CSI: Children's Science Investigations

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INTRODUCTION

Imagine not being able to watch your favorite football team in their playoff game. You record the game and can't wait to rush home to watch it. On your way home, you stop off at the corner grocery store and pick up some popcorn and soda. As you lay your food on the counter, the checkout clerk announces the winner of the football game. The thrill is now gone. There is something about suspense, surprise, and anticipation that appeal to human nature.

For me, it all started when I received my first Nancy Drew book for my birthday. I was in middle school and primarily interested in boys and having fun. Reading was not a great interest to me. But I couldn't let a perfectly good book go to waste. I planned to read it and dispose of it. The dinghy, yellow cover and the sleuthing girl on it did not peak my interest. As I got into the book, though, something changed. There was an urgency to find out what was going to happen. While I've moved on to more sophisticated reading material, many of the books that are hardest for me to put down, are those that have the same level of mystery and deal with the dark side of humanity. Tom Clancy, Sue Grafton, and John Grisham are some of the most popular writers of our time. Their books deal with everything from white-collar crime to murder. One thing that appeals to young and old alike is suspense.

Is it any wonder that among the top twenty shows for the week of January 24-30, 2005, according to the Nielson ratings, there are listed eight shows that contain the theme of crime, murder, and lawlessness? They are as follows:

#3 *CSI*
#6 *CSI: NY*
#7 *Cold Case*
#8 *CSI: Miami*
#10 *Numb3rs*
#11 *Without a Trace*
#12 *Law & Order: SVU*
#17 *Law & Order: Criminal Intent*
Among the top ten, all three versions of *CSI: Crime Scene Investigations* appear on the list.

Why do we have such a great obsession with the dark side of life? Some psychologists believe that we have a great interest with evil because it makes us feel better about ourselves – that we are not as bad as the "bad guys." The interest in good versus evil begins at a young age. Little boys play "cops and robbers" and will turn just about any gadget into a weapon. Many kids want to be policemen and investigators. My sisters and I used to love watching the cartoon *Scooby Doo* where the main characters would solve spooky crimes. While I can't explain the psychology behind this interest, as a teacher, I can tap into it. Therefore, I will be doing a unit called *CSI: Children's Science Investigations*.

My students are 4th graders at an inner city school in Houston. Like all children, they have a great curiosity about the world around them. Unfortunately, they watch too much television,

including shows that have themes that are not appropriate for young children. In my unit I want to provide the excitement of a crime scene without the blood and gore that goes along with many of these popular shows. Therefore, the crime scene will deal with something being stolen, instead of someone being murdered. The unit will be appropriate for the children between 4th and 8th grade. I will include background information that can be used for older children dealing with more complex material so that it is adaptable for many grade levels.

BACKGROUND INFORMATION

When we think of the word forensic we may think of death or murder, but according to *The American Heritage Dictionary*, the word merely means "pertaining to or employed in legal proceedings or argumentation" (524). Criminology is looking at trends and reasons behind criminal behavior. Criminal investigation is the process of discovering, collecting, identifying, preparing, analyzing, and presenting evidence, often directly from or related to a crime scene, to prove the truth or falsity of an issue of law (Axelrod 8).

When casing a crime scene it is necessary to use all five senses – touch, taste, feel, sight, and hearing – as well as the elusive sixth sense, intuition. According to Jon Zonderman in his book, *Beyond the Crime Lab*, "The basic principal in examining physical evidence is rather simple. Whenever a person leaves a place, he or she both takes something away from that place and leaves something at that place." That will be the basis for our crime scene investigations. One must first know the difference between physical evidence and chemical evidence that could be found at a crime scene.

- Physical evidence – This can include ballistics, footprints, fingerprints, hair, fibers, and notes.
- Chemical evidence – Some examples include DNA, blood type, gun powder, paint, ink, lubricants, and unknown substances.

Six questions should be asked during the investigation:
What – What exactly happened during the crime?
Who – Who are the suspects?
Why – What is the motive?
When – When exactly did the crime take place?
Where – Where did the crime occur and where did the criminal/s go afterward?
How – How was the crime carried out?

There are many roles that are part of solving crimes. A few are:

Anthropologist – Someone with a degree in social science who uses skeletal remains to determine sex, age, race, and marks of trauma (Schulz 12).

Ballistic Analyst – A specialist who examines guns and ammunition and uses his or her expertise to interpret gunshot wounds (13).

Criminalist – A specialist in observing and interpreting physical evidence.

Document examiner – Someone who uses his or her expertise to examine written material including handwriting, ink, and paper.

Psychiatrist – A medical doctor who specializes in human behavior and may help determine the motives of the criminals and their mental competence.

Serologist – A medical specialist who identifies and examines blood and other body fluids (13).

I would like to challenge something that the culture portrays: the "bad people" in our society are unattractive and the "good" people are beautiful. This goes all the way back to childhood when we read fairy tales. Think about some of the beautiful heroes and heroines in popular children's stories: Snow White, Cinderella, Prince Charming, and Belle (even her name means beautiful.) Most of the bad characters are ugly, such as Cinderella's evil stepsisters. This fallacious notion was reinforced by Cesare Lombroso who was born in Italy in 1835. He developed the theory of the born criminal, arguing that criminality was first and foremost the product of heredity (Axelrod 35). He believed that a criminal had certain facial and body features such as a small, sloping forehead, a bumpy face, large bushy eyebrows that meet, large protruding ears, sloped shoulders, and disproportionately long arms. None of these features are considered attractive. Obviously this idea that beauty and character are related is not true. All you have to do is look at some of the notorious criminals from our own society. Consider convicted murders Jeffery Dahmer and Scott Peterson. They are both very handsome men. We may laugh at Lombroso's 19th century theory, but some people still believe in fairy tales. For example, while in prison, both Dahmer and Peterson have received letters from women proposing marriage. We must emphasize to our children that external beauty and inner character are not the same thing.

THE PLAN

The unit will be taught during three full days during the last month of school when testing will be completed. The first day will have a crime scene set up when the students enter the room in the morning. The second day will include analysis of items not included in the crime on the first day, such as blood and DNA that will not be a part of the crime scene. On the third day, the students will create their own crime scene devising character profiles and using material learned from the first two days.

Day One

On the first day, there will be a crime scene set up in the room when the students come to class in the morning. The teacher should be a little late and enter the room when the students do. She will be shocked to find the classroom mascot is stolen. The room will be in disarray. There will be papers thrown on the floor, dry plaster of Paris spilt and stepped on, an apple with a bite taken out of it, and worst of all, the classroom mascot will be gone. A note left by the thief will be on the table. Much preparation will go into preparing for the first day and getting several members of the staff to participate. The administrators and office staff should be informed of what is going to happen so that they can assist in any way.

As soon as the students see what happened and see that the teacher is very upset, she should buzz the office and have someone come take a look at the classroom. She will explain that she was working until 5:30 the night before, and everything was fine when she left. The office member will agree to check the time schedules and see who checked out after 5:30 the night before. She will return with a list a five people who agreed to be suspects. One possible scenario might be to have four teachers and the janitor. The perpetrator and teacher will stay late the day before setting up the room. They can knock over some unbreakable things such as books and papers. The perpetrator can pour over the dry plaster of Paris and step in it leaving a good shoe impression. A couple of pieces of the hair should be left on the table. The perpetrator should leave some fingerprints on the table. He should also write a note with handwriting in cursive that is slightly disguised. He will not bite the apple until the following morning because it could dry out and change shape.

After the names of the suspects are given to the teacher, the class can sit down and decide a plan of action. First the pieces of evidence should be gathered and the class can decide how to gather the same types of evidence from the suspects. The students can be broken into small groups of two or three students and have each group do the evidence gathering from each of the

suspects. The other students can be assigned different roles, such as chief criminologist for measuring and drawing the shoe prints, special scientist in examining the hair under the microscopes, dental expert in examining the apple, chief fingerprint lifter, and document examiner of the note. Every student should examine all the pieces of evidence, but certain individuals can be in charge of different areas.

The following sections under each day's plan will provide general information on the historical and scientific background of each type of evidence that may be left at a crime scene and how to use the information to teach the unit.

Shoe Prints

It is quite easy to detect shoe prints. Consider the trial of O.J. Simpson where he was accused of killing his ex-wife, Nicole Brown Simpson and her friend, Ronald Goldman. An FBI expert on shoe prints testified that the bloody prints were made by expensive and relatively rare Bruno Magli shoes in Simpson's size 12 (Axelrod 178). Simpson denied owning such ugly shoes, but later, video footage of him wearing the shoes the previous year was uncovered.

During the preparation of the crime scene, the perpetrator will step in a white powdery substance. Plaster of Paris works well, but if that is not available, flour will work well too. Because it will be very easy to detect similar tread marks, the shoes that the perpetrator wears on the day of investigation should be different than the shoes that left the prints at the crime scene. The students will measure the print in both length and width. (They can also measure in centimeters and inches to improve their math skills.) They should then draw the print being careful to depict the tread marks.

Fingerprints

Fingerprinting, also known as dermatoglyphics, has been around a long time. It was known by the ancient Chinese, who recorded it in drawings on official wax seals attached to important state documents (Rainis 28). In 1892, a man named Sir Francis Galton wrote a book called *Fingerprints* in which he describes characteristics called minutiae. Today they are called Galton's Details. When the Federal Bureau of Investigation (FBI) was formed in 1924, they began gathering prints and today there are more than 250 million sets on file. The FBI receives more than 34,000 prints every workday. There are so many prints on file, that if they were stacked, there would be 133 stacks, each as tall as the Empire State Building (Axelrod 162). They have realized that they needed a new system to keep track of all the information, so in 1999 the FBI developed a computerized system that electronically scans evidence prints, the Integrated Automated Fingerprint Identification System (IAFIS). Without the help of computers, someone would literally have to sit down with a magnifying glass and painstakingly go over stacks of fingerprints in order to find a match – a process that could take weeks (Dawe 3).

There are several ways that professionals use to lift prints. If they are good prints, then graphite, carbon, or magnetic powders work well. Harder prints may require chemical processing to develop. Iodine vapors react with skin oils to stain invisible print brown (Axelrod 163). The image quickly fades and must be photographed immediately. Other chemicals that are used are ninhydrin, silver nitrate, and cyanoacrylate which is a fancy term for Crazy Glue or Superglue. The Superglue is put in a closed container with the prints and heated. The glue settles on the prints leaving a white outline.

Everyone has a unique set of fingerprints, however, most experts agree that 95% of identical twins have matching fingerprints (McLain 211). There are three broad groups of fingerprints: loops, arches, and whorls. Loops have ridges that start on one side of the finger, curve around, and exit on the same side. They make up 65% of all prints. Varieties are the plain loop that enters and exits on the right side, the plain loop that enters and exits on the left side, the central

pocket loop, the lateral pocket loop, and the twinned loop (Axelrod 164). Arches come in two varieties, the plain arch and the tented arch. They account for 5 percent of fingerprints (165). Whorls are circular patterns that have no entrance or exit. The simple whorl is made of concentric circles and the accidental whorl has two inner whorls that eventually diverge.

The identifying factor amongst the billions of fingerprints is not whether they are loops or whorls, but the various patterns of ridges. "Common features include islands (small enclosed ridge patterns), dots (isolated dots rather than ridge lines), bifurcations (ridges that diverge or fork in various ways), and ending ridges (ridges that don't connect, but simply dead end). In order to declare a match between a file print and an evidence print, a minimum of 12 identical points is typically required" (Axelrod 165).

For our activity, the fingerprints should be left on a table with a clean, smooth surface. To get good prints, rub the fingers on the nose or forehead to make them oilier. The fingers should be pressed firmly on the table. Be sure not to smear the fingers. For an activity on fingerprints, look at lesson one. A less creative way to get better prints is to order a magnetic fingerprint powder kit from a science materials supplier such as Fisher Science Company or Wards Scientific. For the purpose of understanding fingerprints, all the students can make a set of theirs. An easy way to get your own prints, and also the prints of the suspects, is to rub them with a magic marker and press them on a sheet of white paper. Another way to gather the information is to rub a pencil on a piece of paper until it is very dark. Rub the fingers in the dark spot and place a piece of scotch tape on the finger and lift off the print. Stick the tape to a piece of paper.

Handwriting Analysis

As Woody Guthrie observed in "The Ballad of Pretty Boy Floyd," "Some people will rob you with a six-gun and others with a fountain pen..."(*The Why Files*). Forgery has been around for as long as the written word. People forge for many reasons, usually monetary, like changing wills. One of the most costly mistakes made was by the German magazine Stern when it paid $4 million for 62 alleged diaries of Nazi dictator Hitler. They failed to note that handwriting changes over the years and especially as you age. Hitler had progressive palsy in his later years (*The Why Files*).

There are several things to look for in handwriting analysis: spacing between words and letters; the slant of the letters as well as the text; unusual features such as a circle instead of a period to dot i's and j's; height, width, size, and shape of letters; loops and curves; how the t's are crossed; and the completion of the final letters in words.

The perpetrator in our crime scene will leave a note written in cursive that may read something like this, "I've got (add the name of your school mascot). She is better off with me than with you. Don't go looking for her if you know what's good for you." It should be long enough to include enough letters to be analyzed. The students will go to each of the suspects and ask them to sign their names. The signatures will be compared to the crime scene note.

Hair

Hair is a common piece of evidence because it is shed so frequently. The average person loses about 100 strands a day. The crime scene will have hair from the perpetrator. It should be left in an obvious and easy to find place so that the teacher will know where to direct the students. Leaving the hair on the floor is not advisable since there will probably be many strands of hair from the students on the floor even if it is vacuumed daily. The hair should be no longer than what could be found on any one of the suspects to make the identification a little harder. It will be examined under the microscope and compared to a sample from each of the suspects. Under microscopic inspection the color may be difficult to detect and is often better determined with the

naked eyed, but some of the features that should be noted are the width, sheen, and the texture of the shaft.

Teeth Impressions

An odontologist is someone who examines teeth or bite marks for criminal investigations. When decomposed bodies have been found, one of the best pieces of remaining evidence is the teeth because the enamel is so strong. The teeth can be compared to dental records. On the other hand, bite marks on bodies have been found on victims at the crime scene. There was one case where the only two pieces of evidence at the crime scene were bite marks on the victim and the blood type of the perpetrator. A man was convicted for life based on those two pieces of information. Ten years later, when DNA was used for criminal cases, this man's DNA did not match, and he was exonerated. Although teeth impressions can be helpful in forensics, they are not sufficient evidence of guilt.

In the morning before the students arrive, the perpetrator will take a bite from an apple and leave it on the table. (If it is done the day before, the apple will wilt and turn brown.) The bite will leave a dental impression. When the students are gathering information from suspects, they will need to ask each one if they can take a bite from an apple. The suspects are school staff members who know what is really taking place and are playing along.

Day Two

On the second day, we will go over some types of evidence that are found at crime scenes that were not included in our first day for several reasons. One is that the classroom crime will be nonviolent. Therefore, when studying blood later, it can be noted that the perpetrator might get cut at the crime scene. Another reason is that there is enough to do on the first day. Hence if a teacher wants to make this a one day lesson, the following days can be left out. Finally, the information might be a bit difficult for elementary students, but teachers of older students can use this information for their classrooms.

DNA

Deoxyribonucleic acid (DNA) is a chemical that is found primarily in the nucleus of cells. It carries all the information that is needed to carry out the functions of the body. It is a coiled structure that is called a double helix that looks like a long twisted ladder. The two long strands are nucleotides and the rungs are nitrogenous-based pairs of adenine, guanine, thymine, and cytosine – A, G, T, and C, respectively. DNA is unique to each individual, except identical twins, but humans share 99.9% similarity in the DNA structure. That may sound like hardly any difference at all, but when you consider that there are three billion bases, a difference of .1% leaves three million different base combinations among individuals. Therefore, it is a good instrument to use in identification. It would be too expensive and time consuming to read all three billion letters, so what scientists who test DNA do is look at a small handful of sites. To do this quickly and cheaply, scientists do not read all the bases, but look at the areas where there are differences. They use a process called electrophoresis that separates fragments by size, which makes visible bands that correspond to the lengths of the fragments. These bands look a little like bar codes. There must be enough sites tested to prove that there is a match. One thing that DNA testing does well is exclude those who are not matches. While this technique has been very successful, it is not perfect yet. There have been problems in the crime labs here in Houston and other places as well, and some cases have been reversed because of this. That is why there is the National Research Council Committee from the National Academy of Sciences that is working to set standards in the industry.

Since understanding the complexity of DNA would be difficult for a 5^{th} grader, they can look at patterns of things in the real world and make comparisons to see if two things are identical or

not. Bar codes appear on almost all things that are sold in America. Therefore they are easily found and will not cost anything. The teacher should cut out bar codes from different items – at least enough for each student to have their own. The teacher will display on the overhead a bar code that matches on one of the students' codes. The students will have to determine if their code matches that one. Note: most bar codes also include numbers that must be whited out for this activity to be successful.

Blood Type

In the event of surgery, it is necessary to know one's blood type. There are four main groups: A, B, AB, and O. At the beginning of the 20th century an Austrian scientist named Karl Landsteiner noticed that red blood cells had differences on their surfaces. He received a Nobel Prize for his discovery. The blood, he noted, either had what he called A molecules and named the blood type A. The cells with B molecules were named blood type B. If the red blood cell had both, it was type AB. If it had neither, it was type O. If two different types were mixed together they might begin to clump within the blood vessel, which could be fatal. A person with type A can donate to type A and AB. Someone with B can donate to someone with type B and AB. A person with blood type O can donate to anyone. When studying the blood of rhesus monkeys, it was noted that some had a protein. Since human blood is similar in composition they named the protein after the monkeys. It is called the Rh factor. Those who have it are positive (+), and those who don't are negative (-). Anyone can receive O- blood, which is called the universal donor. Someone with AB+ can receive any blood type and is the universal recipient. The percentages of each type are as follows:

O+	38.2%	O-	6.5%
A+	33.3%	A-	6.0%
B+	10.0%	B-	2.0%
AB+	3.5%	AB-	0.5%

It is very easy to determine blood types. Two types of serum are added to blood and they may clump depending on the blood type and the type of serum. This is a very rapid and inexpensive test.

While real blood should not be used in the classroom, you can buy inexpensive kits from science supply companies that have both the blood type serums and artificial blood that is safe to use. They also have kits that have different types of animal blood. Cow blood can cheaply be obtained from the bottom of the packaging of hamburger meat.

Chemical Substances

There may be different types of chemical substances left at a crime scene. Some could be plentiful such as narcotics, and some could be trace residues that may not be detectable with the naked eye. It is possible that a substance that is found at someone's workplace could be carried on the shoes to the scene of a crime. Toxicologists are scientists who specialize in chemical substances. Lesson two provides an activity using different types of powders. Lesson three has an activity that uses a chemical in a liquid solution.

Chromatography

Ink is a complex chemical made up of several chemicals (Wiese 68). Chromatography is the process of separating these chemicals. In one type of test, the different types of ink are placed in water and the colors are carried by the water at different speeds. If there are several different known markers being compared to the ink that was used to write the note at the scene of a crime, they may be able to determine a match. Lesson four provides the information to be able to do this.

Day Three

On the third day, the students will work in groups to create their own crime scenes. They will use the information learned from the first two days and add their own creativity to make them unique and personal. They can have their main suspect be an actual person in the room or a make-believe person. They can even come up with some of their own ideas that have not been included in the unit. The most important thing is that their plan is logical and can be solved. The first half of the day, the groups will plan their crime and the second half should be devoted to the others students solving them. I've added a couple of activities to do to start the day on a fun note. These involve the personal or psychological side of forensics that can be included in their crime, such as writing in code.

Observation

Give the students a photo or drawing of a setting with several people and some activity. It might be a picnic or people in line in a bank. The students will have one minute to look at the picture. When the minute is up, take the picture away from them and they will answer some questions about the picture, such as "What was the man on the left side of the picture wearing?" "How many people are in the picture?" "What is the time on the clock?" This activity will show them how hard it is for people to notice all of the detail around us. Many witnesses at crime scenes have conflicting stories, not because they are not telling the truth, but because it is too hard to remember every detail or because they believe what they want to believe.

Writing in Code

Sometimes criminals write in code. These codes can often be extremely difficult to understand. More often, the military branches have people trained to detect very elaborate codes that the enemies have developed. The students will make their own code. They can switch the letters for numbers or pictures, write backwards, or create a cryptogram. A cryptogram is simple letter for letter substitution. There may be a pattern such as A is B, and B is C or A is Z and B is Y, or they can have no pattern. This makes the decoder have to use word length, apostrophes, and a lot of common sense. See lesson five for a code activity.

CONCLUSION

This unit is meant to be a fun addition to a classroom. By incorporating their interest in crime and mystery, they will be learning many different disciplines of science, such as chemistry and biology. Who knows – one of them might grow up to be a crime scene investigator? Criminals beware!

LESSON PLANS

Lesson One – Fingerprints

Objective

The students will be able to identify the different types of fingerprints and the different ways that fingerprints are lifted from a crime scene.

Materials

- Black ink
- Burnt toast
- Baggies
- Magnetic powder with duster that can be purchased at a science supply company such as Fisher Scientific or Wards Scientific
- Pencils

- Paper
- Scotch tape

Procedure

First, the students should make a copy of their own set of fingerprints by rubbing a pencil on a piece of paper and then rubbing their finger on the smudge. They will take a piece of scotch tape and lift the print off of it and place it on a piece of paper. This should be done for all ten fingers. They should be labeled for the right and left hands and for the fingers: thumb, forefinger, middle finger, ring finger, and pinkie. The students will observe the prints and classify the prints according to their different types. The students will also make a charcoal powder with the burnt toast. They will put the toast in baggies until it is crushed to a fine powder. They will gently brush some of the powder on the fingerprints that were left at the crime scene. After pouring some of the charcoal powder, they shake the rest of the powder off and use a piece of tape to lift those prints. Place them on a piece of white paper. Finally, they will use the professional magnetic powder to get samples of the prints from the list of suspects. These will be compared to the fingerprints found at the crime scene. If the carbon powder was not successful, try talcum powder. Lift with scotch tape and place on a black piece of paper.

Conclusion

It may be difficult to determine which suspect has matching fingerprints with those found at the crime scene because usually those left at crime scenes are incomplete or smeared. This is should not discouraging since criminologists have the same difficulty. They should be able to determine which method – the charcoal powder or the magnetic powder – is better at showing fingerprints. The magnetic powder should leave better prints.

Lesson Two - Mystery Powder

Objective

The students will look at several different white powders and test them to figure out what they are and how they are related to the substance found at the crime scene.

Materials

- Flour
- Baking soda
- Cornstarch
- Laundry detergent
- Purple cabbage
- Iodine
- Vinegar
- Plastic trays
- Hand lenses
- Bottles with eyedroppers

Procedure

The night before this activity, boil about a half of the cabbage head until the water is a dark purple. This will serve as an acid/base indicator. Place the liquids in the bottles with eyedroppers. The four powders will be labeled A, B, C, and D. The students will use their use their senses and write down a description of what they observe. As in any lab activity they should not taste the substances. They may touch and smell the powders, as well as observe them with a hand lens. The students will place the four powdered substances in three rows with each of the powdered substances in each row so that there is an array of twelve scoops of powder. If

nothing else is available, an egg carton will suffice. They will place the iodine, vinegar, and cabbage juice acid/base indicator in each of the powders. The students will write down what they observe. The teacher will present to the students and unknown powder and the students will have to test it to see which one matches their known samples.

Conclusion

The acid/base indicator is purple but will turn pink in acids. It will turn yellow to green in bases depending on the strength of the base. The laundry detergent and the baking soda are both bases, so they should turn yellow or green. The iodine will react with flour and the cornstarch by turning a very dark purple. The vinegar will fizz in the baking soda and the laundry detergent because they are bases.

Lesson Three – Invisible Ink

Objective

The students will use a chemical substance to write a hidden message on a piece of paper. The following experiment is found in the *Usborne Book of Science Experiments* (Bingham 38).

Materials

- Laxative pills that contain phenolphthalein
- Hot water
- Tablespoon
- Bowl
- Q-tips
- Pen
- Baking soda
- Tissue

Procedure

First soak any colored coating off of the pills. Put the pills in a bowl and add five tablespoons of hot water, and stir until the pills dissolve. This solution is the invisible ink. Dip a Q-tip in the solution and write a message on a piece of paper. You may have to keep dipping after every letter. When the ink is dry, write a false message with a pen. To read the message, mix one tablespoon of washing soda with four tablespoons of hot water. Dip a tissue in this solution and dab it over the envelope. The hidden message will appear.

Conclusion

Phenolphthalein is acid/base indicator. It turns pink when mixed with an alkali like the baking soda solution.

Lesson Four – Chromatography

Objective

The students will test the ink in a pen by using a simple method for separating the colors of the ink.

Materials

- 5 different black markers – preferably one with permanent ink, one that is washable, and some by different companies
- Coffee filters
- Glasses
- Paper clips

Procedure

Cut the coffee filters into pieces about 4"x3". The students will work in groups of five and each will have a different marker. They should draw a line across the pieces of coffee filter about half way up. Fill each glass with about one inch of water, and paper clip the messages on the insides of the glasses so that the bottom half inch of the filter paper is in the water solution. Let it soak for overnight. The water will move up the pieces of paper and the colors of the ink will spread out and separate. The students will compare their results with one that the teacher made that could have been left at a crime scene and see if they can match it with on of their markers.

Conclusion

Since different kinds of inks are uses to make different kinds on materials, they will separate in different ways. It is possible that nothing definitive can be drawn from this activity, but that is often the case in real crime scenes. They must keep doing all of the experiments, and then they can draw their conclusions.

Lesson Five – Codes

Objective

The students will have to determine the message in a hidden code.

Procedure

Write the following codes on the board. The first one is simple and the letters are one step away from the actual letter. If they look at all the letters in the code and count backward one letter in the alphabet, they will have the actual letter.

> NZ OBNF JT EBWJE. JG ZPV XBOU UP DBUDI NF, ZPV IBWF UP DSBDL UIJT DPEF. JU'T WFSZ FBTZ.

Translation: My name is David. If you want to catch me, you have to crack this code. It's very easy.

The following code has a random letter substitution.

> W CFZQ XCQ XQAAN RQFY. CQ'B PIX CFYDQA. XI VQX CWD RFJT, OQFZQ XQP AIOOFYB WP F RYIEP UFUQY RFV WP XCQ IKKWJQ. CFZQ F "RQFYN" VIIA AFN! CF CF!

Translation: I have the teddy bear. He's not harmed. To get him back, leave ten dollars in a brown paper bag in the office. Have a "beary" good day! Ha Ha!

Conclusion

The first code was easy, but the second was much more difficult. They should know that there are only two common English words with one letter, *a* and *i*. The code word CQ'B at the beginning of the second sentence could only be *he's* or *it's*, but the first letter of the code word doesn't match up with either of the single letter words, therefore it could not be *it's*. Since they know that word is *he's*, they can fill all of those letters in the code. They will notice that there is

now a three-letter word that appears twice and the last letter is an *e*. That word is the most common three-letter word in English, *the*. If they continue with this train of thought, they should be able to finish the code. They may even want to include a coded message in the crime scene they will create. After all, kids love a good mystery!

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This book is a must-have for doing crime scene experiments for children of all ages. Activities include physical, chemical, and biological investigations.

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A nice addition to a crime scene library.

CSI Resources

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There are two sections to this book. The first is a crime scene for "younger detectives" in grades 2-3 and the second for "older detectives" in grades 4-8.

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This site describes how difficult fingerprints are recovered.

Handbook of Forensic Services. 2003. FBI. 6 July 2005. <http://www.fbi.gov/hq/lab/handbook/forensics.pdf>
This 181 page handbook covers almost every aspect of forensic science including weapons of mass destruction, shoe print identification in the snow, and examining feathers.

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This book provides a good overview of DNA and its importance in solving crimes. Special cases are presented and used to explain how DNA was used in them.

Siegfried, Donna Rae. *Biology for Dummies*. New York: Wiley Publishing, Inc., 2001.
All aspects of biology are covered from botany and zoology to genetics and anatomy. Blood typing and DNA are covered in a concise manner.

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A clear description of both inorganic and organic chemistry is presented here. The authors deal with 17 molecules that have had a great impact on our lives. These include the nitro compounds, glucose, cellulose, and salt.

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This is an easy to read and interesting book on the history of chemistry for the layperson.

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A complete history of chemistry as well as scientific thought through the ages is laid out in this entertaining book.