

Bioluminescence

Name _____

Bioluminescence refers to the creation and emission of light by a living organism. It is a type of chemiluminescence: the emission of light because of a chemical reaction. Organisms use bioluminescence and light up certain parts of their bodies for various reasons. For many underwater organisms, bioluminescence is helpful for attracting prey, in the form of a light lure dangling in front of a fish's mouth or a glowing liquid squirted out by a squid. The organism we might immediately identify as using bioluminescence is one that lights up in the air: the firefly.

Fireflies use a chemical reaction to produce and emit light, exhibiting bioluminescence. This chemical reaction involves the combination of oxygen, calcium, a type of energy called adenosine triphosphate (ATP), and a chemical called luciferin. If this combination happens near a bioluminescent enzyme called luciferase, light is produced and the firefly's abdomen begins to glow. The reaction itself happens in the firefly's light organ: the organ lights up when oxygen is available, and goes dark when it is not available. Therefore, the firefly is able to selectively add oxygen to the other chemicals, choosing when to begin the chemical reaction and produce its light. The firefly can also move oxygen from outside its body to its inner cells using smaller tubes called tracheoles.

One interesting feature about fireflies' bioluminescent light is that it is cold light. Cold light refers to a specific type of light that occurs without the production of much heat. In most chemical reactions, energy is given off as heat – but in bioluminescence, this is not the case, so very little energy is lost during the chemical reaction. The production of cold light instead of hot light allows fireflies to glow without burning up.

Bioluminescence is utilized by many organisms – from fireflies to countless deep-sea creatures – potentially making it the most common form of communication on the planet. Firefly larvae can use it as a warning mechanism to ward off predators, and adult fireflies can glow to identify members of their species or of the opposite sex as part of mating rituals. Whatever the purpose, bioluminescence remains a unique and exciting scientific phenomenon that continues to light up our world.

- 1. The words “bioluminescence” and “chemiluminescence” both have a common root in the Latin word *lumen* meaning light. Using what you know about the definitions of the two words, infer the meaning of the two prefixes that make the words differ.**
 - a. *Bio* meaning life vs. *Chemi* meaning relating to chemistry
 - b. *Bio* meaning plant vs. *Chemi* meaning life
 - c. *Bio* meaning relating to chemistry vs. *Chemi* meaning life
 - d. *Bio* meaning firefly vs. *Chemi* meaning light

- 2. A firefly is unable to produce its light. There are the correct amounts of calcium, ATP, oxygen, and luciferin available. What is the most likely reason for this occurring?**
 - a. Too much oxygen is available in the firefly’s body.
 - b. The combination of chemicals did not occur close enough to luciferase.
 - c. Luciferin is toxic to the light organ.
 - d. The organism has ceased being bioluminescent permanently.

- 3. Which of the following is not a use for fireflies’ bioluminescence mentioned in the article?**
 - a. Finding a mate
 - b. Warding off predators
 - c. Feeding young fireflies
 - d. Identifying members of the same species

- 4. Why is it significant that fireflies are able to selectively choose when to turn on and off their light?**
 - a. As much heat is produced as is light, and too much heat can kill the firefly.
 - b. For the best chance of survival, it is not always optimal for the light to be on.
 - c. The light produced will not be easy to see in the daytime.
 - d. Fireflies gain energy from the light, and too much energy can be damaging.

- 5. Which of the following is an incorrect statement about cold light based on the information given in the article?**
 - a. Cold light gives off very little heat when it is produced.
 - b. Cold light is a safer option for fireflies than hot light.
 - c. Fireflies’ light organs produce cold light.
 - d. Fireflies’ light organs both heat up and light up.

6. Which organism is least likely to use bioluminescence?

- a. *Myctophum punctatum*, the spotted lanternfish
- b. *Litoria caerulea*, the Australian green tree frog
- c. *Taningia danae*, the giant squid
- d. *Photinus pyralis*, the common eastern firefly

7. Which of the following is an appropriate title for this article?

- a. Bioluminescence Under the Sea
- b. Light Up the Night: Fireflies and Fireworks
- c. Bioluminescence in the Firefly
- d. How Fireflies Communicate