Exploring Our Planet

Pages 1-3 Exploring Our Planet with Dr. David Gallo NGSS & CASEL lesson

Watch the Video Here

Materials Required for This Lesson/Activity	
Quantity	**Description**
Per student	Laptops
Per student	small poster boards (11x14)
per class	colored pencils

Pages4-6 Exploring Our Planet with Jill Heinerth NGSS & CASEL lesson

Watch the Video Here

Materials Required for This Lesson/Activity	
Quantity	**Description**
for class demonstration	water
	Tupperware container (at least 6 inches deep)
	lasagna pan
	hammer
	hot water
per group (4)	1000 ml beakers (2)
	100 ml graduated cylinder
	stirring rod
	vegetable oil
	blue food coloring

Exploring Our Planet with Dr. David Gallo

Grade/ Grade Band 6-12	**Topic:** Oceanography	
Brief Lesson Description: In this lesson, we follow oceanographer Dr. David Gallo to the depths of the oceans to explore creatures that glow in the dark. Students will explore the reactions behind bioluminescence and the creatures that use it.		
Performance Expectation(s): **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.**		
Specific Learning Outcomes: 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.		
Narrative / Background Information		
Prior Student Knowledge: Students should be able to define and describe adaptation, biodiversity, variation, and natural selection.		
Science & Engineering Practices: **Constructing Explanations and Designing Solutions** 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 ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)	**Disciplinary Core Ideas:** **LS2.A: Interdependent Relationships in Ecosystems** ● 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. (MS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ● 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. (MS-LS2-5)	**Crosscutting Concepts:** **Patterns** ● Patterns can be used to identify cause-and-effect relationships. (MS-LS2-2) **Stability and Change** ● Small changes in one part of a system might cause large changes in another part. (MS-LS2-5)
Possible Preconceptions/Misconceptions: 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.		
LESSON PLAN – 5-E Model		

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

Lesson Created by Stacy Douglas
For questions, please contact info@usasciencefestival.org

Exploring Our Planet with Jill Heinerth

Grade/ Grade Band 6-12	**Topic:** Oceanography	

Brief Lesson Description: In this video, Jill Heinerth discusses exploring the water systems on earth. This lesson examines the water systems available for human use and ways to conserve freshwater.

Performance Expectation(s):
MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Specific Learning Outcomes:
Students will gain a visual perspective on global water distribution.
Students will understand the limited supply of freshwater that exists on the earth.
Students will persuade others to conserve our freshwater supply

Narrative / Background Information

Prior Student Knowledge:
Students should understand the water cycle.
Students should be able to define watersheds and groundwater.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop and use a model to describe phenomena. (MS-ESS2-1)	**ESS2.A: Earth Materials and Systems** All Earth processes are the results of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)	**Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

Possible Preconceptions/Misconceptions:
Students know that water is cycled through the water cycle and therefore believe it cannot be wasted. Students don't understand the time required to refill the aquifers, which can be thousands of years.
Students may also believe that lack of water is not a problem in the United States. California has experienced a record-setting drought. Demand for water continues to climb. Water managers in 40 states are planning for shortages in the next decade.

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:
Gather the following materials for this demonstration:
- Tupperware container 6 inches deep
- lasagna pan
- hammer
- hot water

DEMO
Fill the Tupperware container with water and freeze. Then turn the container upside down and empty the block of ice onto the lasagna tray. Tell the students that the block of ice represents limestone.
Hit the block of ice once or twice with the hammer to create small cracks in the ice. Ask students how limestone might become cracked (possible answers: earthquakes/uplift). Ask students where does rainwater go once it hits the ground? (possible answers: evaporates into the air, rolls along the surface to watersheds, and seeps into the ground).
Elevate one end of the pan before pouring hot water over the ice. Ask students to observe what happens and record it in their notebooks. Share with students that there are several kinds of formation processes: stream erosion, lava tubes, sea caves, ice caves, acid-formed caves, etc.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Ask students to describe the world beneath their feet, give them 2 minutes to think and write down their ideas, and another 2 minutes to share with a partner. After students share their ideas show the video Exploring Our Planet with Jill Heinerth. Then have students record what Jill Heinerth finds under our feet.

EXPLAIN: Concepts Explained and Vocabulary Defined:
Explain to students that 71% of the Earth's surface is covered in water.
96.5% of all water on Earth is held in oceans; water also exists in the air as water vapor, in rivers, lakes, and streams, as icecaps and glaciers, and in the ground as soil moisture, and underground in aquifers.

Assign students to read one of the following articles:
- How Much Water is There on Earth?
- Aquifers and Groundwater
- Where is Earth's Water?
- 45 Ways to Conserve Water in the Home and Yard
- Water Conservation Tips for Kids
- Native Plants Help Conserve Water

Students identify a claim (relating to water conservation), evidence, and reasoning to write a summary of the article.

Vocabulary:
freshwater- naturally occurring water that is not salty and suitable for consumption.
saltwater- naturally occurring salty water found in seawater/oceans.
groundwater- water held underground in the soil or in pores and crevices in rock.
aquifers- a body of permeable rock which can contain or transmit groundwater.

ELABORATE: Applications and Extensions:
Prior to starting the elaboration section of this lesson, you will need to gather the following materials (per group):
- 1000 ml beakers (2)
- 100 ml graduated cylinder
- stirring rod
- water
- vegetable oil
- blue food coloring

Students will work in teams of 4. Each team should collect two 1000 ml beakers and label one *world's water supply* and the other *US water use*. In the beaker labeled *world's water supply* measure out 970 ml of water and add 2 drops of blue food coloring. Pour 30 ml of vegetable oil into the beaker. Ask students to draw and label their diagram saltwater and freshwater.

In the 2nd beaker labeled *US water use*, add a portion of water in the following amounts:

Faucets (handwashing, rinsing fruits/vegetables, dampening a cloth)	120 ml
Glass of Water	50ml
Baths	90 ml
Showers	210 ml
Washing Machines	220 ml
Dishwasher	30 ml
Toilet Flush	280 ml

Ask students to compare their water use to the amount of available freshwater. Then students should answer the following questions:
1. Where is most of the world's water found?
2. Is all the water on Earth fit for human use? Explain.
3. What percent of the world's water is fit for human use?
4. Based on the *US water use*, what accounts for the smallest water use? largest water use?
5. List 3 ways you could conserve water around your home.

Students then write a report about the limited amount of water on the planet. State a claim, and provide evidence, and clear reasoning.

EVALUATE:

Formative Monitoring (Questioning / Discussion): Students responses to questions during the demonstrations and activity.

Summative Assessment (Quiz / Project / Report): Claim Evidence Reasoning Report

Elaborate Further / Reflect: Enrichment: Students create an ad campaign for water conservation to convince their families to reduce their water consumption.

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: SOCIAL AWARENESS

Listening carefully is a communication skill. It is also an important factor in being socially aware. This activity, Sandwiches and Hamburgers, is a group activity that requires students to listen very carefully.

Instructions:

1. Give students the verbal cues: when I say sandwiches, pull on your earlobe, and when you hear the word hamburgers fold your hands.
2. Practice saying "sandwiches, hamburgers" repeatedly a few times and have students touch their earlobes or fold their hands to correspond with what is said.
3. Now tell a story involving sandwiches and hamburgers. And watch.

This game can be a lot of fun, with people misjudging the verbal cues and the actions, leading to some good-hearted laughs. Be sure to follow the activity with a discussion about social awareness and listening carefully.

INTERDISCIPLINARY CONNECTIONS/IDEAS

SL.8.5 - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
SL.8.2 Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.

Materials Required for This Lesson/Activity

Quantity	Description
for class demonstration	water
	Tupperware container (at least 6 inches deep)
	lasagna pan
	hammer
	hot water
per group (4)	1000 ml beakers (2)
	100 ml graduated cylinder
	stirring rod
	vegetable oil
	blue food coloring

Lesson Created by Stacy Douglas
For questions, please contact info@usasciencefestival.org