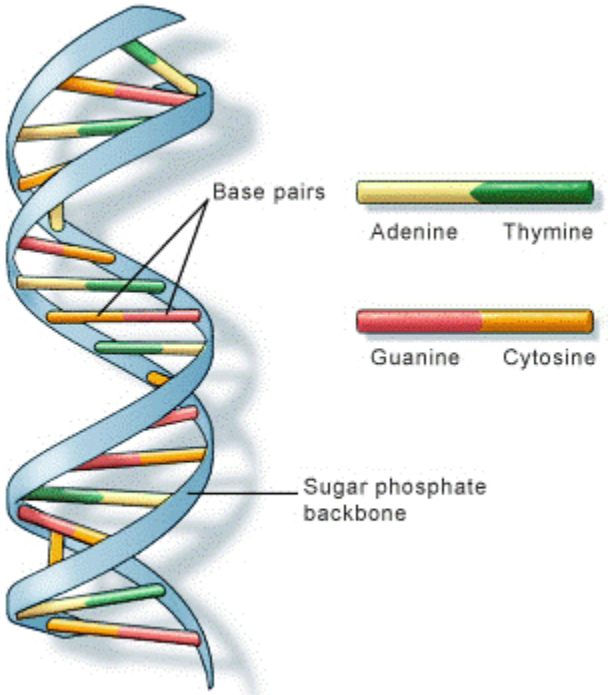
Review Sheet DNA Chapter 7

1. Define the following and give an example: karyotyping, biological evidence, radioactive probes, DNA, electrophoresis, allele, gene, STR,VNTR, unencoded DNA, chromosomes, genome, restriction enzymes, PCR, DNA polymerase, primers

   Karyotype- number and appearance of chromosomes in the nucleus of a cell
   Biological evidence – evidence from something living (hair, saliva, blood, etc.)
   Radioactive probes – molecule labeled with a radioactive isotope, dye, or enzyme that is used to located a particular sequence or gene on a DNA molecule
   DNA – a molecule composed of sugar, phosphate, and nitrogenous bases; contains all of your genetic information
   Electrophoresis – a method of separating molecules, such as DNA, according to their size and electrical charge using an electric current passed through a gel containing the samples
   Allele- a form of a gene
   Gene – a segment of DNA that contains information used to produce a protein
   STR – Short tandem repeat
   VNTR – variable number of tandem repeats
   Unencoded DNA – does not code for a protein
   Chromosomes – structure composed of tightly coiled DNA
   Genome – a person's complete set of DNA
   Restriction enzymes – molecule that cuts DNA at a specific base sequence
   PCR – polymerase chain reaction; used to rapidly make multiple copies of a specific segment of DNA
   DNA polymerase – adds nucleotides to create DNA
   Primers- short sequence of DNA that is the beginning site of DNA synthesis
2. How long has DNA been used in forensic science? What decade?

   1980s
3. Describe the structure of DNA including all parts and how they bond to each other. A always bonds to? G always bonds to?

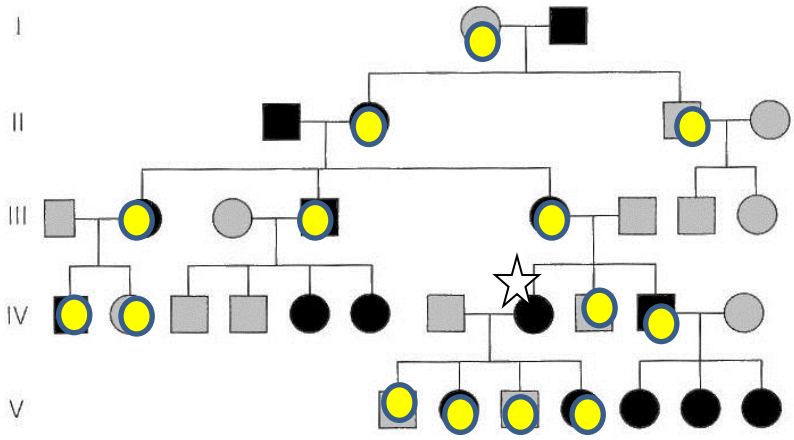


U.S. National Library of Medicine

4. What part of the DNA is used to create DNA profiles?

   Non-coding region; "junk DNA"

5. How much of the DNA is junk DNA?
   98.5%
6. How many chromosomes are in each cell in the body except the egg or sperm? How many are in the egg or sperm? How many base pairs are in all of this DNA?
   46; 23; 3 billion
7. How many strands of DNA make up each chromosome?
   2
8. What is DNA profiling and what is it used for?
   DNA profile is a visual representation of variations within peoples' DNA. Used for tissue matching and paternity.
9. What is mitochondrial DNA and how is it used in DNA profiling? Who is it inherited from?
   Found in mitochondrial only. Inherited from only your mother. You can trace back ancestry using mtDNA.
10. Indicate which individuals in the pedigree below would have the same mitochondrial DNA as the individual with a star next to them.




11. Describe the process of electrophoresis including all equipment/parts involved and what happens in each part. Be sure to include, agarose gel, restriction enzymes, radioactive probes
    An agarose gel is placed in an electrophoresis chamber with a buffer solution. The wells of the gel are placed near the negative electrode. DNA is cut with restriction enzymes into fragments, and labeled with radioactive probes so that only certain bands are visible. DNA is loaded into the gel, and the electric current is applied. DNA migrates toward the positive end of the gel, with the shorter fragments moving fastest and the larger fragments moving slowest.
12. How is the DNA separated in gel electrophoresis?
    By size
13. What would happen is you loaded the DNA in an electrophoresis chamber at the positive end not the negative end?
    Nothing; DNA is negatively charged, so would not be attracted to the negative end.
14. What is CODIS? What do the letters stand for?
    Combined DNA Index System; database that stores DNA profiles of people that have been convicted of serious crimes.
15. Describe the process of PCR. Include how it is done, what natural process it is similar to and how, why it is done.
    It is similar to DNA replication. First, primers are added to the DNA molecule. DNA polymerase bind at the site of the primers and then adds nucleotides complementary to the DNA strand.
16. On a gel how would you be able to tell which bands had gone through more amplification of PCR?
    They would be thicker/darker
17. Why do you have to change the temperature throughout the process of PCR?
    First temperature change splits DNA. Second allows primers to attach. Third activates DNA polymerase.

18. What enzymes are involved in PCR and what do they do?

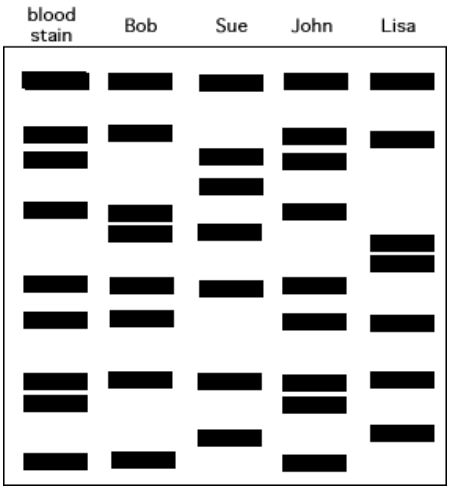
DNA polymerase – adds nucleotides

19. Look at the DNA fingerprint to the right and answer the questions that follow:

Which person is a match to the blood stain? John

How do you know?

All bands match the blood stain.




20. Below is a DNA molecule. You have just been given the restriction enzyme *Hind* III, which recognizes the sequence A|AGCTT and cuts the DNA as shown.

TTCGA|A

How many DNA fragments would you end up with if the DNA below is exposed to this enzyme?

.

GCTTAAGCTTCGATACGGTACCATGCAAGCTTAACGTAAGCTTGCTACGTGAAG

CGAATTCGAAGCTATGCCATGGTACGTTCGAATTGCATTCGAACGATGCACTTC

4. (3 cuts = 4 fragments)

21. Use the following data table to determine the genotype of Mr. Cash

| Person | D3 | VWA | FGA | AMEL | D8 |
|---|---|---|---|---|---|
| Mr. Cash | 16,21 | 11, 15 | 22,27 | X,Y | 8,17 |
| Mrs. Cash | 18 | 17, 21 | 20,25 | X | 13, 19 |
| Joey Cash | 16,18 | 15, 17 | 20,27 | X,Y | 13,17 |
| Amelia Cash | 18, 21 | 11, 21 | 25, 27 | X | 8,19 |
| Stefani Cash | 16,18 | 15, 21 | 22,27 | X | 17,19 |

Could a person with the following genotype be Mr. Cash's long lost son? Why or why not?

D3 16, 22 VWA 11, 19 FGA 27 AMEL XY D8 19, 25

No. The son has a 19 and 25 allele for the D8 locus. Mr. Cash does not have either of these alleles.

22. Give the genotype of the person below.


23. Calculate the frequency of a person with the following peaks on their DNA profile:

D3 = 13 vWA = 18,20 FGA = 24,25

$(0.011^2) = 0.000121$ $(0.000121)x\ (0.004972)\ x\ (0.01536) = 9 \times 10^{-9}$

$2(0.226)(0.011) = 0.004972$

$2(0.120)(0.064) = 0.01536$

24. Use the following information to show how you would calculate the frequency of the father being a match to the child.

| Locus | Mom | Child | Alleged Father |
|---|---|---|---|
| D3 | 13, 15 | 15 | 15, 16 |
| VWA | 14 | 14,18 | 18 |
| FGA | 19, 26 | 22, 26 | 22, 27 |

(0.299) x (0.226) x (0.182) = 0.0123

**Allele Frequencies**

**D3**

| Allele | Freq. |
|---|---|
| 13 | .011 |
| 14 | .089 |
| 15 | .299 |
| 16 | .246 |
| 17 | .207 |
| 18 | .137 |

**vWA**

| Allele | Freq. |
|---|---|
| 14 | .102 |
| 15 | .128 |
| 16 | .218 |
| 17 | .251 |
| 18 | .226 |
| 19 | .067 |
| 20 | .011 |

**FGA**

| Allele | Freq. |
|---|---|
| 18 | .017 |
| 19 | .067 |
| 20 | .145 |
| 21 | .187 |
| 22 | .182 |
| 23 | .156 |
| 24 | .120 |
| 25 | .064 |
| 26 | .036 |
| 27 | .010 |
| 28 | .010 |