The Case of the Missing Crown

J.van der Gleason is a rich tycoon worth billions of dollars. He earned his wealth and fame as an internationally acclaimed fashion designer in the garment industry. The *Van Der Glea* line of clothing is revered worldwide. J. van der Gleason is an eccentric Newport socialite who resides in a lavish mansion in Newport, Rhode Island.

One day, van der Gleason was enjoying his morning crumpet and tea while reading the financial section of the *Wall Street Journal* in his study. The study wall is decorated with a collection of Renaissance paintings that he purchased over the years. Creations by Giotto, Jan van Eyck, Rembrandt and Titian "wallpaper" the walls of the study. Also part of his collection located in the study is his most cherished possession, the *Iron Crown of Charlemagne*. Van der Gleason purchased the *Iron Crown of Charlemagne* at auction for 12.5 million dollars. Today it is believed to be worth 32.7 million dollars. The crown is on display in the study, enclosed within a thick glass encasement.

The crown has a rich history. Charlemagne was crowned the first Holy Roman Emperor, with the Iron Crown by Pope Leo III in Rome on Christmas Night, 800 AD.   As King of the Franks, Charlemagne established and ruled over a kingdom that spanned virtually all the Christian States of Western Europe, including what is now France, Switzerland, Belgium, The Netherlands, half of Italy and Germany, part of Austria and a small part of Spain.

Iron Crown of Charlemagne

At 11:00 am on this day, van der Gleason left home for his daily stroll with his trusty companion Galina, a Russian wolfhound. His stroll was along the beautiful Cliffs of Newport. He did this every morning at the same time- it was his daily routine. When he returned home 45 minutes later, regrettably, he found the *Iron Crown of Charlemagne* missing. The glass case that enclosed the crown was shattered and glass strewn all over the Persian rug. In the midst of the broken glass was a heavy iron poker, presumably used to break the glass case. He was mortified. He immediately called the Newport police to report the crime.

Within minutes, two of Newport's finest, detectives Hichcock and Holmes arrived at the mansion. They were quickly greeted and escorted to the study by Porterford, the butler. The detectives took photographs and gathered evidence from the few clues left behind by the thief.

While searching for clues, detective Hichcock noticed a small sliver of glass on the rug covered with a small trace of blood. Apparently, the thief was cut while breaking the glass encasement. Hichcock carefully removed the evidence from the rug and placed it into a sterile plastic zip lock bag for safe keeping. Later, he brought the blood covered shard to the FBI forensic lab for analysis.

While detective Hichcock was gathering evidence, his partner, detective Holmes asked van der Gleason who was at the mansion when the crime was committed. Van der Gleason said that seven people were inside the mansion during the crime. Immediately, Holmes summoned all seven individuals to the study for questioning. Holmes demanded that all seven suspects remain on the premises until the investigation was completed. For several hours she interrogated the suspects. After the interrogation, the suspects were allowed to leave the mansion as long as they would agree to a give a DNA sample. The samples were taken by swabbing the inside of their cheek with a sterile cotton swab. Each cotton swab was placed in its own sterile zip lock bag and brought to the FBI forensic lab for analysis.

The Seven Suspects

Porterford; the butler
Colonel Hornblower; Army officer, retired
Franz; the chef
Vance; the chauffeur
Martini; the carpenter
Ms. Martin; the maid
John; the gardener

Suspect Profile and Motives

Porterford; the butler

He is an employee who has served as the van der Gleason butler for 12 years. He was in the study serving van der Gleason his tea and crumpet before van der Gleason left with Galina to go on his morning. Porterford, although somewhat loyal to van der Gleason, finds his loyalty waning and is unhappy with his salary as a butler. He thinks van der Gleason is far too stingy with his money and that he is worth a lot more for all the work he does. He often refers to van der Gleason as van der "penny pincher."

Colonel Hornblower; retired Army officer

He is your typical adventurer with a rich military background. Colonel Hornblower has a fascination for shooting by going hunting. He's a dashing and handsome man with a proud demeanor. He loves to challenge people to a duel if they cross him and he isn't afraid to speak his mind. He has been a friend of van der Gleason for 23 years, but argues with him all the time. The morning before the robbery, a dispute occurred when van der Gleason ordered him to stop shooting his pistol at gophers on the grounds of the mansion. A humiliated Hornblower challenged van der Gleason to a duel. Van der Gleason ignored his threat and retired to the study. Colonel Hornblower views van der Gleason as a "crusty" old man.
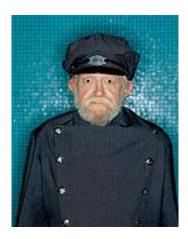
Franz; the chef

Although Franz was in the mansion at the time of the crime, nobody saw him in the study that morning. He was in the kitchen preparing lunch for van der Gleason. Franz is an internationally known French chef who is proud of his cooking skills. Early that morning, van der Gleason told Franz that his food was giving him heartburn. Franz, always the hothead, didn't take his comment about his cooking skills very well at all. Franz was observed cussing and throwing pots and pans against the wall in the kitchen after this confrontation. Franz was fit to be tied.

Vance; the chauffer

Vance was seen in the garage that morning preparing the limousine for the day. Vance was to drive van der Gleason to the Board of Directors meeting at the *Van Der Glea Corporate Headquarters* in Boston at 3:00 pm. Vance is a trusty worker who admires his boss for all the wealth he has acquired. Vance dreams about being wealthy someday too. He has the notion that when van der Gleason passes on, he will inherit the bulk of his wealth because of their friendship. However, Vance is getting impatient and would like the loot now.

Martini; the carpenter

Martini seldom visits the mansion. However, van der Gleason asked Martini to renovate the library. He speaks very little but always knows his stuff. He is an amiable person who would do anything for van der Gleason when sober. Martini's only fault is that he sometimes drinks too much and tends to get intoxicated regularly. In this state he is unpredictable in his actions. That morning he had a few nips too many.

Ms. Martin; the maid

Ms. Martin is a light-hearted maid who dusted the study directly after van der Gleason left for his walk. She has had a fascination with the *Iron Crown of Charlemagne* for years. In the past, Ms. Martin has been observed staring in wonderment at the crown for hours and fanaticizes about having it for her very own. When nobody is around, she has been known to remove the crown from its case and wear it on her head as she does her daily chores. She loves to be called Princess.

John; the gardener

John is the gardener who keeps the grounds in tip top shape. While a hard-working individual, he tends to hide the fact that his only weakness is gambling. John consistently loses money at the casino. His bets are bad and they are getting worse. John is drowning in debt and is constantly broke. He's always looking for an easy way to make money to feed his addiction.

Activity: Using Gel Electrophoresis to Solve a Crime

In this section you will take DNA samples of the seven suspects as well as the DNA found at the crime scene use gel electrophoresis to determine who committed the crime.

- Each table will have one electrophoresis chamber.
- The four students per table will break up into two groups with each group having their own gel wells.
- The first group students will run solutions A, B, C of the suspects and CS (DNA left at the crime scene).
- The second group will run D, E, F, and G of the remaining suspects.
- When the activity is completed, the two groups will compare their results to determine who left the blood sample on the glass shard.

The Crime Scene (CS) DNA sample and the DNA of the Seven Suspects

CS Crime scene DNA
A   Porterford; the butler
B   Colonel Hornblower; Army officer, retired
C   Franz; the chef
D   Vance; the chauffeur
E   Martini; the carpenter
F   Ms. Martin; the maid
G   John, the gardener

Group 1

1. Label four microfuge tubes-   CS, A, B, and C.

2. Set the P-20 micropipette to 2 uL and dispense 2 uL dH$_2$O to each microfuge tube. CS, A, B, C.

3. Add 8 uL CS (crime scene) DNA to the labeled CS microfuge tube.

4. Eject the tip into the waste container and replace it with a fresh tip.

5. Follow steps 2 and 3 for the microfuges labeled A, B, and C.

6. Place all four microfuges tubes in the microcentrifuge for 10 seconds

Group 2

1. Label four microfuge tubes- D, E, F, and **G.**

2. Set the P-20 micropipette tip to 2 uL and dispense 2 uL of dH$_2$O into each microfuge tube: D, E, F, G.

3. Add 8 uL of suspect D DNA to the microfuge tube labeled D.

4. Eject the tip into the waste container and replace it with a fresh tip.

5. Follow steps 2 and 3 for the microfuges labeled E, F, and G.

6. Place all four microfuges in the microcentrifuge for 10 seconds.

Loading the DNA into the Gels

1. Pour the melted agarose into a gel casting tray. Make sure you place **two-eight teeth or ten-teeth combs** into the gel casting tray. Group 1 will use the first set of wells, and group two the second set of wells. Allow the gel to solidify before removing the two combs.

2. Place the agarose gel into electrophoresis chamber. Make sure the gates are down on both sides before placing the gel into the cast tray. The wells should be located next to the negative electrode (black).

3. Slowly add the 1X SB buffer into the electrophoresis chamber until the buffer covers the gel by 1-2 millimeters. Make sure the gel wells are filled with buffer. Do not connect the electrodes at this point.

Group 1

1. Set the micropipette to 10uL and slowly load each sample into a separate well as indicated below. Use a fresh tip for each sample.

> Well 1   add 10 µL sample CS
> Well 2   add 10 µL sample A
> Well 3   add 10 µL sample B
> Well 4   add 10 µL sample C

2. When loading each sample, center the pipette over the well and gently depress the micropipette plunger to slowly expel the sample. Use your other hand to help support your pipette hand to avoid shaking.

Group 2

1. Set the micropipette to 10uL and slowly load each sample into a separate well as indicated below. Use a fresh tip for each sample.

    > Well 5   add 10 µL sample D
    > Well 6   add 10 µL sample E
    > Well 7   add 10 µL sample F
    > Well 8   add 10 µL sample G

2. When loading each sample, center the pipette over the well and gently depress the micropipette plunger to slowly expel the sample. Use your other hand to help support your pipette hand to avoid shaking.

Turning on Power Supply

1. Close the cover tightly over the electrophoresis chamber. Connect the leads to the power supply, black to black and red to red.

2. Turn on the power supply and set the voltage to 130 v. Press the "run" switch to begin the process. Look for tiny bubble rising in the chamber.

3. Stop the process in approximately 15 minutes and unplug the electrodes from the power supply. Carefully remove the gel from the gel tray from the chamber and place it on a piece of paper toweling. Compare the pattern of both gels.

Post-Lab Questions

1. Compare the dyes in the lanes of both wells to determine whose DNA matches the sample left at the crime scene. Who committed the crime?

2. The crime scene suspect left behind a sample of blood at the crime scene that was used to construct a DNA profile of the thief. Are there other ways that the perpetrator could have left a DNA sample for forensic Identification?

3. Besides DNA evidence, list other types of non DNA evidence that a crime suspect could leave behind that might be used as forensic evidence?

Teacher Key

The solutions contain various combinations of Bromophenol blue (purple) , Xylene cyanole (blue), and Orange G (orange).

	Suspect	Colors on Gel
A	Porterford; the butler	Orange, purple
B	Colonel Hornblower; Army officer, retired	Blue
C	Franz; the cook	Orange, purple
D	Vance; the chauffeur	Blue, purple
E	Martini; the carpenter	Orange, purple, blue
F	Senorita Esmerelda; the maid	Purple
G	Juan; the gardener	Orange
E	Crime Scene	Orange, purple, blue

Some Examples of DNA Uses for Forensic Identification

- Identify potential suspects whose DNA may match evidence left at crime scenes
- Exonerate persons wrongly accused of crimes
- Identify crime and catastrophe victims
- Establish paternity and other family relationships
- Identify endangered and protected species as an aid to wildlife officials (could be used for prosecuting poachers)
- Detect bacteria and other organisms that may pollute air, water, soil, and food
- Match organ donors with recipients in transplant programs
- Determine pedigree for seed or livestock breeds
- Authenticate consumables such as caviar and wine

Is DNA effective in identifying persons?

[answer provided by Daniel Drell of the U.S. DOE Human Genome Program]

- DNA identification can be quite effective if used intelligently. Portions of the DNA sequence that vary the most among humans must be used; also, portions must be large enough to overcome the fact that human mating is not absolutely random.
- Consider the scenario of a crime scene investigation . . .
- Assume that type O blood is found at the crime scene. Type O occurs in about 45% of Americans. If investigators type only for ABO, finding that the "suspect" in a crime is type O really doesn't reveal very much.
- If, in addition to being type O, the suspect is a blond, and blond hair is found at the crime scene, you now have two bits of evidence to suggest who really did it. However, there are a lot of Type O blonds out there.
- If you find that the crime scene has footprints from a pair of Nike Air Jordans (with a distinctive tread design) and the suspect, in addition to being type O and blond, is also wearing Air Jordans with the same tread design, you are much closer to linking the suspect with the crime scene.
- In this way, by accumulating bits of linking evidence in a chain, where each bit by itself isn't very strong but the set of all of them together is very strong, you can argue that your suspect really is the right person.
- With DNA, the same kind of thinking is used; you can look for matches (based on sequence or on numbers of small repeating units of DNA sequence) at many different locations on the person's genome; one or two (even three) aren't enough to be confident that the suspect is the right one, but thirteen sites are used. A match at all thirteen is rare enough that you (or a prosecutor or a jury) can be very confident ("beyond a reasonable doubt") that the right person is accused.