Title: Come and Get It! Feeding Time for Zombies and Other Pathogens.

or

Dinner is Served!

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Abstract: This action plan is designed to challenge average-level Biology I students to think objectively and creatively about the realities inherent in an outbreak scenario. Aside from learning about how viral outbreaks differ from bacterial, students will also learn about prions and plasmodium, and their methods of attacking the body. Methods used to accomplish instruction will include a "zombie" outbreak simulation, a computer-generated pandemic simulation, the use of "Outbreak" DNA kits and gel electrophoresis, as well as an examination of brain structures that would be involved in a "zombification" process. This research will culminate in a public-service-style pamphlet intended to educate the public on ways to stop or slow the advance of an emerging pathogen.

Rationale: Many of my students are interested in the TV show "The Walking Dead", and I believe that this interest represents a unique opportunity to teach them how an emerging pathogen could behave in a worst-case scenario. My demographic in Biology I classes has become more and more disinterested in content as state and county requirements have continued to limit the scope of instruction. This mini-unit will take advantage of existing interest among the majority of the students and translate that interest into the classroom. The end result, obviously, is not to prepare them for an actual zombie outbreak, but to teach them about the very real threat of a pandemic that could actually occur in their own lifetimes. This has the potential to tie in with history classes that can discuss the global pandemic of 1918, as well as math classes that could set up the mathematical models used to predict the spread of an outbreak.

Timeline Overview:

This lesson is projected to cover six days during the first semester of the school year.

Student Outcomes:

1. The students will be able to explain how an invading pathogen interacts with their immune systems.
2. The students will be able to describe the threat of a highly virulent pathogen, and how it relates to their lives.
3. The students will be able to explain how viral DNA can be detected, and how it infects a cell.
4. The students will be able to predict how a deadly pathogen could spread through a population.
5. The students will be able to design a public service announcement that will educate the public about the threats from a specific pathogen and/or a global pandemic.

Standards:

- SC.912.N.1.1 - use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs)
- 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.17.20 - Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.
- SC.912.L.16.10 - Evaluate the impact of biotechnology on the individual, society and the environment,including medical and ethical issues.
- SC.912.L.16.7 - Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.
- SC.912.L.14.52 - Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.
- SC.912.L.14.26 - Identify the major parts of the brain on diagrams or models.
- SC.912.L.14.27 - Identify the functions of the major parts of the brain, including the meninges, medulla, pons, midbrain, hypothalamus, thalamus, cerebellum and cerebrum.

Lessons:

- Days 1 and 2:
  Students will be introduced to various types of pathogens, and how they vary. Special attention will be given to how these various pathogens interact with the immune system, what happens when a pathogen enters a population, how pathogens can jump from one species to another, vectors, etc. Resistance and mutations in pathogens will also be discussed. I expect to use a combination of PowerPoint and sort video clips to direct these objectives. The concept of a “pandemic” will be introduced, along with background on the pandemic of 1918, and students will have an opportunity to discuss why a pandemic can become a global outbreak in the first place, as well as which factors in today’s society would increase the chances of pandemic over those in 1918. They will also be required to predict how quickly an outbreak in one country could become a true pandemic, and then be shown three pandemic outbreak scenarios of influenza in Thailand (Cummings), as well as a simulation of "H5N1-like" flu over a 120 day period in the U.S. (Burke), both from the Johns Hopkins website.

- Day 3:
  In this class period, students will be introduced to the micropipettes, and instructed on how to use them properly. Using colored water, they will complete the “Pipetting by Design” activity. This activity is intended to prepare the students for using the pipettes in the “Outbreak” DNA lab on day 4.

- Day 4:
  On day 4, Students will use the “Outbreak” DNA kits and gel electrophoresis to identify the viral strain responsible for a potentially deadly fictitious disease outbreak. The “disease” in question will be a virulent strain of zombie virus. After the lab,each group of students will discuss how this virus is transmitted, what measures can be used to contain the outbreak, and why it is significant that the pathogen is viral in nature (i.e., what difference that makes in “treatment” or outbreak control, vaccination, inoculation, etc.) Each group will need to write up a lab report detailing their findings.

- Day 5:
  For this lesson, students will enact a simulation adapted from Michael Rudy's best practice, Predator/Prey Simulation. Instead of animals, students will be divided into groups of either humans (uninfected) or zombies (infected). To begin, we may start with only one or two zombies, depending on the size of the class. Uninfected members will have blindfolds and will be allowed to take up to three steps at a time, but will also have a small bell tied to their clothing. Infected members will also be blindfolded, can only take one step at a time, and must moan every three steps. When a "zombie" touches a "human", the human will become infected. He then takes off his bell, and must follow the parameters laid out for the infected members instead. He may, however, call out to others that he has been infected before he "turns", if he chooses. Some humans may also be given a squirt bottle with appx ¼ inch of water in it. A direct hit on a zombie will kill it, but the ammunition is very limited.

  The purpose of the simulation is, essentially, to demonstrate how a pathogen can move through a population with nothing more than a touch. The squirt bottle can represent vaccinations, medicine, or control methods, and the people who have them can represent doctors, CDC workers, etc. The methodology of the simulation simply makes it memorable for the students, and ties into their prior knowledge.

- Day 6:
  Today's lesson will tie several concepts together. First, we will look at structures of the brain, their locations and their purposes. Then, we will discuss what types of pathogens can attack the brain, and how they attack. Finally, students working in pairs will try to decide which parts of the brain the zombie virus would have to attack and what its effects would have to be in order to result in the walking dead. Each pair will have to draw a diagram of the parts of the brain and indicate the areas they believe would be affected, then briefly share their final evaluation with the rest of the class.

Data Collection Techniques:

- For a final assessment, each student will be required to design a 3-fold public service pamphlet detailing what to do in case of an outbreak, preparations, how to minimize exposure, symptoms, etc. Each student will need to choose a specific pathogen (list will be provided). Grade will be determined through a rubric that will take into account, among other characteristics, creativity and attention to detail.
- Formative assessment – end result of "Pipetting by Design"
- Lab Reports

Use of Equipment Lockers/Field Trip to UF:

- Gel Electrophoresis – E-Gel
- Pipetting stations

Connections to ICORE Summer Institute:

- "Pipetting by Design" lab
- Gel Electrophoresis
- Viruses and the immune system? – Presentation by Dr. McFadden

Improvement on Traditional Teaching Techniques:

To be honest, I've never taught anything like this. I've gone over brain structures, the immune system, viruses, and DNA before, but never integrated like this, and I've never taught pipetting at all. Usually all of these concepts are scattered all over the year, and I have a hard time believing that the students are grasping much of it. I think that having all of these concepts unified together in a mini-unit with a hands-on component will be much more effective in helping students truly understand what is being taught. It is also my hope that the nature of this lab will spark interest in some students in continuing to explore emerging scientific ideas.

Budget and Budget Justification

Item	Cost	Vendor
Outbreak! Fingerprinting Virus DNA 8-station Kit – bulk DNA	$120.00	Carolina
Gel Electrophoresis – E-Gel 2-18 packs G5218-0	$392.00	InVitrogen
Pipetting by Design		
Pipetting Stations		

As mentioned above, it is critical for my "Outbreak" scenario that I be able to model a real outbreak situation. This is where the "Outbreak!" Fingerprinting Virus DNA Kits and the E-Gels come in. While I might be able to come up with another method that would give similar results, the point of this whole exercise is to give a realistic idea of how workers at the CDC or WHO might actually look for viral DNA. The pipetting stations are essential to teaching students correct methodology before they attempt to do the actual DNA lab, and again, builds proper lab technique.

Literature Cited

Cummings, Derek. (August 3, 2005).Computer Simulation Analyzes Strategies for Stopping Flu Pandemic.*The Johns Hopkins Bloomberg School of Public Health.* Retrieved 6/15/2013. http://www.jhsph.edu/news/news-releases/2005/cummings-midas.html

Burke, Donald S., MD(April 26, 2006). Computer Simulations Help Nations Prepare for Flu Pandemic. *The Johns Hopkins Bloomberg School of Public Health.* Retrieved 6/15/2013.http://www.jhsph.edu/news/news-releases/2006/burke-pandemic.html