
A Balanced Biosphere

Unit 1

This slide deck is intended to help guide you and your students through the sequence of this unit. While you may choose to use these slides as a helpful tool to prompt and facilitate students, all detailed information for each unit is in the student and teacher unit booklets.

Unit Essential Question

How have natural processes and human activities created the ecosystems we see today?

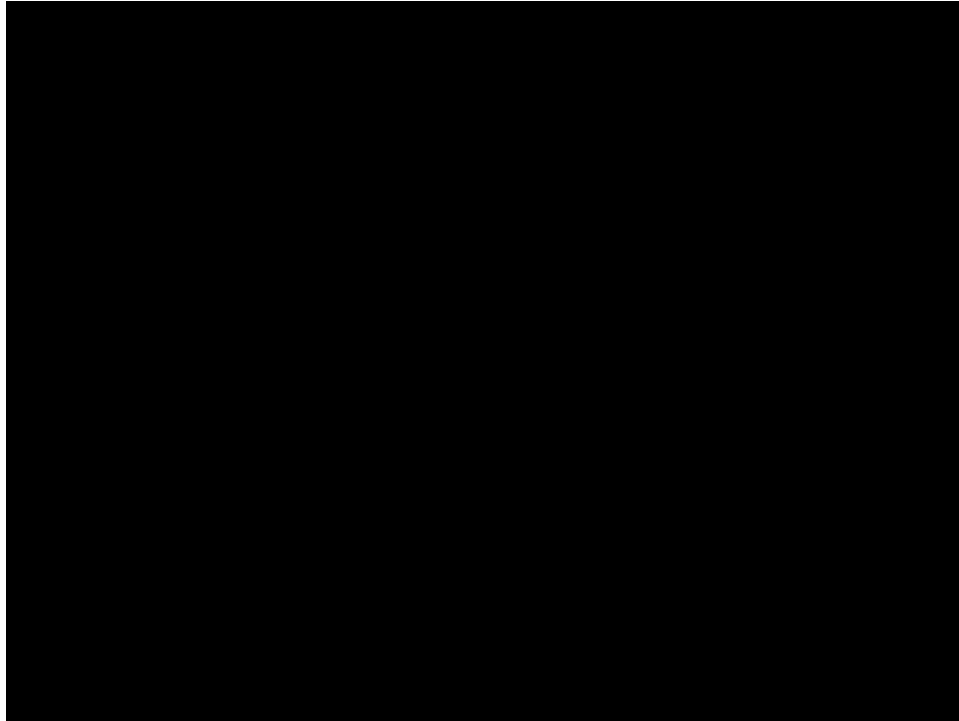
A Well-Functioning Biosphere

Lift-Off Task

Biosphere 2



Biosphere 2



<https://tinyurl.com/ybcnvzby>

Biosphere 2

Explore your schoolyard as one example of an ecosystem. Look up, look down, and look around you.

- What do you see?
- What things do you not see in the schoolyard but you might see in another ecosystem?

Generate Questions!

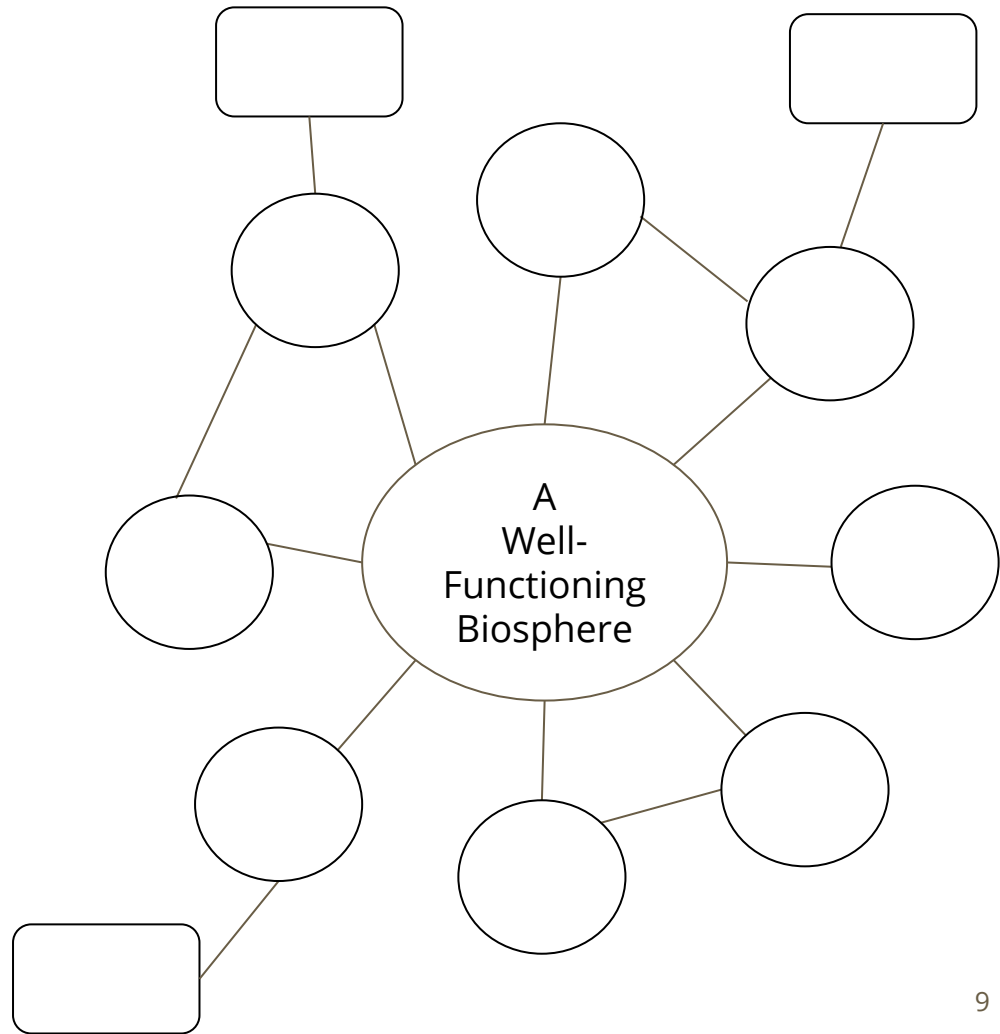
If you wanted to know more about how biospheres function, what questions would you ask?



Group Concept Map

As a group, create a concept map that shows:

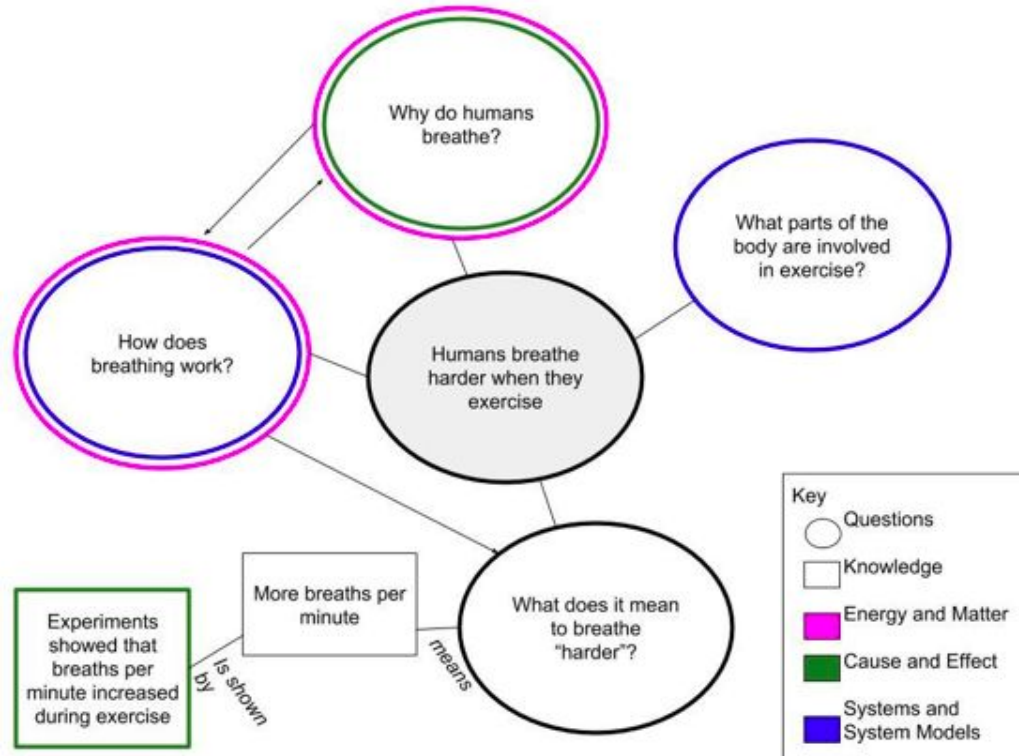
- Questions your group members had in common (circles)
- Possible answers to some questions (squares)
- Connections between related questions (lines)



Class Concept Map

As a class, create a concept map that shows:

- Key questions (circles)
- Possible answers to some questions (squares)
- Connections between related questions (lines)
- Crosscutting concepts used (trace in color)



Introduction to the Culminating Project

Design an arena for the next *Hunger Games* movie!



Group Project - Presentation of arena design (diorama or poster-sized map)

Individual Project - A self-guided tour of arena (brochure or flyer)

Connecting to the Culminating Project

You have been asked to create a Hunger Games arena that mimics an environment you may see on Earth. Your arena will be very similar to a biosphere in that you are designing your own ecosystem. Using your prior knowledge of ecosystems,

- ❑ What parts of an ecosystem should you be thinking about including in your arena? Make a list or draw a diagram of an ecosystem with parts labeled

Complete this **individually** in your Project Organizer.

Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in the Lift-Off Task.

Pangaea Puzzle

Task 1

What questions do you still have?



Engage

How do you think the continents might have once fit together?



Explore

Alfred Wegener (1880 - 1930)



This meteorologist thought that the continents were once closer together and moved over time to where they are today.

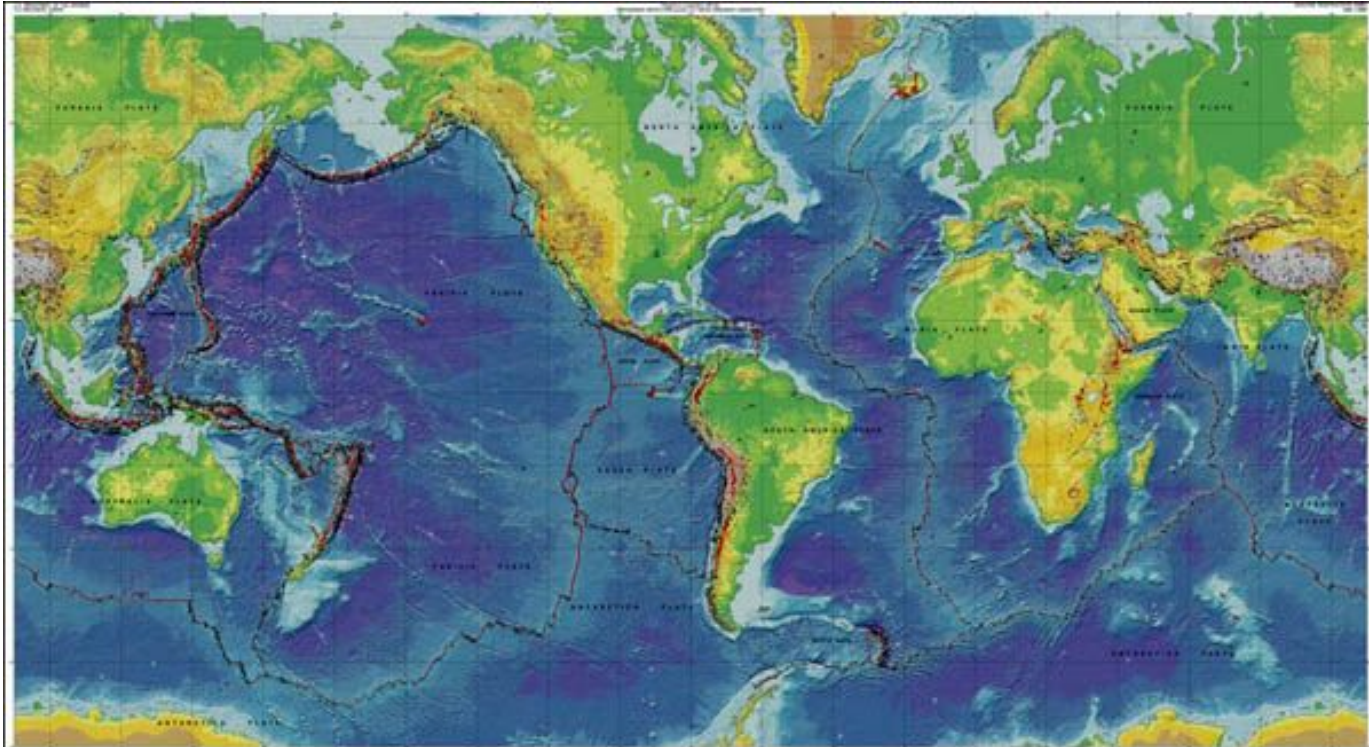
Have the continents really moved over time? How can we be sure?

Analyzing and Interpreting Data

As a group,

1. You will be assigned two continent pieces.
2. Examine the information on the *Evidence Cards*.
3. Draw how you think your two continents may have once fit together.
4. Describe the evidence that supports your decision.
5. Prepare to present the evidence.

Group Presentations: How have the continents moved over time?



Class Discussion: Do you think the continents have moved over time?



Sentence Frames:

- “I think the continents have moved over time because...”
- “The most convincing type of evidence was _____ because...”

Explain

Alfred Wegener's Theory of Continental Drift



<https://www.youtube.com/watch?v=RgJZ0ySEKYg> (stop video at 4:40)

Think-Pair-Share

In pairs, discuss:

- What was Alfred Wegener's idea?
- What inspired him to get to this idea?
- Why didn't anyone accept his idea at the time?

Constructing Explanations

Do you agree or disagree with Wegener's theory? Based on your data analysis, do you think the continents have moved over time?

Use evidence from your *Explore* chart to support your position.

Elaborate

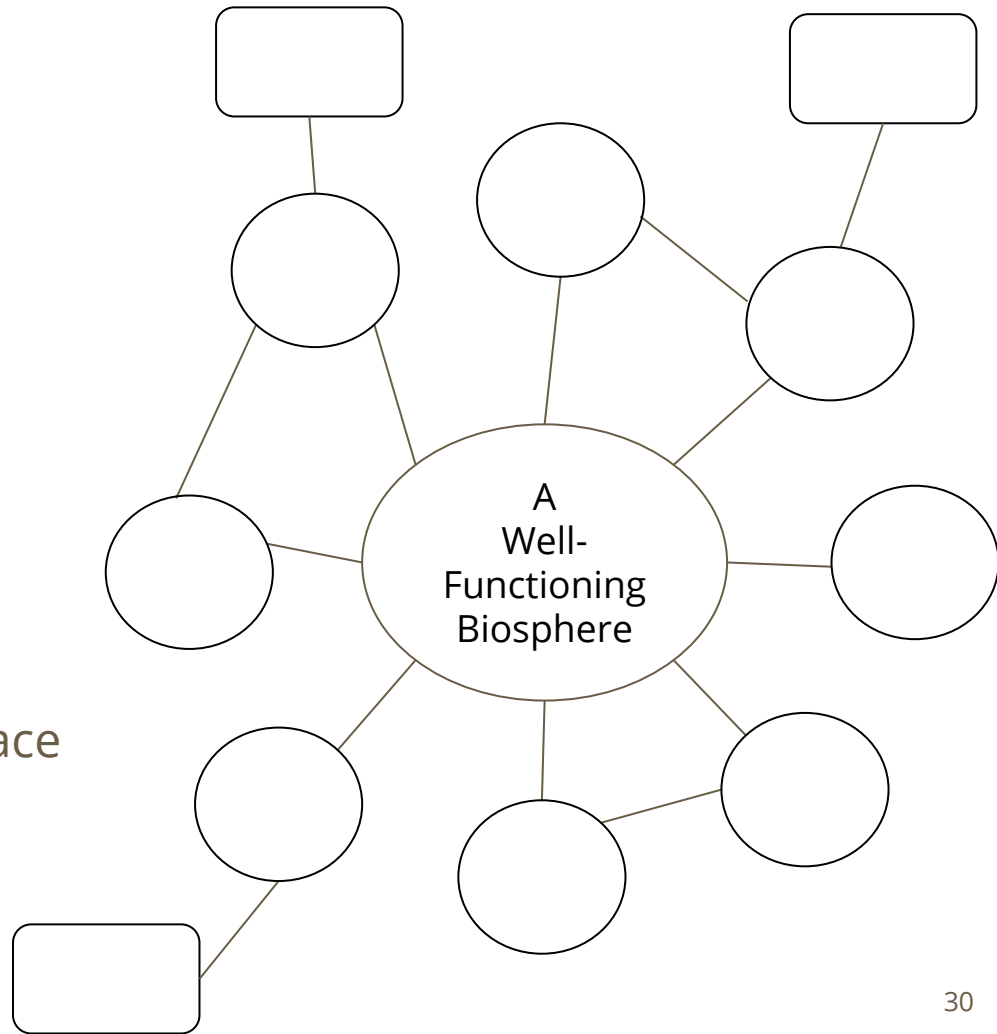
Stronger Clearer

1. **Individual Think Time:** What will you say to your partner without looking at your explanation?
2. **Partner Discussions:**
 - a. **Student A:** Describe your explanation.
 - b. **Student B:** Listen and ask clarifying questions.
 - c. **Student A and Student B:** Write down any notes to make your explanation stronger and clearer.
3. **Repeat with 2 more partners!**
4. **Revise your explanation.**

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
 - Patterns
 - Systems and System Models



Evaluate

Connecting to the Culminating Project

You have been asked to create an arena that mimics an environment you may see on Earth. Over the course of this task, you gathered evidence of how past plate motions have led to some geologic features you see on Earth. As a group, decide on a location for your arena that would have the geologic features you want. Then individually,

- Draw a map showing your arena location on Earth as well as any relevant surrounding continents, making captions that answer the questions below:
 - On what continent would your arena be located? Why are you locating it there?
 - What features would you find (mountain ranges, types of rock, glaciers, etc)?
 - How can you use plate motions to explain these features?

Complete this **individually** in your Project Organizer.

Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 1.

Using Available Resources

Task 2

What questions do you still have?



Engage

What do these news headlines tell us about natural resources?

Mining in Tibet: The Price of Gold, *The Economist*

Saudi Arabia's Oil Policy: Beyond OPEC, *The Economist*

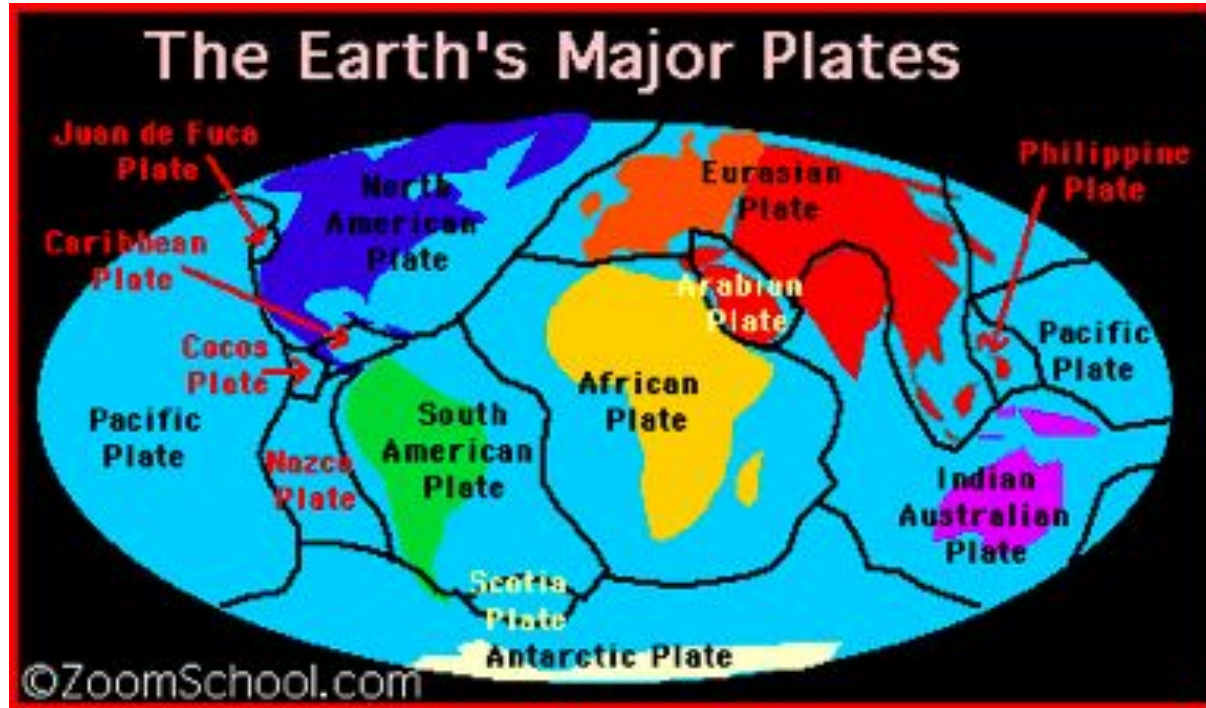
Gold! Gold! Gold! Gold! Sixty-Eight Rich Men on The Steamer Portland, *The Seattle Post-Intelligencer*

US National Arrested On Sierra Leone 'Blood Diamond' Charges, *The Guardian*

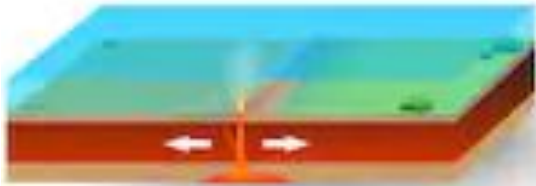
Drying Up: The Race to Save California From Drought, *Newsweek*

Explore

Tectonic Plates



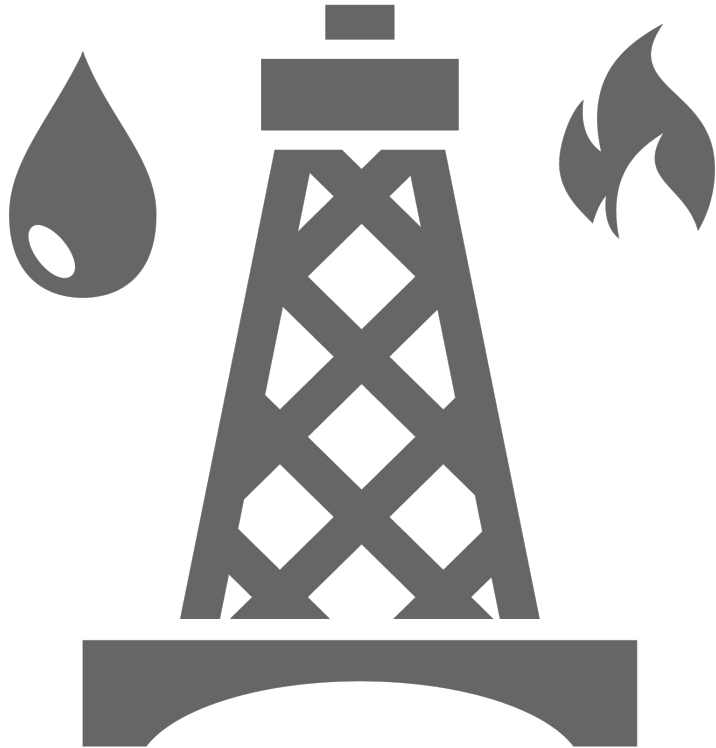
Developing and Using Models - Plate Tectonics



With your group,

1. Use the materials provided to model the different ways plates can interact.
2. Draw diagrams of each interaction.
3. Explain what geologic features you think are created.

Cause and Effect - How is Oil and Natural Gas Made?



1. Read the article about oil and gas formation.
2. Draw a flowchart to explain the process.
3. Answer the questions to help you figure out how plate interactions and natural resources are connected.

Explain

Constructing Explanations

Are all resources distributed evenly throughout the world? Why or Why not?

Use evidence from the *Engage* and *Explore* as well as cause-and-effect reasoning to justify your response.

Elaborate

Is coal evenly distributed around the world?

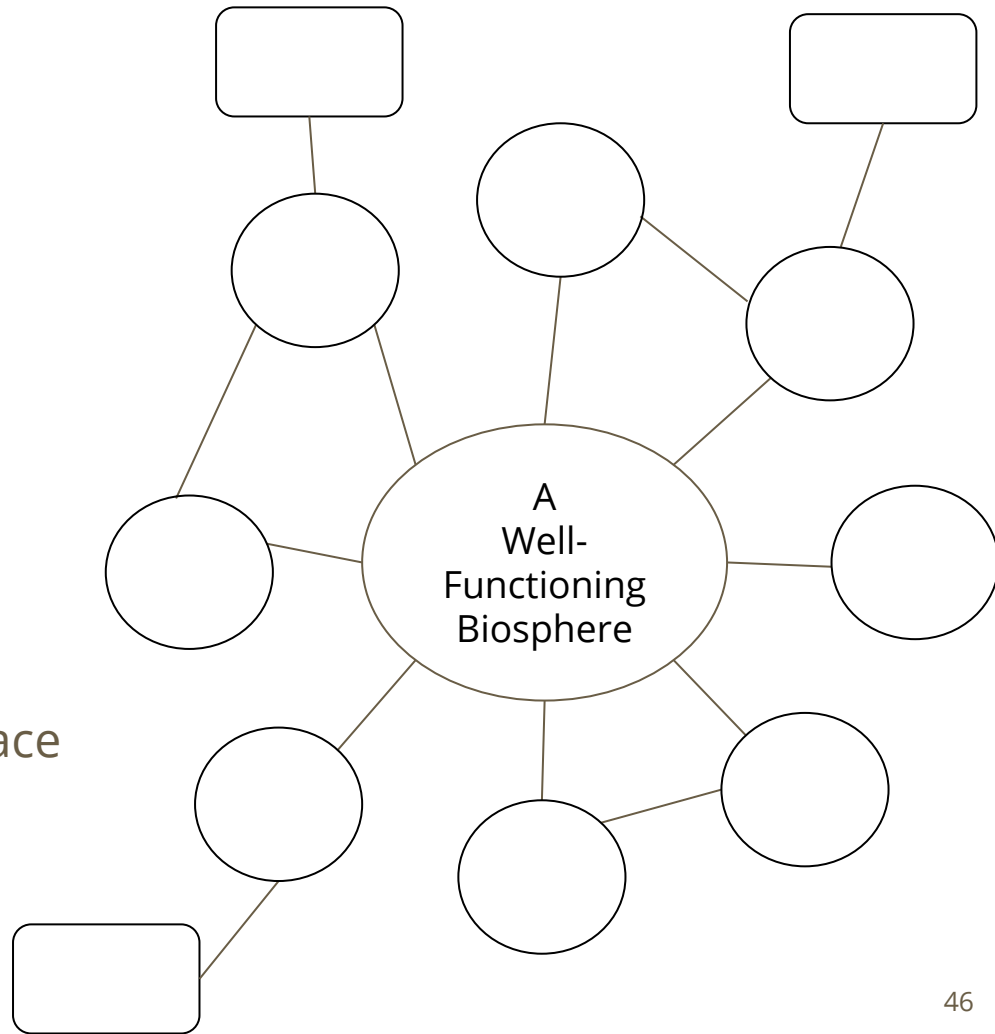


Coal was created 300 to 400 million years ago during the Carboniferous period, which had a generally warm and humid climate. Plants in tropical swamp forests died and became buried and compressed in sediments to form coal. Mining techniques can remove the coal from earth to be used by humans.

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
 - Cause and Effect



Evaluate

Connecting to the Culminating Project

You have been asked to create an arena that mimics an environment you may see on Earth. Every arena needs certain resources to function. Now that you have discovered how resources have been distributed on our own Earth, decide which resources your arena will have.

- What natural resources will your arena have the most and least of?
- What geoscience processes will have caused these resources to be available in your arena?
- What evidence is there for why these resources are unevenly distributed?

Complete this **individually** in your Project Organizer.

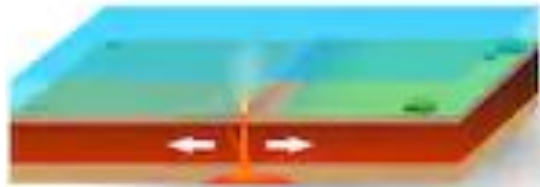
Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 2.

Produce, Reuse, Recycle

Task 3

What questions do you still have?



Engage

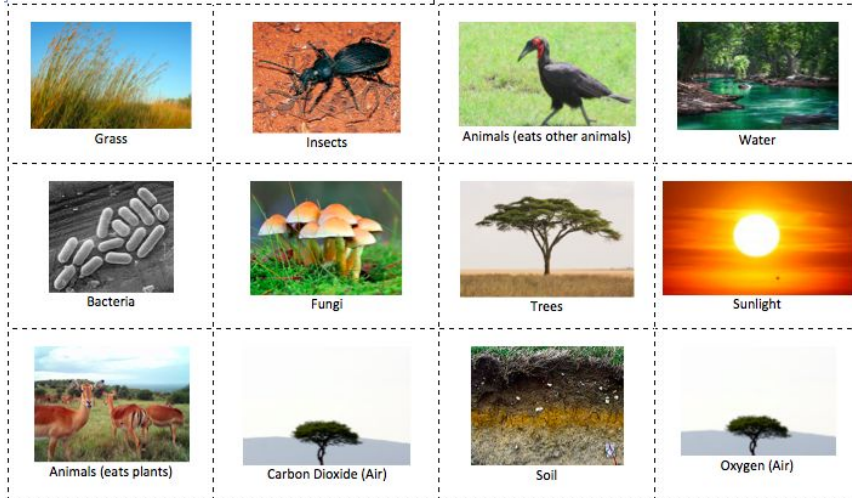
Make a hypothesis: Why did so many plants and animals die?

In 1815, on the Indonesian Island of Sumbawa, the volcano Mount Tambora erupted, immediately killing thousands and causing much of the world to enter a global chill. The year that followed is known as “The Year Without Summer” because the volcano scattered tons of ash and debris into the air, blocking some of the sunlight that usually warms the Earth’s surface. In that year, thousands of plants and animals died, leaving thousands more humans to die without food.



Explore

Developing Models - Ecosystem Interactions



With your group,

1. Cut apart and analyze the ecosystem cards.
2. Arrange the cards on a poster.
3. Draw arrows and labels **in pencil** to describe how the parts interact.

Explain

Revise Your Model - Ecosystem Interactions

A Well-Functioning Ecosystem: How Do Living Things Help Cycle Matter and Energy in an Ecosystem? *Explain*

Every living organism needs certain things to survive, grow, and do their daily activities.

The most important part in an ecosystem is sunlight. Plants capture energy from the sun to grow and make their own energy. This is why we call plants producers—they *produce* the energy for the entire ecosystem. However, plants don't only need sunlight to survive and grow. They also need nutrients and water from the soil and carbon dioxide from the air. In this process that plants use to create their own energy from the sun, they also release oxygen back into the air.



Unlike plants, animals do not create their own energy. They eat plants and other animals to get their energy. This is why we call them consumers—they *consume* other organisms for energy. Animals that eat only plants are called herbivores. Animals that eat other animals are called carnivores. Other animals, like many humans, that eat both plants and animals are called omnivores. Like plants, animals need extra things in order to survive and grow. They also need water and oxygen from the air in order to convert what they eat into energy they can use. As a result of this process, they also release carbon dioxide back into the air.

There is also a third category of organisms that are very important to the functioning of an ecosystem, but they are rarely talked about. Decomposers are organisms that recycle nutrients from dead plants and animals and return them to the soil to be used again by new plants.



As you can see, plants and animals in an ecosystem all rely on each other to live! Scientists sometimes describe these interactions using a food web. Food webs are models that show how matter and energy are transferred between different living things in an ecosystem. In a food web, arrows are drawn in the direction that matter or energy is flowing; in other words, towards the organism that is doing the consuming. In today's task, you will be making a model that is similar to a food web, but also includes non-living matter, rather than just living organisms.

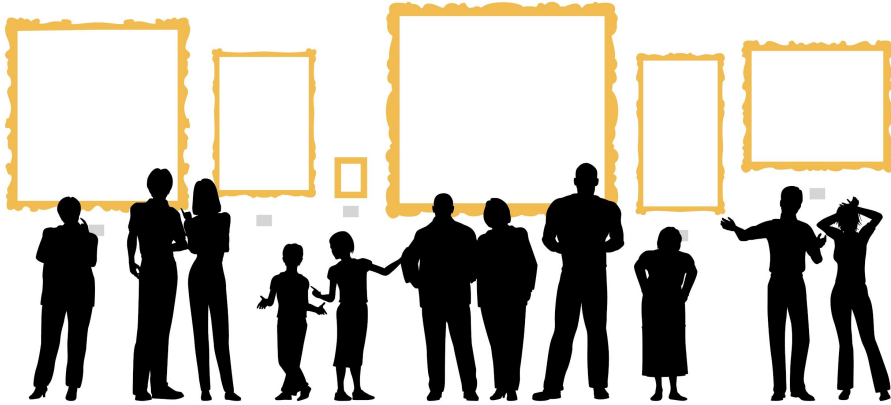
Individually,

1. Read and annotate the article about ecosystems.

With your group,

2. Revise your model using the list of criteria in your student guide.

Gallery Walk



1. Display your poster model on a wall.
2. Walk around to view other groups' models.
3. On another group's poster, leave comments:
 - a. 1 Positive comment
 - b. 1 "I Wonder..." comment

Elaborate

Return to the case of the Mt. Tambora Eruption

Why did so many plants and animals die?

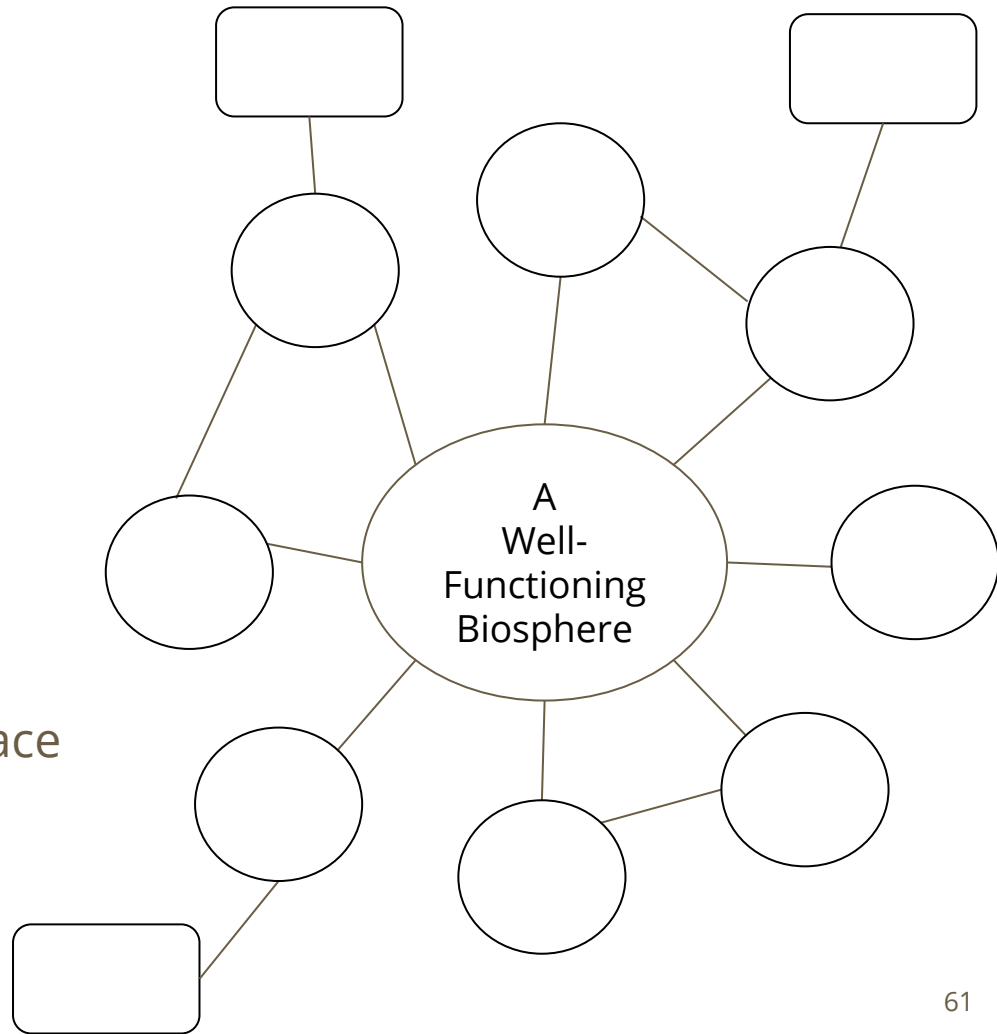
Individually explain what happened using what you have learned about the cycling of matter and energy amongst parts of an ecosystem.



Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
 - Systems and System Models
 - Energy and Matter



Evaluate

Connecting to the Culminating Project

You will be creating an arena that mimics an environment you may see on Earth. Your arena already has its main geological features, but as we learned today, there are also other non-living factors and living factors that make up an environment. Design the landscape of your arena, focusing on the non-living things that will be needed to support life.

- Draw a visual diagram showing how non-living matter will cycle through your environment (You do not need to pick specific plants and animals for your arena yet; you can just draw example plants and animals for this diagram).
 - Be sure to label the examples of living and non-living matter and use arrows to show where they go.

Complete this **individually** in your Project Organizer.

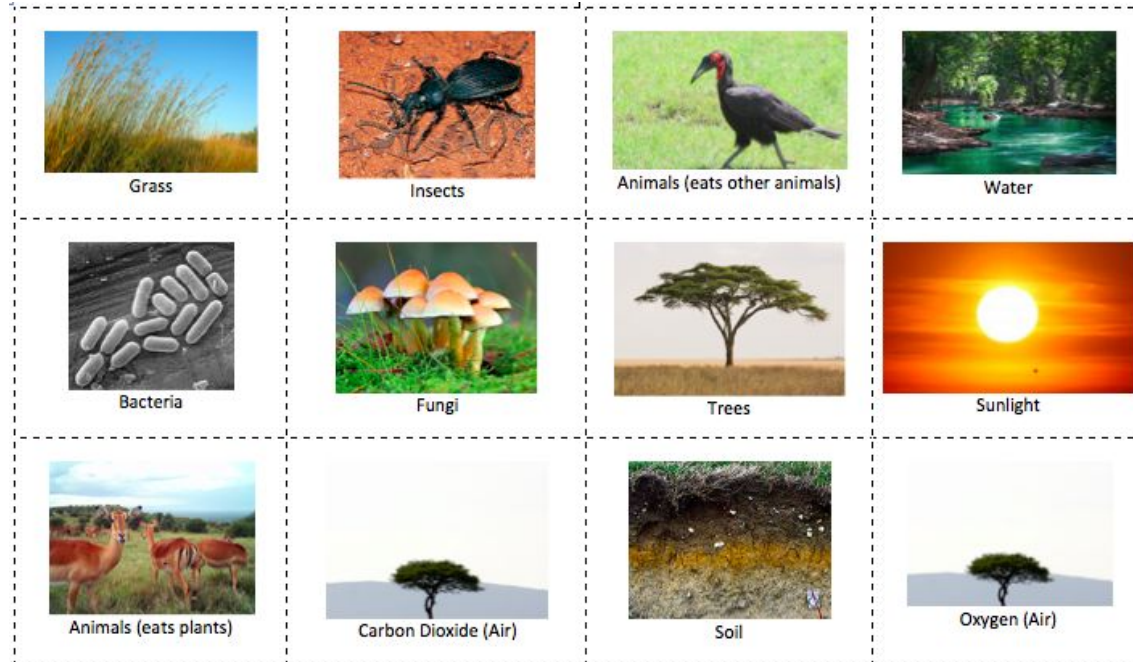
Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 3.

Interactions Between Organisms

Task 4

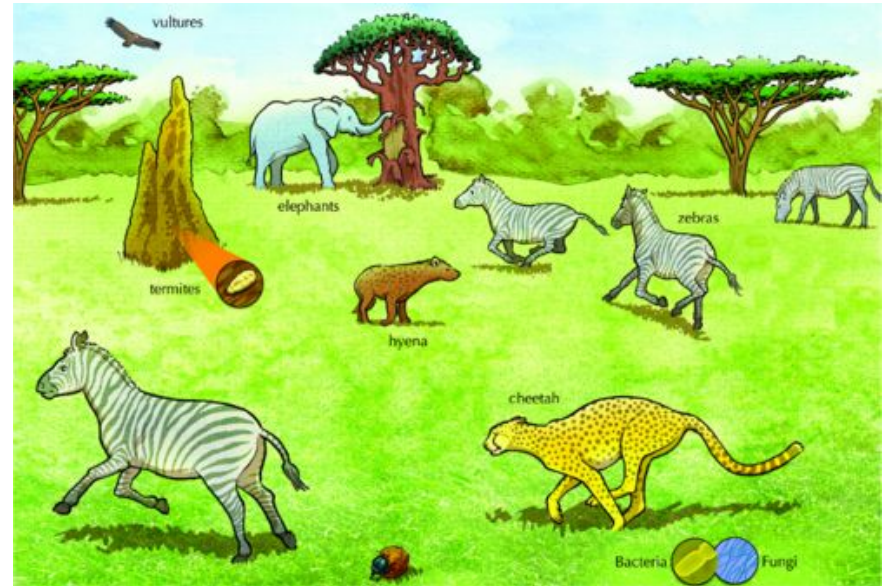
What questions do you still have?



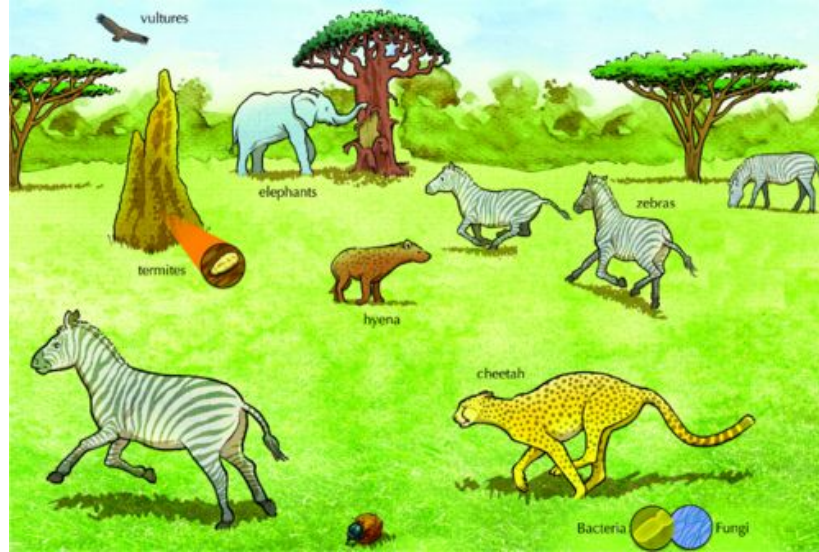
Engage

How do organisms interact in an ecosystem?

1. Imagine any kind of ecosystem in your mind. What types of plants and animals would you find there?
2. Brainstorm at least three ways specific organisms would interact.
3. Draw a picture showing the environment you imagined.
4. Write captions or a paragraph to describe each of the three interactions.



Think-Pair-Share



Share your picture with a partner who drew a different type of ecosystem. Even though your ecosystems are different, did you draw any similar interactions between organisms?

Explore

Look for Patterns

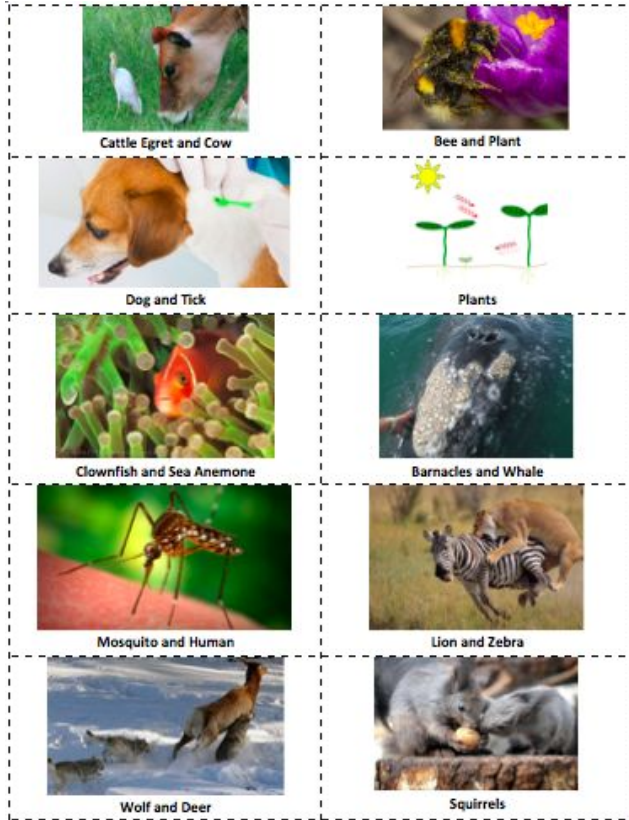


Individually,

1. Visit each station and analyze the image.
2. At each station, record the following in the data collection chart:
 - a. The characteristics of the ecosystem
 - b. What organisms you see interacting
 - c. A description of how they interact

Explain

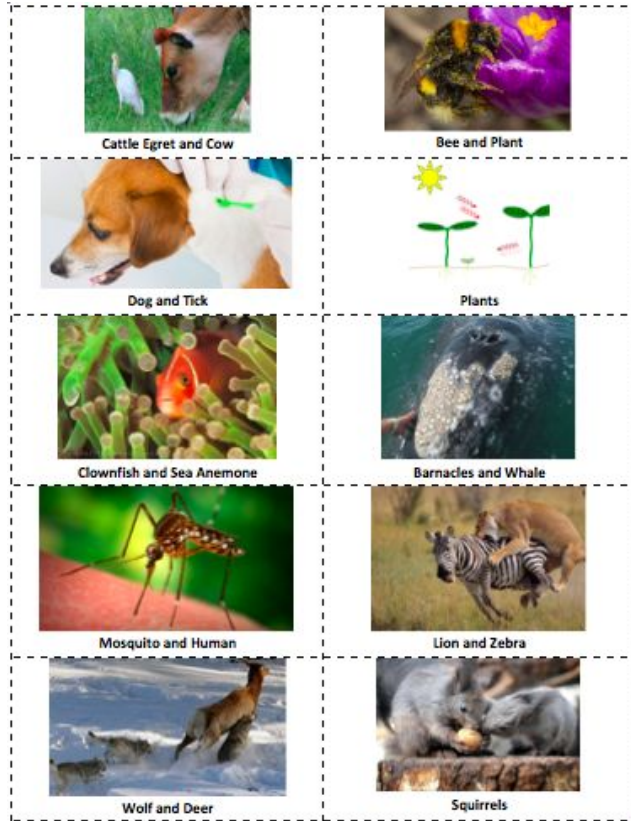
Construct Explanations - Organism Interactions



With your group,

1. Cluster the Interaction Cards to group interactions that seem alike.
2. Record and describe each grouping in your student guide.

Identifying Patterns in Organism Interactions



1. Tape your group's assigned Interaction Cards on the board, adding to previous groupings or starting new ones.
2. Analyze the groupings your class has made:
 - a. Do you disagree with any of the groupings? Why?
 - b. Do any changes need to be made?

What were your group's labels?

Interaction Description	Your Label
Two organisms fight over a resource, such as food, water, or territory.	
One organism lives on or inside another organism and harms it in the process.	
Both species benefit from the relationship.	
A predator feeds on its prey.	
One member of the relationship benefits and the other is neither helped nor harmed.	

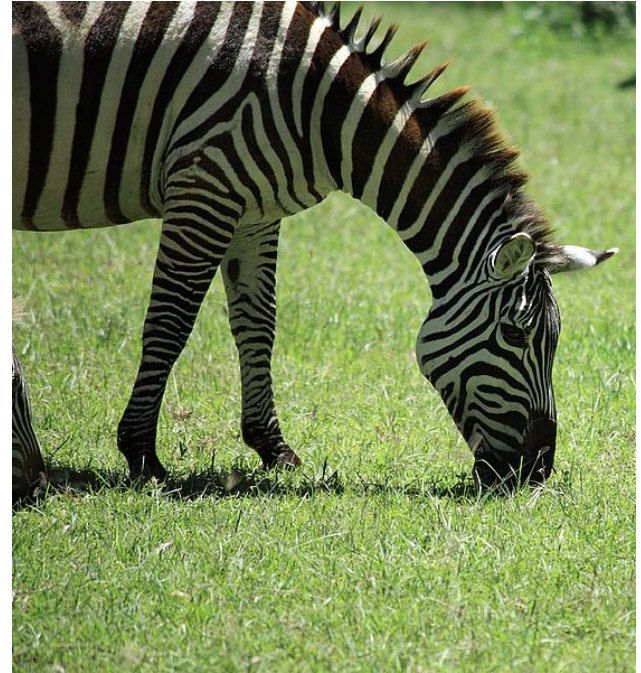
Scientists have done the same thing!

Interaction Description	Your Label	Scientific Name
Two organisms fight over a resource, such as food, water, or territory.		Competition
One organism lives on or inside another organism and harms it in the process.		Parasitism
Both species benefit from the relationship.		Mutualism
A predator feeds on its prey.		Predation
One member of the relationship benefits and the other is neither helped nor harmed.		Commensalism

Elaborate

How can we apply these patterns to new scenarios?

1. The zebra population is exploding in the savannah. At the same time, populations of many small animals that live in the Red Grass that zebras eat are beginning to die out. Why do you think populations of these small animals are dying out? What could we do to help prevent these small animals from going extinct?



How can we apply these patterns to new scenarios?

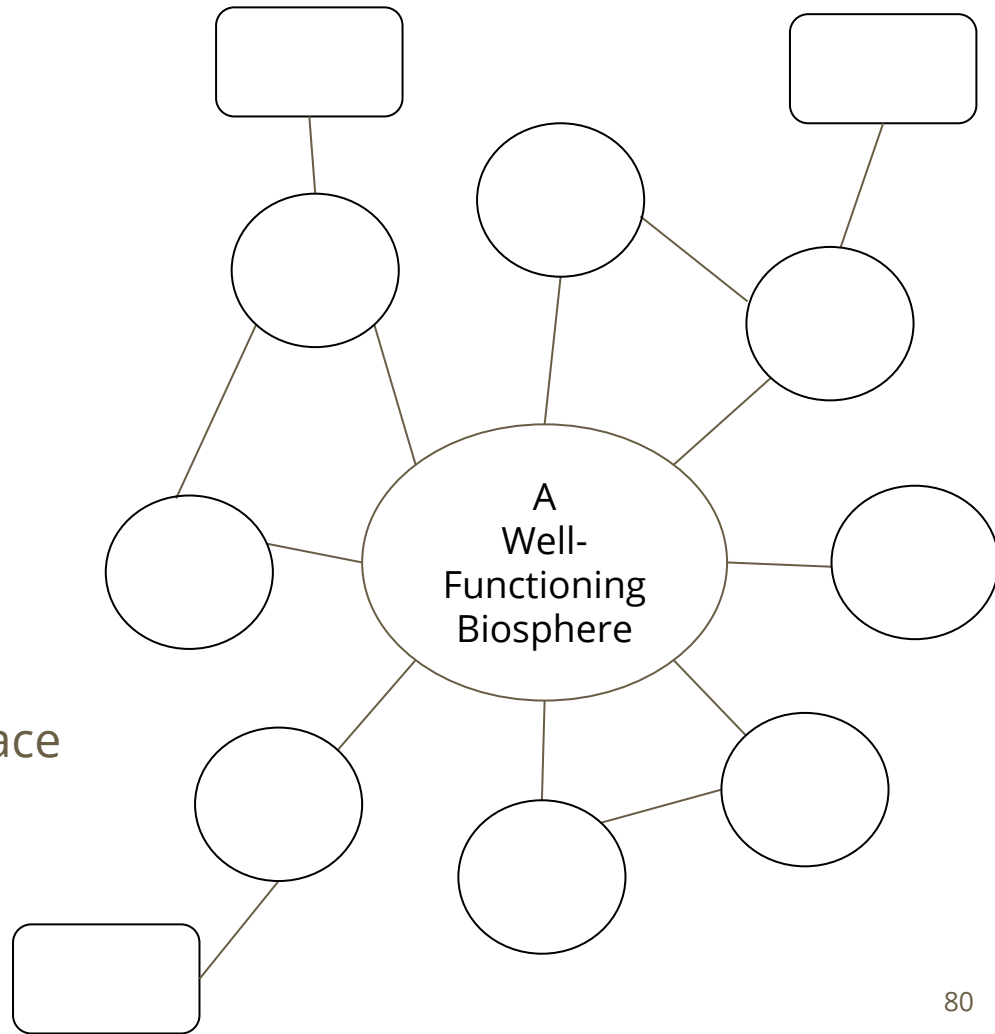
2. Since *Finding Nemo* came out in theaters, there has been an increased demand for pet clownfish. Now marine biologists are noticing that the sea anemone population is also decreasing. What can we do to help build up the sea anemone population? Explain why your solution would help.



Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
 - Patterns



Evaluate

Connecting to the Culminating Project

You will be creating an arena that mimics an environment you may see on Earth, including any relevant organisms. In your arena, you will be creating a challenge for your contestants, so the winner may win additional supplies. The challenge will be to locate a specific plant/animal by using information about another plant/animal. The contestants will use their knowledge of ecosystem interactions to connect the known plant/animal to the unknown plant/animal.

- Identify what plants and animals you will include in your arena.
- Design this challenge by making a flowchart tracing one organism to another using at least two different organism interactions we have studied.
- Explain how each plant/animal leads the contestant to the next plant/animal by describing the organism interactions.

Complete this **individually** in your Project Organizer.

Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 4.

A Chain of Resources

Task 5

What questions do you still have?



Engage

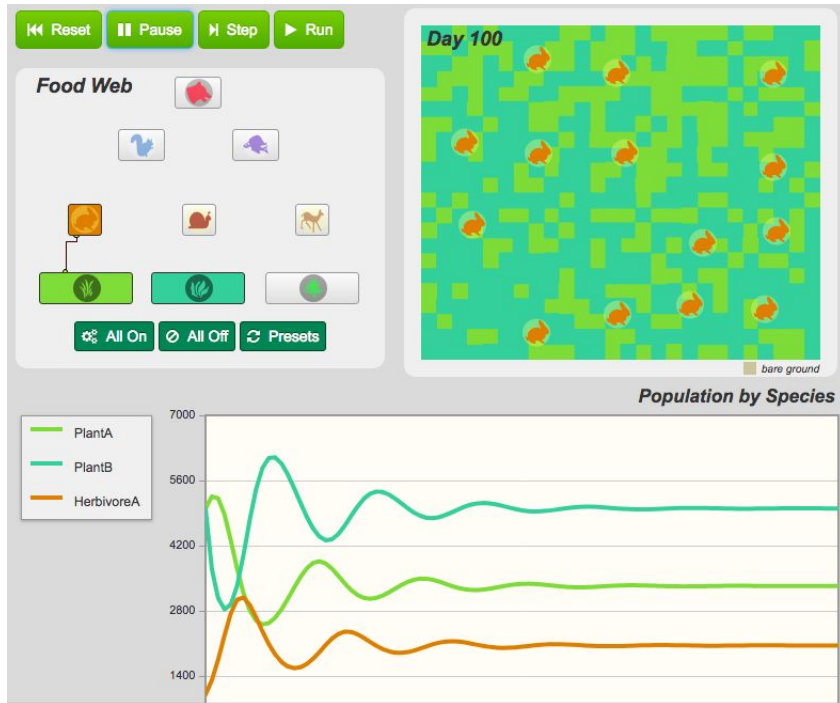
What would happen if we took away 95% of the rainwater from the rainforest?



<https://www.youtube.com/watch?v=LHPuo0rwM1w>

Explore

Systems and System Models: Exploring Ecosystems



In pairs or as a group,

1. Explore the *Interactive Labs Ecology Lab* computer simulation.
2. Follow the directions in your student guides.
3. Record observations.
4. Analyze and interpret the data using discussion questions in your student guide.

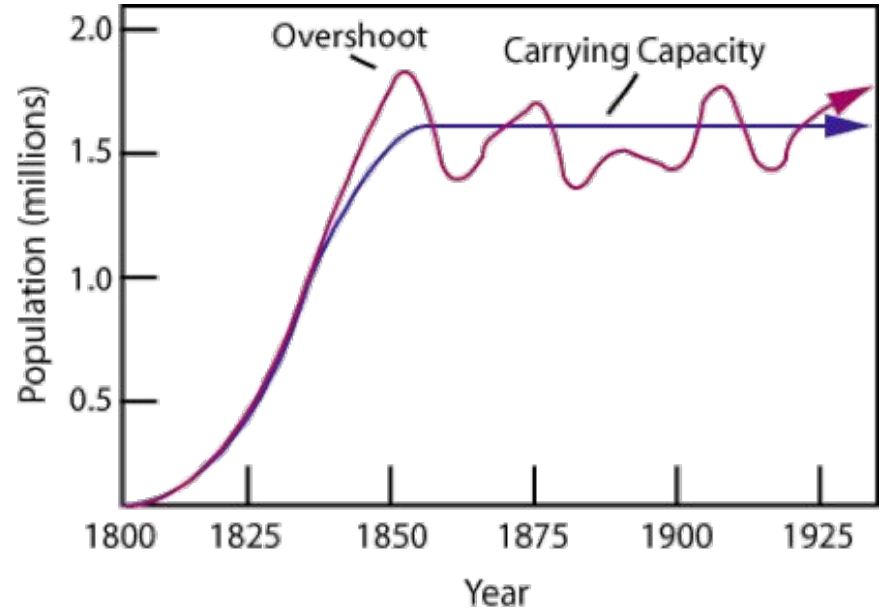
Explain

Constructing Explanations

Come up with a general rule to the following question:

How do available resources affect the populations of different organisms in an ecosystem?

Use at least one example from the simulation as evidence to justify your rule.



Elaborate

Can we use our rule to predict what will happen to the Amazon rainforest?



<https://www.youtube.com/watch?v=hIIU9NEcjyg>

Think-Pair-Share

1. What resource is being depleted (taken away) here?
2. Why do you think this resource is necessary for organisms in this ecosystem?

Can we use our rule to predict what will happen to the Amazon rainforest?



https://www.youtube.com/watch?v=M4jhjt1_eyM

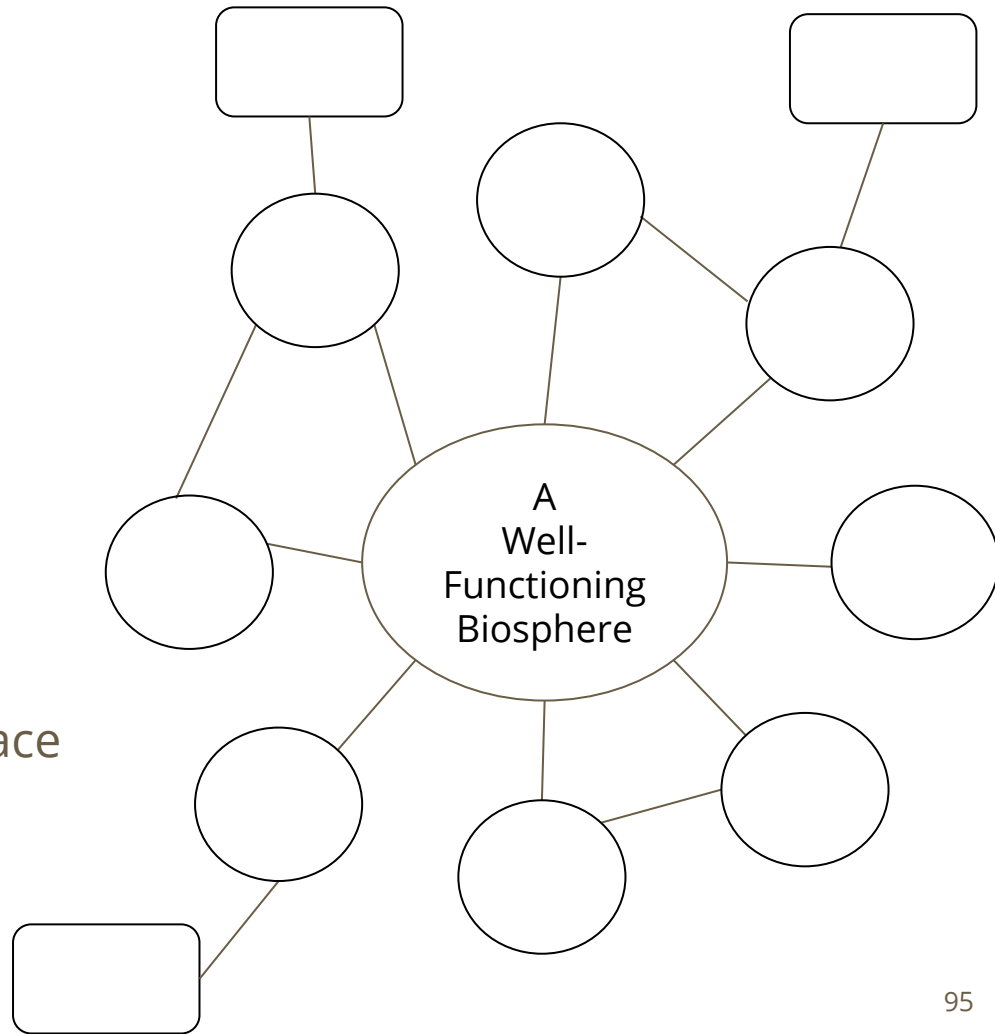
Think-Pair-Share

1. Why are humans cutting down trees?
2. What effects does deforestation have on the population of plants and animals in that area?
3. What can we do to stop this from happening?

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
 - Cause and Effect
 - Systems and System Models



Evaluate

Connecting to the Culminating Project

You will be creating an arena that mimics an environment you may see on Earth. Reflect back on the last two responses in your Project Organizer. Think about what key resources are needed in order to accommodate the organisms you have chosen. Based on these key resources, prepare for the worst:

- If budget constraints resulted in removal of one main resource, predict what will happen to the populations of different organisms in your arena.
- Figure out as many effects as you can and explain them in a flowchart or paragraph format. Use data from the task to justify your predictions

Complete this **individually** in your Project Organizer.

Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 5.

Culminating Project

Design an arena for the next *Hunger Games* movie!



Group Project - Presentation of arena design (diorama or poster-sized map)

Individual Project - A self-guided tour of arena (brochure or flyer)

Don't forget to use your checklist of criteria!

Group Project Criteria for Success

Your arena presentation should include:

- A geographic map or diorama of your arena that is easy to understand and shows the following features with illustrations:
 - The continent where the arena is located and surrounding continents
 - Relevant geographic features, such as mountain ranges, types of rock present, glaciers, etc.
 - Which natural resources the arena has most and least of
 - The non-living things that are needed to support life in the arena
 - A contestant challenge: to locate a specific plant/animal by using information about another plant/animal

- An oral presentation that:
 - Explains the features of your arena (listed above)
 - Is organized logically
 - Is interesting to the audience

Design an arena for the next *Hunger Games* movie!



Group Project - Presentation of arena design (diorama or poster-sized map)

Individual Project - A self-guided tour of arena (brochure or flyer)

Optional Template

Welcome to the Next Hunger Games Arena!

Geographic Features

Paste photo of arena map here and identify geographic features

Explain how plate motions led to the geographic features in your arena. Describe the patterns in data from Task 1 that provide evidence for these past plate motions.

Natural Resources

Paste photo of arena map here and identify where natural resources are found.

Explain how geoscience processes and current human activities affect which resources are available in your arena. Use evidence from Task 2 to support your explanation.

Non-Living Things

Draw a model (including arrows and labels) that shows how matter and energy are cycled within your arena ecosystem.

Explain how you can track the flow of energy through your arena's ecosystem.

Living Organisms

Paste a photo of arena map here or draw a flowchart to show how the contestant challenge works.

Explain how each plant or animal leads the contestant to the next plant or animal. In your contestant challenge, you should utilize and identify at least two different types of organism interactions, based on patterns you observed in Task 4.

Human Impact

Describe the potential effects on the entire ecosystem if budget constraints result in the removal of one major resource from your arena. Give examples of populations of organisms that may be affected in order to explain why removing a resource can result in a chain of effects. Describe data from Task 5 that allows you to predict this outcome.

Thank you for your consideration!

Don't forget to use your checklist of criteria!

Individual Project Criteria for Success

The self-guided tour of your arena (as a brochure or flyer) should describe all parts of your arena, including:

- Geographic Features
 - Identify the geographic features in your arena based on its location.
 - Explain how plate motions led to the geographic features in your arena.
 - Describe the patterns in data from Task 1 that provide evidence for past plate motions.
- Natural Resources
 - Identify the natural resources available in your arena.
 - Explain how geoscience processes and current human activities affect which resources are available in your arena.
 - Use evidence from Task 2 to support your explanation.
- Non-Living Things
 - Draw a model (including arrows and labels) that shows how matter and energy are cycled within your arena ecosystem.
 - Explain how you can track the flow of energy through your arena's ecosystem.
- Living Organisms
 - Describe how the contestant challenge works: Explain how each plant or animal leads the contestant to the next plant or animal.
 - In your contestant challenge, you should utilize and identify at least two different types of organism interactions, based on patterns you observed in Task 4.
- Human Impact
 - Describe the potential effects on the entire ecosystem if budget constraints result in the removal of one major resource from your arena.
 - Give examples of populations of organisms that may be affected in order to explain why removing a resource can result in a chain of effects.
 - Describe data from Task 5 that allows you to predict this outcome.

Peer Review

Self-Guided Tour Peer Review Feedback

Complete after you have a full first draft of your brochure or flyer for the self-guided tour.

Self-Guided Tour Owner's Name	
Self-Guided Tour Reviewer's Name	

Review the following sections of the Self-Guided Tour:

Geographic Features

- Identify the geographic features in your arena based on its location.
- Explain how plate motions led to the geographic features in your arena.
 - Describe the patterns in data from Task 1 that provide evidence for past plate motions.

➤ Positive Comment:

➤ Constructive Comment:

Natural Resources

- Identify the natural resources available in your arena.
- Explain how geoscience processes and current human activities affect which resources are available in your arena.
 - Use evidence from Task 2 to support your explanation.

➤ Positive Comment:

➤ Constructive Comment:

Non-Living Things

- Draw a model (including arrows and labels) that shows how matter and energy are cycled within your arena ecosystem.
- Explain how you can track the flow of energy through your arena's ecosystem.

➤ Positive Comment:

➤ Constructive Comment:

Living Organisms

- Describe how the contestant challenge works: Explain how each plant or animal leads the contestant to the next plant or animal.
 - In your contestant challenge, you should utilize and identify at least two different types of organism interactions, based on patterns you observed in Task 4.

➤ Positive Comment:

➤ Constructive Comment:

Human Impact

- Describe the potential effects on the entire ecosystem if budget constraints result in the removal of one major resource from your arena.
 - Give examples of populations of organisms that may be affected in order to explain why removing a resource can result in a chain of effects.
- Describe data from Task 5 that allows you to predict this outcome.

➤ Positive Comment:

➤ Constructive Comment: