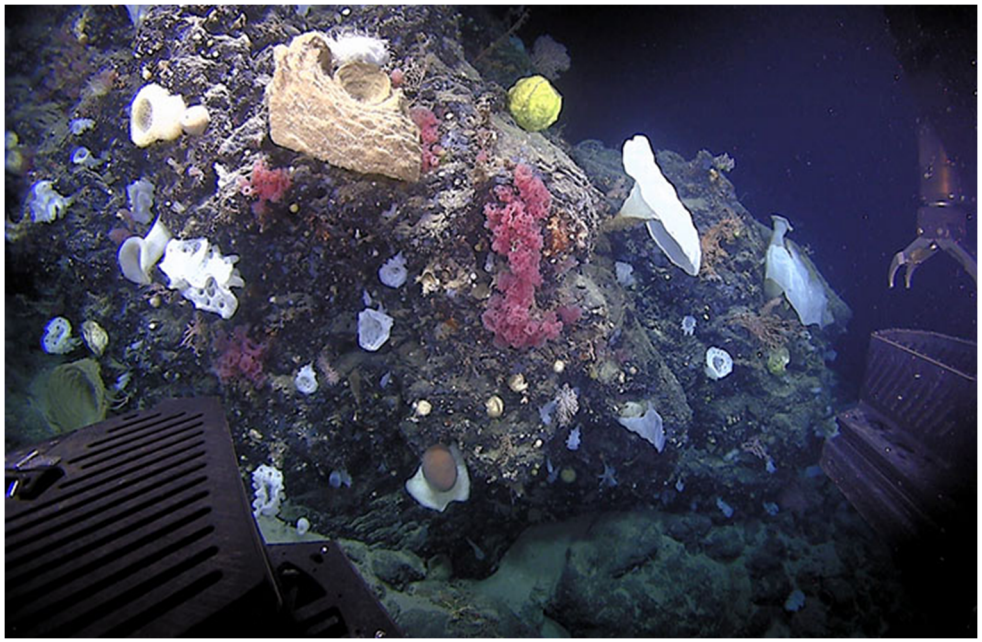
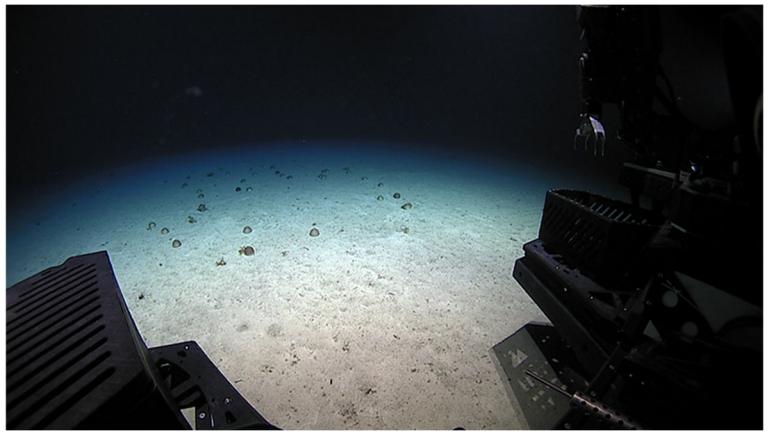
Habitat Complexity in the Deep Sea



Introduction: Sandy Seafloor and Kelp Forest



Voyage to the Ridge, 2022 (Dive 8)
NOAA Ocean Exploration

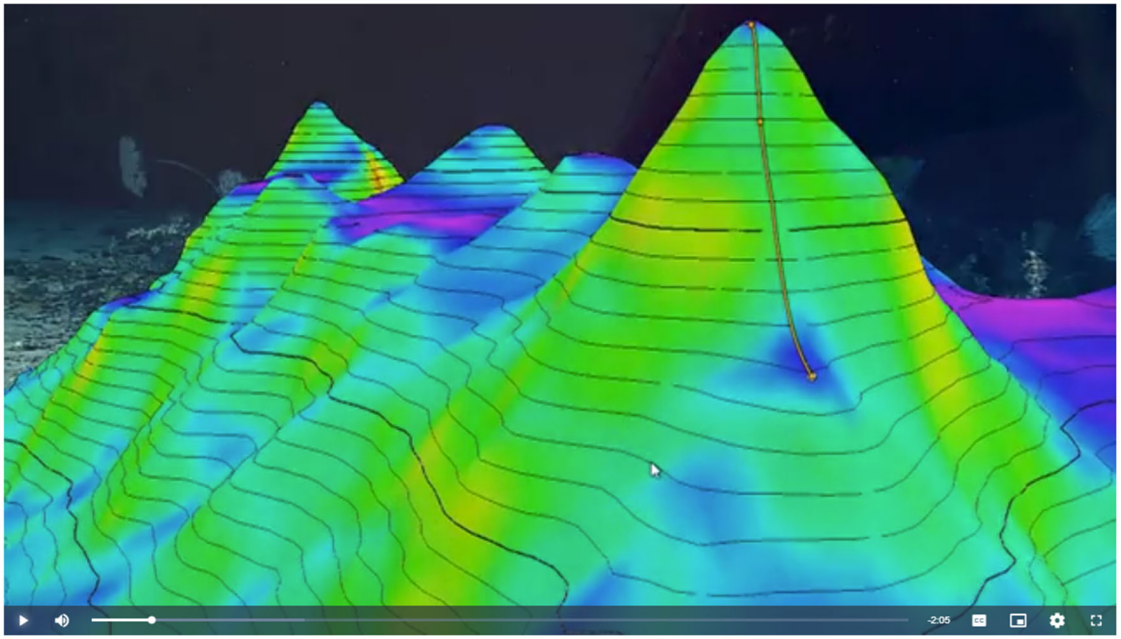
Video (play without audio)
Image

Underwater Forests
NOAA National Ocean Service

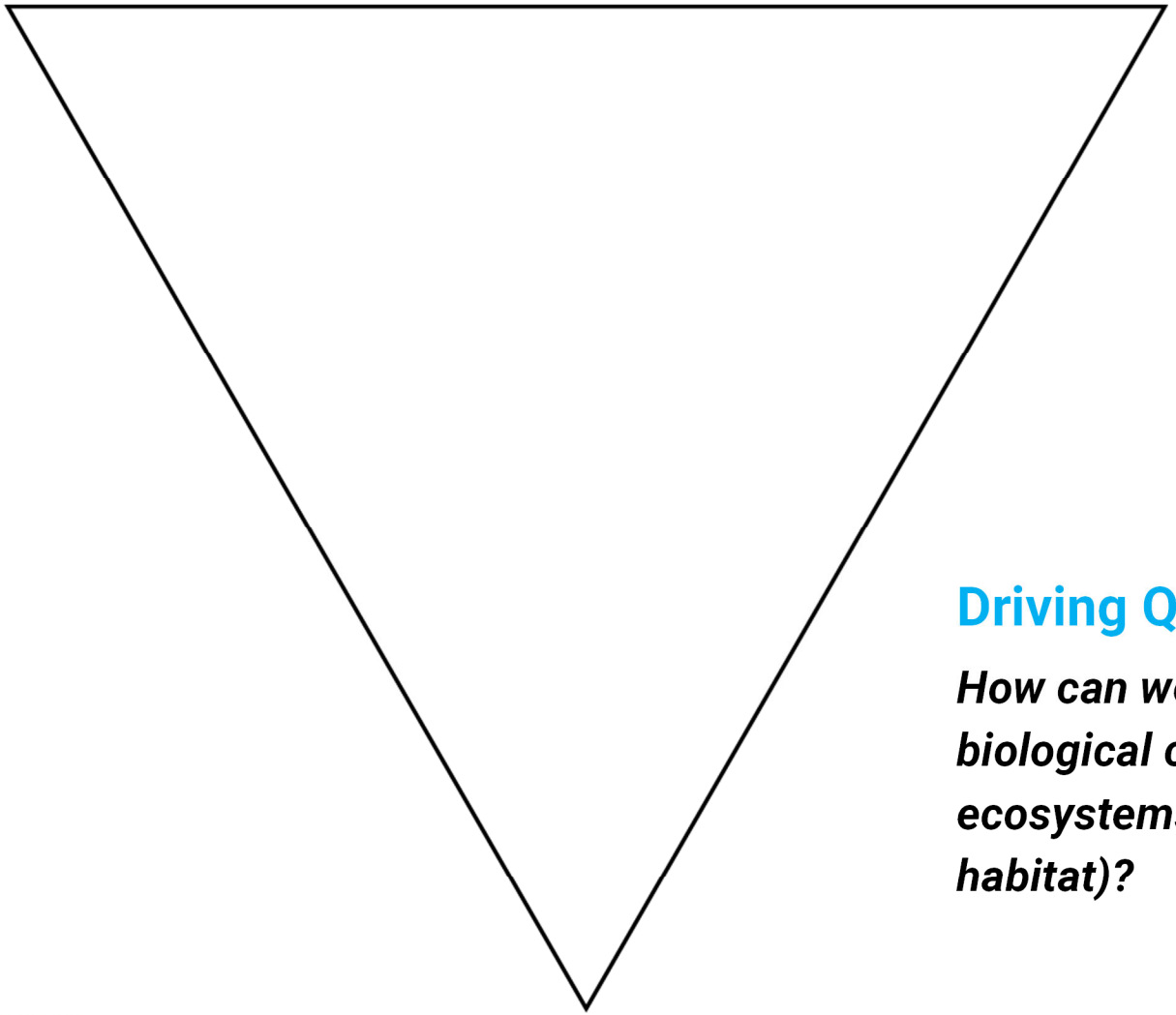
Video (play without audio)
Image

Learning Procedure : A Protected Oasis

A Protected Oasis: July 27, 2021



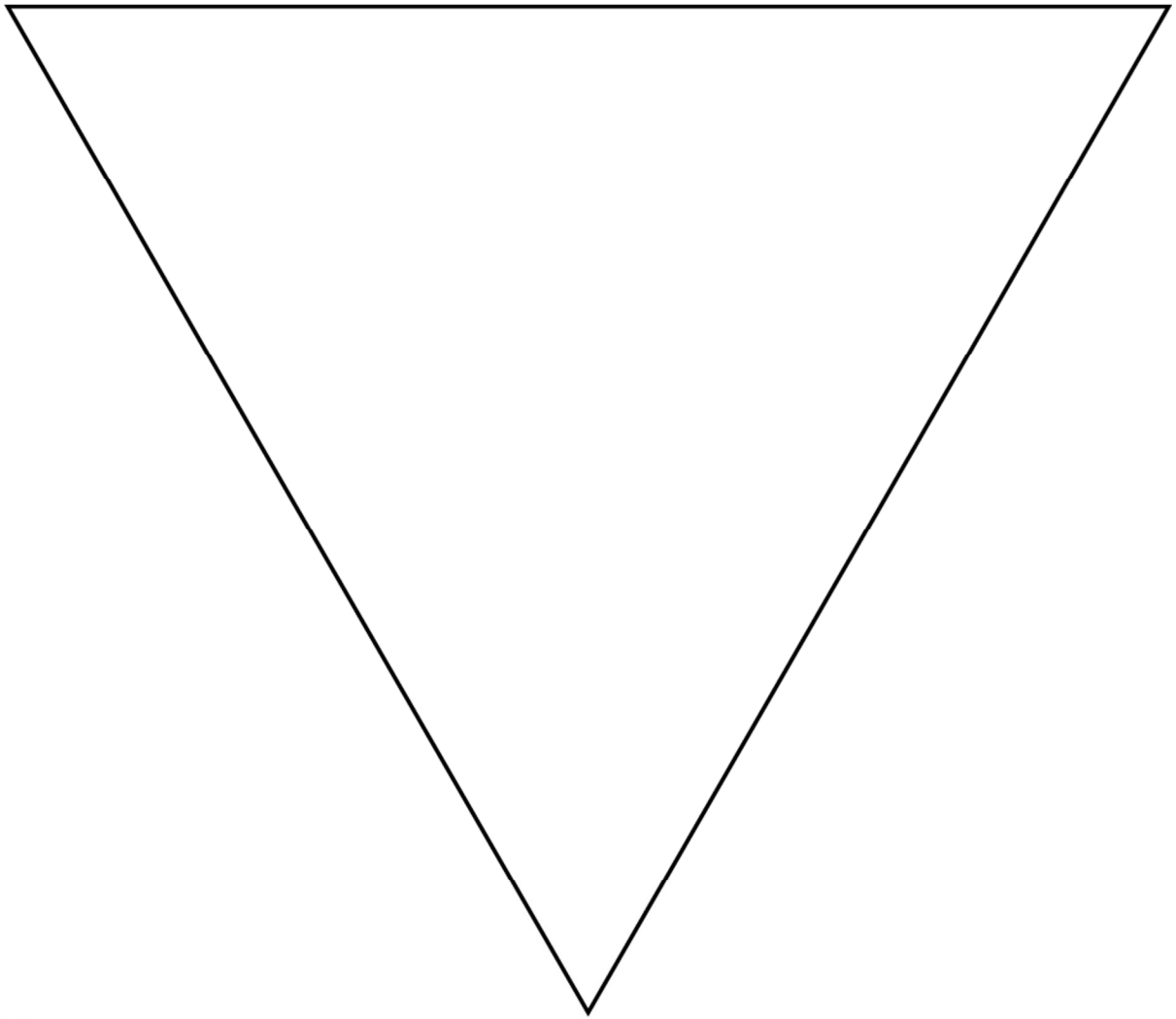
https://oceanexplorer.noaa.gov/multimedia/video-playlist-ex2104-oasis/



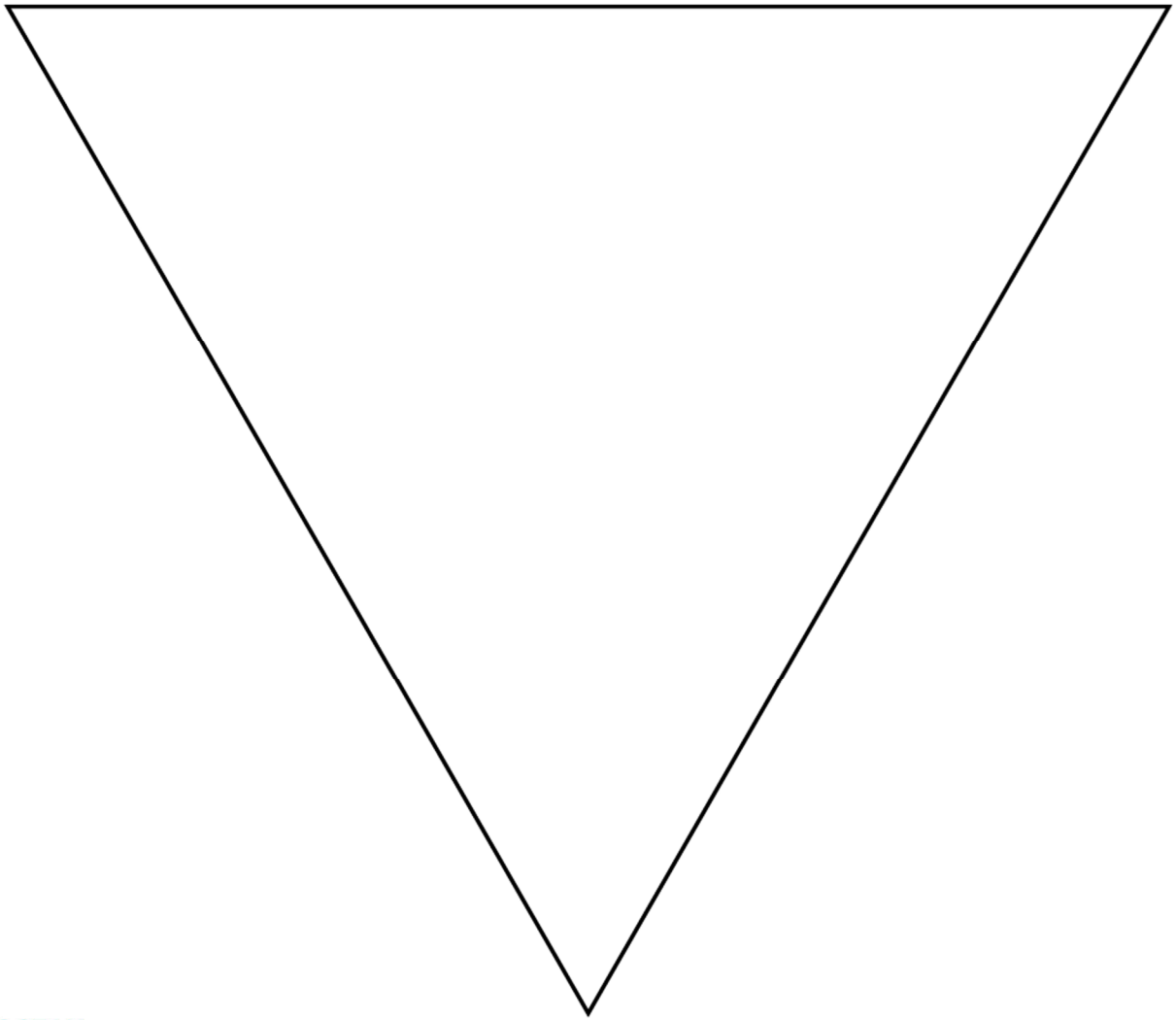
Driving Question:

How can we model the physical and biological complexity of deep-sea ecosystems (like seamounts, or any other habitat)?

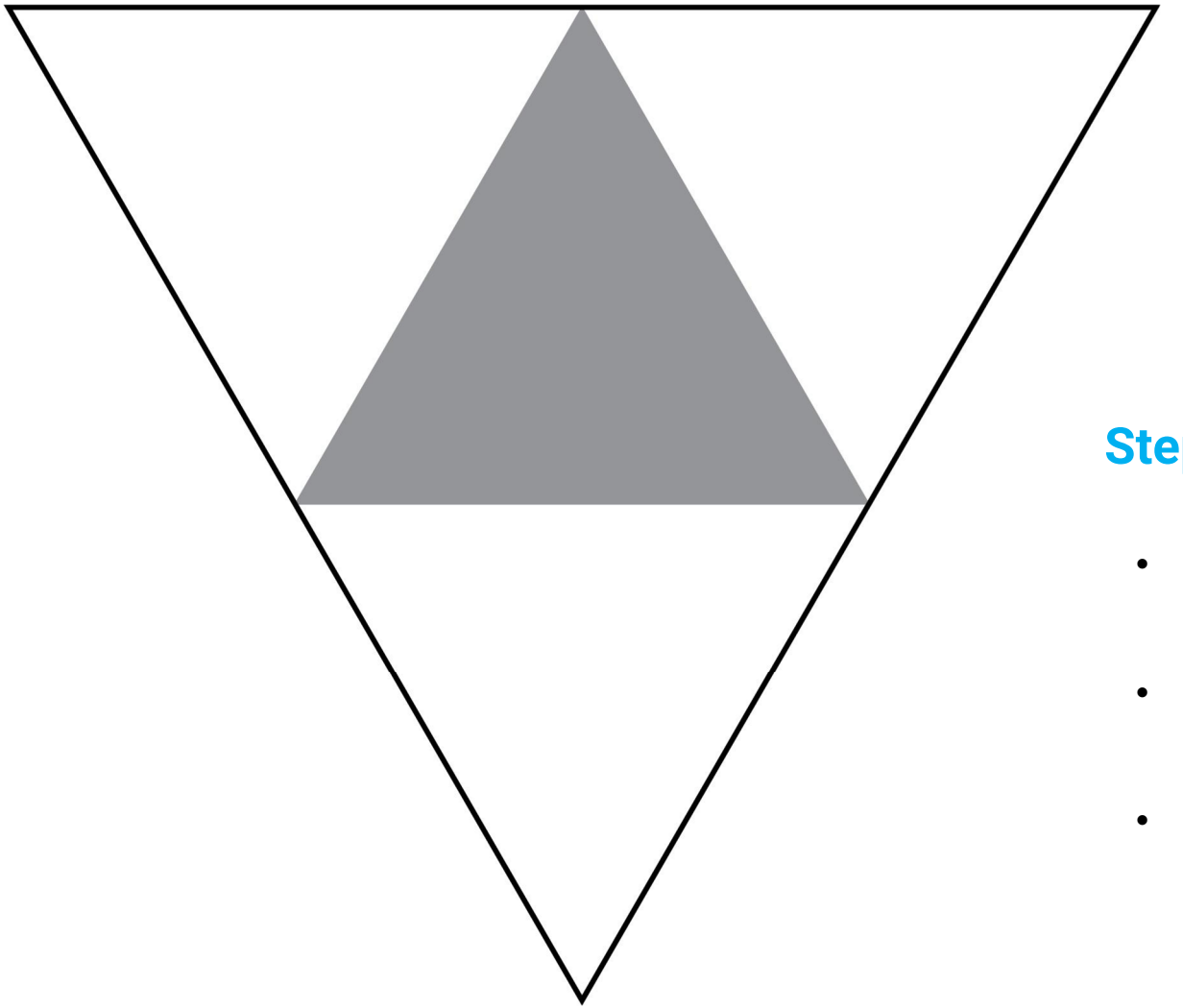
OCEAN EXPLORATION



KEY	
Color	**What this color represents**
White	
Gray	
Red	
Purple	
_____	
_____	
_____	
_____	



KEY	
Color	**What this color represents**
White	Seamount rock face
Gray	
Red	
Purple	
_____	
_____	
_____	
_____	



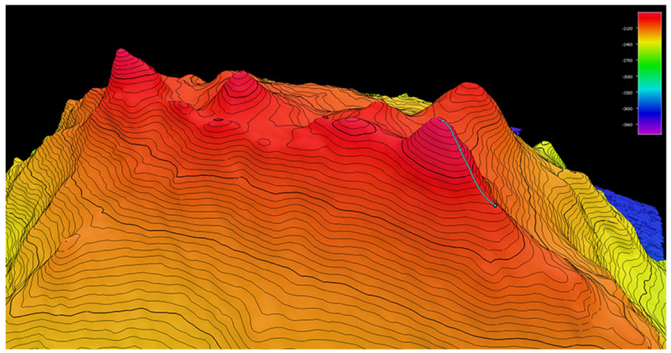
Step 1:

- 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 gray.

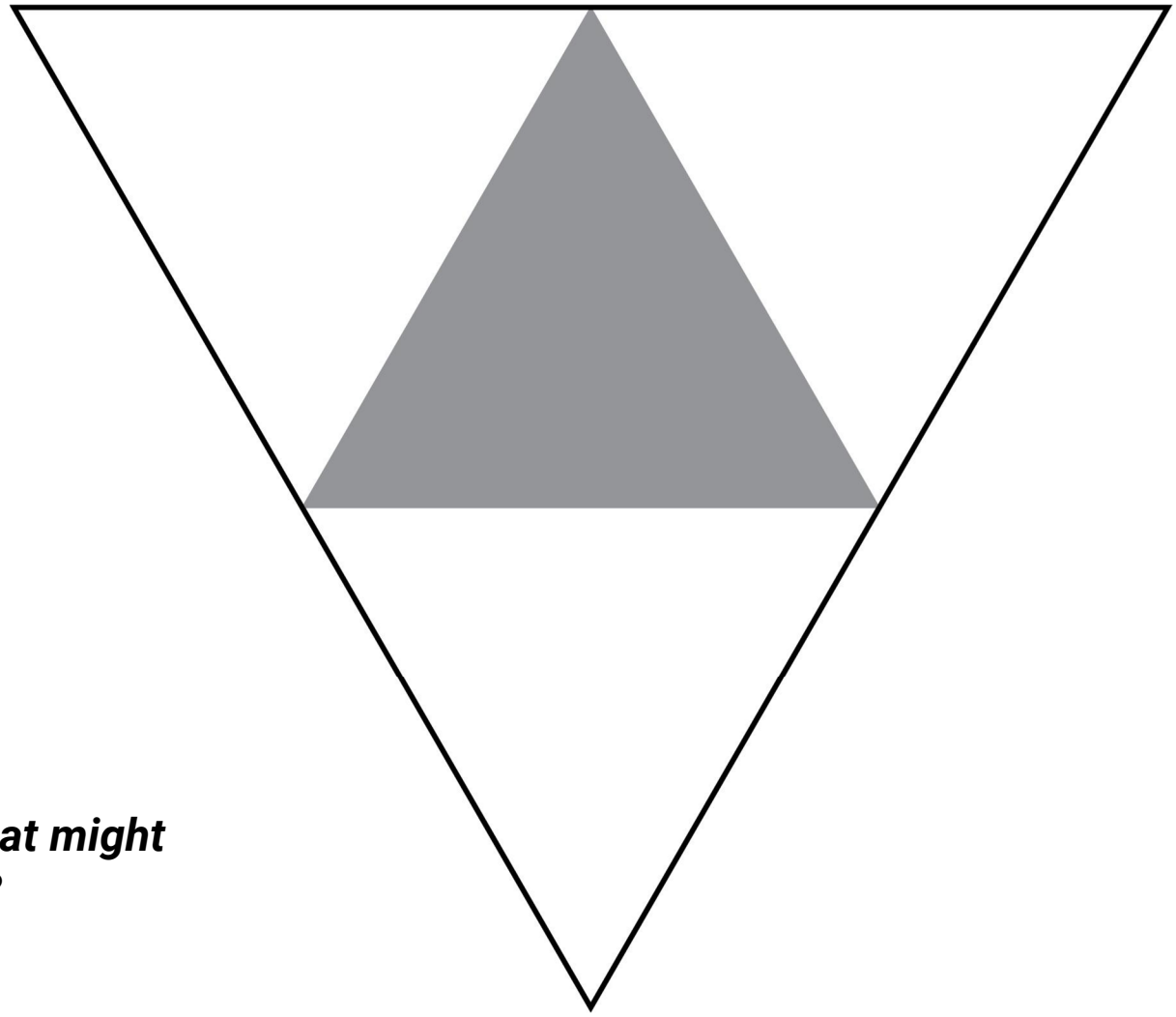
Watch the video:

Life Two Miles Down (00:00 - 00:30)

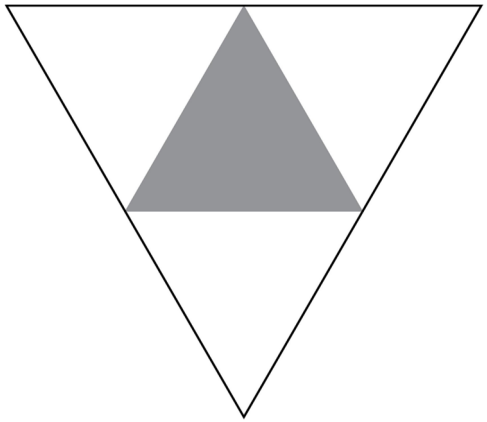
NOAA Ocean Exploration



- ***Thinking back to the video, what might the shaded triangle represent?***

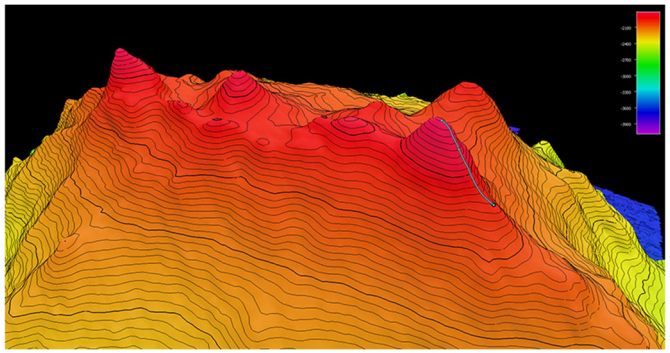


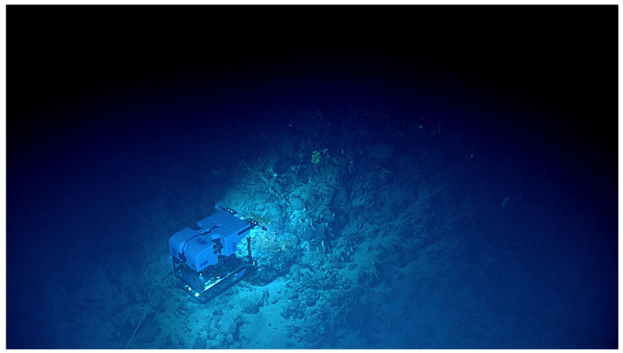
Helpful Hints

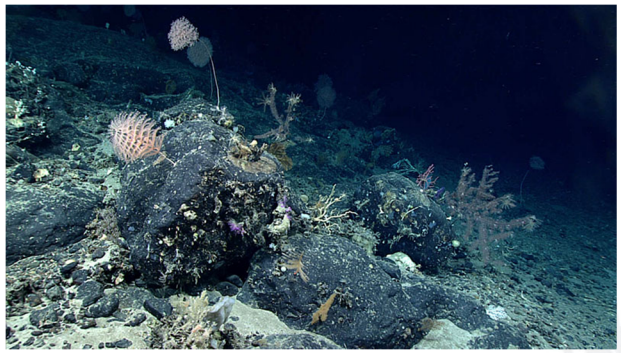


Below are some still images from Retriever Seamount, the featured seamount in the video.

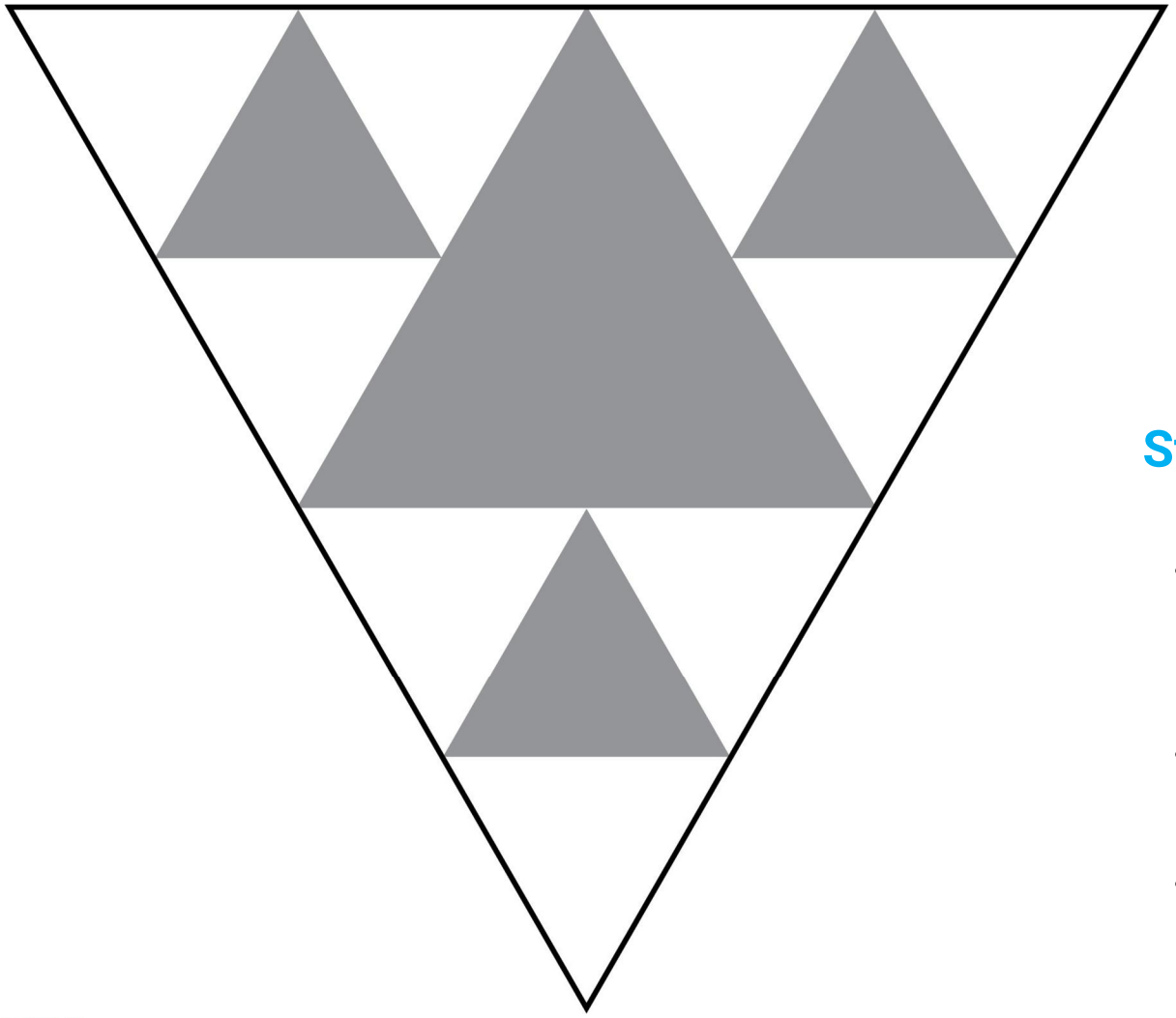
What do you think the gray, shaded triangle represents as the next level of complexity in the seamount ecosystem?





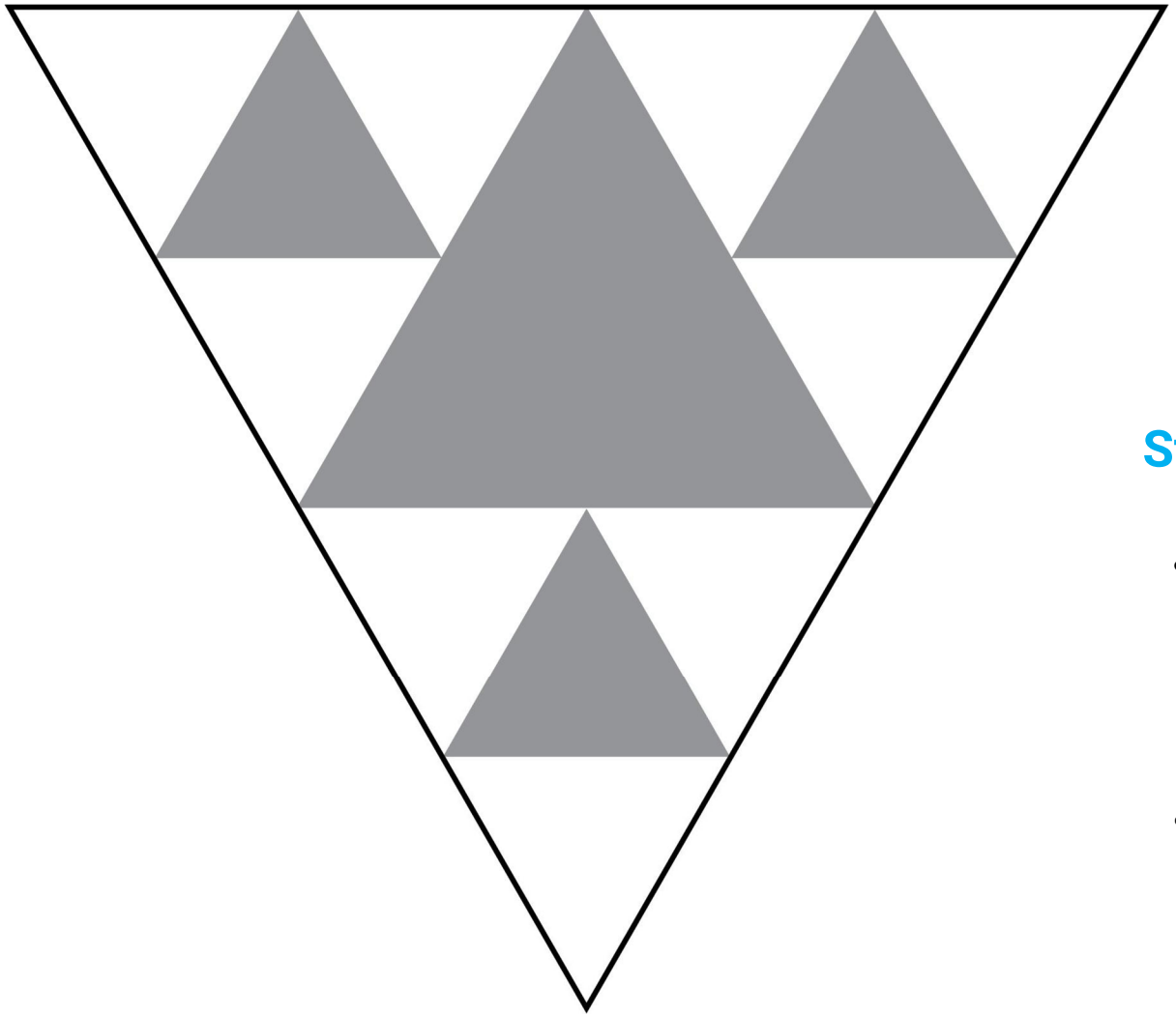


All images courtesy of NOAA Ocean Exploration



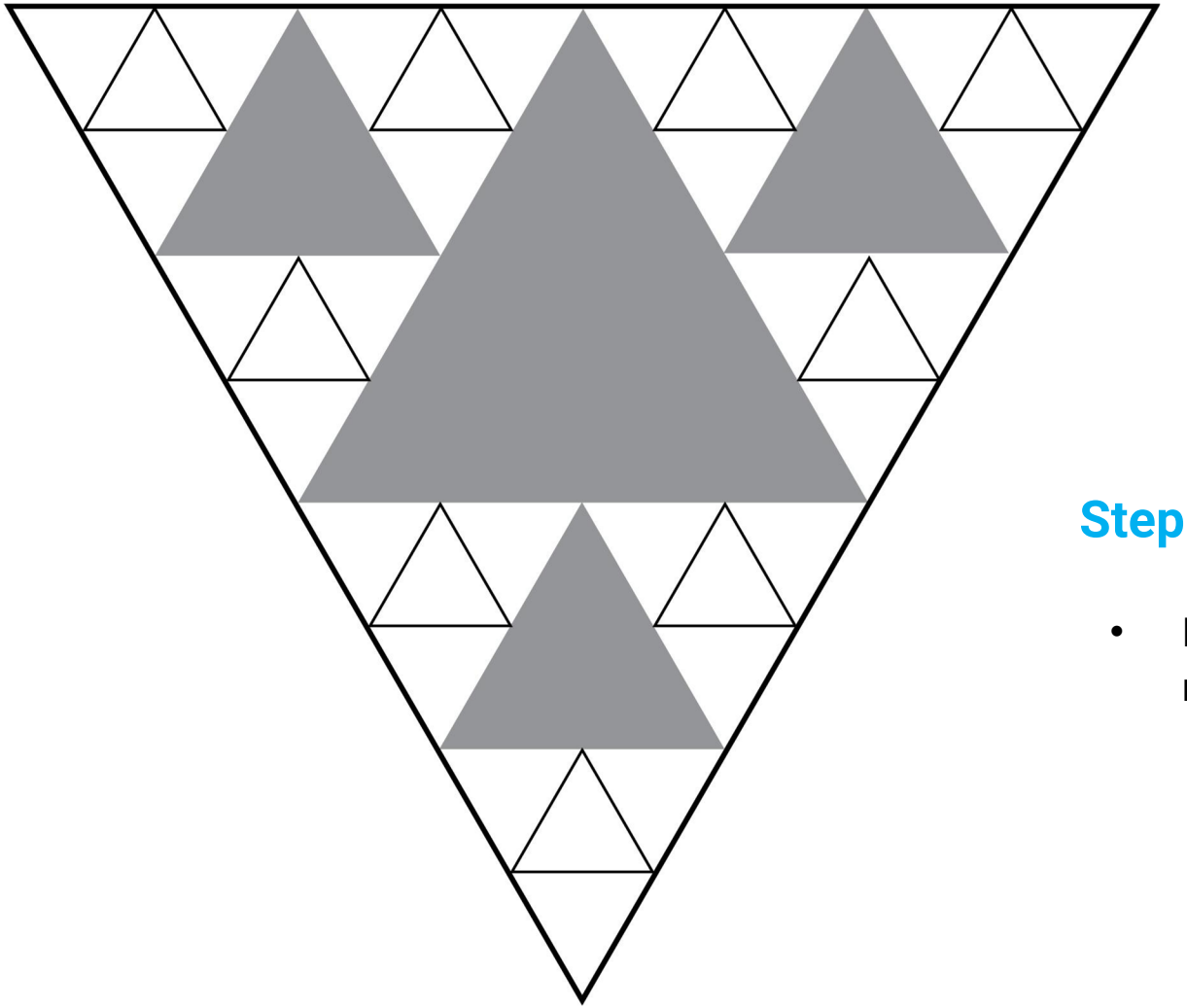
Step 1 continued…:

- Consider you are looking down at a small portion of the surface of a seamount.
- Repeat the measurement process in each of the three white triangles.
- Color your three new triangles the same gray.



Step 1 continued…:

- ***Again, thinking back to the video, what might these additional gray triangles represent?***
- ***Label these on your worksheet.***



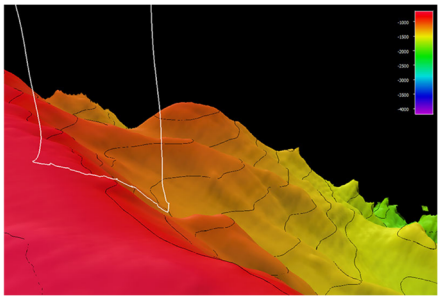
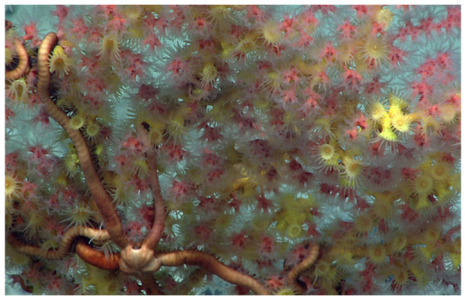
Step 2:

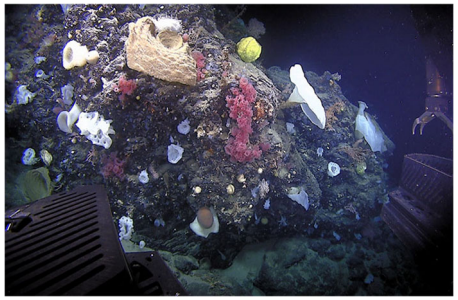
- Repeat the division process in the next layer of 9 white triangles.

Watch these four short videos:

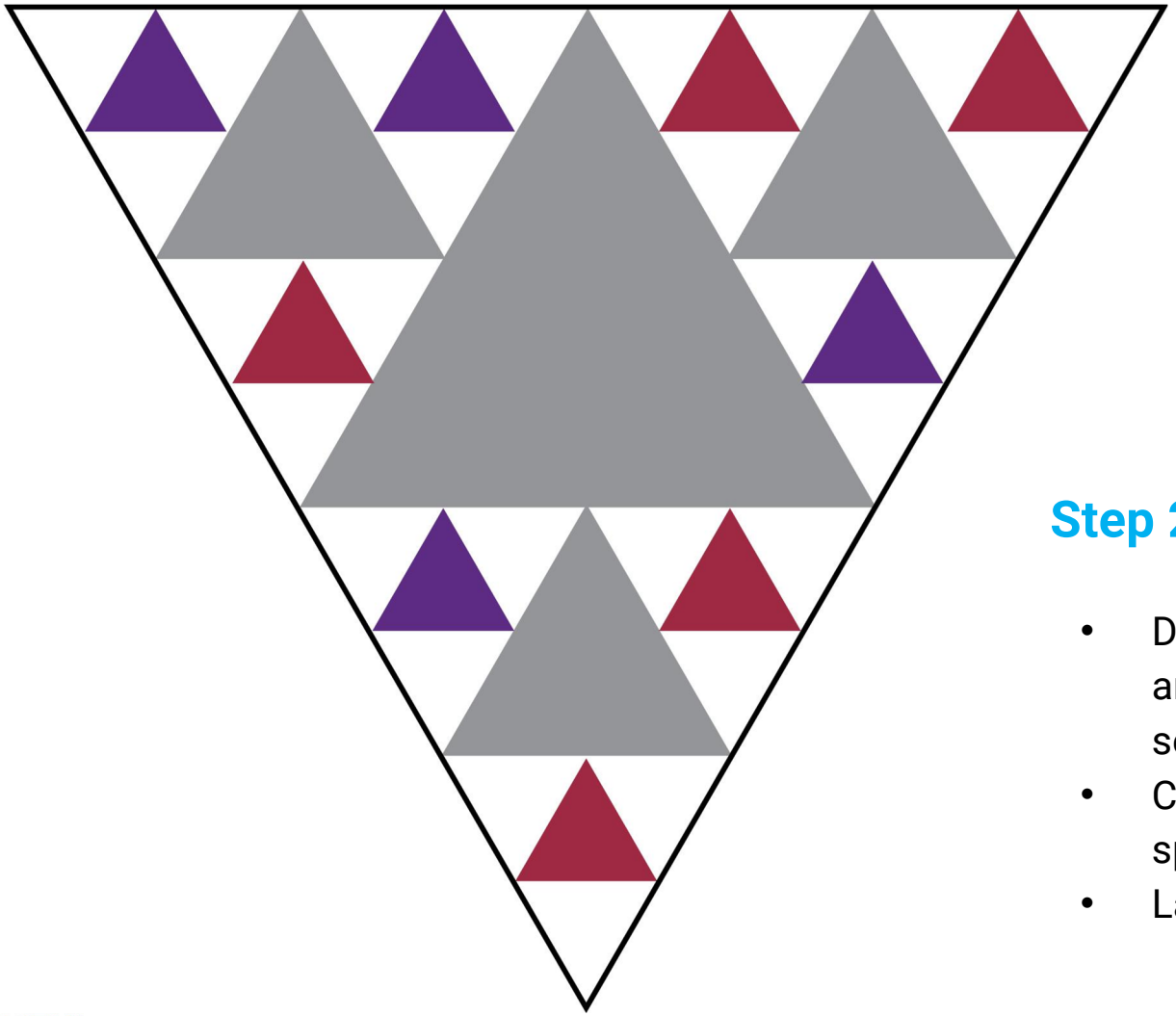
Giacomini Seamount (1:21)
NOAA Ocean Exploration
A Coral Garden (1:23)
NOAA Ocean Exploration

Forest of the Weird (1:42)
NOAA Ocean Exploration
Sponge-A-Palooza (1:14)
NOAA Ocean Exploration

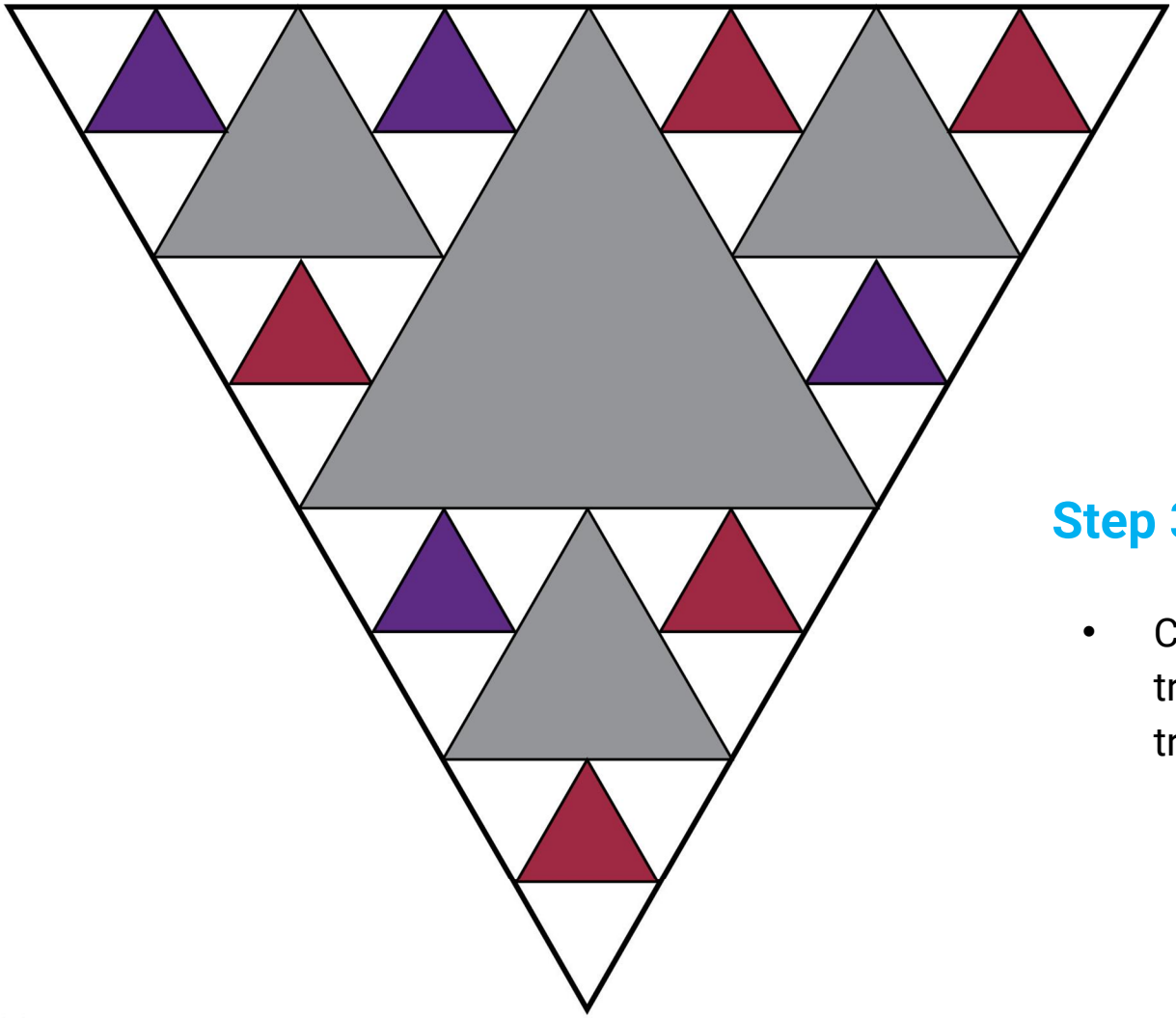


- ***What might these nine triangles represent in a seamount habitat?***



Step 2 continued…:

- Decide on the abundance of corals and sponges living on your seamount.
- Color your corals red and your sponges purple.
- Label them in your key.



Step 3:

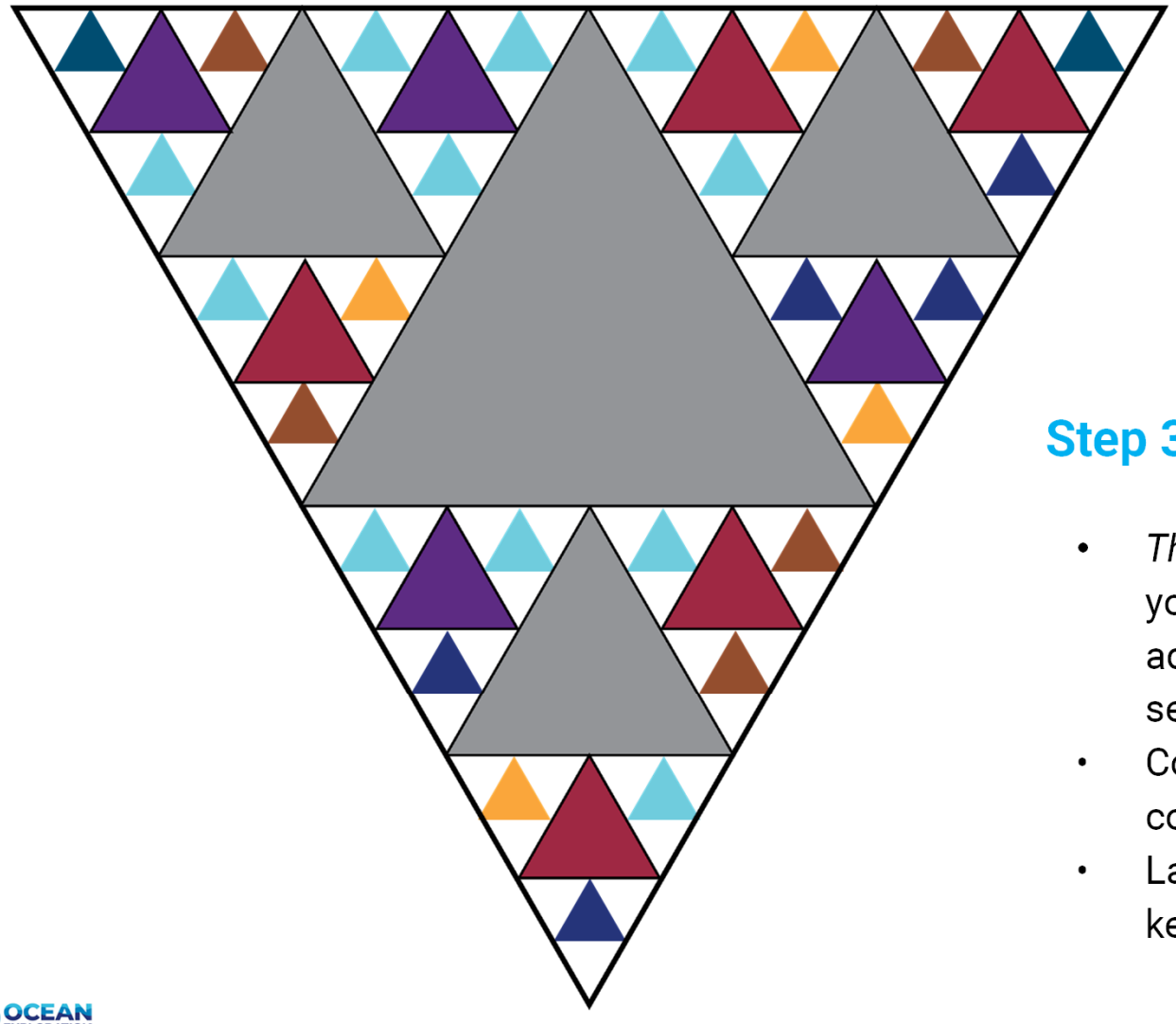
- Continue the division of the triangles again for the 27 new triangles you just created.

Watch these two short videos:

From a Coral Polyp an Island Grows (1:10)
NOAA Ocean Exploration
Giacomini Seamount(1:21)
NOAA Ocean Exploration



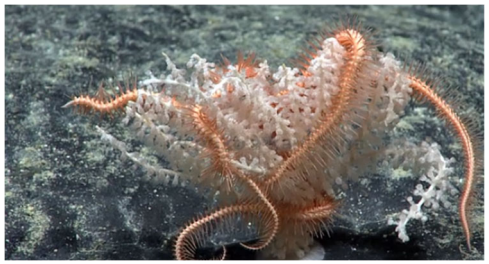
- ***What might these triangles represent in a seamount habitat?***



Step 3 continued…:

- *This time…* based on the videos you've seen, decide what additional organisms live on your seamount and how many of each.
- Color each species a different color.
- Label what they represent in your key.

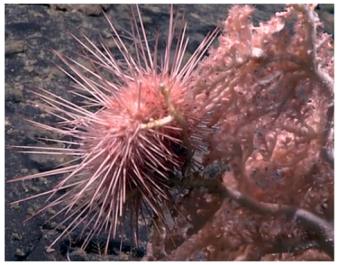
Deep-sea Coral and Sponge Communities: Sample inhabitants



Brisingid sea star

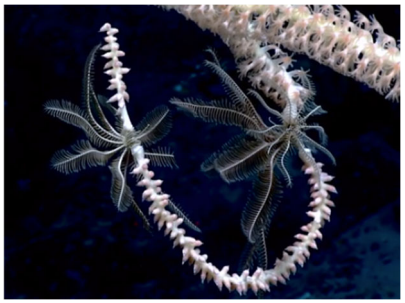
Sea star

Squat lobster



Sea urchin

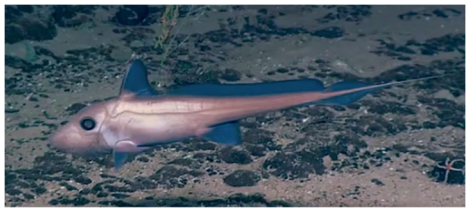
Sea anemone



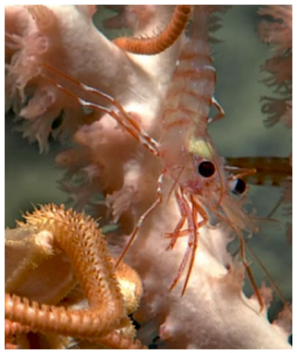
Feather stars

Hermit crab with anemone “hat”

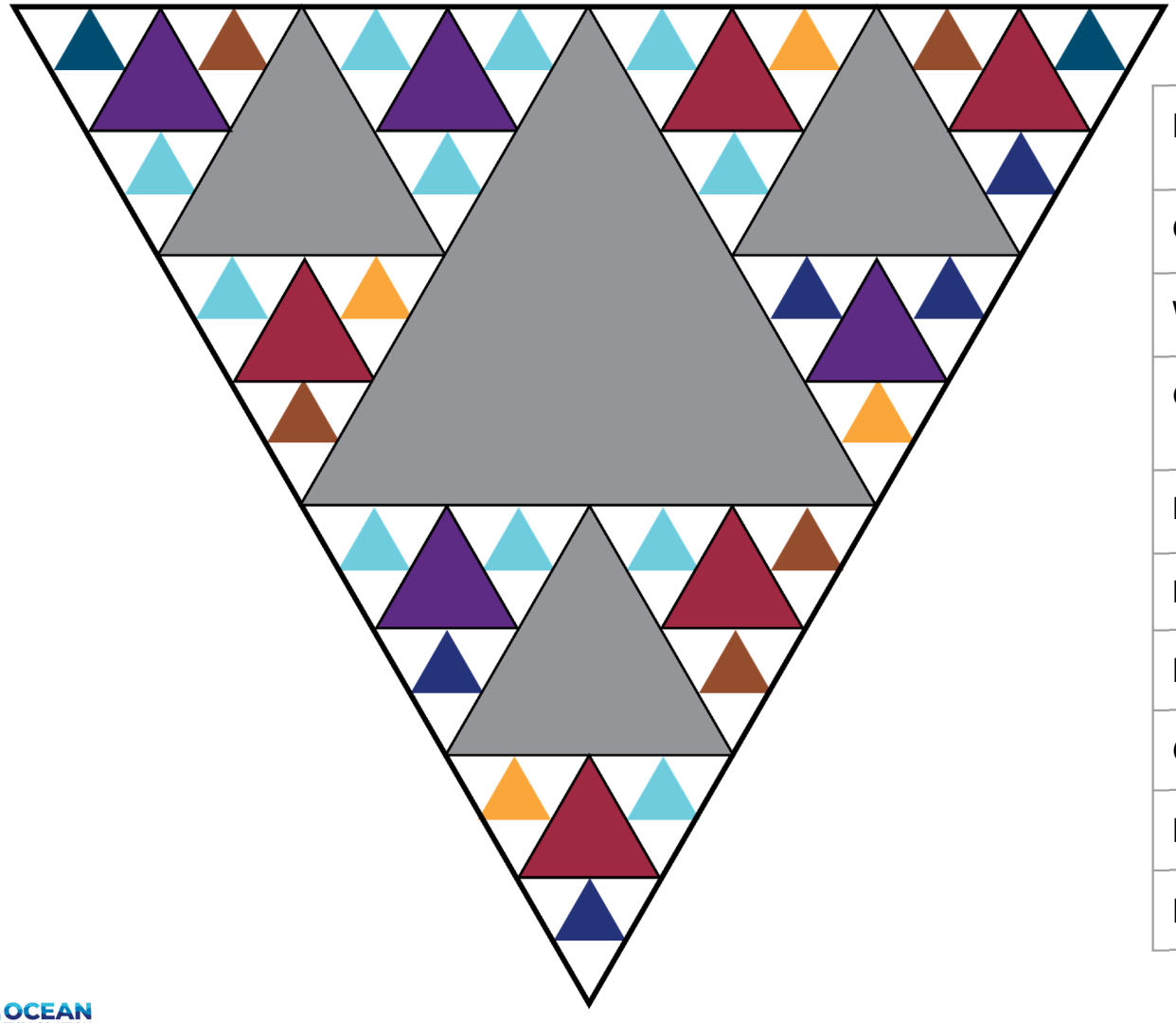
Sea cucumber



Ratfish



Shrimp



KEY (completed sample)	
Color	**What this color represents**
White	Seamount rock face
Gray	Rocks/boulders; nooks/crannies
Red	Deep-sea corals
Purple	Deep-sea sponges
Light blue	Brittle stars
Orange	Feather stars
Brown	Squat lobsters
Dark blue	Anemones

- ***Could you keep going with more triangles?***

  Watch this video
  - Coral in Concert (5:09)
    NOAA Ocean Exploration

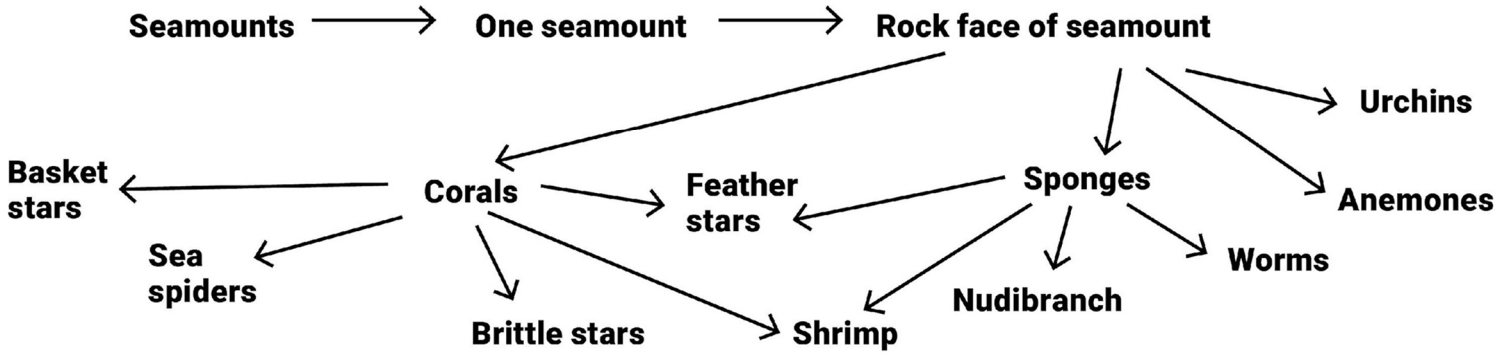
- ***What could even smaller triangles in your model represent?***

- ***How does this model mimic a real habitat?***

Put the Pieces Together

- Can you illustrate the increasing complexity of the habitat/community you built with a word diagram?

Example:



What did we learn/observe?

- ***What did you learn about seamounts as habitat?***
- ***What did you learn about deep-sea corals and sponges?***
- ***What did you learn about available space in a habitat/habitat complexity?***
- ***What would likely happen if the corals and/or the sponges were removed from this habitat?***

- ***What are the limitations of this model?***

Put the Pieces Together

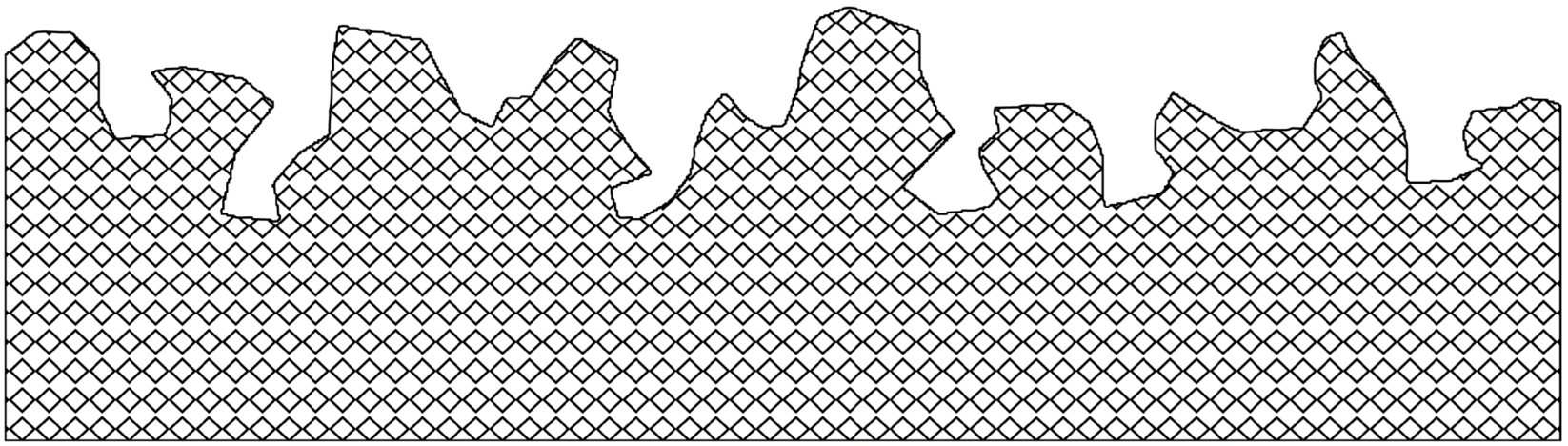
Consider how the term Rugosity applies to a real seamount.

Rugose: wrinkled or ridged surface

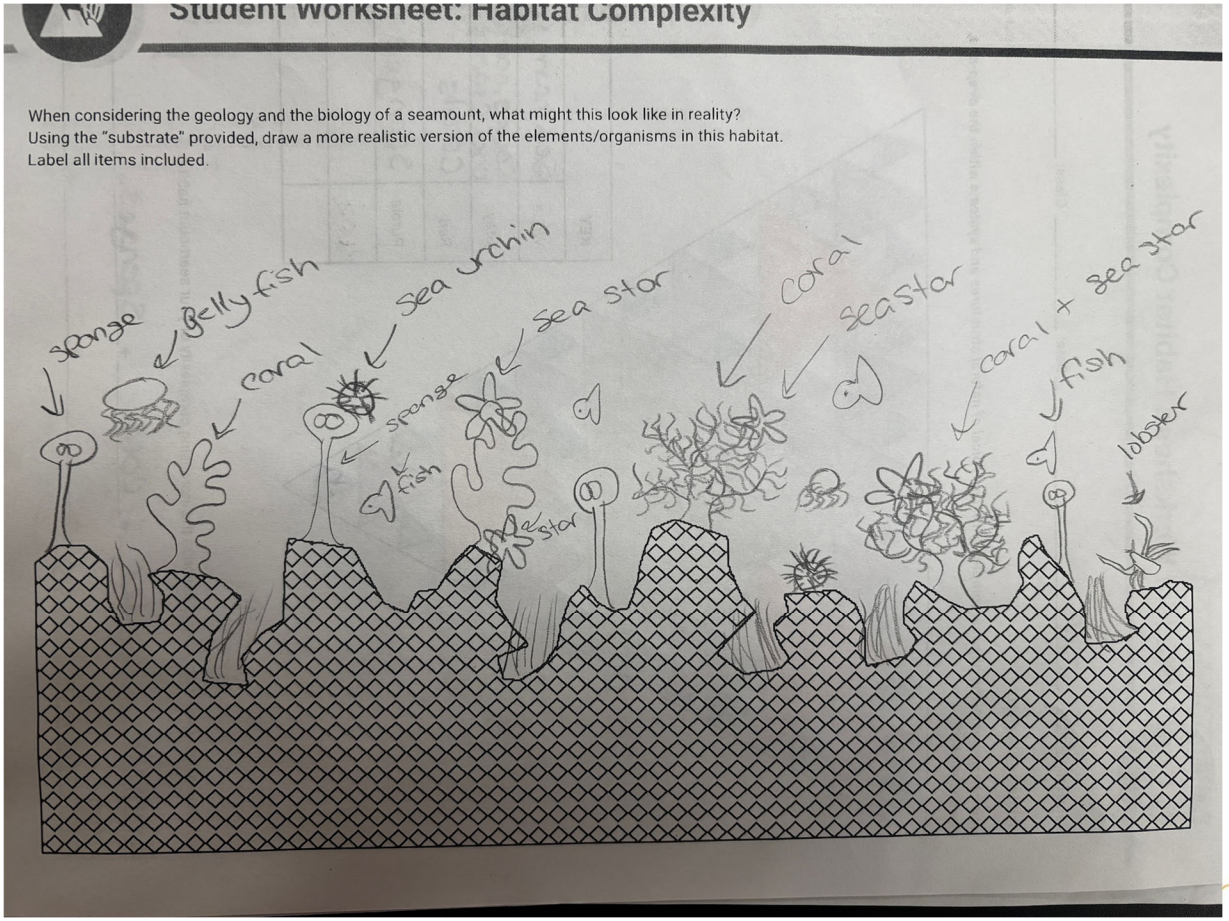
Rugosity: refers to the quality or state of being wrinkled, rough, or having a wrinkled or ridged surface

Seamount Substrate

- Consider the habitat you just explored.
- Using the “substrate” provided, draw a more realistic version of the elements/organisms in this habitat.
- Label all items included.



Seamount Substrate: Sample of Student Work



Student Worksheet: Habitat Complexity

When considering the geology and the biology of a seamount, what might this look like in reality?
Using the "substrate" provided, draw a more realistic version of the elements/organisms in this habitat.
Label all items included.

Optional Wrap-Up Videos

If you have not already, show the full Coral in Concert video.

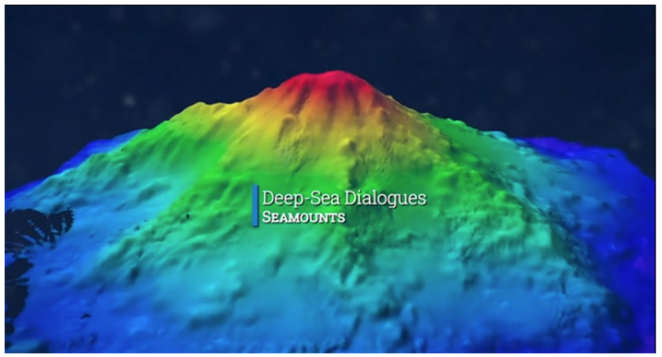
Aleutians Bound, (4:36) *NOAA Ocean Exploration*

0 - 0:52 = corals, 0:53 - 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*

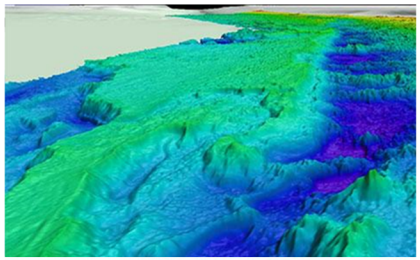


Extension: Million Mounds Coral Complex

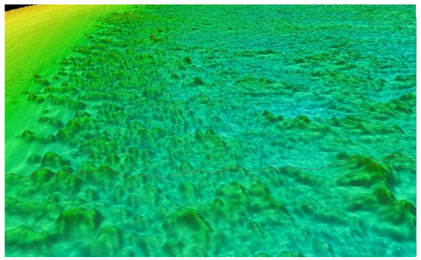
Ancient Coral Gardens, (3:27) *NOAA Ocean Exploration*

- Full video of habitat and organisms

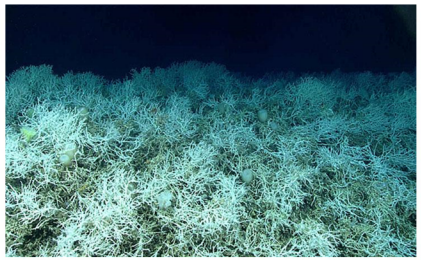
Finding a Previous Undetected Coral Reef, (2:15) *NOAA Ocean Exploration*



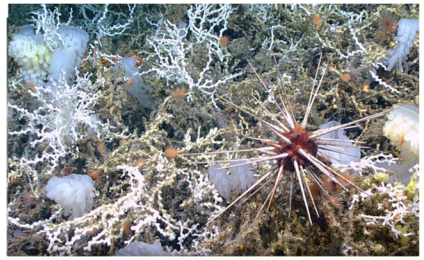
Map of mounds near Gulf Stream



Mounds off the southeast US coast



Lophelia *coral mounds*



A variety of species making their homes within the coral mounds

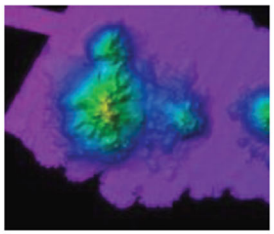
Background information: Million Mounds coral complex

Extension: Seamounts

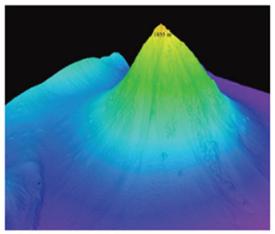
- Can you illustrate the increasing complexity of the habitat you built with a word diagram?

Example of complexity at different scales as we zoom in on a habitat:

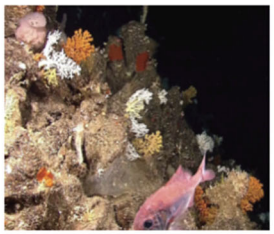
Seamounts → Seamount → Rocky outcropping of a seamount covered in corals and other organisms → Coral branch covered in feather stars and brittle stars → Arms of a feather star…



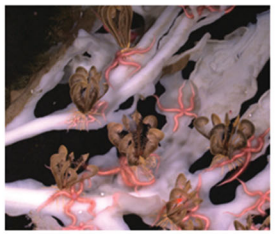
Seamounts



Seamount



Rocky outcropping of a seamount covered in corals and other organisms

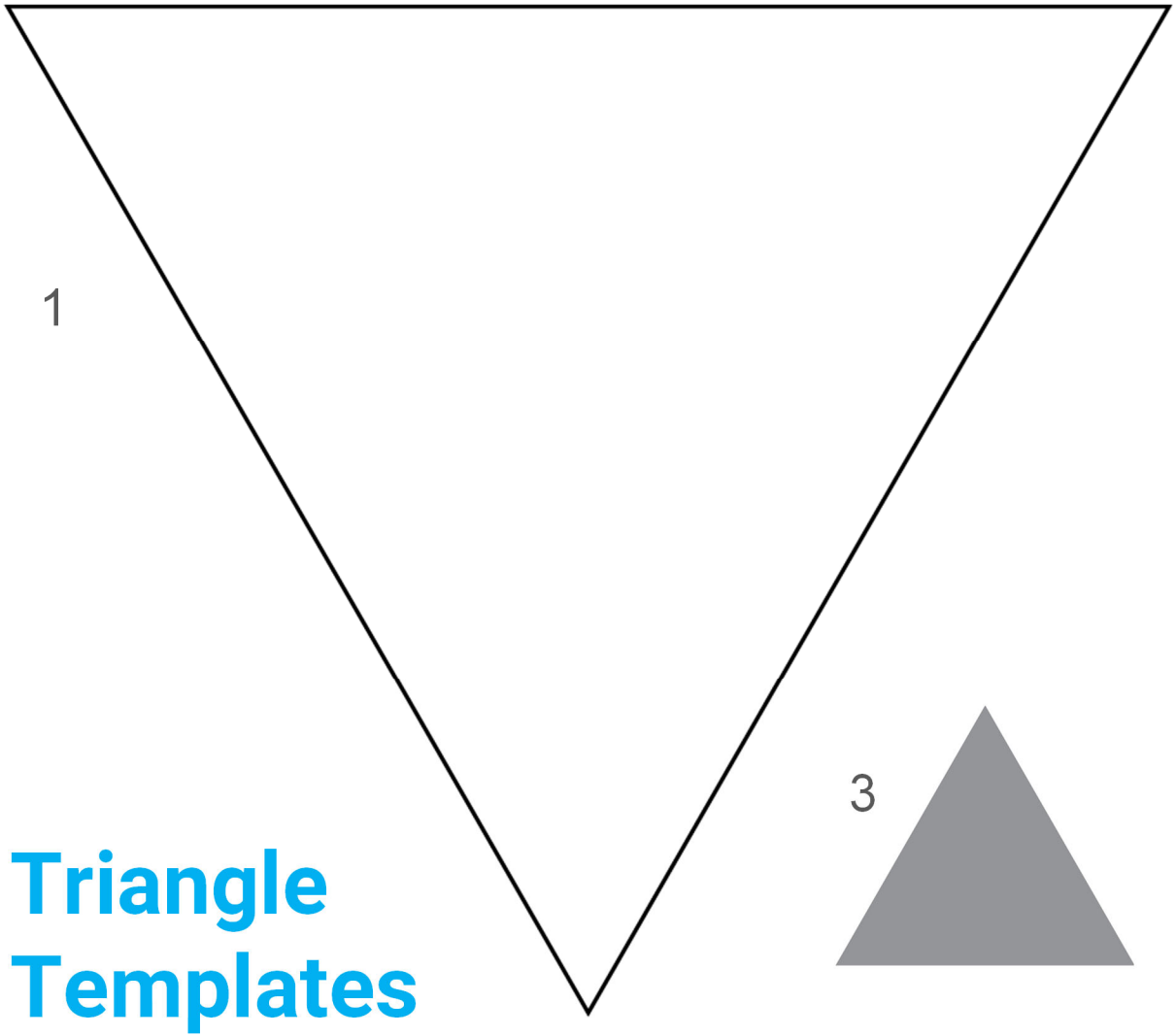


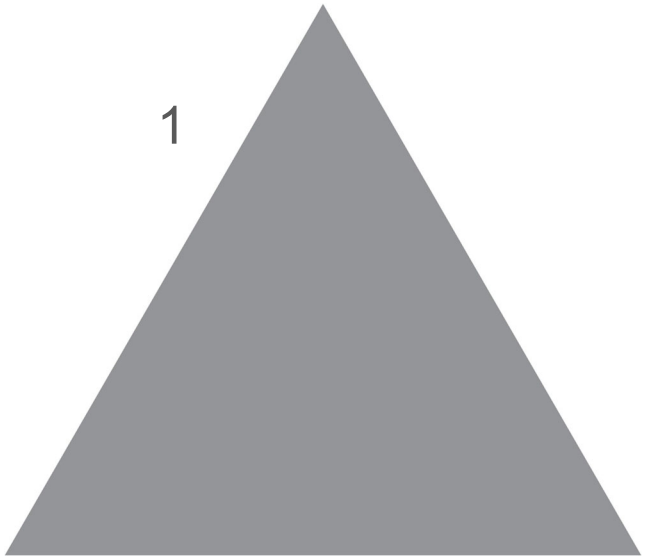
Coral branch covered in feather stars and brittle stars

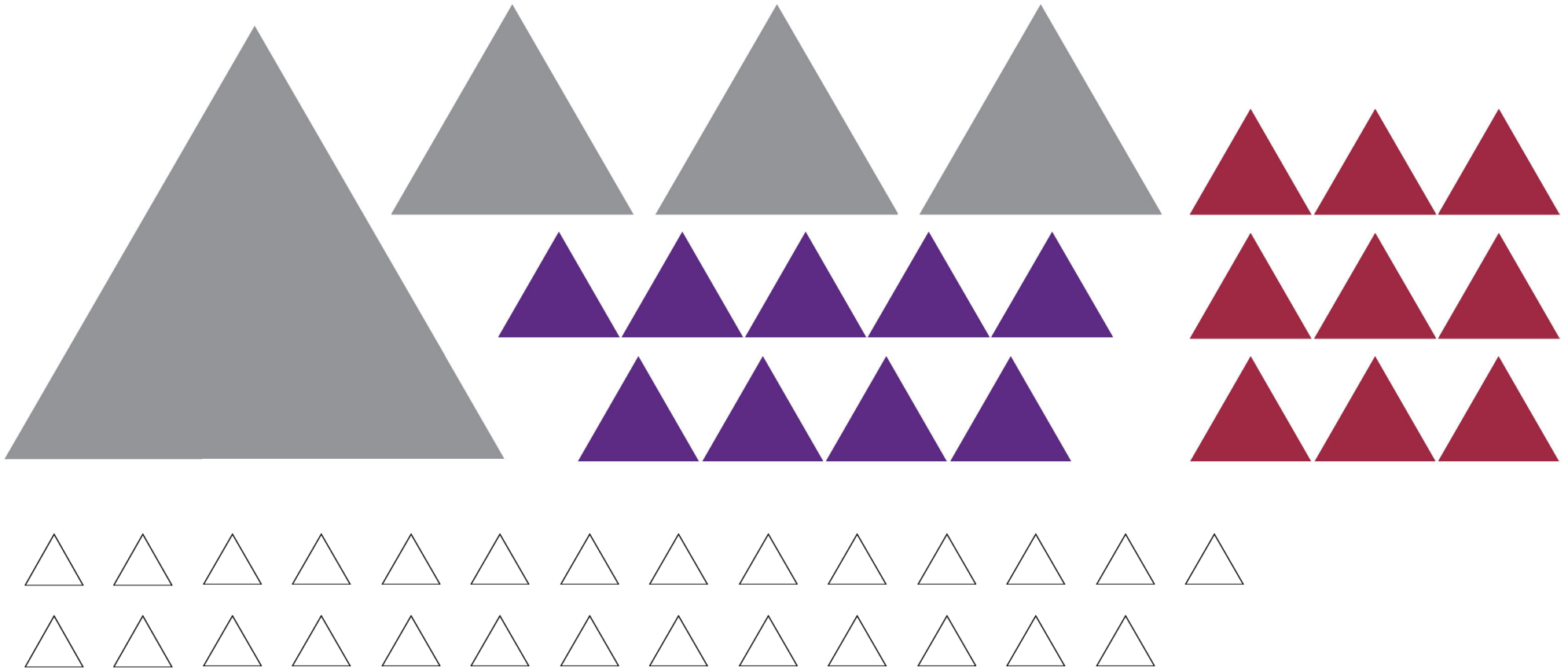
Arms of a feather star…

Image source: https://archive.oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/photolog/photolog.html#

Triangle Templates



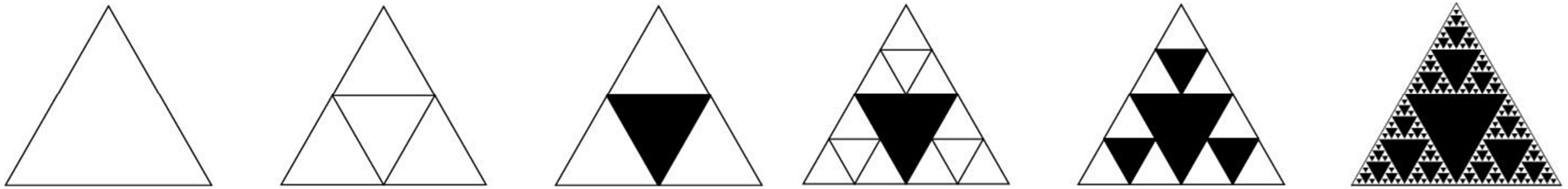




Triangle Templates

Optional Extension

Sierpinski Triangle - the triangle can be infinitely divided into identical triangles that decrease in size. This makes it a useful tool to model the infinite levels of complexity at multiple scales within natural systems.



Least Complex

Largest scale feature in the ecosystem, what

Most Complex

Small scale feature in the ecosystem,