Table of Contents

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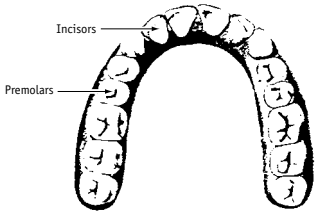
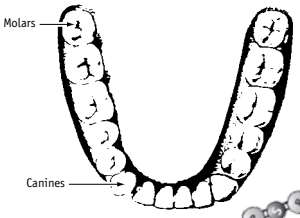
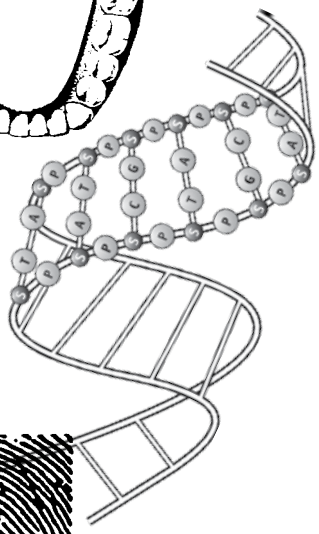
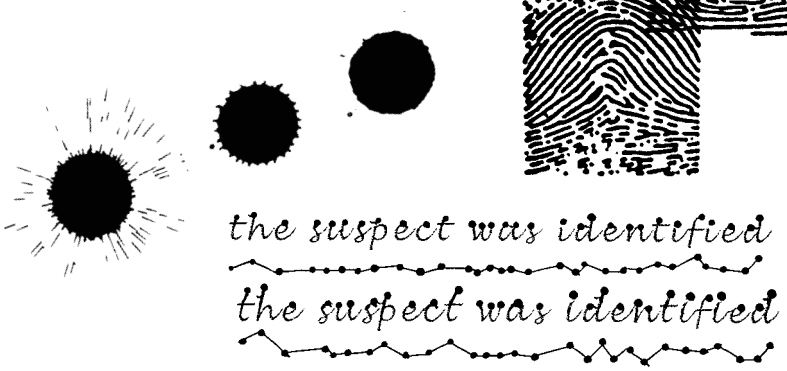








Introduction and Research Base

Inquiry-Based Learning

Over three decades ago, the American Association for the Advancement of Science (AAAS) began a three-phase project to develop and promote science literacy: Project 2061. The project was established with the understanding that just doing more science is not the answer (1989, p. 4).

As Project 2061 began, researchers questioned the appropriateness and effectiveness of science textbooks and methods of instruction. Since textbook instruction puts more emphasis on learning correct answers and less on exploration, collaboration, and inquiry, the AAAS asserts that this manner of instruction actually "impedes progress toward scientific literacy" (1989, p. 14).

This same concern resurfaced over a decade later by Daniels and Zemelman (2004) who call textbooks "unfriendly." When most adults are choosing literature, they do not pick up their child's science textbook. Daniels and Zemelman assert that today's textbooks are best used as references when students need large amounts of information on a particular topic. Instead, they recommend the use of "authentic" sources.

Project 2061 recommends pedagogical practices where the learning of science is as much about the process as the result or outcome (1989, p. 147). Following the nature of scientific inquiry, students ask questions and are actively engaged in the learning process. They collect data and are encouraged to work within teams to investigate the unknown. This method of process learning refocuses the students' learning from knowledge and comprehension to application and analysis. Students may also formulate opinions (synthesis and evaluation) and determine whether their processes were effective or needed revision (evaluation).

The National Science Education Standards view inquiry as "central to science learning" (p. 2 of Overview). In this way, students may develop their understanding of science concepts by combining knowledge with reasoning and thinking skills. Kreuger and Sutton (2001) also report an increase in students' comprehension of text when knowledge learning is coupled with hands-on science activities (p. 52).

Values and Skills

Scientists work under a distinctive set of values. Therefore, according to the AAAS, science education should do the same (1989, p. 133). Students whose learning includes data, a testable hypothesis, and predictability in science will share in the values of the scientists they study. Additionally, "science education is in a particularly strong position to foster three [human] attitudes and values: curiosity, openness to new ideas, and skepticism" (1989, p. 134). *Forensic Science* addresses each of these recommendations by engaging students in thought-provoking, open-ended discussions and projects.

Within the recommendations of skills needed for scientific literacy, the AAAS suggests attention to computation, manipulation and observation, communication, and critical response. These skills are best learned through the process of learning, rather than in the knowledge itself (1989, p. 135).

How to Use This Book

Forensics is a fascinating subject that employs all areas and types of science. To that end, it offers both an excellent platform for science instruction and practice as well as a wide-ranging field for assessment. Because the field is so wide and varied, this book can be utilized in total or in part.

The ideal place to begin is with the introductory overview on forensics and contact traces (pages 11-29). The more students understand about the history and development of forensics, the more they are likely to enjoy the science itself. It may even be worthwhile to supplement this study with readings from some of the classic literary criminalists, such as Sir Arthur Conan Doyle's stories of Sherlock Holmes or Edgar Allan Poe's *The Murders in the Rue Morgue*. You also might read real case studies, easily found on the Internet and in newspaper archives. The real-world, practical applications of science in this realm are almost always intriguing to students and whet their appetites to learn and know more.

Once forensic science as a whole has been introduced, look to the fact sheets and labs that follow for hands-on forensic experiences. The fact sheets provide the necessary overview of the material involved in the lab. The labs allow students to put into practice what they have learned. While the labs may certainly be done without using the fact sheets, to ensure the most successful results, the labs work best when preceded with a study of the fact sheets and provided comprehension questions.

A Note About Safety

It should go without saying, but whenever working with the "stuff" of science, one should always exercise the extremes of caution and safety standards. Because these labs deal with forensics, they sometimes call for organic substances to be used. Such items should only be handled with the strictest safety measures and adherence to school codes. It is likewise true for chemicals and equipment. Be sure that both you and your students are familiar with and use safety measures and protective gear. One can never be too cautious in these matters.

Arriving at the Crime Scene (cont.)

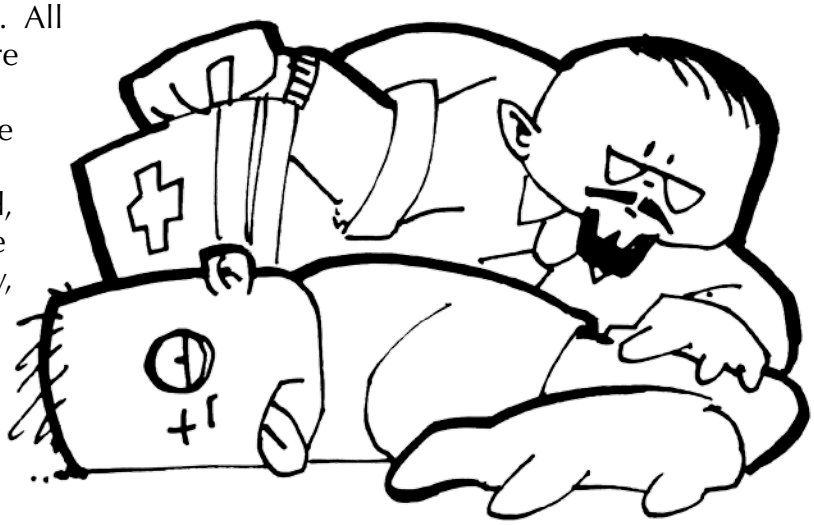
If the crime scene is in a building, the next area to be inspected will be the point of entry. The CSI must try to think as a criminal might and predict the movements the criminal probably made, so that he or she will be able to identify the most likely places where evidence may be found and look there first. For example, they may look for fibers from clothes on a door frame at shoulder height where the criminal may have rubbed his or her shoulder.

It is the CSI's role to assess the crime scene and prioritize how it will be searched. Often, the actual crime scene is searched last. The CSI may call in extra expert help, such as a pathologist, to examine a dead body; a forensic biologist to analyze blood splatters; or a ballistics expert to look at powder burns or inspect some discarded cartridge cases.

Only after the CSI is satisfied that all possible evidence has been collected will the cleanup of the site begin. Bodies will be removed to the morgue where a police pathologist will make a postmortem examination. All other pieces of evidence are photographed before their positions at the crime scene are recorded on a map. They will then be collected, bagged, and labeled before being sent to the laboratory, where they will undergo the appropriate analysis as requested by the officer in charge of the investigation.

Comprehension Questions

1. In the correct order, list four things that should be done by the first police officer who arrives at a major crime scene. Give reasons for your answer.
2. Explain the difference between the roles of the crime scene investigator and the detective in charge of the investigation.
3. Describe at least three procedures that are carried out to prevent contamination of the crime scene.
4. Explain why in most serious crimes a large number of photographs are taken and a map drawn.
5. Why is a small ruler placed in a photograph of a piece of evidence?
6. When would a forensic pathologist be called in, and what is his or her responsibility?



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Comparing Blood Samples

If a dark stain is found at a crime scene, it may be blood belonging to either the victim or criminal. Or it could be something else, like furniture polish or another dark stain. Before sending a sample to the lab for testing, the CSI must first establish that the stain is blood. For this reason, a presumptive blood test is done. This is a test that is quick and simple to carry out at the crime scene, confirming that the stain might be blood and so deserves further investigation.

There are two common ways such a test is done. In many countries, a KM (Kastle-Meyer) or LMG (leucomalachite green) test is done. In some states, forensic investigators use a hemastix. *This is simply a plastic strip with a small square of special indicator paper attached to one end. Details of both procedures are described below.*

Materials

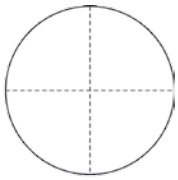
- phenolphthalein (Kastle-Meyer or KM) solution
- leucomalachite green (LMG) solution
- hydrogen peroxide
- a number of small pieces of filter paper
- pipettes, if solutions are not in dropping bottles
- some dark brown or maroon stains, including dried animal blood and other substances, and also horseradish and fresh rust, each on a white ceramic tile

Procedure

1. Copy the results table below into your science notebook and use it to record observations.

Material	Observations for KM Solution	Observations for LMG Solution
blood stain		
horseradish		
fresh rust		

2. Fold one of the small filter papers into quarters as shown.



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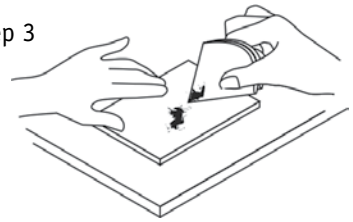
Comparing Blood Samples (cont.)

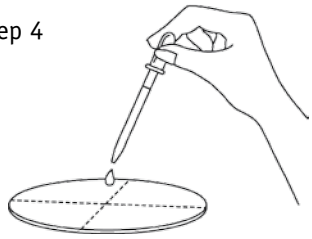
Procedure (cont.)

3. Scrape the dried stain with the sharp corner of the filter paper. Leave enough of each stain to repeat the test with the second solution if you have it available.
4. Open out the filter paper and add one drop of KM or LMG solution to the stain in the center.
5. Add one drop of hydrogen peroxide to the center. If there is blood present, you should see an instant color change.
6. Record your observations in the results table, and then repeat steps 2 to 5 using the second solution, and record these results as well.
7. Now repeat these presumptive blood tests using a small amount of horseradish, and then some fresh rust. Record these results as well.

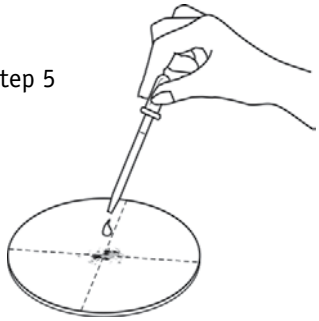
Step 3



Step 4



Step 5



Analysis

1. What color did the blood turn the indicator?
2. What can you conclude regarding the accuracy of these tests to identify blood from the other dark red or brown stains?
3. Discuss how useful you think these tests are when used at a crime scene.
4. Make a list of all the steps a Crime Scene Investigator (CSI) would carry out if a suspicious dark brown stain were found at a crime scene in your local area.
5. If the stain showed positive to blood, what would you expect the CSI to do next?