

Emerging and Reemerging Infectious Diseases

Course

Medical
Microbiology

Unit V

Microorganisms

TEKS

130.207(c)5EFH

Prior Student Learning

-Intro to
Microorganisms
-Immune
Response
-Basic Infection
Control

Estimated time

2-4 hours

Rationale

The landscape of infectious diseases is ever changing and what works to kill a microorganism today may not work tomorrow. Students should be aware of new or changing patterns of infection and the affects they may have on global health.

Objectives

Upon completion of this lesson, the student will be able to:

- Examine emerging diseases and the reemergence of diseases such as malaria, tuberculosis, and polio
- Evaluate the effects of anti-microbial agents
- Outline the role of the governing agencies in monitoring and establishing guidelines based on the spread of infectious diseases

Engage

The CDC has a publication that is updated monthly or bimonthly with the most recent disease trends specifically about emerging diseases. Take a look at the most recent copy online or sign up for the emails to use throughout the school year. http://wwwnc.cdc.gov/eid/article/19/8/13-0121_article.htm?s_cid=eid-gDev-email Select an article that will peak your student's interests to use for your engage idea giving them a solid tie to how this lesson really is useful in the 'real world'.

KEY POINTS

Teacher's Note: The following overview is for your reference. The information should be provided to the class from the student presentations described in the first activity.

I. Influenza

- A. Definition: Influenza (the flu) is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness, and at times can lead to death. Some people, such as older people, young children, and people with certain health conditions, are at high risk for serious flu complications.
- B. Name: Influenza Virus (type A, or B)
- C. Type: Virus normally passed from person to person through droplet spray.
- D. Disease: Signs and symptoms of the flu include feeling feverish, chills, cough, sore throat, runny or stuffy nose, body or muscle aches, and fatigue. Some people may have vomiting and diarrhea, though this is more common in children than adults. Complications of flu can include bacterial pneumonia, ear infections, sinus infections,

dehydration, and worsening of chronic medical conditions, such as congestive heart failure, asthma, or diabetes.

- E. Treatments: There are antiviral drugs that can be taken if started early enough in the illness.
- F. Vaccines: There is a new seasonal vaccine available every year in both injection and nasal spray form.
- G. Levels in the US: For an accurate level of influenza infections (updated weekly) see the CDC site:
<http://www.cdc.gov/flu/weekly/fluactivitysurv.htm>

II. Syphilis

- A. Definition: Syphilis is a sexually transmitted disease (STD) caused by a bacterium. Syphilis can cause long-term complications and/or death if not adequately treated.
- B. Name: *Treponema pallidum*
- C. Type: Bacteria (spiral shaped) spread by close contact.
- D. Disease: Syphilis is transmitted from person to person by direct contact with syphilis sores. Sores occur mainly on the external genitals, vagina, anus, or in the rectum. Sores also can occur on the lips and in the mouth. Syphilis can be transmitted during vaginal, anal, or oral sexual contact. Pregnant women with the disease can pass it to their unborn children. After the initial sore heals the disease can develop into a secondary, latent and neurosyphilis condition if not treated. For more information see:
<http://www.cdc.gov/std/syphilis/STDFact-Syphilis.htm>
- E. Treatments: There are no home remedies or over-the-counter drugs that will cure syphilis, but syphilis is easy to cure in its early stages. A single intramuscular injection of long acting Benzathine penicillin G (2.4 million units administered intramuscularly) will cure a person who has primary, secondary or early latent syphilis. Although data to support the use of alternatives to penicillin is limited, options for non-pregnant patients who are allergic to penicillin may include doxycycline, tetracycline, and for neurosyphilis, potentially probenecid.
- F. Vaccines: No current vaccines but consistent use of latex condoms can reduce the spread of the bacteria.
- G. Levels in the US: CDC estimates that, annually, 55,400 people in the United States get new syphilis infections. There were 46,042 reported new cases of syphilis in 2011, which is almost as high as the number of new HIV infections and much higher than the number of gonorrhea cases. Of new cases of syphilis, 13,970 cases were of primary and secondary (P&S) syphilis, the earliest and most infectious stages of syphilis. There were also 360 reports of children with congenital syphilis in 2011.

III. Ebola

- A. Definition: Ebola hemorrhagic fever (Ebola HF) is a severe, often-fatal disease in humans and nonhuman primates (monkeys, gorillas, and chimpanzees) that has appeared sporadically since its initial recognition in 1976.
<http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/ebola/qa.htm>
- B. Name: Ebola virus (an RNA virus in the family filoviridae)
- C. Type: Ebola virus has several sub types that are named from the locations there were isolated from. The infection can be spread from human to human by secretions.
- D. Disease: The incubation period for Ebola HF ranges from 2 to 21 days. The onset of illness is abrupt and is characterized by fever, headache, joint and muscle aches, sore throat, and weakness, followed by diarrhea, vomiting, and stomach pain. A rash, red eyes, hiccups and internal and external bleeding may be seen in some patients. They are not sure why some patients survive and others do not. It has been noted those who die have not mounted a full immune response to the infection.
- E. Treatments: There is no standard treatment for Ebola HF. Patients receive supportive therapy. This consists of balancing the patient's fluids and electrolytes, maintaining their oxygen status and blood pressure, and treating them for any complicating infections.
- F. Vaccines: The prevention of Ebola HF in Africa presents many challenges. Because the identity and location of the natural reservoir of Ebola virus are unknown, there are few established primary prevention measures.
- G. Levels in the US: Confirmed cases of Ebola HF have been reported in the Democratic Republic of the Congo, Gabon, Sudan, the Ivory Coast, Uganda, and the Republic of the Congo. No case of the disease in humans has ever been reported in the United States.

IV. Malaria

- A. Definition: Malaria is a mosquito-borne disease caused by a parasite. People with malaria often experience fever, chills, and flu-like illness. Left untreated, they may develop severe complications and die. In 2010 an estimated 219 million cases of malaria occurred worldwide and 660,000 people died, most (91%) in the African Region. (cdc.gov)
- B. Name: *Plasmodium species*, the following four species are most common in human infections: *falciparum* (most deadly), *malariae*, *vivax*, *ovale*. Details and photos available at:
<http://www.cdc.gov/malaria/about/biology/parasites.html>
- C. Type: Parasite carried by a mosquito vector. Life cycle image:
<http://www.cdc.gov/malaria/about/biology/>
- D. Disease caused: malaria infection has an incubation period followed by fever and rigor cycles and often involves multiple organs and relapses. See <http://www.cdc.gov/malaria/about/disease.html> for

details.

- E. Treatments: Most drugs used in treatment are active against the parasite forms in the blood (the form that causes disease) and include: chloroquine, atovaquone-proguanil (Malarone®), artemether-lumefantrine (Coartem®), mefloquine (Lariam®), quinine, quinidine, and doxycycline, clindamycin (both used in combination with quinine).
 - a. In addition, primaquine is active against the dormant parasite liver forms (hypnozoites) and prevents relapses. Primaquine should not be taken by pregnant women or by people who are deficient in G6PD (glucose-6-phosphate dehydrogenase). Patients should not take primaquine until a screening test has excluded G6PD deficiency.
 - b. How to treat a patient with malaria depends on: the type (species) of the infecting parasite, the area where the infection was acquired and its drug-resistance status, the clinical status of the patient, any accompanying illness or condition, pregnancy, drug allergies, or other medications taken by the patient. (cdc.gov)
 - c. There are strains of malaria that are resistant to most available medications. They often appear in the Far East and spread west to Africa. There is always research being done to find the next medication to fight the resistant strains.
- F. Vaccines: There are medications that can be taken when traveling to reduce infection but no vaccines at this time. Prevention is key and includes using mosquito nets, long sleeves, mosquito repellent, anti-malarial medications, and screened or air conditioned living quarters.
- G. Levels in the US: No current endemic areas, only travelers that were infected elsewhere.

V. Tuberculosis

- A. Definition: Tuberculosis (TB) is a disease caused by a bacterium called *Mycobacterium tuberculosis*. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as the kidney, spine, and brain. If not treated properly, TB disease can be fatal. TB disease was once the leading cause of death in the United States. (see: <http://www.cdc.gov/tb/topic/default.htm> for any details on topics below.)
- B. Name: *Mycobacterium tuberculosis*
- C. Type: Acid-fast bacteria that is slow growing but has a slime coating that makes it hard to treat with antibiotics.
- D. Disease: TB is spread through the air from one person to another. Signs and symptoms include a bad cough lasting for 3 weeks or longer, coughing up blood or sputum, weakness and fatigue to name a few. The TB bacteria are put into the air when a person with TB disease of the lungs or throat coughs, sneezes, speaks, or sings. People nearby may breathe in these bacteria and become infected. The infection can be in the lungs, kidney, spine and brain. Not

everyone infected with TB bacteria becomes sick. As a result, two TB-related conditions exist: latent TB infection and TB disease

- E. Treatment: Active replication of the bacteria that is not controlled by the immune system leads to TB disease. TB disease can be treated by taking several drugs for 6 to 9 months. There are 10 drugs currently approved by the U.S. Food and Drug Administration (FDA) for treating TB. Of the approved drugs, the first-line anti-TB agents that form the core of treatment regimens include: isoniazid (INH), rifampin (RIF), ethambutol (EMB), pyrazinamide (PZA). Latent TB can be treated with the same drugs but for a shorter time as there are fewer bacteria present. There are some cases of TB that are resistant to most medications that have proven to be very difficult to treat.
- F. Vaccines: There is not a vaccine widely used in the United States. Bacille Calmette-Guérin (BCG) is a vaccine for tuberculosis (TB) disease. This vaccine is not widely used in the United States, but it is often given to infants and small children in other countries where TB is common. BCG does not always protect people from getting TB.
- G. Levels in the US: TB is the leading killer of HIV positive patients and affects over 10,000 US patients a year. For more details see: <http://www.cdc.gov/tb/statistics/default.htm>

VI. Polio

- A. Definition: Polio is a crippling and potentially deadly infectious disease caused by a virus that spreads from person to person invading the brain and spinal cord and causing paralysis. Because polio has no cure, vaccination is the best way to protect yourself and the only way to stop the disease from spreading. In the late 1940s to the early 1950s, in the United States alone, polio crippled around 35,000 people each year making it one of the most feared diseases of the twentieth century. By 1979 the country became polio free. (cdc.gov)
- B. Name: Poliovirus causes the disease poliomyelitis
- C. Type: Virus spreads from person to person, only affecting people.
- D. Disease: Approximately 95% of persons infected with polio will have no symptoms. About 4-8% of infected persons have minor symptoms, such as fever, fatigue, nausea, headache, flu-like symptoms, stiffness in the neck and back, and pain in the limbs, which often resolve completely. Less than 1% of polio cases result in permanent paralysis of the limbs (usually the legs). Of those paralyzed, 5-10% die when the paralysis strikes the respiratory muscles. The death rate increases with increasing age.
- E. Treatment: There is no cure for polio but vaccination is the best defense.
- F. Vaccines: There are two types of vaccines that can prevent polio: inactivated polio vaccine (IPV) and oral polio vaccine (OPV). Only IPV has been used in the United States since 2000; however OPV is still used throughout much of the world. IPV is given to children in the US

at months 2 and 4 and again between 6-18 months. A booster is given at 4-6 years. (<http://www.cdc.gov/vaccines/vpd-vac/polio/in-short-both.htm#trans>)

- G. Levels in the US: in 1979 the US became polio free, but it still affects other parts of the world.

VII. Smallpox

- A. Definition: Smallpox is a serious, contagious, and sometimes fatal infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination. (<http://emergency.cdc.gov/agent/smallpox/>)
- B. Name: Variola virus
- C. Type: A poxvirus spread from person to person with much contact.
- D. Disease: The first signs and symptoms are fever and malaise then sores appear in the mouth that break open and shed lots of virus. The patient will develop a rash over their body of small red spots with more on the limbs than the torso. The bumps become pustules that will begin to scab over. The person is contagious until the last scab falls off – about 4 weeks.
- E. Transmission: Generally, direct and fairly prolonged face-to-face contact is required to spread smallpox from one person to another. Smallpox also can be spread through direct contact with infected bodily fluids or contaminated objects such as bedding or clothing. Humans are the only natural hosts of variola. Smallpox is not known to be transmitted by insects or animals. A person with smallpox is sometimes contagious with onset of fever, but the person becomes most contagious with the onset of rash. The infected person is contagious until the last smallpox scab falls off.
- F. Treatment: There is no proven treatment for smallpox, but research to evaluate new antiviral agents is ongoing.
- G. Vaccination: Not given in a regular rotation but if it was needed the vaccine is still available. The vaccine is made from a virus called vaccinia which is a "pox"-type virus related to smallpox. The smallpox vaccine contains the "live" vaccinia virus—other vaccines containing live virus include measles, mumps, and German measles. For that reason, the vaccination site must be cared for carefully to prevent the virus from spreading. Also, the vaccine can have side effects. The vaccine does not contain the smallpox virus and cannot give you smallpox.
- H. Levels in the US: Smallpox outbreaks have occurred from time to time for thousands of years, but the disease is now eradicated after a successful worldwide vaccination program. The last case of smallpox in the United States was in 1949. The last naturally occurring case in the world was in Somalia in 1977. After the disease was eliminated from the world, routine vaccination against smallpox among the general public was stopped because it was no longer necessary for

prevention.

VIII. Agencies

- A. Students should be answering the following questions in their presentations: What are agencies already doing? What else should be done?
- B. Agencies that will be good resources:
 - a. Centers for Disease Control (CDC) most links were given in the above sections or you can check the alphabetical listing at [cdc.gov](http://www.cdc.gov). More specifically there is an entire page and publication devoted to emerging diseases through the CDC at: http://wwwnc.cdc.gov/eid/article/19/8/13-0121_article.htm?s_cid=eid-gDev-email (same as the engage link)
 - b. World Health Organization (WHO – pronounced the W. H. O. not ‘who’) great for a global perspective and a good resource for information on other countries. www.who.int/en/
 - c. State health and human services department can be found at: <http://www.hhsc.state.tx.us/> and local health departments can be found online and regional areas are defined on the map at this page: http://www.hhs.state.tx.us/aboutHHS/HHS_Regions.shtml

Activity

1. Divide the class in to four groups and assign each of them one of the following infections: malaria, polio, tuberculosis and smallpox. Ask the class to give a brief recap of the following points: infecting organism name, type and disease caused, treatments and vaccines currently available, pattern of effectiveness with the treatments (are they becoming resistant?), current infection levels in the world and the United States today. Have students develop a hypothesis of the future outcome for the disease and some possible responses needed to keep the organism in check. (for smallpox have them look at a bioterrorism option) (see resource links below). Note – Emerging and Reemerging Infectious Disease Research brainstorming sheet provided at the end of the lesson.
2. Research emerging diseases and keep a journal or blog or do weekly updates on what infections are mutating, emerging and becoming resistant each week. (EID Journal – http://wwwnc.cdc.gov/eid/article/19/8/13-0121_article.htm?s_cid=eid-qDev-email – they can even subscribe to it).
3. Like Smallpox there are many diseases that are well under control that could be used as a bioterrorist weapon. Have students brainstorm possible scenarios and what the response would need to be to prevent an epidemic. (i.e., a person is purposefully infected with smallpox and takes an airplane overseas infecting many passengers that return to several different countries, spreading the infection to many areas of the world in one day.) See resource link: <http://emergency.cdc.gov/bioterrorism/> or <http://emergency.cdc.gov/agent/agentlist.asp> for an alphabetical list with links to more information on all agents that they currently think could be used as bioterrorist weapons. Research maybe presented in any platform the teacher prefers. Encourage students to highlight details about the infectious organism and what procedures are already in place to prevent widespread problems.

Assessment

Presentation Rubric

Multimedia Rubric

Quiz

Materials

Internet access

Materials for presentation - teachers discretion

Quiz

Resources:

Malaria: <http://www.cdc.gov/malaria/> for great resources and images.

NPR Video sponsored by the CDC can be found at:

<http://www.npr.org/blogs/health/2012/12/13/167188333/herbs-and-empires-a-brief-animated-history-of-malaria-drugs>

Tuberculosis: <http://www.cdc.gov/tb/> for great resources and images.

<http://www.cdc.gov/tb/topic/basics/personalstories.htm> Personal testimonies about how TB affected patients of all ages, nationalities and backgrounds here in the US.

Polio: <http://www.cdc.gov/polio/> for great resources and images.

<http://www.cdc.gov/vaccines/vpd-vac/polio/default.htm> Specific information about the vaccination.

Smallpox: <http://emergency.cdc.gov/agent/smallpox/index.asp> Basic information and emergency preparedness response for smallpox.

<http://emergency.cdc.gov/agent/smallpox/vaccination/index.asp> Specific information about the vaccine.

Bioterrorism: <http://emergency.cdc.gov/bioterrorism/> good starting place.

<http://emergency.cdc.gov/agent/agentlist.asp> Alphabetical list with links to more information on all agents that they currently think could be used as bioterrorist weapons.

Emerging Infectious Diseases Journal: <http://wwwnc.cdc.gov/eid/>

Accommodations for Learning Differences

For reinforcement create a chart for novel and reemerging disease patterns. Organize the diseases by type of microorganism and note the mode of transmission, treatments/vaccinations, morbidity/mortality rates and level of current infections in the US or world. See Emerging and Reemerging Infectious Disease Chart.

For enrichment have students create a paper, project or presentation that combines research about a selected disease and world history. Have students develop positive and negative scenarios of how the disease could have changed the course of history if it had been handled differently.

National and State Education Standards

National Health Science Cluster Standards

Health Science HLC01.01 Academic Foundations

Health care workers will know the academic subject matter required for proficiency within their area.

Use knowledge of human structure and function: Analyze the interdependence of the body systems as they relate to wellness, disease, disorders, therapies and care rehabilitation.

Use knowledge of diseases and disorders: Analyze methods to control the

spread of pathogenic microorganisms. Contrast various types of immunities. Analyze body system changes in light of diseases, disorders and wellness.

TEKS

130.207(c)5 (E) Evaluate the effects of anti-microbial agents;
(F) Examine reemergence of diseases such as malaria, tuberculosis, and polio; (H) Outline the role of the governing agencies in monitoring and establishing guidelines based on the spread of infectious diseases.

Texas College and Career Readiness Standards

Cross-Disciplinary Standards

- C. Research across the curriculum 2. Explore a research topic 6. Design and present an effective product.
- E. Technology 1. Use technology to gather information. 3. Use technology to communicate and display findings in a clear and coherent manner.

Social Studies Standards

III. Interdependence of Global Communities

- A. Spatial understanding of global, regional, national and local communities 2. Connect regional or local developments to global ones
- B. Global analysis 1. Apply social science methodologies to compare societies and cultures

Science Standards

VI. Biology

- F. Systems and homeostasis 1. Know that organisms possess various structures and processes (feedback loops) that maintain steady internal conditions

English/Language Arts Standards

IV. Listening

- A. Apply listening skills as an individual and as a member of a group in a variety of settings 1. Analyze and evaluate the effectiveness of a public presentation 2. Interpret a speaker's message; identify the position taken and the evidence in support of that position.

Emerging and Reemerging Infectious Disease Research

Group Disease: _____

Infecting Organism (scientific name): _____

Type of Organism: _____

Disease Signs, Symptoms and Progression:

Treatments Available (remember to include locations available and type of treatment):

Patterns of Effectiveness (Does treatment always work? Are there patterns of resistance? What are they?):

Vaccine (include locations available):

Current levels of infection in the USA and worldwide:

Morbidity/mortality rates:

Hypothesis of the future outcome for the disease and some possible responses needed to keep the organism in check:

Bioterrorism possibilities (if applicable):

Emerging and Reemerging Infectious Disease Chart

Name	
Type of Microorganism	
Mode of Transmission	
Disease signs, Symptoms, and Progression	
Treatments	
Vaccine	
Morbidity/Mortality rates	
Level of current infection in the US or world	
Name	
Type of Microorganism	
Mode of Transmission	
Disease signs, Symptoms, and Progression	
Treatments	
Vaccine	
Morbidity/Mortality rates	
Level of current infection in the US or world	
Name	
Type of Microorganism	
Mode of Transmission	
Disease signs, Symptoms, and Progression	
Treatments	
Vaccine	
Morbidity/Mortality rates	
Level of current infection in the US or world	

Emerging and Reemerging Infections Quiz

Match the following diseases with the type of microorganism that causes them.

Answers may be used multiple times

- | | |
|-----------------|-------|
| 1. Malaria | _____ |
| 2. Tuberculosis | _____ |
| 3. Polio | _____ |
| 4. Influenza | _____ |
| 5. Syphilis | _____ |
| a. Parasite | |
| b. Virus | |
| c. Bacteria | |

Multiple Choice Questions:

6. Which of the following must pass through a mosquito vector to infect humans?
 - a. Smallpox
 - b. Influenza
 - c. Malaria
 - d. Polio

7. There is a cure but not vaccine for syphilis; which medication must be given?
 - a. Quinine
 - b. Penicillin
 - c. Tylenol
 - d. BCG shot

Short Answer Questions:

8. Which diseases have a vaccine that can be used to prevent the infection?

9. Describe the treatment options for patients with tuberculosis.

10. How can a malaria infection be prevented?

Emerging and Reemerging Infections Quiz **KEY**

Match the following diseases with the type of microorganism that causes them.
Answers may be used multiple times

- 1. Malaria **A**
- 2. Tuberculosis **C**
- 3. Polio **B**
- 4. Influenza **C**
- 5. Syphilis **B**
 - a. Parasite
 - b. Virus
 - c. Bacteria

Multiple Choice Questions:

- 6. Which of the following must pass through a mosquito vector to infect humans?
 - a. Smallpox
 - b. Influenza
 - c. **Malaria**
 - d. Polio
- 7. There is a cure but not vaccine for syphilis, which medication must be given?
 - a. Quinine
 - b. **Penicillin**
 - c. Tylenol
 - d. BCG shot

Short Answer Questions:

- 8. Which diseases have a vaccine that can be used to prevent the infection?
 - a. **Smallpox, TB, Polio, Influenza**
- 9. Describe the treatment options for patients with tuberculosis.
 - a. **Several antibiotics are needed for several months to defeat a TB infection especially a resistant infection. Some medications may include: isoniazid (INH), rifampin (RIF), ethambutol (EMB), pyrazinamide (PZA).**
- 10. How can a malaria infection be prevented?
 - a. **Mosquito nets, long sleeves, mosquito repellent, anti-malarial medications, and screened or air conditioned living quarters.**

Multimedia Rubric

Student: _____ Class: _____

Title: _____ Other Group Members: _____

Date: _____

Scoring criteria	5 Excellent	4 Good	3 Needs Some Improvement	2 Needs Much Improvement	1 N/A
Clearly and effectively communicates an introduction of the theme/objective of the project.					
Clearly and effectively communicates the content throughout the presentation.					
Integrated a variety of multimedia resources to create a professional presentation (transition, graphics).					
Presentation holds audience attention and relates a clear message.					
Timing between slides is beneficial for the viewer to read or observe content.					
Each image and font size is legible to entire audience.					

Scale:

26-30 A Excellent

21-25 B Good

16-20 C Needs Some Improvement

11-15 D Needs Much Improvement

6-10 F Not Appropriate

TOTAL=

Comments

Oral Presentation Rubric

Student: _____ Date: _____

Scoring criteria	4. Excellent	3. Good	2. Needs Some Improvement	1. Needs Much Improvement	N/A
Clearly and effectively communicates the main idea or theme.					
Presenter is self-confident and clearly expresses ideas.					
Presenter answers questions with well thought out responses.					
Holds audience attention and maintains eye contact.					
Visual aids are clear and add to the presentation.					

NOTE: N/A represents a response to the performance which is "not appropriate."