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## Lesson 7: Exploring Insects of the Sagebrush Landscape

### Unit: 5<sup>th</sup> Grade Ecology Unit: A Sagebrush Expedition Lesson: Exploring Insects of the Sagebrush Landscape

**Overview:** Lesson 7 explores insects that exist within the sagebrush ecosystem. Students will investigate what kinds of insects they can find around their school yard and identify them according to their order. They will learn how to make bug traps in order to catch a variety of insects. They will be able to compare the insects found in their school yard to insects they find on a field trip to the sagebrush. Students will learn more about a particular order of insects by creating a species account of an insect they found. This account will include the insects' importance to the sagebrush ecosystem, what parts of the sagebrush ecosystem does it rely on, and what connections does it have with humans.

#### Main Take Away:

Insects play a vital role in the sagebrush ecosystem by (a) contributing to the function of nutrient recycling by degrading or consuming leaf litter, wood, carrion, and dung and by dispersal of fungi, (b) forming an important part of the food chain as food for many mammals, birds, amphibians and reptiles, and (c) plant propagation through pollination and seed dispersal.

#### Learner Outcomes

*Students will be able to...*

- Explain what an insect is by giving 3-4 characteristics that define an insect from other bugs.
- Describe the role of insects in the landscape equation and their importance to the sagebrush ecosystem food web.
- Create a bug trap and explain how this scientific tool can help us gain a collective understanding of the role that insects play in the sagebrush landscape.

#### Getting Ready

**Materials:** Bug traps (plates, cups, nails, water, and soap), insect identification books, insect nets, insect boxes or vials, magnifying glasses.

**Preparation:** Review how to set up the bug traps to demonstrate to students. Gather all materials and review basic information about insect characteristics and insects that live in the sagebrush ecosystem.

**Location:** School yard, classroom, sagebrush landscape

#### Length of Time:

1-2 Lessons

Approximately 60-75 minutes

1 Lesson could be a field trip to the sagebrush

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

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

#### Place-Based Principle(s) Addressed:

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

<p>Systems and System Models: A system can be described in terms of its components and their interactions.</p> <ul style="list-style-type: none"> <li>• <b>Science and Engineering Practices: 5-LS2-1:</b> Developing and Using Models to describe phenomena.</li> <li>• <b>Connections to Nature of Science: 5-LS2-1:</b> Science, Models, Laws, Mechanisms, and Theories explain Natural Phenomena. Science explanations describe the mechanisms for natural events</li> </ul>	
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**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 what an insect is by giving 3-4 characteristics that define an insect from other bugs.
  - Describe the role of insects in the landscape equation and their importance to the sagebrush ecosystem food web.
  - Create a bug trap and explain how this scientific tool can help us gain a collective understanding of the role that insects play in the sagebrush landscape.

- Specific Lesson Language Objectives: *Students will be able to...***
- Understand the meaning of insect and be able to write or use orally the following terms: head, abdomen, thorax, wings, antennae, compound eyes, stinger, and six legs to label a diagram of an insect.

- Key Vocabulary Words:**
- Insect
  - Head, abdomen, thorax
  - Antennae, compound eyes, six legs, stinger
  - Characteristics
  - Bug trap
  - Scientific tools

**Background Information for the Teacher:**

There are well over 1 million species of insects. They outnumber all other animals combined by more than 4 to 1. There are more species of beetles than species of flowers. Insects range in size from larger than the smallest mammals to small enough to crawl through the eye of a needle. They have been around since before dinosaurs.

**Secrets for insect success include:**

**Small size:** insects can exploit many more niches (places in food webs) in a given area compared to larger animals  
**Short life cycle:** insects can develop in temporary habitats such as water puddles and decaying organic matter, and adapt to changing conditions much more rapidly than other animals.  
**High reproductive capacity:** as an example, an aphid has 50 offspring within its three-week lifespan.  
**Complete metamorphosis:** insects with complete metamorphosis, such as beetles and butterflies, can exploit two

separate niches in one lifetime.

**Exoskeleton:** an exoskeleton protects insects from dehydration and damage.

**Flight:** wings allow rapid movement to new habitats and food sources, and to escape from predation.

**Diversification:** although insects all have the same basic structure; each insect species has adapted to its own particular environment.

### **Insects have diversified in two ways:**

1) Insects are present in every type of habitat except the middle of the ocean. They are found on the tops of mountains and underground caves. They thrive in deserts, rivers, fields and forests. They have even been in space: Biosatellite II orbited the earth with fungus gnats, roaches, and wasps. Insects are probably crawling through your house right now. Some of the more highly specialized insects even build homes for themselves. Caddisflies, as larvae, make cases in which they live. A few species of wasps, aphids, midges, and psyllids can make galls (special swellings of plants due to feeding by the insect), which they feed on and receive protection from. Many wasps, bees, and ants (order Hymenoptera) create nests, burrows, or social colonies. Termites, which belong to a different order (Isoptera), also build large colonies and live socially. Parasitoids live inside another insect until becoming adults. Other insects live in or on the leaves, stems, or roots of plants.

2) Although they each have the same general body plan, different species of insects have developed changes in appearance and function of their body parts to adapt and survive in different niches.

Camouflage allows some insects to blend into surroundings. Certain butterflies, treehoppers, and caterpillars blend with their surroundings to hide from predators. However, some predators, like assassin bugs and praying mantis use camouflage for surprise attacks.

### **Other mechanisms used for protection include:**

**Hairs and spines:** Many caterpillars have hairs and spines. Some are "urticating" hairs, which sting, others prevent parasitoids from laying eggs in the caterpillars.

**Stingers:** Wasps can sting repeatedly while honeybees only sting once. Some wasps use their stingers to paralyze prey, then lay eggs and let their larva feed on the prey.

**Poison:** Some insects feed on poisonous plants and accumulate the plant's poison (e. g. monarch gets its poison from milkweed). Other insects have a mechanism to produce their own poisons (e. g. ladybug).

**Mimicry:** Some unrelated poisonous insects share color patterns. For instance, milkweed beetles and ladybugs are both red and black. Both of these insects produce poison. It is believed that a predator will learn to avoid all red-and-black insects if it feeds on one that makes it sick. Sometimes, non-poisonous insects will mimic these color patterns as well, even though they are not poisonous. An example: the non-poisonous Viceroy butterfly which mimics the poisonous Monarch butterfly.

**Discussion:** The defenses that insects employ can be compared to those of more familiar animals: hairy caterpillars are like porcupines; bombardier beetles have a spraying mechanism similar to a skunk.

## **Insect Form, Function, and Development**

### **External Body Plan**

The integument or body wall of an insect is used for muscle attachment and protection from damage and desiccation. The integument is made up of two layers: the epidermis, which consists of living cells. These cells secrete the outer layer, the cuticle, which is composed of protein and chitin. Caterpillars and soft-bodied insects

have cuticles that are mostly endocuticle, which remains flexible. Hard-bodied insects have a harder exocuticle, with the endocuticle underneath.

An insect's body is made of three main body parts: a head, thorax, and abdomen.

The **head** is the center of coordination and feeding, with antennae, eyes, and mouthparts

**Form and Function of Insect Mouthparts** - Different insects possess different types of mouthparts. These mouthpart types can be compared with the functions of common objects:

- chewing mouthparts (grasshoppers) - scissors
- sucking mouthparts (stinkbugs) - turkey baster
- stabbing mouthparts (deer fly, mosquito) - boxed drink straws
- coiled mouthparts (butterfly) - party favor
- sponging mouthparts (housefly) - dishwashing wand-sponge

Some insects with stabbing mouthparts can transfer diseases. This can be shown by first up taking colored water with a turkey baster, let it out, then uptake clear water with the baster. The clear water will become slightly colored.

The **thorax** is the center of locomotion, containing legs (1 pair per segment) and wings, if present (on the last two thoracic segments). Front wings may be modified to very hard (beetles) or leathery (grasshoppers), and function as armor. True flies (order Diptera) have a special adaptation to their second pair of wings, which have evolved into knob-like structures called halteres, which are used for balance.

### **Insect Development:**

Insects grow by molting, as opposed to gradual development of humans. Whenever an insect grows slightly larger, it must shed its skin. Once insects become adults, they are unable to molt any further, and will not grow any larger.

**Metamorphosis:** Insects have either Simple or Complete Metamorphosis.

**Simple Metamorphosis:** Development proceeds from an egg to nymphs (which usually look like the adult, except for underdeveloped wings) to an adult. Examples include grasshoppers and milkweed bugs. Also called "incomplete metamorphosis."

**Complete Metamorphosis:** Development proceeds from the egg to a larva, which is usually wormlike and does not resemble the adult insect. When full-grown, the larva transforms into a pupa, then finally the adult. The pupal stage is needed to develop the wings and other appendages such as antennae. Examples of this type of development are butterflies and moths, beetles, wasps and flies.

### **Building Background for Students: (ELL Principle)**

#### **Activate Prior Experiences:**

The teacher will explain that students will do the following:

1. Review the unique characteristics of sagebrush and its importance to the sagebrush ecosystem.
2. Brainstorm through think-pair-share and concept map about what they know about insects. This can include kinds, physical characteristics, behavior, what eats them and what they eat, etc.
3. Share stories about encounters with cool insects.

#### **Link to New Learning from Prior Learning:**

The teacher will explain to students that they will:

1. Watch a short video about a local research scientist that studies insects and how they return to sites that have been disturbed by humans.
2. Make connections to the research being done by this scientist and what they have learned so far throughout the unit. Students will also be asked to connect this research to the landscape equation and food web model.
3. Participate in an insect expedition to find out what insects live around their school. They will then compare the data they collect to data collected when on a field trip to the sagebrush ecosystem.
4. Engage in insect order account where students will have the opportunity to choose an order of insects they would like to learn more about. They will draw a picture and include important information about the insect order. Students will then step into the shoes of the teacher as they share their insect account and a few things they learned.

**Vocabulary:**

The teacher will:

1. Draw an insect and have students label its unique characteristics during the concept map brainstorm. This will help students use the vocabulary they already have to describe the insect and learn new vocabulary.
2. Have students act out or draw new vocabulary and add these to the word wall.

**Common Student Misconceptions/Student Challenges:**

- Insects or bugs are annoying and not very important to an ecosystem.
- There are only a few types of insects that live in the sagebrush ecosystem.
- Insects are small so they cannot be a major food source for other organisms.

**Materials:**

- Materials for a bug trap
- Insect samples
- Naturalist Journal

**Set-up:**

- Collect necessary materials to make a bug trap
- Insect specimens (dead or alive)
- Make a diagram of an insect for students to label

Lesson Agenda	Suggested Procedure	ELL Rationale
<p><b>Review:</b> Approximately 15min</p> <p><b>Bean Seed Investigation</b></p> <p><b>Review what students learned about the unique characteristics of the sagebrush shrub.</b></p>	<p><b>Bean Seed Investigation Wrap up:</b></p> <ul style="list-style-type: none"> <li>• Give students time to make their final measurements and observations about their bean plant. Make sure all students have information written down in their naturalist journals.               <ul style="list-style-type: none"> <li>○ Students will need to write or draw a conclusion based on the data they collected about whether or not seeds rely on soil to sprout and grow.</li> <li>○ Students will have time to discuss these as a group the following day and will share conclusions with the class.</li> </ul> </li> </ul> <p><b>Review:</b></p> <ul style="list-style-type: none"> <li>• Act, describe, or draw the various, unique characteristics of the sagebrush shrub and have students guess the characteristic. Discuss why each characteristic is unique and important for the sagebrush. <b>(D1)</b></li> </ul>	<ul style="list-style-type: none"> <li>• Reviewing the unique characteristics of sagebrush will increase comprehensibility through repetition and using multiple methods to recall information.</li> </ul>

<p><b>Engage:</b> Approximately 25min</p> <p><b>Activate prior knowledge and experiences through a brainstorm of what makes an insect an insect.</b></p> <p><b>Students will learn more about what local research scientists are discovering about insects that live in the sagebrush landscape.</b></p>	<p><b>Insect Brainstorm:</b> Approximately 15min</p> <ul style="list-style-type: none"> <li>• Write the word insect on the board and draw a picture of an insect.</li> <li>• Ask students to take a moment and think about what makes an insect an insect. Have them write down 1-2 things in the naturalist journal. <ul style="list-style-type: none"> <li>○ Students can turn to a partner to discuss characteristics of an insect.</li> </ul> </li> <li>• Ask students to come up to the board and write or draw what they brainstormed to create an insect concept map. (This can be done on a large piece of paper if wish to save)</li> <li>• After every student has contributed to the brainstorm ask questions to help fill in any blanks. <ul style="list-style-type: none"> <li>○ Example Question: “What might eat an insect? What might insects eat? Why do you think insects are important to the sagebrush ecosystem?”</li> <li>○ <i>Potential student responses:</i> <ul style="list-style-type: none"> <li>▪ <i>Birds and lizards rely on insects for food.</i></li> <li>▪ <i>Insects can eat other insects, nectar from flowers, or plants.</i></li> <li>▪ <i>Insects are important because they provide food, help with pollination, and contributing to the cycle of nutrients through consumption and decomposition.</i></li> </ul> </li> </ul> </li> <li>• Explain that today students will be exploring insects that live in their community and discovering their importance. <b>(D2)</b></li> </ul> <p><b>Research Scientist Video: Megan Wilson</b> Approximately 10min</p> <ul style="list-style-type: none"> <li>• Explain to students they will watch a video about a local UW scientist who studies insects that live in the sagebrush ecosystem.</li> <li>• Ask students to write down 1-2 things they discover from watching the video.</li> <li>• After the video discuss the following question: “What can we learn about the sagebrush ecosystem through insects?” <ul style="list-style-type: none"> <li>○ Have students share their thoughts through think-pair-share.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• A think-out-loud brainstorm and concept map about insects will access prior knowledge.</li> <li>• Giving students the options to work with peers and then either write or draw what they know about insects will lower the affective filter and increase comprehensibility.</li> <li>• Think-pair-share will increase interaction.</li> <li>• Watching a video followed by a discussion of what they saw and learned will increase comprehensibility.</li> </ul>
<p><b>Explore:</b> Approximately 30-45min</p>	<p><b>Insect Expedition: Preparation:</b></p> <ul style="list-style-type: none"> <li>• Group students into 2-3 and equip them with the following; net, bug boxes or vials, naturalist journals, pencils, insect identification book.</li> <li>• Before going outside explain that they will be exploring what types of insects live around their school yard. They can identify insects to order (butterfly, ant, beetle, bee, etc.) using their prior knowledge or insect identification book.</li> </ul>	<ul style="list-style-type: none"> <li>• Hands-on experience of looking for insects will increase comprehensibility and interaction as they work in pairs.</li> </ul>

	<ul style="list-style-type: none"> <li>• Explain that students will need to record their data so that eventually they can compare and contrast the insects they find around their school yard to the insects they may find in the sagebrush landscape. <ul style="list-style-type: none"> <li>○ Brainstorm and draw an example table on the board and have students make a template in their journals before heading outside.</li> </ul> </li> </ul> <p><b>Bug Trap Demonstration:</b></p> <ul style="list-style-type: none"> <li>• Once outside give a short demonstration of how to set up an insect trap.</li> <li>• Explain that students should set up traps in a variety of places but let them choose.</li> <li>• Dig a hole that is the height of the plastic cup.</li> <li>• Place cup in the hole and place about 1inch of water in the cup with 1-2 drops of soap. The soap helps break the water’s surface tension so insects fall in and drown. (Depending on students and time, surface tension can be discussed here).</li> <li>• Place plate over cup and gently hammer in three nails to hold the plate in place. Make sure there is a bit of space between the plate and the ground so insects can get under the plate.</li> <li>• Have each pair of students set up 2-3 bug traps. Explain they will check them over the next few days to discover what insects live around their school yard.</li> </ul> <p><b>Exploration:</b></p> <ul style="list-style-type: none"> <li>• When students have finished placing their bug traps, they can explore the school yard and try to discover as many types of insects they can. <ul style="list-style-type: none"> <li>○ Inform them they need to record what type of insect they find and how many of each kind in the table they created in their naturalist journals.</li> </ul> </li> <li>• Encourage students to capture a few insects in the insect boxes or vials to use for their insect species account they will create the following day.</li> <li>• With the remaining 5minutes bring students together to share what they found.</li> </ul>	<ul style="list-style-type: none"> <li>• Writing out data sheet together beforehand will increase comprehensibility and help students gather data while in the field.</li> <li>• Modeling and demonstrating bug trap with step-by-step instructions will increase comprehensibility.</li> <li>• Guided exploration time will increase both interaction and comprehensibility. It will also help students link new learnings to prior learnings.</li> <li>• Comparing insects found near their school to those later found in the sagebrush will increase higher order thinking as they compare and contrast the data they have collected.</li> </ul>
<p><b>Explain/ Elaborate: (Following class period)</b> Approximately 60min</p>	<p><b>Insect Order Account:</b> Approximately 30min</p> <ul style="list-style-type: none"> <li>• Students will choose an insect order to learn more about. Preferably they will choose an insect they discovered the previous day, but they can also choose an order found in the insect books.</li> <li>• Students will write up their insect account in their naturalist journal. Explain this will be a graded assignment.</li> <li>• Insect account needs to include the following: <ul style="list-style-type: none"> <li>○ Common name and Scientific name of Insect order</li> <li>○ Drawing of insect</li> <li>○ 2-3 physical characteristics about insect order</li> <li>○ A behavioral trait of insect order</li> <li>○ Habitat and Diet of insect order</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Insect order account will increase comprehensibility as students are given the opportunity to explore an insect order they are personally interested in.</li> </ul>

<p><b>Students will discover more about a particular order of insects through a detailed insect order account.</b></p> <p><b>Students will connect their new knowledge about insects to prior knowledge about interdependent relationships and food webs.</b></p>	<ul style="list-style-type: none"> <li>○ What might eat this insect</li> <li>○ One interesting fact about insect order (S1)</li> <li>● <b>Example:</b> <ul style="list-style-type: none"> <li>○ Butterfly (<i>Lepidoptera</i>)</li> <li>○ Drawing</li> <li>○ Butterflies have a long tongue like structure called a proboscis used to reach nectar. They have four wings, two being much larger than the other two.</li> <li>○ Butterflies go through metamorphoses changing from a caterpillar into a butterfly.</li> <li>○ Certain species of butterflies and moths use the sagebrush and other shrubs in the sagebrush ecosystem to create their cocoons. They eat nectar from flowering plants.</li> <li>○ Many bird species enjoy eating butterflies such as flycatchers.</li> <li>○ Some species of butterflies use mimicry for protection. They will mimic the pattern of a poisonous butterfly to ward of predators.</li> </ul> </li> <li>● Interesting facts about insects can be told to the class to share new knowledge.</li> </ul> <p><b>Food Web Connection:</b> Approximately 30min</p> <ul style="list-style-type: none"> <li>● Students will be asked to connect insects into what they have learned about independent relationships and food webs in the sagebrush ecosystem.</li> <li>● Pose the following: “You need to think about how and where insects play a role in the sagebrush food web. What do they rely on and what relies on them?”</li> <li>● Ask students to discuss their thoughts with an elbow buddy.</li> <li>● Students will then be asked to draw a model of these interdependent relationships in their naturalist journals.</li> <li>● They need to include at least three components and one must be an abiotic or cultural component.</li> <li>● Their model should clearly demonstrate how each component is connected. <ul style="list-style-type: none"> <li>○ This can be both illustrated and written. (F1)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● Presenting about insect order will increase interaction by having students be teachers.</li> <li>● Presenting about insect order will also increase higher order thinking by having students synthesize what they have learned.</li> <li>● Making connections to the sagebrush ecosystem food web will increase higher order thinking.</li> </ul>
<p><b>Evaluations and Assessment Check-Ins:</b>  D: Diagnostic assessment  F: Formative assessment  S: Summative assessment</p>	<p><b>Evaluations and Assessment Check-Ins:</b>  <b>(D1):</b> This assessment will help students review what they learned the last class. This repetition will help solidify the new information and can be used to link to the new learning that will take place.  <b>(D2):</b> This exercise will reveal students’ prior knowledge about insects and access any misconceptions they have about them, such as spiders being an insect.  <b>(F1):</b> Students knowledge and ability to make connections between food webs and the role insects play in them will be assessed through this activity. It will encourage teachers to evaluate whether or not they need to re-visit the topic of interdependent relationships (this is one of the NGSS for the unit)</p>	<ul style="list-style-type: none"> <li>● Repetition, modeling and using demonstrations will increase comprehensibility.</li> <li>● Insect brainstorm will access prior knowledge.</li> </ul>



	<p><b>(S1):</b> The insect account is one of the four parts of the students' naturalist journal and will be a graded piece. They will be evaluated on its completion and engagement in learning more about a specific insect order. They will also be asked to share an interesting fact with their classmates.</p>	<ul style="list-style-type: none"><li>• Connections made will increase higher order thinking.</li></ul>
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**References:**

- Megan Wilson's video about her work with insects.
- Variety of Insect guide books.