the

Case of the Crown Jewels

A DNA Restriction Analysis Laboratory Activity

MdBioLab

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Case of the Crown Jewels

Introduction

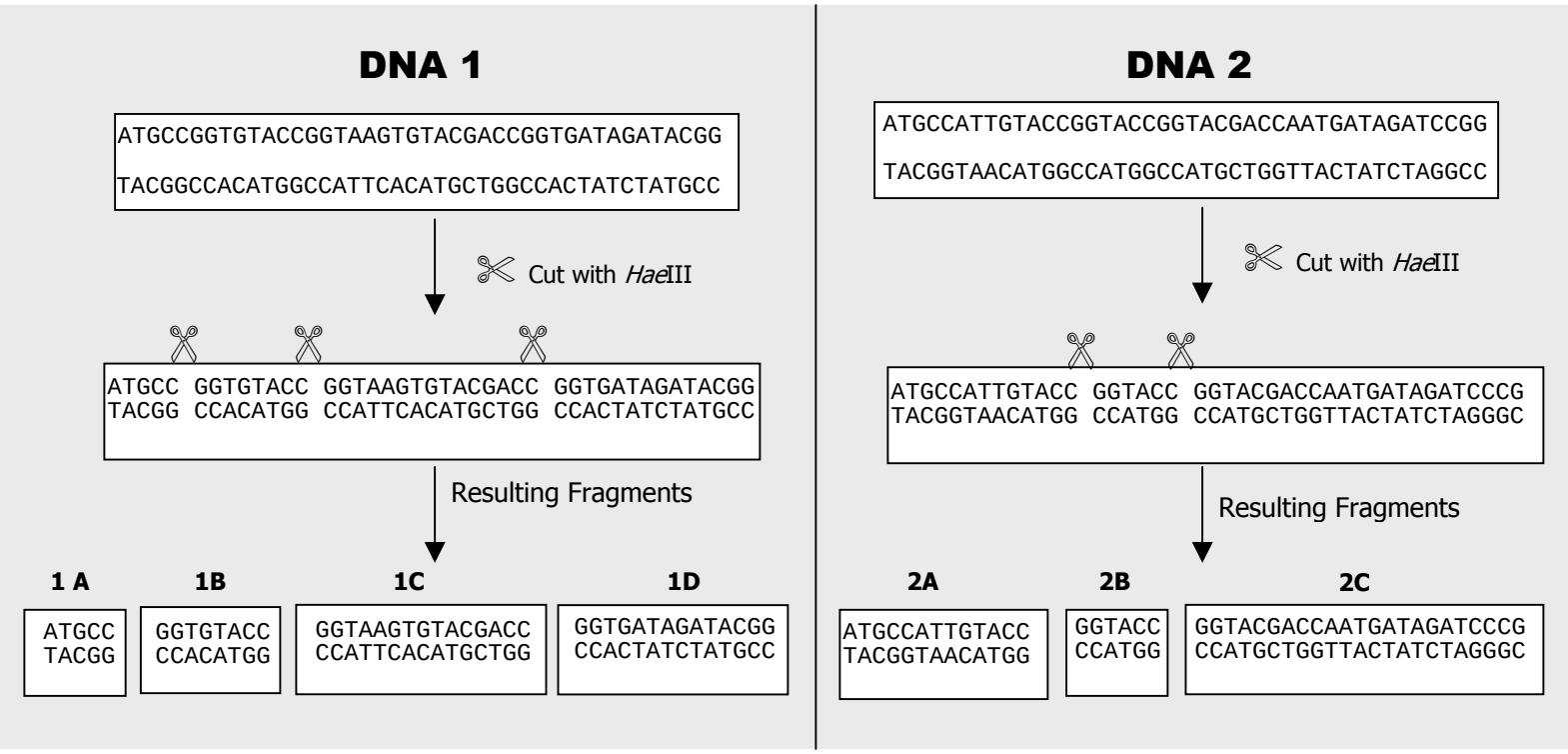
DNA restriction analysis is a technique with wide ranging applications in medicine, research, and forensics. The Case of the Crown Jewels is an activity that simulates the DNA fingerprinting process used by forensic scientists, which relies on restriction analysis to analyze DNA evidence from a fictional crime scene.

DNA restriction analysis is based on the following assumptions:

- DNA molecules can be identified by a difference in the sequence of bases
- Enzymes, which are produced naturally by bacteria, cut DNA molecules at specific sites denoted by base sequences

When a restriction enzyme is used to cut different DNA molecules, the size of the fragments generated will be unique to each molecule. As shown in Figure 1, both DNA 1 and DNA 2 are cut with *Hae*III, an enzyme that cuts between the base pairs GG|CC and CC|GG.

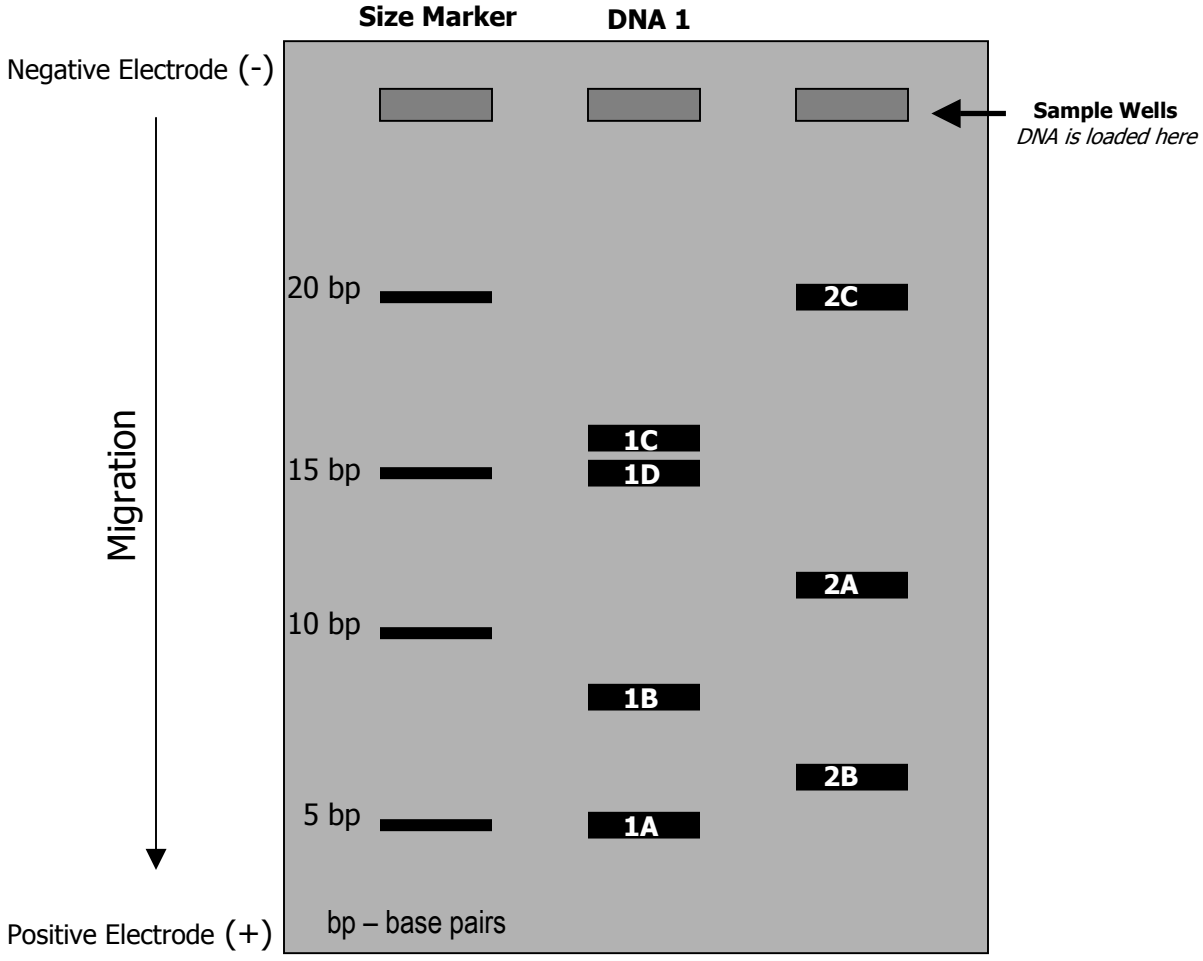
FIGURE 1: Restriction Digest of Two DNA Fragments



After being cut by restriction enzymes, DNA fragments remain mixed in solution and indistinguishable from one another. One way to distinguish between the different fragments created is to compare them by size. Different size fragments of DNA can be separated using gel electrophoresis.

Gel electrophoresis is a technique for separating molecules based on the differential movement of charged particles through a matrix when subjected to an electric field. In non-technical terms, DNA is negativelycharged – thus, when in the presence of an electric current, DNA will travel according to size (smallest pieces first) towards the positive electrode. By comparing the resulting pattern of DNA fragments on the gel, the DNA strands can be differentiated.

FIGURE 2: Gel Electrophoresis of Fragments from Restriction Digest with *Hae*III



CITY POLICE DEPARTMENT
POLICE REPORT

INCIDENT DATA

Incident Type: Museum Theft
Complaint Status: Pending DNA Results
Processed by: Officer Joe Friday
Other Officers: Officer Dee Enae
Officer Ligase

PROPERTY

Property Code: Jewelry/Precious Metal
Owner's Name: City Museum
Name: Crown Jewels
Value: $1,000,000

BURGLARY DATA

Method of Entry: Unlawful Entry through broken window

Narrative: The crown jewels were allegedly stolen from the City Museum. Once on the scene I noted that the only window in the room was broken. Officer Ligase approached me and said that there were no prints or any apparent evidence left at the crime scene. However, upon further inspection of the window, my partner, Dee Enae, noticed that there was some blood on the sill. The thief had cut himself on the broken glass. The blood sample was collected and sent to the crime lab via the messenger, R. Renee, who gave the package to the technician Edna N. Zime.

SUSPECT DATA

Suspect Number: **1**
Name: **Pockets Peterson**
Brief Description of Suspicion: A widely known and successful crime thief. Peterson has been known to brag that he could get by any security system. He said he would prove it by someday taking the crown jewels. No stone has been known to have higher security.

Suspect Number: **2**
Name: **Cruella "The Cat" Blanchard**
Brief Description of Suspicion: Owns the largest private collection of precious stones in the world. She has offered millions of dollars for them. Having been a member of the prestigious ninja swat team, she has the talent and guts to pull off such a crime.

Suspect Number: **3**
Name: **Professor Angstrom**
Brief Description of Suspicion: Past curator of the museum that housed the crown jewels. He was recently fired from his job and replaced by the boss's niece. His motive may be revenge.

Suspect Number: **4**
Name: **The Resident Scientist**
Brief Description of Suspicion: Credited for discovery of the crown jewels. She claims they are rightfully hers.

CRIME LAB DATA

Crime Lab Investigator: Edna N. Zime
Evidence Messenger: R. Renee

List of Evidence Received: Plastic bag with Blood
DNA from four suspects

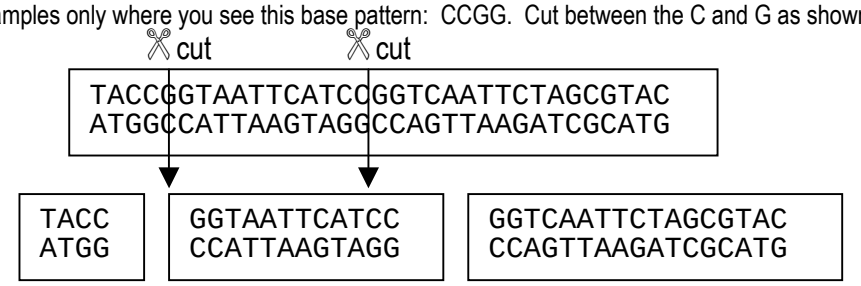
List of Procedures Used: DNA Extraction
Polymerase Chain Reaction
DNA restriction analysis

Narrative: After receiving the package with the plastic bag marked *Crime Scene*, the crime scene DNA was extracted from the blood sample in the bag. Because the sample was so small the DNA was amplified using the polymerase chain reaction. Lab assistants used DNA isolated from four suspects and compared them to the crime scene DNA using DNA restriction analysis.

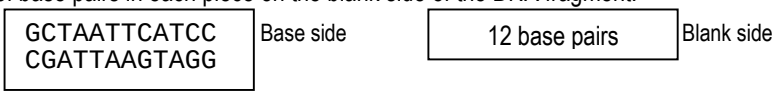
Results: See attached *DNA Results Poster* from lab assistants

DNA Evidence Evaluation

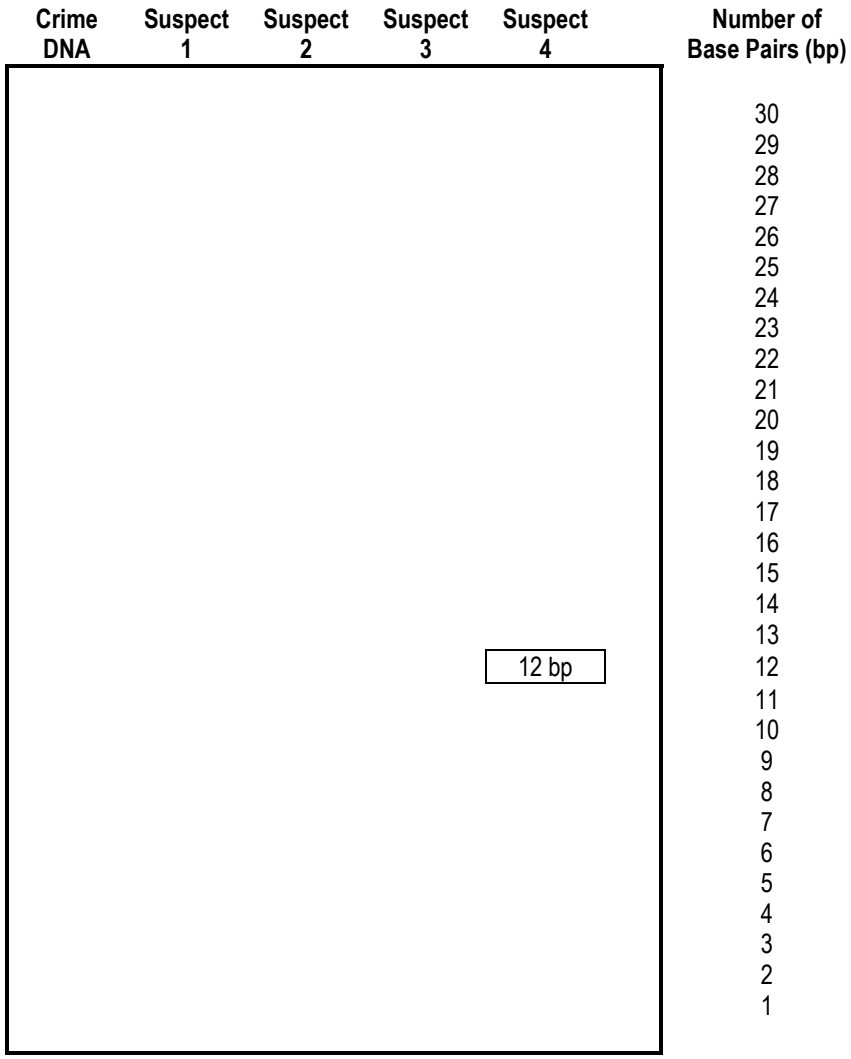
1. Turn your paper strip with the DNA base sequences over so the side with the bases is facing you. Use your scissors (restriction enzymes) to cut your DNA samples only where you see this base pattern: CCGG. Cut between the C and G as shown in this example:



2. Count the number of base pairs (bp) in each piece of DNA that you have created. A base pair consists of two complementary bases. Record the number of base pairs in each piece on the blank side of the DNA fragment.



3. Tape your DNA sequences on an 8.5X11in. chart (blank sheet of paper) according to the number of base pairs. Be sure to put your sample in the proper column. Follow the example below:



Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA Crime DNA

GTCGACCGGTGACCGTGCGTACACAGTGCTCCGGATAGCTGATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTGTCACGAGGCCTATCGACTATCGAGGCCAC

Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA Suspect 1 DNA

GTCCCAGCCGGACCGTACCGGTAGATCAGCCGGTAGATTGATAGCGTGATGTG
CAGGGTCGGCCTGGCATGGCCATCTAGTCGGCCATCTAACTATCGCACTACAC

Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA Suspect 2 DNA

GTCTACGTAATCGTAGCCATCCGGACAGTGTGCACGATCGTACATGCTACGTG
CAGATGCATTAGCATCGGTAGGCCTGTCACACGTGCTAGCATGTACGATGCAC

Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA Suspect 3 DNA

GTCGACCGGTGACCGTGCGTACACAGTGCTCCGGATAGCTGATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTGTCACGAGGCCTATCGACTATCGAGGCCAC

Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA Suspect 4 DNA

GTCTCCATCCGGACTACCATACATCTGGTGTACCCGGTGATATCGTCCGGGTG
CAGAGGTAGGCCTGATGGTATGTAGACCACATGGGCCACTATAGCAGGCCCAC

CITY POLICE DEPARTMENT
FINAL REPORT

Your name: _____

Name of the person who's DNA was found at the crime scene:

_____

Evidence: Explain how you came to your conclusion (you may include diagrams and explanations):