



What Really Happens When You Pop That Pill?

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This curriculum unit is recommended for:
Chemistry, AP Chemistry, Medical Interventions, Human Body Systems, Anatomy and
Physiology, etc. Grades 10-12

Keywords: Drugs, Painkillers, NSAIDs, Opioids, Medical

Teaching Standards: See [Appendix 1](#) for teaching standards addressed in this unit.

Synopsis: This Curriculum Unit will focus on the effects of drugs on the body. The target audience is high school students. I want students to understand exactly what happens in their body when they take a painkiller, or use steroids, or something like Adderall to stay up all night studying. We will focus on the purpose of the drug, how the body metabolizes the drug, and adverse effects. Then we will study some of the strongest opioids, such as Fentanyl and OxyContin, to discover their mechanisms of action, side effects, addiction tendencies and what happens when they are abused. This unit will help students understand the fundamentals of chemistry, anatomy and physiology, metabolism, and pharmacokinetics. These are advanced topics for high school students so completion of the courses of Biology, Chemistry, are required and Anatomy and Physiology and/or PLTW Human Body Systems is strongly recommended. In addition to coursework and assessments, students will perform labs to demonstrate metabolism of drugs and the adverse effects. Students will hopefully come away with a better understanding of how drugs work so that they can make informed decisions.

I plan to teach this unit during the coming year to 48 students in Health Sciences Courses that have taken chemistry, biology and Anatomy & Physiology or forensics and are in grades 11-12.

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Introduction

Rationale

The reasons for teaching this unit are several. First and foremost, it's about educating students. In this day and age, everyone, including and perhaps especially children and adolescents, have access to more drugs, both legal and illegal, than ever before. There are painkillers, stimulants, drugs to improve strength and performance, drugs to suppress asthma attacks, and many more. Students should be educated on what happens to the body when they take drugs that seemingly 'help' them. This is not to turn students away from drugs for medicinal and legitimate purposes. Some drugs are beneficial, and indeed necessary, for optimal health. Painkillers can help a student coping with a broken limb, or migraine headache, or severe menstrual cramps. Corticosteroids help students with asthma or with severe skin conditions such as eczema. This unit is help students make informed decisions on which drugs to take and for what purpose.

Demographics

Phillip O. Berry Academy of Technology is a Magnet School in an urban environment. A 'magnet school' means that we pull students from all over Mecklenburg County, and not from an assigned 'district'. This ensures a truly diverse population of students with different interest. I would describe our population of approximately 1600 students as diverse and open minded. Even though the population is predominately African American (70%) and Latino (20%), we have a fair amount of Asian and White students as well. Students are divided into 'Academies' based on their interests. The three Academies are Health Sciences, Engineering, and IT. I am a teacher in the Health Sciences academy. Students in this academy have expressed an interested in medical careers, including life sciences such as biology and physical sciences such as chemistry. The biomedical classes I teach or have taught include Human Body Systems (a study in anatomy and physiology grades 10-11), Medical Interventions (a study of the diagnosis, treatments, and preventions of disease grades 11-12), and Biomedical Innovations (a study of cutting edge medical technology grade 12). I feel this topic is extremely relevant to the students who take or have taken Human Body Systems or Medical Interventions, or Forensic Science.

Unit Goals

My goals of this unit are to teach students about the science of drug interaction and how certain drugs work and affect the body. I want them to have a full understanding (or at least a working knowledge) of how drugs work. So often, when students think 'drug' they think about cocaine or heroin. Teenagers, along with many other people think of 'drugs' as illegal substances and other substances as 'medicine' such as NSAID's or inhalers, etc. They do not realize that all 'medicines', and even caffeine, found in their coffees, cola, and 'energy drinks', are indeed drugs or contain drugs. The goal of this unit is not to advise or recommend, but to inform. I am brought back to fifth grade, with the D.A.R.E. program (Drug Abuse Resistance Education) and the 'Just Say No' campaign started by President Reagan in the 80s. The goal of D.A.R.E. was to 'scare you straight' by showing films of people foaming at the mouth from overdosing and going to the pharmacy and begging the pharmacist for 'just two pills for tonight'. I remember one particular jarring scene of a man with a hole in his leg, from too many heroin injections. I think my target audience (high school kids) are too old for the 'scared straight method'. I want to have healthy academic conversations about the current feeling about drugs and education sessions that can help them distinguish between perceptions and reality.

Content Research

Learning about Medicinal Chemistry has been an incredible journey. Through the seminar, I have begun to delve into the science behind medicine, from a chemical standpoint. I have begun to study *pharmacodynamics*, which is the study of what a drug does at its site of action; and pharmacokinetics, which is the study of how a drug transports from its site of administration to its site of action and then out of the body.

When studying the chemistry of drugs, one must first answer the question, *What is a drug?* If you Google the word [drug](#)¹ Wikipedia will provide this definition: 'a substance, other than food, which has a physiological effect when introduced into the body'. Loosely translated, it means that a drug temporarily changes the way the body or a part of the body functions. According to the FDA (Food and Drug Administration), drugs can be used [legally] for five purposes: to diagnose, cure, mitigate, treat, or reduce the effects of a disease or condition in humans and animals². A drug can be anything from the caffeine in your morning coffee to propofol, a drug used to administer anesthesia during surgery (and killed Michael Jackson due to unlawful abuse and negligence) to Cisplatin, a platinum-based drug used to treat cancer.

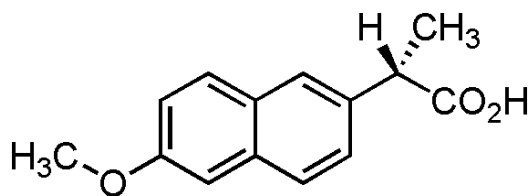
It is logical that after one defines what a drug *is* and what a drug *does*, that one would next want to know how a drug passes through the body. Drugs pass through the body through the ADME process: absorption, distribution, metabolism, and excretion³. Absorption is how the drug gets from the site of administration (ingest, IV, transdermal, inhale, etc.) to the bloodstream. Distribution is how the drug is transported to and from the target (the part of the body on which the drug is supposed to act). Metabolism is the process of chemical modification of a drug via the liver, which serves as the body's "detoxing station". Excretion is how the drug leaves the body usually being through the kidneys by way of urine. This is why urine is usually used in drug screening. One might even go as far as to say that the kidneys and liver are the two most important organs related to how a drug functions in the body.

One other important area we have discussed in the seminar is how a drug actually makes it through the process of being approved for use by the FDA. After research and a proper lead is identified, the drug is created (synthesized) and purified, animal testing is done. A lead is a chemical formula that shows promise to continue the process of drug development⁴. After the animal tests are done and have produced results that human testing can begin, clinical trials are conducted in four phases. The purpose of clinical trials is to answer questions such as side effects (Phase I), how effective the drug is (Phase II), and if the drug is better than current drugs on the market (Phase III). Then all data must be submitted to the FDA (or other national drug authority in another country) for approval. The FDA will review the data and decide whether the drug can be marketed. Phase IV studies (post-marketing and surveillance) are done after the drug is released to continue to gather data on the safety and long term effects of the drug. The entire process is a multi-billion dollar investment for pharmaceutical companies, which explains why some drugs are very expensive. See [Appendix 4](#) for an infographic on the drug approval process.

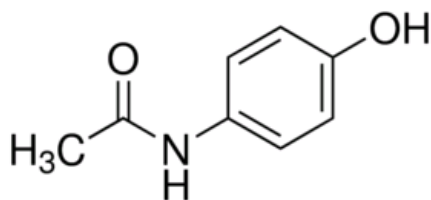
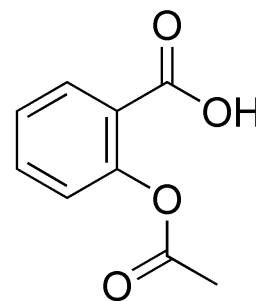
My current research on how painkillers work has proven to be fascinating. In my Human Body Systems class, students learn that pain is a signal from the body part to the brain that something is wrong, or that the body is doing something different. In essence, pain is 'all in your head'⁵. How and when the brain receives pain messages is complex. Pain can be used as a warning to the body such as when an animal (bee, spider, snake, etc..) bites and injects venom

into the body. Without pain, one may not realize that they have been bitten and the venom could cause permanent damage or death. The sense of pain can also be delayed. If one has been severely injured, such as in a crash or fall, the sensation may be delayed until the person can reach safety. The body does this by flooding itself with adrenaline. Painkillers act by interfering with the pain messages sent to your brain⁶. This could raise the question of whether painkillers are psychoactive or neuro interceptors. That might be addressed in a later CU.

The first drug class that I have researched are Non-Steroid Anti Inflammatory Drugs. These are some of the most common drugs used to reduce pain, fever, and inflammation. Common examples of these drugs are aspirin (Bayer) and ibuprofen (Motrin, Advil). NSAIDs work by blocking COX (cyclooxygenase) an enzyme that produces prostaglandins, which are key in the inflammation process. NSAIDs also affect platelets, which are involved in blood clotting. This is why aspirin therapy is often used to prevent heart attacks in patients and administered at the time of a heart attack. The drawback however, is that overuse of the drugs can lead to excessive bleeding, especially in the stomach lining. All NSAIDs carry this warning. Since NSAIDs are less effective of relieving chronic pain, such as arthritis or post-surgical pain, they can be overused or people may turn to more powerful pain relievers, such as opiates. You can see more about how I conducted my resource by visiting my [annotated bibliography](#) for sites and other sources.



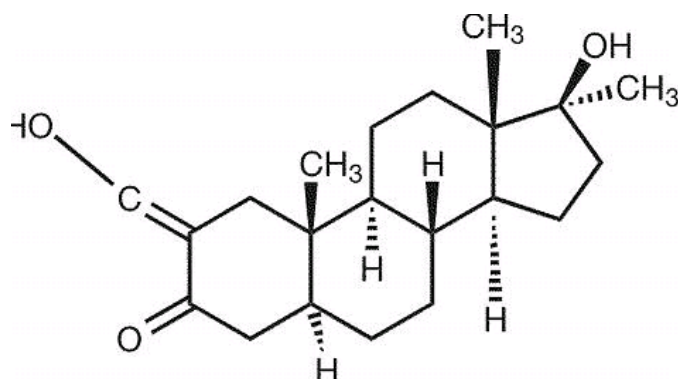
← Chemical structure of naproxen sodium.
Chemical structure of aspirin.↓



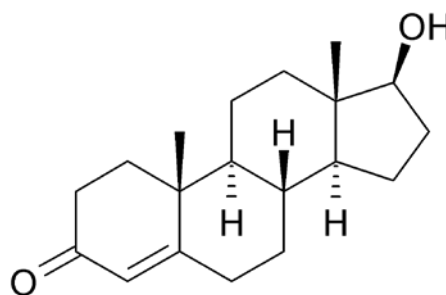
Chemical Structure of Acetaminophen. ↑ * Structural images not subject to copyright.

I have also researched steroids. I am specifically referring to anabolic steroids, which are used to increase strength or athletic performance, hence the nickname 'performance enhancing drugs'. Steroids mimic androgens, such as testosterone. Corticosteroids, the other class of steroids, are used in medications to treat asthma, arthritis, or skin conditions such as eczema. Anabolic steroids stimulate muscle growth, which is why steroid users often look 'over muscled'. Although anabolic steroids improve strength, endurance, and increase muscle mass, the research has *not* concluded that steroids improve performance, skill, or agility. Using legally, anabolic steroids can be subscribed to patients with extremely low testosterone or that have muscle wasting diseases such as AIDS or cancer.

Chemical structure of an anabolic steroid. ↓



Chemical structure of testosterone. ↓ Note similarities.



*Structural images not subject to copyright.

Once an anabolic steroid enters the body, the drug travels to the muscles where it is taken up by the cell's nuclear receptors. The drug then sends signals to mRNA via DNA to increase protein production and stimulate muscle growth, thus interfering with the body's natural processes⁷. Increasing muscle mass through weight lifting occurs when micro tears form in the muscles when they are pushed beyond their limits by lifting heavier weights that the muscles normally tolerate. The body acts to repair these micro tears by overproducing protein to repair the tears, resulting in an increase in muscle size. Steroids increase muscle size without this process.

The side effects of steroids are many. Since steroids attach to nuclear receptors, and the nucleus controls all functions of the cell, the steroid essentially 'takes over' the cell. Some include excessive acne, weight gain, hair loss, severe mood swings, and increased aggression. The increased aggression is often referred to as 'roid rage', in which small incidents may set the user off and cause them to become violent. Also, even though steroids increase the size of muscles, they can also cause the muscle tissue to become more susceptible to injury. Gender specific side effects include the shrinking of genitalia and growing of 'female breasts' in males, and excessive body hair growth, menstrual changes, and genitalia changes of females⁸. As with most drugs, steroids can become addictive, the body may develop a dependence on the drug and the user likes the way steroids make him or her look, so they continue to take the drugs.

Performance enhancing drugs are illegal in athletic competition. Many athletes have lost their careers over steroid use. The most notable case is Lance Armstrong, who won seven Tour De France titles and an Olympic medal for cycling. After the federal investigation and the subsequent admission by Armstrong, he was stripped of his Tour De France titles and forced to

return his Olympic medal. This however, does not stop thousands, or perhaps millions, of athletes to continue to abuse anabolic steroids. The methods of delivery are as varied as the methods used to avoid detection in drug screenings.

The third drug I plan to focus on is Adderall. Adderall is a stimulant used to treat ADHD and narcolepsy. The drug is a combination of amphetamine (traditionally called an 'upper') and dextroamphetamine, another central nervous system stimulant⁹. The intended purpose is to increase focus and concentration in patients with ADHD and to halt the overwhelming drowsiness that occurs in patients with narcolepsy. It is one of the most commonly prescribed drugs for children with ADHD (along with Ritalin)¹⁰.

Adderall, if used responsibly, can be an effective drug in the treatment of ADHD as part of a total treatment program. However, there are side effects. They include, but are not limited to, insomnia, mood swings, loss of appetite and 'crashes' which occur when the intended effects of the drugs wear off. It is a schedule II controlled substance, which means there is a high risk of abuse and addiction.

Abuses of Adderall come in many forms. The drug is intended to be taken orally, but has been crushed and snorted by abusers, which is not only causes the drug to be less effective than the oral route, but may damage the nasal passages in the same way that snorting cocaine does. If taken with alcohol, which has been done to 'prevent' a person from the effects of intoxication such as impaired functions, it becomes dangerous because it may cause the abuser to drink even more, thus increasing the risk for alcohol poisoning. Many students use it as a 'smart drug', thinking it will help them stay alert and improve focus when studying for a major test, even though studies conducted have found no association with the consumption of Adderall and an increase in academic performance. Adderall, like many other substances, has also been used as for weight, which is usually temporary and is dangerous, leading to heart issues such as heart attacks and cardiac arrest¹¹.

I have recently decided to include opioids in my CU. Opioids are a class of drugs that include opiates, which are drugs such as morphine that are derived from the opium latex of the poppy plant, indigenous to Asia¹². Opioids also include synthetic derivatives of opium such as hydrocodone, oxycodone, and fentanyl, which are many times more powerful and more addictive than morphine¹³. Fentanyl in particular is up to 50 times more powerful than heroin and can be 100 times more powerful than morphine. Opioids work by binding to opioid receptors in the brain, causing a flood of a euphoric like sensation. Pain is a sensation, so the sensation of pain is replaced by the euphoric sensation. This is why the drugs are so addictive. Opioid abuse leads to, and has led to many deaths. According to some sources, as many as 70 people die of opioid overdose every year, the most recent notable death was of the Pop Icon Prince, who died of an accidental overdose of fentanyl in 2016¹⁴. The problem is that many opioids depress the respiratory system to such a degree that the person may stop breathing, occurring in death.

Instructional Implementation

My best vision for this class is to be set up as a class that meets after school twice weekly (Mondays and Thursdays) for 75 minutes over the course of 18 weeks. Students who are interested in the course must first meet the prerequisites (at least a junior, have taken biology and chemistry and passed with a B or better, have taken at least one Biomedical, Forensics, or

Anatomy and Physiology class). If the students meet the prerequisites, then they can apply for the course. The application must include at least one teacher recommendation and student must write a brief response of 250 words or less as to why they want to take the course and what they hope to learn.

The best way to introduce a unit, in my opinion, is a short video clip or article to capture the student's attention. Introductory video clips should be no longer than three minutes, to keep the students engaged. Before the video clip, I will give students a survey (see appendix 3). The survey will ask what types of medications have they taken, and what types of chronic conditions (asthma, diabetes, ADHD, etc.) for which they take daily medications. The survey will be in a Google Form, so that data can be saved, and it will be confidential. Students will not enter their ID number or name. Only their age and gender. The introductory video clip will be of President Trump declaring an 'Opioid Emergency' in the United States¹⁵. The students will have three questions to answer after the clip; 1) What is an opioid? 2) Give three examples of opioid medications. 3) Describe the relationship between opioids and drugs such as heroin and morphine. 4) Do you agree with the President that there is currently an opioid emergency? The first three questions will require some research. Students have access to technology via Internet on their Chromebooks to do some research. We will then watch a twelve minute video clip on opioid addictions among teens¹⁶. After the video students will have a chance to rethink their answer to the fourth question. The students will then engage in a Socratic seminar to discuss the video clips so far and their opinion of what a drug actually is (see [appendix 2](#) for lesson plans).

This class will be organized into five units. The units are 1) What is a drug? (Pharmacology) 2) NSAID's and OTC medications, 3) Anabolic Steroids, 4) ADHD medications, and 5) Opioid and Addiction. Each unit would have a pre-assessment before the unit begins and a post assessment after the unit (see [teacher resources](#)). The course will also have a final project in which the students profile a pharmaceutical company. The class will include at least one field trip to tour a pharmaceutical company. This entire course will be set up in a 'flipped classroom' Socratic style course (see teacher resources). I will do small lessons to give students background information that they need for the course. The lessons will be posted online and students will be responsible for completing the lessons and mini assessments (see [appendix 3](#)) before coming to class. In class, we will focus mainly on labs and Socratic seminars to discuss the content. A 'flipped classroom' works by delivering instructional content outside of the classroom (usually online) and in class time consists of labs, discussions, and what may typically be classified as homework¹⁶ (see teacher resources). Since I plan to offer this class after school as an option for advanced students, it is important to keep the class as non-traditional as possible to keep students interested.

Coursework

As stated before, the course will be set up based on the principles of the flipped classroom and Socratic seminars¹⁷. Students will be given an assignment, which will include an instructional video with a mini-assessment and an article to read. The students will have two attempts to pass the assessment with a score of 80% or better. Assessments will be five questions. If students do not pass on the second try, then they will receive reinforcement exercises in class to be sure they master the concepts being discussed in class.

The first 'lesson' will take place after the introductory class. Students will be assigned a 7 minute video describing what 'pain' is. Students will take a 5 question mini-assessment on the video clip. Instead of an article, students will be assigned part of a video (pushing the limits-sensation) to watch, focusing on pain. In class, before the seminar, students will answer reflections questions on the video. These questions will be subjective, focusing on the student's interpretation on what the video was about. After the reflection, the Socratic seminar will begin. The seminar will last anywhere from 20 minutes (if the students have a lab or formal assessment), to one hour if the seminar will be the main focus of class. After the seminar, students will then complete another reflection on the seminar. Each seminar will have focus questions. There will be three focus questions for a twenty minute seminar and five to seven questions for a longer seminar.

If the focus of the seminar will be an article instead of a video, the structure of the class will work the same way. Students will watch the instructional video and complete the assessment, then read the article. Students will have to annotate the article using close reading strategies (see teacher resources). A great way to remind students of close reading strategies is to post an anchor chart in the classroom (see teacher resources). Students may have the article with them to refer to during the discussion if they have annotated it. The pre and post seminar reflections will be the same as if they watched a video.

Labs

Labs are an important part of every science based course. This course I have designed will have at least three labs. The labs I have chosen are economical, relevant and have the degree of rigor I would expect for high school students. The first lab would be on drug detection and toxicology. This lab, from Carolina Biological, simulates drug detection techniques using thin-layer chromatography. The drugs in this kit are not all simulated. Some of them are weak concentrations of actual drugs that are commonly used. In this lab, students extract drugs from simulated urine using columns, elute the drugs, run them on chromatographic gels, and use visualization techniques to identify the drugs. The lab may be done in or two ninety lab periods and is easily separated into drug isolation and chromatography sections. Approximately fifty minutes is required for completing the thin layer chromatography and visualization process, which must be done all at one time. Since the lab involves many parts, teachers may cater the lab to include only the parts they feel will most benefit the students. The second laboratory experiment is a drug analysis lab, which investigates contaminants from common OTC medications. This is sold from Carolina Biological as a Drug Analysis lab. This lab would be completed during or after unit 2 (NSAIDs and OTC drugs). Some of the drugs tested for are OTC cold medicines, sleep aids, analgesics, mouthwash, and iron sulfate. Students use detection strips to test for the presence and concentration of the drugs. The final lab is on addiction and the brain's response. This lab, sold by Science Take-Out, features a fictitious drug 'Floratryp' an opioid which is highly addictive. The lab includes simulated medical reports and a fictitious patient. The students will analyze medical reports, conduct research on addiction, and carry out lab analysis on simulated dopamine levels in the human brain. This lab comes with a pre and post assessment.

Assessments

Each unit will have one summative assessment at the end of the unit (see appendix 3). Each lesson of the unit will have a mini-assessment after the lesson is complete. This way, I will know if the students are on target to demonstrate mastery of the assessment at the end of the unit. Each mini assessment from a lesson will consist five multiple choice questions. Students will also have to fill out a reflection in class, both before and after the seminars. These reflection questions will help them with the free response questions included in each summative assessment. The unit assessments will be 15-17 questions, with two questions being free response. I will use a rubric to grade these questions. The goal of these assessments is for students to demonstrate mastery. Since mastery is defined as a score of 79% or higher, students will be allowed to take the assessment 1 additional time to achieve mastery if they do not achieve the minimum score the first time¹⁸. Before students retake the assessment, they will complete a series of reteaching and relooping activities, focusing on which areas they did not master.

Final Project

The final project will be introduced during unit 3 of the class, but will not be due until the end of the course. The students will receive a project description and rubric upon introducing the project. The project will focus on pharmaceutical companies. The student will choose a pharmaceutical company from a list provided from the teacher. The students will have to create a profile of the company including the company name, who founded the company, the headquarters location, revenue from the 2016 fiscal year, current President/CEO and the stock price. The students will then choose three drugs from the company. The profile of the drugs must include name, generic name (if applicable), chemical formula, indications, side effects, and any recall or newsworthy information. For example, if student chose to profile *Subsys* which is a form of fentanyl manufactured by the Pharmaceutical company INSYS, they would include the accidental death of Prince and the current declaration of an 'opioid emergency' by President Trump. The students must also find and cite at least one journal article on at least one of the drugs they profiled. Lastly the students must cite their references using MLA citation (generally accepted form by CMS). This project will be in the form of a presentation. The presentation could be a presentation poster, slideshow, or Prezi ©. The presentation will be timed, and be no less than five minutes and no longer than ten minutes. In addition to presenting the information to the class, the project must be submitted using the learning management system (Google Classroom, Canvas, Schoology, etc.) to the teacher.

Literacy Incorporation

In Phillip O. Berry's [School Improvement Plan](#) , all faculty participated in professional development workshops promoting literacy in the classroom. These workshops continue through this year (2017-2018). The focus of these workshops is text complexity and literacy strategies such as close reading, and annotation. These are set up through vertical alignment in PLC sessions (professional learning community) to encourage rigor through text complexity, text dependent questions, academic dialogue, and tasks¹⁹. I have chosen the book *Dr. Feelgood: The Shocking Story of the Doctor Who May Have Changed History by Treating and Drugging JFK, Marilyn, Elvis, and Other Prominent Figures*. This book tells the story of Dr. Max Jacobson, a German Jew who immigrated to the United States before his family could be arrested by Hitler and the Nazis. He had experimented in pain management in France and Czechoslovakia (now

Czech Republic) using Amphetamines and a cocktail of vitamins. He experimented on himself, as many doctors did during that time (1930s-60s). The reason I have chosen this book is for the ties to many other subjects in the core curriculum:

- History (WWII, Nazis, Immigration to the US)
- Politics/ History (JFK meeting with Nikita Khrushchev of Russia, Bay of Pigs Vienna Summit)
- Health Sciences (Medical History of JFK)
- Medicinal Chemistry (Amphetamines and their derivatives)
- Human Body Systems (Nervous system response to stimulants such as Adderall and Methamphetamine)

An example of a text dependent question:

Starting at the bottom of page 64 and continuing to page 65, cite evidence from the texts that suggests at least two reasons why the medical community did not accept Dr. Jacobson's findings on his pain management cocktail.

An Example of a close reading strategy:

In Chapter 7: The Vienna Summit, Create a timeline of events, including the Bay of Pigs and events that led up to Kennedy's meeting with Khrushchev that contributed to the President's ongoing addiction to Dr. Jacobson's methamphetamine 'vitamin cocktail' and his increasing dependence on Dr. Jacobson.

Text dependent question from Chapter 7:

How did the Vienna Summit increase Jacobson's feeling of self-importance?

This book provides an intimate view of the personal medical histories of some of the most Famous Americans, and shows that no one is immune to addiction. It also shows how drugs may have contributed to major events in history. Some sources state that the reason the meeting with Khrushchev did not go well at the Vienna summit is because JFK was 'too high' to focus and therefore fell victim to Khrushchev's aggressive tactics²⁰.

Field Trips

There are several small pharmaceutical companies in Charlotte, one being ENDO, a specialty pharmaceutical company located in South Charlotte. I feel the students will benefit from a tour of a pharmaceutical company to see the actual process in motion. The staff there would provide a presentation on their company and how the medications they produce affect human health. Students will then be able to ask questions and receive a tour of the plant. The benefits of seeing a pharmaceutical company are: 1) students can see for themselves the process of drug manufacturing 2) students can explore a career or internships in the pharmaceutical industry 3) students may interact with medical professionals that can act as mentors. Educational journeys provide a practical experience that cannot be duplicated in the classroom.

Another idea for a field trip is a visit to the local forensics lab. The technicians there could talk about what happens when law enforcement seizes drugs. This presentation could discuss the chain of custody, identification, and disposal of the drugs. They could also talk about Methamphetamine labs and why they are so volatile. The forensics lab could also discuss the process of drug testing, not only urine screening but testing hair and nails for drug 'timeline'²¹. Forensics is another career path in both Health Sciences and Law Enforcement that students can explore.

Appendix 1: Teaching Standards

Honors PLTW Medical Interventions

MI 1.2 Students will study infectious diseases and antibiotics, investigating how antibiotics work and the different classes of antibiotics.

MI 3.3 Students will study cancer drugs and pain management, investigating how the drugs work and what patients can do about the side effects, such as severe pain, fatigue, and hair loss.

Honors PLTW Human Body Systems

HBS 3.4g Analyze urinalysis results to diagnose disease, drugs, and dysfunction in human body systems.

HBS 5.3c Students will explain how the human body senses and processes signals of pain.

HBS 5.3e Students will outline what happens inside the body when a person feels pain.

HBS 6.1a Students will describe how the body systems respond to extreme external environments.

AP[®] Chemistry

LO 2.1 Describe how the body systems respond to extreme external environments.

CTE Health Occupations Pharmacy Technician

3.01 Understand classifications of medications.

3.02 Understand compounding medications.

Appendix 2: Sample Lesson Plan

Course: Medicinal Chemistry

Day: 1

Topic: Emergency?!

Class duration: 75 Minutes

Objective: To set a pace for the course and decide whether the study of drugs today is relevant.

Warm-up/Bell Ringer: Students fill out survey on drugs and their medical conditions. (5 minutes)

Course Opening: Students watch a CNN clip of President Trump declaring an ‘Opioid Emergency’. (2 minutes)

Guided Practice: Students answer the following four questions (10 minutes)

- 1) What is an opioid?
- 2) Give three examples of opioid medications.
- 3) Describe the relationship between opioids and drugs such as heroin and morphine.
- 4) Do you agree with the President that there is currently an opioid emergency?

Lesson Presentation:

Students watch the video clip ‘It’s ‘chemical warfare’ on our children’.

Then students can revisit their answer to the fourth question from guided practice to see if they have changed their position. (15 minutes)

Personal Connection:

Students will engage in a Socratic seminar with the following focus questions:

1. Is there a difference between ‘drugs’ and ‘medicine’?
2. How do you feel about the current system of drug administration (prescription vs nonprescription)?
3. Are there any ‘illegal’ drugs that should be legal and why?
4. Are there any ‘legal’ drugs that should be illegal and why?

The seminar will last 30 minutes. Students will be given two popsicle sticks, which represent the number of times they can speak. After they use up their two sticks, they must wait until all students have spoken at least twice before they speak again. Students will be graded on participation and the quality of their answers.

Independent practice: Students will complete a reflection on the Socratic seminar. (8 minutes)

Additional Practice: Students will receive information on their first out of class assignment to prepare for the next class. (5 minutes)

Appendix 3: Survey, Sample Assessments, and Rubrics

Introductory Survey

<https://goo.gl/forms/HNcJO1ROhuHtzLCB2>

Sample mini assessment

<https://goo.gl/vwYk9B>

Sample Rubric for Final Project

<https://goo.gl/feXHvi>

Appendix 4: Infographic on the FDA Drug Approval Process

<https://www.fda.gov/downloads/drugs/resourcesforyou/consumers/ucm284393.pdf>

Teacher Resources & Student Resources

Socratic seminar

"Socratic Seminars – Read.Write.Think." Readwritethink.org. Accessed October 30, 2017.

<http://www.readwritethink.org/professional-development/strategy-guides/socratic-seminars-30600.html>. A website that discusses the fundamentals and how to prepare students for a Socratic Seminar.

"How to Teach a Socratic Seminar." Paideia. Accessed October 30, 2017.

<https://www.paideia.org/about-paideia/socratic-seminar/>.
A website explaining the merits and how to teach a Socratic seminar.

Flipped Classroom

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