Name _____

DNA MURDER MYSTERY

1 per group = 2

BACKGROUND:

On the morning of November 22, 1983, the body of a young woman was discovered just outside the grounds of a mental hospital in Narborough, 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 suspect's DNA, a fingerprint of a second possible suspect was also analyzed. 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/sci 2 restriction enzyme (transparency)
1 blue marker
1 red marker
1 green marker
1 black marker
1 yellow highlighter
scissors
glue stick

ACTIVITY:

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

Step 1: Color Coding The DNA Samples

-Use the following color scheme to color code the DNA samples found on the blueprints sheet.

Adenine- red
Thymine- green
Guanine- black
Cytosine- blue
Radioactive probes- all bases should be colored yellow

Step 2: Restriction Enzyme Digest

-Cut out the crime scene DNA.
-Slide NEO/SCI 1 along the DNA strand until the colors match up. This represents the enzyme's recognition site.
-Cut the DNA as shown by the dotted line on NEO/SCI 1. DO NOT cut the restriction enzyme transparency.
-Continue down the DNA strand looking for more matching sites. There may be several recognition sites within one strand of DNA.
-Repeat the procedure using NEO/SCI 2. You should now have 4 fragments.
- Determine the length of each fragment in base pairs. Record your answer in TABLE 1.

Step 3: Electrophoresis

-Glue the fragments onto the electrophoresis chart. Fragments should be glued in the Crime Scene column according to their base pair length.

Step 4: Repeat the digest and electrophoresis for the remaining 3 DNA samples. Process one strand at a time so that the fragments don't get mixed up!

TABLE 1

DNA SAMPLE	NUMBER OF RESTRICTION SITES	NUMBER OF FRAGMENTS	SIZE OF EACH FRAGMENT
CRIME SCENE			
VICTIM			
SUSPECT 1			
SUSPECT 2			

Step 5: 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 analyze samples. In order to distinguish one suspect's 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 sepearate the DNA strands so 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 seperating 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 within your digested DNA strands (hint: search the bottom strand only)
-Glue the probes on top of the matching TCC sequences. These fragments are now radioactive.

Step 6: 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 attached to the 3bp 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.

ANALYSIS:

1. Based on your atutoradiogram results, which suspect is the murderer? Explain your answer.

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

   a. digesting the DNA with restriction enzymes?

   b. electrophoresis?

   c. separating the DNA into single strands before the probe?

   d. mixing the DNA sample with probe DNA?

   e. autoradiography?

DIRECTIONS: An autoradiogram is an x-ray picture of the DNA fragments. Only those fragments containing the radioactive probes show up under x-ray. Using a black pen, draw a horizontal line to indicate the placement of probe containing fragments (ie if the 7 base pair fragment of crime scene DNA contains a probe, you would draw a line at the 7bp mark of lane 1).

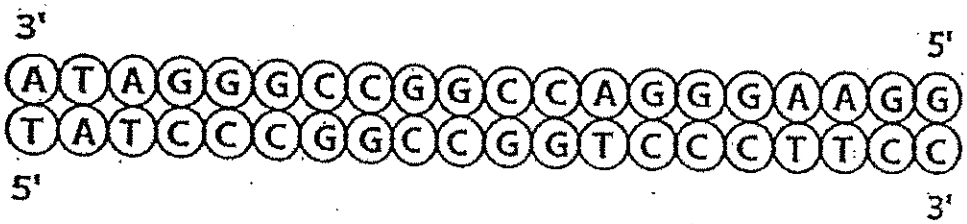
Autoradiogram

DNA Size Marker in Base Pairs	CRIME SCENE Lane 1	VICTIM Lane 2	SUSPECT 1 Lane 3	SUSPECT 2 Lane 4
10				
9				
8				
7				
6				
5				
4				
3				
2				

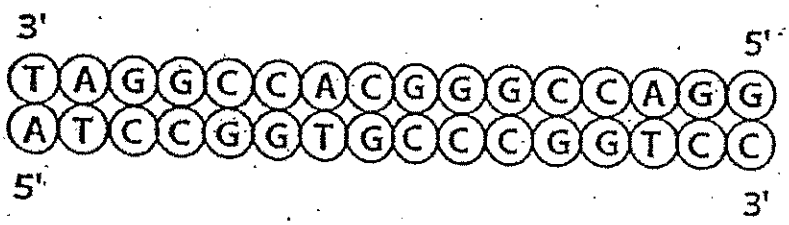
	CRIME SCENE DNA	VICTIMS DNA	SUSPECT 1	SUSPECT 2
9BP				
8BP				
7BP				
6BP				
5BP				
4BP				
3BP				
2BP				

DNA SEQUENCE BLUEPRINTS

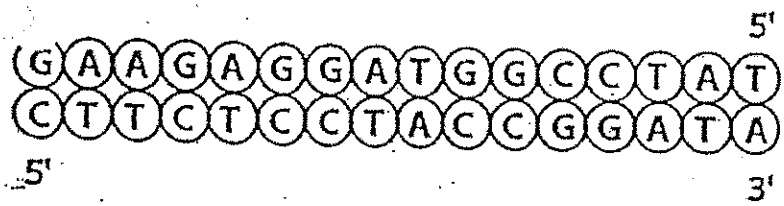
...me Scene DNA



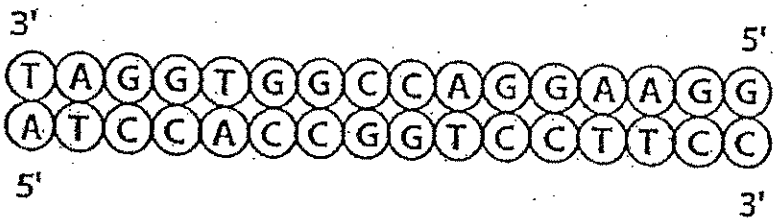
Victim's DNA



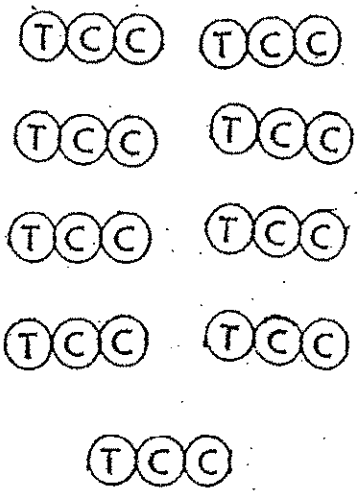
Confessed Murderer's DNA-Suspect 1



Suspect 2



* RADIOACTIVE PROBES (Color yellow) *



* Color Code *

adenine - Red
thymine - green
guanine - black
cytosine - blue