

Dark Biology: Pathogens Through the Eyes of a Bioterrorist!

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Abstract:

This action proposal will immerse 11th grade environmental science students in an intensive, hands-on, biotechnology based curriculum unit focused on emerging pathogens and their use in bioterrorism with the intention to generate learning gains and allow students to gain knowledge of and interest in science. The action proposal will take place over the course of nine weeks or until fully completed. Multiple learning styles will be used over the course of the action plan. The students will participate in a variety of activities, ranging from lectures, hands-on labs, and student involvement in multiple simulations of what would happen in a true outbreak of a pathogen. As learning process continues, students will research and debate the ethics that goes along with researching a virus or bacteria that could be used as a bioterrorism weapon. As a hopeful final extension my students will Skype with students in Broward County to complete a full simulation of a mystery infection, which is the result of a bioterrorist act.

Rationale:

This project will target 11th grade student in a standard environmental science course. Students at my school are very interested in topics such as virus spread and bioterrorism. This year I will be incorporating parts of the following books: The Hot Zone, The Demon in the Freezer, and Panic in Level 4. All of these are true stories written by Richard Preston. This action plan will increase my students reading and comprehension skills, as well as increase and improve student's lab skills and knowledge of biotechnology.

“Dark Biology: Pathogens Through the Eyes of a Bioterrorist” will broaden students knowledge of viruses and bacteria, what are they comprised of, the mechanics behind how they work, and how they could be used or altered to do harm. They will research how these pathogens could be used a large scale to cause large damage by methods such as making them air borne, put into the water system, sprayed on farms or agriculture, or used in our meat food sources. Students will use various techniques to solve multiple mystery bioterrorist events over the course of the semester. *These will be only simulations!* By engaging in this in-depth study of pathogens students will gain excitement and knowledge of the workings and skills, careers, and ethical issues available in the science field.

Description of teaching unit or module(s), including expected outcomes:

This teaching unit, which will span approximately 9 instructional weeks, or one quarter, as it will run alongside what the students are learning in class, will focus on the following:

- SC.912.L.14.3: Compare/contrast plant and animal cells as well as compare/contrast prokaryotic and eukaryotic cells.
- SC.912.L.14.4: Compare/contrast the structure and function of various microscopes.
- SC.912.L.14.52: Basic functions of the immune system, including specific and nonspecific immune response, vaccines, and antibodies.

- 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.
- SC.912.L.16.10: Evaluate the impact of biotechnology on the individual, society and environment, including medical and ethical issues.
- SC.912.L.16.17: Compare/contrast mitosis and meiosis.
- SC.912.L.16.7: Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.

The learning outcomes are as follows:

- Students will differentiate between plant and animal cells, as well as prokaryotic and eukaryotic cells.
- Students will differentiate between the structure and function of various microscopes and be skilled with use both light and dissecting microscopes.
- Students will understand the basic functions of the immune system.
- Students will explain how different factors and agents affect both individual and public health.
- Students will evaluate the impact of biotechnology.
- Students will differentiate between mitosis and meiosis.
- Students will describe the lifestyles of viruses and bacteria.
- Students will compare and contrast the relationships among organisms.
- Students will compare and contrast how different methods of transmission can affect how many people are affected by the virus or bacteria.

The student learning outcomes will be achieved through the completion of the following activities:

- Book study of parts of The Hot Zone, The Demon in the Freezer, and Panic in Level 4
- Lesson: Cells: Bioterrorism: The Basics
- Student research: categories and examples of bioterrorism pathogens
- Giant Microbes Activity
- Lesson: Exploration beyond the naked eye: Microscopes!
- Microscopes lab
- Lesson: Biotechnology Basics
- Lesson: DNA vs. RNA: Why's it so important?
- DNA extraction lab
- Micropipetting and designer plates lab
- Gel Electrophoresis lab
- Lesson: Virus vs. Bacteria: What's the big difference?
- Lesson: Immune system: Who needs one?
- Glow germ lab
- Lesson: Transmission methods: Air, Soil, Water, Crops, Animals, Person-to-person
- Viewing: "Outbreak" and "Contagion" and completing a detailed analysis of both
- ELISA lab
- Lesson and debate: Bioethics
- Lesson: Careers in science
- Hopefully an extension: Simulation students with Broward
- Hopefully field trip to UF for a Medical mysteries type of simulation or contagious disease

Data collection techniques and/or student assessment:

- Unit pretest
- Lab reports
- Movie analysis (fact vs. fiction)
- Successful completion of simulations with write ups
- Successful completion of extension
- Unit post test

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

- Giant microbe
- Pipetting stations kit and designer plates
- Gel electrophoresis
- Contagion movie
- Detecting water borne pathogens thorough colormetric methods
- Pipetting my design
- Bacterial pathogens slide set
- Medical mystery (would like to do this lab or similar one at UF)

ICORE summer institute elements specifically included (UF connections):

- Topics from Dr. Kassidy Chauncey's lecture on "Bioterrorists and Anthrax"
- Help and assistance from Dr. Kassidy Chauncey
- "Contagion" movie study

Lesson Title: Dark Biology: Pathogens Through the Eyes of a Bioterrorist
Bioterrorism: The Basics!

Content Topics:

- Pathogens and bioterrorism

Target Grade Level:

- 11th grade

Specific Subject:

- Environmental Science

Objectives:

The student will be able to:

1. Explain the term bioterrorism and produce examples of recent bioterrorism acts.
2. Describe the recent changes in life science.
3. Explain the importance of biosecurity.
4. Explain and give examples of each of the CDC categories for bioterrorism weapons.

Materials:

Student materials (per group of 3-4 students):

- Posterboard
- Markers, crayons, or colored pencils
- Internet access
- Magazines
- Scissors
- One roll of clear tape or one bottle of glue

Procedure and Discussion Questions:

1. Brief lecture introducing, explaining, and discussing the term bioterrorism. (20 minutes)
2. Student research time about their bioterrorism weapon and it's category on CDC website, which will be done in groups of 3-4 students. (25-30 minutes)
3. Student time to work on posterboards and prepare for presentation about their assigned bioterrorism weapon and it's category on the CDC website, which will be completed in groups of 3-4 students, same groups as #2) (30 minutes)
4. Presentation of each group of their assigned bioterrorism weapon and it's category on the CDC website, which will be completed in groups of 3-4 students, same as above) (30 minutes)

Assessment Suggestions:

For objective 1, the following two question bellwork assignment will be given:

1. Please explain the term bioterrorism.
2. Please produce 2 examples of recent bioterrorism acts.

For objective 2, the following bellwork question will be given:

1. Please list 3 recent changes in life science.

For objective 3, the following bellwork will be given:

1. Please explain the importance of biosecurity and list two examples of why it is important in a minimum of one paragraph.

For objective 4, students will research in groups of 3-4 one of the bioterrorism weapons and what category it is in on the CDC website, create a poster about their assigned bioterrorism weapon and category, and present as a group their information.

Resources:

Dr. Kassidy Chauncy powerpoint : Bioterrorism Basics

CDC website on bioterrorism: <http://www.bt.cdc.gov/bioterrorism/>

Lesson Title: Exploration beyond the naked eye: Microscopes!

Content Topic:

- Microscopes: types, uses, and basics

Target Grade Level:

- 11th

Specific Subject:

- Environmental Science

Objectives:

The student will be able to:

1. Compare and contrast the structure and function of various types of microscopes.
2. Explain how to make a microscope slide for different types of media.

Materials:

Per class:

- 6 light microscopes
- 3-5 dissecting microscopes (depending on availability)
- Bacterial pathogens microscopes slide set
- Clean slides and slide covers
- Pond water

Procedure and Discussion Questions:

1. Color code microscope worksheet handed out and completed by students as a homework assignment. Worksheet was found in the Biology Teacher Color Book. (20-30 minutes at home)
2. Brief lecture on the structure and function of the various types of microscopes, to include demonstrations of the light and dissecting scopes, as well as photographs of other types of microscopes. (20-30 minutes)
3. Demonstration, which should be projected on the overhead screen, of how to make your own microscope slide using pond water. Other methods can be shown as YouTube video clips (If deemed appropriate). (15 minutes)
4. Lab work stations using the microscopes. Each station should have 2 slides for the students to view and sketch what they see. One station should have the students use pond water to create their own slides. 3-5 dissection scopes should be set up with various items for students to view (bugs, leaves, etc). (50 minutes)

Assessment Suggestions:

For objective 1, students will be give a list of the following types of microscopes and must be able to explain the fuctions: light microscope, dissecting microscope, electron microscope (both scanning and transmission). Also, students will have completed a microscope color code and turned the completed color code into the teacher.

For objective 2, students will have to demonstrate their ability to create their own slides using pond water.

Resources and References:

Biology Coloring book