PLANT ID

FOURTH GRADE TEACHER GUIDE

Ecology in Classrooms & Outdoors

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UNIT OVERVIEW

SUMMARY

This unit includes lessons that allow students to dive into the world of botany. Botany (the study of plants) is a great way for students to view the natural world around them by giving them useful tools needed to understand how plants are identified. In each hands-on activity, students will learn the names and distinguishing characteristics of many common plants found in the Pacific Northwest, so the next time they are exploring the outdoors they can share their expert knowledge with their friends and families.

OVERALL GUIDING QUESTION

What are the common native plant species that you may find in the Pacific Northwest?

OBJECTIVES

Each student will be able to:

- Identify seven native plant species found in the Pacific Northwest
- Use a dichotomous key to distinguish between plants
- Describe characteristics of plants and plant parts, and apply this knowledge to ethnobotany, mathematical symmetry, and artistic expression

USING THIS GUIDE

The ECO Plant ID unit incorporates four interdisciplinary lessons to fully explore soil and engage students across science, math, English language arts, social science, and art. It is necessary to present the science lesson before the additional lessons to lay the foundation of understanding. ECO has created a recommended order beyond the science lesson, but teachers are free to modify the sequence.

Each lesson offers suggestions for a closing circle, discussions, or journal prompts. These suggestions may be used anytime throughout the unit as an assessment to monitor student progress.

Each Place-Based Unit has been intentionally designed to consider Diversity, Equity, and Inclusion in every classroom.

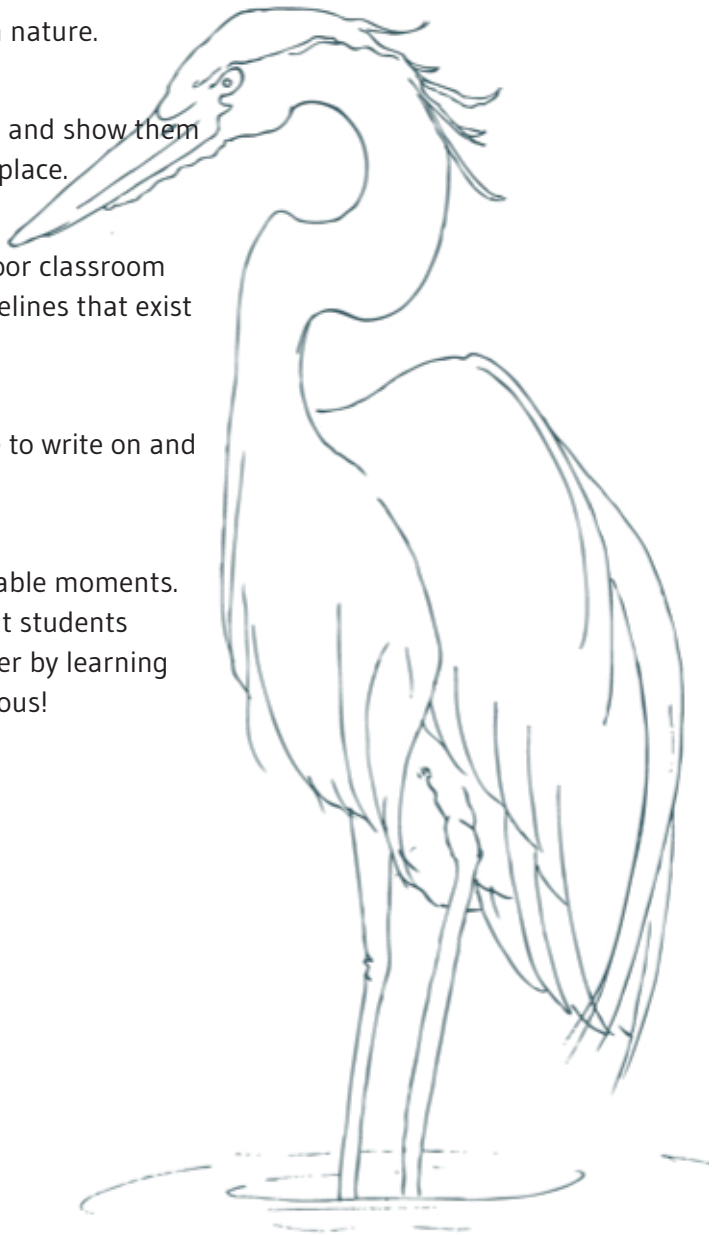
SOIL INQUIRY

UNIT OVERVIEW

WANT TO TAKE THE LEARNING OUTSIDE?

This unit is designed to be delivered indoors or outdoors! We encourage teachers to find spaces in the schoolyard where students are able to learn and interact directly with nature.

- Take students on a walk around the schoolyard and show them the outdoor classroom before the lesson takes place.
- List expectations and boundaries for your outdoor classroom so that students remember that the same guidelines that exist inside, exist outdoors.
- Make sure to bring clipboards or a hard surface to write on and have students wear appropriate clothing.
- Remember, outdoor learning is all about teachable moments. Encourage curiosity, pause for observations that students are excited about, and nurture a sense of wonder by learning alongside your students. Enthusiasm is contagious!



SUPPORT

Please contact **support@ecologyoutdoors.org** with any questions or concerns.

TRAINING

Videos of ECO educators delivering select sections of the lessons are available. Contact **support@ecologyoutdoors.org** for access.

PLANT ID

STANDARDS OVERVIEW

SCIENCE (NGSS)

- 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction.

MATH

- 4.G 3.Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line symmetric figures and draw lines of symmetry.

ELA/SOCIAL SCIENCE

- 4.W.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- 4.RI.7 Interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the text in which it appears.
- 4.RI.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
- 4.W.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly
- Geography 3.4.7 Explain the interactions between the Pacific Northwest physical systems and human systems, with a focus on Native Americans in that region

ART

- VA.1.CR1.4 3. Constructively use, explore and manipulate materials and organizational principles to create a work of art that communicates an idea

PLANT ID BACKGROUND

Botany, the scientific study of plants, is a field in which plant identification is key. Botanists study plants, their characteristics, where they are found, and their roles in their respective ecosystems. Botanists study wild and domesticated plants, and can work in many capacities such as agriculture, government, medicine, restoration, and more.

Ethnobotany is a lens through which plants and their properties are studied from the perspective of humans' use of plants. Ethnobotany studies the traditional knowledge and customs of groups of people and locally-found plants in order to understand traditional lifeways and connection to place. For additional resources on the tribes in your area, you can find accurate information by searching the Oregon Department of Education's website for *Tribal History Shared History* curriculum developed for K-12 teachers to use.

In this unit, students are able to explore native Pacific Northwest plant species through a study of leaf samples, where they will classify them based on their **characteristics** such as structure, leaf arrangement, and leaf edge. In addition, students will spend time researching the ethnobotany of a sample, determine if they have symmetry, and do art related to the plants, all in order to further "get to know" the plants and identify them. Students will practice using a **dichotomous key**, an identification tool used by botanists that present physical characteristics as two options and lead to the correct species.

The plant samples in this unit are found in folders, and include:

Thimbleberry (A): *Rubus parviflorus*

Thimbleberry, similar to a raspberry, produces red edible berries and is a bramble (thorny bush). It has medium-sized white flowers that bloom in May-June, and fruits throughout the summer. It is found in many habitats: forests, edges/ecotones, wetlands, shorelines, and open fields.
Leaves are simple, have five lobes, and leaf edges are toothed. The leaves are also covered in small "hairs," making them fuzzy to the touch.

Elderberry (B): *Sambucus racemosa*

Red elderberry is common in the Pacific Northwest as well as the rest of the United States, Europe, and Asia. It is identified by its red clusters of fruits and can be found in moist areas such as streambanks, shady or open forest, and clearings that maintain moisture. Elderberries are enjoyed by wildlife such as deer, raccoons, squirrels, and birds, who disperse seeds.
Leaves are compound, opposite, and have toothed edges.

Huckleberry (C): *Vaccinium parvifolium*

Red huckleberry is a common shrub found in the western-most parts of the Pacific coastline. Its small, pink flowers bloom April through June, with bright red edible berries fruiting in July and August. Huckleberries can often be found growing on top of rotting logs and dense forests, as they prefer moist, nutrient-rich soils.
Huckleberry leaves are small and simple, alternating, and have smooth edges.

Big leaf maple (D): *Acer macrophyllum*

Big leaf maple gets its name due to it having the largest leaves of all maple species (up to 12 inches across!). It has also been called the Oregon maple. Big leaf maple is found on the Pacific coast from Alaska to southern California. These trees are important shade-makers in riparian areas and return important nutrients to forest soils when their leaves decompose.
Leaves are simple, lobed, and have smooth edges.

[1] *http://botanicaldimensions.org/what-is-ethnobotany/*

Snowberry (E): *Symphoricarpos albus*

Snowberry shrubs range the entirety of the Pacific Northwest and are recognized by their white clustered fruits that occur in September and remain through the winter. They can be found in open forests, clearing, and rocky slopes, and are excellent at erosion control.
Leaves are simple, opposite, and have smooth edges.

Hazelnut (F): *Corylus cornuta*

The common name for this shrub found in the Pacific Northwest is the Western Beaked Hazelnut (or California Hazelnut), which can be found from British Columbia to California.
Leaves are simple, rounded ovals with toothed edges. Leaves are also fuzzy in texture.

Vine maple (G): *Acer circinatum*

Vine maple is a shrub-like tree that can densely cover areas underneath the cover of conifer trees (the understory). Mostly found in moist/wet areas from British Columbia to northern California, but can survive in less moist soils and as ornamental (decorative) trees in yards.
Leaves are simple with toothed edges, and are symmetrical with 7-9 evenly spaced, equal-height lobes.

For more detailed information on these (and more!) native plants, we recommend visiting Native Plants PNW at http://nativeplantspnw.com/

WHY LEARN PLANT IDENTIFICATION?

Plants are all around us, and their existence is integral to ours. Yet many people do not know the names of plants that surround them, let alone their importance in the ecosystems they are a part of. Recently the term "plant blindness" has been getting more attention in the media, although it was a term researchers came up with in 1998! According to Wandersee and Schlusser, "plant blindness" is the *"inability to see or notice the plants in one's own environment—leading to:*

(a) the inability to recognize the importance of plants in the biosphere, and in human affairs;

(b) the inability to appreciate the aesthetic and unique biological features of the life forms belonging to the Plant Kingdom; and

(c) the misguided, anthropocentric ranking of plants as inferior to animals, leading to the erroneous conclusion that they are unworthy of human consideration." (Wandersee and Schlusser, 1998).[2]

When students are given the tools to learn about and appreciate the plant life around them, they are more likely to notice changes in their local environment, understand ecosystem dynamics, and have an appreciation and love for the ways in which plants benefit the planet. In addition, learning how to identify native Pacific Northwest plants helps to entice students to get outdoors and spend time in nature, benefitting their mental, physical, and emotional well-being. Lastly, understanding how native plants thrive can guide students in recognizing if a habitat is in good health and balance.

ACADEMIC VOCABULARY

botany **characteristic**
ethnobotany **dichotomous key**

[2]*William Allen, Plant Blindness, BioScience, Volume 53, Issue 10, October 2003, Page 926, https://doi.org/10.1641/0006-3568(2003)053[0926:PB]2.0.CO;2*

SCIENCE LESSON

PLANT IDENTIFICATION

SUMMARY

In this lesson, students will leap into the unique world of botany by practicing plant identification. Students will learn about the basic characteristics of plant and leaf structure and then apply this knowledge to identify native Northwest plants through the use of a dichotomous key.

OBJECTIVES

By the end of the lesson, students will be able to:

- Identify seven native plant species of the Northwest
- List and describe the key characteristics of plant species

GUIDING QUESTIONS

1. What are the similarities and differences between leaf structures?
2. What are the common native plant species that you may find in the Pacific Northwest?

LESSON-AT-A-GLANCE

GRADE LEVEL 4

INTEGRATED LEARNING FOCUS Science

LESSON DURATION 45 minutes

CLASS SIZE 20 - 30

ACTIVITY TEAMS 3 - 4

MATERIALS

- Presentation *Plant ID*
- 12 sets of dichotomous key worksheets
- 12 sets of laminated Native Northwest Plants
- Pencils

NGSS

- 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction.

ACADEMIC VOCABULARY

botany	**toothed**
photosynthesis	**opposite**
characteristic	**alternate**
arrangement	**simple**
leaf edge	**compound**
lobed	**leaflet**
smooth	**dichotomous key**

ACTIVITY PROCEDURE

1. PREPARE THE ACTIVITY

Set up the presentation titled *Plant ID*. Print enough copies of the Dichotomous Key worksheets for each small group of 3-4 students to have one during the activity. Set out sets of laminated plant samples to be used during the activity; each set should have a plant sample labeled from A to G.

2. INTRODUCE THE TOPIC OF BOTANY

Slide 2: What is botany?
Begin with this open question to the class. **Botany** is the scientific study of plants, including their physiology, structure, genetics, ecology, distribution, and classification.

Slide 3: Labeled parts of a tree

Ask: What are the different parts of a plant?
Using a tree as an example, go through the different parts of a plant, and ask students to describe what the different parts of the plant do.

- Roots: absorb water and nutrients from the soil.
- Trunk or stem: trunks, or in smaller plants, stems, are the strength and structure of the plant, and allow passage of water and nutrients to the branches and leaves, and sugars (food) to the roots.
- Bark: provides protection for a tree.
- Branches: add additional structure and also function as transport for water, nutrients, and sugars.
- Leaves: leaves are the "food factories" of a plant.
- Seeds: different plants have different seeds. Seeds look different from one another because they are dispersed through different methods (blown by the wind, carried by animals, hidden inside cones, etc.)
- Flowers and fruit: are the reproductive parts of a flowering plant. Flowers hold pollen and, once pollinated, turn into a fruit with seeds inside.

Slide 4: What do leaves do for the plant?

Give students a moment to consider their answer and turn to a neighbor to share. Then, invite students to share with the class. Leaves are the "food factories" of the plant. Plants make their own food in their leaves using carbon dioxide, water and sunlight. Leaves are responsible for absorbing carbon dioxide and releasing oxygen. This process is called **photosynthesis**.

Humans breathe in oxygen and breathe out carbon dioxide. Humans and plants are the perfect compliment to one another. If we did not have plants, animals, including humans, would not be able to breathe.

3. LEAF CHARACTERISTICS

Tell students that today they are going to become plant detectives to solve the mystery of identifying plants, based only on what their leaves look like.

Explain to students that they are going to investigate and identify different types of plants by learning the **characteristics** (things they notice about the appearance) of leaf samples. Not all plants look alike, and the leaves are one of the most obvious differences. Leaves may look different, but they all provide the same function – photosynthesis, creating food for a plant.

Explain that the class will be making observations using the images you are showing them. These observations are key to identifying plants as a botanist.

Slide 5: Evergreen vs. Deciduous

Ask: What is the difference between these two images?
The maple leaves are deciduous, meaning the leaves fall off for the winter so the plant can save energy. The evergreen leaves on the right stay on the tree year-round.

Slide 6: Broadleaf and needle-like

We can also describe the leaves as being either broadleaf or needle-like. There are a few evergreen broadleaf plants in the Pacific Northwest, such as rhododendron or wax myrtle, but for now we will

focus on evergreen plants with needle-like leaves versus deciduous plants with broad leaves.

Slide 7: Winter images

Here is what the deciduous and evergreen trees look like in the winter.

Slide 8: Leaf characteristics

Tell students there are three types of characteristics that they will learn about in order to do the plant identification activity later. These three types of characteristics are: **leaf edge** (what the edges or margins of the leaf look like) , **leaf arrangement** (how the leaves are arranged on the stem), and whether or not the leaves are **simple** or **compound**.

Slide 9-18: Leaf edge

Use the slides to discuss leaf edges, having students make observations of the images to understand how a leaf edge may look **smooth**, **toothed** (like a saw edge), or **lobed** (like ear lobes).

Show students that leaves may be lobed and have smooth edges, or lobed and have toothed edges. One way to help students remember what a lobed leaf looks like is to have them pretend to trace the leaf with a pencil. If they feel they must go "in and out, in and out" to trace the leaf, it is lobed.

Slide 19-24: Leaf arrangement

The second type of characteristic students will look at is the leaf arrangement. Use the slides to discuss the two types of leaf arrangement; **opposite** and **alternate**.

Opposite leaf arrangements are symmetrical (leaves are growing directly across from one another on the stem).

Alternate leaf arrangements are not symmetrical on the stem, they are staggered.

For a short movement break, invite students to stand up where they are and call out "opposite" or "alternate" to have them mimic leaf arrangements with their arms, thinking of their body as the stem.

Slide 25-29: Simple vs. Compound

Explain that the final type of characteristic students will look at is whether a leaf is **simple** or **compound**. Simple leaves have one bud and a single leaf growing from it.

Compound leaves have one bud with multiple **leaflets** growing from it. All of the leaflets together are considered one leaf.

4. PASS OUT MATERIALS

Students are now ready to practice their knowledge with real leaf samples. Remind students that the samples are fragile and should not be bent.

Split students into groups of three or four and pass out leaf packets to groups to share, reminding them that these samples are all of native plants found in the Pacific Northwest.

To practice, prompt students to hold up an example of each of the leaf characteristics. Ask students to hold up an example of: a leaf with a smooth edge, a simple leaf, a lobed leaf, alternating leaves, etc.

5. PLANT ID ACTIVITY USING A DICHOTOMOUS KEY

Slide 30: Using a dichotomous key

Show students a copy of the **dichotomous key**, and explain that a dichotomous key is a tool that scientists use to determine what type of organism (in this case, plant) they are looking at. A dichotomous key is like a map that always only has two directions to choose from (hence the prefix di-).

To start, practice one identification as a class by selecting a sample, selecting the appropriate leaf characteristics in the key, and writing in the correct name on the bottom of the dichotomous key sheet.

Remind students that with each new plant sample, they will start at the very beginning of the key.

Using their new knowledge of the types of leaf characteristics, students will now use their dichotomous key in their small groups to identify all seven of their laminated plant samples. Make sure students put their names on the worksheet, and take turns writing the plant names when they learn them. Move around the classroom to assist students who are stuck.

Review answers as a group at the end, finding brief descriptions of each plant in the Overview section of this guide.

ANSWER KEY:

A = thimbleberry

B = elderberry

C = huckleberry

D = big leaf maple

E = snowberry

F = hazelnut

G = vine maple

CLOSING CIRCLE

Has anyone identified any of these native plants outside, either around the school, their neighborhood, or out in nature?

Challenge students to make observations about the plants they see outside of class that they cannot identify. What characteristics can they point out? In class, they can use the Internet or a field guide to try and figure out the mystery plants they find.

ASSESSMENT OPTIONS

Collect groups' worksheets to assess learning.

Dichotomous Key: Native Plant Identification

1a. Leaves are lobed 2

1b. Leaves are not lobed 4

2a. Leaves have less than 7 lobes 3

2b. Leaves have 7 or more lobes ..... Vine maple

3a. Leaf edges are smooth ..... Big leaf maple

3b. Leaf edges are toothed ..... Thimbleberry

4a. Leaf edges are toothed 5

4b. Leaf edges are smooth 6

5a. Leaves are simple ..... Hazelnut

5b. Leaves are compound ..... Red elderberry

6a. Leaves have opposite arrangement ..... Snowberry

6b. Leaves have alternate arrangement ..... Red huckleberry

1. Plant A is: _____

2. Plant B is: _____

3. Plant C is: _____

4. Plant D is: _____

5. Plant E is: _____

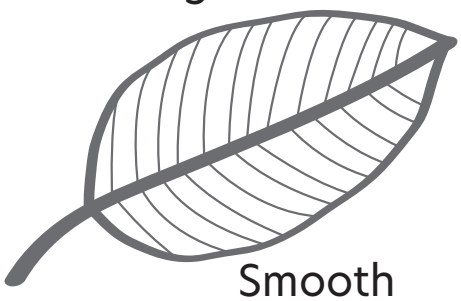
6. Plant F is: _____

7. Plant G is: _____

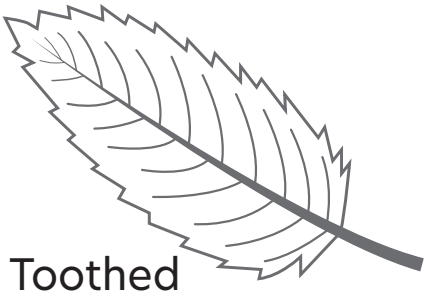
LEAF CHARACTERISTICS WORKSHEET

LEAF IDENTIFICATION

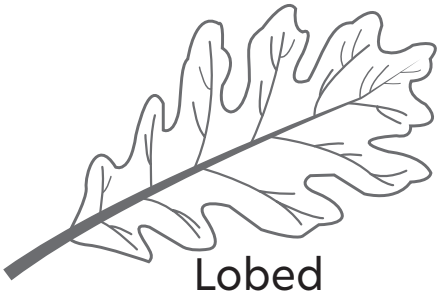
Leaf Edges



Smooth

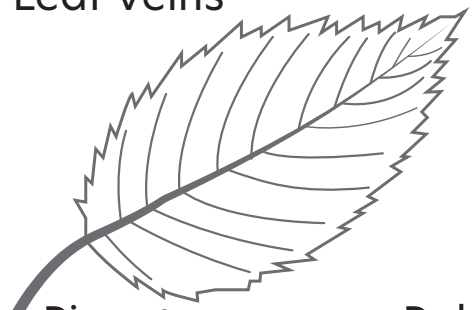


Toothed



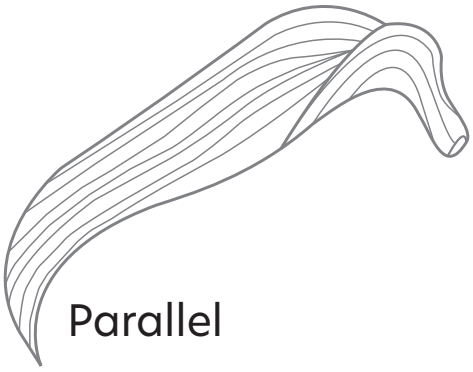
Lobed

Leaf Veins



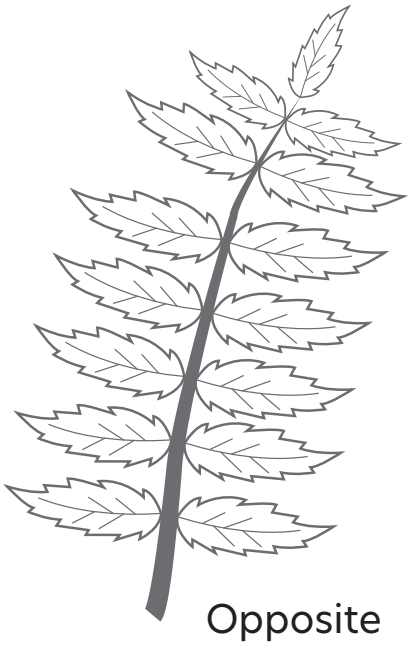
Pinnate

Palmate

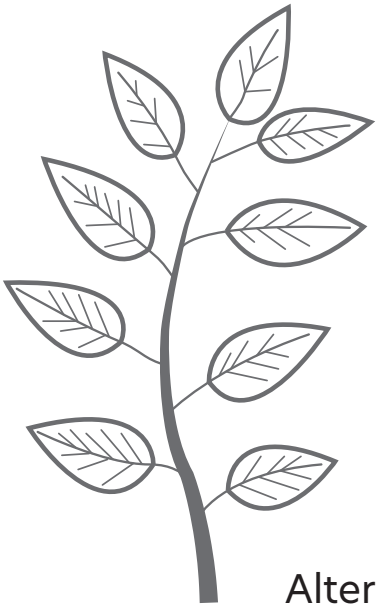


Parallel

Leaf Arrangement



Opposite



Alternate

MATH LESSON

PLANT SYMMETRY

SUMMARY

In this lesson, students will use plant leaves from the science lesson to understand symmetry. By drawing an axis line across the laminated plant samples, students will be able to visualize where the line of symmetry is for some leaves, recognize that there are multiple lines of symmetry for some leaves, and notice that there are some leaves that are not symmetrical in any way.

OBJECTIVES

By the end of the lesson, students will be able to:

- Demonstrate an understanding of symmetry through leaves

GUIDING QUESTIONS

1. How do you know if something is symmetrical?
2. Can symmetry be seen in nature?

LESSON-AT-A-GLANCE

GRADE LEVEL 4

INTEGRATED LEARNING FOCUS Math

PREPARATION 10 minutes to collect leaf samples from outdoors, if using

LESSON DURATION 45 minutes

CLASS SIZE 20 - 30

MATERIALS

- 12 sets of laminated native Northwest plants
- Plant samples collected from outdoors (optional)
- 30 dry-erase markers

MATH

- 4.G 3.Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line symmetric figures and draw lines of symmetry.

ACADEMIC VOCABULARY

symmetrical/symmetry
axis
horizontal
vertical
diagonal

ACTIVITY PROCEDURE

1. WHAT IS SYMMETRY?

Introduce the laminated plant samples. Remind students they are fragile and should not be bent.

These plant samples are all plants native to the Northwest, our geographic area. Tell students they will be studying each sample in order to determine if the leaves are symmetrical and if their line of symmetry is vertical or horizontal.

Ask: What does symmetrical **mean?**
An object that is made up of exactly similar parts facing each other or around an axis. One way to describe this is a "mirror image". Have students think of something they already know is symmetrical, like a circle.

Ask: What is an axis**?**
An imaginary line that divides an object in half.

Before you can start studying the plant samples, it is important to distinguish between the different types of symmetry that are used in math and science.

Explain to students that ecologists and biologists find symmetry in nature from the tiniest single-celled organisms to the structure of leaves and flowers, and even in the human body!

Reflectional symmetry, also known as mirror or line symmetry, is what you will be focusing on today during this activity. Reflectional symmetry is when an object can be flipped around an axis and still appear the same. An object may have more than one line of symmetry.

Rotational symmetry, also known as radial symmetry, is when an object mirrors itself after being rotated around a central point. Snowflakes are excellent examples of rotational symmetry.

Point symmetry, also known as spherical symmetry, is only common in nature in very tiny, spherical organisms, such as single-celled protozoa. An object with point symmetry can be cut in half on any line, and each half is an exact mirror of itself.

2. SHOW AN EXAMPLE

Hold up one of the plant samples or place it under the document camera. Using a dry-erase marker, draw a dotted line as the axis that does not create symmetry.

Ask: Is this symmetrical?
No, because the axis is drawn in a place that does not create exactly matching parts on either side. It is not a mirror image over the axis.

Erase the line and draw the axis in a place that does create symmetry.

Ask: Is this symmetrical?
Yes. The axis is drawn in a place that creates exactly matching parts on either side. If you were to fold the object in half on the axis, each side would match up perfectly. A symmetrical object will have a mirror image on the other side of the axis.

Explain to students that a line of symmetry may be **horizontal**, **vertical**, or **diagonal**.

Note: Not every single leaf will be symmetrical. Challenge students to use the leaf structure and arrangement vocabulary they learned from the science lesson. Invite students to hypothesize which leaves will be symmetrical; smooth, lobed, toothed, opposite, alternate, simple, compound.

3. FIND SYMMETRY IN THE SAMPLES

Pass out 3-4 plant samples and one dry-erase marker per student. Remind the students they will not be folding the samples. Instead, they will be drawing a dotted line to create an axis to show if a sample is symmetrical. It may be that there is more than one line of symmetry.

As students complete all of their samples, invite them to trade with a table partner or someone with different samples.

If you collected plant samples from outdoors, have students use these to test their knowledge, and sort them into groups of horizontal, vertical, or no lines of symmetry.

CLOSING CIRCLE

Invite students to share with a partner who had the same plant sample.

- Do you agree on the line of symmetry?
- Were there any lines you missed?
- Were there any plants that had more than one line of symmetry?
- Were there any plants that had no lines of symmetry?

ELA LESSON

ETHNOBOTANY RESEARCH

SUMMARY

In this lesson, students will research one plant of their choosing from either the plants in the science lesson or a plant from the schoolyard. During their research, students will learn where the plant is found regionally, the practical uses of the plant, and the customs associated with the plant.

OBJECTIVES

By the end of the lesson, students will be able to:

- Define ethnobotany as the study of how people of a particular culture and region make use of indigenous (native) plants
- Investigate, research, and present findings on a particular local plant to an audience

GUIDING QUESTIONS

1. What are key details about the plant and where it is found?
2. What can the plant be used for?
3. What are some traditional uses of the plant?
4. Who used the plant in a traditional way?

LESSON-AT-A-GLANCE

GRADE LEVEL 4

INTEGRATED LEARNING FOCUS ELA and Social Science

LESSON DURATION 45-60 minutes for research, option for multiple work sessions

CLASS SIZE Any

MATERIALS

- Leaf samples from the science lesson or collected from schoolyard
- Copies of Ethnobotany Research Guiding Questions handout
- Research tools such as computers with Internet and/or library books
- Presentation methods: Presentation board, paper, markers/ colored pencils
- Computers with Google Slides, PowerPoint, or KeyNote

ELA

- 4.W.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- 4.RI.7 Interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the text in which it appears.
- 4.RI.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
- 4.W.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

SOCIAL SCIENCE

- Geography 3.4.7 Explain the interactions between the Pacific Northwest physical systems and human systems, with a focus on Native Americans in that region.

ACADEMIC VOCABULARY

botany **indigenous**
ethnobotany

ACTIVITY PROCEDURE

1. PREPARE THE ACTIVITY

Print copies of the Ethnobotany Research Guiding Questions handout for each student.

Collect resources for students to do research, including computers or tablets, library books, encyclopedias, or field guides. A list of recommendations is included in this lesson.

2. WHAT IS BOTANY?

Review the word botany from the science lesson. Begin with this open question to the class. **Botany** is the scientific study of plants, including their physiology, structure, genetics, ecology, distribution, and classification.

3. WHAT DOES "ETHNO" MEAN?

Ethno is a prefix that implies the study of different societies and cultures, combined with another area of study. Enthno means *people*!

Ask: When you combine "ethno" and "botany", what do you get?
People + plants = ethnobotany. **Ethnobotany** is the study of how people of a particular culture and region make use of indigenous (native) plants. Plants provide food, medicine, shelter, dyes, fibers, oils, resins, gums, soaps, waxes, latex, tannins, and even contribute to the air we breathe. Many native peoples also use plants in ceremonial or spiritual rituals. [3]

4. CHOOSE A PLANT TO STUDY

Explain to students that they will be conducting a research project on one or more Pacific Northwest plants of their choosing. When they have finished, they will have a well-researched report to share with the rest of the class in order for everyone to get a better understanding of why the plant is important to local people and cultures.

Tip: If you choose to go outside, be sure to choose an area with plants that provide options for students. Review guidelines for going outside as a class. You may need clippers or scissors so students can clip a small sample from the plant and bring it inside.

5. TIME TO RESEARCH

When students have chosen a plant from the school grounds or from the science lesson, have them start by looking up the common name to discover the scientific name and any names that come from **indigenous** (naturally existing in a place or country rather than arriving from another place)[4] groups.

Guiding questions for research (included on handout):

- Who are the indigenous people who use this plant?
- What was the plant used for?
- Was the plant used for more than one thing; food, clothing, shelter, dye, ceremony…?
- Where was the plant found originally?
- Where is this plant found today?
- How is this plant used today?

As the students are gathering their research, encourage them to dive deeper. Help students find quality images to download and/or print for their presentation.

[3] *(U.S. Forest Service https://www.fs.fed.us/wildflowers/ethnobotany/)*
[4] *https://dictionary.cambridge.org/dictionary/english/indigenous*

At this time, you may be having students use the Internet for searching or looking in library books and field guides. Here are some wonderful websites and field guides we recommend:

- Pojar, Jim and Andy MacKinnon, *Plants of the Pacific Northwest Coast*, Lone Pine Publishing, 1994
- Native Plants PNW: An Encyclopedia of the Cultural and Natural History of Northwest Native Plants: http://nativeplantspnw.com/
- Kruckeberg, Arthur R., *Gardening with Native Plants of the Pacific Northwest*, University of Washington Press, Third Edition (2019)
- U.S. Department of Agriculture PLANTS database: https://plants.sc.egov.usda.gov/java/ (Download your selected plant's "plant guide" PDF)
- Gunther, Erna, *Ethnobotany of Western Washington*, University of Washington Press, 1973 (recommended for teacher use, it's quite technical!)
- Elpel, Thomas, *Botany in a Day: The Patterns Method of Plant Identification*, Hops Press, LLC; 6th edition, 2013

6. CREATE A PRESENTATION

Depending on the resources available to you, allow for students to choose a presentation method. Some options include:

- Creating a poster board to display key research, illustrations, and printed images
- Developing a digital presentation using Google Slides, PowerPoint, or KeyNote
- Giving an oral presentation and passing around images or samples

CLOSING PRESENTATION

Invite students to present their findings to the class to practice their oratory skills. You may even decide to host an event in which families and members of the community join to learn about the research your students did.

ASSESSMENT OPTIONS

Use the provided Ethnobotany Research Project Rubric to assess students' projects.

FURTHER READING

https://www.fs.fed.us/wildflowers/ethnobotany/

https://www.nwvisualplantid.com

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_045486.pdf

https://www.wnps.org/ethnobotany

https://libguides.wwu.edu/c.php?g=308316&p=2062013

https://ncascades.org/discover/north-cascades-ecosystem/files/Medicinal%20Plants%20of%20the%20North%20Cascades.pdf

Student Name: Title of Project:

Plant ID Unit Ethnobotany Research Project Rubric

	Not yet meeting expectations	Somewhat meets expectations	Fully meets expectations	Exceeds expectations
Facts and sources	Project does not have sources or accurate facts	Project includes fewer than 3 sources; most facts are accurate	Project includes 3 sources for facts; all facts are accurate	Project includes more than 3 sources for facts; all facts are accurate
Research and understanding	Little to no work was done to research the topic	Research has been done on the topic	Research is complete and specific questions have been answered about the topic	Research has been done on the topic and on questions beyond those provided
Written components	Little to no work was done to check spelling, grammar, and punctuation	Writing is complete and some work was done to check spelling, grammar, and punctuation	Writing is complete and was edited for correct spelling, grammar, and punctuation	Writing is complete, has a clear flow and delivers information thoughtfully, and was edited for correct spelling, grammar, and punctuation
Project presentation and delivery	Little to no work was done to complete the project presentation	Project presentation is almost complete	Project presentation is complete and delivers the information thoughtfully	Project presentation is very neat and organized, has additional details, and delivers the information thoughtfully

Comments:

Name:
Date:

Ethnobotany Research Guiding Questions

Name of plant (common name):_____

Scientific name:_____

1. Who are the Indigenous people who use this plant?

2. What was the plant used for?

3. Was the plant used for more than one thing; food, clothing, shelter, dye, ceremony...?

4. Where was the plant found originally?

5. Where is this plant found today?

6. How is this plant used today?

ART LESSON

PLANT PRINTING

SUMMARY

In this lesson, students will explore the beauty of leaf characteristics by using Sunprint paper to bring a design to life. As an alternative, students may apply the same artistic study of the beauty of leaf characteristics by doing a leaf rubbing using plant samples and crayons.

OBJECTIVES

By the end of the lesson, students will be able to:

- Create a piece of art using Sunprint paper and native Northwest plants that showcases the structure and form of the leaves

GUIDING QUESTIONS

1. What are the unique characteristics of native Northwest leaves?

2. How can leaves be used to create an artwork showcasing the leaf arrangement or depicting symmetry?

LESSON-AT-A-GLANCE

GRADE LEVEL 4
INTEGRATED LEARNING FOCUS ART

LESSON DURATION 30 - 45 minutes
CLASS SIZE 30

MATERIALS FOR SUNPRINTS:

- Collection of leaf specimens from outdoors
- Clippers, if collecting samples during class
- Sunprint paper
- Clear tape
- Shallow container for water
- Paper towels

MATERIALS FOR

- Plain paper
- Crayons with the paper removed
- Leaf specimens, either laminated or collected from outdoors

ART

- VA.1.CR1.4 3. Constructively use, explore and manipulate materials and organizational principles to create a work of art that communicates an idea.

ACADEMIC VOCABULARY

print	**opposite**
characteristic	**alternate**
arrangement	**simple**
smooth	**compound**
toothed	

ACTIVITY PROCEDURE

1. PREPARE THE MATERIALS

For Sunprints: fill the shallow container of water and set aside for the print making, and set out clear tape and paper towels. Do not open the packet of Sunprint paper or remove it from the package until students are ready to print to ensure the paper isn't exposed to sunlight prematurely.

For leaf rubbings: ensure students have plain paper and various colors of crayons with the paper removed.

Get students ready to go outdoors to collect leaf samples from around the schoolyard. You may want to bring clippers if you are able to cut any samples. Otherwise, this activity may be best done in the fall when there are plenty of leaves on the ground for students to use in their art.

Ask: Can you identify the plants you selected?
Invite students to look at the plant samples they selected and see if they can identify them using their knowledge from the science lesson. It is OK if students selected plants that are not the same as the plants in the science lesson. Then, return to the classroom with your assortment of plant samples.

2. REVIEW SYMMETRY IN NATURE

Remind students of the science lesson and the different types of leaf arrangements: **opposite** and **alternate**. Opposite leaf arrangements are symmetrical (leaves are growing directly across from one another on the stem). Alternate leaf arrangements are not symmetrical on the stem.

Some of the other leaves and leaflets from the samples are also symmetrical.

Ask: How do we know if something is symmetrical?
An object that is made up of exactly similar parts facing each other or around an axis. We can create a visible axis by drawing a line down an object, if both sides of the axis are the same/match then the object is symmetrical.

Hold up one of the plant samples or place it under the document camera that could be symmetrical. Draw a dotted line as the axis that does not create symmetry.

Ask: Is this symmetrical?
No, because the axis is drawn in a place that does not create exactly matching parts on either side. Erase the line and draw the axis in a place that does create symmetry.

Ask: Is this symmetrical?
Yes. The axis is drawn in a place that creates exactly matching parts on either side. A symmetrical object will have a mirror image on the other side of the axis.

Hold up some of the samples from the science lesson and ask students if they are symmetrical or not symmetrical. Tell students they are going to take their knowledge of symmetry and use it to create art with a unique media called Sunprint paper.

Note: If you are doing the alternative activity and using samples to make leaf rubbings, have students lay plain paper over the top of their leaf samples and hold their crayons sideways, using the flat edge to create an artwork in this way

3. HOW TO MAKE A SUNPRINT

Sunprint paper is a special type of paper that undergoes a chemical reaction when exposed to the sun (Visit https://www.sunprints.org/how-it-works/ to learn more). Introduce the paper and how it works to the class.

Invite students to select the plants they want to use to create an art piece using the special paper. Encourage them to arrange their plants to make a visually interesting shape, like a symmetrical pattern or using leaves with different edges for contrast. Instruct students to finalize their design or layout before they let you know they are ready for their next steps.

Using the instructions in the Sunprint paper packet or below, guide students through the print-making process.

Step 1: Arrange your objects on a piece of Sunprint paper out of the reach of the sun.

The blue molecules embedded in the paper are sensitive to ultraviolet light. For best results, prepare your print in a place where the sun's light cannot reach the paper as you arrange objects on top of it. Direct sunlight will expose the paper quickly, but even ambient light in the shade, or in a room with a big window will cause slow exposure of the paper.

Step 2: Make the leaves as flat as possible on the paper. You can use clear tape if students want the edges to lay flat on the paper.

Step 3: Take your Sunprint outside and lay it in direct sunlight for 2-5 minutes.

The areas of the paper exposed to the sun will fade from blue to white. When you see most of the color disappear from the paper, your print has been fully exposed. If no direct sunlight is available, don't worry–just expose your print a little longer and wait for the same fading effect. Under cloud cover, the process will take 5-20 minutes depending on the thickness of the clouds.

In this step, two crucial molecules in the paper are interacting, forming a new molecule. Their interaction is initiated by specific wavelengths of ultraviolet light. The new molecule is colorless so that as the blue molecules are converted, the white of the paper base begins to show through. Areas of the paper covered by your objects still contain the original blue molecule, so they remain blue.

Step 4: Rinse your Sunprint in water. Watch the white turn to blue and the blue turn to white.

To get the deepest blue that the paper can give, leave it in the water for a while (1-5 minutes).

There are two exciting things happening to the paper while it is underwater. First, the original blue compound is water-soluble, so that when you immerse it in the bath, the water carries it away, leaving only the white paper base in those areas. Second, the colorless compound whose formation was caused by the sun's energy is not water-soluble, so it cannot wash away in the water bath. It is sensitive to the water in another way.

Just as the sun's light stimulated a chemical change in the previous step, the water stimulates another chemical change in this one. The water causes an oxidation reaction that turns the colorless compound into the deep blue of a finished Sunprint.

Step 5: Lay your Sunprint flat on an absorbent surface and allow it to dry.

You can use a paper towel or a piece of cardboard as a bed for your Sunprint while it dries. Putting it on something absorbent will help to avoid the formation of water spots by drawing the water away from the Sunprint paper. When you take your paper out of the water, the active chemical will not have finished oxidizing. The water remaining in the paper will do the job before it evaporates. By the time it is all gone, you will have a beautiful, deep blue Sunprint!

CLOSING CIRCLE

- Create a gallery of the students' work. Invite students to show their art and tell their peers about what they have chosen to create.
- An option to take this learning one step further is having the students find the scientific name of their leaf sample, then the common name, and then the traditional or indigenous name.

