***BASIC LABORATORY EXERCISES FOR FORENSIC SCIENCE:***

**AIDS, HELPFUL HINTS, AND ANSWERS**

**Exercise 2: Crime Scene Investigation and Deductive Reasoning**

1. What is the timeline of events surrounding Professor Kline’s disappearance and death?

Friday—May 11:

5:15 p.m. Professor Kline leaves his office for a weekend meeting with Dr. Myers.

5:45 p.m. Professor Kline meets Dr. Myers and Emily at the Jacobs Falls dig site.

7:54 p.m. Sunset. Professor Kline is strangled to death with the fly line from his tent sometime after sunset.

2. What is the earliest possible time/date of Professor Kline’s death?

Friday evening after sunset is the earliest possible time of the Professor’s murder.

3. Who do you think had the means to commit the crime? Who knows what sort of person is capable of murder?

 Emily’s alibi is suspect in the sense that, just because she has hotel receipts and seminar materials, this does not prove attendance. On that theme, her hotel receipt indicates double occupancy. In addition, the e-mail Emily received from Dr. Myers was received after you and Stransky began questioning her! If the e-mail was genuine, she could not have known about it when she claimed she did. Emily had access to Dr. Myers’s computer, so she must have composed it and sent it to herself after she offered it to you as evidence. This explains why Mrs. Myers’s first name is misspelled in the text of the e-mail (either in her haste or ignorance)—Dr. Myers did not misspell his own wife’s name! The significance of this is not readily apparent.

 Mrs. Myers could be a resentful, disdainful woman who feels she may be better off alone, but her seemingly genuine grief seems to mitigate this level of suspicion.

4. Who had a motive?

There is no clear motive spelled out by witness statements or physical evidence. One might consider what Dr. Myers’s reaction would be if Professor Kline had reacted unfavorably to the legitimacy of his archaeological findings, but this is speculation because we have no opportunity to question Dr. Myers directly.

More speculation might include Emily’s motives; she may not be as innocent as she wishes to appear. Perhaps she wants to claim this “big find” for herself!

The environmentalist was clearly upset to learn about Dr. Myers’s dig and may have felt justified in using any means necessary to defend his cause. Additionally, his alibi is questionable.

5. What, if any, further information would help you with this case?

Answers will vary. If needed, direct students’ discussion to the investigative data that can be gleaned from the following:

 a. An autopsy report, which may explain the cause of death.

 b. Toxicology reports, which may reveal if the deceased was poisoned or drugged.

 c. X-rays of the body, which may show bullets. These wounds were not visible externally due to advanced decay.

 d. Trace evidence analysis of Dr. Myers’s Jeep, recovered at the scene.

 e. Analyses of the additional evidence found in the dumpster behind Emily’s apartment.

**Exercise 4: Forensic Glass Analysis**

Exercise I: Procedure Part 8

How close did you come to calculating the known density of aluminum (2.70 g/cc)?

Responses will vary. This is a good opportunity to discuss the concepts of percent error and sampling variability. There is no way to produce a duplicate measurement of exactly the same magnitude every time. This necessitates the practice of multiple measurements to determine an average of the values.

Exercise II: Comparing Glass Density

Preparation of the sodium polytungstate (SPT) solution (density 5 2.80 g/mL). Visit the Sometu company website for product information.

Time: Approximately 30 minutes

*Note*: Do not use metal in the preparation or storage of this solution.

 a. Set up a 250 mL plastic beaker with a magnetic stir bar.

 b. Add 36.0 mL distilled or deionized water to the beaker.

 c. Measure 164.0 g SPT powder (Na6 (H2W12O40)•H2O).

 d. While stirring gently, gradually add the SPT powder to the water. Allow the SPT to completely dissolve before making further additions. *Never add water to the SPT,* as an insoluble clump will form.

 e. Seal tightly and store at room temperature in a plastic or glass container.

 f. Transfer to a dropper bottle or aliquot into sealable containers and provide a plastic (disposable) transfer pipette for student use.

 g. Be sure to test all glass fragments beforehand to determine how much SPT solution will be needed for each assay. It may be helpful to guide students by informing them of this amount before they begin.

**Exercise 6: The Microscope**

Exercise I: The Compound Microscope

Is the letter “e” right-side-up? Is the “e” still right-side-up?

The orientation of the letter “e” when viewed through the lens of a compound microscope should be upside-down relative to its orientation when viewed by the naked eye. In addition, when the stage is moved to the right, the image in the eyepiece should move to the left.

Exercise II: The Stereomicroscope

Part II—Examination of Typeface

Is the “e” still right-side-up?

The image of the object as viewed through the eyepiece should appear in the same orientation as it is on the stage.

Part III—Examination of Nails

1. Are all five nails exactly the same shape?

Your students should recognize that each nail is unique in some way, even if they appear identical to the naked eye.

2. Is each head the same thickness as the others?

Answers will vary.

3. Are they all the same length?

Answers will vary.

4. Do the striations appear to be identical?

Answers will vary.

5. Is there a particular shape or mark that occurs on each nail that has no bearing on the quality or performance of the product?

Answers will vary.

**Exercise 7: Forensic Hair Analysis**

Exercise I: Casting Scale Patterns

1. Compare this to the actual hair—which is a better image for viewing the scale pattern?

The cast is preferred to the actual hair for examination of the scale pattern on the surface of a hair.

**Exercise 8: Handwriting Comparison**

Exercise I

Part I—Example 1

The letters on the left are from the forgery. Examples of Howard Hughes’s known handwriting are on the right. Point out the differences between the two using specific examples.

Many letter forms do not match Hughes’s writing. For example, the “i” dots and “t” crossings are incorrectly formed. Hughes normally signed his middle initial “R” with one stroke. The forgery has a two-stroke “R.”

Part I—Example 3

Compare the known signatures from Howard Hughes to the questioned signatures.

The letter “o” in Howard has a tendency to be higher on the right side in the questioned writing, whereas in the known handwriting, the emphasis is on the left shoulder of the letter “o.”

The letter “w” in Howard has a descending appearance in the known writing, whereas in the questioned writing, “w” is considerably larger and more uniform in height.

The letter “g” in Hughes in the known writing gives the appearance of being a “figure 8” with the lower part of the “g” containing a very large round loop. The questioned “g” shows a more elongated lower loop.

The staff of the letter “h” as it descends to the baseline in the authentic writing has a tendency to curve to the left; in the questioned writing it has a tendency to slant to the right.

The “es” in Hughes is rather small with a long tapering sweep in the “s” in the genuine writing. In the questioned writings, the “es” are extremely large; the “e” is very rounded, and the “s” contains a loop with a very short blunt ending stroke.

Exercise I

Part II—Are You a Good Forger?

Can you copy your signature the same every time?

It is impossible for the average person to rewrite his or her signature exactly the same way every time. The amount of variation between signatures from the same individual is different for each writer.

**Exercise 11: Blood Spatter Evidence**

Sin A 5 width of bloodstain

Length of bloodstain: Where A = the angle of impact

Note: There is a 5-degree error factor with this formula. This means that your calculations are good to plus or minus 5 degrees of the actual value of the angle of impact.

Stain Shape vs. Impact Angle

Measure the stain’s length and width in millimeters of the nine bloodstains shown below. Use the formula previously described to calculate the angle of impact for each bloodstain.

Part IV—Examining Your Work from Part II

Do your calculations match the angles you used in your experiment?

The calculations should be close to the expected values, but variation in measurement technique will produce some deviation from expected values.

**Exercise 12: Bloodstain Analysis**

This exercise introduces the student to the analytical scheme appropriate for the forensic characterization of a bloodstain. This exercise includes a detailed procedure for applying immunoassay to species identification.

 The purpose of the food coloring portion of the immunoassay exercise is to demonstrate in a dramatically visual manner that substances can and will diffuse through the agar, and that when they meet a reaction can occur.

 The section containing HA, HS, and SA is to be used by the students to help interpret the crime scene results. This experiment takes advantage of the fact that a calcium phosphate precipitation line will form when a calcium chloride solution (HS) comes in contact with a potassium phosphate solution (HA).

A band should develop between HS and HA, simulating an antigen-antibody interaction. There should be no corresponding band between HS and SA, demonstrating that the binding reaction between HS and HA is specific.

 Finally, the student is presented with an unknown to be tested against various simulated antisera. The unknown sample will form a band with its corresponding antiserum.

Use the following reagent as each simulated serum/antiserum:

HS—simulated human serum: 2 M saturated calcium chloride. Add 58.8 g of calcium chloride to 100 mL of deionized water. Mix, then bring to a volume of 200 mL with deionized water.

?S—2 M saturated calcium chloride, as above

DA—simulated deer antiserum: deionized water

RA—simulated raccoon antiserum: deionized water

SA—simulated skunk antiserum: deionized water

HA—simulated human antiserum: 1 M saturated potassium phosphate tribasic. Mix 42.5 of potassium phosphate tribasic to 100 mL of deionized water. Mix, then bring to a volume of 200 mL with deionized water. Potassium phosphate dibasic can also be used.

**Exercise 14: Tool Mark Analysis**

Exercise II: Casting Tool Marks

Can you think of an item that an investigator could search for at the crime scene that would help you to complete your analysis?

Any item that the student can imagine that could make the same or similar marks on the piece of “evidence” submitted for analysis will help investigators at the crime scene, and may help to direct the investigation as a whole.

**Exercise 16: Forensic Entomology**

This exercise includes an excellent application of logic and deductive reasoning to crime scene investigation, and amply illustrates basic principles of forensic entomology.

To set up the “evidence” baggies for the fictional cases described in this exercise, add a few of each of the pipe cleaners in the following colors and lengths (in mm):