Name: _____
Hour: _____

DNA Murder Mystery

Background:

On the morning of November 22nd 1983, the body of a young woman was discovered just outside the grounds of a mental hospital in Norborough, England. Although it was not immediately evident who committed the crime, a very important piece of evidence was left behind. Police extracted a sample of the murderer's DNA from blood samples found at the crime scene. Three years later, the same DNA results were obtained from a blood sample recovered from another crime scene. The DNA samples eventually turned out to be the clues that solved both crimes.

Shortly after the second murder, the local police arrested a man who worked at the mental institution where the first body was found. He confessed to the second murder, but denied any knowledge of the first one. Because the police were fairly certain that both murders had been committed by the same person, they needed to find some way of proving that the suspect had killed the first victim.

Norborough police compared the suspects DNA fingerprint to one obtained from the first crime scene. In addition to the confessed suspects DNA, a DNA fingerprint of a second possible suspect was also analyzed.

Just like how an actual human has a fingerprint – a series of ridges on each finger and each pattern of ridges varies from person to person so that a person can be identified, DNA also has a fingerprint. DNA fragments are caused by specific enzymes to create a DNA fingerprint pattern. This process is used to identify individual organisms that have DNA. DNA fingerprinting is also used in paternity analysis, criminal cases and other studies of ecology and evolution.

You have been chosen to undertake the important task of comparing the DNA fingerprints to determine if one of the current suspects committed the murder.

Materials:

1 Sheet of DNA blueprints
1 neo/sci 1 restriction enzyme (transparency)
1 neo/scie 2 restriction enzyme (transparency)
1 blue colored pencil
1 red colored pencil
1 green colored pencil
1 grey colored pencil
1 yellow colored pencil

Procedure

Each student will be responsible for conducting a DNA analysis of 4 DNA samples found on the DNA blueprint sheet.

- **Step One: Color Coding the DNA Samples**
  - Use the following color key to color code the DNA samples found on the blue prints sheet
    - Adenine – Red
    - Thymine – Green
    - Guanine – Grey
    - Cytosine – Blue
    - Radioactive Probes – All bases should be colored yellow

- **Step Two: Restriction Enzyme Digest**
  - Cut out the crime scene DNA (only)
  - Slide neo/sci 1 along the DNA strand until all the letters match up. This represents the enzymes recognition site.
  - Mark a spot on the DNA as shown by the ***dotted*** line on neo/sci 1. ***Do not cut the transparency!***
  - Continue down the DNA strand looking for matching sites. There may be several recognition sites within one strand of DNA.
  - Repeat the procedure using neo/sci 2.
  - Cut through the crime scene DNA where marks were made. The crime scene DNA should have 4 fragments.
  - Determine the length of each fragment in base pairs. Record your answers in Table 1.
  - Tape or glue the fragments according to their base pairs on Electrophoresis Table under crime scene DNA.
  - Repeat the procedure with the remaining DNA sequences
    - Be sure to only cut ***one*** DNA sequence at a time and record your answers in Table 1 and the Electrophoresis Table before moving onto the next DNA sequence to avoid mixing up your DNA sequences!!

Table 1

DNA Sample	Number of Restriction Sites	Number of Fragments	Number of Base Pairs for Each Fragment
Crime Scene			
Victim			
Suspect 1			
Suspect 2			

Electrophoresis Table

	Crime Scene DNA	Victim DNA	Suspect 1 DNA	Suspect 2 DNA
9 BP				
8 BP				
7 BP				
6 BP				
5 BP				
4 BP				
3 BP				
2 BP				

➢ Step Three: Attaching Radioactive Probes

When the human genome is digested, fragments of every base pair length are possible due to the size of our genetic code. Electrophoresis produces a smear of undistinguishable fragments for everyone making it impossible to analyze samples. In order to distinguish one suspects DNA from another, a short DNA strand with radioactive phosphate groups called a probe is used to locate specific DNA sequences in each DNA sample. Only a few fragments of each person's DNA will have the complimentary sequence needed to attach the probe. This creates a radioactive "barcode" that is unique for each individual.

The first step is to separate the DNA strands to that a complimentary piece of DNA (the probe) can bind to the sample DNA. Due to the nature of this activity, we will ***not*** be separating our DNA. The next step is to mix sample DNA with the probes. The probes attach making some, but not all, of the fragments radioactive.

- Cut out the DNA probes
- Locate the probe sequence with in your digested DNA strands (hint: search the bottom strand only)
- Glue or tape the probes on top of the matching TCC sequences. These fragments are now radio active
  - ***All*** radioactive probes are going to be used.

➢ Step Four: Making an Autoradiogram

Once radioactive probes are attached, an x-ray picture of the DNA fragments can be made. This picture is called an autoradiogram.

- Locate the autoradiogram chart.
- Using a black pen, draw a horizontal line at each base pair length that has a probe attached.
  - Example: The Crime Scene DNA has a probe at the 3 BP fragment. A black line should be drawn in Lane 1 (Crime Scene) at the 3BP position. This has been done for you as a sample.

Autoradiogram

DNA Size Marker in BP	Crime Scene DNA Lane One	Victim DNA Lane Two	Suspect 1 DNA Lane Three	Suspect 2 DNA Lane Four
10 BP				
9 BP				
8 BP				
7 BP				
6 BP				
5 BP				
4 BP				
3 BP				
2 BP				

Analysis Questions

1. Based on your autoradiogram results, which suspect is the murderer? Explain your answer in detail. _____

2. What would be the resulting autoradiogram would look like if you performed the DNA fingerprinted procedure, but skipped:

   a. Digesting the DNA with restriction enzymes? _____

   b. Electrophoresis? _____

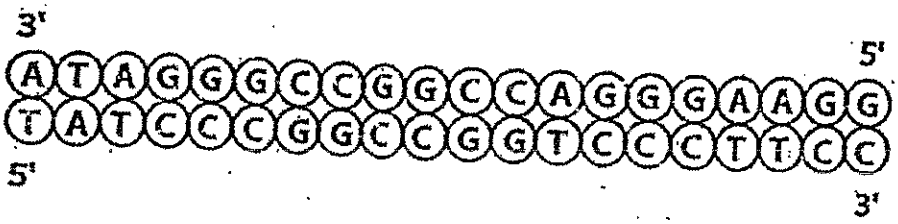
   c. Separating the DNA into single strands before the radioactive probe?

   d. Mixing the DNA sample with the radioactive probe DNA? _____

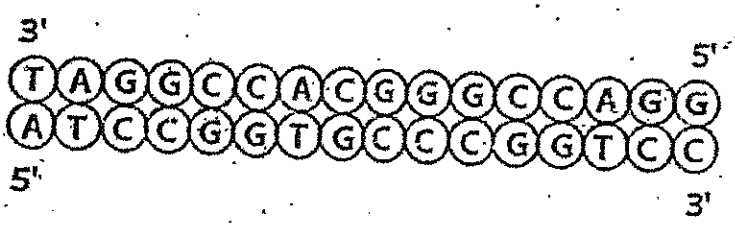
   e. Autoradiography? _____

DNA SEQUENCE BLUEPRINTS – See color code below

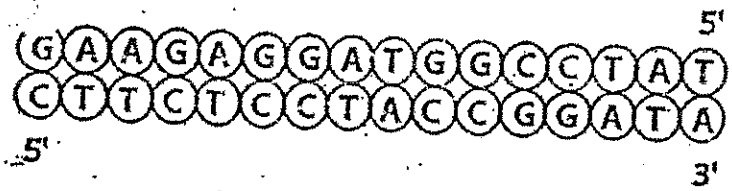
Crime Scene DNA



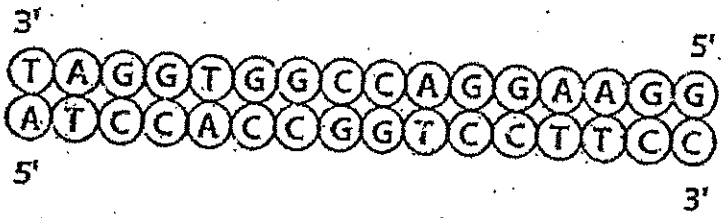
Victim's DNA



Confessed Murderer's DNA-Suspect 1

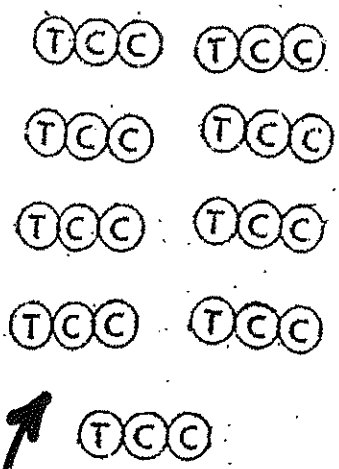


Suspect 2



Color all of these yellow!

RADIOACTIVE PROBES



Color all of these yellow!

Color Code Key for Blueprints

* Adenine - Red
* Thymine - Green
* Guanine - Grey
* Cytosine - Blue