NGSS 3D
STEMscopes™
K-12 SCIENCE

Ecosystem Biodiversity

7th Grade Sample Lesson

www.stemscopes.com/science

Scope (Unit) Ecosystem Biodiversity

Explore (Lesson) Scientific Investigation - Biodiversity

The following pages introduce lesson resources that guide you through the STEMscopes NGSS 7th grade lesson. This sample lesson does not include all the elements and features of our digital and print science curriculum.

Resource List:

The following resources, as well as additional Scope resources not listed, can be found in the digital curriculum *7th Grade Scope, Ecosystem Biodiversity.*

Home

- Standards Alignment
- Sample Lesson Plan
- Teacher Scope Presentation
- Teacher Background
- CCC and SEP Scoring Rubric
- Answer Keys
- Materials List

Engage

- Investigative Phenomena – Introductory activity that facilitates a connection between the content and real-world phenomena and encourages students to ask why or how something happens.
- Graphic Organizer – Students fill this in as they work through the elements of this Scope.
- Accessing Prior Knowledge – A brief probing activity to gauge students' prior knowledge before engaging in the inquiry process.
- Hook – An engaging activity that includes instructor preparation, supplemental resources, and ready-made handouts for students.

Explore

- Explore 1: Scientific Investigation – This lesson sample.
- Explore 2: Activity
- Explore 3: Engineering Solution
- Explore 4: Tuva Task

Explain

- Picture Vocabulary – Key terms explained through pictures and by definition.
- Linking Literacy – Strategies to help students comprehend difficult informational text.
- STEMscopedia – Reference materials that include parent connections, career connections, technology, and science news.
- Communicate Science – A class activity in which students use different forms of communication to discuss scientific topics connected to the content of this Scope.
- Science Rock - Science Rock – A musical/video software platform where students can sing and learn from standards-based science songs.
- Concept Review Game – An interactive game that helps students review important concepts.
- Content Connections Video – A short video that supports student understanding of the content.

Elaborate

- Math Connections
- Reading Science
- Career Connections
- Scientist Spotlight
- PhET: Simulation Practice
- SEP Simulations

Evaluate

- Claim-Evidence-Reasoning
- Open-Ended Response Assessment
- Multiple Choice Assessment

Intervention

- Guided Practice
- Independent Practice
- Concept Attainment Quiz

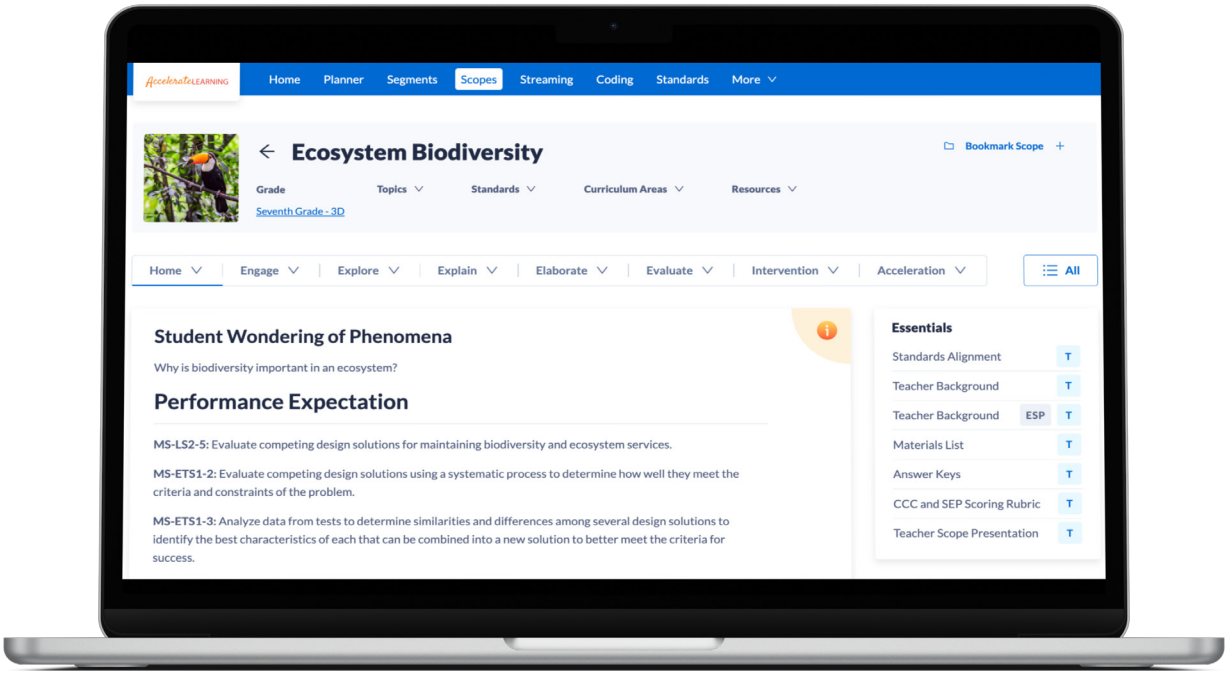
Acceleration

- Extensions
- Science Art
- Books on Topic

Table of Contents

Scope (Unit) Overview

Scope (Unit) Ecosystem Biodiversity



Student Wondering of Phenomena

Why is biodiversity important in an ecosystem?

Performance Expectations

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.

Scope (Unit) Overview

Scope (Unit) Ecosystem Biodiversity

Three-Dimensional Focus

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)	LS2.C: Ecosystem Dynamics, Functioning, and Resilience Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) LS4.D: Biodiversity and Humans Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on – for example, water purification and recycling. (secondary) (MS-LS2-5) ETS1.B: Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary) (MS-LS2-5)	Stability and Change Small changes in one part of a system might cause large changes in another part.

Ecosystem Biodiversity

Explore 1: Scientific Investigation - Biodiversity

Everyday Phenomena

How does an area of low biodiversity compare to an area of high biodiversity?

Description

Students model the spread of disease in an area of low biodiversity compared to an area of high diversity and then calculate the biodiversity index of a lawn ecosystem compared to a grassland in order to determine if areas of high or low biodiversity are healthier.

Materials

Printed Materials

1 Biodiversity (per student)
1 Biodiversity CER (per student)

Reusable

2 Index cards (per student)
2 Quart-sized plastic bags (per group)
100 Small items, such as beans, paper clips, beads, all the same (per group)
5 Small items, different from above, all the same (per group)
12 Small items, different from above, such as beans, lentils, tokens, pennies, two of each (per group)
1 Black marker (per teacher)
1 Calculator (per group)

Preparation

- Print one copy of Biodiversity and Biodiversity CER for each student.
- For Round One index cards: For every 10 students, mark one of the cards with an X.
- For Round Two index cards:
  - On one side, there should be one of five different geometric shapes. For example, circle, square, triangle, rectangle, and diamond.
  - There should be roughly the same number of each shape. For example, if you have a class of 20, make four cards of each shape.
  - All the Xs on Round Two index cards should go on cards with the same geometric shape.
  - For every 10 students, mark one of the cards with an X.
  - For example, the cards that have the X could all go on circle cards.
- Label the two plastic storage bags, one for each habitat: lawn and grassland.
- You will need 12 different small items to represent species.

- For the lawn container: Two species only. Combine 100 of one species (small items) and five of another for a total of 105 organisms. The index will be 2/105= .019.
- For the grassland container: 12 species, two of each for a total of 24 organisms. The index will be 12/24= .5.

STEMcoach in Action

The skills inherent in designing and implementing a scientific investigation are applicable to many situations outside of the science classroom. Skills such as observing, asking questions, collecting and analyzing data, and drawing and communicating reasonable conclusions are important to all individuals. When we say "cultivating scientific investigation" we are describing the practices that help students develop the skills associated with scientific investigation. For more information on Cultivating Scientific Investigations, please click on the provided link.
Site

Procedure and Facilitation Points

1. When humans went from being hunters and gatherers to an agricultural society, they changed the biodiversity in the ecosystem in which they farmed. What do you think biodiversity means? (You can break down this definition for the students.) Bio – life; Diversity – variety
2. When a farmer plants a field for harvest, how many different types of crops does the farmer most commonly plant in that field? Generally, the farmer plants one crop, i.e., planting a cornfield or a wheat field.
3. If a field is left to grow naturally, how many types of organisms will grow? Many different types of plants will grow.
4. Which field would have the greater biodiversity? The natural field
5. In addition to food crops, trees are also grown as crops in many places. One type, such as white pine, is planted and later harvested to make various wood products. Trees are resources that humans rely on. Remember, a resource is a source or supply from which benefit is produced.
6. Introduce the question: Is an area with greater biodiversity or lower biodiversity healthier for an ecosystem?
7. Have students complete their hypothesis.
8. Guide students through the following steps to complete Part I:

Round One

1. We are going to model a forest ecosystem. Forests are considered terrestrial ecosystems. Terrestrial ecosystems are ecosystems on the land as opposed to in the water.
2. Give each student an index card.
3. Have all students get up and shake hands with at least three different people. Students cannot shake the hands of their group members. Make sure they get up and move around.
4. Once students have shaken hands with three different people, have them return to their seats.
5. Once everyone is seated, have students that have an X on their card stand up. Imagine that the class is a forest of white pine trees. The students that are standing just got attacked by a pine beetle that affects white pine trees. The beetles damage the tree so much that they cannot be used as lumber.
6. Not only that, but the disease can spread. Thus, students who shook hands with any of the three standing students have now become infected and must stand.
7. Again, if any of the seated students shook hands with any of the standing students, then they are now infected. Have these students stand up.

8. Repeat this until all of the students are standing.
9. Return all of the cards and sit back down.
10. Discuss the Round One questions together as a class.
    i. Why did everyone end up with pine beetles? They are the same species of tree, and the disease can spread easily. This is a good time to review that a species is a group of organisms with similar characteristics that are able to interbreed or exchange genetic material.
    ii. What can farmers do to prevent similar pest spreads from happening in agricultural fields? Farmers can spray crops with chemicals to prevent infestations. Some farmers use natural organic chemicals, while others use man-made chemicals. Farmers can also plant a diversity of species using the principles of permaculture. Permaculture is a new method of farming that uses the principle of biodiversity to create better farming practices.

11. Instruct students to read the directions for Part II and complete the activity.

Round Two

1. This will be very similar to round one. This time, give students the cards with the different geometric shapes. There will be one or two that have a card with an X.
2. Repeat steps 2–3 from Round One.
3. Have students with cards that have an X stand up. These students should all have the same geometric figures, which represent white pines that have been infected with the pine beetle. The other figures represent different pine and tree species that are grown in the same area as the white pine.
4. Have students with the same geometric figure that shook hands with the students that are standing stand up. As in Round One, if they are the same shape, they are the same tree species, and pine beetles will also infect them.
5. Discuss the following Round Two questions together.
    i. How was Round Two different from the Round One? There were more species of trees, so the loss of usable lumber was less severe.
    ii. Which ecosystem would be healthier and more resilient? Explain. The second would be more resilient because if one species dies out, there are more species that may survive and carry on.
6. Use the table to record your data.
7. Open one of the bags and count the items that represent different plant species. Record the type of habitat and the data in your data table.
8. Return all of the items into the bag before you open the second bag. This will keep the items from getting mixed up.
9. Open the next bag and repeat the process in Step 2.
10. You have now completed the count of different species in a lawn and grassland. Now you can calculate the biodiversity index. Use the calculator and divide the number of species by the total number of organisms. The answer will be a decimal. The closer the number is to 1, the greater the biodiversity. A rain forest will have a number of .75–1.

11. Give students time to compare data with other groups. Then discuss the following questions:
    1. Which habitat had the highest biodiversity index? Explain. The grassland had the highest biodiversity because it had a larger variety of plants and animals.
    2. Why do you think a rain forest has such a high biodiversity index? The rain forest has a large number of different species of plants and animals.
    3. Which ecosystem would be able to survive a disease better? Why? The grassland would be able to survive a disease better because of its large number of different plants.

12. Give students a copy of Biodiversity CER and have them write a scientific explanation describing the advantages of a polyculture forest (high diversity).

Connection to the Investigative Phenomena

Once students have completed the activity, have them refer to the Investigative Phenomena question, anchor their learning, and revise their thinking.

Language Acquisition Strategies

Claim-Evidence-Reasoning

Have students work in pairs to develop their CER. After completing the CER, have students read another student's reasoning and ask questions to make sure they understand what was written. Then have students write a rebuttal or reflection based on the other student's CER responses. Allow students to complete the following sentence stems before the discussion portion: -My claim is _____. -My evidence is _____. -My reasoning is _____. -I heard you say _____, and I haven't thought about that before. However, I think _____.

Explore

Ecosystem

Explore Lesson

Name: _____ Date: _____

Biodiversity

Question

Will an ecosystem be able to tolerate a disease better if it has more biodiversity or less biodiversity?

Hypothesis

Procedure

Part I: Tree Diversity
Round One

1. Follow your teacher's directions as they take you through this activity.
2. Complete the following questions at the end of the activity.
    a. Why did everyone end up with pine beetles?

    b. What can farmers do to prevent similar pest spreads from happening in agricultural fields?

Round Two

1. Follow your teacher's directions as they take you through Round Two.
2. Complete the following questions at the end of Round Two.
    a. How was Round Two different from Round One?

    b. Which ecosystem would be healthier and more resilient? Explain.

Explore

Part II: Biodiversity Index

1. Use the table to record your data.
2. Open one of the bags and count the items that represent different plant species. Record the type of habitat and the data in your data table.

Ecosystem	Number of Different Species	Total Organisms in Bag	Biodiversity Index
Grassland			
Lawn			

3. Return all of the items into the bag before you open the second bag. This will keep the items from getting mixed up.
4. Open the next bag and repeat the process in Step 2.
5. You have now completed the count of different species in a lawn and grassland. Now you can calculate the biodiversity index. Use the calculator and divide the number of species by the total number of organisms. The answer will be a decimal. The closer the number is to 1, the greater the biodiversity. A rain forest will have a number of .75–1.
6. Complete the following questions.

    a. Which habitat had the highest biodiversity index? Explain.

    b. Why do you think a rain forest has such a high biodiversity index?

    c. Which ecosystem would be able to survive a disease better? Why?

Explore

Name: _____ Date: _____

Biodiversity

Question

Will an ecosystem be able to tolerate a disease better if it has more biodiversity or less biodiversity?

Hypothesis

I think an area with greater biodiversity will be better at tolerating a disease.

Procedure

Part I: Tree Diversity
Round One

1. Follow your teacher's directions as they take you through this activity.
2. Complete the following questions at the end of the activity.
   a. Why did everyone end up with pine beetles?

      They are the same species of tree, and the disease can spread easily.

   b. What can farmers do to prevent similar pest spreads from happening in agricultural fields?

      Farmers can spray crops with chemicals to prevent infestations. Some farmers use natural organic chemicals, while others use man-made chemicals.

Round Two

1. Follow your teacher's directions as they take you through Round Two.
2. Complete the following questions at the end of Round Two.
   a. How was Round Two different from Round One? There were more species of trees, so the loss of usable lumber was less severe.

   b. Which ecosystem would be healthier and more resilient? Explain. The second would be more resilient because if one species dies out, there are others that may survive and support the ecosystem.

Explore

Part II: Biodiversity Index

1. Use the table to record your data.
2. Open one of the bags and count the items that represent different plant species. Record the type of habitat and the data in your data table.

Ecosystem	Number of Different Species	Total Organisms in Bag	Biodiversity Index
Grassland	12	24	0.5
Lawn	2	105	0.019

3. Return all of the items into the bag before you open the second bag. This will keep the items from getting mixed up.
4. Open the next bag and repeat the process in Step 2.
5. You have now completed the count of different species in a lawn and grassland. Now you can calculate the biodiversity index. Use the calculator and divide the number of species by the total number of organisms. The answer will be a decimal. The closer the number is to 1, the greater the biodiversity. A rain forest will have a number of .75–1.
6. Complete the following questions.

   a. Which habitat had the highest biodiversity index? Explain. The grassland had the highest biodiversity because it had a larger variety of plants and animals.

   b. Why do you think a rain forest has such a high biodiversity index? The rain forest has a large number of different species of plants and animals.

   c. Which ecosystem would be able to survive a disease better? Why? The grassland would be able to survive a disease better because of its large number of different plants.

Picture Vocabulary

Ecosystem Biodiversity

Picture Vocabulary

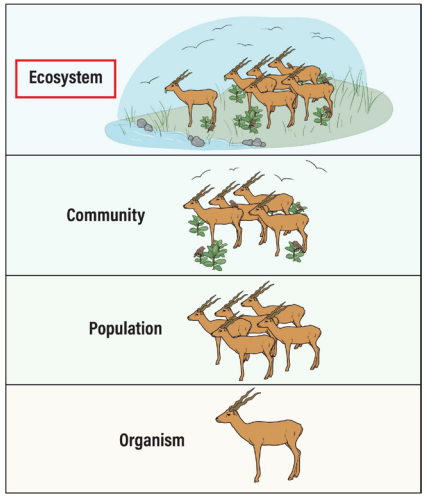
Biodiversity

Tundra: low biodiversity

Rain forest: high biodiversity

The number of different species of plants and animals in an area

Ecosystem



A system comprising all the biotic and abiotic factors in an area and all the interactions among them

Recycling

Proper disposal of used resources so they can be reprocessed into new products

Resource

A source or supply that benefits organisms

Species

A group of organisms with similar characteristics that are able to interbreed or exchange genetic material

Terrestrial

On or of Earth

Water Purification

The process of removing undesirable chemicals and contaminants from water

Math Connections

Ecosystem

Name: _____ Date: _____

Floods: Short-Term Impact

When floods occur, habitats are affected in ways that upset the balance of flora and fauna in the area. In 2011, Hurricane Irene devastated the United States' east coast, from North Carolina, through Virginia, New Jersey, New York, New Hampshire, and Vermont. The flooding from Irene greatly affected the trout population in several watersheds in Vermont.

Below is a chart displaying the data collected before and after Tropical Storm Irene hit Vermont.

Wild Trout Populations in Vermont

Watershed	Pre-Irene (trout per mile)	Post-Irene (trout per mile)
Slide Brook	1,100	425
Union Brook	450	275
Stony Brook	750	250
Dog River	900	425

Create a double bar graph comparing the trout populations before and after Tropical Storm Irene hit Vermont. Include a key.

1. What is the mean number of trout prior to Tropical Storm Irene?

2. What is the mean number of trout after Tropical Storm Irene?

3. What is the percentage decrease in the mean number of trout in the four watersheds?

4. What percentage of the trout in all four watersheds were from Stony Brook prior to the storm?

5. What percentage of the trout in all four watersheds came from Stony Brook after the storm?

6. Which watershed experienced the largest percentage decrease among the four watersheds?

Claim-Evidence-Reasoning

CER Assessment

Name: _____ Date:

Scenario

Ecosystem services are ecosystem functions that humans benefit from. These serv
grouped into four main categories: **provisioning** (the production of food and fresh wa
regulating (control of climate and disease), **habitat** (pollination of crops and nutrient cycle
cultural (recreational benefits). The human population is dependent on healthy ecosystems. The global value of ecosystem services is estimated to be over $100 trillion dollars.

External Data

Summary of Monetary Values for Each Service per Biome
Values in value/ha/year
2007 Price Levels
ha = hectare = 2.471 acres

	Marine	Coral Reefs	Coastal Systems	Coastal Wetlands	Inland Wetlands	Freshwater	Tropical Forest	Temperate Forest	Woodlands	Grasslands
Provisioning Services	102	55,724	2,396	2,998	1,659	1,914	1,828	671	253	1,305
Regulating Services	65	171,478	25,847	171,515	17,364	187	2,529	491	51	159
Habitat Services	5	16,210	375	17,138	2,455	0	39	862	3	1,214
Cultural Services	319	108,837	300	2,193	4,203	2,166	867	990	7	193
Total Economic Value	491	352,249	28,917	193,845	25,682	4,267	5,262	3,013	314	2,871

Services	Type of Service Included
Provisioning Services	Food, water, raw materials, genetic resources, medical resources, ornamental resources
Regulating Services	Air-quality regulation, climate regulation, disturbance moderation, regulation of water flows, waste treatment, erosion prevention, nutrient cycling, pollination, biological control
Habitat Services	Nursery service, genetic diversity
Cultural Services	Aesthetic information, recreation, inspiration, spiritual experience, cognitive development

Claim-Evidence-Reasoning

Prompt

Choose one of the ecosystems listed on the table. Make a claim as to the value of biodiversity in this particular ecosystem in terms of services it provides. Write a scientific explanation to justify your claim.

Claim:

Evidence:

Reasoning:

PEER EVALUATION
Peer Name:
Rebuttal:

Claim-Evidence-Reasoning

Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Not applicable	Answers the question and is accurate based on the data	No claim or does not answer the question
Evidence	Cites data and patterns within the data, and uses labels accurately	Cites data from the data source but not within the context of the prompt	No evidence, or cites changes but does not use data from the data source
Reasoning	Cites the scientifically accurate reason using correct vocabulary and connects this to the claim. Shows accurate understanding of the concept	Cites a reason, but it is inaccurate or does not support the claim; Reasoning does not use scientific terminology or uses it inaccurately.	No reasoning, or restates the claim but offers no reasoning
Rebuttal	Rebuttal provides reasons for different data or outliers in the data. Rebuttal can also provide relevance to the real world or other uses for the findings.	Rebuttal is not connected to the data or is not accurate.	Does not offer a rebuttal

Claim-Evidence-Reasoning

Name: _____ Date: _____

Scenario

Ecosystem services are ecosystem functions that humans benefit from. These services are grouped into four main categories: **provisioning** (the production of food and fresh water), **regulating** (control of climate and disease), **habitat** (pollination of crops and nutrient cycles), and **cultural** (recreational benefits). The human population is dependent on healthy ecosystems. The global value of ecosystem services is estimated to be over $100 trillion dollars.

External Data

Summary of Monetary Values for Each Service per Biome
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Habitat Services	Nursery service, genetic diversity
Cultural Services	Aesthetic information, recreation, inspiration, spiritual experience, cognitive development

Claim-Evidence-Reasoning

Prompt

Choose one of the ecosystems listed on the table. Make a claim as to the value of biodiversity in this particular ecosystem in terms of services it provides. Write a scientific explanation to justify your claim.

Answers will vary.

Claim: It is very important to protect the biodiversity of coastal wetlands ecosystems.

Evidence: The diverse species found in a wetlands ecosystem provide provisioning services by serving as an abundant food source because of its many fish and bird species. The plant species work together to provide regulating services by filtering large quantities of fresh water. The wetlands ecosystem also provides habitat services by serving as a nursery for a variety of bird species. The wetlands biodiversity provides cultural services with its beautiful aesthetics such as water lilies, elegant cranes, swans, ducks, and unique tree species like cypresses and willows.

Reasoning: Food and water are two of our most basic needs. The plant species in this habitat filter fresh water and the animals serve as an excellent source of food. By maintaining biodiversity in wetland habitats, we are protecting resources we need to survive.

PEER EVALUATION
Peer Name:
Rebuttal:

Claim-Evidence-Reasoning

Rubric for Writing a Scientific Explanation

Points Awarded	2	1	0
Claim	Not applicable	Answers the question and is accurate based on the data	No claim or does not answer the question
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