

DNA Study Guide

1. Write the full name of the molecule DNA.

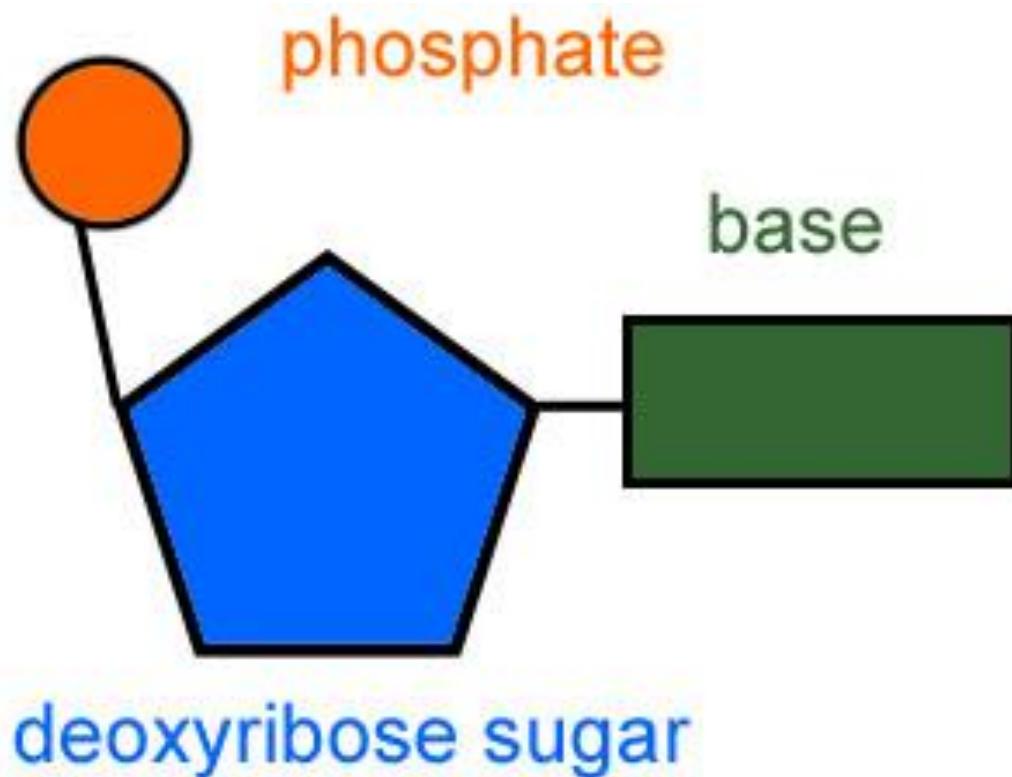
- Deoxyribonnucleic Acid

2. Describe the structure of a DNA molecule as proposed by Watson Crick in 1953.

- Double Helix



3. Draw and label the structure of a DNA nucleotide.

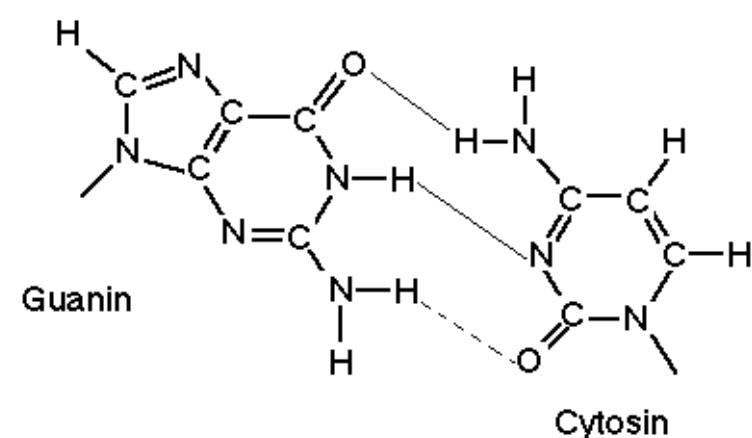
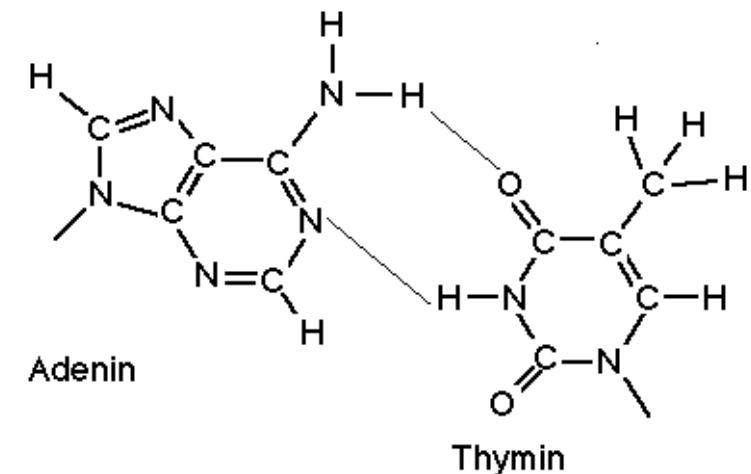
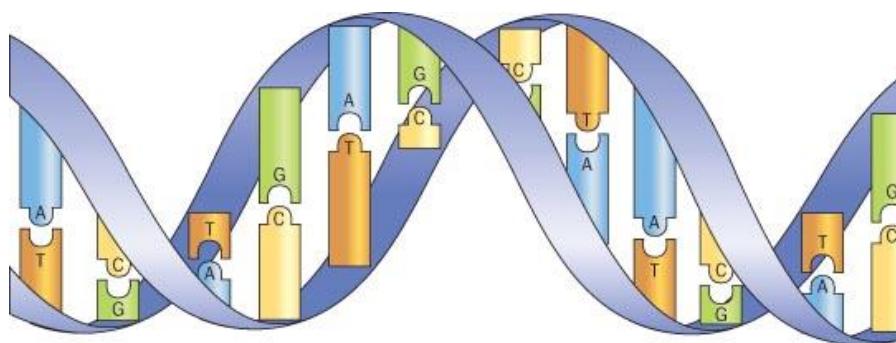


4. List four nitrogen bases found in a DNA molecule

- Adenine
- Thymine
- Cytosine
- Guanine

5. Explain complementary base pairing of DNA

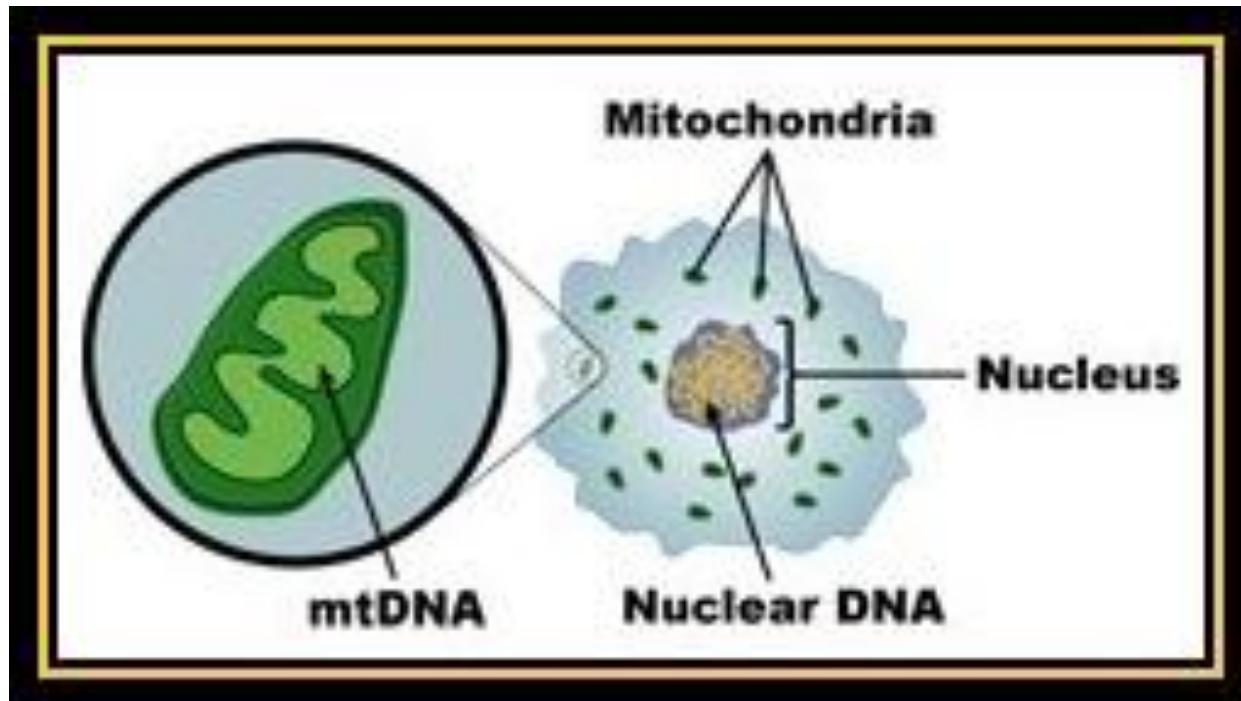
- Base-Pairing Rules
 - adenine (A) binds only with thymine(T)
 - Cytosine (C) binds only with guanine (G)



6. State the function of a DNA molecule.

- DNA contains the genetic material of a cell; holds all of the instructions needed for a cell to make proteins and to replicate.

7. Describe two different organelles within a cell where DNA can be found.



8. Discuss the relationship among DNA and genes.

- A gene is the basic physical and functional unit of heredity.
- Genes, which are made up of DNA, act as instructions to make molecules called proteins.

9. Compare DNA found in

- A. Two unrelated individuals. – **share about 97% of the same Nitrogen bases**
- B. Two related individuals. – **Will share greater than 97% Nitrogen bases.**
- C. Identical twins. – **Will have the same genetic material**

10. Describe how DNA analysis is used in areas other than solving crimes.

Inheritance Matching

- Each band in a child's DNA fingerprint must be present in at least one parent

11. Explain what is meant by the human genome and the number of genes found in the human genome.

- Genome is the complete set of genetic material of an organism.
- the exact number of genes encoded by the genome is still unknown
- The International Human Genome Sequencing Consortium researchers have confirmed the existence of **19,599** protein-coding genes in the human genome and identified another **2,188** DNA segments that are predicted to be protein-coding genes.
- ***So, essentially 20,000-25,000***

12. Describe what percentage of your DNA consists of the coding portion of DNA and what percentage of your DNA consists of the non-coding DNA?

- 3 percent of the human DNA sequences code for proteins
- 97 percent is non-coding and is repetitive; repeating the same sequence over and over

13. Explain the difference between an allele and a gene.

- A gene is the basic physical and functional unit of heredity.
- Genes, which are made up of DNA, act as instructions to make molecules called proteins.
- An allele is an alternative form of a gene

14. Describe what are VNTRs (Variable Number of Tandem Repeats).

- A. These initials are abbreviations for what words?
Variable Number of Tandem Repeats
- B. What size are VNTRs? 9 to 80 bases in length
- C. Why don't they seem to have any effect on the person (refer to "junk DNA")

15. Explain the role of VNTRs in gel electrophoresis

- VNTRs separate during electrophoresis to provide bands to be read as a DNA profile.

16. Discuss Sir Alex Jeffrey's observations about polymorphisms found within DNA

- Alec Jeffreys found that RFLP (P for Polymorphisms) technology could be used to develop patterns of restricted DNA that were more or less specific to an individual.

17. Compare and contrast VNTRs with STR
(short tandem repeat) in regard to:

- Short Tandem Repeats (**STR**)
2 to 5 bases in length
- Variable Numbers of Tandem Repeats (**VNTR**)
9 to 80 bases in length

18. Explain the role of DNA fingerprints in:

- a. Tissue matching - Two samples that have the same band pattern are from the same person

- b. Inheritance matching - Each band in a child's DNA fingerprint must be present in at least one parent

19. Describe an example of varying allele frequencies found between two different populations and how allele frequencies are determined through population studies. (Population Genetics)

	Caucasians	African American	Hispanic	Asian
O +	37%	47%	53%	39%
O -	8%	4%	4%	1%
A +	33%	24%	29%	27%
A -	7%	2%	2%	0.5%
B +	9%	18%	9%	25%
B -	2%	1%	1%	0.4%
AB +	3%	4%	2%	7%
AB -	1%	0.3%	0.2%	0.1%

American RedCross: Blood Type and the American Population

- Almost 100% of South Americans have type O

20. List 4 different sources of DNA that can be collected from a suspect.

- isolated from biological evidence such as blood, saliva, urine, semen, and hair

21. Explain why DNA evidence is considered to be individual evidence

- DNA analysis allows even a small sample of tissue to be identified with a single individual.
- DNA contains, in non-coding regions called *junk DNA*, many repeated sequences that vary in number between individuals.
- These differences between individuals can be used to produce a DNA fingerprint for an individual.

22. Explain the role of PCR in DNA evidence amplification.

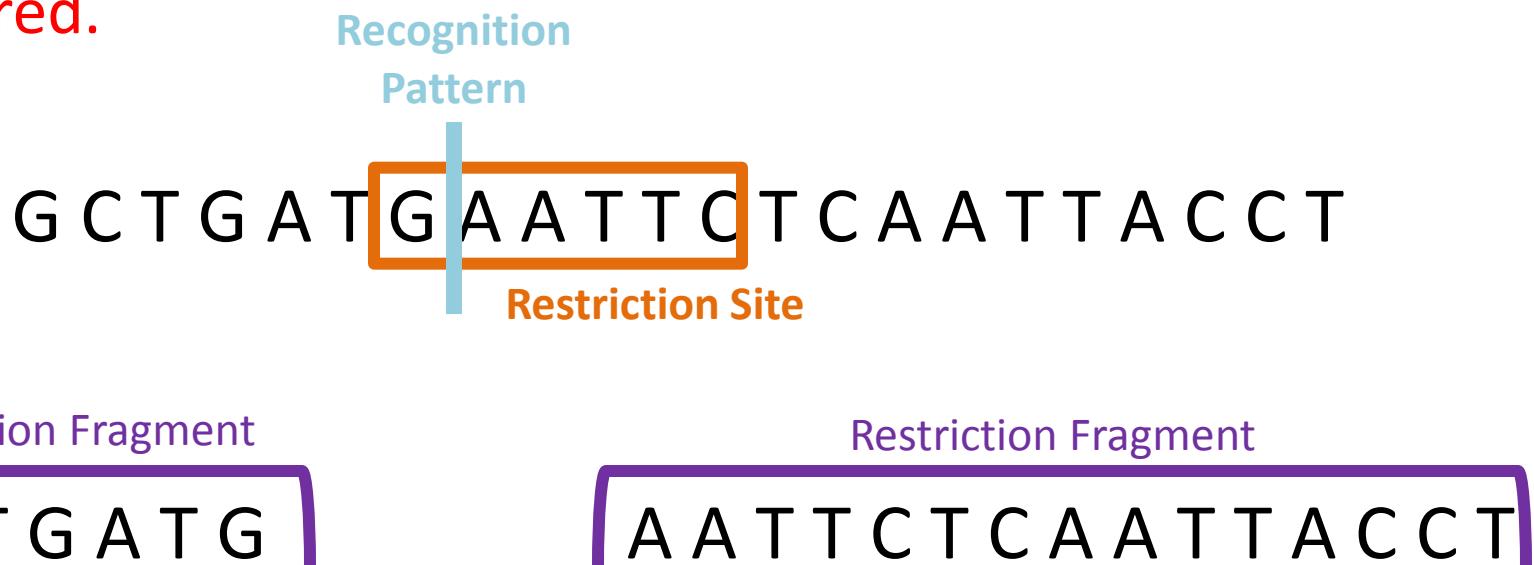
- PCR is a technique for making many copies of a defined segment of a DNA molecule.
- Polymerase chain reaction (PCR) for DNA amplification has largely eliminated the problem resulting from the tiny samples usually available.

23. Explain how DNA evidence is collected and packaged.

1. Use disposable gloves and collection instruments
2. Avoid physical contact, talking, sneezing, and coughing in the evidence area
3. Air-dry evidence and put it into new paper bags or envelopes
4. Dry or freeze the evidence
5. Keep evidence cool and dry during transportation and storage

24. Discuss how restriction enzymes are used in DNA fingerprinting. Include in your answer:

- a. Restriction sites on DNA – where enzyme attaches to DNA strand; ex) GAATTC
- b. Recognition patterns on DNA – where the “cut” occurs; ex) GA
- c. Restriction fragment – what results after the “cut” has occurred.



25. Given a restriction enzyme and its recognition site, to be able to determine where the enzyme will cut and how many bands will be produced after the digest.

Recognition
Pattern

G C T G A T **G A A T T C** T C A A T T **G A A T T C** A C C T

Restriction Site

Recognition
Pattern

G C T G A T **G A A T T C** T C A A T T **G A A T T C** A C C T

Restriction Site

Restriction Fragment

G C T G A T G

Restriction Fragment

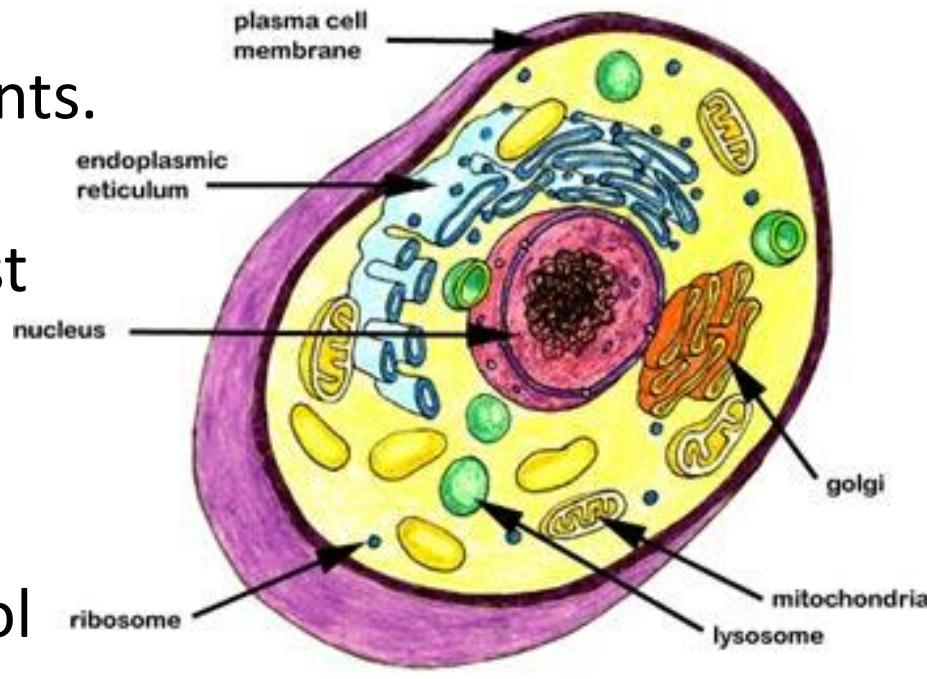
A A T T C T C A A T T G

Restriction Fragment

A A T T C A C C T

26. Discuss how DNA is extracted from cells.

- Removing membrane lipids by adding a detergent or surfactants.
- Removing proteins by adding a protease (optional but almost always done).
- Removing RNA by adding an RNase (often done).
- Mixing the DNA with an alcohol — usually ice-cold ethanol or isopropanol. Since DNA is insoluble in these alcohols, it will clump together, giving a *pellet* upon centrifugation.



Human Cheek Cell

27. Explain the term gel electrophoresis and state the role of each of the following items:

- A. Gel – **the medium through with the DNA moves**
- B. Wells – **where the DNA is loaded into the gel**
- C. Positive Electrode – **where the DNA moves to**
- D. Negative Electrode – **where the DNA moves from**
- E. Power Source – **produces the electric current**
- F. Restriction Enzymes – **cuts the DNA into Restriction fragments.**

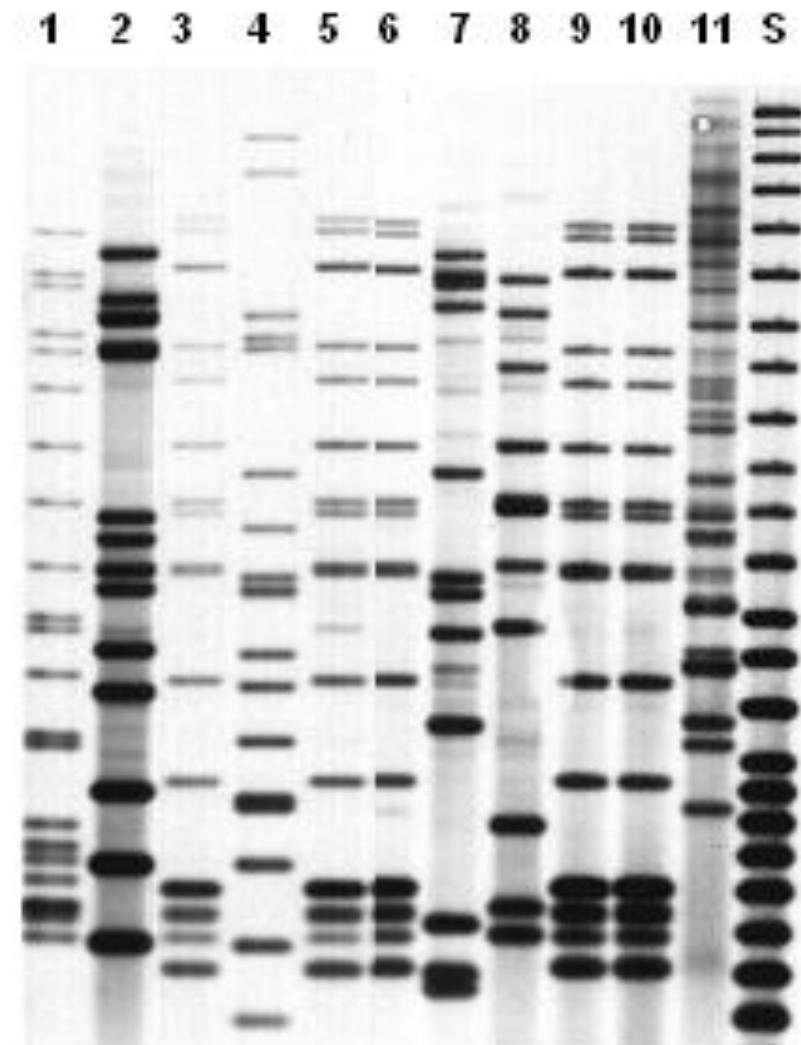
28. Explain how to load the digested DNA into a well (what lab instrument)

Use a micropipette and make sure not to poke through the bottom of the gel



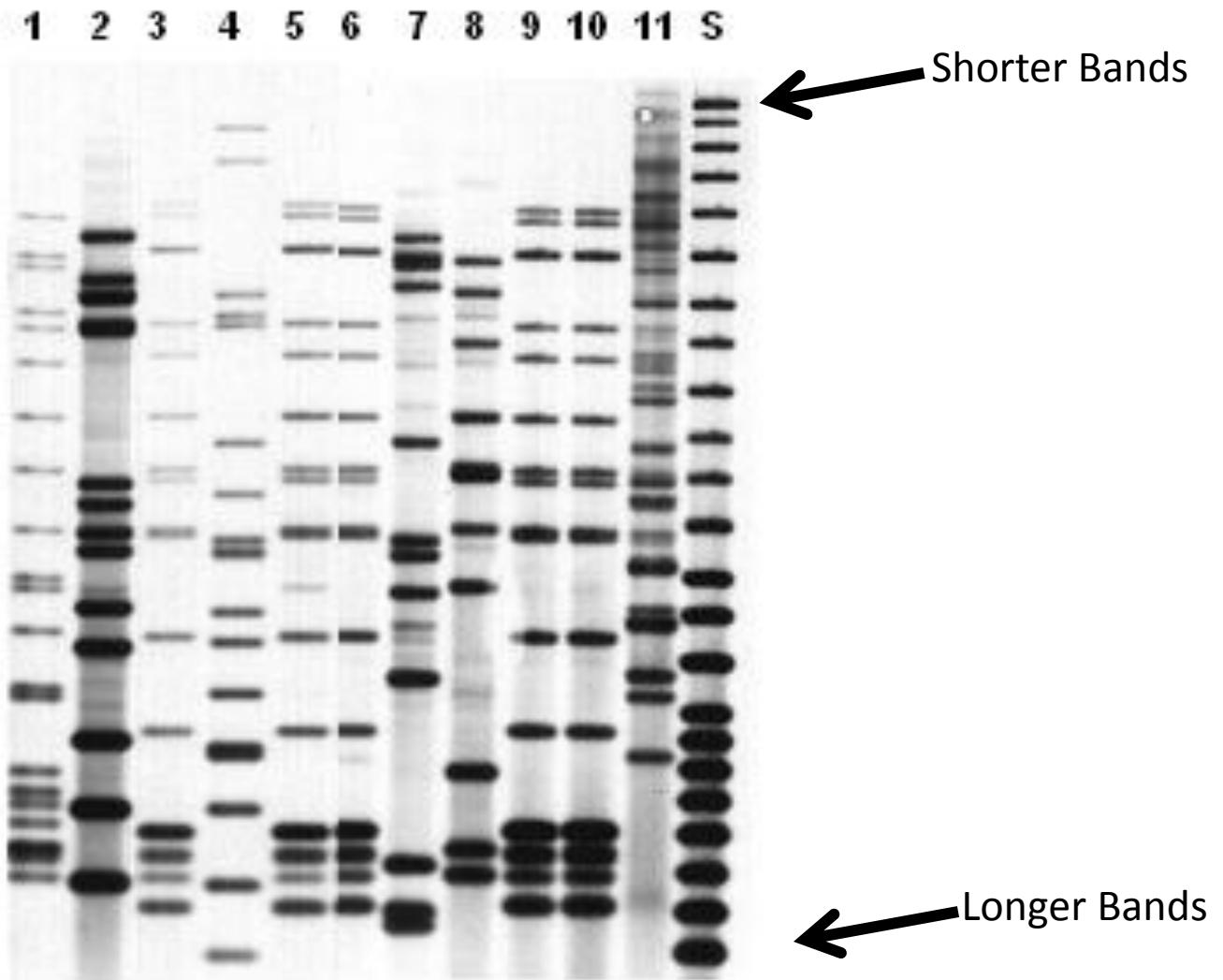
29. Explain the role of the standard DNA in gel electrophoresis.

- The standard or “ladder” lets serves as a measurement device.
- The ladder is a collection of DNA fragments of known size (e.g. 100, 500, 1000, 2000, 5000, 10000 base pairs) so that if it is loaded beside the samples, it can offer a 'ruler' that can be used to determine the size of the fragments in the samples.



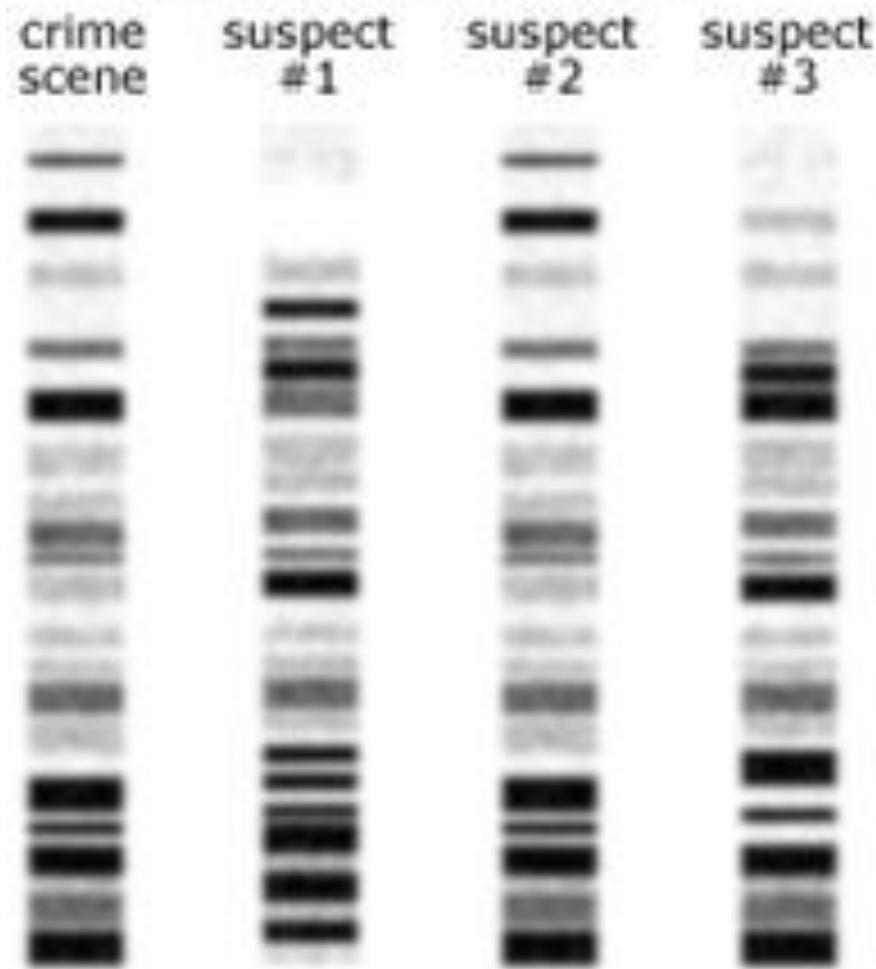
30. Given a picture of a DNA fingerprint, to be able to identify (describe the position of):

- A. The largest band
- B. The smallest band

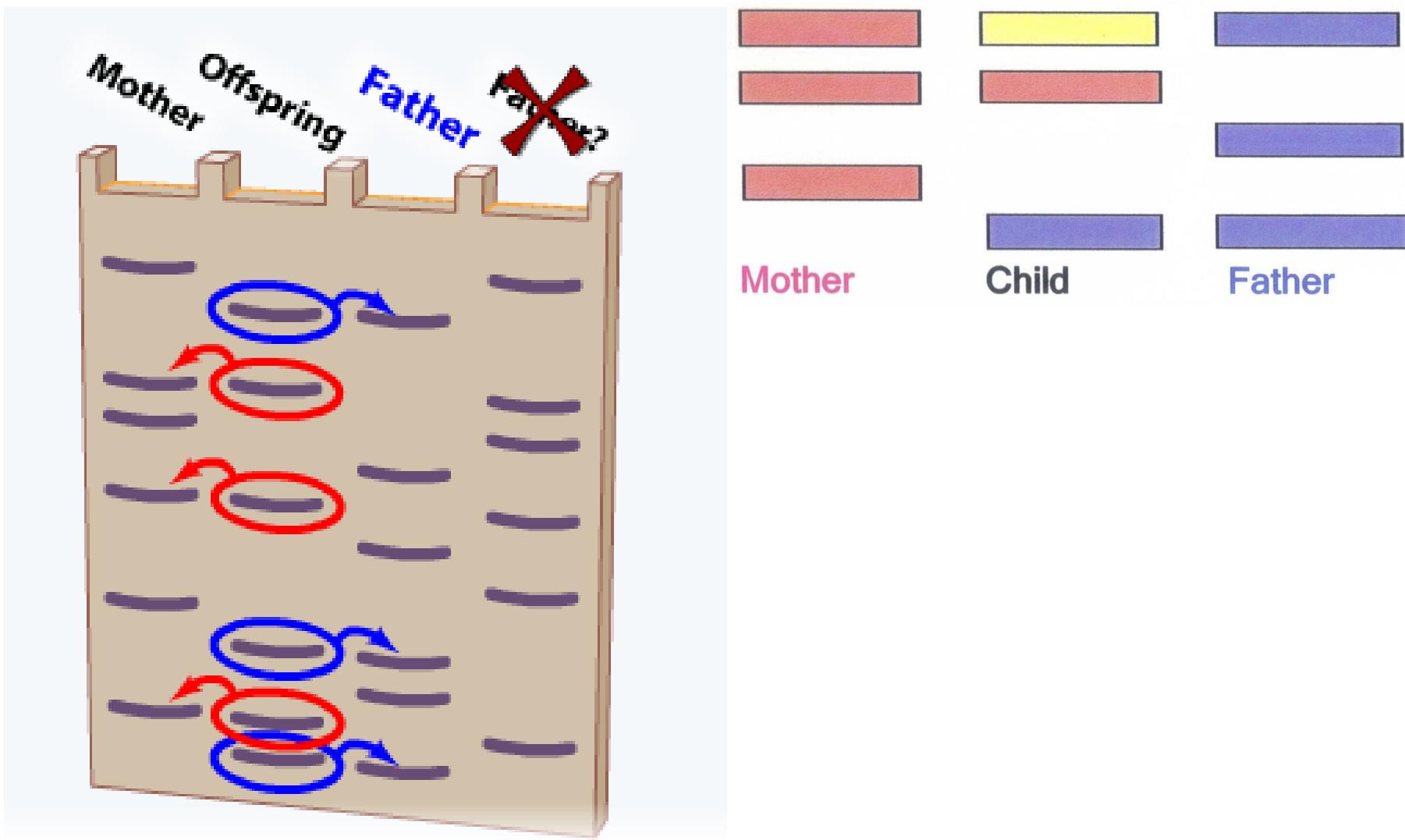


31. Interpret a DNA profile and determine if there is or is not a match between two different sources. What do you look for?

DNA samples from:



32. Apply your knowledge of DNA to be able to determine paternity of a child from analyzing DNA profiles of the child and the man accused of being the father. How would you know if a child came from a set of parents?



33. State the function of the mitochondria.

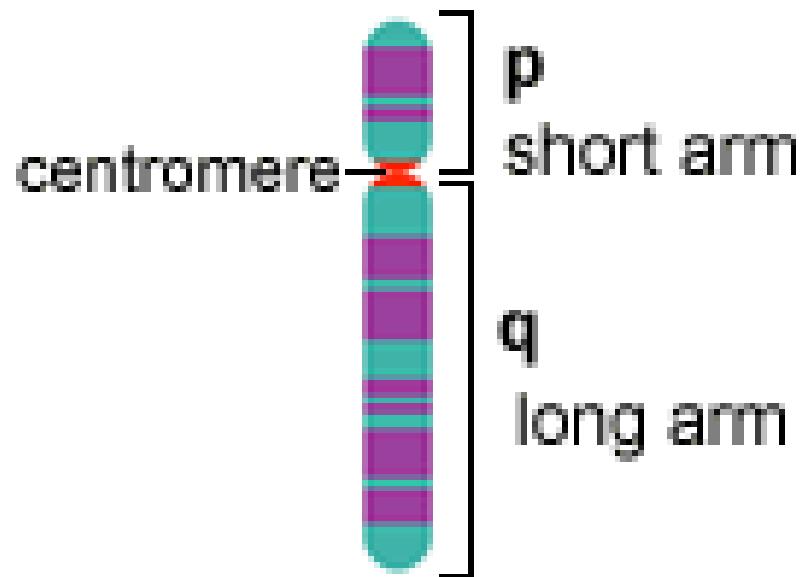
- Mitochondria - "cellular power plants" because they generate most of the cell's supply of adenosine triphosphate (ATP)

34. Discuss the advantage of using mtDNA instead of nuclear DNA in an attempt to identify the remains of an individual

- mtDNA (Mitochondrial DNA) can sometimes be found in material where nuclear DNA can not. ie. bones and hair shafts

35. Draw a chromosome and label the centromere, p arm, and q arm.

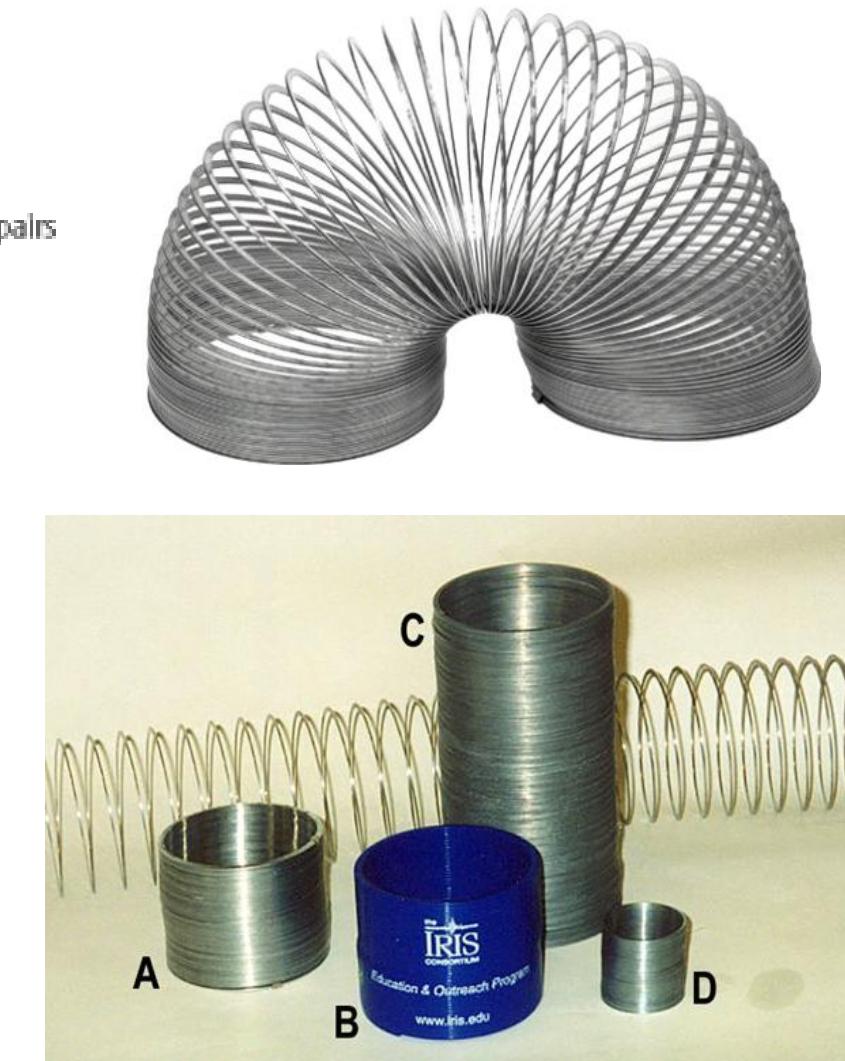
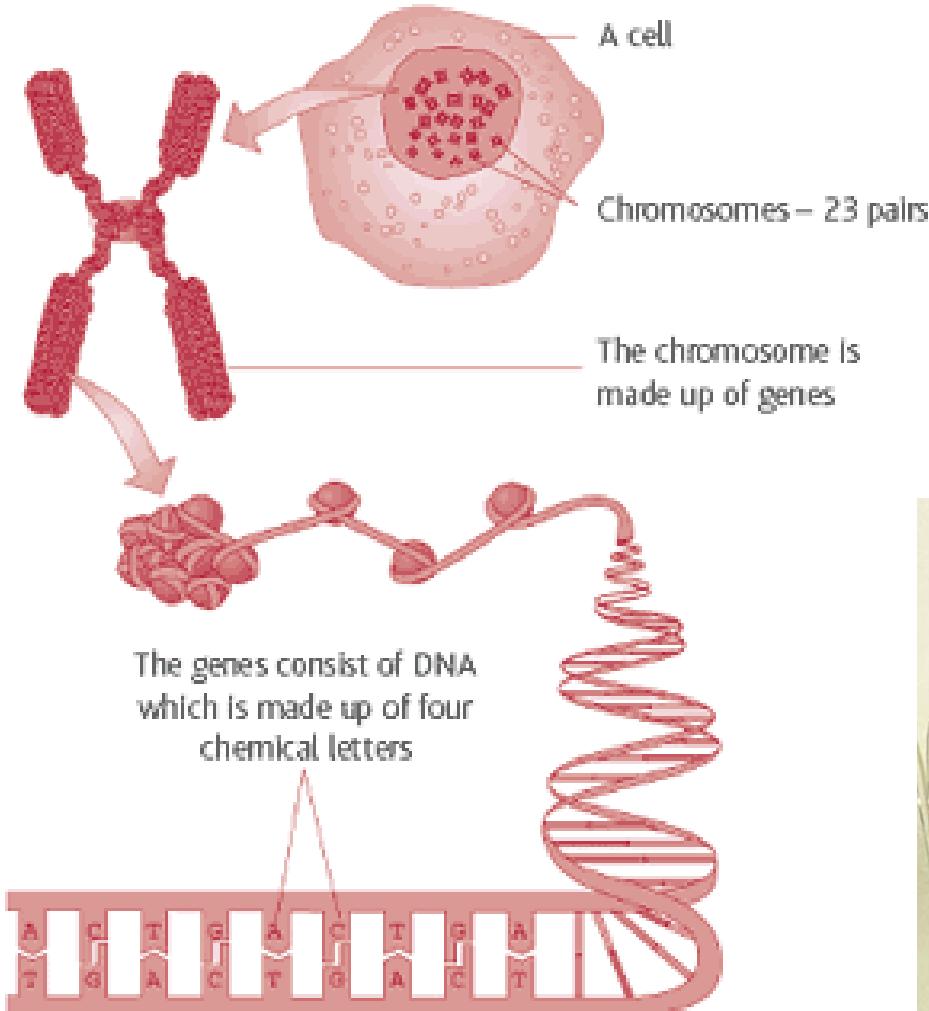
Short and Long Arms of a Chromosome



36. How does a gene relate to a chromosome?

- Genes are segments of chromosomes and , therefore, segments of DNA.

37. How does a chromosome relate to a slinky?



38. What is karyotyping?

The chromosomes of a cell, usually displayed as a systematized arrangement of chromosome pairs in descending order of size, used to detect chromosomal abnormalities

39. What is the forensic significance of the Colin Pitchfork case?

- First time DNA profiling was used to solve a crime.

40. What is the forensic significance of the Tommie Lee Andrews case?

- First time DNA evidence was used in the US to solve a crime

41. What detail is historically important in the Ian Simms case?

- First time DNA was used to convict a murderer when no body was found