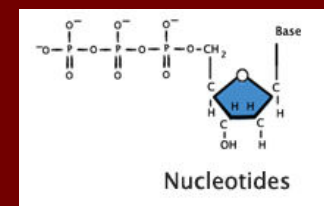
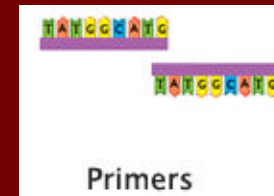
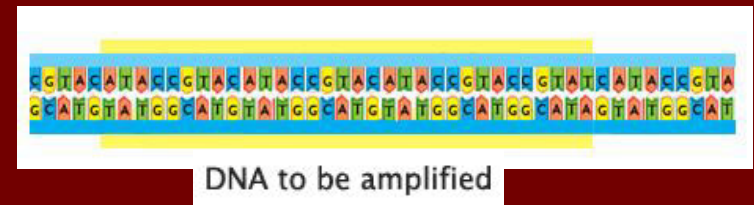
- A lab technique used to amplify segments of DNA



PCR

❖ Reaction requirements

- Template DNA – total genomic DNA isolated from an organism that contains a target region to be amplified
- DNA primers - Short pieces of single stranded DNA that flank the target
- *Taq* DNA polymerase - Attaches nucleotides on the growing strand of DNA
- Nucleotides (GATC) – Polymerase adds complementary nucleotides to the template





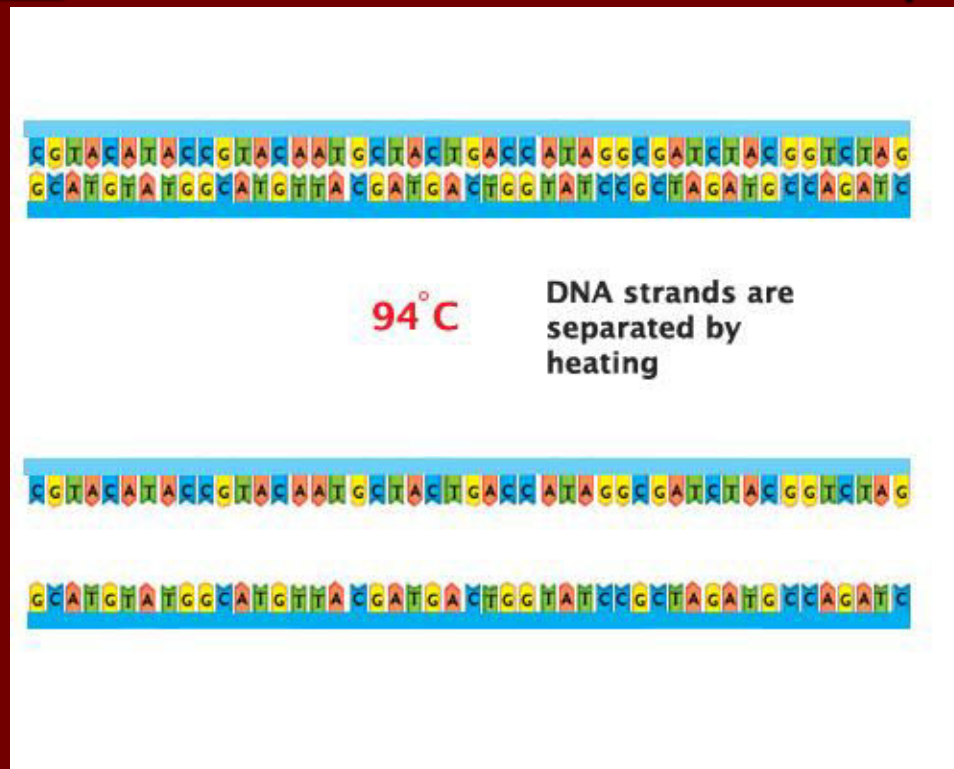
PCR

- ❖ Reactions are placed in a machine called a thermal cycler. The machine cycles through three temperatures.



PCR

1. Heat samples to **94°C** for a minute or so to denature the double stranded template DNA.



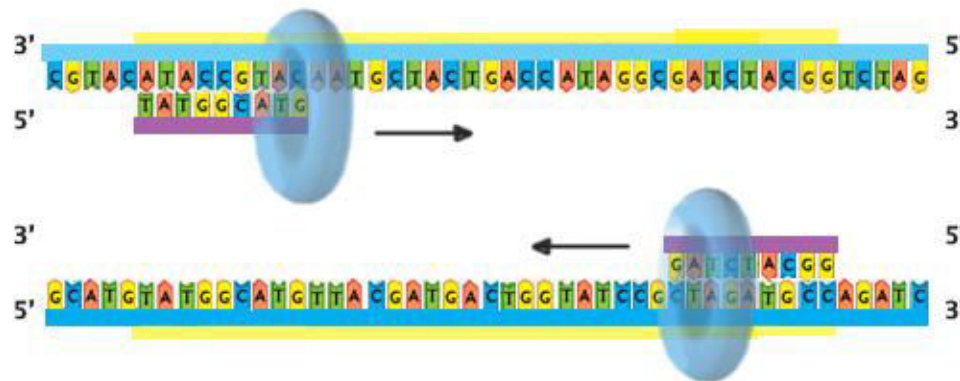
PCR

2. Drop temperature to around **50 or 60°C** to allow primers to anneal.



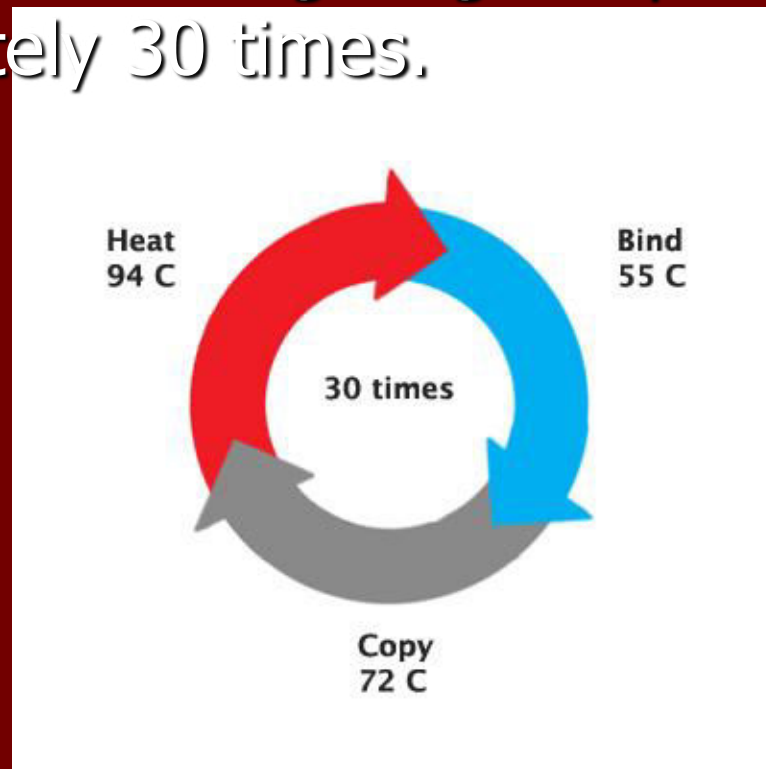
PCR

3. Maintain temperature at **72°C** for a minute or two to allow the polymerase to elongate the new DNA strands.



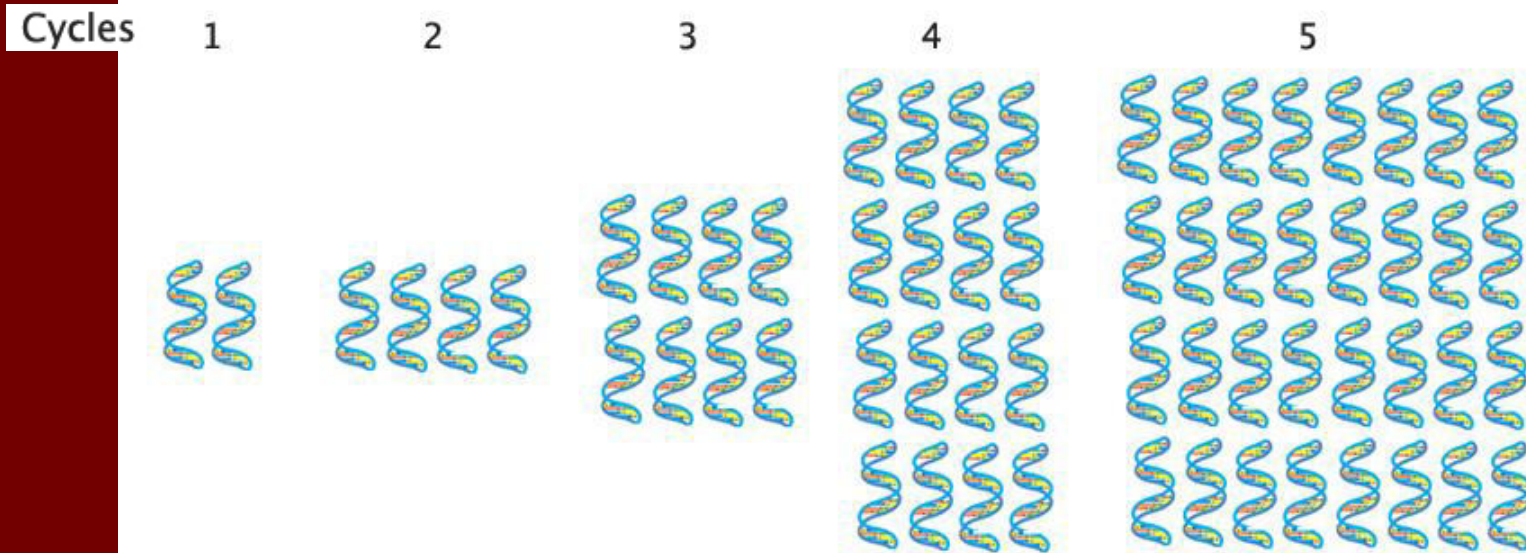
PCR

- ❖ The thermal cycler repeats the denaturing, annealing, and elongating temperatures approximately 30 times.



PCR

- ❖ PCR amplification is logarithmic, meaning the number of copies of the target is doubled every cycle.

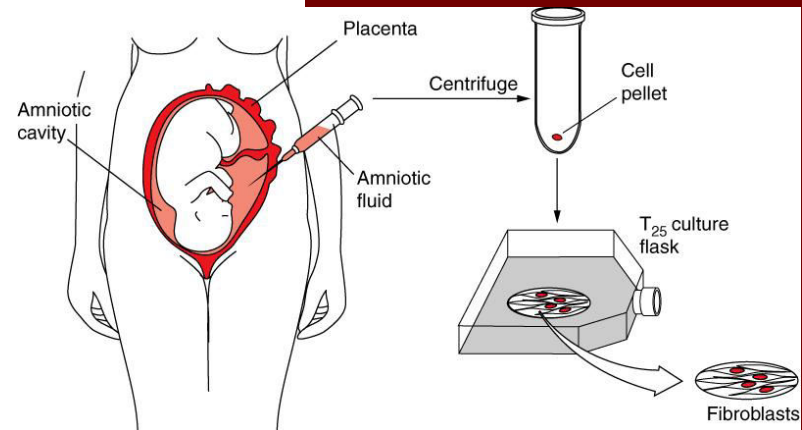
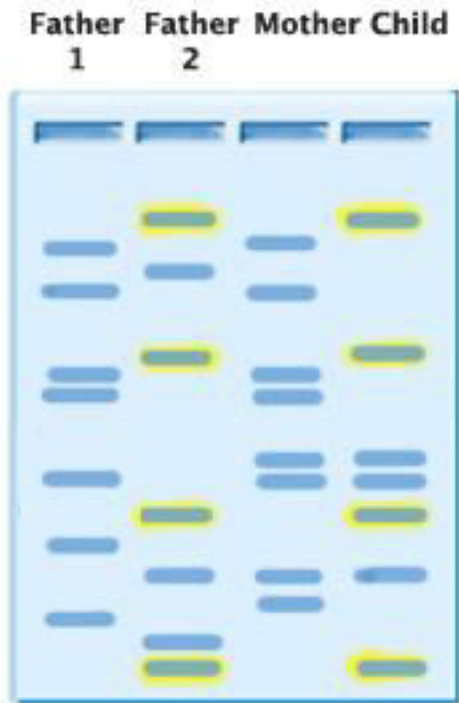


PCR

PCR animation

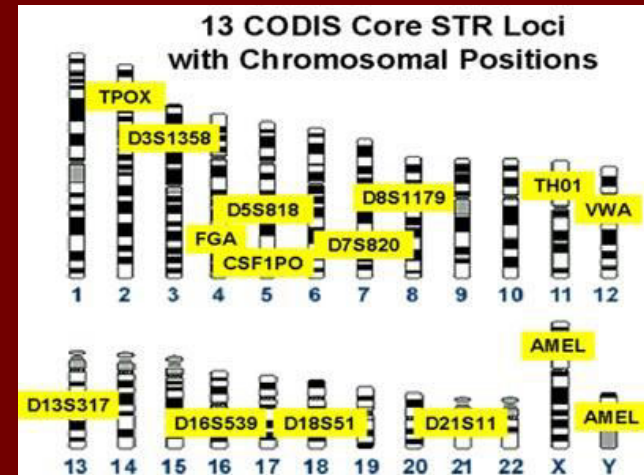
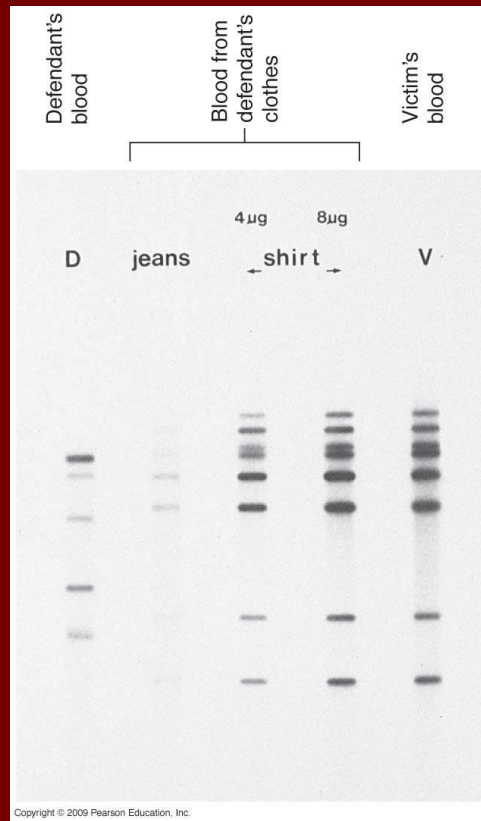
Applications

❖ Paternity Testing



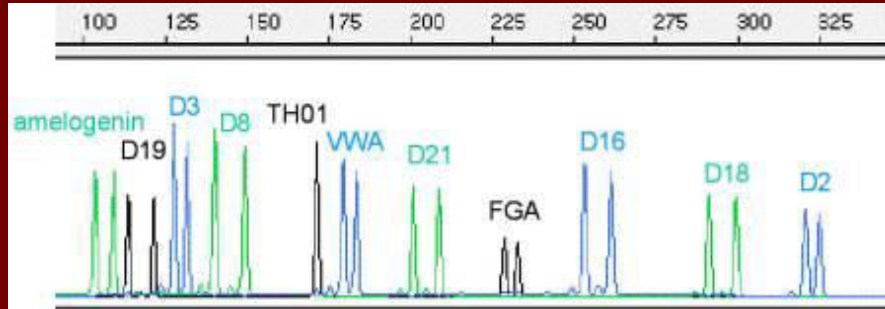
Applications

❖ Forensics

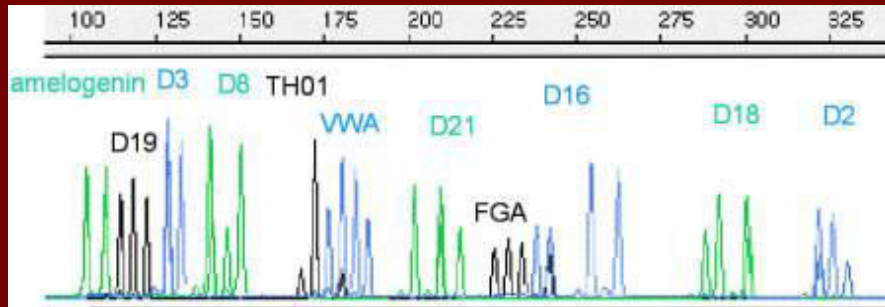


Applications

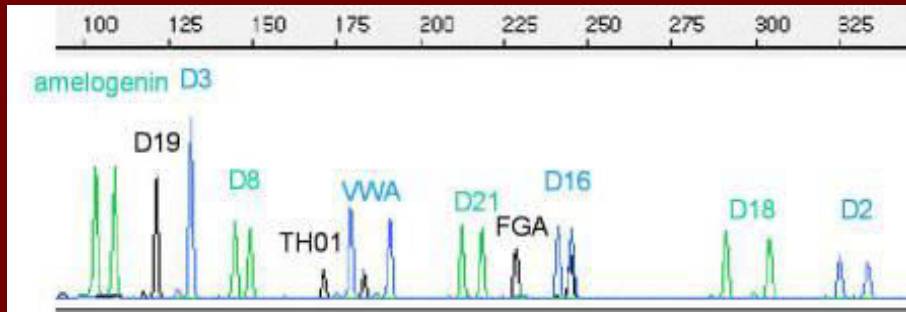
Victim



Crime Scene



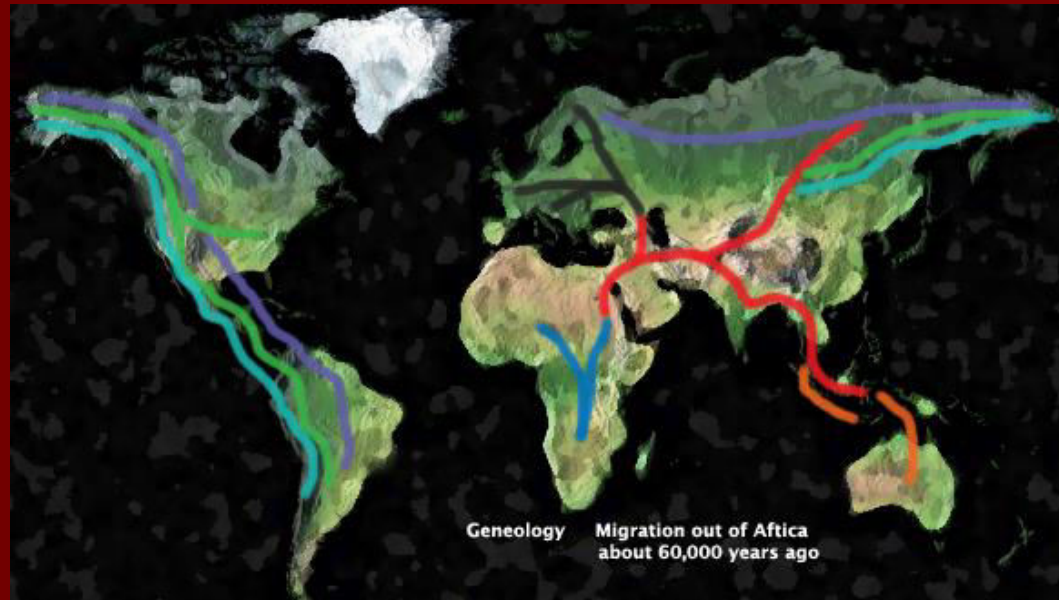
Suspect



DNA
Fingerprinting
Animation

Applications

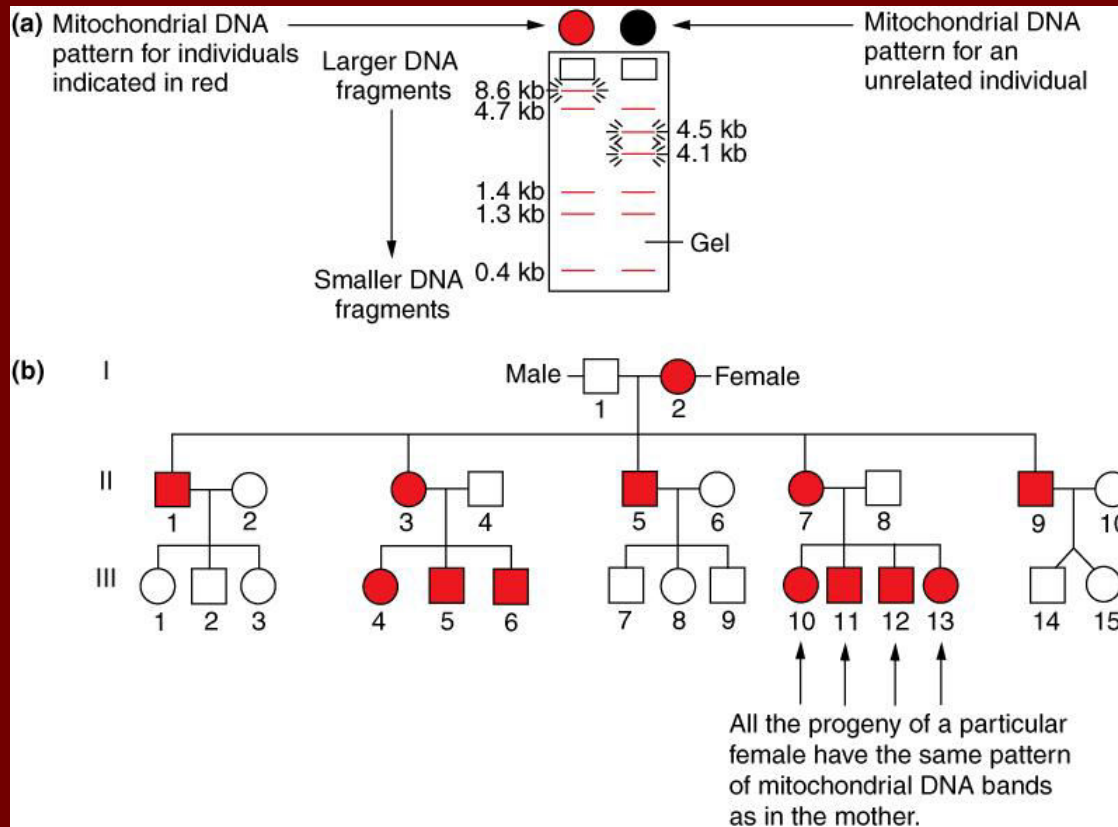
❖ Genealogy



Genealogy animation

Applications

❖ Genealogy



Thank you

