

# Science Lessons for Grades 9-12

## “Uncovering the Mysteries of Bioluminescence”

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**Discipline:** Integrated Science I-III, Biology, Marine Biology  
**Grade:** 9 to 10, 11 to 12

### Standard

- Standard A: Students should develop abilities to do and understand scientific inquiry.
- Standard C: Students should develop an understanding of behavior of organisms, the cell, matter, energy, and organization in living systems.

### Purpose/Goal

- List and compare the advantages and disadvantages of light production in the deep sea.
- Identify the role of bioluminescence in behaviors such as finding food, avoiding predation, and attracting a mate.
- Simulate what happens to light intensity and wavelength at increasing depths in the ocean.
- Identify variables that may effect light production in ostracods.
- Measure light production from an ostracod and construct a graph displaying change over time.
- Design and conduct an investigation of the variables that effect light production in ostracods.

### Context

During this lesson, students use light producing organisms (ostracods) and models to demonstrate the costs and benefits of bioluminescence in deep sea environments, and the functions of light production. In the first activity, special deep sea glasses are used to simulate low light levels in the deep sea, helping students to visualize the adaptations needed to survive in this extreme environment. Students will also use dried ostracods, a light producing organism, to explore bioluminescence and how light production in deep sea environments can be both costly and beneficial.

### Preparation

- Read background essays and information provided in the lesson plan
- Assemble pairs of “deep sea glasses” (directions provided in lesson plan)
- Obtain a vial (500 mg) of dried luminescent ostracods

### Website

Carolina Biological Supply : ([www.carolina.com](http://www.carolina.com)) Vendor for dried ostracods

Ocean Explorer : ([www.oceanexplorer.noaa.gov](http://www.oceanexplorer.noaa.gov)) Provides background information, videos, photos and activities related to light production and behaviors observed in deep sea creatures.

SLD Lighting : ([www.sldlighting.com](http://www.sldlighting.com)) Vendor for blue filter gel plastic.

The Bioluminescence Web Page : ([www.biolum.org](http://www.biolum.org)) Provides background information and reliable information on marine bioluminescence.

### Motivation

This lesson introduces students to bioluminescence and light production in deep sea environments. Our design integrates biology, chemistry, and physics to show the students various behaviors exhibited by deep sea organisms. Light producing organisms (ostracods) and models are used to demonstrate the chemistry of bioluminescence, costs and benefits of light production in deep sea environments, and the behaviors associated with light production.

### Description

Day 1: During the first class period, students are divided into groups to explore bioluminescence and the effects on feeding and predation. Each student is given a pair of “deep-sea glasses” (directions provided) containing various layers of blue film to simulate the intensity and wavelength of light at increased depths. They are also

provided with a small container for collecting colored food items. The students put on the deep sea glasses and collect the first ten food items with only one blue layer on the glasses in front of their eyes. Additional layers of blue film are added to mimic the loss of light at increasing depths and students repeat the exercise with each additional layer.

The students return to their seats and the teacher stands at the front of the classroom with various colored glowsticks. With the lights off, the teacher presents the different colored glowsticks and instructs the students to indicate if they can see the colored lights or not. Each student then receives a small glow stick of various colors in addition to their deep sea glasses. Students are partnered according to the color of their glow stick and determine a signal they will use to find their partner. Some signals may include flashing or waving the glowstick in particular patterns recognized by their partner. Students then move to the opposite end of the classroom from their partner, the lights are turned off and they are instructed to find their partner using their signal. The teacher acts as the “predator” and eliminates students from the activity if their signal is detected, but the students are unaware that a predator will be present. After the first round, the students are allowed to alter their signal to find their partner while at the same time avoiding detection by the predator.

Day 2: During the second class period, the students return to their same groups to participate in an exercise investigating bioluminescence in ostracods. The teacher may demonstrate the crushing and glowing of the ostracods prior to handing out materials to students. Each group of students receives a small sample of dried ostracods, a small watchglass, a metal spatula, and a stopwatch. Students brainstorm variables that effect the duration of light produced by the ostracod (salinity, temperature, amount of water). Once the students have picked their variable to test, the appropriate water is given to each group. Students crush the dried ostracods in the watchglass using the metal spatula prior to added the water. The lights are turned off, the appropriate water added, and the students begin stirring the mixture while timing. The timer is stopped when no more luminescence is observed (which can take up to 10 minutes).

### **Assessment**

Worksheets are provided to guide the students through the activity and require them to think critically about why animals behave in certain ways. During the first activity, the students fill in various tables tallying the colored food items they collect while wearing the deep sea glasses. Follow-up questions interpreting the data allow the students to think critically about light attenuation and wavelength in the deep sea. They are asked to list advantages and disadvantages of bioluminescence and explore the various behaviors associated with light production. In the second activity, students are asked to discuss and list variables and design an experiment with their group. After testing, they construct a bar graph and answer questions interpreting their data.

### **Follow-Up Activities**

Marine Bioluminescence : Secret Lights in the Sea : This video provides the students an overview of bioluminescence and some of the advantages and disadvantages presented to the various animals that utilize this form of light production and can be used as a supplement to this lesson.

([http://www.hometrainingtools.com/catalog/special-categories/new-products/p\\_vd-litesea.html](http://www.hometrainingtools.com/catalog/special-categories/new-products/p_vd-litesea.html))