

Introduction-Forensic Science

1. Introduction of topic
 - a. Definition of Forensic Science-Uneasy/unholy marriage of
 - i. Science-the objective seeker of truth & knowledge
 - ii. Forensics-the argumentative persuader of courtroom advocacy
 - b. Prefer to think of ourselves as our Mother's Child-Mother Science
 - i. Pure
 - ii. Incorruptible
 - iii. Firmly rooted in Scientific Method
 - c. Lots of pressure from detectives, police departments, lawyers for "Bad Science"
 - i. Have students comment on each of these examples of "Bad Science"
 1. There is an old Bad Science joke about a scientist who was working with an ant. The scientist would cut off one of the ant's legs and shout, "Jump!" And the ant would jump. The scientist cut off a second leg, and told the ant to jump, and again the ant jumped. And so it went, until the scientist had cut off all six of the ant's legs. This time, when told to jump, the ant did not jump. This proves it, the scientist concluded, when you chop all the ant's legs off, it becomes deaf!
 2. Misinterpretation of Test Results - In a robbery trial, the victim, a bartender testifies that the defendant had come into the tavern earlier in the night for a glass of beer. Three unwashed glasses were found at the scene, seized, and later processed for fingerprints.

Two of the glasses yielded prints, but they belonged to persons unknown - not the defendant. The prosecutor suggests that the fingerprint examiner testify that the third beer glass must have been used and then wiped clean by the defendant, because the other two glasses were obviously not used by him. The fingerprint examiner suggests that the prosecutor look elsewhere for this kind of testimony. The prosecutor looks surprised.

3. Manipulation of Raw Data - An accident reconstruction expert with a computer is hired by a plaintiff's attorney to determine the speed of the defendant's vehicle in a two-car collision. The expert enters into his computer program the road surface drag factor, skid and yaw mark lengths, and the location and severity values of the vehicle damage. The first run of his computer program produces an unrealistically high speed for the defendant striking vehicle. The expert changes his drag factor estimates and tries again. The figures are still outrageous. Three program runs and several crush data changes later, the speed determination begins to look more believable. The defendant's attorney begins his attack of the tests with a subpoena for all five of the expert's computer printouts.
4. Comparing Apples and Orangutans - In a product liability suit, the plaintiff's attorney finds an expert who will testify that, if the shotgun involved in the shooting had as safe

a firing mechanism as a rivet gun, the incident may not have happened at all.

5. Manipulation of Test Results - During a burglary trial, the prosecution produces seven latent fingerprints which were recovered from inside the victim's house. The fingerprint examiner testifies that he has identified these prints as belonging to the defendant. The prosecutor testifies that the fingerprints are like seven different photographs of the suspect inside the house. Because he does not want a repeat of an earlier case lost to the defense attorney, the prosecutor calls a second examiner to the stand to verify the comparisons made by the first. The prosecutor then states that the seven fingerprints, times two examiners, make fourteen little photographs of the suspect inside the house. Later, when asked why he didn't call a third examiner to up the score to twenty-one fingerprints, the prosecutor replies that he had simply neglected to subpoena a third examiner.

6. Compulsive Computing - A .223 Remington bullet is found lodged in the side of a house several hundred feet to the rear of a rifle practice range where .223 ammunition is frequently used. The investigators want to know if it is possible for a .223 bullet to fly the several hundred feet necessary to reach the house from the range, so they ask a firearms examiner. The examiner, who has recently invested in a ballistics program for his home computer, took down the range, wind speed, bullet

shape, temperature, barometric pressure, and several other pieces of data. His computer charted the results. Finally his answer to the investigator was, "Yes, it is possible." As a qualified firearms examiner, he had already known that the house was well within the range of the .223 bullet and could have given the same answer when first asked the question...without computation.

7. Denial - In many major criminal investigations, it is the practice of detectives to offer a polygraph examination to the suspect, and, in cases of questionable accusations, to the victims. While they are not admissible in court, the polygraph results are relied upon as a valuable investigative tool. One day a young police officer shoots and wounds a juvenile who he claims fired upon him first, although no weapon was found. The officer claims he was also struck several times about the head and shoulders with a board prior to the shooting, although he exhibits no bruises, head injuries, or defense injuries to his hands or arms. When asked about this lack of consistent injuries, a detective reports that the officer was wearing a bullet resistant vest. The detectives do not offer the suspect or the police officer a polygraph examination in this particular case.
8. No Scientific Methodology - A city truck driver runs a stop sign and causes an accident which results in severe injuries. Instead of relying on skid marks, crush damage, and scene evidence, the city

authorities order a traffic investigator to conduct acceleration tests to determine the maximum possible speed the truck could have achieved in the one-block distance leading up to the crash. Because the truck was disabled in the crash, the traffic investigator uses a motorcycle to run the one-block acceleration test and reports back a peak speed of 35 miles per hour for the city truck.

9. Too Many Cooks Spoil the Broth - A city bus rear-ends a carload of teenagers, killing four. The first traffic investigators at the scene measure the skid marks of the bus and determine that the bus driver was speeding. A national civil rights leader claims that the bus driver is being made a scapegoat by the city solely because he is of a racial minority. The follow-up investigation by the city authorities reports that the original traffic investigators, who have been abruptly removed from the case, must have been measuring tire marks tracked through melted roadway tar and that, on second thought, the city bus driver was not speeding. A local television station gets a radar gun and reports that most drivers, including city bus drivers, regularly exceed the speed limit on this stretch of road. Tire tracks in tar look nothing like skid marks to the trained eye of the investigator. Excessive speed aside, it is unlawful to follow another vehicle at an unsafe distance.
10. Pursuit of the Inconsequential - In the faked robbery of a fast food restaurant, the

night manager shoots to death an employee in a walk in cooler, hides the "stolen" money and a .357 magnum revolver and calls police. The crime scene personnel notice fallen dust on a restroom floor and discovers the money hidden in a ceiling panel. The revolver is found among the night manager's possessions. In preparation for the trial, the prosecutor asks for a shooting sound test to be done inside the restaurant's walk in cooler. This, he says, will determine whether or not the fatal shots could have been heard by a teenage girl who was having sex with a man (not her boyfriend) in her boyfriend's van parked across the street from the restaurant. The girl, who incidentally had a full length cast on her leg at the time (another mystery altogether), did not recall hearing much of anything, least of all gunfire. Her partner that night also somehow missed the sounds. The crime scene investigator refused to participate in such an experiment, arguing that it was irrelevant, invalid, and just plain silly...and what would it prove, anyway? The prosecutor suggests that the defense might use the fact that the girl had not heard the shots to argue that the time of the murder was somehow different. "Then let the defense make a sound test," the investigator says, leaving. The prosecutor is insistent. After being turned down by the police firearms instructor and the state regional laboratory examiners, the prosecutor gets three detectives to fire the shots for the sound test. To duplicate the

sounds of a .357 magnum, they load the weapon with light .38 special target loads; they fire the quieter ammunition into a sandbagged pipe inside the walk in cooler so as not to make holes in the walls. It is several months later, and the air temperature is sixty degrees cooler than the night of the murder. By the time the test begins, the noisy morning rush hour traffic has clogged the street in front of the restaurant. To duplicate the hearing of the busy girl with the cast on her leg and other things on her mind, they use the prosecutors ears as he stands across the street. (Later there were several profane allegations about what the prosecutor had to endure to fully recreate the event.) The results of the test? "It sounded like a hand clap," said one of the detectives stationed in the restaurant's dining room. So, apparently one can induce deafness by making love to a girl in a full-length cast, the same as one can by cutting all six legs off an ant.

ii. To Prevent "Bad Science

1. The first is the methodological battle plan called "Ockham's Razor," named after the 14th century philosopher William of Ockham. In philosophy, a problem should be stated in its basic and simplest terms. In science, the theory that fits the facts of a problem with the fewest number of assumptions is the one that should be selected. This is the great-grandfather of K.I.S.S. (Keep It Simple, Stupid) theory, and it works well against Bad Scientists.

2. The second tactic is termed "reducio ad absurdum," which is the disproof of a proposition (or stupid experiment) by showing the absurdity to which it leads when carried out. A good example of such a situation is the aforementioned case of the prosecutor who argued that seven fingerprints identified by two fingerprint examiners make a total of fourteen little traces of the burglary defendant. The reduction ad absurdum of that case is the notion that a third fingerprint examiner would up the ante to twenty-one clues, or that a dozen examiners identifying a single print would make for twelve traces of the defendant. The clues multiply like bunny rabbits. The mind boggles. Think of where the Bad Scientist is trying to lead you. And look to the dark at the end of the tunnel.
3. The final fallback is to common sense, the bane of Bad Scientists the world over. It was Thomas Huxley who said, "Science is simply common sense at it's best - that is rigidly accurate in observation, and merciless to fallacy in logic." This is where the juries trod on the best laid plans of eloquent attorneys. They step back for a moment and resort to instinct, to common sense. Lawyers, especially those true believers who do the prosecuting, are notoriously bad at feigning common sense. They are better at reduction ad absurdum. Cops, on the other hand, are excellent at instinct and common sense, but poor at

seeing the absurdity of a proposition's logical conclusion.

2. Observation-The first step to good scientific investigation
 - a. Use the How observant are you? activity to demonstrate to the students that memory is not literal. We do not remember exactly what we see, our memories are affected by opinion, expectation, and other subjective factors.
 - i. This activity demonstrates our ability to remember details accurately. Testimony about personal experience is frequently used during an investigation. How accurately do people remember what they have seen? What factors may play a role in what we can remember and describe about something we have witnessed? Consider these questions as you do the following activity.
 1. Pass out the pictures face down. At your signal have students turn the picture over and look at it for 30 seconds. Have them turn the papers back over and collect them
 2. Ask the class to write on another sheet of paper the answers to these questions
 - a. What time was it on the clock?
 - b. How many people were in the scene? How many males? females?
 - c. Describe the person at the front of the line. Was it a man or a woman? Was he or she wearing a hat? What kind of clothes was the person wearing? Could you tell how tall the person was? Did he or she have any distinguishing features?
 - d. What day of the month was it?
 - e. Did you notice anything unusual in the picture?

3. Have the class give you the answers to put on the board.
 4. If you wish/time permits, you can pass out the pictures again for the students to look at with the questions in hand
- b. Have the students discuss the factors that may affect memory. Then, use the How observant are other people? activity to allow the students to see how eyewitnesses may not be reliable.
- i. As you experienced, your own memory can sometimes fool you. But what about other people's memories? Try out this exercise to see how witnesses to the same science remember different details. Think about how useful an individual's testimony can be. Does it help to have several witnesses to a scene?
 1. Divide the class in half, thirds, or fourths depending on the size of the class. You want 6-8 people per group.
 2. Have two of each group be the detectives. The rest are the eye-witnesses to a scene.
 3. Have the detectives all go out in the hall for a couple of minutes
 4. Pass out the second set of pictures face down.
 5. Have the students turn them over and look at them for 30 seconds. Have them turn them face down and collect them.
 6. Have the detectives come back in and go to their group. Each detective should question each witness. Have the detectives reconstruct the scene. If the detectives need some help coming up with questions to ask suggest:

- a. How many people were involved in the scene?
 - b. What can you tell about each individual's hairstyle, gender, approximate age, etc.
 - c. Was there anything unusual going on?
7. Compare the reconstructions of the groups with each other and the original. Do more eye-witnesses help or hurt?

3. Perceptual Fallacies

- a. Our normal perceptions do not correspond directly to reality. The things that we perceive (see, hear, smell, etc.) are not entirely determined by what our senses detect. Our perceptions are also determined by what we expect, what we know, what we believe
 - i. Our perceptions are not photographs they are *constructions*- something that our minds manufacture
 - ii. what we perceive is partially determined by what we know or believe
 - iii. constructive perception has survival value - helps us make sense of the world
 - iv. So, seeing is not necessarily believing
- b. Our tendency to have perceptual experiences in the absence of stimuli
 - i. color constancy
 1. We often perceive an object to be a color because we expect it to be a certain color. EXAMPLE: If you have a cutout of a tree and a donkey both made from green material, and lit by red light, people will often perceive the cutouts as green trees and gray donkeys.
 2. You can have left brain/right brain conflict when reading words that are a certain color

3. Pass out sheets with words written in color. Have Students follow directions. Collect Sheets
 4. We also perceive color sometimes when it is physically impossible. EXAMPLE: The vision cells in the center of the retina are the only ones that can see color. Therefore, we should only see color in the center of our visual field. Objects in our peripheral vision should not appear in color. But we see color throughout the field. Why? Color constancy! Try looking at colored objects with your peripheral vision - what do you see?
- ii. size constancy - learned perception (does a truck driving in the distance get smaller?)
 1. You perceive the size of familiar objects (like a truck) to be the same size no matter how far away they are because you know that distance doesn't change the size of an object. However, the size of the image on your retina shrinks as an object moves away from you.
 2. There is a tribe called the Ba Mbuti that provide evidence that size constancy is learned. This tribe lives in a thick jungle where they never are able to see more than a few yards away. When taken into a field and shown buffalo in the distance, they asked what kind of insects they were. When told that the animals were buffalo, the tribes people thought it was witchcraft.
- c. Expectation
 - i. We perceive what we expect to perceive
 1. Flashing light experiment- subjects were told to walk down a hall and stop walking

when they saw a light flash. Many subjects stopped walking despite the fact that no flash was given. They simply expected a flash and believed they saw one. Similar experiments have shown subjects who could feel warmth, smell an odor, or feel an electric shock because they expected to.

2. We have all experienced such hallucinations. Have you ever seen the hands on a clock move only to find out that the clock didn't run? Have you ever heard the phone ring when you were in the shower, but later found it had not rung at all?
3. What other experiences have you had that may have been due to expectation?

d. Looking for Clarity in Vagueness

- i. When our senses are confronted with a formless stimulus, we often perceive something distinct. We look at clouds, smoke, fuzzy paintings and see shapes that are familiar. This illusion is called pareidolia. Many cases of pareidolia are common
 1. Man in the Moon - cultural example
 2. Samoans see a woman weaving
 3. Chinese see a monkey pounding rice
 4. East Indians see a rabbit
 5. Jesus' image in a tortilla - famous case of a housewife in New Mexico who found the shape in the skillet burns and took it as a sign of Christ's second coming
 6. Messages in rock music
 7. Man in the shadows - Do you ever feel as though someone is following you?
 8. UFOs - we try to make something familiar out of a vague object.

9. The Blondlot Case and N-rays - famous case in which scientist Rene Blondlot announced the discovery of N-rays, which could be detected by the human eye and were emitted by metals. They apparently increased the brightness. Blondlot claimed that this type of radiation was blocked by lead. Scientists could not reproduce his results because the experiments were entirely subjective. Another scientist named Wood challenged Blondlot while participating in a test of N-rays. He told Blondlot that a lead sheet was in place when it was not, and Blondlot claimed to see the rays. Wood then placed the lead sheet in front of the source of N-rays and Blondlot claimed to see the N-rays. Blondlot's observations depended entirely on his beliefs, and were not correlated to when the sheet was actually in place

e. Memory

- i. our memories are constructive, not literal
- ii. imagine a scene.....How do you look at it?
- iii. Recall a scene - do you look at it through your own eyes?
- iv. Car accident film - hit vs. smash and long term memory - if people watch a car accident on film and are asked a question after viewing the scene, the wording of the question affects how the subject remembers the scene. When asked "How fast were the cars going when they smashed?", subjects reported faster speeds when asked about it again later than subjects who were asked, "How fast were the cars going when they hit?"
- v. Selective memory - Dreams, we have over 250 a night but only remember a few of them, if any

f. Judging

- i. We can lead ourselves to believe that something is paranormal or supernatural when it actually isn't
- ii. Have you ever had a friend call just when you were thinking about them? It may seem strange or paranormal, but there are many more times when you think about someone or something and nothing related happens.
- iii. What are the chances that 2 people out of a party of 23 have the same birthday? $1/2$ ----- $1/1000$ ----- $1/40$ ----- $1/2020$ (Answer $1/2$!)
- iv. How many things happen to you in the course of a day? Incredible pairings are more likely than you think

g. Science is a systematic attempt to get around these limitations. Science tries to remove personal experience from the scientific process.

i. Scientific Method

1. State Problem using operationally defined variables
2. Form a hypothesis
3. Determine the variables
 - a. Independent variable(s)
 - b. Dependent variable(s)
 - c. Control(s)
 - d. Standards of comparison
(Experimental control)
4. Determine the materials and procedures
5. Make qualitative observations
6. Obtain quantitative data
7. Analyze and interpret the results
8. Identify possible sources of error in the experiment
9. Write a conclusion
10. Determine other tests to be done

4. Have Students start hand writing analysis for next day
 - a. Pass out a check to each student and have them endorse the back using the name of the payee (forge the signature)
 - b. Collect the endorsed checks keeping the groups separate
 - c. Have each student write this note on a piece of paper
Dear Mr. Miller,
Please excuse Allison from school yesterday. She was sick with a high fever.
Sincerely,
Mrs. Smith
 - d. Collect the excuses keeping the groups separate

5. The Wife Puzzle

- a. Use if there is more time. Adjust instructions to time available-can be take home problem to work on for next day
 - i. A lovely cashmere sweater was found torn to shreds (What a Crime!!) on the sidewalk in the international quarter.
 - ii. The sweater police talked to six witnesses, including the shredder. The six were very open about what had happened. The only trouble was that none of them spoke any language the police could understand. Nevertheless, the police were able to piece together the following information
 1. The witnesses were three men and three women: Fred, John and William; Gloria, Gilda, and Barbara
 2. The men were married to the women, though not necessarily in the order listed
 3. William's wife was the cashmere murderer
 4. Fred speaks and understands only Basque
 5. John is bald

6. The couple who live next door to Gilda and her husband have the same color hair she does, and speak both Spanish and Basque.
 7. William's wife recently gave Barbara a home permanent
 8. Gilda's husband speaks only French
- iii. Who destroyed the lovely sweater?
 - iv. Solution to the Wife Puzzle
 1. If you can identify William's wife, you'll know the shredder
 2. William's wife isn't Barbara, because the former gave the latter a permanent. William's wife must be either Gilda or Gloria
 3. Fred's wife isn't Gilda, because he speaks only Basque and her husband speaks only French. So Fred's wife is either Gloria or Barbara.
 4. If John is bald, he doesn't live next door to Gilda and he doesn't speak Spanish and Basque.
 5. Therefore, John must speak French and be married to Gilda. Only Gloria can be William's wife and the horrible cashmere shredder.

6. Time left over? Have students introduce themselves to class

Materials Needed:

Bank Observation Picture

Meal Observation Picture

Words in Color Sheet

Bank Checks