Color	Descriptor
	Lesson Information
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	Suggested Procedure

Lesson 5: Food Webs in the Sagebrush Ecosystem

Unit: 5th Grade Ecology Unit: A Sagebrush Expedition
Lesson: Food Webs in the Sagebrush Ecosystem

Overview: The objective of this lesson is have students understand the meaning of matter and how it moves into, out of and within the sagebrush ecosystem among plants, animals, insects, decomposers and the environment. They will be given the opportunity to create a model demonstrating understanding of the different trophic levels and how matter moves between these layers through exploration, acting, application, and synthesis work. They will investigate how all species are connected, as well as explore the idea that the removal of one can species can affect the whole system. Students will create a deeper understanding of the interconnected relationships that exist within the sagebrush landscape.

Main Take Away: Students will be able to demonstrate their understanding of the movement of matter among plants, animals, decomposers and the environment, as well as the interdependent relationships that exist within an ecosystem. They will do this through the exploration and development of models that represent these phenomenon.

Learner Outcomes

Students will be able to…

- Explain and give examples of some of the interdependent relationships that exist in the sagebrush ecosystem through developing a model that shows these relationships and their interactions with the environment.
- Describe the movement of matter and transfer of energy among plants, animals, decomposers, and the environment using the sagebrush ecosystem as an example.

Getting Ready

Materials:
Pictures of various sagebrush plants, animals, insects and decomposers and pieces of rope tied together for the food web activity, yarn, naturalist journals and pencils.

Preparation:
Print out pictures of sagebrush plants, animals, insects and decomposers. You will need to punch holes in the cards and tie a piece of string or yarn so that the cards can be worn around students' necks. Print out description cards as well. Print out copies of trophic level diagrams and ecosystem worksheets. Cut rope into pieces that are about 6-8 feet long and tie four pieces together. Make enough of these for each student or pair of students to have.

Location:
Parts can be done in the classroom. The food web activity would be best done outside or where students have room to move around.

Length of Time:
2 Lessons
Approximately 60-75 minutes

NGSS Standard(s) Addressed: 5th grade Life Science 2: Ecosystems: Interactions, Energy, and Dynamics

- **Performance Expectations: 5-LS2-1:**

Place-Based Principle(s) Addressed:

- Using local experts
- Learning takes place in the school yard, local community, and local environment.

Students who demonstrate understanding can: develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. • **Disciplinary Core Ideas: LS2. A**: Interdependent Relationships in Ecosystems • **Cross Cutting Concepts: 5-LS2-1:** Systems and System Models: A system can be described in terms of its components and their interactions. • **Science and Engineering Practices: 5-LS2-1:** Developing and Using Models to describe phenomena. • **Connections to Nature of Science: 5-LS2-1:** Science, Models, Laws, Mechanisms, and Theories explain Natural Phenomena. Science explanations describe the mechanisms for natural events	• Engaging students in experiential and project-based learning

Unit Connections
(How specific lesson connects to overall goals and objectives of the unit)

Transfer Goals: ***Students will be able to independently use their learning to understand that…***

- TG1- Science is a process that helps us gain a collective understanding of how the world works, it is a lifelong process, it is applicable every day, and accessible to everyone.
- TG2- Humans are an interconnected part of the natural world and can have both positive and negative impacts.
- TG3- Cultivating a sense of place, through intentional interactions, inspires curiosity about one's community and helps to develop a conservation ethic.

Unit Essential Question: ***Students will keep considering…***
What is special about my community and what can I learn from it?

Specific Lesson Content Objectives: ***students will be able to…***

- Explain and give examples of some of the interdependent relationships that exist in the sagebrush ecosystem through developing a model that shows these relationships and their interactions with the environment.
- Describe the movement of matter and transfer of energy among plants, animals, decomposers, and the environment using the sagebrush ecosystem as an example.

Specific Lesson Language Objectives: ***Students will be able to…***	**Key Vocabulary Words:**
• Understand the meaning ecosystem, producer, consumer, and decomposer and be able to draw an example of each of these words.	• Ecosystem • Decomposers • Consumers (herbivores, omnivores, carnivores) • Producers • Model

Background Information for the Teacher:
Trophic Levels (pyramid): (*See example attached below)*
The trophic pyramid models the basic structure of interaction in all biological communities characterized by the manner in which food energy is passed from one trophic level to the next along the food chain. The base of the pyramid is composed of species called autotrophs, the primary producers of the ecosystem. Producers use energy from the sun to transform inorganic matter (CO2 and water) into organic matter that becomes food for consumers. All other organisms in the ecosystem are consumers, also called heterotrophs, which either directly or indirectly depend on the primary producers for food. Food contains both matter, that can become part of the consumer, and energy, which fuels the consumer's metabolic processes.

As organisms metabolize the food they consume, organic matter is returned to the atmosphere as CO2 and water, and energy is lost from the system. At each trophic level as much as 80 to 90 percent is lost in the form of heat (), as organisms expend energy for metabolic processes such as staying warm and digesting food. The higher the organism is on the trophic pyramid, the lower the amount of available food with its associated energy. For example, the amount of food energy that herbivores and detritivores (primary consumers) can take in is limited by the biomass (amount of matter) of the plants they devour. It follows that the carnivores (secondary consumers) that feed on herbivores and detritivores and those that eat other carnivores (tertiary consumers) have the lowest amount of energy available to them. For this reason, biomass is greatly reduced at higher trophic levels compared to the lowest. Also, because of the loss of energy, the system would not be sustainable, except for the constant input of sun energy into the system through photosynthesis.

Food chains and food webs:
Because all species are specialized in their diets, each trophic pyramid is made up of a series of ***interconnected*** feeding relationships called food chains. Most food chains consist of three or four trophic levels. ***A typical sequence may be plant, herbivore, carnivore, top carnivore; another sequence is plant, herbivore, parasite of the herbivore, and parasite of the parasite.*** Many herbivores, detritivores, carnivores, and parasites, however, eat more than one species, and a large number of animal species eat different foods at different stages of their life histories. In addition, many species eat both plants and animals and therefore feed at more than one trophic level. Consequently, food chains combine into highly complex food webs. Even a simplified food web can show a complicated network of trophic relationships. Below the pyramid are the decomposers. Decomposers are organisms that break down dead or decaying organisms. Like herbivores and predators, decomposers are heterotrophic, meaning that they use organic substrates to get their energy, carbon and nutrients for growth and development. They are crucial in recycling matter back up through the pyramid. For example, an animal may die and its body will decompose back into soil, providing necessary nutrients for plant growth, which then can feed the herbivores, who then feed the carnivores.

Building Background for Students: (ELL Principle)

Activate Prior Experiences:

The teacher will explain that students will do the following:

1. Take a few moments to think about what an ecosystem is and some examples of an ecosystem.
2. Share these ideas with a partner or table peers.
3. Draw an example of an ecosystem in naturalist journal.
4. Students will share what they discussed and drew in order to help all students gain a better understanding of what an ecosystem is and what can be found in the ecosystems where they live.

Link to New Learning from Prior Learning:
The teacher will explain to students that they will:

1. Engage in an activity that will demonstrate the interdependent relationships that exist within an ecosystem.
2. Use this activity to expand upon specific examples from the sagebrush ecosystem.
3. Create their own food wed/food chain in their naturalist journals to understand their understanding of interdependent relationships that exist in an ecosystem.

Vocabulary:
The teacher will:

1. Have a student add the word “ecosystem” to the word wall.
2. Have a second student add a drawing of what ecosystem looks like to the world wall.
3. Play the game Abiotic Simon says so students continue practicing the vocabulary associated with the landscape equation.

Common Student Misconceptions/Student Challenges:

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- There is only one type of food chain, such as plant, herbivore, carnivore, top carnivore.
- A food chain is linear and therefore is not connected to the other food chains (Better to think about it as a web)

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Materials:

- Pictures of various sagebrush plants, animals, insects and decomposers
- Species information cards
- Pieces of rope tied together for the food web activity
- Yarn for the picture cards
- Naturalist journals and pencils.

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Set-up:

- Print out pictures of sagebrush plants, animals, insects and decomposers.
- Punch holes in the cards and tie a piece of string or yarn so that the cards can be worn around students' necks.
- Print out species description cards
- Cut rope into pieces that are about 6-8 feet long and tie four pieces together.
- Make enough of these for each student or pair of students to have.

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Lesson Agenda	Suggested Procedure	ELL Rationale

Bean Seed Mini SCI:
Approximately 5-10min
 	
Review:
Approximately 10min
	Bean Seed Mini SCI:
	• Let students have a few minutes to take a look at their bean seed investigations and record whether or not they have sprouted.
	
	Review: Approximately 5min
	• Have students review what the "B" stands for in the landscape equation. ***(Biotic)***
	• Pose the following: "what is another way to describe this scientific term?"
	• *Potential student response:*
	  o *Something that living, breathing, has to make or find food*
	• Put a few pictures from the landscape equation in front of a small group of students and have them separate out what they think is biotic. **(F1)**
	  o When finished have students walk around the room to inspect other groups.
	  ▪ If student disagrees with a choice, they must raise their hand and explain their reason for disagreeing.
		• Review and repetition increases comprehensibility for students.
		• Having students think of how they can describe what the word "biotic" means increases higher order thinking.
		• Having students review peers work helps to increase interaction.

Engage:
Approximately 15min
 	
Engagement in what is an ecosystem
	What is an Ecosystem?
	• Give students the following definition of an ecosystem and ask them to reflect upon its meaning through a drawing. Students' prior knowledge will emerge through a pictorial description of what they believe this definition to mean. Write the definition on the board so students can see it and ask them to write which word they think to be the key word in their journal. **(D1)**
	  o ***An ecosystem is a group of living organisms interacting with their environment***
	• Have groups rotate with sharing their drawings and the word they circled to be the most important.
	  o Note: The circled word may differ between groups because students might find different words to be the most important. Encourage them to disagree, but make sure they can explain why they chose the word they did.
		• This activity will activate students' prior knowledge of what an ecosystem is.
		• Working together in pairs to discuss and review the definition of an ecosystem increases interaction.
		• Groups can be comprised of native English speakers or high proficiency English speakers with lower proficiency students.
		• Pointing and drawing can be

		used to show understanding with lower proficiency students.

Explore:
Approximately 30min
 	
Exploration of what a food web is specific to the sagebrush ecosystem
	Food Web Activity:
	Explain to students that they will now explore more about these connections that occur in an ecosystem through a fun activity.
	• Hand out a sagebrush organism card (*examples attached below)* to each student, which they will wear around their neck. Also hand out the matching information card.
	• Have students share what card they have and ask them to describe their role in the sagebrush ecosystem. Have students think about whether their species produces food energy, consumes food energy, or breaks things down to return them to the soil. (Producers, consumers, decomposers)
	  o Examples:
	  ▪ Student has deer mouse, an animal that consumes energy through eating plants.
	  ▪ Student has wheatgrass, a plant that produces its food using energy from the sun and nutrients from the atmosphere, but also provides food for other species.
	  ▪ Students has a meadow mushroom, a decomposer that breaks down dead plants and animals and turns their bodies back into soil.
	• Next, hand out a clump of ropes to each student (or pair of students). These clumps are composed of 4 ropes tied together at one end.
	• Explain that each student has been transformed into the organism they are wearing.
		• Activity will link new learning from prior learning through demonstrating the relationships that exist within an ecosystem and how they are interdependent.
		• Activity will create a common experience among students that will increase comprehensibility and interaction.
		• Organism names will be written in both English and ELLs native language. They will be encouraged to ask peers or teacher any questions about their organism.
		• Having organism cards in both languages will help with new

	- They can act out their organism. - Pose the following: "Our goal is to visually represent how these organisms from the sagebrush ecosystem are connected to one another (or interconnected). Your job will be to think of how you connect to another organism by thinking about what your organism eats, what might eat you, or if the organism provides another habitat need, such as shelter. - If students are struggling with these connections work through a few examples with them. Encourage them to take another look at their description cards and to ask a peer for help and advice. - Students will demonstrate connections by holding onto a rope they feel they connect to. (Example: student who is a prairie dog might grab onto person who is grass and the person who is a black footed ferret) - At the end students should have created a giant, tangled, spider web that shows many connections. The idea is that each organism has many connections to other organisms in the sagebrush ecosystem. - When finished debrief activity by posing the following: "Observe around you, what have we just created?" *Potential student response:* *A tangled form that looks like a spider's web.* *A food web!* "Which organisms have more connections than others? Why do you think this is?" *Potential student responses:* *The grass has many connections because many herbivores rely on it for food.* *The coyote has many connections because it is an omnivore and will eat plants and animals.* *The golden eagle only has a few connections because it is a top predator (it only eats certain animals)* "What role does the mushroom or decomposer example play in the food web?" *Potential student responses:* *When an animal or plant dies the decomposers turn them back into soil and nutrients.*	vocabulary by linking new word to both picture and native word. - Pairing students will be done strategically: low proficiency ELL students with a native or high proficiency speaker. This will increase interaction. - Have ELL students point responses to oral commands or describe these interactions between organisms using the real life examples in front of them. This scaffolding will allow students to demonstrate their understanding while increasing comprehensibility and vocabulary.

	○ ***Emphasize here that plants and animals are made up of matter and therefore this matter is being cycled through the system.*** ○ "What happens if we remove an organism?" ○ Give students the opportunity to predict what might happen before it does. ○ Have a student drop all their ropes and leave the web. **(F2)** ○ *Potential student responses:* ▪ When that organism leaves everything it was connected to was affected. ▪ When the sagebrush leaves the web, the sage grouse, mouse, songbird, etc. are affected. ○ Have students give reasoning to their responses (the sage grouse needs the sagebrush for food and shelter). • ***Additions based on time:*** ○ *Have students remove other organisms in the web. How many organisms can you remove before the web or system collapses?* ○ *Add abiotic factors into the mix such as soil, water, sun, and temperature.*	
Explain: Approximately 15min (Following day) **Additional explanation of an ecosystem and its food web**	**University of Wyoming Research Scientist Video:** • Explain to students that now they will watch Courtney Duchardt's video, another research scientist from UW. It will help to explain how she looks at interdependent relationships or connections among organisms in the sagebrush ecosystem to better understand what vegetation is needed for all species to survive. • After watching video pose the following question: "What interdependent relationships does Courtney look at for her research? How do these help her understand the overall ecosystem better?" ○ *Potential student responses:* ▪ *Prairie dogs and mountain plovers* ▪ *This relationship helps her to understand what type of vegetation is necessary for both of these species.*	• Students will increase comprehensibility by taking what they have learned about interdependent relationships and deciphering new ones from the video. • Explaining these relationships and their importance to a particular ecosystem will increase higher order thinking.
Elaborate: Approximately 30min **Food web modeling activity**	**Modeling Concepts through Performance:** • Explain that students will use what they learned in the food web activity to try to make more connections between organisms in order to demonstrate the idea of interdependent relationships that exist in the	• Modeling understanding will increase comprehensibility

	sagebrush ecosystem as well as model the transfer of matter and flow of energy within the sagebrush ecosystem.
	• Announce that students will be developing a model of these concepts through a play. They will work in small groups of 4.
	• Each group must have at least one abiotic component and each abiotic component should be different among the groups. Assign each group an abiotic component such as water, soil, temperature, rocks, etc.
	• Students will need to creatively model the relationships that exist within the sagebrush landscape emphasizing the transfer of matter that occurs and flow of energy.
	  o Transfer of matter that occurs as consumers eat producers and decomposers break down bodies.
	  o Energy flow that occurs as producers use the energy from the sun which is transferred into the bodies of consumers and given off as heat.
	• As they prepare for their performance have students record the relationships they are going to act out in their naturalist journals to record this model they are developing to represent this natural phenomenon. **(S1)**
	• Each group will take 2-3 minutes to act out these relationships making sure to clearly demonstrate the species they are representing and how each component is related. **(F3)**
	  o Example:
	  ▪ Group models this natural phenomenon through acting out how plants need the sun to produce their food through photosynthesis and then grows to be great food for a prairie dog which eats this plant. The prairie dog become nice and fat and a great meal for a swift fox. The fox uses the energy from the prairie dog and releases some of that energy through breathing. The fox eventually dies and decomposers break its body down and return some of the fox's nutrients and matter to the soil to be used by plants again.
		and understanding of concept.
		• Acting out interdependent relationships will also increase comprehensibility.
		• Being able to provide evidence for why they chose the components they did when acting out their food web will increase higher order thinking.
		• Higher order thinking will also be increased through generalizing understanding by applying what students have learned.
		• Lower proficiency speakers can demonstrate understanding through short phrases and drawings. This is helpful because they can express their thoughts using actions.
		• Working in small groups increase interaction. Important to strategically create groups for this activity.

Evaluations and Assessment Check ins: D: Diagnostic assessment F: Formative assessment S: Summative assessment	**Evaluations and Assessment Check ins:** **(D1):** Worksheet that will encourage students to access prior knowledge about what an ecosystem is and creatively respond to new information through drawings and key words. **(F1):** Card sort will give students the opportunity to access their prior knowledge and what they learned in previous lessons about what is biotic, as well as promoting metacognition through surfacing uncertainties in their thinking. **(F2):** Adding an additional layer to the food web activity that allows students to predict and visually see what might happen if an organism is removed. Students will demonstrate what they have learned through the ability to predict these connections. **(F3):** Students will actively demonstrate their knowledge of the interdependent relationships in the sagebrush ecosystem through actively acting out these relationships in small groups. **(S1):** Students can potentially be graded on the model they create in their naturalist journal, as one model will be graded at the end of the unit. This model will demonstrate their understanding of the interdependent relationships that exist in an ecosystem, specifically looking at the sagebrush ecosystem. It will also demonstrate their understanding of how matter cycles within the trophic levels of the ecosystem.	

References:

- Biodiversity Institute organism cards and description of food web activity.