

Disruptions in Ecosystems: Assessment Support Materials

Assessing student learning is a critical component of effective instruction. Strong assessments provide the teacher with an understanding of how students’ ideas are developing, and where to target the feedback and support to strengthen student understanding. Effective instruction includes both assessment for learning (formative) and assessment of learning (summative) (Black & Wiliam, 2003; Gipps & Stobart, 2003; Stiggins, 2002). Formative assessment allows teachers to understand how students are progressing and how they might alter their instruction to address students’ needs; summative assessment offers information about where students are with their learning at the conclusion of a chapter or a unit.

The three-dimensional nature of the NGSS requires new approaches and a range of methods to capture students’ progress as they build understanding over time (NRC, 2014). The *Disruptions in Ecosystems* unit’s integrated assessment system includes varied opportunities for assessing students as they progress through the unit. The following support materials are intended to help navigate this system and use it to plan for assessment in each chapter and across the full *Disruptions in Ecosystems* unit. They lay out ways that students’ ideas develop during the unit and are revealed through the assessments to assist teachers in planning for and responding to students’ progress.

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Section One: Navigating Assessment in *Disruptions in Ecosystems*

Supports for identifying and utilizing assessments are built into the Teacher’s Guide for each of the five chapters in *Disruptions in Ecosystems*, starting with the Assessment Overview. The Assessment Overview is provided at the beginning of the Teacher’s Guide for each chapter, directly following the Chapter Overview. The Assessment Overview provides, in tabular form, the disciplinary core ideas, science and engineering practices, crosscutting concepts, performance expectations, and math and ELA standards (where applicable) addressed in the chapter. Asterisks indicate which performance expectations are primary and secondary to the chapter. Aspects with no asterisks are addressed in the chapter but not directly linked to the PEs being assessed. Suggested assessment opportunities are noted by activity with the appropriate Procedure step or Analysis item indicated. Performance expectations are formally assessed in the final evaluate activity for each chapter, while progress toward one or more of the three dimensions linked to the performance expectations are formatively assessed throughout the chapter. The number of NGSS dimensions a task assesses can be determined by reading down the table. For example, if the same Analysis item in an activity is listed as a potential assessment for both the disciplinary core idea and the crosscutting concept, it is a two-dimensional assessment. If a science and engineering practice is also listed for that item, it is a three-dimensional assessment.

When planning assessment for the chapter and unit, it is important to look at how understanding is built and assessed across the three dimensions and to decide which aspects are going to be the focus of instruction. Within the Teacher’s Guide for each activity, the assessment opportunities highlighted in the Assessment Overview are described in more detail in the corresponding Teaching Step. Choosing where and when to assess students should be determined based on students’ level of understanding and familiarity with the three NGSS dimensions, and on the instructional focus chosen for the learning sequence. For example, in Chapter One the scientific practice of explanation is emphasized and specific supports are provided in the student and teacher materials. If students are not familiar with the practice of explanation, it is likely that all opportunities for support and assessment would be appropriate. However, if students have been working with this practice prior to the unit, some supports may not be necessary and fewer assessment opportunities may be needed to evaluate the students’ progress with the practice of explanation.

Below are descriptions of how understanding of the three dimensions is built and assessed within each chapter. Specific opportunities are indicated in (), and colored dots indicate the dimensions being assessed. 🟡 = Disciplinary Core Idea (orange) 🔵 = Science and Engineering Practice (blue) 🟢 = Crosscutting Concepts (green)

Chapter One: Wolves in Yellowstone

Chapter one focuses primarily on patterns of interactions among organisms in ecosystems, the scientific practice of explanation, and the crosscutting concept of patterns used to identify cause and effect relationships. These three dimensions are assessed formatively throughout the chapter, and the summative assessment of the performance expectation occurs in the final evaluate activity. Key aspects of the assessments in each activity are outlined in the table below, as well as general guidelines for what might be expected in student responses and suggestions for providing feedback. Note that the table below only includes the opportunities to assess the main aspects of the three dimensions of the primary PE for this chapter (i.e. the aspects directly correlated primary PE as determined by the NGSS). A number of other assessment opportunities are highlighted in the Assessment Overview and may be applicable depending on the focus of instruction for the chapter.

Activity	Assessment Focus	What to Expect/Encourage
1. Engage	Elicit students' initial ideas about the DCI (Analysis 2 ✓) and related to taking and supporting a position in a scientific argument. (Analysis 3 ✓✓)	Students will likely have a range of ideas, questions, and responses. These are good opportunities to use as a baseline for future assessments and student growth. Any feedback provided to students should focus on areas of growth, and not be corrective.
2. Explore	Formative assessment of students' use of the food web as a model to understand patterns of interaction, make predictions, and create simple explanations. (Steps 4-15 ✓✓✓ and Analysis 2 ✓✓ & 4 ✓✓)	Students are just beginning to use the food web model that will be revisited throughout Chapters 1 and 2. Encourage students to help each other as they work in groups to develop their models and use them as a basis for their understanding and explanations. Focus feedback on students' exploration of possible interactions. Emphasize that students will have multiple opportunities to revise their models and explanations in this activity and throughout the rest of the chapter.
3. Explore	Assess students' application of understanding of patterns of interaction introduced in Activity 2 to deepen their understanding of specific types of organism interactions (e.g. competition, mutualism, etc.). (Steps 2-6 ✓✓ and Analysis 2 ✓✓, 3 ✓ & 4 ✓✓)	Students should be able to apply their knowledge of patterns of specific interactions from the previous activity to more generalizable categories of organism interactions (predator-prey, mutualism, etc.). Students are continuing to practice basic explanations (note that the scientific practice of explanations has not been formally introduced yet). Analysis 2 provides an opportunity to encourage students to begin to add detail to their simple explanations.
4. Explain	Assess students' analysis of patterns of interactions and cause and effect	Student responses will vary depending on their familiarity with analyzing graphical

	<p>based on graphical data (Steps 1 ✓, 2 ✓, 4 ✓, 7 ✓, 8 ✓ and Analysis 1 ✓✓). Students' also begin to incorporate the interaction of living and non-living factors in their understanding of ecosystems. (Analysis 2 ✓✓) Student explanations in Analysis 3 (✓✓) are still informal.</p>	<p>data. There are many opportunities to assess students' analyses of graphical data throughout the unit, so this opportunity can serve as a baseline or as a more significant assessment depending on students' background knowledge. Encourage students to work in groups to answer Analysis item 1 and 2 if they are less confident interpreting graphs.</p>
5. Elaborate	<p>Continue to assess students' analyses of patterns in graphical data. (Steps 2 to 4 ✓✓) This activity is the first opportunity in the unit to formally introduce and assess students' ability to construct scientific explanations using the Explanation Tool. (Step 8 ✓✓✓)</p>	<p>This activity provides an opportunity to assess students' ability to identify types of interactions (predator-prey, etc.) based on analysis of graphical data. Scaffolding suggestions are provided in the Teacher's Guide, and should be adjusted depending on students' familiarity with analyzing graphs. The Teacher's Guide also provides scaffolding suggestions for helping students to construct their first formal explanation. Students often initially struggle with determining what is appropriate evidence and how to express scientific reasoning. At this point it is appropriate to minimize formal assessment and emphasize that students will have many opportunities to practice constructing explanations as the unit progresses. Working on the explanation as a class or in small groups is suggested.</p>
6. Evaluate	<p>Students' are assessed on the performance expectation in this activity. (Step 2 ✓✓✓)</p>	<p>Students' have been practicing analyzing patterns of interactions throughout the chapter, and a summative assessment is appropriate for both the DCI and CCC. The Teacher's Guide suggests supports for students constructing their written explanations, and assisting each other through peer review and revisions. The walking debate (Step 4) provides another opportunity for peer feedback in a less formal format. Assessment of and feedback on students' explanations should emphasize that they are just beginning to learn how to construct scientific explanations and that they will have many more opportunities over the unit to improve. Explain to students that this is a practice that takes time to develop.</p>

Chapter Two: Ecosystem Models

Chapter two examines the flow of energy and the cycling of matter in ecosystems, the scientific practice of developing and using models, and the crosscutting concept of energy and matter. These three dimensions are assessed formatively throughout the chapter, and the summative assessment of the performance expectation occurs in the final evaluate activity. Key aspects of the assessments in each activity are outlined in the table below, as well as general guidelines for what might be expected in student responses and suggestions for providing feedback. Note that the table below only includes the opportunities to assess the main aspects of the three dimensions of the primary PE for this chapter. A number of other assessment opportunities are highlighted in the Assessment Overview found and may be applicable depending on the focus of instruction for the chapter.

Activity	Assessment Focus	What to Expect/Encourage
1. Engage	Elicit students' initial ideas about the DCI (Steps 2 ✓ & 4 ✓ and Analysis 1 ✓)	Students will likely have a range of ideas, questions, and responses. These are good opportunities to use as a baseline for future assessments and student growth. Any feedback provided to students should focus on areas of growth, and not be corrective.
2. Explore	Formative assessment of students' use of the food web as a model to demonstrate the movement of energy and matter in ecosystems. (Steps 3 ✓✓✓ & 4 ✓✓✓ and Analysis 1 ✓✓)	Students revisit the Yellowstone food web from Chapter 1, incorporating new organisms including decomposers, and begin exploring in more depth the movement of matter and energy in ecosystems. Focus feedback on students' ideas about energy flow and matter cycling. Emphasize that students will have multiple opportunities to revise their models in this activity and throughout the rest of the chapter.
3. Explain	Formative assessment of students' understanding of the movement of matter in an ecosystem. (Step 3 ✓✓✓ and Analysis 1-3 ✓✓✓).	Students should be developing a deeper understanding of where organisms get matter from and how it moves through the ecosystem. The Anticipation Guide provides a structured process for students to explore, then revisit and revise their ideas throughout the activity as they learn more about matter in ecosystems. Analysis 2 provides an opportunity to have students construct a formal explanation for where plants obtain the matter they need to grow.
4. Explain	Formative assessment of students' understanding of the movement of	This activity provides students the opportunity to deepen their understanding of energy flow in ecosystems and how this

	energy in an ecosystem. (Step 12 ✓✓✓ and Analysis 3-5 ✓✓✓).	differs from the movement of matter. They return to the Anticipation Guide to revise their ideas about energy in ecosystem.
5. Elaborate	Continue to assess students' understanding of matter cycling and energy flow in ecosystems through the lens of how these processes would be affected by a disruption (Step 11 ✓✓✓ and Analysis 2 ✓✓).	This activity provides an opportunity to assess students' ability to differentiate between the cycling of matter and flow of energy in an ecosystem. Class discussions (Steps 3 & 10) can be utilized to clarify misconceptions or confusion prior to the summative assessment in the next activity.
6. Evaluate	Students' are assessed on the performance expectations in this activity (Steps 5 ✓✓✓ & 6 ✓✓✓ and Analysis 2 ✓✓✓).	Students' should be able to provide a fairly detailed explanation of the cycling of matter and flow of energy in an ecosystem at this point, and a summative assessment is appropriate for both the DCI and CCC. The model development and presentation in groups provides a less formal opportunity for students to demonstrate their knowledge. Students' explanations in Analysis 2 provide an opportunity for more formal, individual assessment and feedback. The practice of explanation will continue to be assessed in Chapters 3 & 4.

Chapter Three: Interactions Between Populations and Resources

In chapter three students learn about the effects of resource availability on populations and ecosystems, engage in the scientific practices of analyzing and interpreting data and of constructing scientific arguments, and the crosscutting concept of cause and effect. These three dimensions are assessed formatively throughout the chapter, and the summative assessment of the performance expectations occurs in the final evaluate activity. Key aspects of the assessments in each activity are outlined in the table below, as well as general guidelines for what might be expected in student responses and suggestions for providing feedback. Note that the table below only includes the opportunities to assess the main aspects of the three dimensions of the primary PE for this chapter. A number of other assessment opportunities are highlighted in the Assessment Overview found and may be applicable depending on the focus of instruction for the chapter.

Activity	Assessment Focus	What to Expect/Encourage
1. Engage	Elicit students' initial ideas about the DCIs (Analysis 1 ✓, 2 ✓, and 3 ✓✓)	Students will likely have a range of ideas, questions, and responses. These are good opportunities to use as a baseline for future assessments and student growth. Any feedback provided to students should focus on areas of growth, and not be corrective.
2. Explore	Formative assessment of students' understanding of resource limitations and competition and the potential effects of human interactions on populations of organisms. (Steps 5 ✓✓✓, 6, & 8)	Students begin the activity with a "no limits" fishing model, then revisit the model with fishing limits, then explore the added complexity of ecosystem disruptions. Encourage students to think about and discuss their initial ideas about the complexity of resource limitations, competition, and how human interaction can influence populations. These topics will be revisited in the next activity.
3. Explain	Assess students' deepening understanding of the complexity of determining the health of an ecosystem and human interactions with that ecosystem (Steps 7 ✓✓✓ & 9 ✓✓✓). This activity is the first opportunity in the unit to formally introduce and assess students' ability to develop a scientific argument using the Argument Tool. (Step 9 ✓✓✓)	This activity provides the students the opportunity to bring together multiple lines of evidence to examine the health of an ecosystem using real-world data, and to construct their first formal scientific argument using that evidence. The Teacher's Guide provides scaffolding suggestions for helping students to develop their first formal argument. At this point it is appropriate to minimize formal assessment and emphasize that students will have many opportunities to practice developing arguments as the unit progresses. Working on the argument as a class or in small groups is suggested.
4. Elaborate	Formative assessment of students' analysis of data related to causes of dead zones. (Step 4 ✓✓✓) Informal	This activity provides students the opportunity to examine another ecosystem disruption, dead zones, which can affect

	assessment of development of scientific argument. (Step 7 ✓✓✓)	fisheries. Assess students' developing understanding of how multiple factors affect the overall health of ecosystems and of fisheries. Expect students' to use the evidence from their explanations of the relationship between nitrogen input and water flow to inform their waking debate about fertilizer use. This is another opportunity for students to practice their argument development skills.
5. Evaluate	Students' are assessed on the performance expectations in this activity. (Step 6 ✓✓✓ and Analysis 1 ✓✓✓)	Students' have been practicing analyzing patterns of interactions throughout the chapter and unit, and a summative assessment is appropriate for both the DCI and CCC. The Teacher's Guide suggests supports for students developing their arguments, and assisting each other through peer review and revisions. Assessment of and feedback on students' arguments should emphasize that they are just beginning to learn how to develop scientific arguments and that they will have many more opportunities over the unit to improve. Explain to students that, similar to constructing explanations, this is a practice that takes time to develop.

Chapter Four: Zebra Mussels

In chapter four students continue to explore the ways in which competition and resource availability affect populations and ecosystems, engage in the scientific practices of analyzing and interpreting data and of constructing scientific arguments, and the crosscutting concepts of stability and change and cause and effect. However, the focus expands to include the effects of changes on physical or biological components of ecosystems as they explore the effects of an invasive species on ecosystems and ecosystem services. The three dimensions are assessed formatively throughout the chapter, and the summative assessment of the performance expectations occurs in the final evaluate activity. Key aspects of the assessments in each activity are outlined in the table below, as well as general guidelines for what might be expected in student responses and suggestions for providing feedback. Note that the table below only includes the opportunities to assess the main aspects of the three dimensions of the primary PE for this chapter. A number of other assessment opportunities are highlighted in the Assessment Overview found and may be applicable depending on the focus of instruction for the chapter.

Activity	Assessment Focus	What to Expect/Encourage
1. Engage	Elicit students' initial ideas about the DCIs (Steps 7 ✓ & 10 ✓✓ and Analysis 1 ✓✓)	Students revisit the familiar concepts of food webs and flow of matter and energy, with the additional layer of complexity of the disruption caused by an invasive species. Encourage students to share ideas without any formal assessment or correction at this point.
2. Explore	Formative assessment of students' understanding of stability and change in ecosystems. (Steps 7 ✓✓ and Analysis 1-3 ✓✓)	Students have an opportunity to make predictions about how the invasive zebra mussel will affect specific abiotic and biotic factors in the short term in an ecosystem. These topics will be revisited in the next two activities on differing time scales. Focus on informally assessing students initial ideas and predictions, and helping them develop testable questions (Step 7).
3. Explain	Informally assess students' ability to develop a scientific argument using a Walking Debate. (Step 11 ✓) Assess their growing understanding of stability and change in ecosystems. (Analysis 1 ✓)	In this activity students test their predictions from Activity 2. Using this data and information from a reading to support their ideas in a walking debate provides an informal opportunity to assess students' ability to obtain data from multiple sources and use that data in a scientific argument. Focus on students' supporting each other in combining data from different sources to support their arguments.
4. Elaborate	Formative assessment of students' analysis of long-term data on the effects of zebra mussels. (Step 11 ✓✓) Formal development of a scientific argument. (Step 14 ✓)	Students have an opportunity to construct an explanation and develop an argument in this activity. Consider completing one of these steps through a small group discussion or as a class and focusing on the other as a more

		formal assessment opportunity. Students should be more comfortable with both practices at this point in the unit.
5. Evaluate	Students' are assessed on the performance expectations in this activity. (Step 1    and Analysis 2   )	Students' have been practicing analyzing patterns of interactions throughout the chapter and unit, and a summative assessment is appropriate for both the DCIs and CCCs. Assessment of and feedback on students' arguments should focus on specific areas where students need improvement, as they have had multiple opportunities to develop arguments at this point. Consider giving students the opportunity to rewrite their arguments after they receive feedback.

Chapter Five: Designing Solutions

In chapter five students evaluate design solutions for maintaining biodiversity and ecosystem services, and design their own methods for monitoring and minimizing human impact on the environment which incorporates the scientific practices of evaluating design solutions and applying scientific principles to design, and the crosscutting concepts of small changes causing larger changes and the broader concept of cause and effect. The three dimensions are assessed formatively throughout the chapter, and the summative assessment of the performance expectations occurs in the final evaluate activity. Key aspects of the assessments in each activity are outlined in the table below, as well as general guidelines for what might be expected in student responses and suggestions for providing feedback. Note that the table below only includes the opportunities to assess the main aspects of the three dimensions of the primary PE for this chapter. A number of other assessment opportunities are highlighted in the Assessment Overview found and may be applicable depending on the focus of instruction for the chapter.

Activity	Assessment Focus	What to Expect/Encourage
1. Engage	Elicit students' initial ideas about the SEPs and CCCs (Steps 7 ✓ & 8 ✓✓)	Students are introduced to an environmental problem and multiple solutions with pros and cons. Encourage students to think carefully about the advantages and disadvantages of each proposed solution. Emphasize that there is no single "correct" choice.
2. Explore	Formative assessment of students' understanding of how change in one area can affect another area. (Analysis 1 ✓ & 3 ✓✓✓)	In this activity students will have different experiences based on which event cards they draw and what decisions they make. This provides students with a variety of cause and effect scenarios to analyze. Continue to encourage students to analyze the advantages and disadvantages of different choices being made and how those choices affect both the immediate and more distant ecosystems. Students ideas are still developing.
3. Explain	Informally assess students' developing understanding of designing solutions including evaluating designs (Steps 6 ✓ & 10 ✓✓✓), identifying criteria and constraints (Analysis 1 ✓ & 2 ✓✓)	In this activity students conduct a deeper analysis of possible solutions to the problem introduced in Activity 1. Be sure students are able to identify and differentiate between criteria and constraints.
4. Elaborate	Formative assessment of students' designing solutions for environmental problems (Steps 8 ✓✓✓ & 9 ✓✓✓ and Analysis 1-3 ✓✓)	Students have an opportunity to design their own solutions to environmental problems. Students may still need some support identifying criteria and constraints or analyzing advantages and disadvantages of proposed solutions. These will be formally assessed in the next activity.

5. Evaluate	Students' are assessed on the performance expectations in this activity. (Steps 4    & 6   )	Students' have been practicing evaluating design solutions and developing their own solutions, and a summative assessment is appropriate for both the DCIs and CCCs. These should be considered developing practices at this point, and it would be appropriate to apply these practices in future units within other contexts to allow students continued opportunities with these practices.
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Section Two: Summative Assessments in *Disruptions in Ecosystems*

This section describes the three-dimensional aspects of the summative assessments for each chapter. There are two summative assessments in each Chapter, an embedded assessment in the Evaluate activity at the end of the chapter, and an end-of-chapter assessment that has been designed to probe understanding of the PE regardless of the curriculum. Annotated versions of both the Evaluate activity and the end-of-chapter assessments follow.

Activity 1.6

While this is the summative activity and assessment for this chapter, students will continue to develop their ability to construct explanations and arguments based on evidence throughout the unit.

Evaluate: Disrupting Ecosystems with Wolves

The scenario presented in the introductory text and graph provide students with a connection to previous activities and engage them in the task by presenting a problem that they will be analyzing.

As you have seen, changing biotic and abiotic factors can affect an ecosystem in many ways. For example, the number of elk in the Greater Yellowstone Ecosystem increased greatly after the wolves were gone. The reintroduction of wolves to Yellowstone contributed to a smaller elk population, as shown in Figure 1 below. Other factors, including disease, severe winter weather, drought, and hunting, also played a role in decreasing elk populations.

In many parts of the United States, white-tailed deer populations are at very high levels. Is it time to reintroduce a predator such as the wolf?

Figure 1.
Wolf and Elk Populations, 1994–2014

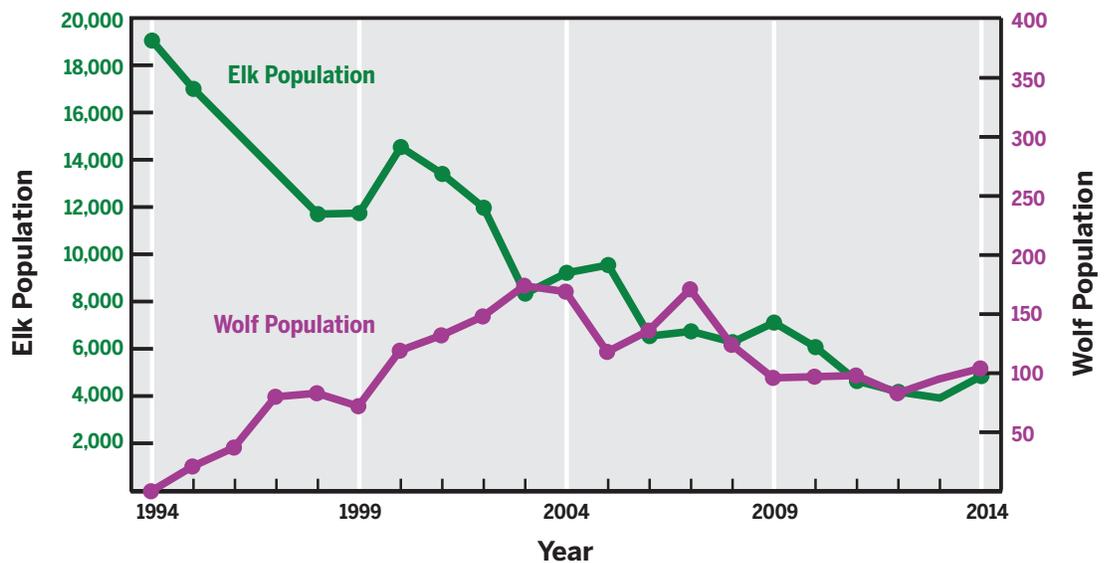


Figure 1. Wolves were reintroduced into Yellowstone in 1995, and they have been counted every year since. Elk counts were made in and near the northern border of the park during the winter. There are no elk data for 1996 and 1997 because of weather.

Guiding Question

Should wolves be reintroduced into the northeastern United States?

Materials

For each student:

- 1 Handout 1.6-1, “DART: Reading Support for Activity 1.6”
- Explanation Tool

The DART (Direct Activity Related to Text) provides scaffolding as students analyze the text portion of the activity. For English Language Learners or struggling readers it may be appropriate to have them do the reading aloud as a class, in small groups, or in pairs.

Procedure

The Explanation Tool provides scaffolding as students prepare to construct their explanations. This is the second use of formal, written scientific explanations in the unit, so it may be appropriate to have students work in pairs or small groups as they use the tool, particularly prior to writing the full explanation. It may also be appropriate to provide sentence starters or other supports as students use the Explanation Tool.

Part One: Interactions between Deer and Wolves

1. Use Handout 1.6-1, “DART: Reading Support for Activity 1.6,” with the reading on the following pages.

Part Two: Developing an Explanation

2. Use information from the reading and the Explanation Tool to construct a scientific explanation answering the question “What effect does a large population of deer have on an ecosystem?” Use the steps below to guide you as you use the Explanation Tool.

The 3-dimensional task requires students to analyze patterns of interactions in ecosystems to construct an explanation.

- **Question:** Record the question “What effect does a large population of deer have on an ecosystem?”
- **Evidence:** Examine information and data from the reading.
- **Science Concepts:** List any science concepts that are connected to the evidence and might help answer the question.
- **Scientific Reasoning:** Describe the scientific reasoning that connects the evidence and science concepts to the question you are trying to answer.
- **Claim:** Based on the evidence of patterns in the data and on your scientific reasoning, state your claim about the effect of a large population of deer on an ecosystem.

Part Three: Using Evidence

3. Use information from the reading, what you have learned in this chapter, and your Explanation Tool to decide:
 - Should wolves be reintroduced into the northeastern U.S. Adirondack ecosystem? Why or why not?
4. Participate in a walking debate with your class to see what others think about this issue. Discuss your points of view, supporting your ideas with scientific evidence from this unit. You may also want to add ideas to your class KWL chart.

This portion of the activity is an introductory opportunity to bring in the practice of developing arguments, incorporating what they have learned in the activity and in particular the explanations they developed based on evidence from this activity and the rest of the chapter.



The reading provides evidence for students to analyze and use in their explanations in Step 1 and arguments in the Walking Debate (Step 3) and helps students reach a deeper understanding of the scenario and problem being presented. The integration of visuals aids readers in making deeper meaning from the text.

Populations of Deer

In this chapter, you have closely examined the Greater Yellowstone ecosystem. People often think of the animals in this ecosystem as living only in the western U.S. At one time, many of these animals existed in large numbers in other parts of the U.S. For example, bears, wolves, elk, and moose were found across the northern states. Today, black bears and moose can still be found in upstate New York and other northeastern states.

One species that thrives in much of the U.S. is deer. White-tailed deer in particular have been successful in the absence of predators. You may have heard of white-tailed deer because it is a host animal for the blacklegged tick, also known as the deer tick. This tick sometimes carries Lyme disease, which can be transmitted to humans when they are bitten by an infected tick. Lyme disease is a growing problem, especially in the Northeast and upper Midwest.

The white-tailed deer population was estimated to be over 30 million a few hundred years ago. Deer, as well as the wolves that ate them, were hunted almost to extinction in the early part of the 20th century. Deer populations recovered when wildlife protections were put into place and predator populations remained low. Today, large deer populations mean that hunters can apply for licenses to kill deer during certain times of the year.

Figure 2.
Number of Deer Intentionally Killed by People, 2000–13

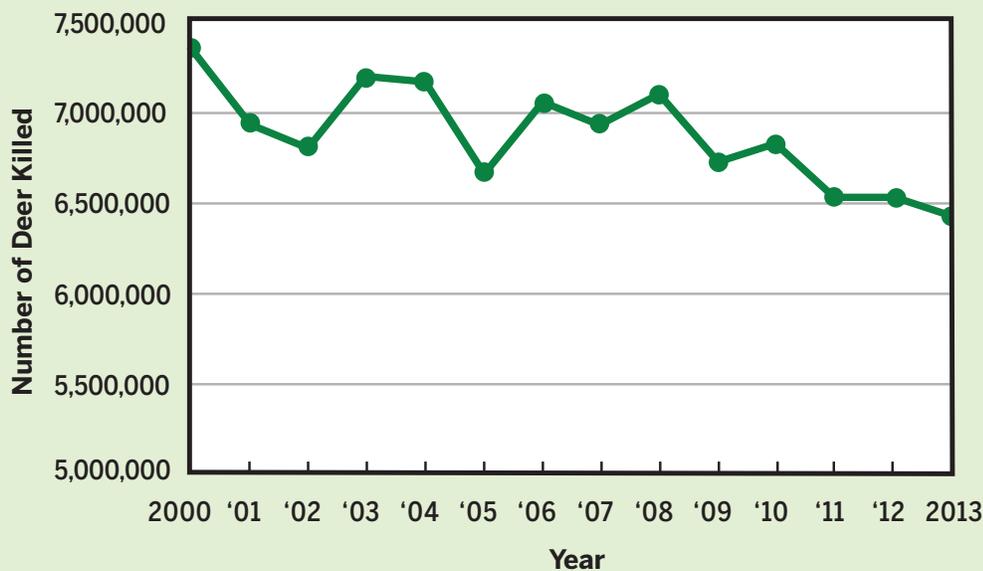


Figure 2 shows that the number of deer killed in 2000 was over 7 million, which dropped to just under 6.5 million in 2013. This represents a 12.6% drop in killed deer.

Deer Within an Ecosystem

Today, white-tailed deer are found throughout North America, from Canada to Mexico. In the northeast, bobcats, coyotes, and black bears eat deer, usually scavenging dead deer. Bobcats and coyotes also hunt them in the winter when the deer are tired and slowed by deep snow. However, these interactions are not enough to reduce deer populations.

White-tailed deer usually live at the forest edge, and are often found in fields and grasslands during summer months. They eat



Trillium

plant leaves, twigs, buds, nuts, and fruits and vegetables. They do not eat grass. The deer scatter seeds in their droppings, spreading certain plant species like *Trillium* (at left) up to 3 kilometers from their original site.

White-tailed deer eat about 3% of their body weight per day, which can be 1–5 kilograms (2–10 pounds) of plant material a day. When large numbers of deer are concentrated in an area, their feeding can affect the local ecosystem, reducing the diversity of plants and small animals. As you can see in the photos below the healthy forest (on the left) has new plant growth on the forest floor as well as on the lower layers of the forest. The forest on the right shows signs of overgrazing. Numerous studies have shown that this can occur when large numbers of herbivores such as deer are feeding in one area.



The healthy forest at left has typical plant life on the forest floor. The overgrazed forest at right lacks young trees, shrub, and other plants typical of a healthy forest.

Deer can also affect the number of songbirds in a forest. Some songbird populations eat or nest in the same trees and shrubs that are consumed by deer. One study found that bird counts across the U.S. showed that high populations of deer correlated with declining populations of certain songbird species.

People and Deer

Hungry deer are not restricted to wild ecosystems. Urban and suburban areas with high deer populations routinely have problems with deer eating flowers, vegetables, shrubs, and other neighborhood plants. It is estimated that they cause about \$250 million in damage to these environments, as well as another \$100 million in damage to cropland.

By far the greatest damage results from collisions between deer and cars. On average, over one million such collisions occur each year. This can sometimes result in human injury or death as well as the death of the deer. Damage to cars involved in deer collisions is estimated to be 1-4 billion dollars a year.

Controlling Deer Populations

Hunting is one way to control deer populations. White-tailed deer are one of the most commonly hunted species in the U.S., with approximately six million deer killed each year. In most cases, the dead animals are used for food.



In addition to hunting to reduce deer populations, some people have proposed reintroducing wolves into areas such as the Adirondacks in upstate New York. The Adirondacks are a

mountainous area inside Adirondack Park, the largest preserve in the lower 48 states and considerably larger than Yellowstone National Park.

The park contains mountains, lakes, rivers, forests, and many types of plants and animals. The park covers about 6 million acres, of which 45% is protected public land. Much of the private land is used for agriculture, forestry, and open space. There are 105 towns and villages within the park, and over 60 million people live within a day's drive of the park.

Analysis

This analysis item allows students to begin to analyze evidence used to develop a scientific argument, a practice they will be working on in later chapters.

1. In this activity, you investigated the question, "Should wolves be reintroduced into the northeastern U.S. Adirondack ecosystem?"
Some students may have argued that wolves should be reintroduced, while other students may have argued that wolves should not be reintroduced. As a class, discuss:
 - a. What scientific evidence supports each side of this debate?
 - b. Discuss the quality and strength of the evidence that supports each side.

Name _____

This information is intended to provide the student with the background information needed to identify the patterns of interactions in this ecosystem.

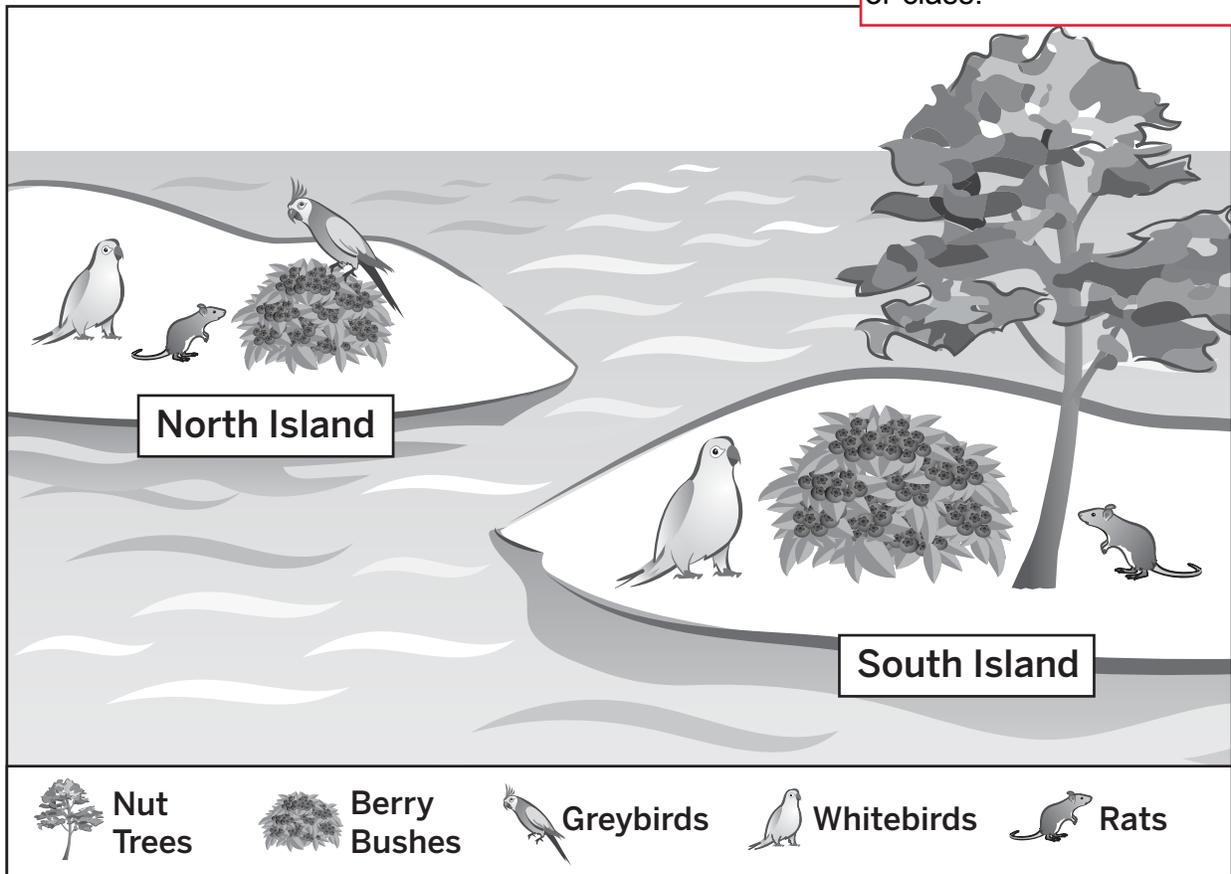
Chapter 1 Assessment

1. Graybirds and whitebirds live on North Island. Both types of birds eat the berries of the berry bush. The seeds of the berry bush grow best after the berries are eaten by birds and dropped elsewhere around the island.

Whitebirds are also found on nearby South Island. The whitebirds on South Island eat berries and the nuts of the nut tree.

Rats are found on both islands. The rats eat berries and bird eggs.

For English Language Learners or students with reading difficulties it may be appropriate to read the ecosystem description aloud to the student or class.



Chapter 1 Assessment

page 2

Question 1a provides students with an opportunity to demonstrate understanding of the DCI MS LS2-1.4. Requiring students to explain their choices allows them to demonstrate their reasoning.

1a. Identify examples of competition, predator-prey, and mutualism between species on each island.

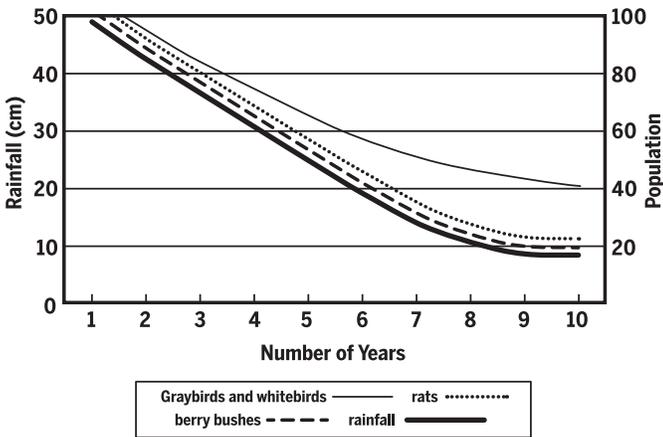
North Island	South Island
Example of competition: Why is this an example of competition?	Example of competition: Why is this an example of competition?
Example of predator-prey: Why is this an example of predator-prey?	Example of predator-prey: Why is this an example of predator-prey?
Example of mutualism: Why is this an example of mutualism?	Example of mutualism: Why is this an example of mutualism?

Chapter 1 Assessment

page 3

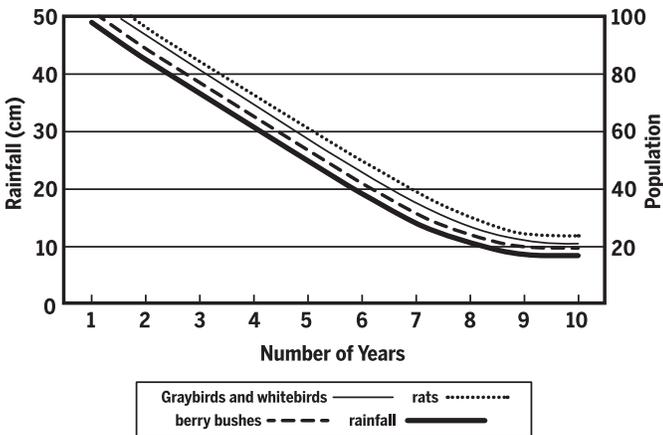
Name _____

1b. Berry bushes need lots of rainfall. Make an X in the box next to the graph below that best predicts what would happen to the populations on the **North Island** during a 10-year period of decreasing rain. Using the space to the right of the other two graphs, explain why these graphs are not the best predictions of what would happen during the period of decreasing rain. You do not need to write anything next to the graph you chose as the best prediction.

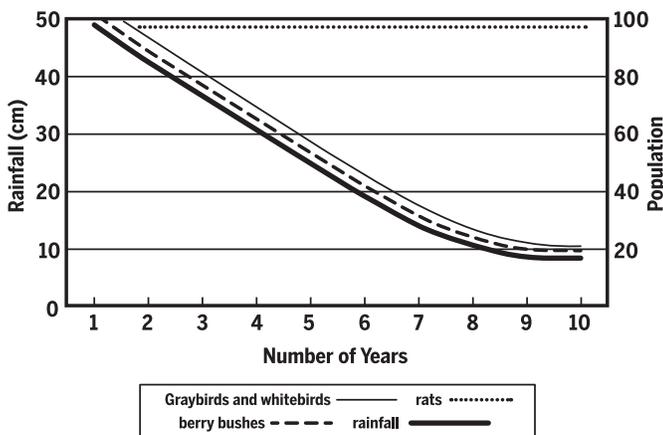


A.

This scenario provides students with a problem to analyze, giving them an opportunity to engage with the task. Responding to the task requires students to use the practices of analyzing and interpreting data and constructing explanations to demonstrate their understanding of the crosscutting concept of patterns and of the patterns of interactions in the ecosystem (the DCI).



B.



C.

Chapter 1 Assessment Student Checklist

This scaffold provides students with a simple support to help them double-check that their responses are complete.

1a. Describes 6 relationships

1b. An X is in one of the boxes

There is an explanation next to one of the incorrect graphs

There is an explanation next to the other incorrect graph

1c. Claim

Evidence (numbers or trends from graph)

Science Concept

Reasoning

Evaluate: Modeling Energy Flow and Matter Cycling in an Ecosystem

So far in this chapter, you have worked to develop models to explain the movement of energy and matter in the Yellowstone Ecosystem. In this activity, you will construct a model of your local ecosystem to predict how the flow of energy and cycling of matter might be affected by various disruptions.



Challenge

How can a model be used to represent and make predictions about an ecosystem?

Materials

For each group of four students

- A variety of materials, supplied by your teacher

For each student

- Explanation Tool

Procedure

1. You will work with your group to construct a model of your local ecosystem. Your teacher will explain the materials available to you as you make your model.
2. Brainstorm organisms that live in your area, and use them to develop a food web that includes at least:
 - 2 producers
 - 2 consumers that eat producers
 - 2 consumers that eat other consumers or a combination of consumers and producers
 - 1 consumer from the top of the food chain
 - 1 decomposer
 - the ultimate source of energy for your ecosystem

You may include more organisms if there are available materials and you have enough time.

3. Gather the materials you need to create your model.
4. Record your food web in your science notebook. Be sure to include arrows showing what eats what.
5. Construct a model of an ecosystem. Use the materials to:
 - a. label producers, consumers, and decomposers.
 - b. show the cycling of matter between the biotic and abiotic parts of your ecosystem.
 - c. show the flow of energy between the biotic and abiotic parts of your ecosystem.

Steps 5 & 6 require students to develop a model that describes the cycling of matter and flow of energy among living and non-living parts of an ecosystem.

- d. include a key if needed.
6. Present your model to the class, making sure to:
- a. describe what happens to the total amount of matter within your ecosystem.
 - b. describe what happens to energy after it enters the ecosystem.

Analysis

1. Imagine that a science museum is making a very large version of your model for a museum display. Write three captions explaining the model for members of the public who will view the display. The captions should describe:
 - a. interactions between living organisms.
 - b. the cycling of matter between abiotic and biotic parts of the ecosystem.
 - c. the source, flow, and loss of energy from abiotic and biotic parts of the ecosystem.
2. Using the Explanation Tool, construct a scientific explanation for the following. A disease kills off the consumers in the top level of the Yellowstone ecosystem. Predict how the flow of energy and the cycling of matter would be affected both in the short term and in the long term. Use the steps below to guide you as you use the Explanation Tool.

This Analysis item provides students with the opportunity to further develop their skills with constructing a scientific explanation. While this practice is not a focus of this chapter, students used this practice in Chapter 1 and will continue to use it throughout the rest of the unit so this provides continuity and sustained experience with the practice.

The Explanation Tool provides scaffolding as students prepare to construct their explanations. This is the second chapter where formal, written, scientific explanations are part of the unit, so at this point it may be appropriate to have students work individually. Depending on your students, you may still wish to provide sentence starters or other supports to some or all students as they use the Explanation Tool.

- **Question:** Record the question “What would happen to the flow of energy and cycling of matter if a disease killed off the top level of the Yellowstone ecosystem?”
- **Evidence:** Use evidence from this chapter that helps you to answer this question.
- **Science Concepts:** List any science concepts that are connected to the evidence and might help answer the question.
- **Scientific Reasoning:** Describe the scientific reasoning that connects the evidence and science concepts to the question you are trying to answer.
- **Claim:** Based on the evidence of patterns in the data and on your scientific reasoning, state your claim about the effects of the ash cloud on matter, energy, and organisms in the ecosystem.

Note that while this is the summative assessment for developing explanations in this chapter, students will continue to develop their ability to construct explanations and arguments based on evidence throughout the unit.

The task is presented as a bulleted list to make sure students recognize all aspects of the task.

Question 1 provides students with an opportunity to demonstrate understanding of the DCI MS LS2.B, and the SEP of developing and using models.

Chapter 2 Assessment

1. The tables below lists organisms in a grassland ecosystem.

- In the box on the next page, **draw a model of this ecosystem** that shows the cycling of matter.
- Use arrows to show how **matter** moves between organisms in the ecosystem.
- Write a caption below your model that explains how matter cycles in the ecosystem.

Biotic components for your model:

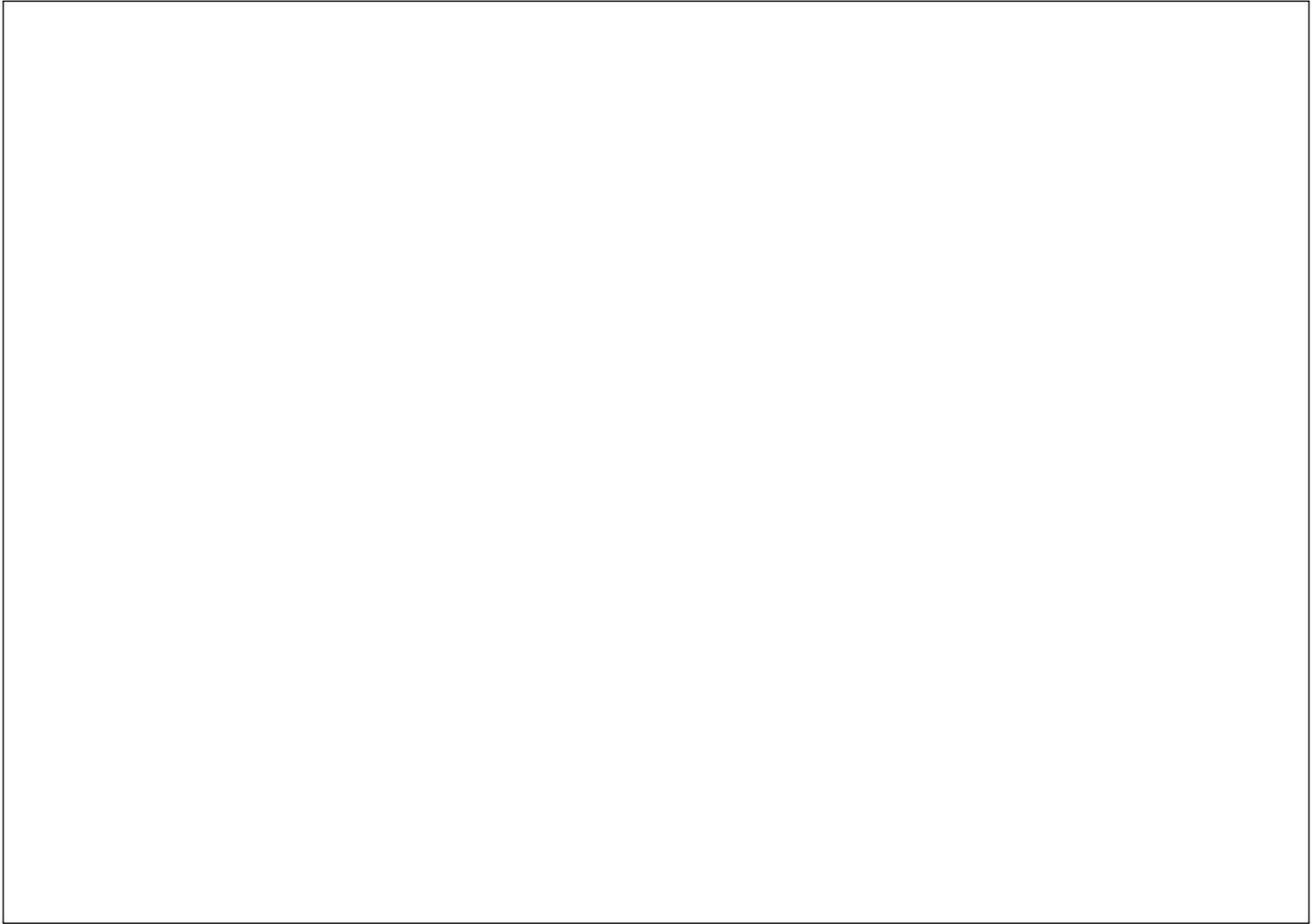
Make a check mark if it is in your model	Organism	What It Eats
	Grass	Makes its own food
	Grasshoppers	Grass
	Garter snakes	Grasshoppers
	Eagles	Garter snakes
	Decomposers (mold/bacteria/fungi)	Dead and decaying organisms

Prompting students to check each component of their model helps ensure they have understood and completely responded to the prompt.

Abiotic components for your model:

Make a check mark if it is in your model	Component
	CO ₂ (carbon dioxide) in air
	H ₂ O (water)
	Soil

Ecosystem Model (Version B)



Caption:

Chapter 2 Assessment

page 3

The scenario provides students with a problem to analyze, giving them an opportunity to engage with the task. Responding to the task requires students to use the practices of using models and constructing explanations to demonstrate their understanding of the crosscutting concept of energy and matter flow and cycling in the ecosystem.

2. Suppose there was a large volcanic eruption and a thick cloud of ash blocked most sunlight from reaching the ecosystem for several months. Use the model you made in Part 1 to construct an explanation for what would happen in the ecosystem.

Construct a complete scientific explanation that answers the question, “How would an ash cloud from a volcano affect the *cycling of matter* in the ecosystem?”

Your explanation should include the following:

- The scientific question
- Your claim
- The relevant evidence that supports your claim (use evidence from your model)
- The science concepts that support the evidence
- Your scientific reasoning that links the evidence and science concepts to the claim

The framing of the question provides scaffolding for students who are less familiar with the practice of constructing explanations. Additional scaffolding could include having students discuss the scenario and data analysis in pairs or small groups before constructing their written explanation. The Explanation Tool used with this curriculum could provide additional scaffolding.

Chapter 2 Assessment Student Checklist

This checklist is provided as a support to assist students in reviewing their answers for complete responses.

1. Model includes all biotic components listed.
- Model includes all abiotic components listed.
- Arrows show the movement (cycling) of matter.
- Caption explains how matter cycles through the ecosystem.

2. Claim
- Evidence (cite specific relationships in the ecosystem model)
- Science Concept(s)
- Reasoning

Evaluate: Chesapeake Bay Oysters

The scenario presented in the introductory text and graphic provides students with a connection to previous activities and engages them in the task by presenting a problem that they will be analyzing.

Eastern Oysters are one of the most important organisms in the Chesapeake Bay ecosystem. The oysters are part of the food web, and they filter the water of the Bay. The oyster fishery is also very important to the area's economy. One hundred years ago Chesapeake Bay was the world's largest oyster-producing area, with fishers harvesting more oysters than all other countries combined. However, the oyster population has been overfished and the amount of oysters available to harvest has decreased dramatically. In this activity you will investigate how this has affected the Chesapeake Bay ecosystem.



Guiding Question

How do increases in the human population affect the resources available to organisms?

Materials

For each student:

- Argument Tool

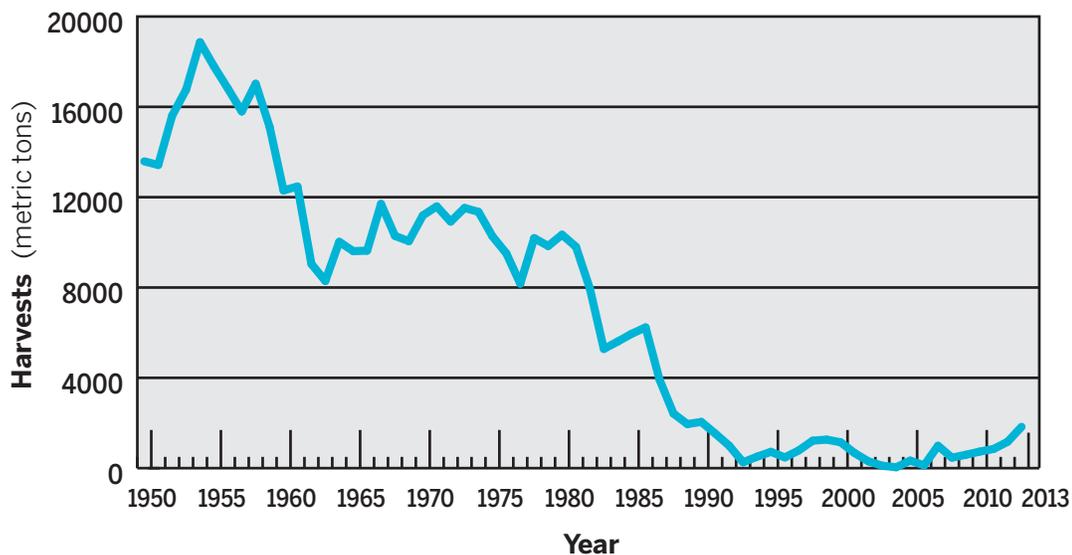
Procedure

Part A: Oysters in Chesapeake Bay

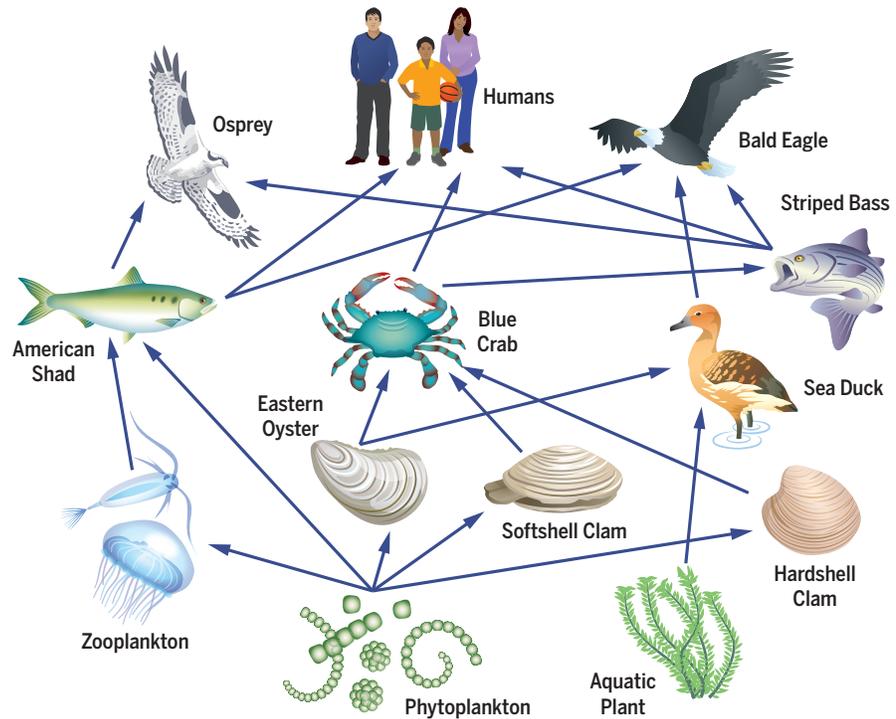
1. With your partner, examine the graph below of the harvests of oysters in the Chesapeake Bay. Discuss what this information suggests about what has happened to the oyster population over time.

Analysis of graphs and other information in this activity provides opportunities to assess students on the practice of analyzing and interpreting data, a key focus in this chapter.

Oyster Harvests in Chesapeake Bay



- Using the food web below, identify two organisms that compete with the Eastern Oyster for resources in the Chesapeake Bay ecosystem.



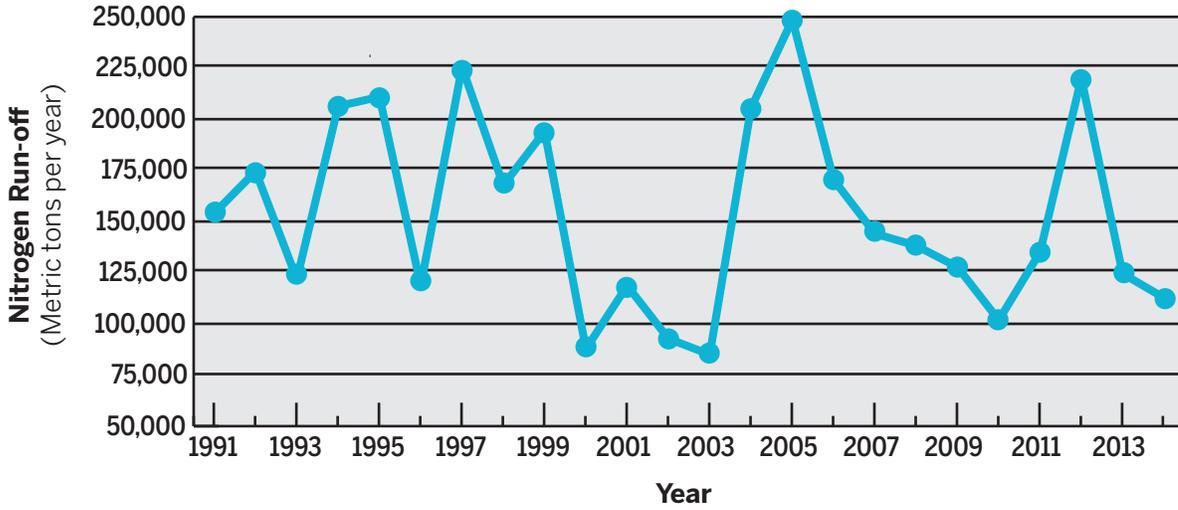
- With your partner, discuss the following:
 - How might the changes in the oyster population affect other organisms in the ecosystem?
 - How might this affect the rest of the ecosystem?
- Follow your teacher's directions to share your discussion with your class.

Part B: Changes in the Chesapeake Bay Ecosystem

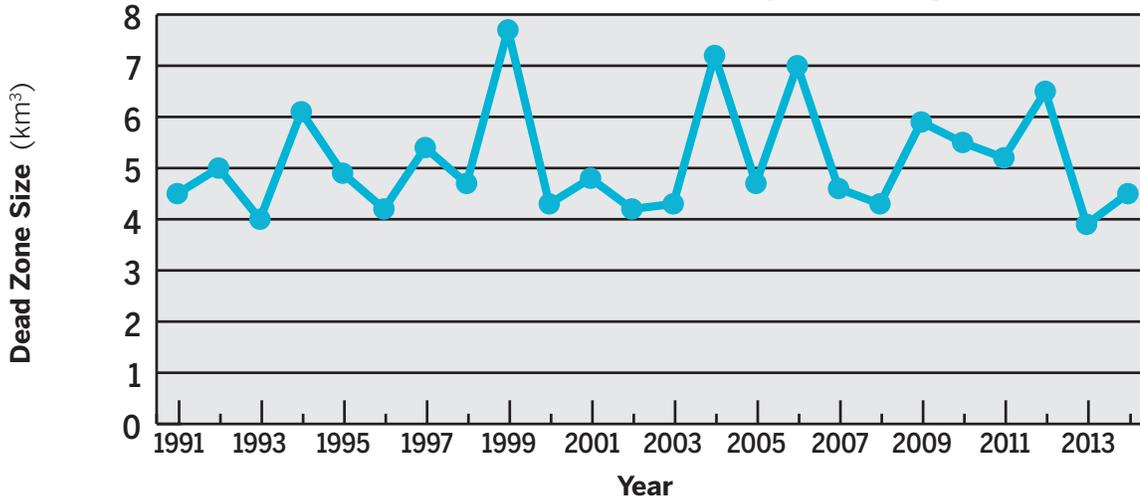
One of the important roles of the oysters is to filter the water in the Bay. As they filter the water they remove nutrients and other matter. One of the biggest challenges for the Chesapeake Bay ecosystem in recent years is the appearance of dead zones. There are farms surrounding the Bay, and the run-off from these farms is the primary source of nutrients that cause phytoplankton populations to increase. This can lead to an increase in the size of dead zones. In general, as the human population increases, so will the number of farms and the amount of fertilizer that becomes run-off.

- With your partner, examine the following three graphs. For each graph identify and discuss any patterns or trends you see in the graphs.

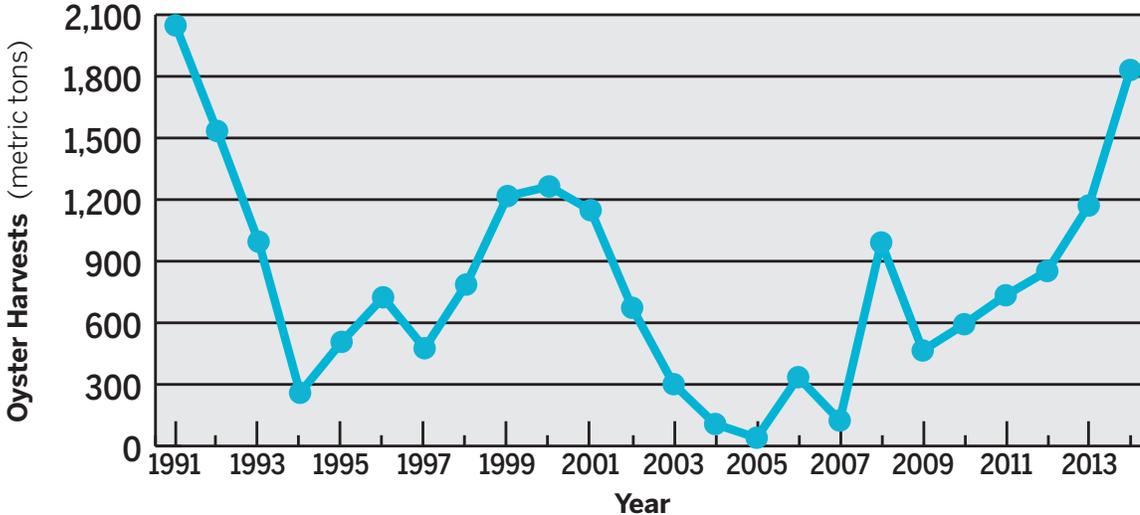
Annual Nitrogen Run-off in Chesapeake Bay



Total Size of Dead Zones in Chesapeake Bay



Annual Oyster Harvests in Chesapeake Bay



This step requires students to combine their analysis and interpretation of data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem with the construction of an argument supported by evidence for how increases in human population impact Earth's systems (the DCI).

- Using the Argument Tool, construct a scientific argument about whether an increasing human population in the Chesapeake Bay area is affecting the number of oysters in the Bay. Use the list below to guide you as you use the Argument Tool.

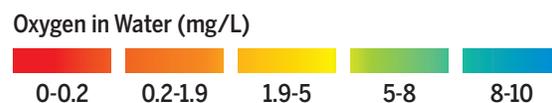
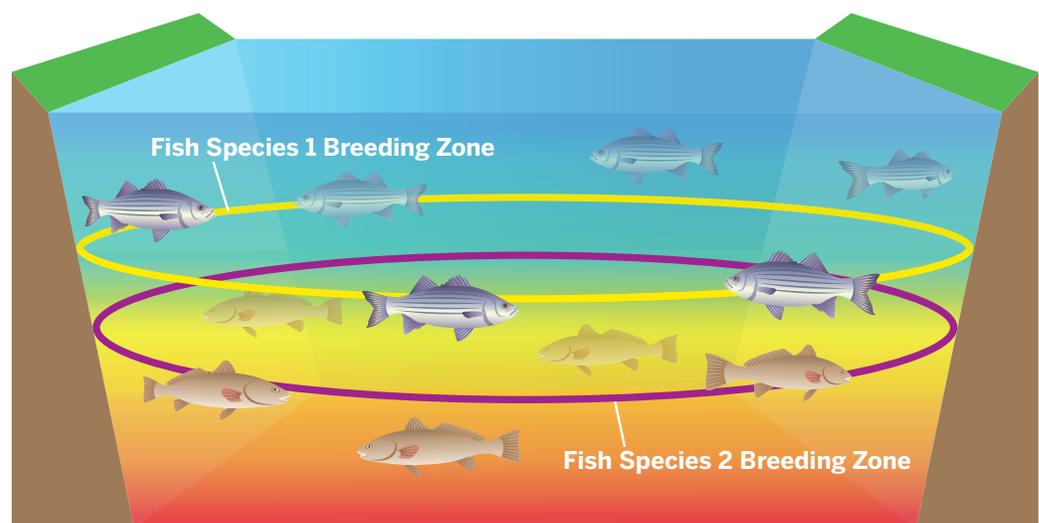
- Question:** Record the question "Is an increase in the human population in the Chesapeake Bay area affecting the number of oysters in the Bay?"
- Claims:** Record the two possible claims that could be made in response to the question.
- Evidence:** What evidence supports each of the two claims?
- Science Reasoning:** For each claim, critique the quality and strength of evidence that supports the claim.

The Argument Tool provides scaffolding as students prepare to construct their arguments. This is the first formal assessment of students' arguments in the unit, so it may be appropriate to have students work in pairs or small groups as they use the tool, particularly prior to writing the full explanation. It may also be appropriate to provide sentence starters or other supports as students use the Argument Tool.

Note that while this is the summative assessment for developing arguments in this chapter, students will continue to develop their ability to construct explanations and arguments based on evidence throughout the unit.

Analysis

- Suppose two species of fish that live in a pond only reproduce during July. For the fish to breed and hatch, there must be at least 2 mg of oxygen in the water. Based on the diagram below, answer the following questions.
 - Which resources will the two species need in order to breed successfully?
 - What effect might this competition have on the populations of the two fish, both long- and short-term?



Question 1 provides students with an opportunity to demonstrate understanding of the DCI MS LS2.A 1-3, the practice of analyzing data, and the crosscutting concept of cause and effect.

The task is presented as a bulleted list to make sure students recognize all aspects of the task.

Chapter 3 Assessment

1. The table below shows the population of deer in a grassland ecosystem over a period of fifteen years. Use the information below and the table to help you answer the questions that follow.

- At the end of Year 4, 80% of the grassland is converted to farmland and fenced to keep the deer out.
- People do not hunt the deer.
- In Year 11, there is a very harsh winter and the deer have very little access to food.

Year	Deer Population	Average Mass (kg)	Number of deer births	% malnourished (severely underweight) deer
1	100	30	30	5
2	110	31	25	3
3	97	29	30	4
4	105	31	15	3
5	83	29	5	46
6	57	27	7	32
7	56	23	6	25
8	58	20	8	18
9	55	19	7	15
10	58	20	5	10
11	35	15	3	72
12	40	18	4	43
13	45	20	7	26
14	48	21	7	10
15	53	21	8	7

Chapter 3 Assessment

page 2

Question 1 provides students with an opportunity to analyze the data for two aspects of the scenario, which they can draw on as evidence for their scientific arguments in Question 2.

1a. Use the data to describe the effect of the grassland being converted to farmland in Year 4 on the deer population.

1b. Use the data to describe the effect of the harsh winter in Year 11 on the deer population.

2a. Construct a scientific argument that argues the question:

“Should the farmland be converted back to grassland?”

Question 2 gives students the opportunity to bring together their understanding of all three dimensions related to PE LS2-1.

Your argument should include the following:

- The scientific question
- Your claim (which is best supported by evidence and reasoning)
- The relevant evidence that supports your claim
- Scientific reasoning that critiques the evidence and evaluates your claim

The framing of the question provides scaffolding for students who are less familiar with the practice of constructing arguments. Additional scaffolding could include having students discuss the proposed change and their data analysis from Question 1 in pairs or small groups before constructing their written argument. The Argument Tool used with this curriculum could be used to provide additional scaffolding.

Chapter 3 Assessment

page 3

Name _____

2b. Imagine that you have a classmate who disagrees with your claim. What claim might your classmate make?

2c. What is the problem with your classmate's claim or the argument based on that claim?

Chapter 3 Assessment

Student Checklist

This checklist is provided as a support to assist students in reviewing their answers for complete responses.

- 1a. I have included **data from the table** that shows what happens to the deer population after Year 4
- 1b. I have included **data from the table** that shows what happens to the deer population after Year 11
- 2a. Claim
 Evidence (numbers or trends from graphs or tables)
 Reasoning
- 2b. I have written a claim that is different than my initial claim
- 2c. I have pointed out a problem with the hypothetical classmate's claim or argument

Evaluate: A New Mussel in Town

The scenario presented in the introductory text and graphic provides students with a connection to previous activities and engages them in the task by presenting a problem that they will be analyzing.

Quagga mussels are an invasive species closely related to the zebra mussel. They arrived in the Great Lakes region a few years after the zebra mussels. Quagga mussels are now found in all of the Great Lakes.



In this activity you will examine data on the spread of the quagga mussel and compare it to data on the zebra mussel populations in one of the Great Lakes, Lake Michigan. You will compare this information to other data about biotic and abiotic factors in Lake Michigan and how those factors have changed as the quagga mussel has spread.



Guiding Question

Has the quagga mussel had a positive or negative effect on the Lake Michigan ecosystem?

Materials

For each student:

- Argument Tool

Note that while this is the summative assessment for constructing an argument in this chapter, students will continue to develop their ability to construct explanations and arguments based on evidence in the final chapter of the unit.

The Argument Tool provides scaffolding as students prepare to construct their arguments. This is the second formal assessment of students' arguments in the unit, so they may be comfortable using the tool independently. It may still be appropriate to provide sentence starters or other supports as students use the Argument Tool.

Procedure

Constructing an Argument

1. Using data from the information items that follow, the concepts you have learned in this chapter, and the Argument Tool, construct a scientific argument about whether the quagga mussel has had a positive or negative effect on the Lake Michigan ecosystem. Use the list below to guide you as you use the Argument Tool.

- **Question:** Record the question “Has the quagga mussel had a positive or negative effect on the Lake Michigan ecosystem?”
- **Claims:** Record the two possible claims that could be made in response to the question.
- **Evidence:** What evidence supports each of the two claims?
- **Science Reasoning:** For each claim, critique the quality and strength of evidence that supports the claim.

This Step requires students to analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in the ecosystem while constructing an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Information Item 1

Presenting information in three forms (text, graphs, and graphics) allows for the assessment of students' ability to analyze and interpret data in various forms including their interpretation of scientific text.

The Next Invasion: Quagga Mussels



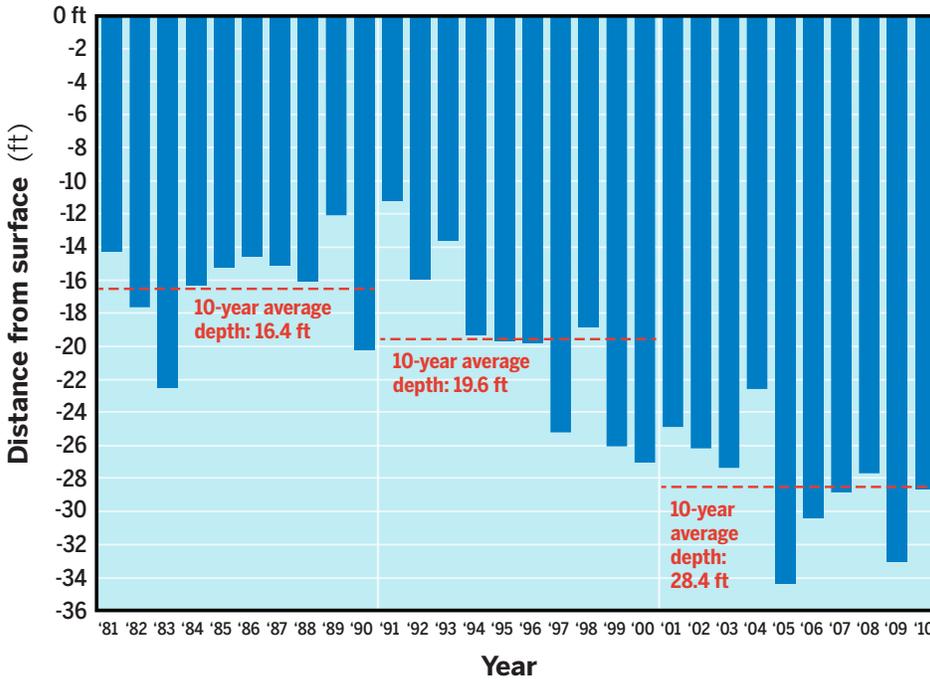
Quagga mussels and zebra mussels share many characteristics, but they also have important differences. They are both filter feeders, and can filter up to a liter of water per day. Both species produce up to a million eggs per mussel per year. Both species will attach to hard surfaces, and can clog water pipes and equipment at water treatment and power generation facilities. Zebra mussels can survive being out of water for longer than quagga mussels. However, quagga mussels can also live on sandy and muddy river and lake bottoms. They can live in deeper water and in a much wider temperature range than zebra mussels.

The quagga mussel's ability to live in deeper water allows them to filter the plankton from the water at the bottom of deep lakes. Scientists believe that the quagga mussels are competing for food with another species, diporeia. Diporeia are a small, shrimp-like organism that used to cover the bottom of many of the Great Lakes. Scientists used to find up to 20,000 diporeia per meter on the bottom of Lake Michigan. Now in some areas there are almost no diporeia left. Diporeia are an important food source for many fish in the Great Lakes, including the Whitefish, chubs, and smelt. Chubs and smelt are prey for trout and salmon. Trout, salmon, and Whitefish fisheries are important sources of income for many people.

Information Item 2

The graph below shows how the water clarity has changed over time in Lake Michigan. The bars indicate how far scientists are able to see into the lake from the surface of the water.

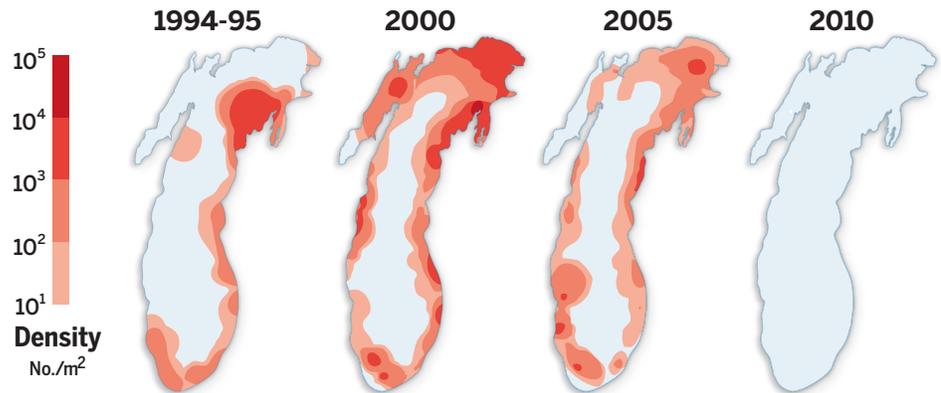
Water Clarity Over Time in Lake Michigan



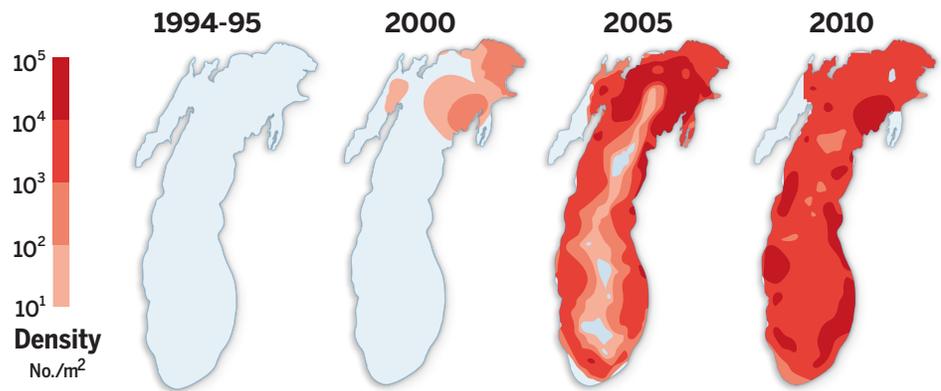
Information Item 3

The maps below show how the distribution of zebra mussels, quagga mussels, and diporeia has changed over time in Lake Michigan, one of the Great Lakes.

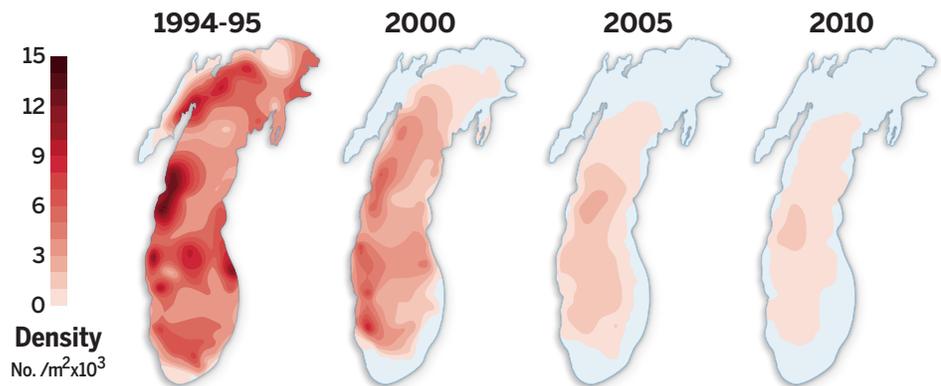
Lake Michigan Zebra Mussel Density



Lake Michigan Quagga Mussel Density



Lake Michigan Diporeia Density



Analysis

1. What additional information would have been useful to know in developing your argument?
2. Compare the change in distribution of the zebra mussels in Lake Michigan to that in the Hudson River over the last 20 years. Do you think that the changes have occurred because of the same reasons? Explain.

Extension

Are there any existing or new invasive species that your local community is worried about? Contact your local park or government officials to ask them if they are concerned about any existing, new, or potentially invasive species.

Name _____

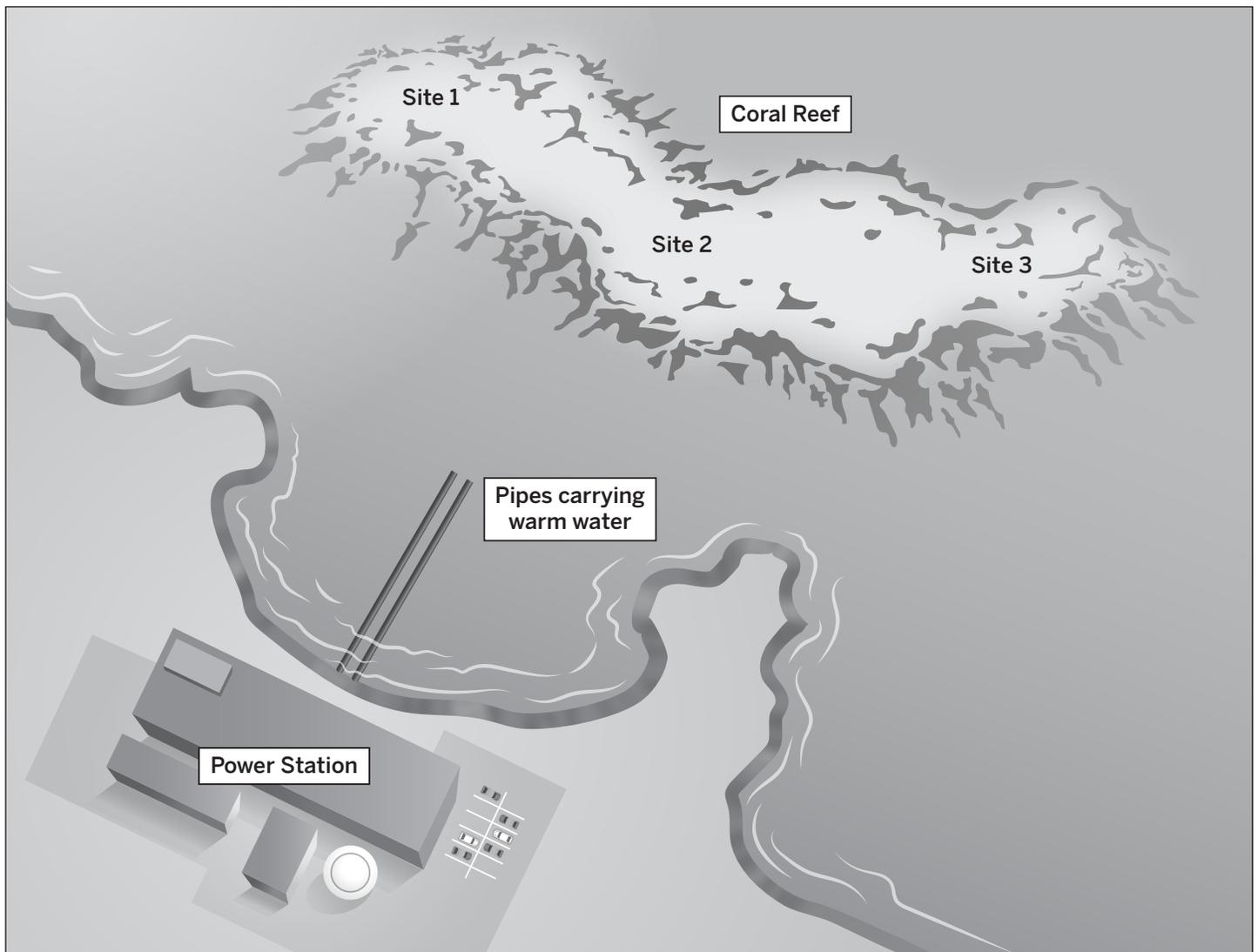
The scenario presented in the introductory text, diagram, and data tables engages students in the task by presenting a problem that they will be analyzing.

Chapter 4 Assessment

1. There is a large coral reef off the coast of an island. Many organisms find food and live in and around the coral reef. The local energy company has built a new power station to meet the energy needs of the growing island population. The power station produces warm water that must be released. Pipes have been built to release warm, clean water into the ocean and 1 kilometer from the edge of the reef.

Algae are an invasive species that can be found near the reef. They use sunlight to make food. When large amounts of algae grow together they can form algal mats. These mats can float on the surface of the water. The mats can block sunlight from reaching the coral reef. Like the algae, coral needs sunlight to grow.

The data tables on pages 2 and 3 show data about water temperature and reef populations in the years following the construction of the power station.



Data from Site 1

Year	Water Temperature (°C)	Size of Coral Reef (square meters)	Size of Algal Mats (square meters)	Total Number of Species living at Site 1 (not including algae)	Estimated Number of Organisms living at Site 1 (not including algae)
1	28	98	0	21	1,200
2	28	97	0	21	1,200
3	31	81	10	19	1,100
4	32	75	15	18	1,000
5	32	71	17	18	900

Data from Site 2

Year	Water Temperature (°C)	Size of Coral Reef (square meters)	Size of Algal Mats (square meters)	Total Number of Species living at Site 2 (not including algae)	Estimated Number of Organisms living at Site 2 (not including algae)
1	28	100	0	20	1,300
2	28	101	0	20	1,300
3	31	83	10	19	1,200
4	31	78	15	18	1,100
5	32	71	20	17	1,000

Data from Site 3

Year	Water Temperature (°C)	Size of Coral Reef (square meters)	Size of Algal Mats (square meters)	Total Number of Species living at Site 3 (not including algae)	Estimated Number of Organisms living at Site 3 (not including algae)
1	28	99	0	22	1,250
2	28	99	0	22	1,300
3	29	98	0	22	1,250
4	28	98	0	22	1,300
5	29	98	0	22	1,250

1. Describe the changes that occurred at the three coral reef sites.

	Describe the changes (if any)
Site 1	<div style="border: 1px solid red; padding: 5px;"> <p>Question 1 provides students with an opportunity to analyze the data, which they can draw on as evidence for their scientific arguments in Question 2. Visually separating student responses to each aspect of the question provides students with a simple scaffold to ensure their responses are complete.</p> </div>
Site 2	
Site 3	

2a. Construct a scientific argument that answers the question:

“Did the power station cause large changes in the populations of organisms living on the coral reef?”

Your argument should include the following:

- The scientific question
- Your claim (which is best supported by evidence and reasoning)
- The relevant evidence that supports your claim
- Scientific reasoning that critiques the evidence and evaluates your claim

← Question 2 gives students the opportunity to bring together their understanding of all three dimensions related to PE LS2-4.



The framing of the question provides scaffolding for students who are less familiar with the practice of constructing arguments. Additional scaffolding could include having students discuss the problem and their data analysis from Question 1 in pairs or small groups before constructing their written argument. The Argument Tool used with this curriculum could be used to provide additional scaffolding.

Chapter 4 Assessment

Student Checklist

The checklist is provided as a support to assist students in reviewing their answers for complete responses.

1. I have described changes to site 1
- I have described changes to site 2
- I have described changes to site 3

2. Claim
- Evidence (numbers or trends from graphs or tables)
- Reasoning

- 2b. I have written a claim that is different than my initial claim

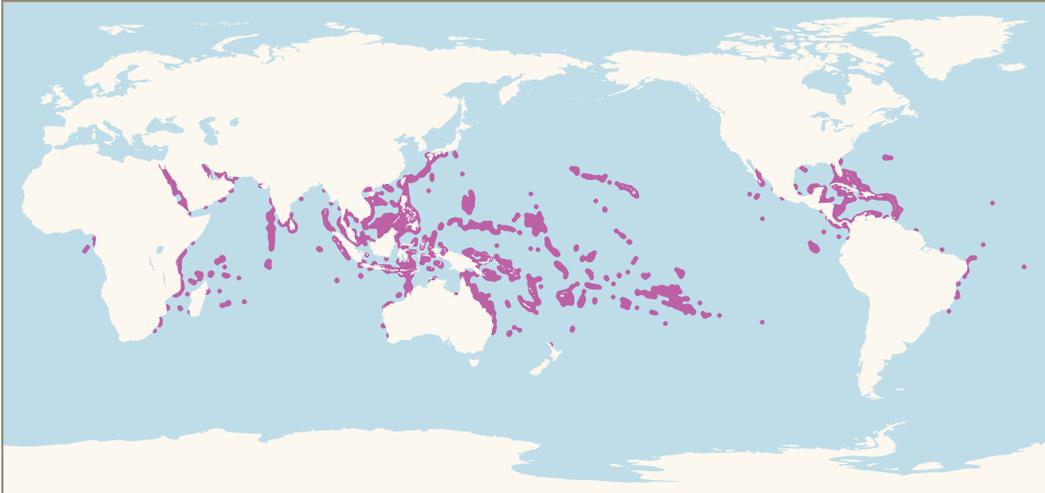
- 2c. I have pointed out a problem with the hypothetical classmate's claim or argument

Evaluate: Coral Reefs

The scenario presented in the introductory text and graphic provides students with a connection to previous activities and engages them in the task by presenting a problem that they will be analyzing.

Coral reefs make up a tiny fraction of the ocean floor but are home to about one million species. It is estimated that about one quarter of all marine organisms live in or near coral reefs. Reefs are important for more than their biodiversity. They help protect coasts from tropical storms, reducing erosion. They are breeding grounds and nurseries for many marine organisms. They also contribute billions of dollars to local economies through ecosystem services such as fishing, tourism, and recreation. However, coral reefs are fragile. Over the past 50 years more than a quarter of the world's reefs have been destroyed. The threats to coral reefs are many and varied. In this final activity you will look at some of these threats as you design and evaluate potential solutions.





Coral reef distribution

Guiding Question

How can the negative impact of humans on coral reefs be reduced?

Procedure

1. Use the Read, Think, and Take Note strategy as you complete the following reading on coral reefs.

Read, Think, and Take Note: Guidelines

As you read, stop at least three times to write one of the following:

- Explain a thought or reaction to something you read.
- Note something in the reading that is confusing or unfamiliar.
- Identify a word that you do not know.
- Describe a connection to something you learned or read previously.
- Make a statement about the reading.
- Ask a question about the reading.

Threats to Coral Reefs

Coral reefs are made up of millions of tiny invertebrate animals called polyps. Polyps rely on algae for their survival. The algae live inside the tissues of the polyps and are producers, capturing the energy of the sun. Most polyps use chemicals from the sea water to make a hard structure around them that they live in. It is these hard cases that make up coral reefs. Healthy coral reefs are full of color and life with many organisms making their homes in or near the reef.



A healthy coral reef

Coral reefs are also easily damaged and are under threat in many parts of the world. On a global level, climate change is causing some parts of the ocean to be warmer. It is also causing some parts of the ocean to become more acidic. These increases in temperature and acidity can damage or even kill the coral reefs. These global threats can be very difficult to address, because they require so many people all over the world to work together.

On a local level there are also a number of threats to coral reefs. These threats can often be addressed by the people living in the communities near the coral reefs. The large number and types of fish that live in coral reefs attract fishers. However, overfishing can



An unhealthy coral reef

cause the number of fish to go down. It can also cause the average size of the fish that are caught to decrease, as fish are caught at a younger age. In order to catch enough fish to feed their families and to sell, some people turn to destructive fishing techniques. One such technique is dynamite fishing, where explosives are thrown into the water. Both the explosion and the shockwaves kill or stun the fish in the blast area. This allows the fishers to collect a large number of fish in a short period of time. The explosion also causes great damage to the coral in the reef. In the end this reduces the amount of coral and the number of fish and other organisms in the area. Even when non-destructive fishing techniques are used, reefs can be harmed. If one or more species is overfished, the food web can become unbalanced. You read about one example of this in the last activity, with the crown-of-thorns sea star.

The beauty of coral reefs makes them an attractive destination for many people. The presence of tourists is important to the local economy as it benefits businesses, such as tour companies, hotels, and restaurants. Unfortunately, tourism can also cause problems for the reef ecosystem. When swimmers and divers stand on or even touch a reef, the coral can be damaged. This is even more of a problem when boats drop their anchors onto the reef. Boats can also

cause pollution with the gasoline and oil that they use. Development of the coast causes an indirect threat to reefs that are nearby. As roads, hotels, and other buildings are constructed, debris and sediment can wash into the ocean and smother the reef. Sediment can also reduce the clarity of the water, which affects the ability of the algae to capture the energy of the sun. Nutrients from substances such as fertilizer can be washed from coastal developments into the ocean. This can cause weed-like algae to grow quickly and overgrow a reef. An increase in the nutrients in the water also allows more of the young crown-of-thorns sea stars to survive and become adults.

Note that the Teacher's Guide provides suggestions for scaffolding this step including using the handout previously used in Activity 5.3 to help students design their solutions.

Steps 4 through 6 require students to apply scientific principles to design a method for monitoring and minimizing a human impact on the environment and to evaluate competing design solutions for maintaining biodiversity and ecosystem services.

2. With your group, select one of the threats affecting coral reefs.
3. Write a paragraph that summarizes the threat and why it is important to develop a solution.
4. In your group, design a method to stop or reduce the threats to coral reefs. In your design, make sure to include the following:
 - The environmental, economic, and social aspects of your proposed solution.
 - The criteria and constraints that apply to your solution.
 - The evidence that you would need to see in order for you to feel that your solution had worked.
5. Follow your teacher's directions to present your solution to the class.
6. Listen to the presentations of other groups and evaluate each of the proposed solutions against the chosen criteria and constraints.

This Analysis Item provides an opportunity to assess students on the construction of an argument supported by evidence for how increases in human population impact Earth's systems.

Analysis

1. Some of the causes of threats to the health of coral reefs are local and some are global. How does the challenge of designing and applying a solution differ when the cause is a global problem, such as climate change?

This is the final opportunity in the unit to assess students on the practice of constructing an argument supported by evidence. Students should be more proficient with this practice at this point in the unit, hence the less formal presentation of this Analysis Item, however you may still find it helpful for students to use the Argument Tool and/or any other scaffolds and supports they have used previously.

Chapter 5 Assessment

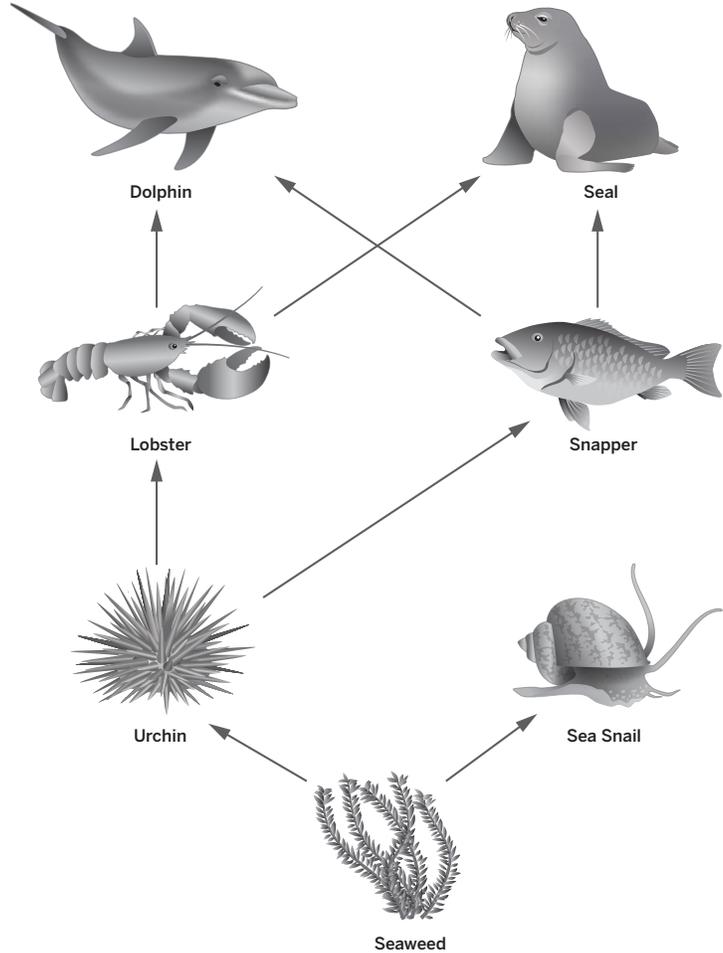
Name _____

The scenario presented in the introductory text, diagram, and data table engages students in the task by presenting context for a problem that they will be analyzing.

1. Seaside City has been a popular vacation spot for the past 25 years. Each year more tourists visit and more people come to live there. A wide range of organisms can be found in the sea near the city. The following food web shows you the feeding relationships between some of these organisms. Seaweed also provides a safe environment for many types of organisms not shown on the food web below.

Visitors love to watch the seals and dolphins. Both tourists and residents enjoy eating lobster or snapper at local restaurants. However, the increasing human population has led to increased demand for lobster and snapper. The table below provides data about the sea near Seaside City. The data indicate that both species have become overfished.

Seaside City Food Web



Year	Number of species in the sea near Seaside City	Number of lobsters per 10 square meters	Number of snappers per 10 square meters	Number of sea urchins per 10 square meters	Percentage of the sea with seaweed
1990	325	5	5	10	50
1995	324	3	3	15	40
2000	320	2	2	20	30
2005	315	1	1	25	25
2010	305	1	0.5	30	20
2015	285	0.5	0.5	35	15

Chapter 5 Assessment

page 2

Question 1a provides students with an opportunity to analyze two proposed solutions and develop an argument. Students also draw on several crosscutting concepts to develop their responses (e.g. cause and effect, consequences of human activity, etc, see teacher support documents for the unit more details). These are all dimensions of PE MS LS2-5.

- a. In 2015 the people of Seaside City decided that the changes in this ecosystem were a problem. Two solutions were proposed. A short list of criteria and constraints were also developed by Seaside City. You were selected as one of the team of scientists and engineers to examine the solutions.

Read the proposed solutions and **construct an argument that answers the question, “Which is the best proposed solution, based on the criteria, and why?”**

Proposed Solution A

The sea near Seaside City would become a protected area, where no fishing is allowed. The area would extend 5 km (about 3 miles) out to sea and around the city. The cost of creating the protected area would be 1.5 millions dollars. Scientists estimate that it will take at least 20 years for the numbers of lobsters and snappers to recover to the 1990 levels. It is estimated that 250 fishing jobs would be lost. However, it is believed that tourism will increase by 20% because of the protected area. As the number of tourists increases, new hotels could be built, creating more jobs. New businesses, such as boat trips for tourists and scuba diving, could also be developed. It is estimated that at least 100 new jobs would be created over the next 5 years. Scientists expect that the number of species in the protected area will take about 30 years to recover to the level that it was in the year 2000.

Proposed Solution B

Five hundred lobsters and one thousand snappers will be brought from other parts of the country. The cost of introducing the species would be \$200,000. They will be added to the ocean near Seaside City. They are different, but related, species from the lobsters and snappers that are found near Seaside City. The introduced species are larger and grow more quickly than the existing species. Sales tax will be increased by 1% to cover the cost of the bringing in the new lobsters and snappers. Divers will be used to catch and remove at least fifty percent of the sea urchins. There will not be a total ban on fishing, but fishing boats will only be allowed to fish during one week each month. It is estimated that 50 fishing jobs would be lost. It is expected to take about 10 years for the area to recover to the level that it was in the year 2005. Tourism is expected to remain the same during that time.

Chapter 5 Assessment Student Checklist

The checklist is provided as a support to assist students in reviewing their answers for complete responses.

- 1a. Claim
- Evidence (numbers or trends from proposed solutions)
- Reasoning

- 1b. New solution is proposed (needs to be different than initial solutions)
- Explains why solution is better than previous solution

Section Three: Interpreting Student Responses to Summative Assessments in *Disruptions in Ecosystems*

When interpreting student responses, it is important to have reasonable expectations for your students. For example, if this unit is being taught at the beginning of sixth grade and students have not had much exposure to the scientific practice of explanation, scoring a 2 in each category might be expected. Alternatively, if the unit is being taught at the end of eighth grade and they have been engaging practice of explanation frequently, higher scores would be expected. It is also important to make students aware of your expectations and to be sure they understand that they are working toward a goal. Growth in students' articulation of various aspects of the practices is an important part of learning and should be accounted for in any overall grading or marking system.

It is critical to provide support to students when appropriate (e.g. fulfilling requirements of an Individualized Education Plan (IEP), allowing new English language learners to answer orally, etc.). Supports might include any combination of the following:

- provide students with a list of key scientific vocabulary to reference when writing their response,
- provide a writing frame, sentence starters, or other scaffold for the responses,
- allow students to discuss their responses in pairs or small groups prior to writing them,
- allow students to edit, score, or otherwise respond to each other's work then revise their final answers, or
- allow students to revise their scored work.

The appropriate type and level of support to provide, and determining when/if to gradually remove support as students progress, will depend on your students and their needs. It can be helpful to work with other teachers in your department, or in other departments at your school (especially ELA teachers) to plan how best to support your students in their growth in engaging in the practices.

A helpful practice, particularly when first scoring student work, is to work with another teacher (or more than one), and to score a subset of responses individually then discuss the scores and come to agreement on "moderated" scores. The exemplars provided below were scored by at least three educators who then discussed their individual scores and agreed on one set of moderated scores for each student response. This process tends to alleviate bias and lead to more consistent scoring (Roberts et al., 1996).

Scored student responses often show patterns in student learning that may not have been apparent before. These can be helpful in modifying your instruction as you progress through the unit or course. Consider using sample answers (without any identifying information) or an amalgamation of answers and having students work in pairs, small groups, or as a class to correct misconceptions or incorrect ideas/information, improve the answers, etc.

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Scored student responses often show patterns in student learning that may not have been apparent before. These can be helpful in modifying your instruction as you progress through the unit or course. Consider using sample answers (without any identifying information) or an amalgamation of answers and having students work in pairs, small groups, or as a class to correct misconceptions or incorrect ideas/information, improve the answers, etc.

Note that student responses below are identical to what students wrote including any grammatical or spelling errors. No content has been added, and only identifying information has been removed. Any writing supports provided by the teacher that were clearly identifiable in student work, such as writing frames or sentence starters, are indicated in *italicized* text.

CHAPTER ONE – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Step 2

General Notes for Scoring and Feedback

Keep in mind that this is the first chapter of five, and that students will have many opportunities throughout the unit to refine their explanations. This is an opportunity to inform both you, the teacher, and your student about where they need to improve. For example, if a student response is hard to interpret, have the student give an oral explanation and ask them probing questions, such as “What more would you like to say about this” or “Is there another piece of evidence you could add?” Probe to see if students can identify evidence, and if you find common mistakes between students consider reteaching. For example, if students all identify an irrelevant concept as evidence (e.g. parasitism), have the class work together to help them identify relevant versus irrelevant evidence. This can be used as a tool to reflect back on the evaluate activity (or the end of chapter assessment) and/or used as a strategy moving forward. Be sure students understand that you expect them to grow in their learning and skills, not to know everything from the beginning.

Providing students with model statements at differing levels to analyze as a class or in small groups can help students reflect on how to improve their own work. Below are several selected empirical examples scorers chose from student work.

Claims: Exemplar One

Claim, Level 2: Deer have a positive effect on the environment because they all get hit by cars.
--

Scorer’s Comments: This student has stated an effect, but the remaining explanation is in direct disagreement with the initial statement.

Claims: Exemplar Two

Claim, Level 1: My claim is blacklegged ticks and people can cause deer's population to decrease.

Scorer’s Comments: This claim does not answer the question asked.

Reasoning

Reasoning, Level 2: These concepts support my claim because the deer is living and the songbird is living, they are interacting which can harm the songbirds.

Scorer’s Comments: This response attempts to use a logic statement (indicated by “because”) but does not clearly link the evidence to the claim. It simply states that it can “harm” the songbirds.

Common points to work on moving forward include:

- revisiting the idea that ecosystems are whole systems, not individual parts, so they can focus on more than one aspect, line of evidence, or effect.
- reasoning involves the logical flow of ideas. Consider showing them some sample logic statements to use as models, such as “The concept of ___ connects my claim to the evidence ___ because _____.” or “The reason my evidence supports my claim is ____.” or “This means _____, which leads to _____, which then leads to ____.”

CHAPTER ONE – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Step 2

ADVANCED/PROFICIENT Exemplar

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	3	3	3

Student Response

The scientific question is, what is the effect of a large population of deer have in the environment? Based on my evidence and reasoning the claim I could make is that a large population of deer have both a positive and negative effect on the environment.

One evidence from the text that supports my claim is that “Deer scatter in their dropping spreading certain plants such as Trillium, up to 3 kilometers from their original site.” Another evidence from the text that supports my claim is that “Deer can also affect the number of songbirds’, some songbirds’ eat or nest on the same trees’ and shrubs the deers’ consume.” The last, but not least, evidence that supports my claim is, “Urban and suburban areas with high deer population routinely have problems with deer eating flowers, vegetables, shrubs, and other neighborhood plants. It is estimated that they cause about \$250 million in damage to these environments and another \$100 million in crop damage.”

The concepts that relate to the evidence and support my claim are cause and effect and competition. These concepts support my claim because, for example the deers’ eat a lot of shrubs and this has an effect on the environment, a bad effect because they ruin a lot of land, and this shows cause and effect. Also, for example, both the deers’ and the birds’ battle for shrubs, which is a bad effect because the deers’ ends up winning and the birds’ gets no food, and this shows competition.

This student answers the question completely with their claim. A claim would also be considered a 3 if it only stated that the deer had a positive effect OR had a negative effect. It would also be considered a 3 if the claim stated a specific positive or negative effect.

This student provides multiple lines of evidence in support of all aspects of their claim, with no irrelevant evidence.

The student provides two clear concepts (cause and effect and competition).

This student included logic statements which connect their evidence to their reasoning, specifically cause and effect reasoning. They correctly incorporate the science concept of competition.

CHAPTER ONE – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Step 2

DEVELOPING Exemplar

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	2	1	1

NOTE: The *italicized* text indicates where a writing frame was provided by the teacher for students to structure their responses.

Student Response
<i>The scientific question is:</i> What effect does a large population of deer have on an ecosystems?
<i>My claim is that:</i> a large deer population has a positive effect on an ecosystem.
<i>The evidence that led to my claim is:</i> The science observations or data says that deer help the ecosystem because in the text it says “that the deer help’s the plant grow 3 kilometers from their original site.”
<i>The concepts that relate to the evidence and support my claim are:</i> that the effect of the deer is positive because it help’s plants.
<i>These concepts support my claim because:</i> it says what effect does it have, it has a positive effect because they help the plant’s by helping them grow more than there original site.

Overall Comment: This student's response has many of the relevant elements, but focused on a positive effect, which is difficult for the student to support. The student's response seems to be losing the forest for the trees.

The student cites evidence accurately from the text, but the evidence is irrelevant and does not support their claim.

The student restates evidence, but does not include any concepts. Note that if the student had identified concepts, but they were inappropriate or incorrect the score could have been considered a 2.

This is a restatement of the evidence, with no logic statement or other reasoning apparent.

CHAPTER ONE – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Step 2

BEGINNING Exemplar

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	2/1	2/1	1

NOTE: This student's response overall does not indicate any use of reasoning or evidence from the text in the activity. It's possible this student has an understanding of the overall concept of disruption, but is unable to express it in a written answer. In this instance, a conversation (as described in the notes at the start of these exemplars) might provide insight into the student's level of understanding.

The response includes a claim. Note that grammar or syntax errors should not alter a student's score according to the scoring guides.

Student Response
What effect does a large population of deer have on an ecosystem? The effect of having a large population of deer in an ecosystem is bad for an ecosystem. Because deers can have effect on ecosystem by disruption. I say because the deer will eat up all of the grass.

This is not evidence from the reading. There is no discussion of grass as a food source or indication that there is grass in the area under consideration.

Disruption could be considered a relevant concept, but the response does not connect the concept to the effect.

CHAPTER ONE – EXTERNAL ASSESSMENT

ADVANCED Exemplar

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
4	4	4	4

Student Response
<p>The population of whitebirds decreased to about half of what it was before because of the decreasing rainfall. Berries need lots of rain so when rainfall decreases, berries should also decrease causing the population of whitebirds to decrease as well. Also, since nut trees don't need that much water so that population didn't decrease that much and white birds eat them, the population of whitebirds decreased to about half of what it is. In addition, rats eat the birds eggs causing the bird population to slightly decrease. This shows a cause and effect relationship because once the amount of rainfall decreases, everything else starts to decrease as well. Overall, the amount of rainfall had caused the population of whitebirds and other animals to decrease.</p>

Overall this student's response clearly conveys that the student understands the relationships between the species in this ecosystem.

This student has combined the claim and reasoning into these beginning sentences. Though students are supported via the Explanation Tool and other scaffolds to construct their explanations in a specific order (question, claim, evidence, reasoning), students should not be penalized for constructing explanations in a logical, clear way simply because it strays from the structure of the scaffold(s).

The student describes the cause and effect relationship between the rainfall and the other variables. This is one way students can connect their claim and evidence using a scientific concept. Providing students with examples, such as this, helps them better understand how to articulate their reasoning.

CHAPTER ONE – EXTERNAL ASSESSMENT

ADVANCED/PROFICIENT Exemplar

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	3	3	3

Student Response
<p>The population of white birds decreased to about half of its original amount because the amount of rainfall decreased so so did the nut tree and berry bushes population. This caused the birds to have to compete with the rats for the decreasing berry bush population. But because of the nut trees the bird population didn't decrease as much as the rats. Thanks to the nut tree population for remaining stable the bird population was able to stay at about half of its original amount. Therefore, the population of birds decreased to about half of its original amount because the number of berry bushes decreasing but the number of nut trees staying at 80 trees.</p>

This student combines their claim and reasoning, similar to the Advanced exemplar above, but includes the incorrect statement that the nut trees decreased.

This student uses the concept of competition to reason through what the data on the graph indicate about the ecosystem.

The student brings in evidence from the graph that the nut trees did not decrease (correct, but contrary to their claim above) and provides reasoning about why the availability of nuts prevented the whitebird population from crashing.

CHAPTER ONE – EXTERNAL ASSESSMENT

DEVELOPING Exemplars

Exemplar 1

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
2	1	0	1

Student Response
The population of white birds decreased to about half of what it was before because the nut trees don't need as much rain as bushes. This shows that the white birds have something to eat and it can be proved that whitebirds eat nuts in the text. In the text it states, "The white birds on the south island eat berries and nuts of the nut tree." In conclusions, this is why half of the white bird population decreased of what it was before.

The student has not articulated reasoning for why the decreasing rain has resulted in the bird population decreasing to half.

This student demonstrates that they see the importance of the nut trees in this scenario: the rain did not affect the nut trees as much as the berry bushes, and thus the birds have a remaining food source. However, the student has not included as part of their claim that the birds did decrease because one of their food sources (the berry bushes) decreased.

In Chapter 1 (the beginning of the unit) it is important to support students in seeing that it is not sufficient to support a claim with evidence from the text only. Students may be used to supporting statements with textual evidence; in science, students should support claims with data (observations, data from tables and graphs) for this item. Just using evidence from the prompt is not sufficient, students have to pull in information from the graph.

In other items, there may be relevant and sufficient evidence in accompanying text, especially if the text is a primary scientific source (e.g. field notebook observations, published research).

CHAPTER ONE – EXTERNAL ASSESSMENT

Exemplar 2

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	1	1	1

Student Response
<p>The reason the population of whitebirds decrease half as much is because they now have a secondary source of food. The text states, "Whitebirds are also found on Southern Island. The whitebirds on South Island eat...nuts of the nearby nut tree."</p> <p>This predator-prey interaction shows how birds don't only need to eat berries, which requires more water. In addition, the text above the graph states, "Nut trees do not need a lot of rain."</p> <p>This depicts that whitebirds have a reliable source of food from nut trees which don't require much rainfall. As an effect, the whitebirds population decreases half as much as before.</p>

Bird/nut is not generally considered a "predator-prey" interaction, since the bird does not kill the entire organism (i.e. the bird eats the nuts and leaves the nut tree behind). Predator-prey relationships involve the predator killing an organism for food.

This is a restatement of given information, the concept is incorrect, and the evidence is textual only, so it would be difficult to reason correctly. However, it is apparent that the student is trying to pull together the explanation with these final two sentences.

The claim addresses one key part of why the birds have decreased by half. The claim does not address why the birds decrease, but does address why the population hasn't crashed to zero ("they have a secondary source of food").

Though scientific facts can be used as evidence, in this case the necessary evidence to introduce to support the claim is that the nuts do not decrease along with the decreasing rain, per the graph.

This textual evidence is supported by findings from the graph, but the student does not mention the graph. If many students in the class are pulling evidence from the text only, and not looking at the empirical data (data tables, graphs, observations), it would be worth it at this point to point out to the class that scientific explanations require scientific evidence, which differs from the evidence from text that is sufficient in ELA courses.

CHAPTER ONE – EXTERNAL ASSESSMENT

Exemplar 3

Moderated Scores			
Claim	Evidence	Concepts	Reasoning
3	3	0/1	0/1

Student Response
The question is “Why did the population of whitebirds decrease to about half of what it was before?” My claim is the whitebird population went down because it were less berry bushes to eat so the whitebird population has been decreasing. The evidence the supports my claim is that on the graph it shows the whitebird at the bottom and you’ll see the berry bushes going down with it. The science concept that supports my evidence is that the white bird population is going down. The graph therefore matches the information.

This student provides an explanation for why the birds decreased, but not for why they decreased by about half.

Student specifically references the graph and the fact that as the berry bushes decrease, the whitebirds decrease as well.

This student does not connect the claim and evidence. To do so they would need to include some kind of logic statement such as "Birds eat berry bushes. If there is less rain there will be fewer berry bushes and the birds will have less food, which means their population will decrease."

CHAPTER TWO – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Steps 5 & 6

General Notes for Scoring and Feedback

While the PE assessment scores represented here are based solely on the students' group-developed model, their oral presentations offer a key opportunity to probe students' understanding more deeply. Be sure to ask them to explain different aspects of the model, particularly any that are not well-represented in this visual format. You may wish to provide students who are shy or uncomfortable presenting to the group the opportunity to present to just you, or have a less formal conversation where they explain the model to you, allowing you to further assess their understanding. The Analysis Items for this activity are also based on the students' model, and provide additional opportunities to assess individual understanding if they provide individual responses. You may also wish to consider having student groups respond to Analysis Item 1 together (they write captions to explain their model further) and add them to their models or share them during their presentation as part of the assessment for the PE.

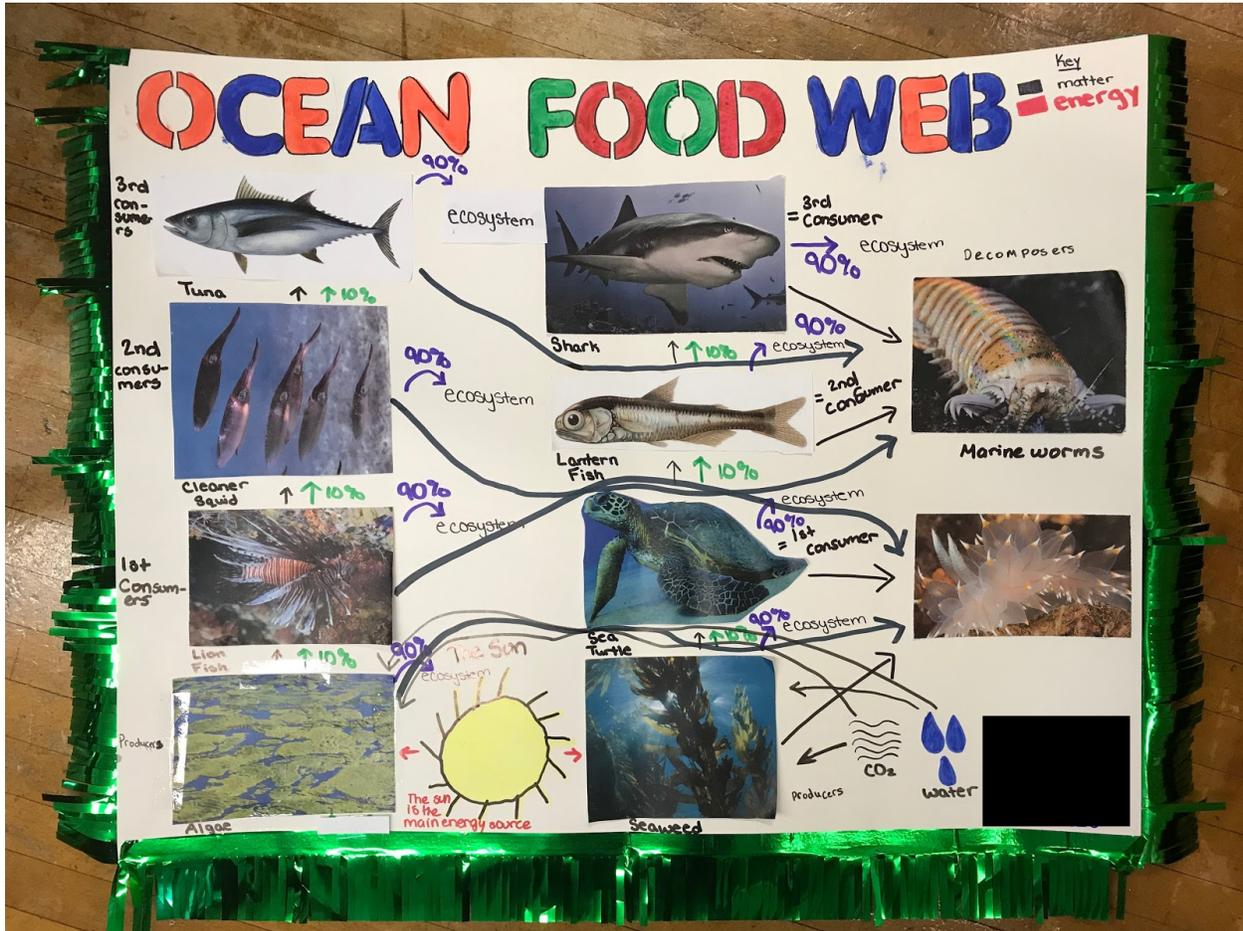
CHAPTER TWO – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Steps 5 & 6

ADVANCED/PROFICIENT Exemplars

Exemplar 1

Moderated Score
4



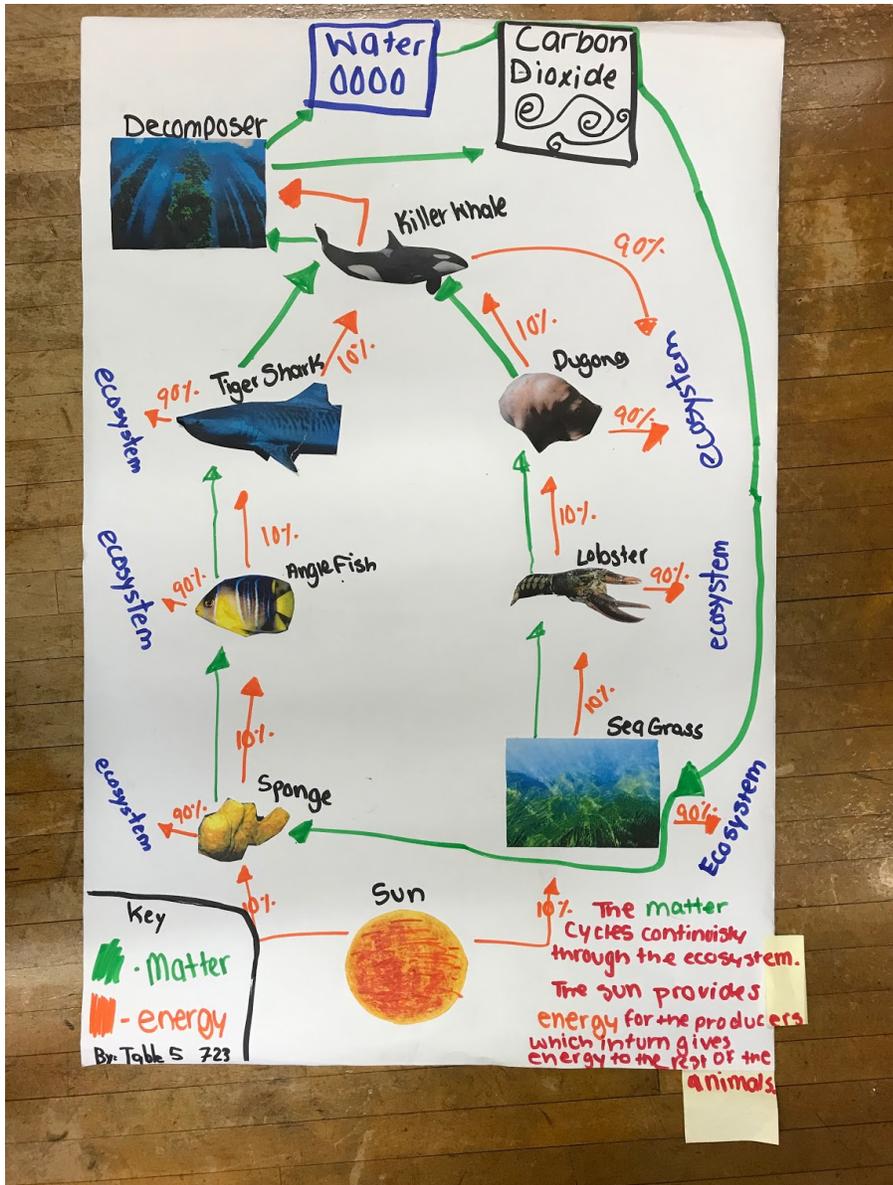
Scorers' Comments
This model includes all components specified in the Procedure with clear labels and examples of cycling of both matter and energy. They have successfully merged a classic foodweb with the energy “pyramid” idea, showing both concepts cleanly in one model. They did not label every single water and CO ₂ connection for each organism, however the cycling concept is still clear.

CHAPTER TWO – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Steps 5 & 6

Exemplar 2

Moderated Score
3



Scorers' Comments

All components seem to be included, although there is no clear distinction between producers and consumers other than by inference. That information could easily be clarified during their oral presentation. The water and carbon dioxide cycling is somewhat muddled, and they seem to be considering the sponge as a producer (this was not a major consideration in scoring - sponges are consumers, although many have mutualistic relationships with algae which may have led to their confusion). Overall a very good model.

CHAPTER TWO – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Steps 5 & 6

DEVELOPING Exemplar

Moderated Score
2



Scorers' Comments
<p>This model is very clean, but abstract, making it difficult to determine how much the students understand relative to the PE. It's hard to determine the cycling, particularly for the carbon dioxide and oxygen, and there is no indication of directionality. This is a good example of a model where the addition of the captions described in Analysis Item 1, and/or an oral presentation with an opportunity to ask the students questions would likely clarify a great deal. While the moderators agreed that with the information presented the score was a "2", they were also in agreement that there were enough hints at understanding that the addition of an oral presentation to clarify would have likely raised the score to a "3."</p>

CHAPTER TWO – EMBEDDED ASSESSMENT

Activity 6 (Evaluate), Procedure Steps 5 & 6

BEGINNING Exemplar

Moderated Score

2



Scorers' Comments

This model is missing many components, and much of it is not labeled. Several of the arrows are going in the wrong direction. However, the color coding indicates some level of understanding of the difference between matter and energy (but not matter cycling and energy flowing, necessarily). An oral presentation with questions would provide the students an opportunity to further explain, which would give the teacher a clearer picture of their level of understanding. For example, they may understand that energy flows from the sun to the producers, but have simply drawn the arrows incorrectly (the misdirection of the arrows is consistent in the diagram). A round of feedback and revision would likely help these students to correct and/or clarify much of the model. While the moderators agreed this exemplar, and the previous exemplar, technically scored the same this was classified as "Beginning" due to numerous errors, whereas the previous exemplar was classified as "Developing" as there were no errors, but it was difficult to interpret the information presented.

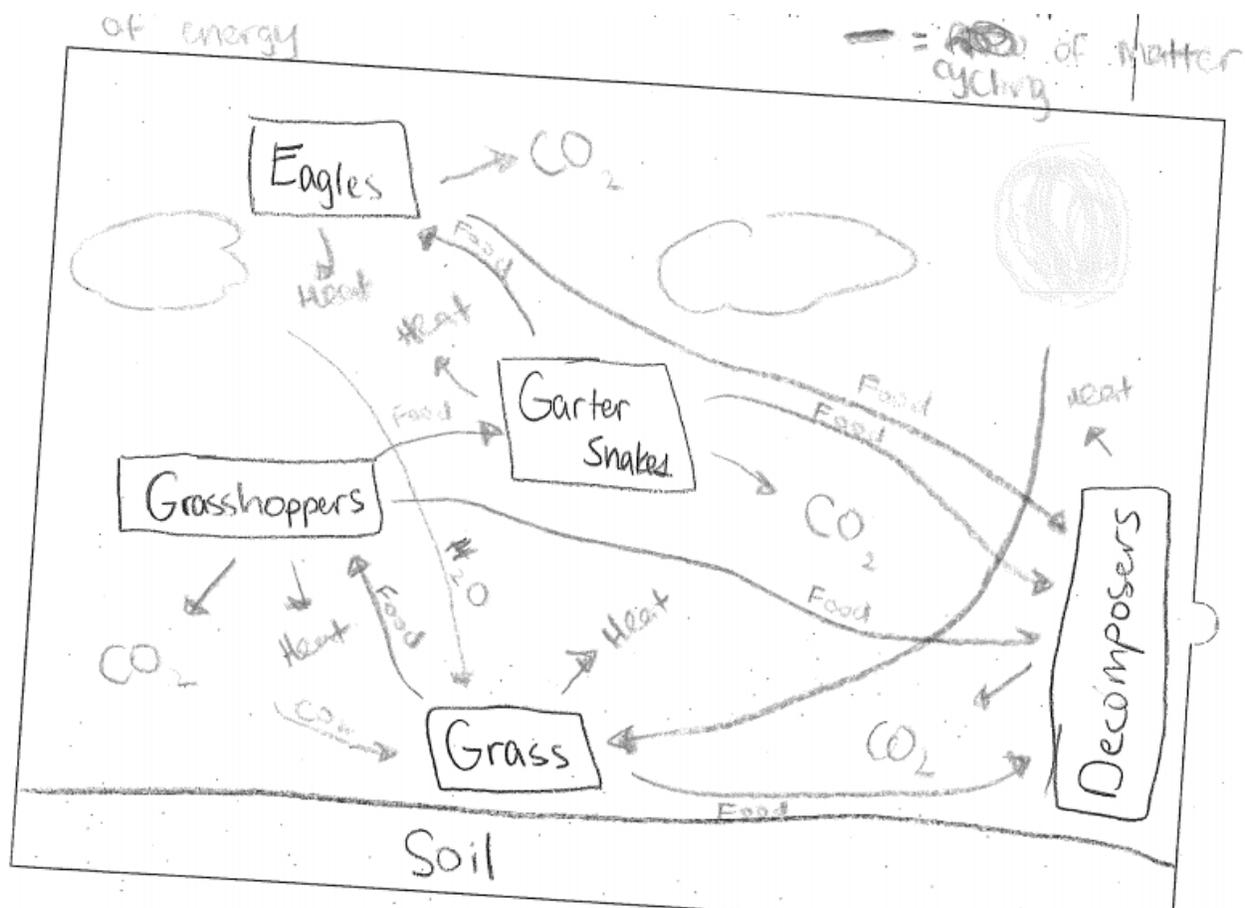
CHAPTER TWO – EXTERNAL ASSESSMENT

Note: For all student work in this section the “Model” score includes the information in the drawn model (Part 1) and the captions (Part 2). In some of the exemplars there were no captions were included. In these instances the “Model” score represents the score based solely on the drawn model. This did not necessarily result in a lower score, if scorers were able to determine students’ understanding according to the criteria in the scoring guide.

ADVANCED Exemplar

Moderated Scores				
Model	Claim	Evidence	Concepts	Reasoning
4	3	4	4	4

Student Response Part 1 (Model)



CHAPTER TWO – EXTERNAL ASSESSMENT

Student Response Part 2 (Caption)
<p>My model shows that the whole cycle starts when the grass conducts photosynthesis using water, sunlight, and carbon dioxide. During the process, the grass lets out oxygen into the air, which is taken in by the other organisms. Then, the other organisms let out carbon dioxide, which the grass then takes in. Once the grass has flourished, grasshoppers eat it. Then, garter snakes eat the grasshoppers, and eagles eat the garter snakes. Decomposers such as bacteria and fungi eat the dead organisms.</p>
Student Response Part 3 (Explanation – Analysis Item 2)
<p>The scientific question is “How would an ash cloud from a volcano affect the cycling of matter in the ecosystem? An ash cloud from a volcano would have a negative effect on the ecosystem. For instance, without sunlight grass wouldn’t be able to perform photosynthesis. Without photosynthesis. Without photosynthesis, the grass would not be able to flourish. This would affect the grasshoppers, because they would lose their main food source. As a result, they would not get the chemical energy essential to survive. Now that the grasshoppers are dying, garter snakes would lose their main food supply and also die off. The eagle, which eats the garters snakes, would also die. Bacteria would benefit for awhile, but die off eventually because living things cannot survive without sunlight. However, once the ash cloud has passed over and there is sunlight the ecosystem will start to grow again. This is because sunlight, water, and carbon dioxide is what grass needs to grow. Once it has grown the grass will attract grasshoppers and the ecosystem will be in balance.</p>

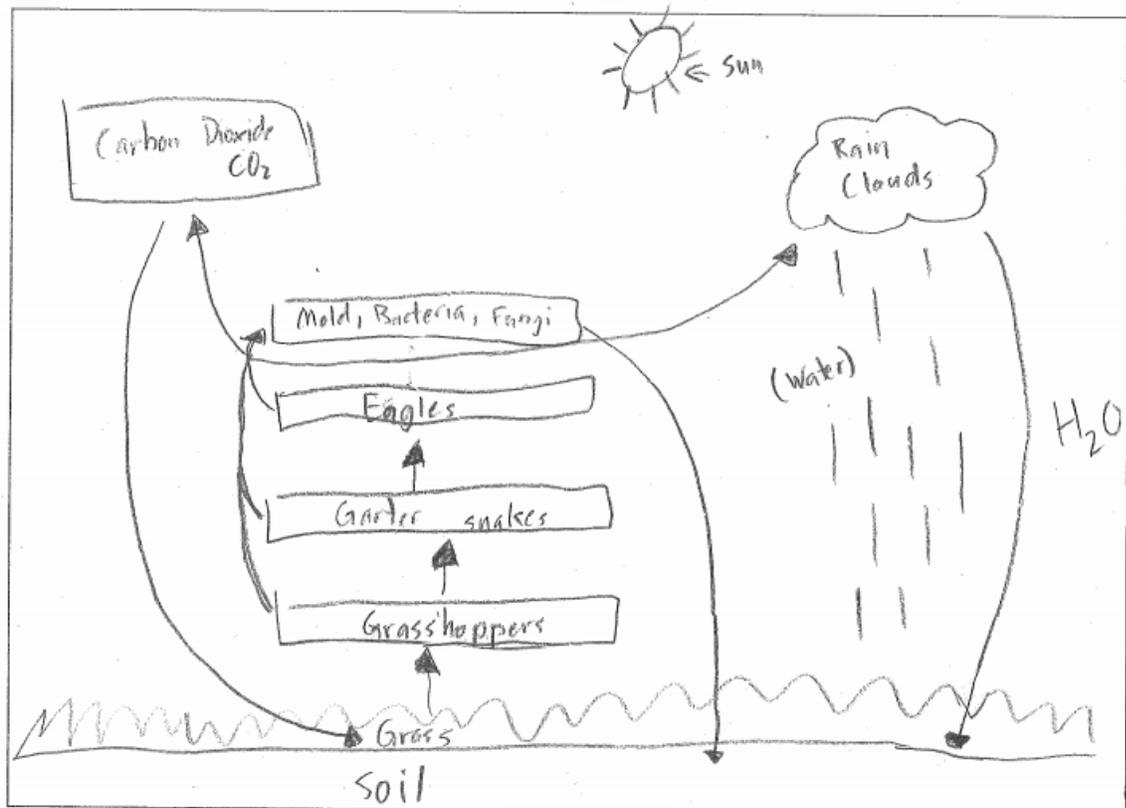
This student has provided multiple science concepts (photosynthesis and chemical energy) and the use of the food chain evidence in the model in a logical chain of reasoning.

CHAPTER TWO – EXTERNAL ASSESSMENT

ADVANCED/PROFICIENT Exemplar

Moderated Scores				
Model	Claim	Evidence	Concepts	Reasoning
4	3	3	3	3

Student Response Part 1 (Model)



Student Response Part 2 (Caption)

No response.

Student Response Part 3 (Explanation – Analysis Item 2)

An ash cloud blocking the sun would kill an ecosystem. According to my model, grass needs carbon dioxide and water to make their own food. This means that if an ash cloud was blocking other clouds and the sun, the grass can't produce their own sugar for food. As a result, the consumers ~~above it~~ won't get matter if the producers don't. Furthermore, producers need sunlight to create matter and grow. This means that producers won't get sunlight if an ash cloud is blocking it. As a result, consumers won't get their food if the plants are dead. In conclusion, ash clouds will block rain and sunlight from being received, the cycling of matter is affected because nothing can cycle without producers producing sugar and matter.

This student's chain of reasoning is slightly disjointed in terms of order, and does not specifically refer to photosynthesis. However, the discussion of the role of carbon dioxide and sunlight provide enough evidence and reasoning to score a 3.

CHAPTER TWO – EXTERNAL ASSESSMENT

Student Response Part 2 (Caption)
Not provided
Student Response Part 3 (Explanation – Analysis Item 2)
An ash cloud would affect the cycling of matter. The plants such as grass and trees need sunlight to continue the process of photosynthesis which they need to make food for themselves. Without no sunlight they can't make food, therefore animals (like grasshopper) wouldn't be able to get food from the grass, decreasing both the grasshopper, grass, and organisms who prey on grasshoppers (garter snakes, the eagle population) would also decrease. The bacteria wouldn't be able to decompose the dead organisms and thus slowing down the cycle of matter in this ecosystem. Also, since the biotic factors, such as trees can't conduct photosynthesis, this affects abiotic parts of the ecosystem. In conclusion, an ash cloud from a volcano would affect the ecosystem with a huge disruptions, along with disturbing the biotic parts, the abiotic parts, would be disturbed as well.

The prompt asks *how* the ash cloud would affect the cycling of matter, but this claim does not make any reference to *how* only that it *would* affect the cycling of matter, hence the score of 2 for the claim.

The student includes a clear, relevant science concept.

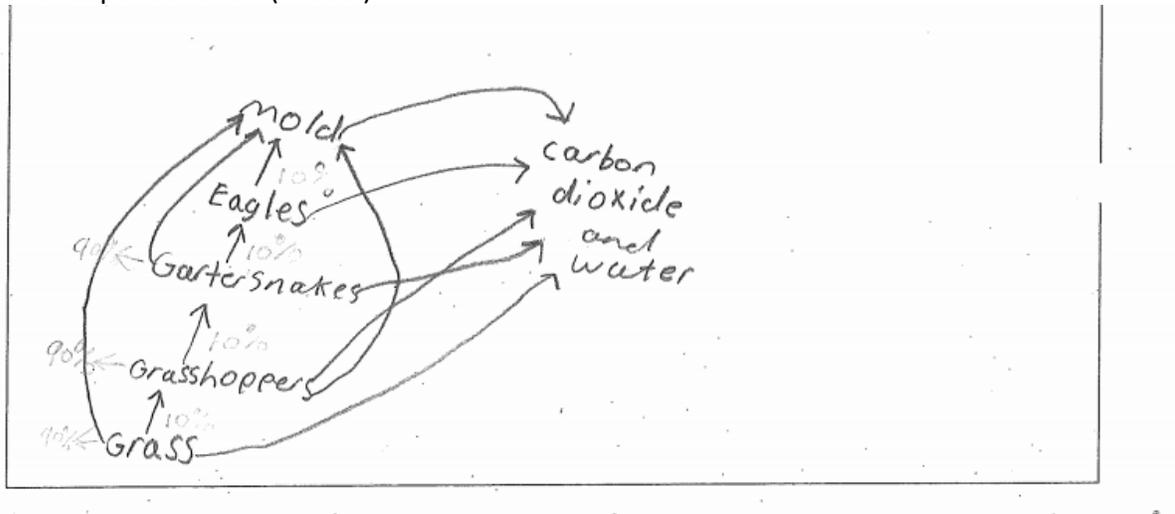
The student uses the concept of photosynthesis logically, and also uses it in the model, to create their explanation.

The student's reasoning would be stronger (i.e. score a 4 instead of a 3) if they specifically referred to water or carbon dioxide as abiotic factors.

CHAPTER TWO – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 2				
Model	Claim	Evidence	Concepts	Reasoning
3	3	2	2	2

Student Response Part 1 (Model)



Student Response Part 2 (Caption)

Caption: First the grass provide's it's own food. Then the grasshoper it's the grass. After that the garter snake it the grasshoper. So then the eagle eat's the garter snake. Finally the mold decomposes the eagle. And that cycle will never end until something happen's to one or more of the organism.

Student Response Part 3 (Explanation – Analysis Item 2)

How would an ash cloud from a volcano affect the cycling of matter in the ecosystem? The whole ecosystem will be messed up because everything relies on the producers. In the model, it shows that the producers starts the whole food chain or food web. Without producers the consumer won't be able to eat. Therefore if plants died the animal that eats producers will die and so on in the food chain or food web.

This student's response meets the criteria for the claim, but is vague when it comes to evidence and reasoning.

For evidence, they do not specifically refer to carbon dioxide, to matter, or to cycling, and provide only generalizations and no specifics from the model.

This student's science concepts include the food chain/web and producer and consumer, but the response is vague ("things are messed up") and do not refer to photosynthesis, energy from the sun, or matter.

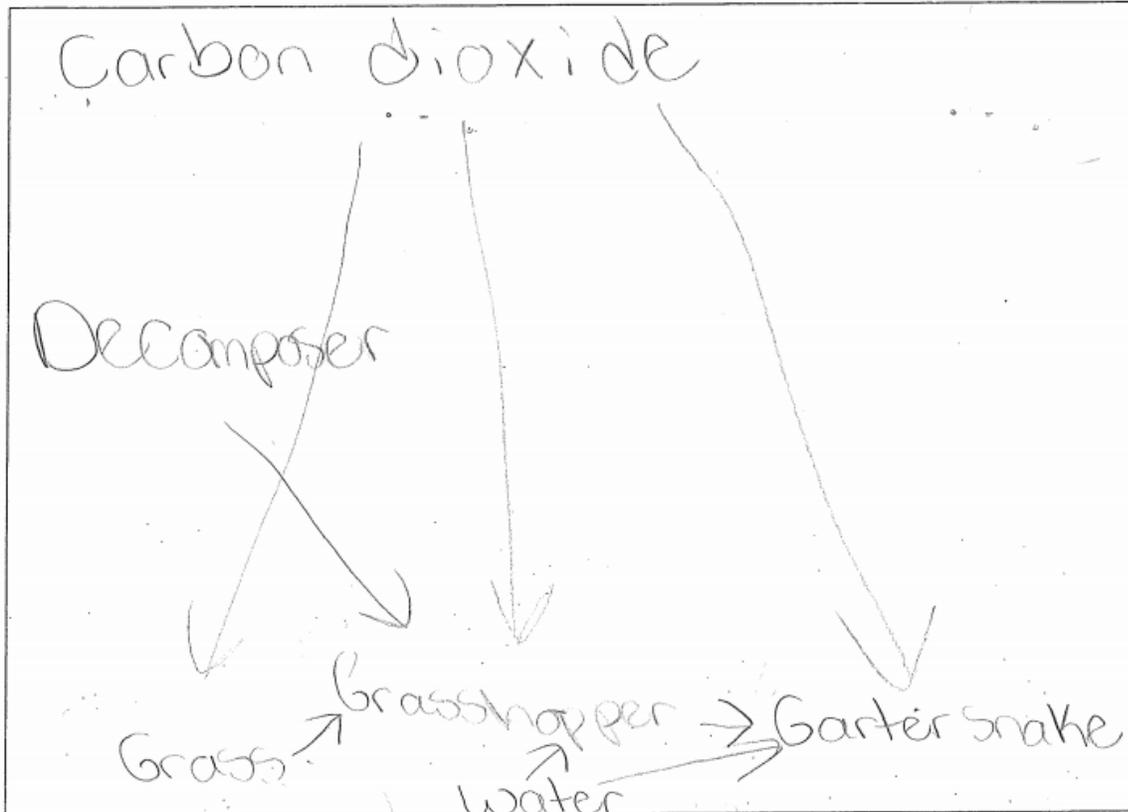
This student's reasoning includes basic logic, but does not link specific evidence from the model to the claim.

CHAPTER TWO – EXTERNAL ASSESSMENT

EMERGING Exemplar

Moderated Scores				
Model	Claim	Evidence	Concepts	Reasoning
1	2	1	1	1

Student Response Part 1 (Model)



Student Response Part 2 (Caption)
Not provided
Student Response Part 3 (Explanation – Analysis Item 2)
How would an ash cloud from a volcano affect the cycling of matter. The cloud and carbon dioxide is filled with ashes which every living thing breaths. Carbon dioxide is air which is where the ash cloud flows. Living organisms need to breathe fresh air. If there's ash in the air, the air is not fresh. So, therefore, if there was ash clouds in flowing throughout the sky living organisms would not be able to breath they could die.

This response uses pollution as the concept to explain the effect of an ash cloud. Though there would be air quality issues if a volcano erupted, the larger issue is that photosynthesis would stop and thus the flow of matter would stop. The prompt specifically asks for a prediction regarding the flow of energy and cycling of matter, so this response is not responding to the prompt

CHAPTER THREE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 6

General Notes for Scoring and Feedback

If students are completing the Critique of Rebuttal in the Argument Tool, it is very common for them to make statements such as “Their evidence isn’t good.” or “My evidence is better.” without stating any specifics. We advise scoring this as a 2.

To help students improve their critiques, encourage them to add a “because” statement after their general statement. For example, “Their evidence isn’t good because they only have one example and I have four.” This is a simple way to incorporate and clarify their reasoning.

CHAPTER THREE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 6

ADVANCED/PROFICIENT Exemplars

Moderate Score – Exemplar 1
3
NOTE: This is a very strong three, with the only area of growth needed being in the rebuttal. With feedback this student would likely move easily to an overall score of a 4.

Student Response
<p>The scientific question is, is an increase in the human population in the Chesapeake bay area affecting the number of oysters in the bay.</p> <p>One claim that can be made about this question is that the increase in the human population is affecting the number of oysters in Chesapeake bay. Another claim you can make about this question is that the increase in the human population is not affecting the number of oysters in the Chesapeake Bay.</p> <p>My claim is that an increase in the human population is affecting the number of oysters in the bay. The evidence that supports my claim is that on pg 88, it states “The oyster population has been overfished and the amount of oysters available to harvest has decreased drastically.” This evidence supports my claim because it shows that humans caused the oyster population to become unstable. Another piece of evidence that supports my claim is that in part B it says that oysters filter the water in the bay. It states “There are farms surrounding the bay, and the runoff from these farms is the primary source of nutrients”. When this happens it creates dead zones, and dead zones cause oysters to die. this supports my claim because farms are owned by humans and the humans are affecting the oysters. The last piece of evidence that supports my claim is on pg 89, the graph shows that in 1953 the population of oysters was overfished so much at 18,000 metric tons that the population of oysters continued to dwindle all the way down to 2,000 tons in 2011. This evidence is strong because it comes from 3 different sources and it shows quantitative data.</p> <p>Some may say that the increase in human population in the Chesapeake bay area is not affecting the number of oysters. I think the problem with this argument is that there is not enough strong evidence to support the claim.</p>

Here the student is identifying two possible, contradictory claims. They go on in the next paragraph to indicate which claim they are supporting.

The student includes two lines of evidence (dead zones and overfishing), and makes connections between the evidence and how it effects the oyster population. This weaves together evidence, concepts, and reasoning.

This student has woven their reasoning throughout the response. Reasoning can be identified by logic statements such as "...supports my claim because it shows..."

This is the only real weakness in this student's response, they do not specifically support their rebuttal (see general notes above).

CHAPTER THREE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 6

Moderate Score – Exemplar 2
3
NOTE: This students' answer is concise, but well written, incorporates all of the required components, and shows a high level of understanding. Feedback should help the student provide a deeper response, perhaps including more quantitative data or other pieces of evidence.

Student Response
<p>My claim is the increase in human population is affected the number of oysters. The evidence that supports my claim is more farms equals more nitrogen run-off. My scientific reasoning is the evidence is strong because if more farms equal more nitrogen run-off then there would be a dead zone and since there is no dissolved oxygen there the oysters will die.</p> <p>Others might claim B is right and that's because their evidence tells that humans are catching a lot fewer oysters now then in previous decades. But the evidence is not strong because lower oyster catch could just be because of overfishing.</p>

All lines of evidence are connected to causal statements.

This sentence brings in reasoning, concepts, and evidence clearly linked in a way that indicates a high level of understanding.

The student critiques the poor evidence in a potential rebuttal, again indicating a high level of understanding.

CHAPTER THREE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 6

DEVELOPING Exemplar

Moderate Score
2

Student Response
<p>The scientific question is, is the increase in the human population in the Chesapeake Bay area affecting the number of oysters in the bay. My claim is that the human population is affecting the number of oysters. The evidence that supports my claim is that in the text it says that dead zones are being caused because farmers (humans) use fertilizers for crops. Another piece of evidence is that the page shows a food web where humans are the top predators and it shows they eat oysters. The evidence is strong because it shows how we affect the population of oysters and it shows how we do it. Other people might claim that humans don't affect the population of oysters. But humans eat/fish oysters and we kinda poison the bay with dead zones. In conclusion, this is why/how humans affect the population of oysters in Chesapeake Bay.</p>

This statement does not provide evidence that humans have overfished the oyster population, only that humans eat oysters.

The student's rebuttal is a restatement of their evidence/argument and not a counter-argument.

This statement indicates some reasoning, but it is not well developed. They do not explicitly link the evidence together (e.g. fertilizers cause dead zones which kill oysters).

CHAPTER THREE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 6

BEGINNING Exemplar

Moderate Score
1
NOTE: While length of answer should not necessarily correlate with the score for a response, in this case there is almost too little content to determine what the student is arguing for or against. This student would likely benefit from a discussion in which they explained their evidence and reasoning and were given feedback on what to include in their written response. Any <i>italicized</i> text below indicates text from a writing frame provided by the teacher.

Student Response
<p><i>My claim is that</i> the human population is affecting the number of oysters</p> <p><i>The evidence that supports my claim is</i> the oyster population doesn't go up 1,500 from 1992 to 2012. The dead zone in 1990 is at 8 km³. In nitrogen 2003 runoff is 250,000.</p> <p><i>The evidence is strong in supporting my claim because</i> it says the years and the amount</p>

The evidence cited is accurate, but random. Citing numbers alone is not evidence, there must be some indication of what trend the data indicates or how it supports the claim.

The rebuttal does not make much sense to the readers.

CHAPTER THREE – EXTERNAL ASSESSMENT

ADVANCED Exemplars

Moderated Scores- Exemplar 1				
Claim	Evidence	Reasoning	Counter	Critique
3	4	4	3	4

Student Response
<p>The farmland should be converted back to grassland. The number of deer was affected by the change. For example, after year 4 the deer population dropped to almost half of what it was before, and never reached back to what it was before the grassland was converted to farmland. The number of deer births also dropped to less than half it was before. The amount of malnourished deer also increased. This was most likely because of the lack of food due to the small space the deer had to live. Without the amount of food required to feed the deer, the deer did not survive as well.</p> <p>A claim my classmate might make is that farmland should not be converted back to grassland. They might say this because the average mass of the deer stayed about the same after year 4. Also, saying that farmland is the reason the deer are in trouble is invalid because there could be many other factors such as weather or human impact.</p> <p>The problem with my classmate's argument is that there could be other reasons for why the deer decreased so much, but the changes to the deer happened right after the grassland was converted. For example, the decrease in the deer's numbers happened in year 5, and then kept going down. The change happened in year 4. So, the grassland should be converted back to make sure the deer population doesn't crash and disappear forever.</p>

The student references three separate indicators and looked at evidence across years.

The student's reasoning connects the concept of resource limitation to the evidence of a decrease in the deer population.

This statement is not accurate, but the counter-claim is acceptable and the following statement would support the counter-claim. They also used reasoning around the concept of cause and effect to critique the classmate's claim (next paragraph). On balance this leads to a three for the counter-claim and a four for the critique.

CHAPTER THREE – EXTERNAL ASSESSMENT

Moderated Scores- Exemplar 2				
Claim	Evidence	Reasoning	Counter	Critique
3	4	4	3	4

Student Response
<p>The deer population is being harmed by the grassland to farmland conversion, therefore, the farmland should be converted back to grassland. The grassland was where most of the deer lived and when it was converted into farmland there wasn't enough space for the deer to live and ended up decreasing the deer population. This was a cause and effect relationship as well as a disruption to the ecosystem. Since the deer population was decreasing, certain types of animals didn't have such a wide variety of predators to consume. This would throw off the food chain since the predators have one less prey to consume (this is a predator-prey relationship). After Year 4, when the grassland was turned into farmland, the deer population went down, from above 100 down to 40s. The deer were also more malnourished and had fewer babies. The change from the grassland to the farmland harmed the deer, so we should convert it back before it's too late.</p> <p>My classmate might say, "We should not convert the farmland back to grassland. Farmland is more important to other organisms lives for food. If it is changed back to grassland the organisms in the area will not have as much food to eat."</p> <p>Although farmland is important, so is the deer population. For instance, if there isn't enough space for the deers to live they will soon die and cause a disruption in the ecosystem, which causes other animals harm, such as the predators of the deer. Also, if their population continues to decrease, their species could be completely wiped out or even extinct.</p>

This student provides much of their reasoning prior to citing specific evidence. The reasoning is clear and appropriate and leads into a discussion of the evidence, hence the score of 4 for both.

The student cites evidence from three indicators across multiple years.

Counter-claim is clear, but does not cite specific evidence.

Student's critique of the counter-claim is thorough and critiques evidence classmate would have likely cited.

CHAPTER THREE – EXTERNAL ASSESSMENT

PROFICIENT Exemplar

Moderated Scores				
Claim	Evidence	Reasoning	Counter	Critique
3	3	3	3	3

Student Response
<p>The farmland should be converted back to grassland. Because of converting grasslands to farmland the number of deer decreased. It shows in the table, in year 5, the number of deers decreased to 83, and it stated before, "At the end of Year 4, 80% of the grasslands were converted to farmland." This shows that because they converted the grasslands to farmland the amount of deer decreased from 105 to 83 and so did average mass and birth. This conversion caused a disruption to the deer and they decreased.</p> <p>My classmate who disagrees with my claim might say that farmlands are much more important than deer, because we need food to survive, so the farmland should stay.</p> <p>The problem with that claim is that my classmate is not thinking about the disruptions that the lack of deer would cause.</p>

The student cites evidence from three indicators, however they do not summarize the trend across the years - they only look at years 4 and 5.

This statement is very generic and does not indicate a deep or clear understanding of the applicable concepts (resource limitation).

The critique is somewhat specific, but does not provide clear explanation or justification, again relying on the vague term of "disruption."

CHAPTER THREE – EXTERNAL ASSESSMENT

DEVELOPING Exemplars

Moderated Scores – Exemplar 1				
Claim	Evidence	Reasoning	Counter	Critique
3	2	2	3	4

Student Response
<p><i>Should the farmland be converted back to grassland?</i></p> <p>Should the farmland be converted back to grasslands? I think they should. I think this because ever since they converted the grasslands, the data has been going down but before when it was grassland the data was the highest it has ever been. So, in conclusion, I think they should convert the farmlands back to grassland because when it was grassland the data was the highest it has ever been.</p>
<p><i>Imagine that you have a classmate who disagrees with your claim. What claim might your classmate make?</i></p> <p>If I imagine that a classmate disagrees with me they might choose the claim that the farmlands should stay and not to convert them back into grasslands.</p>
<p><i>What is the problem with your classmate's claim or the argument based on that claim?</i></p> <p>The problem with my classmates claim is that ever since year 4 where they converted the grassland into farmland the data/population of the deer kept getting low and before year 4 the data/population was the highest it has ever been. The population was 97 at the low and 110 at the high and when there was farmlands the low was 35 and the high was 83, not including year 4 because that is when it was converted. So, in conclusion, I think that my classmates claim is wrong.</p>

The student does not reference specific indicators or explain the trends, just says "data has been going down." Based on their critique (see comments below) it is likely that specific feedback here would lead to significant improvement in a revised response.

Here the student describes trends in specific indicators and their effects on the deer population. This indicates they understand the data, trends, and underlying concepts, and their response would benefit from feedback and revision.

CHAPTER THREE – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 2				
Claim	Evidence	Reasoning	Counter	Critique
3	2	1	3	2

Student Response
<p>Yes, I think the farmland should be converted back to grassland. I think that because the deer was there first and they can't just go to a other grassland. My evidence is that in year 11, only 3 deer were born cause of the farmer and their farmland.</p>
<p>They would say I think that they should keep the farm land because the people need fruit and vegetable. Also, the farmer need money to feed his family.</p>
<p>What I think is the problem is I understand that they need money. But there are other people that need money too. Like the hunter. They need money just like the farmer.</p>

The student cites specific data, but not until Year 11 (after conversion of the grassland and the harsh winter). Their response could be improved by citing data from across years, or from adding data about other indicators.

The evidence for the counter-claim is not based on data provided (although it is logical).

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

General Notes for Scoring and Feedback

If students are completing the Critique of Rebuttal in the Argument Tool, it is very common for them to make statements such as “Their evidence isn’t good.” or “My evidence is better.” without stating any specifics. We advise scoring this as a 2.

To help students improve their critiques, encourage them to add a “because” statement after their general statement. For example, “Their evidence isn’t good because they only have one example and I have four.” This is a simple way to incorporate and clarify their reasoning.

NOTE: Bold text in sample responses indicates that the argument tool and/or similar writing frame was used. Any *italicized* text is directly from the tool/writing frame and plain text is the student’s own response.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

ADVANCED/PROFICIENT Exemplars

Moderated Scores – Exemplar 1			
Claim	Evidence	Reasoning	Rebuttal
3	3	3	3

Student Response
<p>Quagga Mussel Argument</p> <p><i>The scientific question is:</i> has the quagga mussel had a positive or negative effect on the Lake Michigan ecosystem. <i>My claim is</i> that the quagga mussel had a negative effect on the Lake Michigan ecosystem.</p> <p><i>The evidence that supports my claim is</i> that the quagga mussels is an invasive species. A second piece of evidence is that the quagga mussels clog the pipes which will stop the water from being filtered which will not be able to be drincken. Another piece of evidence is that the quagga mussels made the population of the diporeia decrease to the point that there was almost none left. A fourth piece of evidence is that since the quagga mussels reproduce a lot just like the zebra mussels there will be so much that there wouldn't be enough oxygen for the other organisms and they will all end up dying. A fourth piece of evidence is that since the quagga mussels are at competition with the zebra mussels not for the diporeia but for the plankton, the zebra mussel and diporeia populations both decrease. A sixth piece of evidence is that the quagga mussels and the zebra mussels both eat the plankton but since they both eat the same food they both get a little which doesn't let the zebra mussels get enough food and the quagga mussels get the diporeia as well so they have enough food to survive.</p> <p><i>Other people might claim</i> that quagga mussels have a positive effect on the Lake Michigan ecosystem. <i>I think that the problem with this argument is</i> that the other people think that there is more evidence for the positives of the quagga mussels than there is negatives for the quagga mussels but there is actually more evidence for the negative side. If there is more pieces of evidence for the negative side, then that means that the quagga mussels are more negative than they are positive. Furthermore, if the population of the other living organisms decrease then you will know that something in the ecosystem is affecting it, and if there is competition between an organism and the quagga mussel then it is positive that the quagga mussel has a negative effect on it.</p>

Claim is clear and direct.

The student's response includes multiple lines of evidence combined with relevant concepts and logic statements indicating their reasoning.

Although there are several spelling and grammar errors in the student's response, this does not effect the score on the response. This student would benefit from feedback on that aspect of their writing, but it does not effect the scorer's ability to gauge their level of understanding of the science concepts and content.

This student's rebuttal evaluates possible counter-evidence and arguments and explains why the counter-argument would not be effective.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

Moderated Scores – Exemplar 2			
Claim	Evidence	Reasoning	Rebuttal
3	3	3	3

Student Response
<p>Quagga Mussel Argument</p> <p><i>The scientific question is</i> has the quagga mussels had a positive or negative effect on the Lake Michigan ecosystem. My claim is that they had a negative effect on the Lake Michigan ecosystem. <i>The evidence that supports my claim is in</i> information item 1 where it states “Quagga mussels and zebra mussels share many characteristics” later on it says “Both species produce up to a million eggs per year per mussel” Also in the same text it says “Scientists believe that the quagga mussels are competing for food with another species “diporeia.” and it says “Diporeia are an important food source for many fish in the Great Lakes, including whitefish and smelt. Chubs and smelt are prey for trout and salmon. Trout, salmon, and whitefish fisheries are important sources of income for many people. Another piece of evidence is in the Lake Michigan map which shows the Diporeia decreasing in 2000 when the quagga mussels were established and in 2005 when the quagga mussels greatly increased the diporeia continued to decrease. This evidence is strong in supporting my claim because it shows how the quagga mussels are decreasing income for people, spreading quickly, and decreasing an important species in the ecosystem. <i>Other people might claim</i> that they are cleansing the water. I think that the problem with this is that even though they are cleansing the water they are still harming the ecosystem more than the water would.</p>

Clear and concise claim.

This student provided multiple lines of evidence to support their claim, at times with simple quotes from the text, but also incorporating relevant concepts (e.g., Chubs and smelt are prey)

This statement sums up the student's reasoning concisely and links to the lines of evidence cited in the response.

This statement evaluates the evidence that might be provided by the potential counter-claim.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

DEVELOPING Exemplars

Moderated Scores – Exemplar 1			
Claim	Evidence	Reasoning	Rebuttal
3	2	2	3

Student Response

The Scientific Question is “Has the Quagga Mussels had a positive or negative effect on the Lake Michigan ecosystem?”

My claim is the quagga mussels had a negative effect on the Lake Michigan ecosystem. The evidence that supports my claim is when the quagga mussel Increase imporant animals to the ecosystem like diporeia, whitefish, chubs, and smelt decrease.

My scientific reasoning is the evidence and my claim connects because it shows that when you have an invasive species in an ecosystem the native species could decrease. Other people might claim it had a posiive effect. I think the problem with this argument is that even thought it’s helping the water in the ecosystem it still is killing animals that are imporant.

Claim is clear.

This student brings in multiple examples from the foodweb , but does not include evidence from the other information items, so it is essentially only one piece of evidence.

This student's reasoning does not clearly bring in concepts, and with only one line of evidence their reasoning cannot provide enough support for their argument to be strong.

Clear rebuttal with evaluation of potential evidence from a possible counter-argument.

Overall, this student would likely improve their argument dramatically with feedback on including more lines of evidence, and thus more reasoning. They clearly understand the concept and structure of argumentation and are well on their way to a strong argument.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

Moderated Scores – Exemplar 2			
Claim	Evidence	Reasoning	Rebuttal
3	3	2	2

Clear claim.

Student Response

The scientific question is: Has the quagga mussel had a positive or negative affect on the Lake Michigan ecosystem? My claim is that the quagga mussels had a negative effect on the Lake Michigan ecosystem. The evidence that supports my claim is In 2010 the density of the quagga mussel population was high up to 10^3 , 10^4 , 10^5 , and they decreased the population of diporeia to zero (0) density. The diporeia was an important food for the fishes and if there is no diporeia, fish populations will decrease. The evidence is strong in supporting my claim because it demonstrates how they effected lake Michigan in a negative way, decreasing populations and harming others. One thing that I can tell you, water clarity does not help us humans, it doesn't cure us. Other people might claim that the quagga mussel had a positive effect on the lake Michigan ecosystem. I think the problem with this argument is that my classmates aren't paying close attention to what quagga mussels are doing to us. They are decreasing fish populations by taking their food away and also quagga mussels are taking our food away (fishes) and if the fisherman don't catch fish, they don't earn money and they could lose their jobs.

The student has brought in, and connected, multiple lines of evidence.

This reasoning would benefit from specific examples. It's hard to determine if the student understands the concepts or is just saying "it's bad."

This reasoning is confusing and unclear.

This rebuttal explains multiple lines of evidence that are important, however it does not analyze any evidence that might have been used in a counter-argument. If this portion was used above in the evidence and reasoning to support the student's claim it would have made the argument much stronger. This student would benefit from feedback helping them to better structure how they organize their argument and the difference between providing evidence and analyzing someone else's evidence.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

Moderated Scores – Exemplar 3			
Claim	Evidence	Reasoning	Rebuttal
3	3	2	2

NOTE: This exemplar is from a class of English Language Learners whose first language is Chinese. All parts of the Argument Tool, including the sentence starters, are provided in English and Chinese, and the student's response is written in English exactly as seen below. Italicized text was provided to the student in the prompt by the teacher.

Student Response
Has the Quagga Mussels had a positive or negative effect on the Lake Michigan ecosystem? The Quagga mussel had a negative effect on lake Michigan. Ever since Quagga mussel came to Lake Michigan the water clarity really clear, which means the things in the water got eaten by the Quagga mussel. They also compete other species for food. The strength of my evidence is that the water clarity is becoming clearer after Quagga mussel came, which means the things in that water is gone by the Quagga mussel. <i>Other people might claim the Quagga mussel has a positive effect on Lake Michigan, I think the problem with this argument is that it doesn't have evidence.</i>

Clear claim.

They have multiple lines of clear evidence.

They bring in concepts here and reasoning, but overall could benefit from another statement that is clear and incorporates other information statements as they primarily focus on water quality.

To score well on a rebuttal, they need to analyze evidence that might be provided by possible counter-claims. This is too simplistic for a high score.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

BEGINNING Exemplars

Moderated Scores – Exemplar 1			
Claim	Evidence	Reasoning	Rebuttal
3	2	1	1

Student Response

The question is “Has the quagga mussel had a positive or negative effect on the lake michigan ecosystem. My claim is the qm had a negative affect on the lake michigan ecosystem. The evidence that supports my claim is the qm clog the water pipes so water cant go in->to us or out->to them. The sciences concept compare to my evidence is that this shows with no water going in some fish might die because some fish feed on the water we give back to them. The reasoning that links the evidence and science concepts to my claim is that this shows how the qm had a negative impact on the lake michigan ecosystem. Other people might claim they have a positive effect I think the problem with this is the qm clog the pipes and we cant get water.

Clear claim.

The student has provided only one piece of evidence and has not brought in the other information items.

The student's reasoning is not logical and does not bring in concepts learned in the chapter/unit.

This is not reasoning, but is a common response when students are unsure how to articulate their reasoning. This student might benefit from specific feedback on how to clarify their reasoning, emphasizing that they have to explain why it's negative. This may be muddled for the student as their earlier reasoning is not logical. An oral conversation might allow for teasing out the student's understanding to help them figure out how to articulate it in writing.

This simply restates evidence from earlier, and does not analyze any potential evidence for a counter-argument.

CHAPTER FOUR – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Step 1

Moderated Scores – Exemplar 2			
Claim	Evidence	Reasoning	Rebuttal
3	3	1	2

NOTE: This exemplar is from a class of English Language Learners whose first language is Chinese. All parts of the Argument Tool, including the sentence starters, are provided in English and Chinese, and the student's response is written in English exactly as seen below. Italicized text was provided to the student in the prompt by the teacher.

Student Response
I think the quagga mussel had a negative effect on the lake michigan. One evidence is that according to the graph, the water clarity is rising every year. That means there is less plankton in the river. Another evidence is according to information item 3 the quagga mussel increase there's when a huge decrease in the diporeia population. <i>Other people might claim it's good. I think the problem with this argument is the river is constantly changing.</i>

Clear claim.

There is no reasoning that connects the student's evidence to science concepts, nor do they explain why their evidence supports their claim. Feedback encouraging the student to continue this statement and go further would likely help them to articulate their reasoning.

Student cites two lines of evidence from different information items.

The rebuttal does not make sense as arguing against a counter claim, and does not analyze potential evidence from possible counter claims.

CHAPTER FOUR – EXTERNAL ASSESSMENT

ADVANCED/PROFICIENT Exemplars

Moderated Scores – Exemplar 1				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	4	4	3	4

Student Response
<p>The question being asked is, “Did the power station cause a big changes in the populations of organisms living on the coral reef.” My claim is that the power station did cause large changes in the populations of organisms living on the coral reef. The evidence to support my claim is that in site 1 the temperature went up 2 degrees C from year 1 to 2 and the algal mats grew from 2 to 10 which blocked the sun which made the coral reef go down and the species that were there die. Another piece of evidence is that in site 2 the same thing happened in year 1 and 3. There was no algae, and there were 1300 organisms and then it dropped to 1000 in year 5 which is almost $\frac{1}{4}$ of the organisms. The power stations do have a large effect because the warmer water makes the invasive species (the algae) go up and block the sunlight from the coral causing the amount of organisms to go down by 300 in the 1st and 2nd sites.</p> <p>Another classmate might make the claim that the power station does not have a large effect on the organisms living on the coral reef. They might say this is because in site 3 there was no algae or a decrease in the amount of organisms.</p> <p>The problem with the argument is that in site 1 and 2 you can clearly see a big change in the amount of organisms that live there, which only happens when the power station is there. Even though there is no effect on site 3, it might be on the other side of the island so the power station wouldn’t effect it.</p>

The student includes specific data from the table for species numbers, and number of organisms, for two sites.

This response includes strong reasoning, connecting the data to the effect of the power plant, incorporating trends shown by the evidence.

The rebuttal specifically addresses multiple points of weakness in the evidence for the alternative claim.

CHAPTER FOUR – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 2				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	4	3	3	3

Student Response
<p>The power station did cause large changes in the populations of organisms living on the coral reef. One way this is shown is by the dramatic decrease of organisms in site 1. In the first years there were ~1,200 organisms. But when the power stations effects were shown the organisms decreased to a low 900. This shows a tremendous disruption, the organisms in the ecosystem has decreased from 1,200 to 900, this is a 300 drop of organisms. To add on, the number of species in site 2 has also decreased. At first (as shown in the table) there were 20 types of species. But in the end when the effects of the power station came into place there were only 17 species left. This shows a great change in the number of organisms in the ecosystem. Three species have become extinct because of the power station. In addition in site 2 the numbers of organisms has greatly decreased. In Year 1 there were 1,300 organisms but in years there were only 1,000 organisms. This shows a 300 organism drop over the years. To sum up, the power station caused large changes in the populations of organisms living on the coral reefs.</p> <p>If a classmate disagrees with my claim, they could say that the power station did not cause large changes in the populations of organisms living on the coral reef. They might say that the power station had no effect of barely any changes to site 3.</p> <p>My classmates claim is wrong for many reasons. One reason why is that the power station effected the number of organisms living in station 3. One way this is shown is in the table. The organisms may have not been affected in the end but they were affected throughout the 5 years. For example, in years 2-3 has decreased by 50 organisms. In year 2 there were 1300 organisms. But in year 3, there were 1,250 organisms. To sum up, my classmates claim is wrong because in site 3 the number of organisms dropped by 50 organisms.</p>

This response incorporates data about number of species and number of organisms, for both sites 1 and 2.

This student's response includes reasoning, but does not clearly include scientific concepts, nor does it clearly connect the power plant to the temperature, to the algal mats, or to the effects on species and organisms.

This student uses specific data from the table to form their rebuttal. However, they don't use the concept of patterns effectively to support their rebuttal. The pattern is overall no change in site 3; there is no downward trend in the number of species.

CHAPTER FOUR – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 3				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	3	3	3	3

NOTE: This exemplar is included because while most students argue that the power plant was having a big effect, this student argued that the changes at sites 1 and 2 are small and there are no changes at site 3.

Student Response
<p>The question that is being asked is, “Did the power station cause large changes in the populations of organisms living on the coral reef?” My claim is that the power station did not make large changes in the populations of organisms living on the coral reef. I know this because the animals are not decreasing from the blockage of sunlight and the algae that is in front of them. This evidence is the species in site 1 only does by three living species (very little). In site 2, the number of species only dropped by 3 (very little), and the number of organisms only drops by 300 (also a small decrease). In the third site the number of species stays at 22 the whole time (which is good) and also the number of organisms only increased by 50 from 1,250 in both years 2 and 4 and then dropped back to 1,250 (this is good). In conclusion, the number overall are staying well and do not show any signs of major changes.</p> <p>They might say that there is a large impact on the number of living organisms and species. The evidence they think supports their claim is that in site 1 the species of living organisms and number of living organisms went down by 3 and 300. Also, in site 2 the numbers of species and living organisms both stayed the same because there are large amounts of sunlight coming to let the reef grow. After this they would say that all of these show a significant decrease in species and organisms.</p> <p>The problem with this classmates claim is that they do not account that you are only taking away a few numbers from 1 big number. First of all, in both site 1 the numbers of species and organisms are already 7, 21, and 1200 so the decrease is minor compared to the majority. Secondly, the number of species and organisms were already at 20 and 1300 so it is not a major decrease. Lastly, the numbers in the species and living organisms did not change at all so there is no problem. In conclusion, the numbers were not majorly decreasing.</p>

The response cites evidence on number of species and organisms at both sites 1 and 2, however their analysis of the trends in these numbers indicates faults in their interpretation of the data. In this instance a conversation between the student and teacher would likely help clarify the student's level of understanding of the concepts being addressed here.

The student does not provide strong reasoning in their critique, they effectively are arguing that the interpretation of the data (by their classmate) is incorrect. This does not align with critiquing the quality and strength of the evidence which is the assigned task.

CHAPTER FOUR – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 4				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	3	3	3	3

Student Response
<p>Did the power station cause large changes in the populations of organisms living on the coral reef?" The power station did cause large changes to the populations of organisms living on the coral reef because the last year, year 5, was always the lowest population for site 1 and 2. In year 5 on site 1 the lowest population was 900 when the other years were at 1,000-1,200. Site 2 was also the lowest population out of all 5 years it was at 1,000 when the other years were 1,100-1,300. Adding on to this, the power station causes big effects to the population because it increased the temperature making the algal mats kind of take over so not enough sunlight gets to the plants. That is how the decrease happened.</p> <p>They would say that the power station didn't cause big effects on the population because the population was lower but not as low as the other years. Since it only dropped to 100 at max.</p> <p>I would say that yes there was definitely an effect on the population. In Year 5, on site 1 it dropped 100 from the last year, year 4. This is actually pretty huge for a drop.</p>

Feedback for this student should include that they have a clear grasp on all of the elements of developing their argument, but they need more depth to reach a level four response, as noted in the comments below.

The student includes evidence from Sites 1 and 2, but only for number of organisms. They did not include number of species.

The student has clear reasoning, but to reach a level 4 they would need to incorporate a little more depth in their response.

Similar to exemplar 3, this student is arguing that their classmate's interpretation of the evidence is incorrect, not critiquing the evidence itself.

CHAPTER FOUR – EXTERNAL ASSESSMENT

DEVELOPING Exemplars

Moderated Scores – Exemplar 1				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	3	2	3	2

Student Response
<p>Did the power station cause large changes in the population of organisms living on the coral reef? Yes, the power station caused a big change. For example, in site 1, it shows 1-5 years. Year 1 was 28 degrees and went to 32 degrees in five year. That cause a change. The number of organisms decrease. Another example is site 2, it say organism living at site 2 it went from 1300 to 1000 in five years. My scientific reasoning is that my evidence was strong because it show how the power station caused a big change.</p> <p>Some one else might say no the power station did not cause a big change in the population of the living organisms in the coral reef.</p> <p>My argument is strong cause in site 1, 2 and 3 they all see big changes coming. This is why my argument is better cause it show it had little changes that led to big changes.</p>

The student does not provide extensive evidence, but they do include key pieces of evidence from both Sites 1 and 2. Feedback to this student should indicate that more evidence would strengthen their response.

The student is reiterating their claim, not providing reasoning. There are no scientific concepts incorporated nor do they link the claim to the evidence.

The student is not critiquing the evidence their classmates might use, instead they are restating why they think their argument is better.

CHAPTER FOUR – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 2				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	2	2	3	3

Student Response
<p>Yes, I think that the power station cause large changes in the population of organisms living on the coral reef. My claim is that they release clean warm water out to the ocean and that change the temperature of what they like. My evidence is that every time they release the warm water the temperature goes higher and coral start to die. Very fast. So I think yes that the power station cause large changes in the population of organisms living on the coral reef.</p> <p>No, I think that the power station is not changing the coral reef. I think this because when they release water the number of organisms are stay high.</p> <p>The problem is that the organisms are stay high but went down too. My evidence is that when they release the water the number drop to 900 before it was on 1200, but now it not.</p>

The student vaguely refers to trends in the data but is not specific in regards to which site, number of species, or number of organisms.

The student addresses the rebuttal and critiques it. Note that grammatical errors do not (and should not) have an effect on the student's score as long as they can clearly communicate their understanding.

CHAPTER FOUR – EXTERNAL ASSESSMENT

Moderated Scores – Exemplar 3				
Claim	Evidence	Reasoning	Counter	Rebuttal
3	1	1	3	1

Student Response
<p>Yes, the power station did cause large changes in the population of organisms living on the coral reef because as you can see in site 1, 2, and 3 the data of these coral reefs are changing sometime each year. To support my claim I would like to say the data base is not stable because as you can see each year are by the bases are going up and down in a bad way. In conclusion, this is my explanation.</p> <p>The claim that my classmate might state is that “No, the power station does not cause large changes in the populations of organisms living on the coral reef.”</p> <p>The problem with the claim is that it’s wrong because the 3 data sites clearly states and shows the sites going up and down in a bad way.</p>

The student makes vague statements about the data changing, but does not explain trends or cite any specific data.

A conversation with this student might help them to determine how to best state their reasoning, as they clearly have some opinion of what they see in the data, it just isn't expressed in their written answer.

Their counter is clear, but needs to cite the evidence that the classmate might use so they can rebut it below.

Without an explanation of what data their classmates would use, it isn't possible for there to be a critique of the data. This is very similar to their first paragraph in style, so feedback on the initial portion of their response might also lead to a clearer response here.

CHAPTER FIVE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Steps 4 – 6

General Notes for Scoring and Feedback

This is a very rich task, and is not a good time to introduce using slide presentations if students are not familiar with how to use/create them. Much of the student work we evaluated that was in the format of a slide presentation was clearly focused more on appearance, particularly animations, fonts, etc., than on the content. If slide presentations are being used it is suggested that the teacher either record the presentations to incorporate the oral information provided in the presentation in the students' eventual scores, or encourage students to use notes that they can turn in as part of their presentation.

Additionally, this is the first and only opportunity in this unit for students to engage in this particular aspect of the practice of Argumentation, "Evaluate competing design solutions based on jointly developed and agreed-upon design criteria," so it should be expected that students will have a lot of room for growth. This Evaluate was intentionally designed as a group-based project to scaffold students' initial work with this aspect of the practice, and it is expected that in future units students would have developed enough skill with this practice to work in pairs and eventually independently.

CHAPTER FIVE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Steps 4 – 6

ADVANCED/PROFICIENT Exemplar

Moderated Scores
3
NOTE: The response below was presented in a poster format. All text has been recreated here, including bold emphasis. Developed by a group of four students.

Student Response
<p>“Tourism & Use of Shockwaves, Run-offs: Destruction of Coral Reefs”</p> <p>Problem: Coral reefs are being damaged by human actions such as, tourism, use of shockwaves, and run-offs.</p> <p>Needs: The solution must make the coral reefs healthier with out disturbing the biodiversyty of the ecosystem and not disturbing the economic and social factors.</p> <p>Name of organization - Peace of Coral</p> <p>Solution: For Tourism: To stop tourisms from destroying the coral reef we will make special areas that tourism can dive in and see the coral reef, and every 10 years we would change the location of the area that they can dive in, so the coral reef can “rebuilt” or go back to the way it was. We would pay the workers 15 - 20 dollars per hour to keep or inforce the area, some of the workers are going to be watch gards to make sure that no one is diving in the for bitin area. We would ask the government to inforce the law of only diving in the districed area. Before diving in, the instructor will talk or inform you that you can’t touch the coral reef and if you do, there would be a fee of \$150, and the money would go to the organization called “Peace of Coral” to pay for the workers and the equipment. To find out if the divers touched the coral reef, we would implant cameras in there suits, which cost 300 per piece so about \$30,000 for 100 cameras.</p> <p>For Banning Shockwaves: We would go the government and argue the banning of shock waves and use of dynamite in water in the are off coral reef. About 20 mile away from reef. And if that doesn’t work make the price of the dynamite and shockwaves higher. So people would stop buying them. The economic will go up because of the people, some people would still by them, but it won’t effect the coral reef because of the 20 mile radies.</p>

Generally this is a well thought out plan that could benefit from increasing the type of detail (see comments below) and some of the accuracy. Some statements could be more specific as well (e.g. "without disturbing the biodiversity" is a very general criteria and could include qualifiers such as not altering number of species on the coral reef or not changing any individual species population by more than 5% up or down.) They also need more detail on their evidence that the plan works.

While some costs are included, and some information about economic effects, students could have provided more thorough examination of economic aspects. Social aspects were not directly discussed, although they seem to be incorporated

CHAPTER FIVE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Steps 4 – 6

Where we will get the money from: From fundraisers and people that come for the coral reef. Also, make fun carnivals that will inform kids and people about the situation of coral reefs, and raise money.

For Stopping Run-offs: Plant trees next to the rivers with main parts at where the run-offs come from, such as Gulf of Mexico, about \$60 per tree. Because trees take in or clean the water from run-off. A tree grows 10-20 years. Get the money from fundraisers.

Constraints:

- Must find away to get the money needed for the solution.
- Time (shouldn't take so long).

Criteria:

- Must not disrupt the biodiversity of the ecosystem.
- majority should agree = shouldn't make them unhappy
- must not cost more than 11 million dollars, must be the cheapest but the most effective solution.

The Time it is going to take: 10 years to start seeing effects of "Peace of Coral" program

Why it is the best:

For Tourism: The area would be changed every 10 year to the coral reef can "rebuild" or go back to the way it was. It states in www.nature.org "...the coral reef take about a minimum of 10 years to grow back..." The tourists would like to visit the site or coral reef dive every ten years to see the other parts of the coral reef which helps the social and economic needs.

For Banning Shockwaves: One example when that method worked is with cigarettes. It states in the article "Why of High Cigarette Prices" that the cigarettes sells went down by 1/3 % and it is because of the up on increase of prices.

For Stopping Run-off: It states www.nature.org "...tree reduces run-off, they take in the nutrients [editor's note: text cut-off in photo of work, but seems to continue for another sentence or two]

The way we can make it [the solution] better: Next time we would be happier because they were the most negatively effective.

There seem to be some misconceptions, such as what causes run-off and how trees prevent run-off.

Constraints and criteria are provided, but not very specific. Feedback might suggest including a number of years, what is meant by not disrupt the biodiversity of the ecosystem (or what an acceptable level of disruption is), majority of whom should agree, etc.

CHAPTER FIVE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Steps 4 – 6

DEVELOPING Exemplar

Moderated Scores
2
NOTE: The response below was presented in a slide format. All text has been recreated here, including bold emphasis. Developed by a group of four students.

Student Response
[Slide 1] We Need Coral Reefs! OR ELSE...
[Slide 2] Problem Slide The problem coral reefs are facing is fertilizer run-off which increases dead zone sizes, and as we are all well aware, results in a decreasing population. [Editor’s Note: includes two coral reef photos side by side with the labels “Before” on a healthy looking reef and “After” on what looks like a bleached coral reef, with no caption provided]
[Slide 3] Criteria and Constraints - Criteria: The coral reefs should be healthy and not overgrown by weed-like-algae Constraints: Environmental - decrease fertilizer runoff so it doesn’t create weed-like-algae Social and Economic - Farmers still have enough money to run their farm and feed their families and companies that buy their crops will have happy customers
[Slide 4] Solution Slide Our solution is to enforce a law in which each farmer buys a certain amount of fertilizer for each acre of land he/she has. If they buy more, they will be warned and payed a fine. If they buy more fertilizer again ¼ of their land will be taken away and given to the government.
[Slide 5] Solution Slides #2 Environment- The environment will be affected because the crops on the farms will get the right amount of nutrients and the extra nutrients will not enter the ocean. Since the fertilizer

In general more detail was needed for many aspects of the argument. Criteria such as "should be healthy" and constraints such as "decrease fertilizer run-off" should be made more specific.

Simple but fairly well thought-out solution.

CHAPTER FIVE – EMBEDDED ASSESSMENT

Activity 5 (Evaluate), Procedure Steps 4 – 6

is not in the water, algal mats will not grow and steal the coral reef's sunlight and they will start growing.

Social - The social impact will be that the farmers will not be too happy, but will still get their needs and other people who are not farmers will be happy because, limiting the amount of fertilizer doesn't affect their business that much.

Economic - The economic impact will be that because of less fertilizer run-off there will be less nutrients and the coral reefs will be healthy which will encourage more tourism and the economy will increase, but it will also decrease a bit because of the crops growing a little slow, but the economy overall will increase.

The presentation includes general evidence of the plan's success, but does not include enough specifics.

CHAPTER FIVE – EXTERNAL ASSESSMENT

ADVANCED Exemplar

Moderated Scores			
Claim	Evidence	Reasoning	New Solution
3	4	4	3

Student Response
<p>The first proposed solution (solution A) is the best solution to choose. According to the document, “Scientists estimate that it will take 20 years for the lobsters and snappers to recover to the 1990s levels.” Although this option takes a longer time to complete, it is more effective. Solution B says it will only take 10 years, but the populations will only recover to what it was in 2005, which was 31.5. Therefore, option A shows that although it may take a long time to complete, it is more effective than option B. Another negative aspect of option two is it risks the biodiversity of the ecosystem. By introducing more animals into the ecosystem, the prey of these animals populations will begin to decrease because there is too many snappers and lobsters in the ecosystem. The lobster and snapper populations can increase too far and become invasive species as well. Solution A, however, balances the ecosystem because they are stopping the fishing of everything in the ecosystem, not just one species. Some may argue option B is better than option A since option A causes 250 fishing jobs to be lost. However, according to the text, it is estimated that at least 100 new jobs would be created over the next 5 years. This reveals that technically only 50 jobs will be lost because there are new jobs that are being made to make up for the lost ones. Hence, solution A is the best solution to choose.</p> <p>One way we can help the snapper and lobster population is if we collect all the lobsters and snappers from Seaside City and place them inside of an aquarium indoors. This way, they can easily recover somewhere that they won’t be harmed by other animals or fishers. But what about the fisherman? Won’t they lose their jobs? The fisherman can continue to fish these animals, just in a different area. Also, some can tend to the lobsters and snappers in the aquarium. This solution may be a bit costly and may take some time, but we can get the money by using the money received from previous lobsters and snapper harvests. One negative aspect of this is that the animals who rely on these species for food won’t have this</p>

Claim is clear.

The student includes and analyzes multiple lines of evidence and reasoning is embedded throughout. Response shows a sophisticated level of understanding.

Student's reasoning includes a clear critique of the counter-argument.

Student does not take into account the impact of removing all lobster and snapper from the ecosystem, which is a serious drawback to the plan, hence the score of a 3 rather than a 4.

CHAPTER FIVE – EXTERNAL ASSESSMENT

species to depend on for food anymore, however there are other animals they can eat. This is a better solution than those produced by Seaside City because it isn't as costly, it doesn't affect the job system and it is less likely for certain species to become invasive.

CHAPTER FIVE – EXTERNAL ASSESSMENT

PROFICIENT Exemplar

Moderated Scores			
Claim	Evidence	Reasoning	New Solution
3	3	3	3

Student Response
<p>Solution B is the best because it recovers the biodiversity in about 10 years rather than 30. It also does recover it back to how 2005 was. One other reason is how jobs are affected. It is estimated that about 50 jobs are lost due to the solution. It would only take \$200,000 to bring the species back which is below the 2 million dollar constraint. Solution A is bad because of the amount of jobs. In total there would be 150 lost jobs because of the new jobs. It would take 30 years to get back to how the biodiversity used to be in 2000. That would take solution B about 15 or 20 years to get back to that percentage. It would even cost 1.5 million dollars to start the solution. That's way more than solution B.</p> <p>My solution is to increase more sea urchins and transport/move some (not all) dolphins and seals. This is a good solution because the urchins are the snapper fish and lobsters prey. This would increase their population. The dolphins and seals are part of the reason why the fish and lobsters are decreasing. People would still get to see the dolphins and seals but not a whole lot. This might earn the people money since some other place might want to buy them. It may cost some money to get more urchins. Though this is better than both solutions because Solution A affects the satisfaction of the fishers and people staying there because 250 fishers lost their jobs and the other people couldn't eat a lot of the snapper fish and lobsters.</p>

The student's evidence, reasoning, and new solution are all strong and well explained. However, they only offer evidence (and thus reasoning and a plan) for recovery of biodiversity and jobs. They do not incorporate effects of invasive species. Feedback, with the opportunity to revise their response, would likely lead to this student being able to develop an advanced level response.

CHAPTER FIVE – EXTERNAL ASSESSMENT

DEVELOPING Exemplar

Moderated Scores			
Claim	Evidence	Reasoning	New Solution
3	2	2	2

Student Response
<p>Which is the best proposed solution based on the criteria and why. I think the best solution is A because it might take long for the animal to recover but there will be more jobs and tourism will go up 20%. To build the protected area it will cost 1.5 million dollars. There will be more jobs for people and they can built hotels. There will be a long recovery time but the people will have jobs.</p> <p>My solution would be to make more hotels to make more money and when I get 2 million dollars I will then buy the protected area so the snapper and lobster can regrow and more fish will be in the water. I will make a law that you can only get 65 fish out of the water each day and that is my solution.</p>

Student provides a clear claim that answers the question.

The student only cites evidence related to economics and not to the ecosystem (e.g. biodiversity and/or invasive species).

Student's reasoning does not completely justify why Solution A is best. Feedback should indicate to the student that they need to incorporate reasoning for each point they are trying to make in order to strengthen their response.

The student has the beginning of a solution that could be very strong, and incorporates concepts addressed in the unit (fishing limits), however they need more details and justification.

Overall, this student's response has great promise, and would likely improve significantly with specific feedback and the opportunity for revision.

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