



## Dinoflagellates of Bioluminescent Bay

### Summary:

Students will learn about micro-organisms called dinoflagellates that are found on the island of Vieques, off the coast of Puerto Rico. Along with the unique characteristic of luminescence, students will learn about the ecoregion they live in.

### Background Information:

The island of Vieques is located about 10 miles off the eastern coast of Puerto Rico. A bay by the name of Puerto Mosquito, is one of the best examples of bioluminescent bays in the world. It contains approximately 600,000 dinoflagellates per gallon of water.

A dinoflagellate (*Pyrodinium*) is a one-celled organism that is generally free-floating, although it does have a whip-like tail called flagella which enables it to move through the water. (This structure is similar to the flagella on the Blepharisma.) The Pyrodinium contain chlorophyll and is able to manufacture food through photosynthesis. (This is a trait it has in common with the Volvox.) The Pyrodinium is bioluminescent, which means it has the ability to produce light when agitated. Scientists are not really sure what purpose the luminescence serves, but speculate it might have something to do with a defense function. Some sort of biological clock informs the organism not to emit the light during the day. It is also possible the blue-green light serves as a means of communication to other organisms in the water. More research is needed to determine the precise reason(s) for the luminescence. As for what causes the luminescence in these microscopic organisms, scientists have studied bacteria that have shown it occurs at a genetic level.

Several specific features enable bioluminescent bays to exist. They are relatively small in size, shallow (no deeper than 14 feet), and have narrow openings to the sea. The most important feature is that all bioluminescent bays are bordered by mangrove forests. The mangroves provide an abundance of vitamin B12, one of the essential nutrients upon which the dinoflagellates live. Through the

**Grade Level:** 5<sup>th</sup> grade

**Goal:** There are differences among ecosystems.

**Key Concepts:** Students will recognize biodiversity exists in marine environments.

**Objectives:** Upon completion of this lesson, students will:

- 1) Compare and contrast the structure of the Pyrodinium to the Blepharisma and Volvox previously studied in class.
- 2) Define marine biodiversity.
- 3) Identify examples of species and ecosystem diversity in the marine environment.

**Teaching Location:** Indoor classroom

**Lesson Time:** One to five sessions, depending on amount of time allotted for research.

**Subject Areas for Infusion:** science, social studies, environmental education

**Standards:**  
Environmental Education  
B.8.3

Science  
A.4.1  
B.4.1

Social Studies  
A.4.1-2  
A.4.4

decomposition process, scavenger bacteria break down the roots and leaves in the mangroves, producing the vitamin B12 needed by the dinoflagellates to live. Without the mangroves, there could be no bacteria. The narrow opening to the sea prevents the tides flushing out the abundance of vitamin B12 the bacteria produces, thereby keeping the concentration high enough to support the dense population of dinoflagellates. Other organisms and animals have the ability to produce luminescence (fireflies, fish, etc.), even in the deeper parts of the ocean, however the shallowness of the bay provide the visitors a front row seat to view the underwater fireworks.

For more information:

General Information on Diversity, Department of Natural Resources:

<http://www.dnr.state.wi.us/org/land/er/biodiversity/>

Information on Bioluminescence Bay and Vieques

<http://www.eleas-vieques.com/bioluminescent.html>

### Materials:

- Map labeling Puerto Rico, Vieques, and Puerto Mosquito
- Access to Internet with one or more computers
- Copy of “Biodiversity Break-Down” for teacher
- “Joy to the Fishes of the Deep Blue Sea” marine biodiversity poster and/or student copies of the poster.
- Poster paper and art supplies

### Set-Up:

- 1) Access the Internet site and LCD projector.
- 2) Prepare a map or Internet site showing Puerto Rico, the island of Vieques, locating Puerto Mosquito.
- 3) Photocopies for students of “Joy to the Fishes and the Deep Blue Sea” (p. 68), “Sea Bits” (p. 29), “Describing Diversity” (p. 70), “Pick a Marine Ecosystem” (p. 71), “Graphic Organizer for Research”
- 4) Sign-up for computer lab access for the students to use during the research portion of the lesson.

### Procedure:

#### Introduction (Day 1)

- 1) Access the Internet and go to Island Adventures Bio-bay Eco-tours at <http://www.biobay.com/>. As students enter the room, have the pictures from Bio Bay on display using the LCD projector. Ask students to brainstorm explanations for the pictures.

#### **Vocabulary**

**bioluminescence:**  
emission of light by living organisms.

**dinoflagellates:** one-celled organism with a flagella.

**marine biodiversity:**  
variety of species found in and around the Earth’s saltwater ecosystems, including oceans, seas, bays, sounds and all areas where fresh water and salt water meet.

**ecoregion:**  
biogeographic areas that are characterized by climate, specific ecologic features, and similar plant/animal life.

- 2) Share a map locating Puerto Mosquito on the island of Vieques, off the coast of Puerto Rico.

Go to these Internet sites to see magnification of dinoflagallates. Share the Background Information provided at the beginning of this lesson with the students.

Microscopy UK- for great information on the basics of dinoflagallates.

<http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artsep01/dinof.html>

Information at The Bioluminescence Webpage

<http://www.lifesci.ucsb.edu/~biolum/organism/dinohome.html#EX>

- 3) Make connections with the structure and habitat of dinoflagallates with the Volvox and/or Blepharisma the students have previously studied during the Microworlds unit.

### **Activity 1 “Biodiversity Breakdown” (Day 2)**

1. Go through the “Joy to the Fishes and the Deep Blue Sea” poster to discuss the five different ocean ecosystems from five different parts of the world. Have students use the “Sea Bits” page to label each of the five ecosystems depicted on their copy of the poster.
2. Read and discuss as a class the “Describing Diversity” worksheet. Discuss the difference between ecosystems and ecoregions.

### **Activity 2 “Pick a Marine Ecoregion” (Days 3 & 4 – Computer lab)**

1. Using the handout “Pick a Marine Ecoregion”, have students work in pairs to do research using the Internet and/or reference books from the library. Students should use the graphic organizer to collect the information. Suggested Internet sites from the World Wildlife Fund: [www.worldwildlife.org](http://www.worldwildlife.org) and [www.worldwildlife.org/wildworld](http://www.worldwildlife.org/wildworld).
2. Students will make a poster of their ecoregion. The poster should show what several parts of the ecoregion look like, identify some of the plants and animal species living there, and include a brief paragraph introducing the region.

### **Conclusion (Day 5)**

Students share their posters with the rest of the class. During the poster presentations, students will be encouraged to take notes on their peer’s presentations. After the presentations, have the students classify the ecoregions into marine ecosystems – estuaries, open ocean, kelp forest, coral reef, and mangrove.

**Assessment (Day 6)**

Students will work independently to complete a chart that will differentiate between at least three of the five marine ecosystems. They may use the notes from the class presentations from the previous day.

**Adaptations:**

**Students with Special Needs** – Internet sites can be arranged ahead of time so they are more successful with finding information. The assessment can be given as a multiple choice format, using a word bank to fill in the chart.

**Younger students** – limit the amount of marine ecosystems to 2 or 3 different kinds.

**References:**

“Biodiversity Break-Down”, pp. 64-71, Windows on the Wild - Oceans of Life An Educator’s Guide to Exploring Marine Biodiversity, World Wildlife Fund, 1250 Twenty-fourth Street, NW, Washington, DC 20037, [www.worldwildlife.org](http://www.worldwildlife.org)

“The Bioluminescent Bays of Vieques”, Barbara Bernache-Baker, Ph.D., Revised June 1995

Name \_\_\_\_\_ Hour \_\_\_\_\_ Date \_\_\_\_\_

Assessment

**Directions:** Fill in the chart below identifying at least three marine ecosystems. Then, fill in the types of genetic diversity and the species diversity you'd expect to see in each of these ecosystems.

Marine Ecosystem	Genetic Diversity	Species Diversity

**Research Notes**

Name: \_\_\_\_\_ Topic: \_\_\_\_\_

**MAKE SURE TO RECORD YOUR SOURCE!**

<b>FACT:</b>	<b>FACT:</b>
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