

Vibrios: Symbiotic Relationships and Human Health

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Abstract:

The focus of my action plan is on symbiotic relationships and the impact of aquatic pathogens on human health. Students will learn about the symbiotic relationship shared by *V. fisheri* and the bobtail squid and will have an opportunity to look at *V. fisheri* underneath the microscope and view its bioluminescent property. Students will also explore the effect of *V. cholerae* in an ELISA simulation activity that focuses on the outbreak issues in Haiti. Since *V. vulnificus* impacts the economy of shellfish through toxin production, I want to give an opportunity for my students to visit a shellfish harvesting plant where they can see how oysters are processed to rid them of pathogens, making them safe for human consumption in the raw form. Background information on these organisms will be presented to the students prior to them working on the activities, to give them some background knowledge of the pathogen.

Rationale:

I am constantly looking for new resources and the ability to incorporate meaningful activities into my biology courses. The incorporation of biotechnology is incorporated in the Sunshine State Standards in all biology courses and is necessary to give students a practical exploration of science. For this action plan, I am going to focus on my marine science classes, since the flexibility in curriculum is currently available.

Marine Science is an integrated science that naturally lends opportunities for field biology studies. The reality of taking students into the field is highly restricted though. I want to show my students through hands-on activities how samples are taken and analyzed, but restrictions on students being in the water or even on boats prevent a lot of this in the County I teach in. The simulations and lab activities that my students will be doing will allow them to get some of these experiences in a controlled, safe atmosphere. Students will be able to apply the knowledge of content in this field by using critical thinking skills and will hopefully spark interest for students to pursue careers in the biology field.

Teaching Modules and Expected Outcomes:

Prior to Modules

Pre-test: Students will be given a series of questions on symbiotic relationships as well as on Vibrios, understanding of disease transmission and immune response to disease.

Module 1: Symbiotic Relationships in Marine Organisms

1. ACTIVITY 1: Students will review the three types of symbiotic relationships that organisms can have. Students will be given the terms mutualism, commensalism and parasitism by the teacher. In small groups (2-3), they will be asked to brainstorm what they remember about these terms (definitions and/or examples). After about 5 minutes, each group will share out what they came up with.

INFORMAL ASSESSMENT: By presenting their brainstorm session, the teacher can get an idea of what their pre-knowledge of these relationships are.

2. PRESENTATION: The teacher will present a short lecture on symbiotic relationships in which the definition of each relationship is given and a terrestrial example of each relationship is given. Afterwards, the teacher will play a clip on the bobtail squid and *Vibrio fischeri*. A discussion of the video clip and a little more information will be given about the behavior of squid and the students will be asked to Think-Pair-Share what kind of relationship is being exhibited (an argument can be made for both mutualism and commensalism).

STUDENT EXPECTATION: Students will be asked to take notes (chart form) on symbiotic relationships during presentation.

3. ACTIVITY 2: Students will engage in a lab where they will look at *V. fischeri* underneath the microscope and look at the bioluminescent property of the bacteria.

FORMAL ASSESSMENT: The students will describe what they observe in their notebook

4. ACTIVITY 3: Students will be in groups of 2-3 and given the names of two aquatic (marine) organisms that have a symbiotic relationship. They will use computers to research these two organisms to find out how these two organisms interact the benefit that one or both organism gains from the relationship.

FORMAL ASSESSMENT: Students will develop a poster in which they describe the type of relationship that their organisms share. They can draw their organisms or print pictures of them and place them on the poster. Students will share their posters with the class. The posters will be hung around the room for the students to observe.

Module 2: Bacteria and Human Health

BACKGROUND: Students will be studying general characteristics of the organisms in both prokaryotic domains. I will then segway into a human health piece through the following activities.

1. PRESENTATION 1: Through a Power Point presentation modified from the presentation given to us at ICORE, I will introduce to the students the organism *V. cholerae*. We will discuss what this organism is and its pathology in humans. I will use the specific case of Haiti to lead them into an upcoming activity – we will discuss the different water sources available to the population are.

STUDENT EXPECTATION: Students will take notes of this presentation to help them in upcoming activity.

2. ACTIVITY 1: Micropipette Skills – students will learn how to use a micropipette (both a 20ul and a 200ul). Teacher will demonstrate how to use and the importance of using the correct tips and changing out the tips.

FORMAL ASSESSMENT: Did the students see a pattern? This indicates how well they followed the directions

3. ACTIVITY 2: Medical Mystery of Epidemic Proportions – Students will simulate an outbreak epidemic of cholera in Haiti. They will employ a series of biochemical tests (Rapid-test dipstick, simulated ELISA and DNA microarray) to test a series of patients and potential water sources of infection to find the true source of contamination. Since they will be broken up in pairs, each pair will share out (collaborate) with the others what they found out about their specific tests.

FORMAL ASSESSMENT: Student will fill out a lab, recording their results. They will take the cumulative data and derive conclusions. We will have a discussion at the end about why Haiti may be more susceptible to cholera outbreaks and why the United States is not.

4. PRESENTATION 2: Through a Power Point presentation modified from the presentation given to us at ICORE, I will introduce to the students the organism *V. vulnificus*. We will discuss what this organism is and its pathology in humans. A discussion on impact in the area of fisheries will be discussed as well as methods in which oysters can be processed to get rid of vibrios.

STUDENT EXPECTATION: Students will take notes of this presentation to help them in upcoming activity.

5. ACTIVITY 3: Fieldtrip to Shellfish Harvesting Plant – the students will travel to a nearby harvesting plant where they can see how shellfish are checked and processed for contamination by bacteria.

FORMAL ASSESSMENT: Students will be given an essay question to take home to share what they learned from this experience.

At the End of Module 2:

Post-Test: Have the students retake test to see how their knowledge of symbiotic relationships and Human Health had increased.

FORMAL ASSESSMENT ESSAY: Describe the different symbiotic relationships that *Vibrio sp.* have with organisms (including humans)

Extension:

When we get to unit on mollusks, I would like to do an activity that centers around using DNA electrophoresis to show the genetic differences between to morphologically similar organisms – the oyster and clam. I will give tissue of known oyster and clam tissue and then one unknown to each pair of students. Each group will need to digest tissue with restriction enzyme to ensure band formation. They will have to identify which organism they had going through electrophoresis procedure. I could center a *Vibrio* case around this activity as well.

References:

Belcher R. 2010 July. Micropipette by Coordinates Activity. University of Florida Center for Pre-collegiate Education and Training Summer Institute

Crabbe, Nathan. 2011, May 16. "Squid Quo Pro". The Gainesville Sun. Accessed on 22 June, 2011. <<http://www.gainesville.com/article/20110516/articles/110519665?p=2&tc=pg>>

Johnson, Judith. 2011, June 20. Molecular Biology of *Vibrio cholera* [lecture]. University of Florida Center for Pre-collegiate Education and Training Summer Institute

Robinson, Eva. 2011, June. Modification of Science Take-Out Experiment: Medical Mystery of Epidemic Proportions. University of Florida Center for Pre-collegiate Education and Training Summer Institute

Science Nation. 2010, November 23. Online video clip. Squid Glow To Protect Themselves. Accessed on 22 June, 2011. < <http://www.youtube.com/watch?v=rAjPkzljYAw>>

Wright, Anita. 2011, June 20. *Vibrios*: Emerging Environmental Pathogens [lecture]. University of Florida Center for Pre-collegiate Education and Training Summer Institute

Budget: Item / Qty / Price per unit (total price) / Source

Vibrio fischeri culture / 3 plates / \$11.60 (\$34.80) / Carolina Biological Supply

Science Take-Out: A Medical Mystery of Epidemic Proportions / 1 kit / \$14 (\$14) / sciencetakeout.com

Hydrion pH paper / 10 vials – 100 strips per vial / \$21.25 for 5 vials (\$42.50) / Carolina Biological Supply [to make more kits for Medical Mystery activity]

Card stock / 1 pkg / \$14.99 for pkg of 250 (\$14.99) / Staples [to make more kits for Medical Mystery activity]

Sodium Hydroxide Solution / 500 mL aqueous 1M / \$6.50 per bottle (\$6.50) / Carolina Biological Supply [to make more kits for Medical Mystery activity]

Phenolphthalein Indicator / 500 mL 1% / \$6.25 per bottle (\$6.25) / Carolina Biological Supply [to make more kits for Medical Mystery activity]

Thumbs-up Microtubes / 1 pkg / \$41 for pkg of 500 (\$41) / Carolina Biological Supply [to make more kits for Medical Mystery activity]

P20 and P200 micropipettes / 9 P20 & 9P200 / \$0 / available at no cost on loan from CPET equipment locker – with tips and well microplates activity

Bus for Fieldtrip to Bartow Shellfish Harvesting Plant – estimated cost \$500

Gel Electrophoresis w/ micropipette / 8 kits / \$0 / available at no cost on loan from CPET equipment locker – with micropipette locker (for Extension Activity)

Gels for Electrophoresis / 15 gels / ??

TOTAL: \$680.04 + gels

Vibrios and Symbiotic Relationships Lesson Plan

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Key Questions:

1. What are the different symbiotic relationships that marine organisms exhibit?
2. What kind of symbiotic relationships do bacteria of the *Vibrios sp.* have with other living things?

Science Subject: Marine Science

Grade and Ability Level: 11th-12th grade / regular level

Science Concepts: Sunshine State Standard SC.912.L.17.6 Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism and mutualism.

Overall Time Estimate: 4 days + assessment test

Learning Styles: Visual, Auditory, Kinesthetic

Vocabulary: parasite, parasitism, host, commensalism, mutualism, symbiotic relationship

Lesson Summary: In this lesson, the students will learn about symbiotic relationships of marine organisms (including those with humans) through lecture, observing footage of the bobtail squid and an activity that allows the students to research the relationships themselves.

Student Learning Objectives with Standards: SSS SC.912.L.17.6 -see above

The students will be able to:

1. Discuss what a symbiotic relationship is and contrast three kinds: parasitism, commensalism and mutualism
2. Give examples of the three types of symbiotic relationships as they relate to marine organisms.
3. Discuss the types of symbiotic relationships that *Vibrio fisheri*, *Vibrio cholerae* and *Vibrio vulnificus* exhibit.

Materials:

Activity 1: no materials: think-pair-share activity

Presentation: Video clip of Bobtail squid w/ PowerPoint

Activity 2: 1 plate culture of *Vibrio fisheri* per class; 13 compound microscopes (1 per pair)

Activity 3: 13 computers (1 per pair); Flash drive to put pictures on OR printer; Computer paper OR Chart Paper (1 per pair); Markers/colored pencils

Advance Preparation: Order the *Vibrio fischeri* a minimum of 3 weeks in advance to arrive the time you want to do Activity 2. Set-up microscopes for Activity 2. Put computers on reserve for Activity 3.

Procedure and Discussion Questions with Time Estimates:

Day 1

1. ACTIVITY 1: Students will review the three types of symbiotic relationships that organisms can have. Students will be given the terms mutualism, commensalism and parasitism by the teacher. In small groups (2-3), they will be asked to brainstorm what they remember about these terms (definitions and/or examples). After about 5 minutes, each group will share out what they came up with.

Total time of Activity: 10 minutes **INFORMAL ASSESSMENT:** By presenting their brainstorm session, the teacher can get an idea of what their pre-knowledge of these relationships are.

2. PRESENTATION: The teacher will present a short lecture on symbiotic relationships in which the definition of each relationship is given and a terrestrial example of each relationship is given. Afterwards, the teacher will play a clip on the bobtail squid and *Vibrio fischeri*. A discussion of the video clip and a little more information will be given about the behavior of squid and the students will be asked to Think-Pair-Share what kind of relationship is being exhibited (an argument can be made for both mutualism and commensalism).

STUDENT EXPECTATION: Students will be asked to take notes (chart form) on symbiotic relationships during presentation. Total time of presentation: 30-35 minutes

Day 2

3. ACTIVITY 2: Students will engage in a brief lab activity where they will look at *V. fischeri* underneath the microscope and look at the bioluminescent property of the bacteria (turn off the lights)

FORMAL ASSESSMENT: The students will describe what they observe in their notebook. Ask students – what shape does this bacteria take on? (students may not know the basic shapes of bacteria but should be able to describe it as being elongated or a bar rather than a rod)

Total time of lab: 20-25 minutes

Day 3 – Day 4

4. ACTIVITY 3: Students will be in groups of 2-3 and given the names of two aquatic (marine) organisms that have a symbiotic relationship. They will use computers to research these two organisms to find out how these two organisms interact and the benefit that one or both organism gains from the relationship.

FORMAL ASSESSMENT: Students will develop a poster in which they describe the type of relationship that their organisms share. They can draw their organisms or print pictures of them and place them on the poster. Students will share their posters with the class with a quick one minute presentation. The posters will be hung around the room for the students to observe.

STUDENT EXPECTATION: Everyone in the class will generate a table that has three columns – Organism 1 / Organism 2 / Relationship Type. As each group presents, each group will list the organisms and write down the type of relationship each pair exhibits along with a brief explanation of who benefits from the relationship and how.

Total amount of time: 1-50 minute period to research and begin making poster; 1-50 minute period to finish poster, share out and record information on table.

Assessment Suggestions:

Nontraditional assessment strategies can be seen in the activities above. Since a formal test will be given on this lesson, below are sample questions for each of the objectives stated:

1. Discuss what a symbiotic relationship is and contrast three kinds: parasitism, commensalism and mutualism

Sample Assessment Question: Compare and contrast parasitism, commensalism and mutualism

2. Give examples of the three types of symbiotic relationships as they relate to marine organisms.

Sample Assessment Question: An anemonefish lives inside a sea anemone and cleans it by clearing off parasites from the tentacles. What kind of symbiotic relationship is displayed here? Explain.

3. Discuss the types of symbiotic relationships that *Vibrio fisheri*, *Vibrio cholerae* and *Vibrio vulnificus* exhibit.

Sample Assessment Question: Which of the following organisms AND type of symbiotic relationship does *Vibrio fisheri* have?

- | | |
|----------------------------|------------------------------|
| A. Humans / Parasitism | C. Catfish / Commensalism |
| B. Gray Whale / Parasitism | D. Bobtail Squid / Mutualism |

Extensions:

Have students read article on UF research of Bobtail Squid – have students research what is known about the results of this research to date.

Resources/References:

Crabbe, Nathan. 2011, May 16. "Squid Quo Pro". The Gainesville Sun. Accessed on 22 June, 2011. <<http://www.gainesville.com/article/20110516/articles/110519665?p=2&tc=pg>>

Johnson, Judith. 2011, June 20. Molecular Biology of *Vibrio cholera* [lecture]. University of Florida Center for Pre-collegiate Education and Training Summer Institute

Science Nation. 2010, November 23. Online video clip. Squid Glow To Protect Themselves. Accessed on 22 June, 2011. < <http://www.youtube.com/watch?v=rAjPkzljYAw>>

Sunshine State Standards – Pinellas County Marine Science Course Curriculum Guide