**Case Number 612700 The Case of the Basement Lab**

Gerald, a recent grad of WSU had just moved to New York City. As is typical of apartment buildings, this apartment building had all of the laundry machines in the basement. While his laundry was running, Gerald liked to poke around in the basement. Gerald didn’t expect to find suitcases of cash that some crook had stashed in the bowels of the building, but he thought he’d at least see a rat — one of those New York rats that’s so big it says, “Here kitty, kitty.” He’d lived here for over a month now, but still hadn’t found anything very exciting. A couple of times he had walked in on some other tenants flirting in the laundry room, like maybe they had a regular rendezvous in the basement. Another time he saw a guy pounding and kicking a washing machine. He didn’t seem embarrassed when Gerald appeared — he just said, “For what we pay in rent, we shouldn’t have to worry about busted equipment!” Rent, it figures. He had already been stressing a bit about the rent, with all those student loans to pay pack and stuff, too bad he didn’t have the deal that some of the older tenants had — it had something to do with rent control. Whatever, Gerald still thought it would be cool to find a suitcase of cash hidden in one of the storage rooms or whatever those other rooms were down there. Maybe the reward money would cover a month’s rent.

When he rounded the basement corner, something caught his eye. A door that always drew his attention and was never unlocked was — open! It was barely cracked, but it was open. He almost didn’t know what to do. He felt an adrenaline rush and got shaky hands — this could be his big break. After loads and loads of laundry he finally arrived at the moment he’d been waiting for, but he hesitated. His mind began to trick him by telling him all the reasons why he shouldn’t open the door Instead he ignored those thoughts, took a deep breath, and slowly pushed open the door. Gerald was ready for anything but prepared for nothing. He exhaled when he realized that nobody was in the room. It wasn’t empty, though. He peeked around. A single light bulb revealed a maze of water pipes on the wall and some sort of makeshift chemistry lab in the middle of the room. He saw a lot of flasks and beakers with tubes connecting them, and burners and other things that he recognized from his chemistry class at WSU. But what really caught his eye was the broken flask. It was broken off about halfway down the neck, and its contents were slowly dripping onto the floor. It appeared to be the only flask containing any liquid. He could see that there was a sheet of paper next to the flask. More curiously, there was also what appeared to be a bloody rag on the floor a few feet away, and what looked like a napkin with blood on it on the counter.

Gerald didn’t really know what to make of it, but he had a hunch why the door was usually locked. Somebody didn’t want other people in there fiddling around; they clearly wanted to keep the place secret. It looked like maybe someone had left in a hurry. Did whoever it was hear him coming down the stairs? He really wanted to check it out, but he had watched enough TV to know that you don’t disturb the evidence. Still . . . he smiled at the thought of blowing the cover off a terrorist plot. He left the room and the laundry and went upstairs. He debated keeping it to himself, but something about the way that whole scene looked just wasn’t right so he called the police.

In this day and age, anything that may be remotely connected to terrorism takes a high priority, so the police arrived immediately. The lead investigator, Detective Glover, interviewed Gerald about how he had stumbled upon the scene. “So you saw that the door was unlocked, and you opened it?”

“Yes, ma’am.” Gerald knew that now was the time to be very polite.

“It’s normally locked then, I take it?” The detective didn’t seem to suspect Gerald of any part in it, but he was taking no chances.

“Yes, ma’am,” he repeated. “I come down here a lot to do the laundry and ever since I moved here, I’ve always kinda wondered what was on the other side of that door, but it was always locked, so I never, you know, knew what it was.” Detective Glover asked him how long they’d lived there, and whether or not he’d ever noticed anything suspicious. One question in particular surprised him.

 “Gerald, what do you think is in there?” the detective asked, motioning in the direction of the dimly lit room.

“I don’t know. I was afraid it might be connected to terrorism. That’s why I called.” Then Detective Glover thanked him for calling. As the detective turned away, one of the other investigators approached her and said something in a low voice. Gerald overheard the word “poison,” which really got his mind racing.

After interviewing Gerald, other tenants, and people who worked in the building, Detective Glover had a short list of people she deemed “persons of interest.” At that point in the investigation there was no hard evidence associating anyone with the lab, so there were no official suspects. However, since there were no signs of forced entry, the investigation centered on the six people who would have had access to the key that could unlock the door to the room. Mysteriously, the key was missing from the maintenance room rack where keys to all of the different utility rooms were kept. Interviews with each of the six people didn’t reveal much, since all of them denied knowledge of the chemistry lab and the missing key.

**Persons of interest:**

***Dan Isacson, building superintendent*** – Mr. Isacson is an outgoing, older man. He is in charge of maintenance for two adjacent apartment buildings, and though he is not required to do any of the actual work himself, he frequently does. He has a large cut on his hand that he claims is from replacing a tenant’s window the previous day.

***Sandra Mueller, secondary superintendent*** – Ms. Mueller tends to keep to herself. Quiet but extremely reliable and superb with tools, she is usually the person who handles the difficult maintenance jobs. She has numerous small cuts on her hands and has an explanation for most of them. None of the cuts seem big enough to bleed very much, if at all. One tenant claims to always hear her grumbling under her breath and swears she once kicked his cat. She also has a widely known phobia of dogs.

***Matt Karmikle, plumber*** – Matt is pretty well known to most of the tenants, and most of them like him. He has worked there for 20 years. He is also a part owner of the building, having been paid with owner’s shares in the building when they couldn’t afford to pay him cash about six years ago. Like most plumbers, his hands and arms are pretty banged up.

***Alan Plower, majority* *owner*** – Alan is not well-liked by several of the older tenants, who claim that he has tried to break their leases. Their maintenance problems always seem to be the last ones fixed. Newer tenants seem indifferent. He claims that the gash across his palm is the result of a recently broken air conditioning unit, which he returned early from a vacation to fix.

***Samuel Anderson, custodian*** – Samuel doesn’t really like the tenants, and they are pleasant to him only because they feel they have to be. In general, he thinks that the people who live there are unnecessarily dirty, intentionally leaving him messes to clean up. They think that he is too grumpy but treat him nicely because he does clean up a lot of messes. He has no obvious injuries. Samuel used to be a custodian at a local high school.

***Susan Plower, co-owner*** – Susan isn’t very well known. She is married to Alan Plower and is also part owner of the building. Because she is a radiologist, she reportedly does nothing in the day-to-day operations of the building. She has access to the key, however. The tenants who live in the room directly below the Plowers have said that the two of them argue frequently.

**THE EVIDENCE**

The pieces of evidence collected at the scene confirm that Gerald was very observant. Since no one claims any knowledge or ownership of the lab, investigators have the following to go on: a rag and a napkin that may have blood on them (which could indicate that more than one person is involved if both test positive for blood and each sample contains a separate blood type); an unidentified liquid; and a sheet of printed paper that lists suspicious information about certain metal compounds. As the investigation begins, detectives are still trying to find a fingerprint anywhere in the lab.

**YOUR TASK**

Based on the information available at the scene, you must conduct a series of forensic experiments to help investigators determine the user and purpose of the lab.

**SAFETY**

This forensic investigation will require you to work with blood (potentially). Barium nitrate, silver nitrate, lithium nitrate, potassium nitrate, aluminum nitrate, lead (II) nitrate, copper (II) nitrate, nickel (II) nitrate, hydrogen peroxide, and Kastle-Meyer reagent will also be used in the course of this investigation. Refer to the safety information in the MSDSs for safe handling and disposal of these materials.

**Prior to lab** in your notebook or a separate sheet of paper (everyone must do a pre-lab) write the experiment name, the purpose of the experiment, the major experimental steps used to achieve this purpose and a summary of the safety precautions for dealing with the materials you will be dealing with. In this experiment you will be working with a piece of evidence which might contain blood as well as solutions of barium nitrate, silver nitrate, lithium nitrate, potassium nitrate, aluminum nitrate, lead (II) nitrate, copper (II) nitrate, nickel (II) nitrate, hydrogen peroxide, and Kastle-Meyer reagent. Look up the MSDSs for the chemicals and summarize the information in your notebook including disposal information and look up safety precautions for dealing with blood and write about that in your notebook as well.

**Exploration**: There are three parts to determining who the occupant of the basement room is, dealing with the potential blood evidence, determining the identity of the material in the flask, and identifying fingerprints (if any are found). First deal with the material found on the rag and the napkin.

**Blood Evidence**

The Kastle-Meyer Color Test is commonly used to presumptively indicate if blood is present on an object. It is fast and easy to use, making it an ideal test at a crime scene or for use on samples taken from a crime scene. The test relies upon the heme, the iron-containing portion of a red blood cell, to catalyze the oxidation of phenolphthalein (also known as Kastle-Meyer reagent). Phenolphthalein is normally clear and colorless, but in the presence of blood and hydrogen peroxide, it becomes pink. If results of a Kastle-Meyer test suggest the presence of blood, investigators then know that further analysis of the residue may provide additional useful information. The disadvantage of the Kastle-Meyer test is that it is presumptive, not conclusive. If any chemical and plant oxidants from sources other than blood are present, the test can produce a false positive result. In this experiment, however, you will minimize false positive results by adding the hydrogen peroxide catalyst last. Other chemical oxidants that may be present will usually produce a pink color before the hydrogen peroxide catalyst is added. The reaction that you will test for is described below:

**Heme iron + phenolphthalin (clear) + hydrogen peroxide 🡪 oxidized phenolphthalein (pink)+ water**

(Heme is a catalyst and is unchanged. Hydrogen peroxide is reduced to water)

**PROCEDURE:**

1. In order to determine that there are no other chemical oxidants present, first test the clean filter paper sample (Negative Control).

2. Apply one drop of ethanol or distilled water to the sample.

3. Apply one drop of Kastle-Meyer (KM) reagent to the same area on the sample, and observe any color change. Record results in your notebook on a table.

4. Apply one drop of 3% hydrogen peroxide to the sample area. Observe and record any color change. (Because there are presumably no chemical oxidants present on this sample, you should observe and record no color changes.)

5. Repeat steps 2 – 4 on the Positive Control paper sample containing a known spot of blood.

You should observe and record a pink color after adding the hydrogen peroxide.

6. Repeat steps 2 – 4 on each of the Unknown filter paper samples. One has been wiped on the spots from the rag found in the basement, while the other has been wiped on the spots from the napkin found in the basement. Observe and record any color changes in the appropriate rows.

7. When finished, clean up your lab area by disposing of the bloody filter papers in the biohazard or other bag supplied by your teacher.

**In your notebook make conclusions about what your results mean.** Explain why tests were done on a clean piece of filter paper and on a filter paper known to contain blood. Why is this test not conclusive with respect to the presence of blood? In your notebook write two to three sentences summarizing the results of this test as they relate to your investigation.

**Material in Flask:**

Police are immediately suspicious when they find a printed list of what appears to be research on various metals, all of which can be used as poisons when mixed in the right combinations and strengths. In order to determine if the unidentified liquid in the broken vial contains any of the metals listed, a flame test must be performed on the unknown and compared to results from the set of chemicals listed.

The flame test is a quick way to identify elements (usually metals) contained in a compound. Flame tests have been around for centuries, yet some understanding of the nature of the atom is necessary to understand the underlying process. In 1913, Nils Bohr devised the base model of the atom. His model was then refined by the quantum theory of Erwin Schrödinger and Werner Heisenberg in the 1920s. In a flame test procedure, a small sample of the compound to be tested is placed in a well-tuned Bunsen burner flame. The heat from the flame excites the electrons in the atoms, raising them to higher energy levels. As electrons fall from the higher energy levels to lower levels, they emit the energy difference as photons (light particles). The photons emitted are of a specific energy for each element; thus, the light associated with them is of a unique color.

In this experiment, you will record and compare the unique colors of the eight metals listed on the information sheet found in the lab against the color of the unknown liquid in the vial. What you find may help you determine the purpose of the liquid itself.

**PROCEDURE:**

1. Place the flame test loop into the solution to be tested and heat the solution to be tested in the flame test loop by holding the loop in the flame. Observe and record the color that results. It’s important to be exact in your description of the color. You may want to repeat the test. Record your results in a table in your notebook.

2. After you are done, allow the flame test loop to cool in the air, then place it back on the paper towel it came from. Do not cool the loop with water or by touching it with your hands, as that will contaminate it.

3. Repeat steps 1-2 for each station. You may repeat any tests if you feel you need to do so to make an accurate match with the unknown liquid. Also record the color for an empty, clean flame loop.

4. Once you have recorded all of the colors for the possible metal poisons, sign out the unknown evidence solution and test its color in the flame. Record. In your notebook summarize this part of the experiment by answering the following questions: According to your observations, what is the identity of the unknown liquid? How sure are you of your identification? What was the purpose of observing the clean flame test loop’s color in the flame? How might this affect other colors observed? What was the major source of error in this experiment? According to Bohr’s model of the atom, why does each element produce a distinctive color? In the post lab you will be asked to summarize why the metal you determined to be present in the unknown may be useful to someone trying to poison others, how it might be obtained, and where it is commonly found. This will help confirm identity in your final conclusion.

**Fingerprints:**

Through a careful examination of the evidence found in the lab, it looks like you may be able to lift one partial fingerprint from a test tube found in the lab by the magnetic powder method used last week. Check out the evidence and perform the latent fingerprint analysis method. Refer to your notes from last week for details on the method. Once you have visualized the latent print compare it with the prints of the “persons of interest” Identify the class of each set of prints, and note what specifically about each set of prints does or doesn’t match the print from the test tube. Remember — the more points of individualization you match, the more likely the positive identification.

**Record the match in your notebook (if any).** As you write your report, think about and address these issues: What are the implications of finding fingerprints at a crime scene? In what scenarios might fingerprints not be meaningful evidence? How might a person avoid leaving a fingerprint behind? What are some other methods investigators might use to determine if a suspect had been present at a crime scene? (You will be actually answering these questions as part of your post-lab.

By now, you have uncovered many of the facts of the case. It is time to summarize your findings. The police need your evidence to corroborate their version of the crime. You need to make a case. Using the evidence that you gathered from the Kastle-Meyer Color Test, the Flame Test, and the Fingerprint Identification, build your case against one of the people that investigators deemed as a person of interest.

This case was derived from a lab available on courttv.com

**At the end of your lab provide a nice summary of the lab by answering the following post-lab questions:**

1. Who was responsible for the basement lab? In your answer be sure to explain how each piece of evidence implicates that person. Cite specific examples, and be sure to rule out the other characters if possible.
2. What are the implications of finding fingerprints at a crime scene?
3. In what scenarios might fingerprints not be meaningful evidence?
4. How might a person avoid leaving a fingerprint behind?
5. What are some other methods investigators might use to determine if a suspect had been present at a crime scene?
6. What was the unknown liquid? How do you know?
7. What was the purpose of observing the clean flame test loop’s color in the flame? How might this affect other colors observed?
8. What was the major source of error in the flame part of the experiment?
9. According to Bohr’s model of the atom, why does each element produce a distinctive color?
10. Why would the metal that you identified as the unknown be useful to someone trying to poison others, how it might be obtained, and where it is commonly found?

11. The Kastle-Meyer reagent is only a presumptive test for blood. What does presumptive test means? Explain the benefits and limitations of presumptive tests, and give some other presumptive tests that are used forensically. Cite any references used to answer this question.