Coherence and Alignment Among Science Curriculum, Instruction, and Assessment (CASCIA) Project

Grade 5 Unit 2: Matter and Energy in Organisms and Ecosystems

Interpretive Guidance and Instructional Strategies for Educators

October 2023

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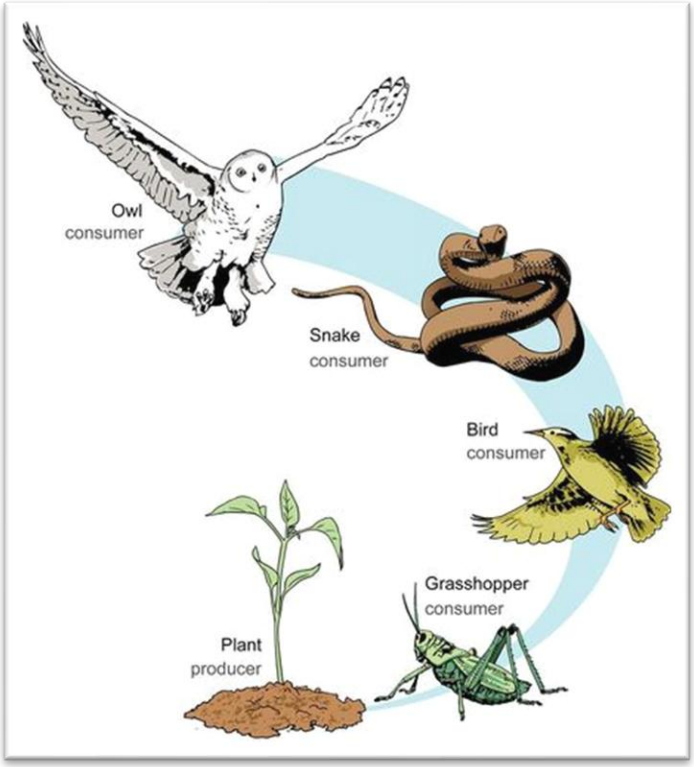
Purpose

The purpose of this document is to help educators understand their students' performance on the Grade 5 Unit 2 Science Assessment and to provide instructional strategies and resources for planning and adjusting instruction to help students learn, whether it involves reteaching previously addressed concepts and skills from the prior instructional unit or planning additional learning opportunities or interventions in the subsequent unit.

Unit Overview

By engaging in this unit, students deepen their knowledge of the interconnectedness of organisms and environments within ecosystems and how matter cycles and energy flows within these ecosystems that enable living things to grow and survive. Students develop their experience and skills with evaluation and explanation through constructing explanations, models, and arguments.



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Instructions for Educators

1. Based on your analysis of student work from the assessment, in combination with additional assessment evidence gathered over the course of the instructional unit, consider themes or trends in your students' performance. Refer to your students' scores on the Classroom Roster Report to determine the degree to which students in your classroom require additional instructional support based on their instructional needs levels—red, yellow, or green—for each performance category.
2. For each performance category, use the provided interpretive guidance (i.e., *What These Results Mean*, *Next Instructional Steps*, and *Example Scored and Annotated Student Work* located in the Grade 5 Unit 2 EOU Assessment Scoring Guide) to understand what your students likely know and are able to do and to consider next instructional steps based on their instructional needs levels. Scored and annotated student work samples are provided for each performance category to demonstrate the evidence students might demonstrate in response to each prompt for each possible score point. The student responses represent the full range of score points possible for each prompt based on the scoring rubric.
3. For each performance category, use the *Instructional Strategies and Resources* organized by Universal Design for Learning (UDL) principle to support the design and delivery of accessible instruction and learning opportunities for all students based on their performance on the Grade 5 Unit 2 Assessment and their recommended instructional needs. These instructional recommendations can be selected and used to intentionally plan instruction and learning opportunities for students across the range of instructional needs levels (i.e., red, yellow, green).

Universal Design For Learning

The instructional strategies and resources provided in this document are organized by the Universal Design for Learning (UDL) principles. UDL is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn." (CAST, 2022). Taking time to reflect on prior instruction when planning for accessible, differentiated, and culturally responsive instruction for diverse learners and culturally diverse classrooms serves to identify ways to improve future instructional practices. The UDL Guidelines provide a framework for this reflection. The guidelines include three principles, Multiple Means of Engagement, Multiple Means of Representation, and Multiple Means of Action & Expression as ways to focus on variety and flexibility in instructional practices.

Multiple Means of Engagement	*The WHY of Learning* - provide options for recruiting student interest, sustaining effort, and promoting motivation
Multiple Means of Representation	*The WHAT of Learning* - provide options for displaying information, including alternatives for auditory and visual information, use multi-media, clarify vocabulary and symbols, support comprehending text, and guide information processing and visualization
Multiple Means of Action & Expression	*The HOW of Learning* – vary the methods for student responses and collection of evidence of their learning, optimize access to tools and technologies, use multiple tools for construction and composing responses, facilitate managing information and resources, and enhance student capacity for monitoring progress

By examining instruction and instructional materials through the lens of each of these principles, we can identify and thus reduce or remove barriers to diverse learners to promote accessible and equitable teaching and learning opportunities. Application of UDL guidelines and principles allows all students to engage with and be provided with multiple means of representing instructional content and expressing what they know and can do which is similarly the purpose of the use of accommodations for students receiving special education, students who have a 504 plan, and emerging Bilinguals.

Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals

Interpretive Guidance for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Red (0-4 score points earned) ➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-8 score points earned)** ➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (9-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Provide a statement in an attempt to support an argument, with **little to no** evidence related to materials plants need for growth or energy transfer in an ecosystem. • State **some** science ideas or information to provide a description or conclusion. • Demonstrate **partial** understanding of the component parts within an ecosystem, such as that plants acquire their materials for growth chiefly from air and water and that the sun is a source of energy, and **show limited understanding** of how matter cycles and energy flows among organisms. • Demonstrate **partial** understanding of the impacts of the introduction of new species into a balanced ecosystem.	**This student is likely able to:** • Present **limited** evidence to support an argument related to materials plants need for growth or energy transfer in an ecosystem. • Use **some relevant** science concepts, theories, or information as reasoning to construct an argument with evidence, data, or a model. • Demonstrate **partial** understanding of the component parts within an ecosystem, such as that plants acquire their materials for growth chiefly from air and water and that the energy released from food was once energy from the sun, and **apply some of these concepts** to describe how matter cycles and energy flows among organisms.	**This student is likely able to:** • Present **convincing**, **valid**, and **reliable** evidence to support an argument related to materials plants need for growth or energy transfer in an ecosystem. • Use **relevant** science concepts, theories, or information as reasoning to construct a **clear and convincing** argument with evidence, data, or a model. • Demonstrate understanding of the component parts within an ecosystem, such as that plants acquire their materials for growth chiefly from air and water and that the energy released from food was once energy from the sun, and **clearly relate these ideas** to how energy flows and matter cycles among organisms.

Interpretive Guidance for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Red (0-4 score points earned) ➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-8 score points earned)** ➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (9-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
	• Demonstrate **partial** understanding of the impacts of the introduction of new species into a balanced ecosystem.	• Demonstrate **complete and accurate** understanding of the impacts of the introduction of new species into a balanced ecosystem.

Interpretive Guidance for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
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Next Instructional Steps		
Provide opportunities for the student to: • Select from and correctly use provided terminology and concepts to engage in argumentation related to how matter cycles and energy flows in an ecosystem. • Collaboratively brainstorm and generate ideas and reasons to support a provided argument. • Collaboratively select from provided evidence, data, and/or models that are relevant to support a provided argument.	**Provide opportunities for the student to:** • Correctly use relevant terminology and concepts to engage in argumentation. • Apply scientific concepts from the unit to explain decision-making, data analysis, and reasoning to construct an argument. • Identify and use multiple sources of relevant evidence, data, and/or models to construct and support an argument. • Evaluate the strength of a provided argument based on the relevance and sufficiency of the reasoning and evidence.	**Provide opportunities for the student to:** • Connect scientific theory correctly, directly, and tightly to the most sophisticated supporting evidence available so that the argument is clearly justified. • Compare and refine arguments based on an evaluation of the evidence presented.

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Argumentation through Discourse*** Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on each other's ideas to coordinate claims, evidence, and reasoning in a scientific argument. Opportunities for scientific discourse should be situated in authentic, interest-driven science investigations. • Use Thinking Maps to show evidence of the Flow of Energy and Matter Cycles. • Discuss how plants and animals change their environment. • Explain how almost all food can be traced back to plants using a flowchart. ***Culturally Responsive Argumentation*** Foster argumentation that is culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students. • Discuss the various parts of the country students live or have lived in. • Are the ecosystems the same or different? How?	• Talk Activities that can Scaffold Argumentation and Talk Activities Flowchart – These tools highlight those talk formats and explain when, how, and why to use each talk format to support student investigations. PDF is available in Spanish. [http://stemteachingtools.org/brief/35] • Smithsonian Science Education Center: Techniques for Encouraging a Culture of Argumentation in Your Classroom – This article discusses avenues for creating a culture of argumentation in a science classroom. [https://ssec.si.edu/stemvisions-blog/techniques-encouraging-culture-argumentation-your-classroom] • The Lawrence Hall of Science: Practicing Oral Discourse Skills – This site provides teachers with a 'Collection of Reteaching Loops,' including reading arguments, writing (basic components, relevant evidence, reasoning), and discourse. [https://argumentationtoolkit.lawrencehallofscience.org/wp-content/uploads/sites/10/2022/08/SG5-Practicing_Oral_Discourse_Skills.pdf] • The #Science of Argumentation – This video shows how Kevin, using reality pedagogy—an approach to teaching that focuses on understanding student realities—finds stories that students are passionate about as a starting point for instruction. "It is our responsibility to create scientifically literate students with a zeal for learning." [https://youtu.be/-MWkN9iIo6I?si=-VmdS6ZxofvaCCse]

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Modeling and Critiquing Scientific Arguments* Use spoken and written examples to model scientific arguments and encourage students to critique and challenge scientific arguments by identifying strengths and weaknesses in reasoning and evidence. • Use an argument paper chain to model and critique how energy from food once was energy from the sun. • Using a debate among students/small groups, discuss pros and cons of an invasive species in an ecosystem.	• Student-Friendly Video on Scientific Argumentation – This brief, animated video explains scientific argumentation in simple terms. Non-examples are also provided. [https://concord.org/blog/student-friendly-video-on-scientific-argumentation/] • Argumentation and Practical Work – This document provides examples of how practical work in the classroom can be used alongside argumentation. Section 5 of this document (page 14) offers an example of how students can critique arguments. [https://www.nuffieldfoundation.org/sites/default/files/files/Argumentation%20Introduction.pdf] • How to Teach Scientific Models – These strategies offer guidance about how to explicitly teach and critique scientific models. [https://edu.rsc.org/feature/how-to-teach-scientific-models/3010560.article]
	*Promoting Engagement through Interactive, Collaborative Games* Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about the flow of energy and cycles of matter. Using engagement to explore composers, decomposers, consumers, and producers. • Use flashcards to quiz each other on the importance of each component of an ecosystem.	• Wordwall Interactive Games -This site offers quick interactive games to reinforce the concepts and vocabulary pertaining to energy and matter. All grade levels are included, so scroll until you find an appropriate level. [https://wordwall.net/community?localeId=1033&query=energy%20and%20matter] • Classroom Review Games - These 10 innovative and entertaining classroom review games are designed to not only improve knowledge retention but also improve engagement. [https://blog.classpoint.io/classroom-review-games/]

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	• Either virtually or through paper and pencil, encourage dialogue and content reinforcement utilizing the *Who Am I? Game*.	
	***Develop Self-assessment and Reflection*** For many learners, recognizing that they are making progress toward greater independence is highly motivating. Alternatively, one of the key factors in learners losing motivation is their inability to recognize their own progress. It is important that learners have multiple models and scaffolds of different self-reflection techniques so that they can identify and choose ones that are optimal.	• Strategies for Self-Reflection – This site will fill your teacher toolbox with prompts and strategies that promote reflection on both the content and the practice of science. [https://www.calacademy.org/educators/science-notebooks-for-reflection] • 4 Ways to Incorporate Reflection in Science Lessons – This article shows how students can make personal connections to scientific concepts when lessons include opportunities for introspection. [https://www.edutopia.org/article/student-reflection-science-lessons/] • 5 Activities That Promote Reflection in the Classroom – This article describes the metacognitive work of reflecting on science learning boosts engagement and encourages the development of critical thinking skills in students. [https://www.edutopia.org/article/reflection-learning-tool/]
	***Vocabulary*** Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and	• STEM Teaching Tools – Practice Brief 66 – This article explains how to support emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66] • Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***

	then apply the academic terminology using the strategies outlined below.
	• Build understanding of domain-specific vocabulary using a multi-sensory approach or having students participate in simulations.
	• Make connections between vocabulary and real-life or future opportunities.
	  ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see Resources) provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students.
	  ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks.
	  ○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge.
	• Read books or watch videos related to vocabulary words and concepts.
	• Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes word
		word lists for students. [https://www.vocabulary.com/]
		• Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas, including science and social studies. [https://textproject.org/wp-content/uploads/qrwp/QRWP_C3_Plants.pdf]
		• The Science Penguin – This site provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html]
		• Interactive Word Walls Enliven Vocab Learning – This article includes teaching strategies to support students' use of a word wall to build an understanding of key vocabulary. [https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary (e.g., predator) using both domain-specific and common terms. • Embed visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	
	*Presenting Information in Different Modalities* Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to the flow of energy and the cycle of matter. • If a school library is available, select books on ecosystems to share with students throughout the unit. • Invite a guest speaker, such as a botanist, waste disposal technician, commercial greenhouse owner, etc., to speak to your students.	• Energy Flow: From Sunlight to Plants to Animals - This site shows how plants harness the Sun's energy and, in doing so, make many forms of life, including human life, possible. [https://az.pbslearningmedia.org/resource/tdc02.sci.life.oate.energyflow/energy-flow/] • The Dirt On Decomposers – This site shows a model to describe the movement of matter among plants, animals, decomposers, and the environment. [https://www.youtube.com/watch?v=uB61rfeeAsM] • Ecosystems for Kids – The interactive video shares about composers, decomposers, producers, and consumers. [https://www.youtube.com/watch?v=PxK4aCBG4Nk]

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Scaffolds for Communicating through Argumentation* Provide scaffolds for argumentative writing and discussions to justify or describe a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Embed visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Provide opportunities to discuss the Flow of Energy and Matter Cycles through use of Thinking Maps	• National Science Foundation – Tools for Ambitious Science Teaching – This site discusses a tool that provides scaffolds for writing that support learners in constructing explanations with evidence. These take the form of sentence frames, guides for how to help English learners practice final explanations, norms for whole class discussion that are developed by students, roles that students can take in small group activities, and others. [https://ambitiousscienceteaching.org/scaffolding-students-written-explanations/] • Bozeman Science: Engaging in Argumentation – In this video, Paul Andersen explains how to have your students engage in argumentation in the science classroom. [https://www.youtube.com/watch?v=L96LiRDWgmI] • Stem Teaching Tool – Practice Brief 25: Equitable Argumentation – This article describes how supporting multiple modes of expression can increase ways that students communicate their arguments. [https://stemteachingtools.org/brief/25]
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their arguments and learning in class. • Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs.	• Deepen Academic Knowledge – This site uses disciplinary facets to deepen academic vocabulary knowledge. [https://www.readwritethink.org/professional-development/strategy-guides/using-disciplinary-facets-deepen] • How to Make Infographics - In this video, discover five ways to use infographics in the virtual or physical classroom. [https://www.youtube.com/watch?v=CGFjy-Hqr7U]

Instructional Strategies and Resources for Performance Category 1: Support Arguments About Energy and Matter Flow Among Plants and Animals *Task 1, Prompt 1 (4 points); Task 1, Prompt 2 (3 points); Task 3, Prompt 3 (4 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	• Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	• Digital Lab Notebook – This digital notebook offers students a digital option for recording lab results, writing lab reports, journaling, drawing, planning, or creative writing, and can be saved as a copy. [https://virtualscienceteachers.org/virtual-labs/]

Performance Category 2: Model Relationships in Ecosystems

Interpretive Guidance for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Red (0-4 score points earned) ➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-8 score points earned)** ➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (9-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Present **incomplete and/or inaccurate** representations related to materials plants need for growth or energy transfer in an ecosystem. • Present **incomplete and/or inaccurate** representations of the cycling of matter or flow of energy in a food web. • Demonstrate **partial** understanding of the impacts of the introduction of new species into a balanced ecosystem and **show limited understanding** of a system in terms of its components and their interactions.	**This student is likely able to:** • Present **clear and complete** representations with **minor errors** of materials plants need for growth or energy transfer in an ecosystem. • Use a model to develop **incomplete but accurate** explanations of the cycling of matter or flow of energy in a food web. • Demonstrate **partial** understanding of the impacts of the introduction of new species into a balanced ecosystem and **apply some of these concepts** to describe a system in terms of its components and their interactions.	**This student is likely able to:** • Present **clear, complete, and accurate** representations of materials plants need for growth or energy transfer in an ecosystem. • Use a model to develop **thorough and accurate** explanations of the cycling of matter or flow of energy in a food web. • Demonstrate **complete and accurate** understanding of the impacts of the introduction of new species into a balanced ecosystem and **clearly relate these ideas** to describe a system in terms of its components and their interactions.

Interpretive Guidance for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Red (0-4 score points earned) ➢ Extensive additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (5-8 score points earned)** ➢ Moderate additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (9-11 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
Next Instructional Steps		
Provide opportunities for the student to: • Select the most accurate and complete particle model of materials plants need for growth or energy transfer in an ecosystem. • Select the most accurate and complete explanation of a macrophenomenon from a range of explanations. • Collaboratively critique and revise incomplete or inaccurate models and/or explanations of energy and matter flow in a system that leads to an explanation of a macrophenomenon.	**Provide opportunities for the student to:** • From a given model, develop a complete and accurate explanation of the cycling of matter or flow of energy in a food web. • Complete a partial model to support an explanation. • Identify and use different representations of the flow of energy and the transfer of matter between organisms in a food web. • Evaluate the adequacy of a provided model to support an explanation based on the relationship between the components of a balanced ecosystem and their interactions (e.g., how changes in a previously stable environment affect the matter flow/energy cycle among the original plants, animals, decomposers in the system).	**Provide opportunities for the student to:** • Compare and refine models of a wide range of macro-phenomena to gather evidence for relationships represented among different components of the food web. • With and without using models, compare and refine explanations of a wide range of macro-phenomena focusing on the generalizability of various influences on interdependent relationships in ecosystems and cycles of matter and energy transfer in ecosystems.

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Modeling through Discourse* Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on others' ideas to optimize the use of a range of models to show relationships among variables or represent analogies and/or abstract concepts to describe a scientific principle or design solution. Opportunities for scientific discourse should be situated in authentic, interest-driven science investigations. *Culturally Responsive Modeling* Foster model-development practices that are culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students.	• Talk Activities Flowchart – This flowchart can help structure activities so that students' talk is more equitable, scientific, and focused on sensemaking in support of a classroom culture based on curiosity and learning. [https://stemteachingtools.org/sp/talk-flowchart] • STEM Teaching Tools – Practice Brief 55 – This article explains why it is crucial to make cultural diversity visible in STEM education. [https://stemteachingtools.org/brief/55] • STEM Teaching Tools – Practice Brief 48 – This article discusses how teachers can use tools to scaffold student science talk and includes Talk Resource Tools to foster shifts in science classroom talk. [https://stemteachingtools.org/brief/48] • Flexible Grouping – This article discusses the benefits of flexible grouping, including increased student engagement. It also defines types of groupings and strategies for creating flexible groups in the classroom. Students can evaluate and refine models of the cycling of matter in differentiated groups. [https://www.kodable.com/learn/flexible-grouping-strategies-and-how-it-to-use-in-your-classroom] • Home Sweet Habitat: Crash Course Kids – This YouTube video shows how habitats form food webs. This video can be used to encourage student discourse about how these organisms are related. [https://www.youtube.com/watch?v=p15IrEuhYmo]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Modeling and Critiquing Scientific Models* Use spoken and written examples to model how to evaluate and refine models comparing predictions with the real world and encourage students to adjust and refine the model by identifying strengths and weaknesses in the model to show the interdependent relationships of organisms in an ecosystem.	• How to Teach Scientific Models – These strategies offer guidance about how to teach and critique scientific models explicitly. [https://edu.rsc.org/feature/how-to-teach-scientific-models/3010560.article] • Using Models to Teach Science – This NSTA article can support instruction in developing and using models to teach science. Information from this article can support teachers as they align instruction with NGSS, specifically the SEP of modeling. [https://www.nsta.org/science-teacher/science-teacher-novemberdecember-2019/using-models-teach-science] • STEM Teaching Tools – Practice Brief 8 – This article describes how models are integral to the practice of science and presents points to consider when helping students develop, test, and use models in science. [https://stemteachingtools.org/brief/8#:~:text=Scientific%20models%20can%20take%20many,present%20within%20a%20single%20model] • MPRES Toolkit for Teachers Conceptual Change: Developing and Using Models – This toolkit offers teachers resources for developing and using models. Including links to NGSS resources and student activities. [https://www.mtscienceducation.org/toolkit-home/scientific-engineering-practices/developing-and-using-models/] • Modeling Level 2: Modeling Phenomenon – This mini-lesson includes a student tutorial with video and thinking slides to

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		guide students in developing and using models. [https://docs.google.com/presentation/d/10cMVQ6ddgbP_oL9PBAwBIF2R5MY9FTMywnyJEvoUBGE/template/preview]
	***Promoting Engagement through Interactive, Collaborative Games*** Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about a phenomenon demonstrating that different plants and animals in an ecosystem depend on one another.	• Habitats and Ecosystems Games – This website includes interactive games on relationships in ecosystems. [https://nebraskapublicmedia.pbslearningmedia.org/collection/plumlanding/t/games-and-videos/habitats-and-ecosystems/] • Food Chains - Science Kids & Activities for Kids – This interactive game allows students to identify and arrange matter in an ecosystem and show its interactions in a food web. [https://www.sciencekids.co.nz/gamesactivities/foodchains.html] • Food Web Tag – This kinesthetic activity allows students to physically model a food web and the cycling of matter in an ecosystem. [https://www.scienceworld.ca/resource/food-web-tag/]
	***Optimize Relevance, Value, and Authenticity of Scientific Modeling*** One of the most important ways that teachers recruit interest is to highlight the utility and relevance of learning and to demonstrate that relevance through authentic, meaningful activities. This can be achieved by modeling phenomena that are engaging and meaningful to students.	• What Do You Look For When Selecting Science Phenomena – This article provides three criteria to look for when selecting relevant, engaging phenomena. [https://iexplorescience.com/what-do-you-look-for-when-selecting-science-phenomena/] • Phenomena Finder – This tool can be used to search for relevant and engaging phenomena that can be modeled to support sense-making. [https://impactscied.illinois.edu/phenomena-finder-project/phenomena-finder#page-2]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• Authentic Learning – A Teaching Strategy – This article describes characteristics, examples, advantages, and disadvantages of authentic learning in the classroom. This article can provide guidance and spark ideas for developing real-world, authentic lessons involving the modeling of matter through an ecosystem. [https://bookunitsteacher.com/wp/?p=5801]
	*Vocabulary* Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and then apply the academic terminology using the strategies outlined below. • Build understanding of domain-specific vocabulary using a multi-sensory approach or having students participate in simulations. • Make connections between vocabulary and real-life or future opportunities. ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see Resources) provides explanations of words using real-world examples.	• STEM Teaching Tools – Practice Brief 66 – This article discusses how to support emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66] • Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/] • Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas, including science and social studies. [https://textproject.org/archive/textproject-word-pictures/] • The Science Penguin – This website provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	Once signed in, an educator can create word lists for students. ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks. ○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. • Read books or watch videos related to vocabulary words and concepts. • Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes Word Pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary using both domain-specific and common terms. • Embedded visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	• Interactive Word Walls Enliven Vocab Learning – This article with teaching strategies supports students' use of a word wall to build an understanding of key vocabulary. [https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	***Presenting Information in Different Modalities*** Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to a phenomenon demonstrating the interconnectedness of organisms in an ecosystem.	• What is Multimodal Learning? 35 Strategies and Examples to Empower Your Teaching – This article defines multimodal learning and presents strategies for the different modalities. [https://www.prodigygame.com/main-en/blog/multimodal-learning/] • Hands on Activities for Introducing Ecosystem to Elementary Students – This website provides hands-on activities that enable students to learn about ecosystems by exploring their own community and by building their own ecosystem. [https://www.plt.org/educator-tips/ecosystem-activities-elementary-students] • Understanding Ecosystems for Kids – YouTube video – This YouTube video defines an ecosystem and explains the interconnectedness of living organisms. It demonstrates how an ecosystem can become unbalanced through natural or man-made disturbances. [https://www.youtube.com/watch?v=bJEToQ49Yjc] • Scientists Say: Food Webs – This informational text for students defines and gives examples of food webs. [https://www.snexplores.org/article/scientists-say-food-web-definition-pronunciation]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	Activate or Supply Prior Knowledge When Modeling Information is more accessible and likely to be assimilated by learners when it is presented in a way that primes, activates, or provides any pre-requisite knowledge. Barriers and inequities exist when some learners lack the background knowledge that is critical to assimilating or using new information. Barriers can exist for learners with the necessary background but might not know it is relevant.	• Prior Knowledge in Science Lessons - This article provides strategies, links, and further reading that might be useful to explore and activate prior knowledge at the start of a lesson or topic. This is important not only for the DCI of the cycling of matter but also for background knowledge of the SEP of modeling. [https://thescienceteacher.co.uk/prior-knowledge/]
	*Scaffolds for Communicating through Models* Provide scaffolds for developing models to provide evidence to explain a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students.	• National Science Foundation – Tools for Ambitious Science Teaching – This site discusses tools to help students construct and revise evidence-based explanations and models. A variety of strategies are provided for students to use models to make their thinking visible. [https://ambitiousscienceteaching.org/tools-face-to-face/#Gottahave] • Matter Cycling System Model – This graphic organizer from Wonder of Science provides a scaffold for students when modeling the cycling of matter. There is also a completed example. [https://static1.squarespace.com/static/59c3bad759cc68f757a465a3/t/5e18a882766381076cf9e64c/1578674307023/5-LS2-1+Matter+Cycling+System+%28Student+Version%29.pdf] • System Level 2 – Components and Interactions – This tutorial allows students to practice thinking through system models to build up food webs from other real-world components and

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		interactions. Use tutorial slides and link to the mini-lesson video. [https://docs.google.com/presentation/d/1j-tcrxSR_pHY7Qil8gybEXFJA0dg5vAZ2BdQYgahGrE/template/preview]
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their developed models and show how their models are useful. • Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs. • Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	• STEM Teaching Tools – Multiple Means of Action and Expression – This article provides considerations for engaging students through multiple means of action and expression. [https://stemteachingtools.org/sp/multiple-means-of-action-and-expression] • Getting Started with Jamboard – This site presents information on how to use the free Jamboard app in the classroom. Students could use this as an option for demonstrating learning. [https://edu.google.com/jamboard/] • Interactive Whiteboard - This platform to collaboratively model conceptual understanding and revise thinking. [https://webwhiteboard.com/] • Padlet – This platform allows students to collect and archive information across groups where students can present and share content instantly. [https://padlet.com/] • Infographic Maker – This presentation software allows students to create data and infographics to summarize learning with charts, graphs, and diagrams. [https://venngage.com/blog/infographics-maker?utm_source=google&utm_medium=cpc&utm_campaign

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		=&utm_content=&utm_term=infographic%20maker&match=e&campaignid=19558960020&adgroupid=143879091486&gad=1&gclid=Cj0KCQjw9fqnBhDSARIsAHlcQYSnvSGACgz1oEBmzQLMma1B3UbfY5Ieynj1ZD6Y7st4Cmtmf7rpiVcaAlEYEALw_wcB]
	***Build Fluencies with Graduated Levels of Support for Practice and Performance*** Getting students to think about how energy and matter move between living things can be tricky. When teaching this topic, teachers can use the "I do, we do, you do" model. • Teacher models a food chain. • Student groups construct another chain. • Then move students on to look at more complicated consumption relationships modeled by food webs.	• Sentence Starters vs Sentence Frames – This YouTube video for teachers describes the difference between sentence frames and starters with guidance on when to use them based on the goal of the writing/speaking task. [https://www.youtube.com/watch?app=desktop&v=6LI6V8jxbXc] • Starting Out with Sentence Stems in Science – This website provides tips for using sentence stems in the science classroom with examples. Printable free classroom poster for science. [https://thesciencepenguin.com/2015/05/starting-out-with-sentence-stems.html] • Gradual Release of Responsibility Creates Independent Learners – This article describes how a combination of instructional methods can be successful for student learning. While this article is not specific to scientific modeling, the combination of demonstration and collaboration, known as the gradual release of responsibility, can be incorporated into helping students construct a model showing the cycling of matter in an ecosystem. [https://www.thoughtco.com/gradual-release-of-responsibility-4153992]

Instructional Strategies and Resources for Performance Category 2: Model Relationships in Ecosystems *Task 2, Prompt 1, Part A (2 points); Task 2 Prompt 1, Part B (3 points); Task 2, Prompt 2 (3 points); Task 3, Prompt 1 (3 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• The Science Series, Making Scientific Models – This video features a teacher instructing students on how to construct a scientific model. The video could be used with students as they are beginning to construct a model of the flow of matter in an ecosystem. The video could be stopped at key places, and the class could work together to develop the model. Finally, the teacher could determine when the students are ready to work on their own. There is also a link to a poster that could be displayed throughout the year to give students a reference when developing models. [https://www.youtube.com/watch?v=MgVCIGPBb9M] • Differentiated Feedback – This article offers tips for providing differentiated feedback when formatively assessing, which can provide a tool for developing fluencies such as scientific modeling. [https://assessmarter.weebly.com/differentiated-feedback.html]

Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers

Interpretive Guidance for Performance Category 3: **Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers** *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3 Prompt 2, Part B (2 points)*		
Red (0-5 score points earned) ➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (6-9 score points earned)** ➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (10-12 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • Present **incomplete and/or inaccurate** representations related to the movement of matter and/or the transfer of energy in an ecosystem. • Present **incomplete and/or inaccurate** explanations about the cycling of matter or flow of energy in an ecosystem. • Demonstrate **partial** understanding of the relationships among components of an ecosystem and **show limited understanding** of how matter cycles or energy flows through organisms and ecosystems.	**This student is likely able to:** • Present **clear and complete** representations with **minor errors** related to the movement of matter among plants, animals, decomposers, and the environment, and how energy in animals' food was once energy from the sun. • Use the model to develop **incomplete but accurate** explanations about the cycling of matter or flow of energy in an ecosystem. • Demonstrate **partial** understanding of the relationships among components of an ecosystem and **apply some of these concepts** to provide an explanation of how matter cycles or energy flows through organisms and ecosystems.	**This student is likely able to:** • Present **clear, complete, and accurate** representations of the movement of matter among plants, animals, decomposers, and the environment, and they can explain that energy in animals' food was once energy from the sun. • Use a model to develop **thorough and accurate** explanations of the cycling of matter or flow of energy in an ecosystem. • Support a **scientifically accurate and complete** explanation or prediction related to how matter cycles and energy flows through organisms and ecosystems.

Interpretive Guidance for Performance Category 3:
Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers

Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3 Prompt 2, Part B (2 points)

Red (0-5 score points earned)	Yellow (6-9 score points earned)	Green (10-12 score points earned)
➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
Next Instructional Steps		
Provide opportunities for the student to: • Select the most accurate and complete particle model of materials plants need for growth or energy transfer in an ecosystem. • Select the most accurate and complete explanation of a macrophenomenon from a range of explanations. • Collaboratively critique and revise incomplete or inaccurate models and/or explanations of energy and matter flow in a system that leads to an explanation of a macrophenomenon.	**Provide opportunities for the student to:** • From a given model, develop a complete and accurate explanation of the cycling of matter or flow of energy in a food web. • Complete a partial model to support an explanation. • Identify and use different representations of the flow of energy and the transfer of matter between organisms in a food web. • Evaluate the adequacy of a provided model to support an explanation based on the relationship between the components of a balanced ecosystem and their interactions (e.g., how changes in a previously stable environment affect the matter flow/energy cycle among the original plants, animals, decomposers in the system).	**Provide opportunities for the student to:** • Compare and refine models of a wide range of macro-phenomena to gather evidence for relationships represented among different components of the food web. • With and without using models, compare and refine explanations of a wide range of macro-phenomena focusing on the generalizability of various influences on interdependent relationships in ecosystems and cycles of matter and energy transfer in ecosystems.

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Modeling through Discourse* Provide varied opportunities (stations, small groups, partners, whole class) for students to engage in interactive discourse where they build on others' ideas to optimize the use of a range of models to show relationships among variables or represent analogies and/or abstract concepts of the flow of energy and cycling of matter in an ecosystem. Opportunities for scientific discourse should be situated in authentic, interest-driven development of models among a system of plants, animals, and decomposers. *Culturally Responsive Modeling* Foster model-development practices that are culturally responsive, drawing from and respecting students' cultural resources, backgrounds, and personal experiences. Provide a range of ways for students to engage in cooperative learning (e.g., think-pair-share, jigsaw, round robin) with diverse groupings of students.	• Talk Activities Flowchart – This flowchart can help structure activities so that students' talk is more equitable, scientific, and focused on sensemaking in support of a classroom culture based on curiosity and learning. [https://stemteachingtools.org/sp/talk-flowchart] • Interdependent Relationships in Ecosystems – This Bozeman Science video by Paul Andersen explains how matter moves from the environment into living organisms and back into the environment in ~ the first three minutes. Food webs are used to show how matter and energy move through organisms. It supports students' understanding of matter and energy flow to inform the creation and evaluation of models. [https://www.youtube.com/watch?v=vFqv_y1QKRA] • Energy Transfer in Ecosystems – This National Geographic article and embedded video discuss the transfer of energy through an ecosystem and includes key vocabulary. It also includes an infographic showing producers, consumers, and decomposers in a suburban environment. [https://education.nationalgeographic.org/resource/energy-transfer-ecosystems/] • STEM Teaching Tools – Practice Brief 55 – This article explains why it is crucial to make cultural diversity visible in STEM education. [https://stemteachingtools.org/brief/55]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• STEM Teaching Tools – Practice Brief 48 – This article discusses how teachers can use tools to scaffold student science talk and includes Talk Resource Tools to foster shifts in science classroom talk. [https://stemteachingtools.org/brief/48] • Biography-Driven Phenomenon- Engage in asset-based ways to mine for student culture, identity, and facets of knowing to avoid assuming cultural relevance. [https://www.youtube.com/watch?v=NuCe47fbnTQ]
	***Modeling and Critiquing Scientific Models*** Use spoken and written examples to model how to evaluate and refine models comparing predictions with the real world and encourage students to adjust and refine the model by identifying strengths and weaknesses in the model to show the interdependent relationships of organisms in an ecosystem.	• Food Web Maker – This website provides pre-made templates to create food webs and aid visualization of interconnections in an ecosystem by creating detailed food webs or food chains to understand ecosystems better. [https://creately.com/lp/food-web-maker/] • Matter Cycling System Model - This graphic organizer from Wonder of Science provides a scaffold for students when modeling the cycling of matter. There is also a completed example. [https://static1.squarespace.com/static/59c3bad759cc68f757a465a3/t/5e18a882766381076cf9e64c/1578674307023/5-LS21+Matter+Cycling+System+%28Student+Version%29.pdf] • How to Teach Scientific Models – These strategies offer guidance about how to explicitly teach and critique scientific models. [https://edu.rsc.org/feature/how-to-teach-scientific-models/3010560.article/]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		• Modeling Level 2: Modeling Phenomenon – This mini-lesson includes a student tutorial with video and thinking slides to guide students in developing and using models. [https://docs.google.com/presentation/d/10cMVQ6ddgbP_oL9PBAwBIF2R5MY9FTMywnyJEvoUBGE/template/preview] • MPRES Toolkit for Teachers Conceptual Change: Developing and Using Models – This toolkit offers teachers resources for developing and using models. Including links to NGSS resources and student activities. [https://www.mtscienceducation.org/toolkit-home/scientific-engineering-practices/developing-and-using-models/] • STEM Teaching Tools – Practice Brief 8 - This article describes how models are integral to the practice of science and presents points to consider when helping students develop, test, and use models in science. [https://stemteachingtools.org/brief/8#:~:text=Scientific%20models%20can%20take%20many,present%20within%20a%20single%20model]
	***Promoting Engagement through Interactive, Collaborative Games*** Use interactive games and collaborative formats to reinforce disciplinary core ideas related to science ideas about a phenomenon demonstrating that energy can be transferred between species in a food chain.	• Energy Flow: From Sunlight to Plants to Animals PBS Science – This interactive helps students answer the questions about paths that energy flows and how energy is transferred from one type of organism to another. [https://nebraskapublicmedia.pbslearningmedia.org/resource/tdc02.sci.life.oate.energyflow/energy-flow/]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	Optimize Relevance, Value, and Authenticity One of the most important ways that teachers recruit interest is to highlight the utility and relevance of learning and to demonstrate that relevance through authentic, meaningful activities. This can be achieved by modeling phenomena that are engaging and meaningful to students. ***Develop Self-assessment and Reflection*** For many learners, recognizing that they are making progress toward greater independence is highly motivating. Alternatively, one of the key factors in learners losing motivation is their inability to recognize their own progress. It is important that learners have multiple models and scaffolds of different self-reflection techniques so that they can identify and choose ones that are optimal. ***Foster Collaboration and Community When Modeling*** All learners must be able to communicate and collaborate effectively within a community of learners. When carefully structured, such peer cooperation can significantly increase the available support for sustained engagement by using norms to structure conversations and interactions. Establishing norms provides opportunities to learn how to work most effectively with others. Options should be provided on how learners build and utilize these important skills.	• Games: Jungle Jeopardy PBS Kids – This interactive allows students to see how the different species of plants and animals in a rainforest depend on one another and to experiment with how changing the amount of one resource affects the whole ecosystem. Their goal is to put together a balanced ecosystem in which each animal has enough food to survive over a period of 12 days. The longer their ecosystem lasts, the more points they will earn for their sticker collections. [https://pbskids.org/plumlanding/educators/context/jungle_jeopardy.html] • Energy Pyramid in an Ecosystem Activity – This website includes interactive games on the food pyramid to conceptualize energy use by organisms in an ecosystem. [https://www.tinytap.com/activities/g25l1/play/energy-pyramid-in-an-ecosystem] • What Do You Look For When Selecting Science Phenomena - This article provides three criteria to look for when selecting relevant, engaging phenomena. [https://iexplorescience.com/what-do-you-look-for-when-selecting-science-phenomena/] • Group Norms for Science Collaboration and Community - This set of norms can be used with students to build community and foster collaboration during group work. [https://htmlsimulations.s3.us-west-1.amazonaws.com/Handout-Classroom-Norms-from-1st-Units-in-OSE-OpenSciEd-2.pdf]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***

	*Vocabulary*
	Provide varied opportunities for students to learn and apply vocabulary in diverse situations and contexts. Vocabulary retention improves when academic terminology is layered on conceptual understanding. To maximize vocabulary building, support students in building conceptual understanding and then apply the academic terminology using the strategies outlined below.
	• Build understanding of domain-specific vocabulary using a multi-sensory approach or having students participate in simulations.
	• Make connections between vocabulary and real-life or future opportunities.
	  ○ Explain, describe, give real-world examples, or provide concrete representations of vocabulary words rather than formal definitions. Vocabulary.com (see Resources) provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students.
	  ○ Build a vocabulary word wall that students can add to and reference during instruction and self-guided activities or tasks.
		• STEM Teaching Tools – Practice Brief 66 – This article discusses how to support emerging multilingual learners as they develop language that interprets and explains phenomena. [https://stemteachingtools.org/brief/66]
		• Vocabulary.com – This site provides explanations of words using real-world examples. Once signed in, an educator can create word lists for students. [https://www.vocabulary.com/]
		• Text Project – Word Pictures – This site provides Word Pictures that are free for educators to use. Their site includes word pictures for core vocabulary and various content areas, including science and social studies. [https://textproject.org/archive/textproject-word-pictures/]
		• The Science Penguin – This website provides ideas to teach science vocabulary. The vocabulary demonstration activity uses real objects to teach vocabulary terms. [http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html]
		• Interactive Word Walls Enliven Vocab Learning – This article with teaching strategies supports students' use of a word wall to build understanding of key vocabulary. [https://www.middleweb.com/37209/interactive-word-walls-enliven-vocab-learning/]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	○ Have students restate the vocabulary word in their own words. Take this opportunity to help students connect new vocabulary, especially general vocabulary, to prior knowledge. • Read books or watch videos related to vocabulary words and concepts. • Sort words, photographs, or concrete representations into categories. Text Project (see Resources) provides Word Pictures that are free for educators to use. It includes Word Pictures for core vocabulary and various content areas, including science and social studies. • Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge. • Define domain-specific vocabulary using both domain-specific and common terms. • Embedded visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.). • Have students create their own glossary of terms.	

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Presenting Information in Different Modalities* Provide information using a variety of multimedia (e.g., videos, interactives, simulations), informational texts, and formats to teach and reinforce disciplinary core ideas related to an ecosystem. *Activate or Supply Prior Knowledge When Modeling* Information is more accessible and likely to be assimilated by learners when it is presented in a way that primes, activates, or provides any pre-requisite knowledge. Barriers and inequities exist when some learners lack the background knowledge that is critical to assimilating or using new information. Barriers can exist for learners who have the necessary background but might not know it is relevant.	• Food Web - Science Trek – This video can be viewed and discussed by students to explain how energy can be transferred between species in a food chain. [https://nebraskapublicmedia.pbslearningmedia.org/resource/idptv11.sci.life.oate.d4kfch/food-chain/] • Weaving the Food Web – This activity allows students to model a kinesthetic river food web by throwing a ball of yarn to show energy flows between components. [https://www.startwithabook.org/sites/default/files/Food-Web.pdf] • Prior Knowledge in Science Lessons - This article provides strategies, links, and further reading that might be useful to explore and activate prior knowledge at the start of a lesson or topic. [https://thescienceteacher.co.uk/prior-knowledge/] • The Dirt on Decomposers - Crash Course Kids - This video talks about food chains and how energy moves through an ecosystem from start to finish. [https://youtu.be/uB61rfeeAsM?si=KnxLYp2PYRtJ_8A7] • Fabulous Food Chains: Crash Course Kids – This YouTube video addresses the way energy moves, or flows, through an ecosystem and how that movement forms Food Chains. Everyone eats, right? But how does that food get the energy to power you? [https://youtu.be/MuKs9o1s8h8?si=yIDZlrNoA7r4q417]

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
	*Scaffolds for Communicating through Models* Provide scaffolds for developing models to provide evidence to explain a phenomenon or support a design solution (e.g., sentence frames, graphic organizers, norms for whole class discussion, roles for students during small group activities) to support communicating in science-specific ways that may seem unnatural for students.	• Matter Cycling System Model - This graphic organizer from Wonder of Science provides a scaffold for students when modeling the cycling of matter. There is also a completed example. [https://static1.squarespace.com/static/59c3bad759cc68f757a465a3/t/5e18a882766381076cf9e64c/1578674307023/5-LS21+Matter+Cycling+System+%28Student+Version%29.pdf] • National Science Foundation – Tools for Ambitious Science Teaching – This site discusses a tool that provides scaffolds for writing that support learners in constructing explanations with evidence. These take the form of sentence frames, guides for how to help English learners practice final explanations, norms for whole class discussion that are developed by students, roles that students can take in small group activities, and others. [https://ambitiousscienceteaching.org/scaffolding-students-written-explanations/] • System Level 2 – Components and Interactions – This interactive website allows students to practice thinking through system models to create a food web using a "Thinking" slide to manipulate components and interactions of objects within a system found on slides 8-9. Video and answer keys are linked on slides. [https://docs.google.com/presentation/d/1j-tcrxSR_pHY7Qil8gybEXFJA0dg5vAZ2BdQYgahGrE/template/preview]

Instructional Strategies and Resources for Performance Category 3:
Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers

Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)

Instructional Strategies and Resources

	Teaching Strategies	***Resources***
	*Expressing Learning in Multiple Modalities* Provide multiple, flexible options for students to communicate their models and learning in class. • Use technologies that facilitate student participation and communication, such as discussion boards, podcasts, or blogs. • Allow students to choose a multi-modal project they would like to complete to demonstrate their learning, such as a poster presentation, debate, short film, lab report, blog, infographic, drawing, poetry, writing and performing a song, creating a game, etc. • Provide a variety of ways in which students can "write" to respond to questions (e.g., traditional form of writing, with sentence starters, using pictures, etc.)	• STEM Teaching Tools – Multiple Means of Action and Expression – This article provides considerations for engaging students through multiple means of action and expression. [https://stemteachingtools.org/sp/multiple-means-of-action-and-expression] • Interactive Whiteboard - This platform provides students opportunities to model conceptual understanding collaboratively and revise thinking. [https://webwhiteboard.com/] • Padlet - This platform allows students to collect and archive information across groups where students can present and share content instantly. [https://padlet.com/] • Infographic Maker - This presentation software allows students to create data and infographics to summarize learning with charts, graphs, and diagrams. [https://venngage.com/blog/infographics-maker?utm_source=google&utm_medium=cpc&utm_campaign=&utm_content=&utm_term=infographic%20maker&match=e&campaignid=19558960020&adgroupid=143879091486&gad=1&gclid=Cj0KCQjw9fqnBhDSARIsAHlcQYSnvSGACgz1oEBmzQLMma1B3UbfY5Ieynj1ZD6Y7st4Cmtmf7rpiVcaAlEYEALw_wcB] • Starting Out with Sentence Stems in Science – This website provides tips for using sentence stems in the science classroom with examples and a printable free classroom poster for science.

Instructional Strategies and Resources for Performance Category 3: Model Energy and Matter Flow Among a System of Plants, Animals, and Decomposers *Task 1, Prompt 3 (3 points); Task 2, Prompt 3 (3 points); Task 3, Prompt 2, Part A (4 points); Task 3, Prompt 2, Part B (2 points)*		
Instructional Strategies and Resources		
	Teaching Strategies	***Resources***
		[https://thesciencepenguin.com/2015/05/starting-out-with-sentence-stems.html]