Exploring the Blake Plateau

Chapter 2
Exploring the Deep

Chapter 2: Exploring the Deep — How Do We Study the Blake Plateau?

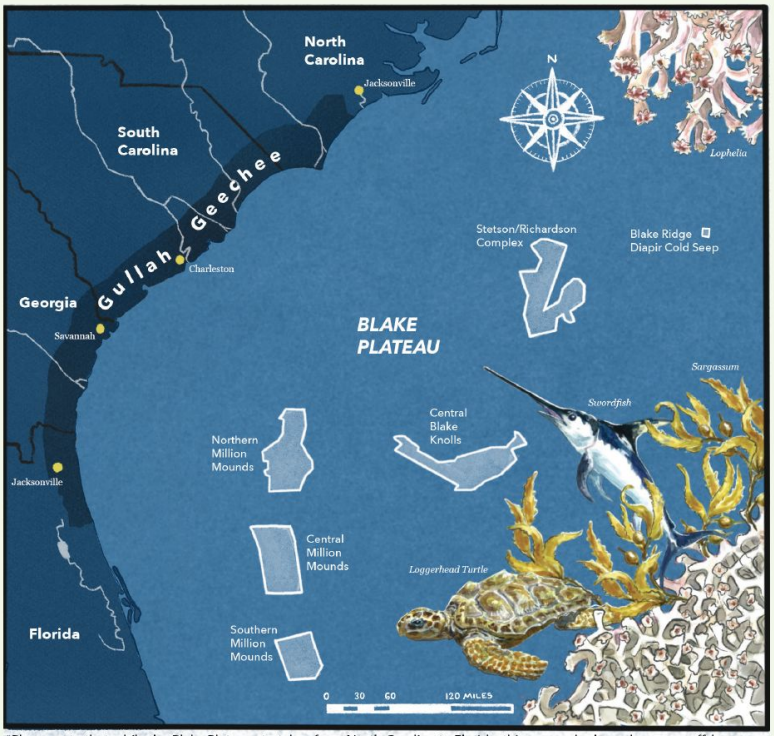
Introduction

Welcome to the **Blake Plateau**, a deep-sea region off the U.S. Southeast coast teeming with **biodiversity** and geologic wonders. The content and activities in this chapter will help learners discover the tools, technologies, and people behind deep-sea exploration. From robotic vehicles to high-resolution seafloor maps, scientists are uncovering new species, ancient **coral mounds**, and important clues about how this ecosystem functions.

The Blake Plateau is home to the world's largest **deep-sea coral** province. From the top of the water column to the seafloor, the Blake Plateau is a refuge for sea turtles, fish, elusive seabirds, whales, and more. It is also a sacred underwater graveyard for the **Gullah/Geechee** people, the resting place of enslaved ancestors who died on their forced travel from their homelands over the plateau during the **Middle Passage**. Dive in to explore the globally significant Blake Plateau and discover how we can protect its important sites and remarkable marine ecosystems.

This is the second in a three-part series, but can be used as a standalone lesson or as part of an extended unit on ocean science, exploration, or environmental geography.

Important Ecological Features of the Blake Plateau



*Please note that while the Blake Plateau stretches from North Carolina to Florida, this map only shows key areas offshore South Carolina, Georgia, and Florida. Conversations with scientists helped shape the polygons' boundaries.

Map by Jessica Russo; Illustrations by Richard Jones

Overview

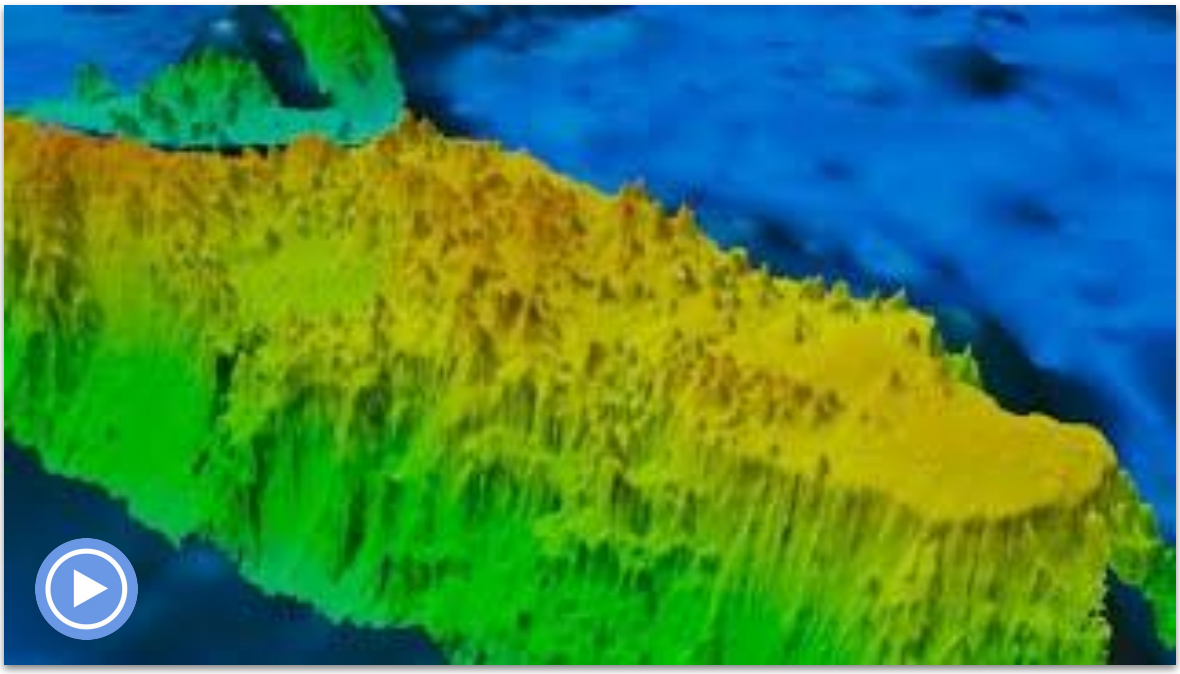
How Do We Explore the Deep Ocean?

Exploring the deep sea is very different from studying shallow-water ecosystems. Below 200 meters (656 feet), sunlight disappears, water pressure increases dramatically, and temperatures drop quickly.

To study deep-sea ecosystems, like the Blake Plateau, scientists use:

- **Remotely Operated Vehicles (ROVs)** – underwater vehicle that is operated and controlled from the surface via a cable, facilitating power and communication.
- **Multibeam sonar** mapping systems – a type of active sonar system used to map the seafloor and detect objects in the water column or along the seafloor.
- Research vessels – a ship or boat specifically designed, equipped, or modified to conduct scientific research, exploration, and data collection at sea.
- High-definition cameras and specimen collectors, typically part of ROVs.

Expeditions aboard ships like the NOAA* Ship *Okeanos Explorer* allow scientists to utilize tools and technology to conduct deep-sea dives, map **coral mounds**, and document species in real time.



*NOAA = National Oceanic and Atmospheric Administration.

Scientific expeditions to the Blake Plateau have revealed thousands of ancient coral mounds, made up of **deep-sea corals** such as ***Lophelia pertusa*** (also known as *Desmophyllum pertusum*). These coral structures have taken thousands of years to grow and are a living habitat for a variety of organisms.

Despite new discoveries, much of the Blake Plateau remains unmapped and unexplored. Dive into a real-life expedition aboard the NOAA *Okeanos Explorer*:

By exploring this chapter, learners will:

- ✅ Explain why deep-sea exploration requires specialized technology
- ✅ Identify tools used to study deep-ocean ecosystems
- ✅ Interpret bathymetric maps of the Blake Plateau
- ✅ Describe the significance of the **Million Mounds** discovery
- ✅ Develop scientific questions based on exploration data

Exploring the Blake Plateau content was created by EarthEcho International and reviewed for accuracy by science and conservation experts at the Natural Resources Defense Council (NRDC).

Meet the Scientists

And the cutting-edge tools they use to explore the ocean

During this activity, learners will understand who studies the Blake Plateau, what technologies are used to study the deep sea, and why this work matters.

MATERIALS NEEDED

- Internet access to view expedition videos and scientist interview clips (18 mins):
  - Seafloor Mapping: The Foundation for Ocean Exploration (7 mins)
  - Deep Dive: The Blake Plateau (3 mins)
  - Connecting the Dots (2 mins)
  - A Tour of the Okeanos Explorer (6 mins)
- Observation Worksheet

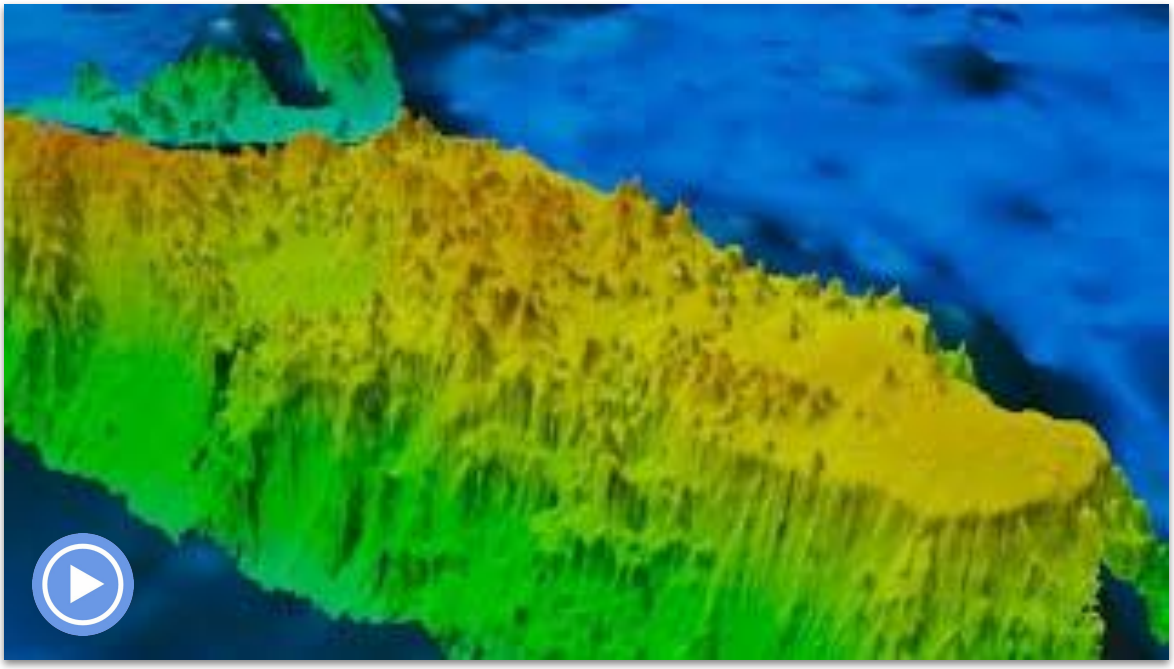
INSTRUCTIONS

1. As you watch the following videos, record responses in the Observation Worksheet. These short video clips feature marine scientists studying the Blake Plateau:
   - Seafloor Mapping: The Foundation for Ocean Exploration
   - Deep Dive: The Blake Plateau
   - Connecting the Dots
   - A Tour of the Okeanos Explorer
2. Using the Observation Worksheet, have a group discussion, and then write 2–3 questions to ask a deep-sea scientist.

INSTRUCTIONS

As you watch the following videos, record responses in the Observation Worksheet. These short video clips feature marine scientists studying the Blake Plateau. Share out your findings and discuss as a group.

Seafloor Mapping: The Foundation for Ocean Exploration



Deep Dive: The Blake Plateau

Connecting the Dots

A Tour of the Okeanos Explorer

MEET THE SCIENTISTS: OBSERVATION WORKSHEET

As you watch the science and technology videos, record responses here.

What tools do you see scientists using?

Did the scientists face any challenges? If so, what were they?

What discoveries surprised you?

What skills do you think are needed to explore the deep ocean?
Hint: Think beyond marine biology - consider other careers and skills shown.

Why do you think we should explore places humans may never physically visit?

How does technology help us to expand what we can learn about Earth?

Think of 2–3 questions you would like to ask a deep-sea scientist:

Observe the Deep

Blake Plateau Expeditions

During this activity, learners can observe a real deep-sea expedition to the Blake Plateau and prepare thoughtful questions for marine scientists.

During expeditions aboard the NOAA Ship Okeanos Explorer, scientists use **remotely operated vehicles (ROVs)** to explore deep coral mound systems known as the Blake Plateau Knolls. These dives are streamed live, allowing scientists and the public to observe discoveries in real time.

During this activity, learners will act as ocean explorers — observing carefully, recording evidence, and developing scientific questions.

MATERIALS NEEDED

- Scientists Exploring the Blake Plateau (4 mins)
- Windows to the Deep - Exploring our Deepwater Backyard (3 mins)
- NOAA expedition video: EX1903L2 Dive 04 Blake Plateau Knolls Jun 24 2019
- Dive Log worksheet
- Dive Daily Update: June 24, 2019 (*optional*)
- Dive Summary and ROV Data (*optional*)
- Key Ecological Features map (*optional*)

Illustration courtesy of Christina Machinski.

INSTRUCTIONS

Far below the surface of the ocean lies the deep sea, a vast and complex landscape. During a 2018 expedition aboard the NOAA Ship *Okeanos Explorer,* scientists mapped extraordinary discoveries on the Blake Plateau, including a massive deep-sea coral ecosystem now known as the **Million Mounds**.

As you watch Scientists Exploring the Blake Plateau video, note down some observations:

- Why are the Million Mounds considered a major scientific discovery?
- How did mapping technology lead to the discovery of this amazing ecosystem?
- List at least 5 organisms observed.
- How does the location of the **coral mounds** relate to the **Gulf Stream**?
- Describe how animals might use coral mounds.
- Did anything surprise you?

Scientists Exploring the Blake Plateau

The Blake Plateau is home to vast fields of **deep-sea coral mounds** — tens of thousands of ancient coral structures built over thousands of years, some rising hundreds of feet above the seafloor.

The mapping revealed:

- Extensive coral mound provinces - the "Million Mounds"
- Steep **ridges** and **scarps**
- Depth changes from ~500 meters to more than 1,000 meters
- The dramatic drop-off of the **Blake Escarpment**

But mapping didn't just reveal geology — it revealed life.

These coral mounds act like underwater cities — offering food, shelter, and nursery habitat in an otherwise barren seafloor. This unique environment provides habitat for a remarkable diversity of species, including:

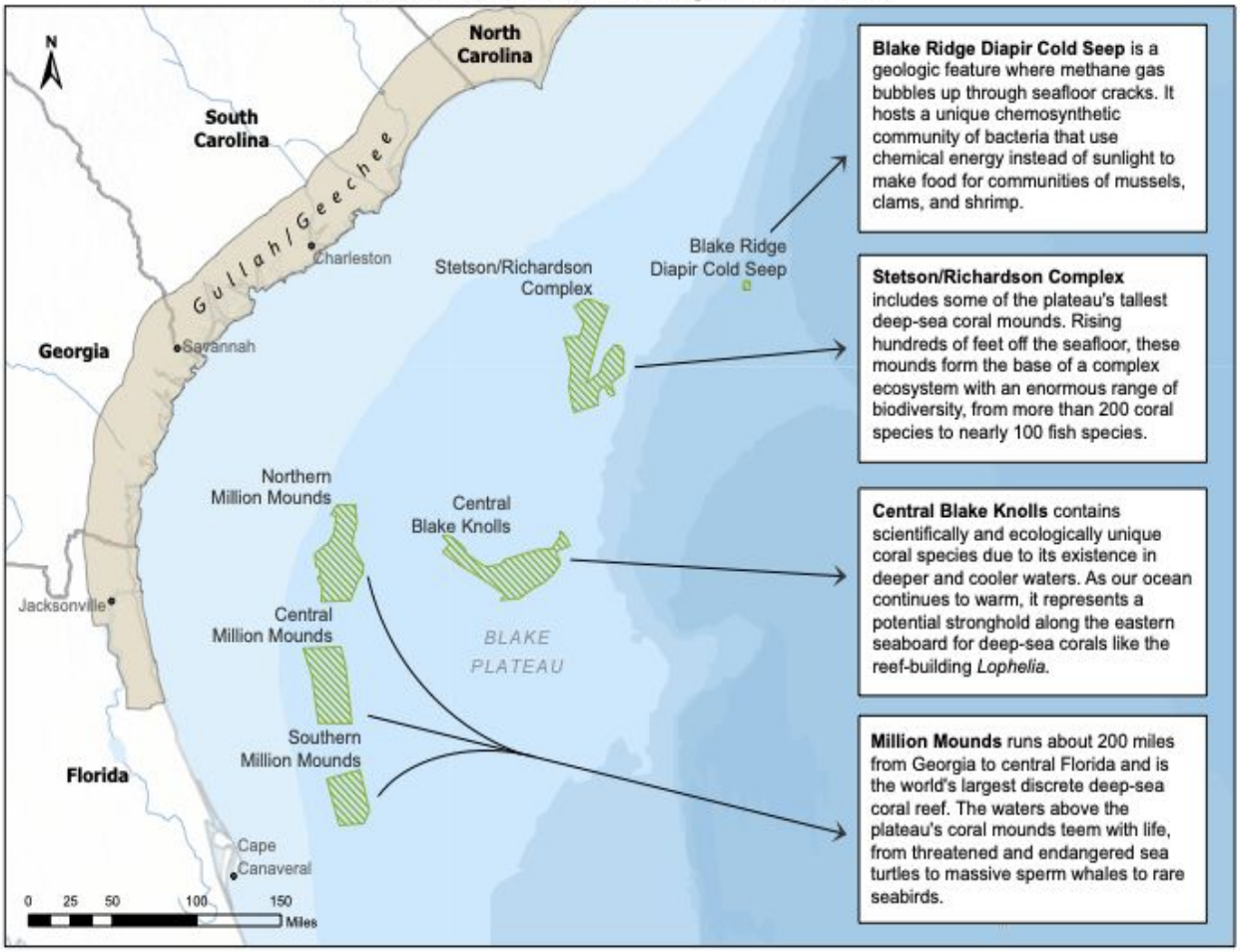
- Deep-sea stony corals such as ***Lophelia pertusa*** (*Desmophyllum pertusum*)
- Black corals and soft corals
- Sponges, including large glass sponges
- Crinoids, or feather stars
- Deep-sea shrimp and crabs
- Squid and octopus
- Numerous fish species
- Larger, visiting animals such as sea turtles and sperm whales

Windows to the Deep 2018: Exploring Our Deepwater Backyard

A year later, in 2019, the exploration continued to one of the small mounds of the Blake Plateau. This time, the dive took place approximately 164 kilometers (102 miles) east of the Florida coast. Initially, this site was mapped during the Windows to the Deep 2018 expedition, which helped inform the dive plan for the 2019 exploration.

Key Ecological Features on the Blake Plateau

Offshore South Carolina, Georgia, and Florida*



Blake Ridge Diapir Cold Seep is a geologic feature where methane gas bubbles up through seafloor cracks. It hosts a unique chemosynthetic community of bacteria that use chemical energy instead of sunlight to make food for communities of mussels, clams, and shrimp.

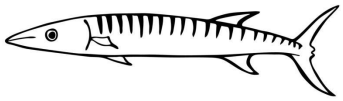
Stetson/Richardson Complex includes some of the plateau's tallest deep-sea coral mounds. Rising hundreds of feet off the seafloor, these mounds form the base of a complex ecosystem with an enormous range of biodiversity, from more than 200 coral species to nearly 100 fish species.

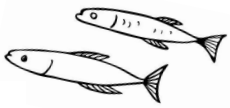
Central Blake Knolls contains scientifically and ecologically unique coral species due to its existence in deeper and cooler waters. As our ocean continues to warm, it represents a potential stronghold along the eastern seaboard for deep-sea corals like the reef-building *Lophelia*.

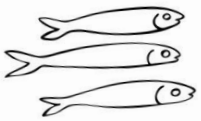
Million Mounds runs about 200 miles from Georgia to central Florida and is the world's largest discrete deep-sea coral reef. The waters above the plateau's coral mounds teem with life, from threatened and endangered sea turtles to massive sperm whales to rare seabirds.

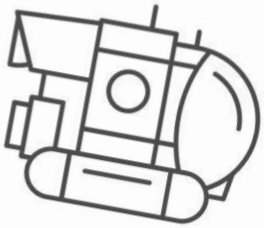
*Please note that while the Blake Plateau stretches from North Carolina to Florida, this map only shows key areas offshore South Carolina, Georgia, and Florida. Conversations with scientists helped shape the polygons' boundaries.

September 26, 2024
WGS 1984









Now, as you watch the Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeast United States, use your observation skills to complete your Dive Log as you observe what is happening.

This 6-hour, 53-minute-long dive took place in June of 2019, at latitude 29.65001042° and longitude -78.46918893°, with a dive depth range of 754 – 826 meters (2,474 – 2,710 feet). As you watch the video, feel free to scroll through to different sections of the dive.

Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeast United States

Here are some tips...

Observe Like a Scientist: Focus on observation before interpretation — just like real scientists do. As you watch the expedition video, record observations in your Dive Log.

Think Like a Scientist: As you observe, write thoughtful questions you would ask a NOAA scientist. Consider questions that might connect geology to biology, explore unknowns, or ask about **exploration technology.**

Reflect Like a Scientist: After your exploration, think a little more about your observations, and ask deeper questions.

DIVE LOG

Date: _____ Dive #: _____

Diver Name: _____

S	M	T	W	R	F	S

LOCATION & CONDITIONS

Location: Lat. + Long:

Approximate Depth:

Seafloor Description: ◯ Flat ◯ Sloped ◯ Rocky ◯ Mound-Filled

Other Condition Notes:

NOTES & OBSERVATIONS:

Geological Features

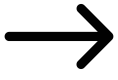
Do you observe ridges, steep slopes, sediment, or exposed rock?

How might these features influence where corals grow?

What types of coral formations do you see? Are they branching, mound-like, scattered, dense?

What evidence did you see that the coral mounds are living ecosystems, not just rock formations?

How does the structure of coral mounds create habitat for other organisms?



NOTES & OBSERVATIONS:

Animal life and behaviors

List at least 5 organisms you notice. What are they doing? For example, are they resting, swimming, feeding, moving between corals? Record your observations in the chart below.

Organism Observed	Behavior Observed

Do certain species appear closely associated with coral structures?

REFLECT & DISCUSS:

What role does technology play in making this exploration possible?

DESIGN YOUR OWN EXPLORATION

If you could explore one unknown ecosystem— ocean, rainforest, polar region, underground cave, or even another planet — where would you go and why?

Why would your research matter?

Sketch or describe this exploration mission, including:

- The technology you would use (ROV, submersible, drone, rover, etc.)
- What discoveries you hope to make

For Teachers

Learning Objectives, Tips, Standards Alignment, Key Terms, and References

LEARNING OBJECTIVES

By the end of this chapter, learners will be able to:

- Explain why deep-sea exploration requires specialized technology.
- Identify and describe tools used to study the deep ocean (e.g., ROVs, multibeam sonar, research vessels).
- Describe the ecological significance of the Million Mounds on the Blake Plateau.
- Analyze how mapping and exploration generate new scientific questions.
- Recognize the interdisciplinary nature of ocean exploration, including engineering, robotics, mapping, and data science.

TEACHER TIPS + INSTRUCTIONAL NOTES

1. Start With Curiosity
   - Begin with expedition footage from the NOAA Ship Okeanos Explorer to spark interest.
   - Use a quick "Observe–Infer–Question" routine before providing background information.
2. Emphasize the Role of Technology
   - Help students understand that:
     - Mapping comes before biological discovery.
     - Sonar "sees" using sound, not light.
     - ROVs allow scientists to explore places humans cannot physically reach.
   - Pause videos and ask:
     - "What problem is this tool solving?"
     - "What would scientists not know without this technology?"
3. Connect Structure to Biodiversity
   - Reinforce the idea that geology shapes biology. Guide learners to notice:
     - Coral mounds cluster in certain depth ranges.
     - Physical structure increases biodiversity.
     - Deep-sea habitats are not flat or empty.

TEACHER TIPS + INSTRUCTIONAL NOTES, CONT.

4. Highlight Collaboration & Careers
   - This chapter provides strong STEM career connections. Point out the interdisciplinary teams aboard expeditions:
     - Engineers
     - Robotics specialists
     - Mapping technicians
     - Marine biologists
     - Data analysts
5. Reflection & Assessment Ideas
   - Exit Ticket Options:
     - "How does technology expand what humans can know about Earth?"
     - "What new question do you have about the deep sea?"
   - Performance Extension:
     - Have students design their own deep-sea expedition plan, including:
       - Target location
       - Technology needed
       - Research questions
       - Why the mission matters
6. Go Further
   - If time allows, explore this resource and activity from NOAA: Student Investigation: Feeding the Million Mounds of Deep-Sea Coral

EDUCATIONAL STANDARDS ADDRESSED

Next Generation Science Standards (NGSS)

Disciplinary Core Ideas (Grades 6–8, 9–12):

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations in an ecosystem.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution (e.g., designing technology for deep-sea exploration).

HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

EDUCATIONAL STANDARDS ADDRESSED, CONT.

Science & Engineering Practices:

- Analyzing and interpreting data (expedition findings)
- Asking questions and defining problems
- Developing and using models
- Constructing explanations from evidence
- Designing solutions (technology for exploration)

Crosscutting Concepts:

- Systems and system models
- Structure and function
- Scale, proportion, and quantity
- Cause and effect
- Stability and change

C3 Framework for Social Studies (Geography Strand)

D2.Geo.4.6-8: Explain how cultural patterns and economic decisions influence environments and the use of natural resources.

D2.Geo.8.9-12: Evaluate the consequences of human-made and natural changes to Earth's surface.

Common Core ELA Connections

CCSS.ELA-LITERACY.WHST.6-8.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information clearly.

CCSS.ELA-LITERACY.WHST.9-12.7: Conduct short research projects to answer a question or solve a problem (e.g., designing a deep-sea exploration mission).

Ocean Literacy Principles

#1: The Earth has one big ocean with many features.
#5: The ocean supports a great diversity of life and ecosystems.
#6: The ocean and humans are inextricably interconnected.
#7: The ocean is largely unexplored.

VOCABULARY + KEY TERMS

Bathymetry The study and measurement of the depth and shape of the ocean floor.

Biodiversity The variety of living organisms within a given ecosystem, habitat, or the entire Earth.

Blake Plateau A wide, flat underwater plain about 80–100 miles off the southeastern U.S. coast that is home to the world's largest deep-sea coral reef system.

Continental Shelf The gently sloping area of the seabed that extends from a continent before dropping into the deep ocean.

Coral Mounds Large, mound-shaped structures built over time by layers of deep-sea coral skeletons.

Deep-Sea Coral Coral species that live in dark, cold waters at depths of 200–1000+ meters, forming complex reef structures without sunlight.

Ecosystem Services Benefits humans receive from ecosystems, such as oxygen production, food supply, and climate regulation.

Escarpment A long, steep slope, especially one at the edge of a plateau or separating areas of land at different heights.

Exploration technology Specialized tools, devices, and systems—such as sensors, AI, rovers, and submersibles—developed to investigate, map, and analyze unknown or extreme environments.

Gulf Stream A warm ocean current that flows north along the U.S. East Coast and carries heat and nutrients across the Atlantic Ocean.

Gullah/Geechee Descendants of West and Central Africans who were enslaved and brought to the southeastern U.S. coast; they have a rich cultural heritage linked to the Atlantic Ocean.

Industrialization of the Ocean Expansion of human activities (e.g., mining, drilling, shipping) into previously undisturbed ocean areas.

***Lophelia pertusa* (aka *Desmophyllum pertusum*)** A primary deep-sea coral species found on the Blake Plateau.

Marine Protected Area (MPA) A designated region of the ocean where human activities are regulated to conserve ecosystems and cultural resources.

VOCABULARY + KEY TERMS, CONT.

Marine Snow Tiny bits of organic material, such as dead plankton and waste, that slowly drift from surface waters to the deep sea, providing food for deep-sea life.

Middle Passage The route across the Atlantic Ocean by which enslaved Africans were forcibly transported to the Americas from the 1500s to the 1800s.

Million Mounds The world's largest known continuous deep-sea coral habitat, located off the coasts of Georgia and Florida. Covering roughly 7 million acres, it consists of thousands of massive, ancient mounds built over thousands of years by the stony coral *Lophelia pertusa* (*Desmophyllum pertusum*) at depths of 200–1,000 meters.

Multibeam Sonar A type of active sonar system used to map the seafloor and detect objects in the water column or along the seafloor.

National Marine Sanctuary Special areas that protect important marine ecosystems around the nation. Some sanctuaries are breeding and feeding grounds for endangered whales, others contain thriving coral reefs or kelp forests, and many are home to historic shipwrecks and other archaeological treasures. National Marine Sanctuaries are managed by the National Oceanic and Atmospheric Administration (NOAA).

Nitrate A nutrient that contains nitrogen and helps plants and algae grow; too much can cause pollution in marine environments.

Nutrient Cycling The movement and exchange of organic and inorganic matter back into the production of living matter.

Polyp The basic living unit of class Anthozoa (further subdivided into subclass Hexacorallia, which includes stony corals, and subclass Octocorallia, which includes soft corals). Polyps can occur either singularly, as in the case of anemones and some stony corals, or can form colonies, as they do in most stony and all soft corals.

Plateau A large, flat or gently sloping elevated area that stands higher than the surrounding land or seafloor.

Remotely Operated Vehicle (ROV) An underwater vehicle that is operated and controlled from the surface via a cable, facilitating power and communication.

Ridges Long, narrow raised areas on the ocean floor, often formed by movement of Earth's tectonic plates.

Scarps Steep slopes or cliffs found where the seafloor drops sharply, such as at the edge of the Blake Plateau.

VOCABULARY + KEY TERMS, CONT.

Shallow-Water Coral Reef Coral ecosystems found in shallow and warm subtropical and tropical seas (typically 0–45 meters deep) that rely on symbiotic algae for energy.

Symbiosis A mutually beneficial relationship between different organisms (e.g., corals and zooxanthellae).

Zooxanthellae Photosynthetic algae living within coral tissues that provide energy through photosynthesis.

REFERENCES + CREDITS

Gasbarro, R., et al. (2022). Distribution and predicted climatic refugia for a reef-building cold-water coral on the Southeast. Global Change Biology, 28(23), 7108–7125. https://doi.org/10.1111/gcb.16415

Hourigan, T. F., et al. (2017). Deep-sea coral taxa in the U.S. Southeast region: Depth and geographical distribution. NOAA; Smithsonian Research Online. http://repository.si.edu/xmlui/handle/10088/34999

National Oceanic and Atmospheric Administration. (n.d.). Blake Escarpment dive plan. NOAA Ocean Exploration. https://oceanexplorer.noaa.gov

National Oceanic and Atmospheric Administration. (n.d.). Million mounds exploration notes. NOAA Ocean Exploration. https://oceanexplorer.noaa.gov

National Oceanic and Atmospheric Administration. (n.d.). NOAA interactive bathymetry viewer. National Centers for Environmental Information. https://www.ncei.noaa.gov/maps/bathymetry

National Oceanic and Atmospheric Administration. (2017, July 26). NOAA discovery of green deep-sea sponge shows promise for cancer research [News release]. https://www.noaa.gov/news/noaa-discovery-of-green-deep-sea-sponge-shows-promise-for-cancer-research

National Oceanic and Atmospheric Administration. (2023, January 20). What does the ocean have to do with human health? National Ocean Service. https://oceanservice.noaa.gov/facts/ocean-human-health.html

National Oceanic and Atmospheric Administration, Office of Ocean Exploration and Research. (2018). Windows to the deep 2018: Exploring our deepwater backyard [Video]. YouTube. https://youtu.be/NdMam3rdFbE

National Oceanic and Atmospheric Administration, Office of Ocean Exploration and Research. (2019, June 24). EX1903L2 dive 04 Blake Plateau knolls [Video]. YouTube. https://youtu.be/F-McjleT-hE

National Oceanic and Atmospheric Administration, Office of Ocean Exploration and Research. (n.d.). Seafloor mapping: The foundation for ocean exploration [Video]. YouTube. https://youtu.be/cpHr1MKIn2c

REFERENCES + CREDITS, CONT.

National Oceanic and Atmospheric Administration, Office of Ocean Exploration and Research. (n.d.). Scientists exploring the Blake Plateau [Video]. YouTube. https://youtu.be/W9Mbv5m598U?si=vaHWgVvfNYZCiqXc

Natural Resources Defense Council. (n.d.). The Blake Plateau: A southern treasure [Fact sheet]. https://www.nrdc.org/resources/blake-plateau-southern-treasure

Ross, S. W., & Nizinski, M. S. (2007). State of deep coral ecosystems in the U.S. Southeast region: Cape Hatteras to southeastern Florida. In S. E. Lumsden, T. F. Hourigan, A. W. Bruckner, & G. Dorr (Eds.), The state of deep coral ecosystems of the United States (NOAA Technical Memorandum CRCP-3). National Oceanic and Atmospheric Administration. https://www.coris.noaa.gov/activities/deepcoral_rpt/DeepCoralRpt2007.pdf

Ross, S. W., & Quattrini, A. M. (2007). The fish fauna associated with deep coral banks off the southeastern United States. Deep Sea Research Part I: Oceanographic Research Papers, 54(6), 975–1007. https://doi.org/10.1016/j.dsr.2007.03.010

Sowers, D. C., et al. (2024). Mapping and geomorphic characterization of the vast cold-water coral mounds of the Blake Plateau. Geomatics, 4(1), 17–47. https://doi.org/10.3390/geomatics4010002

Thiele, T., Imbert, M.-C., & Bouley, T. (2020, May 4). A healthy ocean can help fight pandemics. China Dialogue Ocean. https://chinadialogueocean.net/en/conservation/13619-healthy-ocean-help-fight-pandemics/

EarthEcho International would like to acknowledge Roy Arezzo, Anna Cazel, and Jennifer Smith for reviewing and providing feedback on this content.