

## Bioluminescence and Diversity in Ecosystems

Companion Lesson to X-STEM All Access Episode "[Exploring Our Planet](#)"

<b>Grade/ Grade Band</b> 6-12	<b>Topic:</b> Oceanography	
<b>Brief Lesson Description:</b> Study bioluminescence, create a scientific poster on a bioluminescent organism, and gain a deeper understanding of this fascinating process.		
<b>Performance Expectation(s):</b> MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.		
<b>Specific Learning Outcomes:</b> Students will be able to explain the overall process of bioluminescence, including the role of luciferins, luciferases, and cofactors. Students will be able to create a scientific poster to communicate technical information.		
<b>Narrative / Background Information</b>		
<b>Prior Student Knowledge:</b> Students should be able to define and describe adaptation, biodiversity, variation, and natural selection.		
<b>Science &amp; Engineering Practices:</b> <u><b>Constructing Explanations and Designing Solutions</b></u> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories  <ul style="list-style-type: none"> <li>● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (<a href="#">MS-LS2-5</a>)</li> </ul>	<b>Disciplinary Core Ideas:</b> <u><b>LS2.A: Interdependent Relationships in Ecosystems</b></u>  <ul style="list-style-type: none"> <li>● Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (<a href="#">MS-LS2-2</a>)</li> </ul> <u><b>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</b></u>  <ul style="list-style-type: none"> <li>● Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. (<a href="#">MS-LS2-5</a>)</li> </ul>	<b>Crosscutting Concepts:</b> <u><b>Patterns</b></u> <ul style="list-style-type: none"> <li>● Patterns can be used to identify cause-and-effect relationships. (<a href="#">MS-LS2-2</a>)</li> </ul> <u><b>Stability and Change</b></u>  <ul style="list-style-type: none"> <li>● Small changes in one part of a system might cause large changes in another part. (<a href="#">MS-LS2-5</a>)</li> </ul>
<b>Possible Preconceptions/Misconceptions:</b> Many students believe genetic variations arise in response to selective pressure. For instance, because their habitat became icy and snowy, polar bears developed new genetic variations that gave them white fur so that they could blend in. Genetic variations arise at random, all the time. Selection can act only on existing variations.		
<b>LESSON PLAN – 5-E Model</b>		

**ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:**

Prior to the lesson obtain glow-in-the-dark sticks (enough for each group of 4 students)

To begin this lesson give each group of students one of the glow-in-the-dark sticks, turn off the lights and ask students to explore the toys and then ask the following questions to spark student interest: “how does the glow-in-a-dark stick work?”, “when would you use a glow in a dark stick?”, “what is the purpose of a glow in a dark stick?”, “why would things need to glow in the dark in nature?”, “name some things that glow in the dark”. Then show the [Exploring Our Planet](#) video featuring Dr. David Gallo. After watching the video, students discuss what they learned about why animals in oceans glow in the dark.

**EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:** Students need access to laptops

Share the following articles with students (Note: reading levels vary)

- [What Is Bioluminescence?](#), Time For Kids, August 24, 2018
- [Why Do Animals Glow? A Guide to Bioluminescence](#), Ocean Conservancy, 2019
- [Teen Studies Living Flashlights of the Deep](#), Science News Explores, October 27, 2014
- [The Dark Ocean Is Full of Lights](#), Frontiers for Young Minds, May 28, 2020
- [The Glow Below: Bioluminescence in the Sea](#), Dive Training Magazine
- [Animals that Glow in the Dark](#), Earth Rangers, July 12, 2019
- [Bioluminescence](#), Smithsonian Ocean
- [Bioluminescence: light in the dark](#), Natural History Museum

Students gather information from the article to explain bioluminescence and facts about animals that use bioluminescence. Students should read at least two articles or work in pairs and share information. Students will then state a **claim** (a statement about how animals use bioluminescence), provide **evidence** (scientific data to support the claim), and finally write out a **reasoning** (explaining and justifying how the evidence supports the claim) Students will share their claim-evidence-reasoning reports with another pair of classmates.

**EXPLAIN: Concepts Explained and Vocabulary Defined:**

Explore how bioluminescence works in this video from [NOVA](#). Bioluminescence is a chemical reaction that produces energy in the form of light. It occurs in fungi, bacteria, and some invertebrates. The purpose of bioluminescence may include warning or evading predators, luring or detecting prey, and finding mates however scientists are not completely sure.

**Vocabulary:**

- bioluminescence**- light emitted by living things through chemical reactions
- luciferins**- light-emitting compounds found in organisms that generate bioluminescence
- luciferases**- the enzyme that when present with luciferins and oxygen light is emitted

**ELABORATE: Applications and Extensions:**

Prior to starting the elaboration section of this lesson, you will need to gather the following materials (per student): a small poster board (11x14), colored pencils, and a laptop.

Students will create a scientific poster for one of the following organisms: Black dragonfish, Lanternfish, Anglerfish, Foxfire (aka fairy fire), Firefly squid (aka Sparkling Enope Squid), Sea Salp, dinoflagellates, Chrysaora melanogaster, pelagic octopus, Giant Keesingia. The poster should communicate the following about the organism:

- Scientific name and common name
- Habitat
- Prey and predator
- Description of bioluminescence and purpose
- Image

**EVALUATE:**

**Formative Monitoring (Questioning / Discussion):** Students write **Claim-Evidence-Reasoning** explaining how organisms use bioluminescence

**Summative Assessment (Quiz / Project / Report):** Students create a **Scientific Poster** illustrating bioluminescence in nature.

**Elaborate Further / Reflect: Enrichment:** Students create a fictional bioluminescent creature and its habitat and write a story explaining how/why the creature uses bioluminescence.

**SOCIAL EMOTIONAL LEARNING ACTIVITY**

**CASEL Competency: Social Awareness**

Social Awareness is the ability to understand the perspectives of and empathize with others, including those from diverse backgrounds, cultures, & contexts. In today’s activity students build relationships through movement. Share this [video](#) from Study.com on Dance As Cultural Expression (you may consider applying for a STUDY.COM account but it’s not necessary for this lesson) emphasizing dance is a form

of cultural expression. Students work in small teams to create a new sequence of movements that expresses personality traits of the group. This is an opportunity for students to explore the strengths of each member of the group as they work together.

Instructions:

1. Think about how you would complete this sentence: "A positive word or phrase that describes me is..."; share with your teammates.
2. Come up with a gesture or pose that captures the trait each person shared.
3. Choreograph these gestures/poses into a dance routine that represents each team member's personality.
4. Rehearse your new routine a few times before sharing with the class.

After teams share, ask students to reflect on the following questions:

- How did it go with your team?
- Did you do your part to contribute ideas?
- Did you learn something new about your classmates?

**INTERDISCIPLINARY CONNECTIONS/IDEAS**

**RI.8.8** - Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound, and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced. (MS-LS2-5)

**RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2)

**RST.6-8.8** - Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)

**SL.8.4** - Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2)

**WHST.6-8.9** - Draw evidence from informational texts to support analysis reflection, and research. (MS-LS2-2)

**Materials Required for This Lesson/Activity**

Quantity	Description
Per student	Laptops
Per student	small poster boards (11x14)
per class	colored pencils



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