

Looking for Patterns in Species Diversity

Science & Global Issues: Biology – Ecology Unit

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**The
Lawrence**
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Science Education for Public Understanding Program (SEPUP)

- Based at the Lawrence Hall of Science, University of California at Berkeley
- Designing science curriculum, working with teachers, and supporting quality science instruction since 1983
- Specializing in issue-based science
- Published by Lab-Aids (www.lab-aids.com)

Why Issues?

In order for students to develop a sustained attraction to science and for them to appreciate the many ways in which it is pertinent to their daily lives, classroom learning experiences in science need to connect with their own interests and experiences.

Next Generation Framework
National Research Council, 2011

Science and Global Issues: Biology

- Redesigned for the NGSS
- Covers all high school NGSS PEs for Life Science
- Sustainability framework

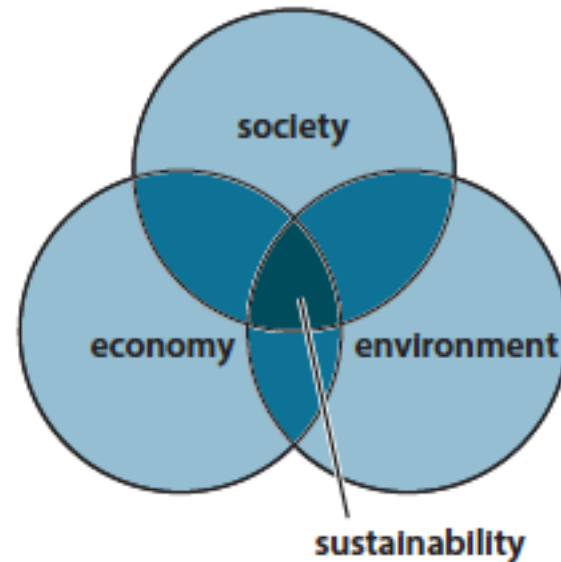
Unit Theme	Content Focus	Sustainability Focus
Changing Human Impact	Sustainability	4-activity Introduction
Living on Earth	Ecology	Human influence on ecosystems
Improving Global Health	Cell Biology	Global health issues
Feeding the World	Genetics	Genetic modification
Managing Change	Evolution	Changes and threats to biodiversity

Why Sustainability?

- More avenues to relevance for students, both local and global.
- Issues clearly relate to science.
- Sustainability decision-making and scientific literacy are closely related—one has the potential to develop and inform the other.

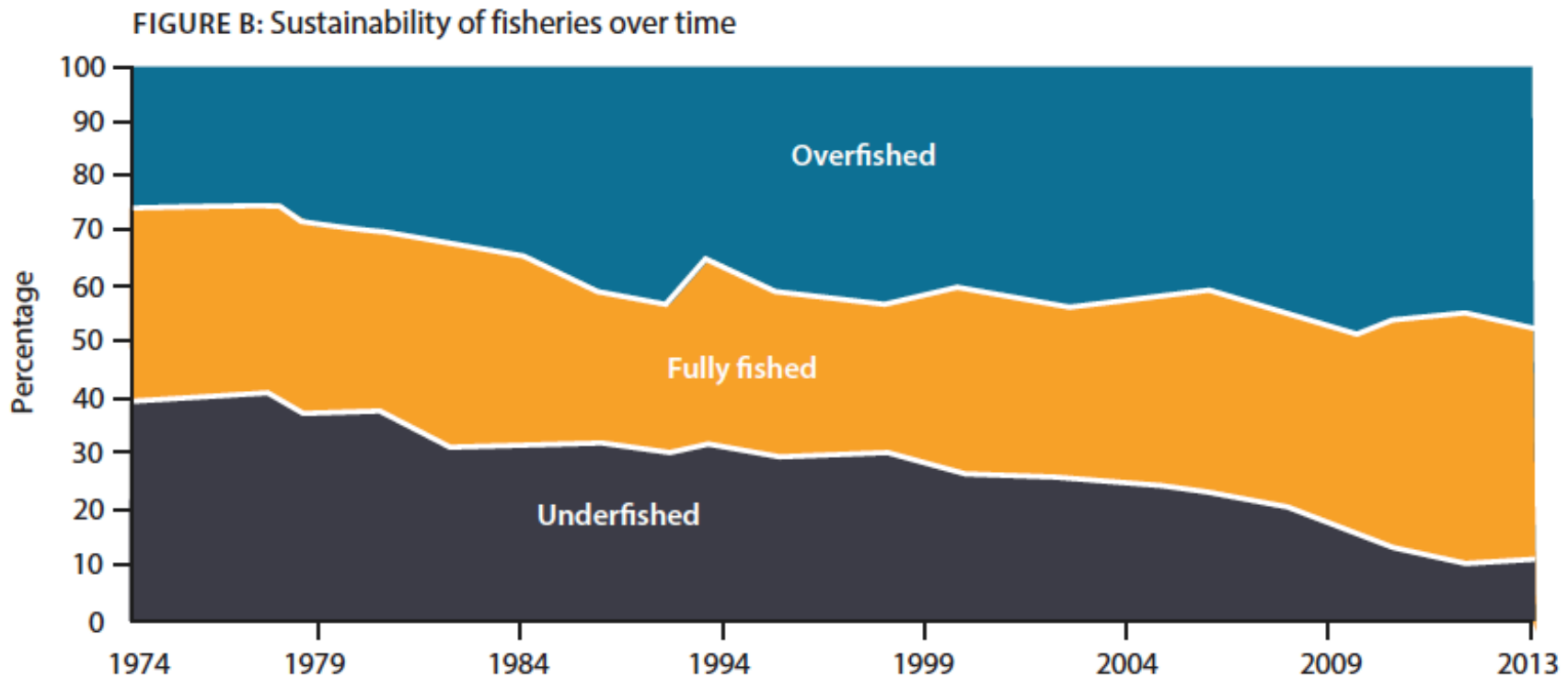
3 Pillars of Sustainability

- Economic Pillar
 - How does the action affect the economy? Does it create or take away jobs? What is the financial cost or benefit?
- Social Pillar
 - How does the action affect social aspects of the community? Does it protect or improve human health? How does it affect food availability, human interactions, etc.?
- Environmental Pillar
 - How does the action affect the environment? Does it protect or endanger critical ecosystems? Does it create or reduce pollution?



Ecology: Living on Earth

- Unit Issue: *People rely on natural resources, including fish, for many reasons including food, yet many fisheries are no longer sustainable.*



Ecology: Living on Earth

Learning Sequence	Activities	Investigative Phenomenon	Performance Expectations Addressed
1	1-3	Different populations of organisms can have a wide range of growth patterns over time.	HS-LS2-1
2	4-5	Coral reefs do not all look the same and can be quite different from one another in several ways.	HS-LS2-2
3	6-10	The population of Southern Resident orcas in the Pacific Northwest has not recovered, despite protection from hunting and capture.	HS-LS2-3, HS-LS2-4
4	11-12	Earth's atmospheric carbon dioxide levels have cycled between 300 ppm and 180 ppm for the past 800,000 years ago, until recently.	HS-LS2-5
5	13-17	Ecosystem health can vary.	HS-LS2-6, HS-LS2-7

PE HS-LS2-2

- PE: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems on different scales.
- SEP:
 - Using mathematics and computational thinking
- DCI:
 - Interdependent relationships in ecosystems
 - Ecosystem dynamics, functioning, and resilience
- CCC:
 - Scale, proportion, and quantity

Activity 4– Scaling Up: Ecosystems

Investigative
Phenomenon:
What similarities
and differences
do you notice?

In the previous learning sequence, you explored individual populations of organisms and factors affecting them. Populations are part of ecosystems that include many kinds of organisms. The song sparrows are part of the Mandarte Island ecosystem, which also includes cowbirds and many other organisms. Coral reefs are another type of ecosystem. Imagine a coral reef in your mind. Which of the photos in Figure 4.1, all of coral reefs, most closely resembles what you imagined? What similarities and differences do you notice among the different reefs? What factors do you think could contribute to these differences? In this learning sequence, you will explore factors that explain some of the differences among ecosystems.

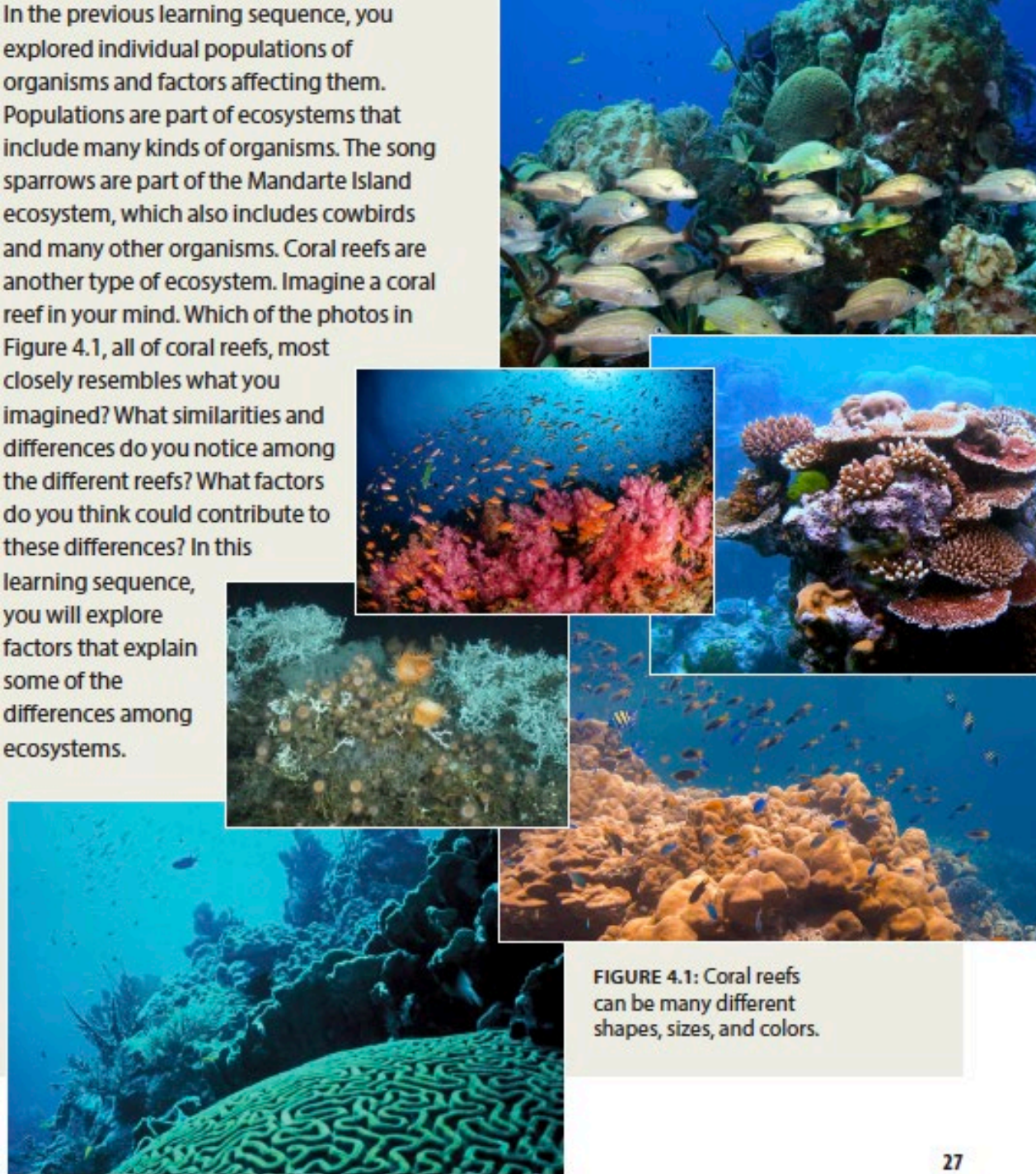


FIGURE 4.1: Coral reefs can be many different shapes, sizes, and colors.

Activity 4–Scaling Up: Ecosystems

- Driving Questions Board
 - *What are the factors that determine the biological diversity of an ecosystem?*
- Introduction & Guiding Question:
 - *What defines an ecosystem?*
- Crosscutting Concept: *Systems and system models*
- Crosscutting Concept: *Scale, proportion and quantity*
- Procedure Step 3
 - Student Sheet 4.1

Activity 4–Scaling Up: Ecosystems

	Ocean Sunlight Zone	Coral Reefs	Intertidal Zone	Humpback Whale Respiratory System
Components	organisms, light, temperature, salinity, depth	organisms, light temperature, depth	organisms, light temperature, air exposure	organisms, oxygen, carbon dioxide
Interactions	abiotic/biotic, predator-prey	abiotic/biotic, predator-prey	abiotic/biotic, predator-prey	abiotic/biotic, predator-prey mutualism
Boundaries	above 200 m	Tropics of Cancer/ Capricorn	near shore, water levels	whale's respiratory system
Scale	most extensive on Earth	about 285,000 km ²	some 100s of meters, some less than 1 meter	size of respiratory system

Activity 4–Scaling Up: Ecosystems

Small group and then class consensus on definition of ecosystem:

An ecosystem is a set of biotic and abiotic components that interact on a regular basis within a particular boundary.

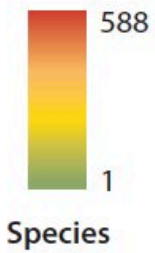
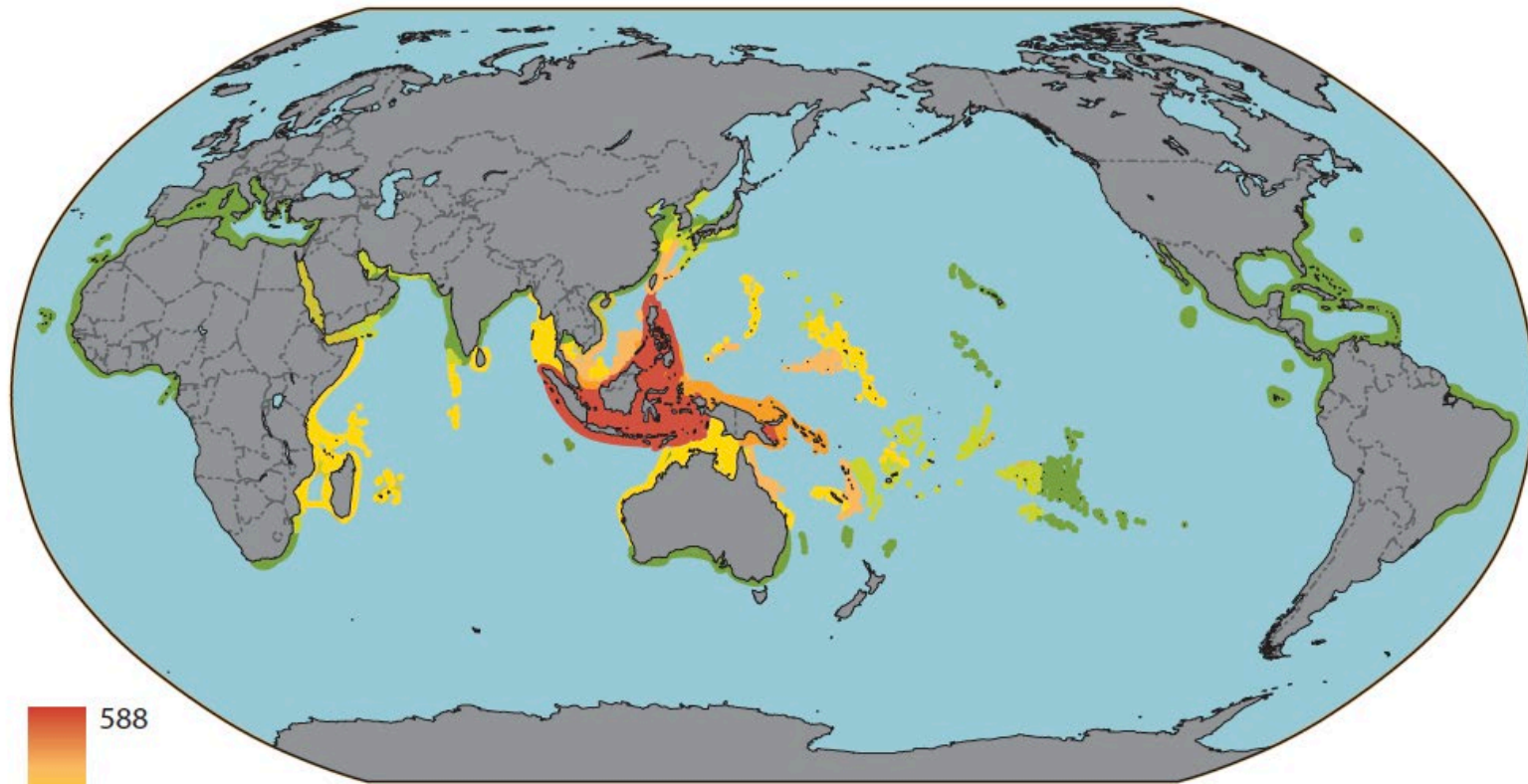
Activity 4–Scaling Up: Ecosystems

- Build Understanding Items:
 - Issue Connection (BU 3)
 - Revisit scale, proportion, and quantity (BU 4)
 - Revisit guiding question (BU 5)
- Extension: Engineering Connection

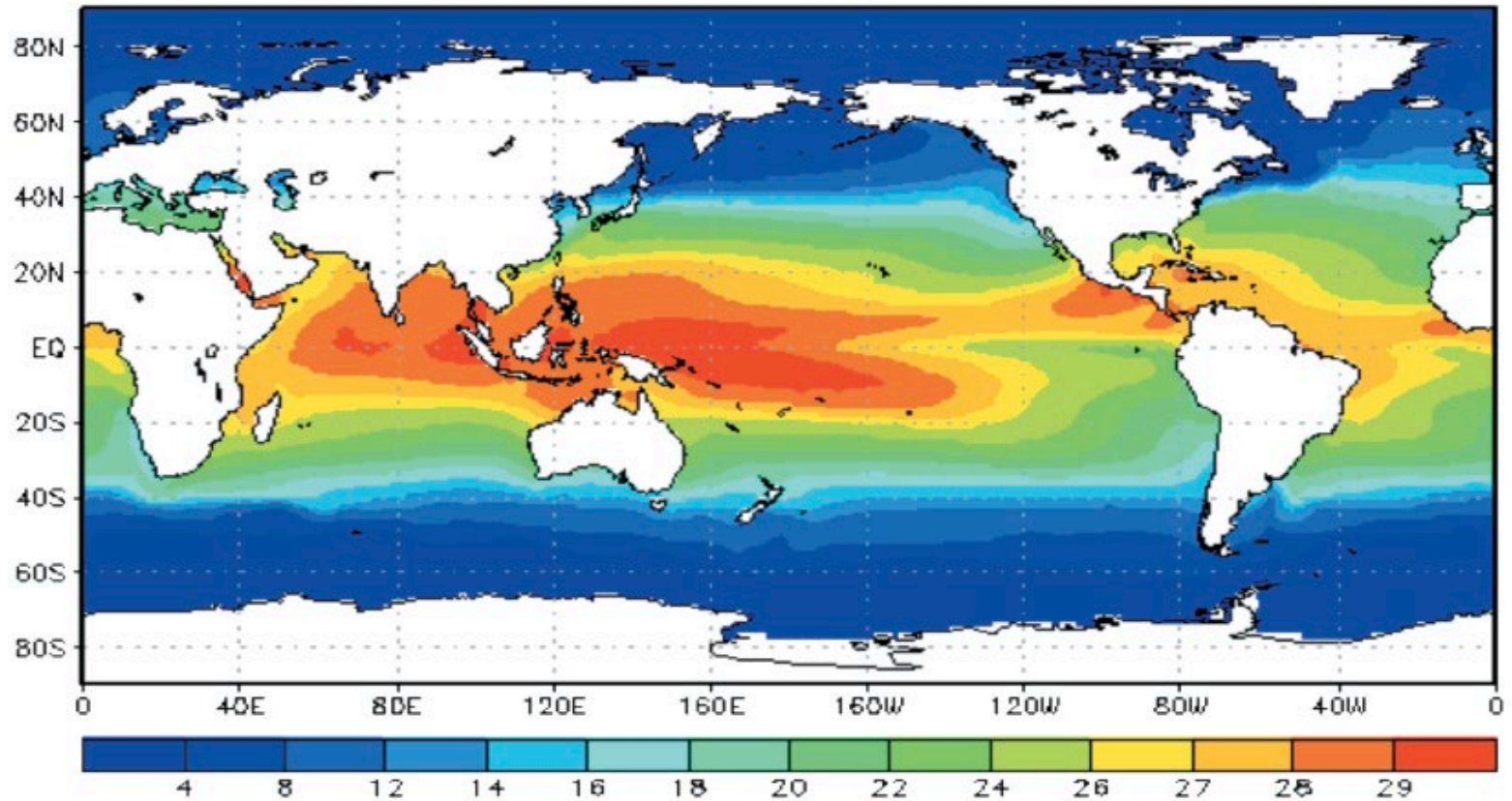
Activity 5–Patterns of Biological Diversity

- Do all places have the same number of species?
- Introduction & Guiding Question:
 - *What patterns of biological diversity occur for different groups of organisms, and what might cause these patterns?*
- Crosscutting Concept: *Patterns*
- Part A: Procedure Steps 1-4
 - Step 1: Explain based on Figure 5.1
 - Steps 2 & 3: Add data, build your explanation
 - Step 4: Revise your explanation

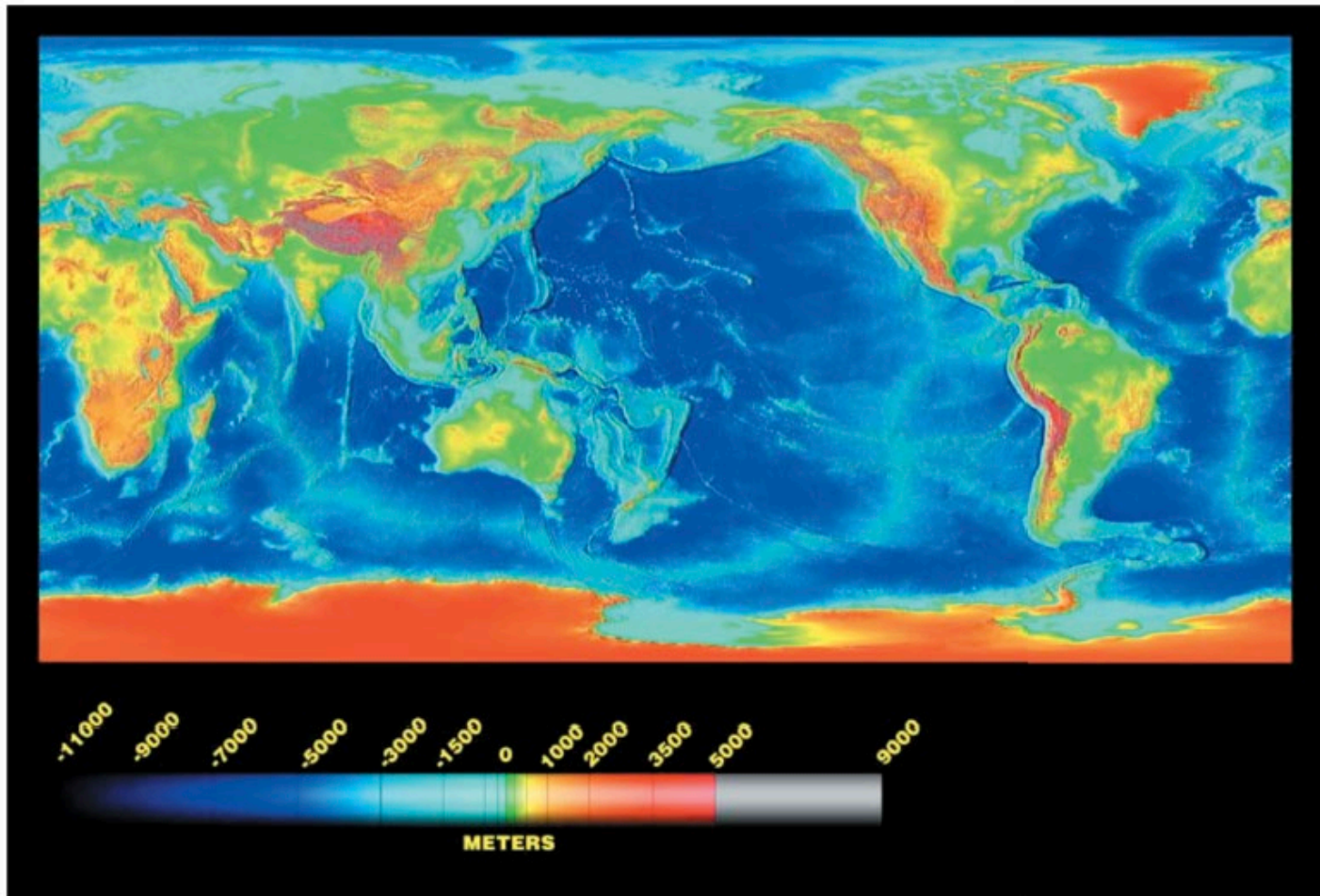
Global Coral Diversity



Ocean Surface Temperature



Ocean Depth



Activity 5–Patterns of Biological Diversity

- Part B: Procedure Steps 5-10
 - Step 5: Vertebrate Diversity Map–reptiles, amphibians, birds, or mammals
 - Step 6: Examine with your group, discuss ideas
 - Step 7: Abiotic Factor Maps, start with Elevation & Topography as a group
 - Step 8: Examine remaining maps individually
 - Step 9: Share observations
 - Step 10: Discuss data and how it might account for patterns

Activity 5–Patterns of Biological Diversity

- Build Understanding Items:
 - PE Assessment (BU 1)
 - Writing Frame
 - Writing Review
 - Revisit Investigative Phenomenon (BU 3)
 - Issue Connection (BU 4)

Teacher's Guide Highlights

- Storyline by learning sequence and by activity
- Sensemaking Progression for each activity
- Connections to Crosscutting Concepts and Science and Engineering Practices
- Diverse Learner supports
- Writing Frames & Writing Review
- NGSS correlations for formative assessments (dots)
- Assessments & Scoring Guides
 - Item-Specific PE Scoring Guides
 - Sample leveled responses

Item-Specific Scoring Guides

Item Specific Scoring Guide – PE-HS-LS2-2 Constructing Explanations (EXP)

Level	Description	Specific Response
<i>Level 4 Complete and correct</i>	<p>The student's explanation</p> <ul style="list-style-type: none">• is supported by sufficient use of appropriate evidence and concepts* <p>AND</p> <ul style="list-style-type: none">• links the evidence and concepts to provide a clear and complete causal mechanism for the phenomenon.	<p>The student's response</p> <ul style="list-style-type: none">• considers all abiotic factors and identifies which factors are most important in explaining the pattern of distribution for their vertebrate group AND which factors do not seem important, using data from the maps• provides a possible causal mechanism for why the factors are important, based on characteristics of the vertebrate group• in Part b, provides an explanation for how their answer changed as they examined additional factors• in Part c, provides a plausible explanation for whether they would see the same pattern at a larger scale
<i>Level 3</i>	<p>The student's explanation</p>	<p>The student's response</p>

Contact Information

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