

## **Title: How do you get sick?**

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### **ABSTRACT**

Biotechnology and genomics are relevant, cutting-edge topics for high school students to learn science in the 21st century. Integrated science, such as biotechnology and genomics, will play an important role in addressing sustainable food production and improvement in human health (NRC, 2009). It is imperative that high school students understand related concepts and consider the benefits and costs of this area of science (McLaughlin & Glasson, 2003) to become informed citizens and make decisions (NRC, 2012). Effective biotechnology education is essential to develop students' knowledge and science literacy (Chen & Raffan, 1999).

The purpose of the lessons in this module is to help students learn what an epidemiologist must do to investigate the cause of an epidemic. These investigations help epidemiologists find out how to control a current outbreak of a disease and to prevent further outbreaks of the disease.

### **RATIONALE**

The study of epidemiology involves understanding certain patterns that exist in the occurrence of different diseases. This study is not just confined to infectious diseases. Students will play as the role of an epidemiologist and also focus on environmental diseases extensively, and even chronic diseases such as heart disease and diabetes, because these diseases also affect different segments of the population differently. By understanding the patterns of a certain disease, the student will then use this information to determine the cause of a sudden outbreak of a known disease.

Epidemiology works to uncover and explain the factors that determine disease frequency and distribution. In the field of infectious disease, epidemiologists identify infectious agents; determine how they are spread, who gets infected, and the results of infection. This is a difficult task because not only are there different infectious agents, but there are also different environments in which they live, methods by which they spread, methods of invasion into the host, and different host abilities to fight the infectious agent. The possibilities are endless.

The purpose of the lessons in this module is to help students learn what an epidemiologist must do to investigate the cause of an epidemic. This activity simulates how a pathogen can spread among a population. Students will exchange paper with one another to simulate the epidemiology of tracking an infectious agent. After this activity, the students should have a better understanding of how infectious agents spread from person to person and ways to prevent outbreaks

This module would allow students to participate in a variety of activities ranging from traditional classroom lectures and unto the reinforcement of some laboratory skills and techniques such as gel electrophoresis, Polymerase Chain Reaction, and BLAST. At the end of the lesson the students should be able to make a poster board with information about the outbreak and the results from their laboratory experiments.

**DESCRIPTION OF TEACHING UNIT OR MODULE(S), INCLUDING EXPECTED OUTCOMES:**

**1. SC.912.L.16.10 - Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.**

- explain the possible impact of biotechnology on the individual, society, and/or the environment
- evaluate examples of the possible impacts of biotechnology on the individual, society, and/or the environment
  - *content should address current issues but will not require knowledge of specific biotechnologies or specific medical issues*
  - *content addressing the possible impacts of biotechnology should not address monetary impacts*

**2. SC.912.L.14.6 - Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.**

- explain the significance of genetic factors to health from the perspective of both individual and public health at a conceptual level
  - *students should not be required to recall specific genetic factors in order to analyze their impact on individual and public health*
- explain the significance of environmental factors to health from the perspective of both individual and public health at a conceptual level
  - *students should not be required to recall specific environmental factors in order to analyze their impact on individual and public health*
- explain the significance of pathogenic agents to health from the perspective of both individual and public health at a conceptual level
  - *students should not be required to recall specific pathogenic factors in order to analyze their impact on individual and public health*

## SEQUENCE OF LESSON:

Day One: Students will do a mind mapping about the following words:

1. Pathogens
2. Diseases
3. Outbreak

Day Two: Close Reading about Cholera Outbreak in Bohol, Philippines last 2011 and Web quest

Day Three: Module 1: How do we get sick. Nearpod lesson

Day Four: Micropipette Activity using ASM worksheets and protocols with some modifications

Day Five: Isolation of Cholera DNA and PCR

Day Six: Gel electrophoresis

Day Seven: Students will work on all of their results, draw conclusions and finish their lab report

Day Eight: Students will develop poster boards informing the community about Cholera

Day Nine: Continue as above

Day Ten: Presentation

The learning outcomes are as follows:

Student evidence should show that they can:

- evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.
- analyze the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.
- conduct an experiment to show the effects of certain technology on the environment.

## **Data Collections techniques, and/or student assessments:**

1. Unit Pre-Test
2. The spread of pathogens (laboratory experiment and simulation)
3. Lab Reports (DNA Extraction, Gel electrophoresis, PCR)
4. Poster Board Presentation
5. Post Test

## **Use of equipment lockers and/or UF visit (either in the classroom or UF campus)**

1. Pipetting stations
2. Gel electrophoresis
3. PCR kit
4. DNA isolation kit

5. Antibiotic resistance bacteria laboratory

**CATALYSES Summer Institute elements specifically included (UF Connections)**

1. Emerging Pathogens by Dr. Glenn Morris
2. Antibiotic Resistance Lab

How your proposal differ from what you normally teach, new pedagogies; how you previously taught this lesson or topic versus how you plan to teach it under your Action Proposal.

1. I will be teaching a new subject this school year which is AP Environmental Science the preparation for this subject is far different from the subject I taught last year which is Marine Science. Before, I only used Canvas, Newsela, Doing Close Reading, and a lot of worksheets. After undergoing this program it gave me a lot of new ways to engage the students in science and make science fun for them.
2. This school year I am planning to incorporate most of the laboratory skills that we did in the program especially that most of my students for this year have their Biology subject during their 10<sup>th</sup> grade.
3. I am planning to teach emerging diseases by integrating this on the biotechnology standards of the AP Environmental Science Curriculum mostly through simulations, laboratory activities, and research workshop.

**LITERATURE:**

1. Teaching Emerging Diseases: A Strategy for Succeeding with Nonmajors by Marion Field Fass  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3633094/>
2. Outbreak, Cells, Pathogens, Disease. By Janice Anderson, Lana Minshew, and Tiffany McLendon
3. Teachers' Concerns About Biotechnology Education by Lisa A. Borgerding, Troy D. Sadler and Mary Jo Koroly

## **SCIENCE LESSON PLAN**

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**TITLE:** How do you get sick?

**KEY QUESTION:** How infectious agents spread from person to person and the ways to prevent outbreaks?

**SCIENCE SUBJECT:** Environmental Science

**GRADE AND ABILITY LEVEL:** 9<sup>th</sup> and 12<sup>th</sup> grade. Some students are finished with Biology

**SCIENCE CONCEPT:** Pathogenesis, Genetic Evolution, Biochemistry

**OVERALL TIME ESTIMATE:** 50-minute class period

**LEARNING STYLES:** Visual, auditory, kinesthetic and collaborative

### **VOCABULARY:**

1. agent: A factor, such as a microorganism, chemical substance, or form of radiation, whose presence, excessive presence, or (in deficiency diseases) relative absence is essential for the occurrence of a disease.
2. biologic transmission: The indirect vector-borne transmission of an infectious agent in which the agent undergoes biologic changes within the vector before being transmitted to a new host.
3. carrier: A person or animal without apparent disease who harbors a specific infectious agent and is capable of transmitting the agent to others. The carrier state may occur in an individual with an infection that is inapparent throughout its course (known as asymptomatic carrier), or during the incubation period, convalescence, and postconvalescence of an individual with a clinically recognizable disease. The carrier state may be of short or long duration (transient carrier or chronic carrier).
4. cause of disease: A factor (characteristic, behavior, event, etc.) that directly influences the occurrence of disease. A reduction of the factor in the population should lead to a reduction in the occurrence of disease.
5. environmental factor: An extrinsic factor (geology, climate, insects, sanitation, health services, etc.) which affects the agent and the opportunity for exposure.
6. epidemic: The occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time.
7. epidemiology: The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.
8. host factor: An intrinsic factor (age, race, sex, behaviors, etc.) which influences an individual's exposure, susceptibility, or response to a causative agent.
9. vector: An animate intermediary in the indirect transmission of an agent that carries the agent from a reservoir to a susceptible host.
10. Proteins: major functions within cells, allowing transport (in and out of the cell), receptor (to be recognized by immune system), and enzymes

## LESSON SUMMARY:

The purpose of the lessons in this module is to help students learn what an epidemiologist must do to investigate the cause of an epidemic. This activity simulates how a pathogen can spread among a population. Students will exchange paper with one another to simulate the epidemiology of tracking an infectious agent. After this activity, the students should have a better understanding of how infectious agents spread from person to person and ways to prevent outbreaks

## STUDENT LEARNING OBJECTIVES WITH STANDARDS:

The students will be able to...

1. **SC.912.L.16.10 - Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.**
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  - explain the significance of environmental factors to health from the perspective of both individual and public health at a conceptual level
    - *students should not be required to recall specific environmental factors in order to analyze their impact on individual and public health*
  - explain the significance of pathogenic agents to health from the perspective of both individual and public health at a conceptual level
    - *students should not be required to recall specific pathogenic factors in order to analyze their impact on individual and public health*

## MATERIALS:

1. Pipetting stations
2. Gel electrophoresis
3. PCR kit
4. DNA isolation kit
5. Antibiotic resistance bacteria laboratory
6. Laptop
7. Bond paper
8. Coloring materials

## ADVANCE PREPARATIONS:

- Teacher must group the students accordingly. (Heterogenous)
  - Prepare the different materials for mind mapping that includes the following:
    - Colored pen
    - Pencil
    - Bond paper

## PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES:

### One Day Lesson Plan

- Lesson introduction (~3 Minutes)
  - Bell-ringer question: How do you prepare for a disease outbreak?
  - Close reading activity about Cholera outbreak in the Philippines
- Activity Procedure (~30 Minutes)
  - Close reading
  - Students will start answering their mind map
- Student-Based Learning (~20 Minutes)
  - Allow students to share their within the group and why they have written the following words
  - When all groups have finished, ask them to create one mind map for each group and present to the class
  - Peers will rate their presentation using a rubric

## ASSESSMENT SUGGESTIONS:

Have the students watch a news report about the epidemic cholera outbreak in the Philippines. They will be handed with a guide questions after watching the video.



# How do you get sick?

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AP Environmental Science  
Marine Science Honors  
Olympia High School



# PURPOSE/RATIONALE



Epidemiology

Diseases

Emerging  
Pathogens

Student  
Awareness

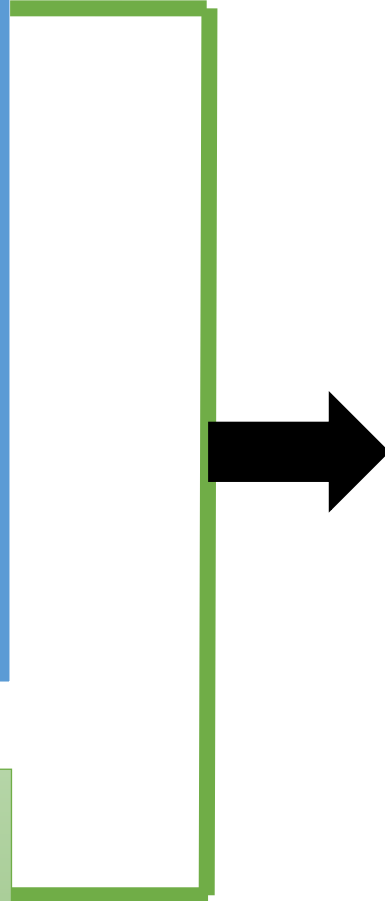
## CURRICULUM STANDARDS

1. SC.912.L.16.10 - Evaluate the impact of biotechnology on the individual, society and the environment, including **medical and ethical issues.**
2. SC.912.L.14.6 - Explain the **significance of genetic factors, environmental factors, and pathogenic agents to health** from the perspectives of both individual and public health



## CORE THEMES

1. Microorganisms and Humans
2. Microorganisms and Environment



By completing this activity, the student will:

1. Learn the concepts involved in epidemiology.
2. Discuss the importance of epidemiology in disease prevention.
3. Experience tracing the spread of a pathogen through a population.

# OVERVIEW OF ACTIVITIES

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