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Lesson 6: Plant Identification and Dichotomous Keys

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Color	Descriptor
	Lesson Information
	NGSS
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	The teacher Information
	Suggested Procedure

Lesson 6: Plant Identification and Dichotomous Keys

Unit: 5th Grade Ecology Unit: A Sagebrush Expedition

Lesson: Plant Identification and dichotomous keys

Overview: The purpose of this lesson is for students to begin to compare and contrast different plant species that are present in the sagebrush ecosystem. For this lesson they will be focusing on shrubs that you can find in this landscape. Students will begin to understand how dichotomous keys work through a sorting and categorizing activity where they will sort and categorize plant samples based on their unique characteristics. Students will begin to understand the importance of using specific adjectives when describing and sorting plants in order to identify them to species. Students will learn more about shrub species that exist in the sagebrush ecosystem through the practice of identifying samples using a simple dichotomous key. Students will also be able to relate how plants fit into the landscape equation throughout the lesson.

Main Take Away: Students will discover the meaning and how to use a dichotomous key as a model for identifying plants. They will then use this knowledge to key out specific sagebrush species they can find in their community.

Learner Outcomes

Students will be able to...

- Compare and contrast different plant species that exist in the sagebrush ecosystem based on physical observations.
- Begin to understand how dichotomous keys work through categorizing provided plant samples using unique characteristics and specific adjectives.
- Use a dichotomous key to identify shrub samples of the sagebrush ecosystem.
- Relate how plants fit into the landscape equation.

Getting Ready

Materials: sagebrush shrub dichotomous key, plant samples, magnifying glasses, naturalist journals, and pencils.

Preparation: prepare plant samples (live or photocopies of pressed plants), print copies of dichotomous keys, collect magnifying glasses and read through lesson plan to understand the activities.

Location: classroom

Length of Time:

1-2 Lessons

Approximately 75-90 minutes

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:**

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:**

Place-Based Principle(s) Addressed:

- Engaging students in investigation, inquiry, and problem solving.
- Engaging students in experiential and project-based learning.

Science, Models, Laws, Mechanisms, and Theories explain Natural Phenomena. Science explanations describe the mechanisms for natural events

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...*

- Compare and contrast different plant species that exist in the sagebrush ecosystem based on physical observations.
- Begin to understand how dichotomous keys work through categorizing provided plant samples using unique characteristics and specific adjectives.
- Use a dichotomous key to identify shrub samples of the sagebrush ecosystem.
- Relate how plants fit into the landscape equation.

Specific Lesson Language Objectives: *Students will be able to...*

- Understand the meaning of compare, contrast, and differences in order to use these words orally, written or by pointing when describing plants.
- Understand the meaning of a dichotomous key.

Key Vocabulary Words:

- Compare and contrast
- Differences
- Dichotomous key

Background Information for the Teacher:

Dichotomous Keys:

A dichotomous key is a tool that allows the user to determine the identity of and is often used for the identification of species. Keys consist of a series of choices that lead the user to the correct name of a given item.

"Dichotomous" means "divided into two parts". Therefore, dichotomous keys always give two choices in each step. At each step, the user must carefully select the choice that more closely resembles the item in question, then follow the lead to the next choice.

See the attached dichotomous key to sagebrush species, and a not-quite-dichotomous key to shrubs found in the sagebrush ecosystem.

Unique Characteristics about Sagebrush:

Sages, genus *Artemisia*, are members of the Sunflower family. The small, non-showy flowers are made up of several tiny florets, each of which can produce a single seed. Sagebrush flowers are wind pollinated, but are a good source of pollen for many insects. Most sagebrush species flower in the late summer and produce seeds in the fall.

The odor of sagebrush is produced by camphors, terpenes and other chemical compounds produced in the leaves. These chemicals reduce insect predation as the plants come into flower during the summer. Towards the end of summer, the compounds break down, making the seed heads palatable to many animals, including deer, elk and moose.

Most species of sagebrush produce two sets of leaves. One set is short-lived, budding out in the spring and dropping off as soils dry. The other set is evergreen. To correctly identify species, it is important to look at only the evergreen leaves. Their evergreen habit is at least partially responsible for the success of sagebrush species because they are able to photosynthesize on warm days all year round. They also have exceptionally efficient root system that is very efficient at scavenging water from dry soils.

Building Background for Students: (ELL Principle)

Activate Prior Experiences:

The teacher will explain that students will do the following:

1. Review interdependent relationships that exist in the sagebrush ecosystem with a partner. Students will be asked to use knowledge they gained from the common experience they shared the previous lesson.
2. Brainstorm with their table group the role that plants play in the food web and ecosystem.
3. Share ideas of what role plants have in the sagebrush ecosystem and what relationships they share with other organisms with the entire class.
4. Engage in two activities that will help them practice using their observation skills to distinguish fine details.

Link to New Learning from Prior Learning:

The teacher will explain to students that they will:

1. Engage in an inquiry-based and hands-on project to learn how to identify different plant species. They will use their observation skills, practiced in previous exercises, to distinguish similarities and differences among a variety of plant samples.
2. In small groups, students will create their own dichotomous key using the plant samples given to them. They will then use this common experience to learn more about dichotomous keys and apply this knowledge to keying out a variety of sagebrush samples.
3. Students will be asked to make connections among this lesson and previous lessons. They will be asked how this lesson fits into the idea of the landscape equation.

Vocabulary:

The teacher will:

1. Have students explore dichotomous keys through an inquiry-based activity and then work together to decipher its meaning.
2. Spend time making sure all students understand the meaning of dichotomous and why it is a good scientific tool used to identify plants.
3. Spend time to define any new vocabulary words needed to key out the different sagebrush species samples.

Common Student Misconceptions/Student Challenges:

- There is only one type or species of sagebrush in the sagebrush landscape.
- When looking across the sagebrush landscape there is not a huge variety of plants and shrubs that grow there.

Materials: <ul style="list-style-type: none"> • Sagebrush and shrub dichotomous keys • Pocket Guide to Sagebrush (http://www.sagestep.org/pubs/pubs/sagebrush_pock_guide.pdf) • Plant samples for sorting • Plant for identification • Magnifying glasses and/or microscopes • Naturalist journals and pencils 	Set-up: <ul style="list-style-type: none"> • Prepare plant samples (live or photocopies of pressed plants) • Print copies of dichotomous keys • Collect magnifying glasses • Read through lesson plan to understand the activities.
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Lesson Agenda	Suggested Procedure	ELL Rationale
Bean Seed Review: Approximately 5min Review: Approximately 5min	Bean Seed Mini SCI: <ul style="list-style-type: none"> • Let students have a few minutes to take a look at their bean seed investigations and record whether or not they have sprouted. Review: <ul style="list-style-type: none"> • Have students turn to an elbow buddy and discuss one interdependent relationship they remember from the previous lesson. Have students discuss how and why they rely on one another. • Ask pairs to share with the class. 	<ul style="list-style-type: none"> • Working with a partner increases interaction. Have students work with a different partner. • Repetition through review helps increase comprehensibility.
Engage: Approximately 15-20min Students will practice their observation and descriptive words skills through two interactive activities.	The More You Look; the More You See: Approximately 10min <ul style="list-style-type: none"> • Prepare students by telling them they are going to be tested on their observation skills. • Stand in front of the class and have students observe you closely. Inform them that they will have 30sec to observe you and then they must turn around and close their eyes, while you change something about your appearance. • Once you have changed something students can turn back around and they must guess what you changed. <ul style="list-style-type: none"> ○ You can make your changes subtle to make it harder for them as you play. ○ Examples: change hair, move necklace or take off watch, change position of feet or arms. • Let a student come up and be the one who changes something. The Importance of Descriptive words: Approximately 10min <ul style="list-style-type: none"> • Next explain that being a naturalist is not only about the observations that you can make but also the way you can describe what you observed to others. • Describe something in the classroom using only a few vague words. Ask students to draw what you described. Have students share what they drew. <ul style="list-style-type: none"> ○ Example: I am observing something big and brown. 	<ul style="list-style-type: none"> • Kinesthetic activities help link new learning from past learning. • Engagements in activities increases students' vocabulary by practicing using descriptive words. • Letting students be the teachers for these activities increases interaction. • For ELL students who may not have

	<ul style="list-style-type: none"> ○ The idea here is that students will have a tough time figuring out what you are describing. ○ The pictures will likely be different among students. ● Next describe the same thing you are observing but using much more descriptive words and detail. Have students try drawing this. <ul style="list-style-type: none"> ○ Example: I am observing an object that is taller than me, in the shape of a rectangle, is a light brown color, and has a square cut out where a piece of glass has been inserted. ○ Students should get that you are describing the door. Have students share their drawings. ● Pose the following: <ul style="list-style-type: none"> ○ “How did the descriptive words and/or drawings help you identify the object I was describing?” <ul style="list-style-type: none"> ▪ <i>Potential student responses:</i> <ul style="list-style-type: none"> ● <i>The descriptive words/drawings helped to narrow down which object you were describing</i> ● Explain to students that they need to use their observation skills and descriptive words to help with the next activities. 	<p>the vocabulary, have them work with a partner to draw what you are describing. Point to some of the descriptive words such as brown, rectangle, etc. Working with a partner increases interaction.</p>
<p>Explore: Approximately 20-30min</p> <p>Students will explore sorting plants according to details they observe. They will do this working in pairs or small groups of three.</p>	<p>Sorting Activity: Approximately 20min</p> <ul style="list-style-type: none"> ● Announce to students that now that they have warmed up their observation and description skills, they will use these skills to sort different plants. <ul style="list-style-type: none"> ○ Have students relate how plants are a part of the landscape equation ● Give each small group of 2-3 students a pile of plant samples. ● Students will be asked to sort the plants into two groups according to the observations they make about the samples. <ul style="list-style-type: none"> ○ Examples: Plants with leaves versus plants with needles, plants with dark green foliage versus plants with lighter green foliage, or plants with larger leaves versus plants with smaller leaves. ● Once students have sorted plants into two groups challenge each group to divide each plant group further. <ul style="list-style-type: none"> ○ Example: Plants with needles: divide into soft needles versus sharp, pokey needles, plants with leaves: plants with small leaves versus plants with larger leaves. ● Once groups have sorted their plant samples into more groups challenge them to sort them further. The idea here is to get students to sort the plant samples until each sample stands alone based on its unique characteristics. ● Make sure that students are using their observation skills to point out the unique characteristics to each plant sample. ● Have groups share how they sorted their plant samples. (F1) 	<ul style="list-style-type: none"> ● Inquiry-based, hands-on experience increases both higher order thinking and interaction. ● Encouraging students to engage in argument using evidence when describing how they chose to sort their plant samples increases higher order thinking. ● Working in strategically planned small groups increases interaction. ● Working in small groups increases use of descriptive vocabulary.

<p>Explain: Approximately 15min</p> <p>Students will be introduced to a dichotomous key (they created one above), which is a model for identifying plants.</p>	<p>Introduction to Dichotomous Keys: Approximately 15min</p> <ul style="list-style-type: none"> • Pose the following: “Why do you think we just spent time sorting these plant samples?” <ul style="list-style-type: none"> ○ <i>Potential student responses:</i> <ul style="list-style-type: none"> ▪ <i>To observe their unique characteristics</i> ▪ <i>To help us see the similarities and differences among the plant samples</i> • Explain that this is how scientists figure out specific species in the natural world. They group things according to their characteristics. This is how they have created dichotomous keys. A dichotomous key is a series of choices, which leads to the identification of a specific item. • Take time to decipher the word dichotomous: di means two and dichotomous means divided into two parts. This is why there are always two options in a dichotomous key. For example: <ol style="list-style-type: none"> 1a. Shrub has spines..... Go to 2 1b. Shrub lacks spines.... Go to 4 	<ul style="list-style-type: none"> • Brainstorming helps students activate prior knowledge and then use that to connect to new learning. • Taking time to decipher the meaning of new words will increase vocabulary.
<p>Elaborate: Approximately 35-45min</p> <p>Using what they have learned about how to develop and use a dichotomous key, students will practice keying out sagebrush species.</p> <p>Students will learn more about sagebrush and creatively share with the class.</p> <p>Students must reflect on knowledge they had</p>	<p>Plant ID using Dichotomous Keys: Approximately 20min</p> <ul style="list-style-type: none"> • Give each small group a plant sample • Ask each group to describe their sample using descriptive words. They need to write at least three of these descriptive words in their naturalist journals. Have students draw their sample, paying close attention to the details. • Hand out the sagebrush shrubs dichotomous keys and have students work together to figure out what species they have. Check identification with a description of the species to see if they match. The Pocket Guide to Sagebrush is a good resource for descriptions. • When they have figured their sample out to species make sure they record this in their naturalist journal. • Have groups rotate through as many plant samples as time allows. • Have groups share results to find out if they are coming to the same identification. If not, have groups work together to try again. <p>Unique Characteristics about Sagebrush: Approximately 15min</p> <ul style="list-style-type: none"> • Explain to students that now they will learn more about an important shrub that exists in this landscape, SAGEBRUSH! • Hand small groups of students a piece of paper that has a description of one of sage’s unique characteristics. (attached below) • Students will read the description and think of how they can act this out to the rest of the class. 	<ul style="list-style-type: none"> • Working in small groups or pairs will increase interaction and comprehensibility as they discuss how to key out the sagebrush samples using a dichotomous key. • Students will synthesize learnings and expand upon learnings as they make connections to previous activities. This will increase comprehensibility and higher order thinking. • Presenting information will increase higher order

<p>before about plants and sagebrush and something new they have learned.</p>	<ul style="list-style-type: none"> • After a few minutes of preparing have student groups present their unique characteristic through a creative theatrical performance. • Have students think about why the sage has some of these unique characteristics and how they help it thrive in this landscape. See attached questions for each group. <ul style="list-style-type: none"> ○ Students can think, pair, share their ideas (F2) <p>Ticket Out:</p> <ul style="list-style-type: none"> • Have students reflect on at least two things they knew about sagebrush before the lesson and at least two things they learned about sagebrush after the lesson. <ul style="list-style-type: none"> ○ Can be written or drawn in their naturalist journals. (F3) 	<p>thinking as students communicate their knowledge and understanding. This can be done using short phrases or drawings for students with low proficiency.</p> <ul style="list-style-type: none"> • Acting out and role play increases comprehensibility. • Ticket out will increase comprehensibility and higher order thinking as they link prior knowledge to new learnings through making connections.
<p>Evaluations and Check ins:</p> <p>D: Diagnostic assessment F: Formative assessment S: Summative assessment</p>	<p>Evaluations and Assessment Check ins:</p> <p>(F1): Students apply what they know about making observations and using descriptive words to sort and categorize a variety of plant samples in order to help understand how dichotomous keys work.</p> <p>(F2): Using what they have learned about ecosystems so far, students work to determine why sagebrush has the unique characteristics it has.</p> <p>(F3): Shows what students have learned throughout the lesson.</p>	<ul style="list-style-type: none"> • Descriptive words help with vocabulary. • Assessments should be modified to meet needs of each ELL student based on their proficiency level.
<p>References:</p> <ul style="list-style-type: none"> • Sagebrush dichotomous key attached below • Unique sagebrush characteristics sheet for acting activity attached below. 		

Dichotomous key to sagebrush species growing near Baggs, WY

- 1a. Spiny shrub, usually less than 10 inches in height, leaves mostly with 6-9 lobes and very hairy.....*A. spinescens*, **bud sagebrush**
- 1b. Shrub or sub-shrub lacking spines.....2

- 2a. Leaves deeply divided, with many narrow lobes.....3
- 2b. Leaves with 3 or fewer lobes.....4

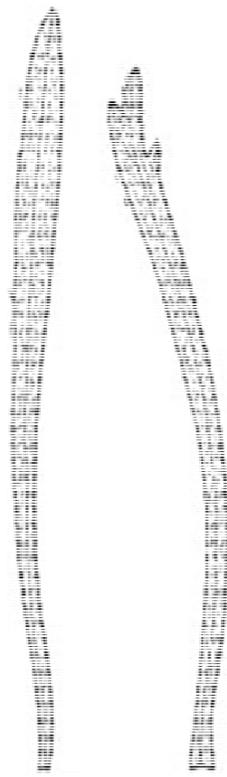
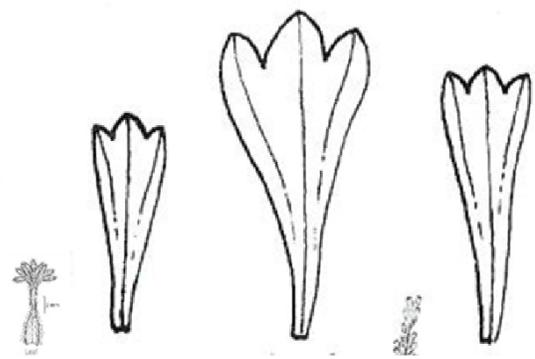
- 3a. Mounded sub-shrub, up to 10 or so inches not including flower stalks, leaves deeply and multiply lobed (“fringed”), hairy and soft.....*A. frigida*, **fringed sagewort**
- 3b. Low sub-shrub, usually less than 4 inches in height, growing on clay soils. Leaves with divided lobes.....*A. pedatifida*, **birdfoot sagebrush**

- 4a. Shrub less than 2 feet tall, usually with multiple stems, leaves with three lobes. Often growing as an “island” surrounded by big sagebrush...*A. arbuscula*, **low sagebrush**
- 4b. Shrubs 2 feet or taller, leaves without lobes or with very shallow or irregular lobes.....5

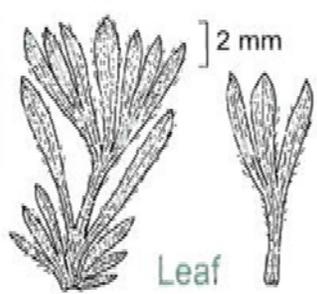
- 5a. Leaves mostly without lobes, but some leaves with irregular lobes, growing in meadows, along streams or in depressions.....*A. cana*, **silver sagebrush**
- 5b. Leaves with three very shallow lobes (“teeth”).....*A. tridentata*, **big sagebrush**

- 6a. Leaves with l:w greater than 3:1, shrubs with rounded tops, growing in valleys.....*A. t. var. tridentata*, **basin big sagebrush**
- 6b. Leaves with length to width ratio less than or equal to 3:1.....7

- 7a. Leaves not exceeding 3 mm in width, 7-11 mm in length.....*A. t. var. Wyomingensis*, **Wyoming big sagebrush**
- 7b. Leaves 3-7 mm x 12-15 mm.... *A. t. var. vaseyana*, **mountain big sagebrush**



Leaf



Unique Characteristics about Sagebrush:

1. Flowers, Seeds and Pollination

- Sages are member of the sunflower family.
- They have small, non-showy flowers which are made up of several tiny florets.
- Each floret produces one seed.
- Sagebrush flowers are wind pollinated, meaning their seeds are spread around by the wind.
- Most sagebrush species flower in the late summer and produce seeds in the fall

2. Sagebrush Odor

- The odor of sagebrush is produced by chemicals in the leaves.
- The odor helps to reduce insect predation as plants begin to flower.
- In the fall the chemicals break down making the seeds tasty to eat by many animals including, deer, elk and moose.

3. Sagebrush Leaves

- Sagebrush have two sets of leaves.
- One set of leaves is short-lived. They bud out in the spring and drop as the soil dries up.
- The other set of leaves are evergreen, meaning they are present all year long. This means they can photosynthesize all year round.

4. Sagebrush Roots

- Sagebrush species have two types of roots.
- They have a big, long taproot that is very good at reaching water deep within the soil.
- They also have shallow, branching roots that are good at sucking up water near the surface.

Questions for each group:

1. Why do you think sagebrush species do not flower until the late summer? Why do you think they have small, non-showy flowers?
2. Why do you think sagebrush is adapted to get rid of its odor so that its seeds are tasty to animals to eat?
3. What is the point of sagebrush having two types of leaves?
4. What do you believe the reason to be for sagebrush having two types of roots?