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Accelerated Creative Problem Solving and Product Improvement Applied to Experimental Devices in a Bloodstain Pattern Interpretation Class--Improving the Role of Insight Development Tools as a Generator of New Ideas in Novel Situations

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Accelerated Creative Problem Solving and Product Improvement Applied to Experimental Devices in a Bloodstain Pattern Interpretation Class—Improving the Role of Insight Development Tools as a Generator of New Ideas in Novel Situations

A Project
in Creative Studies
by
Douglas A. Ridolfi

Submitted in Partial Fulfillment
of the Requirements
for the Degree of
Master of Science

May 2018
Abstract of a Project

*Accelerated Creative Problem Solving and Product Improvement Applied to Experimental Devices in a Bloodstain Pattern Interpretation Class—Improving the Role of Insight Development Tools as a Generator of New Ideas in Novel Situations*

This project uses an action research centered study protocol to examine the effects of a problem-based learning exercise related to bloodstain pattern interpretation in a crime scene processing and general criminalistics class taught as part of an upper division forensic chemistry major in a four year college. The goal is to apply design principles and creative problem solving methods directly adapted to a project involving interpreting a set of crime scene photographs depicting blood spatter and with the aid of guided exercises in ideation and design, lead students into the development of alternate theories of how the bloodstains were created in the context of reconstructing a criminal event and how students can translate these ideas into the creation of processes and apparatus that replicate the flight dynamics of blood and injury patterns that lead to these shapes for the ultimate purpose of crime scene reconstruction, theory validation, and courtroom demonstration. The quality of the final projects will be based on a rubric that examines the novelty and scientific validity of the project based on creative product assessment protocols drawn from various sources. The assignments and final project success in inspiring student growth in the topic area of bloodstain pattern examination will be based on their scores in project creativity vs. their success in a pre- and post-examination related to bloodstain pattern principles. The role of corroboration, prototyping, insight development tools, and work space design, acceleration of the creative process and development of appropriate evaluation assessments of creative products will be part of the action research study. It is hoped that through this research, general methods of instruction may be developed that relate creative problem solving tools to generation of creative ideas in specific domain areas.

Key words: Prototype, insight, creativity tools, bloodstain patterns, problem-based learning.

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Date
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Dates of Approval

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Project Advisor: J. Michael Fox

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Candidate: Douglas A. Ridolfi
I would like to thank Dr. Susan Keller-Mathers who I initially approached and who helped me in the formative stages of this project development and provided guidance and examples in the improvement of suitable rubrics for my class model construction and re-enactment project for the re-production of bloodstain patterns. Her observation that this project might follow an action research model prompted me to learn more about this useful research methodology.

Creative Studies Department Chair, Dr. Gerard Puccio provided much needed advice on how this project might be useful for introducing project-based learning and creative methods into general science classes. Other recommendations such as the use of Basadur’s Divergent Thinking Assessment for the monitoring of any changes in divergent thinking before and after project completion were helpful suggestions along with thoughts on how insightful information could be garnered by critically observing students as they participated in exercises and created work products leading to the completion of their projects.

A fellow student, Melissa Miller, a distance graduate student in the Creative Studies, M.S. program from Genesee Community College Nursing Program, who I met in CRS 614 Advanced Cognitive Tools for Creative Problem Solving, alerted me to the role of medical moulage in nursing simulations and its use in enhancing realistic nursing training. This set me on a new path that may help me in the preparation of future classes and workshops where re-enactments and maximizing realism are important.

I have read with great interest the works of Dr. Ron Beghetto and his use of creativity in the classroom and I thank him for his comments on my project at the Creativity Expert Exchange Conference at Buffalo State on October 14, 2017 during my un-conference presentation related to accelerating creative problem solving. His general comments on speeding up creative thinking and the role of abductive reasoning in early creative thought development were very helpful.

My project research was greatly enabled thanks to the staff at Butler Library for obtaining numerous references and books from Interlibrary Loan. The Creative Studies Library provided a wealth of classic, foundational material for my study. Joseph Riggie from the reference library staff was kind enough to speak to my class and prepare a PowerPoint lecture related to library and Internet search of the patent literature both domestic and internationally.

My studies were continued thanks to my supervisor and Chemistry Department Director, M. Scott Goodman, Ph.D. for signing my UUP tuition funding requests to help defray costs throughout the three years that I have been taking classes in the master’s program in Creativity and Change Leadership and for his understanding about how creativity might enhance my future classes even in very conservative and domain-knowledge based areas as forensic chemistry.

Dr. John Cabra, although not directly involved in this project, introduced me to design thinking concepts and processes related to improvement of social conditions as part of his CRS 594 Design Thinking class. This provided the initial introduction into adapting design and creative problem solving into action based learning related to forensic chemistry. His abbreviated version of the adaption of the FourSight model to determine problem solving preferences was used to make a rough assessment of the
problem solving preferences of my students. Many of his slides were incorporated into Lab Lecture 1.

Support was provided by Gina Games at Buffalo State’s Institutional Review Board and I thank her for assistance in preparing and forwarding the paperwork necessary for this project’s IRB review. Her cooperation and that of her staff ensured a smoother approval process.

I cannot overlook the tremendous help Mike Fox, my faculty advisor, provided by stepping in during my final semester to provide oversight to my concluding project write-up. Our numerous discussions helped to keep this project grounded in creativity and the spirit that all instructional methods and most issues in life can be improved, if not solved, by creative problem solving methods.

In addition to the faculty, staff, and students of the International Center for Studies in Creativity at Buffalo State that I have not mentioned, and who contributed to my general education in creative problem solving methods, I would like to thank my students who were willing to try new instructional methods, to stretch their imaginations, and who made all of this research possible.
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SECTION ONE: BACKGROUND TO THE PROJECT

Project Purpose

Introduction

The purpose of this project is to use creative problem solving (CPS) tools to enhance ideation and design-based thinking and apply them to a highly specialized domain area—the interpretation of bloodstain patterns for the purposes of crime scene reconstruction. The tools are adapted from several areas of creative and design thinking and practice such as idea generation, problem solving, decision making, quality improvement and customer relations and have been incorporated into a forensic chemistry class devoted to introductory forensic science and crime scene investigation methods.

This section will cover a brief history of how the CPS process evolved at the International Center for Creative Problem Solving and the application of CPS methods to instruction in post-secondary environments. There were also statements of significance and specific questions that guided this study that will be outlined.

Historical Development of the Creative Problem Solving Model

The Creative Problem Solving Model, henceforth referred to as CPS, has evolved significantly over the past 50 years. The rise of CPS as a topic of special interest and its use in business and educational setting began with the work of Alex Osborn—an advertising executive who recognized that creativity could be taught and expressed his beliefs in his seminal publication, *Applied Imagination: Principles and Procedures of Creative Problem Solving* (1953).
Creativity has been defined in many ways but at its essence it is the ability to come up with novel solutions to practical problems. People not acquainted with the field often have the notion that creativity applies to the arts, creative writing and similar activities. Creativity is in fact applicable to any field of human endeavor. Creativity is not limited to exceptional individuals, but can be taught and applied to daily life situations as well as more complex problems.

The ideas generated must be novel—something that has not been thought of before but not so far fetched that they have no useful application. The ability to apply these novel ideas as part of a practical solution to a problem is the first step in innovation which is the successful application of these original ideas.

Although the observation and speculation of the creative process has been of interest to mankind for centuries, the serious study of creativity and methods of creative problem solving have been comparatively recent. Early studies of the creative process equated it with mythical properties that could not easily be understood or with thinking peculiarities that bordered on madness. John Dewey at the turn of the twentieth century developed a two-stage model of problem solving based on a state of doubt followed by an act of searching (Fox & Fox, 2010, p 126).

The first attempt to fathom the creativity thinking and problem solving process was in 1926 by Graham Wallas in his book, *The Art of Thought*. The first part of the process was what he termed “preparation” or the stage in which all aspects of the problem were investigated in a concentrated, intense, conscious fashion. The next part of the process was “incubation” in which aspects of the problem were not actively thought about. One would often engage in activity and thinking totally unrelated to the problem at
hand. The next step was “illumination” where solutions to the problem made an appearance at unexpected times. During the illumination stage there is a point that Wallas calls “intimation” when the new idea is rising to the state of consciousness. People would often be engaged in different activities or would be working in other, unrelated creative activities, when a solution to the problem would suddenly present itself. The final step would be “verification” in which parts of the problem, revealed through the illumination phase, would be addressed in more conscious though and one could use conventional problem solving to verify that the ideas represented viable solutions to the problem at hand (Wallas, 1926, p 40).

In addition to academicians, psychologists started to direct their attention to the study of creativity. An early advocate of its study was J.P. Guilford who began serious study of the creative person in 1950. As president of the American Psychological Association, he challenged its members to begin a thoughtful study of the creative process as this facet of psychological performance was lacking in the literature. Guilford’s Structure of the Intellect Model described the modes of thinking conducive to creative problem solving with a key component being the ability to use divergent thinking or the ability to come up with as many novel ideas as possible (Davis, 2004, 256).

One of the first codified processes for creative problem solving came from the non-academic world of advertising and business. Alex Osborn in his 1953 book, *Applied imagination: Principles and procedures of creative problem-solving*, described his problem solving process or Osborn’s Seven-Step CPS Process:
1. Orientation: Pointing out the problem.

2. Preparation: Gathering pertinent data.

3. Analysis: Breaking down the relevant material.

4. Hypothesis: Piling up alternatives by way of ideas.

5. Incubation: Letting up to invite illumination.


7. Verification: Judging the resulting ideas.

By the 1963 edition of his book, the creative problem-solving process had been reduced to the basics of (1) fact-finding, (2) idea-finding, and (3) solution-finding (Osborn, 1963, p 86).

Osborn recognized the importance of quantity in order to obtain quality, that is, one had to generate a lot of ideas in order to get useful ideas so he developed the concept of divergence or generation of many ideas through a process he termed “thinking up” which was later coined into the term “brainstorming” by his colleagues. The concept was first described in his 1948 book, *Your creative power: How to use imagination*. Many people in a group setting would submit ideas without criticism from the rest of the group regardless of how outlandish or unworkable they might sound. He would then select the most useful ideas through a process of critical evaluation or convergence. A key aspect of this process was to avoid criticism of any initial ideas. Just as one cannot drive a car simultaneously using the brakes and gas pedal, one cannot come up with novel ideas if each idea is being criticized immediately after it is brought up. There is a time for divergent thinking or coming up with as many ideas as possible, unrestrained and a time for convergence where these ideas are evaluated for suitability to the particular problem.
Another key aspect of the process is to build on other’s ideas even if they appear somewhat outlandish. For example, if one wants to learn a foreign language, one team member may suggest being born into a foreign language speaking family. Instead of dismissing the idea, one can think of ways by which one can create a similar experience, e.g. by hosting a foreign exchange student or having a pen pal in a foreign country.

Osborn wanted to apply creative problem setting to the academic environment and in 1954 formed the Creative Education Foundation at the University of Buffalo. In attendance at the first Creative Problem Solving Institute, Dr. Sidney Parnes from the University of Pittsburg began a long-term collaboration with Osborn.

Parnes gave academic credibility to Osborn’s model and the new Osborn-Parnes CPS model consisted of five steps:

1. Fact-finding
2. Problem-finding
3. Idea-finding
4. Solution-finding
5. Acceptance-finding

After Osborn’s death in 1966, Parnes continued to work on the creative problem solving model to make the process more transparent and generally applicable. A series of exercises were created for a Creative Studies Project that lead to the publication of the *Creative Behavior Workbook* by Sydney Parnes in 1967. In an insert as part of the book, it contained one of the first visual graphics of the CPS process.
Ruth Noller joined Sydney Parnes as the first faculty members for the new graduate classes taught at Buffalo State in Creative Studies starting in 1967. The same year the first research journal of its kind, *The Journal of Creative Behavior* was published by the Creative Education Foundation which had now moved to Buffalo State.

Parnes and others worked on the model and in 1976 developed another graphic

The model emphasized a linear approach that may not always be appropriate in problem solving but clearly outlined the role of Fact-finding (FF), Problem-finding (PF), Idea-finding (IF), Solution-finding (SF), and Acceptance-finding (AF). Parnes had added a
sixth step called objective finding or mess-finding at the beginning of the process. The process has been elaborated in other versions:

Fig. 3 The 1998 version of the Creative Problem Solving Model

The series of arrows highlighted the aspects of convergence and divergence that were important at each step. In 1985, the convergent and divergent aspects were further explained and the model was converted to a vertical format under the guidance of Dr.
Scott Isaksen and Donald Treffinger. In 1987, in order to make the model more workable, Isaksen and Treffinger organized the six CPS stages into three main components of Understanding the Problem (Mess-Finding, Data-Finding and Problem-Finding), Generating Ideas (Idea-Finding) and Planning for Action (Solution-Finding and Acceptance-Finding).
Isaksen and Treffinger in 1987 sought to make the CPS more explicit and flexible based on their consultation with clients in business and education. Recognizing the explicit roles of facilitator, client and resource group that Bill Shephard and Roger
Firestein elaborated on in 1981 it became important to explain the CPS process in plain language and support the issue of problem ownership. In educational settings, it became important to have a flexible format whereby students could apply CPS in ways that were meaningful to them.

The graphical approach to describing the CPS as a linear process came under scrutiny. Gregory Pershyn in his 1992 Master’s Thesis on *An Investigation into the Graphic Depictions of Natural Creative Problem Solving Processes* came to the conclusion that not all creative problem solvers used a linear model. Effective, natural problem solving took many different routes and Pershyn’s research suggested that the CPS model would be more universally applicable if it took into consideration some of these differences. As a result in 1993 the CPS model was modified substantially by Dr. Scott Isaksen and Brian Dorval.

![Components of CPS (v5.0)](image)

Fig. 5 Introducing an Iterative Process to Creative Problem Solving Model, Version 5.0
The new model suggested that problem solvers may not need all of the steps and that there may be several different routes to a solution. Metacomponents of Task Appraisal and Process Planning were added in 1994. From 1994-1995, Blair Miller, Jonathan Vehar and Roger Firestein continued to modify the process to make it easier to understand and used plain English.

In 2000 there were extensive changes to the CPS framework which included a Planning Your Approach aspect and more details such as Constructing Opportunities, Explaining Data, and Framing Problems to the Understanding the Problem/Challenge portion and addition of Developing Solutions and Building Acceptance to the Preparing for Action step. The CPS model now included productive thinking tools for generating and focusing options.

![CPS v6.1 Framework](image)

Fig 6. Incorporating Thinking Tools into the CPS Model, Version 6.1
The Plain Language CPS developed by Miller, Vehar, Firestein in 2004 used a series of Venn diagrams into which plain language explanations were placed with matching converging and diverging recommendations.

![Creative Process Diagram]

Fig. 7 Plain Language Model of CPS

In 2002, the Center for Creative Studies changes its name to the International Center for Studies in Creativity. Work continued on improving the CPS model.
In 2007, Gerald Puccio, Marie Mance, and Mary Murdock published *Creative leadership: Skills that drive change* and in this book they introduced the Thinking Skills Model.

The central part, *Assessing the Situation (Gather Data)* has three stages: *Clarification, Transformation* and *Implementation*. The cycle can be entered at any stage. Inside the cycle are six basic steps:

1. Explore the vision.
2. Formulating challenges.
3. Exploring ideas.
4. Formulating solutions.
5. Exploring acceptance.
6. Formulating a plan.

![Thinking Skills Model](image)

In 2001, *FourSight: The Breakthrough Thinking Profile* based on the work of Gerald Puccio, which looked at the link between creative problem solving and individual thinking preferences, was published. This research revealed that people have a preference for one or more thinking styles that creative problem solving requires. The FourSight test reveals an individuals’ preference as high or low for Clarifier, Ideator, Developer, or Implementer.
The four components of the FourSight model have been simplified to be more useful for students learning the creative problem solving method for the first time. They reflect the basic steps of Osborn’s original concept:

1. Fact-finding (clarify).

2. Idea-finding (ideate).


Fig 10. Visually Simplified Thinking Skills Model

This model was introduced in 2010 by Dorte Nielsen and Sarah Thurber to make a visual model for FourSight which makes CPS easier to teach and remember.

**The Role of Design Thinking and Prototype Development**

The use of design theory has a somewhat more varied history. What was initially grounded in engineering design has now seen applications in the resolution of difficult social issues. Like creative problem solving, design thinking relies on a number of tools and steps in how problems are approached. Many of the tools in design thinking are directly adapted from classic creative problem solving methods while others have been adapted or entirely new tools have been introduced to help with particular aspects of design thinking such as prototyping and design evaluation. Design thinking focuses heavily on the problem, the users and the end results (Kelley, 2013, p 77).

In carrying out design sessions in pursuit of a large project, the procedure can be broken down into a number of discrete sessions (Langford & McDonagh, 2003);
• Immersion or warm-up tools. These tools are used to create an effective, relaxed environment to promote discussion and idea generation to follow. These are tools designed to get users prepared in advance for a session. Methods include journaling, photo documentation and use of product work books.

• Problem analysis tools are more formal and systematic to promote deconstruction of complex situations before going on to find final solutions. The process uses tools for clarifying the problem and breaking it down into manageable parts.

• Idea generation and development tools. These are ideation tools to create new ideas and develop off of existing ones. Brainstorming methods would fall into this category. In design thinking there is often some type of hands-on activity such as two dimensional (layout) and three dimensional (form) modeling.

• Concept evaluation tools. These consist of tools that allow proposed solutions to be evaluated by participants. Some are informal and unstructured while some may involve numerical data analysis.

As with creative problem solving, the heart of the design thinking process is divergent thinking. Guilford summarized his set of creativity skills as:

• Fluency: The ability to generate a lot of ideas.

• Flexibility: The ability to generate diverse sets of ideas.

• Elaboration: The ability to elaborate on a given idea.

• Originality: The ability to generate ideas that had not been thought of before (Burnett & Keller-Mathers, 2017, p 286).

The lack of divergent thinking is probably the main bottleneck in the creative process. Most professionals tend to be hard thinkers, i.e. using logic, reason, being concerned with
precision, consistency, exact specifications, flow charts, focus, abstractness and the like.

The creative process requires soft thinking: metaphors, day dreaming, humor, acceptance of ambiguity, playfulness, heuristics, flights of fantasy, paradox, generalizations, analogies and related ideation for the generation of divergent thinking. Soft thinking tries to find similarities and connections among things to create novel concepts while hard thinking focuses on their differences (Vidal, 2006, p 2).

Assessment of Creative Products

In the early stages of creativity research, investigators sought to find a concise definition of the creative process. Mel Rhodes (1961) in his foundational article, An Analysis of Creativity, sought to find a universal definition of creativity. He came up with 56 criteria that could be used to study creativity that could be divided into four main elements. These was the Person or traits covering intelligence, personality, persistence, tolerance for ambiguity, free thinking, not concerned with social acceptance and general traits that separate creative people from the less creative. There was the Process or motivation, perception, domain knowledge, thinking styles and in general, the means by which one goes about being creative. There was the Product, or how these ideas are communicated to others in tangible form such as an invention, words, painting or some other material form. And there is Press or Place, i.e. the Environment in which creative work is done. This became known as the 4Ps (Fox & Fox, 2010, p 20).

Researchers studying creativity have realized that the true measure of a person’s creativity ability is by studying their creative product (MacKinnon, 1978, p 187). There have been a number of studies that have sought objective methods to assess creative
products, particularly those related to inventions and products of some commercial utility.

Westberg (1996, p 120) created an 11 item check list for the evaluation of student inventions related to a class she taught to students regarding creating inventions. The emphasis was on appraising student inventions for novelty, solution to a need, and degree of original thought, workability, and novel use of materials, promotional appeal and a reflection of good problem-finding ability. Her lesson plan for elementary school children consisted of (Westberg, 1996, pp. 257-258):

- **Lesson One:** Introduction to the process of inventing (develop an awareness of inventions and an appreciation for their contributions in everyday life).
- **Lesson Two:** Inventing Practice and Inventor’s Notebooks (to participate in inventing experiences and become acquainted with inventor’s notebooks and good record keeping).
- **Lesson Three:** Find a need or a want (the first step in the invention process; developing a “bug list” where students learn problem finding techniques and problem definition).
- **Lesson Four:** Think of solutions (students work on the second step of finding solutions).
- **Lesson Five:** Evaluate solutions (students develop skills in researching, elaboration and evaluating solutions).
- **Lesson Six:** Make a model or prototype (develops skills in prototyping, learn to use tools and where to go for technical assistance).
• Lesson Seven: Name the invention (learn the methods use to name and market their inventions).

• Lesson Eight: Share the invention (communicate and share the invention with others). In my exercises with student in product development for the validation of bloodstain patterns, students would “promote” their devices by their ability to explain its operation to a lay jury, explain how the apparatus would mimic a physiological blood spatter-creating event and how to respond to criticisms from opposing experts.

Another student assessment for creative products was developed by Reis & Renzulli (1991, p 130). Although geared more generally toward creative products, not necessarily inventions, this grading scale looked at critical problem definition and focusing and level of use of resources including diversity and appropriateness of resources, logic, appeal to audience and overall assessments of product originality, student’s familiarity with the subject, care and attention to detail and how this would contribute to general knowledge.

I developed a grading rubric and general rubric for evaluation of the bloodstain pattern generating apparatus for the FOR 312 Chemistry & Criminalistics class in which this project was a part of the student’s grade. These two documents are found in the class syllabus, Appendix C, pages 116-117.

Susan P. Besemer has made one of the more comprehensive studies of product evaluation initially producing a Creative Product Analysis Scale as part of her master’s thesis research (Besemer, 1981, pp. 74-77). The foundation of this work is more fully explained in her book, *Creating Products in the Age of Design: How to Improve Your New Product Ideas!* (2006).
The core ideas for analyzing a product’s creativity are novelty (newness of process, materials and design), resolution (functionality, usefulness and workability of the product), and elaboration or synthesis (the stylistic attributes of the product). In any event, to be successful and marketable, the product must do three things: it must work well and fulfill a perceived need, it must be viewed as a way to improve the consumer’s life and it must be affordable (Besemer & O’Quin, 1984, p 115).

Additional considerations for a prototype model development deal with aspects of the products implementation. Here when a product is developed there are time constraints (can model variations be tested simultaneously or sequentially); legal and regulatory constraints, marketing constraints and performance constraints. Some of these considerations such as time constraints and the ability to test models of similar design may have some applicability as being able to determine which apparatus are not producing good results and can be abandoned.

With this research project, some modifications to the Creative Product Analysis Model would need to be made. Low cost, adaptability and simplicity, use of commonly available materials, portable and easy to set up would be logical considerations as part of the design appeal. My intention with this project was to develop student interest in perfecting their design to such an extent that they would want to develop the project as a marketable product for classes performing bloodstain pattern analysis within forensic science programs. To this end, lectures were developed to incorporate design theory and consumer marketing and evaluation along with creative problem solving applications related to bloodstain pattern interpretation and the design and validation of their proposed apparatus.
**Action Research and Problem-Based Instruction**

Action research is a relatively recent research endeavor where individuals being studied (often in an educational or social services environment) are part of the research team and can provide input that can push the research into new directions. Teachers take the position of professional problem solver. When identifying an area of research, one needs to consider the following criteria (Mills, 2018):

- The area of focus should be concerned with teaching and learning and be part of one’s own professional practice.
- This area of focus is within the investigator’s control.
- The area is something that one feels passionate about.
- The area of focus is an area that the teaching professional would like to change or improve.
- The research questions should be answerable given the researcher’s time and resources and expertise.
- The researcher needs to decide on an appropriate data collection method (qualitative, quantitative or both).
- Ethical questions that the researcher might face while conducting the study need to be resolved.
- Will the outcome of the study lead to some type of action?
- How will the proposed action be connected to the study’s data analysis and interpretation?

When the data gathering part of the research is completed, the write-up will provide some source of clarification and reflective thought and accurate expression.
With solid data, one can advocate for their position and hopefully the research and its conclusion will lead to some type of actionable result.

I felt that action research was a suitable approach to the problem-based learning exercises and lectures that I was designing for my experimental class. Many of the exercises were developed as the class progressed and as roadblocks to students’ understanding of key concepts were identified. This study was somewhat complicated by the non-traditional role some subjects such as bloodstain pattern interpretation take when presented in a classroom to students learning about the concepts for the first time as there has not been any previously published literature related to apparatus design in educational settings related to bloodstain pattern validation using creative problem solving methods. Details of each problem-based unit to be discussed later.

**The Role of Bloodstain Pattern Analysis in Crime Scene Reconstruction**

When individuals are engaged in violent behavior, blood is often shed and the distribution of blood at a crime scene can provide an investigator with information related to relative positions of suspects and victims, relative energy levels used to create wounds, number of blows struck, direction of strikes, sequencing of events and environmental changes blood may have been subjected to.

Forensic science procedures are relatively standardized with established standard operating procedures necessary to ensure, accurate, reproducible results that provide defensible results that will hold up in a court of law. Procedures and equipment are validated and standard operating procedures are created based on established scientific principles. There is relatively little room for creative activity and prototype development in many forensic practices. An area where there is room for ideation and creative
judgment is in the areas of criminal investigations and related aspects such as crime scene reconstruction. Even though there is an attempt to provide standardized methods, forensic science by its nature often involves the investigation of situations that have not been encountered before and hence the need for creative problem solving methods.

Aspects of crime scene reconstruction such as the analysis of photographs of bloodstain patterns, taken at a crime scene, present challenges to their proper interpretation. Forensic scientists need to be able to evaluate the subtle clues that may be in a photograph, correlate it with other information such as autopsy reports and crime scene reports and laboratory findings in other disciplines to come up with logical explanations as to what may have occurred.

Creativity comes in to play in terms of developing plausible scenarios of what may have transpired at the scene and finding ways to validate these hypotheses. Forensic scientists may need to develop a method to simulate the pattern found at a scene and relate this to their conception of what may have happened. Sometimes this validation effort in the distribution of bloodstains can be enhanced through the use of mechanical apparatus that can project blood onto a surface in a manner that roughly simulates the way a person would cause blood to be spattered when attacking another individual. Sometimes the prototype needs to address the mechanical aspect of projecting blood, but may also need to address the process of how the bloodstain pattern was created. This may involve considerations of impact force, directionality of blows, sequencing of events, and environmental changes. With bloodstain pattern analysis, therefore, one may need to develop methodologies that take in the process of how bloodstains are distributed about a scene as well as developing apparatus for the creation of a bloodstain pattern.
Students were provided individually with a set of four photographs and divided into three groups where the group was presented with a problem scenario that they would need to solve as a group. The individual photographs, the students were to evaluate on their own and I provided an initial consultation to help guide the students along and to assess how much they had done on their own. The 52 individual photographs and the two group photographs are illustrated in Appendix G, pages 224-228. The individual photographs are assembled from text books, the Internet and from my own cases when I was employed as a criminalist with the Los Angeles County Sheriff’s Department, Scientific Services Bureau. They illustrate a wide range of possible blood shedding events with some pictures illustrating a single bloodstain interpretation principle and other photographs more complex in nature. My goal with supplemental lectures was to use creative problem solving methods to complement the scientific methods of observation, experimentation and evaluation with ideation and envisioning multiple scenarios that might possible fit the bloodstain patterns left at a crime scene.

**Statement of Significance**

The flexibility of the CPS method and other problem solving and design tools has led to their applications in a number of fields. Parnes and Noller did a series of studies of the effectiveness of CPS methods in improving student creativity. A summary of their findings as outlined in their three part study suggested that creativity was improved when using applying their creativity tools to particular problems and puzzles in their workbooks (Parnes & Noller, 1974).

In view of the limitations of creativity assessment, is it possible that these limited scope tests that Parnes & Noller have used to justify an increase in activity are teaching to
the test and not measuring real creativity gains in specific domain areas? This can only be tested by looking at instruction in specific domain areas and developing a battery of creativity and ideation enhancing exercises based on CPS and design and prototyping principles specific for that domain area.

The problem solving aspects of many sciences is algorithmic based with established protocols and often a single correct answer. In fields such as physics, engineering, chemistry and forensic chemistry, this is particularly so.

The field of forensic science and criminal investigations uses rather prescriptive methodologies that limit ideation but work well to converge on a single suspect. How can one introduce creativity into such areas? Creativity in practical law enforcement can be characterized as avoiding premature closure. Current creativity assessments place a high premium on remaining open to new ideas in addition to idea fluency or number of responses to a given idea, idea originality or the uniqueness and usefulness of ideas, idea flexibility or the number and/or uniqueness of categories of responses to a given stimuli and elaboration or the extension of ideas within a specific category (Kaufman, et. al, 2008, p 13).

The purpose and significance of this project was to focus the creativity tools toward a specific prototype device and/or process to reproduce a bloodstain pattern given to the student as a photograph that documents the appearance of this stain at a particular time and location at a crime scene. Students were taking an upper division forensic chemistry class, FOR 312 Chemistry and Criminalistics. The class is a general introduction to crime scene processing and chemistry applicable to a number of forensic techniques, taught as the primary entry level course into the forensic chemistry series at
Buffalo State College. The class has topics in general forensics and modules in bloodstain pattern interpretation and accompanying lab exercises. Students went through a similar set of exercises and testing in Fall 2016 and the results of their performance were matched against a group of students in the Fall 2017 class with the same types of individual and group bloodstain pattern assignments but now supplemental by lectures related to problem solving and design theory and reconstruction relevant to the bloodstain pattern project and a series of intermediate exercises intended to assess and refine student creative problem solving skills directed specifically to enhancing creativity in the completion of the bloodstain pattern exercises. The lectures and interim exercises are listed in the Appendix and will be discussed individually later.

**Project Questions**

Specific questions that were initially contemplated for this study were:

- Will the successful completion of a device and/or process for interpretation of student bloodstain patterns lead to an elevation in test scores between a pre-test and final test at the end of the semester related to bloodstain pattern interpretation and will the superiority of the model be correlated with a greater final test score?

- Will the addition of exercises to enhance creative problem solving related to the bloodstain project enhance the creative aspects of the project beyond presentation of information related to bloodstain pattern interpretation?

- What visualization or other approaches can give direction to stalled idea generation without providing too many hints and how might questioning of students in discussion guide their ideation?
• What is more likely to result in the most creative design—the generation of a lot of simple designs and working models or concentration on one carefully crafted project?

• What is the effect of group vs. individual effort on project design and development?

• Can organized approaches such as intelligent fast failure or ideation methods lead to accelerated model production?

• How can the grading rubric be improved to reflect the model design and its relevance to the specific problem and can this rubric have general applicability for the evaluation of commercial science kits with an extension of Besemer’s Creative Product Analysis Model but geared toward grading items such as: simplicity, relevance to the scientific question, enhancement of understanding of the physical phenomenon and lesson (and the applicability of the design as an aid in explaining the scientific principles to others), comprehensiveness, ease of adaptability to different environments (such as the courtroom) which may have different levels of resources, etc.

• Are there aspects of work space design within the classroom that can be used to facilitate creative prototype development?

Definitions

Creativity research and bloodstain pattern interpretation and crime scene reconstruction, like any other specialized area of study, has developed its own vocabulary. The following is a list of key terms whose definitions are important for a better understanding of the goals of this project:
• Accelerated: Application of aids to speed up the creative problem solving process in arriving at a final, finished product.

• Active learning: Hands-on supplemental instruction beyond traditional lectures that permit students to engage in real-life applications that enhance knowledge and learning in specific domain fields.

• Bloodstain pattern: A static pattern on a surface that reflects the flight dynamics of blood in motion by which activities of participants in a blood letting event can be fixed in time.

• Constraints: Limitations that need to be considered when constructing a device in order to more accurately reflect the events that occurred at a scene (velocity, gravity, blood properties, etc.)

• Cues / clues: Hints, idea sheets, any demonstrable aid to help students jumpstart stalled ideas relating to their projects or forces them to consider alternate possibilities that can be explained by the same set of physical events.

• Creative Product Analysis Model: an instrument designed to evaluate a product based on its novelty or uniqueness, inventiveness and newness and functionality.

• Experimental devices: A device capable of interacting with blood to put blood in motion to simulate the actual physical event recorded in a crime scene photograph or on an object without using the actual weapon (e.g. generation of high speed blood spatter without the use of firearms).

• Insight development: Methods to study and enhance the utilization of that region of incubation just before the development of the “Aha!” moment in problem resolution.
• Job aids: Simplified instruction sheets and worksheets.

• Prototype: Experimental device may be several models before final form is adopted.

• Reconstruction: Based on physical evidence, determining past activities, events.

SECTION TWO: PERTINENT LITERATURE

Summary

This section describes literature that has been reviewed as part of the background development of this project. My literature review centered on assessments of creative products, the creative workplace, classic creativity literature, as it relates to thinking creatively and in particular the development of insight and various sources related to design thinking. As action research was a new research area for me, I looked at some background literature related to this process, especially as it relates to research in education.

The literature related to bloodstain pattern interpretation is rather specialized and the general mechanics of the reconstruction process and the development of apparatus to replicate bloodstain patterns is not something that has been addressed in this literature in a systematic way, particularly within an educational or training context. Some of the literature that was helpful came from unexpected areas. One of these areas was the specialty field in nursing education known as medical moulage. This is a full time discipline in many nursing programs where a practitioner creates medical simulations of injuries and clinical conditions that includes the simulation of blood, blood clots and other bleeding simulations to enhance the realism of training for medical professionals.

References related to basic logical constructs such as deductive, inductive and abductive thinking provided some insight into the generation of creative ideas. I had not appreciated the possibility of using abductive reasoning to come up with creative solutions but the reasoning process at its simplest, presents a problem or an observation and a method for determining whether or not a possible solution might work in that instance.

I also reviewed some of the work related to group dynamics. Students had two separate types of assignments; one where they worked independently of four bloodstain images of varying complexity and one where they worked in a group of three people to prepare an apparatus to create a bloodstain pattern or examined a more complex bloodstain pattern (multiple events happening, overlapping events, environmental alterations, etc.) presenting a generally wickeder type problem than in any individual photo in their individual projects. This arrangement was hoped to provide some insight into group dynamics and if multiple contributors of CPS novice students could successfully pull their mental resources and be in a position to tackle these more difficult projects. The literature reviewed was on general collaborative research as seen in academic environments.

Some of the literature was a little more difficult to assess or to find specific areas that might have special relevance to my research questions. The topic of accelerating ideation was a particularly difficult one to find material. There are business models such
as intelligent fast failure and models where group problem solving is reduced in time frames but nothing that revealed a novel way of speeding up insight and ideation. Acceleration of ideation in the literature was centered on reducing the time for the various CPS components and methods such as accelerated fast failure. A standard reference in the area of fast failure is Jack V. Matson (1991) *How to Fail Successfully: A Bold Approach to Meeting Your Goals through Intelligent Fast Failure*.

A related problem, getting over mental ruts was also short of literature but this problem is somewhat related to methods for ideation acceleration as a stumped idea could lead to excessive delays in problem solving. Here, a combination of literature review and some personal insight can lead to ways to overcome mental blocks, many of which are domain specific.

There was additional literature that was looked at such as the role of play in ideation, and various modes of research design theory with no particular end in mind. All aspects of the design process were looked at including marketing and customer satisfaction as it was felt that these bloodstain re-enactments would eventually find themselves going to court to present local reconstructions based off the attempted simulations. Hand-in-hand with methods of ideation, was the introduction of ideation tool kits and scenarios that would help create cooperative design thinking in students when they worked in groups for their individual projects and when given time to work on their group projects.
Review of the Relevant Literature

One of the most common types of evidence in crimes of violence is the presence of blood. Blood is not deposited randomly but often forms a pattern that can be used to recreate positions of victims and assailants, their actions and other aspects of the scene events that may be helpful in a reconstruction of what took place (James, Kish & Sutton, 2005).

When looking at a stain pattern, the forensic scientist may be presented with alternate possibilities as to how a bloodstain pattern may have been produced. In order to resolve this dilemma, the reconstructionist may need to conduct experiments with blood in an attempt to recreate some of these patterns. This experimentation may involve the use of models and devices that can simulate some of the events suspected of disrupting the source of blood in order to produce the observed pattern (Wonder, 2007; Williams & Taylor, 2013).

The research looked at the cognitive and performance aspects of device construction that would be of use in generating bloodstain events that would simulate some of the conditions that created bloodstain patterns at the crime scene. It is important that the likely mechanism behind the generation of a bloodstain pattern be verified or validated in order to more accurately determine what transpired at a crime scene. This information can then be compared with witness accounts, suspect statements, pathology, crime scene and forensic reports and thus provide an objective, independent assessment of the crime. Such corroborating evidence is of critical importance within the criminal justice system for the prosecution of crimes of violence.
The study, addressed the cognitive elements behind model building, i.e. will specific guidance vs. general guidelines on model development have an effect on originality, flexibility, practicality, ease of conceptualization and actual applicability to the simulation of the bloodstain pattern to which they are trying to duplicate? As one measure of the utility of their model in addressing the bloodstain pattern they are trying to simulate, will the superior model lead to improved understanding of the process of bloodstain pattern recreation which will be reflected in improved scores on written examinations related to bloodstain pattern interpretation, and fluid dynamics and physics related to bloodstain production under various situations?

**Mental Ruts, Constraints and Prototype Design**

The most original and innovative designs for models or apparatus designed to serve a specific function come about when people are engaged in free thinking with little limitation. Recent research has suggested that the imposition of some constraints can actually provide an incentive for renewed effort to solve problem, provided that people have sufficient domain knowledge and expertise and are motivated (Medeiros, Partlow, & Mumford, 2014).

When a reconstructionist crafts a piece of apparatus to recreate a bloodstain pattern, the analyst must take into account the force and velocity used to create the pattern. There are also issues related to fluid mechanics, density and gravity that need to be taken into consideration in order to create an authentic pattern. The effect of these restraints should be measured in some fashion. There is a danger that with too many restraints, attempting to put together a functional prototype will be inhibited. People tend
to employ the same methods that may have been useful in a similar situation but are no longer supplying the same physical forces under the new conditions of the present situation.

Providing students with a clue such as a similar piece of apparatus may have a deleterious effect on creativity. Previous studies (Smith, 1995) have demonstrated that people tend to have a fixation on a prior design that they have been exposed to and subsequent prototype models lack originality. This can result in a constraint to subsequent creative thinking and greater difficulty in moving out of conceptual ruts.

The application of creative problem solving to the creation of prototype models has been studied by Finke (1995). Divergent thinking (the generation of novel ideas) and convergent thinking (the evaluation of ideas for suitability to a problem at hand) are the two key attributes of creative thinking and Finke has studied their applications to generating useful models. By using only a few fundamental shapes and forms and giving participants no prior instructions, they have been able to generate a host of original and useful invention designs.

The work by Finke could serve as a model for designing an idea cart of useful tools and gadgets that can be modified and rearranged to produce the contraptions needed to duplicate blood spatter events. An alternate approach would be to have drawings or shapes as part of a design template by which students could assemble practical devices for duplicating the bloodstain patterns. These “pre-inventive forms” as Finke refers to these simple shapes, foundational to more complex designs, were incorporated into
Smith and Linsey (2011) have developed a scheme for the removal of mental blocks and design fixation that impede development of prototypes. Their method relies on forgetting counterproductive solution attempts by putting them out of one’s mind and finding something more appropriate; redefining problems by coding objects in many different ways and by using analogies to provoke new ideas. A worksheet or training module with instructions along this line might be useful for getting over design ruts. A supplemental worksheet could provide information about the fluid dynamic and other properties of blood and how this fits into a reconstruction. Interim Assignments 4, 6, and 10 and Lab Lectures 2, 3, 4, and 6 were my attempts to provide counter measures to stalled ideas. I adapted the concept and modified it to the Four Ds: Defocus or take time off from your activities for doing something else involving little mental demand such as going for a walk. Defer judgment: by not being overly critical, we open up new ideas. Distancing / stepping away: look at variations of the problem from different angles (forced connection with random images, SCAMPER). Drill Down Deeper or look at the subject at its core elements and see if that provides insight (Lab Lecture 4, Appendix AA).

General aspects of prototype design will draw upon previous work of Besemer (2006). Besemer looked at consumer products, old and new and came up with an objective method of evaluating the creative and useful aspects of a product using a Creative Product Analysis Model and rating scale. With some modifications, this could serve as a method for assessing some of the creative aspects of student apparatus design.
According to the Creative Product Analysis Model, a product is judged by its novelty or uniqueness, inventiveness and newness. A second criterion is resolution or functionality and performance of a product. This is judged by four factors: if the design and product is logical, useful, and valuable (i.e. how well does it work), and is its operation easy to understand. The third criterion is style or how the product is presented to the consumer. For this there are three criteria which are how well-crafted the product is, is it organic or user friendly and its elegance or degree of refinement.

**Science Kits to Aid in Understanding Underlying Principles and Their Evaluation**

The science kit provides a method to compartmentalize specific concepts to be taught in a lesson plan. The kits promote conceptual understanding of underlying scientific content, have self-contained material that explains the lesson and basic concepts to the instructor, promote hands-on learning and provide an alternate means by which a student can demonstrate his or her grasp of the concepts (Dickerson, Clark, Dawkins & Horne, 2006).

Although the applicability of science kits in teaching general science concepts has been recognized, the innovative thought that has gone into their construction has not been well documented. The majority of these kits are domain specific and focus on a narrow range of conceptual elements. As this project proceeds, documentation related to the development of the bloodstain apparatus into a possible commercial kit will be kept in mind.
Accelerated Insight and Creative Problem Solving

Insight is viewed as an unconscious leap in thinking that short circuits the normal thought process leading to a sudden realization of a problem’s solution. No clear cut mental pathway has been discovered regarding how insight works but some researchers have, after examining the discoveries made by eminent scientists, concluded that insight is based on selective encoding or recognition of important features that may not seem obvious to others—selective combination of ideas, and selective comparison between new information with old information acquired in the past (Davidson, 1995).

Insight is considered a part of incubation whereby a problem is worked on without resolution and suddenly, when engaged in an unrelated activity, the solution to the problem appears. Methods by which this process can be accelerated have received little attention in the literature. Brophy (1998), suggests that a persons’ ability to switch between divergent and convergent thinking can accelerate the creative problem solving process but offers no general means of stimulating and accelerating the process. The use of cues provided during incubation has not yielded consistent results in quickening the solution of problems or design of prototypes (Dodds, Smith & Ward, 2002).

Despite the lack of literature, the ability to come up with creative ideas quickly can provide competitive advantage. In a learning environment, one can more rapidly abandon designs and theories that are not suitable. This idea of stimulating innovation through intelligent fast failure can serve as a means of more rapidly going through scenarios and designs that don’t work until the more desirable solution, the one that more closely matches your reconstruction, is achieved (Tahirsylaj, 2012).
Using methods to speed up the creative problem solving process is not new. Osborn had speed CPS guided by asking a client a series of questions: “(1) Why is it necessary? (2) Where should it be done? (3) When should it be done? (4) Who should do it? (5) What should be done? (6) How should it be done? (Osborn, 1963, p 230).”

Learning CPS takes time but once that is done, you can attain problem solving resolution rapidly in some situations. In general, it is possible to speed up the thinking process once the subject area is mastered.

Where do we get hung up in the CPS process? It is often in the initial problem recognition phase. We need to consider constraints. Logical constructs have been thought to provide clues to some problems. Students in one exercise are asked to develop a method for high velocity blood dispersion (the type typically found after a gunshot wound) but without the use of firearms. They need to think in terms of high pressure rather than high velocity and this sometimes provides the clue that they need to get over this hurdle. In another assignment, students are asked to simulate a bleeding person walking at variable speeds. Most students think of a device attached to a cart or miniature race car with a blood dripping apparatus. The resulting bloodstain patterns could just as easily be duplicated if the dropper apparatus is held stationary and a movable belt is placed underneath and run at different speeds. We need to encourage tentative as well as alternate explanations among our students.

We require CPS the most when we are uncertain. Sometimes we have to test tentative solutions. Charles Pierce introduced the concept of abductive reasoning (Eco & Sebeok, 1983). Abductive reasoning puts forth a tentative hypothesis and then one can use a more solid form of reasoning such as deductive reasoning to go forward or perhaps
inductive reasoning with further testing. It is the only one of the three logical arguments that generates new ideas (Sosa, Connor, Corsor, 2017, p 488).

A deductive argument is an argument in which we expect the conclusion to follow necessarily from the premise; i.e. we expect the premises to support the conclusion in such a way that if they are assumed true, it is impossible that the conclusion be false:

- If a substance is a noble gas it is inert. Since argon is a noble gas, it is inert.

These are the types of arguments we strive for. It is a purely logical construct based on established rules.

An inductive argument is an argument in which we expect the conclusion to follow only probably from the premises; i.e. we expect the premises to support the conclusions in such a way that if they are assumed true, then based on the assumption, it is only probably that the conclusion is true:

- Neon has unstable isotopes. Therefore, since argon is similar to neon in many ways, it probably follows that argon has unstable isotopes too.

This is the type of argument often seen in scientific research when a number of hypothesis are being tested based on tentative initial observations and one is trying to make a generalization based on these observations. One must recognize that not all instances of a particular phenomenon can be observed and hence we must draw inferences about whether or not a particular proposed rule is applicable in all situations.

An abductive argument is a hypothesis or presumptive inference or a conjecture about reality that needs to be tested.
- All noble gases have unstable isotopes. This gas has unstable isotopes. This was a noble gas.

Abductive reasoning is closely related to creativity and design because it is about inventing a possible solution for a problem. Abductive reasoning is about finding an explanation, not necessarily the only one. Unlike deduction and induction where the conclusion follows from the inputs, creativity is an abductive process of finding a new and possibly fitting solution from “somewhere” (Sanders & Stappers, 2012, p 60).

<table>
<thead>
<tr>
<th>Deductive Reasoning</th>
<th>Inductive Reasoning</th>
<th>Abductive Reasoning</th>
</tr>
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<tbody>
<tr>
<td><strong>Before</strong></td>
<td>Shops sell goods only from 9 to 5 and this cake was bought in a shop</td>
<td>I looked at many ways of making cakes and always the cake was made of flower</td>
</tr>
<tr>
<td><strong>After</strong></td>
<td>Therefore, cake was bought between 9 to 5</td>
<td>Probably flour is a necessary ingredient for making a cake</td>
</tr>
</tbody>
</table>

Table 1 Creativity Related Examples of the Three Reasoning Processes

Another means of accelerating the creative problem solving process is by reducing some of the cognitive load on students. If there was an atlas or app of basic bloodstain patterns that students could refer to then this might reduce some of the processing time. The pamphlet by Judith Bunker (2001). *Bloodstain Evidence Manual: A Practical Guide to Examination of Bloodstains and Patterns Volume 3—Identification Stain and Pattern Characteristics* is the closest source that might fulfill that requirement. When teaching students systematic observations, they need to determine also, what information is relevant and if the solution fits the current need. Perhaps the most fruitful and simplest method of generating novel ideas is by emergence or combining opposites (Kelly & Kelly, 2014, pp. 101-102). Lowering the floor sufficiently so that all students can get into the problem space will make the process more democratic and will not
impede the creativity aspects. Bottlenecks or points where students might get hung up on some of the concepts need to be addressed. These can often be identified by appropriate testing.

The study looked at the type of creative problem solving tools applicable to creative product development as applied to prototype experimental devices to replicate bloodstain patterns in a bloodstain interpretation class that can generate new ideas quickly, provide insight into the workings of fluid dynamics and physics in the production of bloodstain patterns, that can validate reconstruction efforts, while overcoming conceptual blocks rapidly. Issues regarding the amount of support to provide the students in developing their models and an assessment of how the novelty, usefulness and relevance of their models translates into increased learning regarding bloodstain pattern analysis (through objective testing) was focus of this research. It is hypothesized that too much guidance can reduce the number of novel ideas and it is further hypothesized that students who demonstrate understanding through their apparatus design will show improved scores on subsequent testing of their knowledge of bloodstain application principles. It is also believed that if students are provided sufficient support to recognize specific bloodstain patterns, this will help reduce the cognitive load and speed up their ability to focus on design issues. Office consultation with students were part of this process in addition to specific lectures related to bloodstain pattern interpretation and exercises that combine CPS and bloodstain pattern interpretation, one example of which is found in Appendix E, page 158. Exercises encouraging fast prototyping were devised to aid students in formulating initial designs (e.g. Interim Assignments 2, 3, 4, 6, and 10).
Lectures were introduced during the lab period to facilitate the transfer of creative problem solving. When providing creative problem solving instruction it is important that they be focused on the cognitive aspects of problem solving, the lectures and exercises should focus on discrete cognitive skills, there should be plenty of case-based opportunities to illustrate the principles and domain-specific practice opportunities should follow the instruction, focusing on more than one divergent thinking or idea generation skill (Medeiros, Watts, Mumford, 2017, p 28).

SECTION THREE: SAMPLING AND EXERCISES

Methods

The subjects for this study were students who were took FOR 312 Criminalistics and Chemistry in Fall 2016 and students who were enrolled in the same class in Fall 2017. The FOR 312 class is a core introductory class in crime scene processing and basic laboratory methods and principles for forensic chemistry majors. This is an upper division course, so students will have satisfied pre-requisites in general physics, calculus, general and organic chemistry and instrumentation. There were 12 students who completed the Fall 2016 class and 12 students who completed the Fall 2017 class.

There was the same core lecture material that encompassed general criminalistics techniques and the bloodstain pattern material was in one lecture in the crime scene processing part of the course material. The difference between the 2016 and 2017 classes was the addition of 9 lectures related to patent searching, creative problem solving and design theory that were supplemented in the laboratory session (see Appendix D). There were 14 interim exercises to further develop creative design and observation abilities of
the students, each of which will be discussed in detail. The age range is about 19 to 21 with junior or senior standing. Most are from within a 50 mile radius of Buffalo, NY and are representative of the racial demographics of the area.

Students were randomly assigned by lot, four 8 x 10 photographs out of a series of 52 that dealt primarily with a single type of bloodstain pattern although some were more complex, involving multiple patterns. Some photos illustrate the same type of phenomenon only in different ways. Complexity of the patterns varies and assignment from simple to complex is rather subjective. Each student created project designs around their four photographs. The Fall 2016 group had two photographs picked at random for their individual projects while the Fall 2017 class had four photographs picked at random for their individual project. The ideal classroom goal would be a series of preliminary sketches followed by a model or working device accompanied by a short write up of their development process and a Power Point that can explain the function of their devices or the accuracy of the reconstruction to the rest of the class.

The second part of the project involves the random assignment of students into three teams. The intention was to build a working prototype or at least a number of working designs and some functioning model of the salient points of the bloodstain scene. In the Fall 2016 class, one group was tasked with developing a device which can recreate high velocity (> 100 ft. / sec) blood spatter without the use of a firearm or air pellet gun. The second group was asked to construct a device that would illustrate the flight trajectory of blood droplets vs. size. The third group was asked to work on two projects: one is a portable grid device for the measurement of bloodstain volume and the development of a method to simulate dripping blood while walking at a variable pace. In
the Fall 2017 class, the first and second groups had the same assignment as the previous year; the third group project was to simulate blood dripping from an open wound of a passenger in a moving car but without the actual use of a full-scale car based on Group Photo 3 of project photos in Appendix H. In the Fall 2017 class was also added a fourth group which involved the construction of a portable measuring grid and the development of a device or process to distinguish spatter onto a vehicle (model) and distinguish between blood due to impact with a blood-filled object or blood that has been dispersed onto a stationary car (based on Group 4 Photo, Appendix G). The completed projects were presented as Power Points documenting the reconstruction for class presentation as well as a detailed write-up.

There were some potential limitations to this study. This was a convenience study consisting of all of the students enrolled in the class and all participating in this design project. Students signed a waiver to participate and had the option of opting out at any point (see Appendices A and B). The small size did not permit randomization or division into different groups. The Fall 2016 class, which did not have the nine lab lectures and the 14 interim assignments to supplement creative thinking and design skills, served as a control group. The students were of similar background academically and socially with about a roughly equal mix of males and females and ethnic group characteristic of the campus as a whole. All students in both the 2016 and 2017 classes were forensic chemistry majors. Previous studies in the creative studies field have relied on college students as part of their study and there is nothing in the student backgrounds that would lead me to exclude a participant. All students enrolled in the Fall 2016 class (12) and all students who completed the Fall 2017 class (12) chose to participate.
One of the research instruments consisted of a questionnaire that provided me with background information regarding each of the students regarding major, class standing, career aspirations, previous science classes, hobbies, previous experience with tools and designing, arts and crafts, etc. as part of the syllabus contact information. This survey was on the last two pages of the class syllabus, Appendix C. No distinct pattern in the responses was noted and these results have not been included in the study.

Another instrument I attempted to use was to encourage students to record their problem solving strategies in the construction of a prototype where they would outline their visualization process to the construction process and how well they felt the model could fulfill the requirements of pattern generation—how well they could theorize a practical device application from a bloodstain pattern and their conceptualization of how that pattern was created incorporating known physical laws of flight, fluid dynamics and how they could work that into a practical application. To this end, I encouraged students to keep a notebook. I provided general information on the maintenance of a notebook on page 119 of the syllabus. Unfortunately most students used the notebook for conventional laboratory assignment data and did not maintain sketches related to the development of their project ideas. The interim assignments captured some of this data which will be illustrated as the assignments are discussed individually.

Guilford’s Test of Divergent Thinking (i.e., Alternate Uses Test) or a variation of it was used to get an idea of the students’ current creative potential. This was adapted to a question on the pre- and post-tests “Think up as many creative uses for an ordinary brick (besides use in construction) as possible. For example, one creative use would be as feet for a snowman.” The other question was “Think up as many creative uses for an ordinary
paper clip (besides typical use as fastening papers together) as possible. For example, one creative use would be as a template for drawing small circles.” The question was alternated between the pre- and post-tests as an extra credit question with points awarded for each answer. Results are tabulated and found in Appendix F.

A comprehensive pre- and post-test exam, related to bloodstain pattern interpretation, was given to all students in both classes. It was a combination of multiple choice, fill in the blank, matching test to measure the students understanding of bloodstain pattern patterns, and the physics principles behind blood spot trajectories and their influence in producing bloodstain patterns that are predictable and reproducible. The test, with results from both years tabulated, is found in Appendix F.

The 12 students in my Fall 2017 study class were given the 14-question Basadur Test For Measuring Preference for Ideation in Creative Problem Solving (Basadur & Finkbeiner, 1983, pp. 14-15) on September 25, 2017 and again on December 6, 2017. An example of the questions are found on pages 266 (open to ideation) and 267 (avoiding premature closure) of the Interim Assignment 14, Appendix W. The class average for each answer hovered around the neutral range “Neither Agree Nor Disagree.” There was no significant difference between the September and December scores.

The 52 photographs used in this study were printed in color on 8 ½ x 11” white card stock with the photo number printed on the back of each photo. At the beginning of class, students drew numbers from 1 to 52 between the 12 students and were given the corresponding numbered photograph. Students likewise drew numbers to determine into
which of the four numbered groups they would be assigned. The same arrangement had been used in the Fall 2016 class.

Students were provided some general guidance in terms of how they wanted to work within their groups. Elizabeth Cohen (1994) has done extensive research on the dynamics of small groups in educational environments. Students in the Fall 2017 class were encouraged to work cooperatively within their groups so that everyone could contribute and perform their design tasks without my direct supervision. To reduce the level of my intervention, I only required that each group have a facilitator who could direct and assign activities within the group (e.g. note taker, resource person, etc.) as they saw fit. A Group Facilitation Directions sheet that outlined these instructions is reproduced in Appendix W, page 273.

The cooperative interaction of the group members did not work well, with no individual within any of the four groups taking responsibility. The effect of group vs. individual effort could not be ascertained from this unsuccessful first attempt. The problem likely stems from the fact that these were random groups and students did not have the opportunity of going through the stages of group formation (Jones, 1983).

My first supplemental lecture was on how to conduct patent searches as Interim Assignments 1 and 3 would involve looking at patent designs and patent literature. This lecture and these two exercises were introduced in the hopes that exposure to related patents related to impact and motion devices might spur some associations leading to ideation of other devices more aligned with their particular projects or at least provide
them with key word search terms that might enhance their literature search in the patent literature and elsewhere.

Interim Assignment 1, Appendix H, pages 229-230, *Comparing Patent Designs*, has two different designs for a golf ball retriever attached in different ways to a golf club. The two illustrations are taken from (Kivenson, 1982). Students did not have any difficulty with the assignment and below is a typical response:

Advantages of design 1:

1. Allows user to scoop the golf ball off the ground without bending over.
2. No need to flip club upside down to use.
3. Can be used to scoop balls out of water.
4. Can be easily attached without bolts.
5. Can be adjusted to height preferred by user.

Disadvantages of design 1:

1. Extra weight on golf club.
2. Must be taken off to play.
3. Fairly bulky.
4. Can fall off since it’s not bolted on.
5. Can scoop up dirt when scooping off dirt/sand

Advantages of design 2:

1. Streamline design.
2. Can be left on to play.
3. Doesn’t require any skill to use.
4. Bolted on securely.
5. Can hold an extra golf ball if needed.

Disadvantages of design 2:

1. Adds weigh to golf club.
2. Manufacturing requires bolts which cost extra to make.
3. Cannot be easily adjusted or removed
4. Golf club has to be flipped upside down to use.
5. Adds extra length to handle which may not be comfortable for user.

Interim Assignment 2 is where students first got together in groups for discussion and brainstorming of their group assignments. I had students try to come up with at least three designs and use the best of these to start to put together a physical prototype. There was limited success with this assignment, most likely because it was still relatively early in the semester and other class priorities may have been an issue. In the Fall 2017 class the 14 interim assignments were additional work assignments that students needed to complete in addition to their non-bloodstain pattern interpretation, regular forensic science lab reports and exercises. The class met on Mondays and Wednesdays from 2:00 to 2:50 pm for lecture on the regular course material and the lab was on Wednesday from 3:00 to 5:45 pm. There was usually time at the end of each lab for 45 to 60 minutes of lecture related to design and creative problem solving. Below are some sample designs, Interim Assignment 2:

![Image of a project diagram](image)

Fig. 11. Representative Group 3 Project Diagram, Interim Assignment 2
Fig. 12 Representative Diagram of Individual Projects, Interim Assignment 2

Interim Assignment 3 was a more extensive review of the patent literature and included an exercise using SCAMPER (Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, Rearrange) a method devised by Osborn to rapidly come up with new configurations for a product and one might also use additional verbs such as add, subtract, multiply, divide, eliminate, subdue, invert, separate, transpose, unify, dissect, distort, rotate, flatten, squeeze, complement, submerge, freeze, soften, fluff-up, by-pass, lighten, repeat, thicken, stretch, extrude, repel, protect, segregate, integrate, symbolize,
abstract, light-up, etc. (Koberg & Bagnall, 1991, p 89). Students did not have difficulty completing the assignment or using the SCAMPER method. Examples of student outputs:

Fig. 13 Example of SCAMPER Re-Design of a Fork.

Fig. 14 Example of SCAMPER Re-Design of a Hairbrush
Interim Assignment 4 was based on the research of Fink (1990) with pre-formed geometrical shapes. For the purpose of adapting it to equipment available for bloodstain pattern recreations, the following components were added: SPONGE, SCREEN/GRID, EYE DROPPER, FUNNEL, WEDGE/INCLINE, PLASTIC BAG, COCONUT, KNIFE/SPIKE, SPRING, SQUEEZE BULB, POSTER BOARD, FAKE BLOOD. In addition, there was an exercise using a biomimicry web site: http://asknature.org/ and the use of collaborative sketching based on the work of (Shah, et al, 2001). Students in general were not very responsive to the pre-inventive forms and likely did not know what to make of these even though they were explicitly covered in Lab Lecture 2. Student examples are included below:

Fig. 15 Representation of Pre-Inventive Forms, Group 3 Project
Fig. 16 Representation of Use of Pre-Inventive Forms, Individual Projects.

Fig. 17 Example of Interim Assignment 4 Collaborative Drawing, Group Project 3
Interim Assignment 5 involved Internet research related to their projects. Students were to provide me with at least 15 key word search terms related to sources of supplies and general construction guidelines and videos and other documentation relevant to producing their devices and facilitating their re-enactments. Students responded with appropriate references.

In Interim Assignment 6, students were given a simple rubric based on a concept introduced by Dr. Steve Macho in Dr. John Cabra’s CRS 594 Design Thinking Field Course which allows inventors to consider constraints in their apparatus. The example used in the paper:

Design a (n) [device, process, etc.] ___e.g. catapult_____________ that (does something) ___projects blood variable distances________ within the constraints of ___a motorized device that permits variable speeds; a device within an enclosed area that prevents blood from flying all over the room but only in one direction; a device small enough to be carried by one person_______________.

The second part of the assignment involved constructing a rating system involving at least five variables related to the construction of their device. The ideas were rated by their subjective evaluation of the novelty of the modification and the feasibility of constructing it with available materials. These two factors were given a numerical value and used to rate the device. Students seemed to understand the rating system but did not pay particular attention to it when making design modifications.

Interim Assignment 7 provided a modeled assessment of a typical bloodstain pattern image of comparable complexity but not included in the student problem set. This exercise provided more of a scripted protocol for how they might analyze their photograph and use the information to then do a reconstruction and then evaluate the results. The assignment led to some additional refinements of their projects although
students concentrated on individual projects rather than group projects so whether or not this project initiated additional ideation was difficult to assess. Samples of student’s sketches are shown below:

Fig. 18 Samples of Interim Assignment 7 Individual Project Sketches
Interim Assignment 8 I had students look at the Ames research center MFRC Blood Pattern Analysis Videos at https://www.ameslab.gov/mfrc/bpa-videos. These are high speed videos of blood being spattered by many different methods. It provides students with a visual means of analyzing their proposed blood spatter events in greater detail. The second part of the assignment was to go online and find Internet images related to their projects. Not everyone appreciated the value of this exercise. Students with Macintosh personal computers were not able to get the downloads but made no attempts to switch computers in order to view the high speed videos.

Interim Assignment 9 was a test I devised related to pattern recognition. Part 1 dealt with finding a star shape inside a complex pattern, all students were successful with this exercise. The second part involved looking at an image based on an actual crime scene photograph and finding a lost item of evidence. About one-third of the students were able to find the ring on the floor, lower right side of the photo. The third part involved two crime scene photos, one before and one after disruption by emergency and law enforcement personnel. Students were asked to find at least 15 items that were missing or displaced between the two images. Students had no difficulty finding at least 15 differences. The fourth part involved reproductions of two paintings by Bev Doolittle an artist of Western Americana subjects who places hidden images and faces in her drawings. The two images are of varying degrees of complexity. Most students could find the appropriate number of images. The final part of the assignment involved finding discrepancies between two DNA electropherograms. There is a subtle difference in numbering because of slight fluctuations in DNA migration between the electropherograms resulting in a one unit difference in one of the alleles. Because of lack
of knowledge on how to read the electropherograms, students were keying in on the wrong values in the charts and did not produce a correct answer among any students in the class. I gave this assignment as a subjective test of student’s powers of observations. Whether or not this test is truly diagnostic of any innate superiority in ability to see fine details in crime scene photographs is open to debate, I don’t think it establishes anything either way, not with the limited sample I had.

Interim Assignment 10 is where students had a chance to create actual prototypes. The assignment layout is based on a merging and modification of handouts provided by Deborah Madelaine and Sari Gluckin for their respective design thinking workshops (based on An Introduction to Design Thinking Process Guide, Standord University School of Design) and given out at the Creative Problem Solving Institute, June 2017 in Buffalo, NY. The assignment was given out the week before and students were asked to obtain simple construction material from home for making simple prototypes. No one responded to this request.

The students were given the entire session to create prototype models. They were asked to share information with someone not in their group with this person serving as an outside advisor. This did not go well. Students with one or two exceptions were concerned about working on their own projects and did not appreciate the concept of getting independent feedback from parties not part of their group. Students were also hesitant to utilize some of the assembled materials. The prototypes that were developed were relevant but not novel or sophisticated. Photos of some of the supply setups are in Appendix Q after Interim Assignment 10. Supplies were in a small cart next to the large laboratory light table. Some high pressure devices such as the garden spray unit which
was used by a group in an advanced bloodstain pattern course to simulate high velocity gunshot wounds were left conspicuously on the table but did not seem to spark any interest in any of the students who needed to simulate high velocity blood spatter within their groups. This assignment provides a lead into the modification of working spaces to facilitate design processes.

Modification of Workspaces to Facilitate Design and Creative Prototyping

A fair amount of time was spent over approximately two years to assemble materials that would be suitable for projects related to bloodstain pattern reconstructions. These were assembled in a three drawer office stationary cart. Other specialized items such as five to six foot lengths of PVC pipe and connector Ts were obtained from Home Depot to construct make shift rooms over which butcher paper could be draped to capture blood spatter. Squares of side wall, tile samples and various types of fabrics have been gathered by students for their projects. A simple tool kit is handy and some students have brought in their own power tools.

Some designers (Doorley & Scott, 2012, p 211) have recommended prototype carts with supplies stocked in five categories:

1. Pliable materials: rubber bands, modeling clay, tin foil, and paper.

2. Structural items: craft sticks, tongue depressors, foam spheres, pipe cleaners, and wire.

3. Connectors: painter’s (blue) tape, white glue, staples and binder clips.

4. Utensils: scissors, staplers, hole punches, pens and pencils and Sharpies.

5. Miscellaneous: decks of cards, toys, hats, stickers, balloons, artificial wigs.
6. Basic tool kit: screwdriver with various heads, Allen wrenches, small files, jeweler’s saw, hammer, crescent wrench, etc.

There should be mock up and drawing material available for sketching and assembling simple prototype devices. McKim (1980, p 35) acknowledges that mock up material is not as well developed by manufacturers as drawing materials. The soft plasticity of clay tends to limit or even define the types of forms that can be visualized but provides good visualization if just surface features are under consideration. Styrofoam is an important alternative to clay it that it is relatively stiff, can be easily formed into a hollow structure and can be glued. Styrofoam heads can be obtained cheaply in boxes of six. More sophisticated heads that have clay cavities for blood, appear more life like and rigid and come in two different orientations are about $250 each from some specialty crime scene supply vendors.

Geometric forms are usually best developed with sheet material. Sheet thermoplastic (such as Plexiglas or styrene) is easily cut by scoring and breaking and can be formed with heat and quickly joined with plastic solvent. Poster board or foam core is a laminated paper and Styrofoam sandwich that comes in various sizes and thickness and provides a stiff and light sheet material that cuts easily and is good for large mockups.

Classes for the prototype and other work were held in the Science and Math Complex on the Buffalo State campus. It is a large studio like room with adequate overhead lighting and movable large tables to work on.

I felt that students had optimum conditions and adequate supplies for prototyping but did not appear to be in the spirit of working with their hands. I have no ready explanation other than the students were not particularly high in ideation.
Early in the semester, students were provided with a lecture related to creative problem solving, the Kirton Innovation and Adaptation Inventory and details regarding the FourSight preferences in lab lecture 1. Students were asked to take a post it note with their name and place it on a chart with the divergence and convergence continuum vertical and the ask vs. tell continuum laterally. Students were provided with the web site for taking the FourSight exam but no students participated. This simple key chart provided a rough estimate of student preferences. There were two implementers and the rest of the class was roughly equally divided between clarifiers and developers with no ideators in the group.

To further reinforce the use of creative problem solving methods, I had a supplemental problem solving—bloodstain pattern analysis case where students could practice some of the creative problem solving methods (see Appendix E, page 158). The worksheet had the ground rules for divergent and convergent thinking and we did a warm-up exercise where students came up with as many possible ways to describe a leaf as they could. Choices tended to focus on shape and color. We next went over a facilitation client worksheet that had been modified for law enforcement/crime scene examination use. They were then introduced to the creative problem solving thinking skills model and the FourSight preferences and how this related to teams and problem solving. An evaluation matrix was part of the worksheet that was a little difficult to integrate into this particular exercise but some students were able to utilize it in their interpretations. A brain writing worksheet was provided for those students who wanted to do some collaboration with fellow students. The crime scene reconstruction consisted of a scene diagram and seven photographs of a simple blood letting event that they were
asked to reconstruct using the CPS methods if possible. This supplemental project was given to both the 2016 and 2017 classes. Little difference was noted and both classes demonstrated comparable skill in interpretation.

Interim Assignment 11 was an attempt to gauge the student’s abilities to recognize fine detail and distinguish artifacts from important features and attempt to get some grasp of what students saw when viewing a photograph. I filled out the form as well for all 52 photographs and found that students were observing traits in the same direction or on the same half of the Lickert scale as me only their average values tended to drift more toward the central values. No discernible pattern was noted. No pronounced indication that students were consistently misinterpreting a feature.

Interim Assignment 12 introduced two concepts related to the project. One was what I called the Desert Island Test. If one was on a desert island and needed to construct the apparatus or duplicate a bloodstain pattern, what three elements would be most crucial for completion of the project (assuming that blood would be readily available)? This would provide me with information about how attuned the student was to the essential components of the reconstruction. The other part was the courtroom introduction—if they had to explain the operation of their apparatus to a lay jury and set it up in court, how would they explain the operation, how would they explain the validation protocol and how would they explain the science and physics behind the mechanical blood creating event so that a lay audience could understand it? Students, who took the time, did reasonably well in answering.

Interim Assignment 13 dealt with wound correlation, i.e. based on the photograph, what could be said about the likely wound that caused the bleeding? This exercise was
linked with lab lecture 8 that dealt with wound characteristics. It was hoped that looking at this aspect would promote additional ideas and other ways of thinking about the photograph. Student response was mixed as some photographs simply did not provide enough information to make a solid determination of wound characteristics.

Interim Assignment 14 contained an end of the year course evaluation related to the bloodstain pattern interpretation project and interim exercises along with the second Basadur Preference for Ideation in CPS. Results have been tabulated and appear immediately after Interim Assignment 14 in Appendix U). Results are mixed and show no general trend other than that the design and creative problem solving aspects were not well received. A number of students expressed adamant opposition to the spirit of using creative approaches to practical problem solving at least related to the bloodstain pattern problem. The one student who provided glowing remarks attended on average only about 1/3 of the class sessions.

The average number of re-designs was three according to the survey. I do not have direct verification for that number in any of the returned assignments so I believe this number is inflated for most students. Few of the students in either the 2016 or 2017 classes submitted multiple attempts—I could not verify that students with multiple attempts would create more novel designs or achieve higher scores on the tests. When there were modifications, the changes were trivial (pulling a cart by hand vs. letting it roll down an incline to create variable motion) and did not reveal any radical changes in thinking. Students were largely fixated on the first design that seemed to work for them even if it was an inferior design. My conversations with students during one-on-one
meetings as documented in Appendix F, page 152 were largely unsuccessful. Examples of multiple prototype designs for Group 3:

Fig 19 First Design for Group 3 Project
Fig 20 Second Design for Group 3 Project

Group #3 Prototype

JUG OF BLOOD

SHEET OF METAL

PULLY SYSTEM

25'

MATERIALS:
- String
- Pully System
- Sheet of Metal
- Jug of Blood

The sheet of metal will be attached to a pully system and the jug of blood attaches to metal. The metal will be propelled down the pully system rapidly to simulate a moving car and the wind resistance associated.
Fig. 21 Third Design for Group 3 Project

Group Project #3 Prototype

09/13/17

MODEL CAR (REMOTE CONTROLLED)

MATERIALS: Remote controlled car
Ken Doll
Syringe (higher gauge)
Blood

To prepare the Ken doll/simulate the wound, the high gauge syringe will be used to create a hole in the doll's head. Blood will then be injected until head is full. Once a steady flow is seen from the doll, it will be placed in an unmarked remote control car and driven rapidly to the finish line. (It is important that the car isn't marked, so blood pattern can easily be viewed.)
Some examples of completed individual projects from design to final bloodstain pattern are illustrated with earlier design attempts illustrated in Fig. 18:

Recreation -

Photo #5 - Impact Spatter

Materials:
- "CRC" Duster Spray
- Butcher Paper
- "Jury" Bike Pump
- Straw
- Electrical Tape
- Commercial Blood

Design:
- Tested at different distances and velocities/pressures
- High Velocity was best outcome gave best area of convergence at a distance of ~16 inches

Fig. 22 Photo 5 Pre-Planning
Fig. 23 Photo 5 Experimental Results
Photo # 13 - expired blood, large volume

Materials:
- 10 mL Syringe
- Commercial Blood
- Straw
- Butcher Paper

Straw in blood, blowing to create bubbles in the blood

Different speeds of plungers were employed. (Pushing [Depressing syringe at different speeds to determine best speed.]

High velocity (highest speed) seemed to give the stain that was most similar (to the original event)

Low, Medium, High

Fig. 24 Photo 13 Pre-Planning
Fig. 25 Photo 13 Experimental Results
Photo # 19 - Impact Pattern (on lamp base)

Materials:
- Lamp base
- Wig
- Commercial Blood
- Tide Pod Container
- Paint Tray Liner
- Log
- Sponges (Cosmetic Wedges)

First Run:
- Tide Pod Container was too weak, and came completely to the blow which oversaturated the wig/lamp base.
- Wig saturated with blood

Second Run → used a piece of wood to hold the wig, results → too hard, not enough impact spatter seen

Final Run → put sponges between the wood and wig to give cushion and more realistic medium for wig/impact → success!
Fig. 27 Photo 19 Experimental Results
Fig. 28 Photo 42 Pre-Planning
At the end of the course, a post-test related to bloodstain pattern interpretation was administered during finals week. The pre- and post-tests were identical except the extra credit ideation assignment was switched between multiple uses for a brick on the pre-test.
vs. multiple uses for a paper clip on the post-test. This was done with the Fall 2016 class as well except that the order of the ideation exercises were reversed. The results between the two exams for the Fall 2016 class with no special intervention in creative problem solving showed about a 30% increase in test scores and about a 196% increase in ideation as measured by the multiple use test. The Fall 2017 class with nine intervention lectures related to design and creative problem solving and 14 interim assignments related to the design project showed about a 16% increase in test scores and about a 271% increase in ideation as measured by the multiple use test. Even though the Fall 2017 class showed a higher score in terms of number of ideas in the post-test, I felt that the answers given by the Fall 2016 class in their post-test were more novel.

The measure of creativity related to projects was somewhat subjective and based largely on the grading rubrics attached to the course syllabus. I was the only person judging the projects. With the Fall 2016 class, the average of the individual projects, as measured by the final PowerPoint and written assignment, was 91% and 91% for the group projects (all members of each group received the same score). In the Fall 2017 class, the average of the individual projects was 92% and the average for the group projects was 91%.

The use of specific course material and exercises related to creative problem solving and design had no measured effect on the novelty or quality of presentations and no effect on the post-test vs. pre-test scores or degree of ideation. Neither class had a distinct design that would cause any particular project to stand out; there was too little difference in project scores to assess any correlation between project quality and differences in pre- and post-test scores other than the observation that if the project photo was directly
related to a test item, the student would get that item correct and there would be a slight increase in the rest of the class scores as well for that item. Questions were developed for the nine lectures and these are compiled in Appendix Z. These questions were scattered in midterm and final exams covering the conventional course material and student scores indicated that the material was read.

SECTION FOUR: KEY LEARNING

Key Learning

Throughout the three years that I have been involved in creative studies, I have felt the energy of people involved in collaborative work who are using daring methods to solve difficult and exceedingly complex problems. I have also been impressed with their motivation. This leads me to ask the question, why was my attempt at introducing creativity so unsuccessful and what can explain the lack of any demonstrable improvement in student performance? Part of this may be relevant to the types of problems faced in business and social settings vs. those faced in science.

The paper by Rittel & Webber (1973) describes two types of problems. There is the tame problem that is well-defined and has one ultimate solution. Problems in science, engineering fall into this category, even if the solution has not been discovered. The other type of problem is the wicked problem where even its basic definition is hard to grasp. Many societal ills such as poverty, global nuclear disarmament, terrorism, etc. fall into that category. Wicked problems are difficult to define, difficult to locate the problem points and difficult in identifying how one might narrow the gap between what is and what needs to be. Rittel and Webber point out 10 key characteristics of wicked problems:
1. There is no definitive formulation to a wicked problem and understanding a wicked problem is based on one’s idea for solving it. Problem understanding and problem solving are intertwined.

2. Wicked problems have no defined solution or end point where one recognizes that the problem has been solved. A wicked problem is terminated not by any logical stopping point but because one has run out of patience, money or ideas.

3. Solutions to wicked problems are not true-false but good-or-bad. There are no objective criteria for determining whether or not the solution is appropriate as there is for determining a chemical structure and confirming it by testing or instrumentation.

4. There is no immediate and no ultimate test of a solution to a wicked problem. Any solution will have consequences that may radiate out and affect people for years. With increased industrialization we are now realizing the long-term effects of pollution and global warming.

5. Every solution to a wicked problem is a “one-shot operation” because there is no opportunity to learn by trial and error as every attempt has a significant impact. In mathematics or design, if one design is not satisfactory, it does not adversely impact subsequent designs but if a freeway is built and it gives unsatisfactory performance, the repercussions can be felt for a long time.

6. Wicked problems do not have a set of well characterized solutions nor are permissible operations easily incorporated into any particular action. There are no criteria for proving that all solutions have identified. The sciences have well defined rules. How does one solve the problem of police brutality?
7. Every wicked problem is essentially unique. There are no classes of wicked problems that can be solved as a general class as each has its own nuances.

8. Every wicked problem can be considered to be a symptom of another problem. In other words, it can be part of a higher level problem just as crime in the street may be related to social ills such as poverty.

9. The same phenomenon can be explained in multiple ways.

10. Refutation of a theory is not the end goal. It is a principle of science that solutions to problems are only hypothesis offered for refutation. The aim in social enterprises is not to find the truth but to offer some improvement for a social ill and in many cases, being wrong cannot be tolerated.

Bloodstain pattern interpretation lies somewhere in between the spectrums of truly scientific, “tame” and “wicked” problems. There is an underlying mechanism for a bloodstain pattern but it is multifaceted, often dependent on interaction with other conditions that are not well characterized but there is one ultimate mechanism by which the blood had been shed. There is a defined end point in the interpretation to a single event, but how this relates to previous and subsequent interactions of participants at a crime scene may be difficult to pinpoint. Bloodstain patterns can be tested but there are numerous conditions that need to be considered, some of which, although a different underlying mechanism can produce the same or nearly the same type of pattern. I believe that bloodstain pattern interpretation would offer the degree of complexity that would benefit from the use of creative problem solving methods.

If CPS and design theory can offer solutions, why were students so resistant to using them? I believe that students need to recognize the value of a procedure and its
relevance before attempting to use it. With CPS, it is not just a set of tools; it is a way of thinking. In an educational setting, where students are faced with additional work, they need to see the value of the method. Motivation is an important aspect of any training program and is more important for students in the hard sciences with well-defined problems who have little need for CPS methods.

One researcher who has focused on motivation in instruction is John M. Keller using his ARCS model approach (Keller, 2010). Motivation is essentially what people desire to do, choose to do and commit to do. Attention getting, other than through practice exercises, is not a component of the creative problem solving process. In many systems of instructional design, getting the learner’s attention is one of the first goals before starting the lesson plan.

Keller’s ARCS model relies on (Keller, 2010, p 45):

- **Attention**: Capturing the interest of the learner and stimulating the curiosity to learn.
- **Relevance**: meeting the personal needs or goals of the learner, making the instruction valuable to the learner.
- **Confidence**: helping the learner to believe that they can succeed in the new task and allow them to control their success.
- **Satisfaction**: Reinforcing accomplishments with rewards, both internal and external or helping students feel good about their learning so that they will want to continue it.

The lectures related to design and CPS differed from the content of the rest of the course. Even though important for the project, which was the most valuable item in the course in
terms of points, students felt that they had come to the course to learn science and not CPS or design theory so it was something that was of no particular value to them. The lectures were at the end of a long lab session and there was no time for de-briefing at the end of the lecture. The material was dry and there was no entertaining segway into the lecture material. I relied on the interim assignments to help generate interest as they would need to know some of the rudiments of the lab lectures in order to most successfully complete these assignments although with this class, that alone was not sufficient motivation. Students can be introduced to CPS methods but they cannot be forced to use it if they have no interest in it or do not see the value. This leads to a third point: Were appropriate problem solving tools being introduced into the class that could help provide insight into better equipment and process design related to bloodstain pattern generation? McFadzean (1998) did research relating the particular problem solving method with a particular type of problem category.

Brainstorming is a method that was developed in the Buffalo area and has been a favored technique within classes in the creative studies program but as a technique, brainstorming does not produce many breakthrough ideas. This method, especially when performed in a group tends to preserve the prevailing paradigm rather than break away from it. Other paradigm preserving techniques are force field analysis and progressive degrees of abstraction (Anon, 2006).

Creativity is enhanced when experience, ideas and diverse elements are mixed together to arrive at new combinations. This is known as association and is the basis of many creative problem solving, paradigm stretching and paradigm breaking techniques. These methods have the common characteristics of (McFadzean, 1998, p 135):
• Presence of unrelated stimuli.
• Forced association of stimuli.
• Use of multiple stimuli.
• Use of collective memory (more than one person working on the problem).
• Not using any idea-filtering rules, i.e. disallowing evaluation
• Presence of an unusual mode of expression, e.g. dancing, singing, drawing, etc.

Paradigm preserving techniques do not require experienced groups to use them and tend to be easy methods to master such as brainstorming and brain writing. Paradigm stretching methods involve prototyping and use of metaphors and analogies. Paradigm breaking methods involve techniques such as fantasy and wishful thinking.

Paradigm stretching and paradigm breaking methods are more applicable toward ill-structured, wicked type problems whereas paradigm preserving techniques can be used for more structured problems that require less imaginative solutions. In the future, my adjustment of the CPS method to the problem type and the capabilities of the student audience might ensure a greater chance of success.

SECTION FIVE: CONCLUSIONS AND FUTURE RESEARCH

Conclusions

The use of creative problem solving and design methods supplemented by interim assignments that integrated these methods into solving a particular problem, a bloodstain pattern reconstruction and design of a process or method to validate the pattern, had no measurable effect on test scores, ideation or prototype design compared to a control group.
There was very limited creative output from the students and I felt that none of the research questions other than CPS having no effect could be adequately answered. Future research projects with more students may permit some of these questions to be answered.

Students who have no interest in CPS or design theory will not use these methods if they perceive no value. Just because there are opportunities for creativity in a class does not mean that students will embrace it.

**Future Research**

If this class is offered again, it will be configured so that students will have a choice between a traditional case study and a bloodstain pattern / design type of assignment. The students will select their own photographs and be given more case information up front. If it is part of a case with multiple pictures, they will all be included. It will be worked more in the context of an actual case than just a single photograph. The emphasis will be on case resolution and reconstruction and not just identification and validation of a particular bloodstain pattern. Hopefully, by making the learning scenario more like an actual case presentation, this will generate more interest and student buy-in.
REFERENCES


Anon. (1958). Ask these 20 questions whenever you study a picture. Popular Photography, Special Issue: What you can learn from pictures, 42 (3), 60-61, March.


ADDITIONAL READING


creative problem-solving skill development in higher education. Hershey, PA: IGI Global.


Appendix A

INFORMED CONSENT

The Use of Accelerated Creative Problem Solving and Creative Product Improvement as Applied to Prototype Experimental Devices in a Bloodstain Pattern Interpretation Class—Exploring the Role of Insight Development Tools as A Generator of New Ideas in Novel Situations

NAME AND TITLE OF RESEARCHER: MR. DOUGLAS A. RIDOLFI, COORDINATOR OF FORENSIC CHEMISTRY
Department/Room Number: Chemistry Department, SAMC 223
Telephone Number: (716) 878-3067
Email: ridolfda@buffalostate.edu
STUDY LOCATION(S): BUFFALO STATE COLLEGE, SCIENCE AND MATH COMPLEX, ROOM 223

PURPOSE OF STUDY

The purpose of this research study is to explore the use of prototype design as an active learning component in a class exercise related to bloodstain pattern interpretation and determining if there is a correlation between the novelty and creative design of the prototype and the student’s score on a pre- and post-test of their knowledge of bloodstain pattern interpretation.

SUBJECTS

Inclusion Requirements
You are eligible to participate in this study if you are enrolled in FOR 312 Chemistry and Criminalistics. If you do not wish to participate in this study, you will be given alternate assignments of equivalent point value. You must be 18 years of age and older to participate in this research study.

PROCEDURES

The following procedures will occur: You will be given photos or descriptions of a bloodstain pattern, one set for your group project and one set for your individual project. You will be given lectures and short assignments to provide practice in group interaction and design as it relates to the bloodstain pattern assignment. You will consult with the professor as it relates to your progress on the device. You will be given a pre-test the first week of class and a post-test during finals to test your knowledge of bloodstain pattern interpretation.

RISKS AND DISCOMFORTS

Some of you may be working with hand tools when building your prototypes. You may also be working with cattle blood or artificial blood you create or acquire online.

BENEFITS

The possible benefits you may experience from the procedures described in this study include a greater appreciation of the dynamics of how bloodstain patterns are produced and how the hypothesized creation of particular bloodstain patterns can be validated. You will have a better understanding of group dynamics and be provided with lectures, instructions and exercises on how to work more effectively in creative teams, how to design apparatus to simulate bloodstain patterns and come away with a better understanding of how to maximize information from photos for the purpose of crime scene reconstruction.
CONFIDENTIALITY

Data Storage

Your research records will be stored in the following manner:

- Exams will be stored in a locked cabinet in my locked office. Scores will be on a spreadsheet on my computer which is password protected.
- Summaries of conversations relating to your projects will be kept in a word document on my password protected computer.
- Individual assignments upon grading will be returned to the student but I will scan the work product before grading and maintain an electronic copy on my password protected computer.
- Any diagrams or extracts from conversations will be redacted of all student identifying information if used in my final write-up.

All data will be retained for at least three years in compliance with federal regulations.

IF YOU HAVE QUESTIONS

If you have any comments, concerns, or questions regarding the conduct of this research, please contact the researcher at the top of this form. If you are unable to contact the researcher or have general questions about your rights as a participant, please contact Gina Game, IRB Administrator, Sponsored Programs Office/SUNY Buffalo State at gameg@buffalostate.edu.

VOLUNTARY PARTICIPATION STATEMENT

Participation in this study is voluntary. You may refuse to answer any question or discontinue your involvement at any time without penalty or loss of benefits to which you might otherwise be entitled. Your decision will not affect your future relationship with Buffalo State.

SIGNATURES

Your signature documents your permission to take part in this research.

____________________________________  __________________
Signature of participant                Date

____________________________________  __________________
Printed name of participant

I certify that the nature and purpose, the potential benefits and possible risks associated with participation in this research study have been explained to the above individual and that any questions about this information have been answered. A copy of this document will be given to the subject.

____________________________________  __________________
Signature of researcher                  Date

____________________________________  __________________
Printed name of researcher
Appendix B

Institutional Review Board
Sponsored Programs Office, Bishop Hall 17
1300 Elmwood Avenue, Buffalo, NY 14222
Phone: 716-878-6700, Opt. 1
Email: click-irb@buffalo.edu
Federalwide Assurance ID#: 00007126

STUDY EXEMPTION

September 5, 2017

Douglas Ridolfi
RIDOLFDA@BUFFALOSTATE.EDU

Dear Mr. Ridolfi:

On 9/1/2017, the IRB reviewed the following submission:

<table>
<thead>
<tr>
<th>Type of Review</th>
<th>Initial Study</th>
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<tr>
<td>Title of Study</td>
<td>The Use of Accelerated Creative Problem Solving and Creative Product Improvement as Applied to Prototype Experimental Devices in a Bloodstain Pattern Interpretation Class--Exploring the Role of Insight Development Tools as a Generator of New Ideas in Novel Situations</td>
</tr>
<tr>
<td>Investigator</td>
<td>Douglas Ridolfi</td>
</tr>
<tr>
<td>IRB ID</td>
<td>STUDY00000084</td>
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<tr>
<td>Funding</td>
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</tr>
<tr>
<td>Grant ID</td>
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</table>

Documents Reviewed:
- Ridolfi Protocol, Category: IRB Protocol;
- Ridolfi Consent, Category: Consent Form;
- Ridolfi Post-Test, Category: Other;
- Informed Consent, Category: IRB Protocol;
- Ridolfi Pre-Test, Category: Other;
- FOR 312 Fall 2017 Syllabus, Category: IRB Protocol;

The Institutional Review Board has considered the submission for the project referenced above and determined it to be Exempt under one of the categories specifically waived under Section 101(b) (1-6) or 101(i) of the Code of Federal Regulations (45 CFR 46). The IRB approved the study from 9/1/2017 to 8/31/2018 inclusive.
IRB exemption is given with the understanding that the most recently approved procedures will be followed and the most recently approved consenting documents will be used. If modifications are needed, those changes may not be initiated until such modifications have been submitted to the IRB for review and have been granted approval.

As principal investigator for this study involving human participants, you have responsibilities to the IRB as follows:

1. Ensuring that no subjects are enrolled prior to the IRB approval date.

2. Ensuring that the IRB is notified of:
   - All Reportable Information in accordance with the Reportable New Information Smart Form.
   - Project closure/completion by submitting a Continuing Review/Modification/Study Closure Smart Form in Click.

3. Ensuring that the protocol is followed as approved by the IRB unless minor changes that do not impact the exempt determination are made.

4. Ensuring that the study is conducted in compliance with all IRB decisions, conditions, and requirements.

5. Bearing responsibility for all actions of the staff and sub-investigators with regard to the protocol.

6. Bearing responsibility for securing any other required approvals before research begins.

If you have any questions, please contact the IRB at the phone number or e-mail above.
Appendix C

Course Procedure and Grading Policy

COURSE Name: Chemistry and Criminalistics

NUMBER & TITLE: FOR SCI 312, Fall 2017

General Information

Instructor: Douglas A. Ridolfi, M.S.

Day/Time/Place: Monday, Wednesday, Friday 2:00 to 2:50 (lecture) SAMC 223
Wednesday 3:00 to 5:40 (laboratory) SAMC 223

Office Hours: Monday and Wednesday 1:00 to 2:00 and Tuesday and Thursday 2:00 to 3:00 pm or by appointment.

Office: 377 SAMC Building

E-mail (my preferred method of communication): ridolfda@buffalostate.edu

Office phone: (716) 878-3067

Course prerequisites: CHE 102, CHE 201, or CHE 321 or CHE 100 with instructor permission.


Credit Hours: 4

COURSE DESCRIPTION:

This course is an introduction to the application of chemistry in criminalistics. Students will learn basic methods of crime scene documentation and evidence collection. Students will be introduced to the theoretical principles of evidence screening and will learn the foundational principles of separation and purification methods, basics of microscopy and instrumentation and some basic categories of evidence and how the crime laboratory may help to enhance criminal investigations. Students will learn the
importance of validation of alternate explanations of physical phenomena such as bloodstain pattern interpretation through the use of experimentation and modeling.

COURSE OBJECTIVES:
This course will focus on the principles and applications of chemical analysis as applied to evidence in criminal investigations. Primary emphasis will be placed on examination of major categories of evidence from initial recognition and collection at the crime scene to preliminary examination and principles of instrumental analysis using a problem solving approach where by evidence is analyzed by a battery of methods to achieve the maximum amount of information with the least amount of alteration. Presumptive chemical tests and their chemistry will be emphasized in this course.

Teaching Goals and Philosophy:
The course will focus on a number of key concepts. Among these is that the subsequent case outcome often depends on the quality and thoroughness of the crime scene processing. To ensure a positive outcome, the crime scene processing needs to be systematic and must focus on items of true evidential value. By the end of the course you will be able to recognize evidence, record it and properly recover and preserve it. Students will also be able to recognize the relative value of evidence and be able to systematically process it to obtain maximum information while minimizing alteration and consumption.

A second key concept is that chemical presumptive tests are a means to aid in the identification and characterization of physical evidence. Individualization or assignment to a unique source is, in most cases, the ultimate goal of forensic analysis. The student will recognize that physical and chemical properties can be used to narrow down the possible universe of items into categories. Logical classification schemes can be used to help narrow down the categories of items. The student will understand the concept of class characteristics and individual characteristics as applied to a broad range of evidence.

A third key concept is that materials can be characterized by comparison to known standards and minute variations can have an effect on the interpretation of whether or not two materials could have shared a common origin. Students will be able to recognize variation in manufactured and natural materials. Students will be able to properly interpret the significance of this variation in the identification process. Students will distinguish between individual and manufactured variation in practical samples or on written exams. They will understand the concepts of class, subclass and individual characteristics through a comparative process with known samples.

A fourth key concept is that physical and chemical properties of materials need to be taken into account when devising analytical methods for separation and purification. Solubility, pH, density, optical characteristics while useful for the separation and initial
characterization of materials is also a reflection of their molecular properties and can be utilized to aid in the identification and individualization of materials.

A fifth key concept is that evidence left at a crime scene can sometimes provide information that permits the reconstruction of events. Bloodstain pattern evidence can provide a static representation of events in motion and can be used to determine what may have happened at a crime scene. More than one type of event may explain a particular bloodstain pattern and the ability to generate multiple theories of what occurred and being able to systematically test these hypothesis can be of great value. Hypothesis generation, hypothesis testing and validation and use of models to duplicate bloodstain pattern events will be introduced.

The purpose of FOR SCI 312 is to increase the degree to which students recognize, process, interpret and report on physical evidence being mindful of the concept that with a sufficient degree of observation at a small enough level that all materials can be individualized to a unique source. How physical properties as determined by preliminary chemical testing and instrumental analysis contributes to this will be explained in this course through lectures, demonstration, laboratory exercises, class discussion, reading and assessments through quizzes, examinations, practical’s and writing exercises.

EVALUATION: Grades for the course will be calculated as follows:

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<th>Assignment</th>
<th>Points</th>
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<tr>
<td>Lab write-ups</td>
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<td>Interim Project Assignments</td>
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<td>Midterm</td>
<td>50</td>
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<tr>
<td>Midterm</td>
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<td>Final</td>
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<tr>
<td>Bloodstain Pattern (individual)</td>
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<td>Bloodstain Pattern (group)</td>
<td>100</td>
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<tr>
<td>Total</td>
<td>1000</td>
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</tbody>
</table>

A = 100-94%  A- = 93-90%
B+ = 89-87%  B = 86-84%  B- = 83-80%
C+ = 79-77%  C = 76-74%  C- = 73-70%
D+ = 69-67%  D = 66-60%  E = below 60%

Point values are estimates for the entire course. Point values and assignments may be adjusted throughout the course at the instructor’s discretion but letter grading will be based on a percentage of the final total.
**Extra points assignment:** Any student can submit the following assignment anytime during the course to receive up to 25 points. This can be done to help make up for poor quiz scores, lab write ups, poor attendance or to ensure a better grade if you are already doing well in the course. Select a relevant, forensic science related book which must be read from cover to cover. **The book report cannot be substituted for lack of completion of any of the above assignments.**

Using a book related to forensic science or some aspect of forensic science (ask instructor), write a book review (6-page minimum and 7-page maximum, 12 point font, double spaced), including:

- The author, the full title, the publisher, the place and date of publication, edition.

You can then…

- Outline the contents of the book, providing your comments of what you have read,
- Evaluate and make critical comments on the book,
- Use quotations or references to new ideas in the book to illustrate a theme you think is important (cite references appropriately using American Psychological Association format),
- Identify the author’s qualifications, and any other personal information you think is relevant to your discussion of the book,
- Compare the book with a similar work by a contemporary or peer or with the author’s other writings (if any),
- Point out the author’s intentions, including the audience for which the book is intended,
- Comment on the book’s over-all organization and/or your feelings about the content.

**COURSE POLICY**

The classroom environment will promote respect for others and yourself as this is a course that will prepare you for a future career:

- No inappropriate dress will be allowed.
- Cell phones are to be turned off and placed out of sight
- Texting (reading and sending) will be delayed until the end of class.
- No sandals or open toed shoes.
- Do not eat or drink in the laboratories or classroom.

**ATTENDANCE:** Regular attendance is required. Each student is expected to attend all scheduled classes. Please e-mail the instructor prior to any scheduled absence. The student will be responsible to make up all missed assignments.
PLAGARISM: Plagiarism means the offering of another’s work as your own. Please adhere to the rules of copyrights and practice proper citing procedures.

SAFETY: The student understands that they will be working with chemicals. All proper laboratory safety procedures will be adhered to including but not limited to safety equipment, proper use of chemicals and the absence of any type of horseplay while in the laboratory. This institution conforms to and makes allowances for students with disabilities. **There will be no make-up laboratories.**

GUIDELINES: These guidelines are subject to change relative to course progress, equipment and instrument availability, etc.

**Bloodstain Pattern Exercise**

The bloodstain pattern homework project has two parts. One part will be done as an individual project and the other will be done as part of a group. For the individual project, each student will randomly be assigned photographs depicting bloodstain pattern. Each pattern will depict one primary mechanism of production. It will be the student’s task to analyze the bloodstain based on knowledge provided in the readings, lecture and additional library and Internet research conducted by the student.

During laboratory there will be weekly exercises some of which will have direct bearing on the project. At the completion of each lab there will be a mini-lecture that will deal with aspects of the project, team building, creative problem solving and the invention process. Small research projects, preliminary sketches and prototypes in teams and individually will help to build the technical foundation for successful completion of this project.

Based on the category of bloodstain pattern and possible method of deposition(s) the student will hypothesize various bloodstain pattern production scenarios, document the reasoning and produce model devices or scenarios that will allow the student to simulate the pattern using an apparatus or method of his or her own design. The final model, bloodstain pattern generation process or model design will be presented during the last week of class in the form of a working model or model sketches and/or process steps and a Power Point presentation illustrating the method by which the bloodstain was simulated. A paper of three to five double spaced pages and three to five references will explain the conceptual development of the models, relevant observations and hypothesis considered and how these were brought together to produce working models and/or demonstrated activity that replicates a bloodstain pattern.

Final working models that illustrated the greatest student knowledge of bloodstain pattern flight characteristics and creative design accompanied by a Power Point that best explains the operating principles of the devices and the method by which the patterns were duplicated will receive the highest grade. Instead of one finished project, a student may opt to present many well-conceived designs of high detail for appropriate apparatus without production of a working model but the designs must be accompanied by a Power Point presentation (10 to 15 minutes, maximum) that would explain the operating principles of the device and the student’s proposal for duplicating the pattern. Producing a model or kit of the highest quality suitable for marketing should be the goal.
The second part of the project is a group project. The student will be part of four working
groups that will design a working model of an apparatus. One apparatus will be used to re-create
high velocity bloodstain spatter (≥ 100 ft. / sec.) without the use of firearms or air rifles or similar
devices. The second apparatus will be a device for the high speed dispersal of blood droplets to
illustrate the correlation between blood size and distance traveled. The third project will simulate
blood dripping from an open wound of a passenger in a moving car but without the actual use of a
full-scale car. The fourth project will be the construction of a grid to measure blood volume on
various surfaces and a device or process to recognize spatter on a vehicle (or model) and
distinguish between blood due to impact with a blood-filled object or blood that has been
dispersed onto a stationary car. The constructed device will be presented as a demonstration to the
class. **Individual & group projects due and presented during the final week of class.**

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<tr>
<th>DATE</th>
<th>TOPIC</th>
<th>Reading/Descriptions</th>
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<td>08/28-09/01</td>
<td>Introduction to Forensic Science</td>
<td>Young, Chapter 1, pp. 1-17</td>
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<td>Forensic Photography</td>
<td>Young, Chapter 2, pp. 18-48</td>
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<td>Crime Scene Diagrams</td>
<td>Young, Chapter 3, pp. 49-71</td>
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<td>09/04-09/08</td>
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<td><strong>09/04 Labor Day, no class</strong></td>
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<td>Evidence Collection</td>
<td>Young, Chapter 4, pp. 72-95</td>
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<td>Fingerprint Processing</td>
<td>Young, Chapter 5, pp. 96-134</td>
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<td>Young, Chapter 6, pp. 135-169</td>
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<td>Impression Evidence</td>
<td>Young, Chapter 9, pp. 234-262</td>
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<td>Forensic Mind-Set</td>
<td>Bell, Chapter 1, pp. 1-11</td>
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<td><strong>09/15 Guest Lecture, Patent &amp; Scientific Literature</strong></td>
<td><strong>Butler Library</strong></td>
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<td>Measurement, significant figures, uncertainty</td>
<td>Bell, Chapter 2, pp. 14-41</td>
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<td>Quality assurance/quality control</td>
<td>Bell, Chapter 3, pp. 42-73</td>
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<td>Sampling, uncertainty</td>
<td>Bell, Chapter 4, pp. 74-98</td>
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<td>Partitioning, equilibria, acid-base chemistry</td>
<td>Bell, Chapter 5, pp. 100-139</td>
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<td>Instrumentation (microscopy)</td>
<td>Bell, Chapter 6, pp. 140-155</td>
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<td></td>
<td>Instrumentation (spectroscopy)</td>
<td>Bell, Chapter 6, pp. 155-205</td>
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<td><strong>Wednesday, Guest Lecture on Networking</strong></td>
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<td>Bell, Chapter 7, pp. 207-250</td>
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<td>Drugs, presumptive testing</td>
<td>Bell, Chapter 8, pp. 251-230</td>
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<td>Drug analysis, drug classes, synthesis</td>
<td>Bell, Chapter 9, pp. 301-329</td>
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<td>Bell, Chapter 10, pp. 330-355</td>
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<td>Bell, Chapter 11, pp. 360-378</td>
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<td>Bell, Chapter 12, pp. 393-419</td>
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<td>Bell, Chapter 13, pp. 420-441</td>
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<td>Arson Investigation</td>
<td>Bell, Chapter 14, pp. 443-467</td>
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<td>Bell, Chapter 14, pp. 467-480</td>
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<td>Bell, Chapter 15, pp. 481-498</td>
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<td>Bell, Chapter 15, pp. 498-515</td>
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<td>Applications of colorants</td>
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<td>Bell, Chapter 17, pp. 536-580</td>
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<td>Property of polymers</td>
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<td>11/13-11/17</td>
<td>Finger print processing</td>
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<td>Chemistry of caustic chemicals</td>
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<td>Crime Scene Sketching Exercise</td>
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<td>Extra credit pre-test</td>
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<td>Lab lecture: Group Problem Solving; notebook requirements</td>
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<td>Interim Assignment: Research an invention</td>
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<td>Interim Assignment: Simple project prototype</td>
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<td>09/13</td>
<td>Latent Print Processing &amp; Lifting; bullet trajectories; bloodstain pattern</td>
<td>LP, Trajectory, bloodstain pattern lab due 09/20; Interim assignment due</td>
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<td>Impression and Striated Evidence; bloodstain pattern fundamentals</td>
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<td>Interim Assignment: Group &amp; individual project criterion list</td>
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<td>Lab lecture: Generating solutions</td>
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<td>Interim Assignment: Internet research</td>
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<td>Color &amp; microcrystal tests, MSP lab due 10/25; Interim assignment due 10/25</td>
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<tr>
<td></td>
<td>Lab Lecture: Evaluating solutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interim Assignment: collaborative sketching</td>
<td></td>
</tr>
<tr>
<td>10/25</td>
<td>Field sobriety tests, ethanol metabolism</td>
<td>FST, Ethanol metabolism lab due 11/01; Interim assignment due 11/01</td>
</tr>
<tr>
<td></td>
<td>Lab Lecture: Model development; rapid prototyping</td>
<td></td>
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<td>Interim Assignment: Material acquisition, project planning</td>
<td></td>
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<tr>
<td>11/01</td>
<td>Explosive analysis and presumptive tests</td>
<td>Explosives lab due 11/08; Interim assignment due 11/08</td>
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<tr>
<td></td>
<td>Lab Lecture: Marketing and product evaluation</td>
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<td>Interim Assignment: Project notebook assessment</td>
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<tr>
<td>11/08</td>
<td>Firearms, ammunition</td>
<td>Firearms lab due 11/15; interim assignment due 11/15</td>
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<tr>
<td></td>
<td>Lab Lecture: Apparatus for BP pattern validation</td>
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<td>Interim Assignment: Alternative prototypes</td>
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<tr>
<td>11/15</td>
<td>Distance determination, paint solubility</td>
<td>Distance determination, paint lab due 11/29; interim assignment due 11/29</td>
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<td>Lab lecture: Re-enactments, medical moulage</td>
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<tr>
<td></td>
<td>Interim Assignment: Simulated blood formulations</td>
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<tr>
<td>11/22</td>
<td><strong>Thanksgiving Recess, No Classes</strong></td>
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<tr>
<td>11/29</td>
<td>Synthetic fibers, indented writing, printing</td>
<td>Synthetic fiber, indented writing lab due 12/06; interim project due 12/06</td>
</tr>
<tr>
<td></td>
<td>Lab Lecture: Interim Assignment</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Emerging</td>
<td>Meets Standard</td>
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<tr>
<td>-----------------------------------------</td>
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<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Analysis of the situation</td>
<td>Poor, superficial, evaluation of situation; insufficient for creating a suitable model or demonstration</td>
<td>Has identified main features or mechanisms which are adequate for making an initial model or process</td>
</tr>
<tr>
<td>Understanding underlying principles</td>
<td>Does not demonstrate understanding of basics of fluid dynamics and identity of bloodstain pattern</td>
<td>Can identify basic bloodstain patterns and how generated, adequate for accurate reconstruction</td>
</tr>
<tr>
<td>Literature review</td>
<td>Unfocused, inadequate literature search, outdated references, too few, too narrow scope</td>
<td>Adequate search of relevant literature, peer-reviewed journals, and multiple sources consulted. Sources appropriately cited.</td>
</tr>
<tr>
<td>Organization</td>
<td>Project, write-up, presentation poorly focused, unorganized, little planning evident</td>
<td>Project completed, write-up completed and PowerPoint completed, scanned for errors, well organized.</td>
</tr>
<tr>
<td>Preliminary development of prototype</td>
<td>No sketches or models, no attempt at pre-conception of device</td>
<td>Adequate preliminary sketches and models. More than one attempt.</td>
</tr>
<tr>
<td>Reconstruction of event</td>
<td>Has little conception of how bloodstain event occurred or incorrect interpretation</td>
<td>Understands how events occurred and can chronicle them in proper sequence</td>
</tr>
<tr>
<td>Originality</td>
<td>Unimaginative design, copied directly from source</td>
<td>Have put their own spin on design making it a unique prototype or process</td>
</tr>
<tr>
<td>Care, attention to detail</td>
<td>Sloppy, poorly constructed and conceived, little care displayed in construction or appearance</td>
<td>Model is detailed sufficiently and functions looks attractive and well made</td>
</tr>
<tr>
<td>Refinement</td>
<td>Sloppy, unoriginal, little thought or care in construction</td>
<td>Has some unique features that enhances appearance and functionality</td>
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</tbody>
</table>
Preparation of presentation | Lacks preparation, unorganized and unfocused | Well prepared, rehearsed, well written | Exemplary presentation, spent time gathering illustrations and care in preparation of diagrams, may use enhanced presentation methods such as video

Bloodstain Pattern Interpretation Final Group and Individual Project Grading Rubric

1. **Preparation**: The nature of the project indicates a high level of preparation on the part of the student.

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2. **Organization of Presentation**: The project presentation was coherent, orderly, easy to understand and follow.

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3. **Originality of project**: The project shows originality in construction and concept that goes beyond course material.

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4. **Underlying principles**: The project and apparatus reflects an awareness and understanding of the primary concepts of blood flight dynamics with appropriate background and related research.

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5. **Analysis of the situation**: The presentation and project adhere to the requirements of the assignment and show a well-researched and in-depth analysis of all relevant hypothesis.

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6. **Literature source**: The paper reflects accurate research and appropriate citation to relevant and up-to-date literature sources and Internet search of relevant resources helpful in design of apparatus.

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7. **Mechanics**: Power Point and write-up with no grammatical errors with paragraphs that include introductory sentence, explanation of details and concluding statement.

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8. **Quality of information**: Information clearly relates to the project design with details that clarify main concepts applied to hypothesis of pattern generation.

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9. **Diagrams, illustrations, and models**: Diagrams, illustrations and photographs are neat and simple and add to the observer’s understanding. Models accurately reproduce the bloodstain pattern.

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10. **Reconstruction of the event**: Recognition of relevant aspects of the bloodstain pattern. Choosing appropriate tools and models to create event. Adequate documentation demonstrating knowledge of workable, suitable model that will answer relevant questions related to the pattern.

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</thead>
</table>
LABORATORY REPORT FORM
TITLE OF LAB EXERCISE
YOUR NAME

ABSTRACT:
This section should include your topic. It should provide some background on your topic area and a short history on the development and need for this type of forensic analysis. Explain how this technique is used as related to the application of forensic science. That is, how this technique may be used for the solving crimes.

Key words: Some relevant key words and their meanings (if necessary).

Methods and Materials:
Unless the methods and materials you use are not in the handout, just type “refer to written laboratory exercise sheets.” Note any modifications.

Procedure:
Unless the procedure you use is not in the handouts, just type “refer to written laboratory exercise sheets.” Note any modifications to procedures.

Results:
Show or explain results in simple terms with the conclusions in an organized format. Charts are often good way to visualize results. Photo documentation with scale and descriptive caption.

Discussion:
This is the most important part of the report. Some research should be shown in this section. This section can compare and contrast techniques, explain the results, and show weaknesses and strengths of the procedure. List other techniques which will enhance your work. List other techniques which can complement your work or list other techniques which are the next step in the orderly analysis of your samples. Also the outcome of your work in establishing individual, sub class or class characteristics. A summary of the lab results should be included. If there are unexpected results, contamination, etc., then this should be noted and explained.

References:
You should have references which come from the Internet, relevant text books, or other reliable references such as journal articles, encyclopedia, etc. Use American Psychological Association writing style guidelines for citations. All statements of fact must have some supporting evidence, either from experimental results you have conducted or documentation from literature review. APA guidelines at https://owl.english.purdue.edu/owl/resource/560/01/
LABORATORY NOTEBOOK FORMAT

Why keep a notebook?

The written information in a laboratory is used for several purposes but most important it is used to record your experimental observations and data as part of any scientific investigation. The notes must be clear, concise and complete. Experiments that fail, that have contamination or unexpected results must be recorded as faithfully as those that were successful. The overriding criteria for successfully recording information are that another scientist can pick up your notebook and reconstruct what you did.

Layout of notebook

The notebook will be bound rather than a loose-leaf or spiral bound with pages permanently and strongly attached together. Pages will be numbered sequentially. The first page will be used for a table of contents. Each page will be numbered and dated and will contain experimental protocols, data, calculations, observations while experiments are in progress and your evaluation and interpretation of data. It will contain copies of charts, print outs and other instrument-generated material. Each lab experiment will generally have an introduction, experimental plan, observations and data section, conclusions/reflection page. Charts and prints outs are pasted in notebook pages at their appropriate locations.

A proper notebook page

The essential parts of a notebook page include:

• The entry was written during or immediately after the observations was made.
• The author has initialed and dated the entry.
• Each laboratory experimental section has a clear, simple, descriptive heading.
• The writing is legible, grammatical and expressed in complete sentences.
• The use of the active voice in the first person indicates exactly who did the work.
• If for clarity, it is desired to start a new entry on a new page when the previous page has not been entirely filled, draw a diagonal line across the unused portion of the page.
• Avoid stating conclusions, particularly of failed experiments—let the results speak for themselves.

Notebook entries

Notebook entries shall be written in ink. Corrections shall be made by passing a single line through the middle of the corrected entry and will be initialed and the correct entry will be made. Sketches of equipment or drawings may be made in pencil. If data is collected on scraps of paper when the notebook is not immediately accessible, the piece of paper shall be dated and initialed and taped to the notebook page. Entries should be made directly into the notebook whenever possible. Avoid uncommon abbreviations. If abbreviations are used, include the definition at the bottom of the page or in a table of abbreviations. Notebook review 12/06/16.
CRIME SCENE REPORT FORM
CRIME SCENE EXERCISE
DATE YOUR NAME

Description of Evidence:
Use this section to give a general overview of the crime scene. You will most likely have an initial walk-through of the scene with the lead detective or officer at the scene who will point out evidence that has been discovered so far, perhaps relay information observed by witnesses related to point of entry, number of suspects, exit route and other information that may be of importance. You will also use this section to provide the address of the location, who was involved with processing the scene, weather conditions or other factors that may have influenced evidence recovery. Indicate the time you arrived at the scene.

Evidence Recovery:
Use this section to record the recovered evidence section by section or room by room or interior of a vehicle vs. exterior, etc. Describe the evidence as it was collected, in order, with the corresponding marker number. Describe physical features of the surroundings if they may have some bearing on the evidence, e.g. broken window in bedroom, front door forced open or front door unlocked, lights on or off when you arrived, etc.

If there are numerous items of evidence, you may want to consider creating an evidence table that correlates an item to an evidence number and to a location based on measurement coordinates. It should be sufficiently detailed and accurate so that the object can be placed in the same location in the room at a later time. If using an outdoor fixture for a reference point, ensure that it is sufficiently permanent (e.g. utility pole with number or other fixed reference).

For certain types of evidence you may want to provide a summary of that evidence type, for example a summary of bullet trajectories. This would be in addition to a table of bullet holes location. From at least two bullet holes, one may be able to determine a trajectory.

Description of Packaging:
Use this section to summarize the items collected as evidence. If it is not obvious, indicate why an items was collected (e.g. for latent prints, DNA, trace, etc.). Indicate how the items were packaged and their final disposition (e.g. given to Officer Smith of the Niagara Police Department or not collected or taken into evidence and logged into the property room of ABC Police Agency).
Supplemental Material:

Indicate what other material is part of your report such as crime scene sketches, evidence logs and handwritten notes or finished diagrams who prepared each item.

List of Supplies for Blood Spatter Project

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>Three Drawer Cart</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Foam Core</td>
<td>- hand held fan</td>
</tr>
<tr>
<td>- Tool kit</td>
<td>- sponge</td>
</tr>
<tr>
<td>- IV bag/tubes/bulb</td>
<td>- small basket ball</td>
</tr>
<tr>
<td>- Brass lamp base</td>
<td>- Different color tape</td>
</tr>
<tr>
<td>- Assortment of plastic funnels</td>
<td>- modeling clay</td>
</tr>
<tr>
<td>- Cutting board</td>
<td>- tea strainer</td>
</tr>
<tr>
<td>- Model race car</td>
<td>- two, one foot high wood manikins</td>
</tr>
<tr>
<td>- PVC pipe &amp; connectors</td>
<td>- mouse traps</td>
</tr>
<tr>
<td>- blender</td>
<td>- folding cm/inch ruler</td>
</tr>
<tr>
<td></td>
<td>- 2, two oz. syringes</td>
</tr>
<tr>
<td></td>
<td>- assortment of hose clamps</td>
</tr>
<tr>
<td></td>
<td>- six clip boards</td>
</tr>
<tr>
<td></td>
<td>- hand pump</td>
</tr>
<tr>
<td></td>
<td>- turkey baster</td>
</tr>
<tr>
<td></td>
<td>- foot pump</td>
</tr>
<tr>
<td></td>
<td>- plastic water pistols</td>
</tr>
<tr>
<td></td>
<td>- balloons and hand pump</td>
</tr>
<tr>
<td></td>
<td>- manikin drawing template, one foot</td>
</tr>
<tr>
<td></td>
<td>- flexible, black cord for stringing trajectories</td>
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<tr>
<td></td>
<td>- assorted 10 ml syringes</td>
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<tr>
<td></td>
<td>- small plastic fans</td>
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<td></td>
<td>- articulated wood hand, life size</td>
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<tr>
<td></td>
<td>- assortment of whoopee cushions</td>
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<tr>
<td></td>
<td>- tile squares</td>
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<tr>
<td></td>
<td>- hand gas pump</td>
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<tr>
<td></td>
<td>- bread knife</td>
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<tr>
<td></td>
<td>- X-Acto knife set</td>
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<tr>
<td></td>
<td>- assortment of wire grids</td>
</tr>
<tr>
<td></td>
<td>- package of Styrofoam heads</td>
</tr>
</tbody>
</table>
Resources

A. Scholarship


**B. Internet Resources**


**STUDENT CONTACT INFORMATION**

Each student will fill out this page and give it to the instructor by the second day of class.

[ ] I have received and read a copy of this syllabus for Fall 2016.

[ ] I understand that I will be held accountable for following the procedures and meeting the standards outlined in this syllabus.

Student name (print) _____________________________________________________

Signature __________________________ Date __________________________

Student Contact Information: Phone _________________ Banner # ________________

E-mail ___________________________ Major __________________________

1. What are your career goals? ___________________________________________

______________________________________________________________________

______________________________________________________________________

2. What would you like to learn from this course? __________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

3. What instructional methods help you learn best? _________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________
4. Is there anything not in the list of topics that you would like to see taught or something emphasized more? _________________________________________
________________________________________________________________________

5. What hobbies do you have that might be applicable to model building?
________________________________________________________________________
________________________________________________________________________

6. What three questions regarding general forensic science would you like to see answered?
   a) _________________________________________________________________
   b) _________________________________________________________________
   c) _________________________________________________________________

7. What three questions regarding bloodstain pattern interpretation would you like to see answered?
   a) _________________________________________________________________
   b) _________________________________________________________________
   c) _________________________________________________________________

8. How proficient are you with hand tools? ________________________________
________________________________________________________________________

9. What classes have you taken in introductory physics? _______________________
________________________________________________________________________

10. Which, if any classes have you taken in creative studies? ________________
________________________________________________________________________
Appendix D

Name ___ FOR 312_Post_Test______
Date ______ 12-13-17

FOR 497/598 Micro Course Bloodstain Pattern Interpretation

8-31-16 Ave. Test Score: 47 + Alternate Use Ave. Score: 6; 12-14-16 Ave Test Score: 62 + 19
Final Exam
8-30-17 Ave. Test Score: 51 + Alternate Use Ave. Score: 4; 12-13-17 Ave Test Score: 59 + 16

1. One of the earliest noteworthy pioneers in bloodstain pattern experimentation was:
   a. Dr. Stuart Kind 2 correct / 12 17% 12-13-17
   b. Ronald Linhart 5 correct / 13 38% 8-20-17
   c. Dr. Malcolm McDonald 10 correct / 12 83% 12-14-16
   d. Dr. Eduard Piotrowski 3 correct / 12 25% 8-31-16
   e. Jackson Thibault

2. The following questions would be appropriate during a crime scene reconstruction using bloodstain pattern analysis, except,
   a. what occurred during the alleged incident 12 correct / 12 100% 12-13-17
   b. when did the purported events occur 12 correct / 12 100% 12-13-17
   c. what was the justification for the assault 13 correct / 13 100% 8-30-17
   d. what was the relative position of victim and suspect 11 correct/12 92% 12-14-16
   e. when and in what sequence did the events occur 12 correct / 12 100% 8-31-16

3. Reconstruction of an event by bloodstain pattern analysis may provide information related to the following, except: 8 correct/12 67% 12-13-17 9 correct / 13 69% 8-30-17
   a. positioning of objects, victim and assailant during blood shedding event 7 correct / 12 58% 12-14-16
   b. mechanism by which spatter pattern was produced 6 correct / 12 50% 8-31-16
   c. additional criteria for estimating post mortem interval 6 correct / 12 50% 8-31-16
   d. assessment of items that were stolen
   e. type and direction of impact that produced the spatter

4. The logical progression of fact finding in a bloodstain reconstruction case is
   a. recognize as blood ➔ assess blood appearance ➔ determine pattern ➔ evaluate mechanism ➔ reconstruct bloodshed event 10 correct / 12 83% 12-13-17
   b. assess blood appearance ➔ recognize as blood ➔ evaluate mechanism ➔ determine pattern ➔ reconstruct bloodshed event 11 correct / 13 84% 8-30-17
   c. recognize as blood ➔ determine pattern ➔ assess blood appearance ➔ evaluate mechanism ➔ reconstruct bloodshed event 10 correct / 12 83% 12-14-16
   d. assess blood appearance ➔ evaluate mechanism ➔ recognize as blood ➔ determine pattern ➔ reconstruct bloodstain event 11 correct / 12 92% 8-31-16
   e. appearance ➔ blood type ➔ pattern type ➔ reconstruct ➔ mechanism
5. Identify the energy forces involved in creating a blood pattern as to low, medium, or high:
   a. impact with base ball bat __medium__ 7 correct / 12  58%
   b. blood pool __low__ 1 correct / 13  8%  8-30-17
   c. stabbing __medium__ 12 correct / 12  100%  12-14-16
   d. gun shot wound __high__ 2 correct / 12  17%  8-31-16
   e. blood trail __low__

6. The minimum, entry level training in bloodstain pattern analysis is,
   a. a 40 hour basic course 1 correct / 12  8%  12-13-17
   b. a 40 hour basic class and 40 hour advanced course 1 correct / 13  8%  8-30-17
   c. a basic and advance course and year of mentoring 2 correct / 12  17%  12-14-16
   d. basic, advanced course, year of mentoring and year of experience 0 correct/12 0%  8-31-16
   e. basic, advance, mentoring, experience and one year of supervised report writing 7 correct / 12  58%  12-13-17 1 correct / 13  8%  8-30-17

7. The IABPA and SWGSTAIN are two organizations involved in the furtherance of bloodstain pattern analysis as a science. The (IABPA/SWGSTAIN) _IABPA_ was established in 1983 by state and local bloodstain analysis practitioners and (IABPA/SWGSTAIN) SWGSTAIN_ was established by the FBI for creation of guidelines for training and bloodstain nomenclature 10 correct / 12  83%  12-14-16  6 correct / 12  50%  8-31-16

8. Identify the following types of bloodstain patterns with their prominent characteristics:
   a. arterial spurt _c_3_ 1. Dispersal of blood from a point source 6 correct / 12  50%  8-31-16
   b. cast-off __d__4__ 2. Blood blocked from reaching surface by intervening object
   c. expired blood _e_5_ 3. When artery is breeched, blood ejected under high pressure
   d. impact spatter _a_1_ 4. Blood released from object experiencing change in motion
   e. void pattern _b_2_ 5. Blood expelled from nose/mouth, injury to airway
   8 correct / 12  67%  12-13-17  5 correct / 13  38%  8-30-17 8 correct / 12  67%  12-14-16

9. This pattern would be consistent with:
   a. arterial spurt
   b. blood dripping into blood
   c. cast-off
   d. impact spatter
   e. projected volume of blood
   9 correct / 12  75%  12-13-17
   4 correct / 13  31%  8-30-17
   8 correct / 12  67%  12-14-16
   3 correct / 12  25%  8-31-16
10. Determine which apparatus listed below would be appropriate for the replication of low, medium, or high velocity impact spatter: 3 correct / 12  25%  12-13-17
   a. blood dripping off a tool ___________low____0 correct / 13  0%  8-30-17__
   b. modified mouse trap ___________medium_2 correct / 12  17%  12-14-16_
   c. blood projected from spinning motor _medium_0 correct / 12  0%  8-31-16___
   d. gunshot to blood soaked sponge ____high__________________________
   e. striking a sponge with hammer ____medium____________________

11. What noteworthy legal case set the precedence for bloodstain pattern interpretation in criminal cases in the United States?
   a. Arizona vs. Andrew Mincie 4 correct / 12  33%  12-13-17
   b. California vs. Robert Trombetta 4 correct / 13  31%  8-30-17
   c. Michigan vs. Gregory Tyler 5 correct / 12  42%  12-14-16
   d. Ohio vs. Sam Sheppard 0 correct / 12  0%  8-31-16
   e. Virginia vs. John Swainburne

12. The primary categories of bloodstain classification that the text book uses are:
   a. clotted, diluted, dried 10 correct / 12  83%  12-13-17
   b. flowing, spurting, pooled 7 correct 13  54%  8-30-17
   c. passive, altered, spatter 11 correct / 12  92%  12-14-16
   d. swipe, wipe, impact 2 correct / 12  17%  8-31-16
   e. cast-off, impact, secondary

13. From the stains listed below, determine if they fall under the category of altered, impact or passive. 7 correct / 12  58%  12-13-17  6 correct 13  46%  8-30-17
   a. pooled blood ___________passive_4 correct / 12  33%  12-14-16__
   b. diluted blood ___________altered_1 correct / 12  8%  8-31-16___
   c. struck with bat ___________impact____________________
   d. gunshot wound ___________impact________________
   e. blood transfer ___________passive____________________

14. A transfer pattern occurs when an already bloody object comes into contact with another surface. 12 correct / 12  100%  12-13-17  12 correct / 13  92%  8-30-17
   a. True 12 correct / 12  100%  12-14-16
   b. False 12 correct / 12  100%  8-31-16

15. A swipe and a wipe are subcategories of a transfer type pattern
   a. True 12 correct / 12  100%  12-13-17  12 correct / 13  92%  8-30-17
   b. False 11 correct / 12  92%  12-14-16  11 correct / 12  92%  8-31-16
16. This pattern is consistent with what type of bloodstain pattern:
   a. arterial spurt 12 correct / 12 100% 12-13-17
   b. blood dripping into blood 8 correct / 13 62% 8-30-17
   c. cast-off 12 correct / 12 100% 12-14-16
   d. impact spatter 6 correct / 12 50% 8-31-16
   e. projected volume of blood

17. The human heart has _____ chambers and _____ valves.
   a. two; two 1 correct / 12 8% 12-13-17
   b. two; four 0 correct / 13 13% 8-30-17
   c. four; four 5 correct / 12 42% 12-14-16
   d. four; two 1 correct / 12 8% 8-31-16
   e. two; six 9 correct / 12 75% 12-13-17 8 correct / 13 62% 8-30-17

18. (Systolic / Diastolic) ___Systolic___ is the pressure during the contraction of the heart
    and (systolic / diastolic) ___diastolic___ is the pressure during relaxation of the heart.
    11 correct / 12 92% 12-14-16 9 correct / 12 75% 8-31-16

19. The blood constitutes what proportion of the body mass in an adult human?
   a. 2 % 2 correct / 12 17% 12-13-17
   b. 5 % 5 correct / 13 38% 8-30-17
   c. 6 % 5 correct / 12 42% 12-14-16
   d. 7 % 3 correct / 12 25% 8-31-16
   e. 8 %

20. What characteristics would be consistent with capillaries, veins or arteries?
   a. thick, muscular cell wall ___________arteries_4 correct / 12 33% 12-13-17_
   b. lie close to body surface ___________veins_2 correct / 13 15% 8-30-17___
   c. lie deeper in body surface ___________arteries_2 correct / 12 17% 12-14-16_
   d. very small diameter ___________capillaries_3 correct / 12 25% 8-31-16_
   e. return de-oxygenated blood back to heart and lungs __veins_____________
   f. transition between arterial and venous system __capillaries________
21. (Bright red / Dark brown) __Bright red__ blood would be consistent with fresh blood from a bleeding hemorrhoid from the rectum where as (bright red / dark brown) __dark brown__ blood would be consistent with partially digested regurgitated blood from an esophageal varices.

22. The physical properties of blood responsible for its flight characteristics and other behaviors:
   a. viscosity / surface tension 7 correct / 12 58% 12-13-17
   b. relative density (specific gravity) 8 correct / 13 62% 8-30-17
   c. optical reflectance / drying time 6 correct / 12 5% 12-14-16
   d. answer a, b 4 correct / 12 33% 8-31-16
   e. answer a, b, c

23. Viscosity of a liquid (decreases / increases) __decreases__ as the temperature (decreases / increases) __increases__. 6 correct / 12 50% 12-13-17 5 correct / 13 38% 8-30-17
   7 correct / 12 58% 12-14-16 8 correct / 12 67% 8-31-16

24. Temperature changes have a greater effect on viscosity than pressure changes.
   a. True 9 correct / 12 75% 12-13-17 10 correct / 13 77% 8-30-17
   b. False 11 correct / 12 92% 12-14-16 9 correct / 12 75% 8-31-16
   8 correct / 12 67% 12-13-17 7 correct / 13 54% 8-30-17

25. (Adhesion / Cohesion) __Adhesion__ is the attractive force between unlike molecules and (adhesion / cohesion) __cohesion__ is the attractive force between like molecules.
   10 correct / 12 83% 12-14-16 9 correct / 12 75% 8-31-16

26. Define the following related to Newton’s laws of motion: 4 correct / 12 33% 12-13-17
   a. 1st Law __1__ 1. A body at rest tends to remain at rest unless acted on by external force
   b. 2nd Law __2__ b 2. Force = mass x acceleration 8 correct / 13 62% 8-30-17
   c. Inertia __4__ d 3. Any influence that can change the velocity of a body
   d. Force __3__ c 4. Resistance of a body to a change in velocity 7 correct / 12 58% 12-14-16
   e. Velocity __5__ e 5. Relating to motion of a body 5 correct / 12 42% 8-31-16

27. Air resistance causes falling blood to assume a tear drop shape.
   a. True 1 correct / 12 8% 12-13-17 1 correct / 13 8% 8-30-17
   b. False 2 correct / 12 17% 12-14-16 4 correct / 12 33% 8-31-16

28. Blood falling off the end of a weapon with a large surface area will create falling blood drops of larger diameter than if they were falling from a weapon with a smaller surface area. 8 correct / 12 67% 12-13-17 6 correct / 13 46% 8-30-17
   a. True 10 correct / 12 83% 12-14-16 7 correct / 12 58% 8-31-16
   b. False
29. All free falling bodies near the earth’s surface will fall with a downward acceleration of ________ ft. / sec. For all practical purposes, there is little change in blood drop size after falling a distance of about ________ feet.
   a. 16 ft. / sec.; 10 feet 5 correct / 12 42% 12-13-17
   b. 28 ft. / sec.; 15 feet 5 correct / 13 38% 8-30-17
   c. 32 ft. / sec.; 4 feet 6 correct / 12 50% 12-14-16
   d. 28 ft. / sec.; 6 feet 4 correct / 12 33% 8-31-16
   e. 16 ft. / sec.; 12 feet

30. Terms describing bloodstains are derived from, 3 correct / 12 25% 12-13-17
   a. physical appearance of the bloodstain pattern 5 correct / 13 38% 8-30-17
   b. mechanism by which the bloodstain pattern was produced
   c. angle of impact by which blood strikes the surface
   d. answer a, and b 3 correct / 12 25% 12-14-16
   c. answer a, b, and c 4 correct / 12 33% 8-31-16

31. The flow of blood through the circulatory system is, 5 correct / 12 42% 12-14-17
   a. heart→veins→capillaries→arterioles→arteries→heart 4 correct / 13 31% 8-30-17
   b. heart→veinuloes→veins→arteries→arterioles→heart 5 correct / 12 42% 12-14-16
   c. heart→arterioles→arteries→capillaries→veinuloes→veins→heart
   d. heart→arterioles→arteries→veins→capillaries→heart 5 correct / 12 42% 8-31-16
   e. heart→arteries→arterioles→capillaries→veins→heart

32. The rate of bleeding is the blood loss volume per unit of time within the circulatory system. This blood loss is influenced by, 11 correct / 12 92% 12-13-17
   a. type of vessel (vein, capillary, artery) 11 correct / 13 85% 8-30-17
   b. diameter of the vessel 12 correct / 12 100% 12-14-16
   c. pressure of blood in vessel 12 correct / 12 100% 8-31-16
   d. if nicked or cut completely through
   e. all of the above

33. The relative percentage of constituents in whole blood is approximately, 5 correct / 12 42% 8-31-16
   a. red blood cells __________3________ 1. 55 % 7 correct / 12 58% 12-13-17
   b. platelets & white blood cells _2_ _b_ 2. < 1 % 4 correct / 13 31% 8-30-17
   c. plasma _______________1__ _a__ 3. 45 % 7 correct / 12 58% 12-14-16
34. Compare the amount of blood loss in an adult with effects:  

- **a. normal blood donation**  
  - 1. 10%  
  - 2. 30%  
  - 3. 50%  

- **b. limited activity but survivable**  
  - 1. 10%  
  - 2. 30%  
  - 3. 50%  

- **c. will cause death in about one hour**  
  - 1. 10%  
  - 2. 30%  
  - 3. 50%  

35. Describe the following characteristics of injuries that could lead to blood loss internal or external:  

- **a. abrasion**  
  - Skin torn by crushing or shearing force  
  - 1. 58%  
  - 2. 46%  

- **b. gunshot**  
  - Most common form of inflicted fatal injury in USA  
  - 1. 25%  
  - 2. 42%  

- **c. incised**  
  - Produced by cutting instrument, length greater than width  
  - 1. 25%  
  - 2. 42%  

- **d. laceration**  
  - Friction on skin surface caused by sliding on rough surface  
  - 1. 25%  
  - 2. 42%  

- **e. stab wound**  
  - Edges sharply defined, produced by cutting instrument  
  - 1. 25%  
  - 2. 42%  

36. Categories of passive bloodstains include the following, **except:**  

- **a. clotted**  
  - 1. 50%  
  - 2. 8%  

- **b. drops**  
  - 1. 23%  
  - 2. 42%  

- **c. flow**  
  - 1. 50%  
  - 2. 8%  

- **d. transfer**  
  - 1. 8%  
  - 2. 42%  

- **e. void**  

37. The diameter of a bloodstain that has freely fallen onto a surface will have a final diameter dependent on the following conditions, **except:**  

- **a. distance drop has fallen**  
  - 1. 67%  
  - 2. 77%  

- **b. hematocrit concentration**  
  - 1. 54%  
  - 2. 42%  

- **c. surface area of object from which it falls**  
  - 1. 50%  
  - 2. 42%  

- **d. surface texture of surface drop impacts**  
  - 1. 50%  
  - 2. 42%  

- **e. volume of falling drop**  

38. Match the term for an impacted blood droplet with its definition:  

- **a. angle of impact**  
  - Pointed edges of stain that radiate out from parent drop  
  - 1. 54%  

- **b. origin**  
  - Angle at which blood strikes a surface  
  - 1. 54%  

- **c. parent drop**  
  - Place where blood spatter originated  
  - 1. 54%  

- **d. satellite spatter**  
  - Droplet from which other features originate  
  - 1. 54%  

- **e. spines**  
  - Small drops of blood that break from parent stain on impact  
  - 1. 54%  

- **f. tails**  
  - Elongated projections from a stain impacting at sharp angle  
  - 1. 54%
39. What is the direction of travel of this stain?
   a. Left to right 9 correct / 12 75% 12-13-17
   b. Right to left 10 correct / 13 77% 8-30-17
   c. Top to bottom 8 correct / 12 67% 12-14-16
   d. Bottom to top 7 correct / 12 58% 8-31-16
   e. Cannot be determined

40. The appropriate formula for determining the angle of impact is:
   a. \( \sin^{-1} = \frac{\text{width}}{\text{length}} \) 7 correct / 12 58% 12-13-17
   b. \( \sin^{-1} = \frac{\text{length}}{\text{width}} \) 2 correct / 13 15% 8-30-17
   c. \( \sin = \frac{\text{width}}{\text{length}} \) 10 correct / 12 83% 12-14-16
   d. \( \sin = \frac{\text{width}}{\text{length}} \) 3 correct / 12 25% 8-31-16
   e. \( \tan = \text{width} \times \text{length} \)

41. When measuring the body of a bloodstain to determine the angle of impact, include all features of the stain including spines and other projections.
   a. True 9 correct / 12 75% 12-13-17
   b. False 8 correct / 12 67% 12-14-16

42. The angle of blood impact can be reliably determined on all surfaces including fabric.
   a. True 11 correct / 12 92% 12-13-17
   b. False 6 correct / 12 50% 12-14-16

43. Identify characteristics that are consistent with *dripped* blood (consistent with falling under the force of gravity) vs. *splashed* blood (consistent with having an additional force applied to the volume of blood beyond that of gravity). 10 correct / 12 83% 12-13-17
   a. regular, smooth edges to parent pool _dripped__10 correct / 13 77% 8-30-17_
   b. satellite drops elongated ___________splashed__10 correct / 12 83% 12-14-16_
   c. irregular, jagged edge to parent pool _splashed__9 correct / 12 75% 8-31-16___
   d. round satellite drops ___________dripped_________________
   e. very elongated spines ___________splashed__________________
   f. symmetrical distribution of round satellite drops _dripped_____________

44. The primary significance of blood flow pattern is,
   a. will change path when it meets an obstruction 8 correct / 12 67% 12-13-17
   b. may have a number of parallel paths 8 correct / 13 62% 8-30-17
   c. **can indicate if a body has been moved** 9 correct / 12 75% 12-14-16
   d. can determine sequence of events 6 correct / 12 75% 8-31-16
   e. can be used to estimate volume of blood lost
45. Define the following terms related to blood transfer: 6 correct / 12  50%  12-13-17
a. Drag 1. Existing source of blood altered by movement of body 5 correct/13  38%  8-30-17
b. 2° transfer 4. Bloody object moving against non-bloody surface 5 correct/12  42%  12-14-16
c. Swipe 3. Non-bloody object moving against blood on a surface 4 correct/12  33%  8-31-16
d. Wipe 4. Two fabric layers in contact, one bloody, transfer of blood pattern

46. Determining direction of a transfer stain swipe or wipe is difficult but there tends to be a reduction in the concentration of blood as the sample moves from initial point of contact to termination point of the stain transfer.
   a. True 11 correct / 12  92%  12-13-17  11 correct / 13  85%  8-30-17
   b. False 10 correct / 12  83%  12-14-16  9 correct / 12  75%  8-31-16

47. What will have the greatest influence on the appearance of a falling blood droplet, i.e., the degree of spatter of a falling blood drop? 6 correct / 12  50%  12-13-17
   a. area of implement from which drop falls 5 correct / 13  38%  8-30-17
   b. hematocrit concentration of blood 7 correct / 12  58%  12-14-16
   c. height from which drop falls 1 correct / 12  8%  8-31-16
   d. surface texture on which it falls
   e. volume of blood in drop

48. The length of this stain is being incorrectly measured:
   a. True 9 correct / 12  75%  12-13-17  6 correct / 13  46%  8-30-17
   b. False 4 correct / 12  33%  12-14-16  5 correct / 12  42%  8-31-16
49. Is the blood pattern consistent with,
   a. blood dripping from a bloody weapon  9 correct / 12  75%  12-13-17
   b. blood from source moving rapidly      10 correct / 13  77%  8-30-17
   **c. blood dripping from a person who is injured**
   d. blood from an arterial spurt           6 correct / 12  50%  12-14-16
   e. blood cast-off from a blood weapon    10 correct / 12  83%  8-31-16

50. An accumulated pool of blood next to a body most likely indicates,
   a. that the blood has only recently been shed and is still flowing out the body
   b. that a shooting is the most likely cause  11 correct / 12  92%  12-13-17
   c. a vein, permitting slow leakage of blood has been damaged  9 correct / 13  69%  8-30-17
   **d. the body has remained in that position for awhile**  10 correct / 12  83%  12-14-16
   e. that head trauma is the most likely injury        12 correct / 12  100%  8-31-16

51. This transfer pattern in blood was most likely produced by blood on a,
   a. awl                                    10 correct / 12  83%  12-13-17
   b. baseball bat                           10 correct / 13  77%  8-30-17
   **c. claw hammer**                       12 correct / 12  100%  12-14-16
   d. knife                                  10 correct / 12  83%  8-31-16
   e. wrench
52. The direction of travel of these footwear impressions in blood is,  

![Footwear impressions image]

- a. left to right  
  4 correct / 12  33%  12-13-17
- b. right to left  
  4 correct / 13  31%  8-30-17
- c. top to bottom  
  7 correct / 12  58%  12-14-16
- d. bottom to top  
  7 correct / 12  58%  8-31-16
- e. cannot be determined

53. The greater the energy used to impact a blood-filled object, the (smaller / larger) __smaller__ the size of the resulting bloodspatter droplets.  

- 12 correct / 12  100%  12-13-17
- 8 correct / 13  62%  8-30-17
- 10 correct / 12  83%  12-14-16
- 6 correct / 12  50%  8-31-16

54. Identify the following blood drop size range with the likely mechanism that produced it:  

- a. Diameter of 5 to 6 mm and force of 5 ft. / sec._3_b_1. Beating / stabbing  
  11 correct / 12  92%  12-13-17
- b. Diameter of ≥ 1 to 3 mm and force of 25-100 ft. / sec._1_c_2. Gunshot  
  11 correct / 12  92%  12-13-17
- c. Diameter of ≤ 1 mm and force of ≥ 100 ft. / sec._2_a_3. Dripped blood  
  92%  
  10 correct / 13  77%  8-30-17
  12 correct / 12  100%  12-14-16
  8 correct / 12  67%  8-31-16

55. Impact spatter forms a conical projection of blood droplets from the point of impact. The individual bloodstain impacts on a near-by surface can be projected back to a two dimensional space called (area of origin / area of convergence) __area of convergence__. From that point, a three dimensional location or a point above can be determined and is called the (area of origin / area of convergence) __area of origin__ .  

- 6 correct / 13  46%  8-30-17
- 8 correct / 12  67%  12-14-16
- 2 correct / 12  17%  8-31-16

56. The importance of properly identifying the mechanism creating the spatter is,  

- a. it helps to identify possible weapons  
  11 correct / 12  92%  12-13-17
- b. it helps to locate victim position  
  12 correct / 13  92%  8-30-17
- c. it helps to sequence possible events  
  12 correct / 12  100%  12-14-16
- d. it helps to trace movements of victim and suspect  
  10 correct / 12  83%  8-31-16
- e. all of the above
57. This pattern is an example of
   a. arterial spurt 3 correct / 12  25%  12-13-17
   b. blood dripping into blood 1 correct / 13  8%  8-30-17
   c. cast-off 1 correct / 12  8%  12-14-16
   d. impact spatter 3 correct / 12  35%  8-31-16
   e. projected volume of blood

58. Factors affecting the appearance of satellite spatter from projected blood would include the following, except:
   a. hematocrit concentration of blood 7 correct / 12  58%  12-13-17
   b. target surface texture 9 correct / 13  69%  8-30-17
   c. volume of parent stain / pool 8 correct / 12  67%  12-14-16
   d. mechanism by which parent stain / pool produced 4 correct / 12  33%  8-31-16
   e. distance traveled by blood prior to striking surface

59. Based on relative volume of back spatter vs. forward spatter, in what direction is the bullet traveling?
   a. Left to right 8 correct / 12  67%  12-13-17
   b. Right to left 10 correct / 13  69%  8-30-17
   c. Front to back 6 correct / 12  50%  12-14-16
   d. Back to front 5 correct / 12  42%  8-31-16
   e. Can’t be determined
60. The depth of penetration of blood inside of a gun barrel is influenced by a number of factors. The most important factor in terms of a reconstruction is, 11 correct/12 92% 12-13-17
a. caliber of the weapon 8 correct / 13 62% 8-30-17
b. distance between muzzle and target 7 correct / 12 58% 12-14-16
c. obstruction by headwear, hair, clothing, etc. 8 correct / 12 67% 8-31-16
d. operation of the weapon (i.e., revolver with fixed barrel or semi-auto, blowback, etc.)
e. velocity of the projectile

61. A complex series of overlapping bloodstain patterns can be subdivided into more manageable regions gridded off into a one foot square grid pattern with scales in a process called,

a. arrow heading 5 correct / 12 42% 12-13-17
b. back tracking 4 correct/13 31% 8-30-17
c. road mapping 7 correct / 12 58% 12-14-16
d. spatial simplification 6 correct / 12 50% 8-31-16
e. zebra gridding

62. Which pattern is consistent with spatter of clotted blood?

a. Left 0 correct / 12 0% 12-13-17
b. Center 1 correct / 13 8% 8-30-17
c. Right 4 correct / 12 33% 12-14-16
d. None 3 correct / 12 25% 8-31-16
e. All

63. Factor(s) that can influence the appearance of blood drops from impact spatter:

a. Number of impacts 12 correct / 12 100% 12-13-17
b. Amount of force applied 12 correct / 13 92% 8-30-17
c. Direction of force 11 correct / 12 92% 12-14-16
d. Location of wounds 12 correct / 12 100% 8-31-16
e. All of the above
64. In what direction are the bulk of these blood droplets traveling?

a. Left to right 11 correct / 12 92% 12-13-17
b. Right to left 11 correct / 13 84% 8-30-17
c. Top to bottom 9 correct / 12 75% 12-14-16
d. Bottom to top 6 correct / 12 50% 8-31-16
e. Can’t be determined

65. Identify which are examples of spatter caused by secondary mechanism, spatter from impact, and spatter consisted with projected blood: 5 correct / 12 42% 12-13-17

a. satellite spatter from blood dripping into blood secondary
b. gunshot wound impact 1 correct / 13 8% 8-30-17
c. cast-off blood projected 5 correct / 12 42% 12-14-16
d. arterial blood spurt projected 2 correct / 12 17% 8-31-16
e. stabbing / beating impact

66. The primary difficulty in accurately distinguishing between medium and high impact spatter bloodstains is, 7 correct / 12 58% 12-13-17 8 correct / 13 62% 8-30-17

a. complications due to angularity of blood spatter drops
b. difficulty in measuring blood droplet size 8 correct / 12 67% 12-14-16
c. lack of standard nomenclature 8 correct / 12 67% 8-31-16
d. overlapping size of blood droplets between the two categories

67. Satellite stains from dripping blood are of concern at a crime scene because they can,

a. be too small to notice and easily missed 7 correct / 12 58% 12-13-17
b. mimic bloodstains produced by impact spatter 6 correct / 14 46% 8-30-17
c. only travel short distances from the parent stain 5 correct / 12 42% 12-14-17
d. be easily removed because of their small size 5 correct / 12 42% 8-31-16
e. are a common source of blood contamination
68. A common excuse that a suspect may have for explaining victim’s blood on his clothing is,  
   a. he let someone borrow his clothing  9 correct / 12  75%   12-13-17  
   b. his clothing was stolen  10 correct / 13  77%   8-30-17  
   c. **he rendered aid to the victim**  8 correct / 12  67%   12-14-16  
   d. he previously had a fight with the victim  9 correct / 12  75%   8-31-16  
   e. he has an injury and it is actually his own blood

69. The physical property of blood responsible for its getting in between fibers in a woven garment,  
   a. **capillary action**  6 correct / 12  50%   12-13-17  
   b. density  4 correct / 13  41%   8-30-17  
   c. flight characteristics  5 correct / 12  42%  
   d. surface tension  3 correct / 12  25%   8-31-16  
   e. viscosity  

5 correct / 12  42%   12-13-17  3 correct / 13  23%   8-30-17

70. Smaller blood droplets tend to travel farther than larger blood droplets.  
   a. True  6 correct / 12  42%   12-14-17  
   b. False  3 correct / 12  25%   8-31-16

71. The following bloodstain mechanisms are classified under projection type spatter, except,  
   a. arterial spurt  8 correct / 12  67%   12-13-17  
   b. cast-off  5 correct / 13  38%   8-30-17  
   c. **dripped blood**  9 correct / 12  75%   12-14-16  
   d. expiredated blood  7 correct / 12  58%   8-31-16  
   e. gush from breeched artery

72. The rate of blood loss increases from least lost to most lost in the following order:  
   a. nicked artery→severed artery→capillary→vein  1 correct / 12  8%   12-13-17  
   b. capillary→vein→nicked artery→severed artery  0 correct / 13  0%   8-30-17  
   c. capillary→nicked artery→vein→severed artery  1 correct / 12  8%   12-14-16  
   d. **capillary→vein→severed artery→nicked artery**  1 correct / 12  8%   8-31-16  
   e. vein→capillary→severed artery→nicked artery
73. Which volume of projected blood displays more energy?

- **a. Left** 7 correct / 12 58% 12-13-17
- **b. Right** 12 correct / 13 92% 8-30-17
- **c. Both are the same** 10 correct / 12 83% 12-14-16
- **d. Cannot be determined** 10 correct / 12 83% 8-31-16
- **e. The images are different parts of same bloodstain**

74. Expirated blood is blood that comes in contact with the mouth, nasal and pulmonary system. When blood is expelled through the mouth, what would one likely see in this type of bloodstain production mechanism? 2 correct / 12 17% 12-13-17

- **a. air bubbles** 4 correct / 13 31% 8-30-17
- **b. mucous** 2 correct / 12 17% 12-14-16
- **c. stains consistent with high velocity spatter**
- **d. answers a and b** 3 correct / 12 25% 8-31-16
- **e. answers a, b, and c**
75. What aspect of a cast-off spatter would suggest a long handled weapon such as a baseball bat as opposed to something short handled such as a hammer?
   a. Length of the pattern 0 correct / 12 0% 12-13-17
   b. Number of parallel blood tracks 2 correct / 13 15% 8-30-17
   c. Increased spacing between blood drops in a track 4 correct / 12 33% 12-14-16
d. Height of pattern above the floor 4 correct / 12 33% 12-14-16
e. Increase diameter of spatter (greater centrifugal force) 1 correct / 12 8% 8-31-16

76. The following would be considered examples of altered blood, except,
   a. cast-off 6 correct / 12 50% 12-13-17
   b. clotted 11 correct / 13 85% 8-30-17
c. diluted 9 correct / 12 75% 12-14-16
d. insects 3 correct / 12 25% 8-31-16
e. voids

77. The drying of a bloodstain proceeds from the center and works outward.
   a. True 11 correct / 12 92% 12-13-17 12 correct / 13 92% 8-30-17
   b. False 12 correct / 12 100% 12-14-16 10 correct / 12 83% 8-31-16

78. These stains are consistent with:
   a. Blood deposited on a dry fabric that became wet 7 correct / 12 58% 12-13-17
   b. Blood deposited on an already wet fabric 8 correct / 13 62% 8-30-17
c. Blood deposited on a dry fabric over a period of time 9 correct / 12 75% 12-14-16
d. Blood on fabric after being washed in washing machine
   e. Blood on fabric with low hematocrit content 7 correct / 12 58% 8-31-16

79. A bloodstain feature that might be of assistance in reconstructing the position of objects that may have been on a surface during an incident and then moved,
   a. cast-offs 8 correct / 12 67% 12-13-17
   b. clotted blood 8 correct / 13 62% 8-30-17
c. dripped blood 12 correct / 12 100% 12-14-16
d. flowing blood 7 correct / 12 58% 8-31-16
e. voids
80. When there are multiple, overlapping bloodstain production events on a location, an important aspect of the overall bloodstain pattern analysis is,
   a. noting direction of swipe patterns  11 correct / 12  92%  12-13-17
   b. noting direction of wipe patterns  5 correct / 13  38%  8-30-17
   c. calculating angles of impact  7 correct / 12  58%  12-14-16
   d. **sequencing of the patterns**  8 correct / 12  67%  8-31-16
   e. counting number of cast-off strokes

81. When making a distinction between a projected volume of blood vs. projected single drops, the text book sets a lower volume for projected volume blood at,
   a.  \( > 1 \text{ ml} \)  5 correct / 12  42%  12-13-17
   b.  \( > 3 \text{ ml} \)  2 correct / 13  15%  8-30-17
   c.  \( > 5 \text{ ml} \)  9 correct / 12  75%  12-14-16
   d.  5 to 10 ml  5 correct / 12  42%  8-31-16
   e.  \( > 10 \text{ ml} \)

82. Which volume of blood displays more energy?
   a. **Left**  12 correct / 12  100%  12-13-17
   b. Right  12 correct / 13  92%  8-30-17
   c. Both are the same  12 correct / 12  100%  12-14-16
   d. Cannot be determined  11 correct / 12  92%  8-31-16
   e. The images are different parts of same bloodstain
83. What type of altered blood would be expected to have high levels of saliva?
   a. arterial spurt 12 correct / 12 100% 12-13-17
   b. cast-off 12 correct / 13 92% 8-30-17
   c. dripped blood 12 correct 12 100% 12-14-16
   d. expirated blood 10 correct / 12 83% 8-31-16
   e. gush from breeched artery

84. Based on the appearance of the large stain, the source of this blood is most likely,

   a. Arterial spurt 11 correct / 12 92% 12-13-17
   b. Cast-off 10 correct / 13 77% 8-30-17
   c. Dripped blood 12 correct / 12 100% 12-14-16
   d. Expirated blood 9 correct / 12 75% 8-31-16
   e. Impact spatter

85. In normal individuals, the time between the initiation of bleeding and the formation of clots is about,
   a. 30 seconds to 1 minute 7 correct / 12 58% 12-13-17
   b. 3 to 15 minutes 6 correct / 13 46% 8-30-17
   c. 20 to 30 minutes 3 correct / 12 25% 12-14-16
   d. > 60 minutes 4 correct / 12 33% 8-31-16
   e. > 90 minutes

86. Isolated blood spots about 1 mm in diameter seen near window sills and in areas not consistent with impact spatter with irregular shapes are likely due to,
   a. cast-off 3 correct / 12 25% 12-13-17
   b. clotted 2 correct / 13 15% 8-30-17
   c. diluted 3 correct / 12 25% 12-14-16
   d. insects 4 correct / 12 33% 8-31-16
   e. voids
87. When processing a scene, determine the role of the following types of bloodstain pattern evidence in answering the what or type of bloodstain generation mechanism involved, the when or relative time interval and the where or position of individuals.

a. arterial _____what_______ 0 correct / 12 0% 12-13-17
b. cast-off _____where_______ 0 correct / 13 0% 8-30-17
c. clotted _____when_______ 0 correct / 12 0% 12-14-16
d. expired _____what_______ 0 correct / 12 0% 8-31-16
e. transfer _____what_______

88. Forces that influence the appearance of a bloodstain pattern,

a. characteristics of the wound providing the source of blood 12 correct / 12 100% 12-13-17
b. direction of the applied force 12 correct / 12 100% 12-13-17
c. obstructions, movement, etc. 12 correct / 13 92% 8-30-17
d. velocity of the impacting force 12 correct / 12 100% 12-14-16

e. all of the above 12 correct / 12 100% 8-31-16

89. Which diagram illustrates the area of convergence and which diagram illustrates the area of origin?

a. Right; left 7 correct / 12 58% 12-13-17
b. Left; right 8 correct / 13 62% 8-30-17
c. Both 6 correct / 12 50% 12-14-16
d. Neither 7 correct / 12 58% 8-31-16
e. Cannot be determined

90. The largest possible angle of impact that describes a stain striking a surface is:

a. 0° 10 correct / 12 83% 12-13-17
b. 45° 6 correct / 13 46% 8-30-17
c. 90° 10 correct / 12 83% 12-14-16
d. 180° 7 correct / 12 58% 8-31-16
e. 360°
91. Based on this stain direction, in order to trace the stain path back to its point of origin, a string laid down over the stain to trace its path of origin would travel from,

- a. same direction of the arrow 6 correct / 12 50% 12-13-17
- b. opposite direction to the arrow 6 correct / 13 46% 8-30-17
- c. at right angles to the arrow upward 7 correct / 12 58% 12-14-16
- d. at right angles to the arrow downward 6 correct / 12 50% 8-31-16
- e. projected above the page

92. The formula for calculating the origin above the convergence point for an impact spatter stain
- a. Tangent (height) = impact angle * Distance to point of convergence 7 correct/12 58% 12-13-17
- b. Tangent (impact angle) = Height / Distance to Point of Convergence
- c. Sine (impact angle) = Height * Distance to point of convergence 1 correct / 13 8% 8-30-17
- d. Arc tangent (height) = distance to point of convergence / impact angle 4 correct / 12 33% 8-31-16

93. When documenting bloodstain patterns at a scene, indicate which patterns are more consistent with cast-off vs. impact spatter and which type of documentation is more appropriate for impact vs. cast-off.
- a. travels in a conical mass ___________impact_0 correct / 13 0% 8-30-17_
- b. determine beginning and end stroke _____cast-off_4 correct / 12 33% 12-14-16_
- c. stains are more circular in the beginning _cast-off_0 correct / 12 0% 8-31-16____
- d. determine area of convergence ______impact_____________________
- e. travels in an arc or linear fashion ______cast-off_____________

94. Estimating the extent of blood loss can be of particular importance in cases where,
- a. body is not recovered, need to know if extent of blood loss is survivable 3 correct / 12 25% 12-13-17
- b. demonstrating the extent of trauma is important 3 correct / 12 25% 12-13-17
- c. determine if victim had been moved after sustaining injuries
- d. answer a and b 4 correct / 13 31% 8-30-17
- e. answer a, b, and c 3 correct / 12 25% 12-14-16 5 correct / 12 42% 8-31-16
95. A difficulty with the estimation of dry weight of blood to estimate blood loss is,
a. there is no set constant for the dry weight of blood 0 correct/12  0%  12-13-17
b. health conditions, hematocrit concentration, etc. greatly effect dry wt. constant
c. **it is difficult to measure the blood weight separately from substrate weight**
d. it is easier to estimate liquid blood volume 1 correct / 13  8%  8-30-17
e. it is difficult to ensure that all blood has been collected1 correct / 12  8%  12-14-16
                                                                 2 correct / 12 17%  8-31-16

96. With a blood pool, one is likely to see clot retraction with clot and serum separation along the edges of the blood pool after about,
a. 1 minute to 5 minutes 2 correct / 12  17%  12-13-17
b. 5 minutes to 30 minutes 5 correct / 13  38%  8-30-17
c. **30 minutes to 1.5 hours** 5 correct / 12  42%  12-14-16
d. 1.5 hours to 3.0 hours 4 correct / 12  33%  8-31-16
e. 5.0 hours to 10 hours

97. Documenting bloodstains associated with a body of assistance with reconstruction,
a. from around nose and mouth (expectorated blood) 11 correct / 12  92%  12-13-17
b. from feet or shoes (to show moving about) 12 correct / 13  92%  8-30-17
c. from hands to show backspatter (from firing a gun) 11 correct / 12  92%  12-14-16
d. such as flow patterns (to demonstrate change in body position)  
   e. **all of the above** 12 correct / 12 100%  8-31-16

98. Sometimes there may be alterations to a scene that can have an influence on the bloodstain pattern interpretation. A good report to have to assess this variable is,
a. Crime scene report 5 correct / 12  42%  12-13-17
b. **Emergency medical technician’s report** 6 correct / 13  46%  8-30-17
c. Forensic laboratory report 3 correct / 12  25%  12-14-16
d. Medical examiner’s report 2 correct / 12  17%  8-31-16
e. Investigator’s report

99. Distribution of blood on the cut sweatshirt indicates that,
a. bloodstaining shows serum and blood clot separation 3 correct / 12  25%  12-13-17
b. bloodstaining shows a reduced hematocrit concentration 0 correct / 13  0%  8-30-17
c. bloodstaining occurred at two or three separate time intervals 0 correct/12 0%  12-14-16
d. bloodstaining occurred after victim was rescitiated 3 correct / 12  25%  8-31-16
e. bloodstaining occurred in affected areas after sweatshirt was cut 10 correct / 12  83%  8-31-16

100. Defense criticism of bloodstain pattern interpretation includes, 9 correct/12 75%  12-13-17
a. it’s an art more than a science like profiling or wilderness tracking 9 correct/13  69%  8-30-17
b. classification of blood spatter impact is arbitrary derived from experience 12 correct/12  100%  12-14-16
c. different surfaces and curvatures can create vastly different appearing stains
d. BPA relies on many outside reports and experts before drawing conclusions
e. all of the above 10 correct / 12  83%  8-31-16

Bonus question (one-half point for every valid answer): Think up as many creative uses for an ordinary brick (besides use in construction) as possible. For example, one creative use would be as feet for a snowman. Post-test 12-13-17

_Use as a weight___ _use for criminal purposes_ _for decoration_____ _length of__
brick__to measure an object___of same size____ _paper weight___ _door__
stopper__paint canvas___ _paper weight___ _door__
top________table____________ weapon______ _book end__
_weight_____decoration_ _stencil_tile______Stamp_trap_ _physical__
fitness________ _ (weight lifting)__ _in a pulley for art_____ _to create__
texture_____ _arm rest_______ _separator____to keep your seat__ _keep__
something up___ _prop something up__phone stand___recreate blood spatter__for
paper mache_ _to create shape/mold__block a pipe__weigh down table__create garden
fence _make a barrier wall_______garden wall____ _water well wall__garden
statues_ _keep door open____paper weight____ _pathway__ _place__
straightener on white hot fire ring wall_Weigh down boeys____ _in__
water brick with holes can be a planter for succulents balance table on uneven ground plant pot (if it has holes) murderer

weapon Parking spot indicator (tire stop) Backsplash in kitchen

Outline of fire pit Brick paths Use as a hammer Build shelving

Build chairs Painting them for landscape decoration

Door stop Paper weight Sanding block Landscape outline Holding a tarp over a mulch fire Level a wobly bench Teather a dog leash Breaking & entering Hide a spare key

Decoration To prop an object up To break glass Create a hole

Weight Barrier Use as a flower pot Stop a car from rolling Weights to keep down a tarp Tiered planter Create a door stop Light holder Flatten a chicken Recreate impact spatter Create an outdoor stove Holders for books Create a limbo stand Bed risers Create a golf hole Have as a pet Hold up a car Drop in blood Use as a void Use as an obstruction Break a window

Weigh down a car in winter Put out a fire Makeshift fire pit Block writing in snow Use as chair Paper weight Door stopper Hold a window open Outline for a garden Defense Paper weight Weight in car for icy weather Door holder Paper weight Door stop Weapon Hammer Bed raisers Decoration Block wheels from
rolling: Hold house keys: Balance uneven: table: Grind:

things (mortar & pestle): Attach item so it is: not lost or stolen: Paint & imprint on: paper to make patterns: Edging of flower bed: Obstacle course for: RC cars / toys: Fire pit walls: Weight for: working:


or: walkway: Table: Chair: Scrape bark off a: tree: Beat together: to scare predators: Book ends: Weights for exercise:

Hold open door: Drop into pool of: blood for spatter:

Stop rolling wheels: Step stool to reach: something: To raise: a table: Paint them: To smash something: To grind up something: into smaller bits: To:

make a platform: To hold down papers: in wind: To outline: a plant bed: to
keep something underwater
To hold down picnic blanket
To break a window
To flatten a flower
To smear blood
Body of a statue
Build a toy house
Hold down leash of small pet
Raise up a computer monitor
Flatten out clay
Make imprints onto a surface
Scratch a surface
Make indents into a surface

Bonus question (one-half point for every valid answer): Think up as many creative uses for an ordinary paper clip (besides typical use for holding papers) as possible. For example, one creative use would be as a template for drawing small arcs. Pre-Test 8-30-17

Sketching a blood spot; sketching multiple blood spatters
Use to make a circle around a fixed point on a sketch
Opening locked doors lock pick
Comparing sizes of evidence to the paper clip for pictures
Scrape evidence into proper storage (bin, cup, bag)
Holding hair up if investigator forgot/lost bobby pin
Make small dots Draw small lines Make a circle to draw blood spatter
Mark more precise spots Pick locks
Pick locks; hair pins; jewelry; needle; chip bag clip/fastener; wall hook
Eye liner stencil; bracelet; ring; lock pick; pencil holder; coil into spring
Drawer handle; mini tourniquet; hold fabric together; business card holder
Pop out sim card; suture a wound; zipper handle; blow dart
Making measurements  Drawing a straight line; Making points
Unlocking a door  Scraping off evidence  Scrapping beneath fingernails
Template for  drawing;  weapons; make shift pins
Picking a lock  Use as a ruler  for straight line  Create patterns like dots
Hold back hair  Could use like a  safety pin; Remove  food from teeth
Scraping material  in a small location;  Cutting paper

Bonus question (one-half point for every valid answer): Think up as many creative uses for an ordinary paper clip (besides typical use as fastening papers together) as possible. For example, one creative use would be as a template for drawing small archs.  Post-Test 12-14-16

Creating a chain  Picture hanger  Pinning hair  Cleaning tool
Using it as a screwdriver for glasses  opening sim card slot  Use as jewelry clasp
Use as a book mark  Unclog a spray can  key chain  opening an envelope
Lock picker  Ornament holder  Earrings  Lottery scratcher
Money clip  Make a compass  Guitar pick  Clean keyboard
Sun dial  Use as florist wire  Etching tool
Writing  Hanging objects  Opening things  Piercing tool
Tattoo needle  Mixing / Stirring  Cutting
Lock pick  Cleaner  Tie things together  Key ring
Zipper handle  Weapon
Clothes hanger for  Doll's clothes  To help find the end of tape to put
Paper clip through  Earring  Cut clay  Book mark
Use to scratch__ lottery tickets__ object to pick up__ with magnet__________
cufflink_________ hold tie to shirt__ fish hook______ key chain______
money clip______ pipe cleaner____ _____________________
picking locks____ spray bottle____ unclogger__ Xmas__ ornament holder__
calendar holder__ belt holder____ diaper pin______ hem holder____
eye glass repair__ cigar filter unstopper__ hair barette____ miniature sling shot_
minute catapult__ pry bar__ book mark__ necklace clasp____ pipe cleaner____
chain link________ fuse replacement__ lottery ticket____ scratcher______
money clip______ wire tightner____ make paint dots____ stiffen wicks____
clean pencil____ sharpeners____ reset electronic____ devices__________
badge holder____ roach holder____ roach stabber____ etching tool____
blow gun dart____ lightening rod for__ elves (maybe not__ this one)________
pierce ear____ get__ something out of a__ crack__ hold shirt in__ place with hole_
get stuff out from__ under fingernails__ take nail polish off_ (pick at nail polish)__
use as template to__ put on eye shadow __ Use to pick key hole__

Use to open super glue_ (have to bend it__ to get snap part of it_ to poke in)____

Hold hair into____ place (like a____ bobby pin)______

Put holes in something_ (paper towel)___ to ventilate____ (making some____
type of contraption_ for mosquitos)___ Sterilize end after_ bending (pop blister)____
Carve something__ into clay or on__ smooth surface____
_make a necklace with _ _connected paper_ _clips__________ ________________
_Blow bubbles_____ _through it after__ _putting it in solution___ _________
_Pin for cloth____ _diapers for babies___ open a bottle_of__ _wine___________
_scratch head with__ _use to hang ______ ornaments on a___ Xmas tree_____
_earring__antenna__ _lock pick________ _hair clip________ _key chain__________
_keyboard cleaner___ _cuff link________ _book mark_______ _tongs_____________
_tweezers________ _pipe cleaner______ _rings__tooth pick__ _hole puncher_____
_bracelet________ _fish hook________ _polka dot maker__ _zipper tab_________
_pop pimplles_____ _declogger________ _skewers______ ornament holder_____
_belt holder______ _picture hanger___ _twist tie__reset__ _electronic devices__
_corkscrew________ _mixer__________ _______________ ________________
_picking a lock_____ _a hook__necklace__ _ear rings_______ _key chain_________
_screwdriver_______ _clean under fingernails_ _scratch a car___ _pop a balloon____
_hair clip_________ _antenna_________ _______________ ________________
_fix a zipper_______ _unlock a door____ _hold things together_ _________________
_a hanger a key___a hook to keep____zipper from opening_ _thumb tack / push pin_
_diaper fastener____ _key chain________ _jewelry fastener___ a skeaver_______
_a nail___fork____ _a pick_an unclogger_ _small chopsticks_ (4 broken in half)_
_toe nail cleaner__ _ear ring________ _an antenna_______ _a tweezer_________
_a hook snake____ _to unclog drain)___ _hole creator_______ _a stencil________
Use to pull a black head tattoo gun _ piercer ________________

Bonus question (one-half point for every valid answer): Think up as many creative uses for an ordinary brick (besides typical use as building material) as possible. For example, one creative use would be as feet for a snowman. Pre-Test 8-31-16

Door stopper _____ Weapon_______ Exercise ___ Hold _ car from rolling____

Shot put ______ Fire pit_________ Weigh down balloons________________

Decoration (border ___ around plants)____ Paper weight____ Weights________

Door wedge____ Weapon________ Flooring ______ Stove________

Weights (lifting _ working out)____ Something to paint _ on (art)________

Shelf___________ Paper weight____ Door stop_______ Table coasters____

Plate___________ Red raisers (put_ underneath bed frame_to raise it higher__

Make a picture___ _frame___________ Ping pong paddle__ _________________

Anchor for a ____ canoe or boat_____ Blood spatter___ reconstruction____

Door stop_______ Block the tires of _ a vehicle to keep_ it from rolling____

Hold down a ____ large piece of _____ fabric___Weapon_ to break window__

Weapon_______ Standard of ____ measurement___ Door stopper__________

Hammer__________ Use as a weight__ for lifting purposes__ Step stool______Stop a car from____ rolling_________ Hold down a ______ piece of paper_______As protection____ (burglary)_________ (self-defense)____

As a table_(putting_ a drink on it)____ Use as a door_______stopper________

Put on edges of pool_ on top of pool cover_in weinter / fall__ season________
Use as balance beam. Use as a "rock" for hopscotch.


Weights. Murder weapon. Nut cracker. a pet "brick".

Many could be used as a stool. Door stop. Step stool. Paper weight.

To lift. Sand something down.

Flatten crinkled paper. Stop car from rolling down the hill.

Door stop. (keep door open). Fix table with leg that is really uneven.

Murder. Break window to get into locked car or house. Gloves.

Purpose: This laboratory session is designed to introduce you to the use of problem solving methods to help clarify the thought processes involved in analyzing complex data often associated with a crime scene reconstruction. The session will illustrate some of the creative problem solving tools that can help resolve many of the conflicting issues that make final determination of a crime scene scenario difficult. I will be facilitating the session and guiding you through some of the question and answer sessions and idea generation methods to enhance your group’s ability to organize data and come up with a better idea of what could have happened.

Ground Rules—Brainstorming

<table>
<thead>
<tr>
<th>Divergent (Hypothesis Generation)</th>
<th>Convergent (Hypothesis Evaluation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defer Judgment</td>
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<td>Strive for quantity</td>
<td>Be deliberate</td>
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<td>Seek unusual ideas</td>
<td>Check objectives</td>
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<td>Build on other ideas</td>
<td>Improve idea</td>
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<tr>
<td></td>
<td>Consider novelty</td>
</tr>
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</table>

Warm-up Exercise

Come up with as many descriptive categories as possible to describe a leaf. Try to come up with at least 35 ideas within five minutes.
Crime Scene Evaluation Worksheet

Victim ___________ Suspect ___________ Agency ___________ Case No. ___________

Possible crime type (homicide, burglary, sexual assault, kidnapping, etc.) ___________

**Data**
- What background information is known?
- Are there multiple scenes?
- What documentation is available?
  - Photographs
  - Crime scene diagrams
  - Investigative reports
  - Witness statements
  - Autopsy reports
- Can an activity timeline be constructed?
- Relative diagnostic value of evidence?
- Is additional expertise needed?

Evidence/photo evaluation:
- What is it? ___________
- Where is it? ___________
- When did it occur? ___________
- What function did it serve? _____________________________________________
- What does it tell us about timing/sequence? _________________________________
- What interrelações does it hold to other items of evidence? __________________

Initial problem statements:
- What evidence is present? Where did the activity originate?
- Are there indications of more than one suspect? Where did the activity end?
- In what ways does the scene evidence correlate with the victim’s injuries?
- _____________________________________________________________________
- _____________________________________________________________________
- _____________________________________________________________________
- _____________________________________________________________________

Purpose and desired outcomes of major case briefing?
- _____________________________________________________________________
- _____________________________________________________________________

**Session Plan:**
- Problem solving stage: ____________________________________________________
- Problem statements: _______________________________________________________
- Initial tool selection: ______________________________________________________
- Resources participants will bring (reports, computer software, evidence prioritization, linkage charts, etc.): _____________________________________________
- Session date: Time ___________ From ___________ to ___________
- Location: __________________________________________________________________
- Logistic needs: __________________________________________________________________
- Major case review participants: __________________________________________________________________
- Who will begin session? __________________________________________________________________
General Notes:
Creative Problem Solving
The Learner’s Model

1. Clarify
   Identify the challenge

2. Ideate
   Generate ideas

3. Develop
   Bring ideas to life

4. Implement
   Giving ideas legs

CLARIFY
Start here when you need to pinpoint the right challenge to pursue.

Explore the vision
Begin with a goal in mind. (If you’re not quite clear on the goal, diverge a list of “wish statements” that begin with “I wish...” or “It would be great if...” and converge by choosing the best one.)

Gather data
What’s a brief summary of your situation? Write the facts, history, key players, big opportunities, current intuitions and criteria for success.

Formulate the challenge
Reflect on your goal and the data around it. Now diverge on possible way to approach it. Remember to phrase challenges as questions and don’t stop at one. Begin each question on the list with a starter like,

“How to...” “How might...” “In what ways might...” “What might be all the...”

Write 10 possible questions and converge on the one that frames the challenge best.

IDEATE
Start here when you have a clearly defined challenge and you need ideas for it.

Explore ideas
Now that you’ve got the right question to set up your idea generation, diverge on all the possibilities, ideas and options that might work. Start with the obvious and push yourself to go beyond. Bump your brain out of its comfort zone and consider novel approaches. Look at ridiculous, even outlandish options. It just might help you branch down a rich new path of possibilities.

Idea shop
Once you’ve got a big pool of ideas to choose from, converge on your favorites. See if they cluster naturally into groupings and get ready to carry them forward into the next step.

Guidelines

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</tbody>
</table>

Wild card: INCUBATION
DEVELOP
Start here when you want to turn promising ideas into workable solutions.

Formulate solutions
Review your top ideas and synthesize them into a “story” of what you’re planning to do next. Write it like a journal entry, giving rich details, clear deadlines and measurable results. Begin with the statement starter...

“What I see myself doing is...”

POINT evaluation
Now it’s time to evaluate and improve your solution. One useful tool for that is POINT, which stands for: Pluses, Opportunities, Issues, and New thinking. So first, consider what are your solution’s pluses? What opportunities might open up if you implemented this idea? What issues might need to be addressed before the idea is ready for prime time? Can you bring some new thinking to overcome those challenges (which you’ve cleverly phrased as questions)? Based on your POINT evaluation, what might you add to your paragraph to improve your solution?

“To strengthen my solution...”

IMPLEMENT
Start here when you need buy-in from others and an action plan to follow.

Explore acceptance
Diverge on a list of who or what might assist you with your solution. Write down how you might enlist their help. Make a list of who or what might resist and how you might overcome that resistance. Converge on your critical area of focus.

Formulate a plan
Diverge on a complete “to do” list of everything that needs to happen to make your solution a success. Then converge on the key steps and sort them into short-term, mid-term and long-term activities. Commit to do something in the next 24 hours!

Assess the situation
Throughout the process try to stay aware of what sort of thinking needs to happen next. Sometimes you’ll assess the situation, gather data and move forward to the next step — sometimes backwards. Your goal is to become increasingly aware of what type of thinking will take you to your goal.
## Process Overview

<table>
<thead>
<tr>
<th>STEP</th>
<th>CLARIFY</th>
<th>IDEATE</th>
<th>DEVELOP</th>
<th>IMPLEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start here when...</td>
<td>You want to create, invent, solve or improve something</td>
<td>You need novel, useful ideas to address your challenge.</td>
<td>You want to turn promising ideas into workable solutions.</td>
<td>You want to get buy in and implement your solution</td>
</tr>
<tr>
<td>Statement starters</td>
<td>I wish... It would be great if...</td>
<td>What I see myself doing is...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How to... How might... In what ways might... What might be all the...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mindset</td>
<td>Clarifiers are strategic thinkers. They identify gaps. They see opportunities. They value facts, questioning and information.</td>
<td>Ideators are imaginative thinkers. They get the big picture. They mix and match ideas to create new possibilities.</td>
<td>Developers are evaluative thinkers. They select, improve and refine ideas to get the solution &quot;just right&quot; for its context.</td>
<td>Implementers are tactical thinkers. They learn by testing and prototyping to see what works.</td>
</tr>
<tr>
<td>Tools</td>
<td>Check for ownership, motivation and need for imagination Gather data questions Phrase challenges as questions</td>
<td>Brainstorming Brainwriting Forced connections Visual connections Excursions</td>
<td>POINT Evaluation matrix Card sort Targeting</td>
<td>Assistors/resisters Action plan Debriefing questions</td>
</tr>
<tr>
<td>Outcome</td>
<td>A statement of the goal, wish or challenge</td>
<td>One or more ideas that will solve the challenge</td>
<td>Well developed, detailed and improved solutions</td>
<td>A plan for taking action</td>
</tr>
<tr>
<td></td>
<td>A well-defined challenge question</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Evaluation Matrix Worksheet

Rating scale: Excellent Okay Poor
A B C D E

Options

Criteria

Sidney Parnes uses the evaluation matrix in his Creative Behavior Guidebook and Creative Behavior Workbook.
Brainwriting Exercise

1. Write question related to segment/evidence piece on top of brainwriting form.
2. Hand each participant, gathered around a table, a pen, a pad of sticky notes and a brainwriting form.
3. Ask each person to silently reflect on the question and write three theories, one per note, to stick on the boxes in the top row, that would be explained by the evidence.
4. When the top three ideas are filled in, toss the sheet to the center and grab a new one.
5. Build on previous ideas. Read all the theories on this new sheet and come up with three more theories. Fill the next row with your ideas.
6. Swap sheets until all the boxes are filled in.
Bloodstain Pattern Scenario Exercise
You have received a series of crime scene photographs and a crime scene sketch from an outside agency that has requested your assistance in reconstructing a shooting incident. A child is reported to have obtained a gun from his mother’s purse which was lying on the side of the bed in this apartment, shooting himself in the head. The district attorney wants to know what sequence of events can be reconstructed from the examination of the blood patterns in the photographs. The mother was in the residence at the time of the shooting.

General view of crime scene:
Based on these images, assume that the red stains are blood. Determine the possible events starting with the shooting. Note relative location of activity and nature of the activity based on bloodstain and other evidence in the crime scene photos. List the events, determine the relative sequence using a time line and then establish a flow chart of final sequence once all photos have been examined.
Appendix F

Student Interviews

Approx. 20 minutes discussing each photo

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Interview with E. S.

September 7, 2016

What are the primary aspects or salient characteristics you noted for each of these blood spatter events? Photo 21 showed a separation of patterns due to configuration on corner of wall. Downward angularity, energetic pattern. May be due to cast off of blood from knife due to large amount of blood spatter. Photo 22 may be a gunshot wound as there is a large bit of bloody tissue in the center of the pattern.

Showed E. S. photo 16 which illustrates a GSW pattern. Close-up GSW often accompanied by muzzle debris from the firearm as well as high velocity blood spatter. He noted that the pattern in photo 22 seemed symmetrical but then on closer inspection, the stains were a little more elongated (“narrower widths”) than bloodstains on the other side of the pattern suggesting some directionality. Photo 22 has a large clump of matter suggesting that someone was in direct contact with the wall. It may have been above a bed “although a blanket should not look like a rug.” Head was probably close to the floor.

Was there more than one impact (Photo 22)? In a beating, need multiple impacts, the first to release the blood and subsequent impacts to scatter the blood. The smooth, solid blood staining next to the big clot suggests steady contact between surface and bleeding head. How would you duplicate this pattern? Might prepare a sponge and throw it against the wall at different angles to try to duplicate the angle.

How might one simulate the situation in photo 22? Might want to have a material that simulates the human head like a watermelon or a coconut. What other property is seen with the head? Hair. What appearance would bloody hair give against a wall? Voids, “particulates”. Would a bloody sponge be the best way to simulate the condition?

How would you simulate a gsw type event without a firearm? Throw a bloody object hard—you could simulate the speed of the bloody mass hitting the wall and not necessarily the speed of the device that produced the initial bloodletting. Need to simulate only a portion of the event, i.e. the impacting blood mass.

Photo 21 described as a high velocity in a corner. May be blood from a swinging knife such as cast-off. Appeared to be more energy in the left hand portion of stain because of
angularity of stains, the stains on the right-hand side of the pattern appear to have hit head on. Downward trajectory. Might be a cut throat, arterial spurt.

How would you differentiate between blood from a swinging knife and an arterial spurt? Pump to produce pressure. Showed E.S. photo 1 or arterial spurt. Pulsation suggesting continuous rotary type of pulsation. His scenario might require just a single pressurized event. How would you simulate this? Use of a spray bottle, pump, balloon. Have blood in a tube under pressure, nick it and release the blood under pressure. The dimensions and the downward angle suggests a body close to the ground or a cut low to the body such as lower part of leg. Pattern, void created by gap, configuration of corner. Shadow present but distance of gap not immediately ascertainable.

What materials would you need to duplicate pattern? Coconut, fake blood, knife. Hand pump, bulb, balloon, some way to introduce pressure, maybe plastic squeeze bottle.

Meeting with the Three Groups

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Group 1 (high velocity without firearms). What mechanical device can introduce rapid motion? Perhaps a toy. E.S. got the idea for a spinning device that is rotated and then spins off a hand-held platform. It can be glued down so that it spins faster and faster. Mouse trap? Might want to research the velocity of hitting a golf ball or striking a baseball. Have a finished project that is marketable.

Group 2 (distance vs. size). Let group know that conditions not as bad as they seem, a simple device such as a rotary motor could accomplish this. How far would blood droplets must travel? Just need to travel six to eight feet. Need a rotary device, an arm to absorb the blood and a means of containing the blood so that it goes through an exit port onto a laid-out sheet of paper.

Group 3 portable device for recording blood volume. Could be of PVC pipe construction with a grid in inches or other convenient scale that can be laid over a blood pool to estimate blood volume loss. What device can travel at variable speed? Remote controlled model sports car. Can have a car that travels at variable speed or a speed at one setting then introduce a mechanical impediment to the wheels and it travels at another speed. What speeds are you considering? Something consistent with human movement. When you go to the gym, the treadmills have a rating of 2 mph for a slow walk, 4 mph to mark transition between fast walk and run and 6 mph for fast run. What blood volumes need to be released, e.g. single drops like from a nose bleed or larger volumes? I anticipate a single drop at a time but I don’t want to impose any unnecessary constraints if you come up with a method for dispersing variable blood volumes, use it. The more variability in function of the design the better. You want us to build a model? You will have working
diagrams and prototypes that you test but ultimately one polished working model.

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Interview with

V.E.

September 12, 2016

Photo 14 what did you see as the primary pattern? Flow pattern that went straight down the body. If she was raped, there may have a wound and bleeding from the vagina. Can’t make any inference along those lines based on just this photo. What type of surface was body on? May be concrete. Look at the blood pool and less intense blood stains from that pool. Would concrete leave that type of pattern? Maybe a rug. Stain above right knee has a lack of staining. May be area where legs were together at the knees preventing blood from flowing into that area. Asked her about the smear area on the lower left leg. Maybe due to gripping the leg when bloody. I can see indications of a hand mark. There appears to be two bloodstaining events. The stains on the upper left thigh are from a separate event. How might the blood flow and smearing be connected? What is the significance of the pooled blood? She may have been kneeling in that position for a period of time.

Photo 20 shows blood going in an upward direction. How far off the ground is the pattern? May be about two feet because of the floor in the other part of the photo. There is a light switch or socket on the wall with the pattern but these can be mid height. What surface is this pattern on? It’s on a wall. What type of weapon may have produced these large stains? May have been made with a baseball bat. Stains are definitely going in an upward direction? What would you do to simulate these stains? Have someone run blood down their legs and have situation with legs together and another situation where someone is grabbing them by the leg. Can we simulate the flow pattern without the use of a body? Can use a manikin or could use something cylindrical. For blood spatter, can strike something at different heights. For the notebook can be cut out sections of our reports and past them in the notebook. Yes, but I want it to serve as a means of recording your ideas for your blood spatter projects.

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Interview with J.M.

September 12, 2016

Photo 29, where is the location of this scene? Appears to be in an office building because of the file cabinet. Where did the victim receive the majority of blows? There is a blood
pool near the bottom of the photo. You have two different types of stains between the file cabinet and the projection on the wall. May be high velocity, may be due to stabbing. Need to consider blood droplet size and distribution and whether the volume of blood seen is consistent with a beating or a stabbing. For the structure on the wall, is there a difference in pattern between the right edge and left edge? The right edge seems to be more spatter straight on while the left side seems to be more at an angle. Looking at the angular stains, can we say anything about the number of blows? We can say that there were more than one, probably three. We can use them to determine sequence? How might you do sequence? Would sequence be important or number of blows struck? Were all of the blood spatters done at about the same time? What would you test for when doing a reconstruction? The victim may have been at different heights when struck. Do you want us to provide a right answer or just go through the thinking process?

Photo 25 appears to be in dining room / kitchen. There are two types of events, blood dripping and something being dragged? The broad area at the right bottom of the drag mark is going from left to right. Can you accurately determine swipe direction? What would account for the large area of swipe vs. the smaller areas? Person may have been dragged and we are comparing a limb vs. a body trunk. How would you simulate this? Manikin, sack. Person may have crawled or person may have been dragged. Is there a difference in drip pattern from one part of room to another? Would furnishings in room account for the difference? You have blood drops in the bottom left corner and smear marks over them, what occurred first? Sometimes there is not enough information to decide one theory vs. another, sometimes the same pattern can be explained by different events that can’t be definitively associated with one event vs. another. Look for the obvious indications of trauma in the photo and the mechanisms that could have produced it. See what types of experiments can resolve them. We are trying to determine if there was more than one suspect. What other aspects of the scene should we be trying to resolve?

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Interview with C.V.

September 14, 2016

Photo 24 what observations have you made so far? Blood pool on the floor in a separate room. There are blood drips in another room. I don’t know what that thing in the center is. (A heating vent). What are the main patterns you are seeing? Pool of blood, blood drops, marks on the floor like shoeprints. There are some marks that look like shoe prints? What type of shoes? They have these things on the sides that look like work boots. They are going in the same direction but one is off to the side. There is a bloodstain by the door where someone may have rubbed against it. How far off the
ground is this rubbed stain? About a foot, maybe a baby’s height. Is the pool of blood volume consistent with a baby or someone larger? More consistent with an adult. You have a pooling of blood near the edge of the. Does this pooling of blood suggest slow flow or could there be splashing or other activities? What type of surface is the pooled blood on? Will this influence the nature of the blood pool? You have a serum and red blood cell separation, what does that tell us about the time interval? The area with the dripped blood, does this appear different from other areas in the room, such as volume of blood lost? Would the volume of blood lost suggest blood dripping from a weapon or a bleeding person? A bleeding person. This person may have been injured in another room and they tried to get to another part of the house. Would the pool of blood suggest that the person got back up again? No there is too much blood. Likely their final resting place. The group of stains are more numerous in one location than the other so he may have been standing there for a while. Do the small droplets around some of the bigger blood drops suggest anything? What about an indicator of the height from which the blood had dropped? What about the splashed blood around the corner of the door, could that be used to evaluate the height of the blood being dropped? How would you evaluate or get an estimate of the height? You would need to get the same type of tile like material to drop blood on. How far the blood satellites are from the main stain may help tell us the drop height. Is there a way we can establish a scale for the photo? What are the dimensions of the tile squares? We have a door of a certain width and spanning about three tiles. We also have the width of the floor heating vent and the squares in the grating.

Photo 15 where did this take place? In a car. Can you tell if it is passenger or driver’s seat? Look at position of arm rest, window, and the locking mechanism. It’s probably the passenger seat. What type of stain is this? It is high energy. Does this represent a single or multiple energetic events? It’s confined to one area, there is no cast off, and it appears consistent with a single event. The stains along the periphery and on the window, we will need to account for them. How large are the stains? You have these stains along the edge. What does this solid color suggest to you? Something with blood on it rubbed up against the surface. Blood spray or mist due to gunshot type forces can produce a solid mist of blood that appears solid if the surface is close enough. Is this what we are seeing here? This decal that looks like a jaguar on the car seat, can this help tell us the make of the car? Is there anything that might help give us a scale to items in the photograph? How could you reproduce this stain? It looks like a gunshot but we can’t use guns so maybe fill a balloon with blood and burst it in that area. What is the shape of the bloodstain? It is “shrimp shaped.” Can that give us any clue about directionality? What part of the body likely produced this stain? The head. There does not appear to be a bullet hole or any gunshot damage unless bullet traveled at an angle and is outside the view of the photo.
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Interview with A.B.

September 16, 2016

Photo 10 what do you think this represents. Looks like a bullet hole. If you look at the smaller stains that appear to have dripped of the bat, they are in the 3 to 5 mm range so it looks like this photo is close to 1: 1. Given that information, what is the size of that central defect? About 1 ½ inches. On what type of surface? Looks like a wall. How can you confirm that it is on a wall and not on the floor? The drip pattern. What is the shape of the hole? It seems to have a somewhat rounded edge, not too sharp or too deep. What type of instrument could have made that mark? Would a baseball bat can leave that type of mark? How did the blood get there? Maybe a cast off of some type. Blood forcibly ejected from an implement like a bat when it comes to a rapid stop is impact spatter. How could we duplicate this? I don’t want to hit a wall and cause damage. You could simulate the same type of effect by coming to a rapid deceleration such as hitting an intervening object that could shield the blow such as a water bottle but still cast-off material from the bat. Is there one part of the stain that seems to suggest greater energy was used to produce the pattern? The part in the middle with the long stains. If you look at the stain pattern, there seems to be three different groupings of stains arranged in roughly a straight line: a series of dripped stains on the left, an impact in the middle and a series of stains involving slightly larger volumes of blood that have impacted the surface to the right. What could cause this differentiation of stains? The blood on the right might be partially clotted and has slightly different flight characteristics. How would you simulate blood in different clotting stages? You have blood staining along the inner periphery of portions of the hole but not in other areas of the periphery of the hole. Is this of any significance? Based on the pattern especially the center portion with the narrow spines of blood, can you make any inference as to whether the person was swinging the bat and hitting the wall was standing to the right or to the left? This may be another variable to research. What volume of blood would you say was on the bat to give the patterns as large as they are? Probably a lot.

What can you make of photo 26? I don’t know. What do you see in the center of the blood pool? Could it be the outline of a body? You have pooled blood and there is cracking? Could it have been there a long time? When do you think this photo was taken? From the blood cracks, a couple of hours afterwards. What about the TV set in the picture? When do you think this photo was taken? Maybe in the 80s. What important areas do you see? The pooled blood and serum separation, the void areas to the right of the major void area and the pattern on the wall from impact or a gunshot. Looking at the center portion, how was the person positioned? On their side. What about the position of their legs? They were folded up and this blood smear indicates one above the other.
resting on top of each other. The void area to the right, could that have been where the head was when they started bleeding and then rolled to the final position? I can see the head, an area for the shoulder and what looks like a shoe mark at the bottom of the photo. You will have to imagine how they could have been positioned if their body position changed at some point and would it fit the blood pooling and transfer stained areas? They could have been on their back and their arm caused the smearing on the upper left by the foot of the bed as they rolled over. What room of the house is this in? The bedroom. What type of surface is the blood on? A tile floor but odd pattern. Can the size of the tiles be used for a size reference? The bloodstain on the wall consists of a broad smear, some spatter around the periphery and some stains that are projected onto the wall at an angle and then blood flows down under the force of gravity. What body part was injured? The head. How would you reconstruct something like this? I don’t know. You might focus on the body outline, blood pool, and transfer and spatter stain and clotting and time of injury.

FOR 312 Chemistry & Criminalistics

Interview with A.N. on

September 16, 2016

Photo 8, what type of pattern is this? Appears to be a blood smear. What properties of blood might explain this pattern? What about viscosity? What about capillary effects of blood adhering to a surface that comes in contact with a pool of blood and is then lifted up? What body part made this? Appears to be two overlapping hands, I can see what looks like fingers at the top and the left side looks like the palm of the left hand. How were the hands positioned? The right hand may have been curled on its side causing a gap and a more intense flow pattern along the edge. The other pattern appears to be flat on the surface. What type of surface is this? May be a smooth surface like tile. What direction was the blood flowing? Looks like wave patterns in the palm indicating an upward flow pattern. If you look at the palms of your hands, you will notice ridges and folds due to natural ridges. The blood could have flowed underneath those surfaces to give a wave like effect. If you look around the fingers, there is dark staining in the middle and weaker staining along the sides, what could cause this? Could it be pressure effects? If the periphery is wide or shallow, could that tell us something about the pressure? The more pressure the wider. What type of force was used to produce these patterns? That is, was there a steady pressure of the hands in blood or was there a slapping motion? Consider the difference in pattern between wading in a puddle of mud vs. jumping or stepping hard creating splashing. How would you simulate a pattern like this? Consider possible ways.

Photo 11 shows a drag pattern. At first, I thought they were being dragged from the bottom of the picture toward the top but now I think it is from the top to the bottom. The top bloodstain is bigger, body may have been there longer. The top bloodstain is bigger in
terms of diameter or amount of blood deposited. Do you see the color transition? You mean between the main blood area and the serum area? Between the main body of the drag mark about midway there is a color shift from the dark reddish brown to a truer red. This may have been a point where the dragging ceased for a period of time, or something opened up in the body releasing fresh blood. Do you know what these dark areas are? Larger bloodstains? These are likely areas of blood clots. There was a period before the body was removed. Large clots formed around the body and became dislodged as the body was dragged. Is the fact that the drag mark swings from side to side of any significance? The size of the body and the configuration of the room. In what room did this take place in? Likely the kitchen. Did the person crawl by themselves? No, there would be hand marks along the side of the blood trail. How was the person dragged? By their feet. Consider how you would simulate the dragging motion of a body and duplicate it. Can you estimate the amount of blood lost and is there an internal scale? The empty plastic water bottle may be of some help. You have counter heights which may be standardized.

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Interview with A. R.

On September 19, 2016

Photo 6 I think that is blood dripping into blood. Look at Photo 3, which is actually a case of blood dripping into blood. Which of the two, Photo 6 vs. photo 3 shows the higher energy level? Photo 3 has an even distribution of blood drops. The drops are rounded in photo 3 but what is different about the appearance of the satellite drops between photos 3 and 6? Focus on the edge between photo 3 and 6. Is the color important? The center stain in photo 3 is redder. In photo 6 the edge is more irregular and the spines are elongated. They are more elongated in photo 6. Elongated spikes in the satellite blood and along the edge is reminiscent of stepping into mud vs. just dropping a rock from a small height. How do we impart more energy to the blood pattern in photo 6 in order to make it appear more energetic? We can use a pressurized force such as a syringe. We can modify the height, i.e. blood squeezed out under pressure close to the surface will have more energy than one squeezed out at some height above the surface where the force of gravity and air resistance can mitigate some of the initial pressure. Is this on a horizontal or vertical surface? Probably horizontal. Look at photo 10—this is an example of cessation cast off. How can you tell if something is on a horizontal or vertical surface? You see run off (as in photo 10). Do you see any indication of any run off in photo 6? It is therefore likely that it is on a horizontal surface. Will the type of surface be important? Think in general terms such as a smooth vs. rough surface. A rough surface may cause some of the stains to sink in. The type of surface will be important when you do your reconstruction. You could probably use butcher paper or lab coat, a type of waxed filter paper or a tile square.
The blood volume will also be important. You can look at 1 ml, 3 ml, 5 ml, etc. and see how the volume is comparable. Pour it out of a beaker from a height. Do we have to do the re-enactment? You said we could draw designs. Yes, but for something this simple, it involves pouring various volumes of blood from a beaker, there is not much design in that type of set up.

Photo 6 looks like cast off, obviously on the ceiling. What can you say about the number of events? Look at the blood patterns as individual entities. What is their primary shape? Think of a simple geometrical shape—a line? How many separate lines can you find? About six. Can you determine direction of the blood stains from this photo? It’s difficult because of the pixilation but based on their position on the ceiling, they appear to be moving down toward the bottom edge of the photo. I would be making a mess trying to do this reconstruction. We have PVC pipe and connector T’s to construct a cabinet that can be draped with the white butcher paper to capture stains. You could use the folded-out cardboard from a large box to serve as a witness panel. You might swing the weapon while lying on your side and the witness panel above you—that would achieve the same type of general motion. Some of the blood drop spacing differs—this may suggest different length weapons but it would be something you might want to try out. How rapidly swing and orientation of weapon are important as well as volume of blood on weapon. Cessation cast off is when a bloody weapon experiences rapid deceleration as when it strikes a shelf and blood is flung off. Photo 10 is a good example of that. You see the hole in the wall where the weapon hit and the areas of bloodstaining throughout but in a linear pattern from the left where blood fell of the weapon due to gravity, the center around the hole in the wall with elongated spatter stains and the clump of spatter beyond the center hole, to the right but not terribly diagnostic.

Photo 28 shows impact spatter and a transfer stain. The transfer stain could have been made by the swiping action of someone’s hair in blood against the wall. The impact stains look like they are going in the same direction. The larger stains on the left side of the wall seem to be running straight down. Those in the middle are going at an angle and those to the far right are going off at even more of an angle so at least two direction shifts and maybe three or four if you count the vertical stains. Some of the stains are impacting at about 60° and others at 10 to 20° and in the three slightly different orientations. The size of the stains suggests different distances of the bloodletting event from the wall. Can you do sequencing of activities? You have two running blood droplets on the left side of the transfer stain that have not been disturbed. There was blood letting, sufficient blood to create a transfer when something was rubbed against the still liquid blood and then additional blood was superimposed over the transfer stain—all suggesting at least three separate events, confirmed by the differences in directionality and difference in size of blood droplets. About how far off the ground is the blood smear? About a foot, it appears a little above an apparent base board along the wall with the bulk of the bloodstains. I
don’t know how I would reconstruct something like this. You would have a blood receptacle off to the side (to the left) like a Styrofoam head filled with a blood substitute that could be impacted at various times, directions, angles, distances from the wall. Then experiment with fabric or hair from a wig or manikin to simulate the smearing.

Photo 12 illustrates a blood stain. There is no scale in this photo but it appears to be an enlargement of a single stain. Roughly what is its length? About 1/4 inch. What type of surface is this? Be aware that this is a magnified image and surface texture may appear exaggerated. Might be a rug. A rug will have a pile and rough surface and would be absorbent. Look at the stain edges, they are sharp including these fine satellite blood streaks below the main body of the stain. What are these circular structures in the middle of the stain? They are air bubbles. When blood comes in contact with blood it can create bubbles in the blood stain. How would you duplicate bubbles? Think of common applications like carbonated drinks. Putting blood in a syringe and shaking it up can produce bubbles. Shooting blood through a screen can help to atomize it. You would also need to consider how to duplicate the angle of impact. Different substrates might be something you would want to test and how to distinguish between different surfaces.

FOR 312 Chemistry & Criminalistics

Interview with S. T.

On September 21, 2016

Photo 1, this looks like someone who was hit with a baseball bat. Do you think that you would easily get this wave-like pattern if it was cast-off from a swinging baseball bat? A baseball bat is swung rapidly and this would be difficult to produce, I would expect to see straight rather than curved cast-off patterns. What about the size of the blood drops? They look big, it looks like too much blood to be on a baseball bat. How far off the ground do you think these bloodstains are? About five feet. Look at the size of the blood drops to help you get an estimate of height. Look at the corner in the wall and the amount of offset. You can also see a hint of the ground in the middle of the photo. I can see spattered blood there. Perhaps it is two feet maybe three feet off the ground. This would tell us something about how likely it is that someone was struck with a baseball bat. Could someone have been bleeding and they walked across leaving the stains. Maybe but what would account for this sinusoidal pattern? Think of something pulsating, think of pressure variation. What organ in the body could generate that type of action? Think of a person’s beating heart. There may be a nick in an artery and blood is spurting under pressure. Could the person have been moving around? The blood pattern apparent just in this photo is consistent with a person in a single position. Based on similar angularity of the impact stains, around 20 or 30°, the blood is projected from a distance and landing on the wall at that angle, consistent throughout the pattern. You also see spatter near the
ground. The subject is probably not too close to the wall since you need to get the continuous pattern around the corner and the rest of the surfaces in the photo. How would you generate this pattern? Could you fill a puppet with blood and swing it at the wall? You might be able to paint a pattern like that in some fashion but the real mechanism of arterial spurting is projected blood under variable pressure and your reconstruction model would not address that. How detailed does the reconstruction need to be, do you need to assemble apparatus or have a body in the re-enactment? Consider that you are trying to explain your results to a jury. You believe that it is due to arterial spurting, so how would you introduce variable pressure that is reproducible to produce this wave like pattern and not involving a person? What can generate variable pressure? Tire pump? Swimming pool pump? Rotary lawn sprinkler? Some blood pressure cuffs can be squeezed to higher pressures with a bulb. You might be able to prick a hole in the cuff and bring it up to pressure, but would you be able to reproduce this entire sequence of up and down waves? You would want something reproducible? Do we have to reproduce the pattern in class? No, you can produce the pattern and do your experimentation outside of class, just have some demonstration available in your Power Point. You can explain your assumptions in a little more detail in your written report. Your objective is to get as much understanding of the causation mechanism as possible and try to duplicate that with some equipment that illustrates your knowledge of blood properties.

Photo 12 looks like a footprint. You have to bear in mind that you are looking at a magnified image. What is this round structure? It looks like a bubble. You can get a sense of the degree of magnification by looking at the rough texture of the background which is a stucco wall. Is this on a horizontal or vertical surface? Looks horizontal. Look at the rough texture, this is more consistent with a wall. This is a single bloodstain impacting at an angle. We can tell direction and we can estimate angle of impact. The bubble tells us that is expired blood. Why is it darker at one end? This is where an additional layer of blood has accumulated producing a darker surface. If you look at other areas of the stain, there are void areas where some of the blood has flaked off the surface. This will give us some hint about length of time on the surface and drying time. We can reproduce direction, and angle of impact and the fact that it is expired blood. The discoloration of the rest of the stain suggest some mixing with other types of material such as saliva. So you would need to investigate properties of blood mixed with saliva.

FOR 497/498 Micro-Course: Bloodstain Pattern Interpretation

Interview with E.V.

September 27, 2016

Photo 22 There is a large mass of blood in the center. The person was close to the wall or against the wall when shot. This is what a gunshot looks like. It has a limited amount of
blood compared to what we are seeing here. You may also see some of the smoke or powder residue against the witness surface. What type of weapon would generate this much blood? Maybe a beating. What type of weapon? Maybe a baseball bat. How far off the ground is the large volume of impacted blood in the center of the pattern? Maybe a foot. Don’t know if the scale is in metric. It may be about 10 inches. What body surface is being struck? Maybe the head. What position is the head? May have been low with shoulders accounting for smeared stain. Does the stain indicate a single or multiple event? The angularity of the stains on the left and the rounded stains on the right probably more than one event and the large blood spot in the middle. What would cause the large blood spot? Could the blood spot be due to clotting? If clotted what would that tell you? It could tell you something about the time interval over which the incident occurred. You have a large stain on the rug just under the pattern, could that help you isolate where the head may have been? The person may have been kneeling or moving from one position to another. Do you think a baseball bat to the head with the head in this low position and the upward spread of bloodstains be easily done with a baseball bat? It may have been something short handled such as a hammer. You have a large amount of blood, it suggests something larger. What about a shoe? Could this represent kicking and stomping? What type of shoe? Probably a boot, maybe something with a steel toe. That would allow someone to continue to swing to the side getting the blood on the left side of the pattern. You may have a combination of kicking and stomping causing squeezing of blood out of a wound. This may be a little harder to demonstrate with a blood-filled Styrofoam head. How could I build an apparatus that would duplicate this? You could create something that would demonstrate certain aspects such as a drop and release mechanism that could drop a weighted shoe from a height and a pendulum device that would simulate a directional impact similar to the shoe. You would need some way to simulate clotted vs free flowing blood. How extensive would the simulation have to be? Would it involve other people? You are trying to demonstrate basic principles of the main events that caused the pattern in a courtroom hopefully with simple apparatus that reproduces a pattern. Document your observations and findings in a Power Point and short paper. You don’t have to demonstrate it in class. There are more expensive heads available for blood spatter work that might be more suitable than Styrofoam.

Photo 9 looks like some stains from a stabbing. Do you think a knife could carry that much blood? It might be from a larger instrument. Does most cast-off come off a weapon from the upward swing or does any come off in the forward swing too? You can have cessation cast off when the weapon strikes a hard surface and comes to an immediate stop. But most cast off is during the more rapid portions of the swing when the weapon is nearly vertical above the head and centrifugal motion causes the blood to fly off toward the ceiling with 90° impact stains. You can tell directionality and you can tell the number of swings. The distance between the bat and the ceiling would not have much of an influence on the pattern. You cannot make many inferences regarding the height of the
suspect and the length of the bat based on the likely height of the ceiling—you are assuming too much from this one photo. If you think these stains could have resulted from a knife then you can do some experiments with that. There may have been blows to the head and stab wounds in the chest. If you think those are possible you can create scenarios and prompts that can test those possibilities.

FOR 312 Chemistry & Criminalistics

Interview with A.M. on September 23, 2016

Photo 17 looks like someone was in a fight, they were in close proximity. You have spatter that has little smearing, is that consistent with someone in a fight? It could be from a gunshot wound. They shot someone close up. Look at the size of the stains. They are small. They appear to be direct impact rather than angular. You have a heavy concentration around their pointing finger and some on the side and some on the forward part of the thumb. The pattern ends abruptly at the wrist. Is it possible that the person could have shot himself? I didn’t think of that—that could explain the lack of disturbance of the blood spatter. If you look between the thumb and the index finger, you can see a void area. They may have been holding something. The heavy blood spatter on the tips of the fingers puzzles me, you may have to consider several different hand positions in order to replicate the spatter. The smear on the index finger tip may have been a result of the gun falling from his grasp. Could the smeared blood, which looks like it might be a flow pattern on the bottom of the hand, could that have resulted from coming in contact with a pool of blood? What if the person shot himself and the gun just fell from the outstretched arm at his side as he slumped over? The salient features you will need to address to the jury in your reconstruction—your belief that it could be self-inflicted is explaining the spatters on the hand and how they could be consistent with holding a gun in various positions consistent with suicide. Bear in mind that the other hand may have used to help position the shooting hand so these things need to be considered. The other factor is distance from point on the body where the shot entered, it must be close enough to be possible for a self-inflicted wound. You have spatter and apparent fine mist, how would you duplicate this? I tried a balloon filled with fake blood but it didn’t work well, the fake blood all settled on the bottom and the balloon did not burst with much force. You might be able to use a spray bottle and squirt it through a fine cloth to simulate the smaller stains. You could use a squirt gun to simulate a gun. You will probably have to use a real hand to test the full range of motion and how it effects blood spatter pattern from different distances with the gun held in different positions.

Photo 13 looks like expirated blood based on the bubbles. This was one of your photos in the pre-test. Don’t know what type of surface this is, the photo is really magnified. Is the
surface on which the blood is resting horizontal or vertical? It appears vertical as blood is running down from a break in the pattern. The expired blood has a line of clotted blood that is holding the rest of the blood back except for this break point where the blood is flowing down. Don’t know what is causing this line at the bottom and what caused the break in the blood “dam.” The straight flow pattern may be from a ridge between two bricks or cinder board. What are some of the things you will be testing in your simulation? Surface material. There may be a regular wall or the cinder blocks that you see in some basements. I could do some of the building materials on brick buildings or the concrete on the side of the side walk curb. To simulate expired blood you could use a syringe and shake up the blood vigorously to introduce bubbles. You can then somehow direct it onto different surfaces. Different surfaces and their effect on the viscosity, surface tension and other aspects of the blood should be tested. What type of enlargement do you think we might be dealing with? The impact stains indicate a direction overall from left to right. Their small size suggests an impact. Larger stains under flow of gravity will be larger. A blood stain falling only under force of gravity would produce a stain of around 5 or 6 mm. If we could correlate that diameter with the blood flow from the expired blood then it would suggest that this photo is about a three times enlargement. This smaller pattern may be easier to reproduce on different surfaces. The major points for testing would be surface effects and expired blood as theorized by the presence of bubbles. Based on the surface you might be able to determine what caused that line of dried blood and the break in the line.

FOR 312 Chemistry & Criminalistics

Interview with H. A.

October 3, 2016

Photo 2 appears to be a couple of blood spots from a cut like a bleeding finger. What type of surface have the blood drops fallen on? It looks like a rug. Why do you say it’s a rug? It has that spread out appearance like blood falling on a rug. What are the size of the blood drops? About 2 mm. If you look at this image, the stains appear roughly life size and a little less than two cm in diameter. Is there anything unusual about the stains? They appear to be close together as if someone was standing in one location. What else about the appearance of the individual stain? It is deep red near the center. You are correct, the stains are a uniform red and they are diffuse at the edge, what would cause that? Well if they fell from a height. Yes, you don’t see much spatter and the stains are uniform in appearance (color) and contour edge is smooth. Size might be due to height from which blood was dropped, these may be close to the surface. True but what could cause stains to diffuse? What is it about the surface? You may have something absorbent like filter paper. I don’t see enough surface detail in the photo to suggest a carpet. It may be something absorbent like thick filter paper. It could also be a surface that is wet. What
about a wet T-shirt? That type of fabric could explain the featureless background white color as well as filter paper. Is the amount of blood you see consistent with blood dripping off a weapon or from a bleeding cut? There is too much blood to be from a weapon. I would test blood falling from different heights. You could use a pipette to disperse individual drops, just stay near the same location to get overlapping blood drops as you see in this pattern. You might want to try different surfaces that have varying degrees of absorbency. You might also want to drop blood on a wet surface and drop blood on a dry surface, allow the blood to partially dry and then subject it to moisture to see if there are any differences in the pattern. You may want to drop it from different heights to see what effect height would have on the breakup and secondary spatter of the stain on wet surfaces.

Photo 16 looks like high velocity like a gunshot. There is spatter. There is also a flow pattern flowing off the face straight down. She probably didn’t move around much. This is fairly clearly a high velocity, a.k.a. gunshot wound probably to the head. You can see the solid misting of areas of blood nearby and the gray smoke-like material at 10:00 o’clock is the debris from the barrel of a gun after firing. Blood is radiating outward from a central area. How would I simulate something like that? Perhaps something high pressure. Could I use a balloon filled with blood? A balloon filled with blood—the blood would tend to settle to the bottom and the balloon would burst at the top, you really can’t get good directionality from something like that. A pressurized device through a narrow opening or a fine screen might work. I have a friend who works at Home Depot and he can loan me a stud gun. You can get a Styrofoam head a pressurize blood with a syringe through a small opening. You would also want to simulate the flow patterns around the face and you would need to investigate the effects of fabrics and positional blood flow in simulating blood on victims clothing on her left collar and right center part of shirt. It looks like the body is propped upward off the ground. Why do you think that is important? It may affect the blood flow to other parts of the body. Not sure if there is blood under the hair, photo too dark. So, you could simulate this with mannequin head, some cloth material to simulate blood flow pattern and some pressurized device shooting blood from interior of head outward to a poster board panel.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation

Interview with K. A.

On October 3, 2016

I think I know that photo 24 represents pooled blood and pattern impressions but I was not sure about photo 21. What do you see in photo 24? There is pooled blood in the other room. There may be two injured people. There appears to be dripped blood from a weapon and footwear impressions. Do you think the amount of blood that you are seeing
is consistent with blood dripping from a weapon? It’s probably from somebody who is wounded and wandering from room to room. You do have those small smeared stains on the edge of the door frame although they are somewhat close to the ground. You have pooled blood in the upper corner of the photo in the room next door and there may be a body out of view of the photo. Can you tell anything about the direction of walking? It looks like they are walking toward the room (with the blood pool) because the curvature of the shoe is becoming narrower. That may be true but look at the amount of blood on the shoes, in out experiments today, this would represent a substantial amount of walking if they had that little blood on their shoe and there is this much-dripped blood on the floor. The Vibram sole pattern looks like it might be from a work boot—it may be from an emergency responder such as EMT, fire, etc. What might be more helpful is to try to determine the sequence—did the footwear impression come after the dripped blood and the person walked on the blood drops or were the footwear patterns there first and then blood dripped on top of the pattern? You may want to experiment with the sequence to see if you can differentiate between these two possibilities. You also have small satellite droplets or secondary patterns due to blood dripping into blood. You may want to verify that blood falling on a tile surface that replicate that small drop pattern. Footwear impressions in blood, the sequence of blood drops and footwear impressions, direction of travel of the footwear impressions, amount of blood lost as one walks on a surface, the effect of blood dropping on smooth tile and the generation of secondary drops and the behavior of large volumes of pooled blood may be things you may want to investigate. Beyond that, this pattern does not reveal much that would be of critical importance and we would have to ask ourselves, does it have any information that we truly wish to investigate and how would it help the case?

Photo 21 may be high velocity such as gunshot or a beating. Look at the size of the bloodstain pattern overall and the size of the drops. You may also have a combination of fresh and clotted blood. I find the narrow focus of the blood spray interesting. What type of surface is this on? It looks like the stain (on the left) is on the side of door. If this represents the side of a door, what does the structure just to the left represent? It looks like the bottom edge of a door. If this blood is from a battering, what would explain the low height of the stain? Maybe an arterial spurt of some kind. The stain pattern on the left is angular and the stain pattern on the right is more of a perpendicular, 90-degree impact. It has an odd, elongated, U-shaped pattern. You have a void pattern that is determined by the door jamb and the overhang related to the wall. There is a baseboard between the rug and the pattern on the right so they are low to the ground. You will need some means of projecting a small volume of blood along the edge of a surface to re-create the void pattern. We have poster board available for that type of model making. A syringe pumping blood through s small orifice may be able to simulate this pattern.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation
Interview with N. A.

On October 4, 2016

Photo 18 looks like a gunshot wound. The person’s head position is indicated by the smeared stain in the center of the pattern. Do you think this is really form a gunshot wound? Look at the amount of blood and the size of the stains? Photo 16 shows an actual gunshot wound and as you can see, the amount of blood and the size of the stains are considerably different. How many distinct traumatic events are represented in this pattern? I can’t say. This photo is part of a series of photos from reconstruction three I gave as a homework assignment. You can tell that there is blood on the edge of the door, so the door was open at one point. What is the overall direction of the pattern? It’s to the left and down. You have some stains that are large going to the left and down and you have some smaller stains going to the left and down at a slightly steeper downward angle. It may be that these smaller stains were delivered from another blow possibly at different distance or force. Are the stains above the pattern due to cast-off? Difficult to say because there are so few of them and they do not appear to be in a linear pattern. If we assume that the red smear just above the center of the stain is due to bloody hair resting against the side of the wall and based on the other features such as the chair and position of the door knob, is it reasonable to assume that the victim was sitting down at this time when struck? There may have been other blood shedding events leading to the hair being bloodied that may have occurred elsewhere but additional blows appeared to have been delivered when the victim was by the wall and close to the door. There are some small blood spots on the back of the chair and some wrapping on the seat so it is not likely that the victim was sitting there when struck. You also have smeared stains on the right arm rest. The blood trail dripping directly down, might this also indicate her position? That is correct. How would you try to simulate a pattern like this? I guess by filling something with blood and striking it in that direction. You could use a Styrofoam head filled with a plastic bag of blood. My mother works in a saloon and we have Styrofoam heads lying around. Can you get a wig as well? It doesn’t have to be human hair; synthetic fabric would work just as well. You could experiment by hitting a manikin with blood filled head next to wall and varying distances from the wall to simulate the bloodstain size and distribution and direction of the stains. You can produce more than one blow at different distances of the manikin form the wall to simulate the different size blood drops. A Styrofoam head can be attached to some old clothing stuffed with newspapers. You could use fake blood from the lab or something that you produced. You might experiment with different weapons. From the amount of blood spattered you might try a two by four or a baseball bat.

Photo 20 looks like blood from a stabbing. If it is from a stabbing, what can you say about the wound location on the body? In terms of damage to the circulatory system, what are we looking at? An artery—could it be arterial spurt? We have large volumes of
blood that appear to have been projected onto the wall and then run down under the influence of gravity. Can you estimate the position of the injured person based on this pattern? Is this plate part of a light switch? It might be a dimmer switch placed at roughly the same height as one might expect to find a light switch? Victim was probably standing up? Where was victim positioned relative to edge of door? Probably right next to it, slightly in front of the pattern? The pattern starts at the top and moves down. Does that reflect a change in pressure? You also have large drops that seem to be paired up. How would you simulate this type of pattern? Maybe something with pressure like a balloon. You would want to duplicate the pressure and you would want to duplicate the large volume of projected blood. A squirt gun of fake blood through tigon tubing. You would need to have something with variable pressure like a circulating pump.

FOR 312 Chemistry & Criminalistics

Interview with H.S.

October 5, 2016

Photo 5 where is this location, i.e. is it inside a residence? It looks like the base of a staircase. It looks like a public access location. I recognize the rubber guards on the footsteps, it’s like the stairs in the public access in my dorm. These are the handrails. What type of stain pattern? At first, I thought it might be gunshot but the blood drops are too big so I think it is medium velocity. Can you guess what type of weapon? I think maybe something like a baseball bat. Could the pattern be consistent with something falling down the stairs? I don’t think so, you have that big blood pool. Do you think there were two bloodletting events or one? I think there were two—you have the pattern with the small stains and then you have the larger stains (with directionality to the edge (by the stairs)). What would influence the size of the stains? The surface. What else? How about distance between the bloodletting event and the surface? What other aspects of the pattern do you see? There is a space between the big stain on the right and the smaller stains on the left and a gap above the stains beneath the hand rail. The stains are down low, what would account for that? Person may have been kneeling. What part of the body do you think may have been injured? The head, maybe the torso. You have a couple of events such as the pooled blood in the corner and the drag marks. What would account for the narrow drag marks? Maybe something small that is bloodstained being dragged underneath the body. You have some bloodstained items on the left corner of the photo. Not much blood on the stair that is visible—probably did not fall down the stair case. The floor appears to be concrete, probably a public access way or perhaps a basement if inside a home. There appear to be large drops of blood on the floor. They may be due to arterial bleeding. Photo 1 is an example of arterial bleeding you have large volumes of blood projected and here you have a sinusoidal wave due to pressure variations. The blood on the wall, how can you tell how recent it is? Could it be the color because older blood
becomes brown? Yes, the blood is bright red so probably fresh. The large blood pool is hard to say because it is so large and thick. Could a head wound produce that much bleeding? Here in photo 26 is example of bleeding from a head wound—it can be quite voluminous. How would you simulate something like this? Not sure. You might use a manikin head or a sponge soaked in blood. You want to simulate these two types of patterns on the wall. You also want to re-create the void area so you may want to change positions. I would like to try to vary the amount of force. That might be an interesting experiment but in a beating, people tend to use their maximum amount of force to produce an injury. You might want to position the blood source at different angles or distances from the wall to simulate the two different sizes of blood drops rather than using varying degrees of force.

Photo 4 at first, I thought it might be high velocity—the stains are small and round and have close to a 90 degree impact and they are on the inside of the shoe. Are you sure they are on the inside? It could be a right shoe we’re looking at in which case this would be the outer edge. What mechanism could produce stains like this? Not sure. It could be blood dripping into blood? What type of variables would you want to test? Maybe the blood volume. The blood volume would have some influence but once you reached that threshold amount to produce these secondary spatters, the size would not have too much influence. You might want to consider the height from which the blood drips into the blood pool. Maybe how close the shoe is to the blood pool? Yes, that would be relevant and you can see that the blood drips only reach a certain height on the shoe. Would you want to use a blood substitute or real blood for this reconstruction? Real blood, it would have the surface properties. It should not be too difficult to simulate once you know the mechanism. I’ve taken a forensic class in high school and we did a reconstruction and experiments with blood. We tested the diameter of blood falling from a height and the angle of impact and another experiment that I don’t remember.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation

Interview with H.M.

October 6, 2016

Photo 5 might be from someone being shot. If you look at photo 16, it is an example of a gunshot wound. Where is this scene located? It may be in a basement. You have a stairway, and you have a concrete floor so it may be a public access location. There is a blood pool and looks like drag marks. I’m not sure if this white material at the base of the stairs is glass. It appears to be white powder or if it is glass it is very finely divided. From the looks of the location, it appears to be used for illegal activity. The red item in the corner is a dildo. The other package with bloodstains may be a drug package but it is very large. There appears to be a lot of activity. How many bloodletting events do you think
occurred? Might be two or three—you have large and small stains. You also have these
angular stains on the left side. What about these apparent void areas? Could this indicate
relative positions of people? What would be the position of the person? They could be
sitting up. They could also be in a kneeling position. Where would that place the striking
person in relation to the stairs? Do you think these bloodstains could be due to falling
down the stairs? No there is too much blood. Could a stabbing result in this blood
pattern? Possibly. Where on the body do you think the person may have been injured? In
blood spatter incidents like this, is it common for a person to be struck in the head? The
head is accessible and the musculature and skin is thinner and blood vessels are closer to
the surface. Photo 26 is an example of the volume of blood that can flow from a head
wound. How would you reconstruct something like this? Maybe use a brush with blood
on the end? You want to simulate a pattern that has some dynamics like what you are
trying to demonstrate. You are attempting to put together a simple demonstration that can
be understand by a jury. The physical dynamics should be like what you are trying to
demonstrate and the waving motion of the bristles would not be similar to what is
occurring from an impact although the pattern may superficially look the same. What
variables would you look at? The wall? The surface would be important but you would
also want to look at the distance between the bloodletting event and the wall and the
direction of impact and maybe the force of the blow. How would I present this? You will
do a Power Point that illustrates how you went about doing your simulation. You will
have a written explanation of your observations like we are going over today and how
that lead to your putting together the simulation you chose to perform.

Photo 29 where do you think this incident occurred? It looks like an office. It may be but
more likely a basement. Look at the items being stored in the corner. This device is
probably a heater, if it has a pilot light, some building codes require that the heater be
elevated about a foot off the ground. Where was the person positioned when struck? You
have pooled blood on the rug in front so he was in contact with that part for at least a
period of time. What can you say about the angularity of the bloodstains? If you look at
the corner, you have some bloodstains impacting on one face and other bloodstains
continuing onto the other face which suggests a position at the junction or corner of the
two surfaces. If you look at the base, you have bloodstains traveling nearly horizontally
across at the bottom of the heater and higher up they are more angular—this may suggest
the victim in different positions when struck. The blood on the file cabinet is straighter on
so he may have been a slightly different position there. Blood on the file cabinet looks
different, I don’t know where that could have come from and the blood is running. This
blood seems to have larger projected blood and may be clotted after beating has
continued for a while after one or two minutes. When you have these large volumes, it
would not be unusual for the blood to drain down. What would you want to duplicate in
this experiment? You will probably want to reconstruct the corners with poster board. It
does not have to be the same dimensions but should be in relative proportions. You may
want to strike an object or a sponge at different heights to duplicate the upward and horizontal blood spatter. With the angular blood at the top, the head was probably struck at an upward angle, maybe at the base of the skull. More horizontal blood travel, he was probably closer to the ground.

FOR 312 Chemistry & Criminalistics

Interview with J. C.

October 7, 2016

Photo 18 looks like medium impact from a stabbing or a blunt instrument. I don’t think the chair was involved—I don’t think she was sitting in it. I see this blood smear on the wall and I’m thinking that her head was there when she was struck. Am I right about this? In photo 16 we have an example of a gunshot wound. Yea—I didn’t see that misting. How many bloodletting events do you think there were? Probably more than one. Anything about the bloodstain pattern that might clue you in to the number of impacts? What about the size of some of the blood stains? You have those small stains up toward the top, could they be due to cast-off? Possibly. We have some along the periphery with good directionality and we have these much smaller stains. Maybe there were different degrees of force. It may also be due to the extent to which the wound was opened up. What part of the body do you think she was struck at? Probably the head. Maybe, the side of her face was next to the wall and she was struck from the back with blood going toward the front. The blood swipe may be due to blood on the hair, it’s possible that she received injuries at some other location and she was already bloody when further struck at this location. I see some other swipes, so she was probably moving around next to the wall. If you look at the base board and blood on the floor you see where the blood drops are heavy and where they are lighter. So that area might be a void? Could be and if you look at the wall, the area to the right and just below the major stain has fewer blood drops so maybe she was close to the wall but not touching against it so that some blood could still flow. This big stain heading downward may be a fresher stain than some of these smaller ones [appearing when there was less of a wound opened]. So, we’re agreed that this is medium impact, probably a blunt weapon? How would you go about simulating this type of pattern? I might use some type of container for the blood, something that has some structural integrity so that it would not just explode like a balloon when hit. Maybe a piece of fruit or something like a watermelon that could be propped up in that position and hit at an angle. A watermelon may not have the same structural integrity. That’s right you have bone in the skull—would need some type of containment. You could try a Styrofoam head that has been carved out to hold a container of blood in a plastic bag. I’m not sure where I would find that. You could look at arts and crafts stores like Michaels or saloons or order them from Amazon and we have a couple in the lab. Halloween is coming up and a few stores that specialize in costumes may have material that might be
suitable for blood simulating or have head substitutes. You could still try a watermelon or
some type of fruit and see how well it fits the pattern but when you demonstrate
something in front of a jury, it needs to have some basis to what is happening with a head
filled with blood. You could attach a Styrofoam head to a manikin assembled from
clothes and filled with newspaper to provide some type of support and observe some of
the void areas. I will give you some other photos related to this case but just describe the
events depicted in this image.

Photo 23 I see a naked woman with some stab marks by the breast. There is some blood
that is close to the body but some areas where there is no blood flow, can’t explain that.
There is a cable in the blood that might be causing the void in some areas. The voids may
be just due to clotting of the blood creating void areas. Oh yea, I didn’t think of that.
There are stab wounds on the breast with blood flowing down—I think she might have
been stabbed on the bed. What about the small blood stains on the back? They seem to be
rounded and some seem to be angular, they might be from the blood coming off the
weapon. There are also some blood stains on the hands near her head. Was she injured on
the head? I can’t tell. This one stain looks like it is dripping down so the hands were in
that position. But what about the large smeared stain on the side of the mattress? Could it
be from a stabbing? If you look at photo 26 you can see the blood pattern from the other
victim the blood smear is similar pattern. It may be due to beating with some of the
splashing of blood falling on the back and legs and arms. Can you tell when she was
stabbed based on the amount of blood dripping from the wound? I don’t think so, I
suspect that all of these stab wounds occurred close to the same time. How would you
recreate a pattern like this? You might try to gather clothing and have a container with
blood and stab it through the material to simulate the blood flow. I would not worry much
about the pooled blood at this point. You might have a Styrofoam head and batter it over
a surface to try to simulate the blood distribution you are seeing on the back. Prepare a
Power Point for a group presentation of your set-up and experiments and a written
explanation of what you saw, like our discussion to hand in to me.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with J.S.

October 13, 2016

Photo 4 looks like blood was projected onto the inner edge of the shoe from a beating—
suspect may have been straddling the victim. I think it is a right shoe, inside (facing
sagittal plane of body). Are you sure? It looks like a left shoe in which case this would be
the outside. Would that change your version of what happened? What makes you think
this blood pattern is from a beating? How would you describe the blood spots? They are
circular, don’t have much angularity and they are spread out, this looks like high velocity.
The blood spots are circular because of perpendicular impact on the side of the shoe. These are small but they are low velocity. What could cause that? Take a look of photo 3, what does that remind you of? It looks like blood dripping into blood. You will note how they have similar rounded blood stains maybe a little bit larger but spaced further apart like in photo 4. In contrast, the high velocity gunshot in photo 16 shows areas that appear to be continuous spots of blood due to the high density misting of the blood. The patterns on the shoe are likely due to blood dripping into blood from a nearby source that got onto the side of the shoe. Could this be blood dripping off a weapon held to the side? A weapon would not retain a lot of blood so it would not be continually dripping. Could it be due to blood dripping from a wound from an arm hung nearby? It may be but we can’t tell the source from the photo, only that it is dripping. The two photos 4 and 16 are from different cases, they are not related to each other. What variables would you consider when doing a reconstruction? The surface. You mean the surface texture of the surface the blood is dripping onto? Yes. You also have this distribution—note that the blood drops reach only to a certain height on the shoe. This could represent different energy levels due to blood dropping from different heights. The blood may have reached terminal velocity. That’s true but terminal velocity is reached at about four feet or so and it seems likely that it would be lower at a scene. But the height of the dripped blood may influence the relative energy level and the height to which the blood will splash as well as distance of the shoe away from the source. Can I use a dropper to drop the blood or do I need to control for the volume of the drop? The volume of a drop dripping into a pool of blood will not be affected much by the volume of an individual drop. Do I have to use a shoe or can I splash something against a piece of paper? A piece of paper will work fine. When doing your reconstruction, you want to work in such a fashion that you can validate the pattern. You may have a prosecution witness in opposition who says the blood pattern is from a beating as you thought previously. You need to devise a demonstration with simple, portable materials for jury display that will illustrate your opinion that this pattern is due to dripping blood and not medium impact from a beating. You will give a Power Point that lists your starting materials, illustrates your set-up and your results. You will then give me a page write up of your observations as we discussed, what the main points to illustrate are and how you translate those principles into a demonstration.

Photo 16 looks like high velocity. Yes, this is a gunshot wound. You have some rounded marks up at the top, are these due to cast-off. Photo 9 is cast-off, you will notice that they form a linear pattern. You’re right, these are not cast-off. Bear in mind that the small stains are not going to travel as far as the larger stains so the large stains will be out near the periphery. The gray stain is due to the muzzle discharge from the gun. Does that mean that the gun was held to the side and near the wall when fired? Not necessarily—if you have a large caliber handgun such as a .357 Magnum or a .44 Magnum, even if the gun is fired into the front of the head, the bullet will often pass through the head and the smoke
and debris from the discharge in the barrel will go completely through the wound path and appear on a nearby surface. You would want to simulate the gunshot wound and the flow pattern on the face. Can I use a manikin’s head, would I have to scoop it out? Would I need a sack of blood like in a zip lock bag? Yes, you can use a Styrofoam head, but these are solid so you would have to hollow them out. Do you have access to guns and a range? I’ll have to talk to my dad since he is the gun expert. We have rifles and shotguns. A .22 rifle would work. You could try a Styrofoam head, just something that can contain the blood and have some outer integrity. I think a hollowed coconut might also work. Could I use a watermelon? Could I try a hollowed-out watermelon filled with blood? You could try those but they need to simulate the actual pattern you’re seeing and be based on the main aspects of what you are observing: high velocity impact and flowing blood pattern. I think I would do the high velocity and the blood flow as separate experiments. You could do that. The blood flow is flowing down over some facial contours, if those are duplicated, that should work fine. Fake blood is no problem, it is cheap and easy to make. I was once responsible for setting up a Halloween fright night at the basement of one of the dorms. For the blood flow, I would like to have some pressure like a tubing with a supply of blood and a squeeze bulb to pump it through a hollowed-out part of the head. That would work. The blood from the nose may be expirated, but it would not have much influence on the blood flow which is mainly a function of the contour of the surface it flows down and highlights the fact that the head position was not changed. You again must devise a reconstruction to counter a defense argument that the pattern may be due to a blunt force trauma and the shooting occurred elsewhere and the body was later moved into position. Would I have to explain these small stains on the victim’s right shoulder? No, this is part of a scene where the husband and wife were shot in their business, there was a lot of other activity going on.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with E.V. on October 17, 2016

Why did you pick these photos? I picked them because I know what they are—a void and blood dripping into blood. Let’s look at photo 30. What do you think this is a void pattern of? I see the handle and the two claws—it looks like a crescent wrench although the head is bigger than any crescent wrench I have seen, so I’m not sure. There is not scale so can’t be sure. You mentioned no scale—what type of energy level was used to produce these stains? Maybe medium impact of low. The size of the larger stains are about 5 to 6 mm in this photo, typical of low impact—I suspect that this photo is close to life size. Do you think the crescent wrench was close to the surface or elevated a bit when the blood spray passed over it? I think it was in direct contact—otherwise I would expect to see more blood drops inside the void area. An elevation above the surface may influence the
appearance of the size of the tool—this is something we may want to check. There are a few tiny blood drops inside the void near the two claw tips but otherwise the drops are not in the void area. You don’t have any running of the blood drops along the edge due to capillary action that you might expect to see if the object was on the surface and directly in contact with blood, but we may want to see if we can test that. What do you notice about the distribution of the pattern? It appears to come from above—I’m assuming that the object is on the ground. There is not much directionality. It is true that the blood has impacted for the most part straight down but there are a few small stains that show elliptical directionality about 20 to 30-degree range. Also, there appears to be three types of stains—the larger, gravity based stains, smaller intermediate size stains and very small round stains. It almost appears as if there were three events with each event depositing stains of a different size. If you look within the pattern, all stains regardless of size are evenly distributed. Do you see something else that is unusual such as the color? What could cause that? It may be fake blood. How would you simulate three different stain sizes? Might be due to different forces or distances. If you look at the Budge case, they scattered stains by ejecting blood through a screen so using a screen or netting of different mesh might simulate this type of pattern. How would you relate this to a physiological response or injury or blood projection phenomenon in real life? How would you simulate this? I might try a tool of similar shape, use some type of sprayer. I would want to stand over the tool and maybe be off to one side—that might account for the little bit of angularity. My little brother had a spray device for blood when he dressed in a Halloween character known as The Screamer, but the device broke and blood tended to drool out.

Photo 3 appears to be blood dripping into blood. Can you estimate the volume of blood? In other words, does the large stain in the middle represent 1 or 3 or 5 ml of blood? If blood is dropped from a large height it reaches a terminal velocity. Does that mean that the blood will only travel so far out toward the periphery? It does reach a terminal velocity for dripping blood but the splash pattern will depend on the volume of blood the drop is falling into, to an extent on the blood volume, the height or energy by which the blood falls and to a large extent on the nature of the substrate the blood drips on. What type of surface do you think this blood has dripped onto? That is, an absorbent or non-absorbent surface? I don’t think it is absorbent. That is true. If you look at the small drops, they are nice and round with sharp edges. This may be a white tile or similar type of material. What type of variables would you like to look at when attempting to duplicate this pattern? I would like to look at the viscosity or thickness of the blood? You mean the hematocrit or red blood cell count? If you were preparing fake blood, how would you treat it to more accurately simulate this blood? I would make it thinner. You might also want to introduce different energy levels, i.e., drop the blood from varying heights. I would like to dry different tiles like glazed tiles. You mean like the reverse side of a tile? Well, there are glazed tiles, and graphite tiles—a wide variety. You might want
to try different blood volumes. What do you mean? Different amounts of liquid the blood is dripping into. You might have a situation in which the blood drops at drop after drop, forming a larger puddle causing splashing or you may have a volume of two or three ml projected onto the surface at one time and then blood drips on it. In the case of projected blood, I would expect to see elongated spines and not separate, rounded drops.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with K. N. on

October 18, 2016

Why did you pick photos 18 and 19? They seemed to go together—you have medium impact stains in photo 18 and it looks like the base of the brass lamp was used as a bludgeon in photo 19. I can see where the victim’s head was placed. Let’s look at the lamp. It was used as a bludgeon. What is causing this smearing along the base? Fibers? If someone is struck in the head, it is likely that the hair will be bloodied and leave an imprint on the base of the lamp. If you look at photo 18 you see medium impact. Here are other photos to accompany this one. I thought this looked familiar. It looks like she was sitting down. I can see from the first photo in the reconstruction paper what looks like blood on the seat. You’re right, it looks like there may have been a change in what was on the seat between these two photographs. The door was both open and closed when bloodletting occurred as can be seen by the blood on the side of the door? Can you determine how many blows were delivered? How would you go about doing this reconstruction? I’m not sure, I’ve never done anything like this before. You can acquire fake blood and manikin heads from art supply stores, brass lamp from Goodwill or Home Depot. A baseball bat might work but the base would not be as broad. You can hollow out a Styrofoam head and put a sack of fake blood inside and do experiments in your garage. Read MacDonell’s book of cases for extra credit—it will provide you with some background for doing reconstructions. Halloween is coming up soon and they may have devices that disperse blood or have head substitutes or costumes and manikins.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with D. B.

October 19, 2016

Why did you choose photos 2 and 10? These were the ones left over and I think I know what is happening in photo 2—it looks like blood being dropped on fabric that is wet. I don’t know if the fabric was still wet when the photo was taken. Would the appearance of the blood change once the material is dried? I’m not certain, but I don’t think it would change. You might want to try this out. What do you think the relative size of the blood
drops are? I think the scale of the photo is a little large, I think the blood drops would be about the size of a penny. Well I think even the size of a penny might be a little large. This stain is about 35 mm across so it is probably a three times magnification. Do these look like separate blood drops to you? There are a couple of places where they seem to overlap—here it looks like two close together. The one in the corner seems very dark. How do you think you would try to duplicate what you are seeing? I would get fabrics like cotton, satin of different weaves and test them wet and dry. I would have blood and drop it with an eye dropper. Do you think fake blood would work as well as real blood? Fake blood does not have same consistency in composition and things might settle out. But you could start with fake blood first. You can try dropping the blood from different heights but I don’t think that would have much of an effect. This is a series of drying experiments on one of my cases.

Photo 10 is confusing me. It looks like a hole in a wall or on the floor, something exposing the underlying surface. The fact that you have blood flowing downwards is a good indication that the blood is on a wall and flowing downward under the flow of gravity. The blood flow also gives an indication of scale—this photo depiction is close to like size. What type of a surface is this? It looks like a wall, a piece of sheetrock. The indentation may have been made by a hammer or a mallet. You have a nice rounded mark—it looks bigger than a hammer, so it might be a baseball bat. This looks like blood on the bat that squished out when it hit the surface. This is what is known as cessation cast off—it occurs when the implement used to strike someone has gathered a lot of blood on its surface which is released suddenly when the bat comes to a sudden stop. The forward stains are part of the cast-off from the tip of the bat just before striking the surface. Same thing toward the right of the stain. Was the person swinging the bat standing on the right or left side? The way the spines from the impact site are pointed, it looks as if they struck the bat while standing on the right-hand side. Would it make much difference if I used a wooden or metal bat? Offhand I don’t think so but a wooden bat tends to be larger diameter. I’m not sure how well that type of surface would retain blood. You might want to try both. Also strike from both sides and maybe use different degrees of force although the relative amount of force is hard to quantitate. What type of surface should I be hitting? It seems like plaster board would give the best results. My father works in construction and I could get some plaster board from him. Do you want me to demonstrate this in class? You can document your experiments that you conduct at home by photos or videos and then bring in the physical item that most closely approximates the pattern. You want a demonstration that is simple and elegant that can be easily set up in a court room. So, a section of dry wall supported against a step stool or small ladder might work well.

FOR 312 Chemistry & Criminalistics

Interview with A. H.
October 24, 2016

Have you come to any conclusion about your two images? Both photo 15 and 30 look like medium velocity. Compare your photo 15 to photo 16 which is high velocity due to gunshot wound. It looks like the victim had his head against the side of the door, he may have been sleeping when he was beaten. The dense concentration of bloodstains in the center is due to the concentration of misted blood in the center. You have larger stains further out on the door because larger blood stains can travel further. Where did this event occur? It was obviously inside of a car. It looks like the passenger side seat. You might want to consider whether the door was open or closed when the person was shot. If you look at this reconstruction photo, the door was open and the person had her face to the side of the door. You can make out a little bit of directionality so blood was traveling from the center of the bloodstain in 360 degrees with a large portion traveling toward the front of the car. In doing the reconstruction you need to consider if the car door was open or closed and the position of the person. If the car door was open, we can reasonably assume that he was sitting in the car seat. It looked like the shooting occurred recently because blood on the window has not had time to drip down. If you look in this other photo of a shooting in a car with blood spatter on the windshield, the blood will not usually drip down. You want to do a reconstruction or a validation of your theory of how the blood was deposited because there may be an opposing expert who may say this is aspirated blood. Is it possible that the person may have been shot in the throat and this caused the aspirated blood? What difference would it make if you can still establish that he was shot by the suspect? Expirated blood and high velocity blood due to gunshot wound are two different mechanisms. An opposing expert could diminish your credibility if they can establish that your identification of the type of blood pattern was in error—the bottom line is that we know the victim was murdered we need to properly identify bloodstain patterns. I thought about using balloons filled with blood and popping them to simulate the high velocity. I think we need to do an experiment with balloons filled with blood, I don’t think the pattern will work out quite as well as people expect and so we need to get that out of our system. I work at Rite store and have access to large cardboard boxes. I could cut one side and that would simulate a door opening. You could use a syringe of blood and force it through a wire mesh or something very fine such as a nylon stocking. Oh, I never thought of that. Would I have to present the demonstration in class? No, you could bring in the final pattern that most closely simulates the one you see in the photo. You would document your setup and the results of your experiments in a series of photos put into a Power Point demonstration. You would have a page or two write up of your observations and how you translated them into your validation project and summarize observations like we are discussing them today.

Photo 30 looks like medium impact, I just don’t know how to explain the void pattern. It looks almost like a hand but I’m not sure what the scale is. Let’s assume it is life size or
So I would be looking at it from up close. I don’t see much directionality except for a couple of stains. I think I could simulate this by spraying blood over the object. Was the object on the ground or on the wall? It has to be on the ground because it would not stay on the wall without someone holding it and in that case, it could not be the murder weapon. So, let’s assume that it is on the ground. Also, you don’t see any of the larger drops running down. I can use a sponge like in the paper you gave us—the ones with the shapes, I didn’t think of using a sponge before. You might want to experiment with placement of the tool at different distances above the ground to see what effect that might have on the relative size of the tool and on the extent to which blood drops can get underneath the tool into the void area. You can experiment with dispersing blood from a syringe onto a screen or mesh or something to break up the blood pattern. I could have a sponge just above and to the left to get the blood distribution. I can’t tell if this represents more than one bloodletting event. The blood drops appear evenly distributed apart and about the same size and overall same directionality. Their appearance or color—might be dried blood. Or it might be fake blood.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation

Interview with S. B.

October 24, 2016

Photo 1 is arterial spurting. I can’t tell about the angle of the corner. I would like to reconstruct this corner using poster board but not sure if this is at right angles and the two walls or parallel or if it is something due to the camera angle. Let’s just assume that it is at right angles and the two walls are parallel. I can simulate the pulsation by having two syringes connected to a third syringe and use a trombone like action to regulate the pressure to the syringe to which they are connected. It won’t hold a lot of blood so I will have to do this a lot of times moving up and down in a wave-like fashion. How might you draw up a larger volume of blood? I could try attaching a longer tube, not sure how I would be able to control it. Maybe a hand pump or foot pump or an educational toy of the heart type pump or peristaltic pump. These were searched on the Internet with a foot pump being a possibility with one tube connected to a source of blood and the other tube as an outlet. When we consider the human heart, it is a series of pumps connected to tubes through which the blood flows and a nick in one of the tubes produces an arterial spurt. If we could rig up a hand pump of some sort and a tube to a supply of blood and another tube with nicks simulating the arterial spurt, that might work. But we would not have the variable pressure. S. B. sketched out a number of diagrams. You could have a bag with two cut corners and have tubes going in either corner and use your hands for pumping. You could have a long plastic tube and pump in blood and then a connected reservoir that is flexible and can be hand squeezed like a deflated ball for pumping from this reservoir. Controlling the pulsation with hands would be difficult, hard to maintain
uniform pressure. Assume the photo is life size. The blood spurts are not far from the ground and you may be able to see a little bit of the floor in one of the corners of the wall. The bloodstains will give a rough scale for the sides of the wall.

Photo 26 looks like someone who was rolled over. You can see the swipe marks on the right just before the bed and looks like he may have reached for the bed which would explain this mark on the bottom of the bed. Looks like he was battered about the head and his hands or something caused smearing. The blood next to the wall has cracks so it has dried for a long time. Here are the rest of the photos for the scene, I will download them if you have a flash drive. There is a lot going on, what should I concentrate on? You have some blood stains to the right that don’t appear in the photo with the undisturbed body so these are probably artifacts due to moving the body. You want to concentrate on the capillary action that causes the blood to run along the side of the body forming this outline of the body when moved. Can I wear a Tyvek suit, are they impermeable? Ann Marie says there is a building with a shower that I can lay in and then wash the blood away. I will have someone pour fake blood toward my head and let it flow down the side of my body. I will use a toy with short fur to simulate the head swipe. I will need a thick sponge to capture the blood spatter. You can use the roll used to support the roll of butcher paper. I could use trash bags filled with water balloons and put a shirt on it. It might be easier if I just lay there for a while. The fake blood may not coagulate like real blood, you may have to adjust with some type of thickening agent. I think the victim had his head on the ground when most of these blows were struck—because of how the head hangs on the neck, the head was not completely on the ground. You have indications of a couple of impacts and then some swipe marks by hair or by hands. It would be important in your reconstruction to consider whether or not the victim may have been leaning with his shoulders resting against the wall when struck or if all of the blows were delivered with the victim’s head lying on the ground. You may have to do some strikes with the sponge directly on the ground and then some strikes with the sponge elevated. I think those could be done in sequence without messing up the overall stain pattern.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with M. P.

October 26, 2016

Why did you choose photos 7 and 28? These were the only ones left over. I think I know what photo 7 is, it looks like a series of blood drops dripping in center. Do you have any idea of the size? It looks like it is on a throw rug. You’re right, it’s probably about two feet in diameter. I could simulate this with a throw rug or swatch and put blood in the center. The main goal of this exercise is not so much to simulate the stain but to provide an accurate estimate of the volume. You have a symmetrical stain so you could pour a
volume of blood like 50 ml into the center of the rug and measure the diameter, then pour another 50 ml into the same spot and measure the increased diameter and plot blood area vs. volume of blood added for each type of material. Should I try a number of different types of throw rugs? What you might want to try is a number of different surfaces at least absorbent vs. non-absorbent. You could test out some fake blood on a throw rug and some on tile and chart out the differences. Here the stain is symmetrical so measuring the diameter and determining the area by $A = \pi r^2$ would provide you with close enough estimate. For irregular surfaces, we may need a grid or something along that line. O.K. I think I know what I need to do on this one.

In photo 28 I see a couple of things going on. There are these big stains on the left and some cast-off and impact and a big smear. Can you tell what type of sequence these events may have occurred? For some reason, I think these big stains on the left-hand side occurred first but I can’t say why. I’m assuming that these things are properly oriented. Well, what direction is the ground? I assume it is down here because I can see a bit of the baseboard. Well look at this smear. Will the smear came first before these two drops on the right? I would like to do an experiment where I create a smear and drop blood at different times to test how the contrast between the falling blood coming afterward would compare with the background smear at different time intervals. I would also like to see what effect the travel path of the smear as seen on the right-hand side would affect the travel path of a drop falling on top of that smear. If I understand you, you are saying how the texture and flow pattern of the smear might affect the blood as it hits the wall at a steep angle—would the drop be deviated in any way from its normal path under gravity?

How would I create a smear? I was thinking of taking some old clothes and putting my forearm in blood and smearing it across the wall. I would recommend something with coarser texture such as a hand towel with a high fabric pile—this would produce a coarser imprint in blood that might be useful for your blood drop experiment. I could probably get plaster board or wall board from Home Depot. How would I simulate the cast-off? Well, you could drip blood onto the surface of a tool and then swing it about. You will just have to determine the direction of the swings and how far from the wall and where they start and end.

CHE 672 Forensic Molecular Biology (extra credit assignment)

Interview with H. M.

October 27, 2016

Why did you choose these photos? I was doing something with fingerprints and so I was just curious. Photo 27 has both bloodstains and fingerprints in blood. Did the bloodstains in the background come from cast off? It is difficult to say. They are pretty evenly distributed. The main point of this photo is to determine what came first, the fingerprint
in blood or the blood spots. You will be doing experiments in drying times. It is hard to
determine sequence in cases like this and there is not much literature on the subject. A
dark object will always appear to be on top. You will want to create the image but you
will test both situations, i.e., the fingerprints first and then the blood spots and the blood
spots and then the fingerprints. You will want to test various drying times. You will
probably want to use real blood for this although you can do some initial trial runs with
fake blood. If you have a fingerprint laid down first and blood that is dilute can
sometimes run along the grooves of the print pattern—that is a pretty good indication that
the fingerprint came first. You might get dilute blood from the runnings off a package of
meat from the supermarket.

Photo 22 looks like a medium impact with the head in the center where this large blood
clot is. What can you say about the overall distribution of the pattern? Note how a dense
concentration of blood is radiating out to the side. Also note the position of this blood
clot, which we can assume is the center of the force that created the stain is relative to the
rug. The center of the stain from the scale in the photo is about 18 inches. What are these
vertical boards, they look like a type of picket fence. These are just part of the wall—you
can see the rug on the bottom of the photograph. Think about where the head is and how
you would achieve this type of pattern. What type of weapon would you use? Could it be
a baseball bat? Well look at the broad distribution of blood to the right and the impact
spatter projecting out to the left. This could be due to a stomping with a boot where the
blood spurts out from both sides. How many bloodletting incidents do you think are
represented in this pattern? More than one. How would you represent or recreate this type
of pattern? I would use a Styrofoam head and fill it with blood. You could do that and
you would have to hollow out a space in the solid Styrofoam and fill it with a sack of
blood. The question might be what is the orientation of the head, with the back of the
head against the wall or the side of the head? How would I document this? You would
take photos of your setups and experiments. You might need to do a couple of things as
separate steps. For example, to represent that center area of clotted blood, you might have
a different, thicker formulation of fake blood and squirt it on the wall first and then
superimposed over that, have your Styrofoam head filled with blood adjusted about 18
inches above the floor. You would probably need to perform the test against a vertical
surface as opposed to trying to do it with the head on the ground. Your goal is to
determine what likely happened based on the pattern and then try to recreate it with these
props in a way that is true to the characteristics of how blood behaves under these
circumstances.
Interview with K. B.

January 3, 2017

Why did you choose patterns 1 and 8? They just seemed interesting. What can you say about pattern number 1? It appears to have large blood drops. There is blood flowing straight down. I’m not sure why it is exhibiting the wavy pattern. This is due to the pressure differences in the pulse from the contraction and relaxation of the heart resulting in a wave like pattern. What would this pattern suggest? It would likely be a system under some pressure to be able to eject blood droplets of that size and it would need to be a system capable of pulsation. Do you have any idea of how to construct something like that? I might use a big turkey baster—not sure. How far off the ground is this? Can you approximate the amplitude of the wave (i.e. the distance between the peak and the trough of the wave)? This might give you a clue as to the type of motion needed in duplicating the pattern. What type of surface is this? It looks smooth, looks like a wall. It may be a painted wall. How far above the ground do you think the pattern is? Is the wall continuous or is there a corner? I see this one area that looks a little darker, I’m not sure if that is due to a corner in the wall. It is due to a corner. We have poster board that can simulate that construction.

What can you tell me about photo 8? It looks like two hands overlapping. Can you tell if they are gloved or bare hands? Looks like bare hands because I can see ridge detail. I think this might be the thumb. Are you sure they are hands? If you consider that this might be a foot, the length of the digits and the shape of the rest of it looks like a foot. The broad base of the structure it is overlapping might be a palm of a hand. You will probably want to try out those different possibilities to see which one most closely resembles your pattern.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation

Interview with A. B.

January 5, 2017

Why did you pick photos 11 and 27? I don’t know, they just looked interesting. What can you tell me about photo 11? It looks like someone was being dragged. Can you tell me the location of the injury? It looks like a wound to the stomach because the area at the beginning of the drag mark is so wide. If that is the case, how would the person be oriented? They would probably have their trunk over the large stain and their feet to the right. So, if that is the orientation, is it more likely that they would have been dragged by their hands? Yes. You have these streaks along the path of the drag pattern, what could have produced these? If this was a woman, it could be due to blood soaked in her hair. If blood originated from a wound to the head, how would that effect your original
conclusion that the person was being dragged by someone pulling their arms? It would still be possible. If that was so, you would have a bleeding head leaving a leading trail but you would have the trunk riding over this trail. If you look at the blood trail, some parts of it are relatively thin. You need to consider the process of dragging when doing your reconstruction and the orientation of the person being dragged and the likely location of the injury. What would you need in terms of supplies in order to do this reconstruction? I don’t know, maybe look at the surrounding areas to see if there are other bloodstains. Looking at surrounding counter spaces, I don’t see anything in the photo. You also need to consider that dragging is relatively passive, low energy, in other words one would not expect to see a lot of impact or energetic type activities that could produce spattered blood. What are the significance of the areas of clotting? I don’t know. These could be areas where blood has clotted meaning a passage of some time. I see clots mainly at points where the drag has changed direction sharply. I would expect the dragging, once it has begun to be continuous, in other words the person doing the dragging would not likely stop and start in the middle of dragging someone. You would need fake blood and we can supply a wig to simulate the hair and have a volunteer willing to be dragged. I would not be constructing an apparatus for this. That is correct but you can create a simple storyboard with stick figures and relevant features to show the way you propose to drag someone and other aspects of your reconstruction. You can try more than one scenario and determine which one looks best.

What can you tell me about photo 22? It looks like footprints with some blood drops on top. If you look at the edge you see a scale. These are bloodstained fingerprints not footprints. There are some small drops, I think they may be due to high velocity impact spatter. They are small drops but there are very few of them in no particular pattern, these may likely be due to secondary spatter from blood dripping into blood with the parent blood pool off to the side outside the photo. Blood drops may appear on top but this is an optical illusion where darker objects appear to be on top. Overall this is a problem that involves sequencing—did the bloody fingerprints come first or did the blood drops come first? What are some of the factors you would look at to reconstruct this event? I would look at the fingerprint patterns to see which fingers made the marks. I would use a pipette and shape blood from it to simulate the blood drops. How would you determine the sequence? I would apply blood first then the fingerprints and do the reverse and compare. What factors would you consider or change or alter? What about the amount of blood on the fingers? Would you let the patterns dry a little first? Yes, I would probably let them dry before overlaying the other pattern. Do you think the surface might have an effect? I don’t think these were done on paper, I think they were done on glass because of the lighting. You mean this is transmitted light? Doing the stains on glass and illuminate with transmitted light would certainly be an option.

FOR 497/598 Micro Course—Bloodstain Pattern Interpretation
Interview with S. T.

January 5, 2017

Why did you choose photos 13 and 17? I just thought they were interesting. What can you tell me about photo 13? I see air bubbles, looks like expired blood and I see a vertical flow so it may be on a vertical surface like a wall. What do you think the scale is? It looks like it is magnified. The bubbles are small and uniform; maybe you can use those as a rough scale. How would you generate bubbles? Shake up the blood; carbonated blood. You have a blood trail flowing vertically but you also have some going off to the side. You also have a dense layer of blood forming a bridge where the blood above it has flowed into. You also have directional bloodstains on top of the pattern. What direction are these traveling? From left to right. The scale may be important in terms of explaining these anomalies like flow pattern traveling horizontally. If we assume that it is a vertical surface of a wall, there may be surface features or a coating on the wall that is influencing the blood flow. Think of a small scale when doing the reconstruction as this may affect capillary action, surface tension and related phenomenon. Think also about coatings that would affect the blood flow and other aspects, maybe buy a small tile square and coat with butter to see how this affects the flow pattern.

What can you tell me about photo 17? It looks like high velocity spatter on a hand. If it is high velocity, we can assume gunshot. Was this person holding the gun? Probably, I see void areas. Was this person close to the person being shot? If close, did this person shoot himself or someone else? Probably himself. What would explain the blood spatter on the fingertips if this person was holding the gun? Could it be transfer from blood on the gun? You will probably have to consider different gun positions and distances when doing the reconstruction. How would you recreate this? Something like a super soaker or a high-quality water pistol or a nerf gun although I don’t know how well that would work since it fires a foam tip bullet. With the super soaker, I can stand in my mom’s bathtub and spray against the wall and the spray would stain my hands.

FOR 312 Chemistry and Criminalistics

Interview with C. O.

October 17, 2017

Looked at photo 49 (blood drops on carpet) first. What do you think this is? Looks like blood dripping from a weapon, I think an injured person would be bleeding more. What is the direction? Left to right. Can you tell me the relative speed? Moderate speed because of the spines on the bloodstains. Consider the distance between blood drops as well. Note the different color of the corner bloodstain, this might suggest some physiological reaction like clotting occurring. You should use the real blood instead of a
blood substitute to try and duplicate this pattern. How would you proceed to duplicate this? I would use an eye dropper. Could this have dropped from a weapon? How would you test blood from a weapon? What type of surface has the blood fallen on? Could be cement, could be linoleum or carpet. What is this smear in the center? Could be a transfer stain. The diffuse transfer stain and the scalloped edges and voids in this corner bloodstain suggest that the stains could be on carpeting with edges affected by carpet pile.

Let’s look at photo 7 (blood pool). What do you think this is? Looks like blood pool on carpet from a person who remained in that position for a while. In this case you will pour a known volume of blood onto the carpet and measure the area and from that calculate the minimum blood volume. You will prepare a graph where you will pour known amounts of blood on a similar substrate in 50 ml increments and volumes flanking the 200 ml of blood substitute that you poured on the carpet. You will be measuring and verifying the blood volume and not just duplicating the pattern. You can also make a measuring grid to measure the volume as part of your group 4 project.

Image 36 (blood on cut shirt). It looks like a sweatshirt, a fraternity shirt. What can you say about the blood pattern? It looks like bleeding at different times. What can account for the sharp demarcation or boundary between the bloodstained areas? Looks like cutting by EMTs. The shirt after it was cut could have been placed in a pool of blood. What about the lighter stain at the top? It could be due to clotting of the blood (serum separation). How would you simulate something like this? Cut a similar shirt and put it in a pool of blood. Did you look at these photos and rank the patterns in any particular order? I looked at them and ranked them by difficulty, similar to the order we are looking at them now.

Photo 34 (dripping blood in car) looked at last. What type of blood pattern is this? It looks too large to be high velocity, maybe something under the force of gravity. What type of location is this? It is the interior of a car between seat and car door. What would suggest an impact pattern? Directionality. Do you see much directionality here? What about the size of the stains? They appear uniform. What about relative energy level? Some stains are higher up on the carpet part of the door. How would you duplicate something like this? Drip blood into a pool. You would want to use real blood for this and not artificial blood.

For the final project, I don’t see how I can produce an apparatus that does two separate things. It seems like a process to me.

FOR 312 Chemistry & Criminalistics

Interview with K. M.
She has done some initial examination of the photographs but has not put them in any particular order. Photo 21 (void area, corner of door) she attempted to duplicate pattern at home by throwing a wet golf ball at the corner. She got the same type of void pattern but the spatter pattern had larger stains.

We looked at photo 44 (hair swipes). She believes this was created by a bloody hand or perhaps a bloody hand holding onto a jacket or some fabric to create the pattern. The side on the right has more blood so it may have exposed skin or exposed wound that is creating more blood flow. She feels that the direction is from left to right based on how the blood is feathering. She thinks the fine swirls can be due to a hand or fabric. She makes out the image of a thumb in profile on the center of the image. Other faint lines suggest finger tips or finger movement. Because of the lack of vertical blood flow, she believes that the swipes could be on a table top. I suggested those as variables to be looked at. I suggested that bloody hair might be a possibility to which she readily agrees. A wig with blood rotated to expose fresh area of blood can account for the reintroduction of blood on the edge of the center stains. A wig can be tried on both vertical and horizontal surfaces to observe if there will be vertical blood flow.

We looked at photo 43 (GSW void on wall due to baseball cap + blood pool) next. It is evident that there is a blood pool. She felt that person was shot low to the ground, possibly two bloodletting events to explain the spatter on the wall and the blood pool. A shot close to the ground would probably not suggest suicide and more likely assault by a second person because a person committing suicide would not shoot themselves on the ground according to her reasoning. There are two events but it will not be necessary to create the blood pooling event as it is the spatter pattern that is of most interest. Could person have been wearing the hat at the time? There is blood spatter inside and on the lower brim of the same size as the rest of the spatter. One stain on right side. Could this be due to someone poking their finger through the hat with blood on their finger? The stain looks like it could be a mist rather than a transfer stain. The void outline matches the outline of the hat very well. I asked how she might duplicate this and she mentioned one of the old-style perfume misters that might disperse stain. She does not have one of these just a newer perfume mister with a fine mist, we would need something that sprays a little more course blood spray. We could look at this from the other direction, perhaps a syringe that sprits out a heavier spray and a screen or nylon stocking mesh to disperse the stain. Spraying from variable distances could be one of the variables. Not sure if either blood or fake blood would be equally suitable.

Photo 21 is a photo of fine blood particles on lower wall board showing a void due to the angle of the blood with a corner. She thinks it might be aspirated blood because of the finer blood drops. Void due to the sharp corner of the wall. What would be a
characteristic of aspirated blood? Bubbles. How can we produce bubbles? Put safe blood in mouth and simulate spraying blood. A safer alternative would be to put the blood in a syringe and shake it up.

Looked at photo 4 which shows satellite spatter on a shoe. What type of pattern do you see? It looks like splashing blood that is covering all areas of the shoe. This type of splashing would be due to what? Could it be due to blood splashing into blood? I don’t think you would have a blood pool nearby and something is dropped into it causing blood splashing. How would you simulate this pattern? You could take a toothbrush or a paint brush with heavy bristles and moisten it with blood and flick the bristles to release the blood. I painted a room recently and a friend used a paint brush in that manner to put stars onto the painted ceiling. You could duplicate the pattern in that fashion but we are trying to convince the court that this pattern was produced by blood dripping into blood. It would be simple enough to set up that type of experiment for the jury. The blood on paint bristles in not mechanistically similar to how we think this actually happened, we want to be true to our reconstruction of events and not just duplicate a pattern. What variables would you look at? Distance of the blood pool from the shoe. What other variables? How about duplicating the energy level found in the stain? How would we determine the relative energy level? By the height the blood spattered onto the shoe. So we could adjust energy for blood dripping into blood by having the dropper at varying heights above the blood pool. The size of the blood pool would be another variable that you could consider.

Looked at group photo of blood flowing from a moving car. How could you reproduce this pattern in the absence of a moving car? You could get an industrial fan and that might create the same effect. What direction is the car going based on the pattern? How would you place the fan (on which side) in order to duplicate this effect? I don’t have an industrial fan but I have a smaller fan. You could see how you can scale the size of the fan with a smaller replica and see how size affects the flow pattern.

FOR 312 Chemistry & Criminalistics

Interview with R.J.

October 19, 2017

She has not had much time to review photos before our meeting. We looked at photo 10 (cessation cast-off) first. She feels that it represents someone impacting a surface with blood being dispersed. She was not able to take the clue of the vertically drip blood trail as an indication that the bloodstain is on a wall vs. a horizontal surface. The vertical blood drip seems to be causing her great confusion in terms of what is going on. Could not provide a cogent explanation of the physical phenomenon involved even when I pointed out the likely origin of the defect on the wall being from a striking implement.
She considers it a possibility that someone was struck with an implement and their head rebounded from the wall. She feels that there is too much blood in the pattern to be accounted for from blood on a bat although she is willing to experiment. In terms of variables, she is considering the distance the bat travels before striking the surface as important. She also suggested angularity of the striking bat to the wall which might be an interesting variable. She feels speed of the bat would be important but she did not elaborate on how speed might be determined.

We next looked at photo 41 which is the bloody sock. She noted the blood on the lower calf which suggested to her an injury in that area or a source of blood higher up on the leg dripping onto the source. She recognizes that the large amount of blood in the toe area could be due to stepping in a pool of blood with the bare sock although she feels that blood could pool inside a shoe as well although this may be less likely because of the less intense stain on the side of the shoe. Experimental conditions will involve blood dripping onto sock both in the shoe and outside and movement of the foot near a blood pool to simulate the different bloody areas around the sock.

Photo 24 (Vibram sole pattern in blood on tile floor) and 25 are from the same crime scene. Provided her with the first six pages of this reconstruction to give her some orientation with the bodies in place. She described the pattern to the right as dripped blood but felt that the pattern allowed her to determine that there were two bleeders at the scene. Asking her to identify the most evidentiary item in the photo, she identified the footwear impressions as being of possible value. She was slow to recognize that this might be the footwear impression of a third party even after showing her the displaced sandals and barefoot condition of both victims. She will do experimentation with footwear and dripped blood.

Photo 25 shows dripped blood pattern in kitchen along with smearing which she recognized readily. Experimentation will involve dripping blood and using an appropriate material to simulate the drag marks.

FOR 312 Chemistry & Criminalistics

Interview with A. C.

October 20, 2017

She has looked at some of the photos beforehand but not to any great detail. We looked at photo 9 which is cast off onto a ceiling lamp. She has identified these patterns as cast off most likely onto a ceiling lamp. When asked about the parallel spatter tracks, she suggests that there may be parallel streams of blood coming off a broad-based weapon such as a board. They could also be due to blood coming off something narrower such as a knife but testing with something wide (she suggests a manila folder with edge dripped
in blood) might be options worth testing. She felt that the speed of the swing might have some bearing on the spacing of the individual blood stains. Directionality of blood pattern suggested some differences in angularity to her. I suggested testing weapons of different length as well as different speeds and angled directions. She felt that another possibility would be that the lamp is a desk lamp on a large desk. She did not answer my query regarding the height of the lamp shade from the base. Although the floor lamp appears unlikely, I will leave that as an option for her to investigate. There is a streak of blood flowing to the right on the lamp. It appears to be flowing laterally and she suggests it may be an artifact of the tapered shape at the edge of the lamp. Can directionality of the blood impacting the surface as well as gravity influence the flow of blood?

Photo 50 is a photo of a void in the middle of a bloodstain on a comforter. She initially felt that this may be a couch but a comforter seems to be a more appropriate surface. She suggested that the stain could be reproduced by taking a bloody sponge and soaking blood onto the fabric in two parallel streaks with a gap in-between. With further prompting, she recognized that the gap in the middle could have been caused by one large stain on an appropriately folded cloth that would create the two tracks. She recognized that there would likely be a correspondence of features between the two halves of the edge of the stain that would suggest that they were once mated together. She knows a source of cheap fabrics that she can use for the simulation. She noted that one end had a heavier staining of blood “possibly where someone’s head was.” I asked her to estimate the size of the stain and she suggested that the size of the stain was about a baseball size making the photo a bit smaller than life size. There is a pleated design in the middle of the pho which may be due to the marking of the edge of the comforter.

Photo 14 is vertical and directional blood flow on the legs of someone lying on the ground. There is vertical blood flow down the legs and blood flowing perpendicular to the vertical blood flow and subsequent smearing of stain in some areas and areas with predominantly smearing due likely to rubbing and contact of the other leg. Pool of blood by the right knee which she feels may be due to an injury of the knee. It appears to be a literal interpretation of the bloodstain but for the reconstruction she need only concentrate on the bloodstains on the right and left leg. When asked how she would reconstruct, she suggested filling trash bags with newspaper to simulate two legs rubbing together. She also has baseball bats to simulate the blood flow but the smearing from two legs rubbing together might be hard to simulate from that. “If it’s a nice day, I can go outside and put blood on my own legs.”

Photo 12 is an enlarged view of an expired drop of blood. It is expirated because it has an air bubble. She works at Rite Aid so she can get a 10 ml syringe and fill it with varying volumes of air to water. This might be an alternate means of producing bubbles in contrast to shaking up the syringe. The orientation of the photo shows the blood stain going up at about a 30 or 40-degree angle when in fact it may actually be going in a
downward direction because there is an accumulation of blood at the leading edge. It would be interesting to see if that can be duplicated with blood projected at different orientations. She noticed the breakup of the main drop into smaller and thinner satellite projected bloodstains and I would suggest that this could be due to surface texture as well as velocity. She though the surface might be concrete but the surface is beige-yellow with rough texture resembling stucco; this might be responsible for the rough edge and stain break up.

We talked about the group 2 project to produce a means of expelling blood based on size and distance traveled. Her group thought about having a blood-filled sack on a platform and dropping weights of variable size onto it to produce varying energy levels. I printed out a photo of the apparatus used by MacDonell involving a wood armature on a portable fan enclosed in a cardboard box with a window slit to allow blood to go out in one direction. She will meet with her group to rethink their approach. Her father is an engineer and she can pass some theories by him for constructing the apparatus and her boyfriend has a lot of fishing poles. She can take a section of a fishing pole and fasten it to a hand crank device. She may develop sufficient speed to create the desired pattern.

FOR 312 Chemistry & Criminalistics

Interview with C. C.

October 20, 2017

She has done some preliminary review of the photographs and has spoken with her group in relation to the group project. We first looked at photo 15 which shows a high velocity impact stain on an interior car door. “I would simulate this using a small, hard ball soaked in blood and shoot it out of a tennis ball canon.” Do you have one of these? “No but I can get hold of a sling shot.” I suggested that this is likely high velocity and that mechanism would not be true to how this stain was generated. Further research on the Internet would reveal ways to duplicate gunshot injuries using things like portable sprayers pumped multiple times to build up pressure than a hose under pressure is ruptured and blood sprays out at a rapid velocity. “If this is a high velocity from a gun then where is the bullet hole?” If you look at the pattern you will find a localized stain with a fine circular mist but there are bloodstains at distant orientations around this central stain along the sides of the car door and on the window. This may be aspirated blood. There still may have been a gun shot with the respiratory track filling with blood and then being exhaled. “Could aspirated blood be projected with that velocity? Yes. Determine what the mechanism or possible mechanisms for the pattern are. Determine which one seems more likely to be tested first then find ways of how to conduct the experiment. Figure in any constraints or features that are important to duplicate in the experiment and test and evaluate.
We next looked at photo 35 which are finger swipes of blood around a light switch. She felt that this was the most difficult photo of the set but she did not elaborate why. Which stains are most clearly reminiscent of finger marks in blood? The two on the left side of the light switch. “Is it possible that there may have been blood on the wall already and the fingers smeared it?” I don’t see any blood stains other than these finger marks, the rest of the wall is clean. “The blood on the right is traveling toward the light switch as if the bloody side of the hand was trying to support himself while falling.” The other stains could be from fingers with blood on them touching the wall. The overall pattern may be from someone trying to grope for the light switch. How would you duplicate something like this? Put my fingers in blood and just try different orientations.

The next photo is photo 52 which shows a combination of patterns on the side of a door. What type of surface is this? Side of a door. What are you seeing? Small stains and large stains going in this outward direction and one big smear as if person was standing then struck and then slid down. Are the big stains that show directionality from one or two medium velocity events? How do the numerous smaller stains fit in to the pattern? The smeared stain in the right corner could be from someone rubbing against the door and falling? What about the heavy stain just to the right of the smear? I didn’t notice that—it though it was part of one large smear. Do you have an area where you can do some of these reconstruction tests? My mother has a garage where I can do these and my dad is an engineer for the roadways. You have a couple of events going on of different energy levels in addition to the smearing. Shooting and a beating might be considerations or shootings from different distances? You need to list all the possibilities and think about this one further.

Photo 18 involves impact spatter on a door. She was supplied with additional photos from bloodstain pattern interpretation exercise 3. Is it possible victim was chased around apartment and was on her knees when she was struck in the head resulting in the smear at the top and the large stain dripping down and the stains in the middle pattern? You can’t draw any inference from these earlier events; you can only look at the terminal activity of the person near the wall, being struck, leaving impact spatter and the smeared stain. I could fill a foam core ball with blood, hold it up in the correct position with a nail and hit it with a baseball bat at different orientations. Do you want to test at least two different orientations. Can I use plastic instead of wood? You can use plastic if you want to avoid a mess but you need to be sure everything is documented so maybe clear plastic. You also need to consider the effects of different materials on the resulting bloodstain pattern. Is there any blood on the chair? I see circular stains just above the chair.

We looked at the group photo of blood moving along the side of a car that is traveling at high velocity. How would you reproduce something like this? We would use a model car along with a fan to increase the simulated speed. How would you mount the fan on the car? We could try the car by itself, the fan by itself and the car and fan together and see
how this would affect the pattern. You may be able to get some quantitative information such as velocity of the car vs. the angle of the resulting blood flow along the side of the door. You could measure the acute angle of the bloodstream after going at varying accelerations.

FOR 312 Chemistry & Criminalistics

Interview with M. B.

October 23, 2017

She forgot to bring her photos in but she has had some chance to look these over. Photo 8 shows the capillary action of blood on hand/foot on smooth, non-porous surface. She felt that this was the most difficult photo to interpret. With some prodding, she felt that the top part of the image represented a hand or foot although only four toes are visible. She thought it might be on a cloth surface. The edges are well defined, with no apparent diffusion of the stain so this may in fact be a non-porous surface of some kind. With some prodding, she recognizes that there are separate top and bottom parts suggesting an overlapping pattern of some type. This might be a foot and a hand or she feels two hands but if two hands, there is a discrepancy between the areas of the heel portion of the top and bottom parts. She was not sure what this represents or how to recreate it. I suggested this was an example of capillary action of blood spreading along a surface and the resulting pattern dependent on the amount of blood and amount of pressure.

Photo 30 she recognized immediately as a void pattern however she described the impact spatter as cast-off. I suggested that the definition of the void pattern and creating it would be the most important part so exact duplication of the bloodletting event was not as critical although it suggests impact. You could probably use some expedient as dipping a short, sturdy bristle brush into blood and shaking the brush or tapping the fibers to create the blood pattern. She realized that it was likely some type of tool. Shown against a crescent wrench, she agreed that this was a likely tool because, “the top part is bigger.” She also recognized that offsetting the tool can create a less well-defined edge and a larger pattern. I suggested looking at spatter mechanism placed at different distances as a variable but probably not as relevant as lifting the tool various distances off the surface and spattering blood onto the top of the tool and observing the resulting void.

Photo 40 she recognized as a blood trail but from blood dripping off a tool because blood dripping from a body would be too variable and cause smearing whereas this blood trail is uniform and heavily stained with blood. She could not provide an explanation regarding the blood from a wound and why it is smearing. You could maximize the amount of blood falling off an object such as a flashlight by dipping it into blood and letting it drip onto the ground but it would soon be exhausted—only blood coming from a wound could provide a steady source. Asking on what side of the body the wound is, she
indicated that it would be on the left side because that side would provide clearance for a person passing by the bicycle in the foreground and the barbecue grill in the background. I pointed out footwear impressions in blood on the right side that she had not noticed. Amount of blood loss, speed of walking and blood dripping from a wound vs. blood dripping from a tool vs. blood dripping from a wound onto a tool and then onto the ground could be variables to look at. She would simulate blood dripping from a wound by pouring fake blood into cloth, holding it like a bag and letting it drip through as she did her experiments.

Photo 51 is a series of blood drops on soil. She described the soil as sand but it is actually a dry, clay like surface. She said she would want to duplicate soil conditions where the blood had soaked in. She could not point out these areas of blood soaking in. The variable would be the number of drops required to make a stain of each size as well as the absorbent character of the soil. She did not have a good grasp of the actual size of the image. She suggested using a length of a blade of grass as a reference point (a scale later revealed at the bottom of the photo indicated that my initial belief that this photo is approximately life size is correct. She described the overall pattern as blood dripping into blood type pattern.

Group project is to create an apparatus that will disperse blood varying distances depending on size. Showed her a photo of the spinning wood amateur based off a fan motor in a cardboard housing to direct blood projection in one direction.

FOR 312 Chemistry & Criminalistics

Interview with N. A.

October 25, 2017

Looked at photos and found one that M. B. had so substituted 28 for 51. N. A. has done some preliminary examination so our conversations moved along rapidly. The first photo we examined was Photo 17 or high velocity blood spatter on a right hand. He felt that this was aspirated blood, he could see bubbles and a fine smearing of blood along the side of the index finder that suggested blood mixed with saliva. I asked if it would be likely to see aspirated blood on someone’s hand and suggested blood from a shooting. If he was holding the gun then how did he get so much blood on the inside of his hand? Person may not have been holding the gun but may have readjusted their hands so that the right hand was holding the barrel. It seems like a lot of blood for back spatter from a handgun—might be shotgun to the head that created this much spatter and he suggested holding a pipe in that hand while spraying blood onto the surface. At first, he suggested a manikin hand or a rubber gloved hand but felt that the bare hand would give the best results. He would take a spray bottle and force it through a screen to further divide the blood into small droplets and spray onto a hand. He felt that the blood should be diluted to better
duplicate the misting that appears as a solid red along the outer aspect of the index finger. Not clear how he would duplicate the areas of higher concentration such along the edge of the hand.

Photo 28 shows a combination of smeared transfer stain and medium impact stains. When asked about sequence, he indicated that the smeared swipe came first and then the medium velocity. He would take a rag that is bloody and drag it across the wall and then hit a sponge to create medium velocity impact.

Photo 45 shows an individual who shot himself in the head. There is blood spatter on the back of his right hand and blood running down the arm of his coat and blood dripping directly onto the floor from his head wound. He would reproduce this by hollowing out a Styrofoam head and placing a blood-filled balloon inside and popping it to simulate the high velocity blood pattern on the back of the hand and then let the head slump over to duplicate the blood flowing down the right sleeve and the blood from the head wound dripping onto the floor.

Photo 29 shows blood spatter from multiple directions impacting the corner of a wall and the face of file cabinet and a blood pool in front of these items. I asked him to place the victim and he would put him near the blood pool. He would simulate the blood pattern by placing a blood-filled sponge and different heights and positions and strike it with a “broad, flat instrument.” He seemed unclear of the exact placement to get the two angles of bloodstains and the exact placement in the middle to capture the bloodstains splitting between the two angled walls, suggesting it was placed at the apex of this structure. He would create a pull of blood and strike it to create the “splash pattern” on the file cabinet to the left of the picture with the larger, dripping stains. Gave no other details of the exact position of the pool of blood.

He is in group 1 and they have agreed to modify a mouse trap to create the high velocity bloodstains. I indicated that a mousetrap would not be of sufficient velocity to create high velocity effects. I recommended that the group do more research along the lines of incrementally developing high pressures such as the pumping action of an air rifle and they might want to research the theatrical production of bullet wounds for ideas.
October 26, 2017

Looked at image 26 (outline of body in blood with medium impact spatter on wall) first. I gave her the other photos associated with this reconstruction on her last visit. She found it difficult to pick out footwear impression in blood because of the pattern on the tile. Person had his throat cut and he bled out and the blood formed an outline of the body where body was in contact with the floor. I asked her why she thought it was a cut throat, her explanation was based on possible projected blood sprays which did not sound plausible. We concentrated on the body outline in blood first. Were there any indications of disturbance of the body? Obviously, the body had to have been disturbed to remove it, but were there indications in the dried blood what may have happened? She pointed out the fan shape swipe type mark near the bed. Some disturbance causing a transfer from one of the bloody legs as the body was turned over. I pointed out some voids in the heavy blood stains on the floor near the body in the most heavily bloodstained areas. Possible imprints of shoes from responders straddling the body. I pointed out the Vibram pattern in the shoe prints in blood from another photo, probably due to medical examiner office personnel. We next talked about the bloodstains on the wall. She pointed out the medium velocity impact spatter. There were focal points of bloodstaining and I suggested that this may be due to impacts of the head against the wall causing the spatter rather than the use of a blunt instrument. She thought about using a blood-filled sponge and striking it or impacting it against the wall. There are about four strike points for the head along the periphery of the smear and the large area of the smear due to contact with the bleeding head causing a large smearing stain in the center and still accounting for impact spatter with far reaching spatter stains. She might try throwing a small ball soaked in blood and other means.

The next image was photo 22 or a likely head stomping against a wall about two feet above the carpet. There is a yellow cigarette lighter which she mistook for a cartridge case. She was initially confused by the proximity of the heavy smear about two feet off the ground. Wasn’t sure if a beating could occur in that confined space. The heavy stain in the center could be the focus of impact and could be clotted blood. She was skeptical of a combination of clotted blood and liquid blood, especially small droplet size in the same event. Explained that clotting can take place in two or three minutes but need a larger quantity of blood generally to see this. The blood to the periphery looks like fine mist but the resolution of the photo is poor and may be more concentrated liquid blood. We could simulate in a similar way to the previous photo. Use a sponge or something soaked in blood and strike it or hit it against the wall. Suggested that this was in fact a stomping type of spatter on the wall. Will try blood soaked sponges and try to duplicate central and peripheral stains.

Photo 39 she found most confusing because it did not represent enough blood to cause injury. I suggested that this photo only represents a small sampling of the entire scene and
another image might be a better representation of the degree of injury and blood loss. Tried to determine mechanism among many possibilities. Contact with the body and the stain seems unlikely because of the undisturbed edges. She pointed to one area as being smooth and devoid of stains at seven o’clock position but not accurately interpreted. I suggested that this was a volume of projected blood, perhaps 20 or 30 ml. I suggested to first try to determine volume of blood on some tile squares. A ruler is present but it is only about 2/3 scale. I suggested that she first estimate the blood volume plotting 10 ml increments and based on the area estimating the minimum amount of blood. That blood could then be projected at varying heights and with varying degrees of pressure. I did not think the nature of the surface would be critical other than that it is flat and protected from the elements. She will use a very large volume syringe or whoopee cushion or balloon to approximate the needed volumes.

Photo 31 shows a void pattern on cloth. She thinks it might be a couch cover or comforter, a piece of the floor is visible in the upper part of the photo suggesting a bed covering or a furniture covering to keep pets off the furniture. There is a void due to the folding of the cloth. She has some concerns about the absorbency of the fabric. Indications of clots in some of the stains and some diffuse edges but diffusion of blood through the fabric is not a major consideration. The blood does not show much directionality and came close to 90% down. She can disperse the blood by projecting it through a screen or pair of nylons or other types of material with a fine mesh. The source of blood would be directly above the void. She would create the void by folding the fabric and would also try an object such as a handoff baton in competitive relay races. It is simply a metal cylinder.

She is in group 2 and their group will probably modify their design to produce a more uniform type of blood spatter size. She is aware of bathroom in basement with bathtub and would use that for some of the lying-in blood experiments.

FOR 312 Chemistry & Criminalistics

Interview with D. D.

October 27, 2017

Photo 27 is an overlap of bloody fingerprints on small blood spatter on a smooth surface. When she first looked at the photo she thought that the fingerprints were footwear impressions and then she saw the ridge detail. She felt that the blood drops came second because there was no smearing of the drops as you might see if the fingerprints were over still wet drops. There is an optical illusion where the darker image will appear to be on top of a lighter one. She was not certain if this was on a wall or a floor. What is the primary characteristic we are trying to resolve? We are concerned about what came first,
the fingerprint or the blood spatter. Determining whether it is on the floor or a wall is not important for this purpose, nor is it important to duplicate the exact mechanism of blood dispersal—a short brush stuck in some blood and then flicking the bristles would be adequate for this experiment. We want to determine which came first so we would test both possibilities. We would also want to vary the blood concentration on the fingers along with the drying time between experiments to see if blood might flow along ridge lines and be a better indicator of sequence.

Photo 46 is a Buck knife disassembled and showing bloodstains in its interior and very light smears on the knife blade. She found this one to be the most confusing. Initially not able to identify blood stains but these were pointed out to her. She felt that a bloody knife would have a concentrated amount of blood on the blade that would cause the “south pointing” direction to some of the blood spatters. Knives commonly don’t retain a lot of blood along the edges but you do see a line of blood that is like the outline of the blade. Blade may have closed shut leading to blood on the interior. Need to experiment with dropping the knife and positioning it in various orientation and how the snapping close of the blade may create a pattern. Has access to similar constructed hunting knives.

Photo 20 she correctly identified as likely arterial spurt against a wall in residence. Large spots of blood have been projected onto the wall. Thought she might fill a balloon partially with blood and project it out under different pressures. This might be difficult to control so one could use a pressure bulb off a blood pressure cuff attached to an intravenous bag and an outgoing tube attached to a syringe that could spurt blood out based on hand pressure to the bulb. She said she could get wall board from home depot. Asked if items could be borrowed for experimentation and reconstruction.

Photo 23 is reconstruction 4, gave her other photos associated with this case. Woman on floor in pool of blood with apparent stab wounds clustered around her right breast and blood impact spatter along her back. Believes it is a sexual assault where victim was on floor and struck on head, leading to the concentration of impact spatter on the side of the bed. Not sure if the wounds were stab or bullet holes but the apparent twisted shape is reminiscent of wounds in bodies where the blade is twisted. A little confused about the straight down path of the bloodstain. Would try to duplicate using a sponge that could be battered directionally to give bloodstains noted over back and would use a dummy or rolled paper dressed in cloth as a target. Could consider mass causality medical moulage to duplicate the knife injuries.

She has group 1 project. N. A. has mentioned that the mousetrap arrangement would only produce medium and not high velocity. Suggested that she think about a pressurized system to generate gas that would be forcibly ejecting blood out of a narrow opening simulating a gunshot wound. Air guns have special valves for increasing air pressure many thousands of times higher than normal pressure then venting it through a small
hole. Suggested that she look at theatrical reproduction of gunshot wounds. Gunshot wounds are high velocity but expired blood from respiratory track is also high velocity. So think in terms of high pressure effects and not necessarily high speed.

FOR 312 Chemistry & Criminalistics

Interview with K. S.

October 30, 2017

“I enjoy the labs and especially the exercises—they force me to think about things…creative ways to look at crime investigation…I studied biology at UB but I became bored because they did not have forensics there…this is my first semester here and I’m starting to enjoy class again.”

Looked at photo 16 (woman in corner, shot in head). She believes that it represents medium impact. Woman probably fell backward and struck her head on wall causing spatter. She was confused by the blood from the woman’s mouth—she did not know where the wound was. I pointed out the fine mist in the center of the spatter. She noted the bloodstains in the lower right that appeared to be blood in hair that swiped the surface. There is also a fine mist that indicates high velocity. There is also a light trail of powder staining on the wall. A high caliber weapon fired at the head will produce a jet of gunshot residue that will travel through the wound track and be deposited on a near-by surface. You can duplicate the high velocity impact and you can duplicate the blood gurgling through the mouth. She envisioned using a blood-soaked sponge placed in a Styrofoam head and then throwing a ball at it to get the high velocity spatter and the gurgling. I told her that would not likely work. What other pattern we studied simulates high velocity? It would be expired blood, forceful sneezing or coughing of blood would mimic the high velocity effects of a bullet. You cannot bring guns onto campus but if you have access to guns and a firing range then you could carry out the experiment there. Otherwise, consider how bullet wounds are produced in Hollywood productions—use of high pressure containers that are vented under pressure to propel blood. I recommended that she also look at medical moulage to simulate some of these effects. She can also dress the manikin in cloth to simulate the blood flow pattern although not a critical aspect of the reconstruction.

Photo 11 is the drag mark resulting from dragging a body which I used to replace her blood drip trail (photo 40). What part of the body was injured? Probably the head. How was the body positioned before it got dragged? Body with legs sticking out to the right or left. If we assume blood is from the head, then that would tend to fix the orientation of the body because the cabinets would block other orientations. She noted an accumulation of blood at the start of the trail near the center of the kitchen cabinets. She recognized the dark areas as clots broken away from the body. The change in position of the drag tended
to dislodge a clot at that point. She suggested that the shoulders of the victim widened the stain and there were faint yellow stains, likely from the victim’s arms. “How exactly does the drag pattern have to be duplicated?” Just enough to indicate dragging of a body with a source of blood and if you could duplicate the breakup of the clots that would be a bonus. Appears to have less blood at the end of the blood trail, lower part of the picture.

Photo 3 is blood dripping into blood from a short height. “I would take a dropper and drop one drop at a time into pool from as high a distance as I could.” I showed her photo 6, a projected volume of blood at low energy but showing more elongated stains than photo 3. The satellite drops are rounded but they are a certain distance from the center of the stain. The volume of the center of the stain as well as my height of blood dropping would influence the appearance of the stains. You would not want to drop from maximum height but rather measure optimum height that would give blood drops out to six to eight centimeters from the center stain and then record that height. Blood volume may influence how far the drops travel out to the periphery, something to test.

Photo 1 is arterial blood spurt. Appears to be close to ground. How close would the person be to the wall? You have blood decreasing in height from high on left side to lower on right side. Could it be due to the person falling? Maybe due to the decreasing arterial pressure. You are trying to simulate the sinusoidal pattern of the bloodstain and trying to simulate the larger drops. Could you use a squirt gun? It would probably not have the bloodstain volume and pressure considerations likely to be different. Could you use a whoopee cushion or a balloon? Probably insufficient pressure to produce desirable effects. In medical mouleage, a blood pressure bulb attached to an IV bag and connected to a syringe nozzle could approximate the pressure variation.

Group 1 needs to review the use of a mouse trap to simulate high velocity. Think of something high pressure that can be pumped several times to build up pressure like a pesticide sprayer. I suggested that she look up how Hollywood produces bullet wounds on screen using high pressure devices.

FOR 312 Chemistry & Criminalistics
Interview with J. O.
November 1, 2017
“The exercises related to creative thinking haven’t been too helpful. When I was at NU
the classes in religion and philosophy covered creative thinking, and looking at things
from all sides.”

He has been studying the photographs extensively. We began by looking at photo 19 or
bloodstains on a brass lamp. I gave him the rest of the photos from bloodstain pattern
course reconstruction number ten. When he first looked at the picture, he thought it was
blood on a door knob. Showed him the image of the entire lamp for orientation. There is
an area of impact spatter. What about this pattern at the base? It looks like bloodstains
from hair. What do you think transpired? She may have been struck more than once in
order to open up the blood source. In the high-speed videos, there was one image of a
sponge that was sealed up with tape that was struck to simulate medium velocity impact
spatter. Can’t say for sure the number of blows but the need to open up the wound to
expose more blood makes sense. How would you duplicate this? Maybe take a manikin
head and strike it with a similar object. Maybe use a sponge. You would need to duplicate
the impact spatter and the pattern from bloody hair transfer.

Photo 42 is a drying blood transfer and sequencing stain pattern. What types of blood
patterns are you seeing? Mainly transfer, swipe type stains. The circular drops appear to
have straight down, 90° impact. What was used to make the swipe? I thought at first
fingers but the striations in the middle stain were made by cotton which I saw in one of
the videos. In this one circular stain, it has dried leaving an outer ring. Blood has flowed
into it from a swipe and partially filled it in with the dried edges of the stain acting like a
retaining wall for the liquid blood. What type of surface is the blood on? It looks like a
tile. The width of the grout appears larger than what I’ve seen in most kitchens. Find a
surface to experiment with. You can produce the vertical blood spatters using a brush
dipped in blood and stroking the bristles. I might use an eye dropper for some of the
larger stains. The vertical stains would be laid down first and allowed to dry. Would then
try to duplicate swipe with cotton. The swipe pattern is rather indistinct other than rough
outline of fingers. Hard to identify a likely source, the possibilities would be nearly
infinite. You may also want to look at the direction of the swipe. Darker blood has the
optical illusion of appearing on top regardless of the order of deposition so be careful of
that. Outline of large stain in lower right-hand corner. Looks like the area of an original
stain that was wiped away. Large stains on the left, hard to identify how they originated.
Black object that looks like a shoe string on top of the photo. Some thin materials that
look like contaminants, stained with blood and on bottom right of photo.

Photo 13 is an enlargement of an expirated blood stain. Is the image life size, smaller,
larger? It is an enlargement and looks like a photomicrograph, the actual stain is probably
about two inches long. What is the orientation? It may be on a vertical surface because of
the arched blood drops. Look at the vertical flow in the center that is due to gravity, so
probably on a vertical surface. What type of surface? Likely a vertical surface. If we look
at the probability of events, it is likely on an interior wall of a residence. These are often stucco type material. Hard to see the texture of the surface. You could start with a section of wall board from Home Depot. You might be able to control that line of blood on the baseline by adding something to influence the surface character of the wall such as stop cock grease, Vaseline, Chap Stick, etc. The effects of surface tension might be accentuated by a small size stain. How was the aeration of the blood created? Presence of CO₂ maybe. How could you create that? Maybe with a syringe, but it would have to be a large syringe, without a needle. How could you create that effect in a syringe? Put blood in and pull back to introduce air. You would also want to shake it vigorously. You can control the flow by putting a piece of rubber tubing to the end of the syringe. The other stains in the pattern would not be important as duplicating the aeration of the stain and the line of surface tension creating that blood dam at the base of the stain.

Photo 5 shows impact spatter by a stair well. Where do you think this incident occurred? By the appearance of the steps, it appears to be a common area of an apartment building. It looks like high velocity but the height of the stain pattern seems extreme and not sure if the large stains to the right of the pattern are related. Also, the square, white object on the left side of the photo has a pattern that does not correspond to the impact spatter on the wall, not sure if it was there during the event. The pattern appears to be impact.

Compared to a high velocity as depicted in the shot woman in photo 16. If there was more than one strike, the stains are well centralized. Larger stains to the right but these could be due to projected blood from the initial impact site. Apparent drag marks and pooled blood at the base of the stairway. Will not try to duplicate these stains but will concentrate on the medium impact spatter on the wall. Could rig a manikin or Styrofoam head and strike it to duplicate pattern. White stains to the very left of the photo, appeared to be there after the incident as it has no bloodstains inside. Don’t appear to be film defects. Unknown and don’t appear to be critical. Will place a cotton covered sponge or cotton cover pile of newspapers or something absorbent to try to simulate the stains on the square, white object in the left corner to see if the absorption of the stains could be simulated to determine if it was there in the corner at the time of the blood spatter. The pink device in the left corner near the white object is a dildo so likely a space frequented by prostitutes, drug users, etc.

FOR 312 Chemistry & Criminalistics

Interview with A. A.

November 7, 2017
Photo 37 shows a bleeding cut on the inner aspect of the arm near the elbow with the blood transferred to the upper arm through flexing. She initially thought it was a bite mark because of the curved surface. We had taken Mikrosil casts of bite marks students made on their arms in a previous lab exercise. She realized at some point that it was not a bite mark, especially considering its orientation on the forearm and was currently stumped as to what could have made the mark. The mark superficially looks like a bite mark but the orientation would prevent someone’s jaw from aligning itself in the angle to create the bite. I pointed out the rough margins and the deep cavity into the skin. Still did not recognize this as a jagged cut. I suggested that one could simulate that curvature by cutting a cylinder at an angle. She could verify this by cutting a cylindrical object such as a rolled piece of clay or a carrot or something similar with a knife and observing the curvature. The U or V shape has an asymmetric side that might be simulated by cutting with the knife positioned at different positions. The curve could then be painted with blood or something that could transfer to another surface to mimic the transfer part found on the upper arm. She asked if construction paper could be used but I felt that this needs some three dimensional, solid character to it and would not easily be duplicated by rolled up construction paper. Seemed to have difficulty grasping the concept but I think she left with a clearer picture of what to do. She asked about the small red stains on the sheet underneath the injured arm. Told her it was likely blood but would not be the focus of our reconstruction.

Photo 2 shows some environmentally altered blood stains that appear to be blood drooped straight down onto a white sheet already moist. She likewise felt that this was blood dropped onto a surface already wet. She noted that adjacent stains were flowing into each other. I asked her what two sequencing experiments involving blood and cloth and water one could carry out. Did not seem to understand my question. I raised the possibility of dropping blood onto a dry cloth, letting the blood dry to varying extents and then adding moisture to varying degrees and dropping blood onto an already wet surface. One could then measure the degree of diffusion. Another aspect would be the difference in blood concentration between a dense center and diffuse stain edges in blood dropped into dry fabric which is then exposed to moisture vs. the uniform density of blood dropped onto an already wet fabric. This I did not point out in the hopes that she would make that observation herself.

Photo 38 appears to be a small (~1.5 cm) stain on a white surface which seems textured as if a paper towel had been placed over a drop of blood and the blood allowed to come through to the other side showing the texture and uneven blood distribution. She surmised that possibility as well. She then discounted that and felt the texturing was more like the texture of the sole of a shoe. I pointed out the small size of the stain and the correspondingly small texturing although it is something that I cannot totally discount. It would be something that she could try to duplicate in one of her trials. I suggested that
the towel over a single stain on the floor might be more likely and should be tried first. The bloodstain could be on the floor or on a vertical surface, could not discount either from the photo although there is no vertical running of the blood. Another possibility might be blood on a cloth that then comes in contact with a wall with no lateral motion. This might account for the uneven distribution of the blood with the preponderance of the right-hand side, a small gap toward the bottom, middle and less staining on the left hand side which she also noted.

Photo 33 is a series of blood drops on a concrete floor in an apparent shared space in an apartment building. Sparse stains, generally rounded appearance. She identified the stains as being likely on concrete. She initially thought this might be inside a building but concrete would not likely be inside a finished building except in garage. Appeared to be between two apartment doors along concrete foot path. Direction of travel suggested by a few round stains with a series of small stains connected and following these would suggest a motion from the back of the photo to the foreground. Large circular stains without much edge irregularity or tailing suggesting slow speeds and low energy levels. She felt that this was blood dripping off a knife. Even though small amounts of blood, there is still a lengthy trail of some feet in length and enough blood to suggest it is too much to fall simply off a bloody weapon, there needs to be some continual source which suggest blood from a bleeding wound. She had some difficulty in accepting this reconstruction as it would assume blood coming from a certain body location which she was not prepared to identify. Unlikely that we could ever identify the location on the body of the bleeding wound but could use something simple such as an eye dropper with blood to drop the blood while walking at varying speeds. Effort would be to try to duplicate the pattern of one larger parent drop and a series of drops next to each other pointing in the direction of travel. This would hopefully verify the direction of travel from the background to the foreground of the photo. She thought the blood might be from a wound on the leg but could not offer an explanation why. Spacing between the drops might have significance in regard to speed of walking but that needs to be tested.
Appendix H

Interim Assignment 1

Comparing Patent Designs

As part of your bloodstain projects, in particular your group assignments, you may find it helpful to examine various types of apparatus that can be adapted to your bloodstain pattern re-enactments. In subsequent assignments, we will be searching the patent literature for devices that might be of use in construction of apparatus specifically adaptable to bloodstain pattern re-creation. These would be gadgets capable of impacting surfaces at variable speeds, motorized devices that might be adapted to project blood at variable speeds, striking devices, etc.

There will also be exercises to allow you to examine the relative merits of competing designs in order to carry out similar functions. In the exercise below are two patent designs for a golf ball retriever. The two designs have the same end objective but approach the problem in different ways. **Design 1**
Based on the two patent diagrams, compare the relative merits of the two designs in terms of practical retrieval of golf balls from a typical golf course environment. When comparing features consider relative practicality of adding and removing the device and bulkiness or stream line of the overall device. Consider possible issues with manufacture that might affect cost. Consider the universal applicability of design in the context of the golf course environment and it they are both equally capable of retrieving a golf ball in difficult locations. Elegance of design, speed of taking the device on and off a golf club and other practical considerations that you can think of should be addressed. Prepare a list of five advantages and five disadvantages of each design in a Word document list and turn in by next class meeting.

Appendix I

Name _________________________
Date __________________________

Interim Assignment 2

Developing Project Designs

The second part of the project is a group project. The student will be part of four working
groups that will design a working model of an apparatus. One apparatus (group one) will be used
to re-create high velocity bloodstain spatter (> 100 ft. / sec.) without the use of firearms or air
rifles or similar devices. The second apparatus (group two) will be a device for the high speed
dispersal of blood droplets to illustrate the correlation between blood size and distance traveled.
The third project (group three) will simulate blood dripping from an open wound of a passenger
in a moving car but without the actual use of a full-scale car. The fourth project (group four) will
be the construction of a grid to measure blood volume on various surfaces and a device or process
to recognize spatter on a vehicle (or model) and distinguish between blood due to impact with a
blood-filled object or blood that has been dispersed onto a stationary car. The constructed device
will be presented as a demonstration to the class.

Each member of each of the four groups will consider the requirements of their projects
in terms of materials and a possible time line necessary for completion and demonstration of their
project by the end of the semester. Consider the process by which the blood source needs to be
acted upon in order to produce the desired effect (how hard, how rapidly, what type of apparatus
needed to produce the effect, etc.) This will be your first attempt to consider the requirements and
constraints of the project, details will be worked out more extensively with later assignments and
there will be opportunities to corroborate with other members of your group.

Produce three rough sketches of possible designs for an apparatus that will likely produce
the blood spatter event. Rank these in terms of those most easily constructed in a realistic amount
of time that would fulfill the requirements. Consider size and provide a rough estimate of
dimensions. Consider the type of material that may be needed. The design can be simple or
complex and assume that any required material is obtainable. In addition to your three sketches,
have a few sentence explanation of how the device works. A sheet of diagram sketches and a few
hand printed words of explanation and a list of materials to be submitted by next week.
Appendix J

Name _________________________
Date __________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 3

Patent Searches and Using Patent Literature

When you consider the construction of your groups’ device for your projects (i.e. a device that will simulate high velocity impact without use of guns or air rifles; a device that will propel blood droplets in such a fashion to show the correlation between size and distance; a device to simulate blood flow and streaming that one might see from blood flowing down the side of a moving car without using a full scale car; a measuring grid--portable and suitable for irregular surfaces, capable of measuring or gridding out irregular pools of blood and a process or device that will distinguish between blood spatter created by impacting a blood filled object with a moving vehicle and blood spattered onto a surface, both stationary) consider looking at broad categories of inventions. To look at inventions that might be applicable, we need to consider the purpose of an invention, their physical principle that underlies it, its parts, features and dimensions and the context of the invention within a family of similar inventions.

The exercises below will provide you with some familiarization with the patent literature. It will also provide you with some clues to break down the attributes of a simple device and search for other devices of similar design or provide you with ideas for modifying existing devices to incorporate them into your project devices.

1. Look up patent number 200, 521. Describe the invention, the inventor and the date of the patent. Use www.uspto.gov and “Patent Number Search” link.
2. Find three different designs for a mouse trap and paste them into your Word document. “How to Access Full-Page Images” link.
3. Provide the patent number, date of patent and a description of the invention of five inventions of Tomas A. Edison.
4. Research the fee for filing a patent. Cite all references.
5. Find sources for international patent designs and provide appropriate citations.
6. Come up with at least five attributes for your group’s device and classify them into categories suitable for searching in the Patent Office Index to Classification and Manual of Classification at www.uspto.gov click “Patents” then click “Guidance, Tools and Manuals” under “Patenting Guides. Can be found under “Tools and Manuals.”
7. Consider the attributes of a common object such as a fork. Using a series of questions through the S.C.A.M.P.E.R. problem solving method, come up with seven novel designs. Provide a simple sketch of each design. Due next Friday.

<table>
<thead>
<tr>
<th>Transformations</th>
<th>Typical Questions</th>
</tr>
</thead>
</table>
| S – Substitute | What can I replace to improve?  
What happens if I change X to Y?  
How can I replace the place, time, materials or people? |
| C – Combine    | What materials, features, processes, people, products or components can we combine within the problem area?  
Where can I create synergy with other products/processes or areas? |
| A – Adapt      | What other products/processes are similar to our problem?  
What could we change in order to adapt them to our problem? |
| M – Modify or Magnify or Minimize | How can we change the product/process entirely?  
Can the product/process be improved making it stronger, bigger, more exaggerated or more frequent?  
Can the product/process be improved making it smaller, lighter, shorter, less important or less frequent? |
| P – Put to other uses | What other products/processes could do what we want?  
How can we reuse other products/processes that are happening? |
| E – Eliminate  | What would happen if we removed a part of the product/process?  
What would happen if we removed everything?  
How can we achieve the same objective, if we were not able to do it this way? |
| R – Rearrange or Revert | What if we revert the process?  
What if we do step B before step A?  
What if A becomes the last step and Z becomes the first?  
What if we perform the two steps together? |

SOURCE: (SANTOS, 2012, P.102)

Appendix K

Name _________________________
Date _________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 4

Exercise 1: Pre-Visualization Methods.

When people are having difficulty in coming up with a basic design, it sometimes helps to have pre-forms available from which more detailed designs can be created. For example, one can use simple designs such as block letters from the alphabet to come up with various combinations and designs.

Given the series of shapes below, use these shapes to form your initial device for your individual project and a design for your group project. The shapes represented are: SPHERE, HALF SPHERE, CUBE, CONE, CYLINDER, WIRE, TUBE, FLAT SQUARE, BRACKET, RECTANGULAR BLOCK, HOOK, WHEELS, CROSS, RING and HANDLE. With the exception of the wire and tube which can be lengthened, shortened and stretched into different configurations, do not alter the basic shape of the other figures and try to maintain relative proportions of all figures. A figure may be used more than once in the design.
In addition to these figures, for the bloodstain pattern creation device you may also use a SPONGE, SCREEN/GRID, EYE DROPPER, FUNNEL, WEDGE/INCLINE, PLASTIC BAG, COCONUT, KNIFE/ SPIKE, SPRING, SQUEEZE BULB, POSTER BOARD, FAKE BLOOD with the details of your own design. Once the figures are created, have a paragraph description of its function. **Design at least two for each project.** For example, with the design below a description might be:

Variable Impact Device
This device uses a bent spring like rod attached to two wood blocks. A volume of blood is placed on the interior surface of one of the blocks and the metal rod connecting the two blocks is raised to create tension then released. The second block strikes the first block with the blood creating a simulated medium impact spatter.

Exercise 2: Using biomimicry to aid in device development. Utilize the Ask Nature web site at http://asknature.org/ to find a biological analog for your device(s) using key words and concepts to use as search terms. Identify at least three appropriate search terms and record responses. Try a test entry such as “attracting a mate,” to start.

Exercise 3: Collaborative drawing

Exchange copies of each of your designs (group and individual projects) with another member of your group and have them add, subtract additional detail or modify existing structures in your design. Provide the other member the design but provide no explanation. You will each have five minutes to make modifications after which you may discuss your modifications.


Appendix L
FOR 312 Chemistry and Criminalistics

Interim Assignment 5

Exercise--Internet Research

Begin to do research relating to your bloodstain individual and group projects. Consider the supplies that you will need to carry out the activities to reproduce your bloodstain patterns. Simulated blood, clothing, costumes, devices to simulate stabbing, shooting, bludgeoning and the resulting blood deposition are going to be of interest. Identify at least 15 key words related to blood spatter interpretation as it related to your projects. There will be meetings with each of you to further define and narrow down the scope of your projects but for this project use as broad a search scope as possible. Consider Halloween and theatrical supplies as well as arts and crafts. Supplies for mass causality, military or battle scenes and crime scene simulations would be appropriate. There is an area of nursing training known as medical mouleage that deals with the replication of injuries, simulation of clotted blood and related prompts that may yield useful information. Find formulas for creating fake or simulated blood. Consider the Ask Nature website for further ideas related to biomimicry and how this might be relevant to your project. Standard print resources as well as Internet sources may be consulted as long as full citations are provided. Complete by Wednesday, next time we meet.

- Compile a list of at least 15 search terms.
- Compile a list of 25 appropriate web sites for supplies and ideas for your individual and group bloodstain pattern projects and use APA format for appropriate citation. Annotate all sources. Be sure to include the link.

Example of proper citation format:

APA Format: Author last name, first initial. (Year of publication). Title of Web Site (in italics). Location of publisher: Publisher name. Retrieved on (date) from (Web URL).

A two page bibliography of references related to accelerated aging of paper and historical document preservation. References related to paper conservation research.
Appendix M
FOR 312 Chemistry & Criminalistics

Interim Assignment 6

Exercises in Problem Re-framing

You will re-frame your primary objective related to your individual and group bloodstain pattern problems using a simple rubric based on the following preliminary design model:

Design a(n) [device, process, etc.] ___e.g. catapult_______________________ that (does something) ___projects blood variable distances________ within the constraints of __a motorized device that permits variable speeds; a device within an enclosed area that prevents blood from flying all over the room but only in one direction; a device small enough to be carried by one person____________

You will do this for your group project (individually) and for your four individual projects. Think of three constraints for each project and prepare in a Word Document for your five projects using the above rubric repeated five times for each of your projects.

Exercise in Project Feasibility

Develop a project feasibility chart for your group project (do this individually). Use a chart similar to the example given below:

<table>
<thead>
<tr>
<th>Idea</th>
<th>Idea Value</th>
<th>Feasibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snap on plate</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Variable Strength spring</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>More than 180° of movement</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Enlarged for more realistic experiments</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Modified to accommodate sponge</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

Consider at least five variables / modifications for your proposed group device. Give these subjective ratings based on Idea Value or novelty of idea and applicability to the situation, on Feasibility or practicality, that is, how easily can it be constructed and provide total results.

Have your re-framing and project feasibility prepared in a Word document for next week.
Appendix N

Name _________________________
Date _________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 7

Evaluating Your Bloodstain Problem

1. Describe the problem. Blood is present on suspect’s left sleeve. The blood has a diffuse appearance as if it has been diluted with water. A stain higher up on the sleeve has a better defined edge and is darker suggesting that it is not dilute. Problem: how to duplicate this stain with these two issues of blood projected onto the sleeve,(likely medium velocity) and stain nearest cuff coming in contact with water. Are there other possibilities that might explain this stain? What would the blood appear like if it landed on a dry fabric? What would the blood appear like if it landed on dry fabric that then became wet? What would the blood appear like if it landed on fabric already wet?

2. Gather additional information. Is there other information that might be useful, for example information providing size? What is the significance of the area of redness near
the left hand? What is the significance of the damaged thumb nail? What would be the significance of the ring? This is all information related to a battering. While perhaps not related directly to the pattern, this other information may provide some context.

3. Think of a possible means to re-create this situation. What force would be used (low, medium, high)? What might be a possible implement to use to create the stain the size that is seen in the photo (a broad surface weapon like a board, a narrow surface weapon like a tire iron, a knife, etc.)? How would the person be positioned to the blood source so as to get the blood on the garment as observed in the photo? Once you have a few ideas, evaluate those that appear most reasonable. An evaluation matrix can be used to look at some models to determine which might be better or at least in what order you may want to proceed if multiple methods of reproducing the stain are possible. Below is one method of reconstruction where a blood-soaked sponge on the corner of a table is struck with a flat, broad and flat surface test tube holder.

4. Evaluate the results from your choice of reconstruction methods. Be aware that there are two parts to this reconstruction: the production of the stain and duplicating the likely environmental alterations that produces a diffuse stain. From the image below you will note that the stain is approximately the correct size (likely to enlarge when water is added). One also needs to be aware that the fabric is Tyvek rather than the cloth fabric seen in the photo. Consider what influence this will have on the results.
Assignment: Evaluate each of your four individual photos using this type of process of observation and information gathering.

- Provide a half page description of each of your individual bloodstain photos.
- Describe the primary problem(s). Be aware that with some photos there may be multiple events that may need to be considered.
- Gather other information from the photo that may be other than blood related that may have some bearing on understanding what happened at the scene.
- List possible methods of reconstruction.
- Choose what you feel is the best or most likely mechanism by which the bloodstain pattern was created and provide a sketch. Provide a few sentences of explanation as to why you feel this is the best solution.
- Provide a few sentences of what you expect to find from your experiment.

Prepare in a word document with your attached diagram(s) and any other method of evaluation such as an evaluation grid and submit by next week.
Appendix O

Name _________________________
Date __________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 8

High Speed Visualization of Bloodstain Patterns

There is an online site that has high speed documentation of blood spatter events. Go to the Ames research center MFRC Blood Pattern Analysis Videos at https://www.ameslab.gov/mfrc/bpa-videos and view the videos most appropriate for your project. There may be more than one video that is appropriate as some of the videos record the same effect but from different angles. Provide me with the name of the video, how it is relevant to each of your four projects and your group project in a written summary of a paragraph for each of your photos.

Online Cataloging of bloodstain patterns

Determine what the key bloodstain patterns are for each of your four individual photos and your group project. Find the most demonstrative image that illustrates that pattern and place the image in a word document. Record the web site with the photo(s) and provide the link. Include relevant key words used in your search. You may need to do a search of key words such as bloodstain patterns, castoff, blood and environmental alterations, impact spatter, transfer bloodstains, blood drip patterns, etc.

Consider this to be a custom compilation of bloodstain patterns relevant to your particular project and to your group’s project. Prepare a report that will be due next week.
Appendix P

Name _________________________
Date___________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 9—Pattern and Evidence Recognition

1. Good crime scene investigators have the ability to identify patterns and separate the background noise from the important image. Identify the star pattern within the star and outline or color it in.

![Star Pattern Diagram]

2. Photography is important in crime investigation because one can often go back to the photo after the scene has been processed and sometimes uncover additional evidence that was not noticed the first time. Look at the photo below and circle and identify the missed item of evidence. The item is common, very small and is in an unusual location. It is not related to the phone receiver in the trash can or the small jar on the table. From: Ferak, J. (2014). Bloody lies: A CSI scandal in the heartland. Kent, OH: Black Squirrel Books.
3. Below are two crime scene photos that depict the scene of a homicide before (a) and after paramedics entered the scene. Describe the points where the scene has been altered. List and describe at least fifteen.

(a) **Before**
4. Below is an image from the artist Bev Doolittle. Circle as many embedded figures as possible.

Below is another image by the same artist. Circle all 14 hidden horses.
5. Comparison of DNA electropherograms. Compare the two DNA electropherograms and note if there is a difference between the two profiles. Ignore all handwritten entries and just look at the profiles. You are comparing the allele designations listed as integer numbers in the top box and ignoring the RFU values and the molecular weight sizing data in the bottom two boxes.
Designing Prototype Kit for Bloodstain Pattern Projects

You will bring in supplies for construction of a prototype apparatus for your group and individual projects. From your basic design concepts, you will develop a number of simple prototypes for your apparatus or to visualize the process for producing your bloodstain patterns. You will have lab time next week to do your construction but this week, you will be gathering together readily available supplies for the construction of the prototypes next week. Some supplies will be available in the lab but most will be assembled by you that are particular to your own and your group projects. Suggested materials for an initial, low fidelity prototype kit might include:

1. Construction paper
2. Magnets
3. Snaps
4. Masking tape
5. Duct tape
6. Post-it-notes
7. Glue sticks
8. Paper clips
9. Decorative pads
10. Hole punch
11. Scissors
12. Stapler / staples
13. Hot glue
14. Glue guns
15. Rulers
16. Pipe cleaners
17. Colored cards
18. Zip ties
19. Foam core sheets
20. Velcro
21. Rubber bands
22. Assorted foam shapes
23. Markers
24. Fasteners
25. Straws
26. ABS sheets
27. Felt
28. Foam sheets
29. String
30. Foil
31. Cardboard rolls
32. Butcher paper
33. Stickers
34. Popsicle sticks
35. Egg & milk cartons
36. boxes (shoe & jewelry)
37. Yogurt cups
38. Toilet paper rolls
39. Wire coat hangers
40. Nuts, bolts, screws
41. Close pins
42. Beads
43. Butter tubs
44. Cans (coffee & soup)
45. Costume jewelry

In Class Design / Prototype Exercise (Take notes during interview and transfer to final Word Document.

1. **PRE THINK:** Think about your most difficult bloodstain pattern challenge. *Ten minutes (2 sessions 5 minutes each).*

   List attributes that makes it so difficult.  List attributes that you have a handle on.
2. INTERVIEW: Find out what constraints, challenges are; ask why? Often and try to arrive at some workable solution. Ten minutes (2 sessions at 5 minutes each)

List Your Observations

List Your Impressions

Observations = what you observe from your information gathering with your partner. Impressions = what you have concluded about your partner’s plans and if they are workable or not.

3. KEY INSIGHTS: What are the key needs and key insights you got about the project?
   Three minutes.
   Needs: What are you trying to solve? Observations: New learning about situation with

4. FRAME AN OPPORTUNITY AREA: How might we... Three minutes
5. IDEATE: Options to test. Sketch some ideas that meet your partner’s needs. Sketch at least four ideas: *Five minutes.*

6. ITERATE: Sketch your big solution and add the details. *Five minutes.*
8. PROTOTYPE & TEST: Build a rough and scrappy model of your design and get feedback. Ten minutes.

9. SHARE YOUR PROTOTYPE & Capture Feedback. Improved drawing based on prototype and feedback. Ten minutes (2 sessions at 5 minutes each).

10. DEBRIEF Record findings and transfer sketches or hand in document next week, photo your prototype(s) and include in word.

Appendix R
Name _______________________
Date _______________________

FOR 312 Chemistry & Criminalistics
Interim Assignment 11

*Project Photo Evaluation*

Examine your four project photographs. Provide a subjective evaluation regarding the quality of the image and your ability to derive useful information that would be helpful for your project. Use the Likert Scale assessment below to rate the relative value of your four project photographs as you rate them. For example if your photo overall is low contrast (little difference between tonal values) you would circle “low contrast.” You have intermediate ranges that you can mark with a check mark leading up to “high contrast” or maximum number of intermediate tonal values.

<table>
<thead>
<tr>
<th>Photo Number</th>
<th>Low contrast</th>
<th>Narrow tonal range</th>
<th>Out of focus</th>
<th>Poor Resolution</th>
<th>No reference scale</th>
<th>Alternate Method to determine relative scale (describe)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>High contrast</td>
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<tr>
<td></td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Full tonal range</td>
</tr>
<tr>
<td></td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Sharp focus</td>
</tr>
<tr>
<td></td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>High Resolution</td>
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<tr>
<td></td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Reference scale</td>
</tr>
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</table>

Alternate Method to determine relative scale (describe)

<table>
<thead>
<tr>
<th>Un-interesting</th>
<th>Repetitive</th>
<th>Chaotic</th>
<th>Smooth</th>
<th>Emotional</th>
<th>Simple</th>
<th>Narrow depth of focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Wide depth of focus</td>
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<td>__</td>
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<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Varied</td>
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<td>__</td>
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<td>__</td>
<td>__</td>
<td>__</td>
<td>Ordered (background)</td>
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<td>__</td>
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<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
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<td>__</td>
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<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Rational</td>
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<tr>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>Complex</td>
</tr>
</tbody>
</table>

Un-interesting __ __ __ __ __ Dynamic
Repetitive __ __ __ __ __ Varied
Chaotic __ __ __ __ __ Ordered (background)
Smooth __ __ __ __ __ Rough
Emotional __ __ __ __ __ Rational
Simple __ __ __ __ __ Complex
Narrow depth of focus __ __ __ __ __ Wide depth of focus
Color not ___ ___ ___ ___ ___  Color critical to scene
Ambiguous ___ ___ ___ ___ ___  Clear cut
Low information ___ ___ ___ ___ ___  High Information content
No continuity ___ ___ ___ ___ ___  High continuity
(between multiple images)  (between multiple images)

Attributes of Primary Object of Interest:
Poorly defined shape ___ ___ ___ ___ ___  Well defined shape
Inaccurate color ___ ___ ___ ___ ___  Accurate color
Object obscured ___ ___ ___ ___ ___  Object visible
by other object in scene (arrangement)

Object(s) need to be re-oriented to give better view / more information? Explain
_________________________________________________________________

Static (no motion) ___ ___ ___ ___ ___  Indication of motion or activity

Substrate blood stain is on:
Smooth ___ ___ ___ ___ ___  Textured
Matt surface ___ ___ ___ ___ ___  Glossy surface
Opaque ___ ___ ___ ___ ___  Transparent

Other (Describe) __________________________________________

Close to camera ___ ___ ___ ___ ___  Far from observer
(apparent depth of object within scene)

Evidence of possible lens distortion ___ ___ ___ ___  No lens distortion

Time of day: ___ MORNING  ___ AFTERNOON  ___ EVENING  ___ UNK

- How might this photo be improved to properly convey the necessary information to resolve the issues in this case?
_________________________________________________________________
Photo Number ______________

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td>__ ___ ___ ___</td>
<td>_____ Full tonal range</td>
</tr>
<tr>
<td>Out of focus</td>
<td>__ ___ ___ ___</td>
<td>_____ Sharp focus</td>
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<tr>
<td>Poor Resolution</td>
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<tr>
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<td>__ ___ ___ ___</td>
<td>_____ Reference scale</td>
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Alternate Method to determine relative scale (describe)

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<tr>
<th></th>
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<th>Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive</td>
<td>__ ___ ___ ___</td>
<td>Varied</td>
</tr>
<tr>
<td>Chaotic</td>
<td>__ ___ ___ ___</td>
<td>Ordered (background)</td>
</tr>
<tr>
<td>Smooth</td>
<td>__ ___ ___ ___</td>
<td>Rough</td>
</tr>
<tr>
<td>Emotional</td>
<td>__ ___ ___ ___</td>
<td>Rational</td>
</tr>
<tr>
<td>Simple</td>
<td>__ ___ ___ ___</td>
<td>Complex</td>
</tr>
<tr>
<td>Narrow depth</td>
<td>__ ___ ___ ___</td>
<td>Wide depth of focus</td>
</tr>
<tr>
<td>Color not critical to scene</td>
<td>__ ___ ___ ___</td>
<td>Color critical to scene</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>__ ___ ___ ___</td>
<td>Clear cut</td>
</tr>
<tr>
<td>Low information</td>
<td>__ ___ ___ ___</td>
<td>High Information content</td>
</tr>
<tr>
<td>No continuity</td>
<td>__ ___ ___ ___</td>
<td>High continuity</td>
</tr>
<tr>
<td>(between multiple images)</td>
<td>_____</td>
<td>(between multiple images)</td>
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Attributes of Primary Object of Interest

<table>
<thead>
<tr>
<th></th>
<th>Poorly defined shape</th>
<th>Well defined shape</th>
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<tr>
<td>Inaccurate color</td>
<td>__ ___ ___ ___</td>
<td>Accurate color</td>
</tr>
<tr>
<td>Object obscured</td>
<td>__ ___ ___ ___</td>
<td>Object visible</td>
</tr>
<tr>
<td>by other object in scene (arrangement)</td>
<td>_____</td>
<td></td>
</tr>
</tbody>
</table>
Object(s) need to be re-oriented to give better view / more information? Explain
_________________________________________________________________

Static (no motion)  ___  ___  ___  ___  _____ Indication of motion or activity

Substrate blood stain is on:

Smooth  ___  ___  ___  ___  _____ Textured
Matt surface  ___  ___  ___  ___  _____ Glossy surface
Opaque  ___  ___  ___  ___  _____ Transparent

Other (Describe) ___________________________________________________

Close to camera  ___  ___  ___  ___  ____ Far from observer
(apparent depth of object within scene)

Evidence of possible lens distortion  ___  ___  ___  ____  ____  No lens distortion

Time of day:  ___ MORNING  ___AFTERNOON  ___EVENING  ____UNK
  • How might this photo be improved to properly convey the necessary information
to resolve the issues in this case?
_________________________________________________________________

Photo Number _____________

Low contrast  ___  ___  ___  ___  ____ High contrast

Narrow tonal range  ___  ___  ___  ___  ____ Full tonal range

Out of focus  ___  ___  ___  ___  ____ Sharp focus

Poor Resolution  ___  ___  ___  ___  ____ High Resolution

No reference scale  ___  ___  ___  ___  ____ Reference scale

Alternate Method to determine relative scale (describe)

Un-interesting  ___  ___  ___  ___  ____ Dynamic

Repetitive  ___  ___  ___  ___  ____ Varied

Chaotic  ___  ___  ___  ___  ____ Ordered (background)

Smooth  ___  ___  ___  ___  ____ Rough
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<th>__</th>
<th>__</th>
<th>__</th>
<th>Rational</th>
<th>Simple</th>
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<th>__</th>
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</tr>
</thead>
<tbody>
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<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>Wide depth of focus</td>
<td>Color not critical to scene</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
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<td>Color critical to scene</td>
</tr>
<tr>
<td>Ambiguous</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>Clear cut</td>
<td>Low information</td>
<td>___</td>
<td>___</td>
<td>___</td>
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<td>High Information content</td>
</tr>
<tr>
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<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>High continuity (between multiple images)</td>
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</tr>
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Attributes of Primary Object of Interest

<table>
<thead>
<tr>
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<th>__</th>
<th>__</th>
<th>__</th>
<th>__</th>
<th>Well defined shape</th>
<th>Inaccurate color</th>
<th>__</th>
<th>__</th>
<th>__</th>
<th>__</th>
<th>__</th>
<th>Accurate color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object obscured by other object in scene (arrangement)</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>Object visible</td>
<td></td>
<td></td>
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<td></td>
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Object(s) need to be re-oriented to give better view / more information? Explain

<table>
<thead>
<tr>
<th>Static (no motion)</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>Indication of motion or activity</th>
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</thead>
</table>

Substrate blood stain is on:

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<th>Smooth</th>
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<th>___</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>Textured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matt surface</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td>Glossy surface</td>
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<tr>
<td>Opaque</td>
<td>___</td>
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<td>___</td>
<td>___</td>
<td>Transparent</td>
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</table>

Other (Describe) ___________________________________________________________

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<tr>
<th>Close to camera</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>___</th>
<th>Far from observer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(apparent depth of object within scene)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Evidence of possible lens distortion ___ ___ ___ ___ ___ No lens distortion
Time of day: ___ MORNING  ____AFTERNOON  ___EVENING  ____UNK

- How might this photo be improved to properly convey the necessary information to resolve the issues in this case?

---

---

Photo Number ____________

<table>
<thead>
<tr>
<th>Low contrast</th>
<th>High contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<table>
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<th>Narrow tonal range</th>
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</thead>
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<td>0</td>
<td>1</td>
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<table>
<thead>
<tr>
<th>Out of focus</th>
<th>Sharp focus</th>
</tr>
</thead>
<tbody>
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<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Poor Resolution</th>
<th>High Resolution</th>
</tr>
</thead>
<tbody>
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<td>0</td>
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</table>

<table>
<thead>
<tr>
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<th>Reference scale</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Alternate Method to determine relative scale (describe)

<table>
<thead>
<tr>
<th>Un-interesting</th>
<th>Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Repetitive</th>
<th>Varied</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chaotic</th>
<th>Ordered (background)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smooth</th>
<th>Rough</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Emotional</th>
<th>Rational</th>
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<tbody>
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<td>1</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Simple</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Narrow depth of focus</th>
<th>Wide depth of focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color not critical to scene</th>
<th>Color critical to scene</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambiguous</th>
<th>Clear cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low information</th>
<th>High Information content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No continuity (between multiple images)</th>
<th>High continuity (between multiple images)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Attributes of Primary Object of Interest
Poorly defined shape ___ ___ ___ ___ ___ Well defined shape

Inaccurate color ___ ___ ___ ___ ___ Accurate color

Object obscured ___ ___ ___ ___ ___ Object visible
by other object in scene (arrangement)

Object(s) need to be re-oriented to give better view / more information? Explain

Static (no motion) ___ ___ ___ ___ ___ Indication of motion or activity

Substrate blood stain is on:

Smooth ___ ___ ___ ___ ___ Textured

Matt surface ___ ___ ___ ___ ___ Glossy surface

Opaque ___ ___ ___ ___ ___ Transparent

Other (Describe) ____________________________________________

Close to camera ___ ___ ___ ___ ___ Far from observer
(apparent depth of object within scene)

Evidence of possible lens distortion ___ ___ ___ ___ ___ No lens distortion

Time of day: ___ MORNING ___ AFTERNOON ___ EVENING ___ UNK

◆ How might this photo be improved to properly convey the necessary information to resolve the issues in this case?

______________________________________________________________

Based on:

Anon. (1958). Ask these 20 key questions whenever you study a picture. Special Issue: What you can learn from pictures. Popular Photography, 42 (3), 60-61 (March).


Appendix S

Name _________________________
Date ________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 12

Desert Island Test

Prepare a list of three essential items you would need to have if creating your pattern on a desert island for each of your four individual bloodstain projects and for your group project. Assume that you have a plentiful supply of blood; what three primary additional parts or materials would you need? Prepare a chart or similar summary in your Word document.

Courtroom Introduction

You are going to prepare an introduction to your project in one or two paragraphs, for each of your project photos and your group photo, as if you were explaining its design to a lay jury. You will briefly explain your observations (what you saw in the photo), the likely pattern, explaining blood spatter terms in a manner that the jury can understand and how you propose to demonstrate your hypothesis of how the blood was deposited in each of your photos. For any apparatus, you will explain briefly the principles on which it works and how it will simulate a particular bloodstain pattern. For a process or sequence, you will articulate the degree of force, sequence of activities, etc. in sufficient detail that someone reading the court transcript of your testimony could duplicate your experimental design. Please try to describe each of your projects in one or two succinct paragraphs. You will be graded on the clarity of your explanations.

Prepare all comments in a Word document for submission next week.
Appendix T
FOR 312 Interim Assignment 13

Wound Correlation
Examine each of your four individual project images and determine what you can of the nature of the wound or injury that the victim might have received to produce the blood patterns noted. Based on the context of items in the photo determine if it is possible to determine:

- Wound position (on the body).
- Extent of the wound (depth in stabbing or shooting cases).
- Extent of blood loss and if survivable (if this was the only condition victim had).
- If likely multiple wounds and their types.
- Type of wound (superficial vs. deep cut; bludgeoning; crushing injuries, gunshot, etc.)
  - If a gunshot wound, can anything be said about possible distance between gun and body surface; large or small caliber
  - If a gunshot wound can one determine if likely suicide, homicide or accident?
  - What type of weapon was likely to have created this wound (cutting, stabbing, chopping, gunshot wound, blunt, etc.)
  - Is there any way of sequencing multiple injuries.
- Possible time interval over which the wounding may have taken place.
- Are there differences in directionality that can provide information about the number and location of injuries?
- If wound is survivable or not.
- Possible clues such as pattern injuries of the implement on body surface, chance of having trace evidence transfer between body surface and weapon, etc.
- If person would be likely to be able to walk away with these injuries.
- If person could have fought back or if there is any indication of self-defense.
- If person would be in a position to defend themselves (e.g. consider element of surprise, weapon type, etc.)
- Can anything be said about where victim was when injuries took place?
- Is it likely that there may be blood from the initial pattern that is spread beyond the photo—provide justification?
- Any other conditions of note in the blood pattern or context of the scene that might offer any information about wounding characteristics—you will receive five extra points if you can provide me with a valid wound-related question that might be answerable through examination of a photo that is not mentioned above.

Please use these questions in evaluating each of your four individual photographs of bloodstain patterns. Please provide a one or two sentence justification for each question. Use these same series of questions for each of your four photographs. Please prepare in a Word document and turn in next week.
Appendix U

Name ____________________________
Date ____________________________

FOR 312 Chemistry and Criminalistics

Interim Assignment 14—Project Survey

Student Evaluation of Bloodstain Pattern Learning Exercises

1. Rank the following technologies that were used within this course in order of preference with 1 being the best and 3 being the worse.
   _____ Blackboard lecture material
   _____ Photographic enlargements of bloodstain patterns
   _____ Viewing of high speed video of blood spatter formation under various conditions

2. How did the technology that was used in this course impact your understanding of the theory and practice of bloodstain pattern interpretation?
   □ No impact
   □ Minor impact
   □ Neutral
   □ Moderate impact
   □ Major impact

3. How did the classroom collaboration on projects, on case studies and other hands-on projects effect your learning?
   □ No impact
   □ Minor impact
   □ Neutral
   □ Moderate impact
   □ Major impact

4. Rank the teaching techniques that were used within this course in order of preference, with 1 being the best and 7 being the worst that best helped you to understand bloodstain patterns.
   _____ Laboratory experiments
   _____ Work groups in projects
   _____ Core lecture material on bloodstain patterns and their interpretation
   _____ Lecture material on design thinking, critical problem solving, reconstruction principles
   _____ Office hour debriefing of patterns and scenes
   _____ Re-enactments of how scenes were created
   _____ Case study homework examples
5. Rank the importance of factors influencing your decision in purchase of materials and equipment for construction of your apparatus / reproduction of your bloodstain pattern with 1 being the most important and 10 being the least important.

_____ availability
_____ cost
_____ service / utility
_____ simplicity
_____ adherence to physiological principles of blood pattern generation
_____ adaptability to new applications
_____ “wow” effect
_____ knowledge of operation--used it or similar device before
_____ something fun to play with when not being used for class assignment
_____ fulfillment of assignment criteria
_____ other (specify) __________________________________________________

6. When purchasing equipment, did you create a parts list first? ___yes _____no or was the purchase spontaneous? _____yes _____no.

7. How many times did you test or modify your design? _________________

8. What additional supplies would you like to see for your bloodstain pattern reconstruction?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

9. Is there anything about the lab set-up / work environment that would help you either be more creative or more conducive to carrying out your experiments?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

10. Would you prefer the group assignments and photographs of bloodstain patterns randomly assigned or would you like to choose them yourselves?
    i) group assignment preference _____ random _____pick group_____ no preference.
    ii) project photos preference _______ random ___ pick group ____ no preference.

11. What activity or hobby do you like to do most of the time--may or may not be school related?

____________________________________________________________________

12. How did you record the progression of your ideas?
    i) Laboratory drawing assignments. _________________________________
    ii) Collaborative sketching with other team members __________________
    iii) Rough sketches in lab notebook _________________________________
iv) Constructed models

v) Other

13. How clear or understandable were the grading rubrics and project instructions in the syllabus?

14. Are there other type of bloodstain patterns or projects that would be worth performing if the same project was offered in another class?

15. What would be helpful in further development of your designs or acquisition of relevant material for your project. Rank in order from 1 for most important to 7 for least important.

16. Where did you acquire technical information (e.g. compositions for making fake blood)?

17. How did you view the blood spatter project within the setting of a general criminalistics and crime scene course and within the context of the other laboratory exercises in FOR 312?

18. What were the most important take-away skills from the blood spatter interpretation and design project? Rank them in order of importance with 1 for most important and 12 for least important:
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_____ Learning skills for prototyping and building of simple model designs
_____ Interpretation of bloodstain patterns from photographs
_____ Integrating diverse information sets such as photos and written descriptions to
    reconstruct crime scene events based on bloodstain patterns
_____ Searching and utilizing patent literature
_____ Product evaluation
_____ Learning general design principles
_____ Developing general skills in reconstruction in general
_____ Other (Explain)_______________________

19. List the interim exercises you found most helpful for your project design and
    implementation.
________________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

20. Please provide any comments about the projects or the course in
    general.________________________________________________________
________________________________________________________________
________________________________________________________________
________________________________________________________________

Measuring preference for ideation in creative problem solving. Research and Working
Paper Series No. 208. Hamilton, ON: McMaster University, pp. 6-7.

training. Journal of Applied Behavioral Science 21, 37-49
Appendix I

Instructions

Following is a series of questions which are designed to increase understanding of how people approach ideas and problem solving. None of these questions are meant to evaluate you in any way. There are no right or wrong answers.

Please answer each question as naturally and honestly as you can. Your best description of the world as you view it is what is wanted. Please write what you think.

Listed below are several statements concerning various situations. Read each statement carefully and indicate the extent to which you agree or disagree with the statements by circling the letter which corresponds.

A = Strongly Agree
B = Agree
C = Neither Agree Nor Disagree
D = Disagree
E = Strongly Disagree

1. I should do some pre-judgment of my ideas before telling them to others.
   A  B  C  D  E

2. We should cut off ideas when they get ridiculous and get on with it.
   A  B  C  D  E

3. I feel that people at work ought to be encouraged to share all their ideas, because you never know when a crazy-sounding one might turn out to be the best.
   A  B  C  D  E

4. One new idea is worth ten old ones.
   A  B  C  D  E

5. Quality is a lot more important than quantity in generating ideas.
   A  B  C  D  E

6. A group must be focused and on track to produce worthwhile ideas.
   A  B  C  D  E

7. Lots of time can be wasted on wild ideas.
   A  B  C  D  E
A = Strongly Agree
B = Agree
C = Neither Agree Nor Disagree
D = Disagree
E = Strongly Disagree

8. I think everyone should say whatever pops into their head whenever possible.
   A  B  C  D  E

9. I like to listen to other people's crazy ideas since even the wackiest often leads to the best solution.
   A  B  C  D  E

10. Judgment is necessary during idea generation to insure that only quality ideas are developed.
    A  B  C  D  E

11. You need to be able to recognize and eliminate wild ideas during idea generation.
    A  B  C  D  E

12. I feel that all ideas should be given equal time and listened to with an open mind regardless of how zany they seem to be.
    A  B  C  D  E

13. The best way to generate new ideas is to listen to others then tailgate or add on.
    A  B  C  D  E

14. I wish people would think about whether or not an idea is practical before they open their mouth.
    A  B  C  D  E
Appendix V

Name ____ 12 Respondents _______
Date ________ 12-6-17 ____________

FOR 312 Chemistry and Criminalistics

Interim Assignment 14—Project Survey

Student Evaluation of Bloodstain Pattern Learning Exercises

1. Rank the following technologies that were used within this course in order of preference with 1 being the best and 3 being the worse.
   ____3____ Blackboard lecture material
   ____1____ Photographic enlargements of bloodstain patterns
   ____2____ Viewing of high speed video of blood spatter formation under various conditions

2. How did the technology that was used in this course impact your understanding of the theory and practice of bloodstain pattern interpretation?
   1 ☐ No impact
   2 ☐ Minor impact
   3 ☐ Neutral
   5 ☐ Moderate impact
   1 ☐ Major impact

3. How did the classroom collaboration on projects, on case studies and other hands-on projects effect your learning?
   0 ☐ No impact
   1 ☐ Minor impact
   5 ☐ Neutral
   3 ☐ Moderate impact
   2 ☐ Major impact

4. Rank the teaching techniques that were used within this course in order of preference, with 1 being the best and 7 being the worst that best helped you to understand bloodstain patterns.
   ____5____ Laboratory experiments
   ____1____ Work groups in projects
   ____3____ Core lecture material on bloodstain patterns and their interpretation
   ____7____ Lecture material on design thinking, critical problem solving, reconstruction principles
   ____4____ Office hour debriefing of patterns and scenes
   ____2____ Re-enactments of how scenes were created
   ____6____ Case study homework examples
5. Rank the importance of factors influencing your decision in purchase of materials and equipment for construction of your apparatus / reproduction of your bloodstain pattern with 1 being the most important and 10 being the least important.

__2___ availability
__1___ cost
__4___ service / utility
__6___ simplicity
__5___ adherence to physiological principles of blood pattern generation
__8___ adaptability to new applications
__9___ “wow” effect
__7___ knowledge of operation--used it or similar device before
__10___ something fun to play with when not being used for class assignment
__3___ fulfillment of assignment criteria
____ other (specify) ____ Clean up (10)____________________

6. When purchasing equipment, did you create a parts list first? ___yes _____no or was the purchase spontaneous? __6___yes __4____no.

7. How many times did you test or modify your design?  __3 (average)_____

8. What additional supplies would you like to see for your bloodstain pattern reconstruction?
__cloth, none, tile/non-porous surfaces, different types of fabric, butcher paper instead of poster board, gloves to protect hands from staining, real blood, more background information, PVC pipe, sponge, fake blood, more tools to recreate crime scene, wig, spray bottles, more fake blood available, more sophisticated supplies for construction, hand tools, a real gun, realistic blood-filled head_____

9. Is there anything about the lab set-up / work environment that would help you either be more creative or more conducive to carrying out your experiments?
__More group brainstorming time in class, in class examples of projects, more instruction so more confident in what is expected so can spend more time creatively, more examples of an apparatus to use, I think looking at creative recreations and set-ups can spark creative ideas, ask questions, asking a million questions got me through the course, if I don’t have to buy my own materials, lab set-up before doing lab, do more than history of bullets, let us use machines, examples of projects presented, supplies readily available, use some left over lab time to work on it, more background on how stains were created, I liked the way it was set up_______

10. Would you prefer the group assignments and photographs of bloodstain patterns randomly assigned or would you like to choose them yourselves?
   i) group assignment preference __4____ random __8___pick group_____ no preference.
   ii) project photos preference _____7____ random __4___ pick group __1___ no preference.
11. What activity or hobby do you like to do most of the time—may or may not be school related?

__Watch crime documentaries, read, reading, spending time outdoors, volleyball, gardening, camping, any outdoor activity, reading, writing, make-up application, reading, going to the gym, work, cook, play with puppies, read, sports, read, cook, watch movies, cooking, sports, play guitar / music, read about crime scenes, go outside on walks / hikes________________________

12. How did you record the progression of your ideas?

   i) Laboratory drawing assignments. _In a folder_, yes, kept notes, yes, sketches & write-ups, yes, yes__
   ii) Collaborative sketching with other team members _Folder, no, yes, yes, yes, yes___
   iii) Rough sketches in lab notebook __N/A_, yes, yes, no, yes, yes yes______
   iv) Constructed models _N/A_, no, sometimes, yes yes____________
   v) Other _notes, drawings, torn interim assignments, photos_____________

13. How clear or understandable were the grading rubrics and project instructions in the syllabus? _Not clear, _very clear, not clear at all, rubric clear, instructions a bit confusing, they were very clear, clear but a bit confusing when knowing if we were supposed to write a group essay, pretty clear, extremely unclear, grading rubrics understandable and clear but instructions could be made more clear, some parts clear, some parts vague and hard to understand, very clear except that syllabus said no firearms ______________________________

14. Are there other type of bloodstain patterns or projects that would be worth performing if the same project was offered in another class? _Swipe patterns, gunshot, cast-off, different velocities of blood spatter, _less interim assignments, large scale patterns, I think we covered most, if not all patterns, yes, for me high velocity spatter and arterial, blood through tires, none, yes, demonstrations for class________________

15. What would be helpful in further development of your designs or acquisition of relevant material for your project. Rank in order from 1 for most important to 7 for least important.

___2___ catalogs of parts and supplies
___1___ web sites of parts and supplies
___3___ art and hobby supplies (specify) _paper, surfaces, hot glue gun, wood, blood, paint brushes, wigs__
___6___ journaling material for recording and sketching (e.g. color pencils, sketch pads, etc.)
___4___ models (human hands, figure, head), others (specify) _body parts from photos, wall creation I used, realistic head / skin__
___5___ sources of used scientific equipment (specify) _pumps, syringes, _______ other (specify) _extra information on photos (1)_-, trial and error methods (2) _
16. Where did you acquire technical information (e.g. compositions for making fake blood)?

___ On a nursing website, medical moulage, (my sister is an RN), OER, online, Wikipedia and craft sites, lab, textbook, I got blood at Party City. Other information came from one-on-one meeting, There was a slide show given to us that had recipes as well as websites on the Internet, I found most information from lecture notes and Google, I bought the blood from Party City, Bought it at Party City, Online Websites, From the professor.

17. How did you view the blood spatter project within the setting of a general criminalistics and crime scene course and within the context of the other laboratory exercises in FOR 312?

0  □ Not relevant
2  □ Some relevance but not as important as other lab exercises
6  □ Moderate relevance, equally as important as the other lab exercises
3  □ Very relevant, more important than some of the other lab exercises
1  □ Highly relevant, among the most important assignments of the entire course

18. What were the most important take-away skills from the blood spatter interpretation and design project? Rank them in order of importance with 1 for most important and 12 for least important:

___6 Learning skills and techniques for problem ideation (coming up with new ideas)
___9 Learning skills and techniques for problem clarification and definition
___8 Learning skills and techniques for problem elaboration (building on a selected design)
___5 Learning skills and techniques for implementation of solutions
___10 Learning skills for prototyping and building of simple model designs
___1 Interpretation of bloodstain patterns from photographs
___2 Integrating diverse information sets such as photos and written descriptions to reconstruct crime scene events based on bloodstain patterns
___11 Searching and utilizing patent literature
___7 Product evaluation
___4 Learning general design principles
___3 Developing general skills in reconstruction in general

_____ Other Sketching ideas, searching for supplies, learn to speak to a jury

19. List the interim exercises you found most helpful for your project design and implementation. ___5, 2, 4, 10, 2, 5, 8, none, 12, 7, 8, 12, 1, 3, 12, none, 4, 5, 7, 12, none, 7, 10 The one where we were asked to find websites for our design. The assignment where we evaluated the blood spatter individually. All interim assignments that require sketching prototypes of each individual project. None, they were very repetitive and confusing. # 12 was most helpful. Interim 12’s courtroom introduction, Interim 7, Interim 8. The resume assignment was helpful. Patent
assignment was interesting as well. I would rather have had homework assignments that included material we were learning in lecture. The homework were very repetitive and a nuisance. Interim assignments 1, 2, 4, 5, 7 gave us purpose to sit down and analyze photos, and think about the project. Nothing to do with problem solving, idea creation, group collaboration, resumes, etc. These are not forensic science topics and were seemingly unnecessary. Prototyping, explanations of blood patterns.

20. Please provide any comments about the projects or the course in general. I wasn’t as interested in the class material as I thought I would be since it’s my major. Lectures don’t deviate much from what is on the PowerPoint slides. Too much work. Many interim assignments could have been shortened or combined. The group project should be due at a different time than the individual project to avoid stress. The patent assignments were very unuseful for the project. Office hours was the most useful in project design. Better instructions and better explanations needed. The topics studied were very interesting but I thought the interim assignments were too repetitive. I also hoped for more chemistry related content. I think the project was very interesting and informal. I just wish more details were given. I love the office hours that we had to bounce ideas off each other about my images. It was a little unclear at first. Very hard to buy my own stuff since most college kids are short on cash. The tests were long and more difficult than I expected. The creative thinking and how to work in groups could be its own class. It did not help with the class or assignments. This needs to be more science based, no teamwork stuff. Labs need to be prepared prior to class, and the homework needs to be more about other material than just the project. The many assignments are great to keep grade high. Tests are difficult and too detail oriented. Should only have take home portion for final. Office hour meeting for photos helped a lot, more regular check ins would keep students on track and more feedback from interim assignments. Coming into this course, I thought it was going to be more focused on the actual science involved in criminalistics, not all of the divergent thinking, group mentality, patent research, etc. I love how much material we covered. I love how diverse the content is. My knowledge on the field has broadened and this class has made me more excited for my future. Amazing course. Blood projects were creative, fun and taught me a lot.


FOR 312 Chemistry and Criminalistics; FOR 497/598 Micro Course—Bloodstain Pattern Interpretation; CHE 672 Forensic Molecular Biology

Project Survey

**Student Evaluation of Bloodstain Pattern Learning Exercises**

1. Rank the following technologies that were used within this course in order of preference with 1 being the best and 3 being the worse.

   _3._ Blackboard lecture material
   _2._ Photographic enlargements of bloodstain patterns
   _1._ Viewing of high speed video of blood spatter formation under various conditions

2. How did the technology that was used in this course impact your understanding of the theory and practice of bloodstain pattern interpretation?

   1. ❑ No impact
   2. ❑ Minor impact
   6. ❑ Neutral
   9. ❑ Moderate impact
   2. ❑ Major impact

3. How did the classroom collaboration on projects, on case studies and other hands-on projects effect your learning?

   1. ❑ No impact
   2. ❑ Minor impact
   1. ❑ Neutral
   9. ❑ Moderate impact
   7. ❑ Major impact

4. Rank the teaching techniques that were used within this course in order of preference, with 1 being the best and 7 being the worst that best helped you to understand bloodstain patterns.

   _1._ Laboratory experiments
   _2._ Work groups in projects
   _5._ Core lecture material on bloodstain patterns and their interpretation
   _6._ Lecture material on design thinking, critical problem solving, reconstruction principles
   _4._ Office hour debriefing of patterns and scenes
   _3._ Re-enactments of how scenes were created
   _4._ Case study homework examples
5. Rank the importance of factors influencing your decision in purchase of materials and equipment for construction of your apparatus / reproduction of your bloodstain pattern with 1 being the most important and 10 being the least important.

1. availability
2. cost
7. service / utility
4. simplicity
6. adherence to physiological principles of blood pattern generation
10. adaptability to new applications
8. “wow” effect
5. knowledge of operation--used it or similar device before
9. something fun to play with when not being used for class assignment
3. fulfillment of assignment criteria
other (specify) __________________________________________________

6. When purchasing equipment, did you create a parts list first? _yes __no or was the purchase spontaneous? _yes __no.

7. How many times did you test or modify your design? _3 (average); range: 0-6__

8. What additional supplies would you like to see for your bloodstain pattern reconstruction?

Blood provided, machinery provided; different fabrics; accurate fake blood; I accomplished everything with the supplies I had; more fake blood; more supplies for group project; a better fan, more fake blood; need a large spool of string; wig; more things in the lab room—Styrofoam heads, fake blood, cardboard boxes used to hold things up; the labs were great and helped us understand the methods used in forensic labs; no; more fake blood actually supplied by the college, tools needed (drill, screws); more fake blood; more blood available, more realistic heads, more things to put blood on besides butcher paper; bats, mops for clean-up; larger knife to hollow head________________________________________

9. Is there anything about the lab set-up / work environment that would help you either be more creative or more conducive to carrying out your experiments?

Lab area more open for experiments; time; a lot of the experiments could be done outside of the classroom, which was nice; the work environment was suitable for my experiments, better lighting for photographs; a better pipe system, one that interlocks; less projects so that we can focus our attention more, better variety of material, large sponges, more syringes; working as a class; more of an open space to carry out the experiments, a place where the clean-up is easy and don’t have to change the paper each time; labs are semi-boring, the projects are more interesting and interactive, learned more than any of the labs we did; _there were more students doing their projects so it made me think creatively; bats, mops for clean-up; I’ve never learned reconstruction, this was all new; ____________________
10. Would you prefer the group assignments and photographs of bloodstain patterns randomly assigned or would you like to choose them yourselves?
   i) group assignment preference ③ random ⑫ pick group ⑤ no preference.
   ii) project photos preference ⑤ random ⑩ pick group ⑥ no preference.

11. What activity or hobby do you like to do most of the time--may or may not be school related?
   _Sports, reading; bike riding; cooking & baking; playing video games; play guitar, listen to music; ink drawings, extensive fiction reading, horror movies helped; reading, skiing, camping; reading; photography; music, sports; movies; hands-on projects, making money; hockey; photography; photography; ________________

12. How did you record the progression of your ideas?
   i) Laboratory drawing assignments. ⑩ drew designs for group & individual__
   ii) Collaborative sketching with other team members ⑨ helped out a lot____
   iii) Rough sketches in lab notebook ⑥ ________________________________
   iv) Constructed models ④ just for group project_____________________
   v) Other ① photographs; I didn’t; just thinking_____________________

13. How clear or understandable were the grading rubrics and project instructions in the syllabus?
   Very clear (2); semi-clear (2); clear (9); vague (1); not clear (1)_____

14. Are there other type of bloodstain patterns or projects that would be worth performing if the same project was offered in another class?  Yes; No, I think we got them all; nope; I can’t think of any; think we covered all; no; no; no; I would like to repeat for better results/different patterns_____________________________________

15. What would be helpful in further development of your designs or acquisition of relevant material for your project. Rank in order from 1 for most important to 7 for least important.
   __3___ catalogs of parts and supplies Outdated, not used, used Walmart more
   __3___ web sites of parts and supplies Probably used more
   __2___ art and hobby supplies (specify) __provided supplies; Home Depot. JoAnns; mannequin heads; JoAnn Fabrics; sponges, strings, baskets; more fake blood, larger surfaces to do blood on; fake blood; I bought blood from Party City_______________________
   __4___ journaling material for recording and sketching (e.g. color pencils, sketch pads, etc.)
   __1___ models (human hands, figure, head), others (specify) __heads, body for drying stuff; heads; more realistic dummies/heads; Styrofoam heads______________________
   __2___ sources of used scientific equipment (specify) ____________________________
   __5___ other (specify) _______________________________________________________

16. Where did you acquire technical information (e.g. compositions for making fake blood)?
   __Internet/online sources (12); just thought of it (1); lectures (1); peers (1)____
Appendix W

Group Facilitation Directions

You will want to pick a facilitator among your group to help the discussion regarding the reconstruction assignment to move along. Choose one person to lead the group discussion. This person will be responsible to see that the discussion moves forward and that everyone gets to voice their opinion. As a facilitator you may:

- Elicit volunteers or appoint group members to act as recorders and resource persons.
- See that discussion does not get bogged down.
- Solicit input from your group about possible scenarios
- Have these different ideas recorded.
- See that creative problem solving methods are applied properly.
- Ensure that everyone has participated in the collaborative drawing exercise of Interim assignment 4 prior to handing it in.
- See that someone keeps track of issues regarding the assignments that are unclear.
- See that questions are concise and clear before approaching the instructor.
- Make sure that everyone is participating and on task.
- Provide me with the name of your group facilitator when you hand in lab assignment five.
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data Collection Method</th>
<th>Data Analysis Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>#1</strong>: Do higher levels of creativity in the products result in higher content knowledge?</td>
<td>Pre- and post-knowledge exams. Creative product assessment Lab notebooks and write-ups</td>
<td></td>
</tr>
<tr>
<td><strong>#2</strong>: Is extent of contribution in group projects and level of novelty and design subtlety related to Foursight preference?</td>
<td>Foursight Student interviews</td>
<td></td>
</tr>
<tr>
<td><strong>#3</strong>: How might one critique designs in order to avoid fixation yet not inhibit free thought in product development?</td>
<td>Student interviews</td>
<td></td>
</tr>
<tr>
<td><strong>#4</strong>: What aids or instructional methods (CPS or product development) were most useful in stimulating new ideas?</td>
<td>Student interviews Job-aid design</td>
<td></td>
</tr>
<tr>
<td><strong>#5</strong>: How does one communicate motion as well as functionality in prototype design?</td>
<td>Job aid design</td>
<td></td>
</tr>
<tr>
<td><strong>#6</strong>: What type of working environment (lab, classroom, home, office, etc.) is more conducive to prototype testing and design?</td>
<td>Journaling</td>
<td></td>
</tr>
<tr>
<td><strong>#7</strong>: What aspects of a student’s background can predict success with prototype development (prior subject knowledge, hobbies, use of tools, classes in physics, engineering, etc?)</td>
<td>Student surveys Student interviews</td>
<td></td>
</tr>
<tr>
<td><strong>#8</strong>: By what criteria does one measure efficiency, timeliness in prototype design?</td>
<td>Creative product assessment</td>
<td></td>
</tr>
<tr>
<td><strong>#9</strong>: What is more likely to lead to a superior design—a carefully crafted single project or a large number of designs? How does this relate to Foursight preference?</td>
<td>Journaling Creative product assessment Foursight</td>
<td></td>
</tr>
<tr>
<td><strong>#10</strong>: What is the role of intelligent fast failure in a classroom, laboratory and product development environment—role of guidance, planning and part of evaluation function.</td>
<td>Creative product assessment</td>
<td></td>
</tr>
<tr>
<td><strong>#11</strong>: Is there subject resistance to intelligent fast failure approaches? What is the role of foursight preference? How does group size promote or inhibit?</td>
<td>Student interviews Creative product assessment Journaling Foursight</td>
<td></td>
</tr>
<tr>
<td><strong>#12</strong>: How do students develop initial designs? What is the role of insight? What role does</td>
<td>Student interviews Journaling</td>
<td></td>
</tr>
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Appendix X

Douglas A. Ridolfi
October 20, 2016
CRS 795
<table>
<thead>
<tr>
<th>Question</th>
<th>Methodologies/Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will exposure to previous, similar designs help or hinder the creative process?</td>
<td>Pre- and post-test scores, Foursight, Student interviews, Journaling</td>
</tr>
<tr>
<td>Will specific guidance vs. general guidelines on model development have an effect of originality of project design and will the novelty and creative aspects of the design lead to improved scores of content knowledge?</td>
<td>Job aid development</td>
</tr>
<tr>
<td>Can a method, procedure, job aid, instructional element such as a lecture, lab or active learning exercise be used to help get students out of mental ruts?</td>
<td>Foursight, Student interviews, Creative product assessment</td>
</tr>
<tr>
<td>What is likely to lead to mental ruts? Lack of domain knowledge? Lack of divergent thinking skills? Previous design success? Are any Foursight preferences prone to this type of mental inhibition?</td>
<td>Foursight, Creative product assessment</td>
</tr>
<tr>
<td>Are there fundamental differences between science experiment kits and other types of creative products that would necessitate a modification of Besemer’s Creative Product Assessment?</td>
<td>Creative product assessment</td>
</tr>
<tr>
<td>Are there ways to assess the creativity of the originator of a creative prototype other than judging the construction of the actual device? That is, how does one assess the cognitive creative components vs. the performance aspects that go into model building?</td>
<td>Creative product assessment, Performance tests, Divergent thinking tests</td>
</tr>
<tr>
<td>How can one extend the learning and motivate students to continually improve on a design after a class is completed? What motivators can be used in the classroom environment?</td>
<td>Student interviews, Foursight</td>
</tr>
<tr>
<td>How can one incorporate prototype design and development in other active learning situations</td>
<td>Student interviews</td>
</tr>
<tr>
<td>How do students rate prototype design relative to conventional lab experiments and classroom exercises?</td>
<td>Student interviews</td>
</tr>
</tbody>
</table>
Appendix Y
Appendix Z
Name_______________________
Date________________________

FOR 312 Chemistry and Criminalistics

Lab Lecture Midterm

1. Identify which of three steps, Clarification, Transformation or Implementation, each of these steps is associated with in the Creative Problem Solving scheme:
   a. Exploring the vision ______________________________________
   b. Formulating challenges____________________________________
   c. Exploring ideas __________________________________________
   d. Formulating solutions _____________________________________
   e. Exploring acceptance ______________________________________
   f. Formulating a plan _________________________________________

2. Identify some of the activities associated with participant observation:
   a. actor _______ 1. The sequence that takes place over time
   b. activity _____ 2. The people involved
   c. event _______ 3. A set of related acts people do
   d. goal ________ 4. The things people are trying to accomplish
   e. time ________ 5. The sequence that takes place over time

3. Breakthrough thinking involves:
   a. Break through thinking is universal and can be done by anyone
   b. It has distinct steps
   c. Steps are accompanied by particular steps
   d. Some of us have preferences for particular mental skills
   e. All of the above

4. Design thinking involves the following, except:
   a. role playing
   b. observing activities of the consumer
   c. developing a customer profile
   d. define a problem
   e. generate ideas
5. Identify the thinking preferences as developed by the FourSight measure:
   a. Clarifier _________ 1. Develop plans to carry out activities
   b. Ideator __________ 2. Define problems
   c. Developer ________ 3. Generate novel ideas
   d. Implementer _____ 4. Carry out projects

6. People who seek to do things differently can be considered (adaptors / innovators) ________, while people who do things better can be considered (adaptors / innovators) ____________.

7. The person who shows no particular preference for clarifying, ideation, developing, and implementation or can perform each of these equally well is known as a(n):
   a. optimizer
   b. driver
   c. visualizer
   d. integrator
   e. gestalt

8. Determine whether each of the following is consistent with convergent or divergent thinking:
   a. generates many options ____________________________________________
   b. favors creative thinking ____________________________________________
   c. likes analysis ___________________________________________________
   d. favors critical thinking _____________________________________________
   e. prefers evaluating and selecting options ______________________________
   f. preference for making____________________________________________

9. Identify the stages of team formation:
   a. forming _______1. Team conducts an assessment of accomplishments
   b. storming _____ 2. Team members become acquainted & generate ground rules
   c. norming _____ 3. People feel part of the team & can work & accept their viewpoints
   d. performing _____ 4. Communicate individual messages; resist control by group leaders
   e. adjoining _____ 5. Team works in a open and trusting atmosphere
10. The most important role in the collaborative group who motivates the others in the team and keeps them on track is the:
   a. checker
   b. facilitator
   c. reporter
   d. recorder
   e. time keeper

11. The broad classifications for inventions are:
   a. practical, rational, and irrational
   b. scientific, technical and innovative
   c. mechanical, chemical, and electrical
   d. broad based, narrow based, and adaptive
   e. significant, insignificant and ground breaking

12. The following would be accepted patent classifications, except:
   a. article
   b. composition
   c. design
   d. minor modification
   e. plant

13. A method for recording the conception of an invention would be:
   a. invention title
   b. circumstances of conception
   c. functional & structural description
   d. applications & ramifications
   e. all of the above

14. The major purpose of the notebook, especially for inventors is,
   a. record ideas and sketches as they are developed
   b. recording ideas in a secure, bound format with no loose pages
   c. establishing timeliness of inventions by dating, witnessing, initialing each page
   d. having an up-do date and accurate table of contents
   e. all of the above
15. The following would be important concepts in invention usability & marketability, except:
   a. cost
   b. weight, size
   c. novelty
   d. how well it copies a big-name brand
   e. durability

16. One would start a systematic search for similar patents by looking first at,
   a. *Index of Classification* alphabetical listing
   b. *Manual of Classification* numerical listing
   c. patent numbers
   d. patents and diagrams pdf
   e. journal articles

17. Define the following terms related to analogy use:
   a. analogy__________1. Word/phrase applied to action not literally true
   b. anomaly__________2. Something that deviates from norm
   c. metaphor__________3. Comparison between things literally true
   d. literal similarity____4. Superficial appearance but not real in properties (dream)
   e. mere appearance_____5. Similarity with key attributes shared (snake like winding road)

18. Looking at structural features such as a feather to describe iridescence of a crystal would be an example of a (surface feature / generative) __________analogy while looking at structural similarities such as the beak of a bird and the shape of a high speed train to generate new ideas would be an example of a (surface feature / generative) __________ analogy.

19. Common ideation methods in design thinking include,
   a. direct analogies
   b. excursions / field trips
   c. rolestorming or participants brainstorming in specific roles
   d. answer a and b
   e. answer a, b, and c
20. The synectics method of ideation using analogies, includes the following analogy types, except:
   a. cosmic analogy or using different environments or creatures as analogies
   b. direct analogy or clear relationship between problem and some object
   c. fantasy analogy or problem is imagined to be attacked by imaginary things
   d. personal analogy or imagining the parts as oneself or traveling into that situation
   e. symbolic analogy or objective impersonal objects to describe a problem

21. In biomimicry we look at designs in nature to help us design analogous structures based on how animals,
   a. build structures
   b. move
   c. camouflage
   d. work in groups
   e. all of the above

22. Ruth Noller, a mathematician, computer programmer and pioneer within the field of creativity, developed a formula for the creative process: \[ C = \int_a(k, i, e). \] The terms are defined as:
   a. attitude, knowledge, intelligence, education
   b. ambition, know-how / practical knowledge, inventiveness, environment
   c. aggressiveness, killer instinct, intensity, effectiveness
   d. attitude, knowledge, imagination, evaluation
   e. adaptability, knowledge, inventiveness, emotion

23. Identify characteristics related to clear-cut vs. complex problems:
   a. all relevant information is available __________________________
   b. problem may or may not be worth solving _______________________
   c. steps between problem and solution are stereotyped ________________
   d. solution known to someone but not necessarily to you _____________
   e. initial models may not be correct ________________________________
   f. may be difficult to articulate the actual problem ___________________

24. The general method for problem solving in established disciplines involves problem inquiry, looking at specific goals, determine methods and means to solve problem, optimize the solution, construct and verify the solution, finalize and “sell” the product.
   a. True
   b. False
25. Successful inventors and entrepreneurs and innovators always strive for low novelty and high usefulness to achieve the most creative products.
   a. True
   b. False

26. The three stages in the creative problem solving cycle are:
   a. knowing, doing, and processing
   b. observing, deciding, and applying
   c. clarifying, transforming, and implementing
   d. ideating, sketching, and prototyping
   e. sketching, prototyping, and developing

27. When examining bloodstain patterns at a scene, a more complex, difficult type of pattern(s) would be:
   a. direction of travel of individual blood droplets
   b. general size distribution of blood droplets
   c. relative position and placement of blood droplets
   d. overlapping patterns and how they might be sequenced
   e. environmental alteration of blood at scene

28. You want to diagram how the parts of an unfamiliar apparatus go together. A visually preferable way of illustrating the assembly would be:
   a. labeled exploded parts view
   b. top, bottom, side views of assembled apparatus
   c. use of dotted lines to show hidden parts of assembled apparatus
   d. three dimensional / perspective drawing of assembled apparatus
   e. ditto lines to show eliminated, duplicated parts of assembled apparatus

29. When one is stumped for new ideas, one can sometimes receive renewed insight by studying a random object or photograph and asking yourself, *when you look at this picture or object, what ideas do you get for solving this challenge?* This ideation technique is called,
   a. brainstorming
   b. dominant closure
   c. forced connections
   d. re-direction
   e. SCAMPER
30. If an idea succeeds, what other things might be derived from your product? This is a futuristic view of some of the advantages of your product when looked at through the PPCO evaluation method. This futuristic view is in what part of the PPCO method?
   a. Plusses  
   b. Potentials  
   c. Pitfalls  
   d. Concerns  
   e. Overcoming concerns

31. A problem solving method that utilizes a variety of analogy types is known as,
   a. analogizing  
   b. biological inventiveness  
   c. compartmentalizing  
   d. direct analogy  
   e. synectics

32. Match the following problem types with their definitions:
   a. tame______1. Clear problem definition but needs immediate resolution  
   b. crisis______2. Clear problem definition  
   c. wicked______3. Unclear problem definition, requires innovation

33. In creative problem re-framing, a significant development or insight that leads to a change in direction of thinking from the original course of action is called a(n),
   a. awakening  
   b. breath of fresh air  
   c. calm before the storm  
   d. insight  
   e. pivot point

34. Good student projects encompass elements of,
   a. originality, practicality, commercial opportunities  
   b. rapid design, prototyping, fast failure  
   c. observation, reflection, implementation  
   d. engagement, outcomes, reflective practice  
   e. modeling, scaling, manufacture
35. Working through a lot of failed prototypes to develop good ideas is a business practice called
   a. breakthrough innovation
   b. competitive prototyping
   c. innovation design
   d. intelligent fast failure
   e. resourceful failing

36. The OODA loop or method of quick orientation to changes in the environment stands for,
   a. Observation, Opportunity, Data, Action
   b. Observe, Orient, Decide, Act
   c. Overview, Occupy, Determine, Adapt
   d. Opposite, Occasional, Develop, Absolute
   e. Opportunity, On-task, Develop, Adapt

37. Determine the most appropriate role and function of logical reasoning types:
   b. Deduction_____2. Experimentation, often used in scientific investigation.
   c. Induction______3. The strongest conclusions are derived from this logic process.

38. Many design models including Agile Design have entry points into the cycle that look for,
   a. a perceived need
   b. information
   c. experimentation steps
   d. iterative process
   e. All of the above

39. One business model in cognitive design methodology follows a business model where customers can participate in the design of their own footwear. This is known as,
   a. customer footwear design
   b. customer co-creation
   c. customer concept development
   d. resource reallocation
   e. sneaker engineering
40. Overcoming mental blocks normally involves the following, except,
   a. departmentalizing
   b. defocus
   c. defer judgment
   d. distancing
   e. drill down deeper

41. The slowest point in the creative problem solving and design processes is generally,
   a. clarification
   b. ideation
   c. implementation
   d. development
   e. constraint finding

42. Occam’s Razor and the Law of Parsimony deal with,
   a. Removing extraneous information from interpretations
   b. Coming up with the simplest hypothesis that fits the facts
   c. Only evaluating one hypothesis at a time
   d. Answers a and b
   e. Answers a, b, and c

43. Bias is a preference or inclination that inhibits judgment to the point of impartiality. Bias can be reduced by,
   a. evaluating the nature and source of all information
   b. separating facts from opinions
   c. distinguishing between primary and secondary sources of information
   d. skeptical gathering of evidence
   e. all of the above

44. When examining evidence, we often look at its interrelationships with other types of evidence. Match the following types of interpretational clues with their respective definitions:
   a. Functional_____ 1. Significance of where an object is
   b. Relational_____ 2. How it was used or what it was used for
   c. Temporal_____ 3. Time duration or when something was used
45. A good scientific theory prevents things from happening. The more the better. This concept of subjecting scientific hypothesis to rigorous testing which would tend to disprove the theory is known as,
   a. amassing data
   b. bias reduction
   c. falsification
   d. negativity
   e. worst case analysis

46. Good standards of practice for crime scene reconstruction include the following, except,
   a. avoiding bias
   b. ensure that eye witness accounts don’t conflict with evidence
   c. obtaining all necessary information
   d. understanding of basic science, forensic science, scientific methods
   e. visit the crime scene whenever possible

47. A reconstructionist would likely have information to a number of sources when doing a crime scene evaluation. The following would typically be of importance, except,
   a. Crime scene documentation
   b. Forensic laboratory, medical, toxicology reports
   c. Investigative and forensic testimony in court transcripts
   d. Newspaper accounts
   e. Witness and suspect statements

48. According to Steno’s Law of Superposition, the layer on (top/bottom) __________ represents the (oldest/youngest) __________ event or geological occurrence. This relates to (absolute/relative) __________ chronology.

49. There are a number of circumstances that can result in uncontrolled crime scene alteration. Alterations that are probably the most conspicuous would be,
   a. emergency medical personnel
   b. first responders searching scene
   c. fluids and stains drying at scene
   d. violent acts or struggle during commission of crime
   e. witnesses and/or suspects altering scene
50. The primary elements of most crimes that one would want to focus on in a reconstruction would be,
   a. approach to the scene, commission of the crime, exit from the scene
   b. control of victim, response of victim, suspect’s fantasies
   c. suspect preparation, victim resistance, display of body
   d. aggression, detention, disposal
   e. voluntary vs. involuntary victim response, primary vs. secondary scenes

51. Summarizing, simplifying and re-arranging visual information from a complex scene can be done by a graphic arts devise known as,
   a. advertising cut-outs
   b. comic strips
   c. graphic organizers
   d. storyboarding
   e. utility showcases

52. Match some of the attributes of *hard vs. soft* thinking:
   a. Logic ____________________________
   b. Dreaming ________________________
   c. Reason __________________________
   d. Precision ________________________
   e. Ambiguity ________________________
   f. Play ______________________________

53. Attributes of play can be helpful in stimulating innovation.
   a. True
   b. False

54. Identify the terms with the action when using the design process in education:
   a. Discovery ________ 1. I tried something new
   b. Experimentation _____ 2. I have an idea
   c. Evolution __________ 3. I see an opportunity
   d. Ideation ____________ 4. I have a challenge
   f. Interpretation _________ 5. I learned something

55. The first step in the design process is,
   a. brainstorm possible solutions
   b. build the prototype
   c. identify a design opportunity
   d. refine your problem
   e. research the design opportunity
56. A mechanical system can consist of the following, except:
   a. component
   b. module
   c. part
   d. system
   e. subsystem

57. An inorganic material consisting of metallic and non-metallic components is called a
   a. ceramic
   b. metal
   c. polymer
   d. synthetic
   e. textile

58. How easily a material stretches when force is applied is known as,
   a. bendability
   b. compression
   c. ductility
   d. stretching
   e. tension

59. A collapsible design that consists of a number of equal length rods forming x’s around a pivot joint which can expand and contract and can be used for retractable mirrors and lights, is called a
   a. bellows
   b. concertina
   c. fan
   d. hinge
   e. nesting

60. When deciding to make changes to prototypes, one needs to decide if the design is still true to aspects of,
   a. aesthetics
   b. feasibility
   c. functionality
   d. true to process
   e. all of the above
61. The Edisonian method of creativity simulation and prototyping involves,
   a. experimentation
   b. random search
   c. trial-and-error
   d. try everything
   e. all of the above

62. In our in-class prototyping, we are involved in most aspects of rapid prototyping, except,
   a. customer evaluation
   b. design
   c. initial requirements / constraints
   d. prototyping
   e. test

63. The following would be a measure of success of your prototype design, except,
   a. device or process adequately reproduces the pattern
   b. it replicates a real-life process
   c. it is elegant, compact and workable
   d. it will dominate market share of other, similar items
   e. you can explain it to the satisfaction of user groups

64. Documenting wounds in detail is important because,
   a. at autopsy they may not be properly documented
   b. they may indicate weapon type
   c. they can represent a physical manifestation of behavior and motive
   d. answers a, b and c
   e. answers b and c

65. This injury represents a
   a. abrasion
   b. bruise/contusion
   c. burn
   d. incision
   e. laceration
66. A fracture of a long bone where a portion of the bone penetrates the skin is known as a(n),
   a. compound fracture
   b. complex fracture
   c. incomplete fracture
   d. multiple fracture
   e. simple fracture

67. When photographing a wound such as a contusion, bite mark, etc., one would use the following photographic methods, except,
   a. different time intervals
   b. oblique
   c. infrared
   d. transmitted
   e. ultraviolet

68. Match the following types of gunshot wounds with their description:
   a. contact________1. Burning, soot, smokeless powder residue, confined diameter
   b. near contact_____ 2. May have tearing of skin, may have site of gun impression
   c. intermediate_____3. Smokeless powder widely dispersed
   d. distant__________4. Circular skin defect with no residue

69. The most important aspect of documenting a restraint is,
   a. characterizing the rope or cordage fiber type
   b. characterizing the weave pattern of the rope or cordage
   c. describing the knot
   d. photographing the restraints in place
   e. all of the above

70. Match the following types of motivational wounds/force with their descriptions:
   a. administrative____1. Single method of injury, short time period, specific area
   b. overkill_________ 2. Aggressive action to restrict victim movement
   c. control__________ 3. From behavior of victim or suspect to protect them from injury
   d. defense__________4. Wounds to prevent or hamper recognition
   e. precautionary_____ 5. Psychological or fantasy fulfillment force
   f. experimental______ 6. Injury beyond the need to cause death.
71. Features that may be of some use in identifying trades or occupation of unknown bodies:
   a. abrasion injuries
   b. contusions and bruises
   c. defense wounds
   d. occupational marks
   e. puncture marks

72. A type of wound that can provide information regarding the devise used to produce the wound:
   a. abrasion
   b. cut marks
   c. patterned injury
   d. physical torture
   e. precautionary force

73. A wound pattern more likely to reveal something about the suspect,
   a. abrasion
   b. bite mark
   c. cut
   d. patterned injury
   e. restraint

74. Reenactments are most useful for short segments of events that are firmly grounded in evidence.
   a. True
   b. False

75. Match the following crime scene types with their description:
    a. preparatory crime scene _____1. Relational dynamics between offender & victim
    b. point of first encounter ______2. Location where some of the interaction took place but not majority of it
    c. primary crime scene ______3. Location for offender planning, watching
    d. secondary crime scene _____4. Where offender engaged in majority of criminal behavior
    e. intermediate crime scene ____5. Location where body is found
    f. disposal site ______________6. Storage of body before final disposition
76. Bloodstain pattern evidence would fall under which category of reconstructive evidence?
   a. action evidence
   b. directional evidence
   c. positional evidence
   d. sequential evidence
   w. all of the above

77. A time line of a violent crime often begins with the same element of
   a. alibi
   b. contact
   c. defense
   d. fantasy
   e. planning

78. Event analysis allows one to
   a. establish specific time events
   b. sequence related segments creating a flow of events
   c. consider alternative sequences and identify contradictions
   d. establish which time events relate to one another
   e. all of the above

79. Some crime scene events may be ambiguous such as deciding between homicide vs. suicide vs. accident. Resolution of these possibilities, especially with fine differentiation of evidence can be aided by a
   a. possibility chart
   b. Venn diagrams
   c. hypothesis matrix
   d. compare/contrast matrix
   e. all of the above

80. Medical moulage is used in nursing training to provide students
   a. desensitization to injuries
   b. realism
   c. training techniques
   d. sensory engagement
   e. all of the above
81. A good thickening agent for artificial blood is
   a. soft drink mix
   b. gelatin
   c. food coloring
   d. shampoo
   e. water

82. The culmination of design thinking working groups is generally a
   a. collaborative drawings
   b. design notes
   c. discussions
   d. research and data gathering
   e. working prototype

83. What an expert brings to evidence examination which is beyond the average lay person is,
   a. training and experience
   b. time and effort
   c. techniques and equipment
   d. answer a and b
   e. answer a, b, and c

84. One of the first things an expert witness presenting evidence or someone engaging in a game for the first time or an instructor delivering a lecture in a new topic area is to,
   a. accommodate information transfer
   b. elicit performance
   c. gain attention
   d. inform audience of objectives
   e. present lesson

85. A typical story arc for scenario-based design involves
   a. a hero, a difficulty, overcoming difficulty, resolution
   b. birth, life, death
   c. conception of idea, planning prototype, producing prototype, testing
   d. trigger event setting scene & preconditions; events resolving a task through technology
   e. conception, use, obsolescence
Appendix AA

Supplemental Lab Lectures related to Creative Problem Solving and Design
WHAT IS A PATENT?

- A patent for an invention is the grant of a property right to the inventor.
- Generally, the term of a new patent in the US is 20 years from the date on which the application for the patent was filed.
- The right conferred by the patent grant is "the right to exclude others from making, using, offering for sale, or selling" the invention in the United States or importing the invention into the United States.
- A patent does not grant the right to make something, but the right to exclude others from making.

COPYRIGHT AND PATENTS - COOKBOOK

<table>
<thead>
<tr>
<th>Patents</th>
<th>Copyright</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of an invention</td>
<td>Expression of an idea</td>
</tr>
<tr>
<td>Patent protects process</td>
<td>Copyright does not protect process</td>
</tr>
<tr>
<td>Provides temporary monopoly of exploitation</td>
<td>Moral and economic rights</td>
</tr>
<tr>
<td>If recipes were patented, they could not be followed without authorization</td>
<td>A cookbook cannot be duplicated but recipes can be followed</td>
</tr>
</tbody>
</table>

https://www.uspto.gov/patents-getting-started/general-information-concerning-patents
WIPO

- World Intellectual Property Organization
- An agency of the United Nations
- Monitors compliance with the Patent Cooperation Treaty
- Most patents only enforceable in the country of origin, WO patents are an attempt to make it easier to file worldwide
  - Filers are granted one year to complete applications with other nations/organizations
  - Eliminates the need to file many applications simultaneously

PRIOR ART

- Not a reference to painting, sculpture, etc.
- 'State of the art'
- All that is ALREADY public knowledge
- In order to be patented, an idea must be NOVEL and NON-OBVIOUS
- Substitutions do not count, i.e. color change, different size, etc.
TYPES OF PATENTS

• 3 main types of patents
  • UTILITY – 20 years from filing
    • Machines
    • processes
  • DESIGN – 15 years from filing
    • Ornamental design
    • Appearance is protected
  • PLANTS – 20 years
    • New plants
    • Asexually reproduced

DANGERS OF KEYWORDS

• Technical terms can replace common English
  • Toy and process of use – patent 2,415,012 is the Slinky
• Words and terms become obsolete
  • Water closet
  • Hi-fi
  • LP
• Domain words
  • Mouse – rodent or input device?
SEARCHING FOR PATENTS

CPC

- Replaces USPC – commonly used by European Patents agencies
- Toothbrush
  - A46B 9/04
    - A = section (human necessities)
    - 46 = Class
    - B = subclass
    - 9 = group (toothbrush arrangement)
    - 04 = subgroup
  - Search from the uspto.gov site: cpc scheme mousetrap

  - World Intellectual Property Organization
### CPC – A01M 23/00

<table>
<thead>
<tr>
<th>A01M 23/00</th>
<th>Traps for animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01M 23/005</td>
<td>[with sticky surfaces (for insects A01M 21/14)]</td>
</tr>
<tr>
<td>A01M 23/02</td>
<td>Collecting-traps</td>
</tr>
<tr>
<td>A01M 23/04</td>
<td>with tipping platforms</td>
</tr>
<tr>
<td>A01M 23/06</td>
<td>with locking mechanism for the tipping platform</td>
</tr>
<tr>
<td>A01M 23/08</td>
<td>with approaches permitting entry only</td>
</tr>
<tr>
<td>A01M 23/10</td>
<td>with rotating cylinders or turnstiles</td>
</tr>
<tr>
<td>A01M 23/12</td>
<td>with devices for throwing the animal to a collecting chamber</td>
</tr>
<tr>
<td>A01M 23/14</td>
<td>Other traps automatically reset</td>
</tr>
</tbody>
</table>

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### USPTO

- **START:**
  - PatFT – US full text – goes back to 1976
  - Select Quick or Number
    - Remember to select database
  - Search: *Slinky 5,415,012 OR 'Cat toy'*
  - AppFT – Applications full-text

USPTO classifies patents with Cooperative Patent Classification (CPC)
[https://www.uspto.gov/web/patents/classification/cpc.html](https://www.uspto.gov/web/patents/classification/cpc.html)
ANATOMY OF A PATENT

Patent Number: US 8,783,275 B2
Date of Patent: Jul. 32, 2014
Title: COMPACT FOLDING UMBRELLA WITH HYBRID RIBS TO RESIST DAMAGE DUE TO INVERSION

Applicant: Kugel, David, New York, NY (US)
Inventor: Kugel, David, New York, NY (US)
Assignee: (usually a company name; not listed if patent hasn’t been assigned elsewhere, as in this patent.)

FIG. 1

CPC SEARCHING

- Enter CPC class in PatFT
- Remove any spaces!
- Select the database (1790 – present)
- Select fields: Current CPC classification
GOOGLE PATENTS

• START
  • https://patents.google.com/?scholar
• Enter title, inventor or keywords:
  • Nikola Tesla
  • Fidget spinner
• Links back to USPTO
• Makes linked searches easier

SCIFINDER - CAS/ACS

• SCIFINDER requires an account, see this page:
  • Preparation of dihydroxy substituted heterocyclic compounds as TRPV1 antagonists and uses in treating pain and other conditions
RESOURCES ON PATENTS

- http://library.buffalostate.edu/patents

FORENSIC SCIENCES

- Summon – everything
  - Example “blood spatter”
  - Example forensic science – look at books
  - Example forensic chemistry – look at ebooks
- A-Z list – journal in the fields of Chemistry and Criminology/Criminal Justice
  - Browse by Social Sciences –Criminology
  - Browse by Law – Criminal Law & Procedure
- Criminal Justice Subject Guide
  - LexisNexis – court cases - Brown v. Board of Education of Topeka
  - Sage Journals – collection of Criminal Justice Journals
- Ebook Library – most up to date science titles – keyword search
FOR 312 Chemistry & Criminalistics

Lab Lecture 1—Group Collaboration and Problem Solving

Objectives

• Creative Problem Solving
• Design Thinking
• Group Collaboration
  – Thinking Styles
Creative Problem Solving

**Clarification Stage**
- Exploring the vision
- Formulating Challenges

**Transformation Stage**
- Exploring Ideas
- Formulating Solutions

**Implementation Stage**
- Exploring acceptance
- Formulating a Plan

Design Thinking

**Attributes**
- Developing solutions with the end user in mind based on:
  - Observing activities of consumer
  - Summarizing processes
  - Developing a customer profile
  - Defining a problem
  - Generating ideas
  - Have at least 3 or 4 solutions available for testing
  - Discussion and check-in with clients

**Participant Observation**
1. *Space*: the physical place or places.
2. *Actor*: the people involved.
3. *Activity*: a set of related acts people do.
4. *Object*: the physical things that are present.
5. *Act*: single actions that people do.
7. *Time*: the sequencing that takes place over time.
8. *Goal*: the things people are trying to accomplish.
9. *Feeling*: the emotions felt and expressed.

*Spradley, J. (1980) Participant Observation*
Break Through Thinking Styles

- Break through thinking is universal and can be done by anyone
- It has distinct steps
- These steps are accompanied by particular mental skills
- Some of us have preferences for particular mental skills
- A preference may not necessarily equate with a strong ability but it is a preference that we prefer when working most types of complex problems
- Preferences can show up as potential strengths or blind spots when attempting to solve a complex problem
- There are various ways to allow us to determine our thinking preferences

Sources of Data

<table>
<thead>
<tr>
<th>Information</th>
<th>Feelings</th>
<th>Observations</th>
<th>Impressions</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Emotions</td>
<td>Notice</td>
<td>Intuitive guess</td>
<td>Inquiry</td>
</tr>
<tr>
<td>Facts</td>
<td>Sentiment</td>
<td>Perception</td>
<td>Hunch</td>
<td>Doubt</td>
</tr>
<tr>
<td>Intelligence</td>
<td>Awareness</td>
<td>Comment</td>
<td>Image</td>
<td>Perplexity</td>
</tr>
<tr>
<td>Memory</td>
<td>Desire</td>
<td>Take in account</td>
<td>Reasonable Expectation</td>
<td>Difficulty</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Sensitivity</td>
<td>Watch</td>
<td>Belief</td>
<td>Uncertainties</td>
</tr>
<tr>
<td>Recollection</td>
<td>Sympathy</td>
<td>Behaviors</td>
<td>Meaning</td>
<td>Curiosities</td>
</tr>
<tr>
<td>What is heard</td>
<td>Empathy</td>
<td>Symbols</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Allows you to build more effective teams
- Allows you to leverage different thinking styles within your group
- Helps to understand and reduce conflict within groups
- Can do projects within groups that will exceed what can be done by a single person

Cognitive Styles

- MBTI: Myers-Briggs Type Indicator
- Puccio’s FourSight
- KAI: Kirton Adaptation-Innovation Inventory
Kirton Innovation Adaptation Inventory

- Adaptors seek to do things better
- Innovators seek to do things differently

Myers Briggs Indicator Type

- Categories related to how we perceive the world and make decisions

16 basic categories
FourSight Instrument

- Reveals preferences for various aspects of creative problem solving
- Clarifiers or problem definition
- Ideators or generation of novel ideas
- Developer or development of plans for carrying out activities
- Implementer or carrying out of projects

Taking a FourSight profile:
https://foursightonline.com/collections/all
Note: $35.00 to take exam
FourSight Preferences

Clarifier
- Clarifies the problem
- Not quick to move to solutions
- Gathers information
- Wants to address the correct problem
- Looks at detail
- May over analyze and not move forward on problem

Clarifiers
- Are:
  - focused, methodical, orderly, deliberate, serious, organized;
  - may analyze to the extreme and not move forward

- Need:
  - order, the facts, an understanding of history, access to information, permission to ask questions

- Annoy others by:
  - asking too many questions, pointing out obstacles, identifying areas that haven’t been well thought out, overloading people with information, being too realistic
Ideator

- Looks at the big picture
- Toys with ideas and possibilities
- Stretches the imagination
- Takes an intuitive approach
- Thinks in more global terms
- May overlook the details

Ideators

- Are:
  - playful, imaginative, social, adaptable, flexible, adventurous, independent; may overlook the details

- Need:
  - room to be playful, constant stimulation, variety and change, the big picture

- Annoy others by:
  - drawing attention to themselves, being impatient when others don’t get their ideas, offering ideas that are too off-the-wall, being too abstract, not sticking to one idea
Developers

- Put together workable solutions
- Plan steps to implement an idea
- Analyze and compare potential solutions
- Examine the pluses and minuses of a solution
- May get stuck in developing the perfect solution

Developers

- Are:
  - reflective, careful, pragmatic, planful, patient, dedicated, discerning; may get stuck in developing the perfect solution
  - Need:
    - a chance to consider and evaluate the options, time to craft and develop ideas into useful solutions
- Annoy others by:
  - being too nit-picky, finding flaws in others' ideas, getting locked into one approach

“Deciding what not to do is as important as deciding what to do.”
- Steve Jobs, Developer
Implementor

- Gives structure to ideas
- Brings ideas to fruition
- Focuses on workable solutions
- Takes the approach of "Just do it"
- May leap to action too quickly

Implementers

Are:
- persistent, decisive,
determined, assertive,
an action-oriented; may leap into action too quickly

Need:
- the sense that others are moving just as quickly,
timely responses to their ideas, control

Annoy others by:
- being too pushy, readily expressing their frustration
  when others do not move as quickly, overselling their ideas
Integrators

- Easily relate to each preference
- Even energy across four preferences
- Concerned about group harmony
- Bridges style differences and plugs gaps
- May loose own voice by pleasing others

Integrators

Are:
steady, flexible, inclusive, team players, stabilizing influences; may lose their own voice to accommodate team

Need:
cooperation, collaboration, energy from others, to feel others are committed to the challenge

Annoy others by:
pointing out what’s not being done, not allowing their voices to be heard, being overly flexible, becoming peace-makers
Need of Each Style Preference

- Developer: To Get It Perfect
- Implementer: To Get Results
- Clarifier: To Get it Right
- Ideator: To Be Varied

Preference for *Ask* or *Tell* assertiveness?

The degree to which you ask or tell in influencing people and situations

- **ASK Assertive**: Slow to decide, Averts risk, Easygoing, patient, Reserved, Attentive and speculative
- **TELL Assertive**: Quick to decide, Takes risks, Confronting, hurried, Expressive, Impatient and directive
Preference for *Divergent* or *Convergent* thinking?

- Prefers Evaluating and Selecting Options
- Has a Preference for Decision Making
- Favors Critical Thinking
- Has a Liking for Analysis

- Prefers to Generate Many Options
- Has a Preference for Making
- Favors Creative Thinking
- Has a Liking for Synthesis

When the 2 Continuums Intersect, they create 4 Primary Approaches to Problem Solving

- ASK
- TELL
**Team Formation**

- **Forming**: Team acquaints and establishes ground rules. Formalities are preserved, and members are treated as strangers.
- **Storming**: Members start to communicate their feelings but still view themselves as individuals rather than part of the team. They resist control by group leaders and show hostility.
- **Norming**: People feel part of the team and realize that they can achieve work if they accept other viewpoints.
- **Performing**: The team works in an open and trusting atmosphere where flexibility is the key and hierarchy is of little importance.
- **Adjourning**: The team conducts an assessment of the year and implements a plan for transitioning roles and recognizing member contributions.

_Jones, 1983_

**Possible Group Roles in Collaboration**

**Facilitator**
- Ensure that members of the team are on track
- Assignment of group roles if necessary (note taker, time keeper, etc.)
- Facilitates and motivates group members to provide peak performance
- Verifies that all contribute

**Recorder**
- Takes notes of important discussions in group
- Writes summary

**Reporter**
- Speaks for the group for the larger group

**Resource Manager**
- Collects and distributes material needed for group function

**Time Keeper**
- Keeps track of time and reminds group of how much time is left

**Checker**
- Checks for accuracy and clarity of thinking during discussion
- Checks written work
Know for Midterm

1. Know the three stages of creative problem solving.
2. Know basic characteristics of participant observation.
3. Know the advantages of breakthrough thinking.
4. Know some of the attributes of design thinking.
5. Know the four thinking preferences as outlined by FourSight assessment.
6. Know methods of testing for cognitive styles.
7. Know traits of ask vs tell assertiveness and how this contributes to determining one’s thinking preference.
8. Know traits of divergent vs. convergent thinking and how this contributes to determining one’s thinking preference.
9. Understand various group roles in a collaborative team.
10. Understand the dynamics of team formation.
FOR 312 Chemistry and Criminalistics

Lab Lecture 2—Role of Creative Design and Inventions

Objectives

• Nature of inventions
• Definition of inventions
• Inventions and examples
• Classification of new ideas
• Initial steps of invention
• Finding a need and filling it
• Searching the patent literature
• Design Theory and implementation
Historical Development of Inventions

<table>
<thead>
<tr>
<th>Era</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primitive</td>
<td>Flint, rubbing sticks, fire bow</td>
</tr>
<tr>
<td>Ancient</td>
<td>Flint &amp; iron striker, magnifying glass</td>
</tr>
<tr>
<td>Middle Ages</td>
<td>Tinder box, long fuse</td>
</tr>
<tr>
<td>1500-1700</td>
<td>Wooden match</td>
</tr>
<tr>
<td>1800-1900</td>
<td>Safety match box and book match</td>
</tr>
<tr>
<td>1900-1925</td>
<td>Liquid fuel pocket lighter</td>
</tr>
<tr>
<td>1925-1940</td>
<td>Platinum catalytic lighter, electric battery lighter</td>
</tr>
<tr>
<td>1940-1970</td>
<td>Butane gas lighter</td>
</tr>
<tr>
<td>Future 30 years</td>
<td>Miniature fuel cell lighters, laser lighter, reusable match, etc.</td>
</tr>
</tbody>
</table>

Shlesinger, 1973

Invention Classification

**Broad Classification**
1. Mechanical
2. Chemical
3. Electrical

**Patent Classification**
1. Method or process
2. New use of an old process
3. Article
4. Machine
5. Composition
6. Design
7. Plant

**Problem area and invention**
1. What is it?
   - Composition
   - Appearance (size, shape and color)
   - Weight
   - Other qualities & characteristics
2. Why does it exist?
   - Can I improve advantages?
   - Can I correct disadvantages?
   - Make it light weight?
   - Make it more compact? Etc.
3. How and why does it work?
4. When, where and how is it used?
5. How is it described?
Recording Conception of Inventions

- Your invention's title
- The circumstances of its conception
- Its purpose or the problem solved
- A brief functional and structural description of the invention as you have conceived it
- An informal sketch
- All possible applications of your invention (or ramifications)
- Your invention's novel features as you know them now
- A brief description of the closest known prior device
- The advantages of the invention over previous developments and/or knowledge in the relevant field

Grissom & Pressman. 2005

Describing Attributes of a Device

Attributes of Present Day Windmills

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tower</td>
<td>penetrated wind direction. Must allow wind to pass through easily. May be necessary to use guy wires with large structure. Optimum height?</td>
</tr>
<tr>
<td>2</td>
<td>Rotor</td>
<td>Multi-leading used in closer spacing. Only three blades in modern version. Whipping in wind? Need to protect against severe weather? Any way to avoid lightning and still use all the wind power during a storm? Any type of brake? Can blades be adjusted? Supposed we need two or more sets of blades in tandem?</td>
</tr>
<tr>
<td>3</td>
<td>Orientation device</td>
<td>Can take advantage of wind direction? If not, how can we face wind?</td>
</tr>
<tr>
<td>4</td>
<td>Power production system</td>
<td>Older mills used belt power, which transmitted shaft work down the middle of the tower. Newer, small units employ automotive alternators. Can wind energy be connected to any other form for storage? Decompose waste to hydrogen and oxygen and store below ground? Possibly use would be on North Africa coast to make possible water from the sea. What is optimum speed for present day generators? Should blades orient to gusts?</td>
</tr>
<tr>
<td>5</td>
<td>Base</td>
<td>Present structural use cast concrete base. Any other applications where steel would be cost effective? Is concrete acceptable?</td>
</tr>
<tr>
<td>6</td>
<td>Miscellaneous</td>
<td>Present diameters were limited to fifteen feet. One large mill built years ago in Vermont was destroyed in storm. Present strength of windmill technology probably improved enough to provide windmills of diameters 150 ft. and more. Need to determine ultimate dimension from efficiency, cost, wind, and aesthetic considerations.</td>
</tr>
</tbody>
</table>
Inventive Steps

1. Look for problems and consider methods for overcoming those problems
2. Look for problems in existing devices—difficult, inconvenient, recurring breakdowns, etc. and find methods to overcome these problems
3. Construct tables showing the historical development of the problem area to evaluate practicality of invention and aid in predicting future trends
4. Classify the problem area in accordance with a known classification system such as Patent Office Manual of Classification to provide ideas in problem area and rapidly bring you up to date on similar areas of development
5. Make a detailed qualitative and quantitative analysis of the problem area to allow you to change the device by different compositions, changing sizes, shapes, colors, weights and other characteristics

6. Use a classification system to consider the primary objects of the subject area and ways to improve it
7. Determine how and why it works
8. Determine conditions for when it can or can't be used
9. Determine where it can or can't be used
10. Determine how it will be used and who will be the user
11. Create a synonym table to create a word image and apply synonyms to the subject to create new approaches and devices
12. Define the subject by creating a sentence definition, e.g. A pack of book matches is: A receptacle for matches including a cover, a striker, a series of connected matches, and means for attaching the matches to the cover

Schlesinger, 1987

Inventive Steps

13. Create new combinations, using tools such as SCAMPER
14. Substitute analogous or non-analogous parts units or systems
15. Add features to create multi-effect devices
16. Delete parts
17. Rearrange parts
18. Consider the effect of physical forces such as pressure, impact velocity, movement, etc.
19. Consider all limitations including regulatory laws, controls, constraints
Factors Affecting Usability and Marketability

- **Cost**—is your device cheaper or more expensive to build than current counter parts?
- **Weight**—can a device that is lighter or heavier be an advantage?
- **Size**—is device large or small in size or capacity and in what ways can this be a benefit?
- **Safety/Health factors**—how would volume of blood or dispersal of blood vs. synthetic blood substitute be a consideration?
- **Speed**—is device able to turn or move faster or at variable rates and how would this be an advantage?
- **Ease of use**—is it easier to use (“ergonomic”), easier to set up and demonstrate reliably especially for courtroom demonstration where time and space might be limited?
- **Ease of production**—is it easier or cheaper to make, preferably with readily available materials and can be mass produced if created as a marketable item?
- **Durability**—is device durable, capable of being disassembled and reassembled and used extensively without significant wear?
- **Reparability**—can it be repaired easily if a part loosens or becomes detached can it be put back without difficulty?
- **Novelty**—do you have multiple ways or designs for doing the same thing in case one of the designs proves unworkable?
- **Convenience/Social Benefit/Mechanization**—does the device illustrate bloodstain deposition principles more intuitively and in an understandable manner?
- **Reliability**—is the device apt to fail less, need repair less, be simpler with fewer moving parts allowing it to work in a greater number of situations?
- **Ecology**—can the device be made of recyclable materials and does it produce fewer waste products and reduces use of resources such as blood?
- **Salability**—would the device be easier to sell than similar devices?

Factors Affecting Usability and Marketability

- **Appearance**—does the device provide an aesthetically pleasing design?
- **Precision**—does the device accurately and predictably provide anticipated results?
- **Noise**—does device operate quietly?
- **Market size**—if one were developing a commercial niche for your product is the volume of possible users adequate for significant sales?
- **Trend of demand**—would you anticipate seeing an increased interest in device in coming years?
- **Seasonal demand**—is device likely to become of permanent interest in the scientific community the year round?
- **Market penetration**—are there other devices already on the market that would compete with your device and its intended application?
- **Potential competition**—is your device so simple that it would be easy to make by imitators?
- **Quality**—does the device put out a much more consistent output than similar devices?
- **Excitement**—is your device so different, novel, innovative, and new that consumers would want to purchase your device over similar ones?
- **Markup**—is device so desirable that it can command a high markup?
- **Packaging**—can it be compactly packaged and transported?
- **Long life cycle**—can it be made to last and be so well designed as not to become obsolete?
- **Related product addability**—will your device usher in a line of similar products?
- **Satisfies a need**—if your device satisfies the need for an easy and dependable and accurate method for describing blood dynamics and replicate blood in flight under varying conditions, then it will be more easily marketed.

Grissom & Pressman, 2005
### Comparison of Attributes

<table>
<thead>
<tr>
<th>Nail</th>
<th>Screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Easy for most people to insert</td>
<td>-- Hard for many people to insert</td>
</tr>
<tr>
<td>+ Goes in fast</td>
<td>-- Goes in slowly</td>
</tr>
<tr>
<td>+ Resists shearing forces</td>
<td>+ Resists shearing forces</td>
</tr>
<tr>
<td>-- Only moderately good at resisting pulling forces</td>
<td>+ Very good at resisting pulling forces</td>
</tr>
<tr>
<td>-- Removable, but surface may be marred by the hammer claw in the process</td>
<td>+ Removable, and surface is not likely to be damaged</td>
</tr>
<tr>
<td>-- Not readily reusable after removal</td>
<td>+ Removable and surface is not likely to be damaged</td>
</tr>
<tr>
<td>-- Unsuitable for some materials such as metals</td>
<td>+ Suitable for many materials, metal, plastic</td>
</tr>
<tr>
<td>-- Rusts</td>
<td>-- Rusts if steel or iron</td>
</tr>
<tr>
<td>+ Easy to manufacture</td>
<td>-- Difficult to manufacture</td>
</tr>
<tr>
<td>+ Cheap</td>
<td>-- Relatively expensive</td>
</tr>
</tbody>
</table>

Pro = +; Con = --

Weber, 1992

### Documentation

- A well-maintained notebook is a crucial part of your project development.
- The more secure your notebook is from after-the-fact entries, the better the evidence is:
  - Bound notebooks
  - Avoid loose leaf or spiral notebooks where pages can be easily removed or three ring binders
- Text entries, final sketches and diagrams should be written in ink:
  - Preliminary diagrams and sketches from which the finished notebook diagrams are derived can be sketched first in pencil with the sketches initialed and dated and attached to the notebook page
- No large blank spaces should be left on a page, X-out large areas that are blank to preclude adding something out of sequence later on
- Don’t erase entries, line them out with a single line, initialed and dated with a brief explanation along side with why it was incorrect
- Entries should be worded clearly and accurately
- Each page of a notebook intended to document the patent process should be signed and dated and witnessed by someone who is impartial with knowledge of the basic scientific principles of your device each day
- Photos or other entries which cannot be written upon or signed directly should be pasted in the notebook and referenced by a caption made directly into the notebook.
Documentation

**Information Recorded**
- Full name
- Date notebook started
- Entries: date, title, hypothesis or goal, brief statement of purpose, background information
- Protocols: calculations, reagents, equipment
- Observations: all that happens (planned or unplanned), raw experimental data, taped in information or reference to data location
- Data analysis: processing of raw data, graphs and interpretations, ideas for future experiments
- Ethics: all data goes in notebook, no pages are removed
- Work needs to be reproducible

Invention Development

- Invention’s title
- The circumstances behind its conception
- The purpose of the problem solved
- Brief functional and structural description
- Informal sketch
- All possible ramifications of your invention
- Your invention’s novel features
- Briefest description of closest known prior invention
- Advantages of the invention over previous developments

Kivenson, 1982
Basic Design Elements

- Pre-Visualization Elements

\[ H + X \rightarrow \star \]  
\[ E + P \rightarrow \star \star \]  
\[ A + \triangle \rightarrow \Delta \]  

\[ Z \rightarrow T \rightarrow H \rightarrow T \]  
\[ B \rightarrow \infty \rightarrow \bigstar \rightarrow \bigstar \]  
\[ Y \rightarrow Y \rightarrow Y \rightarrow \bigstar \]  
\[ K \rightarrow \Box \rightarrow \Box \rightarrow \bigstar \]  
\[ + \rightarrow \bigstar \rightarrow \bigstar \rightarrow F \]  
\[ D \rightarrow \bigstar \rightarrow \bigstar \rightarrow \bigstar \]  

Finke, 1990

- SPHERE, HALF SPHERE, CUBE, CONE, CYLINDER, WIRE, TUBE, FLAT SQUARE, BRACKET, RECTANGULAR BLOCK, HOOK, WHEELS, CROSS, RING and HANDLE

Basic Design Elements

- Variable Impact Device

Blood pattern related supplies: SPONGE, SCREEN/GRID, EYE DROPPER, FUNNEL, WEDGE/INCLINE, PLASTIC BAG, COCONUT, KNIFE/SPIKE, SPRING, SQUEEZE BULB, POSTER BOARD, FAKE BLOOD

Bone Impacting Device

trauma to be established.

Key words: Trap, striker, hammering, pounding, impactor, variable force, spring, kinetic tester, sudden impact, terminal velocity, etc...

Finke, 1990

Fig. 1: Bone Impactor Machine
**Patent Search Process**

- Searching patent literature may provide information related to previous devices
  - Review previously issued patents
  - Research trade journal articles
  - Check wholesale and retail channels to see if a similar device has been marketed
- Information about previously issued patents can be obtained from online patent databases
- PDF files of patents or published patent applications can be obtained through Patent Logistics: [http://free.patentfetcher.com](http://free.patentfetcher.com)

---

**Patent Search Process**

- When performing patent searches, you need to determine the invention’s most relevant search classification (by class and subclass)
- You can find appropriate classifications in any of the following references available through the US Patent Office website: [www.uspto.gov](http://www.uspto.gov)
  - *Index to the US Patent Classification* lists all possible subject areas of inventions alphabetically
  - *Manual of Classification* lists all classes numerically and subclasses under each class
  - *Classification Definitions* contains a definition for every class and subclass

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*Fig. 2-8. The patent search process. Kivenson, 1982*

*Fig. 6-8. Process for the production of plaster of Paris. Kivenson, 1982*
Invention Families of a Fork

- **An eating implement.** This would include knives and spoons.
- A **hand tool.** This would include saws, razors, screwdriver, etc.
- A **tool.** Any tool.
- An **artifact.** Any object.
- A **piece of metal.** The context would include airplanes, computers, coins, etc.
- A **silver-colored object.** This would include objects of polished metal.
- A **pointed device.** Shapes like knives, bayonets, pointed sticks, etc.
- A **tool with three or four prongs.** This would include pitchforks and some garden implements.

Weber, 1992

Inventor Resources

- Inventor’s Bookstore: [www.inventorhelp.com](http://www.inventorhelp.com)
- Inventor’s Digest: [www.inventordigest.com](http://www.inventordigest.com)
- National Inventor Fraud Center: [www.inventorfraud.com](http://www.inventorfraud.com)
- National Technology Transfer Center: [www.nttc.edu](http://www.nttc.edu)
- Ronald J. Riley’s Inventor Resources: [www.inventoried.org](http://www.inventoried.org)
- The Patent Café: [www.patentcafe.com](http://www.patentcafe.com)
- United Inventor’s Association: [www.uiausa.org](http://www.uiausa.org)
- Findlaw: [www.findlaw.com](http://www.findlaw.com)
- Internet Patent News Service: [www.bustpatents.com](http://www.bustpatents.com)
Uses of Analogy

Examples of Common Expressions Using Analogies

- It's like trying to find a needle in a haystack (when describing something tedious and difficult)
- His management style was like trying to re-arrange deck chairs on the Titanic
- The novel, the movie, etc. gave a rollercoaster ride of emotions
- Life is like a box of chocolates—you will never know what you are going to get

Definitions

- Analogy: a comparison between two things typically for the purpose of explaining something literally true (e.g. flowing liquid through a pipe has been compared to resistance in electrical circuits)
- Anomaly: something that deviates from the norm
- Metaphor: a figure of speech in which a word or phrase is applied to an object or action to which it is not literally true, e.g. he had fallen through a trapdoor of depression
- Literal similarity: similarity in which key attributes are shared, e.g. the mountain road was winding as a snake
- Mere appearance: superficial appearance but not real in properties, e.g. visualizing a flower in a dream

Gentner, 1989
Synectics Ideation Methods

- Personal analogy: become the items (sense, act, think, feel)
- Direct Analogy (other worlds)
- Fantasy Analogy (I wish I was like...)
- Symbolic analogy uses imagery to describe a connection

Symbolic analogy
Symbolic analogy uses objective impersonal image to describe problem.
- Musical plate: repetition, spread
- Proof plate: relax, experience, granularity, fuzziness, balance

Fantasy Analogy
- Imagining oneself as a coffee cup: warm and inviting, wanting to be hugged
- Imagining oneself as a butterfly
- Chain as caterpillar
- Pissing gour
- Symbolic: to intensify awareness about global warming: use of heat-sensitive ink
- Fantasy analogy: for increasing awareness of effects of pollution

Ideation Methods

- **SYNECTICS**

- **SCAMPER**
- TRANSFER
- ANALOGIZE
- SYMBOLIZE
- NOTHINK
- PARODY
- DISTORT
- METHOD"
Teaching With Analogies

1. Introduce target concept
2. Recall analogy concept
3. Identify similar features of concepts
4. Map similar features
5. Draw conclusion about concepts
6. Indicate where analogy breaks down

(Glynn, et al., 1989)

Teaching With Analogies

• Reading/English: Analogies can be used to introduce new vocabulary
• Writing: Analogies and metaphors can be used to enliven writing
• Social Studies: Analogy to introduce events, e.g. a family feud as an introduction to the Civil War
• Science: Analogy to introduce concepts comparing the form of a bird to an airplane to introduce principles of aerodynamics
An Analogy Organizer

New Concept: Bird Migration

Familiar Concept: Vacation

**Similarities**
- Birds and humans are in need of rest while traveling.
- Coastal wetlands are important to bird migration; rest stops are important to people driving long distances.
- Both birds and people travel from cold climates to warm climates.
- Birds and some people return to the same general area year after year.
- Some birds migrate during daylight. Some people travel during the day.
- Travel routes that both people and birds use are usually well established.
- Bad weather is a hazard for both people and birds.

**Differences**
- Ponds and marshes provide food and shelter for traveling birds.
- Rest areas, hotels, and gas stations provide food, rest, comfort, and fuel for traveling people.
- Hazards include predators and buildings for birds, but malfunctioning transportation is a hazard for people.
- Migration is instinctual; vacationing is planned.
- Some people vacation to a colder climate. When birds migrate, it is always to a warmer climate.

**Categories of Comparisons**
- Dependence on rest
- Travel to warm locations
- Methods and hazards of travel
- Return to original location

---

An Analogy Processing & Development

**Stage 1: Characterization**
Develop a model of expertise

**Stage 2: Representation**
Transition to an improved model for classroom use

**Stage 3: Field Test**
Examine work students do when using the model

**Iterations**
Examine student work with design-based research repetitions

**Stage 4: Redesign**
Improve the model and instructional resources

**Cycles**
1. Explore
2. Refine
3. Extend

Source:
Analogy—Biology of the Cell

Components of a Eukaryotic Cell
- Nucleus
- Mitochondria
- Ribosomes
- Endoplasmic Reticulum
- Cell Membrane
- Lysozyme

Analogous Structures in a Factory
- Doors and walls
- Planning center/blue prints
- Furnace/ energy source
- Storage area
- Presses / molding operations
- Trash compactor

Synectics

- Problem as given
- Analysis and explanation by an expert
- Purge
- Generation of problem as understood
- Choice of problem as understood
- Evocation question
- Evocation question for personal analogy
- Metaphor activities
  - Personal analogy
  - Direct analogy
  - Compressed conflict
- Evocation question for direct analogy
- Choice of book title
- Examination of analogies
  - Making the strange familiar
  - Making the familiar strange
- Force fit
- View point

Gordon, 1961
Biomimicry

- Looking at designs in nature to develop analogous structures
- Looks at how animals
  - Build structures
  - Camouflage
  - Move
  - Work as a group
- Ask Nature web site
  https://asknature.org

A restaurant owner wants to attract more patrons. Using the Ask Nature web site, a search term for "attracting mates" could be used

Biomimicry Exercise—Making a Better Venus Fly Trap

- What can a Venus fly trap tell us about making a better:
  - Purse?
  - Mouse trap?
  - Umbrella?
  - Garbage disposal?

Source:
https://www.google.com/search?q=venus+fly+trap&tbm=isch&source=univ&sa=X&ved=0ahUKEwjryLU9PUAhVGPj4KHR4VCEsQiRA4IngE&biw=1440&bih=794
**Know for Midterm**

1. Know the derivation of Ruth Noller's formula for creativity.
2. Know defining criteria that differentiate clear-cut and complex problems.
3. Know general approach to problem solving in established disciplines.
4. Know the four quadrants on the novelty vs. usefulness scale for products.
5. Know the three stages of creative problem solving.
6. Know what general things to look for when evaluating bloodstain patterns.
7. Know some of the principles of simplified sketching.
8. Know some of the basic problem solving methods for ideation, clarification and evaluation.
9. Know how to use the PPCo method for evaluation.
10. Know use of metaphors, analogies, biomimicry in synetics or other applications that aids in prototype design.
FOR 312 Chemistry and Criminalistics

Lab Lecture 3—Creative Problem Solving and Product Development in BPA

Objectives

- Creative problem solving
  - Applications in bloodstain pattern analysis
- Product development concepts
  - Morphological matrix
  - TRIZ
  - Synectics
- Bloodstain pattern validation
  - Methods of blood pattern generation
  - Mechanical equivalents
  - Introducing variation in pattern generation
Ruth Noller’s Formula for Creativity

- **Creativity** (C) is a function of **Attitude** (a) applied to **knowledge** (k), **imagination** (i), and **evaluation** (e)
- **Creativity** only emerges when these ingredients interact
- **Knowledge** is the person’s accumulated experience, usually in a specific context or domain
- **Imagination**, the production of novel ideas, is necessary to get beyond current knowledge in order to produce new approaches
- **Imagination** must be guided by evaluation
- **Attitude** gives this formula its drive and momentum

\[ C = \int_a (k, i, e) \]

\[ A = V, DP, IM \]

- A productive and positive attitude is a combination of **Vision** (V), **Deliberate Practice** (DP) and **Intrinsic Motivation** (IM)
- **Vision** provides a destination for one's creativity
- **Deliberate practice** is a systematic use of creative strategies
- **Intrinsic motivation** or a strong internal desire to do what is necessary to reach the vision must be present

---

**Creative vs. Critical Thinking**

Venn Diagram — Tool for Comparing and Contrasting

**creative Thinking**

- Curiosity (1)
- Openness to Novelty (1, 2, 3, 4, 5, 6, 7)
- Reasoning by Metaphor & Analogy (1, 4, 6)
- Invention (2, 4)
- Imagination (2, 4, 6)
- Playfulness (4, 6)
- Idea Generation (4, 7)

**critical Thinking**

- Description (1)
- Interpretation (1, 6)
- Analysis (1, 6)
- Identification (3)
- Categorization & Classification (3)
- Evaluation & Assessment (3, 5)
- Reasoning Through Logic (3, 6)
What is Creative Problem Solving

Brain Biology

**Left Hemisphere**
- Systematic and controlled
- Inhibited in responding emotionally
- Dependent upon words for meaning
- Produces logical ideas
- Objective processing of information
- Serious, systematic in solving problems
- Receptive, abstract thinking
- Dislikes improvising
- Little use of metaphors and analogies
- Deals with one problem at a time, sequentially
- Critical and analytical in reading
- Logical in solving problems
- Grasps certain, established truths

**Right Hemisphere**
- Playful and loose
- Responds with emotions, feelings
- Produces humorous ideas
- Subjective processing of information
- Playful in solving problems
- Self-acting, concrete thinking
- Like improvising, highly psychic
- High use of metaphors and analogies
- Deals simultaneously with several problems at the same time
- Creative, synthesizing, association in reading
- Intuitive in solving problems
- Grasps uncertain truths

Problem Types

**Clear-Cut Problems**
- Problem clearly stated
  - All relevant information available
  - Neither too little nor too much information
- Steps between problem and solution fairly stereotyped
- Solution already known to someone but not necessarily to you
- Only one answer was correct

**Complex Problems**
- Is the problem worth solving?
- Being able to recognize the problem clearly enough to write it down may be difficult
- Initial models may not be correct
  - Other, alternate models may exist
- It is important to realize that alternate means of solving a problem exist
- A generalized approach may not always work
Approach to Solving Problems in an Established Discipline

- Problem inquiry
  - Basic need
  - Basic problem
  - Comprehensive picture of the existing state of the art
  - Worth solving?
  - Probably solvable?
  - Should you solve it?

- Specific goals
  - Constraints
  - Define what would be an acceptable solution

- Determining means
  - Propose ideas
  - Make sketches
  - Make calculations
  - Search for similar solutions
  - Evaluate, modify, combine ideas

- Solution optimization
  - Define user or situation
  - Look at solution and how adequately it addresses the original problem
  - Modify the proposed solution and add other modifications to increase flexibility to address variables that may come up

- Construction and verification
  - Make drawings
  - Make models
  - Acquire the material and parts
  - Build model
  - Test model
  - Make changes
  - Evaluate accuracy and ability to resolve original problem

- Finalize and “sell” the product
  - Identify potential market
  - Plan a marketing strategy
  - What makes your model stand out?

Research Design

1. Select a topic based on evaluation of bloodstain pattern images
2. Perform literature search and define topic
3. List data to be recorded, variables to be studied and controls
4. Develop a list of starting material
5. Gather materials and find secure area for experimentation
6. Design and manufacture devices for reproducibility and methods to introduce variables producing preliminary sketches of apparatus, construct prototype modes and prepare and construct final design
7. Conduct study
8. Evaluate data and draw conclusions
General Problem Solving

- Purpose of device or goal one is trying to achieve in the demonstration
- Conversion of information to some mechanical form
  - Constant re-evaluations and upgrades
- Split design process into steps
  - Objectives
  - Planning
  - Implementation
  - Evaluation/checking
- Definition of the essential problems
- With evaluation, there needs to be a decision regarding the one best course of action

Information Evaluation

- Reliability or how trustworthy and correct the information
- Sharpness or precision and clarity of the information
- Volume & Density or the number of words and pictures needed to describe the system
- Value or importance of the information
- Originality or novelty of information
- Complexity or structure or similarity between information symbols and information elements
- Degree of refinement or quality of detail in the information

Pahl, et al., 2007
Design Process

Main Goals: Clarification of task; conceptual design; preliminary lay out of design; detailed design

EMBODIMENT DESIGN CHECKLIST

Pahl, et al., 2007

Potato Harvesting Machine—Modular Designs

Pahl, et al., 2007
What Makes A Product Creative?

**Novelty vs. Usefulness**
- *Repeating past mistakes* (low novelty, low usefulness) E.G. General Motors' 10 mile-per-gallon Hummer H3, introduced at a time when gas prices were at a record high.
- *Utilitarian products* (low novelty, high usefulness) E.G. pencil.
- *Fads* (high novelty, low usefulness) E.G. things that are popular one year and forgotten the next such as the Rubik's Cube or pet rocks.
- *Creative products* (high novelty, high usefulness) E.G. Apple I Pads, flash drives, iTunes.

What Makes a Creative Product—Novelty & Usefulness

<table>
<thead>
<tr>
<th>Novelty</th>
<th>Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

- **Fads** (product disappear when novelty wears off)
- **Creative Products** (original & meets a need)
- **Repeating past mistakes** (unproductive traditions or habits)
- **Utilitarian Products** (product that stands the test of time)

Wonder, 2007

Puccio, et al., 2012

USEFULNESS
Product

Donald W. MacKinnon (1978)

- Three absolute criteria for product evaluation
  A. New: Must be original
  B. Useful: Must solve a problem
  C. Produced: Can’t remain an idea, must actually be produced

- MacKinnon included two optional characteristics
  D. Aesthetically pleasing
  E. Transformational: product must alter human condition (seldom met)

Susan Besemer (1981)

- Creative Product Semantic Scale

Creative Problem Solving

Clarification Stage
- Exploring the vision
- Formulating Challenges

Transformation Stage
- Exploring Ideas
- Formulating Solutions

Implementation Stage
- Exploring acceptance
- Formulating a Plan

Creative Leadership: Skills That Drive Change
Pucio, Murdock, & Manos (2007)
Creativity Tools

Clarification Tools
- Storyboarding
- Data Questions
- Phrase Challenges as questions
- Mind mapping
- Levels of abstraction
- Truth tables
- Check lists
- Link/Network analysis

Ideation Tools
- Brainstorming
- Forced Connections
- SCAMPER
- Brainwriting
- Excursions
- Morphological matrix

Developing Tools
- PPCo (Pluses, Opportunities, Concerns, Overcoming)
- Evaluation Matrix
- Paired comparisons
- Card Sort
- SWOT Analysis
- Targeting
- Managing risk

Implementation Tools
- Assisters and Resistors
- Stakeholder Analysis
- Action Steps
- Performance Dashboard
- The Learning Cycle
- Timelines
- Ranking
- Flowcharting

Decomposition of Idea Generation (IG) Methods into Components (Kulkarni, 2000).

<table>
<thead>
<tr>
<th>IG Method</th>
<th>Tackles</th>
<th>Promoters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphological Analysis</td>
<td>Random connections</td>
<td>Combinatorial play</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>Provocative stimuli, Suspended judgment</td>
<td>Emphasis on quantity, Use of analogies</td>
</tr>
<tr>
<td>K-J Method</td>
<td>Random connections</td>
<td>Combinatorial play</td>
</tr>
<tr>
<td>Method 6-3-5</td>
<td>Provocative stimuli</td>
<td>Delayed judgment</td>
</tr>
<tr>
<td>C-Sketch</td>
<td>Provocative stimuli, Flexible problem representation</td>
<td>Imagery, visual thinking (graphical)</td>
</tr>
<tr>
<td>Gallery Method</td>
<td>Provocative stimuli, Random connections</td>
<td>Imagery, visual thinking, Feedback</td>
</tr>
<tr>
<td>Storyboarding</td>
<td>Provocative stimuli, Suspended judgment, Random connections</td>
<td>Emphasis on quantity, Sketching</td>
</tr>
<tr>
<td>Fishbone Diagrams</td>
<td>Random connections, Flexible problem representation</td>
<td>Emphasis on quantity</td>
</tr>
<tr>
<td>Synectics</td>
<td>Provocative stimuli, Suspended judgment, Change frame of reference</td>
<td>Use of analogies and metaphors, Imagery</td>
</tr>
</tbody>
</table>
Evaluation of Bloodstain Patterns

- The overall arrangement of blood drops and how this is representative of one dynamic event
- Direction of travel of blood drops in a general pattern and individual drops
- Recognition of overlapping patterns relating to different events and how they might be sequenced
- Evaluation of stains as a group and how they can be associated with specific events
- Position and placement of spots with respect to each other and the pattern as a whole
- Distribution of sized of blood spots and general size ranges
- Environmental changes to blood spots and how surfaces and immediate environment can affect pattern
- How other evidence would assist in verification of patterns

Types of Blood Pattern Experiments

- Blood substitutes and blood properties
  - Physical characteristics
    - Capillary action
    - Viscosity, surface tension and other flow characteristics
    - Fluid dynamics and flight characteristics
  - Expired blood
- Impact spatters
  - Secondary spatters
- Transfer patterns
  - Patterns in blood
  - Sequence of patterns
- Cast-off patterns
  - Cessation cast-off
- Altered blood
  - Drying times
  - Surfaces
  - Effect of environment
- Voids
  - Sequencing
  - Positioning
- Flow patterns
Practical Drawing and Record Keeping

- Use captions, labels in notes and diagrams to explain parts, stains, important observations
- Use multiple views of apparatus from different orientations but have at least one characteristic view from which it is most recognizable
- Include measurements and angles of parts with everything to scale
- Use dotted lines to show things that are invisible—hidden from view
- Cutaway, exploded, sectioned, shaded diagrams may be appropriate
- Isolate or portray important parts separately if the apparatus is complex
- Create breaks in long pieces by connecting parts with dotted lines to show parts eliminated in order to save space and simplify drawing
- Add name and date and witness signature to sketches and completed drawings
- Complete first in pencil and then ink in

---

Practical Drawing & Record Keeping

- **Simplified Drawings**
  
  DIAGRAMS ARE EASIER TO DRAW THAN PICTURES AND OFTEN MORE EFFECTIVE

- **Reference Letters and Numbers**

  [Diagram showing heart and lungs]

  **Caption**: Caption

  **Note**: Arrows show course taken by the blood

  **Diagram showing heart and lungs**

  Nelms, 1957
Practical Drawing & Record Keeping

- Phantom Lines to illustrate hidden features
- Ditto lines to eliminate need to draw duplicate parts
- Draw things in characteristic or recognizable representation

Simplified Construction Elements

Visual Elements: SPHERE, HALF SPHERE, CUBE, CONE, CYLINDER, WIRE, TUBE, FLAT SQUARE, BRACKET, RECTANGULAR BLOCK, HOOK, WHEELS, CROSS, RING, HANDLE

- Variable impact device to simulate medium impact spatter
- Blood is placed on one block facing inward, wire connecting the two blocks is of variable tension
- Opposite block is lifted up and strikes against blood on opposite block simulating medium velocity spatter

Nelms, 1957

Finke, 1990
Collaborative Sketching

- Have a group of four or five designers
- Ask each designer to sketch a possible solution
- Work independently (without talking) for five minutes
- Then have each person pass the sketch to another person
- Take five minutes more and encourage each designer to:
  - Add to
  - Modify
  - Delete
- Keep passing until each person has had a chance to work on every design

*Shah, 2001*

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General Design Principles

- Orcam’s razor: The most elegant design is the one that can perform the same function but using the fewest moving parts
- The superior design is one that can accommodate variables reflective of real-life situations, e.g., blood drop vs. running device that can disperse variable amounts of blood to simulate different wound severities reflected by different amounts of bleeding
- Easy to learn how to operate
- Adherence to key concepts—it should be a learning tool and illustrate relevant scientific principles
- Minimum space requirements
- Refinement, skill in design, quality of detail, readiness for commercial application
- Adaptability or still capable of some functionality, e.g., an escalator when it is not working becomes a functional staircase

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Besemer’s Creative Product Evaluation

- **Novelty**—the extent of newness
  - Original—the product is unusual or is infrequently seen in a universe of products made by people with similar experience and training
  - Transformational—the product is so revolutionary that it forces a shift in the way that reality is perceived by its users, listeners or viewers
  - Germinal—the product is likely to suggest additional, future creative products
- **Resolution**—the degree to which the product fits or meets the needs of the problematic situation
  - Valuable—the product is judged worthy by users, listeners or viewers because it fills a financial, physical, social or psychological need
  - Logical—the product or solution follows the accepted or understood rules for the discipline
  - Useful—has practical applications
- **Elaboration and Synthesis**
  - Elegant—the solution is expressed in a refined, understandable way
  - Complex vs. simple—the product contains many elements at one or more levels vs. a product that is basic
  - Understandable—the product is presented in a communicative, understandable manner
  - Well-crafted—the product has been worked and reworked with care to develop it to its highest possible level for that time
**Ideation--SCAMPER**

<table>
<thead>
<tr>
<th>Substitute</th>
</tr>
</thead>
<tbody>
<tr>
<td>What or who can you substitute?</td>
</tr>
<tr>
<td>What processes or materials can be used instead?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Combine</th>
</tr>
</thead>
<tbody>
<tr>
<td>What elements or parts might be combined or blended?</td>
</tr>
<tr>
<td>How can you combine purposes, applications or materials?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adapt</th>
</tr>
</thead>
<tbody>
<tr>
<td>What else is like this?</td>
</tr>
<tr>
<td>Does the past offer a similar situation?</td>
</tr>
<tr>
<td>How might we find something analogous and adapt it?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modify</th>
</tr>
</thead>
<tbody>
<tr>
<td>What can you add or increase?</td>
</tr>
<tr>
<td>How can you change the meaning, color, shape, sound, frequency?</td>
</tr>
<tr>
<td>What can you subtract, shrink, streamline?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Put to other uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>What else can it used for?</td>
</tr>
<tr>
<td>What other markets might be interested?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eliminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>What can you get rid of or omit?</td>
</tr>
<tr>
<td>What can you do without?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rearrange</th>
</tr>
</thead>
<tbody>
<tr>
<td>What if you rearranged or reversed patterns or assumptions?</td>
</tr>
<tr>
<td>What can you interchange, transpose or reconnect?</td>
</tr>
</tbody>
</table>

---

**Brainstorming—Hypothesis Generation**

**Divergent (Creative) Thinking**

Divergent thinking is a broad search for many novel and diverse alternatives

- Defer judgment
- Go for quantity—have a time limit, say 5 minutes for 35 ideas
- Seek novel ideas—best ideas are often found in the last third of ideas generated
- Build on ideas
- Make connections

**How it is done.**

- State the problem or issue to be explored, giving background data
- Give members of the group a pad of 3 x 5 inch sticky notes and a dark, felt-tipped marker
- Participants write one idea per sticky note (expressed as headlines, not full description)
- When idea is written, have them read it aloud and hand it to the group facilitator to put on flip chart or large paper pad
Forced Connections

- Brainstorming can be effective until you run out of ideas.
- This tool jars your mind into creative action by forcing a connection between your challenge and unrelated objects.

**When you’re stuck**

- Pick an image or object totally unrelated to the challenge and ponder it.
- Write down at least 5 attributes, qualities, characteristics or feelings associated with the object.
- Force a connection by asking: *When you look at this picture or object, what ideas do you get for solving this challenge?*
- For each attribute list several ideas.
- Good subject matter for pictures includes nature, people, food or machinery but avoid recognizable people or controversial material.

Brainstorming—Hypothesis Selection

**Convergent (Evaluative) Thinking**

Convergent thinking is a focused and affirmative evaluation of alternatives.

- Apply affirmative judgment
- Assess all ideas including novel ones
- Stay focused
- Check your objectives

**How it is done.**

- Participants will be given sticky dots.
- Based on participants assessment of the evidence, they will place a sticky dot on post-it for which more evaluation is desired.
- Post-its are rearranged in some logical fashion into groups.
- Ask the group to select a word or phrase that best describes each grouping.
- Look for post-its that don’t fall into any group and consider if these represent useless noise or the germ of another viable theory.
Phrase Challenges as Questions

<table>
<thead>
<tr>
<th>Instead of...</th>
<th>Ask...</th>
</tr>
</thead>
<tbody>
<tr>
<td>it’s too expensive</td>
<td>How might we fund it?</td>
</tr>
<tr>
<td>it’s too complicated</td>
<td>How might we simplify it?</td>
</tr>
<tr>
<td>The staff won’t go</td>
<td>What might be all the ways we can influence</td>
</tr>
<tr>
<td>along with it</td>
<td>them?</td>
</tr>
</tbody>
</table>

Miller, et al., 2011

- How can you rewrite problems as questions?
  Question starter + Actor + Action + Goal
- In what ways might + I + secure + a promotion?
- Question starters:
  - How to... H2
  - How might...HM
  - In what ways might...IWWM
  - What might be all the ways...WMBAT

Product Re-Designs and Improvements

- Improved Circulating Pump
- Arterial Spurt Pattern

Initial Design of Re-Circulating

Wonder, 2007
The Idea Box—Morphological Matrix

Morphological analysis

<table>
<thead>
<tr>
<th>Head</th>
<th>Eyes</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullet</td>
<td>Big</td>
<td>Dark</td>
</tr>
<tr>
<td>Skeletal</td>
<td>Blue</td>
<td>Black</td>
</tr>
<tr>
<td>Bell-shaped</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Egg-shaped</td>
<td>Dark</td>
<td>Light</td>
</tr>
<tr>
<td>Dome-like</td>
<td>Deep</td>
<td>Yellow</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Pale</td>
</tr>
<tr>
<td></td>
<td>Sunken</td>
<td>Blushing</td>
</tr>
</tbody>
</table>

Draw a face

<table>
<thead>
<tr>
<th>Hair</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blond</td>
<td>Baby</td>
</tr>
<tr>
<td>Dark</td>
<td>Child</td>
</tr>
<tr>
<td>Long</td>
<td>Teenager</td>
</tr>
<tr>
<td>Short</td>
<td>Adult</td>
</tr>
<tr>
<td>Gray</td>
<td>Mature</td>
</tr>
<tr>
<td>Curly</td>
<td>Old</td>
</tr>
<tr>
<td>Bold</td>
<td>Ancient</td>
</tr>
</tbody>
</table>

4. Make random runs through the parameters and the variations for the parameters.

Morphological Matrix—Hypothesis Generation

- Matrices provide a visual representation of a complex set of data
- With a matrix we can analyze the relationship of any two sets of variables
  - Compare one type of information with another
  - Compare pieces of information of the same type
  - Categorize information by type
  - Identify patterns in the information
  - Separate elements of a problem
- Morphological analysis generates a large number of possibilities for any complex situation
- It can be used in an investigative context to identify the full set of possible explanations for some event
- Start by defining a set of key parameters or dimensions of the problem and break down each of these dimensions further into relevant forms or states or values that the dimensions can assume

Zwicky, 1969
Product Re-Design & Improvement

- Medium Impact Apparatus
- Variable Drum Device to simulate blood striking at different speeds

Wonder, 2007

Developing—PPCo and ALUo Models

**PPCo—Conventional**
- Plusses or what is good about the idea
- Potentials or if the idea succeeds, what other benefits might result?
  - May be ranked from most important to least important
- Concerns: Phrase concerns in the form of questions, “How to...?”
- Overcoming concerns

**ALUo—Engineering**
- Advantages of new design
- Limitations of new design
- Unique or features indicating that this is different from similar designs
- Overcome the limitations of the new design
Evaluation—POINT Method

- People generally seek validation of their ideas
- They ask others for positive input and constructive criticism of any problems
- This type of input can be accomplished by evaluation tools such as POINT
  - P or plusses—what are some of the good ideas
  - O or opportunities—future thinking about what are the potentials for these ideas
  - I or improvement—what are some of the areas of concern that prevent the idea from reaching its full potential
  - NT or new thinking—what can be done to correct the concerns, improve the product and make it attractive to other users

PPCO
- Praise first. Say something that you like about the idea.
- State Potential. What could occur if the idea really took off?
- Articulate Concerns. Use open-ended questions to identify areas you think need to be resolved.
- Overcome. Charge your colleague, yourself, or the group to consider how to overcome those concerns

Human Models

- Artist Hand Model
  - Head Tilt Device
- Mannequins

Wonder, 2007
Synectics

- Problem as given
- Analysis and explanation by an expert
- Purge
- Generation of problem as understood
- Choice of problem as understood
- Evocation question
- Evocation question for personal analogy
- Metaphor activities
  - Personal analogy
  - Direct analogy
  - Compressed conflict
- Evocation question for direct analogy
- Choice of book title
- Examination of analogies
  - Making the strange familiar
  - Making the familiar strange
- Force fit
- View point

Gordon, 1961

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Apparatus for Lab Environment

- Slow Bullet Device (overview)
- Slow Bullet Device (close-up)
- Scaffold for Cast-off
- Lab jack to adjust void pattern height

Wonder, 2007
Know for Midterm

1. Know the derivation of Ruth Noller’s formula for creativity.
2. Know defining criteria that differentiate clear-cut and complex problems.
3. Know general approach to problem solving in established disciplines.
4. Know the four quadrants on the novelty vs. usefulness scale for products.
5. Know the three stages of creative problem solving.
6. Know what general things to look for when evaluating bloodstain patterns.
7. Know some of the principles of simplified sketching.
8. Know some of the basic problem solving methods for ideation, clarification and evaluation.
9. Know how to use the PPCo method for evaluation.
10. Know use of metaphors, analogies, biomimicry in synetics or other applications that aids in prototype design.
FOR 312 Chemistry & Criminalistics

Lab Lecture 4—Problem Finding and Reframing; Criterion Development

Objectives

- Tame and wicked problems
- Agile Design Thinking
- Intelligent Fast Failure and Prototyping
- Creative Problem Framing
- Criterion Development
Problem Types

wicked problems

- clear problem definition
- single organization
- regular leadership: implement existing solution

- clear and finite problem definition, but urgent need for solution
- need for new solutions, more permission for action and innovation
- directive leadership: demand for action and for someone taking control

- unclear problem definition, not finite
- requires innovation and learning, as well as multiple agencies
- adaptive leadership, to create multi-stakeholders environments and experiment


Wicked Problems

- Seemingly intractable with chronic policy failure
- Sits astride organizational boundaries and responsibilities
- Interdependencteal and multicausal
- Difficult to define
- Solutions can lead to unforeseen consequences
- Inevitable changing behavior
- No clear solution
- Socially complex
Wicked Problems


- Open ended
- Time dependent
- Ill-defined
- Negotiable constraints
- Incomplete, contradictory and changing requirements
- Initial and end states often ambiguous

Taming Wicked Problems

Sample Problems

**Lamp not working**
1. The switch is malfunctioning
2. There is no power
3. The light bulb needs to be changed, etc.
   - The starting point is clearly defined: an undesirable situation of a lamp not working
   - The end point is clear: the desired situation of a lamp working defined as its light bulb emitting light

**Reframing the problem**
- How can a lamp work better?
- What can a future lamp be like?
- What is wrong with lamps today?
- What are lamps for?
- What is a lamp?
- How else could future lamps work?
- How are current lamps not working?
- Who needs light, where and what for?
- These questions are still specifically about a lamp yet neither the starting point nor the end result are defined and they go beyond diagnosing a faulty device
- They call for divergent thinking but deviate from the problem at hand avoiding the What alternative uses can you find for a lamp question and allowing for greater openness of suggestions but still maintaining focus on the problem

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Creative Problem Framing

- **Initial framing**: no specific problem is defined as a starting point, but instead targets are framed based on general themes or with a target population or location in mind allowing problem-solvers to scope out more general solutions which may evolve over time
- **Source of insight**: reframing may evolve from any of the activities that are part of problem solving (interviews, surveys, brainstorming, etc.)
- **Degree of change**: Creative problem reframing may redefine the task in terms of changing the target user, technology or other issues originally considered critical.
  - If there is a significant development or insight that leads to a change in direction from the initial route, this is known as a pivot point
- **Clarity in new direction**: Original problem description may fail to lead to creative solutions and project may have to be tabled until a more unambiguous direction is identified
- **Changes in ownership**: Power structures and egos need to be taken into account if reframing leads to different problem ownership

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Sosa, 2017
Creative Problem Reframing

- **Range of representations:** Being able to maintain multiple representations and integrate them such as written reports, sketches, photographs, video recordings, prototypes, etc.
- **Detached commitment:** creatives must be able to let go of their original goals if they prove to be unproductive
- **Learning:** fail fast, fail often, fail in different ways and fail cheap
- **Time:** reframing problems often have unpredictable timelines
- **Complexity:** one needs to maintain a systems view of feedback cycles, parameters, rules, delays and interactions that can lead to leverage points


Guidelines for Creative Problem Framing in Higher Education

- **Design across disciplines:** studio-based student projects where students work in teams and develop and test candidate solutions over the course of a semester
- **Begin anywhere:** rather than follow a particular flow chart or method, students can also respond to general design briefs that relate to their own experiences and talents and interests
- **Expect the unexpected:** good projects incorporate three main dimensions of learning: engagement, outcomes and reflective practice with reflective engagement evident through written reports, oral presentations or photographs and videos
- **Question everything:** creative studio projects require a permanent tension between skepticism and motivation that supports learners making decisions in conditions of high uncertainty and ambiguity
- **Design and converge:** the transition between these phases is often signaled by insights that lead to the reframing of problems with the instructor managing the divergence-convergence balance in a team
- **Co-creation:** listen to feedback and act on it especially from non-experts

Ryan, 2000-2010
Sample Problem Reframing

<table>
<thead>
<tr>
<th>Initial Problem Framing</th>
<th>Problem Re-Framing</th>
<th>Key Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declaring her daughter’s room “a mess,” a mother demands that her daughter clean her room immediately. The daughter adamantly refuses. A pitched battle ensues</td>
<td>The mother and daughter design a “safe space” for mutually important information—which clothes are dirty and which papers need to be reviewed and returned to school.</td>
<td>The mother equates “mess” with “chaos in her daughter’s life.” To test this, a friend suggests she relocate tow objects in the “mess.” The daughter easily detects the change, proving an order in her room although one incomprehensible to her mother.</td>
</tr>
<tr>
<td>Design a device that applies blood stains at a variable rate simulating running with an injury dripping blood</td>
<td>Rethink design of device and how blood might be applied to a surface. The issue becomes blood falling onto something rapidly moving.</td>
<td>A variable speed conveyor belt like arrangement that might be seen on a belt sander is adapted to apply blood to the rapidly moving surface while the blood dropping device is fixed in a stationary position</td>
</tr>
</tbody>
</table>

Design Thinking Method

- Learning
- Time
- Complexity
- Initial framing
- Source of Insights
- Degree of change
- Clarity in New Direction
- Change in ownership
- Range of Representations
- Detached Commitment
Intelligent Fast Failure

- You cannot make creative breakthroughs unless you are willing to be wrong
- If there is a failure, try to fail in different ways
- Try new things rapidly, evaluate and move on
  - Try
  - Test
  - Adjust
  - Try again
  - Fail
  - Modify
  - Scrap
  - Start over

"The best way to get a good idea is to get a lot of good ideas." ----- Linus Pauling

Insightful Fast Failures


Mistakes can crush us down.
Using Logical Arguments to Gain Initial Insights into Complex Problems

- The best hypothesis to explain a phenomenon are
  - Simplest and most natural
  - Easiest and cheapest to test
  - Will contribute to our understanding of the widest range of facts
- Abductive reasoning is one of the simplest logical methods to gain intuitive information about a condition and provides hypothesis that one can test with more established logical reasoning such as deduction
- Put forth a tentative hypothesis, test it and then use deductive reasoning to go forward

Deduction
Case  All serious knife wounds result in bleeding
Result This was a serious knife wound
Rule  There was bleeding

Induction
Case  This was a serious knife wound
Result There was bleeding
Rule  All serious knife wounds result in bleeding

Abduction
Rule  All serious knife wounds result in bleeding
Result There was bleeding
Case  This was a serious knife wound
**Agile Design**

- There are a number of similar design models that have an entry point with a perceived need, information gathering, experimenting and iterative steps.
- Agile design looks for constant feedback that leads to new exploration and insight development and identification of pivot points or points with fundamental changes in one's approach and point of view regarding a problem.

**Rapid Prototyping**

- Rapid prototyping allows us to see what works and what doesn’t.
- Failure tests our resolve, motivates us to learn more and forces us to recognize our weaknesses.
- Don’t stop with an initial idea—always keep experimenting, testing, failing and learning from the failure.
**When is an Idea Ready to Pursue?**

**Is your idea worth pursuing?**
- Is it effective? Will it work? Will it do what you want it to do?
- Is it efficient? Is your idea better than a similar device already developed? Is it significantly different?
- Is it intuitive? Can it be operated easily?
- Is the timing right? Is this idea practical right now? Can it be adapted to change?
- Is it feasible? Can it be done? Does the technology exist to support the concept?
- Is it easily understood or capable of being explained? Have you fully conceptualized your original thought?

<table>
<thead>
<tr>
<th>Idea</th>
<th>Value</th>
<th>Feasibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snap on plate</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Variable strength spring</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>More than 180° of movement</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Enlarged for more realistic experiments</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Modified to accommodate sponge</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

**Modify Basic Designs to Suit New Needs**

**Basic Mousetrap**

**Variable Strength Spring**

Design a(n) __________ that functions within (constraints) __________
Cognitive Design Methodology

- Journey mapping: tracing a possible route of starting on an adventure, encountering obstacles and surmounting them
- Value chain analysis: identifying those activities that are most valuable
- Mind mapping: visually connecting concepts
- Brainstorming: diverging and coming up with many ideas rapidly
- Concept development: considering all ramifications of a new concept
- Assumption testing: experimenting, user surveys to see how your product fits in to its use by consumers
- Rapid prototyping: developing many simple model concepts from common materials
- Customer co-creation: allow customer to participate in design process, e.g. designer athletic footwear
- Learning Launch: experimental protocol to test the effectiveness of a new initiative

Criterion Development

- What do we need in order to drive forward with our concept?
- What are the constraints on our design?
- Are we addressing the correct problem?
Overcoming Mental Blocks

- Defocus—take time off from your activities for doing something else involving little mental demand such as going for a walk
- Defer judgment—by not being overly critical, we open up to new ideas
- Distancing / stepping away—look at variations of the problem from different angles (forced connection with random images, SCAMPER)
- Drill Down Deeper—look at the subject at its core elements and see if that provides insight

Slow Points in the Creative Problem Solving Process

- We often reach a slow point when first evaluating and trying to make sense of a problem
- Once a clear problem has been defined, the process can often proceed quickly
- So the initial recognition stage is an important issue to resolve before the process can be sped along
- Another slow point is obtaining enough domain knowledge to solve the problem
- A novice searching patterns will take the most time
- Having a wide, descriptive vocabulary of bloodstream patterns and their appearance will help
- One can externalize some of the domain knowledge by utilizing references and outside experts knowledgeable of the relevant domain

Creative Problem Solving

You can keep focusing on:

- **Clarity**
  - Challenges. The specific challenge I want to tackle is: “How to...?”
  - Clarity. The real results I want to achieve are:
  - Controllables. The things I can control in the situation are:

- **Creativity**
  - Choices. The possible options for achieving the results are:
  - Consequences. The pluses and minuses of each option are:
  - Creative solutions. The other possible creative solutions are:

- **Concrete Results**
  - Conclusions. The route I want to follow is:
  - Contracts. The contracts I need to make to achieve the results are:
  - Concrete results. The specific action plan for achieving the results is:

PROBLEM FRAMING

```
"The elevator is too slow."
```

SOLUTION FINDING

```
Refining the problem

"The wait is annoying."
```

SOLUTION SPACE

```
"Make the elevator faster."
Install a new lift
Upgrade the motor
Improve the algorithm
```
```
"Make the wait feel shorter."
Put up mirrors
Play music
Install a hand sanitizer
```
Know for Midterm

1. Understand criteria for tame, crisis and wicked problems.
2. Understand steps in creative problem reframing.
3. Understand how creative problem reframing can be used in higher education.
4. Know concept of intelligent fast failure.
5. Understand methods for accelerated problem solving such as OODA (observe, orient, decide, act) loop.
6. Understand the types of logical arguments.
7. Know basic components of agile design.
8. Know some of the basic components of cognitive design methodology.
9. Know methods to help overcome mental roadblocks.
10. Know some of the things that can slow down the creative process.
FOR 312 Chemistry and Criminalistics

Lab Lecture 5—Scientific Method, Professional Standards, Post-Scene Modifications

Objectives

- Professional standards
- Scientific method
- Evidence Dynamics
  - Superimposition
  - Secondary transfer
- Scene artifacts
- Scene protocols
Professional Standards of Crime Scene Reconstruction

- The practical standards of crime scene reconstruction center around basic scientific foundations and precepts that regulate evidence interpretation
  - Use of scientific method
  - Logical through process
  - Avoiding bias

Oversimplification and Occam’s Razor

- Oversimplification occurs when a complex situation is described in simplistic terms that neglect its complexity
- It is sometimes done out of a desire to achieve a greater degree of certainty than would be possible if all facts were considered

**Occam’s Razor**
- One should use the least blended hypothesis from an otherwise equivalent series of hypothesis and remove the extraneous and non-essential from subsequent interpretations—William of Occam (1288-1348)

**Law of Parsimony**
- One should separate established facts from irrelevant information and unfounded assumptions—Sir William Hamilton (1788-1856)
Reducing Bias

- Bias is a preference or inclination that inhibits judgment to the point of impartiality.
- Reflection
  - Observation—collection of facts
  - Reflection combines facts
  - Experimentation verifies the results of the combination
- Critical thinking
  - Active and skillful conceptualizing, applying, analyzing and synthesizing and evaluating information gathered from observation, experience, reasoning as a guide to action and belief
- Critical thinking involves the skeptical gathering of evidence
  1. Evaluating the nature and source of all information.
  2. Recognizing bias.
  3. Separating facts from opinions.
  5. Synthesizing information.

Scientific Method

- Theories are developed and attempts are made to improve them.
- Better theories have better explaining power: they explain more, explain with greater precision and allow us to make better predictions.
- Socratic method builds knowledge and solves problems through debate and discussion.
- Scientific method is an approach to knowledge building and problem solving that is based on the development of empirically testable hypothesis that are then tested against a series of experiments designed to dispute them.
Defining the Questions to be Answered by the Scientific Method

**Event Analysis**
1. What is it?
2. What function did it serve?
3. What does it tell us about timing and sequence?
4. What interrelationships does it hold with other items of evidence?
   - **Relational clues**—significance of where an object is
   - **Functional clues**—condition of an object in terms of how it was used or what it was used for
   - **Temporal clues** are indications of time duration or when something occurred

**Understanding Argument Conclusions**
- Code for “right” thing or way to do something, i.e., the “correct” happen
- Describes something that will happen, i.e., the “will” happen
- Describes something that has happened, i.e., the “past” happened

Science Falsification

- The main criteria of the scientific status of a theory is its falsifiability, refutability, or testability
1. It is easy to obtain confirmation for nearly any theory if we look only for confirmation.
2. Confirmations should count only if they are unanticipated and would have refuted the theory if not predicted as being incompatible.
3. Every good scientific theory prohibits certain things from happening, the more the better.
4. A theory which is not refutable by any conceivable event is not scientific—irrefutability is not a virtue of a theory but a vice.
5. Every genuine test of a theory is an attempt to refute it.
6. Confirming evidence should not count except when it is a genuine test of the theory, i.e., an unsuccessful attempt to falsify.
7. Some genuinely testable theories, when found to be false are still upheld by their supporters by introducing auxiliary assumptions—it may rescue the theory from refutation but at the cost of lowering its scientific value.
Standards of Practice

1. Reconstructionists must strive to avoid bias.
2. Reconstructionists are responsible for obtaining all information necessary to perform an adequate reconstruction.
3. Reconstructionists are responsible for determining if the evidence they are examining is of sufficient quality to perform an accurate reconstruction.
   a) Identify the item of evidence
   b) Be able to place the item in the location at original crime scene
   c) Identify everyone who handled the item
   d) Determine all tests performed and results
   e) Ensure proper packaging
4. Reconstructionists should visit the crime scene whenever possible.
5. Conclusions and their bases must be provided in written format.
6. Reconstructionists must demonstrate an understanding of science, forensic science, and the scientific methods.
7. Reconstructions must be based on established facts.
8. Reconstructions must be valid inferences based on logical arguments and reasoning.
9. Reconstruction conclusions must be reached using the scientific method.
10. Reconstruction findings must distinguish between individualizing factors and all others.
11. Reconstructionists must understand the concept of trace evidence transfer and other aspects of evidence dynamics.
12. Any evidence, data, or findings on which reconstruction conclusions are based must be made available through presentation or citation.

Requested Information

1. A list of all agencies that responded to the crime scene or have assisted the investigation to date.
2. All available crime scene documentation, including collection and personnel logs, notes, sketches and photos.
3. All available investigative reports and notes from all assisting and responding agencies.
4. All available forensic reports, notes and laboratory findings from all responding and assisting agencies.
5. All available medical reports and notes including paramedics, autopsy reports and photos, toxicology reports.
6. All relevant investigative and forensic testimony for any court proceedings to date.
7. A list of all witnesses to the crime or crime scene.
8. Any documentation of witness and suspect statements, recordings, transcripts and investigative summaries.
Evidence Dynamics--Superposition

- Steno's Law of Superposition (1669) states that layers of rocks are distributed in a time sequence with the oldest on the bottom and the youngest on top unless a subsequent action disturbs the arrangement.

- From an archaeological standpoint, artifacts are deposited on a time sequence as well.

- Evidence items lying on top of each other can provide time sequence to the crime scene reconstructionist.

Evidence Dynamics--Superposition

- Based on superposition, the bottle must have preceded the hair's final position and the hair preceded the purse's final position as well as the cell phone's position.

Bevel & Gardner, 2008
Evidence Dynamics--Chronology

- Absolute chronology relates to dating an event to a particular time
- Relative chronology relates to the relative sequence of a series of events with one occurring first, then second and so on based on overlapping features

Sequence of Shots Through Glass
Evidence Dynamics—Steno’s Law of Lateral Continuity

- Steno’s Law of Lateral Continuity recognizes that strata are not deposited in a way that provides distinct, abrupt boundaries
- As one approaches the end of the boundary, the strata features become less pronounced
- A disruption in lateral continuity such as a void in a bloodstain pattern can indicate something has been disturbed at the crime scene

Evidence Dynamics—Lateral Continuity

- A woman claimed that an intruder was standing in this area trying to enter a window
- The continuity of the dirt is undisturbed
- Lateral continuity can be used to define both when continuity is disturbed by some action and when it is not
- It can help make associations between disassociated areas

Bevel & Gardner, 2008
Evidence Dynamics—Locard Exchange Principle

• A contact between victim and suspect often leaves evidence
  • Microscopic traces
  • Impressions
  • Biological fluids

Common Crime Scene Alterations

• Environmental conditions
  • Extremes in temperature and weather
  • Prior or ongoing human activity unrelated to event (e.g., continuing pedestrian traffic)
  • Animal predation
• Violence or destructive act resulting in evidence transfer or creation
• Evidence alteration, destruction or removal
  • By suspect
  • By victim
  • By witnesses, etc.
• Changes brought about by passage of time
  • Drying of stains
  • Post mortem changes
• Evidence alteration by professional staff carrying out their duties
  • First responders searching premises
  • Emergency medical staff trying to preserve life
  • Law enforcement moving items before documentation
  • Evidence not recognized by crime scene staff
  • Coroner moving and transporting body
• Evidence alteration by forensic scientists performing tests
Foundations of Reconstruction

1. Learn the background of all participants and the history of the crime scene
2. Address all first impressions
3. Identify the critical elements of the crime—anything that establishes motions, positions, actions of the participants
4. Determine the tools or weapons
5. Seek the motive of the crime
6. Seek any associative evidence—was anything taken or left behind
7. Seek alternatives to the most obvious reconstruction—no reconstruction can be dismissed until it has been proven by the evidence to be impossible

Elements of the Crime

1. The suspect’s preparation for the incident
2. The approach to the victim
3. Control of the victim or containment
4. Detention
5. Aggression
6. Response of victim
   • Voluntary
   • Involuntary
7. Disposal/Display
8. Flight/alibi
9. Post incident behavior
• A storyboard is a graphic organizer which displays images in sequence
• It is intended as a means to pre-visualize a motion picture, animation or moving graphics
• It can also be used to capture the essential character of a crime scene image for purposes of aiding in reconstruction
• Summarizing and simplifying the visual information from the scene can help provide yes or no type answers to key theories that may develop

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description of Evidence &amp; Observations</th>
<th>Interpretation</th>
<th>Theory 1 (Homicide)</th>
<th>Theory 2 (Suicide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SENTINEL .22 REVOLVER SN 22-2452</td>
<td>Four live rounds as similar to the one recovered from the floor—could be the same</td>
<td>Support (aggression)</td>
<td>Refute</td>
</tr>
<tr>
<td></td>
<td>Four live cartridges &amp; two expended cartridges</td>
<td>Ammunition replaced into cylinder after discharge</td>
<td>Support (cold)</td>
<td>Support</td>
</tr>
<tr>
<td>2</td>
<td>Blood on grip of weapon</td>
<td>Deceased blood on grip of weapon</td>
<td>Support Victim’s response</td>
<td>Support</td>
</tr>
<tr>
<td></td>
<td>Orientation of ammunition relative to hammer</td>
<td>Cylinder rotates to bring up expended round instead of live</td>
<td>Support (abuse)</td>
<td>Refute</td>
</tr>
<tr>
<td>1</td>
<td>WHITE NIGHTSHDOW NORN BY VICTIM: Tight from buttocks to shoulder</td>
<td>Subject dragged by arms or pushed self with feet while lying on back</td>
<td>Support (disposal)</td>
<td>Refute</td>
</tr>
<tr>
<td>2</td>
<td>Twist in left sleeve</td>
<td>Victim arm raised while dragging on back</td>
<td>Support (disposal)</td>
<td>Support</td>
</tr>
<tr>
<td>3</td>
<td>Hair same color as victim’s on left sleeve</td>
<td>Victim upper arm made contact with head hair</td>
<td>Support</td>
<td>Support</td>
</tr>
<tr>
<td>1</td>
<td>PHOTO OF VICTIM’S RIGHT HAND Near weapon</td>
<td>Close proximity to firearm</td>
<td>Support (display)</td>
<td>Support</td>
</tr>
<tr>
<td></td>
<td>Scott on palm area and interior of digits</td>
<td>Scott pattern similar to hand over cylinder when fired</td>
<td>Support (aggression)</td>
<td>Refute</td>
</tr>
<tr>
<td>4</td>
<td>VICTIM’S PURSE: wallet, keys, money, credit cards, checks, etc.</td>
<td>Robbery likely not a motive</td>
<td>Support (motive)</td>
<td>Support</td>
</tr>
<tr>
<td>5</td>
<td>PHOTO OF VICTIM’S FACE: Blood running from nose to eye over forehead</td>
<td>Blood flow controlled by gravity—head dropped backward</td>
<td>Support (disposal)</td>
<td>Refute</td>
</tr>
<tr>
<td></td>
<td>Interrupted trail across cheek</td>
<td>Possibly wiped by victim’s right finger</td>
<td>Support (suicide response)</td>
<td>Support</td>
</tr>
<tr>
<td>6</td>
<td>PHOTO OF VICTIM’S HEAD WOUNDS</td>
<td>Two holes surrounded by gray soot</td>
<td>Possible to shoot self twice</td>
<td>Support (aggression)</td>
</tr>
</tbody>
</table>
Cylinder Flare

- Area of soot around cylinder of a revolver which indicates cylinder position of fired round
- If cylinder is opened after a shooting, last fired rounds should have cylinder flares
- If there is a mismatch between cylinder flare location and position of fired cartridge cases then this would suggest a substitution after shooting

Crime Scene Protocol

- First officer/first responder
  - Secures scene after searching for suspects who still might be present on the scene and searching for injured parties
- Additional police officers may be called to the scene for added security
- Emergency medical staff may arrive at the same time as first responders and are responsible for preserving life and treating injured parties and not preserving evidence
- Investigators will be on scene shortly thereafter
- Crime scene processing staff will be on site once scene is secure and search warrants obtained
Lapses in Crime Scene Protocol

- Failure to search or recover
- Failure to secure scene
- Premature scene clean up
- Actions of medical examiner staff
- Packaging issues
  - Incomplete chain of custody
  - Improper packaging
  - Loss of evidence
  - Contamination of evidence
- Issues with improper evidence storage and/or destruction of evidence
- Examination by multiple sections of crime lab

Ensuring Proper Evidence Collection

- What comprises the chain of custody for a given item (notes, sketches, photos, logs, signatures, etc.)?
- Is the chain consistent or are there gaps?
- What were the conditions like at the scene at the time of the incident and later at the time of discovery (indoor/outdoor, raining/sunshine, humid/dry, windy/calm, etc.)?
- Was any effort made to record the environmental factors that might have affected the evidence?
- What did the item look like at the scene?
- When was the item collected and by whom?
- Was the exact location of the item documented?
- Was the item collected properly?
- When and how was the item packaged?
- Was the collection documented and how?
- What effects did transportation have on the item?
- Is the name of every individual and agency that handled each item of evidence known? How?
- Is every test or examination that has been performed on the item known? How?
- Was the item stored properly after collection and before testing?
- What does the item of evidence look like now and why? How much change has there been?
- Has the initial officer at the scene been interviewed to determine what was done to secure the scene?
- Have the EMTs been interviewed to determine what they observed upon entering the scene and what they did that might affect the evidence?
Know for Midterm

2. Know the key steps of reducing bias.
4. Understand significance of falsification of scientific theories.
5. Know the basic standard of practices for reconstructionists.
6. Know what material resources are needed for conducting a reconstruction.
7. Understand the significance of Steno’s Law of Superposition and Lateral Continuity.
8. Know some of the common situations that can lead to post-scene alterations.
9. Know some of the critical elements of a crime that will help one to focus when performing a reconstruction.
10. Know how to use the storyboard concept to help keep track of evidence, observation and theories of a crime.
FOR 312 Chemistry & Criminalistics

Lab Lecture 6—Material Acquisition, Project Development, Preliminary Prototyping

Objectives

- Material acquisition
- Stimulating creativity
- Role of play
- Prototyping
Modes of Thinking

- Most professions involve hard thinking
- Hard thinking emphasizes the following concepts:
  - Logic
  - Reason
  - Precision
  - Consistency
  - Work
  - Exactitude
  - Algorithms / flowcharts
  - Efficiency
  - Results
  - Reality
  - Directness
  - Focus
  - Analysis
  - Specificity
  - Abstraction, etc.

- Soft thinking emphasizes the following concepts:
  - Metaphors
  - Dreaming
  - Humor
  - Ambiguity
  - Play
  - Approximation
  - Heuristics
  - Pleasure
  - Process
  - Fantasy
  - Paradox
  - Diffusion
  - Hunches
  - Generalizations
  - Analogy, etc.

- Soft thinking tries to find similarities and connections among things and processes
- Hard thinking focuses on their differences

The Design Process in Education

1. Discovery: I have a challenge
   - How do I approach it?
2. Interpretation: I learned something
   - How do I interpret it?
3. Ideation: I see an opportunity
   - What do I create?
4. Experimentation: I have an idea
   - How do I build it?
5. Evolution: I tried something new
   - How do I evolve it?
The Design Process

• Process of getting from “think” to “thing”

1. Identify a design opportunity
   – Identify many design possibilities and narrow them down later

2. Research the design opportunity
   – Gather information about the nature of the problem; find out about user needs and similar products

3. Brainstorm possible solutions to the problem
   – Come up with at least five to ten ideas; use brainstorming, SCAMPER and other techniques

4. Write a design brief
   – Define the problem clearly in a problem statement, describe user needs and proposed solution and sketch solution

5. Research your solution
   – Do a literature review and talk to experts

6. Refine your solution
   – Analyze the solution for feasibility, how closely it replicates the phenomenon of interest and implications; consider materials and methods for constructing the project

7. Prepare design requirements and conceptual drawings
   – Write up the criteria the solution must meet and constraints and sketch drawings

8. Build models and component parts
   – Analyze the project design for its systems, components, and parts then build a model of the entire design and its process

9. Build the prototypes
   – Develop project specifications and create a working prototype

10. Improve your solution. Test, evaluate, and revise
   – Evaluate the prototype for function, feasibility, true to phenomenon it is trying to replicate and other criteria and revise or build another prototype

Role of Play

• Traits of players
  – Risk takers
  – Humorous
  – Flexible
  – Fun
  – Great diffusers
  – Imaginative
  – Willing to experiment
  – Hands-on
  – Spontaneous
  – Innovative
Role of Play

- Johan Huizinga in *Homo ludens: A study of the play-element in culture* (1950) did one of the first systematic studies of the role of play in human activities.
- He defined an activity as playful if it is:
  - Fully absorbing
  - Intrinsically motivating
  - Includes elements of uncertainty
  - Involves a sense of illusion or exaggeration

Characteristics of Play

- Freedom (you don’t have to play)
- Separation (distinct division between play and non-play activities)
- Non productive orientation (not producing goods)
- Rules (can follow real life or suspend reality)
- Fictitiousness (an awareness that the play is different from real life)
- Both explores and represents what ever the player experiences in his or her daily life (e.g. playing out a recent experience)
- Types of play
  - Physical play
  - Play with objects
  - Symbolic play
  - Pretense/socio-dramatic play
  - Games with rules
Basic Principles of Rapid Prototyping

1. You can prototype anything
2. Prototypes are disposable
   - Don’t prototype anything you are not willing to throw away
   - The solution might not work
   - Don’t give in to the temptation of making it more detailed if the overall design is flawed
3. Build enough just to learn but no more
   - The prototype is designed to answer a question
4. Ideally, the prototype should appear real if getting input from a user

Mechanical Systems

- **System**: A group of related subsystems or components that form a whole functioning device
- **Subsystem**: A system of components and parts that is part of a larger system
- **Component**: A group of parts that work together that perform a specific function in a system or subsystem
- **Part**: The smallest piece of a design

**Bicycle Parts**
1. Drive systems: pedals, crank sets (crank and chain wheel), chains, axles, wheels
2. Steering system: handlebars, front wheel, headset bearings
3. Brake systems: brake levers, cables, and calipers
4. Structural system parts: 
   - Frames
   - Wheels
   - Handlebars
   - Seats
<table>
<thead>
<tr>
<th>Materials Class</th>
<th>Definition</th>
<th>Examples</th>
<th>Properties</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>Metals are combinations of metallic elements such as iron, gold or lead. These elements when combined, have electrons that are non-localized and as a result have certain physical properties</td>
<td>Steel, aluminum, iron, gold, lead, copper, platinum, brass</td>
<td>Strong, dense, ductile, electrical and heat conductors, opaque</td>
<td>Electrical wiring, structures (buildings, bridges), automobiles (body, springs), airplanes (engine, fuselage, landing gear assembly), trains (rails, engine components, body, wheels), shape memory materials, magnets</td>
</tr>
<tr>
<td>Ceramics</td>
<td>Ceramic materials are inorganic materials with non-metallic properties usually processed at high temperatures at some time during manufacture</td>
<td>Porcelain, glass, cement</td>
<td>Lower density than metals, strong, low ductility (brittle), low thermal conductivity, corrosion resistant</td>
<td>Dinnerware, figurines, vases, art, bath tubs, sinks, electrical and thermal insulating devices, water and sewage pipes, floor and wall tile, dental fillings, abrasives, glass windows, television tubes</td>
</tr>
<tr>
<td>Polymers</td>
<td>A polymer contains many chemically bonded parts or units that are bonded together to form a solid</td>
<td>Plastics (synthetic nylon, liquid crystals, adhesives), rubber</td>
<td>Low density, poor conductors of electricity and heat, different optical properties</td>
<td>Fabrics, car parts, packaging materials, bags, packing materials (Styrofoam), fasteners (Velcro), glue, containers, telephone headsets, rubber bands</td>
</tr>
<tr>
<td>Composites</td>
<td>Composites are two or more distinct substances that are combined to produce a new material with properties not present in either individual material</td>
<td>Fiberglass (glass and a polymer), plywood (layers of wood and glue), concrete (cement and pebbles), wood, cotton, silk</td>
<td>Properties depend on amount and distribution of each type of material. Collective set of properties are more desirable and possible than with any individual material</td>
<td>Golf clubs, tennis rackets, bicycle frames, tires, cars, aerospace materials, paint, wooden craft stick, paper</td>
</tr>
</tbody>
</table>

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**Material Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>How heavy objects are that occupy the same space</td>
</tr>
<tr>
<td>Ductility</td>
<td>How easily a material stretches when force is applied</td>
</tr>
<tr>
<td>Strength</td>
<td>How much weight a material can hold without failing or breaking</td>
</tr>
<tr>
<td>Fatigue</td>
<td>How easily a material withstands repeated stresses</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>Whether or not electricity passes through the material</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>How easily heat passes through the material</td>
</tr>
<tr>
<td>Optical Properties</td>
<td>How easily light passes through (transparent, translucent, opaque)</td>
</tr>
<tr>
<td>Corrosion</td>
<td>If the material degrades easily because of the physical environment</td>
</tr>
</tbody>
</table>

Intel Corporation, 2004
## Materials for Modeling

### Supplies for Structure
- Foam (Styrofoam in sheets and several shapes, including foam tubes for pipe insulation)
- Foam core board
- Balsa wood (sheets and pre-cut strips from craft supply stores)
- Modeling clay
- Aluminum foil
- Pipe cleaners and plastic straws
- Cardboard (tubes, boxes of all sizes, flat pieces)
- Paper (including poster board or card stock weights)
- Erector set
- Lego set
- Dowels, bamboo skewers
- Wheels

### Other Optional Structural Supplies
- Recyclable materials such as wine corks, aluminum soda cans, bubble wrap, packaging peanuts and twist ties
- Sample items for larger constructions: PVC pipe and connectors, lumber (plywood and 2 x 4s) of different sizes

### Parts and Materials to Connect Things
- String
- Wire
- Rubber bands
- Rubber tubing
- Tape (duct, masking, packaging, electrical)
- Glues (epoxy, superglue, glue sticks, glues for hot glue gun and rubber cement)
- Hinges
- Nuts and bolts, washers, assorted screws
- Nails, thumbtacks

### Tools
- Pliers, hot glue gun
- Saw, tin snips, hot glue gun
- Screwdriver, tin snips

## Low Fidelity Prototype Kit

<table>
<thead>
<tr>
<th>1. Copy paper</th>
<th>22. Rubber bands, multicolored</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Magnets</td>
<td>23. Assorted foam shapes</td>
</tr>
<tr>
<td>3. Snaps</td>
<td>24. Markers</td>
</tr>
<tr>
<td>4. Masking tape</td>
<td>25. Scissors</td>
</tr>
<tr>
<td>5. Duct tape (different colors)</td>
<td>26. Glue sticks</td>
</tr>
<tr>
<td>6. Tape</td>
<td>27. Tape</td>
</tr>
<tr>
<td>7. Post-it-notes</td>
<td>28. Straws</td>
</tr>
<tr>
<td>8. Glue sticks</td>
<td>29. Construction paper</td>
</tr>
<tr>
<td>10. Decorative brads</td>
<td>31. Foam sheets</td>
</tr>
<tr>
<td>11. Hole punch</td>
<td>32. String</td>
</tr>
<tr>
<td>12. Scissors</td>
<td>33. Pipe cleaners</td>
</tr>
<tr>
<td>13. Stapler &amp; staples</td>
<td>34. Foil</td>
</tr>
<tr>
<td>14. Hot glue</td>
<td>35. Butcher paper</td>
</tr>
<tr>
<td>15. Glue guns</td>
<td>36. Stickers</td>
</tr>
<tr>
<td>16. Rulers</td>
<td>37. Pop sickle sticks</td>
</tr>
<tr>
<td>17. Pipe cleaners</td>
<td>38. Cardboard rolls (assorted sizes)</td>
</tr>
<tr>
<td>19. Zip ties</td>
<td>40. Leather scraps</td>
</tr>
<tr>
<td>20. Foam core sheets</td>
<td>41. Balsa wood</td>
</tr>
<tr>
<td>21. Velcro</td>
<td>42. X-Acto knives</td>
</tr>
</tbody>
</table>
Creative Toolkits

- Creative toolkits are collections of physical elements conveniently organized for participatory modeling, visualization, or creative play by users to inform and inspire design and business innovation teams.
- Kits for flexible or Velcro modeling will contain a range of three-dimensional forms, buttons and ambiguous design elements that can be easily attached to each other and removed.
- Interface kits can contain paper or card elements representing design features for flexible arrangement suggesting mock or ideal web or device interactions.
- Collage kits can contain an inventory of images and words or shape and symbol elements for open interpretation and use relevant to initial design.
- LEGO “Serious Play” has specialty design elements for building metaphors, creative story telling and a “Mindstorms” version for equipment prototyping.
- Drawing kits will contain various papers, cards, markers, pencils and pens to accommodate a large potential range of exercises by participants.
- One goal of toolkit creation is to arrive at a set of elements that can be reused for a variety of research sessions in participatory design.
- In addition to toolkits that may target specific design activities or subject themes, flexible parts can also be assembled to encourage play.

Planning Models

Modeling Questions

- What do you want or need a model of?
  - List at least three possibilities
- For each model possibility:
  - Is this a system or component of your design model?
  - What will this model help you to understand about your idea?
  - Will it be a small of full-scale version?
  - What will you need to build it?
  - What materials on hand will work for your model?
  - What is not on hand for building your model?
  - Will the model have adjustable features?
  - Is this the most accurate means of duplicating your bloodstain pattern?
<table>
<thead>
<tr>
<th>Collapsible Principles</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>1. Something that is stressed (compressed) for storage and relaxed for action</td>
<td>Sleeping bag, rubber band</td>
</tr>
<tr>
<td></td>
<td>2. Something that is stressed (stretched) for action while relaxed for storage</td>
<td></td>
</tr>
<tr>
<td>Folding</td>
<td>Soft materials that are flexible and directionless can be folded</td>
<td>Clothes, blankets, towels, tents, curtains, flags, plastic bags, jump ropes</td>
</tr>
<tr>
<td>Creasing</td>
<td>Something that can be folded along preset lines or creates giving an object (folded and unfolded) water appearance, may also facilitate the act of folding and unfolding</td>
<td>Maps, pop-up books, newspapers, boxes</td>
</tr>
<tr>
<td>Bellows</td>
<td>Used where a flexible and sealed connection is needed</td>
<td>Airport bellows gates, hanging fabric, shoe shelving, paper lanterns</td>
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<tr>
<td>Assembling</td>
<td>The whole is separated into parts for storage</td>
<td>Jigsaw puzzles, Lego blocks, motorized wheel chairs</td>
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<tr>
<td>Hinging</td>
<td>Objects with flexible joints</td>
<td>Laptop computers, pianos, mobile phones, umbrellas, ladders, glasses, folding scissors, strollers, pocket knives, folding bicycles</td>
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<tr>
<td>Rolling</td>
<td>Objects that are rolled and unrolled repeatedly</td>
<td>Extension cords, tape measures, roll-up dog leashes</td>
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<tr>
<td>Sliding</td>
<td>Collapsible that expand and contract as their parts slide open and closed</td>
<td>Telescopes, car antenna, sliding ladders, autofocus camera lenses</td>
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<tr>
<td>Nesting</td>
<td>Two or more objects that fit together to occupy less space than they do individually</td>
<td>Russian dolls, measuring spoons / cups, shopping carts</td>
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<tr>
<td>Inflation</td>
<td>Something that blows up to expand</td>
<td>Balloons, inflatable rafts, inflatable neck cushions</td>
</tr>
<tr>
<td>Fanning</td>
<td>An object that has a pivot that holds its leaves together to allow multiple leaves to be viewed at the same time</td>
<td>Fans, sample color swatches, fan-mounted Allen wrench keys</td>
</tr>
<tr>
<td>Concertina</td>
<td>Collapsible that have a number of equal rods connected by pivots to form a string of Xs which can be expanded and contracted</td>
<td>Retractable mirrors and lights</td>
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</table>

### Budget

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<thead>
<tr>
<th>Materials</th>
<th>Quantity</th>
<th>Cost</th>
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Total Cost =
### Prototype Revisions

<table>
<thead>
<tr>
<th>Priority</th>
<th>Problem</th>
<th>Criteria</th>
<th>Revision</th>
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### Creativity Stimulators

- Abandonment, Temporary (Laying it aside, stopping work, sleeping on it)—temporarily decide to stop project activity
- Adapting (Modify, copy, rearrange, restructure)—Are there other areas where similar problems existed and have been solved? Will the same solutions apply here?
- Addition to (use of auxiliary attachments)—How can we add more strength? Features? More value?
- Alternative approaches (ask, “What are the alternatives?” and make a list)—brainstorming
- Analogy (metaphorical analogies)—possible likenesses of the familiar and the present problem
- Anomaly study (Observe and study phenomenon which are derivations from the usual)—curiosity, special range study
- Association (memory, combining, analogy, imagining/visualizing)
- Assumption challenging (Question every accepted assumption about your project)—questioning, observation, curiosity
- Attribute listing (list attributes, change one or more attributes or specifications, bring unrelated objects together to form new combinations)—Morphological analysis
- Auxiliary, use of (an additive that makes the solution possible without becoming a substantial part of it)—imagining / visualization, addition subtraction
Creativity Stimulators

- Big Dream (Think up the biggest dream possible, read and study every subject connected to your big dream, engineer your dream into reality)—flash of insight, illumination, wishing, intuition
- Blast & Refine (blast the problem, create ideas, refine them)—competition, cost reduction
- Block diagram manipulation (identify functioning blocks for things to be created, play with combinations, propose a plausible system)—input / output study
- Brainstorming (facilitator who helps group come up with novel ideas, defer judgment)
- Can’t be done (find precisely what can’t be done and apply deliberate creative effort to propose ways it can be done)—impossibility, delaying, abandonment
- Catalogue study (browse through catalogs directly or peripherally related to the problem)—reading, play, cost reduction
- Challenging accepted scientific theories (Research what has been taken for granted by others who have attacked the same problem, challenge it and set up a line of attack)—questioning, curiosity
- Check list (prepare a specific list of problems needing solutions and possible solution ideas needing follow up)—listing, formula, approach
- Combining (act of bringing things together in new combinations)—synthesis, forced connections
- Competition / Profit Motive (What can my competitor do to go me one better?)—incentive, vicarious thinking, cost reducing

Creativity Stimulators

- Computers (software, graphics)
- Conference / Meeting attendance (ideas from going to related conferences, e.g. International Association of Bloodstain Pattern Analysis (IABPA))
- Contrast (Determine what exists for solving the problem and ask what can be done differently)—Venn diagrams for compare & contrast
- Course taking (take formal courses in the problem area)
- Curiosity (inquire with care into what excites us)—playing, directing interest
- Deadline setting (establishing deadlines and numerous sub deadlines in the course of the project)—planning
- Decision(s) (Reaching a clear-cut plan of action—crisp decisions may free us from doubt and lead to entirely new viewpoints)—starting, choices, judging
- Deficiency identification (weaknesses; find the defects and let them suggest improvements)—criticism, tear down sessions, focusing deliberately
- Directing Interest (Deliberately guiding our initial small interest toward a subject or problem to see if it grows and gives us a fresh viewpoint)—focusing, curiosity
- Edisonian Method (try everything, random search, trial-and-error)—experimentation
Creativity Stimulators

- Empathetic Involvement (Imagining yourself to be the problem to provide a new outlook)—vicarious thinking, analogies
- Encouragement (find someone needing encouragement and encourage them and observe how it stimulates you)—emotion, motivation
- Escaping (temporarily escape from a given situation, problem or environment to renew ourselves)—retreating, walking, solitude
- Experience (search through everything in one’s experience that may have a bearing on the problem)—Memory
- Experiment (Think what should be done; assemble needed apparatus; conduct the experiment; interpret the results)
- Explaining it (explain the problem to a good listener and then carefully listen to the listener’s reactions and statements for ideas)—talking with others, listening
- Fact accumulation (find all the facts that can be relevant to the problem)
- Fantasy (imagine the best of all possible worlds leading to the most elegant of all possible solutions)—play, similarity, nature
- Focusing deliberately (Deliberately address ourselves to the problem or idea, thinking of it exclusively)—concentration, meditation
- Forced relationship (Isolate the elements of the problem; find the relationship between the elements of the problem; record the relationships; analyze / find the patterns; develop new ideas from the patterns)—matrix of ideas, morphological analysis

Creativity Stimulators

- Generalize (Mental feedback of a series of observations or experiences leading to an improved judgment)—reflection, review, simplifying
- Gordon Technique (Synectics) A group attacks the underlying concepts rather than the problem itself. Concepts are explored at length. Concentrating on the underlying concept prevents early closure on the problem and encourages radical application of old techniques.
- Graphing (plot theoretical or experimental curves)
- Guessing (Hunch) Tentative ideas are proposed which may not be initially based on facts. Verification and modification done later.
- Historical review (Accumulate relevant prior art documents or apparatus and study and review)—literature search, patent search
- Hobbies (engaging in a spare time activity solely for the joy of it)—play, relaxation
- Hunch (Intuition) A strong, recurring intuitive feeling about a problem or solution idea.
- Idea Needler List (have a prepared list of idea needlers as a stimulator)
- Idea quota setting (set ourselves a quota of ideas to come up; in thinking them up, others beyond the quota may appear)—imagining, focusing deliberately
- Illumination / flash of insight (It comes to us after we have stopped working on a problem: 1. Preparation. 2. Frustration / incubation. 3. Sudden insight. 4. Verification)
## Creativity Stimulators

- Imagining/visualization (Association in new relationships of ideas already possessed by the mind) Consists of 1. Visual imagery or power to see things in the mind’s eye, 2. Reproductive imagination or bring pictures back into the mind, 3. Structural visualization or ability to create a clear picture of a solid product from a flat blueprint.
- Improvement searching (1. Select an embodiment of the present art. 2. Search for improved ideas.)
- Lack of knowledge (Put people who are not educated in their line and put them on to research because they don’t know what can’t be done and are willing to try)
- Laws and effect study (Examine descriptive lists of known physical laws and effects then suggest new ideas for our problems)—Physics texts may be helpful stimulators
- Listening (Riveting our ears and mind on what is being said; may involve reception, comparing to what is already known and formulating new idea proposals)
- Mathematics (1. A model is proposed. 2. Assumptions are made. 3. Equations are written and calculations made. 4. Answer is found and checked. 5. Result is interpreted for new insights).
- Meditation (To be thoughtful, alone with oneself)—flash of insight, illumination
- Memory (Recalling past experiences potentially relevant to the problem)—Meditating, reflecting
- Minify/Scaling down (What if this was smaller? What could I omit? How about dividing? How could this be made more compact? Lower? Shorter? Lighter? Streamline? Why does this have to be so heavy?)

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## Creativity Stimulators

- Modify (To change or reshape an idea, concept or apparatus: New twist? Change meaning, color, motion, sound, odor, form, shape?)
- Morphological Analysis (1. State problem broad and generally. 2. Define independent variables broad and generally. 3. Each independent variable becomes an axis on a morphological chart. 4. Each independent variable is expressed in a number of ways with unit dimensions on each of the n axis. 5. Each drawer of idea combinations is examined for problem solution possibilities.)
- Multiple projects (Carry several projects. When one goes sour for need of new ideas, temporarily drop it and work on another project. When we come back, we may have the needed insight.)
- Nature’s way/biomimicry (Look around in nature and find a basically similar problem. Observe how it is solved in nature.)
- Need identification (A need, perhaps not specifically recognized is brought into consciousness)
- New experience seeking (Deliberately seek out new experiences likely to evoke new idea combinations)
- New uses/other uses (Discovering a fact and then imagining what it could be useful for)
- New scientific fact study (Inform yourself of new scientific facts from research. Creatively probe how to use them on your problem)
- Note taking (Jot down on paper what you are thinking about, feeling, seeing or hearing for later use and idea stimulation)
- Note book writing/journaling (Write down your thoughts and ideas in a notebook. The act of writing or sketching frequently suggests new ideas, reveals gaps in our thinking, exposes unsolved problems and uncovers weaknesses)
Creativity Stimulators

- Observation (To inspect, take note of, watch, or pay attention to which implies a keen awareness, perhaps seeing what others have missed)—Curiosity, interest
- Order of magnitude (Make a ballpark calculation or estimate of magnitude)—Mathematics, educated guess
- Partitioning / sub-dividing / factoring the problem (subdivide the objective into discrete elements and generate ideas for each element separately)
- Patent Gazette Study (thumb through issues of Official Gazette, review drawings and abstracts of patented inventions that have expired and are free to anyone)—Reading
- Play (the activity of floating and considering associations apparently irrelevant to the problem at hand; random manipulation and experimentation; pleasurable, satisfying and done for amusement)—self renewal, experimentation
- Questioning (first you isolate the subject or problem you want to think about and then you ask a series of questions)—Idea needler, new uses
- Reading in related and non-related fields (Set time aside to read in other fields, starting with related fields and gradually going to areas farther removed from your specialty)—Relaxing, self-study
- Rearrange / restructure (How else can this be arranged? What if the order were changed? Should this come before that? What layout might be better? Interchange components?)—Modify, adapt
- Relaxing (Be alert to the arrival of new ideas while relaxing)—Illumination, flash of insight
- Restatement of problem (To change our way of looking at the problem)—restructuring

Creativity Stimulators

- Reversal / Contrast / Inversion (Do the opposite of present convention. Transpose positive and negative? What are the opposites? What are the negatives? Should we turn it around?)—Alternative approaches
- Ridiculous, Use the (Pluck the most ridiculous idea from your list of ideas, reflect on the characteristics and how it might be applied to the problem)—Play, curiosity, reversal
- Similarity / Contrast (Similarity: What is this like? What attributes has this in common with that? Isn’t this the same as that? Contrast: What is this unlike? What is the point of difference? What about the opposite and vice versa?)—reversal, analogy
- Simplifying (Strip off non essentials, usually for purposes of (a) lowering cost, (b) making it easier to make, (c) improving reliability, (d) promoting acceptance)—Intuition, beauty
- Six step approach use (An ordered problem solving approach is applied)—Approach, methodology, formula
- Sketching / Drawing (Sketch your ideas on paper)—recording
- Sleeping (Go into the state of sleep and record new ideas during semi-sleep or upon wakening)—escaping, subconscious
- Special range study (Is there a special range of physical conditions within which a particular phenomenon takes place?)—Anomaly, observation, experimentation
- Substitute (Search for a substitute. What other material, process or device could be used to solve or eliminate this problem?)
- Subtracting (What can we eliminate? Suppose we leave this out? Why not fewer parts? How can this be streamlined?)
**Creativity Stimulators**

- Summarizing / Concluding (1. Think over the totality of a situation. 2. Force yourself to write out a specific summary or set of conclusions)—meditation, reflection, focusing
- Talking with others (1. Search out someone we respect and trust. 2. Talk with them about our creative work. 3. Observe and record new viewpoints stimulated.)—Relationships, listening
- Testing (Conceive and physically run a controlled test to verify expected performance and detect weaknesses. Frequently results in fresh viewpoints)
- Time allocation (Set aside a definite period for creative thinking about a specific problem)—Deadline setting, scheduling
- Travel (Personal exposure to new places, people, things, and ideas by taking a trip for pleasure or business)—Illumination, adapting
- Value analysis (An objective, systematic and formalized of performing a job to achieve only necessary functions at a minimum cost with six questions evoked concerning each part: a. What is it? b. What must it do? c. What does it do? d. What did it cost? e. What else will do the job? f. What will that cost?)—Competition, cost reduction
- Vicarious thinking (A bridge by which we put ourselves into another’s place)—analogy, empathetic involvement
- Wishing (To desire or crave creating something)—motivation, emotion, needs identification

_Bailey, 1982_

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**Making a High Fidelity Prototype**

**Why Use This Method?**

1. May provide the proof of concept.
2. It is physical and visible.
3. Useful for refining functional & perceptual interactions.
4. Assists to identify any problems with the design.
5. Helps to reduce risk.
6. Helps members in team to be on the same page with an idea.
8. Feedback can be gained from the user.

_Curedale, 2013_
Making a High Fidelity Prototype

**How to Use This Method**

1. Create final design through guided iterative process
2. Create database if needed
3. Build prototype
4. Prepare for testing
5. Select users / audience
6. Conduct tests
7. Record notes
8. Evaluate the results
Did The Design Meet It’s Goals?
Some of the Ways to Measure Success
1. The device / process adequately reproduces the pattern
2. It replicates a real life process, at least for the major aspects of the pattern
3. It is elegant, compact, workable
4. You can explain it to the satisfaction of user groups
5. Improved operation over other similar designs
6. Economical to build from readily available materials

Know for Final
1. Know some of the characteristics of hard and soft thinking.
2. Know the steps in the design process.
3. Know the usefulness of play.
4. Know the basic subsystems of a mechanical system.
5. Know the basic properties of materials.
6. Know some of the collapsible principles for making products smaller.
7. Know what to look for when revising prototypes.
8. Know some of the creativity stimulators.
9. Know some of the steps in making a high fidelity model and why.
10. Know some of the measures of success for your design.
FOR 312 Chemistry and Criminalistics

Lecture 7—Wound Analysis

Objectives

• Types of wounds
  – Recognition
  – Preservation
  – Documentation
  – Reconstruction
    • Intent
    • Origin
  – Activities after injury
• Restraints
• Occupational marks
• Patterned injuries
Introduction

- Wounds sustained by a victim or offender can be the result of intentional or accidental behavior
- They vary in appearance due to
  - Severity
  - Extent
  - Amount of force delivered
  - Body location
  - Characteristics of the weapon
- They can represent a physical manifestation of both behavior and motive

Wound pattern analysis involves injuries and their,
- Recognition
- Preservation
- Documentation
- Examination
- Reconstruction
  - Nature
  - Origin
  - Intent

General Guidelines

- Wound analysis requires documentation of the injuries and the surrounding environment
  - This should include negative documentation of areas where no injuries exist
- It is useful to perform wound analysis on offenders as well as victims
- A wound pattern should be interpreted in the context of the event in which it occurred
  - As part of a particular history
  - As part of a series of events
- It is important to establish the origin of the injury
  - How was it likely caused
  - What behaviors does it represent

- Multiple disciplines may be involved in the interpretation of a complex, extensive and/or questioned injury
  - Forensic dentists
  - Forensic pathologists
  - Firearms examiners
  - Criminalists
- It is important to establish the motivation or intent of an injury in its context
  - Accidental
  - Intentional
    - Motivation
- Wound patterns may be reliant upon physical evidence
  - Pattern transfer
    - Footwear and tire tracks
  - Physical match
    - Broken knife tip to knife blade
  - Trace evidence transfer
    - Broken glass fragments to broken bottle
Types of Wounds

- Documentation of wound
  - Measured
  - Photographed in context
  - Photographed with and without a scale
  - Photographed with alternate lighting
    - Oblique
    - Ultraviolet
    - Infrared
    - Different time intervals

- Determination of wound type

- Blunt force trauma
  - Abrasions
  - Contusions
  - Lacerations
  - Fractures

- Burns
  - Direct exposure to open flame
  - Contact with hot objects
  - Radiated heat waves
  - Hot liquids
  - Chemical burns

- Sharp force injury
  - Stab wounds
  - Incised wounds
  - Chop wounds

- Gunshot wounds

Blunt Force Trauma--Abrasions

- Removal of superficial layers of skin due to surface contact and friction
  - Ligature furrows where movement causes the skin to break and redden
  - Long, parallel marks left on body by dragging it over a rough surface
Blunt Force Trauma--Contusions

- Injuries caused by a blow of some kind resulting in rupture of surface blood vessels although skin is not broken
- They can be patterned (imprinted, not directional) or non-patterned
- They include bruises and hemorrhages which can often be aged based on color
- Differentiating ante mortem vs. post mortem contusions is an important consideration

Blunt Force Trauma--Lacerations

- Impact to body surface leading to breakage of skin
- These torn or jagged wounds tend to have abraded and contused edges
- They can be differentiated from sharp force injuries by the presence of tissue bridges bridging one side of the laceration to the other (indicative of shearing or crushing force)
  - Bullets striking the skin tangentially, without penetrating can mimic lacerations and incised wounds
**Blunt Force Trauma--Fractures**

- Force applied to the skeletal system resulting in fracturing of underlying bone describing a number of physical forces
- Direct trauma—when an object strikes the body or when the moving body strikes a stationary object
  - Crush fractures
- Indirect trauma—trauma resulting in fracture beyond the site of immediate impact
  - Linear fractures
  - Avulsion fractures
  - Tension fractures
  - Angulation fractures
  - Rotational fractures
  - Compression fractures

**Classification of Fractures**

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Image Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prominent</td>
<td>Crisp image of bone fracture</td>
</tr>
<tr>
<td>Minor</td>
<td>Less prominent image of bone fracture</td>
</tr>
<tr>
<td>Complete</td>
<td>Full image of bone fracture</td>
</tr>
<tr>
<td>Incomplete</td>
<td>Partial image of bone fracture</td>
</tr>
<tr>
<td>Simple</td>
<td>Single fracture image</td>
</tr>
<tr>
<td>Multiple</td>
<td>Multiple fracture images</td>
</tr>
<tr>
<td>Complicated</td>
<td>Complex fracture image</td>
</tr>
<tr>
<td>Compound</td>
<td>Compound fracture image</td>
</tr>
</tbody>
</table>

---

**Burns**

- Child abuse cases
  - Limb forced into hot water
  - Often sharp mark of demarcation

**Time to Third Degree Burn**

<table>
<thead>
<tr>
<th>Water Temperature</th>
<th>Time to Burn</th>
</tr>
</thead>
<tbody>
<tr>
<td>120°F</td>
<td>1 second</td>
</tr>
<tr>
<td>119°F</td>
<td>2 seconds</td>
</tr>
<tr>
<td>118°F</td>
<td>10 seconds</td>
</tr>
<tr>
<td>117°F</td>
<td>40 seconds</td>
</tr>
<tr>
<td>116°F</td>
<td>2 minutes</td>
</tr>
<tr>
<td>115°F</td>
<td>5 minutes</td>
</tr>
<tr>
<td>114°F</td>
<td>10 minutes</td>
</tr>
<tr>
<td>113°F</td>
<td>30 minutes</td>
</tr>
<tr>
<td>112°F</td>
<td>1 hour</td>
</tr>
<tr>
<td>111°F</td>
<td>3 hours</td>
</tr>
<tr>
<td>110°F</td>
<td>8 hours</td>
</tr>
<tr>
<td>100°F</td>
<td>24 hours</td>
</tr>
</tbody>
</table>

**Thermostat Setting vs. Scald Time**

<table>
<thead>
<tr>
<th>Water Temp</th>
<th>Scalp Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>100°F</td>
<td>0.5 sec</td>
</tr>
<tr>
<td>95°F</td>
<td>1.0 sec</td>
</tr>
<tr>
<td>90°F</td>
<td>5 sec</td>
</tr>
<tr>
<td>85°F</td>
<td>15 sec</td>
</tr>
<tr>
<td>80°F</td>
<td>30 sec</td>
</tr>
<tr>
<td>75°F</td>
<td>1 min</td>
</tr>
<tr>
<td>70°F</td>
<td>1.5 min</td>
</tr>
<tr>
<td>65°F</td>
<td>2 min</td>
</tr>
<tr>
<td>60°F</td>
<td>3 min</td>
</tr>
</tbody>
</table>

Figure 3. Thermostat setting vs temperature and scald (burn) time for adult skin, infants, children, and elderly subject to burns at lower temperatures.
Sharp Force Injury—Stab Wounds

- These injuries are due to being pierced with a pointed instrument
- The depth of the injury into the tissue is usually greater than its width in the skin
- One can often ascertain the type of cutting surface
  - Single edged knife (e.g. steak knife)
  - Double edged knife (e.g. stiletto type blade)

Lines of Langher

- Cut marks perpendicular to Langer's lines will produce gapping wound
- More difficult to measure true width of a knife blade
- Skin needs to be held together with tape to measure true width
Correlating Injuries with Damaged Clothing

- Pajama sketch
- A number of overlapping stab holes when clothing bunched up
- 48 Stab holes

Correlating Injuries with Damaged Clothing

- Clothing is often used to reconstruct injuries
- Clothing may display powder patterns to permit determination of firing distance and location of entry and exit wounds
- Clothing can also indicate the location of stab wounds that can be matched to a body
- The pattern of clothing defects can often be used to reconstruct folds of the clothing and consequently likely positions of the wearer when the injuries were received
- Placing the clothing on a manikin and placing markers next to clothing defects can aid in relating clothing defects to each other
- The cutting of clothing performed by paramedics often complicates some aspects of this reconstruction

- Damaged clothing displayed on manikin
**Sharp Force Injury—Incised (Cut) Wounds**

- Injuries due to sharp instruments being drawn across the skin
- Produces wounds longer than they are deep

**Sharp Force Injuries—Chop Wounds**

- These injuries are due to heavy instruments with a sharp edge
- They go deep into the tissue and can be associated with bone fractures
- They can have a combination of incised and lacerated characteristics
  - Axes
  - Hatchets
  - Machetes
  - Swords
  - Meat cleavers
- Gunshot wound
  - Penetrating (entrance wound only)
  - Perforating (entrance and exit wound)
- Entrance wounds
  - Contact
  - Near contact
  - Intermediate
  - Distant
- Exit wounds
- Atypical entrance wounds (e.g. ricochet)

**Gunshot Wounds**

**Therapeutic and Diagnostic Wounds**

- Wounds produced by emergency medical responders
  - Opening of chest for emergency heart massage
  - Needle marks
  - Incisions
  - Puncture marks
- Cardiac leads
- Devices to open airway
Post Mortem vs. Ante Mortem Wounds

- Perimortem wounds are inflicted just before or just after death
- Antemortem wounds occur before death
  - Tend to be accompanied by bleeding
  - Often have vital reactions such as bruising
- Postmortem occur after death
  - Generally little or no bleeding

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>ANTEMORTEM WOUND</th>
<th>POST MORTEM WOUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage</td>
<td>Arterial</td>
<td>Venous</td>
</tr>
<tr>
<td></td>
<td>Blood clotted and the clot is laminated</td>
<td>Blood usually not clotted and if clots it is non laminated</td>
</tr>
<tr>
<td></td>
<td>Firmly adherent to the lining of endothelium</td>
<td>Weakly adherent to the lining of endothelium</td>
</tr>
<tr>
<td></td>
<td>Firm, rubbery and variegated</td>
<td>Soft, friable chicken fat(yellow) or current jelly(red) appearance</td>
</tr>
<tr>
<td></td>
<td>Copious amount</td>
<td>Homogeneous</td>
</tr>
<tr>
<td></td>
<td>Deep staining of edges which can't be washed away</td>
<td>Slight amount</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Staining is superficial and can be washed away</td>
</tr>
<tr>
<td>Wound edges</td>
<td>Gaping, everted, swollen</td>
<td>Apposed, not swollen</td>
</tr>
<tr>
<td>Vital reaction</td>
<td>Signs of inflammation, infection(pus, slough) and healing(granulation tissue) present</td>
<td>Not present</td>
</tr>
<tr>
<td>Enzyme histochemistry</td>
<td>Negative and positive vital reactions</td>
<td>Vital reaction absent</td>
</tr>
<tr>
<td>Wound serotonin and histamine content</td>
<td>Increased</td>
<td>No increase</td>
</tr>
<tr>
<td>Microscopy</td>
<td>Clot has platelets</td>
<td>Clot lacks platelets</td>
</tr>
<tr>
<td></td>
<td>Leukocyte and RBC infiltration in between muscle fibers</td>
<td>No infiltration</td>
</tr>
</tbody>
</table>

Wound Pattern Analysis Worksheet

<table>
<thead>
<tr>
<th>Location</th>
<th>Length</th>
<th>Width</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of Injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Activity After Potentially Lethal Injury

- Individuals have been known to survive and perform activities for 10 to 15 seconds after destruction of heart
- Even suffering major injuries, people can carry out activities for surprising periods of time afterward
  - Phineas Gage—major head trauma
- Some trauma would be likely to produce immediate incapacitation
  - Decapitation
  - Total body destruction
  - Spinal injuries

Restraints

- A restraint is any item found at the crime scene or brought to the crime scene that is used to physically control, limit, contain or restrict the victim
  - Used to make living victims more compliant and less of a threat to the suspect
  - Used to make deceased victim less unwieldy and more compact for transport
- Likely to leave only a smooth transfer impression if victim is deceased or compliant or does not move around much and restraint is not too tight
- Movement with tight restraint attached can produce abrasion and contusion of the tissue beneath the restraint
- Variety of wound patterns can be produced
  - Shirt collar pulled up around victim's neck can leave fabric impression
  - Handcuffs or zip ties can produce circular abraded and contused patterns
  - Zippers and metal buttons on clothing can leave impressions
  - Garrote around victim's neck can leave abraded and contused ligature furrow

Documentation

- Preserve knots (do not untie but cut at ends)
- Have tags attached to cut ends to preserve orientation
- Photograph bindings in situ
- Photographing removed bindings or placing them on a photocopier is a good way to preserve appearance
Environmental Wound Patterns

Any item at the crime scene that comes into contact with victim or offender in such a manner as to cause an injury. These items are part of the scene and the fact that they caused an injury is an unintentional part of the victim/offender interaction. These can include injuries from transportation of the body at the scene or during transport to facility where autopsy is to be performed. Injuries can be caused by animals.

Victim/Offender Contact Wound Patterns

- Body parts and clothing items and jewelry can leave distinctive patterns.
- Items worn on the body can become part of the wound pattern:
  - Fist used to punch victim causing black eye
  - Open hand used to slap face leaving distinctive mark
  - Belt and or belt buckle producing injury when striking someone on back
  - Victim’s own necklace or scarf causing distinctive impression marks
  - Offender striking victim in face while wearing distinctive ring leaving impression
  - Offender stomping victim on back leaving impression of footwear
  - Victim biting offender leaving distinctive bite mark
- Timing: not every wound found on victim is associated with the crime under investigation.
- Injuries are a part of everyday life and relevance of a wound must be established in terms of both source and timing.
Motivational Origin of Wounds

- Lethal force
- Administrative force
- Brutal force
- Overkill
- Control-oriented force
- Defensive force
- Precautionary force
- Experimental force
- Physical torture

Motivational Origin of Wounds

- Lethal force: Intentional infliction of injuries to vital areas to cause death
- Administrative force: delivery of a specific, purposeful amount of injury in order to accomplish a specific task
  - Short time interval
  - Single method of injury
  - On a specific or vital area
    - Sniper killing victim with single shot
    - Killing with a single dose of poison
    - Breaking someone’s hands for failure to pay a debt
    - Striking a victim once to gain compliance
Motivational Origin of Wounds

- Brutal force: Physically aggressive behavior that results in multiple injuries that inflict damage until death results
  - Often motivated by anger
  - Multiple blows to the face with a blunt object
  - Shotgun blast to the face
  - Multiple stab wounds over many areas of the body
- Overkill: Injury beyond the need to cause death
  - Multiple attacks to victim’s face
  - Multiple stab wounds
  - Combination of weapons

Motivational Origin of Wounds

- Control-Oriented force: aggressive action to restrict victim movement
  - Use of restraints
  - Forcing victim to disrobe
  - Locking victim in a room
  - Breaking victim’s legs or feet

Finger Marks on Skin Surface
Motivational Origin of Wounds

- Defense wounds: behavior on part of victim to protect himself from injury
- Precautionary force: wound patterns intended to hamper or prevent recognition and collection of evidence and thwart investigative efforts
  - Inflicting misleading injuries to genital areas to suggest that it was a sexual assault
  - Chopping off victim’s head, hands and feet to thwart identification

Inmates may be slashed in face or other sensitive areas for a variety of reasons
- Rival gang members
- Suspected snitch
- Nearly any other type of grievance
- Small piece of broken razor blade attached to a support such as piece of a toothbrush
- Can be hidden in mouth
- Can produce significant incised wounds

Injuries in Prison
Motivational Origin of Wounds

• Experimental force: force that has psychological or fantasy-fulfillment
  - Does not require a conscious or living victim
  - Postmortem evisceration
  - Postmortem biting of victim’s breast

• Physical torture: Intentional and repeated infliction of a nonlethal injury to the victim
  - Victim must remain alive
  - Usually some type of specific motive
    • Revenge
    • Extract information
    • Sexual gratification (sadism)

Occupational Marks

• People involved in occupations with repetitive tasks, those involved in hard manual labor and the use of specialized tools will often produce calluses and scars in areas of the body that come into contact repetitively with these tools

• These marks can sometimes be of use in personal identification of unknown individuals based on likely occupations

• Occupational Marks (1948) by Francesco Ronchese, M.D. categorized many of these occupations and their marks
Occupational Marks

Granite Cutter

Hand writer's Callus

Ronchese, 1948
Occupational Marks

Plasterer's Calluses

Plasterer's Calluses

Ronchese, 1948

Occupational Marks

Surfer's Knots

Surfer's Knots
Patterned Injuries

- Patterned images can provide information regarding the tool or weapon used to produce the injury.

Patterned Abrasions

Patterned Injuries

Fall onto steel wire

Skill Level/Pace and Stress

- The scores on the two axes are T transformed, resulting in 50 for the mean of the whole South African population. The scores of 75% of the population are within a range of ±1 to ±1. The higher the score, the higher the risk of mental ill-health.

# Know for Midterm

1. Know how to properly document a wound and know some of the factors that can account for its appearance.
2. Know how to recognize the different wound patterns and mechanisms.
3. Know the different types of bone fractures.
4. Know diagnostic aspects of sharp force injuries, burns, gunshot wounds.
5. Know how to recognize entrance and exit gunshot wounds and gunshot wounds fired from varying distances (contact, intermediate, distant).
6. Understand the importance of restraints and how to properly document them.
7. Understand and recognize the different motivational forces behind wounds and their patterns.
8. Know the significance of occupational marks.
9. Understand the significance of patterned injuries.
10. Understand significance of wound pattern and injury type in crime scene reconstructions.
FOR 312 Chemistry and Criminalistics

Lab 8: Re-enactments, Medical Moulage, Product Evaluation, Promoting

Objectives

• Crime scene types
• Science behind re-enactments
• Medical Moulage
  – Basics of clinical simulations
  – Traumatic injuries
  – Bleeding rates and blood simulation
• Product / Process / Project Evaluation
• Promotion/believability
Crime Scene Types

- Preparatory crime scene
  - Location where offender(s) planned, prepared for, watched or waited in order to execute the offense or some part of it

- Point of first encounter
  - Relational dynamics

- Primary crime scene
  - Where offender engaged in majority of criminal behavior

Crime Scene Types

- Secondary crime scene
  - Location where some of the victim—offender interaction occurred but not the majority of it

- Intermediate crime scene is any scene between primary crime scene and disposal site
  - Transportation of body to disposal site
  - Storage of body before final disposition

- Disposal site
  - Location where body is found
### Reconstruction Evidence

- **Sequential evidence**—anything that helps to establish when an event occurred or the order in which two or more events occurred
  - Overlapping footprints/tire tracks
  - Radial fractures in plate glass to establish sequence of shots
  - Blood underneath broken glass at a burglary
- **Directional evidence**—anything that shows where something is going or where it came from
  - Trajectory analysis
  - Bloodstain trails
  - Footwear and tire impressions
- **Locational/positional evidence**—that shows where something happened, or where something was and its orientation to other objects
  - Fingerprint inside/outside a window
  - Orientation of tool mark
  - Bloodstain patterns
  - Livor mortis and change in position
  - Cartridge shells to show where someone was shooting
- **Action evidence**—anything that defines activity
  - Bloodstain patterns
  - Gunshot wounds and holes and cartridge cases
  - Broken window
- **Contact evidence**—something that demonstrates whether and how two persons, objects or locations were at one point associated with each other
  - Trace evidence
  - Fingerprints on an object
  - Biological fluid transfer
- **Ownership evidence**—something that identifies "who" with a high degree of certainty
  - DNA
  - Written signatures
  - Fingerprints
  - Vehicle registration, etc.
- **Associative evidence**—trace evidence that can be identification or ownership evidence
  - Fiber evidence on victim linked to suspect vehicle
  - Trace evidence suggesting a shared environment between victim and suspect
- **Limiting evidence**—defines nature and boundaries of crime scene
  - Points of entry and exit
  - Fences
  - Beginning and end of blood trails
- **Inferred evidence**—anything that should be at the scene but wasn't found
  - Deceased's wallet
  - Victim stabbed or shot but no weapon found
  - Deceased female victim without underwear
- **Temporal evidence**—anything that denotes passage of time
  - Clock knocked over
  - Ice melting in a drink
  - Decrease in body temperature after death
- **Psychological evidence**—any act committed by the suspect to satisfy a personal need or motivation
  - Tortures victim to satisfy sadistic motivation

### Creating Timelines

- Break crime down into small events
- Place the events in relative order
- Elements that may be found in a crime:
  - Fantasy—the person thinks about the offense and what he is going to do
  - Planning—the person plans what he is going to do
  - Contact—the person chooses a way to approach the victim
  - Control—the person takes control of the victim
  - Offense—the act against the victim
  - Defense—the resistance of the victim
  - After—what to do with the evidence of the crime
  - Flight—leaving the scene
  - Alibi—making an excuse for the time
  - Fantasy—remembering what has been done; imagining it better or different; then it starts over
Role-Playing

- Participants engage in animated, free-form hypothesis generation and theory revision regarding potential actions of individuals involved in an event
  - May use props
  - May revisit the scene
  - May approximate victim and offender responses and choices
- Assists with answering the question of whether or not something could have happened in a particular way given the known evidence and physical limitations

Reenactments

- Once theories of the evidence are deemed sufficiently reliable, a physical demonstration of some kind may be needed to relay a proposed reconstruction accurately and fully
- A reenactment is a process in which the participants mimic the actions involved in a specific event or series of events
- A reenactment has a fixed scenario intended to educate or convince others of the accuracy of the theory
- Reenactments are most useful for short segments of events that are firmly grounded in the evidence
Event Analysis

1. Collect data from the scene and evidence
2. Establish specific time events
3. Establish which time events relate to one another
4. Sequencing related segments, establishing a flow of events
5. Consider all possible sequences, re-examine evidence to resolve contradictions
6. Based on the event segment sequence, final ordering of the events themselves
7. Flowcharting the entire incident and validating the sequence

Example

- Data Elements
  - A pattern transfer (right palm print) is present on the west wall in blood (bloodstain pattern report)
  - The blood is that of the victim (DNA report)
  - The ridge detail in the print is identified to the suspect (fingerprint report)

- Event segment
  - The suspect touched the west wall with his right hand subsequent to the victim’s injuries

Hypothesis Matrix

Victim found with bullet in forehead
Bathrobe cord around neck
Half submerged in the bathtub

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: The victim was shot first</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>H2: The victim was strangled first</td>
<td>+</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>H3: The victim was drowned first</td>
<td>+</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1: The victim could have lived for several minutes after the gunshot</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>E2: The victim had petechial hemorrhaging in the eyes</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>E3: The victim had no water in the lungs</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>E4: The victim had no scratch marks on his neck indicative of an attempt to alleviate pressure from the ligature</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>E5: The victim had no abrasions on his neck indicative of a struggle while being strangled</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
Medical Moulage

- Moulage, which is French for “casting or molding” is the art of creating lifelike injuries to assist in providing shock desensitization, realism, and training techniques to medical staff, first responders, military and youth education groups.

- Moulage may be as simple as applying premade rubber or latex wounds or as complex as using advanced makeup and theater techniques to provide elements of realism.

Medical Moulage in Education

- Moulage is a technique that supports the sensory perception of a scenario.

- Allows educators to bridge the gap between a clinical case and a simulation.

- Assists the student in confirming the physical signs that support a diagnosis.

- Enables students to discover the physical signs that support a diagnosis.

- Teach students how to gather data in order to arrive at a correct diagnosis:
  - Increase knowledge
  - Improve performance response time
  - Evaluate clues
  - Critical thinking
  - Realism
  - Sensory engagement
  - Suspension of disbelief
Medical Moulage in Nursing Education

- When simulation became available in nursing education, it enabled educators to simulate clinical experiences
- Students could handle critical, complex and high risk cases without endangering patients
- Unfortunately, simulations provided a lack of scenario realism
- Nursing experience is based on sensory experience
  - What is felt
  - What is seen
  - What is heard
  - What is smelled

Considerations in Moulage Construction

- Time and skill level required to prepare
  - Advanced
  - Intermediate
  - Beginning
- Objective—what participant would gain from the simulation
- Appropriate case application (or disease application in a clinical setting)
- Ingredients—create a list of ingredients needed to make recipe
- Equipment—list the equipment needed to facilitate the re-enactment
- Process—list the sequence of events if there is a complex set of activities
  - Direction of force
  - Amount of force
  - Body location of injury
  - Sequence of blows or other activities
  - Post-injury environmental changes, etc.
- Set the stage—have an appropriate case scenario, case file, accompanying photographs, etc. to set the general scene
- Time constraints—modified formulas if one needs to set up a scenario in a hurry or with limited resources, e.g. before a jury during trial
- Clean-up or how to disassemble and store
- Technique—develop a step-by-step guide to take one through the development process of the moulage
Basic Moulage Equipment & Ingredients

- Adhesive bandages
- Ammonia
- Apron
- Baby oil
- Baby powder
- Blush powder makeup, red and pink
- Bubble wrap, large
- Cat food, dry
- Cinnamon
- Cold cream
- Coffee grounds, used
- Comb
- Condoms
- Cornmeal grain, cereal cooked
- Cornstarch
- Cotton swabs
- Cream soup
- Drink mix, colored
- Egg crate foam 6" x 6"
- Face powder, skin tones
- fake feces
- Fish oil
- Foam makeup wedges
- Food coloring, red, green, blue, yellow, caramel
- Freezer bags, gallon size
- Frosting
- Frosting top
- Gelatin
- Glue, latex
- Glycerin
- Goggles
- Golf ball
- Green tea bags
- Hair gel, clear
- Horseradish
- Kimchi
- Limburger cheese
- Makeup, white cream and yellow cake

Paintbrushes, small, medium, and large
- Petroleum jelly
- Plastic wrap
- Press'n Seal wrap
- Razor blade or scalpel
- Scissors, household
- Shampoo, pearlescent
- Syringes, all sizes
- Tape, clear
- Tape, double-sided
- Tapioca, stones
- Tool box or fishing tackle box
- Toothpicks
- Tweezers
- Watercolor markers
- Watercolor paints
- Eyeliners, brown and black
- Eye shadows, blues, maroons, purples, greens, gray, red, and violet
- Memory foam
- Play-Doh
- Nails, rusty

Oatmeal packets
- Waxwed paper
- Wheat grain cereal, cooked
- White rice

Supplies
- Bottles, flip-top, plastic, 4 oz.
- Bridal netting
- Candy thermometer
- Comb
- Fan, small, portable
- Food coloring, Carmel
gel effects, clear, flesh-colored, red
- Glycerin
- Hotpot, 32 oz.
- Makeup, blue base, white cream
- Palette, laminated, 9" x 9"
- Palette knives, two
- Palettes, Masonite 5 ½ inches x 6 inches
- Stipple sponges
- Syringes, 20cc
- Tape, plastic
Equipment & Applicators for Moulage

- Bowls
- Can opener
- Colander
- Funnel
- Measuring cups
- Measuring spoons
- Microwave
- Microwave-safe dishware
- Refrigerator
- Rolling pin
- Spatula
- Timer
- Utility knife
- Whisk

Merica, 2012

Basic, Liquid Blood
- One 15 fl oz. bottle, white pearlescent shampoo, any brand
- One ten oz. tube, lubricating jelly, water-based
- 4 (15 oz.) envelopes of unsweetened soft drink mix, red
- 3 drops blue food coloring
- 2 drops caramel food coloring
- 2 oz. sugar-free Jell-O, red
- Add all ingredients together in a bowl and stir with whisk and using a funnel, pour into storage bottle

Thick, Liquid Blood
- 1 cup water
- One packet flavored gelatin, red
- Four (0.15 oz.) envelopes of unsweetened soft drink mix, red
- 2 drops, blue food coloring
- 1 drop caramel food coloring
- ½ cup coca powder
- 1 teaspoon baby oil
- Over medium heat, combine water and gelatin in a sauce pan, whisking ingredients to remove clumps then add coloring, soft drink mix, coca powder and continue to stir until consistency of pancake batter then remove from heat and stir in baby oil.
Making Blood Clots

**Blood Clots, Standard**

- One 3 oz. box red gelatin
- One (0.15 oz.) envelope of unsweetened soft drink mix, blue
- Two (7g) packets unflavored gelatin
- ½ cup boiling water
- ½ cup cold water
- 2 drops caramel food coloring

Evaluating Design Thinking Working Models

- Handwriting and drawing on a white board
- Writing a personal sticky note
- Clustering sticky notes and applying a label
- Collaborative creation of hand drawings
- Intense discussion of a design topic
- Presenting insights, ideas and frameworks
- Presenting a physical prototype
## Attention Gaining Elements

<table>
<thead>
<tr>
<th>Gagne’s Nine Events</th>
<th>Keller’s ARCS Model</th>
<th>Common Game Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain attention</td>
<td>Attention</td>
<td>Scenario exposition</td>
</tr>
<tr>
<td>Inform of objectives</td>
<td>Problem setup</td>
<td></td>
</tr>
<tr>
<td>Stimulate recall</td>
<td>Relevance</td>
<td>No existing game equivalent</td>
</tr>
<tr>
<td>Present stimulus / lesson</td>
<td>Offer challenge / choice</td>
<td></td>
</tr>
<tr>
<td>Provide learner guidance</td>
<td>Confidence / challenge</td>
<td>Provide direction</td>
</tr>
<tr>
<td>Elicit performance</td>
<td>Elicit action / decision</td>
<td></td>
</tr>
<tr>
<td>Provide feedback</td>
<td>Satisfaction / success</td>
<td>Discernible outcome</td>
</tr>
<tr>
<td>Assess performance</td>
<td>Success / failure screens</td>
<td></td>
</tr>
<tr>
<td>Accommodate retention &amp; transfer</td>
<td>No existing game equivalent</td>
<td></td>
</tr>
</tbody>
</table>

Gunther, et al., 2008

## Gaining Approval & Capturing Interest

<table>
<thead>
<tr>
<th>Major Category</th>
<th>Sub-category</th>
<th>Instructional Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>Perceptual arousal</td>
<td>1. What can I do to capture their interest?</td>
</tr>
<tr>
<td></td>
<td>Inquiry arousal</td>
<td>2. How can I stimulate an attitude of inquiry?</td>
</tr>
<tr>
<td></td>
<td>Variability</td>
<td>3. How can I maintain their attention?</td>
</tr>
<tr>
<td>Relevance</td>
<td>Goal orientation</td>
<td>1. How can I best meet learner’s needs? Do I know the needs?</td>
</tr>
<tr>
<td></td>
<td>Motive matching</td>
<td>2. How &amp; when can I present learners with appropriate choices, responsibilities, influences?</td>
</tr>
<tr>
<td></td>
<td>Familiarity</td>
<td>3. How can I tie instruction to learner’s experiences</td>
</tr>
<tr>
<td>Confidence &amp; Challenge</td>
<td>Learning requirements</td>
<td>1. How can I assist in building a positive expectation for success?</td>
</tr>
<tr>
<td></td>
<td>Success opportunities</td>
<td>2. How will the learning experience support or enhance their belief in their competence?</td>
</tr>
<tr>
<td></td>
<td>Personal control</td>
<td>3. How will learners know success is based on their efforts?</td>
</tr>
<tr>
<td>Satisfaction &amp; Success</td>
<td>Natural consequences</td>
<td>1. How can I provide opportunities for learners to use their new skills?</td>
</tr>
<tr>
<td>Dempsey &amp; Johnson, 1998</td>
<td>Positive consequences</td>
<td>2. What will provide reinforcement?</td>
</tr>
<tr>
<td></td>
<td>Equality</td>
<td>3. How can I assist student’s in having positive feelings about their success?</td>
</tr>
</tbody>
</table>
**Guiding Field Activities**

- **Activities** are goal-directed sets of actions—what are the pathways that people take toward the things that they want to accomplish including specific actions and processes?

- **Environments** include the entire arena in which the action takes place.

- **Interactions** are between and someone or something else and the building blocks of activities:
  - What is the nature of routine and special interactions between people and objects in their environments and across distances?

- **Objects** are the building blocks of the environment, key elements sometimes put to complex or unrelated uses, possibly changing their function, meaning, and context:
  - What are the devices that people have in their environments and how do these relate to their activities?

- **Users** are the people whose behaviors, preferences and needs are being observed:
  - Who is present?
  - What are their roles and relationships?
  - What are their values and biases?

*Martin & Hanington, 2012*

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**Scenario Based Design**

- A scenario is a narrative that explores the use of a product by a consumer.

- Writing scenarios makes design ideas explicit and concrete and design teams can envision how a device is likely to be used.

- Written from the standpoint of different users who may interact with a product in different ways.

- Once framed by a specific use or point of view of a user, scenarios can be written to follow a traditional story arc:
  - The action begins with a trigger event, which sets the scene and the preconditions, and events with resolution of a task by an intervening technology that assists and delights the person.

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**Five reasons for scenario-based design**

- Yield descriptions of end-user experiences evoke reflection about design issues
- Scenarios can be written at multiple levels, from many perspectives and for many purposes
- Scenarios can be abstracted and categorized to help design knowledge cumulative across problem instances
- Scenarios can be written at multiple levels, from many perspectives and for many purposes
- Scenarios can be abstracted and categorized

*Chevallier 2004*
Kano Analysis of Customer Satisfaction

- Survey method that tries to determine what attributes are more important to a user
- Required elements are the baseline features
- When desired attributes are added, the perceived value goes up
- Attractive elements will enhance appreciation for the item but won’t create disappointment or frustration if they are not present
- Neutral elements the consumer has no strong feelings either way
- Reverse quality elements negatively impact customer satisfaction and should be left out

Believability

- Whether or not a jury accepts an exhibit or testimony will be based on the expert’s
  - Education
  - Experience
  - Simple explanation
  - Use of demonstrative aids

- What the expert witness brings to evidence examination which is beyond the lay witness:
  - Training and experience
  - Time and effort
  - Techniques and equipment
Questionable Demonstrable Evidence

- Claiming a bullet match by placing a thick line down middle of single bullet
- Accentuating the effects of a distance determination by substituting black powder for smokeless powder
- Using a pumpkin and a 2 x 4 to demonstrate a blood spatter event
- Referring to evidence item as "murder weapon" rather by evidence number when listed on court chart
- Displaying a court chart of an "ideal match" rather than a match between the two bullets in question without adequate explanation

Know for Final

1. Know the different crime scene types.
2. Know the different types of reconstruction evidence.
3. Know the elements that might be found in a crime.
4. Know basics of event analysis.
5. Know importance of role-play and reenactment in reconstructions.
6. Know how to construct a hypothesis matrix.
7. Know applications of medical moulage.
8. Know basic recipes for making blood and clots.
9. Know basics of design thinking work methods.
10. Know some of the basics for gaining interest in gaming applications.