TEACHER OVERVIEW

Invasive Plants

9th—12th Grade

Nature Vision Student Packet

The materials contained within have been created by Nature Vision, an environmental education nonprofit organization that brings programming to schools and local greenspaces for over 70,000 PreK-12th grade students each year in King and Snohomish Counties. This work from home curriculum materials packet is designed to foster an understanding of invasive plants. Packets can be completed either independently or with the help of an adult caregiver. Each day of the week offers materials building on previous days learning, offering a variety of activities including art, writing, and field exploration.

These materials are provided to you by King County Noxious Weed Control Program. The program works throughout King County to prevent and reduce the economic, environmental, and social impacts of noxious weeds in King County, Washington. Their focus is to provide education and technical assistance to landowners and public agencies to help everyone find the best control options for noxious weeds on each site and to reduce the overall impact of noxious weeds throughout the county. Learn more by visiting: https://kingcounty.gov/weeds.

This unit supports NGSS Performance Expectations across various disciplines, as well as supporting K-12 Integrated Environmental and Sustainability Standards. These are listed at the bottom of this page. Teachers will be supplied with PDF formats of materials to be emailed to families, or teachers may print and send to students to complete at home.

In this packet, students will learn about the differences between native, introduced, and invasive plants. They will learn why some invasive plants are categorized as noxious weeds, and the harm these species can do to the environment if they are allowed to spread. Students will study noxious weeds found in King County specifically, before exploring the environmental, economic, and agricultural impacts these plants have on our local communities. With this in mind, students learn about different methods of controlling noxious weeds, then create a plan for how they can do their part to address the issue of noxious weeds in their community.

If you have any further questions or concerns regarding this packet, please email our Office Coordinator at info@naturevision.org.

Grades 9-12
Supports NGSS Performance Expectations: HS-LS2-6, HS-LS2-7, HS-ESS3-4, LS2.C, LS4.D, ETS1.B.

Grades 9-12
Day 1 - Invasive Plants and Noxious Weeds
Day 2 - Economic, Agricultural, and Ecological Impacts
Day 3 - Identification and Research
Day 4 - Prevention and Best Management Practices
Day 5 - Plan a Solution

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PARENT/CAREGIVER OVERVIEW

Invasive Plants

9th-12th Grade

Welcome to Nature Vision's student packet for home use. Nature Vision is an environmental education nonprofit organization that brings programming to schools and local greenspaces for over 70,000 PreK-12th grade students each year in King and Snohomish Counties. We are excited to be offering this version of our programming directly to students at home!

This packet is designed to be completed over the course of one week, with each day focusing on a different aspect of environmental science and stewardship. The majority of these materials can be completed independently, but we thought it would be important to provide background information for any adults who may be helping to complete or answer questions. We've included the basic learning objectives for each day along with some vocabulary.

These materials are provided to you by King County Noxious Weed Control Program. The program works throughout King County to prevent and reduce the economic, environmental and social impacts of noxious weeds in King County, Washington. Their focus is to provide education and technical assistance to landowners and public agencies to help everyone find the best control options for noxious weeds on each site and to reduce the overall impact of noxious weeds throughout the county. Learn more by visiting: https://www.kingcounty.gov/weeds.

Challenge yourself to post all the things you are doing with your friends and family to help control the spread of noxious weeds! Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!

Please contact info@naturevision.org with any questions or concerns
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NOTE: Students may require support in reading directions and/or completing some tasks. While many activities in this packet are creatively oriented and open ended, you may consult the answer key located at the back of the packet for additional assistance or guidance.

Unless otherwise noted, images courtesy of King County Noxious Weed Control Program

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PARENT/CAREGIVER OVERVIEW: DAY 1

Invasive Plants and Noxious Weeds

Background Information: Native plants have been living in an area for a very long time and are adapted to live there specifically. In contrast, introduced species are plants or animals which were brought to a place by humans. Introduced plants may travel from place to place as seeds stuck to people's clothing or hidden in goods shipped across long distances. Some introduced plants are transported knowingly to be grown in gardens. When an introduced plant has negative impacts on local flora and fauna it is called an invasive plant. Some invasive plants have such an extreme negative impact that they are considered noxious weeds and are slated for control by state and county governments.

Learning Objectives: Students will be able to describe the difference between native, introduced and invasive plants, and what makes a plant a noxious weed. Students will understand the threat posed by noxious weeds in their own community. Students will explain the impact noxious weeds can have on ecosystems.

Main Activity: Map Analysis

- ***Overview****:* Students will examine maps of King County and make observations about the distribution of different noxious weeds throughout the county
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weeds Abroad

- ***Overview****:* Students read about how a plant native to western America became a noxious weed in Europe
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Prevention is the Best Medicine

- ***Overview****:* Students will look at images and determine how to better do these activities without spreading noxious weeds
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weed Stewardship Challenge

- ***Overview****:* Students complete a daily stewardship challenge related to noxious weeds
- ***Parent/Caregiver Tasks****:* If needed, help the student share their work on social media

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PARENT/CAREGIVER OVERVIEW: DAY 2

Economic, Agricultural, and Ecological Impacts

Background Information: Invasive species can damage a region's ecology, and also a region's economy and agricultural viability. Invasive plants can spread through ecosystems, choking out native plants, and reducing the diversity of plants present. Reduced diversity negatively affects the overall health of an ecosystem by reducing variation of potential food for herbivores. Invasive species can also pose a threat to agricultural interests, as noxious weeds can crowd out crops and make animals sick. The same effects that harm agriculture also harm wild deer and elk populations, which can in turn reduce recreational opportunities. Logging, fishing, and boating are all also affected by invasive species, such that economic damage owing to invasive species in Washington State approaches $500 million annually.

Learning Objectives: Students will use evidence to demonstrate the economic, agricultural, and ecological impacts invasive species can have in Washington State.

Main Activity: Ecosystem Impacts

- ***Overview****:* Students will read an excerpt of a scientific journal article and draw conclusions about the effects of human actions on species survival
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Economic Impacts

- ***Overview****:* Students will read excerpts from a 2017 report to the State of Washington and consider the economic impacts that invasive species can have within the state
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Invasive Animals

- ***Overview****:* Students will watch a TED-Ed talk and consider how introduced animal species upset delicate trophic webs
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weed Stewardship Challenge

- ***Overview****:* Students complete a daily stewardship challenge related to noxious weeds
- ***Parent/Caregiver Tasks****:* If needed, help the student share their work on social media

PARENT/CAREGIVER OVERVIEW: DAY 3

Identification and Research

Background Information: Invasive plants that are negatively impacting ecosystems in Washington State are added to a list of noxious weeds that the Washington State Noxious Weed Control Board (WSNWCB) draws up yearly. The WSNWCB classifies weeds as one of three classes: Class A (i.e. this weed is found in a limited range and needs to be eradicated before it can spread more), Class B (i.e. this weed is found in a somewhat limited range, and should be eradicated or contained), and Class C (i.e. this weed is very prevalent). The state mandates action against all Class A weeds and selected Class B weeds that are still limited in parts of the state. Counties decide whether to require control of any other Class B or C noxious weeds, and which weeds should be recommended for action or volunteer efforts.

Learning Objectives: Students will be able to conduct research to help explain why a particular invasive plant is considered a noxious weed, and summarize their findings to others through visual media.

Main Activity: Self-guided Investigation

- ***Overview****:* Students will research a noxious weed of their choice using the provided resources
- ***Parent/Caregiver Tasks****:* Determine whether students can do research online about a noxious weed that may be found in your neighborhood

Optional Activity: Identification Challenge

- ***Overview****:* Students will examine pairs of plants to spot which are noxious weeds and which are not
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weed Cutting

- ***Overview****:* Students will collect a sample of a noxious weed and preserve it to show others
- ***Parent/Caregiver Tasks****:* Accompany the student outside if it is safe to do so. Help students determine if plants are safe to touch, and then safely interact with them. If possible, help students share their work on social media with the hashtag #kingcountyweeds

Optional Activity: Noxious Weed Stewardship Challenge

- ***Overview****:* Students complete a daily stewardship challenge related to noxious weeds
- ***Parent/Caregiver Tasks****:* If needed, help the student share their work on social media

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PARENT/CAREGIVER OVERVIEW: DAY 4

Prevention and Best Management Practices

Background Information: There are many measures taken to reduce the threat of noxious weeds. Prevention is one of the most effective measures. Some examples of prevention are brushing off hiking boots before leaving a natural area, never dumping home aquariums into bodies of water, and choosing to plant native plants in our home gardens. When a noxious weed does take over an area, there are steps we take to either eradicate (remove completely) or control it (prevent the noxious weed from spreading). The most effective measures to use against a particular plant are called the Best Management Practices.

Learning Objectives: Students will be able to identify best practices for controlling and preventing the spread of noxious weeds.

Main Activity: Let's Pull Together!

- ***Overview****:* Students will read a blog post from the King County Noxious Weed Control Program about controlling a few types of noxious weeds
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Early Detection, Rapid Response

- ***Overview****:* Students will think about the timeline of a noxious weed infestation, and the challenges to removing these weeds over time
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weed Stewardship Challenge

- ***Overview****:* Students complete a daily stewardship challenge related to noxious weeds
- ***Parent/Caregiver Tasks****:* If needed, help the student share their work on social media

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PARENT/CAREGIVER OVERVIEW: DAY 5

Plan a Solution

Background Information: Noxious weeds are a human caused problem, and humans have to be part of the solution. One of the most important things we can do to help control noxious weeds is be vigilant and report noxious weeds around us. We can also take other precautions like brushing hiking boots to prevent seed spread and organizing community events to control or eradicate noxious weeds. We can take ownership of our backyards and communities, removing noxious weeds and inspiring others to do the same.

Learning Objectives: Students will generate an actionable plan to help control the spread of noxious weeds in their community.

Main Activity: Looking at King County Recommendations

- ***Overview****:* Students will look at the established Best Management Practices for a noxious weed and determine if they are appropriate for their community
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Letter Writing

- ***Overview****:* Students will write a letter to spread the word about the importance of controlling noxious weeds
- ***Parent/Caregiver Tasks****:* If possible, help students share their work on social media with the hashtag #kingcountyweeds

Optional Activity: Noxious Weeds Pledge

- ***Overview****:* Students will take the Noxious Weeds Pledge, understanding that they are an important part of preventing the spread of noxious weeds in their communities
- ***Parent/Caregiver Tasks****:* If possible, help students share their work on social media with the hashtag #kingcountyweeds

Optional Activity: More Information

- ***Overview****:* Students have additional resources to learn more about noxious weeds and how they can help make positive change in the future
- ***Parent/Caregiver Tasks****:* None

Optional Activity: Noxious Weed Stewardship Challenge

- ***Overview****:* Students complete a daily stewardship challenge related to noxious weeds
- ***Parent/Caregiver Tasks****:* If needed, help the student share their work on social media

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PARENT/CAREGIVER OVERVIEW: VOCABULARY

DAY 1

Biodiversity: How many types of animals, plants, and other living things are found in an ecosystem. More diversity of living things in an ecosystem indicates that the ecosystem is healthy and strong.
Ecosystem: An interdependent system of plants, animals, and inorganic parts (e.g. water, soil nutrients, and sunlight)
Infestations: When a species has taken over enough of the resources in an area to negatively affect the ecosystem
Introduced Plant: Any type of plant that was brought to an area by humans
Invasive Plant: A plant that spreads quickly and takes up resources that ecosystems need
Native Plant: A plant which has evolved in an area for a very long time and become part of an ecosystem
Niche: In ecology, the role an organism plays in an ecosystem, including all biotic and abiotic interactions with its environment
Nuisance Weed: A plant growing in a place where it is not wanted
Noxious Weed: An invasive plant which has such strong negative effects on an ecosystem, natural or economic resources, or public health that it is tracked by public offices
Nutrient: A chemical necessary for something to live, including nitrates, phosphates, and potassium
Opportunistic: Able to quickly spread into unused areas
Rhizome: An underground stem that sends out both roots and shoots
Riparian: Related to wetlands adjacent to rivers or streams

DAY 2

Alien Species: Any plant or animal species that was introduced to an ecosystem by humans
Extirpated: To become extinct in a specific geographic region
Food Web: A visualization of the way energy moves through an ecosystem generally through one organism eating another
King County Noxious Weed Control Program/Board: A part of the King County government that tracks noxious weeds and provides people the information and expertise to remove them

DAY 3

Adaptation: A trait a living thing has that helps it survive
Control: To prevent a plant infestation from spreading further or growing larger
Eradicate: To remove any traces of a plant that could re-grow
Washington State Noxious Weed Control Board: The Washington State government organization that determines what plants are noxious weeds, tracks noxious weeds and gives people resources to remove them

PARENT/CAREGIVER OVERVIEW: VOCABULARY

DAY 4

Best Management Practices: The most effective strategies for getting rid of noxious weeds
Erosion: The wearing down of rocks and soil by wind and weather that damages hillsides and fills bodies of water with dirt
Herbicide: A chemical that was engineered to kill plants
Restoration: Replanting an area with native plant species to recreate a healthy ecosystem

DAY 5

Anthropogenic: Caused by human activities
Extinct: All of the members of this species have died out in the wild
Stewardship: The duty we have to take care of the natural world around us

DAY 1

Invasive Plants and Noxious Weeds

A **native plant** is one which, as a species, has evolved as part of an **ecosystem** and occupies a vital **niche**. In contrast, an **introduced plant** is a plant that was brought here from a different ecosystem, usually from a distant part of the world with a similar climate to ours here in the Pacific Northwest. Humans have many motivations for bringing plants from elsewhere in the world. Some are plants that could be used for agriculture or are popular ornamental garden plants. Sometimes these plants were brought to the Pacific Northwest unintentionally. A problem with introducing plants from other ecosystems is that a very small percentage might become invasive. **Invasive plants** are ones that negatively impact the ecosystems they spread into. They spread quickly for a number of reasons. One is that there may not be any herbivores that eat them in their new habitats. For example, in Europe, tansy ragwort gets eaten by cinnabar moths. When tansy ragwort moved to Washington, however, there were no cinnabar moths here, so ragwort could spread much more rapidly.

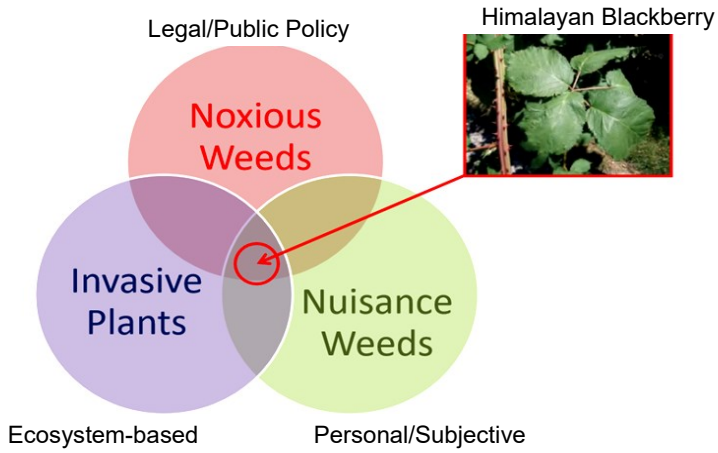
These plants may have fast growing roots that absorb a lot of water, soil **nutrients**, and sunlight. Some sprout earlier in the spring, casting shade onto later-sprouting native plants. When grown, these invasive plants produce thousands of seeds to take over even more of the ecosystem.

Invasive plants are also **opportunistic**, growing quickly into new openings. In one common scenario, an ancient Douglas fir tree is blown over in a windstorm, creating an opening in the forest canopy where understory plants can now grow. If invasive plants are present in the ecosystem, they will move quickly into this new opening, preventing Douglas fir seedlings or native understory plants like Sword fern, Salal or Oregon grape from creating new habitat and food sources for the animals that live in the forest.

Poison-hemlock is a noxious weed that is dangerous to humans and many animal species. As the name suggests, every part of this plant is poisonous to eat.

When this happens, these invasive plants are also **nuisance weeds**, because they are growing in a place where they aren't wanted.

More worrying still are **noxious weeds**, which are opportunistic, invasive plants that are so dangerous to ecosystems that they have been listed by the Washington State government for control and removal. These plants are weeds no matter where they are because they have a negative impact growing anywhere in King County. Because they are invasive and opportunistic, these noxious weeds spread quickly and reduce the **biodiversity** of forests, prairies, rivers, lakes, and streams throughout the Pacific Northwest. Some may also be hazardous to humans trying to remove them.



Himalayan blackberry is a widespread example of an introduced plant that meets the criteria for being an invasive plant, nuisance weed, and a noxious weed.

Vocabulary

Biodiversity: How many types of animals, plants, and other living things are found in an ecosystem. More diversity of living things in an ecosystem indicates that the ecosystem is healthy and strong.
Ecosystem: An interdependent system of plants, animals, and inorganic parts (e.g. water, soil nutrients, and sunlight)
Infestations: When a species has taken over enough of the resources in an area to negatively affect the ecosystem
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Nuisance Weed: A plant growing in a place where it is not wanted
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Nutrient: A chemical necessary for something to live, including nitrates, phosphates, and potassium
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Rhizome: An underground stem that sends out both roots and shoots
Riparian: Related to wetlands adjacent to rivers or streams

Main Activity

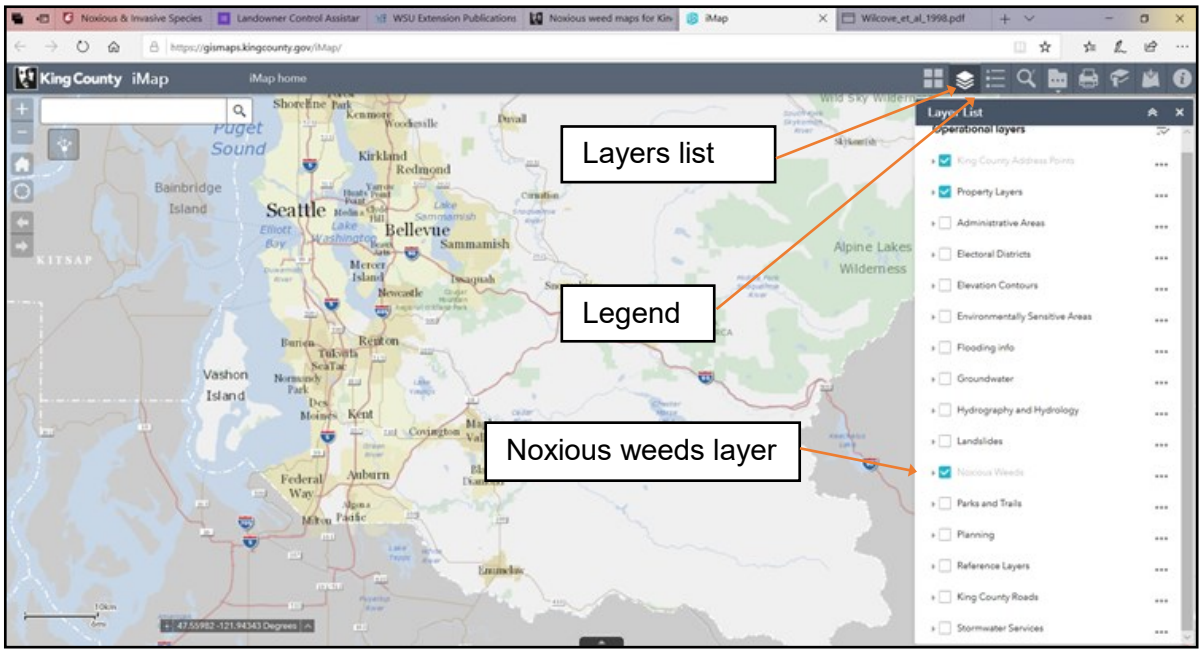
Map Analysis

King County tracks the spread of the most serious noxious weeds across our county. By recording this data, we can stop the spread of noxious weeds, identify sources, and control **infestations**.

Materials: Writing utensil, (if possible) computer/phone/tablet and internet connection

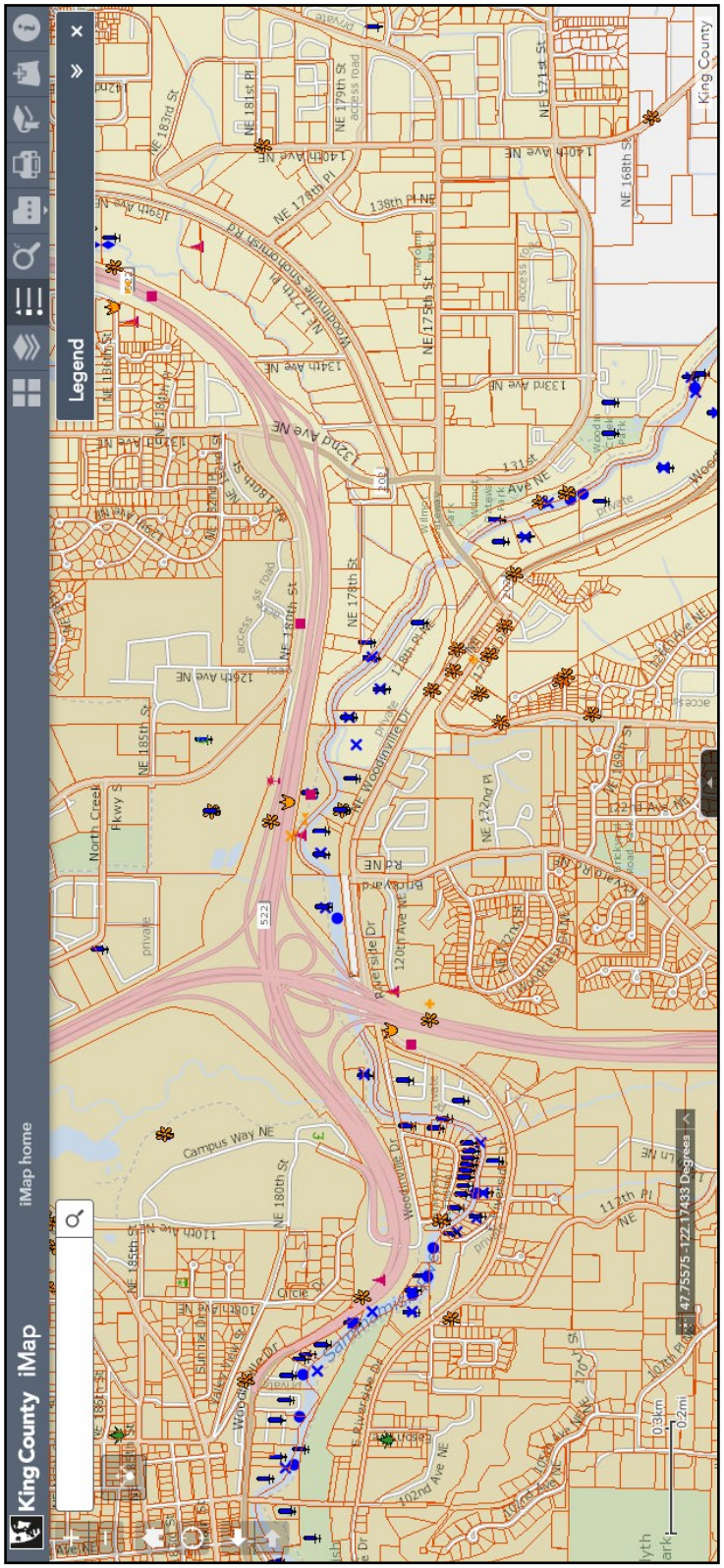
If possible, ***with an adult's permission***, check out the most updated map of noxious weeds in your neighborhood at the following link: https://gismaps.kingcounty.gov/iMap/.

In the top right-hand corner of the map, open the layer list and apply the "Noxious Weeds" layer to the map. Then use the plus symbol in the top left-hand corner to zoom into your neighborhood until you can see the symbols of different noxious weeds that have been reported in your community this year. Zoom in enough that you can tell which symbols are which, but far enough out that you still see a variety of noxious weeds.



Click the legend icon in the top right-hand corner next to the Layers list to see the identities of each noxious weed according to symbol. Use this map to answer the questions on the following pages.

If you are unable to access the King County iMaps page, you may use the map below of an area in Woodinville, WA, instead.



Noxious Weeds

All noxious weeds (current survey year)

- Brazilian elodea
- Velvetleaf
- French Broom
- Ravenna Grass
- lesser celandine
- Ricefield Bulrush
- Wild Chervil
- Shiny Geranium
- Saltcedar
- False-Brome
- european coltsfoot
- Small Balsam
- common hawkwee
- common reed
- floating primrose
- garden loosestrife
- hairy willowherb
- parrotfeather
- perennial pepperweed
- policeman's helmet
- purple loosestrife
- water primrose
- absinth wormwood
- Dalmatian toadflax
- diffuse knapweed
- gorse
- kochia
- lawnweed
- leafy spurge
- mouse-ear hawkweed
- other hawkweeds
- perennial sowthistle
- rush skeletonweed
- Savoy hawkweed
- Scotch thistle
- tall hawkweed
- velvet leaf
- viper's bugloss
- Bohemian knotweed
- buffalobur
- clary sage
- dyers woad
- garlic mustard
- giant hogweed
- giant knotweed
- Japanese knotweed
- Spanish broom
- yellow nutsedge
- bighead knapweed
- goatsrue
- houndstongue
- meadow knapweed
- milk thistle
- orange hawkweed
- spotted knapweed
- sulfur cinquefoil
- tansy ragwort
- yellow hawkweed

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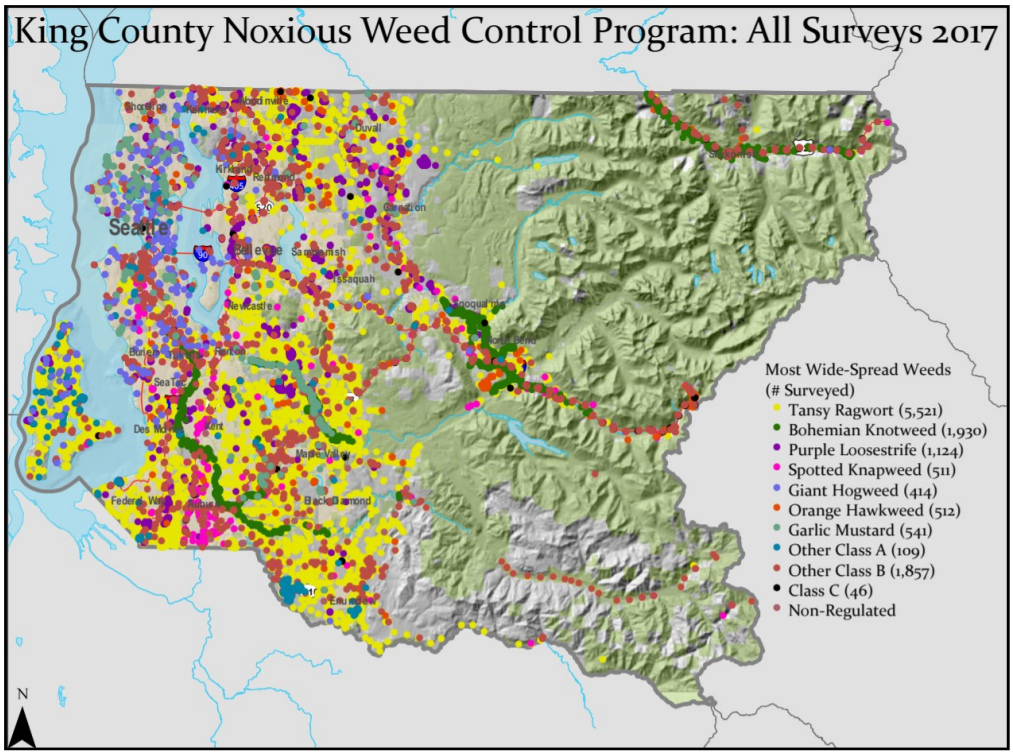
List the noxious weeds you found in your community.

Are there different infestation patterns for different noxious weeds? Based on your observations, are there noxious weeds that take over **riparian** areas (the land around rivers, lakes and streams)? Are there noxious weeds that infest parks, or forests, or agricultural areas?



Based on the map above, what noxious weeds are most prevalent throughout King County? What noxious weeds do we find in heavily urbanized areas? What noxious weeds do we find in more rural areas?

Optional Activity

Noxious Weeds Abroad

Plants native to the Pacific Northwest can also become noxious weeds if they are introduced to ecosystems in other parts of the world, as in the example below.

Materials: Writing utensil

Read through the excerpt from the article below. Mark the information that you think is the most important, and then answer the questions below.

From: "Lupine Invasions" by Marie Davie, in Science Connected
Source: https://magazine.scienceconnected.org/2016/10/lupine-invasions/

Lupinus polyphyllus, the big-leaved lupine, is native to the western United States and Canada, from British Columbia and Alberta south to California and east to Montana, Idaho, and Nevada — but in Norway and the rest of Europe it is an introduced invader. In many European countries, lupines have escaped from household gardens where they were originally planted for their vivid blossoms. Once on the loose, they rapidly colonize disturbed habitats such as roadsides, where they are particularly well adapted to spread and thrive.

What makes this plant so well adapted to spread? Nutrient-poor soils in marginal habitats are less of a barrier to lupine than to most native plants because of lupine's two specialized mechanisms for acquiring essential nutrients including nitrogen, phosphorous, and potassium.

However, once established, the effects of this invader are mixed. Despite enriching soils and making habitats more suitable for other species, lupine does not share well with others. The overall number of plant species in areas invaded by lupine actually decreases as the quick-growing, tall lupines shade later-emerging, shorter native plants and outcompete them.

And it's not just other plants that can be negatively impacted by lupine invasions. In Finland, lupines have a bottom-up effect on the ecosystem, decreasing the number and diversity of moths and butterflies occurring in invaded areas, as they are a poor food source for these insects.

***Article Questions**:*

How did lupine arrive in ecosystems in Norway?

Why is lupine causing problems?

Based on the text, what is a “bottom-up” effect? Define it in your own words.

One takeaway from this article might be “well, noxious weeds aren’t always so bad,” because lupine adds nutrients back to the soil and is a “pretty” plant. How would you refute this argument?

Optional Activity

Prevention is the Best Medicine

One important way to control noxious weeds is to prevent them from spreading in the first place. Let's examine the following images to see how human actions spread noxious weeds, and how we can change our behaviors to stop the spread.

Materials: Writing utensil

Look at the following images. For each image, what is a behavior you see which might spread noxious weeds? What is something that can be done to reduce the spread of noxious weeds doing this activity? Use the space next to the picture to write down your ideas and thoughts!

(photo credit USDA Forestry)

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(photo credit Utah State University)

Optional Activity

Noxious Weed Stewardship Challenge for Day 1

King County has incredible biodiversity when it comes to plants. But without experience, it can be a struggle to identify which plants are native and which are noxious weeds, especially since most plants are neither. Let's take a look at just a few of these plants and learn which ones are beneficial to the surrounding ecosystem and which are harmful. They are from the two extremes, either native plants or noxious weeds.

Materials: Writing utensil

Take a look at the following plants. Read through their descriptions and decide whether these are native plants or noxious weeds. Highlight evidence from the description.

Now look at the plants you suspect are noxious. How do you think they may have travelled to King County? What actions can we take to prevent these plants from spreading more? Post a photo of this plant on social media and challenge your neighbors to identify it. Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds

Salal: Tolerant of both sun and shade, salal may have large, spreading **rhizomes**

Garlic mustard: This European food plant is *allelopathic*, meaning it releases chemicals into the soil to prevent nearby plants from growing

English ivy: This evergreen vine is well-adapted to growing year-round in much of western Washington

Sword fern: This large fern prefers growing in cool, shaded areas with plenty of moisture

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Bleeding heart: Widely grown in gardens, this wildflower relies on ants to spread its seeds

Purple loosestrife: Each of these purple-flowered plants can produce up to 2 million tiny seeds each year

Snowberry: This plant's tiny white berries are an important food source for quail, grouse, deer, and elk, but are poisonous for humans

Osoberry: These trees can reproduce through sagging branches rooting into the ground, so mature trees are often surrounded by clones

Tansy ragwort: This plant's wind-borne seeds can live in soil for 15 years, re-growing every spring even if it has been pulled

Herb Robert: When pulled or crushed, this plant lets out a pungent odor, hence this plant's other name: "stinky Bob"

DAY 2

Economic, Agricultural, and Ecological Impacts

Noxious weeds are a spreading problem in King County. Every year, Himalayan blackberry takes over acres of our local parks, creating a hostile environment for birds and butterflies. English ivy weakens and knocks over trees, endangering people and preventing those trees from absorbing carbon dioxide and producing oxygen. Tansy ragwort poisons horses, cows and sheep who mistake it for safe grazing grass. Giant hogweed covers unwary gardeners with terrible burns and scars.

However, there are members of our community that are working to prevent the spread of noxious weeds, to remove them where practical, and to stop new species of invasive plant from arriving in King County. **The King County Noxious Weed Control Program/Board** is a part of the King County government that tracks noxious weeds and provides people the information and expertise to remove them. These efforts are made possible because people in our community help out by reporting noxious weeds, volunteering their time to remove them, and spreading knowledge to their neighbors.

Students from a local high school restoring a park

Vocabulary

Alien Species: Any plant or animal species that was introduced to an ecosystem by humans
Extirpated: To become extinct in a specific geographic region
Food Web: A visualization of the way energy moves through an ecosystem generally through one organism eating another
King County Noxious Weed Control Program/Board: A part of the King County government that tracks noxious weeds and provides people the information and expertise to remove them

Main Activity

Ecosystem Impacts

"Alien" species are one of the primary factors driving the extinction of plants and animals in the United States.

Materials: Writing utensil

Read this excerpt from Wilcove et al. (1998), *Quantifying Threats to Imperiled Species in the United States*. Examine the included graph to answer the questions on the following pages.

"Biologists are nearly unanimous in their belief that humanity is in the process of ***extirpating*** *a significant portion of the earth's species. The ways in which we are doing so reflect the magnitude and scale of human enterprise. Everything from highway construction to cattle ranching to leaky bait buckets has been implicated in the demise or endangerment of particular species. According to Wilson (1992), most of these activities fall into four major categories, which he terms "the mindless horsemen of the environmental apocalypse": overexploitation, habitat destruction, the introduction of non-native (alien) species, and the spread of diseases carried by* ***alien species****. To these categories may be added a fifth, pollution, although it can also be considered a form of habitat destruction.*

...

To obtain an overview of the threats to biodiversity in the United States, we tabulated the number of species threatened by five categories of threats: habitat destruction, the spread of alien species, overharvest, pollution (including siltation), and disease (caused by either alien or native pathogens). We restricted this coarse-scale analysis to imperiled plants and animals occurring within the 50 states and falling into any of four categories: all full species of mammals, birds, reptiles, amphibians, and fish with status ranks of "possibly extinct," "critically imperiled," or "imperiled," as determined by The Nature Conservancy (TNC) in association with the Network of Natural Heritage Programs and Conservation Data Centers (Master 1991); all full species of freshwater mussels, butterflies and skippers, tiger beetles, and dragonflies and damselflies with status ranks of possibly extinct, critically imperiled, or imperiled, as determined by TNC; all full species of vascular plants with status ranks of possibly extinct or critically imperiled, as determined by TNC; and all species, subspecies, or vertebrate populations listed by the US Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service as threatened or endangered or officially proposed for listing under the Endangered Species Act (ESA) as of 1 January 1996. (The ESA permits the listing of species and subspecies of plants and animals as well as "distinct population segments" of vertebrates.) A total of 2490 imperiled species, subspecies, and populations fit these criteria.

Information on the threats to each of these species, subspecies, and populations was obtained from a number of sources, including the Federal Register (i.e., the listing notices published for all species designated as threatened or endangered under the ESA), a survey of biologists conducted by Richter et al. (1997) for aquatic species, the Natural Heritage Central Databases managed by TNC, and interviews with specialists in particular species groups and geographical regions. We included only known threats and excluded potential or hypothetical ones. We did not attempt to distinguish between ongoing and historical threats, partly because such information is usually lacking and partly because the distinction itself is problematic in the case of habitat destruction. Nor did we try to distinguish between major and minor threats to each species because such information was not consistently available.

In a few cases, it was impossible to assign a particular human activity to one of the major threat categories; we excluded these activities from our coarse-scale analysis.

We were able to obtain information on threats for 1880 (75%) of the 2490 imperiled species, subspecies, and populations that met our criteria for inclusion in this study (Table 1). (For 52 of the species, we could not identify any anthropogenic threats.) We used the resulting database to determine the relative significance of the major threats categories and to investigate differences between species groups in their vulnerability to particular threats. We compared the distribution of threats among plants and animals, among vertebrate and invertebrate animals, and within vertebrate classes. We also compared the distribution of threats among terrestrial and aquatic species, Hawaiian and mainland vascular plants, and Hawaiian and mainland birds. For all comparisons, statistical significance was assessed using the chi-squared contingency test (two-tailed).

…

Table 2 presents a summary of the percentages of species that are imperiled by habitat loss, alien species, pollution, overexploitation, and disease. Not surprisingly, habitat destruction and degradation emerged as the most pervasive threat to biodiversity, contributing to the endangerment of 85% of the species we analyzed (Figure 1). Indeed, habitat loss is the top-ranked threat (in terms of the number of species it affects) for all species groups. Competition with or predation by alien species is the second-ranked threat in the overall analysis, affecting 49% of imperiled species. Alien species affect a higher proportion of imperiled plants (57%) than animals (39%); this difference is statistically significant (chi square = 60.23, d.f. = 1, P<<0.001). However, certain groups of animals (most notably birds and fish) appear to be as broadly affected as plants by alien species."

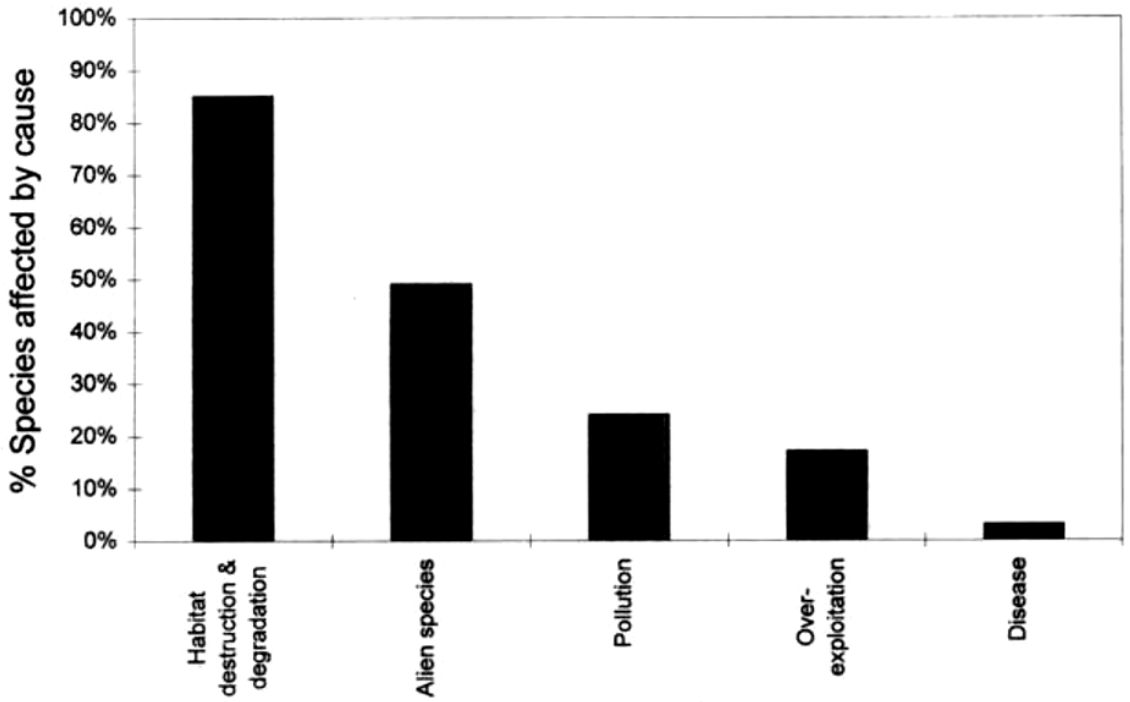


Figure 1. The major threats to biodiversity. Data refer to species classified as imperiled by The Nature Conservancy and to all endangered, threatened, and proposed species, subspecies, and populations protected under the Endangered Species Act. See also Table 2.

Article Questions:

An “alien” species is a species of organism that was introduced to an ecosystem by humans. How is this different from an invasive species? How is it different from a noxious weed? Are all invasive species “alien”? Are all noxious weeds “alien”? Could a species be “alien” to an ecosystem and not be invasive or noxious? How?

What are the two most significant threats to the survival of endangered species according to the article? What percentage of endangered species are threatened by each?

Wilcove et al., states that "(a)lien species affect a higher proportion of imperiled plants (57%) than animals (39%)". Is the difference statistically significant according to the article? Why might plants be more vulnerable to "alien" species than animals?

**If you are interested in what you read in this article, there is a more up-to-date version of this article from the same authors (2006) that you may research. However, the underlying concepts remain consistent, and the older article dives more thoroughly into the methodology behind the study.*

Optional Activity

Economic Impacts

The impacts of invasive species aren't just to ecosystems. Outdoor industries lose millions of dollars and thousands of jobs every year to noxious weeds and pest animals. Read through the excerpt from *Washington State's Economic Impact of Invasive Species for 2017* and answer the questions on the following pages.

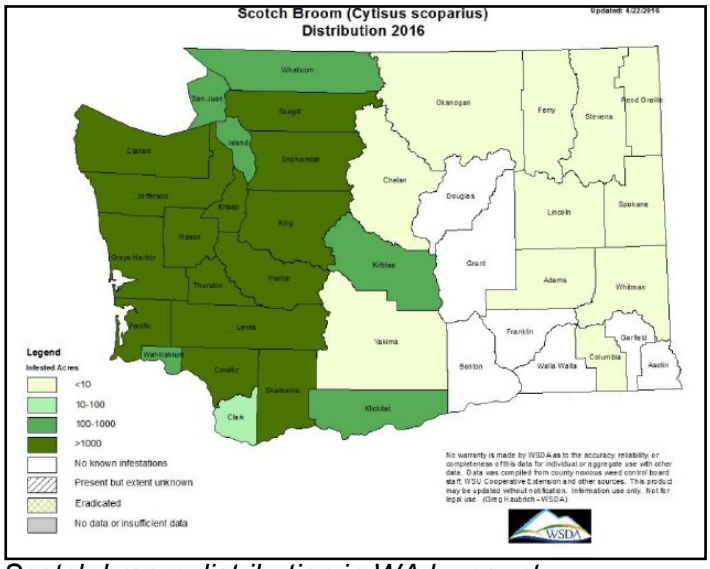
Materials: Writing utensil

Invasive Species in Washington
Washington is at risk from a wide variety of invasive species. These nonnative plants and animals have an adverse impact on Washington's landscapes, ecosystems, agriculture, commerce and recreation.

Total Costs of Invasive Species
Crops: Cropland has the potential to be quickly infested by invasive plants, which reduce overall yields and require resources for their control. Furthermore, crops are directly lost through invasive animal consumption. The direct impact of invasive species on crops grown in Washington is estimated to be $239.5 million per year.
Livestock: Invasive noxious weeds in pastures and rangeland displace desirable forage that help sustain livestock. In some cases, these plants are also toxic to livestock and horses and can be fatal. The direct economic impact of invasive species on the livestock industry is estimated to be $120.1 million annually.
Timber: Many invasive species can severely impact Washington's $1.68 billion timber and logging industry. Invasive noxious weed species such as Scotch broom can outcompete new saplings, which reduces future timber harvests. Insect species such as the gypsy moth have a more immediate impact on the timber industry by defoliating and stressing, resulting in mortality of adult trees. The direct economic impact of invasive species on the timber industry is estimated to be $124.8 million.
Recreation: Recreational activities such as hunting, fishing, and boating can all be adversely affected by invasive species. Many of the same species that impact a rancher's ability to range their cattle also reduce elk and deer populations. Aquatic invasive species can cause declines in fish populations and reduce access to popular fishing areas. Other aquatic species can clog up boat propellers and render public boat launches unusable. The direct economic impact to recreational activities from invasive species is estimated to be $20.5 million per year.

Most Costly Invasive Species
Plant Species:
Rush skeletonweed has an extensive root system that allows it to outcompete native grasses and valuable crops for water. Major crops impacted include wheat and potatoes, both of which are major commodities in Washington. It has the potential to have a total economic impact of $149.2 million, putting 1,080 jobs at risk if it were allowed to spread an additional 12% per year into susceptible land types.

Scotch broom



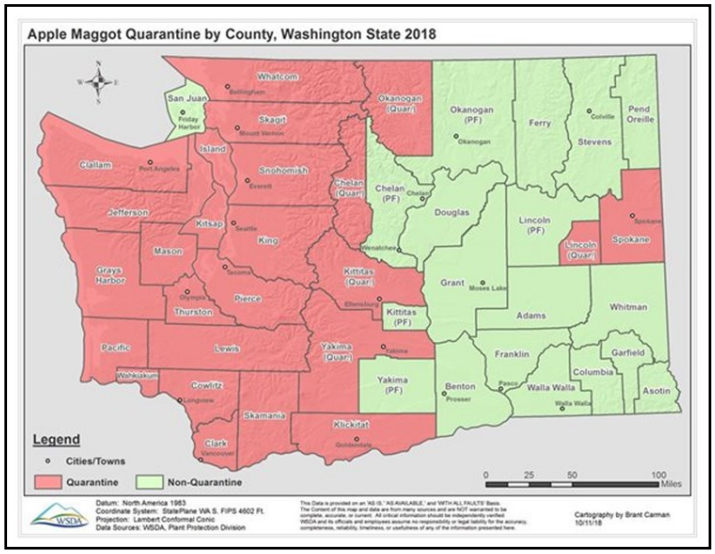
Scotch broom distribution in WA by county

Scotch broom quickly forms dense stands which quickly outcompete young trees and desirable forage plants. Furthermore, Scotch broom can be toxic to cattle. Scotch broom is widespread in western Washington and has the potential to cause a total of $142.7 million in lost sales and 660 job losses in Washington per year if it were allowed to spread an additional 12% per year into susceptible land types.

Animal Species:

Apple maggots infest apple, pear and cherry orchards, rendering significant numbers of fruit unsuitable for sale. Since apple maggot is an invasive species, any orchard infested with apple maggot cannot export any of its fruit without undergoing treatment. The total economic impact from apple maggot is estimated to be $392.5 million, putting 2,900 jobs at risk per year .

Apple maggot-infested apples



Apple maggot quarantine in WA by County in 2018

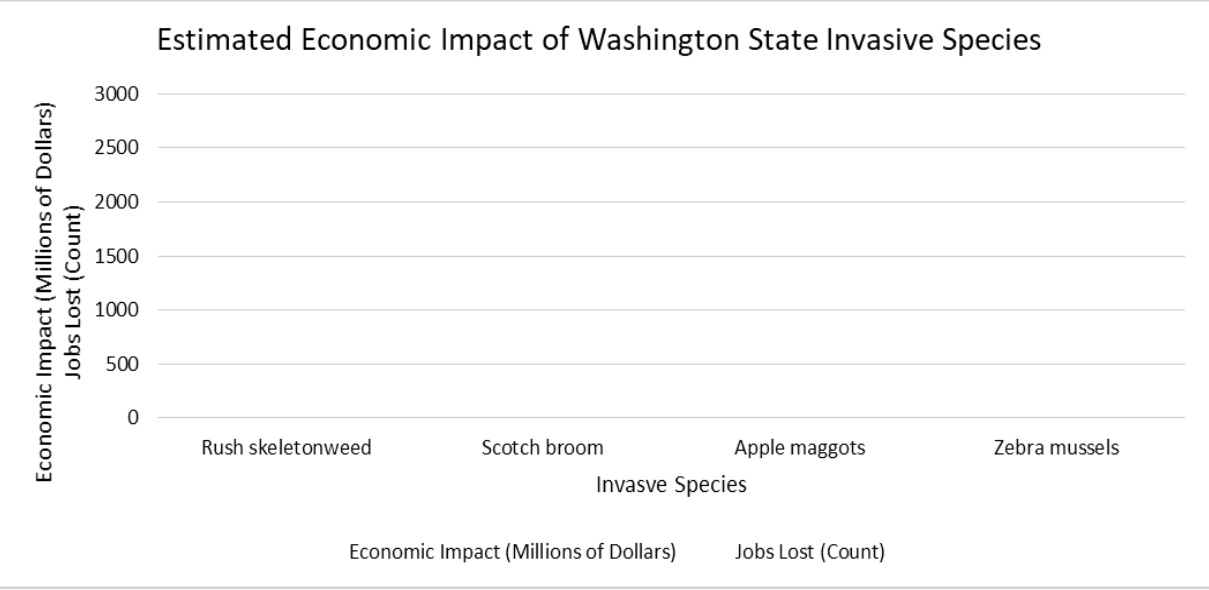
Zebra mussels are not currently found in Washington but do have the potential to infest numerous bodies of water in the Columbia River Basin. Zebra mussels can clog intake valves in dams as well as colonize public boat launches, rendering them unusable. If zebra mussels were to establish in Washington, the economic impact could be as large as $100.1 million. This translates into an estimated loss of 500 jobs.

Article Questions

How do invasive plant and animal species hurt the Washington State economy? Cite an example from the text in your answer.

Based on the image *Apple Maggot Quarantine by County, Washington State 2018* what is the purpose of the apple maggot quarantine? Could the same principals be applied to zebra mussels?

Fill in the graph showing the potential impact of each species below. Use the information on economic cost (in millions of dollars) and jobs lost to create two bars per species, and be sure to label with the color you used for each bar.



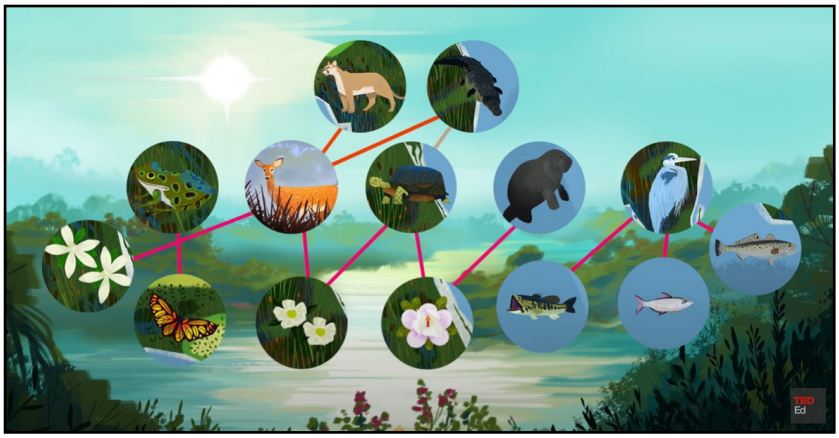
Optional Activity

Invasive Animals

Invasive animals are also a serious threat to ecosystems across our planet. ***With an adult's permission,*** check out this Ted-Ed video describing invasive species across the world: https://www.youtube.com/watch?v=spTWwqVP_2s&feature=youtu.be

After watching, answer the questions below.

Materials: Computer/phone/tablet, internet connection, writing utensil



This image from the video is an example of a **food web**, demonstrating that our ecosystems are a delicate balance that can easily be impacted by the introduction of a new species. Create a food web for a Pacific Northwest forest in the space below. Be sure to include a variety of species and lines indicating the flow of energy.

As with the introduction of the python in the video, add an invasive plant to your food web. What species are impacted first by the introduction of this invasive plant? Is there a "bottom-up effect", as opposed to the "top-down effect" from the python?

Optional Activity

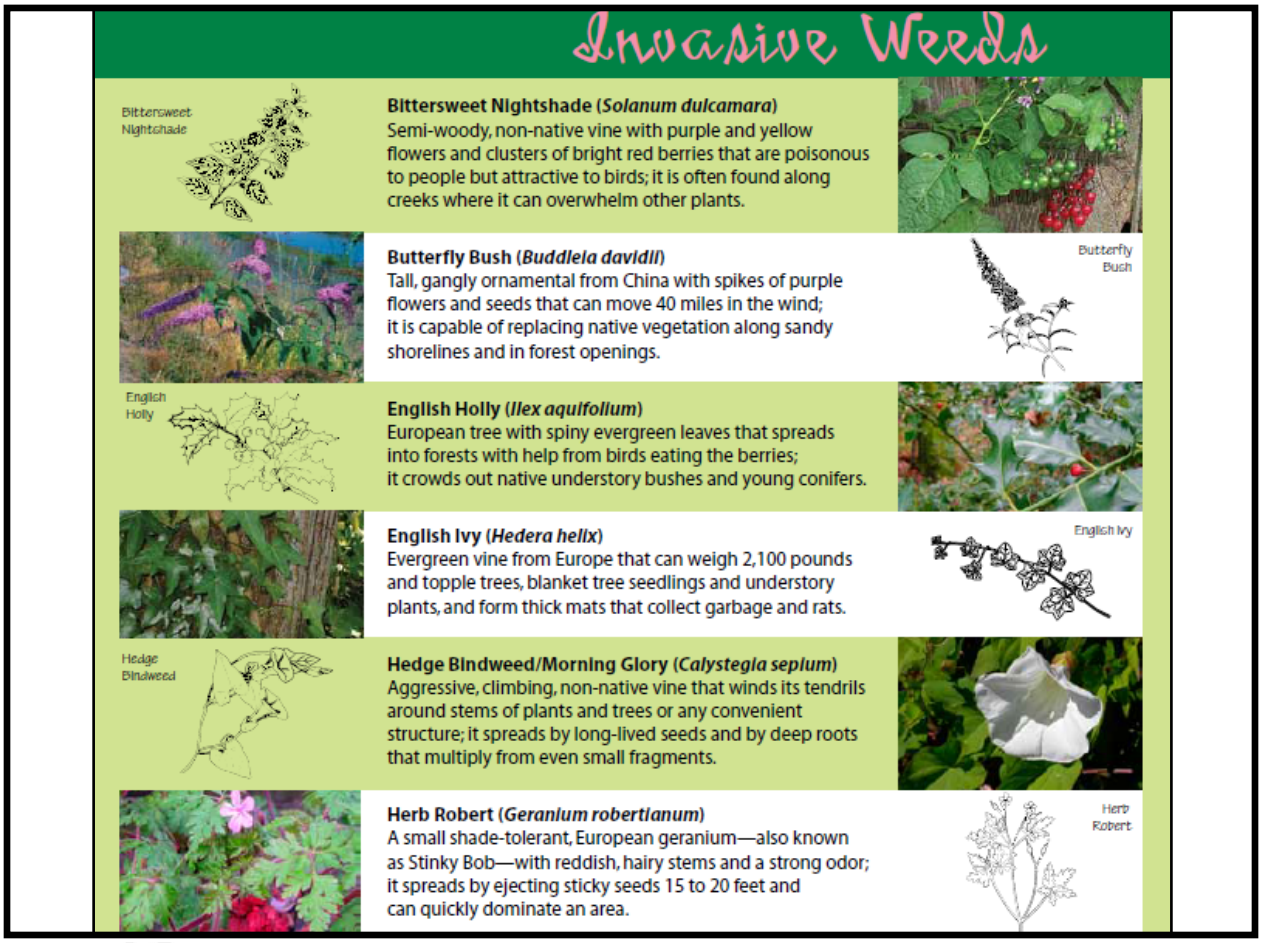
Noxious Weed Stewardship Challenge for Day 2

Noxious weeds are present in our own communities. Let's see if we can find some!

Materials: Writing utensil, computer/phone/tablet, internet

Now that you know about invasive plants and noxious weeds, can you find them in your neighborhood? Are they growing in your own backyard? Can you spot any from your window or doorway at home? Do you think there are any growing in the parking lot of your school or by any of the entrances? Check out King County's Neighborhood Bullies pamphlet, included below, to learn about the most common invasive plants in King County. If you find a noxious weed, you can report it to the King County Noxious Weed Control Program here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/infestation-form.aspx.

Challenge yourself to post all the things you are doing with your friends and family to help control the spread of noxious weeds! Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!



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Knotweed (*Polygonum cuspidatum*, *Polygonum sachalinensis, and Polygonum bohemicum*)
Massive, clump-forming, bamboo-like perennials from Asia that spread aggressively from stem and root fragments and crowd out native vegetation, degrade habitat, and increase erosion.

Old Man's Beard (*Clematis vitalba*)
An aggressive deciduous, non-native vine, with woody stems up to 100 feet long that blankets entire groves of trees, and becomes festooned with masses of fluffy white seeds that spread in the wind.

Poison-hemlock (*Conium maculatum*)
Tall, non-native plant with stout, purple-spotted stems, parsley-like leaves and tons of small, umbrella-shaped flower clusters; often shows up in gardens, parks and roadsides and is deadly if eaten.

Scotch Broom (*Cytisus scoparius*)
Yellow-flowered bush in the pea family from Scotland with very long-lived seeds that has spread widely into open areas and cleared forests throughout the region; it poses a fire hazard and invades grassy areas.

Yellow Archangel (*Lamiastrum galeobdolon*)
Fast-growing, tough European perennial ground cover with distinctive silvery-gray markings; it is very competitive in shady forests, spreads readily from yard waste piles, and crowds out understory plants.

The following HIGH PRIORITY noxious weeds are regulated in Washington and control is required on all properties in King County.

Garlic Mustard (*Alliaria petiolata*)
Shade tolerant, garlicky herb from Europe with small, white flowers that quickly takes over in woodlands, harms beneficial soil fungi, replaces native plants, and is extremely tenacious and difficult to eradicate.

Giant Hogweed (*Heracleum mantegazzianum*)
Imposing 15-foot tall plant from Russia with jagged leaves, huge flower clusters, and thick, purple-blotched stems that can create burns and blisters when handled; it has spread into parks, ravines, alleys and backyards.

Policeman's Helmet (*Impatiens glandulifera*)
Up to ten feet tall, hollow-stemmed Asian annual with pinkish flowers that spreads quickly by shooting seeds 15 to 20 feet, grows in dense stands and quickly dominates gardens, parks, and wetlands.

Source: https://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Neighborhood-Bullies.pdf

DAY 3

Identification and Research

Keeping in mind the impacts of noxious weeds to ecosystems, people, and the Washington State economy, let's dig deeper into the categories of noxious weeds and research a specific noxious weed.

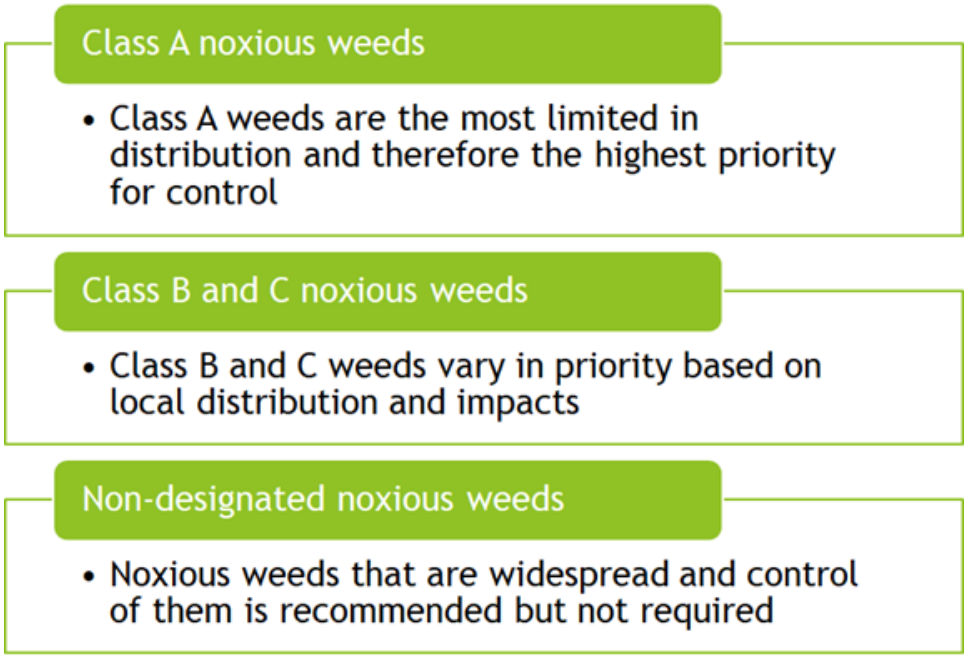
Every year, the **Washington State Noxious Weed Control Board** (WSNWCB) creates a list of invasive plants that are negatively impacting Washington State. These plants are officially considered noxious weeds, and the WSNWCB sorts them into three categories to help county officials know how to deal with these noxious weeds. The three categories are Class A, Class B, and Class C noxious weeds. Some weeds do not have a class but are still controlled by King County.

- Class A noxious weeds are not yet wide spread across Washington, which means through determined group effort, they can be **eradicated** before they spread. Every county in Washington is required to help remove these weeds if spotted.
- Class B noxious weeds are found in parts (but not all) of Washington. It will be difficult to eradicate all of these plants, but their spread can be contained. It is up to each county to decide how to **control** these weeds, so check with local county noxious weed authorities to find out how they are controlling each individual Class B weed.
- Class C noxious weeds are very widespread, so eradicating them is almost impossible (not to mention expensive). However, Class C noxious weeds can still be damaging to ecosystems, so individual counties choose to control Class C weeds if they can.
- King County Weeds of Concern are plants not listed as noxious weeds by the state but are nonetheless problematic in King County. It is still recommended that everyone work to prevent the spread of these weeds.

These classes of noxious weeds inform how the county controls noxious weeds. Every resident of Washington State is required to help eradicate Class A noxious weeds, but even if Class B and Class C weeds are not controlled in your county, they are still having a negative impact on ecosystems, animals and people that can be reduced by efforts we'll discuss in detail in Day 4 and 5.

The classes of noxious weed are summarized below. If you want to learn more, a list of all noxious weeds in Washington State sorted by class is available here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/laws/list.aspx.

Tansy ragwort is one Class B noxious weed that must be thrown in the trash, not the municipal compost, as it remains toxic



A summary of the major classes of noxious weeds

Vocabulary
Adaptation: A trait a living thing has that helps it survive
Control: To prevent a plant infestation from spreading further or growing larger
Eradicate: To remove any traces of a plant that could re-grow
Washington State Noxious Weed Control Board: The Washington State government organization that determines what plants are noxious weeds, tracks noxious weeds and gives people resources to remove them

Main Activity

Self-guided Investigation

We've had some chances to observe and learn about the noxious weeds that may be in our own neighborhoods. Now it's time to dig in and become an expert on one particular noxious weed.

Materials: Noxious weed fact sheets (below), writing utensil, (if possible) computer/phone/ tablet and internet connection

Choose one of the plants you've learned about earlier this week. You will become an expert in that plant. Research answers to the following questions using the noxious weed fact cards below. These contain data collected from across Washington State. Links to the report and other resources are at the end of this activity.

If you can, ***with an adult's permission***, go online to the King County Noxious Weed Control Program website (kingcounty.gov/weeds) to find more information about your chosen noxious weed.

How would someone identify your noxious weed? Are there any plants it could be confused with? What are its defining characteristics?

What **adaptations** does your noxious weed have that help it grow aggressively in Washington?

What impact does your noxious weed have on Washington ecosystems?

Does your noxious weed have a significant economic impact in Washington State? Why or why not? What is one piece of evidence that supports your claim?

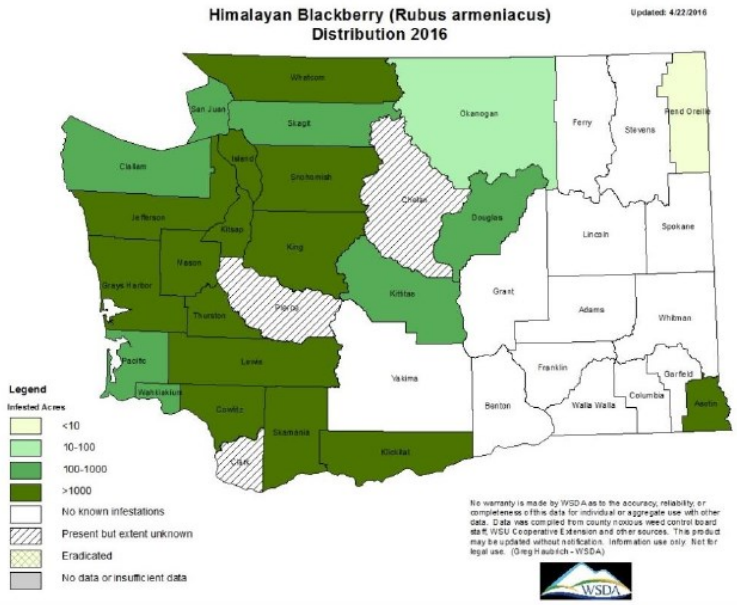
Is your noxious weed Class A, B, or C? Is it none of those? Why is it important to control or eradicate your noxious weed?

Noxious Weed Fact Card

Himalayan Blackberry (*Rubus armeniacus*)

Description
Thicket forming evergreen shrubs 8 to 15 feet tall with arching, thorny canes. Has white to pink flowers with five petals, large black berries and leaflets usually in groups of five on main branches. Himalayan blackberry has round to oblong leaflets, and reproduces by seed and also by rooting at cane tips. Highly invasive and painful to control. May look similar to the native plant trailing blackberry *Rubus ursinus,* which is smaller, has three leaflets, and grows along the ground.

Impacts
Cattle and livestock: Outcompetes native pasture plants and impacts quality of grazing lands.
Timber: Prevents growth of shade intolerant trees such as Douglas fir and Ponderosa pine.
Croplands: Can infest croplands and requires control.



Other Considerations
Recreation: Himalayan blackberry produces dense thickets that restrict access to or limit the use of public lands and increase park management costs.
Cost of control: Birds and animals consume fruit and carry seed over a wide area. Any control program needs to be long term.
Host for berry pest: Himalayan blackberry is a host species to the spotted-wing fruit fly, *Drosophila suzukii*, a serious insect pest of berry and tree fruit crops in the Pacific Northwest.

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Direct Economic Impact of Species
If Himalayan blackberry spread an additional 12% in the 19 counties with significant infestations in Washington, that would translate to approximately: 17,000 invaded acres of croplands, 284,000 acres of rangeland and wildland, 2.1 million acres of timberlands, and 1,605 miles of rivers and streams. Timber is the natural resource affected the most by Himalayan blackberry, with a direct economic impact of almost $14 million worth of timberland. Impacts to timber account for 68% of the total estimated direct impacts from Himalayan blackberry.

Two of the counties most affected by Himalayan blackberry are Lewis County and Grays Harbor County, which have estimated direct impacts of $2.4 million and $2.1 million respectively.

Direct Impacts to Crops			$-1,369,500
	Blueberry		$-323,000
	Strawberry		$-54,000
	Other Berries		$-2,500
	Hay		$-990,000
Direct Impacts to Livestock			$-4,025,000
Direct Impacts to Timber			$-13,903,000
Recreation in Wildlands			$-1,135,000
	Direct Impacts to Hunting		$-247,000
	Direct Impacts to Fishing		$-888,000
Total			**$-20,432,500**

Total Economic Activity at Risk
Looking at the broader Washington economy, Himalayan blackberry infestation could have a cumulative output impact of $48.7 million. This loss of output translates into a loss of 230 jobs in Washington and $12.7 million in lost labor income.

Control
Himalayan blackberry is considered a class C noxious weed in Washington state. Dig up plants removing the root ball completely. For larger stands, first cut the canes with loppers or a brush cutter, then dig up the remaining root ball. Regular, repeated cutting can suppress and weaken blackberry. Pile up canes on a dry surface to keep stems from re-rooting. Dispose of plant material in city or county provided yard waste bins if available. Herbicides are an effective control method if applied to actively growing plants at the time of year recommended on the product label. Follow all label directions. Plant desirable species to discourage weeds from reestablishing.

Noxious Weed Fact Card

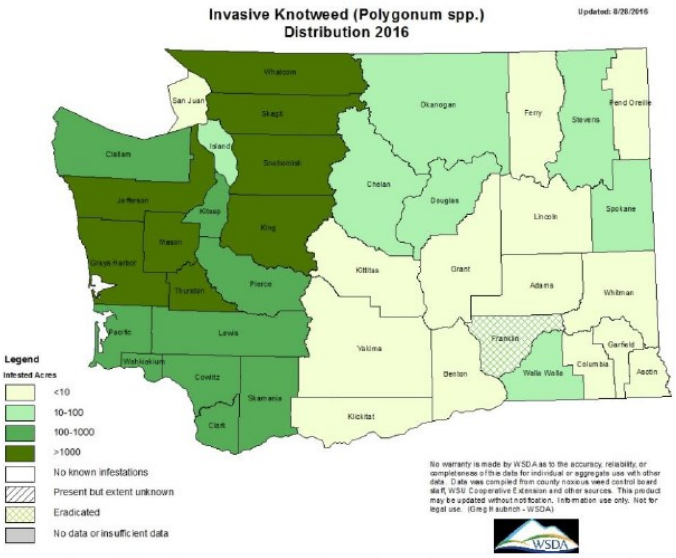
Giant Knotweed (*Polygonum sachalinense*)

Description

Stems are stout, cane-like, and reddish-brown. The plants die back at the end of the growing season but their old reddish-brown canes often persist. The stem nodes are swollen and surrounded by thin papery sheaths. Leaves are either heart-shaped or spade-shaped or somewhere in between. The flowers are small, creamy white to greenish white, and grow in showy plume-like, branched clusters from leaf axils near the ends of the stems. The fruit is 3-sided, black and shiny.

In the Pacific Northwest, there are four similar species of invasive knotweed that are difficult to tell apart and share similar habitat, impacts and control methods. They are all large, robust perennials that spread by long creeping rhizomes to form dense thickets. These tall, bamboo-like plants were introduced from Asia as ornamentals beginning in the early 1800's in England and in the United States by 1890.

Due to their widespread use, the lack of natural predators, and their ability to spread by root and stem fragments, invasive knotweed species have spread and become widely established throughout North America and Europe. Knotweed clones can completely clog small waterways and displace streamside vegetation, increasing bank erosion and lowering the quality of riparian habitat for fish and wildlife. Rapid spring growth and deep, extensive roots enable knotweed to outcompete most other plants, even small trees and shrubs. Knotweeds can tolerate partial shade and are most competitive in moist, rich soil. Invasive knotweed species are commonly found along roadsides and on stream banks but also may be present in yards, vacant lots, edges of fields, parks and many other places.



Impacts

Environment: Invasive knotweeds can significantly alter riparian habitats, food webs, and native plant communities.
Rivers and Streams: Invasive knotweeds can rapidly dominate river embankments and cause severe soil erosion, impacting water quality and salmon habitat.

Other Considerations

Wildfire: Dry knotweed biomass can be a fire hazard.
Infrastructure: Knotweed rhizomes can damage septic systems and infrastructure such as roads and pipes.

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Direct Economic Impact of Species
Invasive knotweed has significant populations in 19 of Washington's 39 counties. However, it is mostly confined to riparian habitats, so economic impact estimates only reflect a 1% impact on rangeland, wildlands, streams and rivers. This is roughly equivalent to 24,000 acres of rangeland and wildland and a further 227 miles of stream banks and river banks. Impacts across counties are fairly similar, with the average direct impact per county estimated at $48,000.

Despite the current modest impacts per county, any increase in the rate of spread has a sizable effect on the direct impacts of invasive knotweeds because of how widespread it is. For example, if the rate of spread were estimated to be 5% of productive lands, total direct impacts from invasive knotweed jump to more than $9.3 million.

Direct Impacts to Livestock			$-1,565,000
Recreation in Wildlands			$-306,000
	Direct Impacts to Hunting		$-41,000
	Direct Impacts to Fishing		$-265,000
Total			**$-1,871,000**

Total Economic Activity at Risk
Looking at the wider economic impacts of invasive knotweeds reveals that at a 1% rate of infestation, total economic output at risk across Washington is nearly $4.5 million. This represents 25 jobs at risk with an associated $1.2 million in lost labor income.

Control
All invasive knotweed species are Class B noxious weeds, including Japanese and giant knotweed, and the most common one, Bohemian knotweed, a hybrid of the other two. Knotweed is very difficult to control once it is established. A combination of treatments and revegetation may be needed to control populations depending on the site. In loose soil, small individual plants can be dug up if done carefully and completely. Plants can re-sprout from rhizomes so be sure to remove the entire root system and inspect for new growth. Cutting and covering with black plastic or geotextile fabric is somewhat effective, but covering must be left in place and monitored for at least five years or until shoots stop emerging when cover is removed. Application of systemic, slow-acting herbicide is the most effective control method. Contact the King County Noxious Weed Control Program for specific suggestions for each situation. Do not compost roots or green stems – they can sprout from nodes.

Noxious Weed Fact Card

Purple Loosestrife (*Lythrum salicaria*)

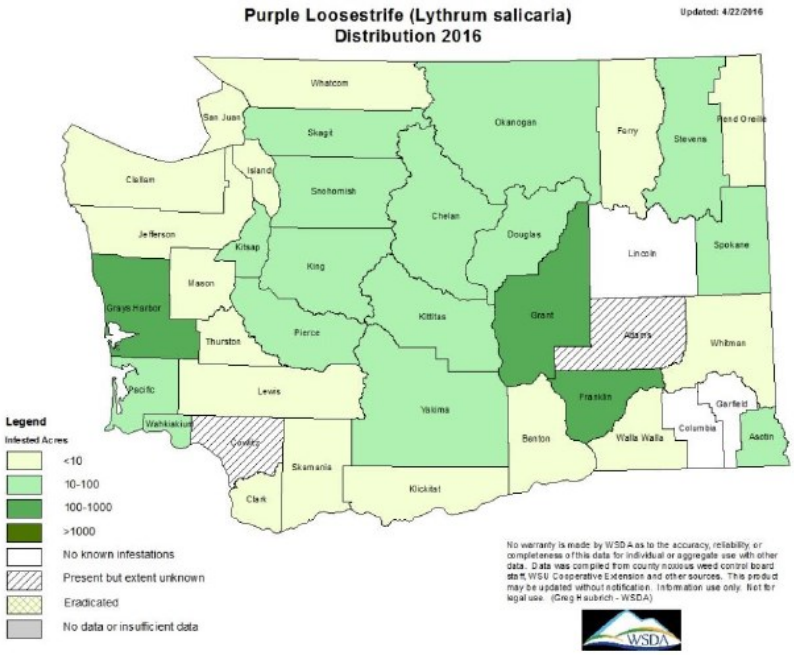
Description

Square stems and showy purple-magenta flower spikes. Flowers are small and numerous with 5-7 petals, growing in densely packed spikes. Leaves are opposite, lance-shaped to oblong and have smooth edges. Reproduces by seed and can form up to 2.7 million pepper-size seeds per plant.

They choke out wildlife habitat, displace native species and clog drainage ditches and irrigation canals. One purple loosestrife plant can produce over 2 million seeds. It is illegal to buy, sell, or transport this plant and property owners are legally required to control these plants on their property. Root and stem fragments and seeds should be kept out of soil and water to avoid further spread

Impacts

Recreational Fishing: Purple loosestrife displaces native plant species in riparian habitats. Once it forms dense stands, it restricts access to rivers.
Shellfish/Wetlands: Native plant species are displaced; wetland animals cannot use it for nesting or food; can lead to soil erosion and damage to floodplain habitat needed for shellfish production.



Other Considerations

Wetlands: Purple loosestrife is very invasive in wetland areas, where it displaces native wetland plants, significantly reducing food and nesting habitat for waterfowl and other animals. It can also alter the aquatic food web.
Irrigation Systems: Can restrict water flow in irrigation ditches.

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Direct Economic Impact of Species
Purple loosestrife impacts are centered primarily around recreational activities such as impacts to hunting waterfowl, fishing and recreational boating. The weed is found in significant amounts in 20 counties across Washington and risks affecting more than 1,600 miles of rivers and streams along with 38,000 acres of boat-able lakes and rivers.

Purple loosestrife is estimated to potentially impact an additional 12% of riparian habitats if it is not controlled, with Grant and Chelan Counties expected have the largest share of impacts with $932,000 and $726,000 respectively. The average direct loss per county due to purple loosestrife is an estimated $308,000. These economic impacts do not reflect the degradation of valuable wetland habitat and function.

Recreation in Wildlands		**$-6,156,000**
	Direct Impacts to Hunting	$-511,000
	Direct Impacts to Fishing	$-1,872,000
	Direct Impacts to Boating	$-3,773,000
Total		**$-6,156,000**

Total Economic Activity at Risk
Purple loosestrife effects on recreation industry suggests that more than $20.8 million in economic output is at risk across the Washington economy. Furthermore, 150 jobs in Washington would be at risk along with $6.6 million in lost labor income.

Control
Purple loosestrife is considered a Class B noxious weed in Washington state. Small infestations can be dug up, bagged, and disposed of, taking care not to disperse seeds. A key principle to loosestrife control is preventing seed production. When removing loosestrife plants, all plant parts and root ball must be discarded in trash or transported to a landfill in plastic bags or in an enclosed or securely tarped vehicle. Due to the highly invasive nature of loosestrife, composting is not a disposal option. Remove as much of the root system as possible because broken roots may sprout new plants. Brush off boots and clothes before leaving the infested area. Herbicides are also an effective control method but only use aquatic herbicides and obtain required permits for using herbicide near water. Please report all populations of these species to the King County Noxious Weed Control Program so we can prevent them from spreading further.

Noxious Weed Fact Card

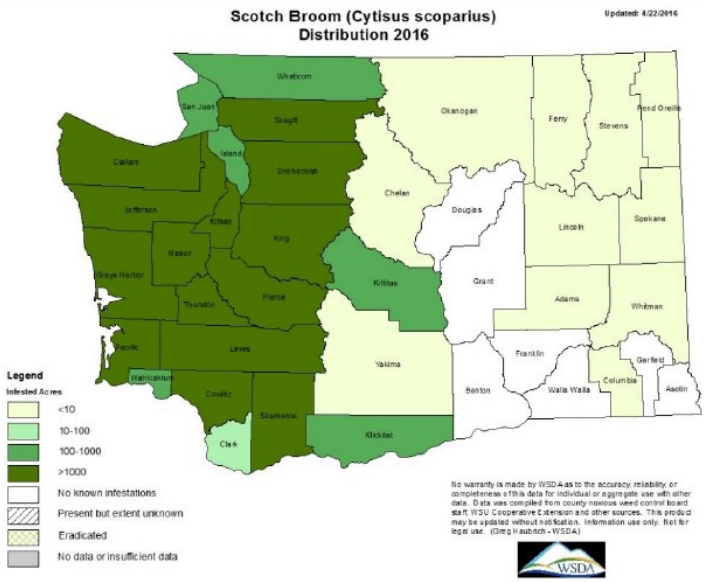
Scotch Broom (*Cytisus scoparius*)

Description

Scotch broom is a perennial evergreen shrub with numerous dark green angled branches with small, simple, or three-part deciduous leaves. The Class B noxious weed grows up to 8 to 10 feet tall and is in bloom from April to June with numerous bright yellow, pea-shaped flowers. As its seeds mature inside black, ripened pods, they are ejected and thrown several feet away from the parent plant to start new plants. Scotch broom roots have nitrogen-fixing bacteria in nodules that help it thrive in nutrient-poor soils.

Impacts

Cattle and livestock: Scotch broom creates dense stands that displace desirable, forage species. It is toxic to livestock.
Timber: Dense stands prevent forest regeneration after clearing.
Field crops: Outcompetes crops for nutrients and water.
Elk: Scotch broom is toxic to elk and reportedly may have once poisoned elk on the Olympic Peninsula. Encroaching Scotch broom reduces forage for elk, potentially reducing hunting opportunities.



Other Considerations

Costs of control: Scotch broom shrubs can produce an average of almost 10,000 seeds per year, which can remain viable in the soil for more than 30 years. This means that any control measures must be extremely long term.
Recreation: Scotch broom can grow in a variety of areas including natural areas, parkland and even dunes. These all increase the cost of parkland management significantly.
Fire hazard: Stands of Scotch broom provide dry biomass that is flammable and can elevate fires to tree canopies.
Environment: Scotch broom can alter soil chemistry and composition, making native plant restoration difficult.
Ecosystems: Scotch broom threatens rare or vulnerable ecosystems such as prairies and Garry oak woodlands.

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Direct Economic Impact of Species
Scotch broom is more abundant in western Washington and extremely difficult to eliminate due to its size, dense stands, and because seed can remain viable for at least 30 years. More than half the counties in Washington are considered to have a significant presence of Scotch broom. Because it is already so pervasive, the risk of increased spread is considered to be extremely high and Scotch broom could invade 35% of productive lands in afflicted counties if landowners stopped controlling it.

More than 1.8 million acres of rangeland and wildland are estimated to be at risk for Scotch broom infestation. A further 6.5 million of timberland is also considered to be at risk of Scotch broom infestation. Kittitas, Lewis and Grays Harbor Counties are the three counties estimated to experience the largest share of impacts from Scotch broom. Kittitas County is estimated to experience roughly $6.5 million in direct losses from Scotch broom. Lewis County and Grays Harbor County are estimated to have $6.2 million and $5.9 million in direct losses from Scotch broom, respectively. Scotch broom impacts average around $2.9 million per infested county.

Direct Impacts to Livestock	$-15,859,000
Direct Impacts to Timber	$-42,907,000
Direct Impacts to Hunting	$-971,000
Total	**$-59,737,000**

Total Economic Activity at Risk
Given Scotch broom's pervasiveness and high average direct impact per county, the wider impacts throughout the Washington economy are similarly significant. An estimated $142.8 million in business activity is expected to be at risk across the Washington economy. This lost business activity is associated with a loss of 660 jobs and more than $36 million in lost wages.

Control
Scotch broom is considered a class B noxious weed in Washington state. Plants shorter than three feet can be hand pulled when soil is moist. Larger plants can be wrenched out with specially designed weed tools which are available to borrow from the King County Noxious Weed Control Program. Cutting large plants near ground level where the stem is brown or yellow during the dry season (i.e. August-September) will kill most plants. Those that survive can be pulled or sprayed when they regrow. Take care to avoid spreading mature seed pods to non-infested areas. Selective herbicides are also an effective control method. Establish a healthy grass cover to reduce weed seed germination and continue to monitor the site.

Noxious Weed Fact Card

Giant Hogweed (*Heracleum mantegazzianum*)

Description

A member of the parsley family, its most impressive characteristic is its massive size. Giant hogweed reaches a height of 10 to 15 feet when in flower and has hollow stems, 2 to 4 inches in diameter, with dark reddish-purple raised spots and stiff bristle-like hairs. Coarse white hairs are also at the base of the leaf stalk. The sharply incised compound leaves grow up to 5 feet in width. White, umbrella shaped flower clusters up to 2 feet wide.

If skin comes into contact with sap, wash immediately with soap and water. Burned skin is very sensitive to sunlight, so keep any exposed areas covered when outside. After the burns subside, darkened areas or scars can persist for several years. The affected areas remain sensitive to sunlight so it is important to keep the burned areas away from direct sunlight as much as possible.

Impacts

Public health hazard. Sap can cause blistering of the skin and scarring. Do not get plant sap on skin. This Class A noxious weed is controlled throughout King County. It does not cause significant economic impact because outbreaks are reported and eradicated.

Control

Giant hogweed is considered a class A noxious weed in Washington state. Always avoid skin contact. Clear, watery sap in leaves and stems can cause burns, blisters and scarring. Mature plants can be killed by digging up at least the first 4 to 6 inches of the central root. Young plants often break off when being pulled from compacted soils, leaving the root to continue to grow. Be sure to bag flowers and seed heads and put in the trash. Wear proper clothing, shoes, and eye protection when attempting any control measures. Systemic herbicide applied to young or pre-flowering plants is another effective control method. Please report all populations of this plant to the County Weed Program so we can prevent it from spreading further.

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Noxious Weed Fact Card

Garlic Mustard (*Alliaria petiolata*)

Description

Garlic mustard, a Class A noxious weed, is a biennial or winter annual herb that generally grows 2-3 (up to 6) feet tall. Lower leaves are kidney-shaped with scalloped edges. Leaves feel hairless, and the root has an "S" or "L" shape just below the stem base. In spring, roots and new leaves smell like garlic, and small, four-petal white flowers appear clustered at stem ends, followed by long, skinny seedpods. This weed spreads by seed and can self-pollinate, helping it rapidly displace native plants along trails, in forests, and on riverbanks, among other areas.

Impacts

Garlic mustard has infested and degraded immeasurable amounts of woodland habitat in City of Seattle Parks properties and nearby private properties, but garlic mustard has also moved into Bellevue, properties along the Cedar River, North Bend, Tukwila, Shoreline and other parts of the county. Early detection, containment and eradication of new sites is of the highest priority.

Because this is a controlled Class A noxious weed, it has not spread enough into King County for economic impacts to be measured. However, garlic mustard is almost impossible to remove once it has established itself in a new site. See controls below.

Control

Make sure to get expert identification before controlling. This plant closely resembles many native plants. For mature plants, carefully pull by hand, loosening soil and removing entire root. The plant will sprout from the root crown if it breaks off. For young plants, hand pulling is NOT recommended. Rosettes tend to snap off at the root, allowing the plant to re-sprout. Dig up rosettes with a trowel or use an herbicide. Bag up and discard all plant matter in garbage. A key principle to garlic mustard control is preventing seed production. Spraying young plants with herbicide is an effective control method. Please report all populations of this plant to the county weed program so we can prevent it from spreading further.

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Optional Activity

Identification Challenge

Some invasive plants look very similar to native plants that are important to our ecosystems. Others are nearly identical to edible introduced plants and have been accidently eaten by people or animals. See if you can spot the dangers below!

Materials: Writing utensil

Compare the photos below. In each set, there is at least one noxious weed, and a plant that looks similar enough that people often pull it by mistake. Can you spot the difference? Use the info attached to help determine which is which. When you think you know which is a noxious weed, circle or draw arrows pointing to the parts of each plant that acted as clues for you to tell the difference.

English holly, a King County noxious weed of concern, is a large, dense, slow-growing evergreen tree or shrub found throughout King County, from natural areas to native forests. Plants reach 15-50 feet tall and 15 feet wide. 1-3-inch-long, thick, glossy, dark green, wavy, and usually spiny leaves grow alternate on stems. Small, whitish, sweetly scented flowers lead in winter to red, yellow, or orange berries. English holly berries are poisonous to humans and pets. In comparison, the native Oregon grape produces blue, edible berries. Its leaves are paired instead of alternating, with less pronounced points.

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Both noxious weed herb Robert and native bleeding heart are low-growing plants found in shaded forest understory. Herb Robert's 5-petaled flowers are in all shades of pink and sometimes white, as opposed to the pink namesake flowers of native bleeding heart. Overall, herb Robert is covered with short glandular hairs, giving the plant a sticky feel and a distinct odor (sometimes this plant is known as "stinky Bob"), where bleeding heart is smoother. Shallow, weak roots make herb Robert easy to pull although large infestations can be highly labor-intensive to remove.


Trailing blackberry is a native species of blackberry in Washington that is smaller, generally grows along the ground, has narrow prickly stems instead of stout, star-shaped or ridged canes, and has only three narrower leaves instead of five rounded leaves like the invasive Himalayan blackberry. All species of blackberry have edible fruits, but the fruits on the native trailing blackberry are smaller (but tastier!).

The noxious weed giant hogweed is similar in appearance to our native cow parsnip, only it is much larger, the purplish blotches are more raised and bumpy, and the hairs on the under surface of the leaf are shorter (about 0.25 mm long). Cow parsnip seeds also tend to be wider at the base whereas giant hogweed seeds are more often elliptical, the same width at the base and seed tip.

(photo credit Ben Legler)

Flowering poison-hemlock may be confused with wild carrot (*Daucus carota*, or Queen Anne's Lace). In contrast with poison-hemlock, wild carrot has one densely packed umbrella-shaped flower cluster on a narrow, hairy stem, usually with one purple flower in the center of the flower cluster, and is usually 3 feet tall or less. Wild carrot also flowers later in the summer. While both species are invasive plants, wild carrot is not poisonous and causes less of an impact in King County. Poison-hemlock is poisonous to ingest and is controlled as much as possible especially in public places where people could be harmed by it.

Optional Activity

Noxious Weed Cutting

Identifying noxious weeds can be a challenge, especially since many resemble other plants. Sometimes the best way to identify a plant is with a sample. By preserving a sample from an invasive plant, you can also assist others in recognizing it.

Materials: A book (hardcover is ideal), paper towels, gloves (recommended)

Identify a noxious weed in your neighborhood that you can safely pick. Weeds with thorns are not recommended for this activity. ***With an adult's permission***, pull it up by the roots. Garden gloves are recommended for this action. Save a portion of the plant that includes the stem and several leaves and flowers if they are present. The rest of the plant can go in municipal compost, but not in a home composting system. Place your plant cutting between paper towels and press it under a heavy surface like a stack of hardback books. Allow this to sit overnight or longer. Once it is pressed, attach a paper label to your cutting that includes the species name, date and the site where you collected it. Now you have a long-lasting sample of a noxious plant species.

One way to share your plant would be using social media. If you do, don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!

An English ivy sample ready to be pressed and labeled

Optional Activity

Noxious Weed Stewardship Challenge for Day 3

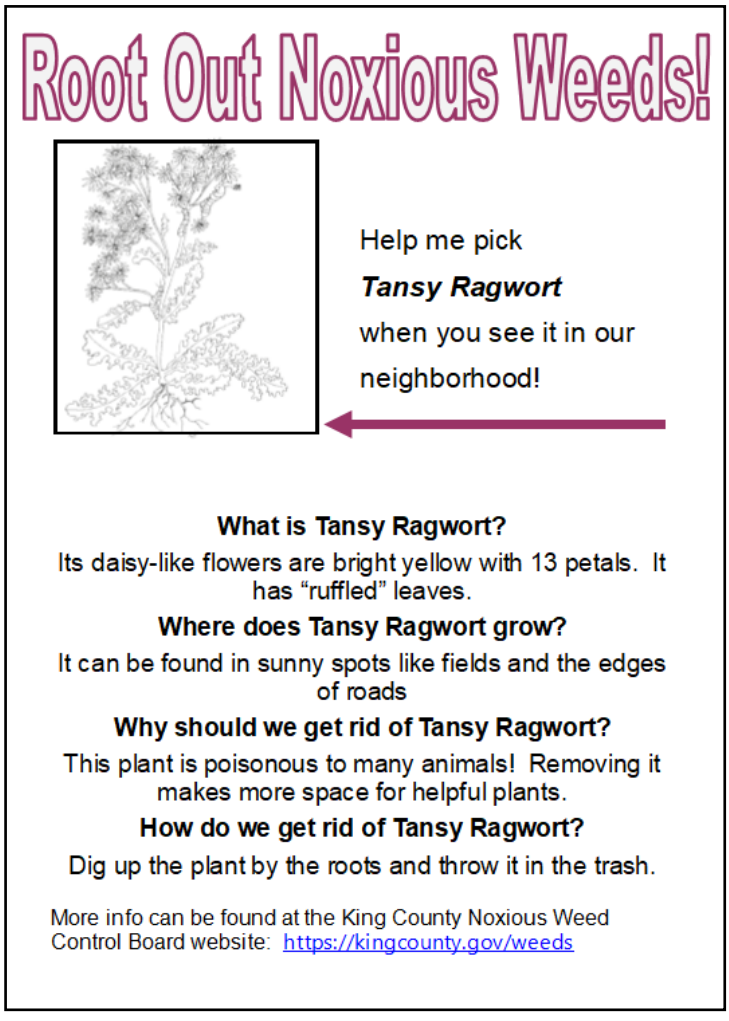
One of the most important ways we can prevent the spread of noxious weeds is by teaching people how to spot them so they can report them.

Materials: Writing utensil, paper, any coloring supplies or art supplies you would like

Create a poster to hang in a window to help teach your neighbors about the noxious weed you researched. Put a picture or a drawing of the noxious weed on your poster. Be sure to include a few facts about the noxious weed such as some identifying features, what adaptations help it grow in Washington, and how it harms local ecosystems. Tell people what they should do if they find this plant. When you are done, share this poster by hanging it in a window or posting it on social media to help others learn about noxious weeds near you.

Challenge yourself to post all the things you are doing with your friends and family to help control the spread of noxious weeds! Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!

Example poster!



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DAY 4

Prevention and Best Management Practices

Now that you understand the categories of noxious weeds and how to identify those common across King County, it's time to explore means and methods of control.

The first consideration is setting a goal that matches the scope of the noxious weed infestation. With most Class A noxious weeds, the goal is to eradicate them in the county. This means removing every single plant, as well as the seeds, roots, stems and leaves that could regrow. With Class B and C noxious weeds, the goal is to control their spread. This means stopping new infestations, especially into public parks and protected natural areas, because these noxious weeds may already be too common to realistically eradicate.

One important way to control noxious weeds is prevention, which we explored on Day 1. If we understand how different noxious weeds spread, we can prevent that with simple practices like banning the sale of these plants at stores, having people check their clothes, shoes, pets, and boats for the "hitchhiking" seeds of these plants, and giving people native plant alternatives to grow in their gardens. If noxious weeds can't spread into our communities, they won't need to be controlled later.

When noxious weeds are already in our communities, King County Noxious Weed Control Program (KCNWCP) has **Best Management Practices**, the most effective strategies to eradicate them. These practices are based on scientific studies and observations of each plant, and also consider the scale of the infestation. It is vital to use the right method for controlling each different noxious weed in each different situation. For instance, removing one poison-hemlock plant in a yard will require different strategies than removing thousands of plants that have grown on the side of the highway. Small infestations, plants with weak root systems, and plants that have grown around native plants that we don't want to damage can be pulled up by hand and thrown away (most plants can go in the municipal compost, with the exception of tansy ragwort which remains toxic). Noxious weeds with deep roots need to be dug out with shovels or special tools. Some large infestations can be more efficiently managed if they are eaten by goats, covered in tarps and mulch, or even safely burned by the county in extreme cases. With plants like Bohemian knotweed, the best management practice is to inject knotweed stems with an **herbicide** (i.e. a plant-killing poison) directly, so that the herbicide cannot damage other plants or the environment.

Vocabulary

Best Management Practices: The most effective strategies for getting rid of noxious weeds
Herbicide: A chemical that was engineered to kill plants
Erosion: The wearing down of rocks and soil by wind and weather that damages hillsides and fills bodies of water with dirt
Restoration: Replanting an area with native plant species to recreate a healthy ecosystem

Main Activity

"Let's Pull Together!"

There are lots of challenges when it comes to fighting noxious weeds. Let's think a little about three common noxious weeds here in King County, and some of the ways we can fight them.

Materials: Writing utensil, paper

The following is an excerpt from an April 10, 2020 post on the King County Noxious Weeds Control Program blog. It contains a discussion of three different noxious weeds: English ivy, Himalayan blackberry, and poison-hemlock. Read the article, and for each plant, answer three questions on the pages that follow.

"Let's Pull Together" (10 Apr 2020) *Source: https://kingcountyweeds.com/2020/04/10/lets-pull-together/*

Another way to help is to control the weeds in your backyard or community space. Weeds don't respect property lines so the weeds on your property could be spreading to your neighbors or into a nearby natural area. But don't despair! Weed control is possible even if you can't do it all at once. Not only will you have a sense of satisfaction from helping protect the environment, but spending time gardening (including pulling weeds) has been proven to lower stress and improve physical as well as mental health.

Here are some common weeds that you just might have outside right now.
English ivy was planted in lots of gardens in Washington. The evergreen vine grows and spreads very quickly and can even grow in the shade. These qualities that people liked are the same reasons it is such a problematic weed. Ivy doesn't stay where it's planted. Birds eat the black berries, which are poisonous to people, and spread seedlings. In a natural area, ivy will quickly smother all the plants in the understory. Then it starts growing up trees.

The vines can grow up to 90 feet long; they make trees sick, prone to rot and more likely to blow over in a windstorm. Plus rats (and other rodents that carry disease) love making their homes in the dense vegetation.

*Some folks have planted ivy on slopes hoping it will provide **erosion** control. But, ivy roots only go a few inches deep and don't do a good job holding onto the soil. So ivy can actually make slopes more likely to fail. But those puny roots also mean that you can pull ivy out with your bare hands! (Always wear gloves).*

English ivy smothers trees and can lead to early death (photo by Karen Peterson)

Early spring is a great time to pull ivy since the soil is still nice and loose from winter rains. If ivy has climbed up your tree, you don't need to pull it all down right away. Make your tree a life ring! Go around the trunk and cut all of the ivy stems and then pull the lower ivy away from the tree, making about a 6 foot cleared ring around the base. The ivy needs to have roots in the ground to survive, so the upper ivy will die and dry out, making it much easier to pull down.

Ouch!

Himalayan blackberry is one of the most recognizable weeds in the Pacific Northwest. It was originally planted for its delicious berries, but the plants almost immediately jumped garden fences and headed into natural areas. Once this plant gets established it can be a real pain!

Blackberry can take over streambanks ("Urban Kokanee Streams" by USFWS – Pacific Region is under license by CC 2.0)

It grows into dense, thorny thickets up to 15 feet tall. This makes it very difficult for animals (including humans) to move through. When blackberry takes over the understory of forests the thickets shade out native tree seedlings and prevent them from growing. Blackberry is common along streambanks, which can cause erosion and damage salmon habitat.

Blackberry spreads by its canes that can root every place they touch the ground and also spreads by seed (humans aren't the only animals eating those tasty berries in the summer). Digging out seedlings when you first notice them is the easiest way to control this plant. Once it is well-established digging plants out is effective, but very labor-intensive.

Goats make cute mowers! (The Buffet by floodllama is licensed by CC2.0)

Some people have good luck by repeatedly mowing blackberries with machinery… or goats! Over time this will weaken the plants and at least leave you with fewer to dig out. Although blackberry damages our environment and reduces habitat for many animals, some birds use the thickets as a place to build their nests. If you see birds visiting your blackberry thickets, you might want to avoid controlling the blackberry during nesting season from April 1 – August 15, or just control the smaller patches around the edges. Replacing the blackberry with native plants will attract native birds and will help discourage the weeds from coming back.

Young poison-hemlock plants look like wild carrots

Poison-hemlock stems are hollow with red or purple blotches or spots and are not hairy

Another way we can all protect the health of our communities and environment is by looking out for and getting rid of poison-hemlock. It's in the carrot family and looks kind of like a wild carrot, especially when young. But, every part of poison-hemlock is toxic and can even be deadly if eaten by people or animals.

Mowing, weed-whacking or burning this plant is highly discouraged because the toxins can be released into the air and breathed in, making you very sick. Some people are sensitive to the sap and extensive contact can lead to the toxins being absorbed through the skin.

I know that all sounds pretty scary, but by taking a few simple precautions anyone can help control this plant. Always wear gloves, long sleeves, and long pants or leggings. In soft soil you can often grab the stem at the base and pull up the long taproot (just like pulling out a carrot). Or you can dig the plants out making sure you get as much of that taproot as possible. When you're done put the plants in a plastic bag and put in the trash, not the yard waste and definitely not your home compost. Poison-hemlock stems can stay toxic for up to 3 years, even when dried. If you see poison-hemlock growing on public land like a park or next to a road let us know about it!

Right now little efforts by all of us can make a big difference. If we all pull together we can make our neighborhoods safe and healthy places for everyone to enjoy.

Poison-hemlock gets tall, but it's still easy to dig up (photo by Jeanette Jurgensen)

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Questions:

What impacts do English ivy plants have on an ecosystem?

What precautions should we take while removing English ivy?

What steps do we take to remove English ivy?

What impacts do Himalayan blackberry plants have on an ecosystem?

What precautions should we take while removing Himalayan blackberry?

What steps do we take to remove Himalayan blackberry?

What impacts do poison-hemlock plants have on an ecosystem?

What precautions should we take while removing poison-hemlock?

What steps do we take to remove poison-hemlock?

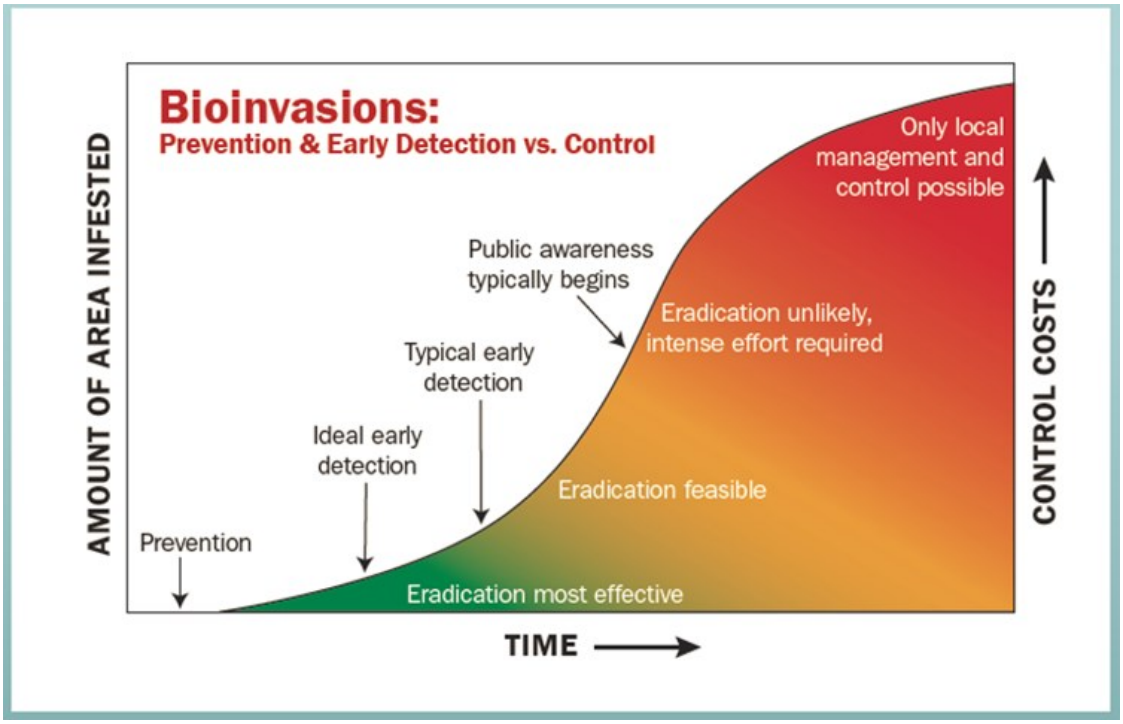
Optional Activity

Early Detection, Rapid Response

We've talked about methods to control noxious weeds already in our ecosystems. But the landscape around us isn't static, and our response to weeds can't be either. Let's consider a timeline for a noxious weed infestation and what our response could look like at different times.

Materials: Writing utensil

Using the figure below, answer the questions that follow.



From Washington Pest Watch: https://invasivespecies.wa.gov/educational-materials/teacher-curriculum/

Questions:

What is the relationship between time, amount of area infested, and control costs according to this graph?

Where would Class A, B, and C noxious weeds fit on the curve of this graph? Which class corresponds to which color (green, orange, or red)?

What would be the ideal outcome when handling a new infestation of a noxious weed? When in the infestation is the ideal time to begin a response to obtain that outcome? What challenges would potentially prevent that response from occurring?

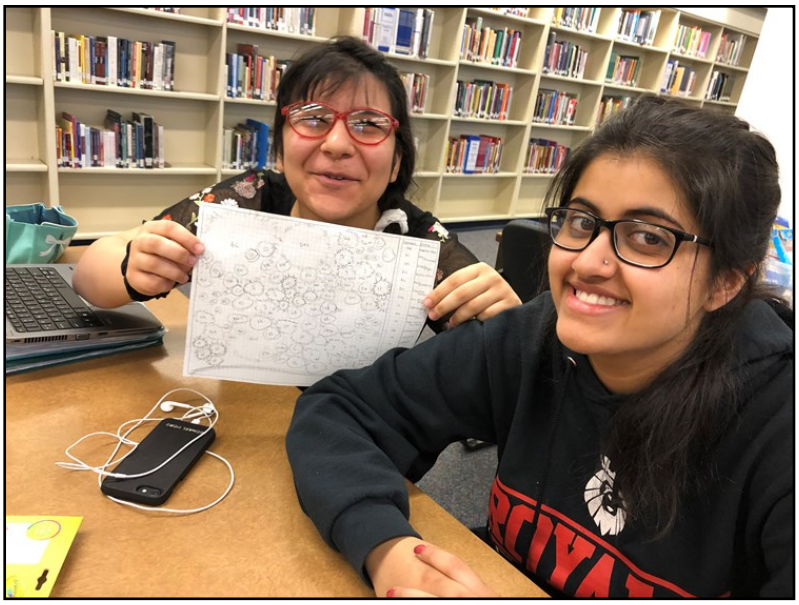
Optional Activity

Noxious Weed Stewardship Challenge for Day 4

After noxious weeds are removed from an area, it is vital to replace them with native plants so that new invasive plants won't regrow in the newly cleared soil. This step helps to recreate the ecosystem that was lost. Thus, the **restoration** of an area is as important as removing noxious weeds.

Materials: Writing and coloring utensils, paper, computer/phone/tablet, internet connection

Think of a place in your community that is currently infested with noxious weeds. Create a map of this site, including any features of the landscape such as trails, bridges, fences, or roads. Then label which native plants you would plant in it after noxious weeds have been removed. Use the example and table below to help you pick out plants and design your space.



Check out the native garden these students have designed!

***HINTS*:**

- It is usually a good idea to group small plants together with others of the same kind.
- If you want to be able to see all of your plants, make sure to put the small ones in front and the big ones in back!
- When choosing plants to put near a big tree, try to find ones that don't need much sun. Some trees can act like a giant umbrella, creating a lot of shade!

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When you're finished it might look something like this, but with fewer plants:

There is a lot going on there! Every item in this image is like one piece of a natural puzzle, with each item representing a single plant. For example, the small circle with 'LOG' refers to a native plant called 'Low Oregon Grape,' while the larger items labeled 'WRC' refer to a tree known as 'Western Red Cedar.' Put together in one single location, these plants form the foundation for a healthy and wonderful ecosystem!

Challenge yourself to post this responsible planting activity you are doing with your friends and family to help control the spread of noxious weeds! Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!

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The table on the next two pages lists many types of native plants, as well as the conditions under which they grow the best. Take these into consideration as you plan your native garden.

	Plant Name	Sun Needs 1=Little 2=Some 3=LOTS	Water Needs 1=Little 2=Some 3=LOTS	Size S=Small M=Medium L=Large	Flowers?	Fruit?
Trees	Vine Maple (VM)	☼	6	M	No	No
	Bigleaf Maple (BM)	☼☼	6	L	No	No
	Madrona (MAD)	☼☼	6	L	No	No
	Paper Birch (PB)	☼☼	66	L	No	No
	Pacific Crabapple (PC)	☼☼☼	666	M	Yes	Yes
	Douglas Fir (DF)	☼☼☼	66	L	No	No
	Shore Pine (SP)	☼☼	66	M	No	No
	Quaking Aspen (QA)	☼☼☼	66	M	No	No
	Western Red Cedar (WRC)	☼	66	L	No	No
Shrubs/ Bushes	Beaked Hazelnut (BH)	☼☼	66	M	No	No
	Oceanspray (OS)	☼☼	66	M	Yes	No
	Tall Oregon Grape (TOG)	☼☼	66	M	Yes	Yes
	Low Oregon Grape (LOG)	☼	66	M	Yes	Yes
	Bald Hip Rose (BHR)	☼☼	66	M	Yes	No
	Black Cap Raspberry (BCR)	☼☼☼	66	M	Yes	Yes
	Rhododendron (RHO)	☼	66	M	Yes	No
	Thimbleberry (THM)	☼☼	66	M	Yes	Yes
	Salmonberry (SB)	☼☼	666	M	Yes	Yes
	Red Huckleberry (RH)	☼	66	M	Yes	Yes

	Plant Name	Sun Needs 1=Little 2=Some 3=LOTS	Water Needs 1=Little 2=Some 3=LOTS	Size S=Small M=Medium L=Large	Flowers?	Fruit?
Small plants/ Ground-cover	Columbine (COL)	☼☼☼	ϭϭϭ	S	Yes	No
	Douglas Aster (DA)	☼☼☼	ϭϭ	S	Yes	No
	Salal (SAL)	☼	ϭϭ	S	Yes	Yes
	Camas (CAM)	☼☼☼	ϭϭ	S	Yes	No
	Bleeding Heart (BLH)	☼	ϭϭ	S	Yes	No
	Swamp Lantern (SL)	☼	ϭϭϭ	S	No	No
	Cattail (CAT)	☼☼☼	ϭϭ	M	No	No
	Trailing Blackberry (TB)	☼☼	ϭϭ	S	Yes	Yes
	Dagger-leaved rush (DLR)	☼☼☼	ϭϭϭ	S	No	No
	Sword Fern (SF)	☼	ϭϭ	M	No	No
	Goldenrod (GOL)	☼☼☼	ϭϭ	S	Yes	No
	Wild strawberry (WS)	☼	ϭϭ	S	Yes	Yes
	Silverweed (SIL)	☼☼☼	ϭϭϭ	S	Yes	No
	Foam flower (FF)	☼	ϭϭϭ	S	Yes	No
	Stream Violet (SV)	☼	ϭϭϭ	S	Yes	No
	Yellow Monkey Flower (YMF)	☼☼	ϭϭϭ	S	Yes	No

DAY 5

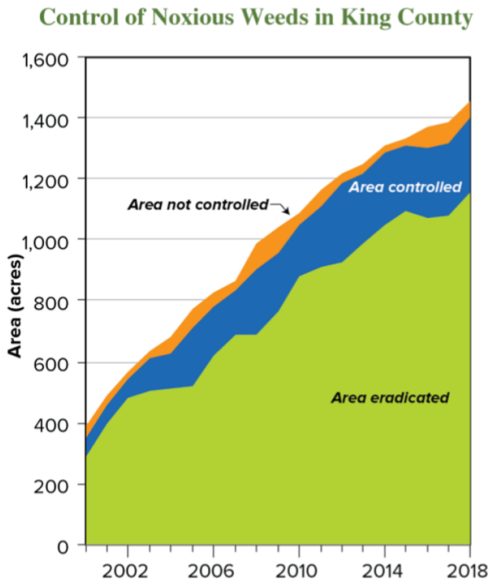
Plan a Solution

This past week, we've explored the nuances of the challenge of noxious weeds. We've thought about what it means for a plant to be a noxious weed, and how human behaviors spread noxious weeds to fragile ecosystems. We've thought about what makes noxious weeds harmful to ecosystems and economies. We've learned the preventative measures every person in King County can take. But what can individual people do to control noxious weeds that have already infested our ecosystems?

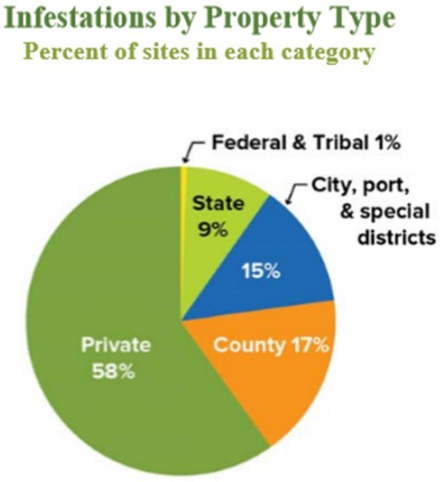
Local high school students work together to restore native prairie ecosystems

Noxious weeds are an **anthropogenic** problem, caused by deliberate or unintentional introduction of new plants to our ecosystems by humans. If we do nothing about noxious weeds, they will continue to grow and harm native species. The biodiversity of the natural places we love will go down, and the plants and animals we care about could even go **extinct**.

This does not have to be the future for ecosystems in the Pacific Northwest. There are many ways to practice **stewardship** and get involved removing noxious weeds in your community. From King County programs removing garlic mustard, to you and your neighbors pulling English ivy, all the way to just you and your friends reporting sightings of noxious weeds to King County, every little bit helps control noxious weeds.



Most of the noxious weed infestations reported to KCNWCP have been eradicated.



Most remaining noxious weed infestations in King County are on private property, often in our own backyards.

Vocabulary

Anthropogenic: Caused by human activities

Extinct: All of the members of this species have died out in the wild

Stewardship: The duty we have to take care of the natural world around us

Main Activity

Looking at King County Recommendations

In order to make a difference, we must understand how to best remove the noxious weeds that are threatening our own communities.

Materials: Writing utensil, (if possible) computer/phone/tablet and internet connection

Select one invasive plant that you have researched this week, one that you have found in your own community. ***With an adult's permission***, find the Weed Alert and Best Management Practices for the weed here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/brochures-reports/brochures-by-species.aspx
If you cannot go online, check out the Best Management Practices for Himalayan blackberry provided after the questions. Answer the questions below.

Summarize how KCNWCP recommends removing this plant in your own words, discussing each form of control (manual, mechanical, biological, chemical if reasonable). Which ones are a realistic solution for you and your community? Why?

Are there other obstacles to removing these weeds? Are they on private property, or in a public place? Who would you have to contact to remove them?

Based on the Best Management Practices for the species and scale of the infestation, is there any additional equipment removal would require? Would you need the support of more people? Describe these challenges below.

After the noxious weed infestation has been removed, what steps would you take to ensure that lingering seeds or new weeds do not cause another infestation?

Control methods for Himalayan blackberry:
"For best results, control methods should be adaptive and employed throughout several growing seasons. Minimize impacts to wildlife, native plants, and pollinators by timing activities carefully and replacing blackberry with beneficial plants. Cover bare soil with mulch, erosion control fabric, or other material, especially near water.

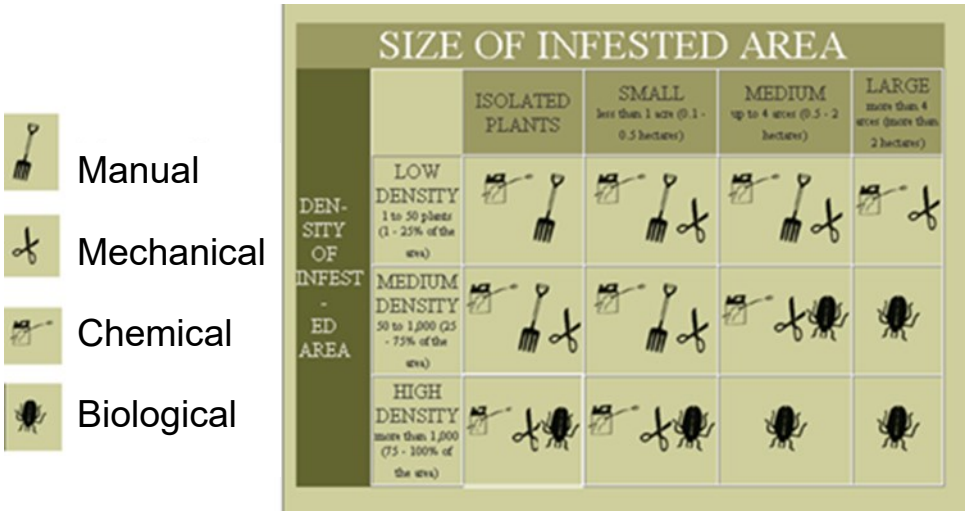
Manual: Effective on small infestations (less than 200 square feet). Uproot small plants by loosening soil around roots and pulling by hand, or remove with stout digging tools like mattocks. For larger, more mature stands, cut canes with loppers or pruners and dig up the remaining rootballs. Small cane fragments can be left in place as mulch; larger cane sections can be piled up to compost on site or burned if allowed in your area. Root balls may regrow and should be discarded with yard waste.

Mechanical: Mowing, including the use of riding mowers and tractor-mounted mowers, can be very effective in controlling blackberries. However, do not use mowers or tractors on sites that are wet or susceptible to compaction or erosion. Instead use loppers, or a hand-held brush cutter or hedge trimmer. Cut 5 times per year for best results. If cutting only once per year, most effective when the plant begins to flower. Make sure to return the following year; without follow-up, the plant may regrow at a greater density than before. In agricultural areas cultivation can also be effective.

Biological: Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques. Biological control methods that may assist in blackberry control include the use of goats and chickens as follows:

Goats and pigs may be effective on clearing or controlling blackberry regrowth from a year to four years old. On mature stands, goats tend to only strip leaves off of the canes. Animals may prefer alternative forage available, so reduce opportunities for selective browsing. Grazing must be continuous or else regrowth will occur. Care needs to be taken to fence off or protect any native or other valuable vegetation. The King Conservation District can provide further information of the use and management of goats for weed control. Chickens can potentially decrease the seed bank in blackberry cleared areas by grazing on the seeds.

(Please note, safe chemical control is an option that is not included here. Manual, mechanical and biological methods are preferred).



The solution depends on the scale of the problem

Optional Activity

Letter Writing

Sometimes efforts to remove noxious weeds work best when they are planned at a higher level. Writing a letter can inspire larger groups to get involved in stopping noxious weeds.

Materials: Writing utensil, paper

Write a letter to a community member explaining why removing noxious weeds is important. Focus on a noxious weed you have learned about this week. Discuss the threats posed by this noxious weed, and the recommended strategies for removing it. Your letter should also explain what noxious weeds are, how they can be harmful to the environment and your community, and how removing them is helpful.

Your letter can be to a neighbor, your school's principal, the King County Noxious Weed Control Board, or even your state legislator. If possible, send your letter.

Optional Activity

Noxious Weeds Pledge

Even if there aren't any invasive plants you can remove right now, you can still have a huge impact. Preventing the spread of noxious weeds is as important as stopping them once they're here.

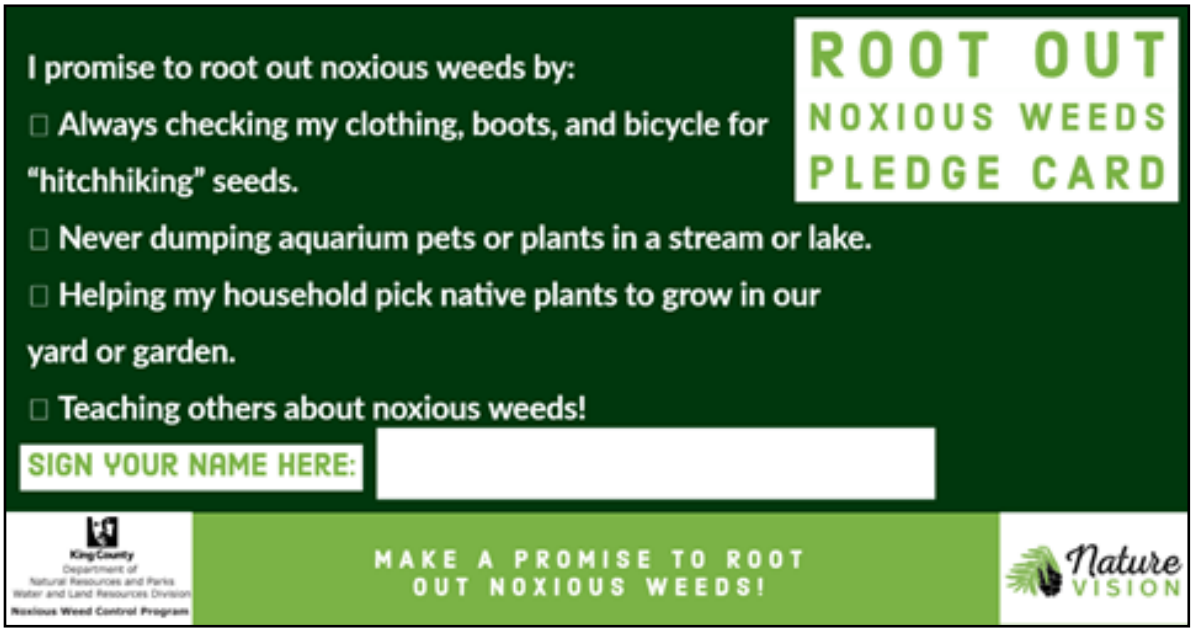
Materials: Writing utensil

Think back through the activities this week. Why is noxious weed prevention as important as eradication and control? (Reread Prevention is the Best Medicine from Day 1 and the background information for Day 4 to inform your answer).

The tragedy of the commons is a conundrum where individual people, acting in their own best interest, cause the deterioration of natural shared resources. Examples of this are all around us. Why should people put in the effort to pull English ivy out of their lawns, or go to the trouble to wash their boats every time they exit a waterway? How do you convince someone to obey the apple maggot quarantine, or brush the seeds off their shoes after a long and exhausting hike through a forest?

For most folks, the answer to this question is: because the government told me to. This is an unsatisfying answer that does not inspire positive change or encourage the preventative behavior we need from everyone if we want a chance to stop the next tansy ragwort or Himalayan blackberry from being introduced into the Pacific Northwest. How would you inspire an adult to care about preventing the spread of noxious weeds?

Read through the “Root Out Noxious Weeds” pledge below. Check off the commitments you are going to make to prevent the spread of noxious weeds. Then, show this card to your household, or even your community via social media to challenge and educate others.



Optional Activity

More Information

***Materials**:* (Optional) computer/phone/tablet, internet connection

To the untrained eye, both of these photos show us a “beautiful” natural landscape that has been “unaffected” by human activity. With the skills you have developed this week, you can observe our parks and other green spaces with a more critical eye. If every person in King County made the effort to identify, report and stop noxious weeds, the ecosystems around us would be healthier and more robust.

One self-defeating mindset is that noxious weeds are an inevitable consequence of human behaviors we cannot hope to change. This way of thinking has failed us in the past. For instance, English ivy was deliberately planted on hillsides in the Pacific Northwest because people noticed how aggressively it spread and hoped that it would stop erosion. This plan backfired because the shallow roots of the English ivy failed to hold onto soil, and because the ivy felled surrounding trees that were helping hold the hillsides together and sequestered carbon dioxide.

Our ecosystems deserve better. A biodiverse temperate rainforest full of Douglas fir, sword ferns, salmonberry, salal, and Oregon grape supports the wildlife that we love, while endless acres of garlic mustard just makes for sick pollinators and deer that have to migrate elsewhere.

We can stop the spread of noxious weeds if we are well-equipped with knowledge and surrounded by a community committed to making our world better, one plant at a time. Thank you for your time and your determination this week!

If you are interested in finding out more information about noxious weeds and what people are doing in your area, there are lots of great resources you check out on the internet with an adult's permission.

Report noxious weeds you see near you here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/infestation-form.aspx

If you'd like to see what noxious weeds have been reported near you, there's a map on the King County Noxious Weed Control Program webpage here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/maps.aspx

If you'd like to know what kind of work is being done in your community, check out the KCNWCP Volunteer Information page here: https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/volunteer-information.aspx

For a handy guide to some of the most common noxious weeds in King County, check out the KCNWCP Neighborhood Bullies Handout: https://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/Neighborhood-Bullies.pdf

Optional Activity

Noxious Weed Stewardship Challenge for Day 5

Now that we know the impact noxious weeds have, let's make a positive change in our own communities.

Materials: Gloves, shovels and other gardening equipment if appropriate.

If you can, go outside ***with your parent or caregiver***. Using the guidelines you researched in the previous activity, gather the tools you need to safely remove your noxious weed from your neighborhood. Get the members of your household involved and make a plan. Which weeds are you removing? What supplies do you need (Gloves? Tools? Garbage bags? Tarps?) If the weeds are on public property (i.e. in a park, on a school campus, etc.), who will you need to contact about removing them?

Just make sure to carefully consider any plant you want to remove. Ask yourself three questions.

1. Is it safe for me to remove this plant? (Remember- it doesn't have to be poisonous or thorny to be dangerous- could the ivy you're pulling knock a tree branch down onto you?!)
2. Am I confident this is a noxious weed? (Check the KCNWCP website if you're not sure)
3. Was this plant put here on purpose? (Lots of people still grow plants like English ivy in their yards. Remember, someone will learn a lot more from being told about the dangers of noxious weeds than being mad that their "perfect" garden was messed up.)

If the answer to any of these questions is NO, leave the plant alone for now. Report the noxious weed(s) on the King County website if you can. Don't worry. There's still a lot you can do to help. Check out the activities below!

Challenge yourself to post all the things you are doing with your friends and family to help control the spread of noxious weeds! Don't forget to use the hashtags #kingcountyweeds and #wainvasives and tag @kingcountyweeds @WAInvasiveSpeciesCouncil @PlayCleanGo @naturevisionorg in your post so we can see your work!

Answer Key

Day 1 Main Activity: Mapping Activity

List the noxious weeds you found in your community.

Student answers will vary.

Are there different infestation patterns for different noxious weeds? Based on your observations, are there noxious weeds that take over riparian areas (the land around rivers, lakes and streams)? Are there noxious weeds that infest parks, or forests, or agricultural areas?

Different noxious weeds have different infestation patterns because they take over different types of habitat. For instance, tansy ragwort is well adapted to take over open fields and prairies, while giant knotweed lines the banks of rivers and other riparian areas.

Based on the map above, what noxious weeds are most prevalent throughout King County? What noxious weeds do we find in heavily urbanized areas? What noxious weeds do we find in more rural areas?

Tansy ragwort is the most prevalent weed throughout King County, with 5,521 separate infestations surveyed. However, tansy ragwort is mostly found in more rural areas, where the open fields and prairies that are its preferred habitat are more common. In comparison, giant hogweed, garlic mustard, and other Class B noxious weeds are more common in urban areas, especially around Seattle.

Answer Key

Day 1 Optional Activity: Noxious Weeds Abroad

How did lupine arrive in ecosystems in Norway?

Lupine was introduced to ecosystems in Norway by humans who wanted to grow it in their gardens. The lupine seeds escaped from gardens and yards, spreading into nearby ecosystems.

Why is lupine causing problems?

Despite adding nutrients like nitrogen back to the soil, lupine is still a noxious weed because it is growing faster and earlier in the season than native plants. The shade lupine produces prevents the native plants from getting the sunlight they need.

Based on the text, what is a “bottom-up” effect? Define it in your own words.

A bottom-up effect is when a loss of plant biodiversity in an ecosystem negatively impacts the herbivores that eat those plants, and the carnivores that eat those herbivores. This means the living things at all trophic levels are negatively impacted.

One takeaway from this article might be “well, noxious weeds aren’t so bad, then”, because lupine adds nutrients back to the soil and is a “pretty” plant. How would you refute this argument?

Lupine is no substitute for the native plants that make up the foundations of the ecosystems in Norway. The improvement in soil quality will not help if native plants are extirpated from the ecosystem, as this will negatively impact pollinators and herbivores, and ultimately harm every organism that is part of the ecosystem.

Answer Key

Day 1 Optional Activity: Prevention is the Best Medicine

Dog:

The seeds stuck to this dog could easily be spread to a new place. Always check your pet's fur for hitchhiking seeds before leaving a natural area.

Lawn mower:

Mowing down noxious weeds can spread the plant to other parts of your lawn. Even worse, some noxious weeds can release hazardous fumes when mowed. Only mow if it is recommended by the noxious weed's Best Management Practices.

Boots:

The seeds of noxious weeds can be spread by sticking to our shoes, especially the fabric of our shoelaces. It is good practice to brush off your shoes before leaving a natural area.

Boat motor:

Aquatic noxious weeds can latch onto boats, especially the motor. Always check your boat when you remove it from the water, or when entering a new body of water.

Blowing dandelion fluff:

Noxious weeds like bull thistle rely on the wind to spread their seeds. Many noxious weeds are best removed before they flower and go to seed.

Pouring out aquarium:

The contents of aquariums should never be disposed of in rivers, lakes or streams. Noxious weeds can be spread from popular aquarium plants. Instead, spread aquarium gravel on the ground to dry out on a hot day, or throw all aquarium contents into the trash.

Answer Key

Day 1 Noxious Weeds Challenge

Native plants: *Salal, Sword Fern, Bleeding Heart, Osoberry, Snowberry*
Noxious Weeds:

Garlic mustard: Allelopathic, small seeds can stick to clothes. Garlic mustard was brought to the Americas as a food for its flavor. Brushing clothes off can prevent spread of Garlic mustard.

English ivy: Grows quickly to cover other plants and can harbor pests like rats. English ivy was brought to the Americas as a garden plant. Pulling ivy up by the roots and throwing it in the garbage or municipal compost (not into a compost pile, as it can grow back) or storing it up in a tree where the roots can't get to the ground will keep it from spreading.

Purple loosestrife: Spreads quickly through lots of seeds and clogs wetlands. Seeds from Purple loosestrife got carried on ships both accidentally and to be planted in gardens. King County uses special methods to try and control purple loosestrife. It can also be pulled out if you are able to remove all the roots.

Tansy ragwort: Can poison wildlife, horses, and other animals. Tansy ragwort arrived in the Americas in hay transported for animals. Try to pull up tansy ragwort (wear gloves) after it forms a shoot but before it flowers and makes seeds. If it has flowered, be extra careful to dispose of plants in the trash, not the compost.

Herb Robert: Spreads quickly and prevents other plants from growing. Herb Robert was used for gardens then escaped. Herb Robert is fairly easy to pull because the roots are shallow.

Answer Key

Day 2 Main Activity: Ecosystem Impacts

An “alien” species is a species of organism that was introduced to an ecosystem by humans. How is this different from an invasive species? How is it different from a noxious weed? Are all invasive species “alien”? Are all noxious weeds “alien”? Could a species be “alien” to an ecosystem and not be invasive or noxious? How?

While invasive species are introduced to an ecosystem by humans, the problem is not that they came from somewhere else, but that they spread aggressively once they arrive in a new ecosystem. Similarly, noxious weeds are “alien” and invasive to the ecosystem that they’ve been introduced too, but they are also actively harming plants, animals and/ or people, and the state has decided to categorize them as noxious so that it can be removed.

All invasive plants and noxious weeds are “alien”, because having no role in this ecosystem is part of what makes them invasive and noxious. For instance, if they were part of an ecosystem, there would be insect species that would eat them. However, many plants are “alien” to ecosystems and do not become invasive or noxious when they are introduced by humans. For instance, oranges, avocados and wheat are all plants that have been brought to the United States to be grown as crops. Because they do not spread into natural areas or harm plants, animals or people, they are “alien” species without being invasive or noxious.

What are the two most significant threats to the survival of endangered species according to the article? What percentage of endangered species are threatened by each?

Habitat destruction and the introduction of alien species are the two greatest dangers to imperiled species according to the article. Wilcove et al., found that 85% of these species are impacted by habitat destruction and 49% are impacted by alien species.

Wilcove et al., states that "(a)lien species affect a higher proportion of imperiled plants (57%) than animals (39%)”. Is the difference statistically significant according to the article? Why might plants be more vulnerable to "alien” species than animals?

According to their chi-square test, the difference in impact between plants effected by alien species and animals effected by alien species is statistically significant. Plants might be more vulnerable to alien species because many alien species eat these plants, or actively compete for sunlight, water and soil nutrients that these plants need.

Answer Key

Day 2 Optional Activity: Economic Impacts

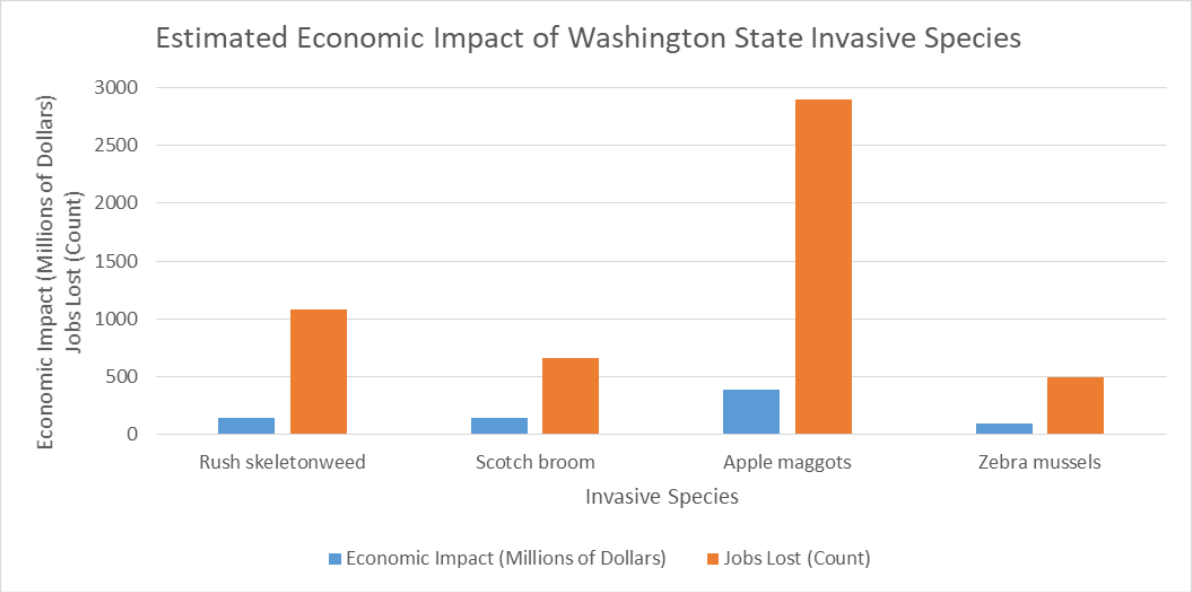
How do invasive plant and animal species hurt the Washington State economy? Cite an example from the text in your answer.

Invasive plant and animal species hurt the Washington State economy by negatively impacting outdoor industries including agriculture, timber, rangeland and recreation. For example, Scotch broom spreads over acres of rangeland each year, where it crowds out the grass that livestock graze on and sickens cattle that accidently eat it. If it is not controlled, it could cause $142.7 million dollars in negative impact.

What is the purpose of the apple maggot quarantine? Could the same principals be applied to zebra mussels?

The apple maggot quarantine prevents homegrown apples that could harbor invasive apple maggots from spreading to unaffected areas. It works because apple maggots have a limited range, and because Washington state has measures in place to encourage people to self-police. The same principles could be applied to Zebra mussels by checking boats for this invasive species before they are let into Washington State waterways. In fact, policies like this are already in place in certain counties.

Fill in the graph showing the potential impact of each species below. Use the information on economic cost (in millions of dollars) and jobs lost to create two bars per species, and be sure to label with the color you used for each bar.



Answer Key

Day 2 Optional Activity: Invasive Animals

Create a food web for a Pacific Northwest forest in the space below. Be sure to include multiple species and lines indicating the flow of energy.

Answers will vary.

As with the introduction of the python in the video, add an invasive plant to your food web. What trophic level is impacted first by the introduction of this invasive plant? Is there a "bottom up effect", as opposed to the "top-down effect" from the python?

The invasive plant impacts the native plant species first. From there, herbivores are negatively impacted because their food source is gone. In turn, the loss of herbivores means there are no prey species for the carnivores to hunt. This is a "bottom-up effect", because something that happened to the lowest level of the food web negatively impacts the entire ecosystem.

Answer Key

Day 3 Optional Activity: Identification Challenge

Oregon grape (Native)
Blue berries, paired leaves

English holly (Invasive)
Red berries, alternating leaves

Bleeding heart (Native)
Distinctive heart-shaped flowers, no “hairs”

Herb Robert (Noxious)
Five-petaled flowers, “hairy” stems

Trailing blackberry (Native)
Sets of 3 small leaves, thinner stems with spikes instead of thorns

Himalayan blackberry (Noxious)
Sets of 5 broad leaves, thicker stems with thorns

King County
Department of
Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program

Nature VISION

Cow parsnip (Native)
Shorter, less noticeable purple color on the stems

Giant hogweed (Noxious)
Much larger, more noticeably purple stems

Wild carrot (Class C noxious, not usually controlled)
Only one densely packed flower cluster, hairy stem

Poison-hemlock (Class B noxious, controlled)
Flowers more spread apart in the cluster, lots of clusters all over the plant instead of just one

Answer Key

Day 4 Main Activity: Lets Pull Together!

What impacts do English ivy plants have on an ecosystem?

We need to control English ivy because it shades out and kills ground cover plants, creating habitat for rats and other pests. Also, if English ivy is allowed to grow onto trees, it increases the likelihood of rot, and of a tree falling over. If an ecosystem was overrun by English ivy, the biodiversity would go down and herbivores would have diminished food sources.

What precautions should we take while removing English ivy?

Gloves should be worn while pulling English ivy.

What steps do we take to remove English ivy?

Because of its shallow root system, ivy can be pulled manually from the ground. If ivy has spread up trees, create a "life ring" by severing the vines that connect the plant to the ground, and pull the ivy you can reach so that it can't reconnect to the soil.

What impacts do Himalayan blackberry plants have on an ecosystem?

Blackberry infestations can grow up to 15 feet tall, killing anything growing below and creating a hostile, thorny habitat for animals. On river banks, blackberry causes erosion that can ruin salmon habitat. If an ecosystem was overrun by Himalayan blackberry, the biodiversity would go down and herbivores would have diminished food sources.

What precautions should we take while removing Himalayan blackberry?

Himalayan blackberry can still be habitat for nesting birds, so we should be careful if picking it during peak nesting season between April 1st and August 15th. Also, the sharp thorns of blackberries can hurt, so wearing gloves and using tools is essential.

What steps do we take to remove Himalayan blackberry?

Digging out the root crowns of Himalayan blackberry is the best way to keep the plants from coming back. However, with large infestations, strategies like repeatedly mowing, or even having goats eat the plant, will be more effective.

What impacts do poison-hemlock plants have on an ecosystem?

Poison-hemlock is important for us to control because it is poisonous to people and animals. If the plants in an ecosystem were outcompeted by poison-hemlock, herbivores would have no viable food source and the entire ecosystem would likely disappear.

What precautions should we take while removing poison-hemlock?

Gloves, long sleeves and long pants are important to protect us from poison-hemlock sap. This plant should never be mowed or burned, because the toxins it releases can also make people sick. Poison-hemlock cannot be disposed of in yard waste or compost, but only in the trash.

What steps do we take to remove poison-hemlock?

Poison-hemlock can be pulled by (gloved!) hand, or using a shovel. As much of the root should be pulled out as possible. All parts of the plant should be put in the trash. If poison-hemlock is spotted in a park or another public place, report it to the King County Noxious Weed Control Program.

Answer Key

Day 4 Optional Activity: Early Detection, Rapid Response

What is the relationship between time, amount of area infested and control costs according to this graph?

Over time, the area infested increases as the weed spreads to new places. Consequently, control costs increase over time.

Where would Class A, B, and C noxious weeds fit on the curve of this graph? Which class corresponds to which color (green, orange, or red)?

Class A fits in the green region of the graph. These weeds have not spread far yet, and eradication is possible.
Class B is in the orange region of the graph where it has spread to some regions. Eradication is not likely, but control is possible.
Class C is in the red region of the graph. Control is difficult and expensive owing to how widespread the infestation is.

What would be the ideal outcome when handling a new infestation of a noxious weed? When in the infestation is the ideal time to begin a response to obtain that outcome? What challenges would potentially prevent that response from occurring?

The ideal is that the infestation is handled early so that the weed can be completely eradicated before it spreads and does widespread harm. This approach is called early detection, rapid response (EDRR).
One challenge may be raising awareness of new infestations rapidly enough to gain the volunteers/funding to eradicate new infestations before they spread too much. Others may include having enough citizen eyes trained to spot new infestations, or having enough volunteers reporting/surveying to catch infestations.