Bioluminescence From Ostracods (Sea Fireflies)

Overview

Energy comes from many different sources in the ocean. *Bioluminescence* is a very common biological energy source. In this activity, students crush dried ostracods on a slide with a little water and observe bioluminescence.

Concepts

- Bioluminescence is formed from a chemical reaction within an organism.
- This form of energy production is very common among sea organisms.
- These energy bursts are utilized in a number of ways.

Materials

- Dried luminescent ostracods (can be mail ordered, see preparation section)
- Glass slide with slide cover
- Water with eye dropper
- "Glow dough" or other glow-in-the-dark material
- Glow stick (optional)
- *Fluorescent* minerals and "black" light (optional)

Preparation

Dried luminescent ostracods can be obtained from biological supply companies, for example Carolina Biological Supply (1-800-334-5511), who refers to them in their catalog as sea fireflies, a term that is often applied to luminescent ostracods. Ordering one gram of sea fireflies (about $50) will be sufficient for one class of students. Half a gram (about $30) will work if students are broken into larger groups.

The fluorescent mineral demonstration is optional. The glow-in-the-dark materials and glow stick demonstrations are simple and engaging, and so are highly recommended. Glow sticks can often be purchased at camping or automotive supply stores, where they are sold as emergency light sources, or from SCUBA diving supply stores which sell them for night diving.

Split the class into pairs or small groups for activity. Each group will need their own ostracod(s), glass slide and cover, eye dropper, and water.

For best effect, darken room before groups attempt to observe bioluminescence.

Procedure

Engagement

Discuss briefly the different types of *luminescence*.

Florescence is where atoms in a crystal are excited by ultraviolet light. They then release that energy as visible light. (Fluorescent rocks glow when exposed to ultraviolet light, when you take the light away, then the glow disappears immediately.)

Phosphorescence is similar to florescence except the material continues to glow after the light source has been removed . This is because the excited atoms do not drop down to ground state right

away, but slowly over time. (Hold "glow dough" or other glow-in-the-dark objects--e.g., some watches, some T-shirt decorations, etc.--up to the light for some time, remove from light and then darken room. These phosphorescent materials will produce light for awhile.)

Chemoluminescence occurs when two chemicals mix, react, and one of the by-products of the reaction is light. (This can be demonstrated by cracking the middle of the glow stick and shaking the two chemicals together to create light.)

Luminescent ostracods produce light, but since it comes from an organism, it is called bioluminescence. Ostracods are a class of *crustaceans*. Luminescent ostracods are known to the Japanese as *umi botaru* (sea fireflies). These small crustaceans live on the sea bottom during the day and venture out and up in the water column to feed at night. Measuring only 0.5 to 5 mm in length, the body of the sea firefly is enclosed within hinged bivalve shells [Fig. 1].

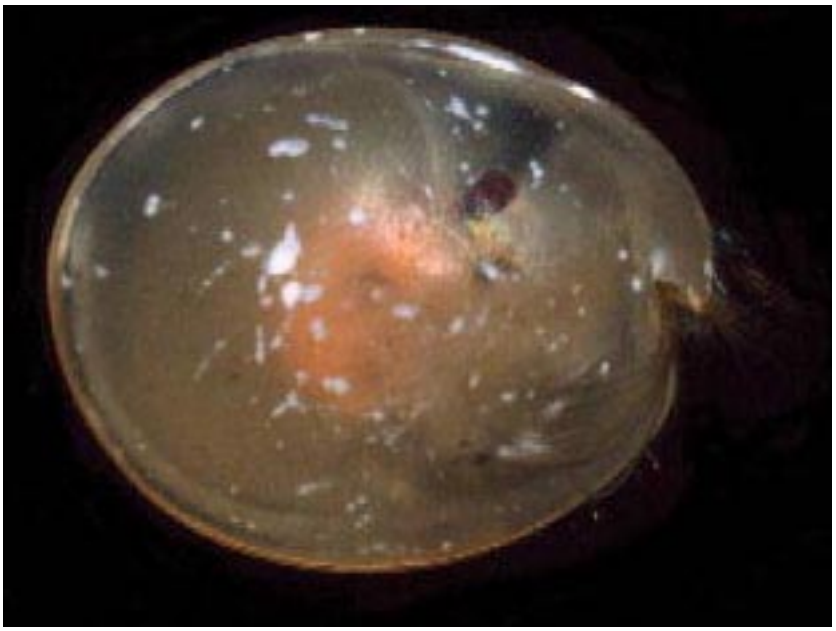

Figure 1. **Ostracod** viewed through a microscope.

If available, demonstrate different examples of fluorescence (e.g., fluorescent rocks), phosphorescence (e.g., "glow dough") and chemoluminescence (e.g., glow stick). Alternatively, give the students the materials (i.e., fluorescent rocks, glow dough, and glow stick) and let them experiment to discover for themselves under which conditions each type of material will glow. This will prepare them for the demonstration on bioluminescence.

Activity

1. In a darkened room, place one or two dried ostracods on a slide.
2. Place one drop of water on the ostracod.
3. Cover and crush the ostracod with the slide cover.
4. Write down what you observe. Can you see bioluminescence? What color is it?

Explanation

Raphael Dubois, who studied bioluminescence in clams in 1887, coined the names *luciferin* and *luciferase* for two components of bioluminescent systems. Luciferin is a species-specific *pigment*. Luciferase is an *enzyme* that *catalyzes* the oxidation of luciferin.

Luciferin and luciferase occur in the submaxillary gland (salivary gland found below the lower jaw) of the sea firefly. Luciferin and luciferase are released into the sea water as granules. If the water is disturbed, the granules dissolve and blue light is emitted. Luciferin acts directly as a *substrate* in the generation of light. Luminescence occurs with the addition of oxygen in the presence of luciferase and salts.

Animals and plants bioluminesce for a variety of reasons. These reasons include attracting mates and prey or scaring predators.

Luminescent ostracods in the ocean produce a bright cloud of luminescence much larger than the ostracod itself. This cloud is likely used to scare or startle predators. Males also use luminescence to attract females.

Ostracods present a simple model for studying an enzyme system. The presence of the required components (luciferin and luciferase) is easily demonstrated, and the product (light) is readily observed and measured. This model is used in research to study the effects of drugs, temperature, pressure, and other variables on enzymatic systems.

Extension

Have students do library research project, each one on a different bioluminescent animal or plant.

Vocabulary

bioluminescence
catalyzes (catalyst)
chemoluminescence
crustacean
enzyme
fluorescence
luciferase
luciferin
luminescence
pigment
phosphorescence
substrate
umi botaru

Source

Orange County Marine Institute and San Juan Institute activity series.