Green Invaders

Activities

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Activity: Plants of the Melting Pot

Objectives

- Understand some reasons why non-native plants were brought to the United States
- Locate on a map the original home of some invasive plants
- Compare the arrival of immigrants with the arrival of invasive plants

Grades

6-12

Group Size

Pairs

Activity Time

One or two 50-minute periods

Setting

Classroom

Materials

- Large world map
- Timeline
- Sticky notes or stickers
- Access to the Internet or copies of plant fact sheets

Optional:
Reference books such as Non-native Invasive Plants of Southern Forests by James H. Miller. USDA. Available on the Web or write: Southern Research Station, P.O. Box 2380 Asheville, NC 28802

Method

Students will compare immigration statistics with the arrival of invasive species to begin to understand how and why invasive plants came to America.

Getting Ready

1. Prepare a timeline on the chalkboard or with a roll of paper (e.g., adding machine paper). Make it long enough to include years from 1600 to present, allowing at least three inches per decade.
2. Collect samples of invasive plants in your area or use the Internet to find pictures of plants.

Introducing the Activity

The first great wave of American immigration started in the mid-1800s. Not surprisingly, some of the most problematic invasive weeds in the United States arrived at the same time. They didn't come here on their own. They were brought here. Our country was not just a melting pot of people; it was a melting pot of plants. Most of those plants were not a problem, but a few turned out to be big pests.

Our well-meaning ancestors brought plants from their home countries for several reasons including:

- **Agriculture**. Plants used for forage for animals (e.g., johnson grass, reed canary grass).
- **Food**. Plants used as vegetables and herbs for home gardens. (e.g., chicory, burdock)
- **Medicine**. Plants used in teas, home remedies, and poultices (e.g., garlic mustard, common mullein)
- **Landscaping**. Plants brought for sentimental reasons – to remind homesick immigrants of their homelands. (e.g., mimosa, English ivy, privet, exotic honeysuckle)

More recently, plants have been introduced for:

- **Wildlife habitat**. Plants imported to provide food and cover for wildlife. (e.g., multiflora rose, autumn olive)
- **Erosion control**. Plants used to stabilize slopes. (e.g., kudzu, lespedeza)

Other plants arrived by accident. Canada thistle seeds may have come to this country in mattresses stuffed with dried weeds, shipments of cattle feed, dirt used as ballast in ships to provide stability or someone's pant cuffs.

Doing the Activity

1. **Ask the students to imagine they are immigrants.** Tell them they will be moving to a faraway country that they know little about. They have heard the conditions are harsh and unfamiliar. Talk about what kinds of plants they would take in order to ensure survival. Be sure that students consider taking plants that will provide food, shelter, clothing and medicines in the New World.
2. **Post the immigration data found in the table on the following page.** Ask the students to graph the data.

Activity: Plants of the Melting Pot

Decade……. ……Millions of Immigrants

1820 – 1830……0.2

1830 – 1840……0.6

1841 - 1850……1.7

1851 - 1860……2.6

1861 - 1870……2.3

1871 - 1880……2.8

1881 - 1890……5.2

1891 - 1900……3.7

1901 - 1910……8.8

1911 - 1920……5.7

1921 - 1930……4.1

1931 - 1940……0.5

1941 - 1950……1.0

1951 - 1960……2.5

1961 - 1970……3.3

1971 - 1980……4.5

1981 - 1990……7.3

1991 - 2000……9.1

Source: *Statistical Yearbook of the INS*

3. **Assign an invasive plant to each pair of students**. Collect examples of invasive plants from your area or use the plants suggested on the following chart. Give students the common and scientific names and make sure they have access to reference books, copies of fact sheets or the Internet. Ask them to find the following information for their plant:
    - From what region did your plant originate?
    - When did your plant arrive in America?
    - Did people bring it intentionally or did it arrive by accident?
    - If people brought it intentionally, why did they bring it?
    - What problems has the introduction of this plant caused?
4. **Locate the introduced plant's native home**. Using the world map, have the students place a sticky note with their plant's name on the region where it originated.
5. **Construct a timeline of invasions**. On another sticky note, have each pair of students write their plant's name and when it was introduced. Ask them to place the notes on the timeline.
6. **Report the reasons for introduction**. Have each group write down the reasons their plant was introduced and what problems resulted from its introduction.
7. **Use the following questions to discuss the information:**
    - How do the reasons plants were brought to the United States compare with the reasons that were discussed at the beginning of the lesson?
    - How does the arrival of the first big wave of immigrants correlate with the arrival of non-native plants in the United States?
    - Are non-native plants still being brought to the United States today? (Yes!)
    - Surely, most immigrants today no longer fear they will be unable to find food, clothing, and medicines in their new homes. Why do you think people are still bringing plants to America? (Familiar food plants, ornamentals, herbs, folk remedies or plants that remind them of home.)
    - Today, immigrants are no longer the main cause of non-native plant introductions. Who is bringing the plants now?

Adapted from "History and Invasive Weeds." Invasive Weeds by Betty Czarapata. 1998.

Assessing the Learning

Assess the student's ability to work in pairs to gather information about the history of invasive plants.

Extending the Learning

Think about the future. Most scientists predict that major ecological disruptions due to invasive weeds will continue to rise. Ask the students to figure out why this may be the case. Consider the following reasons:

- Increased access to remote areas of the world
- Changes in global trade and mobility
- Demand for new plants for horticulture and landscaping

Activity: Plants of the Melting Pot

Autumn olive *Elaeagnus umbellata* Native to China and Japan Introduced to US in the 1830s Landscape plant, wildlife food and cover	**Johnson grass** *Sorghum halepense* Native to the Mediterranean Introduced to US in 1830s Forage	**Dames rocket** *Hesperis matronalis* Native to Eurasia Introduced to US in 1600s Garden plant; medicinal plant
Japanese knotweed *Polygonum cusidatum* Native to eastern Asia Introduced to North America in 1880s Ornamental plant; erosion control	**Oriental bittersweet** *Celastrus orbiculatus* Native to eastern China, Korea, Japan Introduced to US in 1730s Landscape plant; crafts	**Kudzu** *Pueraria montana* Native to Japan and China Introduced to the US in early 1900s Erosion control; forage
English ivy *Hedra helix* Native to Europe Introduced to US in colonial times. Ornamental. Source of varnish, dye, and tanning substances	**Multiflora rose** *Rosa mulitflora* Native to Japan and Korea Introduced to the US in 1830s Erosion control; living fence; snow fence; wildlife food and cover	**Chinese lespedeza** *Lespedeza cuneata* Native to Japan Introduced to the US in 1890s Erosion control and wildlife food
Chinese privet *Ligustrum sinense* Native to China Introduced to Us in the 1830s Ornamental	**Japanese honeysuckle** *Lonicera japonica* Native to Japan Introduced to US in 1800s Ornamental, Wildlife food	**Garlic mustard** *Alliaria petiolata* Native to Europe Introduced to the US in the 1860s Food plant; medicinal plant
Japanese stilt grass *Microstegium vimineum* Native to Asian Unintentionally introduced to US around 1910s	**Tree of heaven** *Ailanthus altissima* Native to China Introduced to US in 1780s Ornamental; medicinal plant	**Chinese wisteria** *Wisteria sinensis* Native to Asia Introduced to US in 1800s Ornamental

Activity: Diversity Index

Objectives

- Realize that scientists use sampling techniques to measure biodiversity.
- Calculate the Diversity Index of plants along a transect line.
- Understand the importance of a measure like Diversity Index in comparing the success of invasive species control methods.

Grades

6 – 12

Group Size

Small groups of 2 – 4

Activity Time

Three 50-minute periods

Setting

Indoors and outdoors

Materials

- 100 beads in a container for each group
- Tent stakes
- 50' cord wound on bobbin
- Paper, pencils, and writing surfaces
- Optional: plant identification books
- Optional: calculators

Method

Students will use sampling techniques in nearby parks, backyards, and natural areas to measure the affects of invasive exotic plants on biodiversity.

Getting Ready

1. Prepare containers of beads for the warm-up activity. There should be 100 beads in each container. Vary both the number of different colors of beads and the number of each color. For example, the container representing a very diverse habitat could be represented by roughly equal numbers of 12 different colors of beads. The container representing the least diverse habitat could have only a few different colors of beads with the majority being one color.
2. Find a location for the outdoor investigations.
3. Check the study site for hazards such as stinging insects or poison ivy.

Introducing the Activity

Biological diversity is all around us. It is found in the variety of habitats that surround us, the different kinds of plants and animals that we see, and the subtle differences among plants and animals of the same kind. There are three levels of biological diversity:

- If we look out the window and see woodlands, wetlands, and grasslands, we are looking at a scene that has high *ecosystem diversity*. On the other hand, if we can only see croplands or housing developments, the ecosystem diversity is low.
- Another level of diversity is *species diversity*. This diversity is displayed by the number of different plants and animals present. A forest with dozens of kinds of trees and hundreds of kinds of other plants is more diverse than a city park with turf and three kinds of trees.
- The third level of diversity is the hardest to see. It is *genetic diversity*. Within a single species of plant or animal, there is variation. Take a close look at two plants of the same species collected from different locations, and you may notice subtle differences in color, leaf shape, or height.

We are going to focus on species diversity among plants. It's not hard to see that a prairie hosts a greater variety of plants than a lawn or that a native woodland is more diverse than a city park. However, sometimes the differences are more subtle than that! How do scientists know that some places are more diverse? How do they know that diversity is declining on a worldwide basis?

In order to discuss these questions, scientists have created concrete ways to calculate the diversity of different areas. One method uses sampling techniques and a formula called the Diversity Index to assign numerical values to the biodiversity of a given habitat. Using the Diversity Index allows scientists to:

- Calculate the diversity of organisms in an ecosystem and establish baseline information about a site. Baseline information provides a reference so that changes to plant communities can be measured.
- Measure the health of an ecosystem or compare healthy and disturbed sites.
- Track changes in diversity at one location over time. Monitoring index values could help determine if the changes are due to succession, disturbance or invasion of a non-native species.
- Show the changes to vegetation at a site during and after an invasive species control project or evaluate the effectiveness of various control methods.

Activity: Diversity Index

Doing the Activity

DIVERSITY INDEX WARM-UP (INDOORS)

1. **Talk about sampling.** If you were a scientist assigned to measure the biodiversity of plants in a habitat, how would you do it? (Entertain all answers, but help students realize that rarely can scientists count every plant in an area. Instead they take samples using various sampling techniques and then perform calculations on the samples.)
2. **Introduce random sampling and the Diversity Index.** Explain that the students are going to use random sampling and a Diversity Index to study the "populations" of various beads in a "habitat" or container. Explain that the students are going to randomly pick a sample of beads from the container.
3. **Get ready for the warm-up activity.** Divide into teams of two. Give each team a habitat with 100 beads. Each color of bead should represent a different "plant" in the habitat. Assign a letter to each bead color by writing a code on the board or asking students to record it in their lab books.
4. **Conduct the sampling.** Instruct students to randomly choose nine beads from their containers, one at a time. Using the letter symbols, they should record each bead as they remove it. Their results should look something like this:

   PBGGWWGBB

5. **Count the number of runs in the sample.** Group letters that are the same by drawing alternating lines above and below the letters. The results from above would look like this:

   P B GG W W G BB

   The number of runs is the number of groupings, or strings, of the same plant found consecutively in the sample. A run can consist of only one plant. This example has six runs.
6. **County the number of individuals in the sample.** The example shows nine individual beads.
7. **Calculate the Diversity Index.** Use the following formula:

   Diversity Index = number of runs/number of plants = 6/9 = .67
8. **Discuss the results.** The Diversity Index is a measure of the biodiversity of a group of organisms in an area. The value of the Diversity Index will vary between 0 (no diversity) and 1 (high diversity). Values around 0.5 indicate that an area is relatively diverse. A healthy forest might have a Diversity Index of 0.7 or 0.8 while an agricultural field might have a Diversity Index of 0.02 or less.
   - How did the Diversity Index values vary from group to group? Note that the variety of beads is not the same from container to container. In other words, some habitats are more diverse than others.
   - Which habitat is most diverse? (Assume that the container with the highest Diversity Index is the most diverse.)
   - Which habitat is the healthiest? Why are populations that are more diverse usually more stable? Why would a diverse population be more resistant to disease, predation and invasion?
   - Which habitat seems to be dominated by one or two species of beads? What is the Diversity Index of that habitat? What kind of real-life habitat might this represent? (It might represent an area that has been planted for agriculture or an area that has been invaded by an invasive species.)
   - Assume two habitats have the same number of "species" of beads. One habitat is predominantly one species of bead with just a few beads of the other species. The other habitat has equal numbers of all the different species. Which will have the highest Diversity Index? (The habitat with equal numbers of each species will have the higher index. The number of different species [species richness] and the number of individuals of each species [species evenness] are both important measures of biodiversity.)

- If you repeated the whole process with the same container of beads, do you think you would get the same results? (Probably not. This is why scientists often take several samples and average the results. If you have time, take three samples and average your results. You can also tally the entire container of beads and see how the Diversity Index of the whole compares with the Diversity Index of the sample.)

PLANT TRANSECT (OUTDOORS)

Students working in teams will randomly locate and establish a transect. They will count and identify the plants along the transect. Based on the amount, size, and diversity of vegetation decide if students should count only those plants that actually touch the string or all plants that lie in the plane of the string. Give students a copy of *Conducting a Plant Transect* as a reference during the field experience. Ideally, students should be familiar with the majority of plants they are likely to encounter. Review these plants with the students and assign letters to them prior to the field trip.

DIVERSITY INDEX CALCULATIONS (INDOORS OR OUTDOORS)

1. **Determine the number of runs.** Ask students to group letters that are the same by drawing alternating lines above and below the letters. Count the number of changes or runs.
2. **Count the number of plants sampled.**
3. **Calculate the Diversity Index.** Use the following formula:

   Diversity Index = number of runs / total number of plants

4. **Find the average Diversity Index for the site**. Instruct students to collect data from all transects studied at one site and compute an average for the location.

DISCUSSION QUESTIONS

1. You calculated the diversity of the plants in the area. Can this number tell you anything about the diversity of insects, birds, mammals, or other organisms? (It would be inaccurate to say that all of these indexes would be identical. However, a diversity of plants offers other organisms a variety of foods and places to hide. Thus, a high diversity of plants usually results in a high diversity of the organisms that depend on them for survival.)
2. What are some of the limitations of the Diversity Index?
   1. The Diversity Index is a snapshot in time. If you did the sampling at a different time of year, you might get different results.
   2. A "weedy" area might score a high Diversity Index. While the area might have a wide variety of plants, these plants don't provide the same quality of habitat as a diversity of native plants. There are some variations of the Diversity Index that adjust for weedy and invasive plants.
   3. The index depends on the skill of the person using it. Someone with more experience identifying or distinguishing between different kinds of plants might get different results.
   4. The transect sampling method does not do a very good job of finding and including rare plants.
   5. There is the chance that the random selection of the sample area could have resulted in a slice of the habitat that was exceptionally diverse or exceptionally lacking in diversity.
3. We've focused on the human-caused losses of biodiversity (e.g., habitat destruction and introduction of invasive species). Are there any natural events that could alter the Diversity Index? (Storms, disease, cycles of predation, floods and other natural disasters.)
4. How do invasive species change the Diversity Index? (As invasive species crowd out native plants, some of the most sensitive species are lost first. The Diversity Index goes down as the number of invasive plants increase. The index goes down because there are fewer kinds *and* numbers of native plants.)

5. What happens to the habitat as the plant diversity declines? (The variety of food and cover also declines. This means that fewer numbers and kinds of animals can find the things they need to survive. In other words, all aspects of diversity decline.)

Assessing the Learning

Use a rubric to evaluate students' work during this lesson. Evaluate students on how they worked in teams, how they approached and completed the task of counting plants along their transects, whether they could correctly identify different species (if required), whether they could record their data on meaningful charts and whether they were able to calculate the Diversity Index.

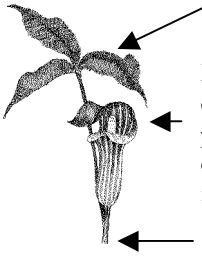
Follow these directions when you arrive at your sampling site.

1. Tie one end of your cord to one of the tent stakes.
2. Push the tent stake into the ground at your team's designated starting point.
3. Stretch the cord to its full length, being careful not to step on the plants that lie along the cord. You will be sampling these plants, so you don't want to disturb them!
4. Tie the other end of the cord to the other tent stake and push it into the ground.
5. Divide responsibilities among your team.
   - One person to identify plants along the transect
   - One person to keep track of letters assigned to plants
   - One person to record data
   - One person to sketch plants the team cannot identify
6. Starting at one end of the cord, walk the entire transect and record each plant along the transect. Record the plants in order as you walk the line, counting all trees, shrubs, and herbaceous (non-woody) plants. Depending on the habitat, your teacher might instruct you to count only the plants that actually touch the line or to count all the plants in the plane of the line (i.e., above and below).

   Follow the directions given by your teacher to assign a letter (i.e., A, B, C, D, etc.) to each different kind of plant. Your teacher might require you to identify each plant or to draw pictures of each plant. Either way, you will record each plant by letter similar to the way you recorded beads in the warm-up activity.
7. When you reach the end of the transect, pull up your tent stakes and rewind the cord on the bobbin.

Sample Plant Sketch

Plant C



Sample Letter Assignment Chart

A – white or pink flowers with grass-like leaves (spring beauty)

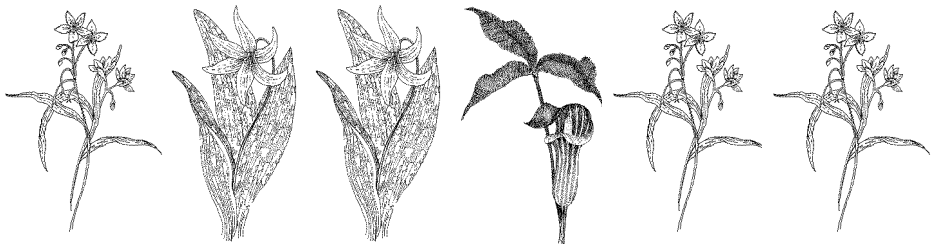
B – yellow lilies with spotted leaves (trout lily)

C – large green flower with 3-part leaves (Jack-in-the-pulpit)

Sample Data Recording

A B B C A A

Sample Transect



A B B C A A

Activity: SuperPlant Bullies

Objectives

- Recognize that invasive species are equipped with adaptations that give them competitive advantages over native species
- Become familiar with some invaders like old world climbing fern, Japanese stiltgrass or hydrilla
- List common adaptations of invasive plants
- Illustrate an invasive plant that is adapted to invade a forest ecosystem

Grades

4 – 8 (and up)

Group Size

Small groups of 4-10

Activity Time

One 50-minute period

Setting

Anywhere

Materials

- Art materials
- Writing materials

Method

Many Green Invaders are unfamiliar plants with strange parts and weird adaptations. Students will invent their own super plant bully and compare them to living plants that have adaptations as bizarre as the ones they have created.

Introducing the Activity

1. **Read one or two of the plant profiles in the guide with the students.**
2. **Discuss the invasive species adaptations.** Discuss what adaptations are and give some examples (e.g., tall plants can take advantage of extra sunshine and shade out their competition). Talk about why plants need adaptations. Ask students to recall the adaptations from the story.

Doing the Activity

1. **Design a SuperPlant bully.** Instruct each pair of students to design a super plant bully that can invade a forested area. The new plant must have at least five adaptations that allow it to out-compete native plants. Students should brainstorm new SuperPlant bullies, draw pictures of them or construct 3D models using art or scrap materials of their choice. Students should label the adaptations and share their illustrations with the class.
2. **Optional:** Truth is as strange as fiction! Choose a real Green Invader from the guide or a website like www.invasivespeciesinfo.gov and research which adaptations give it a competitive edge. Make up a nickname for the invader and write a funny story that depicts the adaptations. Remind the students to use powerful words, similes, and metaphors. See if other students can match a picture of the real invader with the student's story.

Assessing the Learning

Observe student participation in the discussion. Evaluate each student's ability to use the information to design a new forest invader. See the sample rubric on the next page.

Activity: SuperPlant Bullies

Sample rubric for older students

Drawings/descriptions/presentations will include the following:

1. **Describe the invasive plant's native climate.** Where did the plant come from? How is the climate of its native habitat similar to the climate of the area it is invading?
2. **Describe the forested habitat that the SuperPlant bully is invading.** Is it a hardwood or conifer forest? Is it open or shady? Is there thick undergrowth? Is it hilly or flat? What is the average temperature? Include any other characteristics that are relevant to your particular plant.
3. **Illustrate or create the Superplant bully.** Prepare a full-color illustration or a 3-D representations of the plant. Include all parts listed below.
4. **Describe the SuperPlant bully.** Include a full description along with both a common and scientific name.
   - What kind of plant is it (i.e., annual, perennial, biennial)?
   - Describe the roots (e.g., fibrous, taproot, adventitious).
   - Describe the stem (e.g., hollow, hairy, weak).
   - Describe the leaves (e.g., big, whorled, glossy, hairy).
   - Describe the flowers (e.g., showy, colorful, fragrant).
   - Describe the fruits (e.g., succulent, dried, hairy).
   - Describe the seeds (e.g., small, winged, bristled).
   - Describe any other special parts or attributes that help it survive and thrive.
5. **Describe the five adaptations.** Include a short paragraph for each adaptation that describes how it allows the SuperPlant to out-compete native vegetation. For example, do the seedpods explode and propel seeds into uninfested areas? Do the roots release a toxin that prevents other plants from growing nearby?
6. **Describe why the plant is so difficult to control or eradicate from an area.** For example, describe the effects of cold, heat, desiccation, herbicides, or mechanical removal on the plant. Does the plant survive and persist even when people try to control it?

Activity: Bane or Blessing?

Objectives

- Analyze the ways information is targeted to different audiences
- Understand how people have introduced invasive plants into natural areas
- Calculate the reproductive potential of an invasive plant

Grades

6 – 8

Group Size

Pairs

Activity Time

One 50-minute period

Setting

Classroom in fall

Materials

- Copy of autumn olive ads for each pair of students
- Transparency of "The Problem with Invasives"
- Overhead projector

Method

Students will check out ads that promote the desirable characteristics of autumn olive. Through simple calculations, they will realize how the promise of "abundant fruit" can be a problem if the plant has invasive tendencies.

Introducing the Activity

Autumn olive sounds like a nice plant. The name has a certain ring to it, bringing to mind bright colors and food. Yet this shrub – once promoted as a wildlife food plant, landscape plant, and restoration plant – has a darker side. The exact qualities that made the plant desirable for one purpose are the qualities that help the plant invade areas where it was never intended to go!

Doing the Activity

1. **Bring in a branch from an autumn olive shrub.** Ask students to describe the leaves, bark, and fruits. Talk about whether it is an attractive plant or not. Discuss why someone might want it in his or her yard.

2. **Check out the ads.** Find plant advertisements on the Internet or pass out copies of the following three autumn olive advertisements. The first is slightly adapted from an Alabama Forestry Commission flyer. The second is a standard landscape description used by several nurseries on the Internet. The third is combined information from the Plant Invaders of Mid-Atlantic Natural Areas and Invasive.org Web sites. Discuss these questions:

   - Who do you think wrote each description?
   - Who were the descriptions written for?
   - Why are the descriptions so different? Look at the words the writers used to accentuate the plant's characteristics.

3. **Look closer at abundant fruit production.** Each of the descriptions mentions the production of fruit, but in very different terms. Discuss these questions:

   - How might the abundant fruits produced by autumn olive be a blessing? Who would benefit?
   - How might the abundant fruits be a bane?

4. **Calculate the autumn olive's reproductive potential.** Ask students to complete the problem titled "The Problem with Invasives" by calculating how many autumn olive shrubs and seeds there would be in nine years.

5. **Discuss potential limits to the population.** Ask students if there would really be that many shrubs in nine years. (Fortunately, autumn olive doesn't produce as many seeds in the woods as in landscape situations. And, not all of the seedlings would survive! For example, seedlings might die because of competition with other plants for water, nutrients, and sunlight. Herbivores might eat the leaves, stems, or fruits. People might mow, use chemical herbicide, or burn the seedlings. Disease or fungus might affect the plants.) Remind students that not all of these factors affect all plants equally. One of the advantages that invasive plants have over native plants is a lack of predators, diseases, and fungi in their new homes. For example, many birds and mammals eat autumn olive fruits, but the seeds appear to pass through their digestive systems intact and ready to germinate – often far from the

parent tree! Recalculate the problem assuming that only 25% of the seedlings survive.

Assessing the Learning

Students should design and write their own landscape tags for autumn olive. They should include information they think is important for homeowners to know when purchasing an invasive plant.

Forestry Commission Wildlife Plantings

When native vegetation is insufficient, planting wildlife foods such as autumn olive will provide excellent cover and food. Autumn olive is a deciduous shrub that grows to eighteen feet tall and has numerous stems. The branches spread out about as wide as the shrub is tall. The bark is thin and smooth, changing to gray as the plant ages. The leaves are dark green with silvery undersides. This plant produces an abundance of small yellow flowers each spring and a heavy crop of berries that ripen throughout August and September. The berries range in color from yellow to dark red and are one-eighth to one-fourth inch in diameter.

Adaptation: Prefers deep well-drained or moderately well-drained soils. Competition from adjacent herbaceous weed and woody shrubs should be eliminated. Autumn olive has low water requirements and a high tolerance to salt and alkali soils.

Uses: Provides soil protection and beautification, and is an excellent food plant for many kinds of birds and mammals. Fruit remains on the plant until late winter, potentially becoming an important wildlife food during periods of seasonal food scarcity. Turkey readily take the red berries in early fall.

Planting time: From mid-winter to early spring. Not native.

Planting Rate: Space the seedlings eight to ten feet apart for hedgerow plating and at least twelve feet apart for individual plants.

Method of Establishment: Machine or hand plant. The hole must be large enough to accommodate the plant roots without crowding. The hole will have to be four to six inches larger in diameter and four to six inches deeper than the actual plant root measurements.

Shipping: Fall and spring. Shipped bareroot and priced in lots of 25, 50, 100+ seedlings.

Invite Autumn Olive into your yard!

Autumn Olive, *Elaeagnus umbellata*, is a medium-sized tree or a large shrub reaching heights of twenty-plus feet. The leaves, borne alternately on the stems, are generally oval in shape, approximately one to three inches long, and lack teeth. The upper surfaces of the leaves are dark green to grayish-green in color, while the lower surfaces are covered with silvery white scales, a conspicuous characteristic that can be seen from a distance when the leaves move. The small light yellow flowers bloom in late April and May. This semi-deciduous shrub is a good plant for fast growing windbreaks and for wildlife food and cover. The small fleshy fruits range in color from pink to red and are produced in abundance each year. Wildlife such as quail, wild turkey and dove relish its fruit.

Mature Height.....15-20 feet
Mature Spread.....15-20 feet
Mature Form.....Irregular
Growth Rate.....Rapid
Sun Exposure.....Full sun
Soil Moisture.....Widely adaptable
Soil Type.....Widely adaptable
Flower Color.....Yellow
Foliage Color.....Green
Fall Color.....Yellow
Zones.....3 – 9

Elaeagnus umbellata

Autumn olive is a deciduous shrub from three to twenty feet in height that is easily recognized by the silvery, dotted underside of the leaves. Small, yellowish flowers occur in clusters near the stems and mature into red, juicy fruits in the fall. Autumn olive is native to China and Japan and was introduced into America in 1830. Since then, it has been widely planted for wildlife habitat, mine reclamation, and shelterbelts. These plantings were often done because the fruits of *Elaeagnus umbellata* are used by many different types of animals as food. However, because the fruit is so desirable to wildlife, birds and other animals have spread the plant throughout a wide range.

Autumn olive is found from Maine to Florida and west to Texas. It is drought tolerant and thrives in a variety of soil and moisture conditions. This trait allows it to invade grasslands, fields, open woodlands, and disturbed areas. It threatens native ecosystems by out-competing and displacing native plant species, creating dense shade, and interfering with natural plant succession and nutrient cycling. Because autumn olive is capable of fixing nitrogen in its roots, it can grow on bare mineral soils.

Do not plant autumn olive. Individual young plants can be hand-pulled, ensuring that roots are removed. If it is burned, it re-sprouts from the stump. If it is cut, it still re-sprouts abundantly. Cutting, in combination with herbicide application, is effective. Hedges can be cut down using a brush type mower, chain saw, or similar tool, and stumps treated with a systemic herbicide like glyphosate or triclopyr. Application of these herbicides to foliage is also effective, but is likely to impact non-target species. Herbivorous animals are not known to feed on it, and few insects seem to utilize or bother it. Canker disease is occasionally a problem, but not enough to be useful as a control agent.

The Problem with Invasives

George and Noreen Lapse live next to a beautiful 40-acre wood and enjoy the birds that live there. They are interested in attracting some of the birds into their yard for a closer look. They visit the nursery and purchase a one-year-old autumn olive for their yard. The tag says that the abundant fruit provides food for many birds, but they have also heard that the shrub can be invasive. They vow to watch it carefully. At the first sign of the shrub spreading into the woods, they determine they will chop it down immediately. Three years later, Noreen gets a job across the state, and the Lapses move. As they drive out of the yard, they sigh as they pass their autumn olive shrub. They are disappointed that it is just now beginning to bear fruit. Someone else will get to enjoy the birds in the yard. When George and Noreen return to visit five years later, will they be surprised?

Calculate how many autumn olive shrubs there will be when the Lapses return and the shrub is 9 years old. Assume all of the seedlings survive. Use a chart to keep track of the number of mature plants, the seeds produced, and the number of immature plants. Use this information to help make your calculations:

- Autumn olive shrubs mature in three to five years. Use an average of four years.
- Mature shrubs produce 40,000 to 120,000 seeds. Use an average of 66,000 seeds per year.
- Seeds can germinate over a wide range of conditions anytime during the growing season. A cold North Carolina winter can scarify (scratch) the seed coats and increase germination rates. Up to 90% of the previous season's seeds can germinate in the next year.

Activity: Wanted Posters

Objectives
- Research an invasive plant
- Present information about the plant in a creative format

Grades
6 – 8

Group Size
Individuals or small groups

Activity Time
One 50-minute period plus homework

Setting
Classroom

Materials
Reference books and/or Internet access
Paper, pencils, markers
Poster board
Optional: access to desktop publishing programs

Method
Students will research invasive exotic plants and design "wanted posters" that illustrate the plant's "shady" characteristics and "crimes".

Getting Ready
Gather reference books and/or obtain access to the Internet for each group of students.

Introducing the Activity
When law enforcement officers want to track down a criminal, they often post wanted posters or display mug shots and distinguishing features on the evening news. We can increase awareness of the problems with invasive plants by making wanted posters.

Doing the Activity
Identify invasive plants that could be featured on a poster. Good possibilities include: Japanese honeysuckle, mimosa, privet, Japanese stilt grass, Tree-of-heaven, Princess tree, multiflora rose, Hydrilla, porcelain berry vine, and English ivy.

Brainstorm information needed for the posters.
- Common name
- Scientific name
- Aliases
- Image (e.g., photo or line drawing)
- Distinguishing features (e.g., flowers, leaves, or fruits that identify the plant)
- Reproductive strategies (e.g., seeds, suckers, or fragments)
- Crimes it is charged with (e.g., shading out, strangling, or stealing resources from native plants).
- Ecological reward for arrest (e.g., more beautiful forest, increased biodiversity, and better habitat for local wildlife)

Create posters. Students can use poster board and markers or computer software to produce their posters.

Present posters to the class.

Display posters in classroom, school, or community buildings.

Assessing the Learning
Posters should include all the essential elements the class decided to include. Posters should be neat and well-organized with headings and subheadings to help readers find important information. Drawings or photos should show the plant's identifying features. There should not be spelling errors.

Activity: Sizing Up Invaders

Objectives

- Survey classmates and/or neighbors to assess community awareness of invasive plants
- Compile and graph results
- Analyze the survey results to determine how best to educate the community about invasive plants

Grades

6 – 8

Group Size

Small groups

Activity Time

Two or three 50-minute periods

Setting

Classroom & community

Materials

Copy of *Sizing Up Invaders Survey* for each student

Method

Students will use a simple survey to assess the knowledge of classmates or neighbors concerning invasive plants.

Introducing the Activity

Invasive plants are here and they are here to stay. Controlling invasive plants costs Americans over $35 billion every year, but many people don't understand what invasive plants are or why they are such a problem.

Doing the Activity

1. Hand out the *Sizing Up Invaders Surveys* and ask students to answer the questions.
2. **Talk about the questions.** This survey is based on an actual survey conducted in northern California in 1998 (Natural areas Journal, Volume 19 (3), 1998, Thomas F. Colton and Peter Alpert).
3. **Look at student responses.** Divide into small groups to analyze the responses. Each group should look at the answers to one or two questions. They should record all the answers to their questions, but focus on the top five answers. They should be ready to summarize the results.
4. **Share summaries.** Ask some of the follow-up questions in the *"Thinking about responses to the invaders survey"* box at the end of this lesson.
5. **Discuss the initial survey results.** The scientists who conducted the initial survey had one basic question: "Does the public perceive biological invasions by plants as a serious problem?" They were trying to find out if people would be willing to pay for vegetation management or make the sacrifices necessary to prevent and control the spread of invasive plants. They found that most people didn't recognize invasive plants as a serious ecological or economic problem. Most people only perceived weeds as problems when they were personally affected (e.g., weeds in their gardens), allergy-causing weeds or weeds that had "stickers"). Most people didn't recognize local weeds as non-native species or think that they were a problem. Nor did they recognize the negative impacts that weeds have on natural areas. The survey was conducted in 1998. Ask students if they think people understand invasive plants any better today. Discuss how the students' responses were similar to or different form the original survey responses discussed in this paragraph.
6. **Prepare to conduct a local survey.** Identify the target audience. Select questions for the survey. The class may choose to use the *Sizing Up Invaders Survey* or develop their own survey. They may choose to survey classmates, parents, neighbors, or a cross-section of the community. If students plan to conduct the survey in a public

place, be sure to obtain permission. If students are surveying a wide variety of people, they may want to add questions about the age and level of education of their audience. When compiling results, students can then identify if these are factors in awareness of the problem.

7. **Conduct the survey.**
8. **Compile data.** Compile survey responses in simple data tables.
9. **Graph responses.** Divide into groups. Assign each group a question from the survey to graph. Graph the top five responses for each question.
10. **Discuss results.** Ask groups to present the findings from their questions. Here are some possible discussion questions:
    - Is there a basic understanding of "invaders" in the community? For example, did the people surveyed acknowledge that weeds are present in natural areas, as well as gardens, croplands, pastures, and lawns?
    - Did the people surveyed understand that weeds are spread by people, as well as by wind, water and animals?
    - Did the people surveyed understand that invaders are a problem? Do they think invaders need to be controlled?
    - If it were your job to educate the school or community about invasive plants, how would you begin?

Assessing the Learning

Based on the results of the survey, ask students to write a short paragraph describing how they would begin to educate the people in their community about invasive plants.

Thinking about responses to the invaders survey

1. **List three invasive plants that are familiar to you.** Take the top five answers and find out if the plants are native or non-native. Why did you identify these plants as invaders? Are these invaders found in croplands, pastures, gardens, roadsides, and /or natural areas? Do they simply have "weed in their name (e.g., milkweed)?
2. **Name the kinds of places that invasive plants grow.** Common responses might include gardens, yards, lawns, fields, and croplands. Did any of the responses identify natural areas as places where invaders can grow?
3. **How do invasive plants spread?** Typical responses might include wind or animals. Did any of the responses show people taking responsibility for the spread of invaders?
4. **Are these plants native to North Carolina or did they come from other countries?**

Mimosa	**Non-native**
Privet	**Non-native**
Wisteria	**Non-native, although there is a native species as well.**
Sweet gum	**Native, although an aggressive pioneer – considered "weedy" by many people.**
English ivy	**Non-native (did the name give this plant's origin away?)**

5. **Are you concerned about invasive plants?** How many responses showed that "invasive plant" was an unfamiliar term? Did the responses indicate an understanding that "invasive plants" invade natural areas?

Sizing Up Invaders Survey

1. List three invasive plants that are familiar to you.

2. Name the kinds of places that invasive plants grow.
   - ❒ Croplands
   - ❒ Gardens
   - ❒ Fields
   - ❒ Forests
   - ❒ Lawns
   - ❒ Lakes
   - ❒ Rivers
   - ❒ Other_____
   - ❒ All of the above

3. How do invasive plants spread?

4. Do invasive plants cause problems for the environment? Yes or No? If yes, briefly describe the problem.

5. Do invasive plants cause problems for humans? Yes or No? If yes, briefly describe the problem.

6. Do invasive plants have any desirable qualities? What are they?

7. Are these plants native to North Carolina or did they come from other countries?

Plant Name	Native to NC	Native to another country	Uncertain
Mimosa	❒	❒	❒
Privet	❒	❒	❒
Wisteria	❒	❒	❒
Sweet gum	❒	❒	❒
English ivy	❒	❒	❒

8. Are you concerned about invasive plants?

9. What is a native plant?

10. Describe yourself:

a) Age: ❒ 7-15 ❒ 16-25 ❒ 26-50 ❒ 50+

b) Sex: ❒ Male ❒ Female

Weed Out!

Objectives

- Research appropriate control measures for a local invasive plant
- Participate in an invasive species removal project

Grades

6 - adult

Group Size

Small groups

Activity Time

Varies with project

Setting

Outdoors

Materials

Varies with project

Method

Students will plan and implement a strategy to manually remove invasive plants.

Getting Ready

1. As you plan a control project, consider these things:
   - Age and abilities of the students.
   - Availability of appropriate tools (Your local natural resource agency may have tools you can borrow.)
   - Plant sensitivities. Be sure the plants you intend to control are safe (i.e., avoid plants that can cause rashes). Remember that some people are hypersensitive!
   - Safety of the site. Check out the site ahead of time to be sure there aren't any safety hazards (e.g., broken glass, garbage, poison ivy, hornet nests, etc.).
   - Preparedness of the students. Review how to dress for success (i.e., long pants, long sleeves, sturdy shoes, water bottles, sunscreen, mosquito repellent).
   - Tool/equipment safety. If you are using tools, make sure students know how to use them safely, when to wear safety glasses, and where to place tools when done.
   - Follow-up treatment. If an herbicide application is needed after cutting trees and shrubs, make arrangements for qualified adults to accomplish the task within the recommended time limits.
2. Consult the Web sites listed in the resource section for information on how to control specific plants. Methods can vary depending on the plant. The North Carolina Botanical Garden's online publication, *Controlling Invasive Plants* http://ncbg.unc.edu/uploads/files/ControllingBooklet.pdf , is a helpful resource. The best strategy may be to partner with a natural resource specialist from your local nature preserve or state park.

Introducing the Activity

This is the capstone activity! You've tracked down and identified invasive plants. Now it's time for you and your students to get your hands dirty!

Doing the Activity

1. **Find a site to adopt.** Ideally, you would carry out this project in the area your class has been investigating. You have identified the invasives in this area. You have records of their populations and can monitor the effectiveness of your control methods.
2. **Decide if your project will be site-specific or species-specific.** In other words, you can choose to try to eliminate all the invasives in an area or to eliminate all the plants of a particular species. If this is your first project of this kind, you should probably concentrate on one species.
3. **Research.** Assign students to find out as much as they can about the plant(s) in the area. What is the extent of the infestation? What are the recommended control measures?

4. **Plan a strategy.** Work together to decide which control method to use, what materials or tools are needed, what time of year to conduct the control and how often the control measures should be repeated. Don't be afraid to enlist the help of an expert at this stage!
5. **Do it!** See following ideas for making the *work* more fun!
6. **Follow through.** Monitor the area as long as possible and schedule additional work days if necessary. Don't just monitor the invasive plants; investigate the impact your project has on other plants and animals at the site.

Assessing the Learning

Assess student's ability to work together to accomplish a common goal. Set age-appropriate expectations and criteria to help students monitor their own participation and behavior during the project.

Students might need a little fun thrown into their invasive control project. Consider some of these ideas:

Pile Up the Plants
Divide into teams. Lay down a large tarp for each team. Which team has the biggest pile of Green Invaders?

Search and Destroy
(This technique works well with plants that spread by seed.) Often there is a central area of infestation surrounded by isolated plants. Provide participants with flags or flagging tape. Form a search line and move through the survey area together. Each time students find an invader, they should destroy it and mark the spot with a flag. The flags will allow your students to return to the area and watch for signs of new seedlings or re-growth.

Have a Contest
Compete to see which team can make the biggest ball of ivy vines. When pulling plants with taproots, have a contest to see who can pull out the longest intact root. Brainstorm other possible challenges (e.g., plant with the most flowers/seeds or tallest plant).

Acknowledge the Hidden Costs of Invasives Control
Count the number of mosquito bites or scratches after a pulling party. Give the winner a certificate or simple prize.

Sing with the Invader Busters
Join the Invader Busters in their marching chant. Sung to the tune of *This Old Man.*

Invader scum! Invader scum!
We will get you one by one
With a knick-knack, paddy whack
Pull it from the ground
Invader Busters comin' round.

Create Art
Use invasive plants to dye fabric, make note cards, create necklaces, or weave baskets.

Design T-shirts
Hold a contest and pick a winning weedy design. Have the T-shirts printed to help spread the word about your class project.

Sponsor a Pull-A-Thon
Gather pledges for each stem, pound, or bag of invasive plants pulled. Use the pledge money to re-vegetate an area with native plants.