

## **Theme: Emerging Pathogens**

Title: Human Hazard: Effect of human infectious diseases on captive marine mammals

Juanita G. Farmer

### **Expertise of the PI, and contribution(s) in developing action proposal**

- 2005 to present - Science Teacher/Department Head at Cooper City H. S.
- 2004 – 2005 – Science Teacher Nova Middle School
- 1999 – 2004 – Science teacher/Department Head at Pembroke Pines Charter Middle School
- 2002 – FAU – Adjunct Professor Department of Education – Middle School Science Education
- 1996 – 1999 – Pool Substitute Teacher Pembroke Pines Elementary
- Professional development opportunities include AMBIENT project, SSI - biotechnology, Mini-Medical School, ICORE – emerging pathogens, and College Board AP trainings.
- Certification Area – Biology
- Endorsements – Gifted Education, Reading in the Science Content area
- Education master's degrees in Biological Oceanography and Educational Technology.

### **Mission Statement**

The goals of this proposal are:

- To introduce students to current biotechnology skills as well as the science of emerging pathogens. Students will understand host-pathogen interactions.
- To encourage students to take an active role in understanding science
- To provide opportunities for students to take part in the understanding of interactions between the world's marine and human resources.

### **Abstract:**

Emerging pathogens are a global issue of increasing concern. Disease is being passed from animal to human through zoonotic transmission. Humans have a direct connection to our oceans. We work and play in coastal areas; we feel a connection to the marine life and enjoy viewing marine organisms and learning more about these organisms through educational programs and ocean parks. We have long thought of the ocean as a dumping ground where we can dump the by-products of human activities, that there were few if any diseases in the ocean environment, now with the advent of new biotechnologies we are realizing that the oceans hold billions of viruses (McFadden, 2009). There is little information that exists about viral diseases that affect marine mammals. This proposal will look at data from marine parks on disease incidents and compare it to information on known viruses to determine if there is any correlation between human and marine mammal viral infections.

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

At the end of this module, students will be able to:

- (1) Explain biotechnology terminology, techniques and applications
- (2) Perform basic lab techniques using micropipettes.
- (3) Describe viral structure and replication.
- (4) Describe and discuss issues related to emerging pathogens, biotechnology and marine organisms.
- (5) Understand the means of transmission of disease between human and marine organism.

As humans we have a fascination with the marine environment and the organisms that reside there. One of the most requested topics in marine science is to study the animals; we especially

have an affinity to marine mammals. Children of all ages enjoy going to marine parks and viewing the mammal shows, in particular the cetaceans. According to Hendrik Nollens a marine biologist from the Univ. of FL Marine mammal medicine is a very young field, so the knowledge of these animals is limited; especially in regards to infectious diseases. (UF Vet Med Pathogen Bklt, 2009). Nollens feels there is a need for modern biotechnology techniques to diagnoses viral diseases in marine mammals. The use of polymerase chain reaction (PCR) is helping to recognize new viruses in less well-studied animals. Information gathered could be important in understanding the transmission of diseases between species and be useful to marine parks in the management of the health of their captive organisms.

This proposal is designed to educate students in the transmission of disease to and from marine mammals. Marine Science II Honors is a course that involves research into relevant topics that affect marine environments. Students will research and then debate the pros and cons of marine mammals in captivity. They will also conduct research on diseases marine mammals and humans have in common. During this investigation students will research the means of transmission of diseases to marine mammals and look at the similarities of virus/protein structures of human and marine borne diseases. Part of the research will be attempting to gather information from aquatic parks on the susceptibility of their organisms to human disease. If that data is not readily available for students, they will use the web based programs presented at ICORE to research the specifics of these diseases, their shape structure, whether bacteria or viral, genetics – DNA or RNA viruses, etc. [RCSB Protein Data Bank (<http://www.rcsb.org/pdb/home/home.do>)]. The students will work in small groups to research one of these the pathogens. Then each group will present pertinent information to the class. Students will collaborate to create informational pamphlets on disease transmission and safety procedures that can be disturbed at marine parks. If time permits the crystallization lab from the McKenna lab will be performed to allow students to gain relevant lab experience and view the crystal formation of the protein structures where viruses bind. However the data bank has detailed diagrams showing the structure of the proteins and nucleotide, therefore will be the main source of information. Upon completion, students will use the National Center for Biotechnology Information - BLAST Assembled Genomes (<http://www.ncbi.nlm.nih.gov/>) site to investigate the genomic and phylogenetic relationship of the different diseases.

The instruction will engage the class in discussions about marine organisms whether they should or should not be in captivity and the long term affect of that situation. Information about disease transmission (including vectors), specific examples of emerging pathogens, global issues related to disease identification and treatment, and the social responsibility will also be entertained. In addition to participating in lectures and classroom discussions, the students will also complete the small-group project, presentation and community service pamphlet on an emerging pathogen. In addition to this module the Biology I Honors class (prerequisite to Marine science) will be taught some of the basic information on emerging pathogens as part of the genetics/biotechnology unit (Tomato Spotted Wilt Virus – in bioengineering unit). During this unit students will perform hands-on simulations and laboratory activities using bacterial transformation, polymerase chain reaction (PCR), and gel electrophoresis. The performance of these activities will assist the students in developing a more thorough understanding of molecular genetics. The biotechnology units can be linked according to the individual units presented in the curriculum.

#### Literature cited

- University of Florida, College of Veterinary Medicine Emerging Pathogens brochure, 2008-06-10. Retrieved 09/05/2009.  
[http://www.vetmed.ufl.edu/research/documents/UFVetMed\\_Pathogen\\_Bklt.pdf](http://www.vetmed.ufl.edu/research/documents/UFVetMed_Pathogen_Bklt.pdf)

- RCSB Protein Data Bank, Retrieved 09/05/2009 <http://www.rcsb.org/pdb/home/home.do>
- BLAST - Basic Local Alignment Search Tool Retrieved 09/05/2009  
[http://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Web&PAGE\\_TYPE=BlastHome](http://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Web&PAGE_TYPE=BlastHome)
- Vastag, Brian. A Curious Catastrophe in the Parrot World, Howard Hughes Medical Institute, August 09, Vol. 22, # 3  
<http://www.hhmi.org/bulletin/aug2009/features/parrot.html#top>

### **Budget and budget justification**

Funds received from this proposal will be utilized for:

- the materials needed to work up and present information on the data – paper supplies = **\$50.00**
- Transportation to the symposium in Jan.24-26, 2010 - **\$100.00**
- Sample bottle and Raw plant material for the extraction of DNA
- Materials necessary for the TSWV lab if time permits the Biology I students to perform the lab activity.
- Micropipettes – class set = up to **\$200** (8 @ \$25)
- Micropipette tips – pack of 1000 for **\$35.00**
- 2 ml EZ Micro Test Tubes - **\$29**
- 1.5 ml EZ Micro Test Tubes - **(2) \$27**
- 500 µl EZ Micro Test Tubes - **(2) \$39**
- 96-Place Racks – **(2) \$36**
- 0.2 ml PCR Tubes With Flat Caps - **\$52**

**Theme: Emerging Pathogens**

<b>Lesson Title</b>	<b>What you left behind: How Flipper caught pneumonia.</b>
<b>Grade Span</b>	<b>9 – 12th Grade Honors</b>
<b>Content Emphasis (Mathematics or Science)</b>	<b>Science – Biology or Marine</b>
<b>Targeted Benchmark(s)</b>	<b>SC.F.1.4.5, SC.F.1.4.8, SC.F.2.4.1, SC.F.2.4.3, SC.G.1.4.1, SC.H.1.4.1, SC.H.3.4.3</b>
<b>Author(s)</b>	<b>Juanita G. Farmer</b>
<b>School</b>	<b>Cooper City High School</b>
<b>Lesson Preparation</b>	
<p><b><u>Learning goals:</u></b> Students will be able to:</p> <ul style="list-style-type: none"> <li>- Understand the affect of captivity on marine mammals</li> <li>- Describe viral structure and replication.</li> <li>- Describe and discuss issues related to emerging pathogens, biotechnology and marine organisms.</li>   <li>- Understand the means of transmission of disease between human and marine organism.</li> </ul>	
<p><b><u>Estimated time:</u></b> Please indicate whether this is a stand-alone lesson or a series of lessons.</p> <p>In Marine Science 2 the course of study would be 1 week on a block schedule. Students will be involved in internet research and develop a presentation related to the organism and/or environment the research focuses on.</p> <p>Will need introductory lesson on marine mammal physiology.</p> <p>Also lesson on disease transmission.</p>	

<p><b><u>Materials/Resources:</u></b> Please list any materials or resources related to this lesson. Students will need a computer with internet access and a printer. Students will need initial list of web sites to visit to obtain data on marine and human diseases.</p> <ul style="list-style-type: none"> <li>- University of Florida, College of Veterinary Medicine Emerging Pathogens brochure, 2008-06-10. Retrieved 09/05/2009. <a href="http://www.vetmed.ufl.edu/research/documents/UFVetMed_Pathogen_Bklt.pdf">http://www.vetmed.ufl.edu/research/documents/UFVetMed_Pathogen_Bklt.pdf</a></li> <li>- RCSB Protein Data Bank, Retrieved 09/05/2009 <a href="http://www.rcsb.org/pdb/home/home.do">http://www.rcsb.org/pdb/home/home.do</a></li> <li>- BLAST - Basic Local Alignment Search Tool Retrieved 09/05/2009 <a href="http://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Web&amp;PAGE_TYPE=BlastHome">http://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Web&amp;PAGE_TYPE=BlastHome</a></li> <li>- The Humane Society of the United States, Retrieved 09/05/2009 <a href="http://www.hsus.org/marine_mammals/what_are_the_issues/marine_mammals_in_captivity/do_marine_mammals_belong_in_captivity_in_the_21st_century.html">http://www.hsus.org/marine_mammals/what_are_the_issues/marine_mammals_in_captivity/do_marine_mammals_belong_in_captivity_in_the_21st_century.html</a></li> <li>- NOAA Fisheries Office of Protected Fisheries Retrieved 09/05/2009 <a href="http://www.nmfs.noaa.gov/pr/species/mammals/">http://www.nmfs.noaa.gov/pr/species/mammals/</a></li> <li>- Cousteau Custodians of the Seas, Retrieved 09/05/2009 <a href="http://www.cousteau.org/news">http://www.cousteau.org/news</a></li> <li>- Jean-Michel Cousteau’s Ocean Futures Society, Retrieved 09/05/2009 <a href="http://www.oceanfutures.org/of_blog-post.asp?ID=94">http://www.oceanfutures.org/of_blog-post.asp?ID=94</a></li> </ul>
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- **A Curious Catastrophe in the Parrot World, Howard Hughes Medical Institute, August 09, Vol. 22, # 3**  
<http://www.hhmi.org/bulletin/aug2009/features/parrot.html#top>
- **Carey, Bjorn. Marine Mammals Contract Human Diseases. FOX News 02/23/06**
- **UnderwaterTimes.com News Service, 02/20/06. Scientists: Marine Mammals Are on Frontline of Failing Ocean Health; Diseases May be Early Warning Sign for Humans.**  
[http://www.underwatertimes.com/news.php?article\\_id=10219834760](http://www.underwatertimes.com/news.php?article_id=10219834760)

**Teacher Preparation:** What do you need to do to prepare for this lesson?

Review background information on viruses, bacteria, basic genetics, marine mammal physiology, position statements from both sides on marine mammals in captivity.

Be familiar with the web sites the students will need to use to research the topic and how to use the search areas and graphics of the web sites.

#### Lesson Procedure and Evaluation

**Introduction:** Describe how you will make connections to prior knowledge and experiences and how you will uncover misconceptions.

Discussion on marine mammals will proceed this lesson including basic morphology, similarities and differences to land based mammals, environmental factors – human influences and exploitation of marine organisms.

Students will research and then debate the pros and cons of marine mammals in captivity. They will also conduct research on diseases marine mammals and humans have in common. During this investigation students will research the means of transmission of diseases to marine mammals

Part of the research will be attempting to gather information from aquatic parks on the susceptibility of their organisms to human disease. If that data is not readily available for students, they will use the web based programs to research the specifics of these diseases, their shape structure, whether bacteria or viral, genetics – DNA or RNA viruses, etc.

#### **Exploration:**

Students will research and then debate the pros and cons of marine mammals in captivity. They will also conduct research on diseases marine mammals and humans have in common. During this investigation students will research the means of transmission of diseases to marine mammals and look at the similarities of virus/protein structures of human and marine borne diseases. Students will research the specifics of these diseases, their shape structure, whether bacteria or viral, genetics – DNA or RNA viruses, etc. [RCSB Protein Data Bank (<http://www.rcsb.org/pdb/home/home.do>)].

Students may also contact local marine facilities and Health agencies to gather data on disease occurrence and draw conclusions on relationships between marine and human diseases.

#### **Questions to consider:**

- **Do marine mammals belong in captivity in the 21<sup>st</sup> century?**
- **Where do captive marine mammals come from – wild or bred in captivity?**
- **Is there any trauma associated with captivity? How is that measured?**
- **Should captive animals be returned to the wild?**
- **Do humans transmit disease to marine mammals? If so all or just a few?**
- **What is the structure of disease that strike both human and marine mammals?**
- **Does genetics matter in the transmission of disease?**

#### **Application:**

The students will work in small groups to research one of these the pathogens. Then each group will present pertinent information to the class. Students will collaborate to create informational pamphlets on disease transmission and safety procedures that can be

**disturbed at marine parks.**

**Students may set up a Role Play or Debate - health review board to determine how disease is being transmitted, what the community needs to do to decrease the transmission now and in the future, how to minimize the detrimental affects to marine organisms and humans at marine parks.**

**Assessment:**

**Assessment will be based upon research gathered, statistical analysis of data (if available), and presentation of information to class in the form of role play or debate.**

**Assessment is at synthesis and evaluation on Bloom's taxonomy.**

**Assessment will be based on the logic and quality of argument, research used, and the professionalism of the pamphlet produced.**

**Teacher Self-Reflection: Record your thoughts on the lesson and describe any modifications you would recommend based on the outcomes.**

**Dependent on students involved debate aspect will be included or omitted.**

**Rubric may need to be updated.**

**To be submitted upon completion of lesson.**