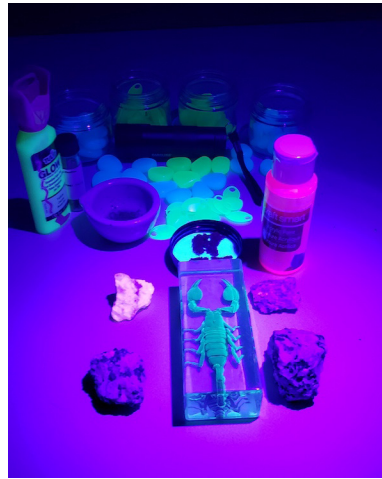


Activity
Parent or Educator

MAKE IT GLOW

A “Cold Light” Kit



Materials

See below for a list of possible materials to include in your kit. Links are provided as information, not endorsement (Date last accessed: 5/26/2020)

- UV (ultraviolet) LED flashlight with a wavelength of about 395 nm. Item can be found at [Carolina Biological Supply](#) & [Amazon](#)
- Fluorescent minerals. *Item can be found at [Carolina Biological Supply](#) & [Etsy](#)*
- Fluorescent scorpion specimen in resin. *Item can be found at [The Evolution Store](#)*
- Fluorescent paint. *Item can be found at art retailers and from [Amazon](#)*
- Fluorescent specimens from inside/outside. For example, fluorescent lichens are easy to find growing outdoors, locate with a UV light. Common household item: laundry detergent
- Glow in the dark items such as pebbles, stickers, toys, etc. *Item can be found at [Amazon](#)*
- Living bioluminescent dinoflagellates. Available from [Carolina Biological Supply](#)
- Sea Firefly *Cypridina hilgendorffii*. Available from [Carolina Biological Supply](#)
- Bioluminescent fungi such as *Armillariella mellea*. Available from [Carolina Biological Supply](#)
- Hand lens. Available from [Carolina Biological Supply](#)

Learning Objectives

By the end of this activity, students should know...

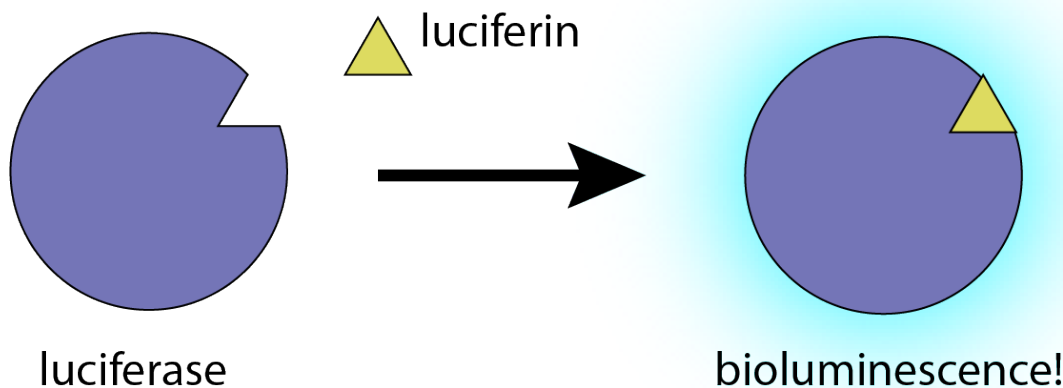
- Luminescence describes light emission in the absence of heat.
- Bioluminescence, fluorescence, and phosphorescence are all examples of luminescence.
- Bioluminescence is light created by a chemical reaction within or by a living thing.
- Fluorescent and phosphorescent light emission is not due to a chemical reaction but instead involves an interaction between a high energy light source and electrons within the material. The molecules have the ability to absorb light of one color and then release some light of a different color; in fluorescence, the release is immediate and in phosphorescence, it can last for minutes or even hours.

Background

The ultimate goal of this activity is to introduce learners to luminescence. When discussing light, the example that students are often most familiar with is the light bulb. Standard light bulbs create light through incandescence, which is when light is emitted by adding heat to an enclosed filament. Students are typically less familiar with other types of light emission. **Luminescence** is one such example and can be defined as light emission with little or no heat. Luminescence is often referred to as “cold light.” Some examples of luminescence are **bioluminescence**, **fluorescence**, and **phosphorescence**.

Bioluminescence is light produced by a chemical reaction inside a living thing.

Bioluminescent species may use different specific reactions to generate light, but the recipe for this ‘living light’ often contains two key ingredients: a luciferase enzyme and a luciferin molecule. The luciferase enzyme contains a small area that finds and binds the luciferin molecule. When the luciferin molecule binds to the luciferase enzyme, a chemical reaction occurs and the luciferin releases light that we can see.



Fluorescence is light emitted from the interaction between a high energy light source, such as a UV light, and fluorescent molecules. Fluorescent molecules have the ability to absorb light energy and then immediately re-emit light of a different energy. Students can observe this phenomenon as an item glowing and changing colors when the UV light is shining on the object. When the high energy UV light strikes objects with fluorescent molecules, at the atomic level, the electrons in the molecule are excited. When the electrons return to their original state, some energy is released in the form of visible light. This can also be referred to as a “package” of light or a photon. This emission of light can be observed as long as the object is illuminated by the UV light. There are a variety of fantastic colors that can be observed so long as the emitted light is within a range that can be seen by humans.

Phosphorescence is similar to fluorescence in that light is absorbed by molecules that make up the object and then re-emitted, but the emission is not as rapid as in fluorescence. Phosphorescent items can glow for minutes or even hours after the external light source is removed. Commercial items that “glow in the dark” are phosphorescent.

Instructions

1. Watch the NSF NeuroNex Bioluminescence Hub [Cold light video](#) on our Education page. Khan, Raisa, “Cold Light” (2019).
2. Have learners use their provided tools, the UV flashlight and hand lens, to determine if each specimen is an example of bioluminescence, fluorescence, or phosphorescence.
3. Once they have worked through all of the items, ask learners to explain how they came to their conclusions. Encourage students to use the included worksheet.

Bonus: Check out the NSF NeuroNex Bioluminescence Hub [What Glows There?](#) Activity

Follow-up Question

What other examples of bioluminescent, fluorescent, and phosphorescent items can you think of? (Encourage students to use the recommended readings and resources, or help them find additional resources at the library or on the web).

Object	<u>Prediction</u> <i>What do you think will happen?</i>	<u>Observation</u> <i>What do you see?</i>	<u>Is this bioluminescence, fluorescence, phosphorescence, or none of these?</u>	<i>Why do you think that?</i>
Minerals				
Toys				
Fungi				

Key

Bioluminescent: dinoflagellates, sea firefly, and fungi

Fluorescent: minerals, scorpion, paint, household items, lichens

Phosphorescent: pebbles, toys, stickers

Note: Fluorescent items require the UV light to glow. As soon as the light is turned off, fluorescent items will stop glowing and phosphorescent items will continue to glow. Bioluminescent specimens do not require UV light, but possibly agitation. For example, stirring the dinoflagellates or crushing the dried sea fireflies.

What other examples of bioluminescent, fluorescent, and phosphorescent items can you think of?

Note: Not a complete list, just some examples to help get learners started!

Bioluminescence	Fluorescence	Phosphorescence
Fireflies, jellyfish, some types of beetles, some types of bacteria, some types of nematodes, some marine crustaceans, krill and many other examples!	Fluorescence in everyday objects Corals, jellyfish, many bacteria, a variety of organisms!	Chemicals such as barium sulfate

Readings and Resources

Cold Light: Creatures, Discoveries, and Inventions That Glow by Anita Sitarski

Bioluminescence: Nature and Science at Work by Marc Zimmer

University of California, Santa Barbara. [The Bioluminescence Web page](#).

[The allure of fluorescence in the ocean](#) by the Monterey Bay Aquarium Research Institute (MBARI)

[Glow Rocks](#) video by the Field Museum

Enjoy this activity? Want to learn more? We want to hear from you! Connect with us on Twitter and Instagram @BiolumHub

Email us your worksheet for a PRIZE at bioluminescencehub@gmail.com