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Infectious Diseases: Hepatitis B and Tuberculosis

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Introduction

I am a teacher at James Hillhouse High School in New Haven, Connecticut. I teach tenth through twelve graders in the subjects of Health, Human Physiology, and Biology. Teaching in an urban setting is greatly challenging and sometimes frustrating. Notwithstanding these obstacles there are some great rewards, such as the differences you have made or the impression you have left on those students you have taught. Demographically, the student population of the school falls into two dominant categories: African American and Hispanic, with a few white students. There is a growing population of students with English as second language. The percentage of people living below the poverty level in New Haven is approximately 25% according to the 2000 census. Attendance and constant movement of students in and out of the school place a strain on the lesson in the classroom.

At any point in time a student will find himself or herself in a science class discussing the topic of infectious diseases. In many cases the student will only remember the topic of sexually transmitted diseases (STDs), also called sexually transmitted infections (STIs), forgetting that there are other types of infectious diseases. All science courses will cover the topic of diseases in some way. In both health science and human physiology, the topic of diseases is covered greatly with an emphasis on how diseases occur and how they are prevented. Also, in the subject area of biology the topic of disease is explored when discussing bacteria and viruses. However, not enough time is being spent on a particular infectious disease in the subject area of biology because of the packed curriculum that is required to be done by March. The intent of this unit is to ignite the students' interest so that they will study this subject further on their own or come away with a greater understanding of infectious diseases. The unit is designed for children in grades 10-12 and will be taught for approximately ten days.

The design of this unit is guided by New Haven Public School Curriculum Science Standards grades 9-12. Specifically, Content Standard 10.2 Microorganisms have an essential role in life processes. In this unit I will focus on two types of infectious diseases: Hepatitis B and Tuberculosis. The focus is on Hepatitis B and Tuberculosis is because of their characteristics. Hepatitis B is caused by a virus, and Tuberculosis is caused by a bacteria.

During the beginning of the unit, the students will learn about the definition of infectious disease and

categories of infectious diseases. I want the students use their prior knowledge of bacterial cells and viral particles to get them interested in the topic. Then, the students will learn about what causes an infectious disease (pathogens). The students will explore the different types of pathogens and how they cause disease. The main focus will be on two specific infectious diseases: hepatitis B and tuberculosis. For each disease the students will explore the cause, symptoms, and treatments. The two infectious diseases will be compared and contrasted. The students will trace the effects of all two diseases on the body systems. At the end of the unit the students will be required to write a research paper on how sanitation, vaccination, and antibiotic medications has decreased the spread and improved the treatment of hepatitis B and tuberculosis in a particular country.

Unit Objectives

At the end of the unit the students will be able to:

- Define the term infectious diseases.
- Explain the causes of infectious diseases.
- Differentiate among the disease carrying organisms.
- Identify the ways infectious diseases are spread.
- Describe the body's defense against disease.
- Explain how the immune system functions.
- Differentiate between active and passive immunity.
- Describe hepatitis B.
- Identify and describe the pathogen that causes hepatitis B.
- Describe how viral infections occur.
- Describe tuberculosis.
- Describe how bacterial infections occur.
- Identify and describe the pathogen that causes tuberculosis.
- Describe how tuberculosis affects the lungs.
- Describe the causes, symptoms, and treatments of the hepatitis B and tuberculosis.
- Describe how the body is affected by an infectious disease.
- Describe how the vaccines work.
- Compare and contrast hepatitis B and tuberculosis.
- Examine the spread of each disease worldwide.

Unit Background

What Is an Infectious Disease?

An infectious disease is caused by organisms that enter, live in, and multiply within the body. These organisms are called microorganisms because of their size; they cannot be seen by the naked eye. Not all microorganisms are bad for your health. In the human body there are many types of microorganisms that cause no problems, and often even help. These microorganisms are helping the body with normal functions and aid in the defense against pathogens. It is important to know what an infectious disease is, but knowing what causes the infection is as important. So, a question to address is: what are pathogens?

Pathogens

Organisms that cause disease are called pathogens. Pathogens are not normally found in the body. Pathogens can be categorized into four main groups; they are bacteria, viruses, fungi, and protozoans.

Bacteria are prokaryotic microorganisms that lack a membrane bound nucleus and organelles. They consist of one cell (unicellular). Bacteria are spherical, rod-shaped, or spiral-shaped. Bacteria are found all environments. They can be helpful or harmful. Bacteria are helpful in the environment by acting as decomposers and by being nitrogen-fixers. They also aid in the production of food.

Viruses are microscopic particles that invade the cells of plants, animals, fungi, and bacteria. Viruses always destroy the cells they invade, and only multiply with a living cell. A virus is not a cell. The composition of a virus is of a core genetic material surrounded by a protein coat. The protein coat protects the genetic material and enables the virus to invade its host cell.

Fungi are simple organisms that are related to molds. Many fungi are free-living in soil or water; others form parasitic or symbiotic relationships with plants or animals, respectively.

Protozoans are a collection of single-celled eukaryotic organisms with a well-defined nucleus). As such, they are among the simplest of all living organisms. Most are invisible to the naked eye. Many are symbionts of other organisms, and about one-third of the living species are parasites1. Symbiont is an organism that is associated with another in a mutually beneficial relationship.

The students have learned about what an infectious disease is and how pathogens are related to infectious diseases in the form of a lecture and discussion. Now, it is time to explore the how the body protects itself from infectious diseases that are caused by these pathogens. The body's system of protection is called the immune system.

Immune System

The immune system is a collection of tissues, cells, and molecules working together to recognize and attack pathogens, the small enemies that lurk about the world, looking for ways to profit at the expense of the human body2. The immune system is the body's defenses against diseases. The major components of the

immune system are the bone morrow, thymus, peripheral lymphoid organs and tissues, and accessory lymphoid organs and tissues3. The immune system is divided into two systems: nonspecific and the specific defense systems. Both systems work together to achieve the common goal of protecting the body from infections. The immune system also preserves the body's internal environment by scavenging dead or damaged cells and patrolling for antigen. The immune system functions by three basic methods: the protective surface phenomenon, general host defenses, and specific immune responses4.

Nonspecific Defense System

The nonspecific defense system provides an immediate response to protect the body from invaders. The term *nonspecific body defense* refers to the mechanical barriers that cover the body surfaces and to cells and chemicals that act on the initial battlefront to protect the body from invading pathogens. The nonspecific defenses are provided by intact skin and mucous membranes, the inflammatory response, and a number of proteins produced by body cells. The body's first line of defense against the invasion of disease-causing microorganisms is the skin and mucous membranes5. Some produce secretions and have structural modifications that enhance their defensive effects. Examples of these secretions and modifications are the skin's acidity, lysozyme, mucus, keratin, and ciliated cells. Even though the surface barriers are very effective, they are something broken. When this occurs the microorganisms invade the deeper tissues, and other nonspecific mechanisms are set into action. These defenses rely on the destructive powers of phagocytes, natural killer cells, inflammatory response, and a variety of chemical substances that kill pathogens and help repair tissue6. Phagocytes engulf and destroy pathogens that penetrate epithelial barriers. Natural killer cells are non-immune cells that act nonspecifically to lyse virus-infected and malignant cells. The inflammatory response prevents spread of harmful agents, disposes of pathogens and dead tissue cells, and promotes healing7.

Specific Defense System

The specific defense system is also called the adaptive immune system. Specific immune responses include humoral and cell-mediated immunity. The immune system generally mounts the attack against particular foreign substances. A major function of the immune system is to make antibodies that will bind to foreign antigens that find their way into the body. The immune system protects the body from most bacteria and viruses both directly by cell attack and indirectly by releasing mobilizing chemical and protective antibody molecules8. As a result of the immune system's actions a person is said to have acquired immunity. Immunity that the immune system creates is called adaptive or active immunity. Active immunity results from having a disease or receiving a vaccine. Immunity that is acquired by receiving antibodies that are made from another immune system is called passive immunity. This type of immunity is temporary9. In contrast to the nonspecific defenses, which are always ready for battle, the immune system must first be primed by an initial exposure to a foreign substance before it can protect the body against the foreign substance. The two arms of immune response are humoral immunity mediated by antibodies, and cellular immunity mediated by living cells.

Lymphocytes and macrophages are the most abundant and important immune cells. Immune system cells and blood are closely related. Both are produced in the bone marrow and both use the blood stream for transportation10. There are types of lymphocytes, which are B-lymphocytes and T-lymphocytes. B-lymphocytes or B-cells produce antibodies and oversee humoral immunity. T-lymphocytes or T-cells are non-antibody producing lymphocytes that constitute the cell-mediated arm of immunity. Macrophages are not antigen specific but play an essential role in helping the lymphocytes.

Antibodies

Antibody molecules are proteins that carry out important functions in the immune system. An antibody's ability to bind to an antigen or chemical is very important. The function of antibodies is to aid in the protection from diseases by binding to the chemical targets on the surface of pathogens like bacteria and viruses. The structure of an antibody consist of a Y-shaped structure and are composed of two identical heavy and two identical light chain polypeptides, which are physically linked to each other. The binding of the antibody to the pathogen is the first step in eliminating the pathogen from the body. The chemical that an antibody binds is called an antigen. An antigen can be composed of a protein, polysaccharide, and also be a small part of a larger molecule. In the body an antigen is usually a foreign substance11.

Antibodies are produced by specialized cells of the immune system that are differentiated forms of B cells. The humoral immunity involves B cells. Foreign antigens cause B cells to divide and differentiate into plasma cells. Each of the plasma cell produces and secretes large amounts of antigen-specific immunoglobulin into the bloodstream. The five types of immunoglobulin are IgA, IgG, IgM, IgD, and IgE. Immunoglobulins A, G, and M guard the body against viral and bacterial infection. Immunoglobulin D acts as antigen receptor of B cells, and immunoglobulin E causes allergic responses. The importance of immunoglobulins are that they work as antitoxins by linking with toxins that bacteria produces themselves and coating the bacteria to make them targets for phagocytes or linking them to antigen, causing the immune system to produce and circulate enzymes12.

After learning about the immune system and how antibodies work the student will learn about vaccines. The students need to have a clear understanding of how antibiotics and vaccines prevent infectious diseases. Not all infectious diseases are alike. They are caused by different types of pathogen, and are treated differently. There are two types of methods that are available to treat diseases or prevent the spread of certain diseases. One method is antibiotics and the other method is vaccines.

Antibiotics

What Are Antibiotics?

An antibiotic is a chemical compound that inhibits or abolishes the growth of microorganisms, such as bacteria, fungi, and protozoans.

Alexander Fleming discovered penicillin, a mold growing on some Petri dishes and also noted that where the penicillin grew, the bacteria did not. What Fleming found revolutionized medicine, as these antibiotics were able to target bacterial cells, leaving the host relatively unaffected.

Antibiotics can be classified in many different ways, they can be classified they their chemical structure, their microbial origin, or their mode of action. They are also frequently designated by their effective range.

How Do Antibiotics Work?

Antibiotics attack bacteria without harming cells belonging to the host organism. There are two ways that antibiotics do this. Antibiotics like penicillin are called bactericidals and kill bacteria by inhibiting cell wall synthesis and thereby damaging the cell. Human and animal cells do not have cell walls, so these antibiotics do not damage them. Erythromycin and tetracycline are bacteriostatic antibiotics; they inhibit nucleic acid and protein synthesis. This type of antibiotic can affect the patient receiving them, but because they have a

greater effect on bacterial cells than animal cells they can still be useful.

After learning about antibiotics the students will be given a lesson about antibiotic and what of infections they are used on. The students will then learn about vaccines.

Vaccines

What Are Vaccines?

A vaccine is preparation of a weakened or killed pathogen, such as a bacterium or virus. A vaccine can also be a part of a pathogen structure, which stimulates antibody production against the pathogen but is incapable of causing severe infection.

How Do Vaccines Work?

A vaccine contains a killed or weakened part of a germ that is responsible for infection. Since the germ has been killed or weakened before it is used to make the vaccine, it cannot make the person sick (some vaccines do cause a mild illness, such as local swelling or redness or fever). Many vaccines work by enhancing the formation of antibodies within the body of the vaccine recipient13. When a person receives a vaccine, the body reacts by making protective substances called "antibodies," which were described above. The antibodies are the body's defenders because they help to kill off the germs that enter the body. In other words, vaccines expose people safely to germs, so that they can become protected from a disease but not come down with the disease14.

There are several steps taken by the body when given a vaccination. First a vaccine is given by a shot. Second over the next few weeks the body makes antibodies and memory cells against the weakened or dead germs in the vaccine. Third the antibodies can fight the real disease germs if the person is exposed to the germs and they invade the body. The antibodies will help destroy the germs and the person will not become sick. Last antibodies and memory cells stay on guard in the body for years after the vaccination to safeguard it from the real disease germs15.

Why Are Vaccines Important?

Vaccines have extended the lives of millions of people each year by preventing infectious diseases. Vaccination is the process of administering a vaccine to an individual or group. Vaccines are available for wide varieties of diseases such as smallpox, rabies, typhoid, diphtheria, tetanus, polio, and measles.

Vaccination and immunization differ in that vaccination uses a live infecting agent, so it can make the individual sick, while immunization does not use a live agent. Once the body has been exposed to a disease it can develop the ability to respond to subsequent or repeated exposure.

At this point the students will recognize that antibiotics are not the only way of treat or preventing infectious diseases. The students will explore how vaccines work and share their findings with the class, and explain the differences between vaccines and immunization. Another lesson that the students will be given at this point is an activity in which they will have to take a position for or against vaccination of children based on scientific evidence. Using the information about infectious disease, pathogens, immune system, antibiotics and vaccines; which provided the students with great deal of background information the student are able to explore the infectious diseases of hepatitis B and tuberculosis in depth. The students will explore the cause,

symptoms, and treatments of the both diseases. The infectious diseases of hepatitis B and tuberculosis are going to be compared and contrast.

Hepatitis B

What Is Hepatitis B?

Hepatitis B is a potentially serious form of liver inflammation due to infection by the hepatitis B virus (HBV). Hepatitis B occurs in both acute and chronic forms, and is one the most common chronic infectious disease worldwide.

Acute Hepatitis B

The majority of acute hepatitis B infections occur in teenagers and young adults. Most these young people will not exhibit any symptoms, and an estimated one in five infected people will develop severe symptoms and yellowing of the skin. The yellowing of the skin is called jaundice. Jaundice is when the infected liver is unable to get rid of certain pigments as it normally does; these pigments accumulate in the body and cause a yellow coloration. The incubation period after infection lasts one to four months16. Symptoms of acute HBV infection include nausea, anorexia, fatigue, low-grade fever, and right upper quadrant pain. The symptoms of acute hepatitis B do not last longer than two or three months. There is a small chance of the infection getting worse as the liver cells die off. If the person's conditions get worse the jaundice will deepen, and the person will bleed easily. The stomach will be distended with fluid. The least common outcome of acute hepatitis B infection is that the person will develop fulminate hepatitis. Fulminate hepatitis is when the liver fails17.

Chronic Hepatitis B

A hepatitis B infection which lasts more than six months is called chronic. The infection will not disappear at this stage. Livers of people who reach this stage in the infection become more and more scarred and less capable of carrying out normal functions. At this point the liver develops cirrhosis. Cirrhosis is the scarring of the liver that is so severe it causes problems with function18. The most serious complication of chronic hepatitis B virus infection is liver cancer. Liver cancer is the most common type of cancer that occurs in men. The natural course of chronic HBV infection is divided into 4 phases:

1. Immune tolerance.
2. Immune clearance.
3. Inactive carrier.
4. Reactivation19.

Description of the Hepatitis B Virus

The hepatitis B virus is composed of an inner protein core and an outer protein capsule. The outer capsule contains the hepatitis B surface antigen. The inner core contains hepatitis B virus core antigen and hepatitis B e-antigen. This cell also contains polymerase, which catalyzes the formation of the cell's deoxyribonucleic acid

(DNA). Hepatitis B is the only hepatitis causing virus that has DNA instead of ribonucleic acid (RNA). (See Figure 1)

What Causes Hepatitis B?

Hepatitis B is spread through contact with the blood and body fluid of an infected person.

Hepatitis B is contracted in the following ways:

- Have sex without using a condom.
- Share needles to inject drugs.
- Get a tattoo or piercing with tools that were not cleaned right.
- Share personal items like razors or toothbrushes.

In addition to these forms of transmission, which occur between two people, a mother who has the virus can pass it to her baby during delivery20.

What Are The Symptoms?

Many people with hepatitis B do not know they have it, because they do not have symptoms. Some people who are infected with hepatitis B have only flu like symptoms, which they may not identify as hepatitis B infection. The symptoms of hepatitis B include the following:

- Feeling very tired.
- Mild fever.
- Headache.
- Not wanting to eat.
- Feeling sick to your stomach or vomiting.
- Belly pain.
- Diarrhea or constipation.
- Muscle aches and joint pain.
- Skin rash.
- Yellowish eyes and skin (jaundice). Jaundice usually appears only after other symptoms have started to go away21.

Treatment

Hepatitis B is an viral infection and is treated differently from bacterial infections. Viral infections cannot be treated with antibiotics, and are treated with antiviral drugs such as interferon alfa-2b, lamivudine, and adefovir dipivoxil. These antiviral drugs work on viral infections in many ways. For example, "the interferon alfa-2b drug is thought to work by affecting viral replication, and by up-regulating cytokines involved in the response to infection"22. Another antiviral drug called Lamvudine inhibits reverse transcriptase, thereby terminating proviral DNA chain extension. It is important to recognize that antiviral drugs are virus specific to be affective.

Prevention

The hepatitis B vaccine has had an enormous impact. From the late 1980s to 2001, the incidence of acute hepatitis B in the United States decreased from more than 300,000 cases per year to 79,000 cases per year. Predictably, the largest decreases have occurred in children and health care workers--the two groups with the highest rates of vaccination23.

Vaccination is recommended for all children and adolescents, adults in certain ethnic groups, health care workers, and other high-risk groups. A three-injection series induces protective antibody levels in 95 percent of children and 90 percent of adults. Those who fail to respond may be re-vaccinated; in this group, 30 to 50 percent will achieve protective levels24.

Tuberculosis

What Is Tuberculosis?

Tuberculosis (TB) is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or *Mycobacterium tuberculosis.*

Tuberculosis can spread from person to person through the air. The disease is spread by a person with active tuberculosis disease of the lungs or throat sneezes or coughs, which spread the bacteria in the air. A person can get infected by breathing in the bacteria.

Not all people who breathe in the bacteria contract the disease. These people have the bacteria in their system and are not sick are called latent tuberculosis infection. People with latent tuberculosis infection are cannot of spreading the disease.

Latent tuberculosis infection

People who have come in contact with the tuberculosis bacteria and become infected and the body's immune system stop the bacteria from growing. After the lungs are infected with the bacteria, the immune system begins to react. The macrophage cells begin to surround the bacteria forming a barrier or wall so that the bacteria cannot continue to spread. If the macrophage cells are successful at stopping the bacteria from spreading the bacteria will become dormant25. At this point the bacteria become inactive, but are still alive in the body waiting for the immune system to weaken to become active again. The bacteria lay in wait of the right opportunity to grow. A person with latent tuberculosis infection usually demonstrates the following characteristics:

- have no symptoms
- don't feel sick
- can't spread TB to others
- usually have a positive skin test reaction
- can develop active TB disease if they do not receive treatment for latent TB infection

Many people who have latent tuberculosis infection never develop active tuberculosis disease. In these people, the TB bacteria remain inactive for a lifetime without causing disease. However, in other people who have weak immune systems, the bacteria become active and cause tuberculosis disease26.

Active tuberculosis

If the immune system is incapable of stopping the growth of the tuberculosis bacteria the bacteria becomes active. "The tuberculosis bacteria actually begin to exploit macrophages for their own survival, causing the white blood cells to form into tightly packed groups called granulomas. The bacteria multiply inside the granulomas, which eventually may enlarge into noncancerous tumor-like nodules. Over time, the centers can liquefy and break through the granulomatous wall surrounding them, spilling bacteria into your lungs' airways and causing large air spaces (cavities) to form (active TB). Filled with oxygen, the air spaces make an ideal breeding ground for the bacteria, which multiply in enormous numbers. The bacteria may then spread from the cavities to the rest of your lungs as well as to other parts of your body27."

The bacteria begin to multiply in the body and cause the active disease. The bacteria then attack and destroy the body tissues. In its worst manifestation, the bacteria create a hole in the lungs. In some cases the active tuberculosis disease takes over the body before the immune system can respond to fight off the bacteria. People with weaken immune system are at greater risk of contracting active tuberculosis.

Testing and Detection

Two types of skin tests are available in the United States, the Mantoux skin test and multi puncture or "tine" test. The Mantoux skin test uses a needle to place a standard dose of tuberculin just under the surface of the skin. The multi puncture or "tine" test uses multiple tines (pins) dipped in tuberculin. The "tine" test is not considered as accurate as the Mantoux test because the quantity of the tuberculin administered cannot be precisely measured. The Mantoux test is recommended for screening and diagnosis.

The TB skin test is usually performed by injecting a small amount of tuberculin under the superficial layers of the skin. The test is then read by a trained individual 48 to 72 hours later. A positive skin test results in a raised bump (induration) at the point of administration. The size of the induration determines whether the skin test is considered significant. A positive (now called "significant") reaction indicates infection with TB. Chest X-rays, sputum tests and other tests are used to determine whether the positive reaction is associated with active TB disease28.

Symptoms of Tuberculosis

Symptoms of tuberculosis depend on where in the body the tuberculosis bacteria are growing. Tuberculosis bacteria usually grow in the lungs. Tuberculosis in the lungs may cause symptoms such as

- a bad cough that lasts 3 weeks or longer
- pain in the chest
- coughing up blood or sputum (phlegm from deep inside the lungs)

Other symptoms of active tuberculosis disease are

- weakness or fatigue
- weight loss
- no appetite
- chills
- fever

Treatment of Tuberculosis

Antibiotics are the primary method of treatment for tuberculosis.The overall goals of treat tuberculosis are to cure the individual and to prevent the transmission of Mycobacterium *tuberculosis* to others. Treatment can take up to nine months.

Currently, there are about ten drugs approved by the FDA to treat tuberculosis in the United States. The most frequently uses drugs to treat tuberculosis are isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), and ethambutol (EMB). However, if these drugs fail, other drugs can be used to treat the infection. Unfortunately, tuberculosis can become resistant to some drugs29.

Prevention of Tuberculosis

Preventive measures include strict standards for ventilation, air filtration, and isolation methods in hospitals, medical and dental offices, nursing homes, and prisons. If someone is believed to have been in contact with another person who has tuberculosis, preventive antibiotic treatment may have to be given. Infected persons need to be identified as soon as possible so that they can be isolated from others and treated.

The Bacillus Camille Guerin (BCG) vaccine is useful in preventing certain types of tuberculosis. Many countries use BCG vaccine as part of their tuberculosis control programs, especially for infants. The protective efficacy of BCG for preventing serious forms of tuberculosis (e.g. meningitis) in children is high (greater than 80 percent). Vaccination with BCG does not prevent infection by M. tuberculosis but it does strengthen the

immune system of first-time tuberculosis patients. As a result, serious complications are less likely to develop. BCG is used more widely in developing countries than in the United States.

Classroom Activities

Lesson Plan One

Lecture and discussion: The Different Types of Pathogens

Goal

To provide the student with background information about the different types of pathogens that causes diseases.

Objectives:

The students will able to:

1 Identify the different types of pathogens.
2 Describe the types of diseases that each of pathogens caused.

Teacher Material

- PowerPoint presentation

Student Material

- Pen or pen, and notebook

Lesson Plan Two

This activity simulates the spread of a disease. The students will exchange a clear liquid from numbered cups.

Goal

The students will understand how infectious diseases can spread.

Objective

The student will be able to determine the pathway of transmission for a hypothetical disease.

Teacher Materials (see appendix B)

Student Materials

- Disposable cup of unknown liquid
- Eyedropper

Procedure

1. Choose any cup and eyedropper from the distribution table. On a piece of paper, record the number on your cup. Each cup and its contents represent a person that might or might not have a disease.
2. Slowly walk around the room and occasionally stop to talk to someone at the meeting. Spend no more than five seconds talking to each person.
3. When the council president (your teacher) says "Exchange!" squirt four eyedroppers full of your liquid into the cup of the person you are talking with. Have that person do the same to your cup. Stir your mixture gently with the eyedropper.
4. Repeat steps 2 and 3 twice. Record the other person's cup number for each exchange. Do not exchange with the same person again.
5. After the third exchange, take your seat. The council president will add a drop of indicator to your cup. If you are infected, the clear liquid will change to pink or red.

Closure

Compare and contrast the results of this activity to the transmission of a real disease

Lesson Plan Three: Introduction to Antibiotics

Stumbling into the doctor's office, the patient demands some antibiotics, but is that what is really needed? In this exercise students are briefly introduced to the idea of antibiotic resistance as a way to focus on antibiotics and the mechanisms by which they work. Students decide whether antibiotics are the right prescription or not. Working as a group, students review multiple illnesses and make decisions.

Objectives:

Students will be able:

- Describe the impact of antibiotics on disease
- Describe what infections antibiotics are useful for

Materials (see Appendix B)

Lesson Plan Four: Exploring Vaccines

Previously students have been introduced to antibiotics which are used to treat various infections; but how do you treat infections that aren't caused by bacteria? Students review the historical background and focus on one vaccine to explore how vaccines work, then share their findings with the class. The class then comes up with a general description of how a vaccine works and articulates the differences between vaccination and immunization.

Objectives:

Students will be able:

1 Explain in a written format how vaccination works and how it draws upon the natural immunity.
2 Differentiate between vaccinations and immunizations.
3 Identify a number of illnesses that can be prevented by the use of immunization.

Materials (see Appendix B)

Lesson Plan Five

Create a persuasive pamphlet in support of or in opposition of vaccination.

Goal

At the end of this lesson the students will assess the risk and benefits of vaccination of children.

Objectives

The students will be able to:

1. Read, interpret and examine the credibility and validity of scientific claims in different sources of information.
2. Articulate conclusions and explanations based on research data, and assess results based on the design of an investigation.
3. Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Teacher Materials (see appendix B)

Student Materials

- Pen or pencil
- Notebook
- Pamphlet template
- Description of the task

Procedure

The students will:

1. View a PowerPoint presentation about vaccines and how vaccines work to protect against infections.
2. Pick a position on vaccination of children; whether they support it or opposite it.
3. Research their position.
4. Create a persuasive pamphlet of their position on vaccination using several sources to support their position.

Closure

The students will orally present their pamphlet.

Illustrations

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1. The Hepatitis B Virus

www.hon.ch/Library/Theme/HepB/viroligy.html Picture and explanations of the virus

2. Tuberculosis Bacteria

www.cbc.ca/.../2006/03/17/tb-who060317.html

www.acsu.buffalo.edu/~lcscott/Tb.html

Appendix A

Connecticut State Science Standard

Grade 10

Strand IV: Cell Chemistry and Biotechnology

Content Standards

Structure and Function- How are organisms structured to ensure efficiency and survival?

Science and Technology in Society- How do science and technology affects the quality of our lives?

The standard states that students will understand the growth and spread patterns of viruses and bacteria enables the development of methods to prevent and treat infectious diseases. The lesson plans will address performance standard D32 which states students should be able to describe how bacterial and viral infectious diseases are transmitted and explain the role of sanitation, vaccination and antibiotic medications in the prevention and treatment of infectious diseases.

Appendix B (Materials)

Lesson Plan Two

http://serendip.brynmawr.edu/sci_edu/waldron/infectious.html

Lesson Plan Three

http://pulse.pharmacy.arizona.edu/10th_grade/disease_epidemics/science/intro_antibiotics.html Lesson Plan Four

http://pulse.pharmacy.arizona.edu/10th_grade/disease_epidemics/science/exploring_vaccines.html Lesson Plan Five

Pamphlet template

http://www.vaclib.org/chapter/wyoming/HealthNotVaccines.htm

http://www.quackwatch.org/03HealthPromotion/immu/immuoo.html

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5343a3.htm

http://www.chop.edu/consumer/jsp/division/generic.jsp?id=75697

http://www.cdc.gov/nip/recs/chil-schdeule-bw-print.pdf

http://www.pitt.edu/~familymd/immunization/immunization-research-n.html

http://www-immuno.path.cam.ac.uk/~immuno/part1/lec06/lec6_97.html

Teacher Reading List

Alcamo. E. I. et al...(2002). *Modern Biology* .Texas Holt, Rhinehart & Winston.

Emerging and Re-emerging Infectious Diseases. (1999, October). *National Institutes of Health Curriculum Supplement Series Grades 9-12* . Colorado Springs, Colorado, United States of America: BSCS. Great activities and information for the classroom.

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Pruitt, B., Crumpler, K. T., & Prothrow-Stith, D. (2001). *Prentice Hall: Health Skills For Wellness.* Glenview, Illinois: Prentice Hall

Zuckerman, A. J. (1975). *Human viral hepatitis : hepatitis-associated antigen and viruses .* Amsterdam: American Elsevier.

Student Reading List

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Hepatitis Vaccine Found. (1980). *Science News* , 231-231.

Marieb, N.E. (2000). *Essentials of Human Anatomy &Physiology.* San Francisco. Addison Wesley Longman.Inc. High school textbook contains information on immunity and antibodies.

Pruitt, B., Crumpler, K. T., & Prothrow-Stith, D. (2001). *Prentice Hall: Health Skills For Wellness.* Glenview, Illinois: Prentice Hall. High school textbook contains diagram of the function of the immune response.

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