Science Screen Report®

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ANTHROPOMETRY: *Studying the New Forensics*

SYNOPSIS

Forensics is the application of science to help authorities gather and analyze material found at a crime scene. It typically requires the detailed collection of evidence with a sophisticated array of high tech tools. Although much of forensic science is used by police to help investigate criminal activity, its original function was to aid the legal system, including the civil courts and public inquiries. It actually dates back as far as 500 BC with one of its first applications, fingerprinting by the ancient Chinese to identify business documents.
Read more: **http://www.mycriminaljusticecareers.com/forensic-science/history-of-forensic-science/**

CURRICULUM UNITS

- ☐ CHEMISTRY
- ☐ BIOLOGY
- ☐ PHYSICAL SCIENCE

CAREER POSSIBILITIES

- ☐ CHEMIST
- ☐ FORENSIC PATHOLOGIST
- ☐ BIOMEDICAL ENGINEER

NEXT GENERATION SCIENCE STANDARDS & NATIONAL SCIENCE EDUCATION STANDARDS

NEXT GENERATION SCIENCE STANDARDS: www.nextgenscience.org

5-PS1-4: Matter and Its Interactions.
Conduct an investigation to determine whether the mixing of two or more substances results in new substances

MS-PS1-2: Matter and Its Interactions.
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

HS-PS1-1: Matter and Its Interactions.
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Grades 5 - 8

Chemistry
Properties of Matter
Chemical Changes
Physical Changes

Grades 9 - 12

Chemistry
Properties of Matter

CRITICAL THINKING EXERCISES

1. State what you think is the most challenging responsibility of a forensic scientist.
2. Compare and contrast the various types of automated recognition.
3. Discuss how a crime scene can be altered by the faulty collection of evidence.
4. Describe how forensic science not only benefits the authorities, but also the victims and those suspected of crime.

ABET
Accreditation Board for Engineering and Technology
www.abet.org

NMOE
National Museum of Education
www.nmoe.org

BACKGROUND

The term "forensic" comes from the Latin and means, simply, having to do with the law. Hence, any discipline that has any ties to the legal system is forensic, and despite the modern day fascination with forensic science, it actually dates back as far as 500 BC. One of its first applications was fingerprinting by the ancient Chinese who would use fingerprints to identify business documents. With regard to forensic science, the term is now commonly understood to refer to the application of scientific principles to questions of law. In short, it means using science to solve crime.

It's also believed that the first recorded autopsy was performed sometime after the death of Julius Caesar in 44 BC. Since the Roman model is the basis for our court and legal system today, it is fitting that it also provides the precedence for our interest in applying scientific principles in the examination of evidence. In the first century A.D., the Roman orator and jurist Qunitilian was able to show that bloody handprints left at the scene of a murder were meant to frame the defendant, an innocent blind man. As the Roman Empire declined in the west, forensic science remained fairly stagnant for the next millennium, as did the applications of criminology and criminal justice.

In thirteenth century China, the book Hsi Duan Yu (The Washing Away of Wrongs) was published and is considered to be the first known guide to pathology. The work describes, among other things, how to determine a victim's cause of death. It also detailed how the criminal investigator identified the type of weapon used in a crime, and how to determine whether a death was accidental or murder.

Beginning in the seventeenth century, as the age of enlightenment bloomed, advancements in science and the social conscience saw the field of forensic science receive a revitalization of sorts. The eighteenth and nineteenth centuries saw an explosion of recorded incidents of the use of scientifically obtained evidence to solve crimes and win convictions. In 1835 Scotland Yard's Henry Goddard became the first person to use physical analysis to connect a bullet to the murder weapon. Then in 1836, a Scottish chemist named James Marsh developed a chemical test to detect arsenic that was used during a murder trial.
Perhaps the biggest leap in forensic science, though, came in 1880 with the work of Henry Faulds and William James Herschel, who published a study in the scientific journal Nature that detailed the fact that human fingerprints were unique to individuals, meaning that no two sets were identical.

The advancements of the twentieth century were built largely upon the groundwork laid in the nineteenth century, perfecting techniques in both analysis and preservation of evidence. The first police crime laboratory was set up in France in 1910...while in the United States the first crime lab was established by Los Angeles Police department in 1924. During the 1920s, bullet examination became more precise when American physician Calvin Goddard created the comparison microscope to help determine which bullets came from which shell casings. In the late 1900s, though, perhaps the largest breakthrough in crime scene investigation since fingerprinting became standard practice came with the advent of DNA analysis and identification.

The recent use of DNA in criminal investigations has lead not only to positive identification of countless criminals, but it has also lead to overturns of prior convictions and the release of hundreds of innocent people. With new advances in police technology and computer science, crime scene investigation and forensic science will only become more precise as we head into the future.

ADVANCED ORGANIZERS

Prior to viewing the video students should have some understanding of the following Science Benchmarks from AAAS, Project 2061. This is a longterm initiative focused on improving science education so that all Americans can become literate in science, mathematics, and technology.

Benchmark 1. The Nature of Science
Section B: Scientific Inquiry, Grades 6-8
By the end of the 8th grade, students should know that

- Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data. 1B/M1b

Benchmark 1. The Nature of Science
Section B: Scientific Inquiry, Grades 9-12
By the end of the 12th grade, students should know that

- Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible, practical, or ethical, they try to observe as wide a range of natural occurrences as possible to discern patterns. 1B/H3

SUGGESTED REFERENCES

- *Criminal Justice Careers:* ***http://www.mycriminaljusticecareers.com/***
- *AAAS, Project 2061:* ***http://www.aaas.org/program/project2061***
- *Interactive Periodic Table:* ***http://www.ptable.com/***
- *Fingerprints and Other Biometrics:* ***https://www.fbi.gov/about-us/cjis/fingerprints_biometrics***
- *CSI Web Adventures:* ***http://forensics.rice.edu/en/For-Educators/Online-Activities.html***
- *Fingerprinting:* ***http://www.smithsonianmag.com/videos/category/smithsonian-channel/where-do- fingerprints-come-from/***

VOCABULARY

Accelerant: A substance that might have been used to quickly start a fire.
Amylase: An enzyme found in saliva that begins the process of digestion.
Arson: The criminal act of deliberately setting fire to property.
Biometrics: The measurable biological or behavioral characteristics used for identification of an individual.
Chromosomes: The basic building blocks of life where the entire genome of an organism is essentially organized and stored in the form of DNA.
Comparison microscope: A device used to analyze side-by-side specimens which results in a split view window enabling two separate objects to be compared simultaneously.
Confirmatory test: The test required to confirm the analysis produced by the presumptive test.
DNA: Deoxyribonucleic acid, which is the hereditary material in nearly every cell of humans and almost all other organisms.
Facial thermography: a program where an energy expert inspects your home and suggests ways you can save energy.
Fingerprint: A unique mark used for identification made by the tip of a finger on an object that it has touched.
Forensics: Using science to help the authorities investigate and analyze a crime scene.
Forensic anthropology: The study of a human skeleton to find clues regarding the individual's identity, possible cause of death, and/or uncover evidence of a crime.
Gas-chromatograph: A device used to analyze a sample that can be vaporized without decomposition.
Infrared radiation: Used by technicians to identify the structure and chemical components of a substance by measuring the amount absorbed.
Latent fingerprints: Made when sweat, oil, and other substances on the skin reproduce fingerprints on a surface such as glass.
Microcrystalline test: Used to identify a suspected substance by adding it to a chemical on a slide and having the mixture form crystals.
Phenolphthalein: A solution that is normally colorless but turns pink when blood is present.
Polarized light microscope: A device that views a suspected substance illuminated with polarized light to determine its properties.
Polymerase chain reaction (PCR): The technique to make millions of copies of DNA from a tiny sample of genetic material for further testing.
Presumptive test: An analysis of a sample which establishes either the sample is definitely not a certain substance or the sample probably is the substance.
Scanning electron microscope: A device that produces images of a sample by scanning it with a focused beam of electrons to determine the sample's surface features and composition.
Static headspace test: Occurs when a substance is heated, causing the residue to separate and vaporize into the top, or "headspace" of the container for possible identification.
Ultraviolet spectrophotometry: Used in presumptive tests which analyzes the way a substance reacts to ultraviolet light.

Vocabulary Learning Tool: Make a Jeopardy Game. **http://www.superteachertools.us/jeopardyx/brandnewgame.php**

INQUIRY ACTIVITIES

Grades 6-8: Fingerprinting Fun

Overview: The importance of data analysis in finding a pattern embedded in raw data is addressed in this activity. During this activity, students investigate what type of fingerprint is dominant. Students rub the pencil on blank paper to make a black spot and rub their index finger on it. Then, they roll the inked finger onto the sticky side of a piece of Scotch tape, remove it slowly, and paste the tape to the post-it note. The fingerprints can be displayed on the board. A debriefing focuses on the idea that when scientists collect data, they start reorganizing their information in a way that makes it easier to interpret.

Procedure: (Students must log procedure and results in their lab notebooks.)

1. To engage the students, the teacher will play a short (2:30) video on "Where do fingerprints come from" found on smithsonianmag.com.
2. Teacher will simulate, using a balloon how a fingerprint changes in size from before birth to adulthood.
3. In order to explore the different types of fingerprint patterns, students will be divided into small groups and each student will assist each other in taking their fingerprints with the materials provided (black 2B pencil, scotch tape, post-it note).
4. Students will then use a magnifying glass to take a better look as they identify their print with the three main fingerprint patterns and label the result.
5. For homework, the students will take their lab notebooks home with them and will take four prints of three different family members (1 person will take two different prints.) Each family member will write their name and how they are related. (Ex: Jane Smith – Mom)
6. The mystery print will be of one of the three other people but it is up to the students to determine whose print it really belongs to the next day in class.

Grades 9-12: Making an Chromatograph

Overview: Chromatography is a method of separating-out materials from a mixture. Different ink pens use different types of ink and this becomes apparent when the ink interacts with a solvent. When we expose a piece of paper with ink on it to a solvent, the ink spreads across the paper and produces a banding pattern of the components of the ink mixture. Some inks are water-soluble, so you can use water as the solvent. Inks which are not water soluble are often alcohol-soluble and you can use isopropyl alcohol as the solvent to create your chromatograph.

Procedure: (Students must log procedure and results in their lab notebooks.)

1. Students work in groups and have several black or blue pens. Cut several coffee filters into 1/2 inch strips.
2. Obtain a sample of the evidence. Have a group member bring a coffee filter to you and use one of the pens to write a note on the coffee filter. Their job is to figure out which pen was used.
3. Set up your chromatography apparatus. Place a drinking straw or other long object across two supports (upside down paper cups work). Do not use styrofoam or plastic cups as some solvents can dissolve them. Place a pan (cut off paper cup bottom) underneath the straw and fill it about 1/2 inch deep with the solvent (water or alcohol).
4. Use each of your pens to place a dark spot of ink about 1/4 to 1/2 inch from the end of each coffee filter strip.
5. Hang these strips from the straw so that the tips of the strips just touch the solvent (you can tape the strip to the straw to hold it in place). Don't let the ink get wet. Allow the inks to separate for about 10 minutes.
6. Examine the banding and determine which of your known suspect pens was the pen used to write the note.