

Title: Pathogens and Protein – Life or Death?

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Abstract:

Pathogens, like viruses and bacteria, are linked to proteins in their structure, infectious nature, and the immunity that is developed against them. How proteins are tied into the emergence and re-emergence of pathogens will be explored in this module. This proposal describes a unit that will be inserted into the Anatomy and Physiology Honors classes after they have studied organic molecules and have reviewed cells. Biotechnology techniques will be emphasized with the students completing two microarray simulations, and an ELISA Immune Explorer Kit – Protocol III. Additionally, the students will select an emerging pathogen and do a research activity on it that will later be presented to the class.

Mission Statement:

The purpose of this module is to instruct students in the fundamentals of viral and bacterial particles, with an emphasis on the proteins they contain and/or produce. It will study a variety of examples of viruses and bacteria and the concept of emerging and re-emerging pathogens. The module will include a discussion of the pathogen's method of transmission, the havoc they wreck in our bodies, and their global impact on societies. Biotechnological methods will be incorporated in the labs to expose students to the biotech terminology and methodology.

Description of Teaching Unit:

This module will be inserted into my curriculum after we have studied organic molecules and reviewed the cell and cell membrane. The students will have completed the isolation of DNA, been exposed to PCR, and have performed DNA gel electrophoresis. Most of the students will not have had any formal instruction on microbes, pathogens, or other techniques of biotechnology. The study of viral and bacterial structures includes proteins. The viral protein coat or capsid is a major ingredient in viral transmission of disease and its ability to elude being conquered because of changes in its coat. Bacterial cells also contain protein and the strong exotoxins, made of protein, are the source of illness and even death. However, the antibodies, made of protein, are a source of immunity to infection, sustaining life. This teaching unit expects to relate proteins to pathogens and to explain how emergence and re-emergence can occur. Along with this, students will learn about many viral and bacterial diseases. Biotechnology will be incorporated so students can see its value as a research tool.

The Pathogens and Protein - Life or Death? will be taught during nine class periods on our alternating block schedule. The proposed schedule for completion of this module is:

Day 1:

- Pre-test on viruses, bacteria, immunology, and emerging pathogens.
- Introduce viruses and viral diseases.
- Do a microviewer activity on viruses.

Day 2:

- Play songs on CD: *They Might Kill You/We are the Microbes*
- Introduce bacteria and bacterial diseases.
- Show a video on bacteria.
- Have students select a viral or bacterial pathogen for research.

Day 3:

- Show video “Internal Defenses”, and have students answer questions about the video information.
- Explain the role of antigens and antibodies in immunity.

Day 4:

- Greet students as they enter class with Glo Germ gel on teacher’s hands.
- Discuss modes of disease transmission.
- Discuss the concept of emerging and re-emerging pathogens.

Day 5:

- Read an article on microarrays and take notes.
- Perform two different microarray simulation experiments – one on viruses and one on water pathogens.

Day 6:

- Read an article on ELISA, and answer pre-lab questions.
- Show students the lab equipment and explain how things will be used.
- Review micropipette usage.

Day 7:

- Perform the Bio-Rad ELISA Immuno Explorer Kit Lab – Protocol III.
- Answer post-lab questions.

Day 8:

- Have students present their projects - WANTED: Deadly Disease.

Day 9:

- Review and give post-test.

The expected outcomes from this module are as follows: The first is making students aware of the basic components of viruses and bacteria and relating their protein structures to the processes of microbe infection in the body or the process of immunity against infection. The second expected outcome is to bring about some understanding of what the emergence and re-emergence of pathogens is and how it occurs across the globe. A third expected outcome is the use of biotechnology to enlighten the students to these techniques that are such a fundamental part of today’s scientific research.

Expertise and Contributions of the Principal Instructor:

The principal instructor was the sole developer of this action proposal. All activities presented in this action research proposal will be performed by the principal instructor with Anatomy and Physiology Honors classes at Lake Gibson High School in Lakeland, Florida.

The principal instructor is uniquely qualified to perform the activities in this action proposal. The principal instructor holds a B.A. degree in Biology and over 40 graduate hours from SUNY at Buffalo, SUNY at Geneseo, FSU, UCF, Florida Southern College, USF, and is working on graduate hours to be earned in Biotechnology at UF. In addition to these studies, the principal instructor has been the Teacher of the Year at Lake Gibson H.S., has been selected as an Outstanding Science Educator by PITTCON, and has received four nominations for *Who’s Who Among America’s Teachers*. The principal instructor has completed training for AP Biology, been selected by NSTA as a participant in its Science and the Food Supply Workshops, has attended a Flinn Scientific Chemistry Workshop, been selected as a participant in the Biotechnology Teacher Leader Program in Philadelphia, attends Mini Medical School at UF as often as possible, has completed two weeks of training in the Emerging Pathogens Workshop as part of the HHMI ICORE in 2009, and has completed two weeks of training in Industrial

Biotechnology at the UF Center for Excellence in Rehabilitative Health Biotechnology (UF CERHB).

The principal instructor has completed 40 years of teaching science in three states, in both public and private schools. This educator holds National Board Certification in Adolescent and Young Adult Science (AYA Science), permanent certification for all sciences in New Jersey and New York and Florida certification in Biology, Chemistry, and Health. The proposed teaching schedule for this educator includes two classes of Anatomy and Physiology Honors, two classes of Chemistry I, and two classes of Forensic Science. This instructor also serves as Science Department Co-chair and has worked as a sponsor for Science Olympiad for several past years. Current memberships are in: Delta Kappa Gamma Society International, Professional Educators Network (PEN), National Science Teachers Association (NSTA), National Association of Biology Teachers (NABT), and the American Chemical Society (ACS) Education Division.

Literature Cited:

1. Alcams, I. Edward and Elson, Lawrence M. The Microbiology Coloring Book, Collins College Publishers, 1996.
2. "Emerging and Re-emerging Infectious Diseases Curriculum Supplement Series," National Institute of Health, 1999.
3. "Emerging Pathogens", articles compiled by Lawrence, Charles D. University of Florida.
4. "Global Screening for Human Viral Pathogens – Perspectives; Emerging Infectious Diseases," July 2003, CDC, 1 August 2009. <www.cdc.gov/ncidod/EID/vol9no7/03-0004.htm>
5. Marieb, Elaine N. Essentials of Human Anatomy and Physiology, San Francisco, CA, Benjamin Cummings, 2006.
6. Todar, Kenneth. "Todar's Online Textbook of Bacteriology," 2008. <www.textbookofbacteriology.net>

Multimedia and Laboratory Resources:

1. Slide Set: "The Virus, National Teaching Aids, Inc.," 1974.
2. Video: Bacteria in the World of Living Organisms Series, Films for the Humanities and Sciences, Princeton, NJ 1996.
3. Video: Internal Defenses in the Living Body Series, Films for the Humanities and Sciences, Princeton, NJ 1991.
4. CD: "Still Stayin' Alive, A Take Out Menu of Musical Hits" by Dr. Carl K. Winter, 2001.
5. Bio-Rad Biotechnology Explorer catalog. <www.explorer.bio-rad.com>
6. USA Scientific catalog. <<http://www.usascientific.com>>

Budget and Budget Justification:

<u>Qty.</u>	<u>Item</u>	<u>Price/Unit</u>	<u>Total Price</u>
1	Bio-Rad ELISA Immuno Explorer Kit	\$150.00	\$150.00
1	50 mL conical screw cap centrifuge tubes, bulk (500/bag)	\$ 64.01	<u>64.01</u>
	Total		\$214.01

The Bio-Rad kit is designed to show how antibodies attach to antigens. This is a vital concept involving the action of proteins. The conical screw cap centrifuge tubes will be used for the two microarray activities.

Detailed Lesson Plan
Marcia B. de Meza
September 9, 2009

Theme: Emerging Pathogens
Lesson Title: Pathogens and Protein – Life or Death?
Subject: Anatomy & Physiology Honors
Grade: 11-12
School: Lake Gibson High School
Time Frame: 3-4 weeks on an alternating block schedule. Classes are 90 minutes long.

Key Learning:

Describe the structures of viruses and bacteria with an emphasis on protein components. Emphasize the role of emerging pathogens in our society. Recognize modes of disease transmission and the body's role in immunity.

Unit Essential Question:

What are the ways in which microorganisms can subject us to illness or death and how can we protect ourselves?

Benchmarks:

SC.912.L.14.42; SC.912.L.14.52

Concepts:

- A. Describe the structure and function of viruses with protein emphasis. List examples of viral diseases.
- B. Describe the structures and function of bacteria with protein emphasis. List examples of bacterial diseases.
- C. Describe antigens and antibodies as protein and their work in immunity.
- D. Discuss the emergence of pathogens and modes of disease transmission.
- E. Describe a microarray and explain an ELISA.

Lesson Essential Questions - Per Concept:

Concept A:

1. What are viruses and how are they structured?
2. What are some diseases they cause?
3. How do viruses replicate?

Concept B:

1. What are bacteria and how are they structured?
2. What are some diseases caused by bacteria?
3. How do bacteria replicate?

Concept C:

1. What are antigens and antibodies?
2. How do they react together?
3. What is their role in body defense?

Concept D:

1. What do we mean by “emerging pathogens” and “re-emerging pathogens”?
2. What is their global impact on societies?

Concept E:

1. What is a microarray and what can it reveal?
2. What is an ELISA and how can it be applied to immunity?

Key Vocabulary:

virus	plasmids	lymphatic system
capsid	endospores	lymph nodes
envelope	binary fission	phagocytosis
host	conjugation	antibodies
lytic cycle	endotoxin	antigens
lysogenic cycle	exotoxin	pathogen
prophage	bacteria	ELISA
retrovirus	microarray	

Materials & Resources:

Essentials:

- 1) Textbook: The Essentials of Human Anatomy and Physiology by Elaine N. Marieb
- 2) Bio-Rad ELISA Immuno Explorer Kit – Protocol III
- 3) Safety wear: goggles, aprons and gloves

Supplemental:

- 1) Microviewers, slide set – The Virus
- 2) Videos: Bacteria
Internal Defense
- 3) Glo Germ gel, UV lights
- 4) CD player, “Still Stayin’ Alive/A Take Out Menu of Musical Hits” CD
- 5) Microarray simulations on viruses and water pathogens, UV lights
- 6) 50 mL conical test tubes with caps, plastic storage bags, plastic containers for liquids – a little larger than sandwich size.

Activating Thinking Strategies/Launch Activity – Per Concept:

- Concept A: Show students a picture of a virus and ask if they know what it is. Discuss the term “microorganism.”
- Concept B: Listen to CD on microbes.
- Concept C: Show “Internal Defenses” video about the actions of antigens and antibodies.
- Concept D: Greet students at door using Glo Germ gel for disease transmission activity. Discuss what “emerging pathogens” means.
- Concept E: Introduction of lab materials to do a microarray and to do an ELISA experiment.

Teaching Strategies – Per Concept:

Concept A:

1. Pre-test and post-test
2. Introduce microorganisms and viruses using PowerPoint, lecturette, and a microviewer activity. Discuss viral diseases.

Concept B:

1. Introduce bacteria using PowerPoint, lecturette, and a short video. Discuss bacterial diseases. Select diseases for research project.

Concept C:

1. Video “Internal Defenses” and answer questions.
2. Lecturette and class discussion on antigens and antibodies.

Concept D:

1. Lecturette and class discussion on modes of disease transmission and the emergence and re-emergence of pathogens.

Concept E:

1. Read articles on microarrays and then perform two different tests.
2. Read articles on ELISA and answer pre-lab questions. Show students the lab equipment and explain how things will be used. Review micropipette usage.
3. Perform the lab on the ELISA. Answer post-lab questions.
4. Students give reports on disease projects.
5. Review and post-test.

Summarizing Strategies - Per Concept:

Concept A: One sentence summary about viruses.

Concept B: Venn diagram comparing/contrasting viruses and bacteria.

Concept C: Venn diagram comparing/contrasting antigens and antibodies.

Concept D: Small group discussion and questions they may have.

Concept E: Pre-lab and post-lab questions.

Assignments:

- A. The microviewer lab on viruses.
- B. Answer the questions on the Internal Defenses video.
- C. Read article on Microarrays and Journal 15 factual sentences.
- D. Read article on ELISA and answer pre-lab questions.
- E. Perform the Bio-Rad ELISA Immuno Explorer Kit – Protocol III and answer the post-lab questions.
- F. Complete a research project entitled, Wanted: Deadly Disease about one of the viruses or bacteria revealed in our microarrays.

Assessments:

1. Pre-test and post-test
2. Writing assignments on articles
3. Microviewer lab questions
4. ELISA lab questions
5. Research project

Application:

1. Students should now have at least a basic idea of the devious work of viruses and bacteria in our world and also the usefulness of some bacteria.
2. They should be aware of names of microorganisms and diseases so they can relate to health news.
3. They should become more wary of disease transmission and take necessary precautions.
4. They should have a greater respect for emerging pathogens and the need for more research to ward off their attacks in the future.
5. Additionally, students will have gained some important research techniques they can apply to future education in a biological field.

Teacher Self-Reflection:

My thoughts before I even began this newly formed unit are:

1. I wish I had more time to help students have an even better understanding of all the concepts.
2. I am pleased to be able to introduce microorganisms to these students and I feel I will have given them some education as to the diseases the microorganisms may cause.

3. The knowledge they gain may help save a life among families and friends.
4. I am happy that the students will have some very current information to help them make better health decisions.
5. The techniques that they will learn and the biotechnology equipment they will use will help expose them to areas of research they would not have known about.
6. I will have done my very best to inform the students about emerging and re-emerging pathogens.
7. I will have enlightened students about many career opportunities referred to in these lessons.