How can cattle improve an ecosystem?

Fifth Grade Earth and Life Science

Three-Dimensional Claim

In this task, students will determine how cattle interact with various organisms (plants, fungi, bacteria, etc.) in an ecosystem to create a model to explain interdependent relationships and how agricultural practices can cause an ecosystem to improve.

Performance Expectations - Next Generation Science Standards (NGSS)

5-ESS3-1. Earth and Human Activity

- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

5-LS2-1. Ecosystems: Interactions, Energy, and Dynamics

- Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

Next Generation Science Standards

This task is intended to elicit student learning of the following NGSS elements for each of the three dimensions:

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. ~~Newly introduced species can damage the balance of an ecosystem~~. (5-LS2-1)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

LS2.B: Human Impacts on Earth Systems

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

ESS3.C: Human Impacts on Earth Systems

- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

Science and Engineering Practices

- *Developing and Using Models*
  - ~~Collaboratively~~ develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
  - Develop and/or use models to describe and/or predict phenomena.

Crosscutting Concepts

- *Cause & Effect*
  - Cause and effect relationships are routinely identified, tested, and used to explain change.
- *Systems and System Models*
  - A system can be described in terms of its components and their interactions. (5-LS2-1)

New York State P-12 Learning Standards

5-LS2-1. Matter and Energy in Organisms and Ecosystems

- Develop a model to describe the movement of matter among plants (producers), animals (consumers), decomposers, and the environment

5-ESS3-1. Earth's Systems

- Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Pillars of Agricultural Literacy Connection

The Relationship Between Agriculture and the Environment (DISCOVERY: Grades 4 - 8)

- Discover how natural resources are used and conserved in agriculture.
- Discover how farmers care for the land by using soil conservation practices.
- Explain that farmers consider how their actions affect the environment.

*To learn more about the Pillars of Agricultural Literacy visit here.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Suggestions for Use

This task best fits as a summative assessment to assess student understanding of the movement of matter among plants, animals, decomposers, and the environment and how humans can use these science ideas to protect (or improve) the earth's resources and ecosystems.

In this task, students are presented with the phenomenon of grasslands with differing health and are given clues to explain how the different parts of the ecosystem interact in order to create a healthy grassland. Students will use their knowledge of weathering and erosion, properties of soil, ecosystem interactions, and the relationship between the soil and other moving parts of grassland ecosystems, gained from the New York Agriculture in the Classroom Next Generation Beef Toolkit - Ecosystems and Soil Health to create a model to explain how the different parts of a grassland/pasture interact with each other to create a healthy, properly managed ecosystem.

Assumptions

Students should have had opportunities to master the following DCI information in the standards:

- Students should be able to distinguish between producers and consumers and be able to describe the interactions between organisms in an ecosystem.
- Students should understand the processes used to obtain natural resources from the environment have consequences, both positive and negative.
    - Students should examine the activities that humans undertake and their effects.
    - Discussions could include but are not limited to farming (planting, grazing, etc.), mining, and building.

Students should have had opportunities to master the content within the New York Agriculture in The Classroom Next Generation Beef Toolkit - Ecosystems and Soil Health.

- As students participate in the first part of the experience, they will get a broad understanding of ecosystems and biodiversity while learning about humans' impact on the land.
- In the second half of the experience, students will learn how humans can regenerate ecosystems that might have been negatively impacted or increase the productivity of less productive land while engaging with a real-life agriculturalist.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Logistics

- **Estimated completion time -** This task may take approximately 60 minutes to complete and may need to be broken into smaller parts.
- **Remote learning adaptation -** If using an online learning service such as Google Classroom, you may choose to assign a unique copy to each student completing the task.
- **Remote learning adaptation -** Using an online illustration tool like Google Drawing may require technology integration instruction. Be sure to provide support with any tools integrated into the task implementation to ensure that the use of the technology does not impede students' demonstration/application of science knowledge/skills.

Materials Needed

- Drawing tools (colored pencils, crayons, etc.)
- Pencils (if printed)
- Paper (if printed)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

How can cattle improve an ecosystem?

Phenomena:

The "Notice/Wonder" chart is not intended to be assessed. The reflection can be completed by students individually and then discussed as a class.

Below, you can see two images of the same pasture. The image on the left (Image A) shows a degraded pasture ecosystem. The image on the right (Image B) is of the same ecosystem but taken years later. Image B was taken after implementing a rotational grazing management plan. In this task, you will create a model to explain how rotational grazing can help restore an ecosystem.

(Image A) (Image B)

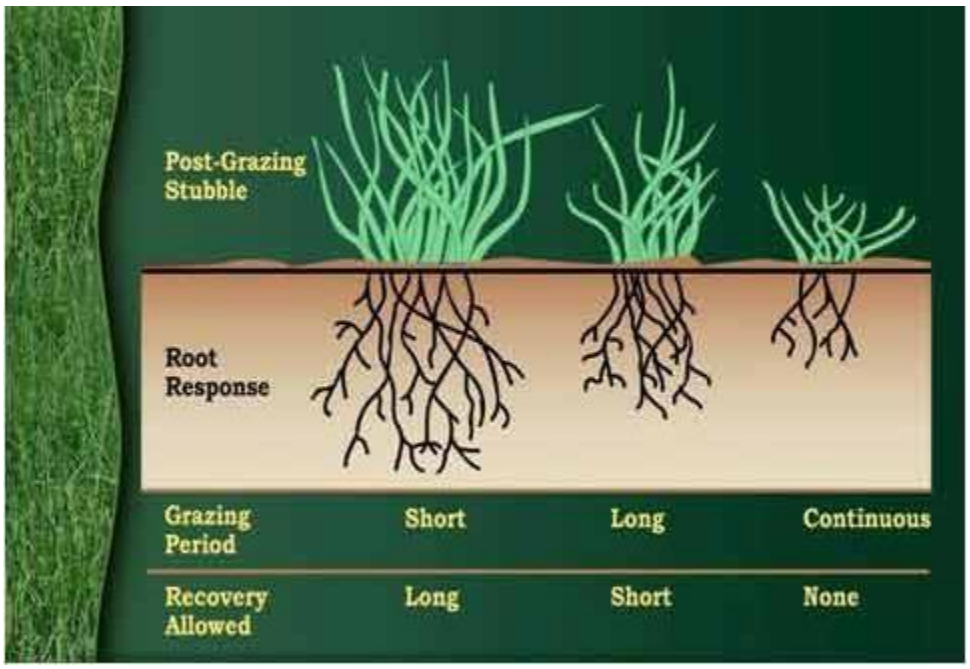
Fill in the chart below with your observations:

I Notice...	I Wonder...

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt A:

When cattle graze on grass, time needs to pass before the grass can be grazed on again. This is because the roots need time to recover, or grow, in order for the grass to stay healthy. The chart below shows the difference between what grass and its roots look like when it is given different amounts of time before being grazed on again.



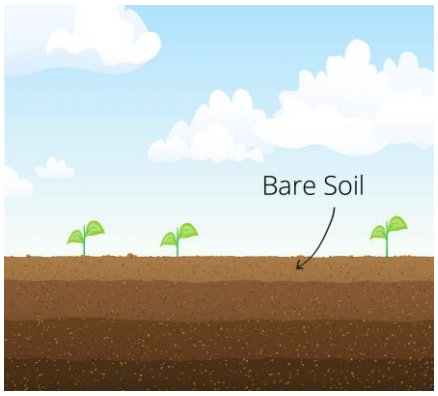
(Chart from https://www.grant.k-state.edu/grazing-pasture-management/)

Explain what happens to the grass <u>and</u> its roots below ground when there is *less* time given before the grass is grazed on by cattle again. Then, explain why you think this happens. You can use words, drawings, or combinations of both.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt B:

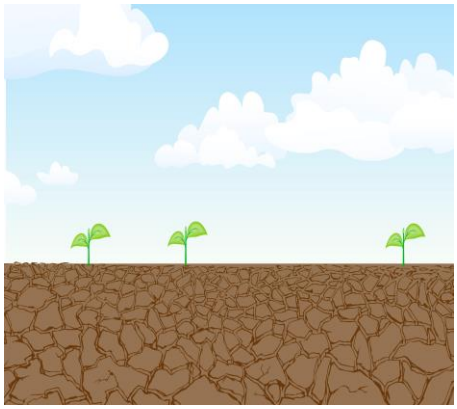
Overgrazing can lead to negative ecosystem impacts such as erosion. Water erosion happens in many forms, one being raindrop splash. The raindrops strike the bare soil, breaking the soil apart. The impact of the raindrops can be lessened by plant cover.



If a grassland is not properly managed, there is often bare soil that is exposed.

The grassland with bare soil gets rained on.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.



Over time, the grassland's soil becomes eroded and plants cannot grow.

When grassland is properly managed, there is more grass coverage, leaving less bare soil. Using what you know about water erosion and plant coverage, **fill in the flowchart <u>like the one above</u>, to show what would happen when there is plant coverage on the grassland.**

1.)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

2.)

Will the grassland become eroded over time? Why or why not?

3.)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt B Assesses	
DCI	ESS3.C: Human Impacts on Earth Systems: Human activities in agriculture have had major effects on the land, vegetation, but individuals and communities are doing things to help protect Earth's resources and environments.
SEP	Developing and Using Models: Develop a model to describe phenomena. (5-LS2-1)
CCC	Systems and System Models: A system can be described in terms of its components and their interactions. (5-LS2-1)

Prompt B Scoring Guidance	
Score	**Components of Student Response (SEP, CCC, and/or DCI)**
+1	The student applies the SEP to create a label explaining that the land is covered by more crops and that less bare soil is exposed.
+1	The student shows that they understand the DCI that human activities in agriculture impact Earth's systems - students understand that since there is more plant coverage, there is less water/splash erosion caused by the rain.
+1	The student utilizes their understanding of the CCC and the interactions of components within a system to explain that the land will not become eroded over time because the plant coverage protects the land from water erosion.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt C:

You are shown a video of Bishop's rotational grazing plans, where he shows a map where he tracks where his cattle are moved to, and plans how much grass they are grazing on.

Video Link

Based on what we discovered about leaf removal and root growth, why does Bishop want to rotate cattle throughout a grass pasture (as opposed to keeping them in the same space)? What effects does this type of grazing have on an ecosystem?

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

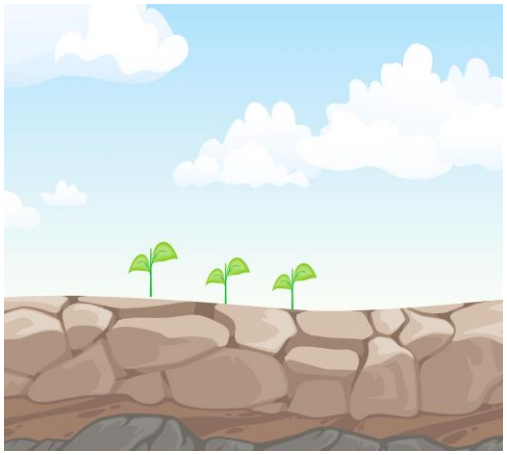
Prompt C assesses:	
DCI	ESS3.C: Human Impacts on Earth Systems: Human activities in agriculture have had major effects on the land, vegetation, but individuals and communities are doing things to help protect Earth's resources and environments.
SEP	
CCC	Cause & Effect: cause and effect relationships are routinely identified, tested, and used to explain change. Systems and System Models: A system can be described in terms of its components and their interactions. (5-LS2-1)

Prompt C Scoring Guidance	
Score	**Components of Student Response (SEP, CCC, and/or DCI)**
+1	The student demonstrates an understanding of the DCI to explain that if cattle are moved around from pasture to pasture, the grass (and its roots) will have more time to grow.
+1	The student applies the CCC by explaining that rotating cattle has several effects on an ecosystem. Effects could include healthier grass and/or roots, improved water conditions, less erosion, or healthier cattle.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt D:

Having nutrient-rich soil is important for grass to grow. The images below show the difference between grass growing in **living soil** versus grass growing in **dirt**. The living soil has organic matter, which provides nutrients for the grass to grow strong roots and get the nutrients it needs to stay healthy.



How is the grass growing in dirt *different* from the grass plant growing in living soil?

Why is it important for grassland managers to make sure their land has <u>nutrient-rich soil</u>?

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

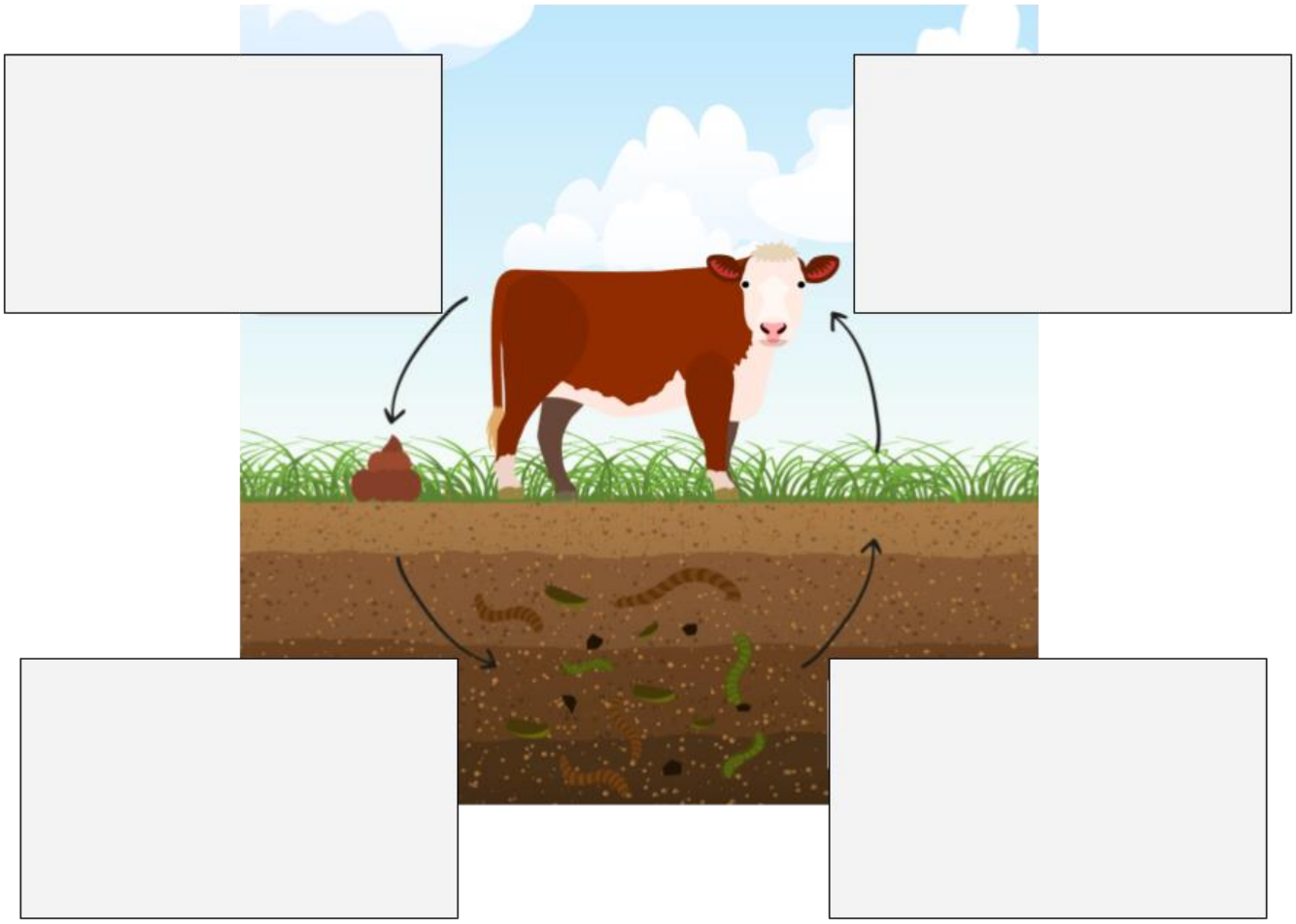
Prompt D assesses:	
DCI	LS2.A: Interdependent Relationships in Ecosystems: Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.
SEP	
CCC	Systems and System Models: A system can be described in terms of its components and their interactions. (5-LS2-1)

Prompt D Scoring Guidance	
Score	**Components of Student Response (SEP, CCC, and/or DCI)**
+1	Students apply the CCC by explaining that grass growing in living soil is healthy and grass growing in the dirt is unhealthy/dead.
+1	Students explain that the roots in the living soil are long/strong and the roots in the dirt are short/weak using their understanding of the DCI and the interdependent relationships between roots and their surrounding ecosystem.
+1	Students apply the CCC by explaining that it is important for farmers to have nutrient-rich soil because the grass needs nutrients from the soil to grow/be healthy.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt E:

You are shown a nutrient cycle of a grassland ecosystem. The cycle shows how decomposers can consume waste material from cows and break them down into nutrients that are released into the soil. These nutrients that came from the waste material are called organic matter. The nutrients from the organic matter in the soil are used by the grass to help it grow.



These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

In the above diagram, describe each part of the nutrient cycle. Then, explain what is happening in each interaction.

How do grazing cows impact the other moving parts of a grassland ecosystem and its nutrient cycle?

What important role do decomposers play in a grassland ecosystem? (Be sure to point out the role decomposers play in returning nutrients back to the soil.) Use words or a drawing to explain how decomposers interact in an ecosystem.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Prompt E Assesses	
DCI	LS2.A: Interdependent Relationships in Ecosystems: Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. ~~Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.~~ LS2.B: Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)
SEP	Developing and Using Models: ~~Collaboratively~~ develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
CCC	Systems and System Models: A system can be described in terms of its components and their interactions. (5-LS2-1)

Prompt E Scoring Guidance	
Score	**Components of Student Response (SEP, CCC, and/or DCI)**
+1	The student demonstrates knowledge of the CCC by identifying components of the system and their interactions, identifying that the cattle graze on the grass.
+1	The student applies the DCI by creating the connection that the cattle's waste will go into the soil to be decomposed by decomposers.
+1	The student utilizes the SEP of developing and using models to explain that the organic matter in the soil provides nutrients for the grass to grow.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

Final: Rotational Grazing Model

Now that you understand how to manage a grassland ecosystem, you are going to **create a model of a rotational grazing system to explain how adding cattle with a management plan to a grassland/pasture can help form a healthy, properly managed ecosystem. Your model should include both words and pictures. Be sure you include each component and interaction from the chart below in your model.**

Components to Include:	Interactions to Include:
• Cattle • Decomposers • Grass • Nutrients • Organic matter • Roots • Soil • Waste material	• Decomposition • Erosion • Excretion • Grass growth • Grazing • Plant coverage • Root growth • Sharing nutrients/Nutrient cycle

Create your rotational grazing model here:

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

FINAL Model Assesses	
DCI	LS2.A: Interdependent Relationships in Ecosystems: Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. LS2.B: Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1) ESS3.C: Human Impacts on Earth Systems: Human activities in agriculture have had major effects on the land, vegetation, but individuals and communities are doing things to help protect Earth's resources and environments.
SEP	Developing and Using Models: Develop a model to describe phenomena. (5-LS2-1)
CCC	Systems and System Models: A system can be described in terms of its components and their interactions. (5-LS2-1)

FINAL Model Scoring Guidance	
Score	**Components of Student Response (SEP, CCC, and/or DCI)**
+1	Students apply the CCC by including components and interactions that help to explain how cattle can help provide nutrients to the soil.
+1	Students demonstrate their knowledge of the DCI by including components and interactions that help to explain how decomposers provide nutrients to the grass.
+1	Students apply the DCI to include components and interactions that help to explain how erosion can be prevented.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from the New York Beef Council.