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Forensic Science: Then and Now

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The Case: (taken from http://www.cyberbee.com/whodunnit/crimescene.html)

Mrs. Jake, a 7th grade science teacher, noticed her door was open when she got to the school. She went in and found the fish tank broken and the goldfish lying in the sink. Next to the fish tank was a piggy bank, a powdery white substance, and a half-eaten chocolate bar. Blue paint and had been spilled and there were footprints of bare feet leading to an open window. The school resource officer was called to the scene.

- *Fingerprints were lifted from the piggy bank and the aquarium—concentric circular pattern.*
- *The powdery substance was collected in a bag and taken back to the police lab for identification—odorless, dissolved in water, bubbled when mixed with vinegar*
- *The chocolate bar was collected for analysis. There appeared to be teeth prints in it.—protruding teeth with spaces between them.*
- *The footprints left on the floor were measured –10.5"*

There are four suspects: Lou Lou, Mark, Peggy, and Mike. Who committed the crime?

Forensics uses science and technology to aide law enforcement in investigating crimes (Gaines & Miller, 2011). The purpose of gathering forensic data is to 1) determine the cause of death or injury, 2) determine the time of death or injury, 3) identify the type of weapon used, 4) identify the victim (if that information isn't available on the person at the time), and 4) hopefully, identify the offender (Gaines & Miller, 2011). There is a long history of using forensic science in police work. The first recorded autopsy was of Julius Caesar in 44 B.C. (Edson, 2011). He was killed by the second stab wound (Edson, 2011). Before the invention of computers and modern scientific techniques, serology, microscopy, dogs, and ballistics were the main tools that forensic scientists used to analyze a crime scene (Lawrence, 2015).

In the 1900s comparison microscopy and comparison ballistics were used to match dust, hair, fibers, and shell casings to a suspect and the murder weapon (Lawrence, 2015). These techniques are still used today, but the science and tests have become more precise and now a whole range of chemicals and substances can be identified (Edson, 2011).

Our Case: Plaster castings of each of the suspects' teeth were taken and there feet measured. All of the suspects have a weakness for chocolate. Lou Lou is 5' 3", Mark is 5' 8", Peggy is 5', and Mike is 6' 6". Using the following formula the height of the suspect can be found: (15%/length of left foot) = height of suspect. *The length of a person's foot is about 15% of their height*. The powdery substance was compared to other white substances (cornstarch, sugar, salt, and baking soda) using microscopy to determine grain size and iodine, water, and vinegar for chemical analysis.

In 1890, the commissioner of the Metropolitan Police in London, Sir Edward Henry, developed a system for classifying fingerprints called The Henry System (Watson, 2015). Fingerprints of suspects are matched to those found at the scene by 8-16 points of similarity (Gaines & Miller, 2011). Fingerprints are lifted by applying a fine dust to the surface—making the print visible--and using tape to carefully "lift" it off (Gaines & Miller, 2011). Another way to collect fingerprints was developed by researchers at Purdue University. This method uses an electrically charged solution of water and alcohol, it is then heated until the liquid evaporates—transferring the charge to the fingerprint—the fingerprint is then read by a special mass spectrometer which produces a 2-D images of the print. By using this method you can even identify what the person touched before leaving the print (Gaines & Miller, 2011). Since this time fingerprinting has been a mainstay in crime scene investigation. Dogs were also used to identify suspects based on scent (Lawrence, 2015).

Our Case: Fingerprints were taken from each of the suspects and compared with those found at the scene.

The science of determining the ABO blood groups left at a crime scene was developed in the early 1900s by Karl Landsteiner (Watson, 2015). Because the majority of the population had the common blood types it was mostly used to rule out suspects rather than identify a particular one (Lawrence, 2015).

The first police laboratory was set up in France in 1910 Edmond Locard (Watson, 2015). Locard is known for being instrumental in developing forensic science and is known as "the Sherlock Holmes of France" (Watson, 2015). The first American crime laboratory was started by Los Angeles police chief, August Vollmer in 1924 (Watson, 2015). Before the FBI established its own laboratory in 1932, they relied heavily on the Scientific Detection Laboratory in Chicago, Illinois (Fox, 2015). This laboratory was started by Colonel Calvin Goddard who was influential in pioneering forensic work in the early 1900s (Fox, 2015).

In the 1980s Kary Mullis develop a novel method for analyzing trace amounts of DNA left at a crime scene called the polymerase chain reaction or PCR (NCBI, 2015). See Figure 1. For an explanation. After DNA analysis and computers were invented to rapidly identify a particular suspect or suspects by using a national database called CODIS (Gaines & Miller, 2011). CODIS is a DNA database of people who have been convicted of various crimes (Gaines & Miller, 2011). Once DNA is amplified it can be analyzed to determine which suspect or suspects committed the crime. Today we use DNA evidence to, also, clear wrongfully convicted people in prisons, called a cold hit (Gaines & Miller, 2011).

How PCR Works

The first step in the PCR reaction is to separate the DNA template of the sample DNA into two strands. To do this the reaction is started at a high temperature of 94-96 ◦C. A RNA primer or starting sequence is then added and it binds to the template strands. DNA polymerase, an enzyme, synthesizes the complementary strand of DNA. The cycle is repeated and more copies are obtained from the template and the primers (PCR, 2015). Then another enzyme goes back and removes the RNA primer and DNA polymerase completes the complementary strand (PCR, 2015).

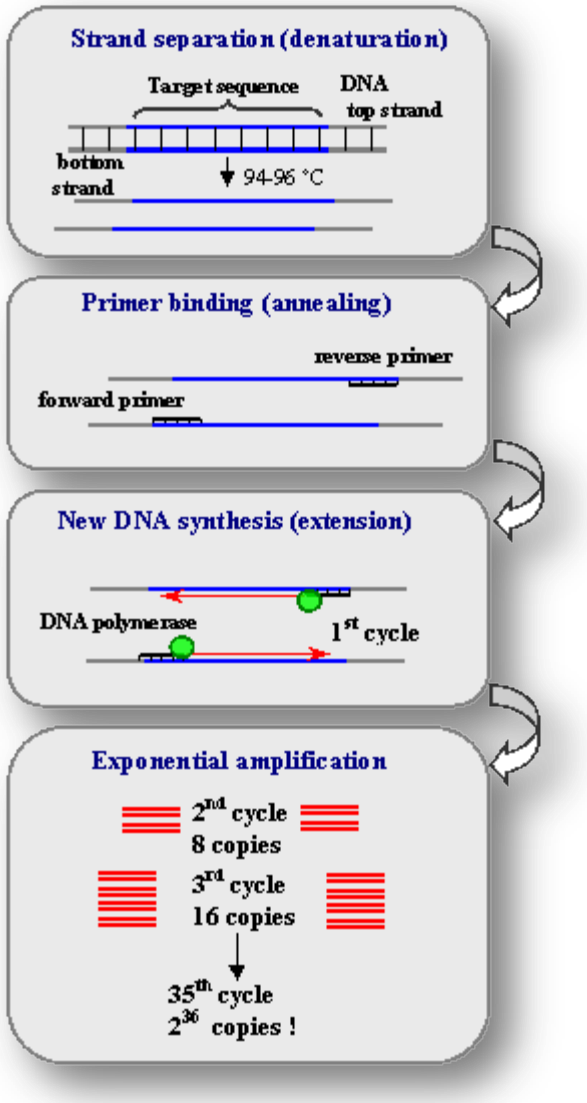

Figure 1.

Our Case: The teeth impressions left on the chocolate bar match those of Mark as do the fingerprints left on the piggy bank and aquarium. Using our formula the height of the suspect is about 70" which is close to 5' 8" matching Mark's height. The powdery substance was baking soda. From the evidence found at the scene of the crime it looks like Mark committed the crime. ***When confronted with the evidence, Mark confessed. At home he had run out of baking soda to get rid of the mothball smell on his clothes. Knowing that Mrs.***

Jake would have baking soda, he went into here classroom before school. The baking soda was in a cabinet above the fish bowl just out of reach. Reaching up to grab the baking soda, he knocked over the piggy bank which knocked over the fish bowl. On the way down his arm hit the blue paint can spilling it everywhere and on his shoes. He also spilled some of the baking soda on the counter. Not wanting to track blue paint all through the halls, he took off his shoes and climbed out the window. As he was climbing out the window the half eaten chocolate bar in his pocket next to the window.

According to a Dr. Ian Burney at University of Manchester: "…You look at less obvious things, like dust. You take them back to the laboratory and analyze them, asking what the traces on and around the corpse can tell you about the circumstances within which that person came to be a corpse. Locard said that the criminologist re-creates the criminal from traces left at the scene. Just as the archaeologist reconstructs the prehistoric beings from his findings (Bailey, 2011)."

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