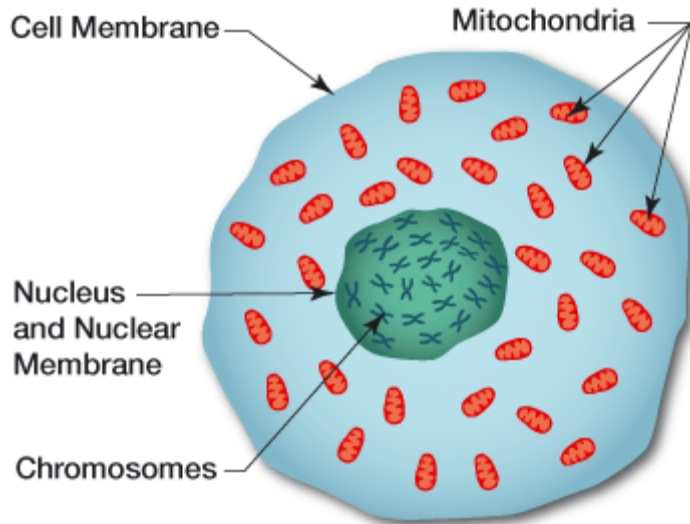


Unit 5 Notes: DNA

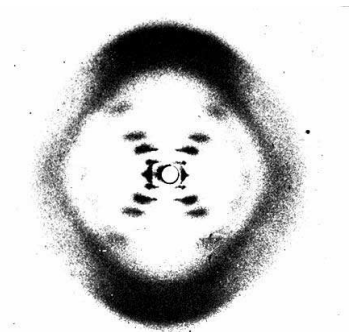
Forensic DNA Analysis: History and Structure of DNA

- What is DNA: stands for deoxyribonucleic acid and contains _____ information.
- It is found on chromosomes located in the _____ of our cells.



Historical Information

- 1953—James Watson, Francis Crick and Rosalind Franklin discover the configuration of the DNA molecule
- 1980—Ray White describes first polymorphic RFLP marker
- 1985—_____ isolates DNA markers and calls them _____
- 1985—Kary Mullis develops PCR testing
- 1988—FBI starts DNA casework
- 1991—First STR paper
- 1998—FBI launches _____ (Federal DNA database)



People of Historical Significance

- James Watson, Francis Crick, and Maurice Wilkins jointly received the Nobel Prize in 1962 for their determination of the _____.
- Interesting fact: _____ had as much to do with the discovery as the three men with her work on X-ray crystallography.
- She died of cancer and could not be honored for her work.

People of Historical Significance

- _____:
 - Credited with DNA profiling using _____
 - Restricting fragment length polymorphisms
 - September 1984, Jeffreys saw his first series of blots on an _____
 - Technique first used in _____,
 - Asked by police to confirm rape confession of 17-year-old Richard Buckland
 - Who was denying rape of another woman

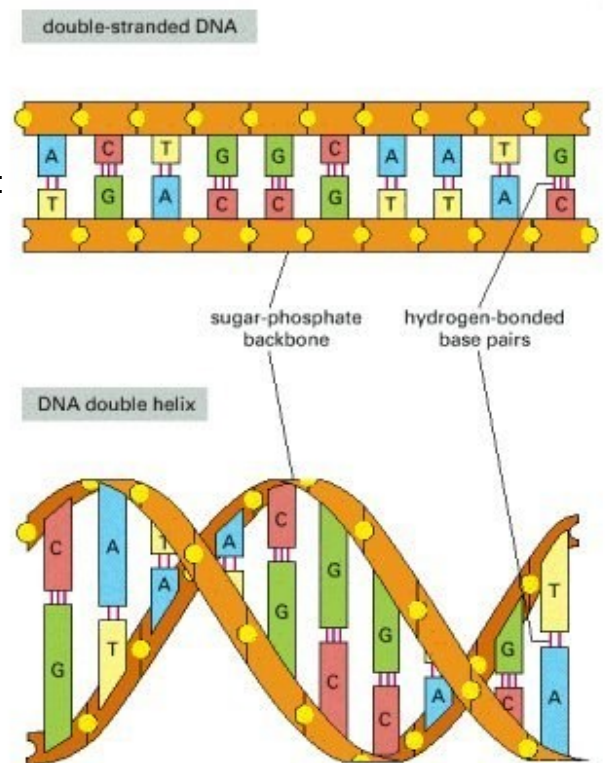
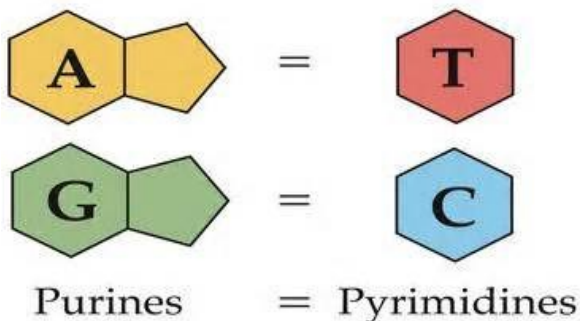
Mid-1980s: The Colin Pitchfork Case

- Two young women raped and murdered in Narborough, England
- Comparison of DNA from Buckland and DNA taken from the victims

- 5,000 local men are asked to provide _____ samples
- Jeffreys used samples from other suspects to later help convict Colin Pitchfork
 - Whose DNA _____ the samples from the victims
- 1st _____ and _____ using DNA evidence

DNA General Information

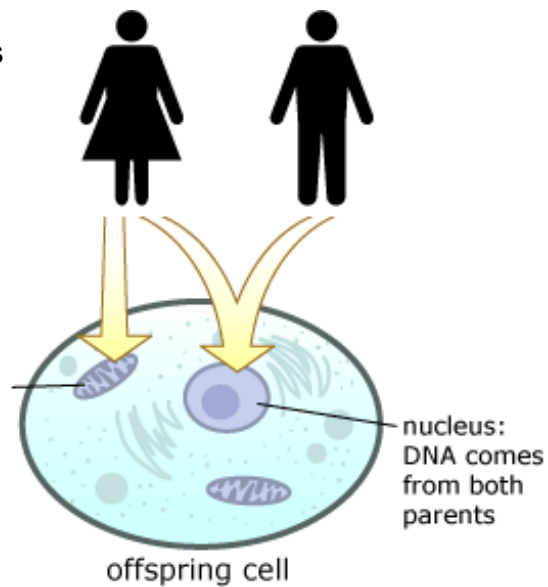
- Double helix—two coiled DNA strands
- Composed of nucleotides (a single unit) containing:
 - _____ (deoxyribose),
 - _____ group
 - Nitrogen-containing base (A, T, G, or C)



- In humans, the order of these bases is _____
- The _____ are made up of sugar and phosphate molecules
- The _____ that form the middle of the molecule are made up of pairs of nitrogen bases
- Four bases in DNA:
 - _____ (A) _____ (T)
 - _____ (G) _____ (C)
- Chargaff's Rule: Bases always pair A to T and G to C.
 - If a sample has 20% Adenine, how much thymine is present?
 - Guanine?

Types of DNA: Nuclear (DNA)

- Found in _____
- Has 23 pairs of chromosomes inherited from both parents
 - 46 total
- Each cell _____



Types of DNA: Mitochondrial (mtDNA)

- Found in the _____
- Is inherited _____
- Each cell contains hundreds to thousands of mitochondria
- Can be found in _____ remains
- Analysis of mtDNA is more:
 - Rigorous
 - Time-consuming
 - _____ than nucleic testing of DNA
- mtDNA is constructed in a circle or loop
- Thirty-seven genes are involved in mitochondrial energy generation
- Is used when _____

Where is DNA Found?

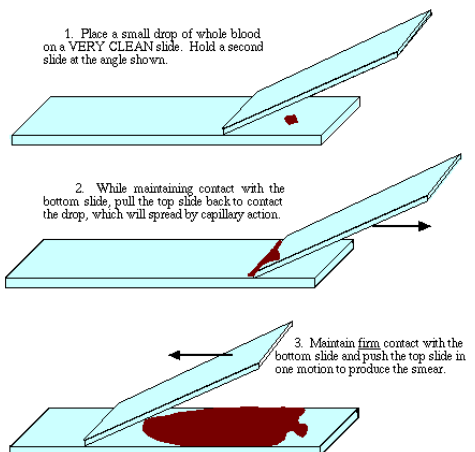
- Genes are portions of DNA that code for specific proteins
- DNA is found in all _____:
 - White blood cells, semen, saliva, urine, hair roots, teeth, bone, tissue, etc.
- Most abundant in _____ cells
- _____ have no nuclei
 - Therefore, _____
- DNA obtained from blood comes from _____

What Factors Affect DNA Evidence

- Several factors can affect DNA left at a crime scene, such as environmental factors:
 - _____
 - Sunlight
 - _____
 - _____
 - Mold
- _____
- DNA testing _____ identify _____ the suspect was at the crime scene or _____

DNA Collection & Comparison

- DNA is collected at crime scenes in a variety of ways using tools such as:
 - _____ and/or blood collection kits (for sample collection of suspects or living victims)
 - _____
 - Tweezers
 - Scissors
 - Sterile cloth squares
 - UV light
 - _____ →→→

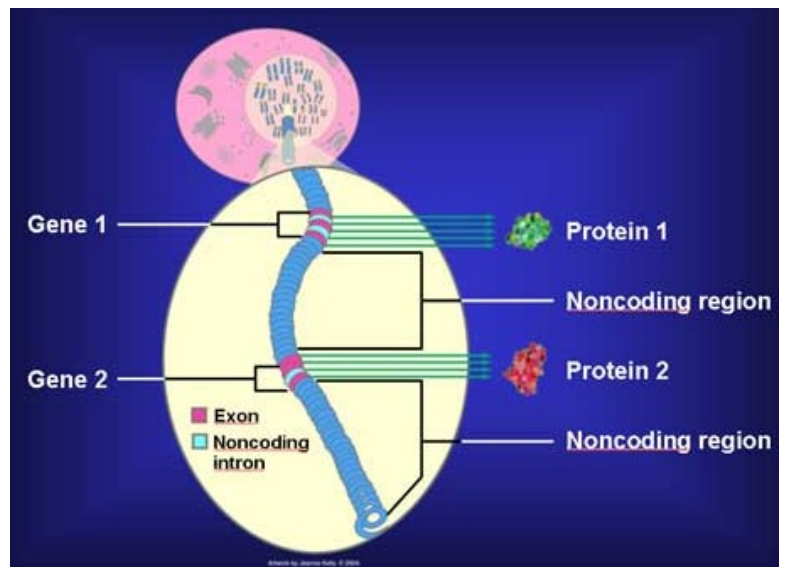
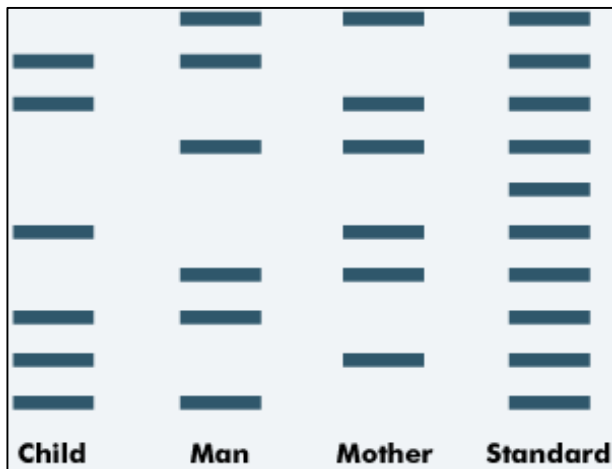


DNA Collection & Comparison

- How is blood collected?
 - Blood on _____:
 - Investigators submit _____
 - Or may use sterile cloth square and small amount of distilled water
 - Dried blood on _____:
 - Investigators send the _____ to the lab
 - Dried blood on a wall, tub or object too big to move to lab:
 - Investigators scrape blood sample into _____ for further analysis

DNA Typing

- Method where DNA is converted into a _____ that distinguish each individual (unique pattern)
- Only _____ of DNA (about 3 million bases) _____ from one person to the next
- Scientists use these _____ to generate a DNA profile of an individual



Non-coding Regions

- 3% of the human DNA code for stuff we need/use
- _____ is non-coding and is repetitive, _____ the same sequence over and over
- 50% of the human genome has interspersed repetitive sequences

Uses of DNA Profiling

- Identifying _____ suspects
- _____ individuals (finding them not guilty/set free)
- Identifying _____
 - Burned bodies, decomposed bodies, etc.
- Establishing _____ and proving family relations
 - “You are NOT the father!”
- Matching _____ donors
- Identifications of John Doe or Jane Doe
- Studying _____ and _____
 - Through nuclear and mitochondrial DNAs
- Studying _____ disorders

Forensic DNA Analysis Notes

The Double-Helix Model

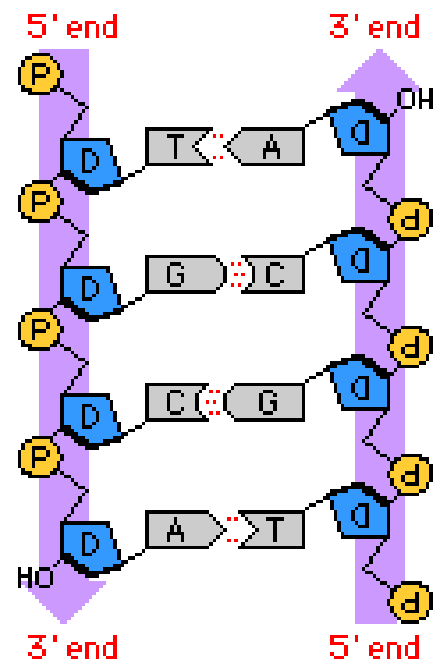
- Explains Chargaff’s rule of _____ (how strands DNA strands held together)
- The nucleotides can be joined together _____
 - So, any sequence of bases is possible

Antiparallel Strands

- In the double-helix model, the two strands of DNA are “antiparallel”— _____
- It allows each strand to carry a sequence of nucleotides
 - Like letters in a four-letter alphabet

Hydrogen Bonding

- Hydrogen bonds between bases hold the two strands together
 - _____ and _____
- Hydrogen bonds can be _____
 - Two strands can separate to be copied



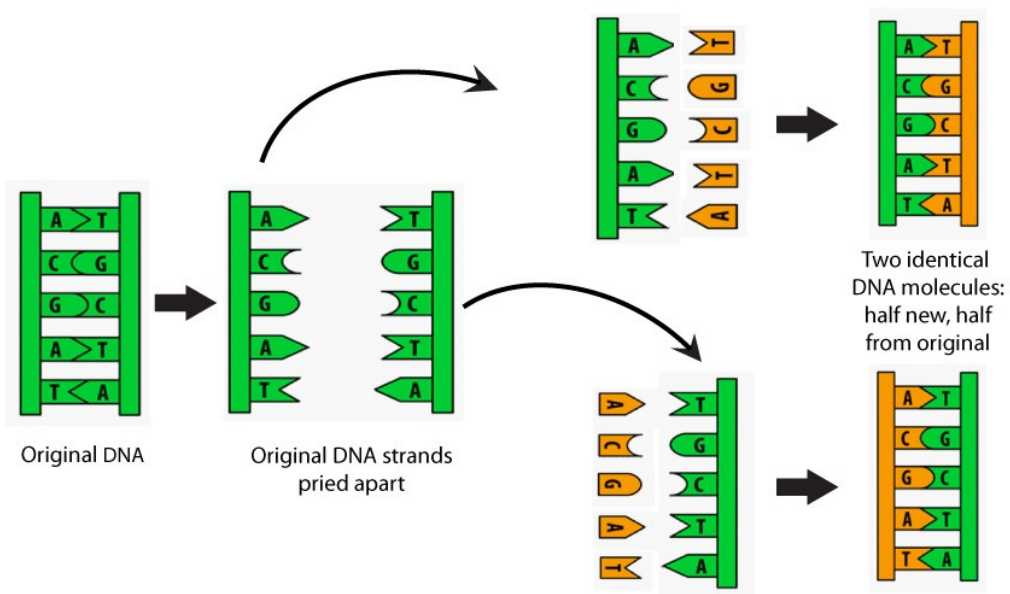
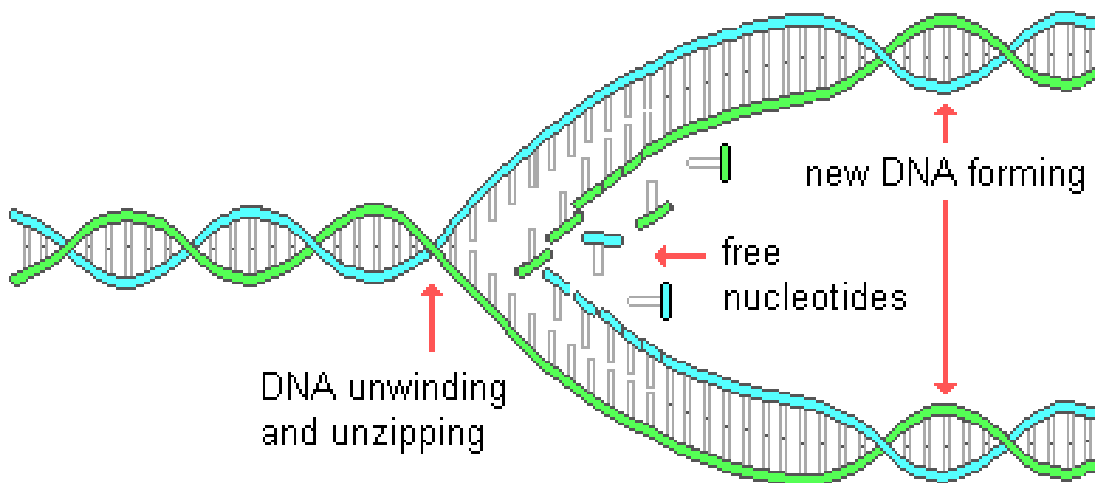
Copying the Code

- _____ of DNA has all the information needed to make the other half:

- Because each strand can be used to make the other strand, the strands are said to be _____

The Replication Process

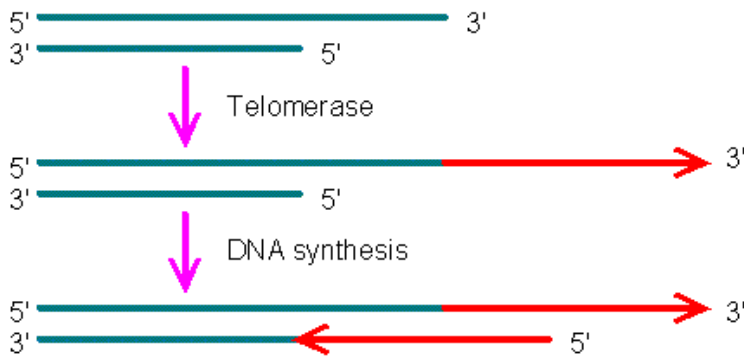
- During replication:
 - DNA molecule separates into _____
 - Then produces _____ strands
 - Each strand of the double helix of DNA serves as a _____, or model, for the new strand



- The result of replication is two DNA molecules identical to each other and to the original molecule.
- Each DNA molecule _____ has
 - One _____
 - One _____

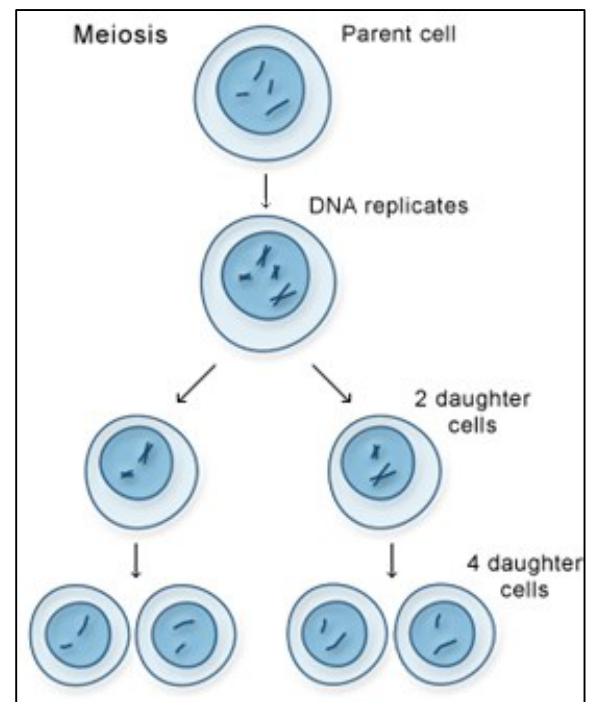
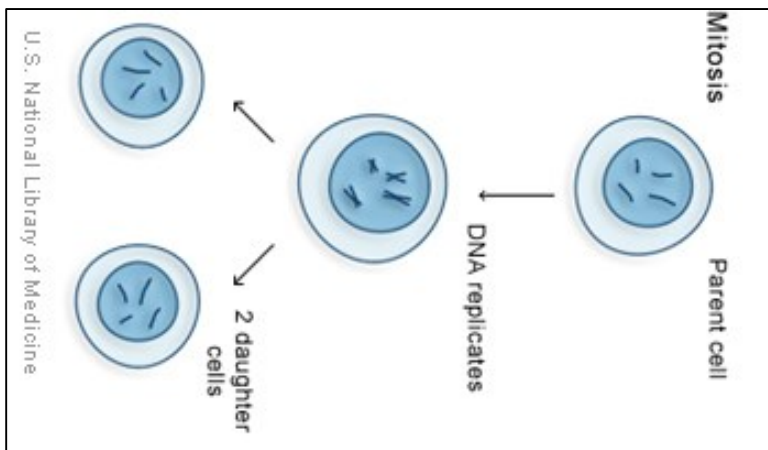
Telomeres

- _____ called **telomeres**
 - DNA is often lost from telomeres each time a chromosome replicates
 - An enzyme called _____ compensates for this problem by adding short DNA sequences to telomeres
 - Lengthening the chromosomes slightly



Eukaryotic DNA Replication

- The DNA copies separate from each other in anaphase of mitosis, producing two cells, _____ coded in DNA.



DNA Analysis Notes

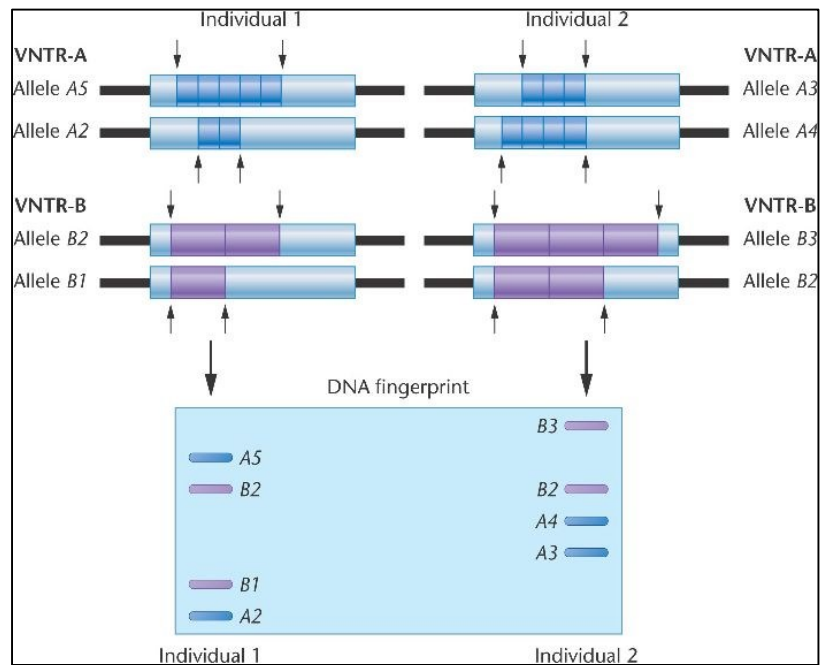
History of Biological Evidence in Forensics

- DNA fingerprinting
 - Also known as _____
 - Used with a _____
- Biological evidence is examined for the presence of inherited traits
- Some forensics laboratory techniques were originally developed for other purposes

DNA Profile

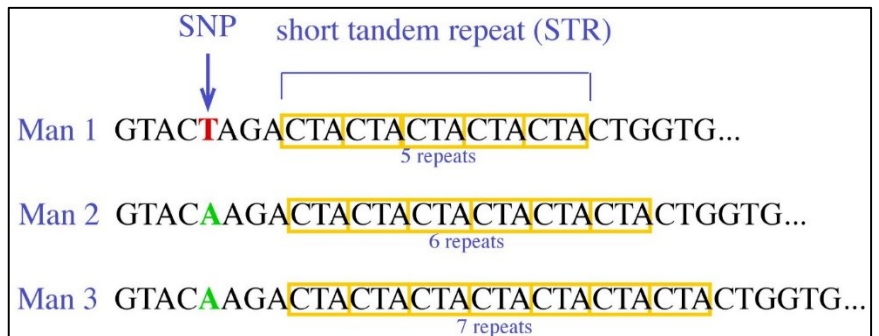
Two types of repeating DNA sequences:

- Variable Numbers of Tandem Repeats (**VNTR**)
 - The number of repeats varies from person to person
 - _____ bases in length



- Short Tandem Repeats (**STR**)

- _____ bases in length

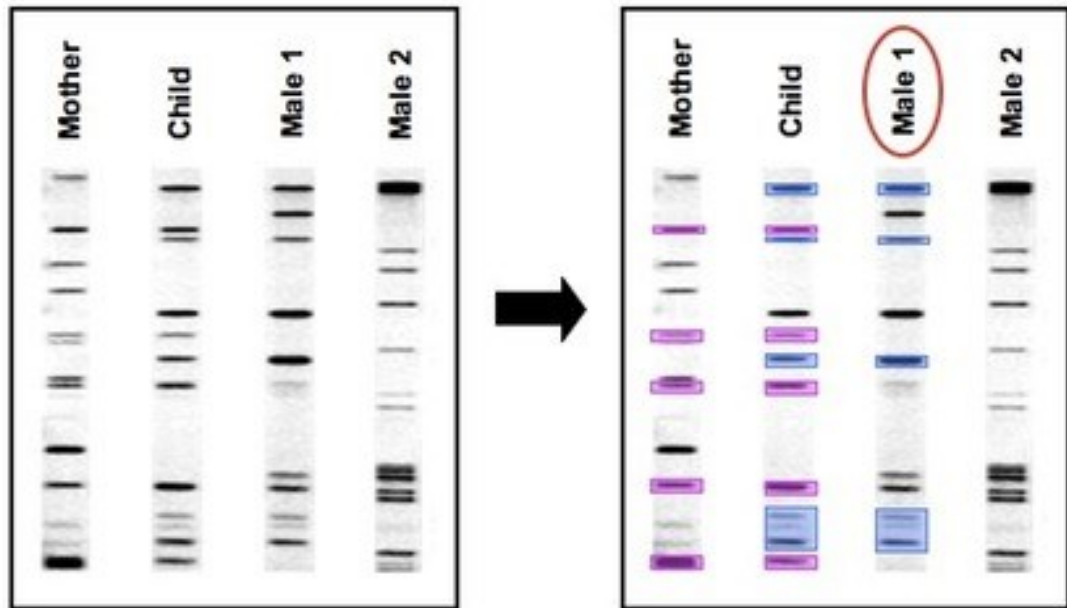


- Shorter lengths make _____ easier to use than _____

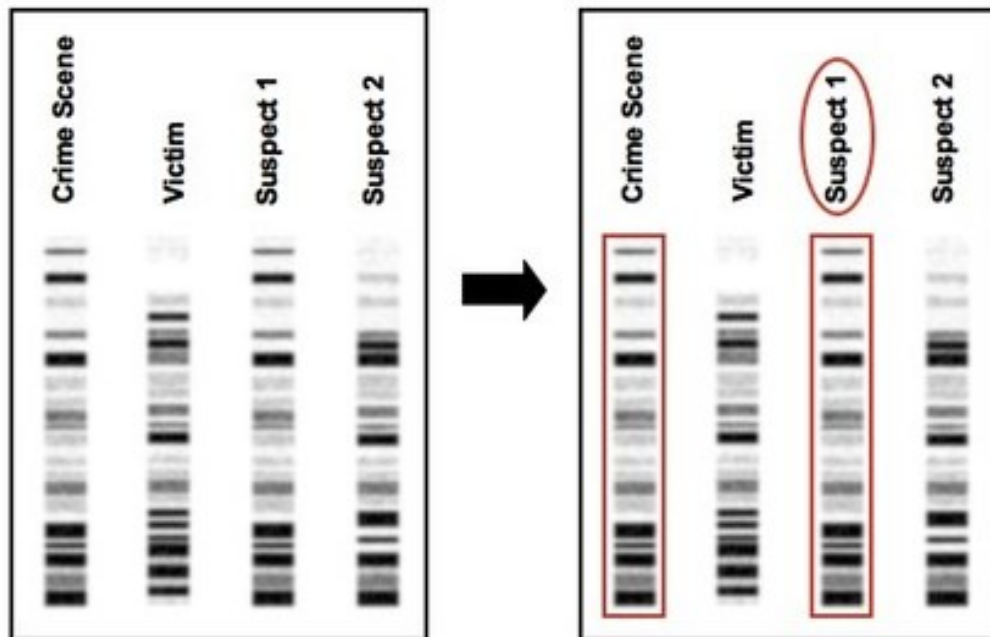
- VNTR and STR data are analyzed for
 - tissue matching
 - inheritance matching

DNA Profile Matching

- _____ Matching
 - Each band in a child's DNA fingerprint must be present in at least _____

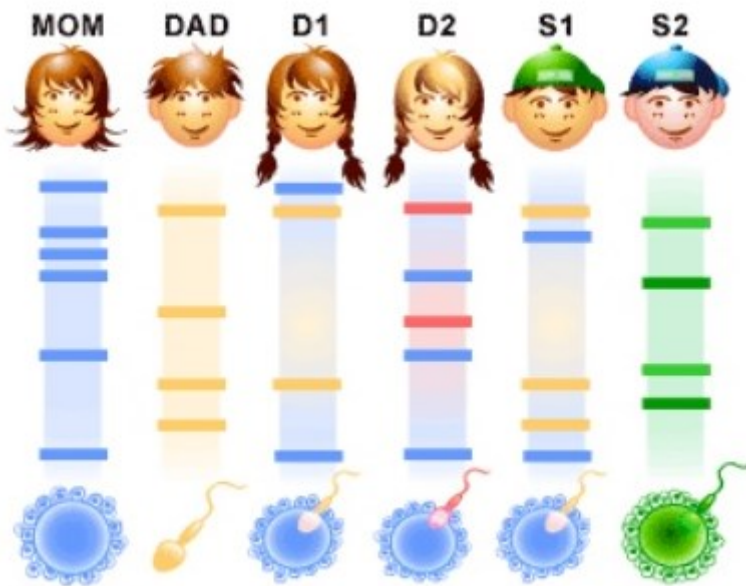


- _____ Matching
 - Two samples that have the same band pattern are from the _____

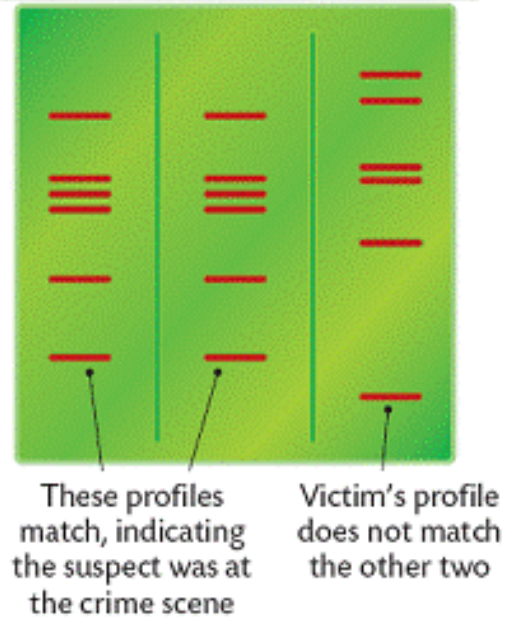


DNA Population Databases

- _____ genetics:
 - Study gene variations among groups of people
 - Look at probability of a person to have same form of a gene (an allele) as another person
- Identifying the suspect in a crime → → → → →
- Identifying an alleged father in a paternity case (below)



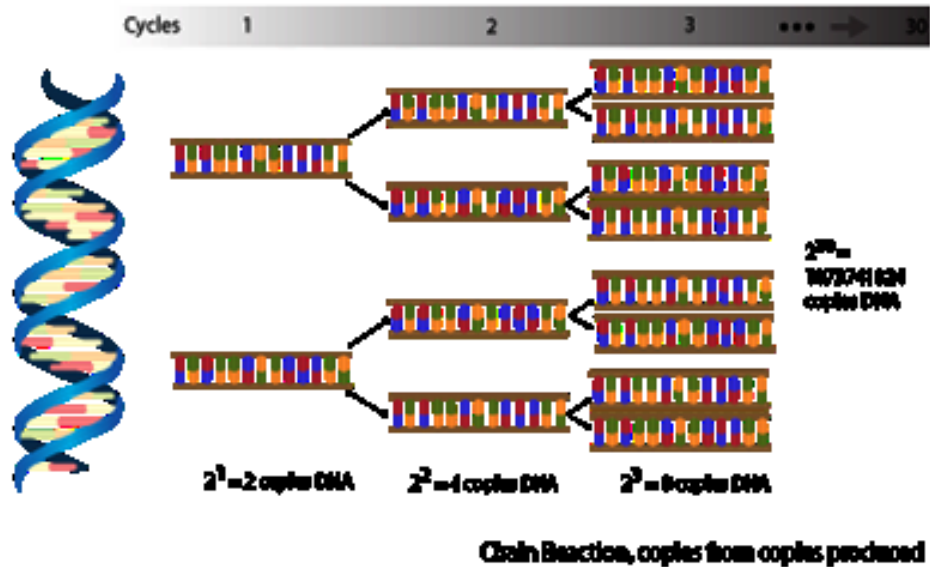
	PROFILE FROM	
SUSPECT'S	TISSUE AT	VICTIM'S
PROFILE	CRIME SCENE	PROFILE



Sources of DNA

- _____ evidence
 - Ex: saliva, blood, skin, hair, urine, etc.
 - _____
 - May be only **trace evidence** (Small amount)
- **Polymerase chain reaction (PCR)**
 - Makes _____ of DNA evidence
 - Amplifies the DNA “_____”

PCR amplification



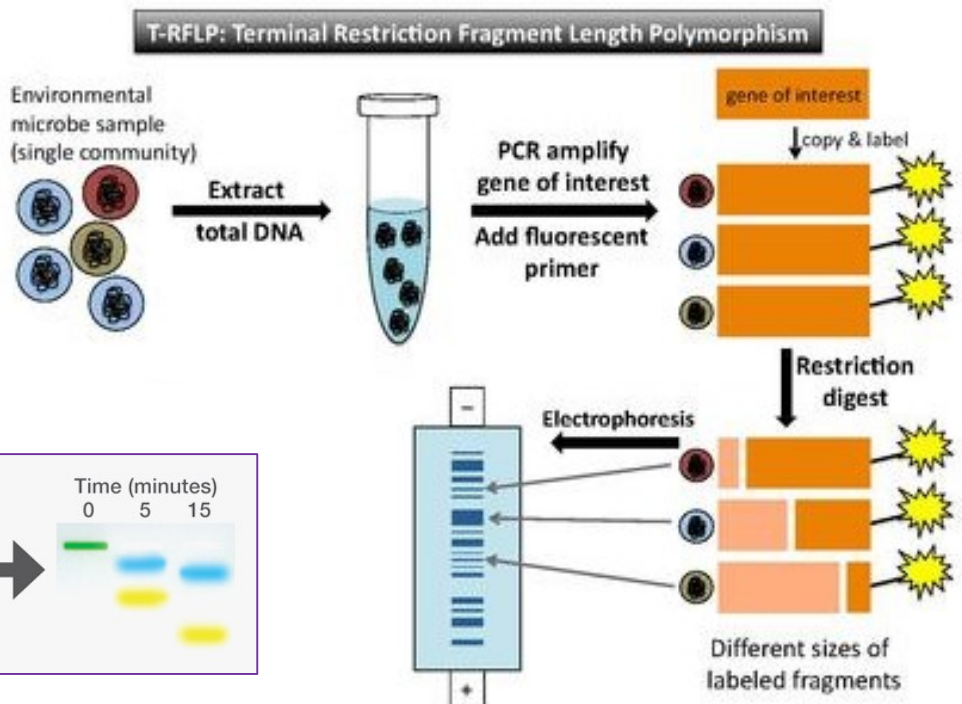
Collection and Preservation of DNA

1. Use disposable _____ and collection instruments
2. _____, talking, sneezing, and coughing in the evidence area
3. _____ evidence and put it into new paper bags or envelopes
4. Dry or freeze the evidence
5. Keep evidence _____ during transportation and storage

Preparing DNA Samples for Fingerprinting

Steps:

1. _____
2. _____
3. _____
4. _____

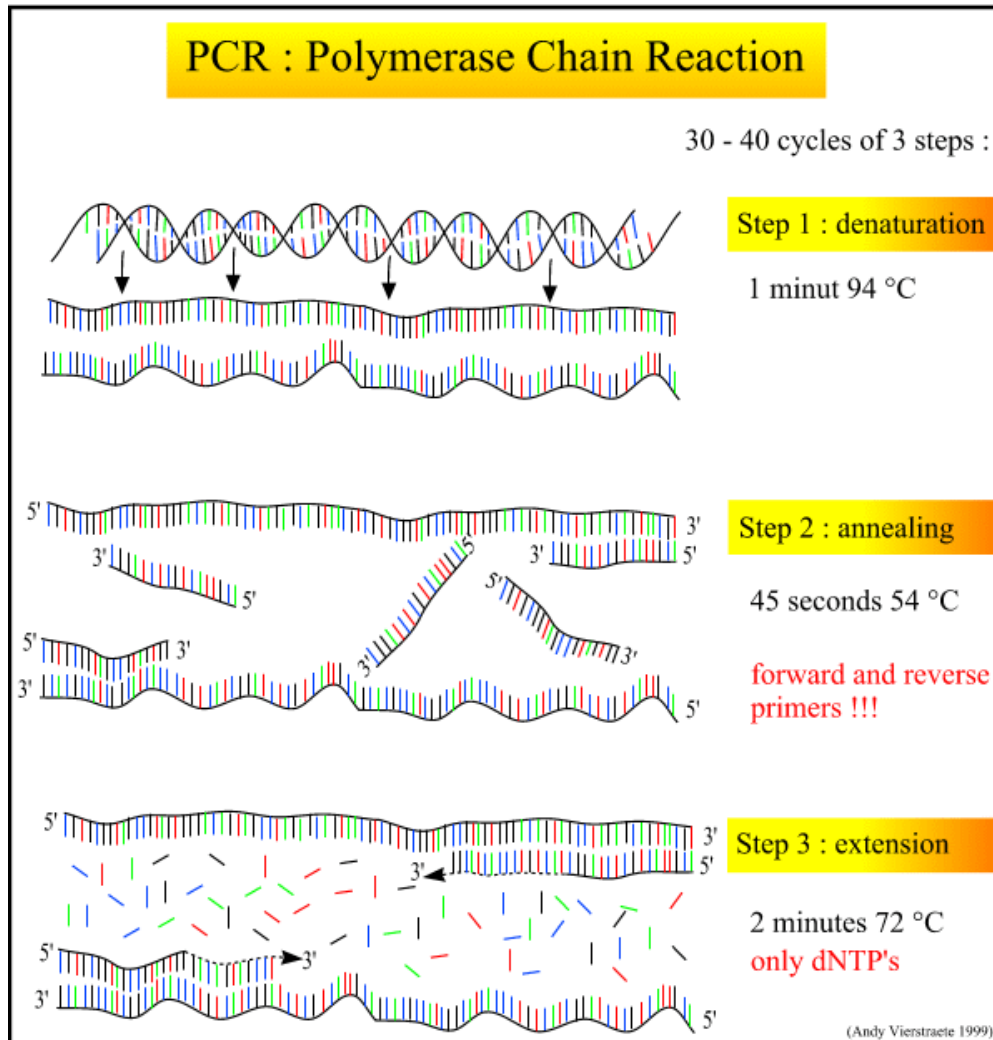


Step 1: Extraction

- A. Cells are isolated from biological evidence such as _____, semen, and hair
- B. The cells are broken to _____ from proteins and other cell components
- C. The DNA can be extracted from the _____

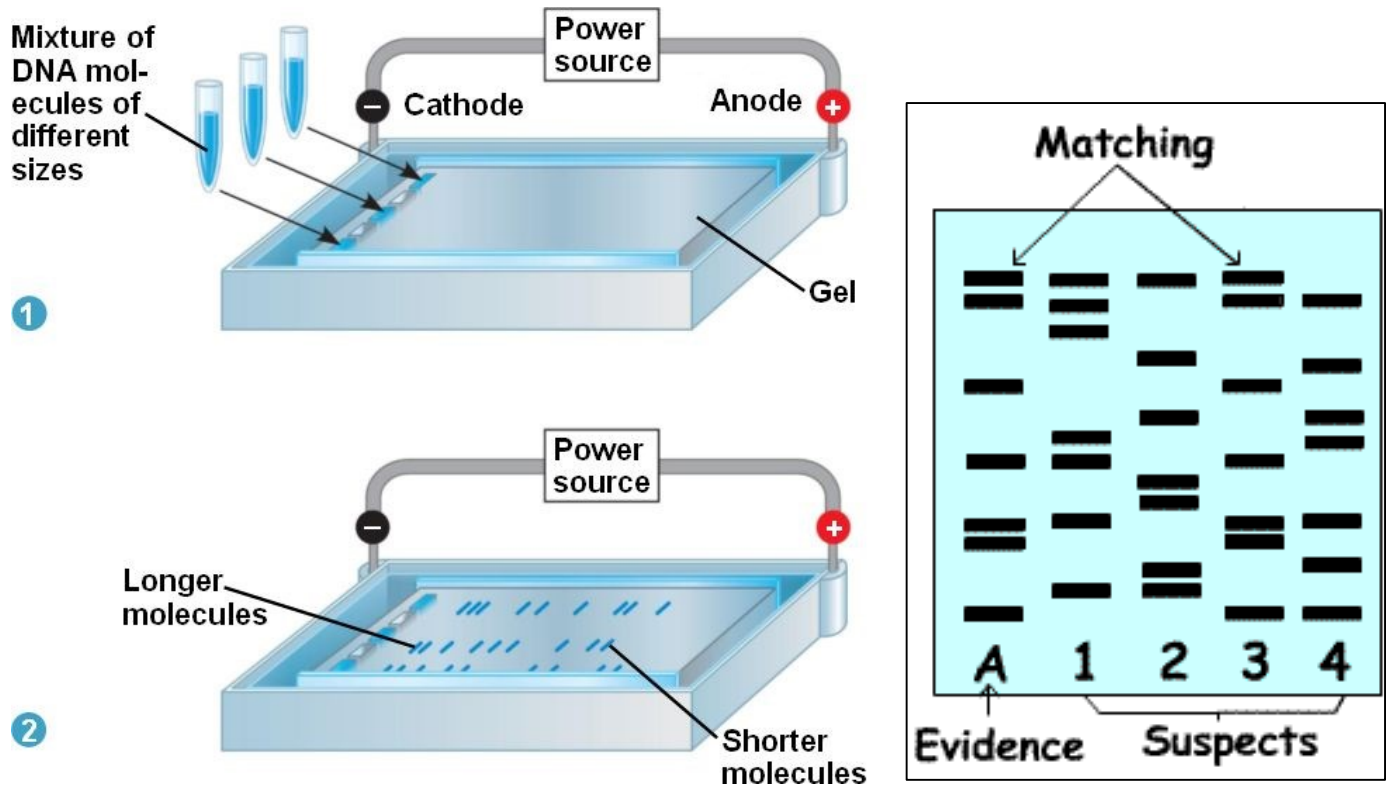
Step 2: Amplification via PCR

- VNTR analyses—polymerase chain reaction (PCR) can be used to amplify the DNA that contains the VNTRs
 - STR profiles—restriction enzymes are unnecessary; PCR allows the amplification of the strands with STR sequences
- I. **Denaturation** (heating): _____ to separate DNA strands
 - II. **Annealing** (cooling): _____ with ends of DNA
 - III. **Extension**: _____ adds nucleotides to the end of each primer



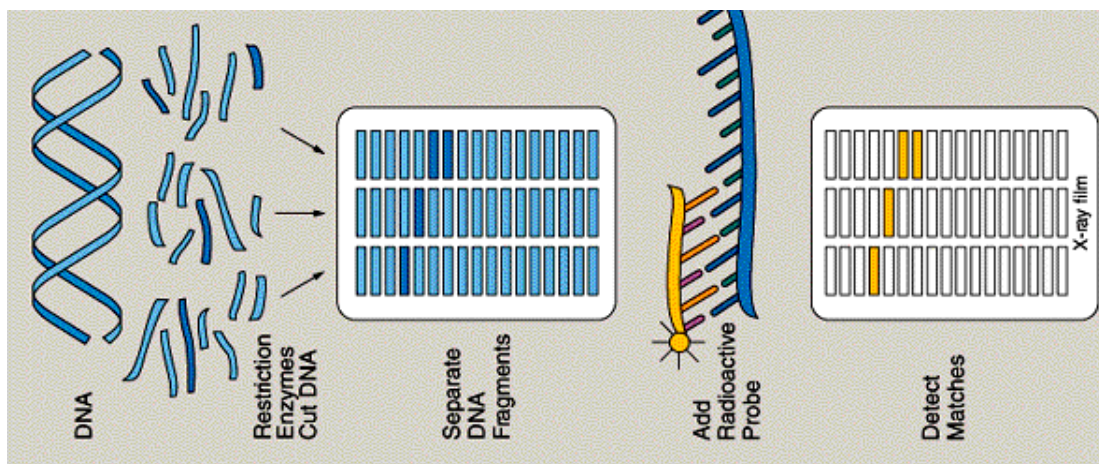
Step 3: Electrophoresis

- Bands of DNA are separated by size using _____
- a. DNA is mixed with special _____
- b. Enzymes cut apart the DNA in specific places forming different sized fragments
- c. DNA is separated within an _____
- d. An electric current is passed through the gel separating the fragments by size



Step 4: DNA probes

- Identify the _____ in a person's DNA
- Created of sequences of DNA bases _____ to original DNA strand
- Binds to complimentary bases in the strand
- In most criminal cases, _____ are used



Analysis of DNA Fingerprints and Applications

- _____ are significant in matching samples of DNA
- DNA fingerprinting can
 - Match crime scene DNA with a suspect
 - Determine maternity, paternity, or _____
 - Eliminate a suspect
 - Free a _____ individual
 - Identify human remains

..... Summary

- DNA contains information needed to copy DNA (replication)
- Allows even small amounts of evidence to be identified with a single person
- DNA many repeated sequences that vary in number (non-coding regions = VNTRs and STRs)
- Differences between individuals can be used to produce a DNA fingerprint for an individual
- Polymerase chain reaction (PCR) for DNA amplification has largely eliminated the problem of having only tiny samples/evidence
- DNA evidence must be collected carefully to avoid contamination with other DNA
- DNA analysis involves extraction of DNA, PCR, gel electrophoresis, and visualization (probes or staining)
- DNA profiles are kept by police agencies in electronic databases (CODIS)