**DEVELOPMENT OF A**

**COMMUNITY COLLEGE LEVEL**

**FORENSIC SCIENCE COURSE**

by

Emily Suzanne Boward

B.A (Hood College) 2011

MOCK GRANT PROPOSAL

Submitted in partial satisfaction of the requirements

for the degree of

MASTER OF SCIENCE

in

BIOMEDICAL SCIENCE

in the

GRADUATE SCHOOL

of

HOOD COLLEGE

May 2019

Accepted:

| | |
|---|---|
| _____ | _____ |
| Perry Wood, Ph.D.<br>Project Advisor | Ann Boyd, Ph.D.<br>Director, Biomedical Science Program |
| _____ | _____ |
| Ricky Hirschhorn, Ph.D.<br>Committee Member | |
| _____ | _____ |
| Craig Laufer, Ph.D.<br>Committee Member | April M. Boulton, Ph.D.<br>Dean of the Graduate School |

## STATEMENT OF USE AND COPYRIGHT WAIVER

I do authorize Hood College to lend this mock grant proposal, or reproductions of it, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

## DEDICATION

I dedicate this work to my parents, Randy and Rhonda, for their endless love and support.

## ACKNOWLEDGEMENTS

Thank you to my advisory committee:

Perry Wood, Ph.D. (Frederick Community College)

Ann Boyd, Ph.D. (Hood College)

Ricky Hirschhorn, Ph.D. (Hood College)

Craig Laufer, Ph.D. (Hood College)

Thank you to the following individuals for their support, advice, and expertise: Investigator Michael Simmons (Oneida County Sheriff's Department); Stacey Wilson (Montana Forensic Science Division); Argi Magers (Maryland State Police); Jeffery Kercheval and Jessica Shaffer (Western Maryland Regional Crime Laboratory); Jerica Wilson (Drexel University); Judy Staveley, Ph.D.; Debra Ellis, Ph.D.; Sharon Smith; Jacob Ashby, Ph.D.; Gregory Coldren, Ph.D.; and Mary Mogan-Vallon (Frederick Community College); Danielle Brown; Molly Rose Johnson; Steven and Vicki Spurrier; Rhonda and Randall Boward.

## Mock Grant Application

Modeled after Department of Health and Human Services
Public Health Services
(based on Form PHS 398)

**LEAVE BLANK—FOR OFFICIAL USE ONLY.**

| Type | Activity | Version – HCBMS.011712 |
|---|---|---|
| Review Group | | Formerly |
| Council/Board (Month, Year) | | Date Received |

1. TITLE OF PROJECT *(Do not exceed 81 characters, including spaces and punctuation.)*
Development of Community College Level Forensic Science Course

2. RESPONSE TO SPECIFIC REQUEST FOR APPLICATIONS OR PROGRAM ANNOUNCEMENT OR SOLICITATION ☒ NO ☐ YES
*(If "Yes," state number and title)*
Number: Title:

**3. PROGRAM DIRECTOR/PRINCIPAL INVESTIGATOR** — **New Investigator** ☐ **No** ☒ **Yes**

3a. NAME (Last, first, middle)
Emily Suzanne Boward

3b. DEGREE(S)
B.A.

3h. eRA Commons User Name
N/A

3c. POSITION TITLE
Graduate Student

3e. DEPARTMENT, SERVICE, LABORATORY, OR EQUIVALENT
Department of Biology

3f. MAJOR SUBDIVISION
Biomedical Science Program

3d. MAILING ADDRESS *(Street, city, state, zip code)*
Frederick Community College
Science Department, Rm C-103
7932 Opossumtown Pike
Frederick, MD 21702

3g. TELEPHONE AND FAX *(Area code, number and extension)*
TEL: N/A FAX: N/A

E-MAIL ADDRESS:
EBoward@frederick.edu

4. HUMAN SUBJECTS RESEARCH ☒ No ☐ Yes

4a. Research Exempt
N/A

4b. Federal-Wide Assurance No.
N/A

4c. Clinical Trial ☒ No ☐ Yes

4d. NIH-defined Phase III Clinical Trial ☒ No ☐ Yes

5. VERTEBRATE ANIMALS ☐ No ☐ Yes

5a. Animal Welfare Assurance No. N/A

| 6. DATES OF PROPOSED PERIOD OF SUPPORT *(month, day, year—MM/DD/YY)* | | 7. COSTS REQUESTED FOR INITIAL BUDGET PERIOD | | 8. COSTS REQUESTED FOR PROPOSED PERIOD OF SUPPORT | |
|---|---|---|---|---|---|
| From | Through | 7a. Direct Costs ($) | 7b. Total Costs ($) | 8a. Direct Costs ($) | 8b. Total Costs ($) |
| 06/01/2017 | 03/01/2018 | | | | |

9. APPLICANT ORGANIZATION
Name: Emily Suzanne Boward
Address:
Frederick Community College
Science Department, Rm C-103
7932 Opossumtown Pike
Frederick, MD 21702

10. TYPE OF ORGANIZATION
Public: → ☐ Federal ☐ State ☒ Local
Private: → ☐ Private Nonprofit
For-profit: → ☐ General ☐ Small Business
☐ Woman-owned ☐ Socially and Economically Disadvantaged

11. ENTITY IDENTIFICATION NUMBER
DUNS NO. N/A Cong. District N/A

12. ADMINISTRATIVE OFFICIAL TO BE NOTIFIED IF AWARD IS MADE
Name
Title: Assistant Director of Grants Management, Finance
Address:
Frederick Community College
Science Department, Rm C-103
7932 Opossumtown Pike
Frederick, MD 21702
Tel: N/A FAX: N/A
E-Mail: EBoward@frederick.edu

13. OFFICIAL SIGNING FOR APPLICANT ORGANIZATION
Name
Title: Assistant Director of Grants Management, Finance
Address:
Frederick Community College
Science Department, Rm C-103
7932 Opossumtown Pike
Frederick, MD 21702
Tel: N/A FAX: N/A
E-Mail: EBoward@frederick.edu

14. APPLICANT ORGANIZATION CERTIFICATION AND ACCEPTANCE: I certify that the statements herein are true, complete and accurate to the best of my knowledge, and accept the obligation to comply with Public Health Services terms and conditions if a grant is awarded as a result of this application. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties.

SIGNATURE OF OFFICIAL NAMED IN 13. *(In ink. "Per" signature not acceptable.)*
N/A

DATE

PROJECT SUMMARY (See instructions):

The main goal of this project is to develop new forensic science curriculum for Frederick Community College. A Forensic Science Techniques class will be designed with both lecture and laboratory components. This course will emphasize concepts and techniques used for forensic processing and analysis at crime and death scenes. The main subjects that will be included are as follows: Introductory Information and Scene Security, Evidence Collection, Crime Scene Photography, Documentation and Sketching, Fingerprint Lifting, Pathology and Death Assessment, Presumptive Testing, Crime Laboratory Methods, Expert Testimony, and Footwear Impressions.

This curriculum will be designed as a four credit lecture/laboratory course. A series of scientifically-based exercises will be designed and tested for use in a classroom setting. Each procedure will be documented, and photographs will be used to enhance and clarify the protocols. In addition, a custom textbook, lecture PowerPoint presentations, and a sample syllabus will be created, providing a standard set of teaching objectives and learning outcomes, which will allow for efficient and productive instruction of this material. This curriculum will be targeted towards criminal justice students and law enforcement professionals in order to provide technical knowledge and skills necessary for crime scene investigation.

RELEVANCE (See instructions):

This course will provide an additional option for a four credit science elective at Frederick Community College. It will supplement courses in the Criminal Justice and Police Science programs, while also providing an introductory survey of the crime scene investigation discipline, suitable for non-science majors. This course content is current and up-to-date, and connects real-world circumstances to the theories and methodology presented in the classroom. By presenting an accurate depiction of this discipline, this course content will also help students discern what is factual on television shows and other media outlets.

PROJECT/PERFORMANCE SITE(S) (if additional space is needed, use Project/Performance Site Format Page)

| **Project/Performance Site Primary Location** | | | |
|---|---|---|---|
| Organizational Name: Science Department, Frederick Community College | | | |
| DUNS: | | | |
| Street 1: 7932 Opossumtown Pike | | Street 2: | |
| City: Frederick | County: Frederick | | State: MD |
| Province: | Country: United States | | Zip/Postal Code: 21702 |
| Project/Performance Site Congressional Districts: 6th Congressional District | | | |

| **Additional Project/Performance Site Location** | | | |
|---|---|---|---|
| Organizational Name: | | | |
| DUNS: | | | |
| Street 1: | | Street 2: | |
| City: | | | State: |
| Province: | Country: | | Zip/Postal Code: |
| Project/Performance Site Congressional Districts: | | | |

## BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

| NAME | POSITION TITLE |
|---|---|
| Boward, Emily Suzanne | Science Laboratory Technician |
| eRA COMMONS USER NAME (credential, e.g., agency login)<br>EBoward | |

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

| INSTITUTION AND LOCATION | DEGREE *(if applicable)* | YEAR(s) | FIELD OF STUDY |
|---|---|---|---|
| Hood College, Frederick, MD | B.A. | 2011 | Biology |
| Hood College, Frederick, MD | M.S. | 2019 | Biomedical Science |

### A. Positions and Honors

| | | |
|---|---|---|
| *2014-Present* | **Science Laboratory Technician I** | Frederick Community College, Frederick, MD |
| *2014-2015* | **Interim Science Lab Manager** | Frederick Community College, Frederick, MD |
| *2013-2014* | **Science Academic Lab Aide** | Frederick Community College, Frederick, MD |
| *2012-2014* | **Office Assistant** | Key Neurology, Frederick, MD |
| *9-11/2011* | **Quality Assurance Technician** | Ventura Foods, LLC, Chambersburg, PA |
| *2011* | **Crime Lab Intern** | Western Maryland Regional Crime Laboratory<br>Hagerstown Police Department, Hagerstown, MD |
| *1-5/2011* | **Teaching Assistant** | Undergraduate Genetics Laboratory Course<br>Hood College, Frederick, MD |
| *2010-2011* | **Student Researcher** | Hood College, Frederick, MD |
| *1/2010-3/2011* | **Student Employee** | Community Scholar Work Study Program<br>Hood College, Frederick, MD |
| *2008-2009* | **Student Laboratory Aide** | Hagerstown Community College<br>Hagerstown, MD |

### B. Selected peer-reviewed publications (in chronological order)

**Boward ES**, Wilson SL. *A comparison of ABAcard® p30 and RSID™-Semen test kits for forensic semen identification*. J Forensic Leg Med 2013;20(8):1126–1130.

## C. Research Support

**Frederick Community College, Science Department** 2013-present
Laboratory supply preparation for the Forensic Biology (BI 130) course
Role: Technician

**Western Maryland Regional Crime Laboratory** 2011
Conducted forensic serological research for identification of human sperm and semen samples
Role: Intern

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FACILITIES: Specify the facilities to be used for the conduct of the proposed research. Indicate the project/performance sites and describe capacities, pertinent capabilities, relative proximity, and extent of availability to the project. If research involving Select Agent(s) will occur at any performance site(s), the biocontainment resources available at each site should be described. Under "Other," identify support services such as machine shop, electronics shop, and specify the extent to which they will be available to the project. Use continuation pages if necessary.

Laboratory:

Frederick Community College is a local, non-profit undergraduate teaching institution. All laboratories in the Science Department operate at a BSL-1 level. The main laboratory workspace (C-102) measures 685 square feet and consists of lab benches, seating, a sink with tap and deionized water faucets and a chemical fume hood. This room will be used to test experimental protocols. Two adjacent rooms (C-105 – 972 square feet and C-105A – 189 square feet) contain additional supplies (i.e. glassware, gloves, small consumables). C-105A has three 4$^{o}$C refrigerators for storing reagents and has a small autoclave for sterilizing biohazardous waste on site. C-105B is a chemical storage room measuring 1052 square feet. Biohazardous waste is collected on site into appropriate bags and sterilized in the autoclave. All chemical waste is collected into chemical resistant bottles, labeled, and stored for disposal by an external company.

Clinical:

N/A

Animal:

N/A

Computer:

A personal desktop computer with Ethernet internet connection is available on-site. Windows 10 software with the Microsoft Suite and Adobe applications are installed.

Office:

Personal office space, measuring 397 square feet, with a phone and desktop computer is available. Departmental equipment also includes fax machine, printer, copier and scanner.

Other:

The Safety and Security department maintains a safe campus environment and responds to incidents.
The PLANT department consists of the maintenance and custodial staff who assist with equipment repairs, trash removal, and maintenance of campus space.
The Shipping and Receiving department delivers all packages and mail for the campus and maintains a campus-wide inventory of all major supplies and equipment.

MAJOR EQUIPMENT: List the most important equipment items already available for this project, noting the location and pertinent capabilities of each.

**The following major equipment is available on site:**

- Digital Camera and Tripod - photography
- Small Handheld Alternate Light Source (455nm) – viewing biological stains
- Compound Light Microscope – viewing microscopic samples
- Forensic Dummy, Prop Gun and Knife – setting up mock crime scenes
- FTIR Spectrometer with Laptop Computer – analyzing chemical compounds

**The following consumables will be purchased with grant funding:**

- Black 2 inch x 4 inch Hinge Lifter (12 each) [Sirchie, SKU:131LB]
- White 2 inch x 4 inch Hinge Lifter (12 each) [Sirchie, SKU:131LW]
- Knife Evidence Boxes 16 inch x 3 inch x 2 inch (Set of 25) [Sirchie, SKU:ECB001K]
- Gun Evidence Boxes 14 3/4 inch x 7 7/8 inch x 2 1/4 inch (Set of 25) [Sirchie,SKU:ECB001G]
- Red SIRCHMARK Evidence Tape with White Stripe 108 ft [Sirchie, SKU:SM50002]
- Crime Scene Barrier Tape[Carolina, Item # 211919]
- Chain of Custody Evidence Envelopes [Carolina, Item # 212122]
- Short Plastic Photo Alphabet (A-Z) [Sirchie, SKU:PEA26VS]
- Evidence Scale Variety Pack (10 scales) [Sirchie, SKU:PPS410]
- Reversible Scale 300 x 150mm [Sirchie, SKU:PPS600]
- DAP 25-lb Carton Plaster of Paris [Lowe's, Item # 41324 Model # 10313]
- Stanley 25-ft SAE Tape Measure [Lowe's, Item # 94846 Model # 33-415L]
- Plastic Bags, Self-Locking, 12 x 15" [Carolina, Item # 713097]
- Presumptive Blood Test Kit [Carolina, Item # 840582]
- Hemastix Blood ID Reagent Strips [Sirchie, SKU: HEM50]
- Sheep Blood, Defibrinated, Pooled, 100 mL [Carolina, Item # 828894]
- Aqueous Leuco Crystal Violet Kit [Sirchie, SKU: LV509]
- BLUESTAR Forensic Mini Kit [Sirchie, SKU: FRA00002]
- Addipak - Water ST 5ml - 100/BX [https://www.amazon.com/Water-ST-5ml-100-BX/dp/B06XXK15ZH/ref=sr_1_1?ie=UTF8&qid=1494643946&sr=8-1&keywords=addipak+water]
- Sterile Swabs Pack of 100 [VWR, #10805-165]
- Crime Scene Drawing Template [https://www.amazon.com/Crime-Scene-CSI-AM-cstemplate-Drawing-Template/dp/B0018DY5MW/ref=sr_1_1?ie=UTF8&qid=1467041368&sr=8-1&keywords=forensic+sketch+template]
- Gloss White/Sketch Card Pad 5 1/2 inch x 8 1/2 inch (pk of 50) [Sirchie, SKU: LB001SP]

## SPECIFIC AIMS

1. Preparing lecture material by
    a. Reading scientific literature for information and current trends.
    b. Consulting experts in various forensic disciplines.
    c. Creating PowerPoint presentations for use in classroom lectures.
2. Preparing laboratory material by
    a. Planning and preparing student activity protocols.
    b. Conducting activity trials by preparing mock crime scenes and evidence.
    c. Documenting laboratory techniques with notes and digital photographs.
3. Compiling a textbook/laboratory manual for the course by
    a. Including all background information, protocols and related photographs.
    b. Using computer software to generate pages and documents for the final publication.
4. Assessing the success of the course by
    a. Creating a standard set of questions, each linked with Core Learning Outcomes, to be used for a pre and post exam assessment.
    b. Using ParScore$^{TM}$ software to collect data.
    c. Calculating improvement in the course through the use of statistical dependent T-tests.
    d. Merging exam data with Enrollment Information Systems (EIS) data from PeopleSoft. A student's profile includes demographics, academic goals, and admission reason.

## BACKGROUND AND SIGNIFICANCE

There are many techniques and protocols used for assessing and analyzing forensic evidence (Fish *et al*. 2014). One aim of this curriculum is to provide students with knowledge and experience with those methods that are common and current (Fakayode, *et al.* 2016), but also safe and cost effective to perform at the community college undergraduate level. Relevance to crime scene analysis will be the main emphasis; the goal is to have students practice and become comfortable with the techniques that they would need in the field, on a scene. In a paper by Fakayode, *et al.* (2016), the authors discuss a program that allowed students at North Carolina Agricultural and Technical State University to participate in a shared, team-work driven mock crime scene investigation. Their results were positive, citing realistic scenarios and encouragement of necessary skills needed for such work (Fakayode, *et al.* 2016).

The Forensic Biology (BI 130) course at Frederick Community College (FCC) is a current 4 credit lecture/laboratory course that focuses on a wide range of forensic science concepts, with much of the emphasis on the scientific laboratory techniques required for analyzing evidence after is has been collected from the crime scene (Staveley 2015). While some concepts overlap between the BI 130 course and this new proposed course (Staveley 2015), this new curriculum will distinctly focus on methods used at a crime scene, with a few chapters expanding into laboratory bench techniques and protocols.

For this new proposed curriculum, providing realistic examples and applications of the various techniques will be essential to the format and design of this curriculum material. The intent is to go beyond presenting standard protocols in writing, but also provide visual steps and representations of the procedures. In this way, the students' understanding would be more cohesive, and the material could be used as a reference outside of the classroom.

## PRELIMINARY REPORT / PROGRESS REPORT

At the community college level, affordability of textbooks is an important factor. Over the past several years, at FCC, many instructors in the Science Department have opted to select or even create custom text and/or laboratory manuals that are then printed through an external publisher or printed in-house at FCC's print shop. Sometimes the custom created texts can be posted to Blackboard as a FlipBook for students to view electronically and print as they desire, but are not available for download. The books contain experiments written by faculty and adapted from other resources, as well as laboratory exercises that are reproduced with permission from companies like Flinn Scientific or Edvotek®.

In a 2013 paper, Haley discusses the implementation of an Introductory Business and Economic Statistics (IBES) textbook. The book was authored at University of Wisconsin Oshkosh, and included course objectives and material that was common across all of the IBES classes; different versions of the book included add-on curriculum that was unique to each instructor (Haley 2013). Preliminary feedback found this new resource to have a positive impact on students' education (Haley 2013). This innovative approach to curriculum ensures that only the necessary content is included, keeping costs lower for students, as well as providing them with a useful and relevant resource.

The current FCC science courses that utilize custom designed texts are

BI 100: Fundamental Concepts of Biology

BI 130: Forensic Biology

BI 220: Cell Biology and Tissue Culture

BPM 214: Techniques in Bioproduction

CH 101 and 102: General Chemistry I and II

CH 201 and 202: Organic Chemistry I and II

PC 115: Introduction to Earth Systems Science

As an example, the BI 130 course previously used an “off the shelf” laboratory manual (Kubic and Petraco 2009) that contained many experiments, but the students only used a fraction of the book for the course at FCC. This manual currently sells for $63.76, which would be marked up even more once it was sold at the FCC bookstore. High book costs can be a hindrance to students who face financial challenges. In 2015, a custom lab manual (Staveley 2015) was designed that included the necessary experiments and other selected worksheets and handouts for the course. This is the manual that is currently required for the BI 130 class, and with the bookstore mark-up, costs a student only $38.00. The cost savings is at least 40.4% of what the previous manual would have cost. With the goals of this project in mind, this approach inspired the creation of the new textbook and curriculum materials, which would only contain the content and information that was needed for the course, and the laboratory activities and protocols that were required. The success of custom designed curriculum has been evident at FCC and provided a strong model for this project.

## RESEACH DESIGN / METHODS

### Aim 1: Preparing Lecture Material (Months 00-03)

The main subjects that will be included are as follows: Introductory Information and Scene Security, Evidence Collection, Crime Scene Photography, Documentation and Sketching, Fingerprint Lifting, Pathology and Death Assessment, Presumptive Testing, Crime Laboratory Methods, Expert Testimony, and Footwear Impressions. While each of these topics could be an individual course in itself, they will be discussed as an overview in each chapter, providing students with background knowledge and understanding of how these disciplines relate to criminal investigations and the ancillary laboratory methods for collecting and analyzing evidence.

Literature will be read and consulted to ensure the proper, current techniques are included; interviews with a professional investigator will be conducted to obtain and clarify information. A supplementary PowerPoint presentation will be prepared for each chapter, directly relating to information in the text. These presentations will be provided to instructors teaching the course, and could be modified as needed. A sample syllabus will be created for this course (proposed course number: BI 230), using the current FCC Forensic Biology (BI 130) syllabus of record as a template.

**Frederick Community College**
**Course Syllabus**
**BI 230, Forensic Science Techniques (xxxx)**

| **Class Begins:** | **Class Ends:** | **Last Day to Withdraw:** |
|---|---|---|
| | | |

**Instructor Information**

| | |
|---|---|
| Instructor: | Office: |
| E-mail: | Phone Number: |
| Office Hours: | Campus Mail Box Number: |

**Course Information:**

| | |
|---|---|
| Course: BI 230, Forensic Science Techniques | Credits: 4 |
| Prerequisites: [(EN 50A or EN 61) and EN 52] OR (ESL 95 and ESL 99) OR (ESL 72 and ESL 73) | Pre or Co-requisites: MA 82 or MA 85 or MA 103A or BU/MA 205A or MA 206A or MA 207A |

**Course Description:** Focuses on the elements and techniques of crime scene investigation. Students will be introduced to various aspects of evaluating a scene including, Scene Security, Documentation and Sketching, Photography, Evidence Collection and Chain of Custody, Fingerprint Collection and Analysis, and Expert Testimony. Lectures will be combined with hands-on exercises to enhance student learning.

**Core Learning Outcomes:**

| |
|---|
| 1. Demonstrate college-level communication skills. |
| • Produce effective and appropriate oral, written and visual information, to communicate topics and information related to concepts of crime scene investigation. |
| • Interpret and synthesize information from oral, written and visual texts. |
| • Apply active listening skills. |
| 2. Demonstrate critical-thinking skills. |
| • Analyze information from various sources. |
| 3. Understand, interpret and apply academic, professional, and civic ethics. |
| • Identify and follow commonly accepted ethical standards in academic, professional and civic contexts. |
| 4. Demonstrate quantitative problem solving. |
| • Interpret and analyze verbal, graphical, numerical, and symbolic representations of mathematics, as it relates to crime scene investigation. |
| • Work collaboratively or individually to solve problems effectively and efficiently using quantitative tools that appropriately model the situation. |
| 5. Apply scientific reasoning. |

| |
|---|
| • Demonstrate an understanding of crime scene investigation through hands-on, collaborative, and independent learning. |
| • Articulate central themes of science, as it pertains to the discipline of forensics and crime scene analysis. |
| • Demonstrate scientific inquiry, as it relates to the discipline of crime scene investigation. |
| 6. Demonstrate technological competence. |
| • Apply effective and appropriate uses of technology in academic, professional and personal contexts. |
| • Use technology appropriate for forensic crime scene investigations. |

**Text(s) and Course Materials:**

| | |
|---|---|
| **Lecture/Lab** | Staveley J, Boward ES. 2016. Forensic Science Techniques. Sagamore Beach, MA: Academx Publishing Services, Inc. |
| **Other** | Safety Glasses and Lab Coat |

**Progress Report**

After every exam, grade points are communicated to the class through Blackboard. Students should use their score on the first exam as an early indicator of their success in this course.

Students will receive an indicator of their progress by the 2nd week of class**.**

**Evaluation Methods:**

| Tests / Papers / Projects | Point Value | Final Grade Scale |
|---|---|---|
| **2 Exams** | 100 points each (200 total) | 90-100 - A<br>80-89.99 - B |
| **Final Exam** | 100 points | 70-79.99 – C<br>60-69.99 - D |
| **Final Project*** | 100 points | Below 60 - F |
| **Hands-On Activities** | 100 points | |
| **TOTAL** | 500 points | |

***Each student will be required to turn in a binder containing all material generated throughout this course (i.e. worksheets, photographs, sketches, analysis results, etc.). More information will be provided during the first class.**

**Codes of Academic Integrity and Student Conduct**

Students are required to uphold the Code of Academic Integrity and the Code of Student Conduct. Students who violate either of these codes may receive a failing grade in the class. Information about these codes and other student policies, procedures, and penalties is available on the Student Policy and Procedures web page at http://www.frederick.edu/current-students/required-communications/student-policies-procedures.aspx

**You must send your Academic Integrity Pledge to the instructor. The form is available at http://courses.frederick.edu/courses/pledge/index.aspx**

**Student Services**

A variety of services are available to assist students in succeeding at FCC. Students can learn more about these services by visiting the Student Services web page: http://www.frederick.edu/student-resources.aspx

Students with disabilities who are in need of accommodations or who have questions related to disabilities services should contact the Services for Students with Disabilities (SSD) office at 301-846-2408. Students can learn more about these services by visiting the Services for Students with Disabilities web page: http://www.frederick.edu/student-resources/services-for-students-with-disabilities.aspx.

**Participation Policy**

Due to the nature of this course, attendance is strongly encouraged. Required laboratory assignments must be completed the day of laboratory. You will be permitted to turn in the laboratory assignments for that week by end of the class. Loss of points if no submission is received. **There are no make-up assignments for missed assignments.**
At the end of the course, students are expected to complete the course evaluation. Student feedback is anonymous.

**Time Commitment for Academic Success**

At Frederick Community College, in all credit courses, students are expected to invest a minimum of two hours completing out-of-class course work for every hour of in-class instructional time. A 15-week, 4-credit course requires a minimum of 75 hours of instructional time and 75 hours of outside course work. Students should expect to invest an average minimum of 9.5 hours per week preparing for the course and completing assignments. For online and hybrid courses, students can expect active instructional time and "out-of-class" course work comparable to face-to-face courses with the same number of credits.

**E-mail Policy**

E-mail is an instructional tool essential to student-instructor and student-student communication. In the Blackboard environment, by default, your e-mail address is available to all students in this course. However, students are permitted to use e-mail addresses of other students in this course only for the purpose and the duration of this course. Students who are concerned about the privacy of their personal e-mail address are reminded of commercially available products that allow them to create unique e-mail addresses specifically for the purpose and duration of this course.

The instructor will respond to regular student email inquiries (grades, posted assignments, and tests excluded), usually within the time frame of **24 to 48 hours** during the regular class week.

**No class assignments will be accepted LATE!**

## Components of the Grade

***Exams*** - Three comprehensive exams will be given. They will cover material from lectures (including audiovisual presentations), class discussions, textbook readings, laboratory assignments and other assigned readings. Exam dates are given on the topical outline. Exam formats are quite variable, and may include multiple choice, short answer, and essay questions. **There are no makeup exams**. Exam points missed in the case of documented serious illness, emergency, religious holidays, or participation in official college functions will be made up by counting the subsequent exam grade twice. Notification in the case of serious illness or emergency must be provided within two business days. You may leave messages on voice-mail or email, which both record the time and date of contact. Please provide notification of official college functions and religious holidays in advance. Supporting documentation must be provided in all instances in order to make up missed exam points. If the subsequent exam carries a different point value than the missed exam, the subsequent exam grade will be pro-rated.

***Laboratory*** – Students are **EXPECTED** to do every lab on campus using the lab book. Students are expected to complete the assignments. At no point are students permitted to copy the assignment or results from others, as this will be considered to be cheating.

## General Course Policies

1. Students are expected to complete all labs and complete all reading assignments.
2. Assignments will not be accepted more than one week prior to the due date, nor will they be accepted late, without prior written approval and confirmation from the instructor (via e-mail). Approval will only be given in rare circumstances: simply not feeling well is not an acceptable reason.
3. Exams cannot be made up without prior written approval and confirmation from the instructor, and only then in the case of a documented medical or family emergency (via e-mail). Make-up exams must be taken within the scheduled time-frame, at the instructor's discretion. Failure to follow this procedure will result in no make-up exam! Make-up exams are usually short essay, and are always different from the regular class exam.
4. All students are expected to uphold the Code of Academic Honesty. This means that you will use your own efforts, ideas, and materials and that you will give full credit when borrowing from another's work. Refer to the FCC Student Handbook for further information on this policy. Your instructor does enforce this policy.

***The instructor and the College believe that students who work consistently with their instructors learn more and have higher academic achievement than those who do not.***

**Additional Instructor Policies**

1. Students are expected to be informed of class policies, lecture reading assignments, assignments given, and announcements made on Blackboard or on the companion web sites.
2. Students are expected to be on time for and attend all lectures. Students will get maximum benefit from lecture if they complete reading and assignments prior to class.
3. All assignments handed in for grading **must be turned in on time**, **typed and clearly marked with you name**. Other homework assignments will be turned in through Blackboard or the website. Late assignments will **not** be accepted.
4. Violations of Course Policy (including but not limited to tardiness, cell phone use, etc.) will result in point deductions (ranging from 1-15 points) from your total grade.
5. If you are having problems understanding concepts in class PLEASE contact the instructor as soon as possible. You may not be alone, if I get feedback from multiple students that a concept is unclear, I am willing to spend more class time on clarifying difficult concepts. In other cases some meetings with the instructor outside of class may be all that is needed to help you better understand the material.
6. Academic dishonesty will not be tolerated. Formation of study groups in *preparing* for exams, quizzes, etc. is encouraged. Giving or receiving help *during* exams, quizzes, or lab exams is considered cheating. *Plagiarizing written assignments* is also considered cheating. Those found to be cheating will receive a failing grade for that assignment and possibly the course. In this class you will sometimes work in groups on certain assignments. It is expected that while you may work together you will write up your own version of the assignment and that you will not copy another's work.

***The instructor and the College believe that students who work consistently with their instructors learn more and have higher academic achievement than those who do not.***

**Email Communication**

All students will receive and be expected to use their FCC email address for their correspondence with faculty and staff at the college. Students can establish and access their FCC email accounts at the login page: http://myfcc.frederick.edu.

***Topical Outline***

*Every effort will be made to keep to this schedule; however, the instructor reserves the right to alter or amend it as necessary. Additional dates, as published in the academic schedule of classes and listed below, may be required as make-up days for inclement weather*

## BI 230 Tentative Course Outline

| Class Week | Lecture Topic | Required Reading |
|---|---|---|
| *The Last Day to Withdraw from this Course is xxx.* | | |
| • In the event of inclement weather, students are <u>expected</u> to complete all lecture readings and submit assignments out-of-class. If a Blackboard error prevents this, the due date may be extended by one day to the entire class, and only if this notice of extension is communicated to the class by the instructor (don't assume).<br>• Regardless of the issue or inclement weather, students should not expect extensions beyond one day (unless communicated to the entire class by the instructor).<br>• Further, it is recommended that students do not wait until the last day to complete and submit tests or assignments (in case of internet issues).<br>• It is the student's responsibility to ensure that he or she checks Blackboard several times per week for updates and/or revisions to the topical outline during the entire duration of the course. | | |
| **Week 1** | **Lecture:** Introduction to Forensic Techniques and the Crime Scene<br>**Activity 1:** Laboratory Safety<br>Explanation of Final Project Requirements | Chapter 1 |
| **Week 2** | Collection of Evidence<br>**Activity 2:** Securing the Scene and Collecting Evidence | Chapter 2 |
| **Week 3** | Crime Scene Photography<br>**Bring Cameras Next Week** | Chapter 3 |
| **Week 4** | Documentation, Reconstruction, Sketching and Technology<br>**Activity 3:** Photography and Documenting the Scene | Chapter 4 |
| **Week 5** | **Exam 1:** Chapters 1,2,3,4<br>**Activity 4:** Compile Photos and Generate Final Sketches | N/A |
| **Week 6** | **Lecture:** Fingerprints and Lifting<br>**Activity 5:** Collecting Latent Fingerprints | Chapter 5 |
| **Week 7** | **Lecture:** Finding a Body – Pathology and Death Assessment<br>**Guest Speaker: TBA** | Chapter 6 |

| | | |
|---|---|---|
| **Week 8** | **Lecture:** Presumptive Testing at the Crime Scene<br>**Activity 6:** Presumptive Blood Tests and DNA Swabs | Chapter 7 |
| **Week 9** | **Exam 2:** Chapters 5, 6, 7, 8<br>**Activity 7:** Prepare Assignments and Questions for Mock Trials | N/A |
| **Week 10** | **Holiday Break** | |
| **Week 11** | **Lecture:** The Crime Lab<br>**Activity 8:** Drug Identification with FTIR Spectrometer | Chapter 8 |
| **Week 12** | **Lecture:** Testimony Skills<br>**Activity 9:** Mock Trials | Chapter 9 |
| **Week 13** | **Lecture:** Impressions at the Crime Scene<br>**Activity 10:** Footwear Impressions | Chapter 10 |
| **Week 14** | **Lecture:** Advances in Forensics<br>**Wrap-Up:** Review of Concepts<br>**Open Time:** Finish Final Projects (DUE at FINAL EXAM) | Chapter 11 |
| **Last Week** | Final Exam Week<br>**Chapters for Exam 3**: 9, 10 , 11<br>**NOTE:** Your instructor reserves the right to make changes to this outline as needed. | |
| **xxx** | **Inclement Weather Make-Up Dates** | |

## Aim 2: Preparing Laboratory Material (Months 04-09)

Laboratory activities will be designed to complement and reinforce the main concepts of this new course. For each topic, the laboratory exercise will be trial-run and documented.

### Introductory Information and Scene Security

This chapter will introduce students to the concepts of general laboratory safety, personal protective equipment (PPE) and how these rules apply to entering and processing a crime scene (Fish et al. 2014, Staveley 2015). Explanations of various roles and positions held by those in forensic science will be discussed as well. No laboratory activity will be designed for this chapter (Fish et al. 2014, Staveley 2015).

### Evidence Collection

The procedures for searching, collecting, and packaging of evidence will be discussed in this chapter. The laboratory activity will provide the students with the opportunity to practice the skills presented in chapters 1 and 2, specifically securing a crime scene and properly packaging and labelling evidence (Figures 1 and 2).

**Supplies:**

- Crime scene barrier tape
- Mock crime scene with evidence

  (prop weapons, clothing, soda cans, cellphone, cartridge casings etc.)
- Forceps or tweezers
- Evidence seals, bags and boxes
- Sharpies and ink pens
- Gloves

(Fish et al. 2014, Lee and Pagliaro 2009)

**Protocol:**

1. The instructor should prepare several mock crime scenes with various pieces of "evidence" for the students to collect.
2. The students should practice securing and blocking off a scene by using the barrier tape.
3. Each student should practice collecting and packaging different types of evidence.
4. Students should refer to the following chart for collecting and packaging methods.

Table 1. Evidence collection procedures (Lee and Pagliaro 2009).

| **Type of Evidence** | **Collecting and Packaging Method** |
|---|---|
| Gun | • Remove ammo first.<br>• Use box as packaging material with securing zip-ties. |
| Clothing | • Use paper first, then in paper bag as packaging material. |
| Knife | • Use box as packaging material with securing zip-ties. |
| Glass or ceramic items (i.e. coffee mug) | • Remove drink with sterile pipet or syringe into secondary container.<br>• Use box as packaging material (standing and stable and secure). |
| Cellphone | • DO NOT power on.<br>• Use envelope for packaging material.<br>• Collect accessories (cords, SD cards, etc.) as well |
| Rope | • Collect whole piece and keep knotted as it was found.<br>• Document if it has to be cut.<br>• Use paper for packaging material. |
| Bullets or Casings | • Use gauze, then envelope or box as packaging material. |


Figure 1. Mock crime scene secured with barrier tape. It is always better to secure a larger area first and then make the area smaller as needed (NFSTC 2013).


Figure 2. Prop knife packaged in evidence collection box. A. The box is properly labeled with chain of custody. B. The knife is secured with zip ties to prevent injury to those handling the box (Lee and Pagliaro 2009).

**Crime Scene Photography**

General rules of professional digital photography will be introduced in this chapter. Figure 3 illustrates the parts and functions of a digital single lens reflex (DSLR) camera (Busch 2007). The concepts to be discussed are listed here.

- Exposure = quantity of light that the camera sensor is receiving (Busch 2007).
- Depth of Field = span of distance that comprises the items in a photograph that are in focus (Busch 2007).
- Shutter Speed = length of exposure; controls how long it takes to create an image, and in part, controls how much light enters the camera (Busch 2007). Shutter speed is listed as a whole number, and the actual speed in seconds is the reciprocal of that number (Busch 2007). In Figure 3A, the number 125 means 1/125 of a second (Busch 2007).
- Aperture = opening in front of the lens that can increase or decrease in diameter to allow more or less light to enter (Busch 2007). As the f-stop number decreases, the aperture size of the lens increases (Busch 2007).
- ISO = indicates how sensitive the camera's sensor is to light (Busch 2007).

Nature photographs will be taken to illustrate and compare these concepts (Figures 4-6).

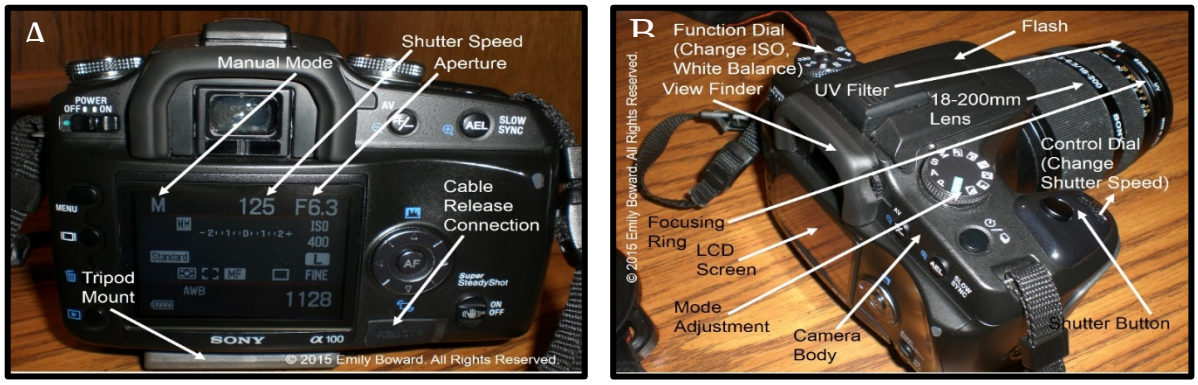



Figure 3. A and B. Anatomy of a digital single lens reflex camera (DSLR). The main components and functions of a Sony α 100 DSLR camera are shown and labeled (Busch 2007).


Figure 4. Effects of aperture size on photograph exposure. These images depict how adjusting the f-stop on a DLSR will affect the photographic result. A. The image is underexposed; the aperture size is too small, preventing adequate light from reaching the camera. B. The image is correctly exposed. C. The image is overexposed; the aperture size is too big, allowing an excess of light into the camera (Busch 2007).

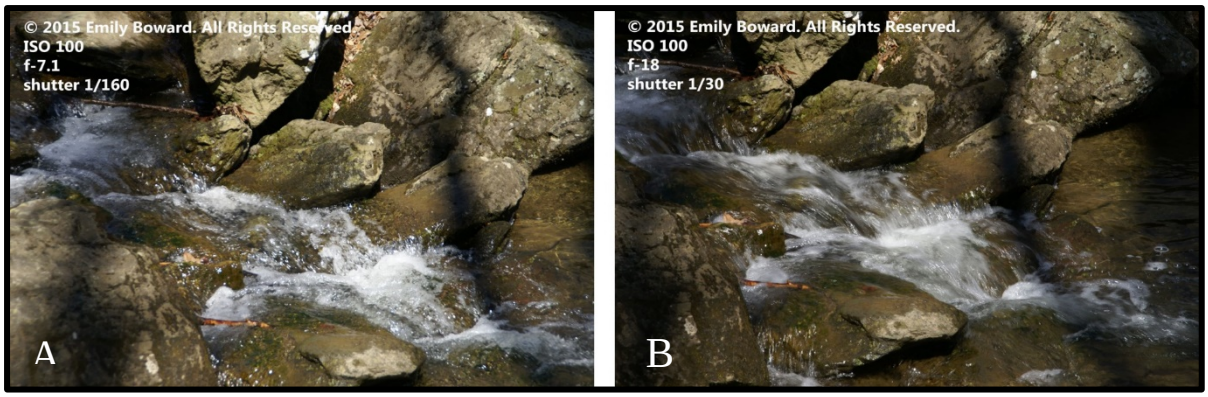



Figure 5. Effects of shutter speed on photographs. A. The higher shutter speed captures the splashing movement of the water on the rocks. B. The lower shutter speed blurs the movement of the water, making it look "silky". Note: at a higher shutter speed, less light enters the camera, so the aperture needs to be larger to accurately expose the image (Busch 2007).


Figure 6. Exposure priorities in photographic composition.
Not every aspect of a photographic composition will be in focus or perfectly exposed – that is beyond the limits of a DSLR. As a photographer, one must assess the scene he/she is photographing, and adjust the settings accordingly. A. In some compositions, the lightest/whitest areas may need to be the exposure priority, in order to indicate important features located there. B. For other compositions, it may be necessary to have those brighter areas be over-exposed, in order to bring out the detail affects in darker/shadowy areas (Busch 2007).

Composing photographs at a crime scene will be explained. Over-all, medium, and close-up shots should be taken, as well as close-up shots with photo markers and measurement scales (Lee and Pagliaro 2009; FBI Academy [accessed 2018]; Redsicker 2001). Overall shots should be taken of the adjacent rooms and exterior of the residence (Lee and Pagliaro 2009; FBI Academy [accessed 2018]; Redsicker 2001). An indoor mock crime scene will be arranged and photographed according to these principles (Figures 7-25). The photographs to be used for this curriculum will be reviewed by a forensic investigator to ensure accuracy in methods. These photographs will provide a complete contextual reference for students to study and review during the course and in the workforce.

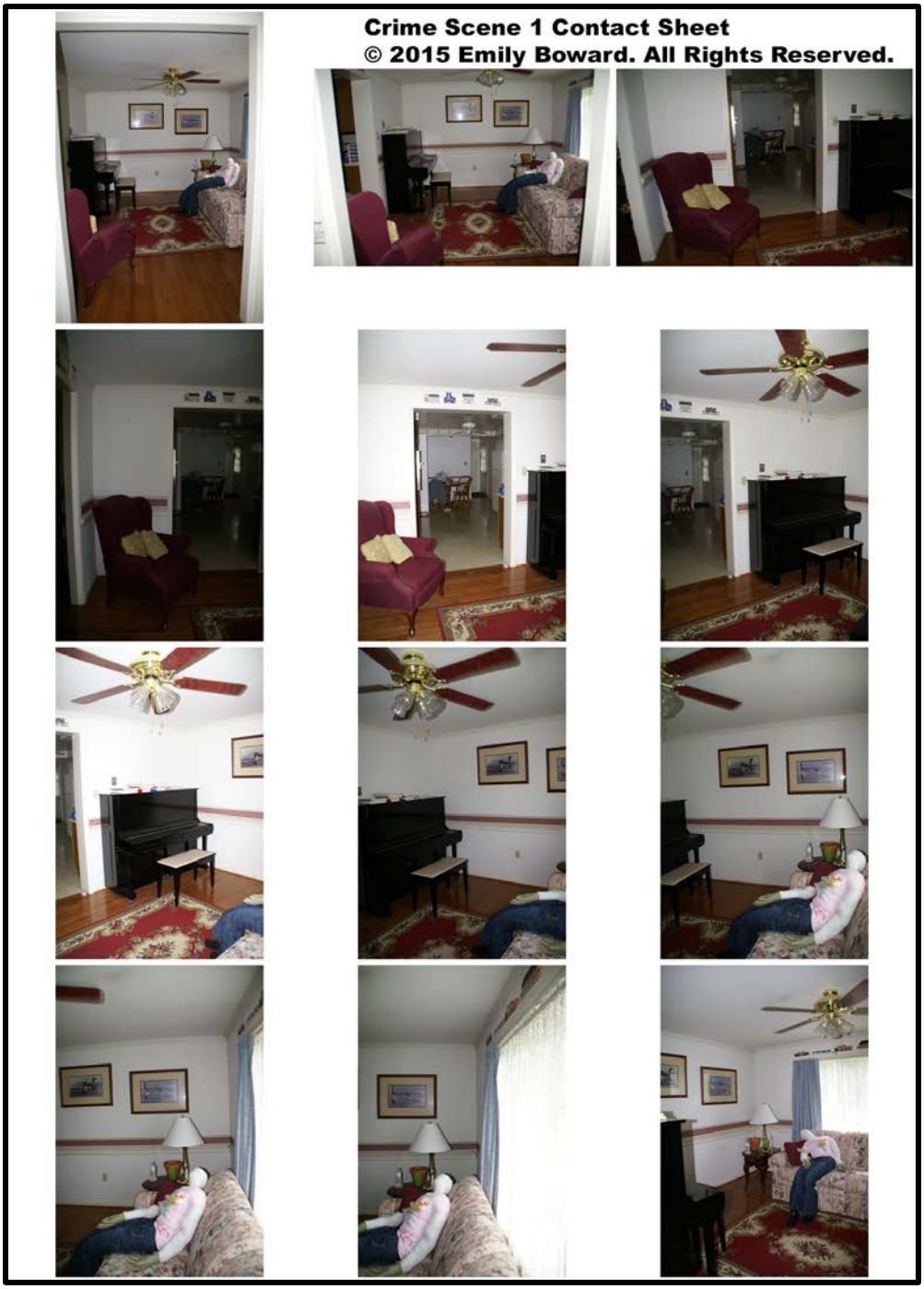



Figure 7. Photographs of a mock crime scene with overall, medium, and close-up shots.


Figure 8. Photographs of a mock crime scene with overall, medium, and close-up shots.


Figure 9. Photographs of a mock crime scene with overall, medium, and close-up shots.


Figure 10. Photographs of a mock crime scene with overall, medium, and close-up shots.


Figure 11. Photographs of a mock crime scene with overall, medium, and close-up shots. Photo markers and rulers are included to document item inventory and sizes (Lee and Pagliaro 2009; FBI Academy [accessed 2018]; Redsicker 2001).


Figure 12. Photographs of a mock crime scene with overall, medium, and close-up shots. Photo markers are included to document item inventory (Lee and Pagliaro 2009; FBI Academy [accessed 2018]; Redsicker 2001).


Figure 13. Photographs of a mock crime scene with close-up shots Photo markers and rulers are included to document item inventory and sizes (Lee and Pagliaro 2009; FBI Academy [accessed 2018]; Redsicker 2001).


**Exterior Contact Sheet**


Figure 14. Photographs of the exterior of a mock crime scene.

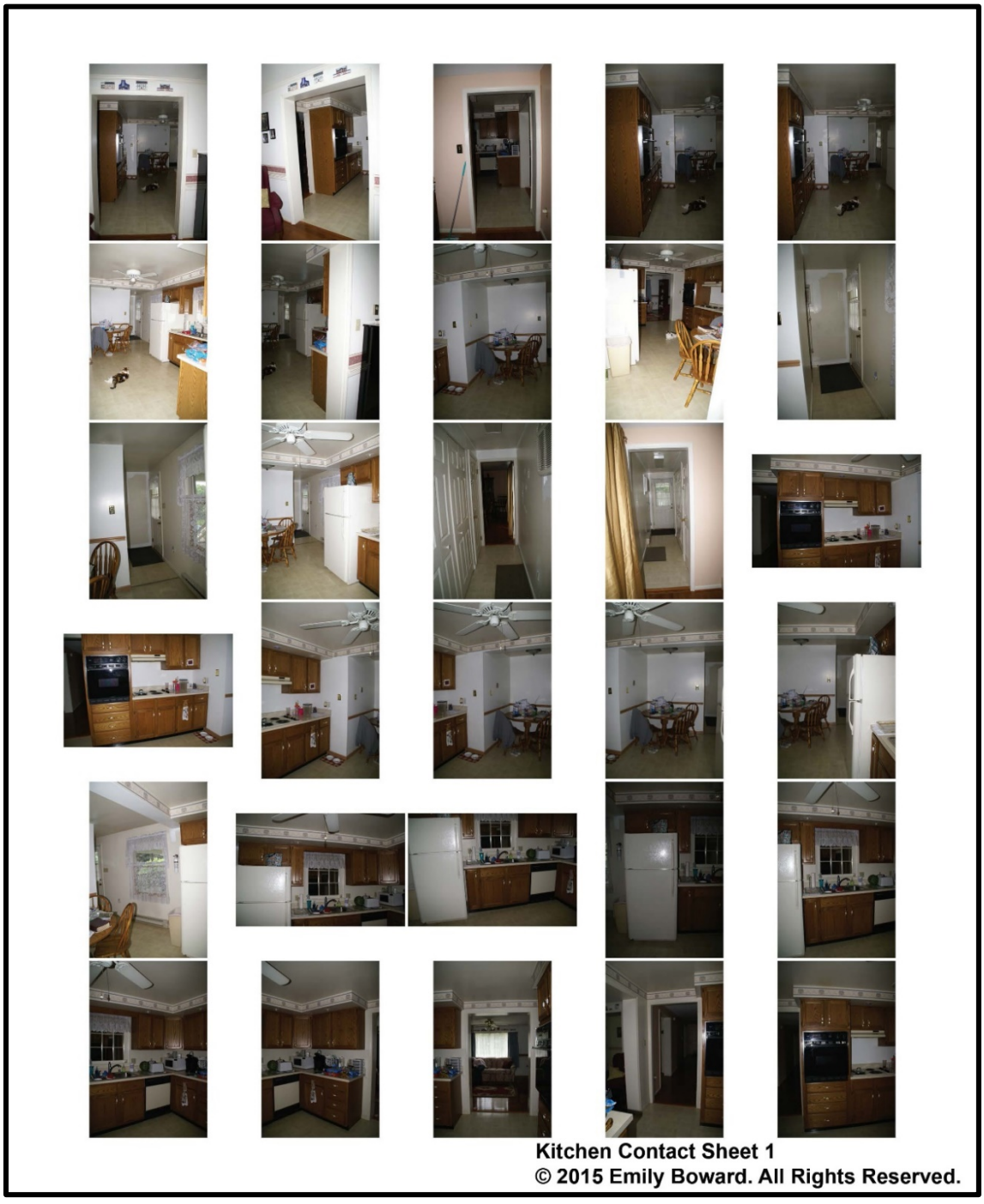



Figure 15. Photographs of an adjacent room (kitchen) of a mock crime scene.


Figure 16. Photographs of an adjacent room (kitchen) of a mock crime scene.

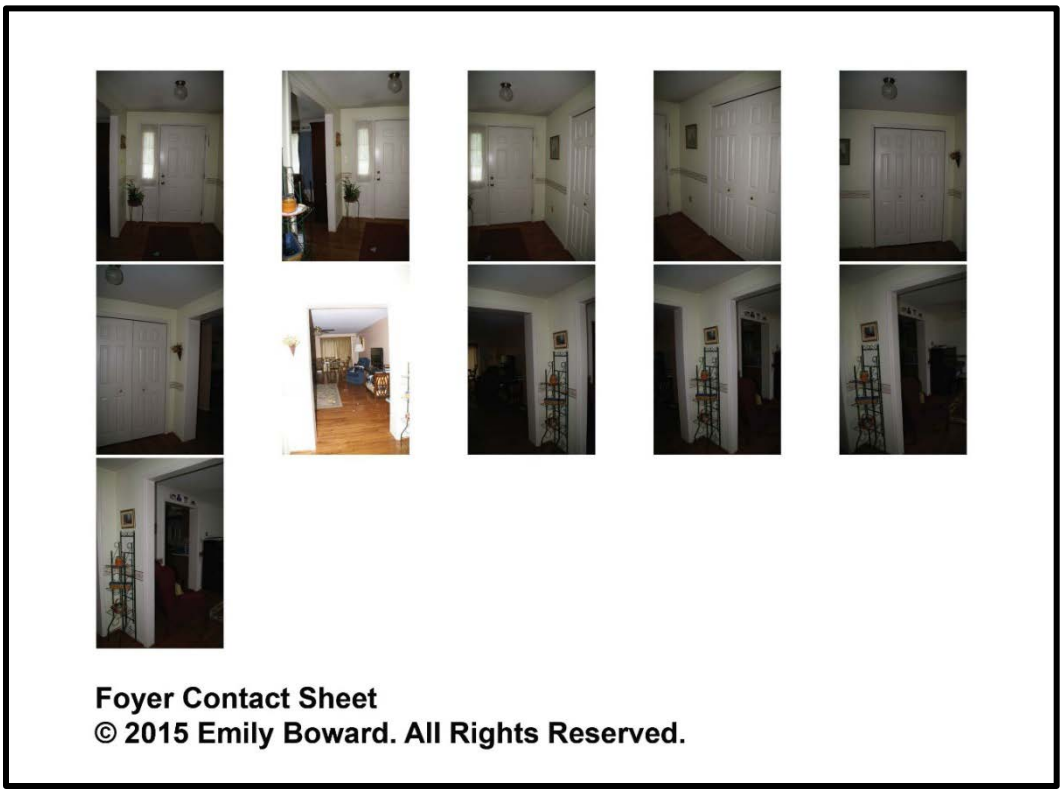



Figure 17. Photographs of an adjacent room (foyer) of a mock crime scene.


Figure 18. Photographs of an adjacent room (first bathroom) of a mock crime scene.


Figure 19. Photographs of an adjacent room (second bathroom) of a mock crime scene.


Figure 20. Photographs of an adjacent room (first bedroom) of a mock crime scene.

**Bedroom 2 Contact Sheet**


Figure 21. Photographs of an adjacent room (second bedroom) of a mock crime scene.

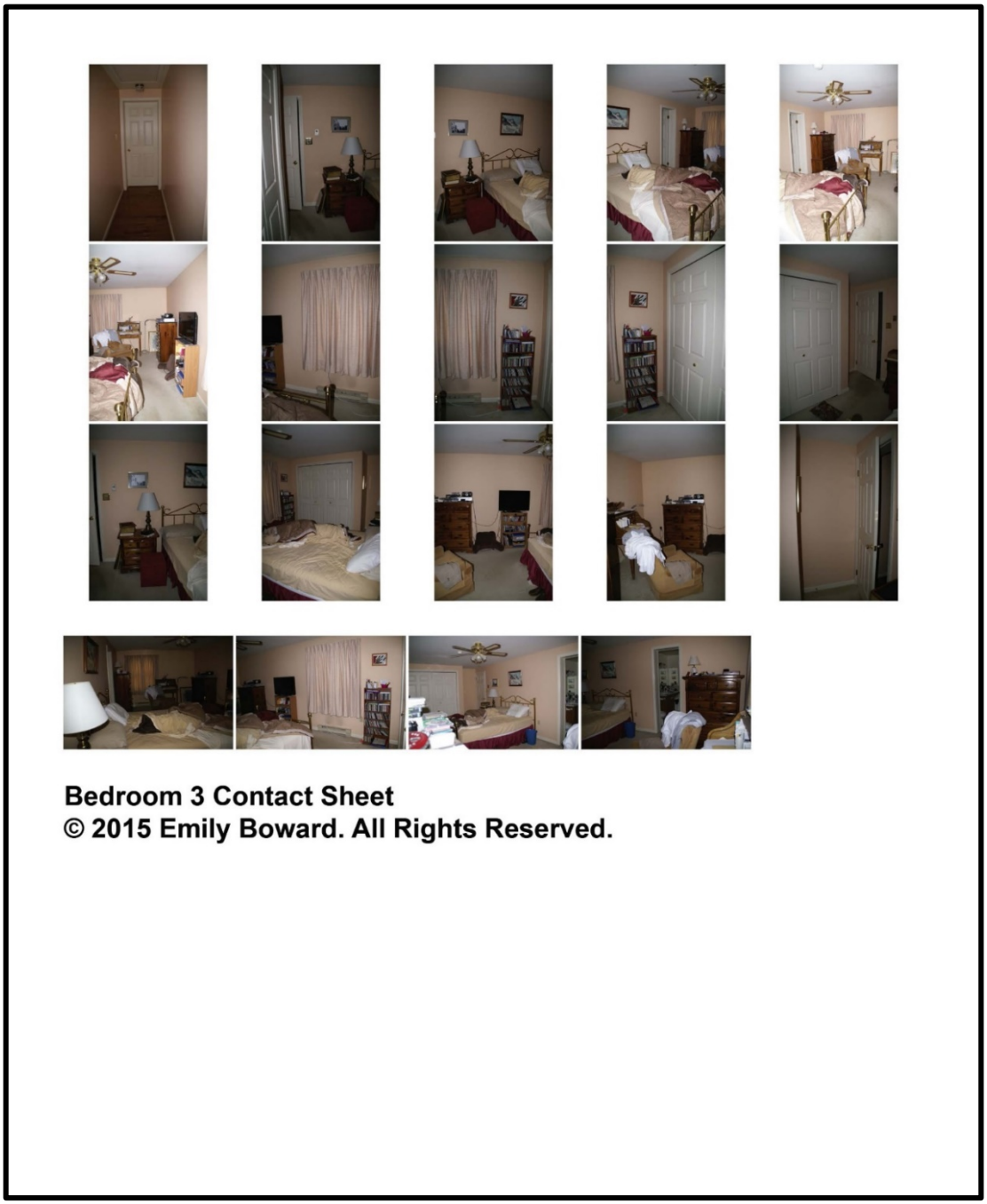



Figure 22. Photographs of an adjacent room (three bedroom) of a mock crime scene.


Figure 23. Photographs of an adjacent room (second bedroom) of a mock crime scene.

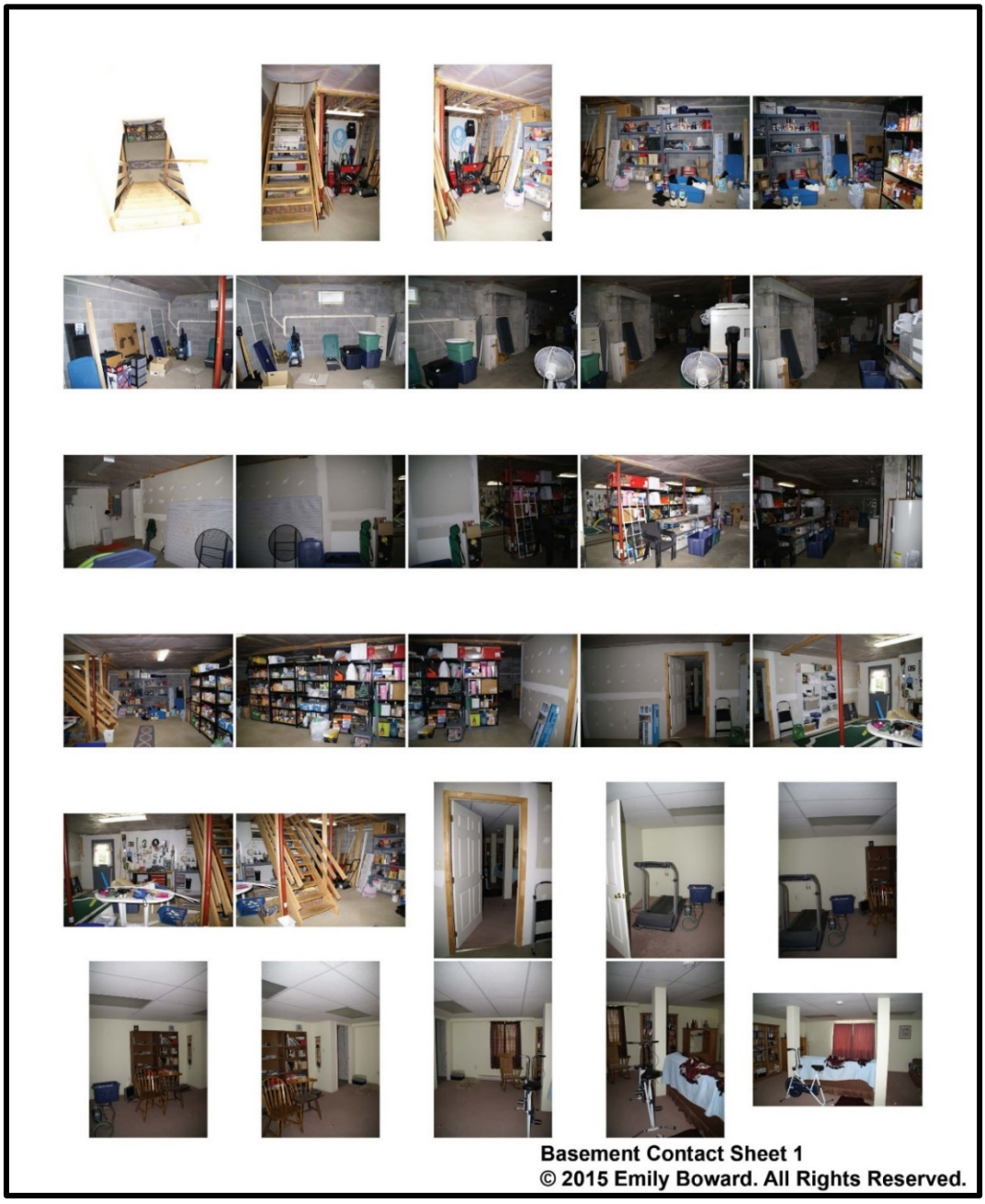



Figure 24. Photographs of an adjacent room (basement) of a mock crime scene.

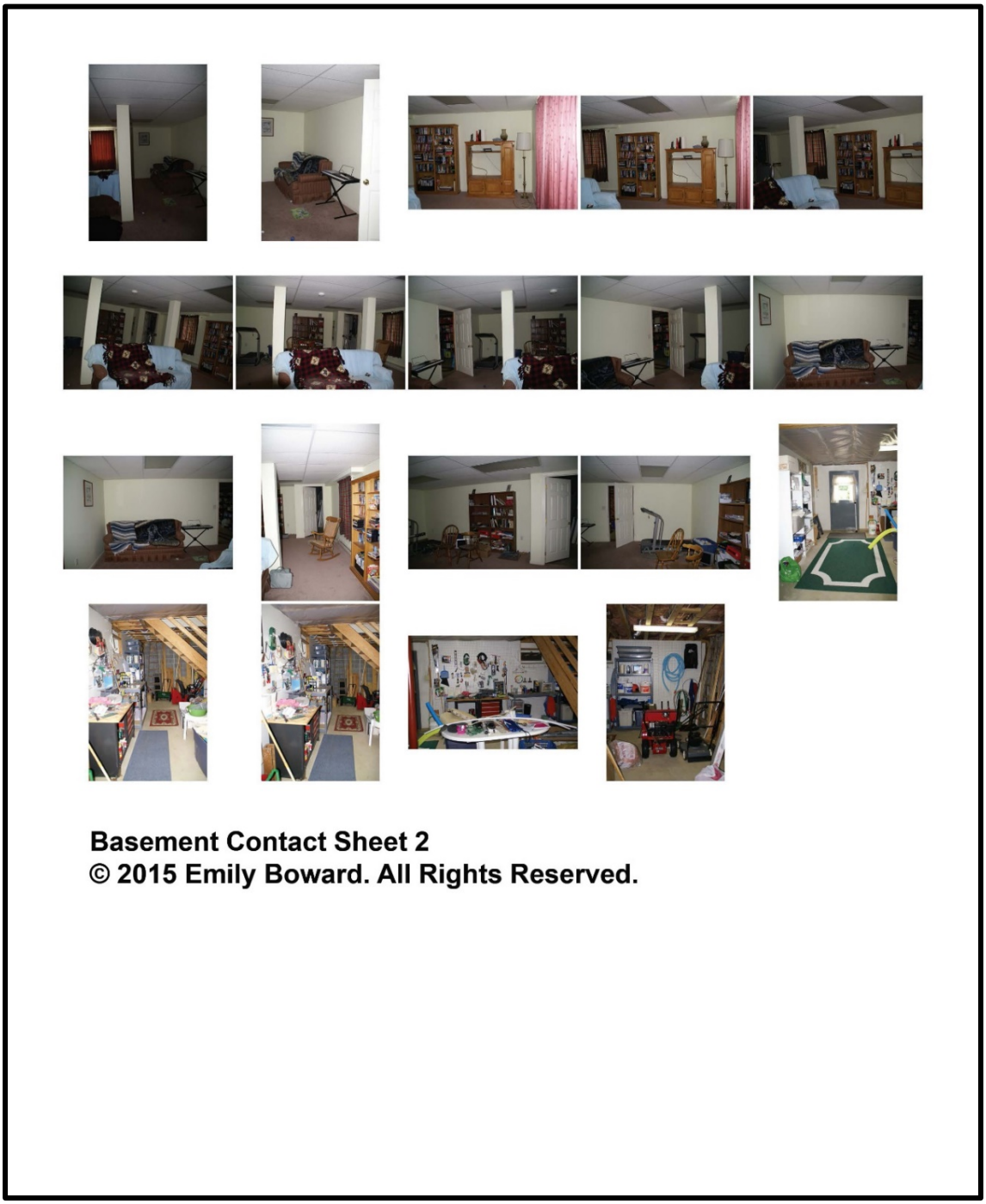



Figure 25. Photographs of an adjacent room (basement) of a mock crime scene.

**Documentation and Sketching**

This chapter will discuss proper methods for documenting and sketching a crime scene. Additionally. overviews of crime scene search methods and reconstruction will be discussed in this chapter (Figure 26). This researcher will consult with a forensic investigator (Oneida County Sheriff's Office, Oriskany, NY, USA) who will provide log templates used for crime scene documentation. These templates will be modified and edited electronically to provide examples of proper documentation methods. These example forms will relate to the mock crime scene in the photography chapter (Figures 31 and 32). Students will be provided the blank templates to use for their laboratory assignment (Figures 33 and 34). A mock outdoor crime scene will be arranged and blocked off with crime scene tape (Figure 28). Measurements will be taken, and a hand-drawn sketch will be generated (Figure 29). An example of a drawing tool used for creating sketches is shown in Figure 27. This hand-drawn sketch will be used to generate an electronic sketch using SmartDraw, LLC software (Figure 30). Both of these sketches will be included to provide students examples of proper sketching methodology. The following laboratory exercise will allow students to combine photography and documentation/sketching skills that they will have learned in the past two chapters.

1. The instructor will prepare two mock crime scenes (indoor and outdoor).
2. Students will divide into two groups – one for each scene.
3. Students will follow the proper guidelines for photographing and documenting the scenes as outlined in Chapters 3 and 4.
4. Half of the group should take photographs first, and the other half should prepare documentation and sketches. Then, they should switch; those who took photographs should prepare documentation, and those who prepared documentation, should take photographs. In this way, each student is able to go through the entire process.
5. The blank documents at the end of Chapter 4 should be used for this exercise.
6. Each student should download a free 7 day trial of SmartDraw, LLC software from this website http://www.smartdraw.com/downloads/ (SmartDraw, LLC [accessed 2018]).
7. The free trial only lasts for 7 days, so only download it once you are ready to create your final crime scene sketch. Be sure to include measurements of evidence and the distances between the items. Ensure that all measurements are to a scale (the scale can be set in SmartDraw) (SmartDraw, LLC [accessed 2018]).

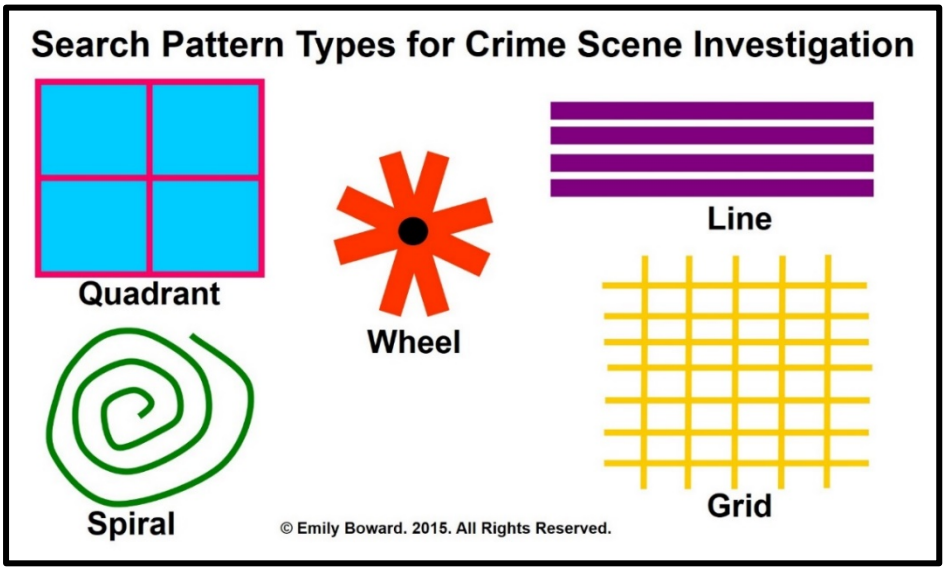



Figure 26. Search pattern types for crime scene investigation (Figure adapted from Lee and Pagliaro 2009).

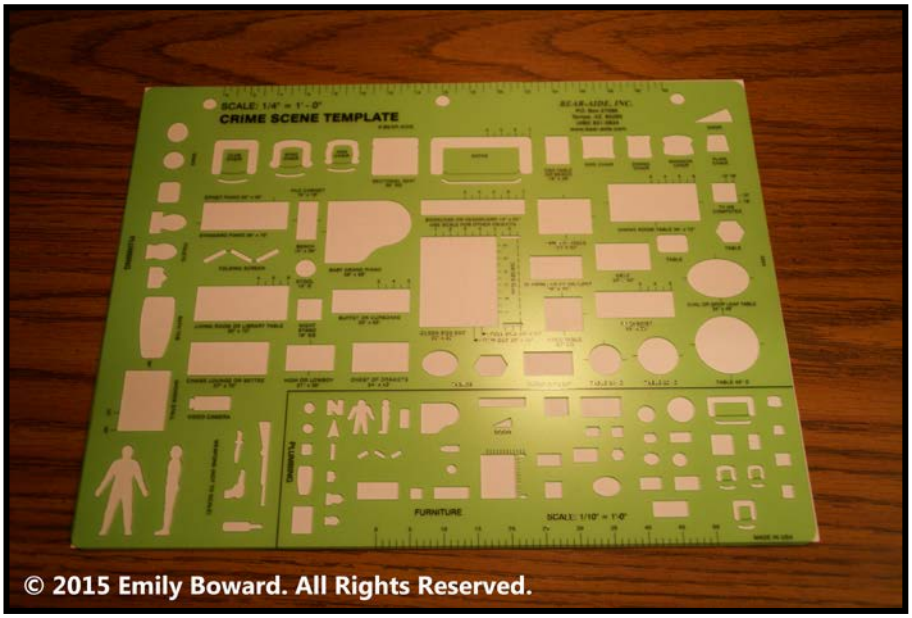



Figure 27. Drawing template for crime scene sketches.


Figure 28. Mock outdoor scene used for rough and final sketches in Figures 29 and 30.

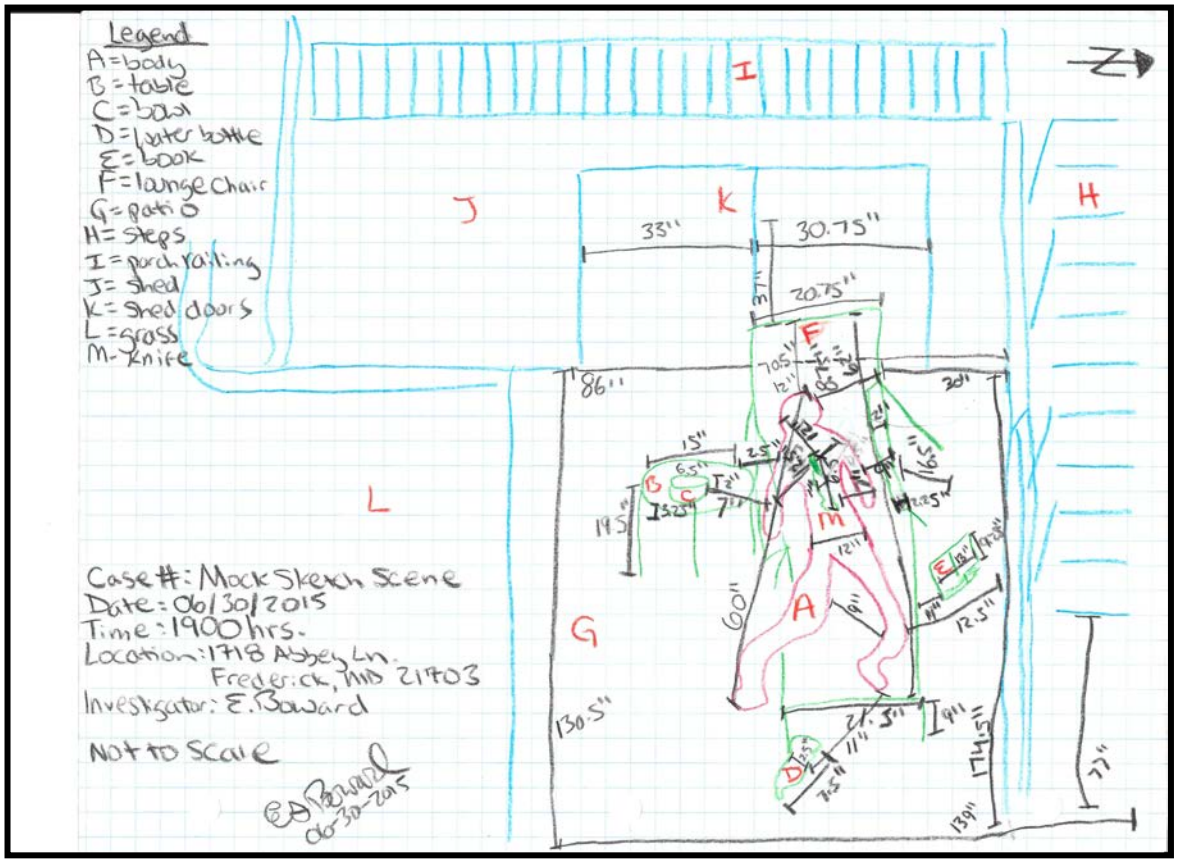



Figure 29. Hand-drawn rough sketch of mock scene in Figure 28.
A rough sketch is done prior to collecting and packaging evidence. Sketches contain a case number, date, time, scene address, main items in scene (body, evidence), indication of scale, a legend, a North directional, and who made the sketch. It can also have the victim name and type of case (Lee and Pagliaro 2009).

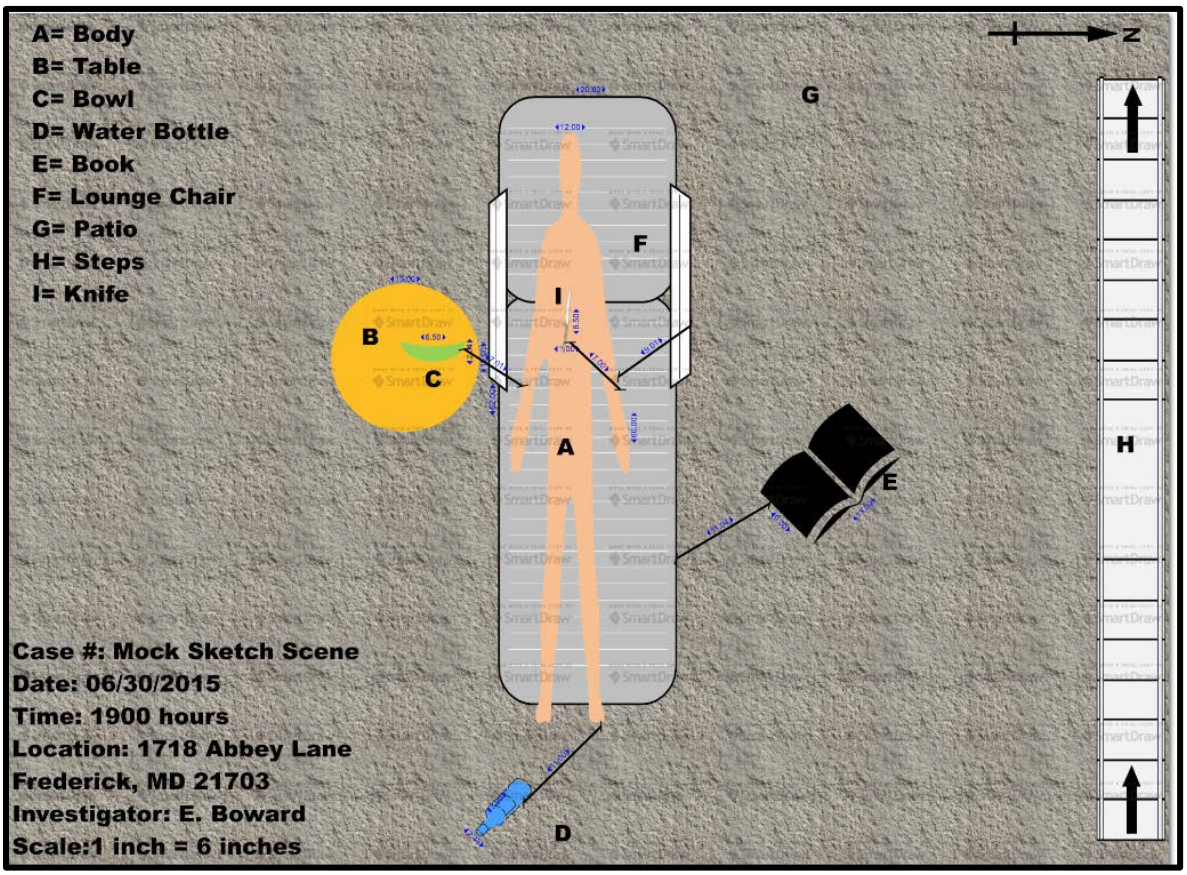
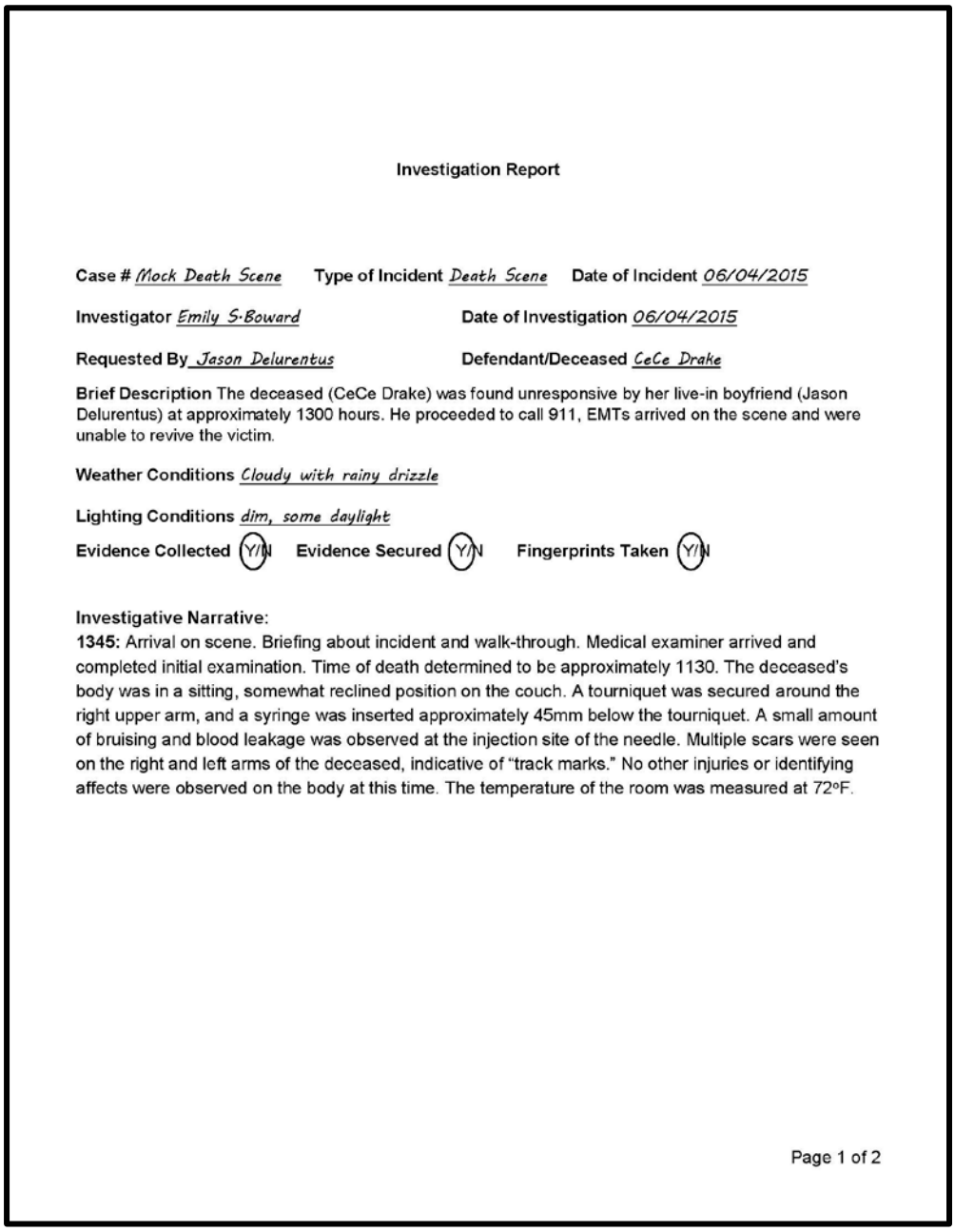



Figure 30. Computer generated (SmartDraw, LLC [accessed 2018]) final sketch of mock scene in Figure 28. Measurements are to scale in the final sketch; software used should also be listed (Lee and Pagliaro 2009).



Investigation Report

Case # Mock Death Scene Type of Incident Death Scene Date of Incident 06/04/2015

Investigator Emily S. Boward Date of Investigation 06/04/2015

Requested By Jason Delurentus Defendant/Deceased CeCe Drake

**Brief Description** The deceased (CeCe Drake) was found unresponsive by her live-in boyfriend (Jason Delurentus) at approximately 1300 hours. He proceeded to call 911, EMTs arrived on the scene and were unable to revive the victim.

Weather Conditions Cloudy with rainy drizzle

Lighting Conditions dim, some daylight

Evidence Collected (Y/N) Evidence Secured (Y/N) Fingerprints Taken (Y/N)

Investigative Narrative:

**1345:** Arrival on scene. Briefing about incident and walk-through. Medical examiner arrived and completed initial examination. Time of death determined to be approximately 1130. The deceased's body was in a sitting, somewhat reclined position on the couch. A tourniquet was secured around the right upper arm, and a syringe was inserted approximately 45mm below the tourniquet. A small amount of bruising and blood leakage was observed at the injection site of the needle. Multiple scars were seen on the right and left arms of the deceased, indicative of "track marks." No other injuries or identifying affects were observed on the body at this time. The temperature of the room was measured at 72°F.

Page 1 of 2

Figure 31 A. Example crime scene investigation report related to the mock crime scene photographed in chapter 3.

Case #: *Mock Death Scene*

**1400:** Photographs were taken of the primary death scene (living room) from all vantage points around the room. Close-up photographs were taken of the full body, head, legs, and left arm. Close-up photos were taken of each piece of evidence: (1) plastic disposable water bottle, (1) green plastic drinking cup, (1) 3 cc syringe, (1) syringe cap, (1) small plastic bag of unknown pills [(4) red, (4) blue, (5) white], (1) cell phone, and (1) cloth tourniquet. Additional close-up photographs were also taken of the pieces of evidence, including scales and lettered photo markers. The photo markers were assigned as follows:

A. Cell phone
B. Bag of pills
C. Body
D. Needle cap
E. Syringe
F. Tourniquet
G. Green cup
H. Water bottle

Photographs were also taken of the other rooms in the residence: TV room, kitchen, (3) bedrooms, (2) bathrooms, foyer, basement, and the exterior of the property.

**1500:** Measurements were taken of the primary death scene (living room); assistance provided by patrol officer Molly Evans. Measurements indicate the relationship and distance between the body, pieces of evidence and major pieces of furniture in the scene. A rough sketch was drawn to indicate the locations of the body, evidence and furniture, with these measurements included.

**1530:** Evidence collection and packaging. The water bottle and green cup were dusted for fingerprints before collection and packaging. No visible fingerprints were observed on these two items, prior to processing. (4) fingerprints were lifted from the green cup and (3) were lifted from the water bottle. Fingerprint dusting and lifting was done by patrol officer Molly Evans. Touch DNA swabs were collected from the rim of the green cup, the side of the water bottle, the syringe and the syringe cap. The bag of pills, tourniquet and cell phone were each packaged and labeled for laboratory analysis, with no processing done at the scene. The green cup, water bottle, syringe and syringe cap were each packaged and labeled for further laboratory analysis, after the initial processing at the scene.

**1630:** The body was released to the Medical Examiner's office.

**1700:** Cleared the scene at 1700 hours. The scene was released on 06/04/2015 at 1700 hours.

*ES Boward* *06/04/2015*

Signature of Investigator Date

Page 2 of 2

Figure 31 B. Example crime scene investigation report related to the mock crime scene photographed in chapter 3.

**Property/Evidence Log**

**Case #** *Mock Death Scene* **Evidence Room Location #** *1231*

**Offense** *Suspicious Death* **Location** *1718 Abbey Ln, Frederick, MD 21703* **C/T/V** *City*

**Date & Time Secured** *06/04/015 @ 1530 hours*

**Location** *1718 Abbey Ln, Frederick, MD 1703* **C/T/V** *City*

**Evidence Secured** (Check One):
X **To Be Processed (Explain)** Requests for laboratory analysis submitted
___ **Storage Only**
___ **Other (Explain)** _____

**Property Secured From**

**Name & Phone # of Person** *Jason Delurentus, 301-846-1705*
**Signature of Person Taken From** *Jason Delurentus*

**Blood Sample Submission** *No*

Defendant's Name
_____

**Disposition** (Internal Use Only)

____ Returned to Owner/Finder
____ Disposal _____
____ TOT _____

**List of All Items Secured**

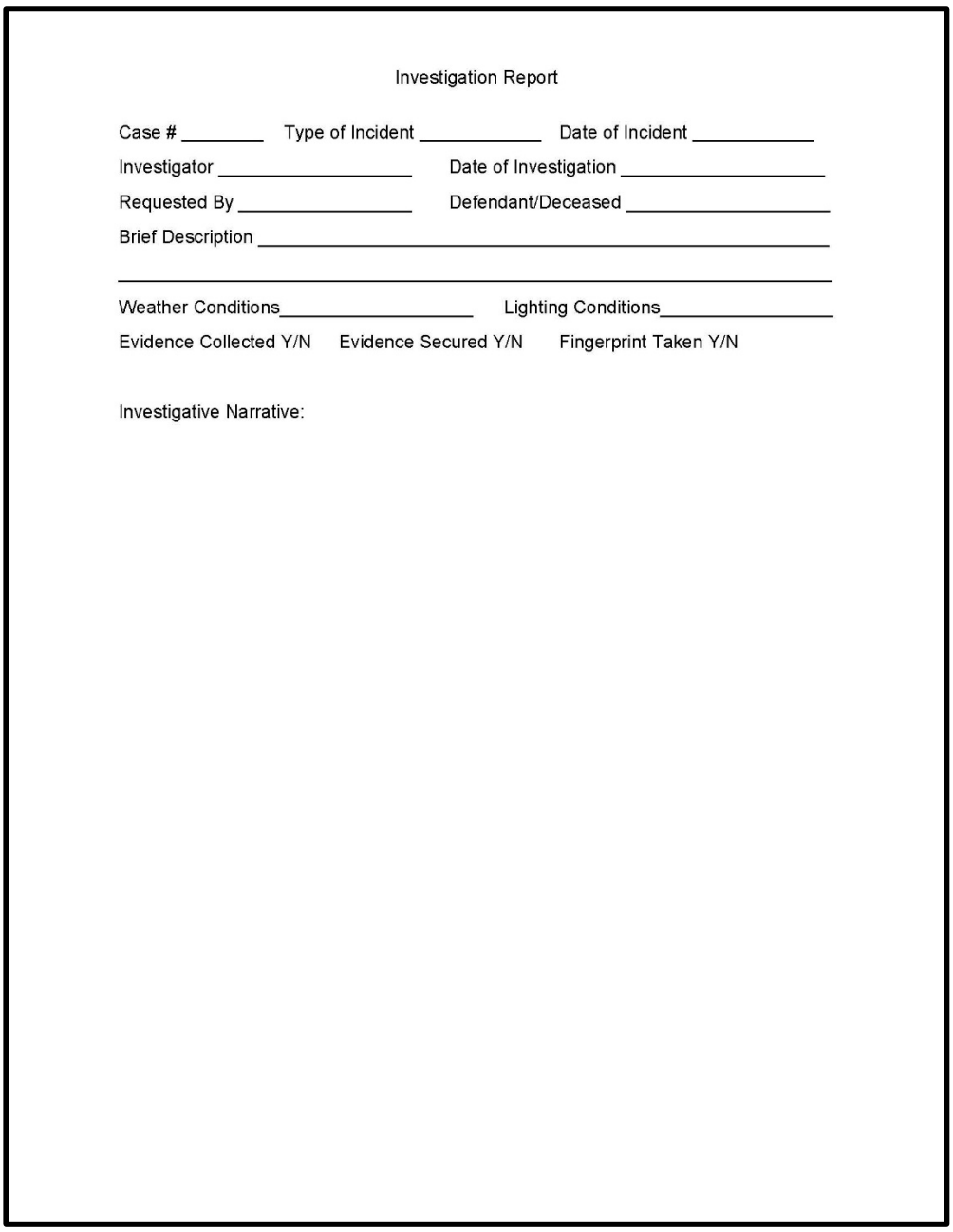
| Item | Brand Name | Model | Serial # |
|---|---|---|---|
| 1·Cell Phone | Motorola | Moto G | TA36602TDB |
| 2·Small Plastic Bag of Pills | N/A | N/A | N/A |
| 3·Syringe Cap | N/A | N/A | N/A |
| 4·Cloth Tourniquet | N/A | N/A | N/A |
| 5·3cc Syringe | N/A | N/A | N/A |
| 6·Plastic Cup | N/A | N/A | N/A |
| 7·Disposable Water Bottle | Acadia | N/A | N/a |

Additional Notes: *All items were recovered from and secured in the residence (living room)·*

*EB Boward* *Emily S·Boward*

Signature of Recovering Personnel Personnel Name Printed

Figure 32. Example evidence/property log related to the mock crime scene photographed in chapter 3.



Investigation Report

Case # _____ Type of Incident _____ Date of Incident _____

Investigator _____ Date of Investigation _____

Requested By _____ Defendant/Deceased _____

Brief Description _____

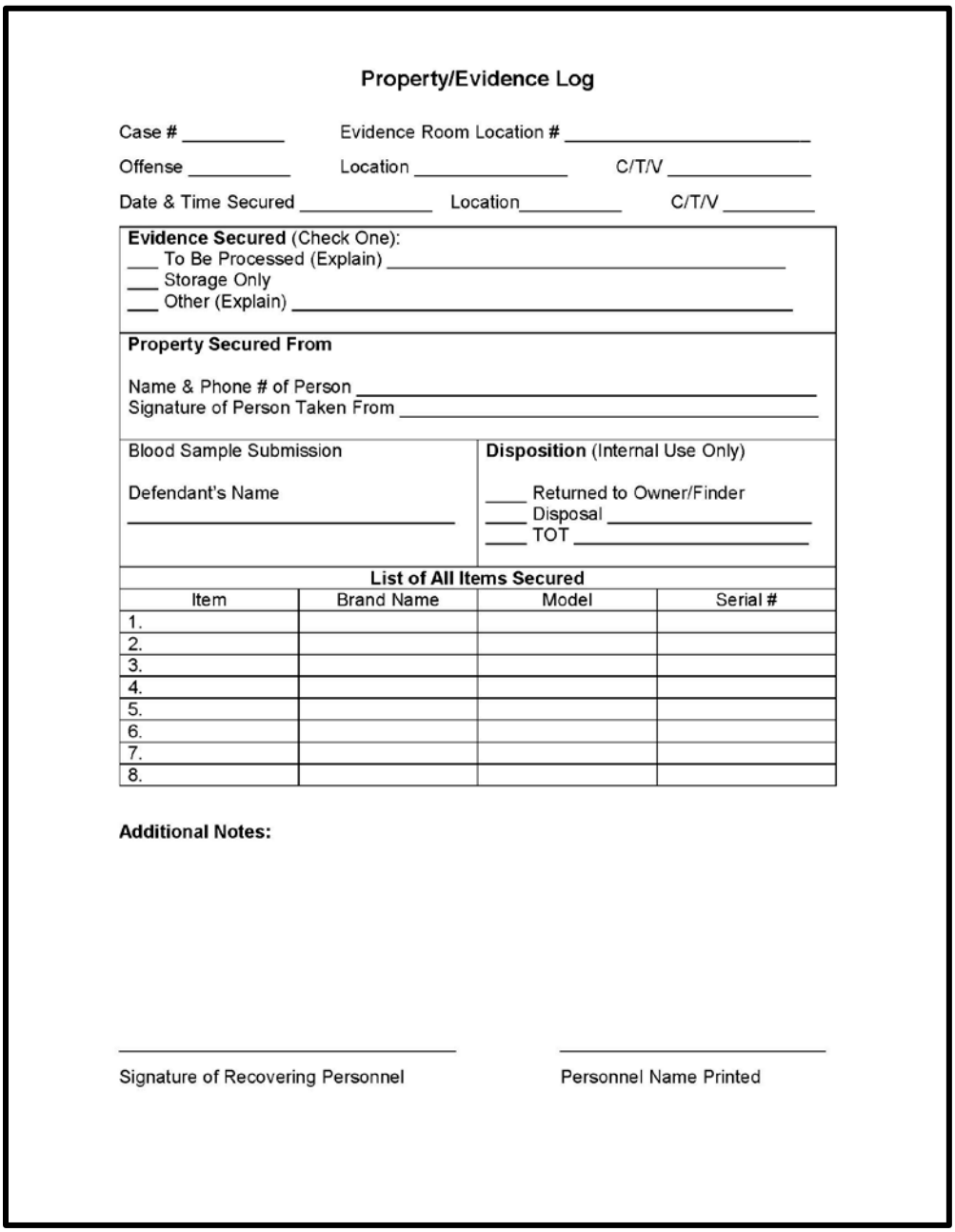
_____

Weather Conditions_____ Lighting Conditions_____

Evidence Collected Y/N Evidence Secured Y/N Fingerprint Taken Y/N

Investigative Narrative:

Figure 33. Crime scene investigation report template for student use.



**Property/Evidence Log**

Case # _____ Evidence Room Location # _____

Offense _____ Location _____ C/T/V _____

Date & Time Secured _____ Location_____ C/T/V _____

**Evidence Secured** (Check One):
___ To Be Processed (Explain) _____
___ Storage Only
___ Other (Explain) _____

**Property Secured From**

Name & Phone # of Person _____
Signature of Person Taken From _____

| Blood Sample Submission | **Disposition** (Internal Use Only) |
|---|---|
| Defendant's Name<br>_____ | ____ Returned to Owner/Finder<br>____ Disposal _____<br>____ TOT _____ |

**List of All Items Secured**

| Item | Brand Name | Model | Serial # |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |

**Additional Notes:**

_____ _____

Signature of Recovering Personnel Personnel Name Printed

Figure 34. Property/evidence log template for student use.

**Fingerprint Lifting**

This chapter will focus on a very common technique used at crime scene investigations – dusting for latent fingerprints (FBI 2011, Fish *et al.* 2014, Lee and Paligaro 2009, Yamashita *et al*. 2014). After a discussion of background information, this chapter will provide a step-by-step method for this technique. A volunteer will complete the steps for collecting a latent fingerprint, and digital photographs will be taken to document the method (Figure 35).

1. The supplies required for collecting latent fingerprints for comparison analysis: brush, powder, lift tape, and backing card.

**Follow these steps for collecting a latent fingerprint:**

2. Label the backing card (Fish *et al.* 2014).
3. Put on gloves, and dip the brush into the fingerprint powder. Shake off the excess (Yamashita *et al.* 2014).
4. Swirl the powdered brush over the area on the object suspected of containing fingerprint evidence; sweep away the excess (FBI 2011, Yamashita *et al.* 2014).
5. Photograph the developed print (FBI 2011, Fish *et al.* 2014, Yamashita *et al.* 2014).
6. Place an appropriately sized piece of lift tape on top of the print. Alternatively, lifters are a convenient choice for preserving the fingerprint; some come with backing cards (Figure 36) (Fish *et al.* 2014, Yamashita *et al*. 2014).
7. Press evenly over the tape (Fish *et al.* 2014, Yamashita *et al*. 2014).
8. Carefully pull it off the object (Lee and Paligaro 2009, Yamashita *et al*. 2014).

9. Attach the lifted print to the backing card (Lee and Paligaro 2009, Yamashita *et al*. 2014).

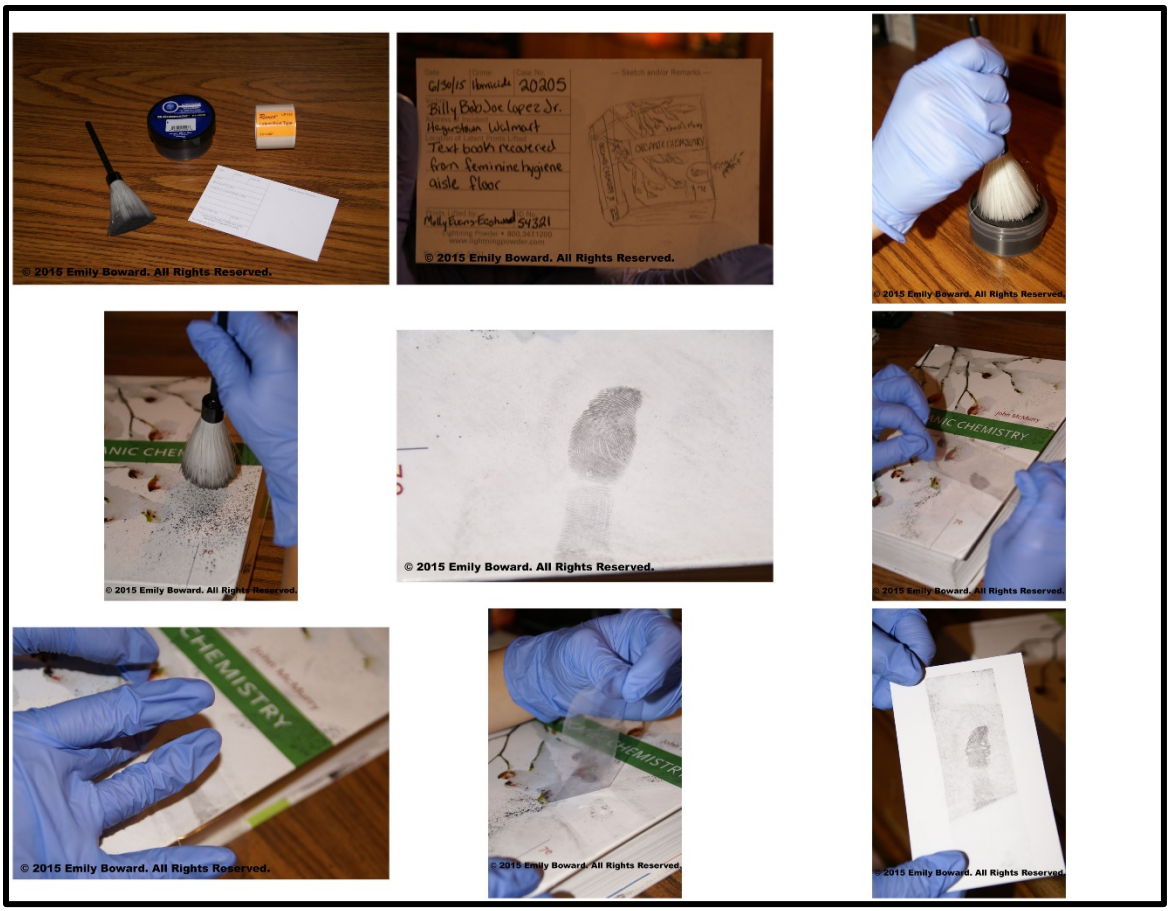



Figure 35. Process for collecting a latent fingerprint (L-R, steps 1-9 in the protocol).

Table 2. How to choose fingerprint powder based on substrate (Romig 2015).

| Powder | Substrate |
|---|---|
| Gray | Dark Color, Mirror, See-through Glass |
| Black | Light Color, See-through Glass |
| Fluorescent | Multi-Color<br>When the print cannot be lifted<br>Alternate light source is required |
| Magnetic | Non-metal<br>Applied with a wand, not a brush |
| Oxide | Wood |
| Metallic | Metal |

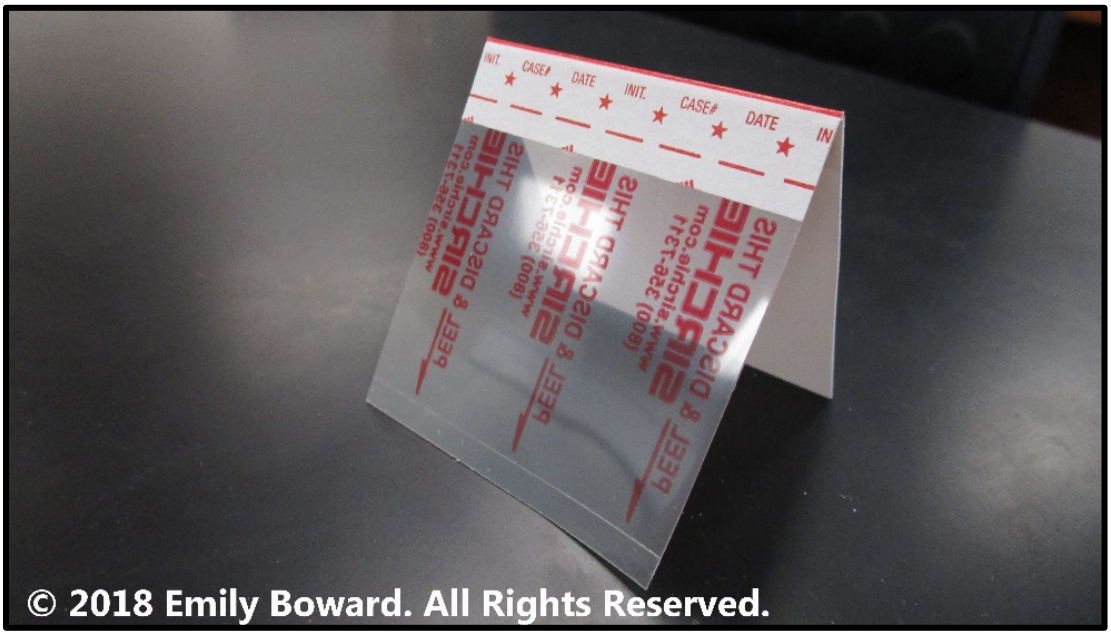



Figure 36. Fingerprint lifter (Sirchie®).

**Pathology and Death Assessment**

No laboratory activity will be designed for this chapter; however a guest lecture or field trip would be substituted for this week, to enhance what students have learned about assessing a body at a crime scene.

**Presumptive Testing**

This laboratory activity will contain three main sections. 1) Using an Alternate Light Source, 2) Presumptive Blood Tests, 3) Collecting DNA Swabs. A small, handheld alternate light source, the MicroBlue II™ (Lynn Peavey Company) at 455 nm, will be used to screen pieces of fabric for blood and saliva (Figure 38). Human blood (via finger stick) will be deposited onto a small piece of fabric (Figure 37a and b), and human saliva will be deposited onto another piece (Figure 37c and d). This researcher will personally provide these samples. The samples will be allowed to air dry, and photographs will be taken under white light and in the dark with the alternate light source. A colored filter will be placed in front of the camera lens to visualize the stains (orange for saliva, yellow for blood) (Fish *et al.* 2014). Saliva fluoresces a bright yellow ring with a diluted center, while blood does not fluoresce (Li 2008, Wilson 2011). Blood spots appear dark, almost black in color (Fish *et al.* 2014). A digital camera with a tripod and cable release will be used to photograph long exposures (Fish *et al.* 2014).

The methods to be provided in this chapter will be available to the students to perform in a laboratory session, however, this researcher strongly recommends using sterile animal blood (Carolina Biological Supply Company, Item # 828894) in place of human provided blood samples at the community college setting. This ensures no biohazardous risk is present.

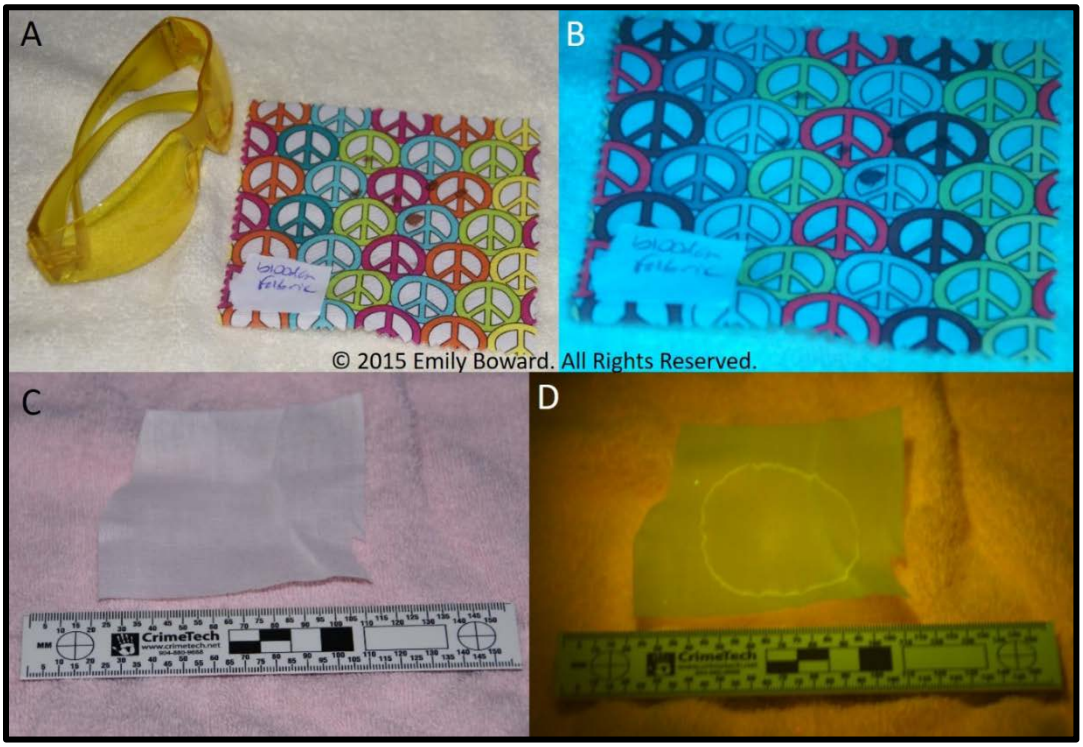



Figure 37. Photographs of blood and saliva on fabric. A. Blood on fabric under white light. B. Blood on fabric under 455 nm ALS viewed with yellow filter – note the dark, non-fluorescent spots (Lynn Peavy Company 2012). C. Saliva on fabric under white light. D. Saliva on fabric under 455 nm ALS viewed with orange filter – note the fluorescence (Li 2008, Wilson 2011).


Figure 38. Orange filter glasses and MicroBlue II™ 455nm ALS used for viewing suspected stains (Fish *et al.* 2014, Lynn Peavy Company 2012).

Various tests for screening for the presence of blood will be included in this laboratory section. All blood samples used will be personally provided by this researcher via finger sticks. Luminol and BLUESTAR® FORENSIC are two chemical formulations used to identify possible blood stains (Dilbeck 2006). A chemiluminescent reaction will allow blood samples to glow blue in color and be visualized by the investigator (Bluestar 2007, Tewes 2015). Human blood will be deposited onto multiple porous and non-porous substrates (fabric, carpet, ceramic tile, metal knife). These stains will be photographed under white light, then treated with either luminol or BLUESTAR® FORENSIC, using the following protocols. The results will be photographed in a dark environment using a digital camera and tripod and cable release (Figure 39). An extraneous light source (flashlight cellphone application) will be used to enhance the photographic detail (Figure 40) (Fish *et al.* 2014). The results of these tests are depicted in figures 41-43. Blood is shown to be presumptively identified in difficult conditions such as blood being painted over (Figure 41b) and blood being cleaned off of a surface with water (Figure 42b) (Bluestar 2007, Tewes 2015).

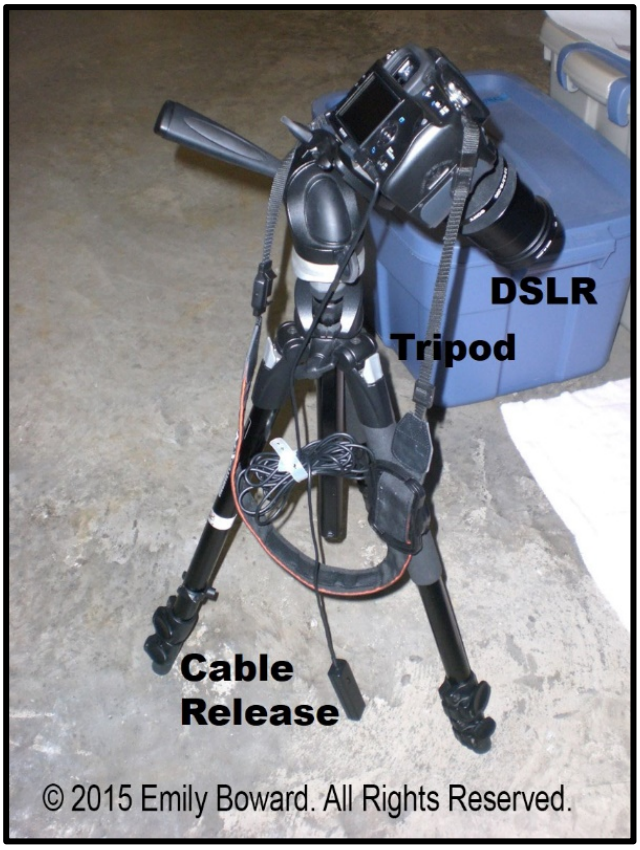



Figure 39. Digital camera set up with tripod and cable release for timed exposures (Fish *et al.* 2014).


Figure 40. Cell phone flashlight providing light for a timed exposure (Fish *et al.* 2014).

*Luminol*

1. Combine Component B with Bottle A (Tewes, 2015).
2. Put on the sprayer top (Tewes, 2015).
3. Use light agitation to mix the solution (Tewes, 2015).
4. Spray the chemical onto the suspected stain, turn off the lights, and observe the reaction (Tewes, 2015).

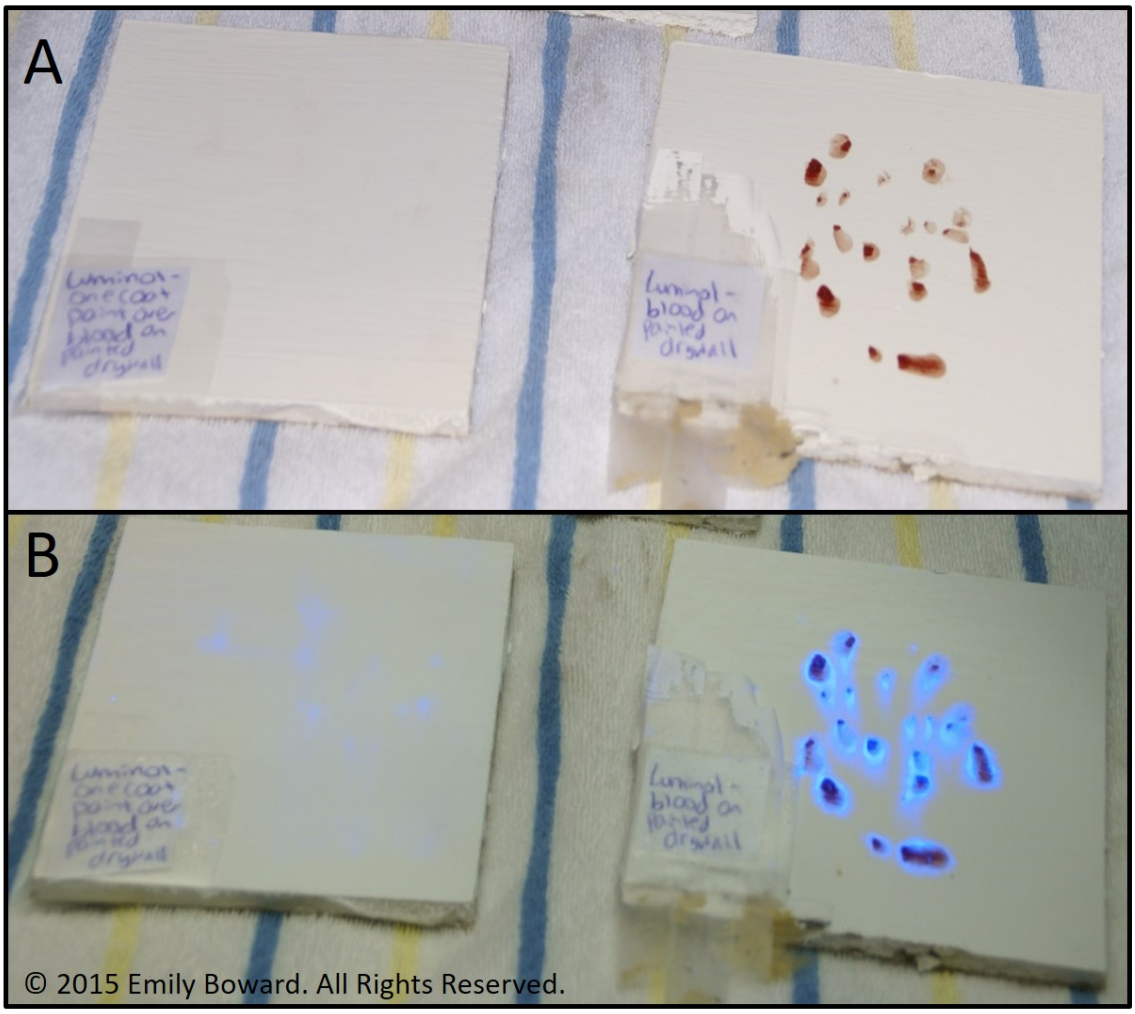



Figure 41. Blood samples on painted drywall with and without one coat of paint over top of the blood. A. Prior to luminol treatment. B. After luminol treatment – note the blue color (Tewes 2015).

*BLUESTAR® FORENSIC*

1. Measure 125 mL of distilled water into a spray bottle (Bluestar® 2007).
2. Remove the two tablets from the packet, and put them into the spray bottle (Bluestar® 2007).
3. Close the bottle, and swirl it periodically until the tablets are fully dissolved (Bluestar® 2007).
4. Spray the chemical onto the suspected stain, turn off the lights, and observe the reaction (Bluestar® 2007).

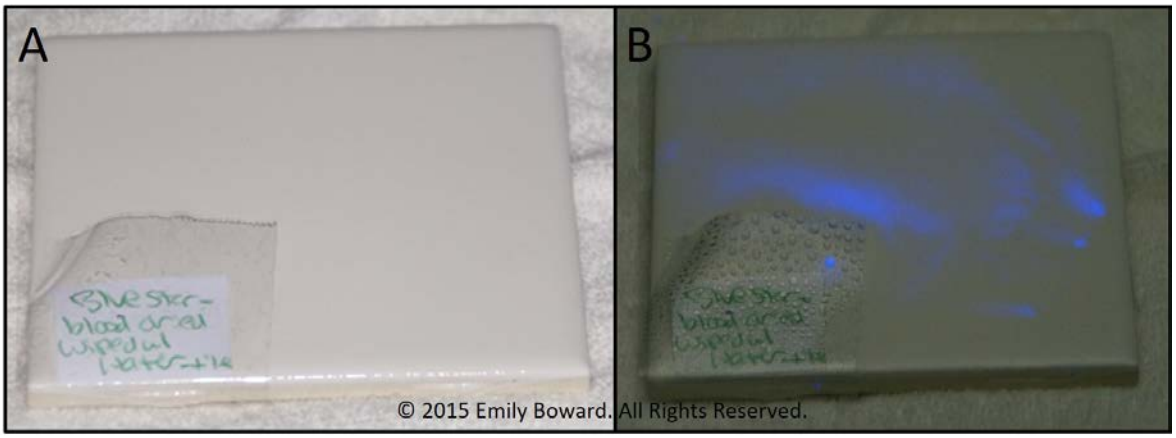



Figure 42. Ceramic tile with dried blood sample wiped off with water. A. Prior to BLUESTAR® FORENSIC treatment. B. After BLUESTAR® FORENSIC treatment – note the blue chemiluminescence (Bluestar® 2007).

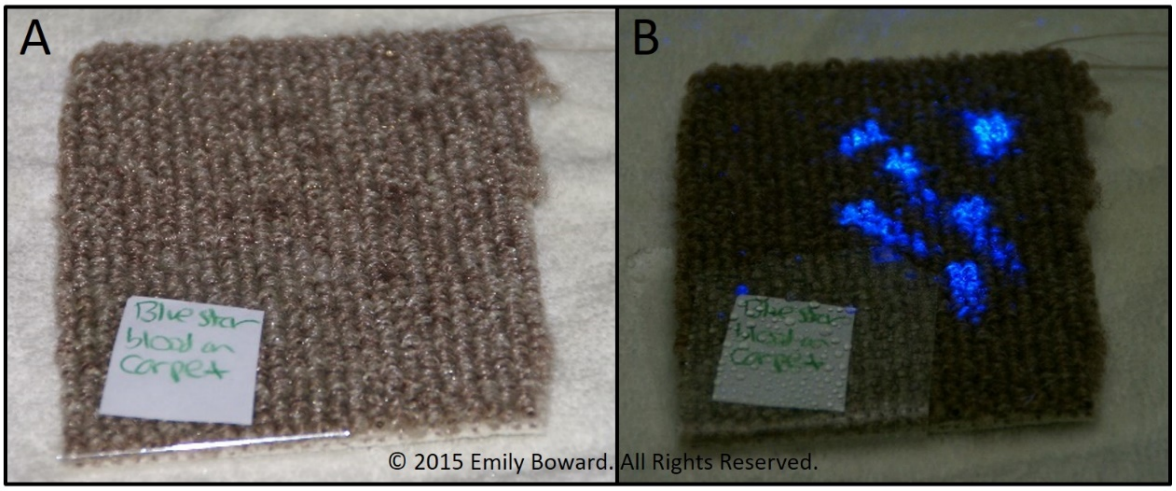



Figure 43. Blood sample deposited onto carpet. A. Prior to BLUESTAR® FORENSIC treatment. B. After BLUESTAR® FORENSIC treatment– note the blue chemiluminescence (Bluestar® 2007).

Three other test reagents that will be introduced into this laboratory activity are leucocrystal violet (LCV), TMB and phenolphthalein. These all involve oxidation reactions that subsequently result in a color change if blood is present in the sample (Colotelo *et al.* 2009, TRITECH FORENSICS 2018, Virkler and Lednev 2009). For all three tests, human blood will be deposited onto ceramic tile, and the following protocols will be used for sample treatment. For the LCV test, bloody fingerprints will be allowed to air dry and then be treated with the reagent (Figures 44 and 45). Human blood will be deposited onto a separate tile and wiped clean with water. The reagent will be applied, to determine if blood traces are still detectable (Figure 46). For the TMB and phenolphthalein tests, a volunteer will collect the blood samples from the tile onto sterile cotton swabs and then use the reagents to analyze those samples. Digital photographs will be taken to document these methods and color change results (Figures 47 and 48).

*Leucocrystal Violet Test*

1. Combine Part C into Part B (TRITECH FORENSICS 2018).
2. Agitate to mix the solution (TRITECH FORENSICS 2018).
3. Combine Part B into Part A (TRITECH FORENSICS 2018).
4. Agitate to mix the solution (TRITECH FORENSICS 2018).
5. Either use a transfer pipet to drop the LCV onto the sample, or add the LCV to a spray bottle, and spray it onto the sample (TRITECH FORENSICS 2018).
6. A vibrant purple color will appear in the presence of blood (TRITECH FORENSICS 2018).


Figure 44. A. Reagent components for LCV treatment. B. Colorless LCV reagent in transfer pipet (TRITECH FORENSICS 2018).

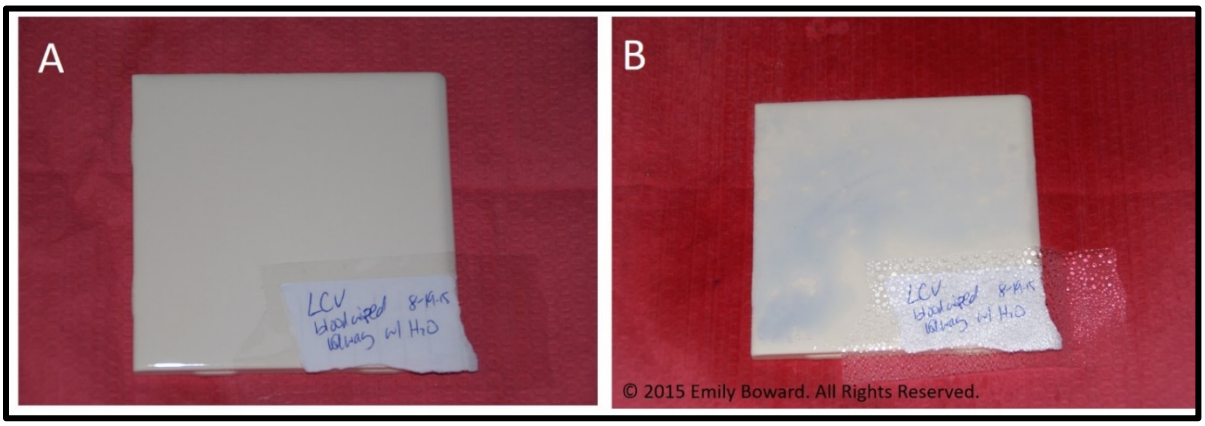



Figure 45. Ceramic tile with blood sample wiped away with water. A. Prior to LCV treatment. B. After LCV treatment. Blood is still able to be presumptively identified (TRITECH FORENSICS 2018).

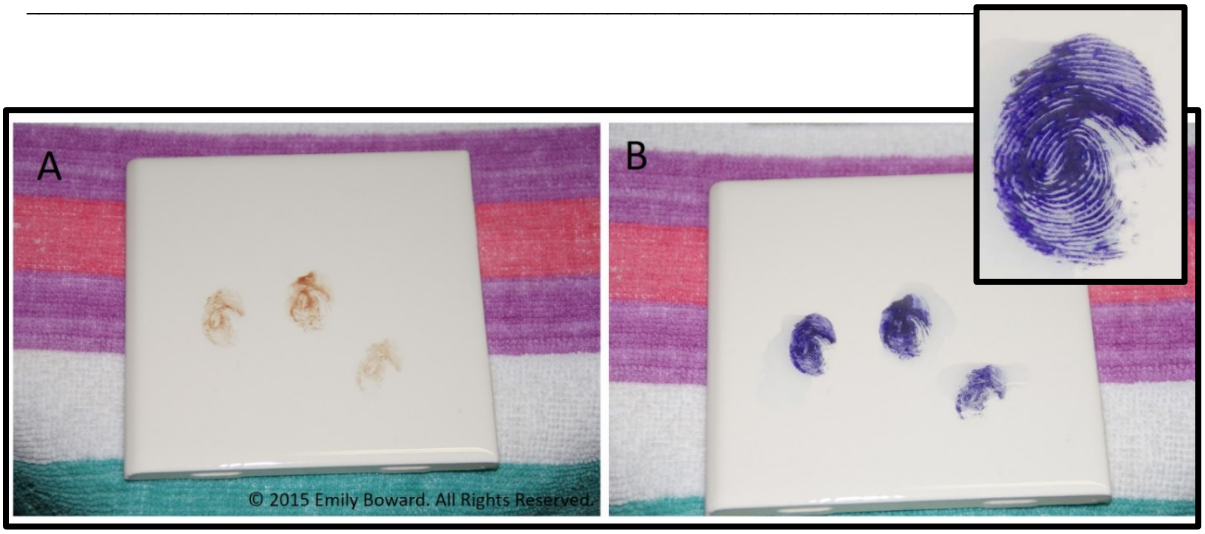



Figure 46. Ceramic tile with bloody fingerprints. A. Before LCV treatment. B. After LCV treatment. The inset photo shows the ridgelines of the fingerprint. This reagent is helpful in bringing out the details of bloody fingerprints (TRITECH FORENSICS 2018).

*TMB Test Strips*

1. Add a few drops of distilled water to a sterile swab (Aldon Corporation 2008, WMRCL 2013)
2. Apply the swab to a spot of blood. Roll/rub the swab over the spot to transfer the substance to the swab (Aldon Corporation 2008, WMRCL 2013).
3. Apply the swab to the test strip (Aldon Corporation 2008, WMRCL 2013).
4. A green color will form in the presence of blood (LW Scientific, Inc. 2011).


Figure 47. Method for testing a spot of blood with a TMB test strip. A green colored positive result is shown here (Aldon Corporation 2008, LW Scientific, Inc. 2011, WMRCL 2013).

*Phenolphthalein Test*

1. Add a few drops of distilled water to a sterile swab (Aldon Corporation 2008, WMRCL 2013).
2. Apply the swab to a spot of blood. Roll/rub the swab over the spot to transfer the substance to the swab (Aldon Corporation 2008, WMRCL 2013).
3. Drop 1-2 drops of ethyl alcohol onto the swab (Aldon Corporation 2008).
4. Drop 1-2 drops of phenolphthalein onto the swab (Aldon Corporation 2008).
5. Cease the test if a color change is observed. Proceed with the testing if no color change is observed (Aldon Corporation 2008).
6. Drop 1-2 drops of hydrogen peroxide onto the swab. A bright pink color will form in the presence of blood (Aldon Corporation 2008).

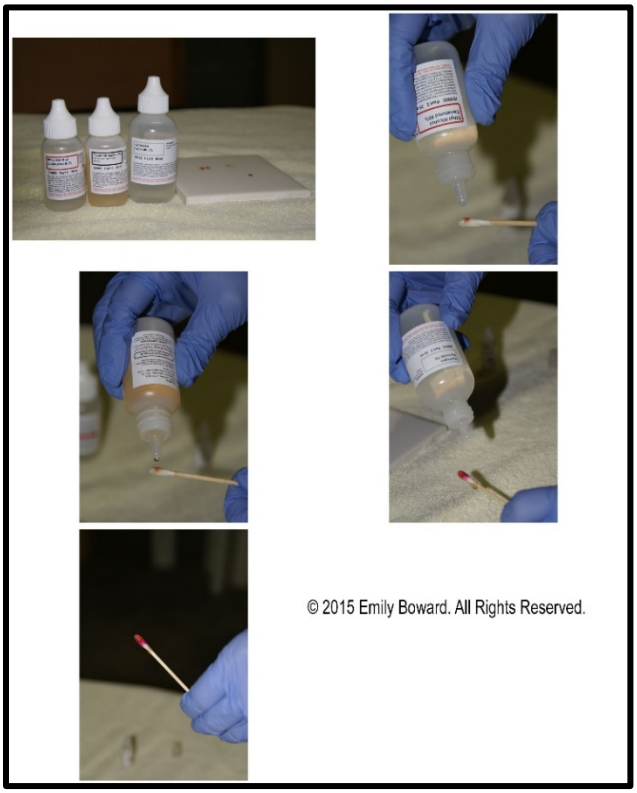



Figure 48. Method for testing a spot of blood with the phenolphthalein test.
A pink colored positive result is shown here (Aldon Corporation 2008).

The final protocol that will be included in this laboratory section is how to perform touch DNA collection from a suspected piece of evidence. Epithelial cells are deposited from human interactions with objects in the environment (Alketbi 2018, Ryan 2012, Williamson 2012). This protocol would be completed at the scene of crime and further laboratory analysis would be used to identify suspect or victim DNA profiles (Alketbi 2018, Ryan 2012, Williamson 2012, Wilson 2012). A volunteer will perform the following protocol, using wall light switches as the mock evidence substrate. Digital photographs will be taken to document the procedure.

*Touch DNA Swabs*

1. Obtain sterile swabs, distilled water and swab carton (Wilson 2012).
2. Label the swab carton with initials of collector, case number, date and time, and close the bottom of the carton (Wilson 2012).
3. Remove sterile swabs and apply a few drops of water, enough that they are wet, but not soaked (Wilson 2012).
4. Twist the swabs while applying their tips and sides to the surface of interest (Wilson 2012).
5. Put the swabs in the carton, and close the top of the carton (Wilson 2012).
6. Write on a paper envelope (NO PLASTIC BAGS ALLOWED) name of collector, time, date, case number, item number, type of evidence and what was swabbed. Also, stick on a biohazard sticker (Wilson 2012).
7. Place evidence tape around the top of the envelope, and write the collectors initials across the tape (Wilson 2012).


Figure 49. Method for collecting a touch DNA sample with wetted swabs (Wilson 2012). Additional collection techniques include using tape or a sterilized blade on the piece of evidence to release the cells (Alketbi 2018, Williamson 2012).

**Crime Laboratory Methods**

A diverse set of laboratory methods will be presented in the lecture portion of this chapter. Therefore, the activity(ies) chosen for this laboratory section could consist of multiple options, such as microscopy (hairs, fibers or sperm cells); handwriting/document analysis (comparison; iodine fuming); ballistics; tool marks (Staveley 2015); chromatography (ink or plant pigment separation) (PLS 2015, Staveley 2015). For this proposal, an activity where students identify unknown chemical compounds using a Fourier-transform infrared (FTIR) spectrometer will be included. FTIR spectroscopy allows the identification of a chemical's individual functional groups (Ellis 2018, Harper *et al.* 2017). The data output is a spectrum which indicates the percentage of radiation that was transmitted (or absorbed) at a particular wavelength (Ellis 2018, Harper *et al.* 2017). The following protocol and instructions were developed and written at Frederick Community College in collaboration with a National Science Foundation Improving Undergraduate STEM Education grant (DUE-1431522) and will be used in this proposed curriculum with permission.

Objective: To determine the identity of an unknown chemical through FTIR spectrometry analysis.

1. The instructor should assign each group of students an unknown compound. The instructor should know the identities of the unknowns (Ellis 2018).
2. The students should be provided with a set of spectra of known compounds (Ellis 2018).
3. The instructor should demonstrate the proper use of the FTIR spectrometer by analyzing a practice sample (Ellis 2018).
4. Each group of students should run the unknown samples and obtain their chemical spectrum (Ellis 2018).
5. Through comparison with the known spectra, each group should be able to determine each unknown chemical (Ellis 2018).

## Instructions for Using the Bruker Alpha FTIR Spectrometer

**INSTRUCTORS:**

***STEPS 1-10 SHOULD BE COMPLETED BY THE INSTRUCTOR PRIOR TO STUDENT USE.***

Verify that the ATR (attenuated total reflection) sample attachment is on the FTIR (Fourier transform infrared spectroscopy) spectrometer. The photo below depicts the ATR on the FTIR. If the ATR is not already in place then do the following:

a. Press the large silver button on top of the FTIR spectrometer until it clicks & stays in the down position (the FTIR spectrometer light will turn from green [or orange] to red).
b. Gently pull the Transmission accessory up and slide it out. Set it safely off to the side.
c. Now slide in the ATR attachment. When it is in the correct position the light will return to green (or orange).
d. Press the large silver button down and it will return to its original up position, level with the FTIR spectrometer body.

1. The FTIR, laptop, and power supply remain on the cart at all times. Position the cart near an outlet.
2. Plug in the black power supply and turn it on by pressing the ⏻ button.
3. Press ⏻ button in top left corner of keyboard to power laptop on. Allow laptop to boot up.

4. Click the icon for *OPUS 7.5* located on the home screen.

5. The password is **OPUS**.

6. Click *Login*.

7. Click *OK* for all pop-up windows.

8. A mandatory non-automatic Performance Test must be run every 6 days. If the test expires before or during your time of use, you will not be able to use the FTIR spectrometer. You must complete the test, then you will be able to obtain spectra of your samples.

    a. To initiate or check the expiration date of the test look at the bottom right corner of the screen. You will see a circle, either green or yellow in color. If green, then the performance test is still valid and nothing needs to be done.


    b. If the circle is yellow then the test has expired. Completion of the Performance Test takes approximately 5 minutes to run. You can resume using the FTIR spectrometer after the laptop confirms that the test is completed. Click on the yellow circle. A screen will pop up. Locate the picture of the accessory you are using. Underneath the picture you will see the word *EXPIRED*. Click the picture; you will see another screen appear. In the top left of the window a button will say *Run PQ Test*. Select the button *RUN TESTS*, and allow the test to run.

    c. You will be notified of the test's completion when a box appears in the bottom right of the screen verifying the test was passed (*Instrument Test Passed*). You will also get a pop-up window OVP-PQ Test Protocol. Close this window, and close the instrument test window.

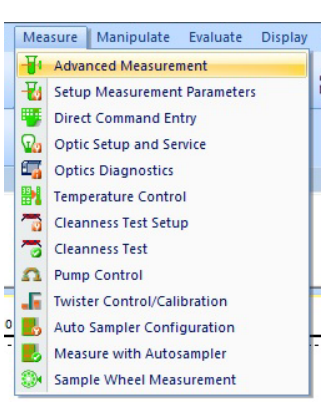
d. If the FTIR fails its *Wavenumber Accuracy Test* you should re-measure the laser wavenumber in OPUS. To do this you click on *Validation* at the top toolbar, select *Set Up OVP*, then click the button in the center of the screen that says *Measure LWN*. BEFORE you click this button, ensure that the ATR stage is clean and not clamped down. Once complete, a pop window will appear stating that a new wavenumber is required. Click *OK*. Then perform the control test again – the FTIR should now pass.

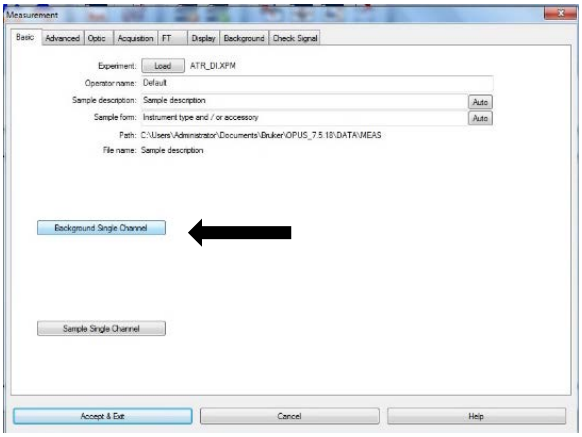
9. The instrument light will have changed from orange to green.

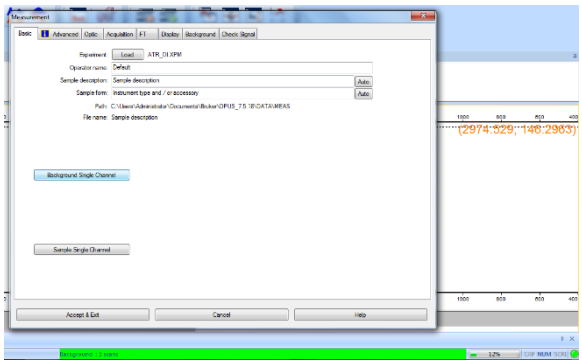
10. The software automatically runs a performance test - **do not** touch the FTIR spectrometer or laptop during this time until a window appears at the bottom right of the screen stating *Accessory Identified*.

11. Now click *Measure BG* in this window to perform a background scan. **Do not disturb** while the progress of the background scan is displayed in bottom right corner of laptop screen. Wait until it reaches 100% and disappears.

12. If this window does not appear, measure the background by selecting *Measure* at the top toolbar, *Advanced Measurement*, and then *Background Single Channel*. This can be done anytime a background measurement needs to be taken.



**STUDENTS:**

13. **IMPORTANT:** If at any time, you notice that the light on the instrument is orange or red, or the circle in the lower right hand corner of the laptop screen is yellow or red, **STOP** and alert your instructor.



14. Place your sample on the ATR stage:

    a. Liquids:
        i. Use a pipette to place 2-5 drops of your sample in the center of the circle.
        ii. Note: if using a volatile substance quickly place a watch-glass concave down over your sample to prevent rapid evaporation of your sample.

    b. Solids:
        i. Use a metal scoopula to obtain a small amount of your sample - a volume no larger than a #2 pencil tip.
        ii. Gently place your sample on the stage in the center of the circle - **ENSURE** that the metal scoopula does not scratch the stage!

    c. Pull the silver lever on the ATR towards you a full 90° so that it is at a 45° angle with the ATR stage. The handle will click into place. When it is in the correct position the lever will remain in the position to which you pulled it.

    d. Your sample is now compressed between the stage and metal pressure tip.

15. Now return to the laptop and click the button with a green test tube with an orange arrow  going through it.

16. In the pop-up window under *Advanced* tab set the following:

    **Resolution to 4**
    **Sample scan time to 24**
    **Result spectrum to Transmittance**

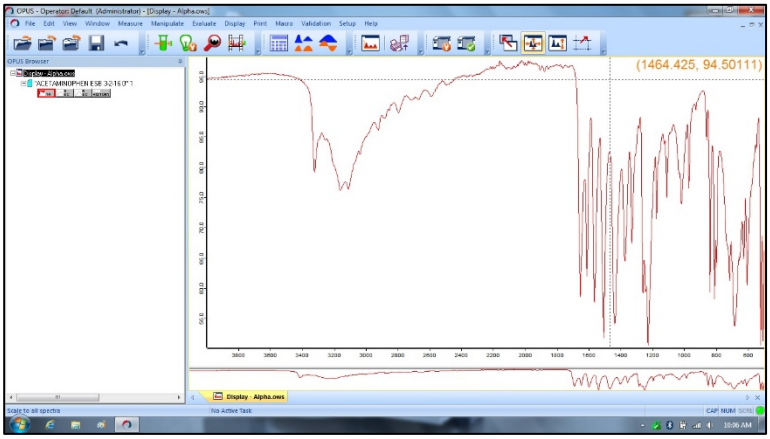
17. Return to the *Basic* tab to type the name of your sample in the *Sample Description* box. This is the name under which your file/spectrum will be saved.

18. Click *Sample Signal Channel*.

19. Click *Start Measurement* button in the bottom left corner of the spectrum graph.

20. Do not disturb your scan while it is in progress. The progress is shown in the bottom right corner of screen.

21. When your spectrum appears click the *Scale* button (it is a navy square with four orange arrows in it). 

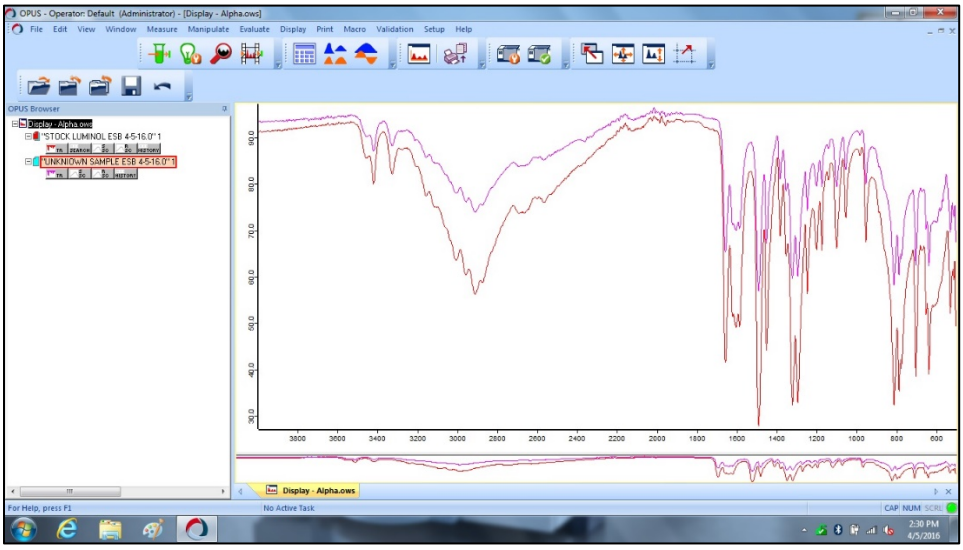



22. To compare your spectrum to a reference compound's spectrum click the red magnifying  glass on the toolbar.

23. Under *Search Parameters* tab change *Minimum hit quality* to 90. Then click the *Search Library* button at the bottom of the pop-up window.

24. A new window will appear containing all spectrum matches to your sample and percent matches. To close your library search click the blue X in the bottom right of the screen.

25. Instead of a library search, you can run a known stock sample in addition to your experimental sample or unknown. Multiple samples can be run one after the other (REMEMBER TO CLEAN THE STAGE IN BETWEEN SAMPLES). Multiple spectra will show in different colors, and then one screenshot can be captured.



26. To capture a screenshot: hold down the *FN* and *PrtScn* keys together on the keyboard to take a screenshot of the spectrum.

27. Open a Paint  file, and paste the screenshot into it.

    Select *File – Save As – JPEG Picture* under the *File* tab. Label the file with your sample name, initials and date, and save the file to your class's folder.

28. Return to OPUS.

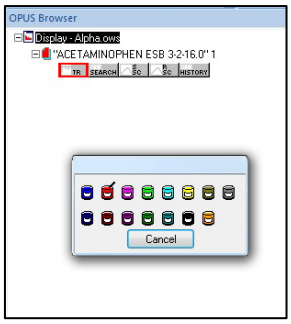
29. Click on the *Save As* icon on the  toolbar.

    Change the file path to your class's folder. This will save the sample file and percent matches data. It can be opened in OPUS at a later date, if needed. You can also email the file to yourself and your group members.

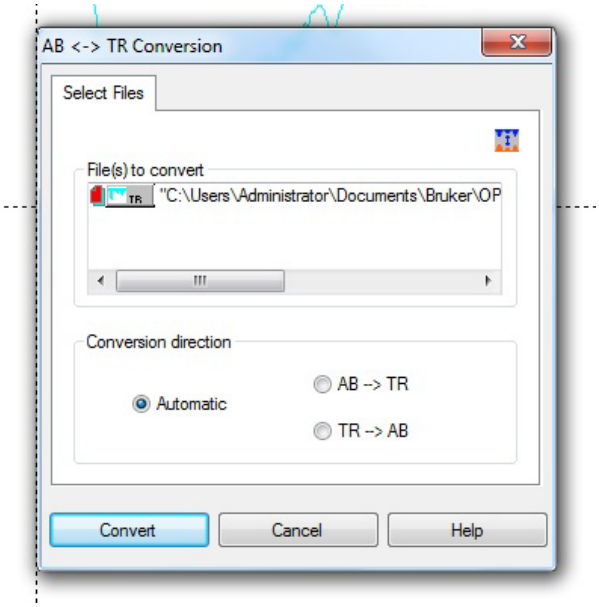
30. Spectrum manipulation tools:

    a. On the left of the screen you can remove your spectrum from display by right-clicking the tiny box labeled *TR* which appears under your file name, then click *Remove From Display*.

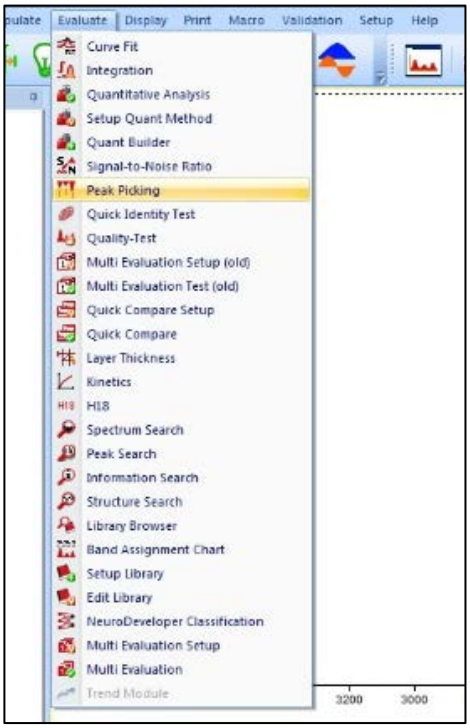
    b. Change the line color by right-clicking the tiny box labeled *TR* which appears under your file name. Select *Change Color*.

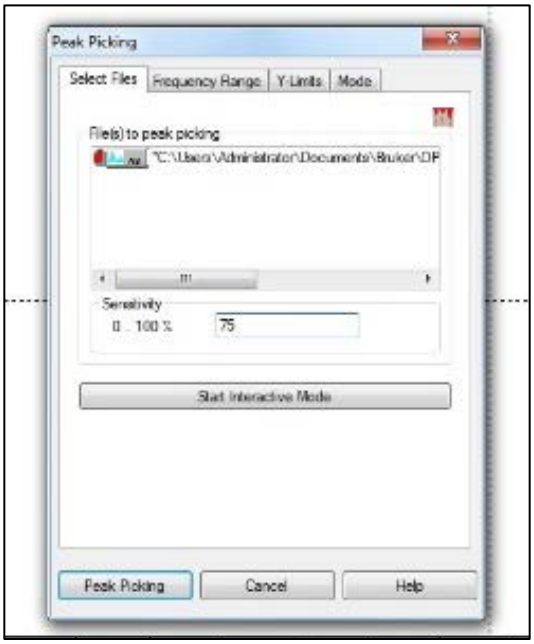



    c. You can switch your y-axis between % transmittance and absorption. Under the *Manipulate* tab: click *AB <-> TR Conversion*. Then click the *Convert* button in the pop-up window.



d. Under the *Evaluate* tab select *Peak Picking*. This allows you to label the x-axis value (which represents the wavenumber) of individual peaks. In the pop-up window, the higher the sensitivity you select, the less peaks it will label. Click the *Peak Picking* button once you have set your sensitivity.

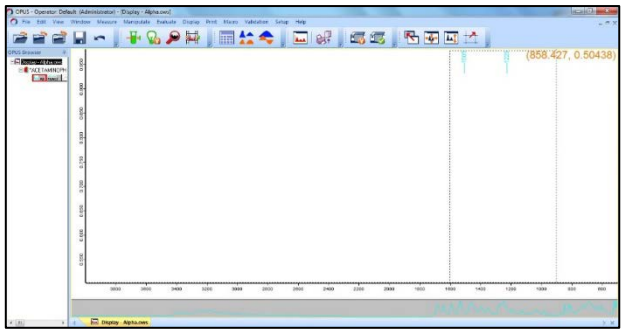


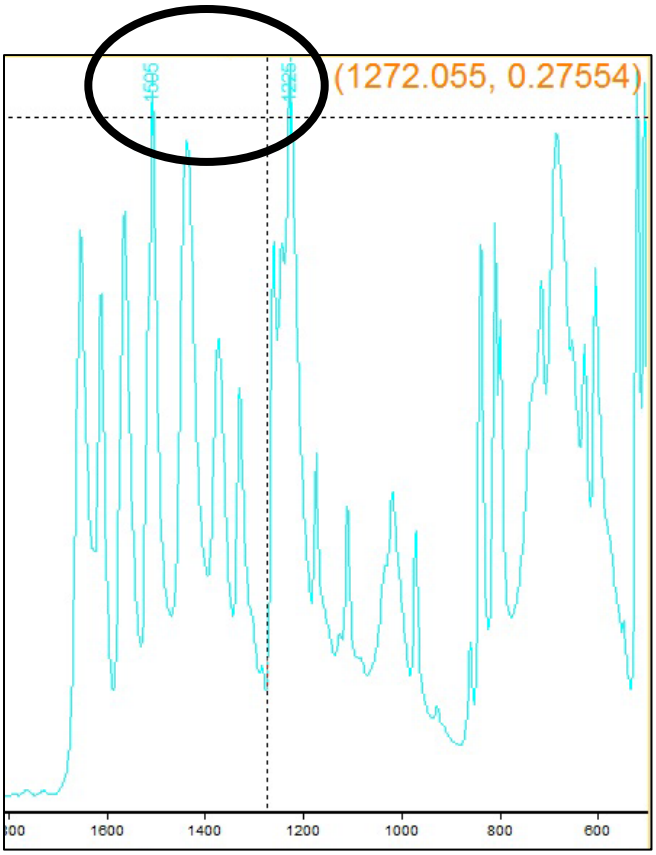




e. To zoom in on a section of the spectrum, right click anywhere on the graph, choose *Zoom*, then choose *Zoom In*.

A vertical and horizontal dotted line will appear for you to draw (click and drag) a rectangle around the section you wish you view magnified. Once you draw a rectangle of suitable size, it can get moved anywhere on the spectrum.
Move to the correct location on the spectrum, then left click the mouse.

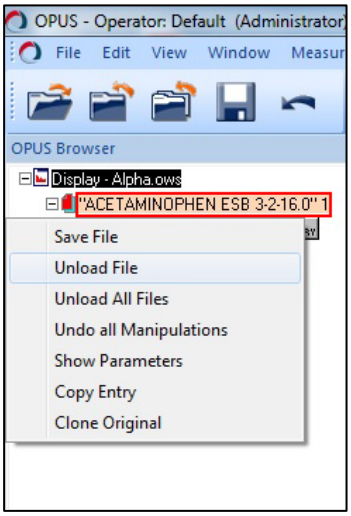
To return to your regular spectrum view, click the scale button, which is 3rd from the right on the toolbar (it is a navy square with four orange arrows in it).






Cropped view of the scaled spectrum with labeled peaks.

31. Once you are finished analyzing your sample and have saved all of your data and images that you need, right click on your file name on the left hand side of the screen. Select *Unload File,* then click *Unload* in the pop up window. This removes your data, so the next group can view their spectra.



32. Clean the ATR stage between each sample by using isopropanol (squirt bottle) and Kim Wipes. Q-tips are necessary for removing all solid residue from the stage's well. Allowing a small puddle of isopropanol to sit for a minute can also help remove stubborn remnants. Ensure that you use only these utensils so that the ATR surface does not accidentally get scratched!

33. When you are finished using the FTIR spectrometer, click the red X in the top right corner of screen to shut down OPUS and then shut down the laptop.

34. Turn off the power supply, and unplug it. Return the cart to the appropriate area.

**Expert Testimony**

Consultation about courtroom testimony via a phone interview with a forensic investigator will be conducted (Oneida County Sheriff's Office, Oriskany, NY, USA). Sample questions and answers will be organized in written format. The laboratory activity will be designed as a series of "mini trials". During a pre-lab exercise, students will be assigned a particular area of expertise (i.e. photography, evidence collection, first response, fingerprinting, documentation, laboratory technician, etc.). Each student will be given an additional role (defense, prosecution, jury member, judge, etc.). Under the guidance and approval of the instructor, students will develop questions and answers for their areas of expertise, and then each will practice testimony skills in a mini-trial.

Students will be provided with these basic testimony skills:

- Be Professional
    - Dress professionally (Ashlock 2010).
    - Walk confidently and use good posture (Ashlock 2010).
    - Enunciate and speak loud enough (Ashlock 2010).
    - Do not use slang terms and "um", "ok," "you know," etc. (Ashlock 2010).
    - Look at the attorney who is asking you a question, then re-direct your eye contact to the jury when you respond (Ashlock 2010; Pagliaro 2013a).
    - Avoid nervous body or exaggerated facial movements (Ashlock 2010, Pagliaro 2013a).

- Be Ready
    - Have all case documents and photographs at the trial – orderly, to be looked at quickly (Fish *et al*. 2014, Paligaro 2013a)
    - Ensure that you are well-versed in the methods you use when conducting investigations and understand other methods and information related to your area of knowledge/skills (Paligaro 2013a).
    - Use language that an 11th grade student would understand – do not be too technical. Analogies can be helpful as well. (Ashlock 2010, Pagliaro, 2013a).
    - If asked about something that is not in your scope of knowledge/skills, state that to the court (Pagliaro, 2013a, 2013b).
- Be Un-Biased
    - A defense attorney will question methods and possibly your qualifications (Ashlock 2010, Fish *et al*. 2010).
    - Do not be agitated or defensive (Ashlock, 2010, Fish *et al*. 2014; Pagliaro 2013a).
    - Do not worry about how either the prosecutor or defense attorney will use your testimony. Just answer the questions truthfully (Fish *et al.* 2014, Pagliaro 2013b).

The following is an example of the line of questioning asked by a prosecuting attorney. The prosecutor will walk a crime scene officer through the case, and have the witness explain, little by little, what he/she did throughout the investigation.

First, the investigator is asked to answer background questions, such as:

- Where do you work?
- How long have you worked there?
- What are your credentials?
- What are your responsibilities?
- What is your job title?
- What training have you had?

Then, the attorney will ask the investigator specific questions about the case.

**Prosecutor:** On June 4th, 2015, were you working?

**Crime Scene Officer:** *Yes.*

**P:** Were you called to a scene that day?

**CSO:** *Yes.*

**P:** What did you do when you got there?

**CSO:** *I met with supervisors, and they briefed me about the incident, and then we did a walk-through.*

**P:** After that what did you do?

**CSO:** *I started taking photographs.*

**P:** Did you take this photograph? [Shows photograph].

**CSO:** *Yes.*

**P:** Does it clearly and accurately depict the scene as you saw it?

**CSO:** *Yes.*

****The attorney will ask the questions in this manner in order to have the photographs submitted into court as evidence.****

**P:** What did you see? or Describe the scene.

**CSO:** *I saw a body lying on the couch, covered in blood.*

**P:** Was the body face-up or face-down?

**CSO:** *Face-up.*

**P:** Did you take the temperature of the room?

**CSO:** *Yes.*

**P:** What was the temperature of the room?

**CSO:** *Seventy-three degrees Fahrenheit.*

****Only answer the question which you were asked (i.e. only provide the temperature measurement if asked for it)**** (Ashlock 2010).

**P:** Did you collect evidence?

**CSO:** *Yes.*

**P:** Is this something you collected? (Shows evidence).

**CSO:** *Yes.*

**And so on…**

**Footwear Impressions**

The following protocol will be written based upon current methods used for casting impressions from shoe wear marks at crime scenes (Saferstein 2007, VDFS 2017, Warrington 2015, Young 2002). This protocol will be followed by making a shoe impression in potting soil mixed with water inside a 9 x 15 inch tray (Figure 50). Photographs will be taken with and without a measuring scale (Figure 51), five cups of Plaster of Paris (DAP®) will be mixed with water in a gallon sized plastic bag, and it will be poured over the impression (Figures 52). The impression will be allowed to set for 50 minutes, and then be labeled with a permanent marker and removed from the soil (Figures 53a). At this point, a shoe cast would be wrapped in paper and placed in an evidence box, without removing any remaining soil or debris (Figure 53b). In order to photograph what a final clean shoe cast looks like, dirt will be removed from the cast surface, and the cast will be allowed to air dry for four to five days. The rest of the dirt will be cleaned off with a dry toothbrush and water. (Figure 54). Figure 55 shows the shoe that corresponds to the initial impression in the soil.


Figure 50. Shoe impression in a soil/water mixture. A 9 x 15 inch tray used indoors to model the conditions for collecting shoe impression evidence (Saferstein 2007, Young 2002).

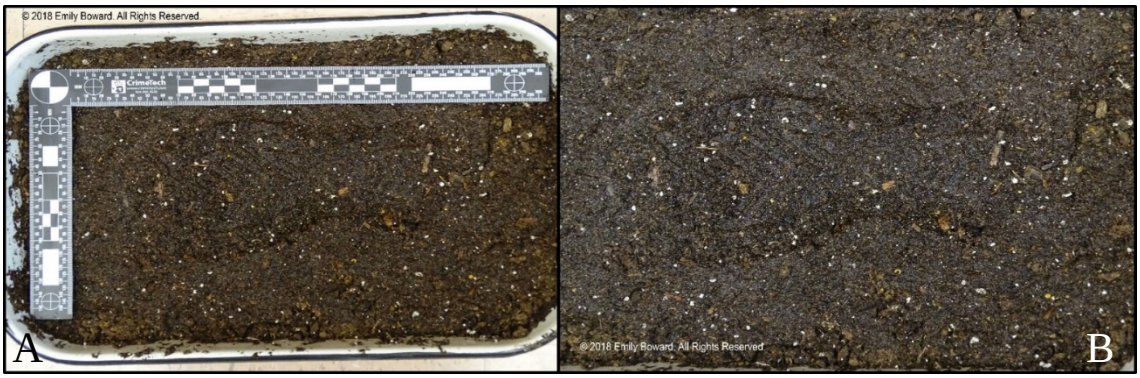



Figure 51. Shoe impression in soil/water mixture. A. With a measuring scale. B. Without a measuring scale. Both types of photographs need to be taken and submitted as evidence during a crime scene investigation (VDFS 2017).


Figure 52. Plaster of Paris mixture poured onto shoe impression.


Figure 53. Hardened shoe cast. A. Labeled with the investigator, date, case and evidence numbers. B. Dirt and debris should not be removed from the underside of the cast, so as not to compromise the impression evidence (VDFS 2017).


Figure 54. Cleaned plaster shoe impression.
The sole pattern of the shoe in Figure 55 can be seen in this impression.


Figure 55. Sole tread of shoe used to make impression in soil.

*Shoe Cast Protocol*

Supplies: Outdoor area with dirt, Plaster of Paris or dental stone, water, measuring cup, large zip lock plastic bag, measuring scale, gloves, camera (Saferstein 2007, VDFS 2017, Warrington 2015, Young 2002).

**In the event of rain, potting soil and large trays can be used to perform the lab activity indoors (Saferstein 2007, Young 2002).**

**Each student should follow this protocol and cast at least two separate shoe prints.**

1. Make shoe print into the dirt (~ ½ inch in depth) (Saferstein 2007).
2. Photograph the shoe print with and without a measuring scale (VDFS 2017).
3. Measure 5 cups of plaster or dental stone into the large bag, add water and mix up the solution, until the mixture is like pancake batter. Be sure to dissolve all clumps (Saferstein 2007, VDFS 2017).
4. Pour the mixture into the print by pouring beyond the edge of the print. This will allow the mixture to flow into the print (Warrington 2015).
5. The mixture should be ~1 inch in depth (Warrington 2015).
6. Label into the wet mixture examiner's initials, date, case number, and evidence number (Warrington 2015, VDFS 2017), OR write this information on the dry plaster with a permanent marker (VDFS 2017).
7. Wait for the mixture to fully dry, then lift it off the print. Dig around the sides of the plaster to help release it from the dirt and also help prevent it from cracking (VDFS 2017).

**Aim 3: Preparing Textbook/Laboratory Manual (Months 10-12)**

Microsoft Word and Adobe InDesign will be used to format and compile the finished textbook. First, the book chapters will be typed in Word documents, then saved and imported into InDesign. Photographs will be annotated in Adobe Photoshop, and either formatted as contact sheets in Photoshop (Figure) or arranged in a Word document or on a PowerPoint slide. These too will be imported into InDesign for the final compilation of the text. Figure 56 shows a screenshot of the InDesign software. Once the final copy is proofread and edited, a representative from Academx Publishing Services will be contacted and sent the manuscript. The textbook will be assigned an ISBN number (ISBN-13: 978-1-68284-074-0), sent to press, and will be available for sale.

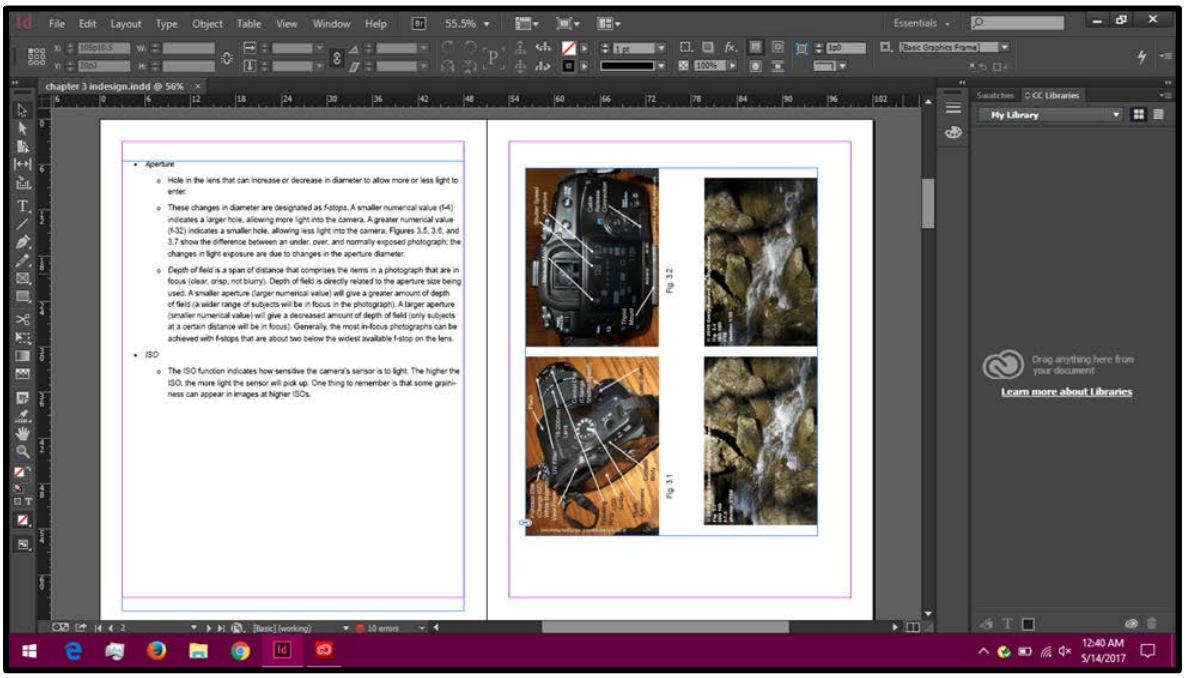



Figure 56. Screenshot of textbook layout in Adobe InDesign.

**Aim 4: Assessing Course Success (Months 12-13)**

A set of standard questions will be selected from the course material and compiled into a multiple choice exam that will serve as a pre and post assessment exam. Students would be given the exam the first day of class and then again as part of their final exam. On the first day of class, students would be instructed that the assessment was a mandatory part of the course, so they would take the assignment seriously. It could be partially weighted or extra credit could be assigned to it, so that it would not dramatically affect the students' grades. In this way, a base-line of knowledge would be established and then compared to the results at the end of the course.

Each question will fall into one of the main categories in the developed curriculum, and each question will match one of the six Core Learning Outcomes listed on the syllabus (Table 3). Students would fill out their answers on a ParScore™ red scantron. Figure 57 shows the answer key for the pre/post exam. Students' answers to individual questions as well as the total exam grade would be compared for the pre and post exams. The ParScore™ software allows item analysis to be completed for each question on an exam (Scantron Corporation 2011). Item analysis uses statistical methods to provide quantitative data about the exam's effectiveness and the students' performance on the exam (Scantron Corporation 2011). The results provide insight into a question's level of difficulty, whether a question has effective distractor answers, and how well a question discriminates between students who have grasped the curriculum content and those who have not (Figure 58) (Scantron Corporation 2011).

Additionally, a right-one-tailed dependent t-test would be used for statistical analysis of the exam scores. Sorby and Baartmans (2000) used dependent t-tests to analyze

scores from pre and post test assessments for engineering curriculum. The alternative hypothesis to be tested would be that students' knowledge would improve when assessed with the pre/post exam. Concurrently, the null hypothesis to be tested would be that students' learning would not improve. The one-tailed t-test allows for comparison of data pairs and if the difference between those pairs is statistically significant (from zero) (KSU 2018, McDonald 2014). A significance level (alpha value) must be chosen; this is the percentage of risk that it would be incorrect to reject the null hypothesis (Rees 2001). The differences between each pair are averaged, and the standard deviation is calculated (Kahn Academy 2018, Rees 2001). From these calculations, the test statistic and right P value would be computed using a Microsoft Excel spreadsheet. Based on the P-value, the null hypothesis is either accepted or rejected (Penn State 2018).

In order to use the t-test, the sample differences being tested must be considered normally distributed; a larger sample size will help to ensure this (KSU 2018, Rees 2001). As an example of this analysis, paired data (pre and post test scores) will be generated with a sample size of 48. At FCC, the cap size of most science courses is 24 students. A similar data set could be obtained from two sections of the course in a single semester or one section taught in the Fall and one taught in the Spring. An alpha value of 0.05 will be chosen, meaning that there is a 5% chance that rejecting the null hypothesis would be incorrect (Rees 2001). The sample mean and the sample standard deviation will be calculated by hand by the formulas shown in Figure 59 (Kahn Academy 2018, Rees 2001) and inserted into the Excel spreadsheet (Figure 60). The spreadsheet will be obtained from a FCC Mathematics faculty member, and it will contain the formulas for calculating the test statistic and P values. In this example data, if the right-tail P value is less than the alpha

value of 0.05, the null hypothesis is rejected, and the alternative hypothesis is accepted, concluding that students did improve in their learning of the course material (Penn State 2018). Figure 61 shows the sample individual student pre and post test scores as a bar graph.

The Office of Planning, Assessment, and Institutional Research at Frederick Community College provides semester enrollment reports which include detailed profiling of the student population (Figure 62) (FCC 2018). This kind of information can be directly linked to the data retrieved from an assessment (2018 conversation with J Ashby, unreferenced). Students provide demographic data as well as academic goals when they register for classes (2018 conversation with J Ashby, unreferenced). By linking this data from PeopleSoft software, the exam results can be evaluated further in relation to students' academic and cultural aspects (2018 conversation with J Ashby, unreferenced).

## Conclusion

According to the four specific aims of this project, the proposed curriculum (*Forensic Science Techniques*), focusing on forensic techniques relating to crime scene investigation, will be successfully designed. Afterwards, a General Education Science Course proposal will be submitted to the FCC Curriculum Committee. While waiting for the course proposal acceptance, the *Forensic Science Techniques* curriculum will be incorporated into the current BI 130 Forensic Biology course at FCC. The new curriculum will supplement the existing content in BI 130 and give students more experience with crime scene techniques. The *Forensic Science Techniques* curriculum will be shared with other professionals at the United States Secret Service; the United States Capitol Police; and local Maryland high schools: Linganore High School (Frederick, MD), Tuscarora High School (Frederick, MD) , Frederick County Career & Technology Center (Frederick, MD), and Towson High School (Towson, MD).

## Questions for Pre and Post Assessment Exam

1. What is the definition of forensic science?
    a. Application of police work to the law.
    b. Application of science to the law.
    c. Conducting crime scene investigations.
    d. None of the above.

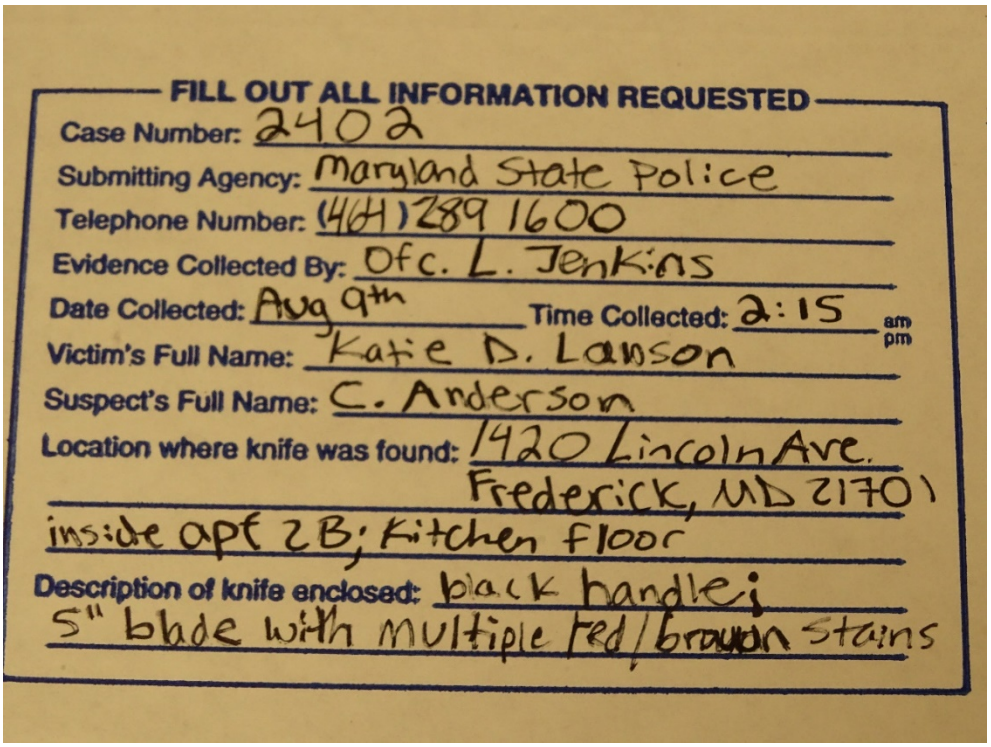
2. Which of these is NOT an example of physical evidence?
    a. Firearm.
    b. Bloody fingerprint.
    c. Eyewitness testimony.
    d. All of these are examples of physical evidence.
    e. None of these are examples of physical evidence.

3. Which of these should a first responder NEVER do at a crime scene?
    a. Move the body.
    b. Smoke a cigarette.
    c. Close an open window.
    d. Use the restroom.
    e. All of the above.

4. What are the five types of physical evidence?
    a. Transient, Pattern, Experimental, Transfer, Latent.
    b. Transient, Pattern, Conditional, Transfer, Associative.
    c. Latent, Experimental, Conditional, Facultative, Associative.
    d. Pattern, Experimental, Latent, Facultative, Associative.

5. What is the proper packaging protocol for a knife?
    a. Secured in a properly labeled paper bag.
    b. Secured in a properly labeled plastic bag.
    c. Secured with zip-ties in a properly labeled box.
    d. Any of these methods are acceptable.

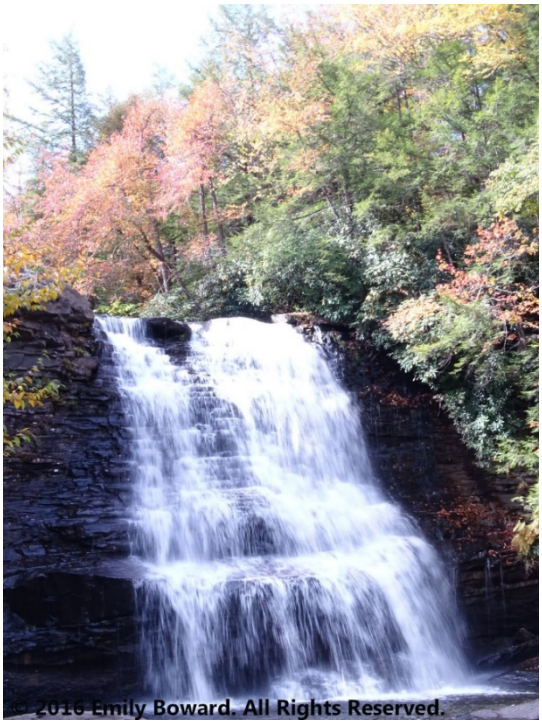
6. What is incorrect in the following evidence label?



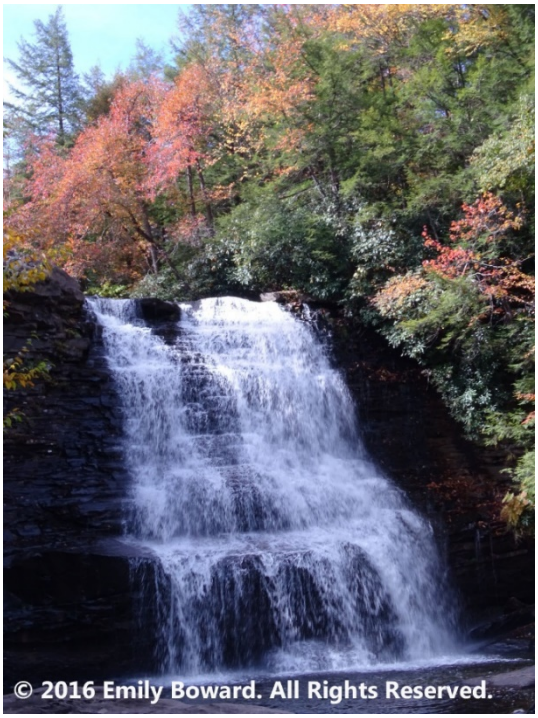

a. Time.
b. Date.
c. Suspect Name.
d. A and B.
e. All of these.

7. Which of these is NOT a rule of crime scene photography?
    a. Never delete any photographs from the camera or memory card.
    b. In general, horizontal orientation provides a better overview of the crime scene.
    c. Always wear gloves when handling any object in the crime scene.
    d. Always photograph a piece of evidence before and after processing.
    e. All of these are rules of crime scene photography.

8. Which of these photographs has a high shutter speed?




A




B

9. Which of these photographs has the lowest f-stop number?


A


B


C

10. What are the six types of search patterns used to look for evidence?
    a. Quadrant, Wheel, Line, Spiral, Grid, Link.
    b. Quadrant, Circle, Line, Chart, Grid, Link.
    c. Circle, Wheel, Chart, Spiral, Square.
    d. Circle, Wheel, Line, Chart, Square.

11. Which of these should be in a crime scene sketch?
    a. North Directional.
    b. Case Number.
    c. Date.
    d. Items and their Measurements.
    e. All of the above.

12. What are the four categories of fingerprints?
    a. Visible, Invisible, Plastic, Latent.
    b. Wet, Dry, Invisible, Plastic.
    c. Wet, Invisible, Metallic, Latent.
    d. Visible, Wet, Plastic, Latent.

13. What powder is used to lift a fingerprint from a dark colored glass-top table?
    a. Black Powder.
    b. White or Gray Powder.
    c. Oxide Powder.
    d. Magnetic Powder.

14. Who conducts autopsies to determine the cause, manner, and mode of death?
    a. Crime Scene Investigator.
    b. Detective.
    c. Medical Examiner.
    d. Prosecutor.

15. Which of these is often used to determine the time of death, as it occurs 36-48 hours after death?
    a. Livor Mortis
    b. Bloating
    c. Rigor Mortis
    d. None of these.

16. What wavelength range does an ALS use?
    a. 300-325nm.
    b. 650-850nm.
    c. 275-310nm.
    d. 450-475nm.

17. Which of these chemicals produces a green colored product when in contact with blood?
    a. TMB.
    b. Phenolphthalein.
    c. Luminol.
    d. None of the above.

18. What bodily fluid stain is shown here?


    a. Urine.
    b. Blood.
    c. Semen.
    d. Saliva.

19. Which of these is NOT a division of a crime laboratory?
    a. Toxicology.
    b. Trace Evidence.
    c. Biology/Serology.
    d. Chemistry/Drug Analysis.
    e. All of these are crime lab divisions.

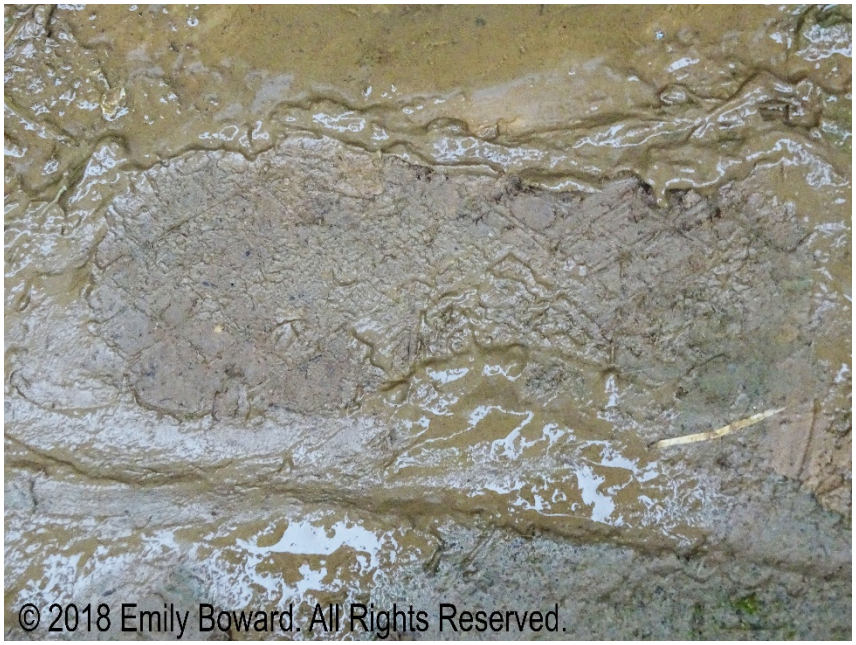
20. What instrument is used to identify an unknown chemical compound?
    a. Compound Microscope.
    b. FTIR Spectrometer.
    c. Electrophoresis Chamber.
    d. Magnetic Resonance Imaging Scanner.

21. Who provides the jury with relevant information based on particular knowledge and skills?
    a. Detective.
    b. Attorney.
    c. Expert Witness.
    d. Judge.

22. Which of these are helpful tips when testifying in court?
    a. Dress professionally.
    b. Use good posture.
    c. Look at the jury when responding to a question.
    d. Have your notes/documents with you on the stand.
    e. All of these are helpful tips.

23. You have testified in court, but later realize you made a mistake. You should…
    a. Call the attorney who asked you to testify and explain that you made a mistake in your testimony.
    b. Not worry about it.
    c. Report to court the next day and ask to re-testify.
    d. All of these are acceptable.
    e. None of these are acceptable.

24. As a crime scene investigator, you find this shoe impression at the scene. What do you do first?




a. Photograph the impression.
b. Pour a plaster mixture onto the impression to make a cast.
c. Document in writing the location and description of the impression.
d. A and C.
e. Look for the matching shoe.

25. Which of these is a proper technique for handling shoe cast evidence?
a. Clean off the dirt and debris from the cast surface.
b. Package in a secure box.
c. After 15 minutes, lift the cast out of the ground.
d. All of these are acceptable.
e. None of these are acceptable.

Table 3. Pre/post exam questions and correlating curriculum categories and course learning outcomes.

| Question | Category | CLO |
|---|---|---|
| 1 | Intro/Scene Security | Apply scientific reasoning |
| 2 | Evidence Collection | Apply scientific reasoning |
| 3 | Intro/Scene Security | Apply scientific reasoning |
| 4 | Evidence Collection | Apply scientific reasoning |
| 5 | Evidence Collection | Apply scientific reasoning |
| 6 | Evidence Collection | Demonstrate critical thinking skills |
| 7 | Crime Scene Photography | Apply scientific reasoning |
| 8 | Crime Scene Photography | Demonstrate critical thinking skills |
| 9 | Crime Scene Photography | Demonstrate critical thinking skills |
| 10 | Evidence Collection | Apply scientific reasoning |
| 11 | Documentation and Sketching | Apply scientific reasoning |
| 12 | Documentation and Sketching | Apply scientific reasoning |
| 13 | Fingerprint Lifting | Apply scientific reasoning |
| 14 | Pathology and Death Assessment | Apply scientific reasoning |
| 15 | Pathology and Death Assessment | Apply scientific reasoning |
| 16 | Presumptive Testing | Demonstrate quantitative problem solving |
| 17 | Presumptive Testing | Apply scientific reasoning |
| 18 | Presumptive Testing | Demonstrate critical thinking skills |
| 19 | Crime Laboratory Methods | Apply scientific reasoning |
| 20 | Crime Laboratory Methods | Apply scientific reasoning |
| 21 | Expert Testimony | Apply scientific reasoning |
| 22 | Expert Testimony | Apply scientific reasoning |
| 23 | Expert Testimony | Understand, interpret, and apply academic, professional, and civil ethics |
| 24 | Footwear Impressions | Demonstrate quantitative problem solving |
| 25 | Footwear Impressions | Apply scientific reasoning |

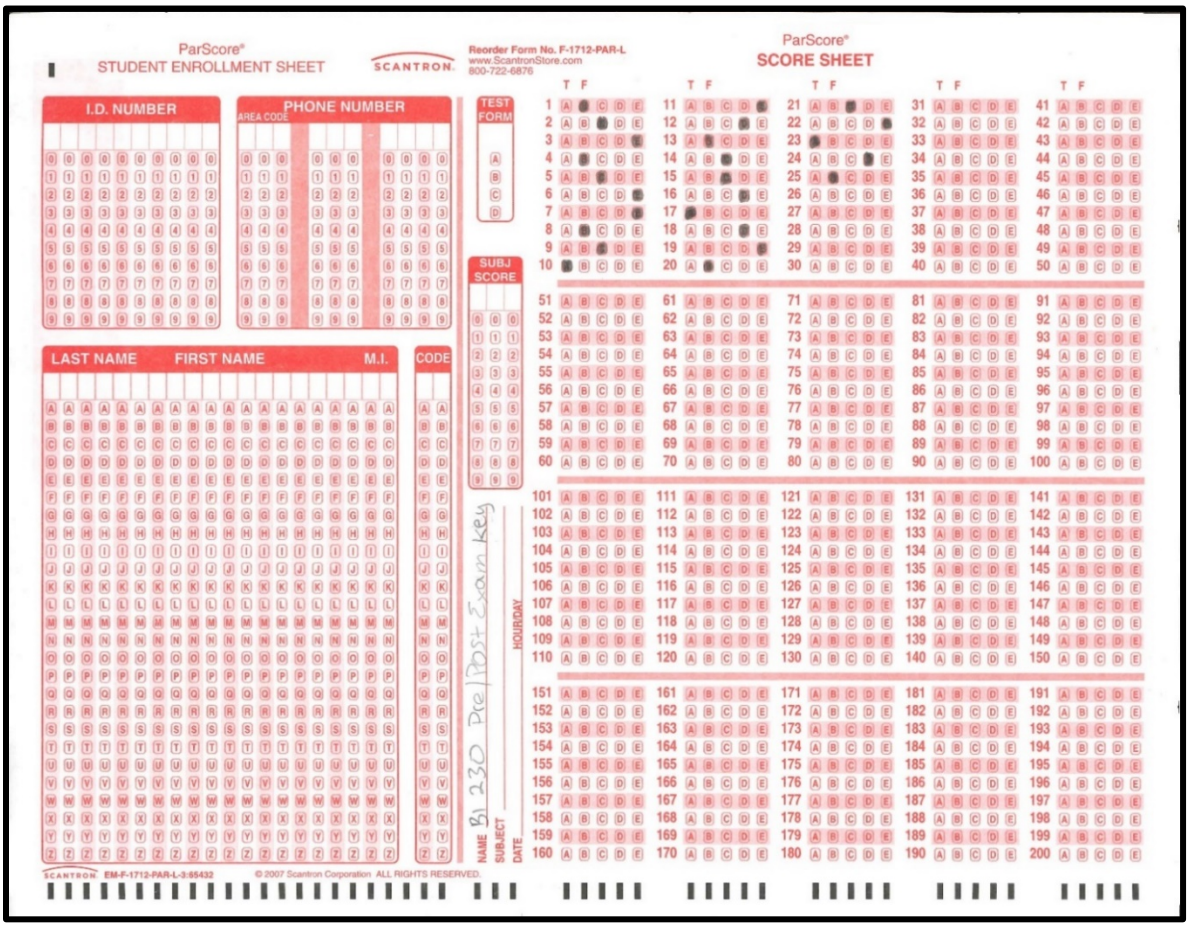
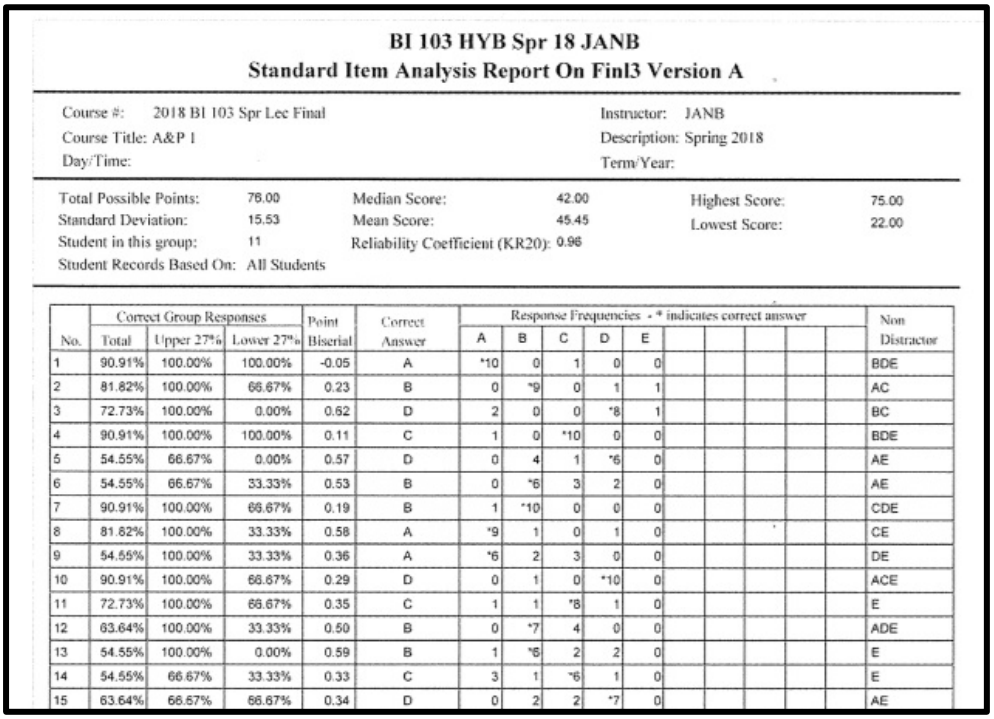



Figure 57. Pre/post exam answer key on ParScore™ red scantron.

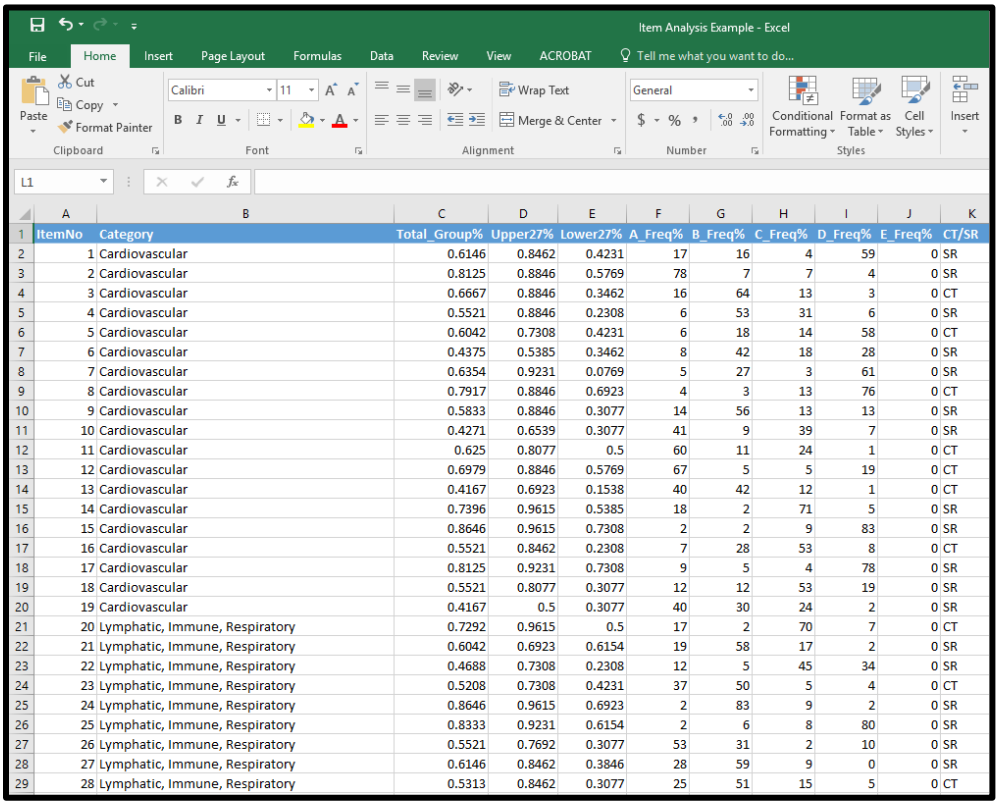


**BI 103 HYB Spr 18 JANB**
**Standard Item Analysis Report On Finl3 Version A**

Course #: 2018 BI 103 Spr Lec Final
Course Title: A&P I
Day/Time:
Instructor: JANB
Description: Spring 2018
Term/Year:

Total Possible Points: 76.00
Standard Deviation: 15.53
Student in this group: 11
Student Records Based On: All Students
Median Score: 42.00
Mean Score: 45.45
Reliability Coefficient (KR20): 0.96
Highest Score: 75.00
Lowest Score: 22.00

| No. | Correct Group Responses Total | Upper 27% | Lower 27% | Point Biserial | Correct Answer | Response Frequencies - * indicates correct answer A | B | C | D | E | Non Distractor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 90.91% | 100.00% | 100.00% | -0.05 | A | *10 | 0 | 1 | 0 | 0 | BDE |
| 2 | 81.82% | 100.00% | 66.67% | 0.23 | B | 0 | *9 | 0 | 1 | 1 | AC |
| 3 | 72.73% | 100.00% | 0.00% | 0.62 | D | 2 | 0 | 0 | *8 | 1 | BC |
| 4 | 90.91% | 100.00% | 100.00% | 0.11 | C | 1 | 0 | *10 | 0 | 0 | BDE |
| 5 | 54.55% | 66.67% | 0.00% | 0.57 | D | 0 | 4 | 1 | *6 | 0 | AE |
| 6 | 54.55% | 66.67% | 33.33% | 0.53 | B | 0 | *6 | 3 | 2 | 0 | AE |
| 7 | 90.91% | 100.00% | 66.67% | 0.19 | B | 1 | *10 | 0 | 0 | 0 | CDE |
| 8 | 81.82% | 100.00% | 33.33% | 0.58 | A | *9 | 1 | 0 | 1 | 0 | CE |
| 9 | 54.55% | 100.00% | 33.33% | 0.36 | A | *6 | 2 | 3 | 0 | 0 | DE |
| 10 | 90.91% | 100.00% | 66.67% | 0.29 | D | 0 | 1 | 0 | *10 | 0 | ACE |
| 11 | 72.73% | 100.00% | 66.67% | 0.35 | C | 1 | 1 | *8 | 1 | 0 | E |
| 12 | 63.64% | 100.00% | 33.33% | 0.50 | B | 0 | *7 | 4 | 0 | 0 | ADE |
| 13 | 54.55% | 100.00% | 0.00% | 0.59 | B | 1 | *6 | 2 | 2 | 0 | E |
| 14 | 54.55% | 66.67% | 33.33% | 0.33 | C | 3 | 1 | *6 | 1 | 0 | E |
| 15 | 63.64% | 66.67% | 66.67% | 0.34 | D | 0 | 2 | 2 | *7 | 0 | AE |



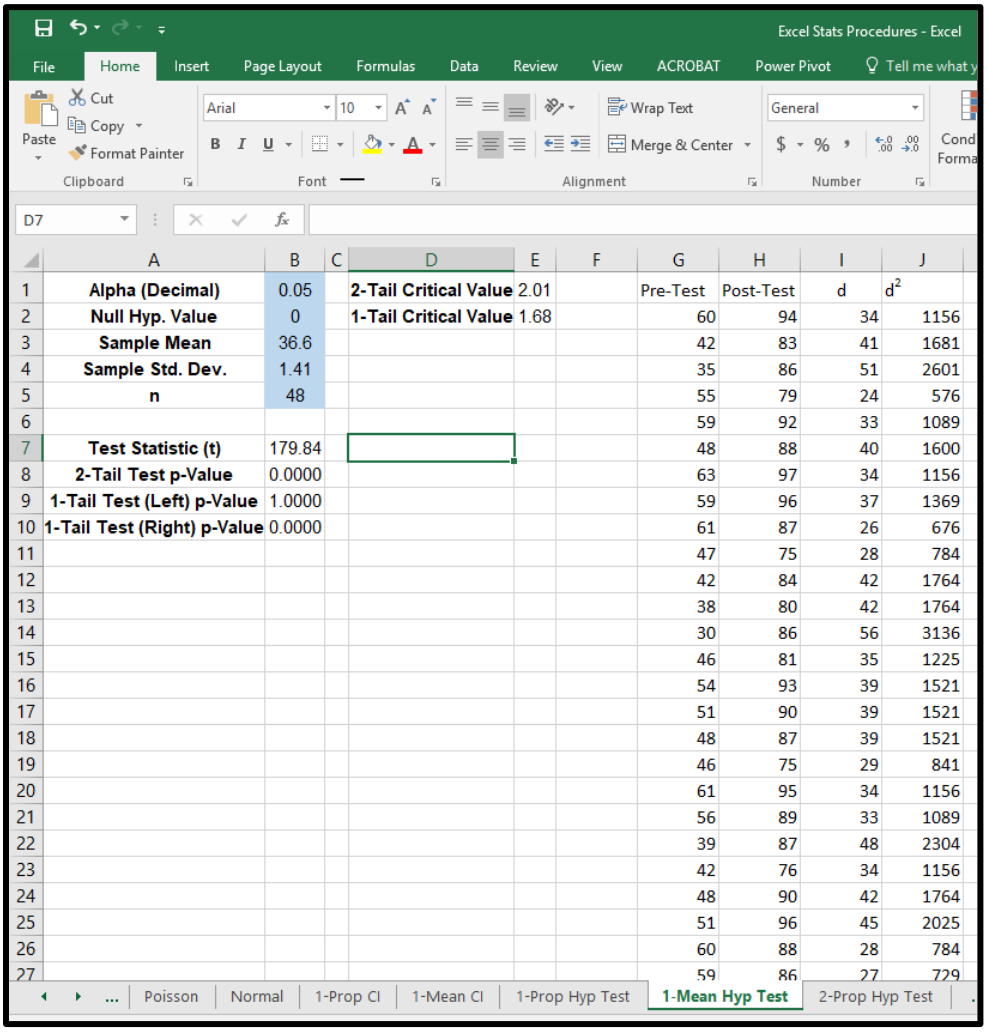
Item Analysis Example - Excel

| ItemNo | Category | Total_Group% | Upper27% | Lower27% | A_Freq% | B_Freq% | C_Freq% | D_Freq% | E_Freq% | CT/SR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cardiovascular | 0.6146 | 0.8462 | 0.4231 | 17 | 16 | 4 | 59 | 0 | SR |
| 2 | Cardiovascular | 0.8125 | 0.8846 | 0.5769 | 78 | 7 | 7 | 4 | 0 | SR |
| 3 | Cardiovascular | 0.6667 | 0.8846 | 0.3462 | 16 | 64 | 13 | 3 | 0 | CT |
| 4 | Cardiovascular | 0.5521 | 0.8846 | 0.2308 | 6 | 53 | 31 | 6 | 0 | SR |
| 5 | Cardiovascular | 0.6042 | 0.7308 | 0.4231 | 6 | 18 | 14 | 58 | 0 | CT |
| 6 | Cardiovascular | 0.4375 | 0.5385 | 0.3462 | 8 | 42 | 18 | 28 | 0 | SR |
| 7 | Cardiovascular | 0.6354 | 0.9231 | 0.0769 | 5 | 27 | 3 | 61 | 0 | SR |
| 8 | Cardiovascular | 0.7917 | 0.8846 | 0.6923 | 4 | 3 | 13 | 76 | 0 | CT |
| 9 | Cardiovascular | 0.5833 | 0.8846 | 0.3077 | 14 | 56 | 13 | 13 | 0 | SR |
| 10 | Cardiovascular | 0.4271 | 0.6539 | 0.3077 | 41 | 9 | 39 | 7 | 0 | SR |
| 11 | Cardiovascular | 0.625 | 0.8077 | 0.5 | 60 | 11 | 24 | 1 | 0 | CT |
| 12 | Cardiovascular | 0.6979 | 0.8846 | 0.5769 | 67 | 5 | 5 | 19 | 0 | CT |
| 13 | Cardiovascular | 0.4167 | 0.6923 | 0.1538 | 40 | 42 | 12 | 1 | 0 | CT |
| 14 | Cardiovascular | 0.7396 | 0.9615 | 0.5385 | 18 | 2 | 71 | 5 | 0 | SR |
| 15 | Cardiovascular | 0.8646 | 0.9615 | 0.7308 | 2 | 2 | 9 | 83 | 0 | SR |
| 16 | Cardiovascular | 0.5521 | 0.8462 | 0.2308 | 7 | 28 | 53 | 8 | 0 | CT |
| 17 | Cardiovascular | 0.8125 | 0.9231 | 0.7308 | 9 | 5 | 4 | 78 | 0 | SR |
| 18 | Cardiovascular | 0.5521 | 0.8077 | 0.3077 | 12 | 12 | 53 | 19 | 0 | SR |
| 19 | Cardiovascular | 0.4167 | 0.5 | 0.3077 | 40 | 30 | 24 | 2 | 0 | SR |
| 20 | Lymphatic, Immune, Respiratory | 0.7292 | 0.9615 | 0.5 | 17 | 2 | 70 | 7 | 0 | CT |
| 21 | Lymphatic, Immune, Respiratory | 0.6042 | 0.6923 | 0.6154 | 19 | 58 | 17 | 2 | 0 | SR |
| 22 | Lymphatic, Immune, Respiratory | 0.4688 | 0.7308 | 0.2308 | 12 | 5 | 45 | 34 | 0 | SR |
| 23 | Lymphatic, Immune, Respiratory | 0.5208 | 0.7308 | 0.4231 | 37 | 50 | 5 | 4 | 0 | CT |
| 24 | Lymphatic, Immune, Respiratory | 0.8646 | 0.9615 | 0.6923 | 2 | 83 | 9 | 2 | 0 | SR |
| 25 | Lymphatic, Immune, Respiratory | 0.8333 | 0.9231 | 0.6154 | 2 | 6 | 8 | 80 | 0 | SR |
| 26 | Lymphatic, Immune, Respiratory | 0.5521 | 0.7692 | 0.3077 | 53 | 31 | 2 | 10 | 0 | SR |
| 27 | Lymphatic, Immune, Respiratory | 0.6146 | 0.8462 | 0.3846 | 28 | 59 | 9 | 0 | 0 | SR |
| 28 | Lymphatic, Immune, Respiratory | 0.5313 | 0.8462 | 0.3077 | 25 | 51 | 15 | 5 | 0 | CT |

Figure 58. Item analysis data from ParScore™. These data sheets are examples of item analysis done for an FCC Anatomy and Physiology course.

$$\bar{d} = \frac{\sum d}{n} \text{ and } s_d = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}} \text{ and Calc t} = \frac{\bar{d}}{\frac{s_d}{\sqrt{n}}}$$

Figure 59. Sample mean (d), sample standard deviation ($s_d$), and test statistic (Calc t) formulas used for the right-one-tailed t-test analysis (from Rees 2001).




| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Alpha (Decimal)** | 0.05 | | **2-Tail Critical Value** | 2.01 | | Pre-Test | Post-Test | d | $d^2$ |
| 2 | **Null Hyp. Value** | 0 | | **1-Tail Critical Value** | 1.68 | | 60 | 94 | 34 | 1156 |
| 3 | **Sample Mean** | 36.6 | | | | | 42 | 83 | 41 | 1681 |
| 4 | **Sample Std. Dev.** | 1.41 | | | | | 35 | 86 | 51 | 2601 |
| 5 | **n** | 48 | | | | | 55 | 79 | 24 | 576 |
| 6 | | | | | | | 59 | 92 | 33 | 1089 |
| 7 | **Test Statistic (t)** | 179.84 | | | | | 48 | 88 | 40 | 1600 |
| 8 | **2-Tail Test p-Value** | 0.0000 | | | | | 63 | 97 | 34 | 1156 |
| 9 | **1-Tail Test (Left) p-Value** | 1.0000 | | | | | 59 | 96 | 37 | 1369 |
| 10 | **1-Tail Test (Right) p-Value** | 0.0000 | | | | | 61 | 87 | 26 | 676 |
| 11 | | | | | | | 47 | 75 | 28 | 784 |
| 12 | | | | | | | 42 | 84 | 42 | 1764 |
| 13 | | | | | | | 38 | 80 | 42 | 1764 |
| 14 | | | | | | | 30 | 86 | 56 | 3136 |
| 15 | | | | | | | 46 | 81 | 35 | 1225 |
| 16 | | | | | | | 54 | 93 | 39 | 1521 |
| 17 | | | | | | | 51 | 90 | 39 | 1521 |
| 18 | | | | | | | 48 | 87 | 39 | 1521 |
| 19 | | | | | | | 46 | 75 | 29 | 841 |
| 20 | | | | | | | 61 | 95 | 34 | 1156 |
| 21 | | | | | | | 56 | 89 | 33 | 1089 |
| 22 | | | | | | | 39 | 87 | 48 | 2304 |
| 23 | | | | | | | 42 | 76 | 34 | 1156 |
| 24 | | | | | | | 48 | 90 | 42 | 1764 |
| 25 | | | | | | | 51 | 96 | 45 | 2025 |
| 26 | | | | | | | 60 | 88 | 28 | 784 |
| 27 | | | | | | | 59 | 86 | 27 | 729 |

Figure 60. Screenshot of Excel spreadsheet to be used to perform the right-one-tailed t-test on sample student pre and post test scores.

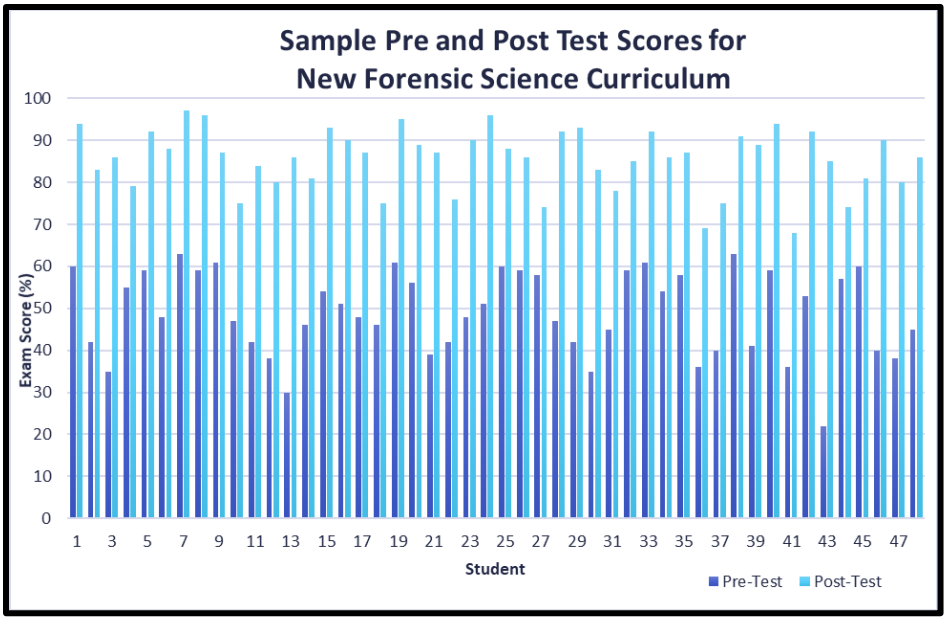



Figure 61. Bar graph of sample individual student pre and post test scores.

CREDIT STUDENT PROFILE REPORT
Frederick Community College
Fall 2014-2018

| | 2014 | 2015 | 2016 | 2017 | 2018 | % Change 2017-18 | % Change 2014-18 |
|---|---|---|---|---|---|---|---|
| **Total Credit Headcount (Unduplicated)** | 6,031 | 6,197 | 6,252 | 6,220 | 6,000 | -3.5% | -0.5% |
| **Total FTE** | 1,779.1 | 1,750.5 | 1,734.3 | 1,773.6 | 1,645.3 | -7.2% | -7.5% |
| *Eligible FTE* | *1,712.2* | *1,689.0* | *1,671.9* | *1,698.8* | *1,583.8* | *-6.8%* | *-7.5%* |
| *Ineligible FTE* | *66.9* | *61.6* | *62.4* | *74.8* | *61.5* | *-17.8%* | *-8.1%* |
| **Full-time** | 2,061 | 2,057 | 1,996 | 2,027 | 1,832 | -9.6% | -11.1% |
| *Percent of Total* | *34.2%* | *33.2%* | *31.9%* | *32.6%* | *30.5%* | | |
| **Part-time** | 3,970 | 4,140 | 4,256 | 4,193 | 4,168 | -0.6% | 5.0% |
| *Percent of Total* | *65.8%* | *66.8%* | *68.1%* | *67.4%* | *69.5%* | | |
| **Female** | 3,411 | 3,459 | 3,501 | 3,483 | 3,425 | -1.7% | 0.4% |
| *Percent of Total* | *56.6%* | *55.8%* | *56.0%* | *56.0%* | *57.1%* | | |
| **Male** | 2,620 | 2,738 | 2,751 | 2,737 | 2,575 | -5.9% | -1.7% |
| *Percent of Total* | *43.4%* | *44.2%* | *44.0%* | *44.0%* | *42.9%* | | |
| **Enrollment by Type** | | | | | | | |
| **Open Campus Students** | 338 | 300 | 231 | 226 | 241 | 6.6% | -28.7% |
| *Percent of Total* | *5.6%* | *4.8%* | *3.7%* | *3.6%* | *4.0%* | | |
| **High School Based Dual Enrollment** | 157 | 544 | 795 | 764 | 924 | 20.9% | 488.5% |
| *Percent of Total* | *2.6%* | *8.8%* | *12.7%* | *12.3%* | *15.4%* | | |
| **New Students** | 1,322 | 1,507 | 1,473 | 1,355 | 1,186 | -12.5% | -10.3% |
| *Percent of Total* | *21.9%* | *24.3%* | *23.6%* | *21.8%* | *19.8%* | | |
| **Returning Students** | 3,830 | 3,415 | 3,323 | 3,484 | 3,077 | -11.7% | -19.7% |
| *Percent of Total* | *63.5%* | *55.1%* | *53.2%* | *56.0%* | *51.3%* | | |
| **Transfer Students** | 175 | 194 | 194 | 182 | 369 | 102.7% | 110.9% |
| *Percent of Total* | *2.9%* | *3.1%* | *3.1%* | *2.9%* | *6.2%* | | |
| From 2-Year (N) | 35 | 21 | 28 | 20 | 44 | | |
| From 4-Year (N) | 140 | 173 | 166 | 162 | 325 | | |
| **Re-admitted Students*** | 209 | 237 | 236 | 209 | 203 | -2.9% | -2.9% |
| *Percent of Total* | *3.5%* | *3.8%* | *3.8%* | *3.4%* | *3.4%* | | |
| **Transfer Majors** | 4,134 | 4,384 | 4,408 | 4,345 | 4,330 | -0.3% | 4.7% |
| *Percent of Total* | *68.5%* | *70.7%* | *70.5%* | *69.9%* | *72.2%* | | |
| **Career Majors** | 1,628 | 1,513 | 1,484 | 1,488 | 1,308 | -12.1% | -19.7% |
| *Percent of Total* | *27.0%* | *24.4%* | *23.7%* | *23.9%* | *21.8%* | | |
| **Course of Interest** | 269 | 300 | 360 | 387 | 362 | -6.5% | 34.6% |
| *Percent of Total* | *4.5%* | *4.8%* | *5.8%* | *6.2%* | *6.0%* | | |
| **African American/Black** | 777 | 785 | 777 | 787 | 738 | -6.2% | -5.0% |
| *Percent of Total* | *12.9%* | *12.7%* | *12.4%* | *12.7%* | *12.3%* | | |
| **Native American** | 23 | 24 | 21 | 14 | 15 | 7.1% | -34.8% |
| *Percent of Total* | *0.4%* | *0.4%* | *0.3%* | *0.2%* | *0.3%* | | |
| **Hispanic** | 583 | 662 | 683 | 726 | 746 | 2.8% | 28.0% |

Figure 62. Example of enrollment report data from FCC (FCC 2018).

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