



How do ecosystem characteristics impact changes and resources available to humans in the event of heavy rainfall?

Middle School Biology & Ecology

Three-Dimensional Claim

In this task, students will **construct explanations and models** for predictions about **cause-and-effect patterns**, including those of stability and change that impact **ecosystems and humans' resources**.

Performance Expectations - Next Generation Science Standards (NGSS)

MS-LS2-2. Ecosystems: Interactions, Energy, & Dynamics

- Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

MS-ESS3-4. Earth & Human Activity

- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]





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

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS4.D: Biodiversity & 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 to MS-LS2-5)

ESS3.A: Natural Resources

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, freshwater, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

ESS3.C: Human Impacts on Earth's Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) on different living things. (MS-ESS3-3)

Science and Engineering Practices

Constructing Explanations

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.

Developing & Using Models

- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.



Engaging in Argument from Evidence

- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Analyzing & Interpreting Data

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Analyze and interpret data to provide evidence for phenomena.

Crosscutting Concepts

Patterns

- Patterns can be used to identify cause and effect relationships. (MS-LS2-2)
- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Stability & Change

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-5)
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Cause and Effect

- Cause and effect relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1), (MS-ESS3-4)





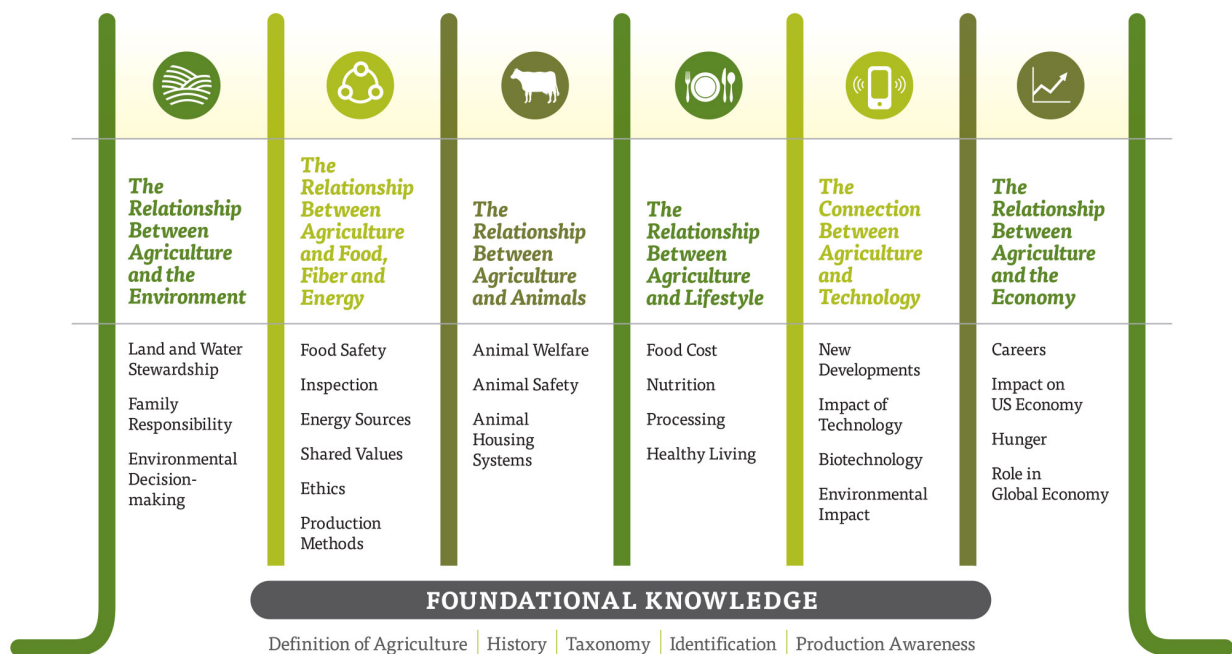
Pillars of Agricultural Literacy Connection

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.



Understanding the intersection between agriculture and society.



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*To learn more about the Pillars of Agricultural Literacy visit [here](#).



Suggestions for Use

This task best fits as a summative assessment to assess student understanding of the interdependent relationships in ecosystems, and the impacts of human activity on ecosystems and resources available to humans.

In this task, students are presented with the phenomenon of a rainfall simulation on a variety of ecosystem samples. Students will then use their knowledge of soil, soil weathering, soil properties, grassland ecosystems, cattle grazing, and the relationship between the soil and other moving parts of grassland ecosystems, gained from the Food and Agriculture Center for Science Education Unit Toolkit: [Suitable Soil](#); sponsored by the Washington State Beef Commission to make predictions about the impacts of rainfall to the ecosystems as well as the resources available to humans.

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 Food and Agriculture Center for Science Education Unit Toolkit – [Toolkit Name] – sponsored by the Washington State Beef Commission.

- 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.





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)
- Video viewing equipment





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Phenomena:

The “Notice/Wonder” chart is not intended to be assessed. Students can complete the table individually to capture observations and reflections as the video is viewed. Then, the charts can be discussed as a class.

[Watch this video of a rainfall simulation.](#)

NOTE: The video has an explanation of the rainfall simulation, the ground cover sample scenarios shown, and the results of the simulation.

Fill in the chart below with your observations from the video:

I Notice...	I Wonder...



Prompt A:

Consider these four scenarios from the state of Washington. Describe your predictions on the impact of excessive rainfall to these ecosystems.

Scenario 1:

Crops grow in this field for part of the year. After the crop is harvested, the soil is tilled and left with nothing covering the bare soil until the next growing season.



Infiltration



Runoff

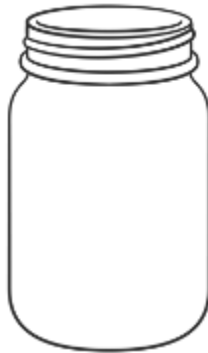


Scenario 2:

A small herd of 75 sheep graze on this land almost continuously. Above the ground, the grass is very short; if we could look below the surface we would see small roots and compacted soil.



Infiltration



Runoff



Scenario 3:

This grassland area is managed with rotational cattle grazing. There plant matter covering the soil, high plant biodiversity, and a water source on the land.



Infiltration

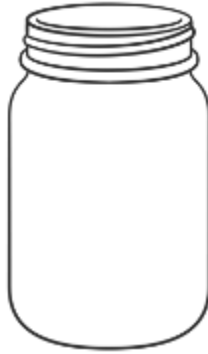


Runoff



Scenario 4:

This forested area has native plants growing, and is preserved as a wildlife area.



Infiltration



Runoff



Prompt A Assesses

DCI	<p>LS2.A: Interdependent Relationships in Ecosystems</p> <ul style="list-style-type: none">Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)
SEP	<p>Constructing Explanations</p> <ul style="list-style-type: none">Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
CCC	<p>Patterns</p> <ul style="list-style-type: none">Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Prompt A Scoring Guidance

Score	Components of Student Response
+1	Unique predictions are given for the 4 different scenarios. The student provides rationale for their predictions.
+1	The student explains why each scenario prediction is different from the others, given relationships among the variables in each scenario. An example might be the influence of plant matter in the results.
+1	The student identifies at least one “downstream effect”, or cause and effect relationship of water resources for each scenario. An example might be the amount of moisture retained and the impact during dry seasons.



Prompt B:

Consider these four scenarios from the state of Washington. Describe your predictions on the impact of excessive rainfall to resources available to humans.

Scenario 1:

Crops grow in this field for part of the year. After the crop is harvested, the soil is tilled and left with nothing covering the bare soil until the next growing season.



Scenario 2:

A small herd of 75 sheep graze on this land almost continuously. Above the ground, the grass is very short; if we could look below the surface we would see small roots and compacted soil.





Scenario 3:

This grassland area is managed with rotational cattle grazing. There is plant matter covering the soil, high plant biodiversity, and a water source on the land.



Scenario 4:

This forested area has native plants growing and is preserved as a wildlife area.





Prompt B Assesses

DCI	LS4.D: Biodiversity and Humans <ul style="list-style-type: none">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 to MS-LS2-5)
SEP	Constructing Explanations <ul style="list-style-type: none">Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
CCC	Patterns <ul style="list-style-type: none">Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Prompt B Scoring Guidance

Score	Components of Student Response
+1	The student acknowledges differences in each ecosystem and how these differences uniquely impact resources available to humans.
+1	The student clearly articulates reasoning for their predictions for impact.
+1	The student gives at least one example of a pattern or cause-and-effect relationship for each of the four different scenarios.





Prompt C:

Select one of the three scenario examples:

- Grassland used for cattle grazing is converted to row crop farmland.
- Native/wild grassland is now managed with rotational grazing.
- Due to the growing population in a suburban area, many acres of grassland used for cattle grazing are converted to land for the development of homesites.

Using drawings, develop a model to explain how this example of human action/interaction can have impacts on the soil and on the ecosystem.



Prompt C Assesses

DCI	<p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none">Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) on different living things. (MS-ESS3-3)
SEP	<p>Developing & Using Models</p> <ul style="list-style-type: none">Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
CCC	<p>Stability and Change</p> <ul style="list-style-type: none">Small changes in one part of a system might cause large changes in another part. (MS-LS2-5) <p>Cause and Effect</p> <ul style="list-style-type: none">Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)

Prompt C Scoring Guidance

Score	Components of Student Response
+1	The student develops a model with at least three elements: (1) depiction of the change, (2) impact on soil, and (3) impact on ecosystem.
+1	The student clearly notes the relationships of elements in their model.



Prompt D:

Write an explanation for the model you created in Part C. Then, predict the impacts this change would have on resources available to humans.



Prompt D Assesses

DCI	<p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none">Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, freshwater, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
SEP	<p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none">Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. <p>Analyzing & Interpreting Data</p> <ul style="list-style-type: none">Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.Analyze and interpret data to provide evidence for phenomena.
CCC	<p>Stability and Change</p> <ul style="list-style-type: none">Small changes in one part of a system might cause large changes in another part. (MS-LS2-5) <p>Cause and Effect</p> <ul style="list-style-type: none">Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)



Prompt D Scoring Guidance

Score	<i>Components of Student Response</i>
+1	The student makes a connection to the way humans depend on this ecosystem for resources, specifically water.
+1	The student gives an explanation of each component of their model.
+1	The student gives at least one example of how a small change in one part of the ecosystem causes larger changes in another part.