Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7th Grade Science Data Visualization (7DVS)
"Under the Sea"
Deep Sea Ecosystems Challenge

Module Description	Students analyze images of corals to evaluate the health of deep-sea ecosystems in the Gulf of Mexico after the Deepwater Horizon Oil Spill. Students will learn different methods of quantifying data from images, in other words to change picture data into numerical data. First, they will view photos of deep-water corals at different time stamps and locations and analyze them according to rubrics. Then, they will color-code the same photos of the corals and compare their analysis to the health score obtained from the rubric. Students will then construct an explanation regarding the recovery of the coral across time and space. The module helps students define and quantify data as well as differentiate between temporal and spatial data. The module covers some basic concepts of ecosystems, abiotic and biotic factor, and benthic environments seeding further exploration of standards later in the semester or year. *Module features Dr. Annalisa Bracco and the ECOGIG teams' work in the School of Earth and Atmospheric Sciences on deep sea ecosystems.*
Related Georgia Standards of Excellence	**S7L4. Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.** a. Construct an explanation for the patterns of interactions observed in different ecosystems in terms of the relationships among and between organisms and abiotic components of the ecosystem. Analyze and interpret data to provide evidence for how resource availability, disease, climate, and human activity affect individual organisms, populations, communities, and ecosystems.

Module Timeline	**50-minute class periods:** 6 days Day 1: Section 1,2 Day 2: Section 2,3 Day 3: Section 4 Day 4: Section 4,5,6 Day 5: Section 6, 7 Day 6: Section 7	**90-minute blocks:** 4 days Day 1: Sections 1,2 Day 2: Section 3,4 Day 3: Section 4 5,6 Day 4: Section 6,7

Documents Included in the Download	**Student Materials Folder**
	   • Student Edition *(recommended to be printed double sided)*
	   • Student Worksheet Packet *(recommended to be printed double sided)*
	
	Teacher Materials Folder
	   • Materials List
	   • Annotated Teacher's Edition
	   • Teacher's Edition
	   • Videos

5E Stage	Student Activities	Teacher Activities
	How will students engage actively in the three dimensions throughout the lesson?	How will the teacher facilitate and monitor student learning throughout the lesson?
Engage How does the lesson capture student interest, activate prior knowledge, and connect to a complex question, global issue, or real-world problem?	• Students are introduced to the Deepwater Horizon oil spill, the ecology of the Gulf of Mexico, and ECOGIG's research into how the oil spill affected the ecosystem *(1.1,1.2)* • Students are introduced to their challenge (assisting ECOGIG with analyzing images of coral to determine the amount of damage) *(1.3)*	• Guide students through text to check for understanding • Review ECOGIG with students • The text references grade level content that is interwoven with this real-life situation- remind students of this. Science isn't limited to their classrooms/books.
Explore How does the lesson allow students to develop a common base of experiences by actively investigating the phenomenon or problem?	• Students explore what information can be gleaned from a photo of a hamburger and ways that images can be rated *(2.1)* • After initial activity, students create a rubric & use to analyze images of hamburgers *(2.2, 2.3)* • Students develop and apply a rubric for examining the health of the coral *(4.1,4.2,4.3)* • Students use their rubrics to evaluate the health of the corals at their site and share results with classmates *(4.3,4.4,4.5)*	• Review rubrics- they're objective so things can be evaluated fairly. • If students struggle with creating rubrics based on images of hamburgers, offer alt. images that they may be more familiar with • Review the importance of creating a standardized rubric and how to apply to images of corals • Monitor students as they analyze images, calculate the heath score and spot trends
Explain How does the lesson allow students to develop, share, critique, and revise their own explanations before connecting those to accepted scientific explanations and terminology?	• Students learn more about the ecology of the deep-sea ecosystems, how ECOGIG explores the coral and observations of how the coral changed after the accident. *(3.1,3.2,.3.3)* • Students learn of the impact the oil spill had on coastal communities and why temporal and spatial data is important to determining the coral's recovery *(5.1,5.2)*	• Guide students through text to check for understanding. The explain sections have the more "standards based" content including key terms. • Review with students the impact that the oil spill had on communities along the coast. The spill was devastating for marine life but also for coastal economies
Elaborate How does the lesson allow students to extend their conceptual understanding of the three dimensions through opportunities to apply knowledge, skills, and abilities in new experiences?	• Students code images of the coral in different colors (red, green, black) based on what they see on the coral. This method was developed by ECOGIG scientists and helps illustrate the health of the coral *(6.1, 6.2)* • Students compare images and notice how coral has changed temporally/spatially. They compare the health scores to coded images and share data with their classmates. *(6.3)*	• Monitor students as they color the coral from their site on transparencies & compare the results to the health score they calculated previously • Review that there are multiple ways of visualizing/analyzing data- depends on the circumstances which method is best • Guide students through text about how computers use A.I. to analyze images
Evaluate How does the lesson—through both formative assessments embedded throughout the lesson and a summative assessment that might coincide with the elaborate phase—make visible students' thinking and their ability to use practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions?	**Formative:** Ongoing questioning and discussion *(all sections)* Evaluating Images: Student Sheet #1 *(2.2)* Creating a Rubric: Student Sheet #2 *(2.3)* Evaluating Images: Student Sheet #3 *(2.3)* Coral Characteristics: Student Sheet #4 *(3.1)* Class Rubric: Student Sheet #5 *(3.2)* Evaluating Images: Student Sheet #6 *(3.3)* Data Visualization Questions: Student Sheet #7 *(6.3)* **Summative:** Construct an Explanation: Student sheet #8 *(7.1)*	

	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5	5.1	5.2	6.1	6.2	6.3	6.4	7.1	7.2
Engage	—	—	—																			
Explore				—	—	—				—	—	—	—	—								
Explain							—	—	—						—	—						
Elaborate																	—	—	—	—		
Evaluate																					—	—

Section 1 – The Deepwater Horizon Accident *(35 minutes)*

The focus of Section 1 is to provide students with a background of the Deep-Sea Ecosystems Challenge. Students are introduced to the Deepwater Horizon accident which resulted in a massive release of crude oil into the ocean which caused a significant amount of damage to the marine ecosystems. This challenge focuses on the damage to the deep-sea ecosystems- specifically the coral communities. Students learn about the ECOGIG research team which is exploring and investigating these ecosystems. ECOGIG's goal is to track the long-term impact of the oil from the explosion on the deep-sea ecosystem. Students will assist ECOGIG by analyzing images taken over several years of coral communities to determine which ecosystems are recovering and which have suffered the most damage.

Preparation

Materials	Student Pages
• Video #1- Explosion of Deep Water Horizon Oil Rig • Video #2- ECOGIG Deep Sea Life: Corals, Fishes, Invertebrates • Video #3- ECOGIG in 60 seconds	• N/A
Prep the Day Before: Review the section and challenge.	

Planning

GPS	**S7L4.** *Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.*
	    a. *Construct an explanation for the patterns of interactions observed in different ecosystems in terms of the relationships among and between organisms and abiotic components of the ecosystem*
	    c. *Analyze and interpret data to provide evidence for how resource availability, disease, climate, and human activity affect individual organisms, populations, communities, and ecosystems*

NGSS	**Performance Expectation:** **MS-LS2-4:** *Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.* **Disciplinary Core Idea: LS2.C**: *Ecosystem Dynamics, Functioning, and Resilience.* **Practices**: *Developing and Using Models, Analyzing and Interpreting Data* **Crosscutting Concepts:** *Patterns, Cause and Effect, Stability and Change*

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Deepwater Horizon • Ecosystem • Benthic zone • Biotic factors • Abiotic factors • ECOGIG • Coral • P. Biscaya coral community	• Why is it important for scientists to explore the coral community for a surface oil spill?	• Discussion Questions: **Participation**

Section 2 – Analyzing Images *(60 minutes)*

Students learn about how the images of coral are the data in this investigation, so before they analyze images of coral they practice discerning information from photos of hamburgers and how they can determine how it would taste. They will create and use rubrics to quantify the data in the photos. This practice of creating and using rubrics will be done again in later sections when they are investigating the images of coral and need to analyze the data from the images.

Preparation

Materials	Student Pages
• Link to color Hamburger Images: tiny.cc/hamburg1	• Creating a Rubric: Student Sheet #1 • Evaluating Images: Student Sheet #2
Prep the Day Before: Review Class Discussion Questions and possible answers. Prepare how to scaffold the rubric example with students if needed.	

Planning

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Inference • Non-numerical data • Scoring rubric • Quantify	• How do these images provide us with data? • How can rubrics be used for quantifying data from photos?	• Discussion Questions: **Participation** • Student Sheet #1: **Formative** • Student Sheet #2: **Formative**

Section 3 – Studying Coral Communities *(35 minutes)*

In this section students are introduced to ECOGIG's methods for using robotic tools and equipment for exploring deep sea ecosystems. They learn about the abiotic and biotic factors of the deep sea ecosystem in more depth and how the Deepwater Horizon oil spill affected this ecosystem. This knowledge will aid students in determining how the health of the ecosystem is recovering as they look for the presence of certain organisms on the coral.

Preparation

Materials	Student Pages
• Video #4: ECO ROVs in STEM ED	• N/A
Prep the Day Before: Review the section and consider additional ways that you may want to introduce the ecology content to students.	

Planning

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Remotely Operated Vehicle (ROV) • Ecosystem • Benthic organisms • Biotic factors • Abiotic factors • Brittle star • Hydroids • Floc	• Why are robotic tools and equipment important for scientific research in deep water ecosystems? • How did the Deepwater Horizon oil spill affect deep water ecosystems?	Discussion Questions: **Participation**

Section 4 – Evaluating the Health of Coral Communities *(60 minutes)*

This section is all about developing and using rubrics for quantifying data from the images of corals. Students begin by analyzing images of healthy and impacted coral and creating a list of characteristics of each. From those lists they create a standardized class rubric and they learn about how the presence of brittle star and hydroids can indicate the health of the coral. Groups of students will then use their rubrics to evaluate the health of coral at an assigned site and they will see how the health of the coral has changed temporally and spatially

Preparation

Materials	Student Pages
- Video #5: Diversity of Deepwater Corals - Coral images - Sheet protectors	- Coral Characteristics: Student Sheet #3 - Class Rubric: Student Sheet #4 - Evaluating Images: Student Sheet #5
Prep the Day Before: Prepare images of corals by placing the images into sheet protectors. Possibly pre-assign sites to groups.	

Planning

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
- Standardized rubric - Inference - Floc - Quantify	- How can we communicate scientific data to the public? - How do these images provide us with important data about the health of deep sea ecosystems and communities?	- Class Discussion Question: **Participation** - Student Sheet #3: **Formative** - Student Sheet #4: **Formative** - Student Sheet #5: **Formative**

Section 5 – Remembering Deepwater Horizon *(15 minutes)*

In this section students reflect on the Deepwater Horizon spill, 10 years after the accident occurred and explore how the spill affected coastal communities. Students learn about temporal and spatial data and how researchers and scientists have spent many years assessing the long-term impact of the spill, both over time (temporal) and across many geographic locations (spatial).

Preparation

Materials	Student Pages
• Video #6: Remembering Deepwater Horizon	• N/A
Prep the Day Before: Review the section and consider additional ways that you may want to introduce the temporal and spatial data content to students.	

Planning

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	     b. Construct an explanation for the patterns of interactions observed in different ecosystems in terms of the relationships among and between organisms and abiotic components of the ecosystem
	     d. Analyze and interpret data to provide evidence for how resource availability, disease, climate, and human activity affect individual organisms, populations, communities, and ecosystems

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Temporal Data • Spatial Data	• How can spatial and temporal data aid scientists with understanding the impact of the Deepwater Horizon oil spill?	• Class Discussion Question: **Participation**

Section 6 – Making More Meaning Out of Data: Coding Corals *(60 minutes)*

In this section students explore another way of looking at the data about the health of the coral. The health score that was determined in section 4 is not precise enough and 2 corals that look very different might end up with the same health score. Another way of visualizing the data is to color code different sections of the coral based on legends (healthy, unhealthy, or recovering). Students will color these sections on transparencies so that the images are not damaged. Students will then compare the time stamped images with the health scores and see how the health of the coral has changed over time. Different groups will share their images so students can see observe how the health of the coral has changed both temporally and spatially. The section also connects students to how computers and artificial intelligence use data to make decisions and inferences- comparing it to the activity that students participated in.

Preparation

Materials	Student Pages
• Wet/Dry Erase Markers: Red, Green, Black (per group) • Sheet protectors (per image) • Transparencies (3 per group) • Coral images • Coding Corals Handout	• Coding Corals: Student Sheet #6 • Data Visualization Questions: Student Sheet #7
Prep the Day Before: Place coral images into sheet protectors.	

Planning

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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Schlerites • Temporal data • Spatial data • Artificial Intelligence • Machine Learning	• How do these images provide us with important data about the health of deep sea ecosystems and communities? • How can Artificial Intelligence assist with analyzing photos?	• Class Discussion Question: **Participation** • Student Sheet #7: **Participation** • Student Sheet #7: • **Participation**

Section 7 – The Recovery Effort *(45 minutes)*

In this section students construct an explanation for the ECOGIG that describes how the health of the corals have changed over time at the three sites they compared. They will use the data they collected from the images of the coral from previous activities as evidence to support their explanation.

Preparation

Materials	Student Pages
• Video #7: Deepwater Horizon: The Science Behind NOAA's Unprecedented Response	• Construct Your Explanation: Student Sheet #8
Prep the Day Before: Prepare materials that students will need for completing their explanations.	

Planning

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	     d. Construct an explanation for the patterns of interactions observed in different ecosystems in terms of the relationships among and between organisms and abiotic components of the ecosystem
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Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Temporal Data • Spatial Data	• How has the health of the P. Biscaya Corals changed over time and space?	• Class Discussion Question: **Participation** • Student Sheet #8: **Summative**