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Course: 5th Grade - Ecosystems & Matter Cycling
Unit Number: 1 **Unit Title: Ecosystems & Matter Cycling**
Timeframe: 9 weeks

Stage 1: Identify Desired Results	
Essential Question: *What thought-provoking questions will foster inquiry, meaning making and transfer?* • *An essential question is open ended; has no simple "right answer."* • *Is meant to be investigated, argued, looked at from different points of view* • *Encourages active "meaning making" by the learner about important ideas.* • *Raises other important questions.* • *Naturally arises*	How does a nurse log help other things live and grow?
Scaffold Questions: *What questions can we ask students that break the essential question into smaller pieces of content?*	Lesson Set 1 (L1-L7): How does a nurse log help plants live and grow? • L1: How does a fallen tree become a nurse log? • L2: What things are found in, on, and around nurse logs? • L3: How can we measure how much a plant has grown? • L4: How can we figure out what plants need to grow? • L5: Where do plants get the matter they need to grow? • L6: How does light help plants grow? • L7: How does a nurse log help plants live and grow?

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	Lesson Set 2 (L8-L10): How does a nurse log help animals live and grow? ● L8: Why does a nurse long seem to lose matter over time? ● L9: How do animals use energy from food? ● L10: How do nurse logs help animals live and grow? Lesson Set 3 (L11-L15): How do decomposers help the nurse log system stay in balance? ● L11: How do termites get matter and energy from wood in the nurse log? ● L12: Where do mushrooms get matter and energy they need to grow? ● L13: Why are decomposers important to the nurse log system? ● L14: What can happen when the balance of an ecosystem is disrupted? ● L15: How do matter and energy flow through a grassland ecosystem?
Brief Summary of Unit:	Have you ever seen a fallen log and wondered how plants could be growing on it or why animals might be visiting? In this unit, students explore nurse logs, which are fallen trees that provide a home for many organisms and help forest ecosystems regenerate. Students first consider how plants are able to grow on nurse logs. They figure out that plants get matter primarily from air and water and transfer energy from the Sun. Students then wonder how matter and energy are transferred between plants and animals, so they investigate animals. They model to explain the transfer of matter and energy in the nurse log system but realize that they observed fungi on the nurse log. Students figure out that decomposers are vital to the system by cycling matter and energy from dead organisms and waste. Students synthesize these ideas through a game to show how the different system components interact as a balanced ecosystem. Finally, they consider how new species like American bullfrogs, which have been recently introduced to nurse log ecosystems, can disrupt that balance.

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Desired Understanding: *The long-term accomplishments that students should be able to do with knowledge and skill, on their own. Frames Standards as long-term performance accomplishments. Answers the questions Why? And What can you do with this?*	This unit supports students in developing foundational science ideas about how matter and energy move through ecosystems. The puzzling phenomenon that drives students' learning in this unit is nurse logs. Nurse logs are fallen trees that provide a home for many organisms in forest ecosystems, especially fallen Sitka spruce, hemlock, cedar, and Douglas fir trees in the Pacific Northwest and redwood forests in the western United States. Although fallen trees in many regions can act similarly to nurse logs by providing a home for other organisms, nurse logs are distinct in that they are often very large and therefore provide a significant amount of biomass to the forest ecosystem. Additionally, the moist and cool climate in which nurse logs are found means that they take many, many years to fully decompose, such that they facilitate regeneration of forest ecosystems. Although they are a key part of the broader forest ecosystem in which they exist, nurse logs also serve as an example of a bounded system that involves plants, animals, and decomposers. Matter and energy move through this system as plant seedlings that take root on the nurse log conduct photosynthesis and feed relationships between plants, animals, and decomposers that live in, on, and around the nurse log. The first lesson set (Lessons 1-7) launches by providing a multimodal variety of options for students to look closer at a nurse log and start to identify and ask questions about what they observe. Lesson 2 specifically focuses students in on moss, which is a key feature of nurse logs in nature and, by providing matter for decomposers to create soil so that seeds from larger plants can take root, key to other organisms being able to live and grow there. Students' questions about moss and other plants on the nurse log compel the investigations that follow to figure out what plants need to grow. Lessons 3-6 gradually support students through investigations to figure out that plants need air, water, and light to grow. They first show in Lesson 3 that when plants grow, they gain weight, which is a measure of the amount of matter an object contains. Students build upon this finding in Lesson 4 to isolate air, water, and light as necessary for plants to grow, and they further identify in Lesson 5 that only air and water provide matter to plants since light does not have weight. Lesson 6 draws upon students' previous understanding (both from everyday experiences and from Unit 4.1: Why does an object's motion change? and Unit 4.2: How do we power clocks and other devices?) about energy to figure out that sunlight provides plants with the energy to produce food to grow, and thus the food of other organisms in an ecosystem can be traced back to plants. Given the particle level of matter and abstract ideas about energy involved in these concepts, modeling to explain is central in this lesson set for students' sensemaking about plant growth. Scientific argumentation and systems

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	thinking are gradually scaffolded through the lesson set, as students' understanding of the interactions between plants, matter, and energy gets more complex. In Lesson 7, students apply their three-dimensional understanding of plant growth as they model new ideas about the nurse log system and write a scientific argument about environments that best or least support plants to grow. In the second lesson set (Lessons 8-10), students leverage their ideas about what animals need to live and grow as they learn about animals that live in, on, and around nurse logs. Nurse logs provide shelter for many small animals (especially invertebrates at different life stages, including eggs) and water by retaining moisture. Most importantly, the nurse log provides food for many animals, both directly (wood of the log as a food source) and indirectly (plants and other organisms as a food source). In Lesson 8, students consider an example of how the matter in a nurse log can be a direct food source for termites. Students visualize how matter is conserved in a system by analyzing data of termites consuming part of a nurse log over time. As an example of an animal that grows immensely to produce eggs, the termite queen in particular is a powerful way to demonstrate that matter from food is used by animals to grow. Students likely know from everyday experiences that food also provides energy, which is leveraged and built upon in Lesson 9. They undertake an investigation (or, alternatively, watch a video) of pillbugs and read about birds in the winter to figure out that animals use energy for all kinds of activities, including movement, body repair, and temperature regulation. Lesson 10 enables students to add what they have learned about animals (which they now have evidence for being consumers of food) back to the nurse log system and then to a new organism in nurse log habitats in California: an ensatina salamander. In the final lesson set (Lessons 11-15), students revisit their questions about the nurse log, wondering how it is possible for termites to get matter and energy from wood. They collect evidence to figure out that microscopic organisms live in termite guts and break down the wood. This motivates the need to figure out more about other organisms that get matter and energy from once-living things. In Lessons 12 and 13, students investigate mushrooms to figure out that they are fungi, which differ from both plants and animals in terms of how they get matter and energy: They break down dead organisms and waste from other organisms for matter and energy. Fungi and other decomposers are key components to the nurse log system, as well as other ecosystems, since they cycle matter and energy through the environment and make them available for other organisms. This leads students to wonder about the impacts of other organisms being removed or introduced to ecosystems, leading to the idea of how newly introduced species can disrupt the balance. In recent decades, American bullfrogs from the eastern United States have been introduced to western regions of the United States as people imported them for food

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	sources and pet trade. Students play a game and then model to explain how introducing new species like the bullfrog can disrupt the flow of matter and energy and damage the balance of ecosystems.
Science Discipline Core Ideas *List all of the standards in this unit.*	PS1.A: Structure and Properties of Matter PS3.D: Energy in Chemical Processes and Everyday Life LS1.C: Organization for Matter and Energy Flow in Organisms LS2.A Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
Science Practices *Which practices will be focused on during this unit?*	Developing and Using Models Engaging in Argument from Evidence Asking Questions and Defining Problems Planning & Carrying Out Investigations Analyzing and Interpreting Data Obtaining, Evaluating, and Communicating Information
Science Crosscutting Concepts *Which Crosscutting Concepts will be focused on during this unit?*	Systems and Systems Models Energy and Matter Scale, Proportion, Quantity Patterns
Essential Standards* *List the Essential Standards that will be taught and assessed in this unit.*	5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen. 5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun. 5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water. 5-LS2-2: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment
Crossover standards*	Math: MP4, MP6, 5.G.A.1, 5.G.A.2, 5.NBT.A.3.B, and 5.NBT.B.7

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Connection to other content areas (Option)	ELA: CCSS.ELA-Literacy.RI.5.3, CCSS.ELA-Literacy.RI.5.4, CCSS.ELA-Literacy.SL.5.1A, CCSS.ELA-Literacy.SL.5.1C, CCSS.ELA-Literacy.SL.5.1D, CCSS.ELA-Literacy.L.5.4, CCSS.ELA-Literacy.L.5.6
Alignment to the Vision of High Quality Instruction in Science *(How do the instructional targets in this unit align to the district's vision of high quality instruction?)*	

Stage 2: Determine Acceptable Evidence

(With the exception of formative assessments, all assessments listed in this section are required elements of the district's curriculum and the data associated will be collected in the district's performance management driver system.)

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Measure of Understanding (Performance Task) *(How will students demonstrate their attainment of the long term understanding?)*	Develop a model to describe the movement of matter and energy among the plants, animals, and decomposers in a grassland ecosystem after wild hogs are introduced.

Assessing the Performance Task
(How will we evaluate quality student work in the performance task? How will we determine that students can use their learning independently?)

Question	Beginning (B)	Developing (D)	Secure (S)
1) The model of the food web below shows the flow of matter and energy through a grassland ecosystem found in Montana. Use evidence from the model to explain: How the grassland ecosystem helps 2-3 animals meet their needs for matter and energy. If this is a healthy and balanced ecosystem.	Student partially or does not yet use the model to explain how the grassland ecosystem helps organisms meet their needs. And/Or Student partially or does not yet use the model to explain that the ecosystem is healthy and balanced because many different organisms are able to meet their needs in a balanced web of life.	Student uses the model to accurately explain how the grassland ecosystem helps 1 or more organisms meet their needs. And/Or Student uses the model to partially explain that the grassland ecosystem is healthy and balanced because many different organisms are able to meet their needs in a balanced web of life.	Student uses the model to accurately explain how the grassland ecosystem helps 2 or more organisms meet their needs. And Student uses the model to fully explain that the grassland ecosystem is healthy and balanced because many different organisms are able to meet their needs in a balanced web of life.

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	2) Using the information you just read and the table below, develop a food web model that shows how matter and energy would flow in this grassland ecosystem if wild hogs became a part of it. You can draw or use labels to represent the plants and animals you choose to include in your model.	Student models to partially or not yet explain (verbally, in drawings, using gestures, or in writing) how matter and energy would flow in the grassland ecosystem if wild hogs became a part of the food web, but most or all of the key components are not included.	Student models to mostly explain (verbally, in drawings, using gestures, or in writing) how matter and energy would flow in the grassland ecosystem if wild hogs became a part of the food web, but a few key components are not included.	Student models to fully explain (verbally, in drawings, using gestures, or in writing) how matter and energy would flow in the grassland ecosystem if wild hogs became a part of the food web. Key components included are ● Several food chains involving the wild hog: Grass - worms - wild hogs Grass - bunny - wild hog - decomposer Grass - wild hog - wolf ● Arrows showing the flow of matter through the food web ● Arrows showing the flow of energy through the
	3) Would this grassland food web be healthy with the addition of the wild hogs? Use evidence from your model to explain your answer.	Student identifies that the web would be healthy AND the evidence does not support the claim.	Student identifies that the food web would not be healthy with the addition of the wild hogs but the evidence included does not accurately support this claim. Or Student identifies that the web would be healthy and uses some evidence to	Student identifies that the food web would not be healthy with the addition of the wild hogs. Student's supporting evidence includes some or all of the following ideas: ● Many of the wild hogs' predators do not live in the U.S. ● Wild hogs reproduce very

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			support this claim.	quickly. ● Wild hogs root in the mud which destroys many plants. ● Several of the animals in depend on grass to eat. Without it they could not meet their needs. ● Many of the animals would be eaten by the wild hogs because they reproduce so quickly. ● Only one wild hog predator because they do not have many natural predators in the U.S. There will be a lot of wild hogs, making it hard for other organisms to meet their needs ● Too many wild hogs using resources will lead to an unbalanced food web as other organisms can not meet their needs.
	4) Imagine that all of the decomposers were removed from this grassland ecosystem. Explain how the ecosystem would change	Student partially or does not yet explain that without the decomposers in the ecosystem, the food web would become unhealthy.	Student mostly explains that without the decomposers in the ecosystem, the food web would become unhealthy. A few key ideas are not	Student fully explains that without the decomposers in the ecosystem, the food web would become unhealthy. The dead things in the system would

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	without the decomposers.		included.	not be broken down. Without the dead things broken down and their nutrients returned to the soil, the grass and other plants could not grow and the animals that rely on the plants for matter and energy would not get it. The animals that eat those animals would not be able to meet their need for food either.
Summative Assessments *(How will we know if students can demonstrate mastery of the unit's content, skills, and common core state standards?) Can overlap the performance-based evidence, thereby increasing the reliability of the overall assessment (especially if*	L7: As students complete the transfer task assessment using the Plants Growing in Different Places assessment and the self assessment using the Self-Evaluation Rubric handout, which students complete independently. L10: Question 2 on the Ensatina Salamanders & Nurse Logs assessment L15: In the Synthesize, as students develop and use models in the Grassland Ecosystem assessment			

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the performance task was done by a group)	
Interim Assessments	L6: Key Formative: Review individual student ideas on the Model to Explain Plants & Energy handout where students have modeled to explain, and during the subsequent discussion where they share with a partner or small group. L13: Key Formative: On the Model a Mushroom handout and during the Consensus Discussion during the third Synthesize
Formative Assessments	L2: Observe Mass Handout L4: Parts B and C of Investigation Setup handout, Part B of the Interpret Plan Data handout L5: In the second Explore when students collaborate to build a model, also, Students' responses during the second Synthesize and their modeling process on the Model to Explain Plants & Matter handout L6: Investigate Sunlight handout, also, Review individual student ideas on the Model to Explain Plants & Energy handout where students have modeled to explain, and during the subsequent discussion where they share with a partner or small group. L7: On the Revised Nurse Log Model handout L8: On the Analyze Data of a Termite Colony handout L9: Review students' ideas on the Investigate Isopods handout and during the Building Understandings Discussion in the first Synthesize. During the Consensus Discussion in the second Synthesize when creating the Isopod & Bird Comparison Chart. L11: On the Evidence for Termite Matter and Energy handout and during the Building Understandings Discussion in the Synthesize L12: On the Investigate Mushrooms handout and during the Building Understandings Discussion during the Synthesize

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	L13: On the Fungi Evidence Collector handout and during the discussion during the first Synthesize L14: In the Synthesize, on the Food Web Exit Slip handout where students reflect on what they figured out about healthy and unhealthy food webs
Student Self-Reflection and Self-Regulation **(Student-Centered)** *(How will we measure students' ability to think meta-cognitively?)*	In Lesson 7, students self-assess for Learning Goal 7.B. They use the Self-Evaluation Rubric with the purpose of evaluating and improving the accuracy and completeness of their arguments about where plants get the matter and energy they need to grow.
State Assessment Practice *(How will we measure students' ability to interact with content and skills in an MSTEP-like or SAT-like format?)*	The unit provides the opportunity for students to close read scientific articles and apply it to their understanding of what is being asked of them. This mimics M-Step/NWEA testing questions. Students will also have to use and interpret models, many of which cross over with mathematics.

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Stage 3: Learning Plan
(Summary of Key Learning Events and Instruction)

What activities, experiences and lessons will lead to achievement of the desired results and success at the assessments?

The learning events –

- *should be derived from the goals of Stage 1 and the assessments of Stage 2 to ensure alignment and effectiveness of the activities.*
- *should match the level of rigor within the standard*
- *support student Acquisition, Meaning Making, and Transfer.*

Lesson # /part of cycle	Investigation Question	Brief Description	What Students are Working Towards Figuring Out	Learning Performance/ Lesson Target
1 Engage (3 session)	How does a fallen tree become a nurse log?	Observe pictures and video of nurse logs. Model to explain our initial ideas about how a fallen tree becomes a nurse log. Brainstorm related phenomena. Share questions to create a class Driving Question Board. Identify how to answer our questions through investigations.	Nurse logs are fallen trees that help other things live and grow. We see lots of things on the nurse logs, and have some ideas about other things that are likely found in, under, and around nurse logs.	
2 Explore (2 session)	What things are found in, on, and around nurse logs?	Closely observe a nurse log through pictures, videos, and a Nurse Log in a Box. Identify the things we see as	A nurse log has a lot of different things that are found in, on, and around it.	

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			components of the nurse log system. Look for nurse log components in our community. Ask questions about moss as an important component. Observe moss to figure out if it is a plant.	These things are components of the nurse log system. Moss may be important to explain how a tree becomes a nurse log. Moss is similar in many ways to plants.	
	3 Explain (2 sessions)	How can we measure how much a plant has grown?	Share personal experiences growing plants. Watch a time-lapse video of a giant pumpkin growing. Investigate how to measure which pumpkin is the biggest. Read a book about scientific arguments. Brainstorm evidence we need to support our claims about plant growth.	When plants grow they gain weight, which is a measure of the amount of matter. Scientific argumentation is the process of supporting claims with evidence and reasoning. To evaluate our claims about what plants need to grow, we need	

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				evidence that includes investigation data about plant growth factors (such as light, soil, water, and air).	
	4 Explain (2 sessions	How can we figure out what plants need to grow?	Evaluate an investigation setup in a video to answer our questions about where plants get the matter they need to grow. Analyze and interpret data from the investigation to make a claim about the factors that help plants grow. Read an article about what plants get from soil.	Plants need water, air, and light to grow. The plants that were not in soil grew and gained matter (weight), so plants do not need soil to grow. Soil helps support plants in a few different ways, but does not provide much of their matter.	
	5	Where do	Investigate the weight of	Air and water are	

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	Elaborate (2 sessions)	plants get the matter they need to grow?	water, light, and air. Collaboratively model how air is made of particles, based on evidence from our observations of air in a syringe. Individually model the sources of matter for a pumpkin plant to answer our lesson question.	made of matter because they have weight, but light is not made of matter because it does not have weight. Air and water are made up of particles. Air is a gas, a type of matter made of particles moving freely in space. Air and water provide plants with matter to grow.	
	6 Elaborate (2 sessions)	How does light help plants grow?	Watch a video of plants moving toward light. Brainstorm how sunlight causes changes and observe how the Sun changes solar toys. Read about how plants transfer and use energy from	Sunlight causes observable changes that are evidence of an energy transfer. Plants can transfer energy	

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			the Sun to grow. Model how plants obtain and use energy and matter.	from sunlight, which they can use to combine the matter from air and water to produce sugar. Plants use some of the energy to grow and also store energy as sugar to use later.	
	7 Evaluate (2 sessions)	How does a nurse log help plants live and grow?	Create a checklist of components and interactions to explain how nurse logs help plants live and grow. Revise our models about the nurse log. Identify things in our community that help plants grow. Argue with evidence about places that support plant growth.	Nurse log systems provide plants with the factors they use for matter and energy to grow. Nurse logs have stored sugars that they produced when they were living trees. There are examples in our community of	

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				other things that help plants grow.	
	8 Engage (2 sessions)	Why does a nurse log seem to lose matter over time?	Observe and ask questions about the phenomenon of "ghost logs". Read a book about animals that to investigate if they make the nurse logs "disappear". Analyze and discuss data about a termite colony in a closed system.	Nurse logs provide animals with important things that they need to survive. Matter does not disappear, it moves from the nurse log to animals when they eat it. Animals use matter from eating other organisms to grow and develop.	
	9 Explore (2 session)	How do animals use energy from food?	Discuss what else animals get from food. Investigate how isopods use energy from food. Read about how	Unlike plants, animals transfer energy from other organisms	

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			birds use energy from food. Discuss how the ways that isopods and birds use energy from food relate to all animals.	when they eat them. Animals use energy from food for moving and balancing body temperature, and use energy and matter to repair their bodies. Animals balance their body temperature in different ways. The energy that animals transfer from other organisms was once energy from the Sun.	
	10 Explore (3 sessions)	How do nurse logs help animals live and grow?	Make a Gotta-Have-It Checklist for how to represent our new ideas about animals. Revise our	Nurse log systems provide animals, including ensatina salamanders,	

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			individual and consensus models of the nurse log system, and provide feedback to a partner. Share what we have figured out on a transfer task about a salamander.	with important things that they need to survive, including food for matter and energy. There are examples in our community of how animals get and use matter and energy	
	11 Explain (2 sessions)	How do termites get matter and energy from wood in the nurse log?	Observe a video of termites for initial ideas about how termites get matter and energy from wood. Read an article for more evidence. Model to explain termite digestion. Consider how microscopic organisms help other animals.	Microscopic organisms in a termite's gut help break the wood down into sugars, which the termite uses for matter and energy. The sugars were made and stored by the living tree before it became a nurse log. The other	

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				parts of the wood are released by the termite as solid waste in the environment.	
	12 Explain (2 sessions)	Where do mushrooms get matter and energy they need to grow?	Decide that we want to explore other organisms in the nurse log system. Investigate mushrooms to look for patterns and compare to how plants and animals get matter and energy. Share our findings about mushrooms in a Building Understandings Discussion. Look for mushrooms and related living things in our own community	Patterns across multiple lines of evidence show that mushrooms are different from both plants and animals in terms of how they get matter and energy. Mushrooms are an example of fungi, which live on living and once-living organisms	
	13 Elaborat	Why are decomposers	Read an article about where fungi get matter and energy.	Fungi are decomposers,	

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	e (2 sessions)	important to the nurse log system?	Watch a video to observe what happens to matter in a system with decomposers. Model to explain how decomposers get and release matter and energy. Add new ideas to our Class Consensus Model. Update our Growing Ideas charts to document our new ideas.	since they break down dead organisms and waste for matter and energy. Decomposers help matter move through a system by breaking down dead organisms and waste for matter to be used by other organisms. Without decomposers, matter and energy would be trapped in dead organisms and waste.	
	14 Evaluate (2	What can happen when the balance of	Discuss which component of the nurse log system is the most important. Play a game	Matter and energy continuously flow	

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	sessions)	an ecosystem is disrupted?	to test our ideas Discuss food webs and how components work together. Introduce a new species to the game to observe impacts.	through different organisms in an ecosystem. Healthy food webs are when the flow of energy and matter are balanced. New species can enter a food web and disrupt its balance.	
	15 Engage (2 session)	How do matter and energy flow through a grassland ecosystem?	Revise our Class Consensus Model. Read a book to find out more about ecosystems. Gather information about the organisms in grassland ecosystems. Complete a summative assessment transfer task.	The addition of a new species can disrupt the flow of matter and energy in an ecosystem.	

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Learning Targets and Success Criteria *What will students be taught? What should they know? What should they be able to do?*	
How will the unit be sequenced and differentiated to optimize achievement for all learners? *Teaching -* • *should reflect the instructional approaches most appropriate to the goals (not what is easiest or most comfortable for the teacher).* • *should employ resources most appropriate to the goals (not simply march through a textbook or commercial program).* • *be responsive to differences in learners' readiness, interests, and preferred ways of learning.*	Throughout the unit, there are a variety of different methods from presenting and re-enforcing the given content. These methods range from videos, discussion, handouts, articles, and hands on models/labs. All assessments are modified with both teacher and special education teacher inputs. Students will be placed into small groups with areas where students can break out into their own, allowing for small groups and individual practices. Students will also be able to give feedback on their learning through the use of exit tickets. This information will be used to gather an understanding of how to better differentiate to each students' specific needs.

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Key Vocabulary	L1: Nurse Log L3: Matter L4: Soil L5: Gas, Particles L6: Absorb, Energy, Producer L8: Food Chain L9: Consumer, Habitat L11: Digest, Microscopic Organism L12: Fungus/Fungi L13: Decomposer, Ecosystem L14: Food Web
Resources *Description or link to resources*	Unit 5.1 Google Drive