OPHS Biology
Unit 6 Notes

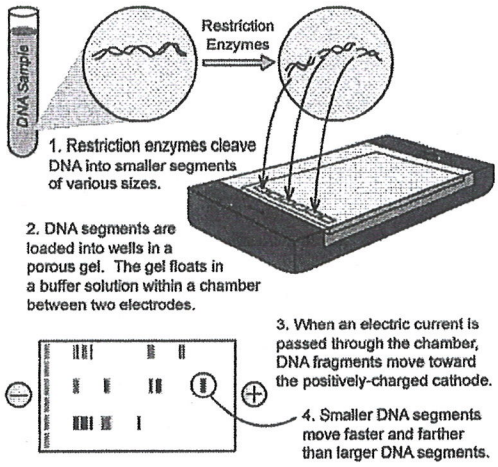
Name: _____
DNA/RNA/Protein Synthesis

Unit 6, Topic 4: Biotechnology

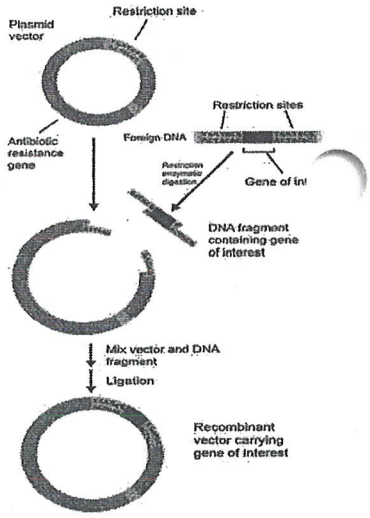
By the end of this topic, you should be able to...

1. *Describe the purpose and methods of gel electrophoresis and analyze electrophoresis results*
2. *Provide examples of the practical uses of biotechnology, including insulin production and cloning*
3. *Describe the purpose and methods of PCR (polymerase chain reactions)*

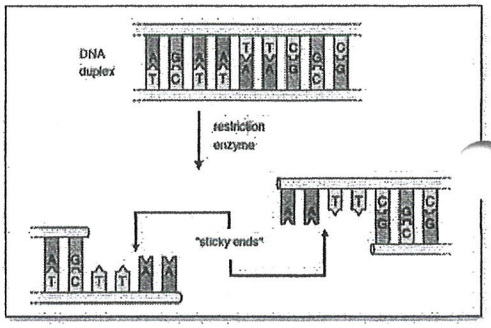
Figure S-2: Gel Electrophoresis



1. Genetic Engineering = Manipulating DNA
   a. With present technology and knowledge of DNA structure, we can extract, identify, modify, copy, and transfer DNA sequences!
   b. Genetic engineering allows scientists to create desirable traits within organisms to meet specific needs without relying on natural mutations.
2. PCR (polymerase chain reaction)
   a. PCR is the artificial replication of DNA in a controlled environment.
   b. We use heat to separate the strands and special heat-resistant bacterial enzymes to speed up the process
3. Extracting DNA - (first step to genetically engineer an organism)
   a. DNA extraction is relatively easy to do from the cells of plants and animals! We can even do it in the classroom!
   b. Once you have extracted the DNA, you can copy, change, and transfer it in helpful ways



4. Cutting DNA – (second step)
   a. Remember: DNA is a very long molecule
   b. In order to make working with DNA more manageable, scientists use restriction enzymes to cut DNA into fragments known as restrictive fragments.
   c. These restrictive enzymes are chemicals that bind to and make cuts at specific sequences in DNA.
5. Separating DNA (third step)
   a. Once DNA is cut into fragments, scientists select only those sequences that code for particular traits.
   b. Gel electrophoresis is one technique that is used to sort DNA sequences by size, which can be read and analyzed.
   c. Once it is sorted, scientists can...
      i. study individual genes on the DNA
      ii. obtain a segment of DNA to copy using a technique called PCR (polymerase chain reaction)
      iii. help locate genetic diseases to potentially eliminate them
6. Changing DNA (fourth step)
   a. Like Frederick Griffith's early bacterial transformation, scientists are able to take segments of one organism's DNA and place it into the genome of other organisms
   b. Recombinant-DNA Technology is the type of genetic engineering where DNA from two are more different sources is joined (resulting in what are called transgenic organisms)



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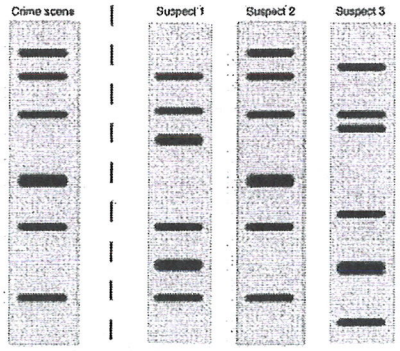
7. Steps in Transforming Bacteria
   a. Recombine DNA-restriction enzymes like *Eco*RI cut the DNA into fragments to prepare them for recombination
   b. Transport DNA-a scientist has to insert recombinant DNA pieces into the host cell (into plasmids, or circular DNA, in bacterial cells)
   c. Transfer DNA- When the host cell divides (by binary fusion), it also makes a copy of the newly transformed plasmid (called a recombinant plasmid)
   d. Genetic markers, such as those for antibiotic resistance, inserted into the plasmid along with the specific desired gene allow scientists to pinpoint transgenic cells
8. Uses of Recombinant DNA Technology
   a. Advances in medicine
      i. Transgenic animals and plants that provide health benefit
      ii. Transgenic animals used as test subjects
      iii. Insulin or Human Growth Hormone production by bacteria
      iv. Human Genome Project & Gene Therapy
   b. Agriculture
      i. Genetically modified plants and animals (their cells don't accept foreign DNA very well so you must infect plant and animal cells with bacteria containing recombinant plasmids)
   c. Personal identification
      i. DNA fingerprinting
      ii. Paternity testing
      iii. Forensic science



   d. Cloning
      i. When humans clone, they use a single cell of an adult organism to grow a new genetically identical individual
      ii. They Inserts the nuclei from the blastula stage (hallow ball of cells after several divisions of a zygote) of an embryo into an adult cell → Ex. Dolly the sheep
9. Human Genome Project
   a. The goal was to determine the sequence of nitrogen bases in human DNA. An entire set of DNA from a body cell is considered that organism's genome.
   b. There are 3 billion base pairs in the human genome and approximately 25,000 genes.
   c. NIH is striving to cut the cost of sequencing an individual's genome to $1,000 or less. Having one's complete genome sequence will make it easier to diagnose, manage and treat many diseases.

[[Language Target for Topic 4: I can interpret gel electrophoresis results through writing; I can compose a written list of the practical uses of biotechnology; I can explain the purpose and methods of polymerase chain reaction]]

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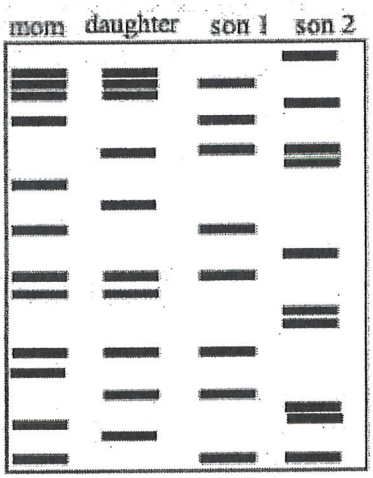
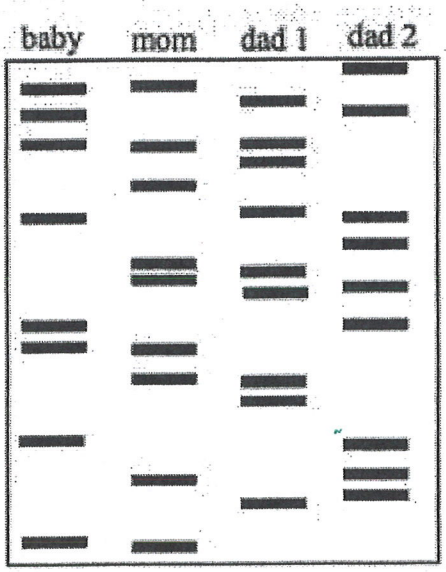
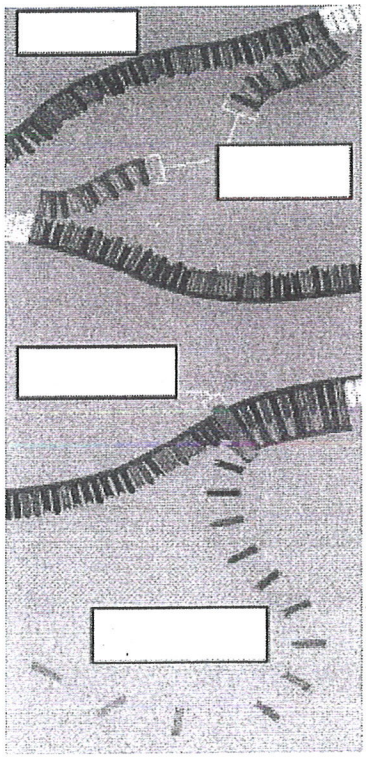
The millionaire, Mr. Big, has just died. He has left behind a wife, daughter and a large inheritance. The news of his death has brought forth 2 men who claim to be the long lost son of Mr. & Mrs. Big. Before Mr. & Mrs. Big were married they had an illegitimate child and had placed him up for adoption. They had tried to find him after they became wealthy but had no luck in locating him. A DNA sample was taken from Mrs. Big, the Big daughter and the two men who claim to be the long lost son. Which, if any, of the men are telling the truth? _____



Mrs. Smith has a baby named Tyra. She believes one of two men can be the father of her child. A paternity test is done and the results are shown above. Which of the 2 men are baby Tyra's father? _____





Match the following terms with their definitions and label each component of the PCR mixture in the diagram (use the letters A-D):

_____DNA polymerase

_____Primers

_____ Nucleotides

_____Genomic DNA template

A. DNA that contains the target sequence that will be replicated using PCR.

B. An enzyme that copies the DNA sequence.

C. A mixture of 4 nucleotides (A,G,C, and T) that will be polymerized into the replicated DNA sequence.

D. A short DNA sequence that allows the enzyme to bind and initiate polymerization.