

LUCIFERIN LIGHTS UP BIOCHEMISTRY WITH THE SCIENTIFIC METHOD

SCIENTIFIC EXAMPLE: WHAT IS BIOLUMINESCENCE?

In the dark, lightless abyss of the deep sea, organisms have been observed creating their own light. This process is called bioluminescence, and relies on both an enzyme reaction and oxidation reaction. Through this process, organisms can create and emit their own light in times of prey avoidance, as well as predation. Prey are able to emit light to disorient predators and allow for an escape attempt, and predators are able to emit a light to draw in prey for a predation attempt. By seeing such phenomena, it is easy to think that it just happens, but it actually involves a complex biochemical interaction.



Figure 2. A deep-sea pandalid shrimp *Heterocarpus ensifer* exhibiting a predator avoidance mechanism by emitting a blue liquid through bioluminescence.
(photo credit: Sönke Johnsen and Katie Thomas)

WHY THIS MATTERS?

From the first discovery of bioluminescence, to the state of knowledge we are currently in, all started from the same scientific method pattern. Consistency is important throughout science and allows the reader of the discovery or experiment to easily interpret if the scientific method was accurate and reputable, or if there were inconsistencies present. Understanding this method is also important in being able to distinguish which aspect they are observing at the moment, and find the aspect of the discovery they desire. Allowing for a consistent and familiar flow through each experiment.

Figure 1. The scientific method flowchart.
(Photo from www.study.com)

NATURE OF SCIENCE PRINCIPLE: THE SCIENTIFIC METHOD: OBSERVE, EXPERIMENT, REASON AND INTERPRET

The area of bioluminescence research follows the scientific experiment pattern: observe, experiment, reason and interpret. First the observation of the light emission, then, recreation of such emission through a variety of tests: stress, prey, predation, alarm etc. Lastly, interpret and provide reasoning: why did something do what it did? How did that happen? Why did it do that WHEN it did?. For example: A bioluminescent organism is observed emitting light for predator avoidance. Then an experiment is developed to recreate the scenario under controlled parameters. Furthermore, a sample is taken from the photophore before and after emission. From the first sample, the luciferin substrate is absent of any enzymes, in the second sample, the enzyme luciferase is present and the luciferin is oxidized. Now the results of the experiment can be interpreted and reasoning behind the reaction can be assessed. Thus, building the knowledge on how bioluminescence occurs.

STUDENT AND TEACHER USE

This case card could be used for aiding students to understand the proper ways to conduct experiments following the scientific method. Additionally, it would be a good reference when trying to decide whether or not the source (scientific article, journal etc.) being used is a good choice or, if there would be a better way this experiment could have been conducted.

References

Dunuweera, A. N., Dunuweera, S. P., & Ranganathan, K. (2024). A Comprehensive Exploration of Bioluminescence Systems, Mechanisms, and Advanced Assays for Versatile Applications. *Biochemistry research international*, 2024, 8273237. <https://doi.org/10.1155/2024/8273237>

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