



Curriculum Units by Fellows of the National Initiative

2007 Volume II: Across the Curriculum with Detective Fiction for Young People and Adults

Using Detective Fiction to Reinforce Problem Solving Strategies and the Scientific Method

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Overview

This curriculum unit is designed to create an introductory science unit for a seventh grade classroom using the elements in detective fiction stories. It will be an appropriate unit for any middle school science classroom and most parts of the unit could be adjusted to suit upper elementary students. The North Carolina middle school science curriculum is an integrated curriculum covering various topics in life, physical, and earth sciences throughout the sixth, seventh, and eighth grade years. However, no matter what the specific science discipline being taught at each grade level, most science teachers will spend at least some time introducing basic process skills in science. As a means of introducing and/or improving those basic process skills, I will be using a combination of science activities and short detective fiction to reinforce concepts and skills needed at all levels of science learning.

The students at my school come from a very wide range of backgrounds. Our students are about 60% Caucasian, 30% African-American, and 10% Hispanic and other minorities. There are a few students in my classes who come in speaking no English at all, so for those students, I will need to make alternate plans for the actual literature portion of this unit. I see few problems with the observation activities. I always group the students so that there are English learners with the English speakers who can guide them through the activities.

This is a unit meant to integrate the science and language arts curriculum as well. I always aim to show students that the different classes they take are not meant to be separate cubbyholes of knowledge, but that all of their classes do have connections to each other. This unit will help students to see those connections and hopefully help them have a better understanding overall.

Introduction

See Spot run! Look at Jane jump! Watch the bird fly! See, look, watch - OBSERVE! The most basic of our senses - our sense of sight - is almost always the first one used in any situation. All of the primary readers used when I was first learning to read emphasized that skill. Even though sight is the first and most basic of our senses, it is rarely used to its best potential, especially among middle school students. The first activities we do at the beginning of the year are working on observation skills. It seems like such an easy thing, but students almost never observe all the details in even the simplest task. Observation is the very backbone of science investigations, and my unit using detective fiction will be meant to enhance that skill. The use of detective stories will help students to become "thinkers" by focusing on clues, logic, and problem solving methods. Detectives are, after all, scientists who must use the scientific method and make observations and then make inferences based on those observations. Using those inferences, detectives must then provide a theory and then continue gathering data (evidence) to prove the theory. The popularity of forensic-based television shows over the last few years has raised the interest of students in this kind of topic. Hopefully, this unit will provide an opportunity for students to make real world connections to the things they see on TV. A good portion of the science learned in the twentieth century was devoted to the catching of criminals. (Evans 1) Although technology has come way beyond what anyone could have imagined a hundred years ago, good old fashioned observation remains the key to successful crime solving. "But although Sherlock Holmes would have been flabbergasted by such quantum leaps [in technology] at least one of his principles remains intact: observation." (Evans 2)

While the primary goal for this unit will be enhancing the students' observation skills and general problem solving skills, I will make some reference to forensics and genetics activities that can be used with this unit. Those two topics can lend themselves to their own very extensive curriculum units. Although I had originally planned for this unit to focus on genetics, I found it very difficult to find the right piece of literature. The earlier detective novels will not have the forensic components best used in a science class. The more recent novels, which furnish great references to genetic clues, most specifically blood, have a content that is almost always extremely violent and would, I believe, be inappropriate for middle schoolers. So for this unit I have decided to focus on the powers of observation best used by Sherlock Holmes. The only drawback is that I will have to spend some time discussing the language and style used in Victorian era writing, which will be difficult for most of my students. This very difficulty, however, will be a great asset for an across-the-curriculum unit.

Inductive vs. Deductive Reasoning

Sherlock Holmes is quite fond of saying something along the lines of "I deduced it." Impressive powers of logic and reason are well known characteristics of the famous detective. His great skill at deduction is mentioned in almost all of the Holmes stories by his friend and assistant Dr. Watson. (Interestingly, the phrase, "Elementary, my dear Watson," never appears in any of Doyle's books, only in the movies.) Although his powers of deduction are legendary, his reasoning skills are very often *inductive*. So what is the difference?

Deduction and induction will arrive at the same conclusion usually, but the conclusion is arrived at in two very different ways. They are actually considered to be opposite from each other. Induction argues from

observation and specific instances. Repeated observations gradually build up to an understanding of how something works. Induction is not a valid method of proof, but does help in the forming of ideas. Using inquiry as an approach to teaching science is done by inductive processes. Inquiry is defined as the process of gathering information and observations to solve problems of interest. Deduction argues from already known laws or principles. If the conclusion is correctly based on already proven facts, then the conclusion must also be true. Deduction is the direct application of prior knowledge to the creation of new knowledge.

The difference between deductive and inductive reasoning in a science class may be illustrated this way. A student drops a piece of granite into a tank of water and observes that it sinks. After doing this several times with various sizes of granite, he will notice that the granite sinks each time and will conclude that granite will always sink in water. This is inductive. Another student may say that granite is denser than water and therefore it will always sink. This is deductive. It is based on a prior knowledge of the density of granite and of water. However, the first student may then conclude that *all* rocks will sink in water, when, in fact, they do not. Pumice, for example, is less dense than water. So inductive reasoning may not always lead to a valid conclusion. The student with prior knowledge of density would know that rocks would have various densities and would not have drawn the conclusion that *all* rocks will sink in water.

Now back to Holmes' deduction. As I stated before, Holmes' deductive abilities are typically the focus of interest in those stories. However, much of what he does is inductive reasoning. For example, in "A Scandal in Bohemia," Holmes sets up Irene Adler with the threat of a fire, which is staged. His purpose in doing this is because he believes women will immediately, in event of a fire, go to retrieve their most prized possession. For mothers, it would obviously be the children. In the absence of children, other women would go straight to gather that most valued object before leaving the premises. While Ms. Adler did indeed go to retrieve the object Holmes was in search of, his reasoning would not be a valid method of proof for all women's behavior in the event of a fire. In Holmes' initial observations of new clients, the clients are generally shocked at the information he gains about them based solely on their appearance at that moment. Most of those initial inferences, however, would be inductive in nature, and not deductive. In the cases where Holmes has knowledge of a particular type of soil or a particular type of cloth, his reasoning would be deductive, but that kind of prior scientific knowledge only pertains to a portion of his analysis of people and situations.

Objectives

The North Carolina science standards - which correlate closely with the national standards - that this unit will address include: designing and conducting investigations to demonstrate an understanding of scientific inquiry, making inferences from data, thinking critically and logically to bridge the relationships between evidence and explanations, and recognizing and evaluating alternative explanations. All of these fall under the heading of "Science as Inquiry," which focuses on process skills to support development of reasoning and problem solving abilities. The National Research Council states that "scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work." In 1910, John Dewey criticized the state of science education as just getting students to memorize a collection of facts. He argued that science should be taught as a way of thinking or as a process. Using detective fiction to teach process skills in science will help in teaching students new ways of thinking. Many critics of current education practices complain that students no longer know how to "think." This unit is meant to address some of those concerns.

In addition to the science standards, this unit will also address some of the language arts standards in our state. These will include refining and understanding the use of argument, exploring and evaluating the problem solution process, and studying the characteristics of literary genres. Reading detective fiction will also allow students to draw inferences and conclusions, and give them the chance to study the characteristics specific to the mystery genre. Although I have concerns about the style of writing and Victorian language that the students most likely have limited experience with, I hope to use the text as an opportunity to discuss the use of context clues and discuss the way language changes through history.

My particular school is a sixth through eighth grade middle school with approximately twelve hundred students. I teach on an A day/B day block schedule and I typically have 28-34 students in a class, for an average total of 180 students. Middle school science classes in my district are heterogeneously grouped, which means that I can have the highest achievers, the learning disabled, and ESL (English as a Second Language) students all in the same class. This requires a great deal of creativity, differentiated instruction, and advance planning. This unit will utilize strategies that can be differentiated to be used in small groups, but can also lend themselves to whole class discussions easily.

The emphasis in middle school in our state has always been on math and language arts instruction. End of the year testing is focused on those two subjects. While we do test in science and social studies, the scores on those tests do not count toward our accountability goals, so because there is less pressure on science and social studies teachers, we sometimes feel as though we are teaching elective classes. The focus on math and language arts is also in the elementary schools, where science is taught "if there is time." Very often students come to middle school with little to no science background. Science content we used to assume students would have when coming to middle school is no longer part of their prior knowledge. We now have to assume zero background in science content. Fortunately, the attitude towards science education is changing, and science will be tested in fifth and eighth grades starting next year.

One of the strategies I have employed in the last few years in an effort to make science more relevant in middle school is to create interdisciplinary units. I have learned how to engage other teachers in this and it has been successful for most of us. I will be discussing one idea for an integrated part of this unit.

Strategies

These activities are planned as the introductory unit in my science class, to occur right at the beginning of the year. I always start with general process skills, which include making observations, inferences, predictions, and hypotheses. This unit will begin with a series of short lab activities that will involve making observations and inferences. Once students have a good background on what makes a good observation, I will introduce very short elementary mystery stories that I will read aloud, having students write down their observations while I read. We will then begin discussions of inferences they can make based on their observations. The number one rule for inferences is that they must be logical. They are not necessarily fact until further observations can be made. Students will be given practice in proving whether or not their inferences are correct.

One of the skills tested in North Carolina is listening skills, and students always score lower on this test than on any other reading comprehension type of test. Even the typical above average student tends to score

poorly on that test. I expect the read aloud activity to help with those scores.

Students will eventually be assigned a short story in the detective fiction genre. I have chosen the short story "The Adventure of the Speckled Band" by Sir Arthur Conan Doyle because this will give students the opportunity to use clues and make inferences to try to solve a mystery story. Although the crime does involve a murder, there is not a lot of violent detail and body fluids are not involved. Forty-eight of Doyle's stories, including this one, are no longer protected by copyright, so getting copies for all of my students is not an issue. Sherlock Holmes is considered one of the earliest forensic scientists in fiction and many of his methods were used in more modern police training.

Classroom Activities

Differentiating between qualitative and quantitative observations

Students will learn the difference between a qualitative and a quantitative observation. Students will be given about three minutes to make as many observations of the classroom as they can. After they have written down their observations, I will have them call out their observations one at a time. I will put them into two different sections on the overhead. Observations with numbers will be in one column and descriptive observations will be in the other column. After there are several examples in each column, I will ask them if they can tell the difference between the two types of observations. Eventually they understand the root words quality and quantity and they then have an understanding of the difference between qualitative and quantitative observations. Both have an important place in science skills.

Activity: There are actually two relatively short activities involved here. The first is one in which students will be given a piece of hard candy and asked to use all of their senses to describe it. This is strictly a lesson in qualitative observations. They are to be as descriptive as possible. We will discuss commercials in which a lot of similes and metaphors are used in order to describe a product. Each student is to write a descriptive paragraph of the candy without using the word "candy" and they are strongly discouraged from using words like "good" and "hard." This exercise lets them know right away that writing will be a regular part of their science class and it also gives me a good idea of where their general writing skills are.

The second activity will include qualitative and quantitative observations. Students will work in groups of four for this activity. They will be given a candle, a ruler, a piece of string, clay to stand the candle up, matches, and a balance. The classroom clock can serve as a timer. They are given approximately ten minutes to make as many observations as possible. I give them no directions on how to use the available materials. After ten minutes, I tell students they will have a quiz on their candle, but will be allowed to use their observation notes while they take it. Very rarely do students get even half of the questions correct because they have not learned how to use everything available to them and fail to see what it means to make detailed, thorough observations. The quizzes are not counted, but after seeing the types of questions asked, they begin to understand what careful observation means. (Copy of sample quiz in appendix.)

Wrap-up discussion: I will ask students to describe situations where careful observations are necessary. Because of the prevalence of forensic-based TV shows, I expect there to be some discussion of crime scene analysis, which will lead us into our unit on detective fiction.

Drawing inferences from observations

Students will have several different situations shown as drawings on the overhead. They will first have to make observations about the drawings and then make inferences about the drawings. We will discuss the difference between the two. Inferences are based on your observations. They may not be correct and need further observation and/or experimentation to be proven correct.

Activity: The first part of the lesson is a demonstration by the teacher. The students will be shown a can of coke and a can of diet coke and a tank of water. The students will be asked to predict what will happen when the two cans are dropped into the water. There are only three possibilities: Both will sink, both will float, or one will sink and one will float. Students will discuss their choice and why they made that choice. After discussion, the cans will be put into the water and students will see that the Diet Coke floats and the Coke sinks. Using inductive reasoning, we could also put in Diet Pepsi and Pepsi, Diet Dr. Pepper and Dr. Pepper to see that the results are the same. Next, they must come up with inferences as to why the cans behave that way. After discussions about the amount of caffeine, sugar, carbonation, etc., we discuss how we could further experiment to find out which of the inferences are correct. We would then discuss the kinds of quantitative observations to make to find out the correct answer.

The second part of this lesson is called "dancing raisins" and once again involves making observations and inferences about the behavior of the raisins.

At the end of both activities, we will discuss what is necessary to prove that the inferences they have made are correct.

Students will listen to an exercise in inferencing to discuss the logic of making inferences. I will be reading the short story "The Nine Mile Walk" by Harry Kemelman because it is an exercise in the possibilities involved in making inferences. After reading and discussing the path taken in connecting a chain of events, I will have students make up scenarios of their own in which multiple inferences are possible. They will be given a period of ten to fifteen minutes to think of a scenario on their own with possible inferences, then they will share their scenarios with a partner. If time allows, students will be allowed to share with the whole class. This exercise will help them understand the backward thinking that sometimes comes with solving a crime.

Learning to listen

Students will listen to very short mystery stories to try to pick up clues by listening. I will be using the Encyclopedia Brown Mystery Collection by Donald Sobol as an introduction to mystery stories. These stories are written on a third to fifth grade reading level and so are probably well below the ability of many of my students. However, for content area classes, this is appropriate, so that students can concentrate on specific tasks during the reading, rather than on vocabulary. I have chosen this collection of mystery stories because they are only five to six pages long and can be read aloud in a relatively short amount of time. There are only a few clues that students will need to listen for to try to solve the mystery. The students will listen as I read aloud and be asked to write down information as I read. I will first have them predict what the story might be about based on the title. I will then read and ask them to describe the mystery or problem when they hear about it. When I assess that all students at least have an accurate sense of the problem at issue, I will then have them begin writing down clues as they hear them. Before the mystery is actually solved, I will have students discuss in small groups of three to four the clues they have heard and develop theories for a possible solution. After a few minutes of small group discussion, I will have a class discussion about the possible solution. I will then read the end of the story and have students think of the clues they may have missed and

why they missed them. I will probably read three to four of these stories to get the students comfortable with this type of story and to continue practicing their listening skills and practicing making inferences.

Using Detective Fiction to practice problem solving

Students will begin reading the short story "The Speckled Band" by Arthur Conan Doyle to work on their problem solving skills.

Activity: I will assign the short story, "The Speckled Band" by Arthur Conan Doyle to be read in sections by the students. This short story, of course, stars the legendary detective Sherlock Holmes. Because some of the language and style of writing will be difficult for my students, I will review many of the unfamiliar words by providing them with a glossary specifically for this story. I will also discuss many of the words with them prior to reading. I will be dividing the story into three sections to be read on three different days. The first section will include enough pages for students to find out what the mystery is and to pick up a few clues to begin making inferences and formulating a theory. We will read the first couple of pages together to make sure the students are comfortable with the style of writing. To go with the story, they will be given a graphic organizer, one that will include the problem, the suspects, possible motives, and evidence (graphic organizer included in appendix). On the first day, the students will read the first eight pages, up to the part where Helen describes the condition of her sister's body. Students will then have enough information to think of suspects and motives. On the second day, students will get the next fourteen pages of the story. This part of the text will give them enough information to begin to formulate some inferences and theories about what may have happened to the woman. After small group discussions, they will continue to write down clues and revise their inferences and/or theories, based on clues or evidence they may have learned from each other. On the third day, students' graphic organizers should be complete with their final theory. We will have a class discussion about their theories and the evidence they have used to come to the conclusion that they have. We will read the third and final part of the story and find out how close students came to solving the mystery. Discussion will include what they might have missed in reading the story that might have helped them to solve the mystery. We will also talk about theories that were not logical and why they were not.

Students will gather "evidence" in the classroom to solve a crime.

Activity: Students will come into a "crime scene" in the classroom where they will have to make observations and gather evidence to try to solve the crime. The crime scene will actually be spread across "centers" in the classroom where students will have the opportunity to analyze fingerprints, compare thread samples, soil samples, and hair samples, and possibly test fluids found at the scene. One of my personal classroom items will be discovered missing, an apparent robbery, and students will be given information about possible suspects to try to figure out who did it. I will arrange ahead of time to have samples from volunteer "suspect" adults in my building.

I have decided for this unit to stay true to the Holmes era and use only the tools that would have been available at that time. Students will have magnifying glasses, samples to compare their own samples with and possibly some chemicals to test some of the fluids found. Fingerprinting had become available as a crime solving tool in the late 1800's. Holmes was knowledgeable about the various soil types in his region and also had familiarity with different types of cloth and material. Holmes was also an accomplished chemist, so students may be conducting some basic chemistry testing of fluids from the scene. For this part of the unit, I will not be looking at blood as evidence, but will be including that aspect of forensic work later in the year, during the genetics unit.

Compare/contrast tools used in crime solving today with tools and methods used in Holmes' time period.

As a tool for comparison between Holmes era crime solving and the current methodology for crime solving, I will be preparing a "murder bag" as used by Scotland Yard in the first half of the twentieth century. The tools included in the brown leather bag brought by detectives to crime scenes were rubber gloves, handcuffs, bottles for samples, screwdriver, magnifying glass, and plaster for making casts of footprints. I will ask students to describe what each of the items may have been used for and then make comparisons between that "murder bag" and a bag that may be used at today's crime scenes. What would still be useful to detectives today and what would be available now that was not available then? Students will create a Venn diagram to compare and contrast the methods of detection used in the early twentieth century with the methods used today. After discussing their diagrams and completing one on the board, we will watch a short video clip of Holmes at a crime scene and then the CSI crew at a crime scene. Is there a disadvantage to relying too much on current technology? Do the old fashioned skills of observation begin to deteriorate with the advent of lasers and computers? Are there differences in the kinds of clues for which they are searching? Students will be given the opportunity to answer those questions in groups, and then in a whole class discussion.

Using a Mystery Story in a genetics lessons

Later on in the year, my students will be learning genetics. I will be using a modern mystery story that is trying to trace the origins of children who were separated from their parents during a war. "Finding the Lost Children" is a true story about trying to find the children separated from their parents during a war. Most of the children were very young at the time of the separation and could not tell who their parents were. The evidence students will use will be based on blood typing, so students will learn how blood type is inherited. Basic blood typing can be used to rule out suspects or victims, but DNA found in the blood must be used for definitive proof of a person's identity. Students will use a simulated activity to match some of the children with their parents based on blood samples. Ethical issues will also be raised in this case because the missing children had been adopted and been well taken care of by other families.

We will also look again at fingerprinting even though fingerprints are not genetic. Even identical twins do not have the same fingerprint patterns, but it will be part of our discussion on what is inherited and what is not. Students will learn the basic patterns of all fingerprints and have the opportunity to observe their own with magnifying glasses and make impressions of them. Fingerprinting was first used in England in the 1800s as a means to prove guilt. It began being used in the United States in the early 1900s and is still used today as a common way to identify suspects. Sherlock Holmes made use of fingerprint evidence in many of his cases, so fingerprinting will be used as another piece of evidence in the discussion about modern crime solving's dependence on old techniques.

Appendix

Candle Observations Quiz

- What was the color of the stripes on your candle?
- What color was the wick of your candle?
- What was the height of your candle?
- What was the circumference of your candle?
- What was the distance between the stripes of your candle?
- What color was the flame closest to the wick?
- At what rate did your candle burn?
- What was the height of your candle after burning it?
- What color was the smoke coming from your candle?
- How many times did the stripe wrap around the candle?

"The Adventure of the Speckled Band" - Evidence Sheet

Describe the victim and the crime

List possible suspects and their Possible Motives Evidence

Characteristics

Who do you think committed the crime and how do you think it was done?

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