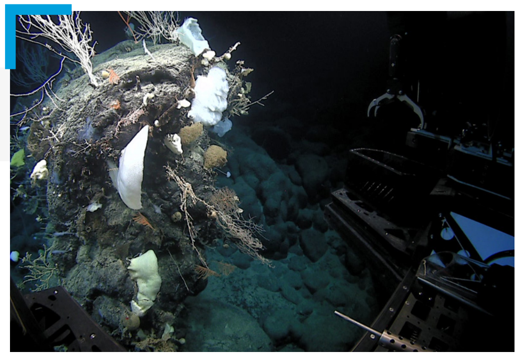
Habitat Complexity in the Deep Sea



Large boulders seen covered in multiple species of corals and sponges during the 2021 North Atlantic Stepping Stones expedition. *Image courtesy of NOAA Ocean Exploration.*

Overview

TOPIC: Habitat Complexity

FOCUS: Students use a model to explore complexity of seamount habitats.

GRADE LEVEL: 6-8 Biogeology/Ecosystem Dynamics

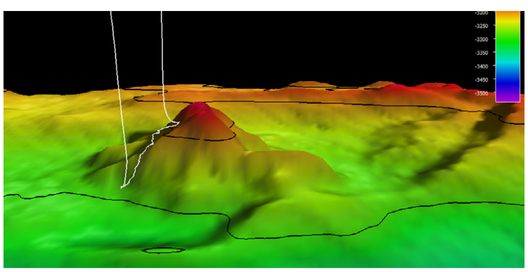
TIME NEEDED: One 50-minute class period (plus additional time for optional extensions)

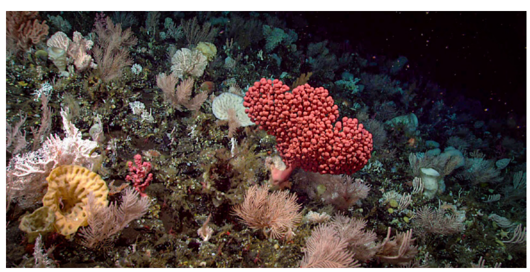
DRIVING QUESTION: How can we model the physical and biological complexity of deep-sea ecosystems?

OBJECTIVES/ LEARNING OUTCOMES:

Students will:

- Develop, use, and evaluate a model that simulates the increasing complexity of biological systems, as observed in seamounts and the communities that inhabit them.
- Recognize that natural structures and systems, like seamounts and the communities that inhabit them, often display recurrent complexity.
- Analyze and interpret data to provide evidence that structural complexity impacts space availability and species abundance and diversity in benthic habitats.
- Explain the role of deep-sea corals and sponges as foundation species, making the ecosystem suitable for many other species.





Seamounts, like Deep Discoverer Dome explored south of the Aleutian Islands off Alaska (left), provide a hard substrate that is necessary for many benthic animals to attach. Colorful and abundant coral species make their homes on these rocky surfaces, providing a foundation for many other organisms to thrive. *Images courtesy of NOAA Ocean Exploration.*

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Performance Expectations (PEs)
MS LS2-1; MS-LS2-4

Disciplinary Core Ideas (DCIs)
LS2.A Interdependent Relationships in Ecosystems
LS2.C. Ecosystem Dynamics, Functioning and Resilience

Crosscutting Concepts (CCs)
Patterns
Cause and Effect
Scale, Proportion, Quantity
Systems and System Models

Science & Engineering Practices (SEPs)
Developing and Using Models
Analyzing and Interpreting Data
Constructing Explanations and Designing Solutions

COMMON CORE CONNECTIONS
ELA/Literacy: WHST.6-8.9
Mathematics: MP.4

OCEAN LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS
Principle 1: FC b
Principle 5: FCs a, d, e
Principle 7: FCs a, b, e

Overview cont.

MATERIALS:

Habitat Complexity in the Deep Sea Slides (project for class)

Per student:

- Habitat Complexity Student Worksheet
- Pencil
- Ruler
- Colored pencils, markers or crayons

Optional approach:
Pre-prepared sets of pre-colored cut out triangles of decreasing size (slides 29-30)

EQUIPMENT:

- Computer; projector and screen

SET-UP INSTRUCTIONS:

- Cue up slides and videos
- Print student worksheets and/or prepare cut out triangles as desired

Educator Guide

Background

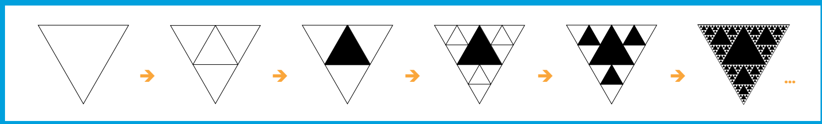
Most seamounts are remnants of extinct volcanoes, while others are actively erupting and growing. Typically, they are cone shaped, but often have other prominent features such as craters and linear ridges. Studies indicate that seamounts function as "oases of life," with higher species diversity and biomass found on and around a seamount versus on the flat, soft-bottomed seafloor.

Seamounts rise up high in the water column, creating complex current patterns influencing what lives on, around, and above them. Seamounts also provide a hard substrate (a location for attachment) where organisms like deep-sea corals and sponges can settle and grow. Deep-sea corals and sponges are often the primary settlers on seamounts, growing up off hard rocks in a variety of shapes, providing a foundation for the dense biological communities explorers have observed. Scientists have found that physical structures in many habitats (for example, forests, coral reefs, and rocky shorelines) have a strong influence on the diversity and abundance of species that live in these habitats.

This lesson is designed to be an introduction to deep-sea biodiversity and complexity. Students are led through an exercise to help them ultimately connect the concept that hard substrate/structure is the base for many complex and diverse ecosystems and to introduce the concept of foundation species and ecosystem engineers. The intention of this lesson is to focus on structural complexity supporting biological complexity on seamounts and within seamount communities at multiple levels.

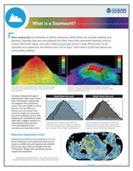
EDUCATOR NOTE

This lesson is a modification of the standard Sierpinski Triangle concept which illustrates fractal geometry and self-similarity. In this instance, the largest triangle represents or models a zoomed out view of a seamount habitat, the preliminary (most simple) structure in this model ecosystem. The view then grows increasingly complex geologically and biologically the closer we look. *Be careful not to imply the triangle is the seamount.* The triangle is *not* used because it is the rough shape of the profile of a seamount, but as a tool to simplistically illustrate a complex concept. For this reason, we have inverted the triangle. Throughout the lesson, it will be important to check in with students to ensure they are understanding and able to differentiate the parts of the model from the real habitat. This exercise could also be done with squares or other geometric shapes that are equally divided.

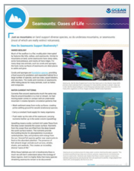


FOR MORE INFORMATION:

- *What is a Seamount?*



- *Seamounts: Oases of Life*



- *Deep-Sea Corals: Rainforests of the Deep*

- *Deep-Sea Corals and Sponges: Foundation Species*

Educator Guide cont.

Introduction

Ask students what they think is meant by *habitat complexity*. Let them brainstorm.

Introduce students to a comparison of a habitat of low complexity to a habitat of high complexity.

Video courtesy of NOAA Ocean Exploration.

> **Show** the video Voyage to the Ridge (2:16) of a sandy seafloor with no sound. (Slide 2)
>
> **Ask** students if they think this habitat has a low level, a medium level, or a high level of complexity.
>
> **Show** the short video Underwater Kelp Forests (3:13) with no sound. (Slide 2)
>
> **Ask** students if they think this habitat has a low level of complexity, a medium level, or a high level of complexity.

Video courtesy of NOAA National Ocean Service.

Students should realize, at the most simplistic level and comparatively, the sandy seafloor is low in complexity and the kelp forest is much higher in complexity.

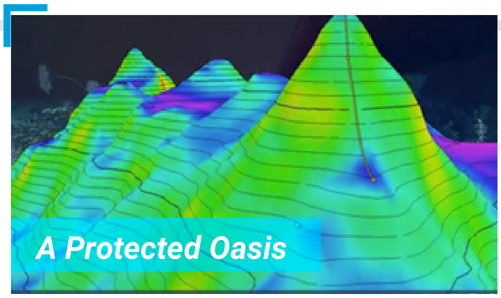
Tell students that they are going to explore this concept using a seamount as the ecosystem, creating a simple example of increasing complexity.

Ask students:

> Now that you've seen a couple of habitats and have a frame of reference,
> *How could we model this using (colored) triangles, i.e. illustrate the complexity of a seamount ecosystem?*
> There are no right or wrong answers here, just ideas.

Learning Procedure

Play the video A Protected Oasis (2:14) to introduce students to the ecosystem they will be modeling throughout the lesson - seamounts.



Video courtesy of NOAA Ocean Exploration.

Ask students to reflect on the discussion from the introduction about the levels of complexity on a sandy bottom and in a kelp forest.

Tell students that similar to a kelp forest, a terrestrial forest, or a tidepool, seamount ecosystems have many levels of complexity.

After watching the video and reflecting on the examples, **ask** students

> *What evidence (both biotic and abiotic factors) do you see that would lead you to describe this seamount ecosystem as complex?*
> Answers may include:
> - Seamount peaks/shape
> - Rock formations (clusters of rocks making the texture of the seamount)
> - Different types of corals - shapes, colors, size
> - Many types of animals living on the coral

Educator Guide cont.

Learning Procedure cont.

Seamount model

Ask students to think about how the blank triangle on the front of their [Habitat Complexity worksheet] can be used to answer the ***Driving Question:* How can we model the physical and biological complexity of deep-sea ecosystems, like seamounts (or any other habitat)?** (Slide 4)

Discuss student responses.

Explain to students that while simple geometric forms, such as circles, triangles, or smooth surfaces, are rare in nature, they can be very useful to model ecosystem complexity.

Explain to students that they are going to use triangles to create a simple model that illustrates complexity within a seamount habitat. As they divide the triangles, this will represent increasing levels of complexity of the seamount, which they will label in the blank key on their worksheet.

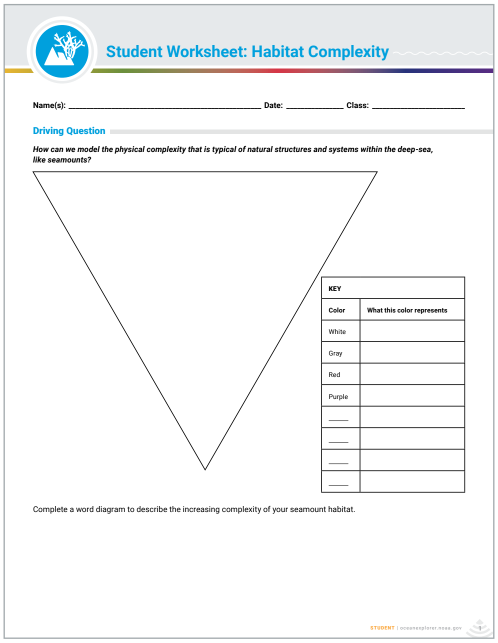
Ask students,

For our seamount ecosystem, what does the large, empty white triangle represent?
What is the most "zoomed out" feature in this ecosystem? (Slide 5)
A Seamount rock face

Tell students to fill in the first row of the color key on their worksheet with:
White = Seamount rock face. (An example is provided on slide 6.)

Important clarification for students: We are using triangles for this activity because they are the simplest shape to model the infinite levels of complexity, NOT because they are the shape of the seamount. (the triangle has been inverted to help avoid this misconception).

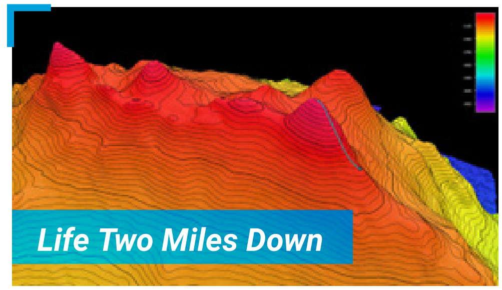
Tell students they are now going to illustrate the next level of complexity in the seamount ecosystem by creating the first division in their triangle.



Educator Guide cont.

Learning Procedure cont.

DIRECTIONS



Video courtesy of NOAA Ocean Exploration.

Step 1 (Slides 7-11):

- Find the midpoint of each side of your largest equilateral triangle.
- Connect the midpoints on each side, forming a new triangle in the middle.
- Color the new triangle in the middle of the larger triangle the color gray.

Show the video Life Two Miles Down, *NOAA Ocean Exploration* (at least 00:00 - 00:30) (Slide 8 and/or the images on Slide 9)

Ask students to think about the seamount ecosystem they just saw.

What do you think the gray, shaded triangle represents as the next level of complexity in the seamount ecosystem?

Seamount rock formations (rocks and boulders) - excellent substrate for organisms to attach to.

Step 1 *cont.* (Slides 10-11):

- Consider you are looking down on a small portion of the surface of a seamount, i.e. 3-6 meters wide.
- Repeat the division process with the three white triangles you just formed.
- Color these three new triangles gray as well.

Ask students:

What do you think these additional gray triangles represent within the beginning of your seamount ecosystem?

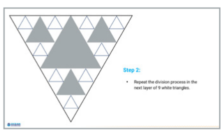
Nooks and crannies within the rocks, providing substrate and hiding places.

Instruct students to label their gray triangles as “rocks and boulders/nooks and crannies” in their key.

Tell students they’re going to continue this progression of dividing the triangles in their model, coloring each new set of triangles different colors, and identifying what part of a seamount they represent at each increasing level of complexity. Students will complete the key to their model as they go.

Step 2 (Slides 12 - 14):

- Repeat the division process in the next layer of nine white triangles.
- Watch these four short videos:
  - Giacomini Seamount (1:21) *NOAA Ocean Exploration*
  - A Coral Garden (1:23) *NOAA Ocean Exploration*
  - Forest of the Weird (1:42) *NOAA Ocean Exploration*
  - Sponge-A-Palooza (1:14) *NOAA Ocean Exploration*

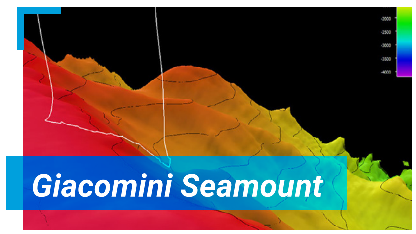


What is the next level of complexity in this habitat based on the videos you watched (what might these triangles represent in a seamount habitat)?

Deep-sea corals and deep-sea sponges. (Students may notice a prevalence of both corals and sponges. Let them know, depending on additional variables within a habitat, either or both organisms can be dominant foundation species.)

Step 2 *cont.* (Slide 14):

- Decide how many of your triangles represent coral and how many represent sponges.
- Color your corals red and your sponges purple and label them in your key.



All videos courtesy of NOAA Ocean Exploration.

Educator Guide cont

Learning Procedure cont.

Step 3 (Slides 15-18):
- Repeat the division process in the next set of white triangles.
- Watch these two short videos:
  - From a Coral Polyp an Island Grows (1:10) *NOAA Ocean Exploration*
  - Again watch Giacomini Seamount (1:21) *NOAA Ocean Exploration*

What might these triangles represent in a seamount habitat?
Note: If students need help, prompt them to consider the names of organisms they heard mentioned in the videos. Share images and organism names (samples provided on slide 18) and make a class list as/if needed. Species could include brittle stars, basket stars, anemones, urchins, feather stars, sea spiders, fishes, etc. Encourage students to create their community of choice!

All videos courtesy of NOAA Ocean Exploration.

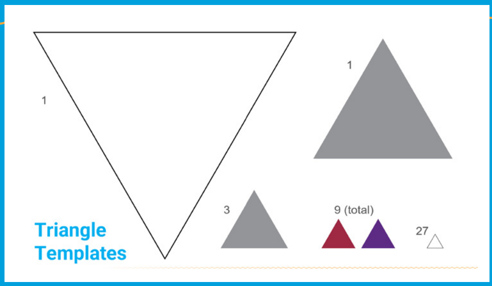
Step 3 *cont.* (Slides 17):
- Based on the videos you've seen, decide what your new triangles represent (what additional organisms live on your seamount and how many of each).
- Color each species a different color and label them in your key.

An example of student triangles with answer key is on slide 19.

EDUCATOR NOTE

This activity could also be done with pre-cut out triangles that students place to create the increasingly complex system. These can be used with the worksheet or as a separate model made with colored foam or construction paper. (See slide 29)

An even more simplistic version is to cut out an equilateral triangle and fold it repeatedly then open it up to reveal smaller and smaller triangles.



Ask students: *Could you keep going with more triangles?* (Slide 20)

Tell students that it obviously is not possible for us to repeat the process infinitely, so our model is only an approximation.

Give students time to consider this, then show all or a portion of this video:
- Coral in Concert (5:09) *NOAA Ocean Exploration*
  - Optional shorter clips if time is limited:
  - 2:01 - 2:28 - high density of corals
  - 3:00 - 3:29 - Coral forest, coral and sponge aggregations, hotspots of diversity
  - 3:29 - 3:50 - Hemicorallia, 200 yrs old, 6 inches at base; crinoids, brittle stars, etc. living on it
  - 4:27- 4:42 High density communities of corals and sponges

Ask students:
- *What could even smaller triangles in your model represent?*
- *How does this model mimic a real habitat?*

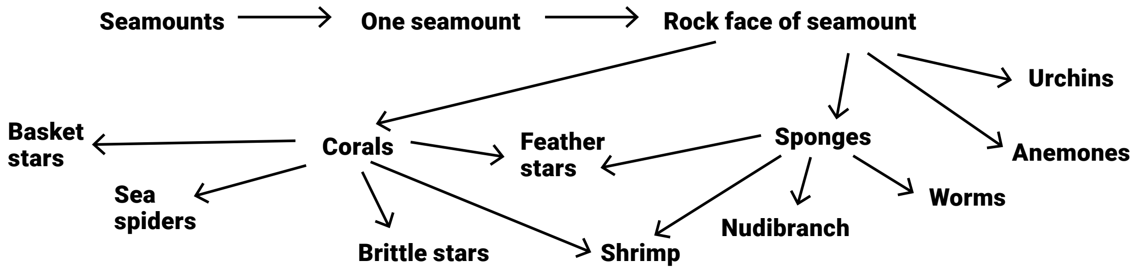
INTERESTING FACT

As of 2025, scientists have visually observed less than 0.001% of the deep sea floor, an area equivalent to about one-tenth the size of Belgium. (Bell et al., 2025)

Educator Guide cont

Put the Pieces Together

Ask students to complete a word diagram of their own seamount, illustrating the many levels of complexity. For example:



Ask students what they learned/observed. (Slide 22)

Suggested guiding questions (student answers will vary):

What did you learn about seamounts as habitat?
Seamount rock formations themselves provide hard substrate/habitat for a variety of species.
They also provide many nooks and crannies (rugosity) for a variety of species to inhabit.

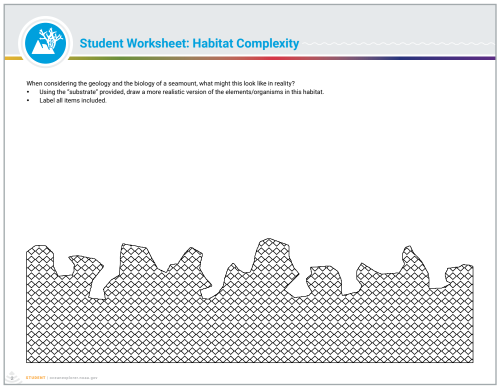
What did you learn about deep-sea corals and sponges?
Deep-sea corals and sponges provide hard substrate and also create intricate habitat (rugosity) for a wide variety of species.

What did you learn about available space in a habitat/habitat complexity?
Repeatedly dividing a fixed space produces an infinite series of increasingly smaller spaces that in nature are potential habitats for a wide variety of organisms. The number of species, and possibly species diversity, often correlates with the physical complexity of the habitat and the variety of resources in that habitat (food/shelter).
Note: multiple variables impact species diversity.

What would likely happen if corals and/or sponges were removed from this habitat?
Answers may include loss of structure for other organisms to live on; possible significant alterations to the community; changes in the food web..

What are the limitations of the model?
It is not possible for us to repeat the process infinitely, so our model is only an approximation.
The triangles only represent a finite number of organisms.

Introduce the term rugosity. (Slide 23) In general, rugosity refers to the quality or state of being wrinkled, rough, or having a wrinkled or ridged surface (rugose). It can describe the appearance of leaves, bark, or even the seafloor, often indicating a complex or uneven texture. In specific fields like oceanography and coral biology, rugosity is used to describe the surface roughness of an area, which can affect water flow and the growth of organisms like coral and sponges.



Guide students to page 2 of their Student Worksheet (Slide 24). Have them show what they've learned by drawing a more realistic 2D picture of what might be living on their seamount and demonstrating the complexity based on what they now know and the videos they watched. A sample of student work is provided on slide 25.

Educator Guide cont

Optional (Slide 26): Consider showing these wrap up videos:

- If you have not already, show the full Coral in Concert video.
- Aleutians Bound (4:36) *NOAA Ocean Exploration*
  - *:00 - :52 = sponges and corals as ecosystem engineers*
    :53 - 2:03 = geology as substrate
- Stunning Biodiversity in Palau's Deep Sea (7:21) *Ocean Exploration Trust*
  - 1:56 - 2:57 = corals as ecosystem engineers
- Deep-Sea Dialogues: Seamounts, (7:57) *NOAA Ocean Exploration*

Extensions

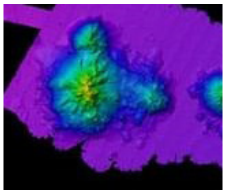
- Coral and sponge gardens can grow on other seafloor features that have hard substrate. This can include mounds of dead coral. Try repeating this exercise by applying the same concept to the discovery and exploration of the Million Mounds coral complex off the southeast U.S. in 2019 and have students compare and contrast habitats. (Slide 27)

  Consider showing these videos, having students identify species, and then create their colorful triangular model to include those species. The dead *Lophelia* coral creates the hard substrate and live *Lophelia* coral, sponges, shrimp, squat lobsters, a few species of urchin, crinoids (feather stars), other seastars, fishes, and even a nearby sunfish inhabit the coral mounds!

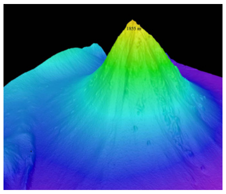
  - Ancient Coral Gardens (3:27) *NOAA Ocean Exploration*
    - Full video of habitat and diversity of organisms
  - Finding a Previous Undetected Coral Reef (2:15) *NOAA Ocean Exploration*

- Consider asking students what *scales* of complexity they observed in the videos and activity. Explain that as we zoom in on a physical structure, we continue to see additional structures that are increasingly small - but still complex - even at the level of individual cells. Below is an example of scales of complexity within a seamount habitat.

Seamounts → Seamount → Rocky outcropping of a seamount covered in corals and other organisms → Coral branch covered in feather stars and brittle stars → Arms of a feather star...


Seamounts

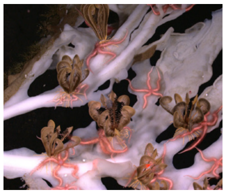
→


Seamount

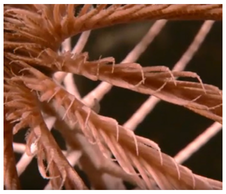
→


Rocky outcropping of a seamount covered in corals and other organisms

→


Coral branch covered in feather stars and brittle stars

→


Arms of a feather star

...

You might chose to introduce the classic Sierpinski Triangle as one example of a class of geometric forms known as fractals: forms that can be infinitely repeating and infinitely complex.

Ask students how this concept might relate to ocean exploration.

Answers may vary, but students should realize that if we observe complexity in natural features at one scale, then we will also find similar complexity at other scales. So, if we observe deep-ocean features over a wide area (for example, with multibeam sonar), we can find areas where features seem to be relatively complex (such as seamounts, underwater volcanoes, deep reefs). We can then observe these relatively complex areas at different scales with different tools (such as video cameras on an ROV) to look for other features, organisms, or anomalies. The idea is that detecting complexity over large areas gives us a way to narrow our search to places that have a relatively high probability for anomalies.

Educator Guide cont

Extensions cont.

- Have students explore examples of how artificial habitats are being used to provide for habitat complexity. The fractal dimension of a habitat can be used as a *predictor of biodiversity* — higher fractal dimensions generally mean higher species richness because of increased surface area and microhabitats. Fractal models are being used to design artificial habitats that mimic the complexity of natural habitats, potentially improving ecological engineering efforts.
- Have students explore the NOAA Ocean Exploration Benthic Deepwater Animal Identification Guide: a collection of in situ images of marine animals created from seafloor video taken during NOAA Ship *Okeanos Explorer* expeditions. This guide has become a trusted scientific resource to help identify deepwater animals seen during underwater vehicle dives. Note the wide variety of corals within the guide.
- Explore the Deep-Sea Coral and Sponge Portal from the NOAA Deep-Sea Coral Research and Technology Program with your students. This interactive map illustrates known deep-sea coral and sponge communities worldwide. Note the associated storymap Characterizing U.S. Deep-Sea Corals and Sponges.

Assessment

Opportunities for formative assessment are embedded throughout the lesson through class discussion and activity. The models constructed as well as the discussion questions can be used as an opportunity for summative assessment.

Scientific Terms

Ecosystem: a system or community formed by the interaction of organisms (biotic) with the non-living (abiotic) parts of their environment.

Ecosystem engineers: organisms that create, modify, maintain or destroy habitat, impacting the environment and the species that live there.

Foundation species: typically abundant species that provide essential habitat or resources for other organisms, shaping the overall ecosystem structure and function.

Habitat: the specific environment where an organism, like a plant or animal, naturally lives and grows.

Habitat complexity: the physical structure and heterogeneity of an environment, encompassing the variety and arrangement of living and non-living elements; a key factor influencing biodiversity, community structure, and ecosystem processes. Complex habitats offer diverse niches, resources, and refuge from predators, promoting coexistence and higher species richness.

Rugosity: the quality or state of being wrinkled, rough, or having a wrinkled or ridged surface (rugose).

Educator Guide URLs/Links

Page 1:
- Large boulders (image): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/05/boulder-hires-1.jpg
- Seamounts (image): https://oceanexplorer.noaa.gov/wp-content/uploads/2023/10/dive07-track-hires.jpg
- Corals (image): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/ex2304-corals-hires.jpg

Page 2:
- Habitat Complexity Student Worksheet (pdf): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/12/habitat-complexity-student-worksheet.pdf
- Habitat Complexity in the Deep Sea Slides (slides): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/12/habitat-complexity-slides.pdf
- Seamounts: Oases of Life (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/seamounts-oases-of-life-fact-sheet.pdf
- Deep Sea Corals and Sponges (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/DSC-foundation-species-fact-sheet.pdf
- What is a Seamount? (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/what-is-a-seamount-fact-sheet.pdf
- Seamounts: Oases of Life (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/seamounts-oases-of-life-fact-sheet.pdf
- Deep-Sea Corals: Rainforests of the Deep (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/rainforests-of-the-deep-fact-sheet.pdf
- Deep-Sea Corals and Sponges (fact sheet): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/04/DSC-foundation-species-fact-sheet.pdf

Page 3:
- Voyage to the Ridge (video): https://oceanexplorer.noaa.gov/okeanos/explorations/22voyage-to-the-ridge/features/urchins/urchins.html
- Underwater Kelp Forest (video): https://www.youtube.com/watch?v=GcbU4bfkDA4
- A Protected Oasis (video): https://oceanexplorer.noaa.gov/multimedia/video-playlist-ex2104-oasis/

Page 4:
- Habitat Complexity Student Worksheet (pdf): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/12/habitat-complexity-student-worksheet.pdf

Page 5:
- Life Two Miles Down (video): https://oceanexplorer.noaa.gov/multimedia/okeanos-explorations-ex2104-dives-dive15-media-dive15-milesdown/
- Giacomini Seamount (video): https://oceanexplorer.noaa.gov/multimedia/okeanos-explorations-seascape-alaska-ex2306-gallery-media-dive03-giacominiseamount/
- A Coral Garden (video): https://oceanexplorer.noaa.gov/multimedia/video-playlist-ex2104-coral-garden/
- Forest of the Weird (video): https://oceanexplorer.noaa.gov/multimedia/video-playlist-forestoftheweird/
- Sponge-A-Palooza (video): https://oceanexplorer.noaa.gov/multimedia/video-playlist-canyon-spongeapalooza/

Page 6:
- From a Coral Polyp an Island Grows (video): https://oceanexplorer.noaa.gov/multimedia/from-a-coral-polyp-an-island-grows/
- Giacomini Seamount (video): https://oceanexplorer.noaa.gov/multimedia/okeanos-explorations-seascape-alaska-ex2306-gallery-media-dive03-giacominiseamount/
- Coral in Concert (video): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex1708/dailyupdates/media/video/concert/concert-1280x720.mp4

Page 7:
- Habitat Complexity Student Worksheet (pdf): https://oceanexplorer.noaa.gov/wp-content/uploads/2025/12/habitat-complexity-student-worksheet.pdf

Page 8:
- Coral in Concert (video): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex1708/dailyupdates/media/video/concert/concert-1280x720.mp4
- Aleutians Bound (video): https://oceanexplorer.noaa.gov/wp-content/uploads/2023/05/aleutians-bound-1920x1080-2.mp4
- Stunning Biodiversity in Palau's Deep Sea (video): https://nautiluslive.org/video/2024/11/01/stunning-biodiversity-palaus-deep-sea
- Deep-Sea Dialogues - Seamounts (video): https://oceanexplorer.noaa.gov/multimedia/edu-resources-dsd-seamounts/
- Million Mounds coral complex (website): https://archive.oceanexplorer.noaa.gov/ex10years/stories/million-mounds.html
- Ancient Coral Gardens (video): https://oceanexplorer.noaa.gov/wp-content/uploads/2019/11/coral-garden-1280x720-1.mp4
- Finding a Previous Undetected Coral Reef (video): https://oceanexplorer.noaa.gov/wp-content/uploads/2018/08/reef-conversation-1920x1080-1.mp4
- Seamount 1 (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/ex1006/logs/media/sticks-boxes-hires.jpg
- Seamount 2 (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/june26/media/june26fig1_hires.jpg
- Seamount 3 (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/july11/media/3july11_hires.jpg
- Seamount 4 (image): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/photolog/media/08_hires.jpg
- Seamount 5 (video screencap): https://archive.oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/photolog/media/movies/0708_rov_highlights_960.mp4
- Eye on the Universe - Mandelbrot Fractal Zoom (website): https://fractalfoundation.org/resources/fractivities

Page 9:
- Benthic Deepwater Animal Identification Guidehttps (website): www.ncei.noaa.gov/maps/benthic-animal-guide/
- Deep Sea Coral and Sponge Portal (website): https://www.ncei.noaa.gov/maps/deep-sea-corals-portal/
- Characterizing U.S. Deep-Sea Corals and Sponges (website): https://storymaps.arcgis.com/stories/cf7a5b4691e54ae59e1573d594a421c4

Information and Feedback

We value your feedback on this activity package, including how you use it in your formal/informal education settings. Please send your comments to: oceanexeducation@noaa.gov. If reproducing this lesson, please cite NOAA as the source, and provide the following URL: https://oceanexplorer.noaa.gov.