

THE MAGIC OF Bioluminescence

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LEARNING OBJECTIVES

Students will learn to:

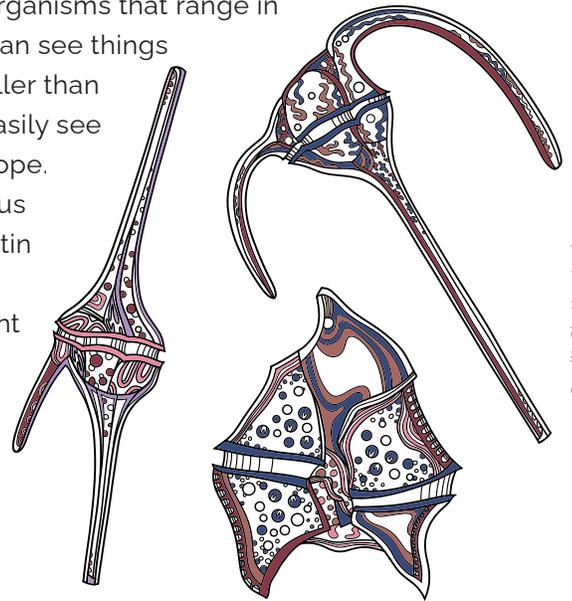
- Work with delicate biological materials
- Observe unusual phenomena of nature
- Observe tiny organisms
- Think about evolution and survival strategies of living organisms

MATERIALS NEEDED

- A flask of bioluminescent organisms called **dinoflagellates**. This can be ordered from [Carolina Biological](#) for about \$10
- A light timer that will automatically turn on and off a light at certain times.
- A microscope

Explore the tiny organisms responsible for the beautiful phenomena called Bioluminescence.

Dinoflagellates are one-celled marine organisms that range in size from .0002 to .08 inches. The eye can see things as small as .0016 inches—40 times smaller than the largest dinoflagellate!—so we can easily see a large dinoflagellate without a microscope. Dinoflagellates are members of the genus *Pyrocystis*, which is derived from two Latin roots: “pyro”, meaning fire, and “cystis”, meaning hollow sac or cavity. The ancient Greek philosopher Aristotle wrote of bioluminescent creatures in *De Anima* and other writings. This image shows what some dinoflagellates look like.



Credit: Shutterstock



THE LARGEST DINOFLAGELLATES
ARE ABOUT AS LARGE AS THIS DOT!

Above: An actor depicting young Alan Lightman encounters bioluminescence when visiting the shore in *SEARCHING part 1: The Stars & The Osprey*. Excitedly, he captures the magic liquid in a jar to share his discovery with his parents. Watch this [TikTok video](#) to learn more.

Preparation

First, order your flask of dinoflagellates. These can be purchased from [Carolina Biological](#). As soon as your culture arrives, open the shipping container, remove the jar, and inspect the culture for damage that may have occurred during the shipping process. Maintain at normal room temperature (65 to 75° F, 18 to 24° C). Avoid rapid temperature fluctuations. Be aware that your culture may need a week or more to recover bioluminescent ability after it has been shipped. Simply moving the culture from light to dark is not sufficient for it to recover bioluminescence, as the chemical reaction is related to the organisms' circadian rhythm. You will need to reestablish a circadian rhythm to recover bioluminescence before manipulating or diluting your culture. This process can take a week or more to complete, depending on

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the conditions your culture experienced during shipping. Set up your fluorescent lamp and timer with a cycle of 12 hours of light and 12 hours of dark. **This is essential for recovering bioluminescence lost during shipping.** Loosen the lid on the jar and place the jar under the light. After you have observed bioluminescence, you may transfer your dinoflagellates to a new container with additional culture.

To induce and observe bioluminescence, you will need a space without ambient light and equipped with a cool white fluorescent bulb and a lamp timer. Choose a bulb with a luminous intensity of 200-400 foot candles, like a 75 watt equivalent CFL bulb. Suspend the lamp approximately 14" from the culture. Do not use an incandescent bulb, as this can generate excess heat that damages the culture.

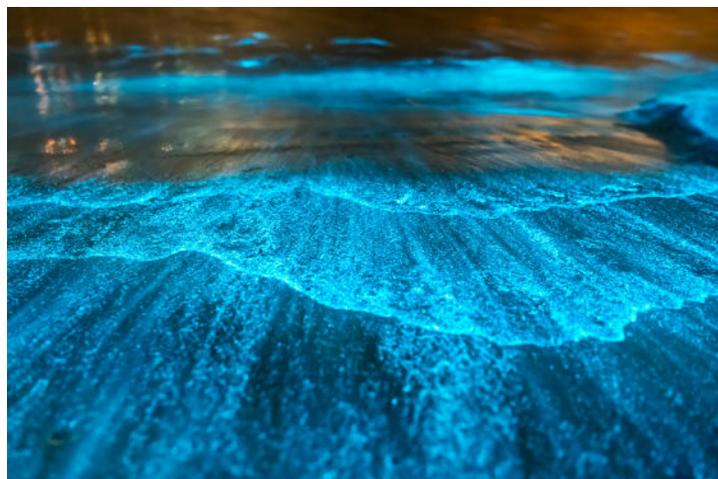
Activities

Bioluminescence can only be observed during the dark portion of the cycle and is most evident 1 to 2 hours after the dark portion of the cycle begins. It is best to observe bioluminescence in a completely darkened room. To induce bioluminescence, gently shake the culture jar to agitate its contents. The individual dinoflagellates should give off brief flashes of bright blue-green light. The dinoflagellates will not glow constantly, and the glow will fade as the culture is agitated multiple times within the same dark cycle. Allow the culture to recharge with a light cycle before attempting to observe bioluminescence again. If you have been unable to observe bioluminescence after 10 days of light cycles, please contact the technical support team at Carolina Biological.

Look at a sample of the culture with a microscope and make drawings of the organisms you can see.

Discussion

- **What other kinds of tiny organisms do you think exist in nature?**
- **Do you think that these tiny organisms are intelligent? If not, why not?**
- **Why do you think that these organisms developed the ability to make bright flashes when agitated?**



Credit: Shutterstock

Beautiful bioluminescent waves glowing on the sand. That's a lot of dinoflagellates!



Dinoflagellates are not the only organisms that glow. Fireflies also produce light. They have special chemicals in their abdomens that when combined create their flashing light. It's believed that they control the flashing by regulating how much oxygen goes to their light-producing organs.