NATIVE OR INVASIVE PLANTS

FIFTH GRADE TEACHER GUIDE

Ecology in Classrooms & Outdoors

TABLE OF CONTENTS

UNIT OVERVIEW 1

STANDARDS OVERVIEW 3

SCIENCE
NATIVE OR INVASIVE 6

PLANT MYSTERY WORKSHEET 12

MATH
INVASIVE PROPAGATION 13

PROPAGATION WORKSHEET 16

ELA
PLANT PASSAGES 24

ART/SOCIAL SCIENCE
PLANT PSAS 27

APPENDIX 30

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NATIVE OR INVASIVE PLANTS
UNIT OVERVIEW

SUMMARY

Natural ecosystems are well-balanced environments, established over many years. The introduction of non-native organisms to an ecosystem can disrupt the balance and lead to undesirable consequences. Through the Native or Invasive Plants Unit, students learn the characteristics of native and invasive plants and solve a mystery of "native or invasive?" using evidence to distinguish between organisms. Using mathematical models for seed distribution, informative-explanatory texts, and the creation of a public awareness campaign, students explore the impact people have on the environment, whether well-intentioned or not.

OVERALL GUIDING QUESTIONS

What characteristics distinguish native and invasive species from one another?

What impacts do non-native invasive plants have on ecosystems?

What role have people played in the distribution of plants?

OBJECTIVES

Each student will be able to:

- Discuss the impacts non-native invasive plants can have on ecosystems
- Explain the role humans have had in introducing non-native plants
- Apply math models to estimate propagation of invasive plant species
- Develop persuasive arguments to raise awareness and encourage community action

USING THIS GUIDE

The ECO Native or Invasive Plants unit incorporates four interdisciplinary lessons to fully explore the importance of native plants and engage students across science, math, English language arts, 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.

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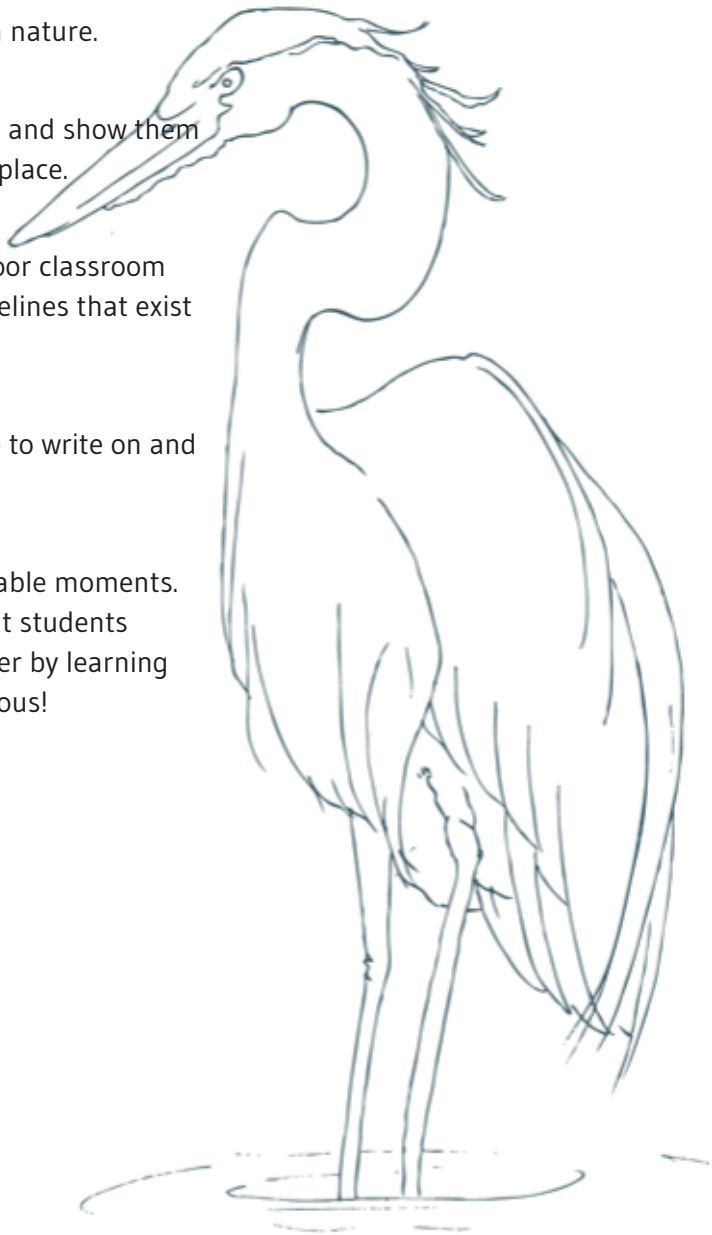
NATIVE OR INVASIVE PLANTS

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.

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NATIVE OR INVASIVE PLANTS

STANDARDS OVERVIEW

SCIENCE (NGSS)

- 5-LS2.A Interdependent Relationships in Ecosystems. Newly introduced species can damage the balance of an ecosystem.
- 5-ESS3.C Human impacts on Earth systems.
- 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MATH

- 5.NF Number and Operations – Fractions.
- 5.OA Operations and Algebraic Thinking
  - 5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
  - 5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
- 5.MD Represent and interpret data.

ELA

- W.5.1 Write informative/explanatory.
- 5.W.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
- 5.W.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
- 5.L.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.

ART

- VA.1.CR1.5 Creating-Generate and conceptualize artistic ideas and work

  1. Generate ideas for an artwork based on cultural influences or social issues.
  2. Use formal and conceptual vocabularies of art and design to describe a work of art (e.g. elements & principles of design).3. Constructively design and manipulate materials, organizational and compositional elements to make meaning in a work of art.
  3. Constructively design and manipulate materials, organizational and compositional elements to make meaning in a work of art.

SOCIAL STUDIES

- Geography 5.13 Describe how natural and human-made events in one place affect people in other places.
- Social Science Analysis 5.28 Propose a response or solution to an issue or problem, utilizing research, to support the position.

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NATIVE OR INVASIVE PLANTS BACKGROUND

Native species are species that normally live and thrive in a particular **ecosystem** and have adapted to that particular environment. Native species' presence in an ecosystem is a result of natural processes and not human influence. **Non-native** species are the exact opposite; they are species that occur outside their natural range, generally due to human activity. Non-native species become **invasive** when they cause ecological or economic harm.

In this unit, students will be focusing on native and invasive plant species and the physical and behavioral **characteristics** (distinguishing trait, quality, or property) of each. Native plants are beneficial and adapted specifically to their ecosystem for many reasons. For example, in the Willamette Valley, native plants are able to thrive through long periods of rain and drought, local diseases and pests, and the soil composition. Native plants also provide critical **habitat**, food and shelter, for native animals. In some cases, native plants are even particularly adept at naturally filtering stormwater.

Students will learn about the characteristics of invasive plant species through studying the Himalayan blackberry, which is a common invasive plant in Oregon. It provides an excellent example of how invasive plant species cause harm by reproducing quickly and taking over native, diverse ecosystems. One characteristic of Himalayan blackberry that makes it such a successful invasive plant species is its high seed production. The fruit of the Himalayan blackberry has many bubbles, or **drupelets**, that cover the seeds. Some studies have found 25 to over 100 drupelets per fruit, which translates to 25-100 seeds per fruit; the more seeds a plant produces the more new plants can germinate as a result.

The seeds of the Himalayan blackberry can also lay **dormant**, or inactive, in the soil for years, which means even if the surface plants have been completely removed, the dormant seeds can still germinate years later. Once the Himalayan blackberry seeds germinate into adult plants, those plants are able to **propagate**, or reproduce, through **cloning** themselves. The adult plant sends out a shoot, or branch, and once that shoot reaches soil some few feet away, it is then able to form roots and grow an entirely new plant. The adult plant is also very strong and forms roots that take considerable effort to remove. Unfortunately, these characteristics that make the Himalayan blackberry such a successful invasive plant is not unique; they are also found in many other invasive plant species. Invasive plants in general thrive in **disturbed areas**, or where vegetation and soil has been removed or altered, which are common in more populated areas.

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WHY STUDY NATIVE AND INVASIVE PLANTS?

According to the National Invasive Species Council, U.S. Department of the Interior, invasive species represent one of the most significant threats to ecosystems, human and animal health, infrastructure, the economy, and cultural resources. Alarmingly, the threat is growing. Climate change and the globalization of trade, travel, and transport are greatly increasing the number and type of species moved around the world, as well as the rate of movement. Simultaneously, changes in land use and climate are rendering some habitats more susceptible to the establishment of non-native species and may amplify the adverse impacts of biological invasion.

Not all non-native species are harmful; however, many are beneficial and play substantial roles in our economy (e.g., in agriculture and fisheries). Whether or not a non-native species is or will become harmful is context dependent; the risks change among localities and through time. It is important for students to recognize this key difference, be able to recognize which non-native plants are invasive, and take action to enhance those ecosystems under threat from invasive plant species.

The study of native and invasive plants will also help students develop critical thinking skills as they wrestle with the tradeoffs associated with the benefits and potential unintended consequences of non-native plant introductions. Knowledge of the impact invasive plants can have on ecosystems will help students think through the impact humans can have on their environments and develop appreciation for native plants and conservation efforts.

ACADEMIC VOCABULARY

characteristic	**habitat**
clone	**invasive**
disturbed area	**native plant species**
dormant	**non-nativeplant**
drupelet	**species**
ecosystem	**propagate**

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SCIENCE LESSON

NATIVE OR INVASIVE

SUMMARY

In this lesson, students delve into the world of native and non-native plants and discuss the characteristics that make some non-native plants act as invasive plants. Then, students share information of local non-native invasive plants and discuss the qualities that make these particular plants undesirable in Pacific Northwest ecosystems. After learning key characteristics of many invasive plants, students will become plant detectives, using photographs and clues to solve plant mysteries.

OBJECTIVES

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

- Define differences between native, non-native and invasive plants
- Describe characteristics which often make non-native plants act as invasive plants
- Distinguish invasive plants from native plants using clues
- Explain ways people have impacted ecosystems with invasive plants

GUIDING QUESTIONS

1. How are native plants distinguished from invasive plants?
2. What impacts can invasive plants have when introduced into an ecosystem?
3. What role do people play in the introduction of invasive plants?

LESSON-AT-A-GLANCE

GRADE LEVEL 5

INTEGRATED LEARNING FOCUS Science

LESSON DURATION 45 minutes
CLASS SIZE Any
ACTIVITY TEAMS Groups of 3 - 4

MATERIALS

- Presentation: *Native or Invasive*?
- Vocabulary cards
- 16 envelopes containing Native or Invasive? activity cards
- Solve a Plant Mystery worksheets
- Journals or paper
- Pencils

NGSS

- 5-LS2.A Interdependent Relationships in Ecosystems. Newly introduced species can damage the balance of an ecosystem.
- 5-ESS3.C Human impacts on Earth systems.
- 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- 3-5-ETS1-2 Generate and compare multiple solutions to a problem based on how well they meet criteria and constraints of the design problem

ACADEMIC VOCABULARY

pathway
characteristic
ecosystem
habitat
introduction
native
non-native
invasive
propagate
clone
dormant
drupelet
disturbed area

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ACTIVITY PROCEDURE

1. PREPARE THE ACTIVITY

Set up the presentation titled *Native or Invasive?* on a screen or using the printed version, and ensure each envelope contains plant photos and clue cards (5 clue cards per plant).

Print enough worksheets for each group of 2-4 students to have at least one during the activity. Some groups may need more than one worksheet if they complete their activity quickly, so print a few extra copies.

2. INTRODUCE NATIVE, NON-NATIVE, AND INVASIVE

Going through the presentation, lead a discussion with students:

Ask: What is a native plant? Do you have any theories about what scientists might mean when they call a plant "native" to an area?
Native plants have been living in their area for many years and are naturally occurring in the area they grow. Over time, plants and animals evolve together and find a balance or "natural state" given the climate, soil and other conditions in their particular area. When things change, the plants and animals have to adapt again over time to the new conditions. Brainstorm with the students some examples, such as Douglas Fir (Oregon state tree), Oregon Grape (Oregon state flower), Bigleaf Maple, Mock Orange, Snowberry, etc.

Ask: What are non-native plants?
Ask students to turn to their neighbor and take turns discussing what they think a **non-native** plant is. Then, ask for volunteers to share what they think a non-native plant is. After multiple ideas have been shared, tell students that non-native plants are foreign to an **ecosystem**, or a community of interacting organisms and their physical environment, and have been **introduced** usually through human activity. Animals and plants are introduced when they are brought to a new area.

Ask: What is the difference between non-native and invasive plants?
Based on the knowledge of what native and non-native plants, have students make an educated guess about the difference between non-native and invasive plants. **Invasive** plants are non-native plants whose introduction does, or will likely cause, economic or environmental harm, or harm to the health of humans, livestock, or wildlife.

Ask: How do invasive plants travel to different areas?
Invasive plants spread in many ways! Have students share their ideas.

- Animals such as birds consuming and spreading seeds
- Humans bringing plants to different ecosystems because they like them for their gardens or landscaping
- Humans bringing plants to different ecosystems because they make them money
- Humans using plants to solve an environmental "problem" that they didn't fully understand
- Humans accidentally spreading seeds in animal feed, on their vehicles, boats, or boots, or because they didn't realize they were non-native

Scientists who study invasive species call these methods for spreading **pathways**. In order to think about how invasive plants can be harmful to the ecosystems they find themselves in, it is important to think about what all plants need to survive and thrive.

Ask: What do plants need to survive and thrive?
Water, sunlight, nutrients (nitrogen, phosphorus, potassium), carbon dioxide (CO_2), and space around them to get what they need. (Not all plants need soil; many grow in water and some even grow in air!)

Invasives can be harmful to native plants and their **habitats**, or homes, by taking up these resources faster than the native plant populations. Moving on, you will discuss how this happens after non-native plants become invasive plants.

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3. DELVE DEEPER INTO INVASIVE PLANTS

Ask: What do you think invasive plants have in common? What are some characteristics that may cause non-native plants to be invasive?
Invasive plants all tend to have similar defining **characteristics**, or features. Most importantly:

- Grow quickly
- Lots of seeds
- Very tough/hardy
- Strong roots

Ask: Has anyone ever noticed that where we live has a lot of blackberry bushes growing in natural areas? (or, raise your hand if you have seen blackberry bushes outdoors before)
Explain to students that you will be using the Himalayan blackberry as an example of an invasive plant, one that they have very likely noticed before if they've spent time outdoors. The Himalayan blackberry is a great example because it showcases many of the characteristics that invasive plants have in general.

4. STORY OF THE HIMALAYAN BLACKBERRY

Himalayan blackberry was introduced intentionally into North America, grows really fast, and takes over the areas where it grows. There is a native Oregon blackberry that does not grow fast, grows low to the forest floor in a vine, and produces very small berries.

Ask: Where do you think Himalayan blackberry comes from?
Based on the name you'd think Himalayan blackberry comes from the Himalayan mountains.

- **Do you know where the Himalayan mountains are? Can you name a famous peak in the Himalayan mountains? Mt. Everest is commonly known as a famous peak.**
- **Why is Mt. Everest famous? Do you know how high above sea level the summit of Mt. Everest is?** Mt. Everest stands at 29,029 feet.
- **Do you know how high the summit of the highest peak in Oregon is (Mt. Hood, also known by its indigenous name Wy'east)?** Mt. Hood stands at 11,250 feet. That's quite a difference - Mt. Everest is more than twice as high! On the map in the presentation, point out where Himalayan mountains are.

Tell the story: Even though this blackberry's common name is Himalayan, its origins are quite different. Most scientists agree the origin of Himalayan blackberry, who's scientific name is Rubus armeniacus, is actually in the Armenia area on the continent of Asia. This is quite a long distance from the Himalayan mountains. Rubus Armeniacus, the Himalayan or Armenian blackberry, was brought to America in 1885 as a cultivated crop by Luther Burbank. Burbank traded seeds with fellow collectors from around the world. In a package from India, a country close to the Himalayan mountains, he found seeds for a huge blackberry with an even bigger flavor. Burbank named it the Himalaya giant. And he found that this blackberry grew like nobody's business, but only in temperate areas, like the Pacific Coast. So, in 1894, he offered the berry in a special circular he sent buyers in mild climates. It was popular. Maybe he chose the name Himalaya giant because he got the seeds from a grower in India and he did not know the origins of the plant or he might have thought the name would make the plant sound exotic and more attractive to buyers. [1]

Ask: Based on the story of the Himalayan blackberry, do you think humans have a role to play in the distribution of invasive species? How so?
Review with the students the different ways that invasive plants can be introduced by humans:

- bringing plants to different ecosystems because they like them for their gardens/landscaping, or they make them money
- using plants to solve an environmental "problem" that they didn't fully understand
- accidentally spreading seeds in animal feed, on their vehicles or boots, or because they didn't realize they were non-native

1 Dornfeld, A, NPR, The Strange, Twisted Story Behind Seattle's Blackberries, Aug, 2016 https://www.npr.org/sections/the-salt/2016/08/29/491797791/the-strange-twisted-story-behind-seattles-blackberries

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5. HIMALAYAN BLACKBERRY AS AN EXAMPLE OF INVASIVE CHARACTERISTICS

Use the presentation to explain the different characteristics that invasive plants have, using the Himalayan blackberry as a local example.

- Invasives produce a lot of seeds.
  Ask: What is another way that invasive plants are able to spread so quickly?
  Invasive plant species often produce a lot of seeds. Have students think again about the Himalayan blackberry. Looking closely at the fruit, you can see many bubbles. These bubbles are called **drupelets** by botanists. Blackberries are aggregate fruit that have numerous drupelets; they are not what a botanist would call a true berry because of the way the fruit is formed. Each drupelet has one seed.
  - **How many bubbles or drupelets do you think there are in one fruit?**
    Some studies have found 25 to over 100 drupelets per fruit. That's a lot of seeds!
  - **How does producing a lot of seeds help a plant spread?**
    Seeds help it make a lot more plants. The more seeds, the higher the chance that the seeds germinate into new plants.
- Invasives are often tasty to animals.
  Ask: How does this characteristic help invasive plants spread?
  Animals eat the fruit, digest the nutrients, and then excrete the seed with the food waste. Animals also often travel various distances from the source, especially birds. The Himalayan blackberry is especially tasty to humans!
- Seeds can stay **dormant**, or viable and inactive. Seeds can hang out for a long time until the conditions are right and it can grow. Himalayan blackberry seeds can stay dormant for up to 7 years! That means a person can remove the entire plant, root ball and all, but still have Himalayan blackberry grow back from the seeds that have been dormant in the ground.
- Invasives grow as vine. Not all invasive plants grow as vines, but many do.
  Ask: Why do you think growing as a vine would benefit invasive plants?
  Vines help plants spread and physically take over other native plants. The vines can grow up and over other plants, blocking their ability to get sunlight or even water.
- Invasives have big, strong root systems.
  Ask: How does this help invasive plants?
  Strong roots like the one pictured in the presentation of the Himalayan blackberry makes it hard to remove the plant. Many people could be tricked into thinking the entire plant has been removed; however, if the root ball stays intact in the ground, then the plant will simply grow back.
- Invasives can often **clone** themselves.
  Ask: What does it mean to clone oneself?
  Cloning is to make a duplicate that is genetically identical. Cloning is a form of **propagation**, or plant reproduction, where the plant sends out a vine. Where the vine touches the soil, it produces roots and a new plant is generated that is genetically identical to the original. This type of spreading results in dense thickets and increases the difficulty of removal.
- Invasive species grow in **disturbed areas**.
  Ask: What is a disturbed area?
  A disturbed area is an area where native habitat (plants and animals) have been damaged or disrupted. This generally happens as a result of human activity, such as clearing land for roas, forest fires or field burns, timber clear cuts for wood, and railroad and power transmission lines right of way. Disturbed areas can also be natural, such as avalanche chute and landslide zones. Disturbed areas provide more open space for fast growing invasive species to flourish. Native plants might take longer and the invasives grow faster and block out the native plants.

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6. IMPACTS OF INVASIVE PLANTS

Use the images on slide 22 of the presentation to compare and contrast two ecosystems. Tell students that the picture on the top was taken in the Opal Creek area in the Oregon Cascades mountain range. It contains forested lands that have never been logged, with 500 to 1,000 year old trees. Tell students that the picture on the bottom is at a creek in Southwest Portland, where Himalayan blackberry has taken over after the area was logged.

Ask: What do we see as differences between these two ecosystems? (Additional guiding questions as needed: looking at the color of the water - what do you see? What about the number of different plants you see?)
On the top, in the Opal Creek area, the water is clear. Clear water often indicates clean water. The roots of native plants help hold soil along the banks of the creek, so less soil and other sediment washes into the water. Native plants can also help absorb pollutants and thus clean the water. On the bottom, the water is muckier, muddier, and dirtier. There are also far fewer different kinds of plants.

Ask: Do you think the area with invasive plants can support as many different species of native animals as an area with native plants?
Using the following slide showing many different animal species, explain that a greater diversity of native plant species helps support a greater diversity of animal species. Animals all have different **habitat** and food requirements, so the greater the diversity of plants, the greater the ability of the ecosystem to meet those needs.

7. SOLVE A PLANT MYSTERY

Divide students into groups of 2 to 4 participants. Hand each group one envelope with plant photos and rainbow-colored clue cards (5 clue cards for each plant), and a copy of the Solve a Plant Mystery worksheet.

Explain that inside each envelope are clues that will help students determine whether or not the plant they are investigating is a native or invasive plant. Using the worksheet, students will "score" their plant based on its characteristics: the value the plant has to wildlife, how the plant spreads, and where the plant grows. Tell students that a score of 10 or higher means the plant is a native plant. A score of 9 or less means the plant is invasive.

Explain that the clue cards that the students will be receiving are color coordinated:

- Red clue cards help with the value to wildlife score.
- Orange clue cards help with how the plant spreads.
- Yellow clue cards help with how the plant grows (speed, etc.).
- Green clue cards help with where the plant grows.
- Blue clue cards give more information about the plant.

Review how the worksheet works as a class by using Himalayan blackberry as an example:

1. On the worksheet, fill in name of plant: Himalayan blackberry
2. The first characteristic is how valuable the plant is to wildlife. Animals eat its fruit and seeds.

   Ask: How else might animals use a plant?
   Animals might use a plant for nesting, roosting, or hiding.

   Ask: Do you think Himalayan blackberry would make a good nesting or roosting spot?
   No, the thorns and thicket would make it very hard for birds to fly through a thicket. It would be hard for many wild animals to browse on the plant other than nibbling on the edges since the thickets are so dense. So, Himalayan blackberry may only be good for its fruit. In fact, Himalayan blackberry can block animals from access to streams or paths and take over areas where native vegetation might have grown. Prompt students to use their fingers to show how valuable the Himalayan blackberry is to animals: one finger for very low, five fingers for very high and anything in between. Give it a 2 since it does bear edible fruit, but it also has negative impacts.

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3. The second characteristic is the speed that the plant spreads. The various mechanisms the plant uses to spread gives clues as to how fast it can spread.

   Ask: Of the listed propagating mechanisms on the worksheet, which would you circle?
   Circle the following spreading mechanisms: animals eat Himalayan blackberry seeds, new plants grow from roots, produce millions of seeds, able to clone, seeds remain dormant, and plant flowers after 2 years (for each cane). (The Himalayan blackberry does not: have sticky seeds and seeds shot from the plant.) Prompt students to use their fingers to show fast the Himalayan blackberry spreads: one finger for very low, five fingers for very high and anything in between. The Himalayan Blackberry has many propagation mechanisms and thus spreads very fast; in this case a higher speed of propagation results in a lower score of 1.

4. The third and final characteristic is where the plant grows. The Himalayan Blackberry grows in several different places and is not found only in the western US. Give it a score of one.

5. Total the points. Fill in the boxes to get the following equation: 2+1+1 = 4.

   Ask: Is Himalayan blackberry native or invasive?
   Remind students that a score of 10 or more points means it is a native plant. The Himalayan blackberry scored a 4, so it is an invasive plant. The plant mystery is solved!

6. If there's time, students may sketch their plant on the back of the worksheet.

Ask for any clarifying questions on the worksheet, pass out the envelopes, and let the activity begin!

If a group of students finishes early, hand them another envelope and new worksheet to solve another plant mystery.

CLOSING CIRCLE

Choose to ask the following questions to facilitate a group discussion, or have students write individual reflections to the prompts in journals.

- What characteristics were the most helpful in comparing and contrasting native, non-native, and invasive plants?
- What are some ways that humans provide a pathway to spread invasive plants?
- What are some other ways that humans alter ecosystems, either for better or worse?
- What are some things you can do to protect a nearby ecosystem from invasive plants?

ASSESSMENT OPTIONS

The plant mystery worksheet the students complete during the lesson can be used for the assessment.

FURTHER READING

Invasive Species, U.S.D.A. Forest Service
https://www.fs.fed.us/pnw/invasives/index.shtml

Invasive Species Management, City of Portland, Environmental Services
https://www.portlandoregon.gov/bes/45696

Invasive Plants Strategy Report 2008, City of Portland Environmental Services
https://www.portlandoregon.gov/bes/article/332727

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Name: _____

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SOLVE A PLANT MYSTERY!
NATIVE OR INVASIVE?

Please work with a partner to examine the contents of your envelope.
Use the rainbow cards to determine if your plant is native (to Oregon) or invasive.

NAME OF PLANT: _____

HOW DO ANIMALS USE THIS PLANT? _____

VALUABLE TO WILDLIFE *(circle one)*	1 not really	2	3 somewhat	4	5 valuable

HOW DOES THIS PLANT SPREAD? *(circle all that apply)*

animals eat seeds	produces millions of seeds	plant flowers after 2 yrs
new plants grow from roots	seeds shot from plant	seeds can remain dormant
sticky seeds	able to clone itself	

SPEED THAT PLANT SPREADS *(circle one)*	1 fast	2	3 medium	4	5 slow

WHERE DOES THIS PLANT GROW? _____

FOUND ONLY IN THE WESTERN U.S. *(circle one)*	1 no	2	3 maybe	4	5 yes

TOTAL POINTS *(add your answers from the boxes above)*: ☐ + ☐ + ☐ = ◯

IF YOU SCORE 10 OR MORE POINTS YOUR PLANT IS NATIVE! *My plant is:* NATIVE *or* INVASIVE
(circle one)

If you have time, please sketch your plant on the back of this paper

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MATH LESSON

INVASIVE PROPAGATION

SUMMARY

In this lesson, students will learn about how invasive plants spread by studying the Himalayan blackberry, a widespread invasive plant found throughout the Pacific Northwest. Using this plant as a case study, they will develop mathematical expressions to estimate seed production and model seed distribution. Then, students will practice their graphing skills in order to communicate their results.

OBJECTIVES

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

- Use equations to calculate how many seeds a Himalayan blackberry plant produces
- Use equations to calculate how many Himalayan blackberry seeds are distributed
- Create a graph to communicate results

GUIDING QUESTIONS

1. How many seeds does the Himalayan blackberry plant generate?

2. How broadly do the seeds distribute?

LESSON-AT-A-GLANCE

GRADE LEVEL 5

INTEGRATED LEARNING FOCUS Math

LESSON DURATION 45 - 60 minutes

CLASS SIZE Any

MATERIALS

- Invasive Propagation Model worksheets, one for each student
- Pencils

MATH

- 5.NF Number and Operations – Fractions.
- 5.OA Operations and Algebraic Thinking.
- 5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
- 5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
- 5.MD Represent and interpret data.

ACADEMIC VOCABULARY

propagation	**fraction**
clone	**percentage**
dormant	**scale**
drupelet	**bar graph**

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ACTIVITY PROCEDURE

1. PRESENT EXAMPLE

Explain to students that they will be modeling seed production and distribution of the Himalayan blackberry plant, an invasive plant commonly found throughout North America including the Pacific Northwest. Seed production and distribution are key to **propagation**, or plant reproduction. Tell students they will be using data collected by ecologists in their equations. Explain that before the students work on the Himalayan blackberry, the class will first be going through the example of an apple tree together.

2. APPLE TREE SEED PRODUCTION

Ask: How many seeds do you think are inside one apple?
Encourage students to make educated guesses. Share that an apple typically has 5 seed pockets with 1 or 2 seeds in each pocket, depending on the health of the tree.

Ask: Let's assume there are two seeds per pocket. How many seeds are inside one apple?
There are 10 seeds per apple. Write the following equation on the board:

5 seed pockets x 2 seeds per pocket = 10 seeds per apple

Tell students one apple tree bears many fruit. Explain that in this example, the apple tree has 10 branches. Five branches are 10 feet long and 5 branches are 6 feet long. Tell students that in order to calculate the total amount of seeds, they first need to calculate how many total apples are on the tree. Write the following equations on the board:

(5 branches x 10 feet) + (5 branches x 6 feet) = 50 feet + 30 feet = 80 feet of branches

Ask: If each branch bears fruit (apples) at 5 apples per foot of branch, what is the equation for the total amount of apples on the tree?
Write the following equation on the board:

80 feet of branches x 5 apples/foot of branch = 400 apples

Ask: We know that each apple has 10 seeds. How many total seeds are in all of the apples on the apple tree?
There are 4,000 seeds. Write the following equation on the board:

400 apples x 10 seeds per apple = 4,000 seeds

3. INTRODUCE HIMALAYAN BLACKBERRY

Tell students they will be applying very similar equations to the Himalayan blackberry plant, which is a common invasive plant in Oregon. Invite students to share whether they have seen this plant growing in a yard, park, or outdoors in a wild place before.

Ask: What do you think makes the Himalayan blackberry a very successful invasive plant?
Encourage students to consider the different traits that they learned about in the science lesson. Explain that the Himalayan blackberry is excellent at reproducing, because the seeds can stay **dormant**, or alive but not actively growing, in soil for years and in addition to dispersing its seeds through animals it can also use **clones**. A plant clones itself by sending out branches that are able to go back into the soil and form new roots and a new plant.

4. REVIEW HIMALAYAN BLACKBERRY WORKSHEETS

Pass out the Invasive Propagation Model worksheets for the Himalayan blackberry. Before students begin working, have them read through the worksheets. Tell students there are a few key terms to review before they begin working. Begin by reviewing that a **drupelet** is similar to the seed pockets of the apple, but in a berry, **drupelets** make up the fleshy, bumpy part all around the seeds.

Review the different math terms on the worksheet and encourage students to use the worksheet as a reference.

Ask: What is a fraction?
Encourage A **fraction** represents a part of a whole.

Ask: What is a percentage?
A **percentage** is a number expressed as a **fraction** of 100. For example, if 25% of seeds fall to the ground around the plant, then that means that 25 out of 100 seeds fall to the ground.

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Ask: What is a bar graph?
A **bar graph** presents data in different categories with rectangular bars that represent the value in each category. In a **bar graph**, one axis will always be the different categories being compared and the other axis will be the numerical value in each category.

Ask: What is a scale?
A scale is the ratio of a distance on a map or in this case, worksheet, to the real distance on the ground. For example, if the greatest distance Himalayan seeds travel is 3 miles, then the entire length of the arrow shown on the worksheet will represent 3 miles, where ⅓ of the length of the arrow will represent 1 mile.

Ask if there are any questions about the worksheets and, once they are resolved, have the students begin working either individually or in pairs chosen by you.

CLOSING CIRCLE

- How do you think the Himalayan blackberry seed production helps it to propagate?
- What other mechanisms does the Himalayan blackberry use to propagate? How might we add those methods (cloning) to our model?

ASSESSMENT OPTIONS

Worksheets, bar graph, and scale to be used as assessment tools.

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Name:

Invasive Propagation Model Worksheet

Using this worksheet, you will develop a propagation model using facts about the Himalayan blackberry plant. To do this, you will calculate the number of seeds a Himalayan blackberry plant will generate in a year and draw a bar graph. Then, you'll calculate how far the seeds will be distributed and draw a diagram.

Part I

Facts about the Himalayan blackberry:

- One (1) seed per drupelet
- 75 drupelets per berry
- 8 canes (vines) per entire plant
- Half the canes are new growth and half the canes are second year growth
- Only second year canes bear fruit
- Canes on average are 20 feet long
- 10 berries per foot of cane

1. How many seeds does each berry have? Show an equation to calculate seeds per berry without evaluating:

2. How many berries does each cane have? Show an equation for berries per cane without evaluating:

3. How many seeds does each entire plant have? Show an equation for the number of seeds per plant without evaluating:

4. Evaluate the equation to solve how many seeds an entire plant has:

5. How many seeds will the plant generate if only half of each second-year cane produces fruit?

6. How many seeds will the plant produce if there are 10 canes rather than 8?

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Part II

Facts about the Himalayan blackberry seeds:

- 1 seed per drupelet
- 75 drupelets per berry
- 8 canes (vines) per plant
- Half the canes are new growth and half the canes are second year growth
- Only second year canes bear fruit
- Canes on average are 20 feet long; only half the length productive
- 10 berries per foot of cane

Facts about how seeds are distributed:

- 25% (25/100) fall to the ground around the plant by gravity
- 40% (40/100) are eaten by songbirds, who travel ¼ of a mile
- 20% (20/100) are eaten by elk, who travel 3 miles
- 10% (10/100) are eaten by coyotes, who travel 1 mile
- 5% (5/100) are eaten by rabbits who live in the blackberry thicket

1. How many seeds does this plant generate in a year (show equation and result)?

2. How many seeds are:

   distributed by song birds? _____

   distributed by elk? _____

   distributed by coyotes? _____

   distributed by rabbits? _____

   distributed by gravity? _____

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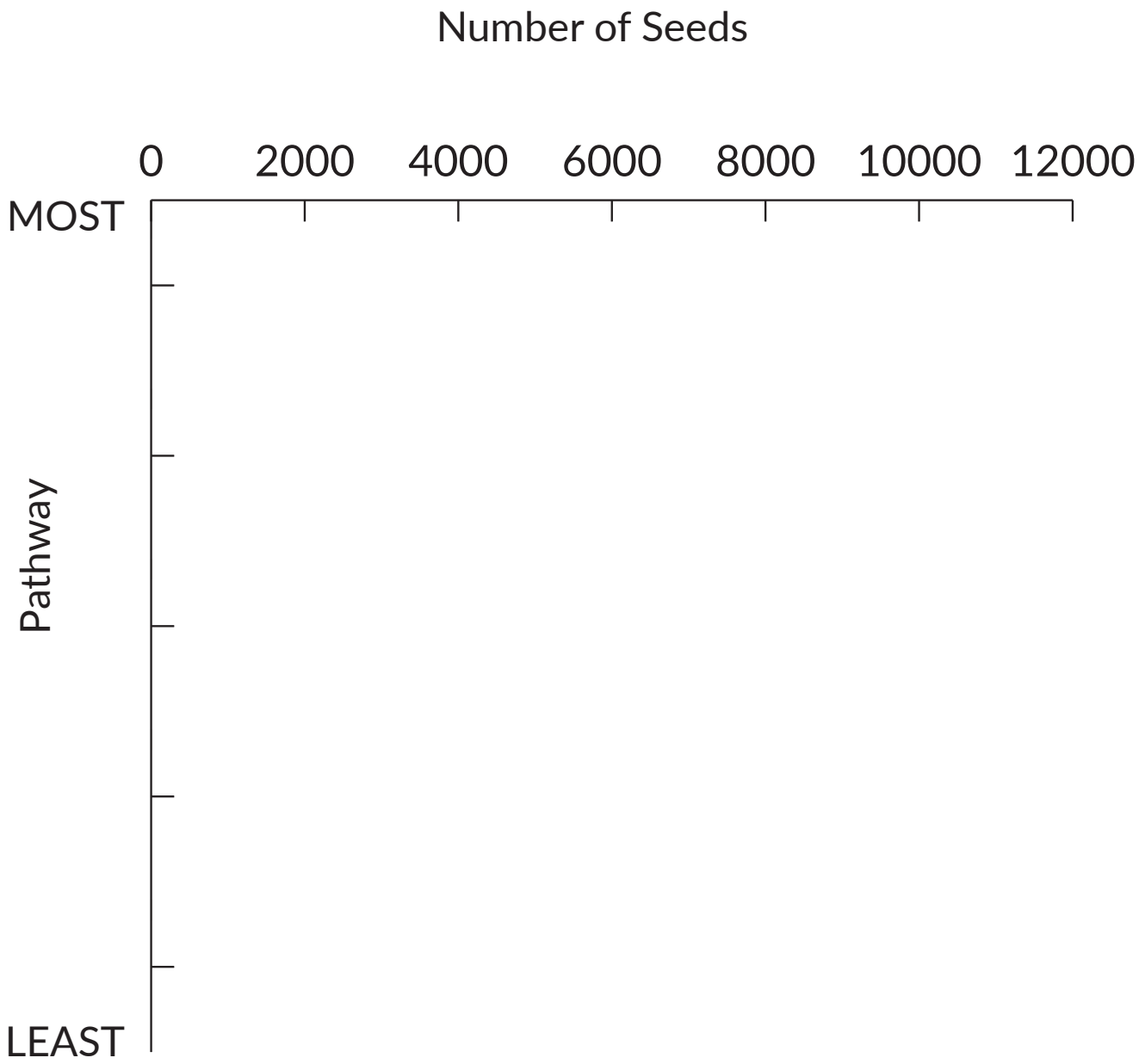
Part III

Draw a bar graph to represent seed distribution by pathway



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Part IV

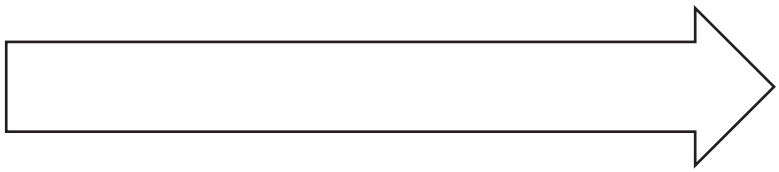
Draw a diagram on the arrow below, showing where the seeds end up (in feet) away from the plant.

Remember:

- 25% (25/100) fall to the ground around the plant by gravity
- 40% (40/100) eaten by songbirds + travel ¼ mile
- 20% (20/100) eaten by elk + travel 3 miles
- 10% (10/100) eaten by coyotes + travel 1 mile
- 5% (5/100) eaten by rabbits who live in the blackberry thicket

Mark the scale along the path, where the seeds end up, and the number of seeds at each spot.

Distance from the plant (ft)



Number of Seeds

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ANSWER KEY

Invasive Propagation Model Worksheet

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Facts about the Himalayan blackberry:

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- 75 drupelets per berry
- 8 canes (vines) per entire plant
- Half the canes are new growth and half the canes are second year growth
- Only second year canes bear fruit
- Canes on average are 20 feet long
- 10 berries per foot of cane

1. How many seeds does each berry have? Show an equation to calculate seeds per berry without evaluating: 1 x 75 seeds per berry

2. How many berries does each cane have? Show an equation for berries per cane without evaluating: (20 x 10) = berries per second year cane

3. How many seeds does each entire plant have? Show an equation for the number of seeds per plant without evaluating: (1 x 75) x (8 x ½) x (20 x 10) = Seeds/berry x 2nd Yr Canes x berries/cane = seeds

4. Evaluate the equation to solve how many seeds an entire plant has: (1 x 75) x (8 x ½) x 20 x 10 = 60,000

5. How many seeds will the plant generate if only half of each second-year cane produces fruit? (1 x 75) x (8 x ½) x (20 x ½) x 10 = 30,000

6. How many seeds will the plant produce if there are 10 canes rather than 8? (1 x 75) x (10 x ½) x (20 x ½) x 10 = 37,500

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Part II

ANSWER KEY

Facts about the Himalayan blackberry seeds:

- 1 seed per drupelet
- 75 drupelets per berry
- 8 canes (vines) per plant
- Half the canes are new growth and half the canes are second year growth
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- 20% (20/100) are eaten by elk, who travel 3 miles
- 10% (10/100) are eaten by coyotes, who travel 1 mile
- 5% (5/100) are eaten by rabbits who live in the blackberry thicket

1. How many seeds does this plant generate in a year (show equation and result)?
(1 x 75) x (8 x ½) x (20 x ½) x 10 = 30,000

2. How many seeds are:

distributed by song birds? 30,000 x 0.4 = 12,000

distributed by elk? 30,000 x 0.2 = 6,000

distributed by coyotes? 30,000 x 0.1 = 3,000

distributed by rabbits? 30,000 x 0.05 = 1,500

distributed by gravity? 30,000 x 0.25 = 7,500

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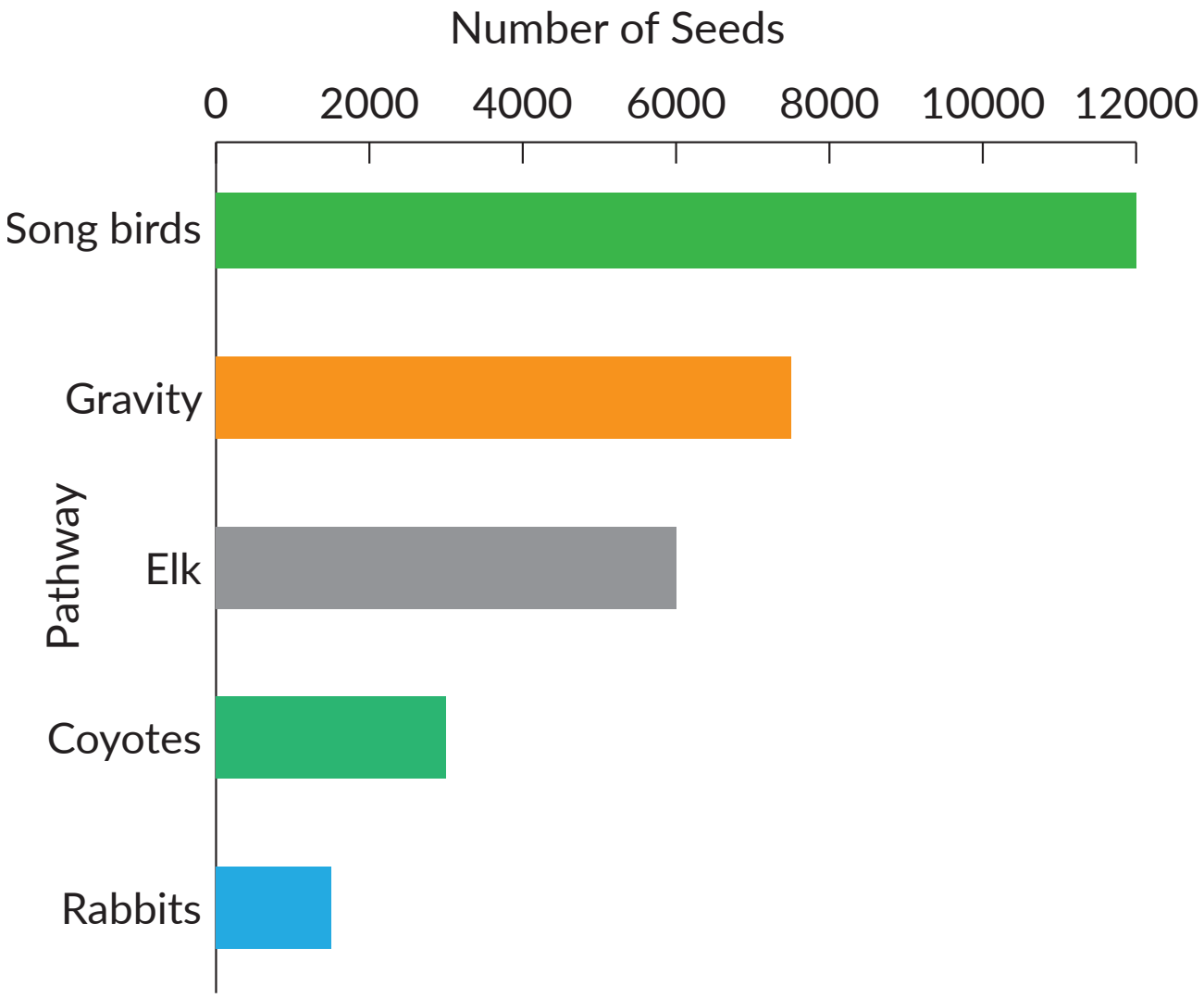
Part III

ANSWER KEY

Draw a bar graph to represent seed distribution by pathway



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Part IV

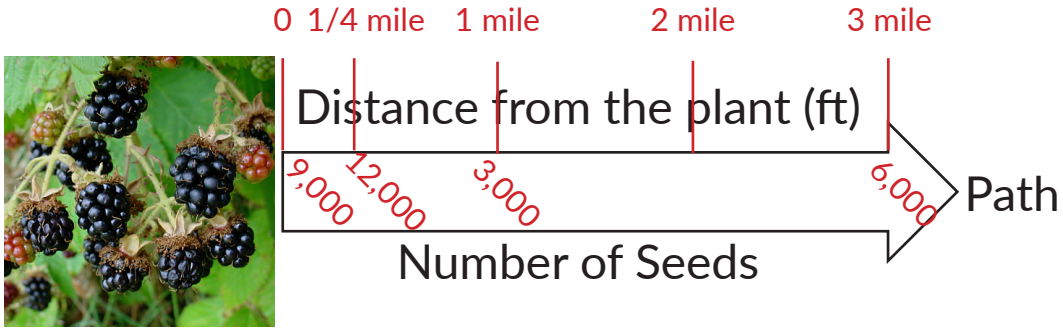
ANSWER KEY

Draw a diagram on the arrow below, showing where the seeds end up (in feet) away from the plant.

Remember:

- 25% (25/100) fall to the ground around the plant by gravity
- 40% (40/100) eaten by songbirds + travel ¼ mile
- 20% (20/100) eaten by elk + travel 3 miles
- 10% (10/100) eaten by coyotes + travel 1 mile
- 5% (5/100) eaten by rabbits who live in the blackberry thicket

Mark the scale along the path, where the seeds end up, and the number of seeds at each spot.



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ELA LESSON

PLANT PASSAGES

SUMMARY

In this lesson, students use their knowledge of the distinguishing characteristics of native and invasive plants in the Pacific Northwest to write two types of passages: informative-explanatory and narrative. Through comparing and contrasting native plants with invasive plants, students will exercise critical thinking skills while practicing writing passages for different purposes.

OBJECTIVES

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

- Explain differences between native and non-native plants
- Communicate benefits to native plants and negative impacts of invasive plants
- Use relevant academic vocabulary appropriately

GUIDING QUESTIONS

1. How do you know if a plant is native or invasive to the Pacific Northwest?
2. How can we take this knowledge and use it to convey information clearly?

LESSON-AT-A-GLANCE

GRADE LEVEL 5

INTEGRATED LEARNING FOCUS ELA

LESSON DURATION 45-60 minutes, may be broken into two sessions

CLASS SIZE Any

MATERIALS

- 16 envelopes containing Native or Invasive? activity cards
- Vocabulary cards
- Journals or paper
- Pencils

ELA

- 5.W.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
- 5.W.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
- 5.W.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
- 5.L.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.

ACADEMIC VOCABULARY

informative-explanatory text
narrative text
exposition
complication
resolution
point of view

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ACTIVITY PROCEDURE

1. REVIEW THE SCIENCE OF NATIVE AND INVASIVE PLANTS

Review basic native, non-native, and invasive plant concepts, including the value of native species and the impacts of invasives. Begin by asking what students recall from the science lesson, using the vocabulary cards if needed.

Ask: What are examples of characteristics of native plants; what makes native plants beneficial to an ecosystem? What are examples of characteristics of invasive plants; what makes invasive plants harmful to an ecosystem?
Native plant species often provide vital habitat and food for native animal species. Invasive plants use their ability to produce many seeds and propagate very quickly or spread via cloning to push out the beneficial native species. In other words, invasive plants may "take over" an entire area.

2. WHAT IS INFORMATIVE-EXPLANATORY TEXT?

Explain that the primary purpose of **informative-explanatory text** is to increase knowledge. When writing an informative-explanatory text, the writer answers questions of why or how. Informative writing needs to be clear, straightforward, and concise.

For example, an informative-explanatory piece of writing may be the answer to a question such as "why does water look blue?", or "how does vitamin A help my eyesight?" Explain to students that the essay would use facts, obtained through research, to answer the question.

Ask: What is an informative-explanatory text that you have read recently? What did you learn from it?
Brainstorm with students different examples of informative-explanatory texts they have recently read, what information was being conveyed in those texts, and what characteristics of the text made it effective. Some ideas may be a scientific paper or a well-researched news article.

3. TIME TO WRITE: INFORMATIVE-EXPLANATORY TEXT

Hand out one envelope containing activity cards to students in groups of two to four. Students will be writing their passages individually, but may be sharing an envelope of materials with their partner or small group. Instruct students to take out paper or journals, and something to write with.

Allow small groups to open their envelope to discover which plant they will be writing about. Have students read the activity cards for the plant and recall if the plant is a native or invasive plant.

Give time for students to individually draft an informative-explanatory text that answers the question, *"How do you know if the [name of plant] is native or invasive to the Pacific Northwest?"* Remind the students that within the text, students should include as many relevant academic vocabulary words as possible and may use the activity cards to help them formulate their passage.

4. SHARE AND RESPOND: INFORMATIVE-EXPLANATORY TEXT

Instruct students to take turns sharing their writing with their partner or in their small group. Give the speaker time to read their passage, then have listeners ask follow-up questions (this is called pair-share).

Encourage listeners to ask follow-up questions such as "did the speaker use all the vocabulary words properly?" and "did the speaker explain the story well and did it make sense?" Have the speaker and listener(s) swap roles. Ask students to write a second draft incorporating the feedback and comments from their partner(s).

When students are finished with their passages, invite them to illustrate their informative-explanatory writing with diagrams or pictures that will help convey information about their plant.

Note: You may choose to break this lesson into two writing sessions. Depending on how much time you have, students may write their informative-explanatory passages in one session and their narrative passages in a second.

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5. WHAT IS NARRATIVE TEXT?

Explain that a **narrative text** is like a story. All narrative texts have the same three elements: the **exposition**, or background information; the **complication**, or the events or central obstacle in the narrative; and **resolution**, the story's end. Tell students that the main purpose of narrative text is to entertain the reader, although if the reader learns something new along the way, it's even better!

Ask: What is a narrative text that you have read recently? What is effective at entertaining you as the reader?
Brainstorm with students different examples of narrative texts they have recently read, the main problem of the story, and what characteristics of the text made it entertaining. Some ideas may be a fictional book, essay, or even a comic strip!

6. TIME TO WRITE: NARRATIVE TEXT

Hand out one envelope containing activity cards to students in groups of two to four. Students will be writing their stories individually, but may be sharing an envelope of materials with their partner or small group. Instruct students to take out paper or journals, and something to write with.

Allow small groups to open their envelope to discover which plant they will be writing about. Have students read the activity cards for the plant and recall if the plant is a native or invasive plant.

Instruct students to write a creative story where the student takes a **point of view** as a part of the ecosystem. Students could write as a human observing the environment, a native plant in the environment, the invasive plant introduced into the environment, or as an animal in the environment.

Encourage students to add illustrations to their stories when they have finished writing.

7. SHARE AND RESPOND: NARRATIVE TEXT

Similar to the share and respond procedure for the informative-explanatory texts, use pair-share for students to get feedback on their first drafts.

CLOSING CIRCLE

- How did it feel to take the perspective of an organism in the ecosystem?
- How did that feel different than writing an informative-explanatory passage?
- What might be the benefit to writing in one way versus another about the same topic?

ASSESSMENT OPTIONS

The informative-explanatory and narrative texts are to be used for the assessment.

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ART/SS LESSON

PLANT PSAS

SUMMARY

In this lesson, students demonstrate ecological knowledge and personal agency through persuasive writing, visual art, and public speaking. Students use their understanding of invasive plants to build a public awareness campaign, influencing perceptions and encouraging actions to preserve native habitats.

OBJECTIVES

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

- Communicate a personal sense of agency in the protection of healthy ecosystems
- Develop a persuasive public awareness campaign around invasive species

GUIDING QUESTION

1. How do public service announcements (PSAs) build community awareness and encourage actions to protect or restore the health of the environment?

LESSON-AT-A-GLANCE

GRADE LEVEL 5
INTEGRATED LEARNING FOCUS ART, SOCIAL SCIENCE

LESSON DURATION 45 minutes
CLASS SIZE Any

MATERIALS:

- Presentation: Plant PSAs
- Construction paper
- White paper
- Pencils
- Colored pencils
- Black markers
- Scissors
- Glue sticks

ART

- VA.1.CR1.5 Creating-Generate and conceptualize artistic ideas and work

1. Generate ideas for an artwork based on cultural influences or social issues.
2. Use formal and conceptual vocabularies of art and design to describe a work of art (e.g. elements & principles of design).
3. Constructively design and manipulate materials, organizational and compositional elements to make meaning in a work of art.

SOCIAL SCIENCE

- Geography 5.13 Describe how natural and human-made events in one place affect people in other places.
- Social Science Analysis 5.28 Propose a response or solution to an issue or problem, utilizing research, to support the position.

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ACADEMIC VOCABULARY

public service announcement
commercial
objective
target audience
persuasive writing
point of view

ACTIVITY PROCEDURE

1. REVIEW THE SCIENCE OF NATIVE AND INVASIVE PLANTS

Review basic native, non-native, and invasive plant concepts, including the value of native species and the impacts of invasives. Begin by asking what students recall from the science lesson, using the vocabulary cards if needed.

Ask: What are examples of characteristics of native plants; what makes native plants beneficial to an ecosystem? What are examples of characteristics of invasive plants; what makes invasive plants harmful to an ecosystem?
Native plant species often provide vital habitat and food for native animal species. Invasive plants use their ability to produce many seeds and propagate very quickly or spread via cloning to push out the beneficial native species. In other words, invasive plants may "take over" an entire area.

2. INTRODUCE PUBLIC SERVICE ANNOUNCEMENTS

Open the presentation *Plant PSAs* and use it to guide the following lesson.

Explain that **public service announcements** (PSAs) are messages delivered in the public interest, which can be on television, radio, newspaper, or other media – like posters in the school. PSAs are messages that benefit the public by raising awareness of an important issue, influencing attitudes, and stimulating actions for the benefit of the public. They differ from **commercial** advertising. The purpose of commercials is to market a product or service, build awareness of the product or service, and create interest in purchase of the product or service. However, PSAs and commercials are both similar in the way they use persuasive writing, which you will discuss later in this lesson.

Ask: Have you seen any PSAs?
Prompt students with examples, if necessary, such as wearing bike helmets, washing hands, smoking, preventing forest fires, etc.

Share examples of PSAs, starting with the posters in the presentation of Smokey Bear.

Ask: What messages are these posters sending? How are they different? What makes them effective, or not, at capturing your attention?
Explain that these PSAs are attempting to grab your attention in a clear, concise manner in order to convince them to take actions to prevent human caused wildfires. The posters use very few words and when they do, they list the phrases in a way that is easy for people to recall later. Giving the campaign a mascot also makes it instantly recognizable.

Share with the students the best practices for a PSA:

1. Start with a goal, or **objective**: what do you want to accomplish or what is the specific action you want to encourage?
2. Select a **target audience**: who do you want to influence? Match the language in the PSA with the selected audience.
3. Attract the attention of the target audience.
4. Deliver one core message.
5. Relate the message to the audience's lives.
6. Clear call to action delivered in a way that motivates the audience to act.

Finally, encourage students to think about how they feel when they view an example PSA, such as the dog waste billboard in the presentation. Some PSAs use humor, or uplifting language, while others may use words or images to make us feel sad or even fearful.

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3. CREATE A PSA

Explain to students they will develop their own public service announcement related to native and invasive plants. Students may work individually or in small groups of two or three. Encourage students to develop a plan including target audience and objective. They can sketch, outline, or storyboard their work before doing the detailed final product.

Encourage students to answer the following questions when planning their PSA:

- What is an invasive plant species that you have studied that is causing harm to the environment?
- What action do you want to encourage?
- Who do you want to take that action?
- What evidence do you need to share to motivate the action?
- What form should you make the PSA (newspaper advertisement, poster for school hallway, newsletter mailed to homes, video, etc.)?

Pass out art supplies and allow time for students to draft and complete their PSA. Once they are complete, invite students to present their PSA to their classmates, post the PSAs on the wall, and take pictures and share via a digital classroom tool, if applicable.

4. SUPPLEMENT WITH PERSUASIVE/OPINION WRITING

Ask: The PSA does its job of raising awareness, but what if someone needs more information? If time allows, students can write a **persuasive/opinion** piece to take the next step in building the case for action. Students should follow best practices for this type of text by supporting a **point of view** with reasons and information. In addition, students should:

- Introduce their topic clearly,
- State an opinion,
- Create an organizational structure in which ideas are logically grouped to support the writer's purpose,
- Provide logically ordered reasons that are supported by facts and details,
- Link opinion and reasons using words, phrases, and clauses (e.g., consequently, specifically), and
- Provide a concluding statement or section related to the opinion presented.

Alternatively, students may develop letters to government officials to advance desired outcomes. Suggestions include: requesting support to establish native plant rain or pollinator gardens on the school campus or encouraging support for invasive species control to protect native habitats. Students should follow the same guidelines for their letter as if they were writing a persuasive or opinion piece.

CLOSING CIRCLE

- How do public service announcements play a role in educating and encouraging action?
- What makes a good public service announcement?
- What role do people play in invasive plant introduction?
- What role do we play in protecting our environment from invasive species?

ASSESSMENT OPTIONS

Use students' public service announcements and persuasive writing pieces for assessment of learning.

FURTHER READING

How to write a public service announcement: http://www.kab.net/kabadditionalinformation/seminars/d74242.aspx

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