

**Title:** Emerging Pathogens

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**Abstract:**

This action plan is designed to give students a comprehensive introduction of emerging pathogens. The purpose is to provide students with a background on bacterial and viral pathogens (including human and plant) but most importantly to peak student interest in this field of science.

The action plan will take place in one 43-minute class and four 47-minute classes. Students will be presented with information through short lectures, they will participate in laboratory activities, and they will do a simple research and presentation at the end of week.

**Rationale:**

This project will target AP Chemistry students who have been studying chemistry for the past two years and are getting ready to start studying a different field of science. Most of these students will be taking AP Biology, AP Environmental Science or Anatomy and Physiology. The teaching unit will be completed during exam review week since these students do not have a final exam after taking the AP Chemistry exam.

“Emerging Pathogens” will give the students a better understanding of infectious diseases and common means of transmission. Students will learn about bacterial pathogens and common bacterial infections and they will learn about viral pathogens and common viral infectious diseases. The lesson will also include information about treatments and prevention; vaccines and antibiotics and it will provide students with knowledge on some very important and relevant problems the world is currently facing due to emerging pathogens.

**Teaching Unit:**

Day 1 – Emerging Pathogens - PowerPoint presentation to overview a variety of emerging pathogens, both bacterial and viral. Presentation will describe what a pathogenic agent is, the different types of pathogens and diseases they cause, as well as the effects of pathogenic agents on individuals and public health. Presentation will discuss what an infectious disease is, what causes infectious diseases and how infectious diseases can be transmitted, reduced, and treated.

Day 2 – Bacterial Pathogens - PowerPoint presentation on antibiotic resistant bacteria. Presentation will explain how antibiotics work and how do antibiotics get to the bacteria in the body. Presentation will explain how bacteria cell can acquire new genes through conjugation and how a population of bacteria may develop resistance to new antibiotics. Students will participate in a lab activity where they will be able to qualitatively test if their E.coli sample is resistant to Ampicillin or Kanamycin.

Day 3 – Viral Pathogens – Students will complete the “CDC Website: Activity, the “Modeling an Epidemic” Activity and the “Tracking an Epidemic” Activity.

Day 4 – Plant Pathogens – PowerPoint presentation on plant pathogens including bacteria, virus, and fungi as well as information about genetically engineered foods.

Day 5 – Students will present a recent (within the past year) emerging pathogen related news article of their choice. The presentation must include date, location, host, vector, environment and outcome. Students will complete a rubric while listening to the presentations.

### **Learning Outcomes:**

1. Students will understand what emerging pathogens are and will be able to name at least one infectious disease caused by a bacterial pathogen and one infectious disease caused by a viral pathogen.
2. Students will be able to explain how bacteria reproduce and how bacterial can become antibiotic resistant.
3. Students will be able to explain how the Ebola virus affects humans and the importance of collecting and studying patient information.
4. Students will be able to distinguish between among plant pathogens such as bacteria, virus and fungi.
5. Students will understand the concept of genetically engineered foods and will be able to have a discussion about pros and cons of genetically engineered foods.
6. Students will be able to research and present a recent piece of news related to emerging pathogens. Students will be able to complete a rubric while listening to a presentation.

### **Data Collection/Student Assessment:**

1. Students will be given an exit ticket where they will be asked to write one example of a bacterial pathogen and one example of a disease caused by a bacterial pathogen along with one example of a viral pathogen along and one example of a disease caused by a viral pathogen.
2. Students will report the antibiotic their bacteria is resist to after completing the laboratory experiment.
3. Students will complete and turn in the CDC website activity. Students will answer the questions upon completing the “Tracking an Epidemic” activity and will present their finding to the class. Groups will be allowed to have a discussion in case they do not agree on who patient zero was.
4. Students will be given an exit ticket where they will be asked to write two interesting things they learned and two questions they still have.
5. Students will submit their research and students will submit the completed rubric for each presentation.
6. Students will complete an online survey as a reflection of the week.

**Item/vendor/cost:**

Item Number	Item	Vendor/Source	Cost
216858	1x Ampicillin Solution, 4 mL	Carolina	\$ 6.25
216862	1x Kanamycin Solution, 4 mL	Carolina	\$ 6.25
216650	1x Luria Broth, 50-mL bottles, Pack of 5	Carolina	\$ 26.50
211540	8x MM294/pAMP Slant	Carolina	\$ 13.50
211550	8x MM294/pKAN Slant Culture Item	Carolina	\$ 14.75
703046	5x Inoculating Needles, Sterile, Disposable, Pack 30	Carolina	\$ 7.45
215098	3x SpectraTube™ Centrifuge Tubes, 15 mL, Pack of 50	Carolina	\$ 32.95

**Locker:**

Vortex:

0-3000 RPM vortex for mixing solutions

Pipetting Stations: 1-20 µl and a 20-200 µl micropipette for each lab group

**Total:** \$401.10 for two applicants**CATALySES elements specifically included (UF Connection):**

Antibiotic Resistant Bacteria Lab

Ebola Epidemic Lab

Topics from Plant Pathogen Day lecture information

Topics from Dr. Morris “So What is an Emerging Pathogen”

Topics from Dr. Venugopalan “Staying Ahead of the Race Against Antibiotic Resistance”

Topics from Dr. Maurelli “A Brief History of Shigella”

Topics from Dr. Barbey “Genetic Engineering in Crops”

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CATALySES 2019 - Lesson Plan

**TITLE:** We are baaaaaack! A lesson on Emerging Pathogens

**KEY QUESTIONS:**

1. What is a pathogen?
2. What are the main types of the different pathogens that exist?
3. What is an emerging pathogen?
4. Why do pathogens emerge?
5. What are some examples of each of the different types of emerging pathogens that exist?
6. Which diseases do these pathogens cause?
7. How can a pathogenic disease affect an individual person?
8. How can a pathogenic disease affect public health?
9. What measures can be taken in order to reduce the spread of pathogens?

**SCIENCE SUBJECT:** AP Chemistry

**GRADE AND ABILITY LEVEL:** 9<sup>th</sup>-12<sup>th</sup> , regular or honors classes.

**SCIENCE CONCEPTS:** Emerging Pathogens including bacteria and viruses.

**OVERALL TIME ESTIMATE:** 50 minutes

**LEARNING STYLES:** Visual and auditory

**VOCABULARY:**

**Antibiotic:** a medicine (such as penicillin or its derivatives) that inhibits the growth of or destroys microorganisms.

**Antibiotic resistance:** the ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive. Antibiotic resistance is a major concern of overuse of antibiotics. Also known as drug resistance.

**Bacterium:** a member of a large group of unicellular microorganisms which have cell walls but lack organelles and an organized nucleus, including some which can cause disease.

**Contagious:** spread from one person or organism to another by direct or indirect contact.

**Disease transmission:** infectious diseases are commonly transmitted through direct person-to-person contact. Transmission occurs when an infected person touches or exchanges body fluids with someone else. This can happen before an infected person is aware of the illness.

**Emerging Pathogen:** An emerging pathogen has been defined as the causative agent of an infectious disease whose incidence is increasing following its appearance in a new host population or whose incidence is increasing in an existing population as a result of long-term changes in its underlying epidemiology.

**Host:** an organism that harbors a parasitic, a mutualistic, or a commensalist guest (symbiont), the guest typically being provided with nourishment and shelter.

**Infectious diseases:** disorders caused by organisms — such as bacteria, viruses, fungi or parasites.

**Pathogen:** a bacterium, virus, or other microorganism that can cause disease.

**Vaccine:** a substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, treated to act as an antigen without inducing the disease.

**Vector:** an organism that does not cause disease itself, but which spreads infection by conveying pathogens from one host to another.

**Virus:** an infective agent that typically consists of a nucleic acid molecule in a protein coat, is too small to be seen by light microscopy, and is able to multiply only within the living cells of a host.

**LESSON SUMMARY:** This lesson will be a lecture with a PowerPoint presentation. In this lesson, students will be presented with examples of emerging pathogens and the diseases they cause. Students will be presented to some of the reasons why pathogens are emerging and reemerging and the transmission process. Students will also learn about ways to reduce the spread of diseases including antibiotic and vaccine.

### **STUDENT LEARNING OBJECTIVES WITH STANDARDS:**

The students will be able to:

SC.6.L.14.6 Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi, and parasites.

1. Give examples of emerging pathogens and diseases caused by the pathogen.
2. Identify if a disease is caused by bacteria or viruses.
3. Explain the difference between a vaccine and an antibiotic.
4. Explain in their own words why pathogens are emerging and the gravity of this problem.

**MATERIALS:** Computer and LCD projector.

**BACKGROUND INFORMATION:** This lesson does not require much background knowledge. It is important for the teacher to research the most recent cases of emerging pathogens in order to start the conversation with the students. Other than that, all of the content necessary is in the PowerPoint presentation.

**ADVANCED PREPARATION:** Research the most recent news on emerging pathogens and familiarize yourself with some of the most important (relevant) outbreaks in history.

### **PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES:**

The PowerPoint Presentation: 40 minutes

Exit Ticket: 10 minutes

### **ASSESSMENT SUGGESTIONS:**

Use the last 5-10 minutes of class to have students complete an exit ticket.

Ask students to list the following based on the information they learned.

- *3 different types of pathogens,*
- *2 reasons why pathogens are emerging, and*
- *1 way to prevent the spread of diseases.*

### **EXTENSIONS:**

Students can be asked to complete any of the following:

- PowerPoint or Prezi to overview a variety of pathogens representing the four main types and the diseases associated with them
- Poster to be posted in community to outline different pathogens and possible things to do if afflicted
- Brochure to be shared with community to outline different types of pathogens and the diseases associated with them
- Public service announcement or short video no longer than a typical commercial to spread awareness of different common pathogens, possible things to do to avoid infection, and what to do if afflicted

### **RESOURCES/REFERENCES:**

- Morris, J. Glenn. *So what is an emerging pathogen?*
- <http://www.epi.ufl.edu/pathogens/>