The Indispensable Forensic Science Tool

Chapter 10

Forensic Science

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Blood of Victim	Semen Recovered from Victim	Blood taken from Suspect A	Blood taken from Suspect B	Blood taken from Suspect C
_____		_____	_____	
	_____			
				_____
_____			_____	
	_____			
				_____

Sir Alec Jeffreys

- Jeffery's and his colleagues were responsible for the process of identifying and reading DNA Markers….DNA Fingerprinting!

- Biological Link-
  - Blood, Semen, Hair and Tissue form a single individual.

DNA

- **DNA** was discovered in the 1950's based on the work of Dr. Franklins technique of X-Ray crystallography!

- **Watson and Crick** capitalized on Dr. Franklin's discovery to identify the actual DNA structure as a **Double Helix**!

- DNA is a **POLYMER**!
- A **polymer** is a very large molecule made by linking a series of repeating units, or monomers…..in this case **NUCLEOTIDES**!

PCR: Polymerase Chain Reaction

- In **PCR**, small quantities of DNA or broken pieces of DNA identified at a crime scene can be COPIED with the aid of DNA Polymerase.

- The copying process is accomplished with the use of a **DNA Thermal Cycler**.
- Each cycle of the PCR technique results in doubling of the DNA Sample.
- 30 Cycles can multiply DNA a billion-fold.

- Sample size is no longer a limitation in characterizing DNA recovered at crime scenes.

DNA Typing with Tandem Repeats

- **DNA molecules** contain sequences of letters that are frequently repeated.
- 30% of the Human Genome is composed of repeating **DNA Sequences**.

- These sequences are know as **Tandem Repeats**!

- **Tandem Repeats** allow Forensic Scientists the ability to distinguish one DNA sample form another through DNA Typing!

Restriction Fragment Length Polymorphisms

- **RFLP's** are repeats cut out of the DNA double helix by a restriction enzyme that acts like a pair of scissors.
- Typically, a standards **RFLP sequence** is 15-25 base pairs long and repeats itself up to a thousand times (1000X).

Electrophoresis

- The **differences** in length between DNA and RFLP's allows Forensic Scientists to distinguish one person from another.
- Once the molecules have been cut by the restriction enzyme, the samples must be sorted out using **Electrophoresis**.

- During the **Electrophoresis Process**, DNA samples cut by restriction enzymes are placed in a gel medium.
- When the gel is subjected to an electrical current, the fragments move across the gel based on relative size (Larger Fragments move SLOWER than smaller Fragments).

Hybridization

- Once **Electrophoresis is completed**… the DNA fragments are chemically treated so the strands separate from each other.

- **Southern Blotting** is the movement of the separated strands to a nylon membrane treated with radioactive labeled probes containing base sequences complementary to the RFLP's being identified.

DNA Typing with RFLP

- The Nylon sheet is placed against X-ray film and exposed for several days. The radioactive decay strikes the film. When the film is processed, bands appear where the radioactive probes struck to the fragments on the Nylon Sheets.

- A typical DNA Fragment pattern shows TWO bands (One RFLP from each Chromosome)

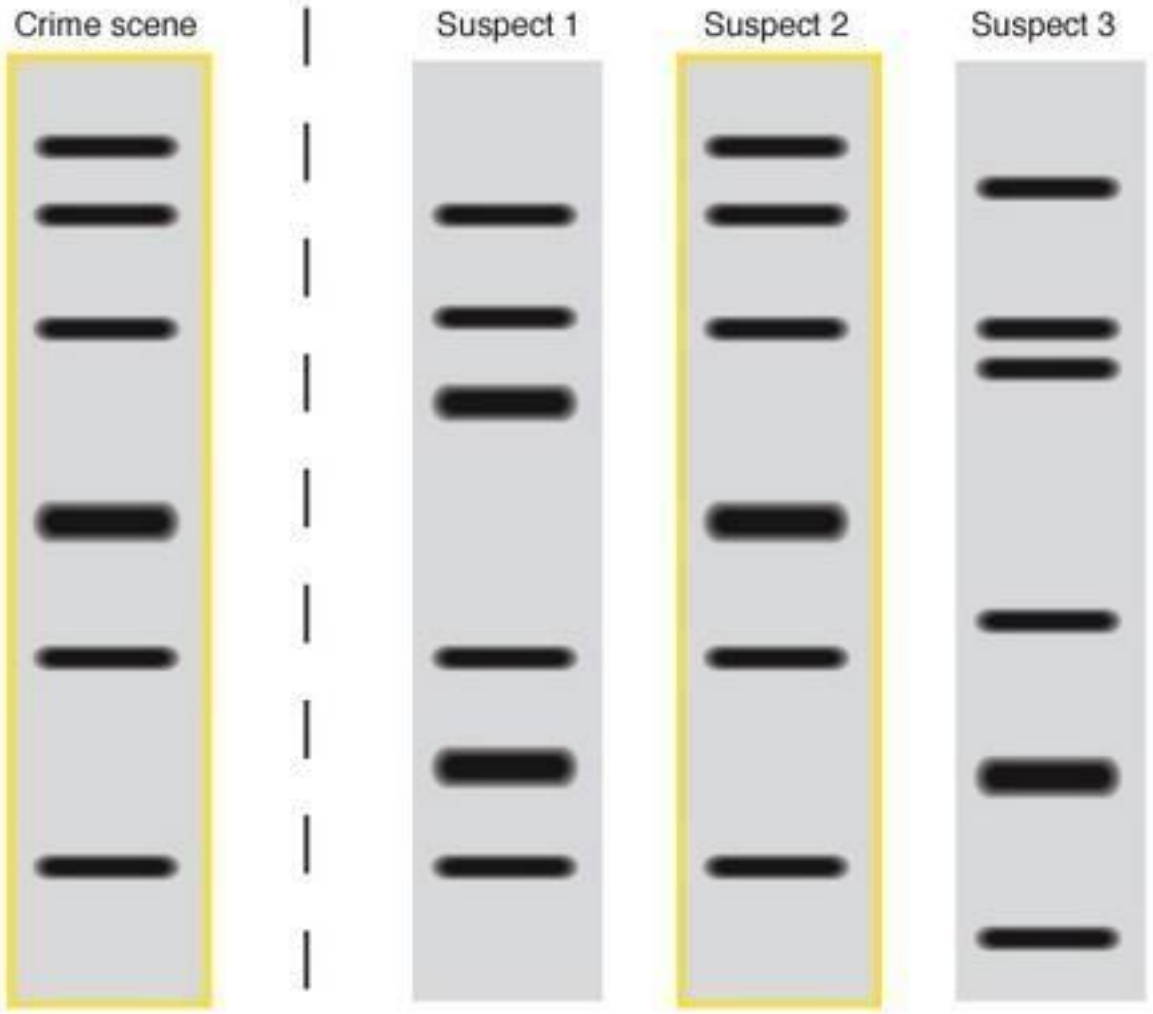
- **IMPORTANT:**
- Although only limited number of people in the population would have the same DNA fragment pattern as the suspect in the population would have the same DNA fragment pattern as the suspect, this test itself cannot be used to individualize the strain to the suspect.

Continued

- **Using additional DNA probes**, each of which recognizes different repeating DNA segments, a high degree of discrimination or even near individualization can be achieved.

- **RFLP DNA Typing** has the first distinction of being the first scientifically accepted protocol in the US. For Forensic Characterization of DNA.

Example


Crime scene
Suspect 1
Suspect 2
Suspect 3

Advantage of PCR

- **RFLP strands** are typically too long.
- **PCR** is best used with shorter fragments of DNA.
- Shorter samples are more stable….less likely to de damaged by environmental factors experienced at crime scenes.
- **PCR** being MORE SENSITIVE than **RFLP** can allow an analyst to characterize the smallest samples of DNA that could NEVER be detected by RFLP.

Polymerase Chair Reaction

- **PCR** is the outgrowth of knowledge gained from the understanding of how DNA strands naturally replicate.
- IMPORTANT:
- During **PCR**...DNA polymerase can be directed to synthesize a specific region of DNA.
- Therefore...PCR can be used to duplicate a strand of DNA understudy millions of time.

Lets Wrap it Up?

- DNA Extraction Lab…coming up soon!
- See me with questions and comments!
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