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- North Carolina Course of Study, Science—sixth through eighth grade
- Tennessee Science Curriculum Standards—sixth through eighth grade
- Goals of Environmental Education

September 2006

Dear Middle School Teacher:

The Exotic Invasive Plant Species Curriculum contains 14 lesson plans written by a middle school teacher, Leslie Marra, from Knoxville Tennessee. In designing the lesson plans, Leslie took the needs of both the students and the teachers into consideration. All lesson plans are written:

- to take into consideration the cognitive, social, and affective development of middle school students;
- to support the students for success;
- to provide background information for the teacher relevant to each lesson;
- for one or two 45- to 50-minute periods; and
- to require few materials.

The lessons are designed to engage students in activities such as Web quests, school ground walks, art projects, chain tag, and a Jeopardy-like contest. This curriculum has a variety of activities, which are designed to engage and at times entertain.

If you know little about exotic invasive species you can still teach this curriculum. Lesson plans provide background information for the teacher. In addition, Web sites, such as Southern Appalachian Man and the Biosphere (<http://www.samab.org/Focus/Invasive/about.html>) provide pictures and flashcards of common exotic invasive species. You and your students can print picture of invasive plants and take them with you on a walk through the school grounds and neighborhood. You may be surprised how many common plants are exotic invasive species (e.g., mimosa tree and bush honeysuckle).

The project team designed the curriculum so that it addresses the North Carolina Science Standard Course of Study and the Tennessee Science Curriculum Standards. By teaching from this curriculum you will be addressing standards and learning outcomes related to ecosystems and scientific inquiry. In addition the curriculum works toward all five goals of environmental education—developing awareness, knowledge, skills and attitudes and giving students an opportunity to participate.

Recent research by the State Education and Environment Roundtable has shown that students enjoy studying their local environment. This curriculum focuses on the environment around your school and in your community. We hope it engages you and your students in the joy of learning about the world around you.

Sincerely,

Gary Peeples  
Rosalyn McKeown  
Jack Ranney  
Leslie Marra

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## ***Background Information on Exotic Invasive Plant Species in the Southern Appalachian Region***

Exotic invasive plant species are alien (non-native) plants that pose major economic and environmental threats in the Southern Appalachians, especially to natural areas. All states are having major problems with invasive plants. Until recently, little has been done to curb this threat other than in the agricultural sector. All kinds of natural areas, greenways, streamside zones, forests, and public rights-of-way are being affected. Managing these threats is costing a lot. Disregarding the threats allows them to become worse.

All non-native plants do not pose a threat. Presently there are 29 plant species listed by the Tennessee Exotic Pest Plant Council as posing “severe threats” to natural areas. Another 49 species are believed to pose “significant threats.” It is quite difficult to predict which new non-native plants will become invasive. Further, the data are only now being collected about the impacts and management of existing exotic invasive plants.

There is a 1999 presidential order (#13112 under President Clinton) requiring federal agencies to take action against invasive plants, to organize a National Invasive Species Council, and to develop a National Invasive Species Management Plan. In 2001, Government Accounting Office Report GAO-01-724 cited that federal agencies were moving too slow in the fight against the growing threat of invasive species.<sup>1</sup> Eventually state regulations will emerge in Tennessee to deal with the threat. None presently exist except for the agricultural noxious weed list.

Cornell University scientist estimated the US cost of non-native invasive species at \$137 billion per year.<sup>2</sup> This includes all invasive species (bugs, plants, diseases) for agriculture, forestry, environment, commerce, communities, and households. Some of these costs include power outages, loss of property value, increased operating costs, loss of game, and loss of endangered species. All of these problems that are attributable to invasive plants in the Southern Appalachians have not been ascertained, but the cost is probably high.

There are several perspectives in viewing the invasive plant problem. These include the principles of invasions that can help us understand how to control them. There are the causes and vectors of invasions that can help us understand how to prevent more invasions. And there are the economic and environmental impacts (and benefits) attributable to invasive plants that can help us choose which species to focus our efforts on and how to manage them. Unfortunately, the threat is so large and costs so high, it is unlikely that all invasive plants can be kept in check.

## **Threats to Native Ecosystems**

### ***Disruption of Ecosystems***

Ecosystems are changed in many ways with the introduction of exotic invasive plant species. Biological diversity (biodiversity) is reduced as native species are displaced by exotic invasive species. Displacement is only the tip of the iceberg; invading species cause more problems. Exotic invasive species interfere with the reproduction of native species in several ways. The breeding of native species is altered, because there are fewer of them. Also, because many

invasive plants produce a lot of flowers they attract the native pollinators. Native pollinators visit the exotics, collecting pollen. Pollinators visit less showy native plants less frequently and when they do visit, they frequently carry pollen from the exotic invasive rather than native plant species. The rate of pollination drops for native species. Exotic invasive plants also disrupt seed dispersal of native plants. Exotic invasive plants tend to produce seeds prolifically. Animals, such as birds, eat the seeds of exotic invasive plants and then carry them afar depositing them along with their feces. Because the seed-eating animals get their fill on exotic invasive plants they eat, carry, and deposit the seeds of fewer native plants. In this way exotic invasive plants reproduce, but reproduction rates of native species are decreased. In some extreme cases invasions of exotic species can cause extinction of native species.

Changes to the ecosystem go beyond biodiversity. Nutrient cycling through the ecosystem is also changed as new plants take up, retain, decompose, and release nutrients at different rates than native species. Additionally, exotic invasive plants change fire patterns, as in the case of Cogon grass. Cogon grass creates a dense mat of materials that make it impossible for native plants to co-exist and cause more frequent and intense fires that injure or destroy native plants

Changes in the plant composition of an ecosystem have consequences on the animals within the ecosystem. Native plants provide forage for specific animals in an ecosystem. One well-known example of this is pandas only eat bamboo. If a native plant is crowded out, the animal that grazes on it loses that source of food, which can be disastrous for the animal. Another unexpected consequence of changing plant composition is a change in the food web within an ecosystem. For example, raccoons and possums have begun raiding of nests of native birds, such as the oven bird. Privet grows so thickly, that the predators can climb through it to low-lying branches of trees to raid bird nests. Of course, the consequences on the animal life in ecosystems invaded by native plants were unforeseen when many of the exotic invasive plants were introduced into the Southern Appalachian region.

### ***Principles of Invasion***

Although scientists<sup>3</sup> have detailed the principles of biological invasions, it is sufficient to identify three phases—arrival, establishment, and spread. Of all the exotic, alien, hybrid, non-native, non-indigenous, horticultural and genetically modified plant species brought into Southern Appalachia, approximately 10 percent or less are able to actually establish themselves as “residents” able to sustain themselves in the Southern Appalachian environment. Of these, perhaps less than 10 percent become aggressive enough to spread and pose threats to native ecosystems.

A more systematic approach is needed to identify and predict non-native invasive plants. Work at the University of Florida (Dr. Alison Fox, Center for Aquatic and Invasive Plants) is underway to determine which plant traits are important in predicting an invasive threat. A few hints have been revealed. These traits include fast growth, early maturity to flowering and seed production, high seed production, and high tolerance of varying site conditions. An important point made by Williamson is that in today’s worldwide commerce and travel, invasive plants can spread rapidly any distance and in any direction. It follows that more arrivals raise the chances of establishment.

The shift from establishment to spread is very hard to predict. It can be within a few years as with Chinese silvergrass or several decades as with Oriental bitterweet. The speed of the transition from arrival to establishment to spread can be influenced by how much arrives over a given time period. That is, repeated introductions (arrivals) raise the chances of establishment and spread.

The biology of the plant and the means of seed dispersal affect its spread. Also, dispersal can be by human beings (intentionally as in landscaping or unintentional as in transporting seeds in packaging materials); by wildlife; by wind; by water; and by moving soil, straw, and other materials around. Establishment is often influenced by the condition of the environment. Usually, but not always, some kind of disturbance leads to more aggressive plant invasions. Forest clearing, right-of-way construction and maintenance (forest fragmentation), forest thinning, severe storms, flooding/drought, fire, over-browsing by deer, severe air pollution events, and habitat destruction for development are examples of disturbance.

All this suggests that prevention, early detection, and rapid response are vital strategies in reducing new invasive plant threats. These three strategies have been the foci of several government agencies and environmental groups.

### ***Causes & Vectors of Invasion***

For the most part, the causes of exotic plant invasions are people. People transport the new plants or seeds, and people are often the cause of forest disturbances that open ecosystems to plant invasions. Plant invasions in Southern Appalachia often start in urban areas and spread from there along rivers, highways, and various other kinds of rights-of-way. Increased development, shipping of nursery materials, and landscaping further facilitate invasions. Invasive species often leap-frog distances and establish new footholds.

It is clear that contributors to this problem are many and include development, landscaping, forest disturbance, commerce, and travel. However, in focusing on the solution, several groups have the opportunity to play important roles. These groups are right-of-way managers; the nursery, seed, and landscape industry; homeowners; communities; government agencies; developers; and conservation/volunteer groups. Efforts to control the spread of invasive plants need to focus on identification of pest plants and enforceable limitations on their use. Education of the nursery industry and homeowners about both the threats of invasive species and good non-invasive alternatives (native or exotic) is also important. With a better system of prevention, early detection and control, and community involvement we can make inroads in managing invasive plants.

## **Using Economic and Environmental Impacts to Strategize**

Two facts dominate creating strategies to manage exotic invasive plant species. First, one cannot get all invasive plants satisfactorily under control in all areas. Second, invasive plants do not all pose the same threats nor do they impose the same level of threat. Considering these facts, what is the strategy for invasive plant management? Determining which invasive plants are most important to manage is a complex process. Seventy-eight plant species are listed as a severe or

significant threat in Tennessee, but the list is not easy to evaluate. The list is neither complete nor agreed upon by all segments of the public.

Factors that seem worthy of consideration include:

1. the ability to thwart or manage the invasion,
2. the extent and intensity of ecological damage to natural areas imposed by the plant species compared to other invasive plants,
3. the cost of thwarting or managing an invasion, and
4. the economic importance of the species (e.g., to the nursery industry) and whether suitable non-invasive alternatives can be identified/developed. Information is incomplete in all of these areas, making decisions more difficult. Prevention, early detection, and rapid response are easy to identify as priority strategies.

Table 1 is an example of how one might prioritize a list of 12 invasive plant species in the East Tennessee area. Priorities may change with geographic location and as better information becomes available. This list is not meant to be inclusive, nor does it necessarily consist of all the worst ones.

<b>Species Name</b>	<b>Prevention Capacity</b>	<b>Early Detection, Rapid Response</b>	<b>Ecological Severity</b>	<b>Economic Un-Importance</b>	<b>Priority Rating</b>
Chinese silvergrass	2	1	1	3	High
Purple loosestrife	1	1	1	1	High
Cogon grass	1	1	1	2	High
Japanese knotweed	2	1	1	2	High
Tree of heaven	3	3	1	1	Medium
Japanese stiltgrass	3	2	2	1	Medium
Oriental bittersweet	2	2	2	3	Medium
Amur honeysuckle	4	4	1	2	Low
Euro/Chinese privet	4	3	1	3	Low
Kudzu	2	2	3	2	Low
Wintercreeper	2	2	3	3	Low
Burning bush	2	1	3	4	Low

1=high, 2=moderate, 3=low, 4=none

## **Control Guidelines**

There are multiple methods and strategies for controlling invasive plants. These winnow down to socio-economic, ecological, physical, chemical, and biological methods. Usually a combination of methods is desirable, as is the case with integrated pest management (IPM). Several sources of information are available on control methods for various lists of invasive plants. The Tennessee Exotic Plant List is available via the Internet at <http://tneppc.org> and the USDA National Invasive Species Information Center at <http://www.invasivespeciesinfo.gov/>.

Socio-economic controls refer to the buying and selling preferences by the nursery industry as well as the landscape and gardening public. Knowledge about the invasiveness of plants should

help the nursery industry promote alternatives and provide guidance as to what not to buy, plant, or propagate among homeowners and gardeners.

Ecological controls are approaches resource managers, forest owners, and other landowners can apply in the way they manage field edges, vegetation composition, forest disturbances, and the density of vegetative cover. Usually the idea is to crowd out or keep out invasive plant species by use of a thick plant cover. Quickly planting areas with aggressive, non-invasive plants is a big help. This is very important in site restoration where sites become more open to sunlight. Some invasive plants are shade-tolerant, but many are not. If an area is to be disturbed, it can be important to time this disturbance when local invasive plant seeds are not being actively dispersed.

Physical control involves hand-pulling, cutting down, mowing, girdling, digging up, root-grubbing, covering with black plastic, removing seed heads/flowers, and otherwise physically affecting a plant. Different approaches are needed for different-sized plants and different species. Often it is important to time these control efforts with specific seasons or conditions to be most effective. Examples of this are pulling up plants when the soil is soft so the roots come up, too; clipping annual grasses before they go to seed; and cutting plants during the early summer when root reserves are at their lowest. The positive aspects of this approach are that no chemicals are involved, the response is immediately observable, and non-target plants mixed in the invasive ones may be better protected. The negative aspects are that these labor-intensive techniques are generally only effective for small invasions; can disturb the soil, making way for more plants to invade (invasive plant seeds and root parts usually reside in the soil); usually require several years of follow-on treatment; and are not always effective. It often helps to replant non-invasive species to retard new invasions.

Chemical control is effective for larger-scale invasions but the right chemicals must be used in the right concentrations, be applied in the proper manner under the appropriate conditions, and be applied at particular times of year to be most effective. Without knowing about these things, it is easy to waste lots of herbicide without achieving effective control.

## Conclusion

Invasive species are an ecological problem in the Southern Appalachian region with large economic implications. Citizens can do a lot to prevent the introduction and spread of invasive plant species, which in turn will protect the integrity of Appalachian ecosystems.

### *References:*

- <sup>1</sup> U. S. Government Accounting Office. "Invasive Species: Obstacles Hinder Federal Rapid Response to Growing Threat." GAO-01-724, July 2001.
- <sup>2</sup> David Pimentel, et al. "Environmental and Economic Costs of Nonindigenous Species in the United States," *Bioscience*, Jan. 2000.
- <sup>3</sup> Williamson, M. "Invasions." *Ecography* 22 (1999): 5-12.
- <sup>4</sup> Parker, I.M., D. Simberloff, W. M. Lonsdale, K. Goodell, M. Wonham, P. M. Kareiva, M. H. Williamson, B. Von Holle, P. B. Moyle, J. E. Byers, and L. Goldwasser. "Impact: toward a framework for understanding the ecological effects of invaders." *Biological Invasions* 1 (1999): 3-19.



## LESSON 1: HEALTHY ECOSYSTEMS

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**Duration:** Three to four 45-minute class periods

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**Background information:**

A healthy ecosystem consists of native plant and animal populations interacting in balance with each other and non-living things (for example, water and rocks). Healthy ecosystems have an energy source, usually the sun. The sun provides radiant energy for producer (plant) growth. Producers change radiant energy into chemical energy for use by themselves and by consumers. Consumers eat producers. Higher-level consumers also eat other consumers. Decomposers break down dead plants and animals, returning vital nutrients to the soil. Plants take up these nutrients, along with water, through their roots. Ecosystems have definite boundaries.

Components of a healthy ecosystem include:

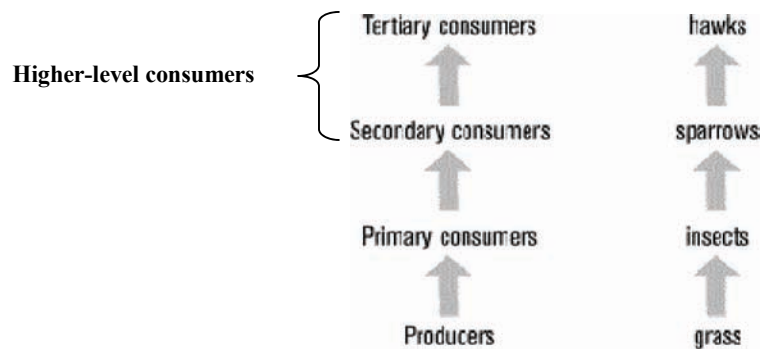
- sunlight (energy source)
- living organisms (producers, consumers, decomposers; predator/prey)
- non-living things (land forms, water sources, soil, rocks)
- dead organisms
- natural boundaries (set by the living and non-living things within the area)

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**Vocabulary:**

Abiotic	Not biotic; non-living components of an ecosystem (for example, water and sunlight)
Adaptations	Changes in form or behavior enabling a species to survive in a particular habitat
Biodiversity	The number of different species in a given habitat
Biome	A living community distinguished by particular plant and animal species and certain climate conditions
Biotic	Of or relating to life; components of the environment that are alive or were alive
Climate	Average yearly weather patterns of a region, including temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds
Conservation	Preservation and management of natural resources

- Dead Formerly a living thing that can no longer react to stimuli, reproduce, move on its own, or grow and develop by cell division; returns energy to the environment by decomposing
- Decomposer An organism that breaks down dead plants and animals, returning vital nutrients to the soil
- Ecosystem All the living things plus the non-living things in an area
- Exotic or non-native Foreign; not naturally from a particular region; introduced to a place
- Food Chain A model that shows only one-to-one links between the levels of producers and consumers



- Food Web A diagram or model that shows organisms in a community hunt more than one kind of prey and are hunted by more than one predator



- Habitat A place providing the types of food, shelter, moisture and temperature needed for survival for a living organism

Living	<i>Actively</i> exchanges energy with its environment over and over again, and requires energy, moves, reacts to stimuli, grows and develops (by cell division), produces energy, adapts to changes, and respire (cellular—transforms chemical energy into a form useful to maintaining the life of the organism)
Native	Animals and plants naturally from a particular region
Non-living	Passively exists in an environment; depends on environmental forces and has no ability to move of its own will, no ability to respond to stimuli, no ability to reproduce its own kind, and no ability to grow and develop by cell division
Predator	A living animal that hunts, kills and eats other animals
Prey	A living animal that is hunted, killed and eaten by another animal
Producer	A plant that changes the sun’s radiant energy into chemical energy
Web of Life	An artistic rendering of a food web (defined above)

*Sources:*

*Some vocabulary and other definitions are adapted from “Glossary,” Glencoe Science: Ecology, McGraw-Hill Companies, 2002. (See their “Online Learning Center” at <  
<http://www.glencoe.com/sites/wisconsin/teacher/science/index.html>>, under “Classroom Tools,” “Student,” click on “Multilingual Glossary MS,” (accessed 09/05).  
Spark Notes/SAT Biology, <http://www.sparknotes.com/testprep/books/sat2/biology/chapter10section3.rhtml>*

**Day One—Living, Nonliving, Dead, and Food Webs** (*one – 45-minute class period*)**Objectives:**

Identify components that influence an ecosystem  
Briefly describe interactions between components

**Prepare in advance:**

- Copy “Organisms Found in the Southern Appalachian Region” onto cardstock
- Cut out and laminate the individual cards
- Cut brightly colored yarn into 40 one-foot long pieces
- Print one “Web of Life” illustration for student preview

**Materials:**

- notebook paper for each student
- tape measures (at least 20 feet)
- brightly colored synthetic string and four stakes, for marking corners of plot
- mallet or hammer, for inserting stakes
- scissors for student use
- four rolls of double sided tape
- six to eight feet of butcher paper (bulletin board paper)

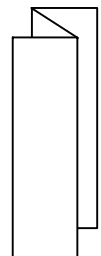
**Description:**

Students will learn to recognize components and healthy interactions in a healthy ecosystem through locating and identifying living, non-living, and dead things in their environment.

**Instructional sequence:**

(10 minutes)

- **Brainstorm** the difference between “living,” “non-living,” and “dead” with the class group (for example: living = grass; non-living = rock; dead = dry fallen leaf).
- **Introduce** vocabulary—biotic and abiotic—explaining how biotic things can be both living or dead and abiotic things are never alive.
- **Model** folding a sheet of notebook paper into a three-part accordion on the vertical.



- **Instruct** students to fold a sheet of notebook paper into a three-part accordion on the vertical.
- **Instruct** students to write at the top of each column, respectively: “biotic—living,” “abiotic—non-living,” and “biotic—dead.”

*(15 minutes)*

- **Lead** students outside.
- **Direct** them to measure out a 15ft. x 15ft. plot in the schoolyard and mark the boundary with brightly colored string.
- **Secure** the string with stakes.
- **Direct** students to categorize things (e.g.: live grass, dead leaf, non-living rock) found in the plot as “biotic—living,” “abiotic—non-living,” and “biotic—dead” on their folded notebook paper.
- **Debrief** students, for example:
  - What have they listed in each column?
  - Did the type of things vary from location to location within the plot?
  - Do any patterns emerge (e.g., many ant hills in the softer soil; more rocks in the harder soil)?
  - What will happen to the dead things?
  - Did you find any decomposers?

*(25 minutes—Teacher Note: The activity can be completed either outdoors or indoors from this point.)*

- **Seat students** in a circle.
- **Discuss:**
  - a healthy ecosystem has:
    - living components
    - non-living components
    - dead components
    - definite boundaries
  - a habitat provides things needed for survival of a living organism:
    - food,
    - shelter,
    - moisture, and
    - temperature
- **Give** each student a card that has a living thing that might be found in a Southern Appalachian ecosystem (provided in “Organisms Found in the Southern Appalachian Region”).
- **Represent** a food web using the cards:
  - Supply each student with two 12” pieces of the brightly colored yarn.
  - Place rolls of double sided tape and scissors ready for students to use.
  - Instruct students to place components on the butcher paper using double sided tape.
  - Illustrate a food web by connecting the cards using the colored yarn.
- **Guide** students to:

- Identify their plant's or animal's connection to the previous and following organism cards
- Model this connection by stretching a piece of yarn between the previous, current, and following cards
- Identify their plant's or animal's purpose in the ecosystem
- Identify predators and prey
- Clarify predator-prey relationships
- **Discuss** the flow of energy to and through an ecosystem, including both growth and decomposition.
- **Emphasize** components and healthy interactions within a healthy ecosystem.

*Source:*

*Lesson Plan adapted from "Unit Plan for Dynamics of an Ecosystem" Curriculum Unit Plan, available online at <<http://www.michigan.gov/scope/>> (accessed 09/05) and Seattle Audubon Society, "Web of Life," available online at <<http://www.seattleaudubon.org/education.cfm?id=58>>, accessed 09/05.*

**Day Two—Web of Life** (one – 45-minute class period)**Objectives:**

- Identify components of a healthy ecosystem.
- Represent components in a healthy ecosystem with a two-dimensional model (collage).

**Prepare in advance:**

Overhead transparency of “Web of Life”

**Materials:**

- overhead projector
- old magazines containing nature pictures (for cutting out pictures)
- scissors (one pair for every two students)
- glue sticks
- sharpened colored pencils
- colored markers
- 9” x 12” construction paper

**Description:**

Students will model interactions in a healthy ecosystem through constructing a Southern Appalachian Region ecosystem “web of life” collage.

**Instructional sequence:**

(10 to 15 minutes)

- **Review** the difference between “living,” “non-living,” and “dead” with the class.
- **Recall** the previous class activity (Healthy Ecosystems, day one).
- **Show** students the “*Web of Life*” illustration on the overhead projector. (A Web of Life is an artistic rendering of a food web.)
- **Discuss** these components of a healthy ecosystem, as you point them out on the “Web of Life” illustration:
  - characteristic living organisms
    - producers
    - consumers
    - decomposers
  - characteristic non-living things
    - land forms
    - water sources
    - soil
    - rocks
  - food chains and food webs

- predator/prey relationships
- **Write** “predator” and “prey” on the board, with brief, simple definitions:
  - Predator: animal that hunts and eats other animals
  - Prey: animal hunted and eaten by another animal
- **Brainstorm/review** predator-prey relationships in the Southern Appalachian region with students.
- **Write** possible Appalachian ecosystems on the board for students (e.g., stream, forest, cove, grassland)

*(30 – 35 minutes)*

- **Instruct** students to work in groups of their choice to construct a “Web of Life” for one of the ecosystems on the board.
- **Direct** students to use pictures cut from old nature and geography magazines to illustrate a “Web of Life” for the ecosystem they choose.
- **Display** “Web of Life” illustrations in the classroom.

*Source:*

*Lesson Plan adapted from “Unit Plan for Dynamics of an Ecosystem” Curriculum Unit Plan, available online at <<http://www.michigan.gov/scope/>> (accessed 09/05) and Seattle Audubon Society, “Web of Life,” available online at <<http://www.seattleaudubon.org/education.cfm?id=58>>, accessed 09/05.*



**Day Three/Four—****Interactive, online grassland activity—Build a Prairie** (one to two – 45-minute class periods)**Background information:**

Grassland is a type of biome. Grasslands are typically filled with deep-rooted grasses, forbs, and other herbaceous species. Few trees or shrubs grow in grasslands. Grasslands are partly dry, receiving 10 to 30 inches rain (25 to 75 cm) per year. Most grassland has a dry season with little or no rainfall. This seasonal dry period prevents the growth of forests. Almost one-fourth of Earth's land surface is covered by grassland. Sometimes, grassland is so big that it is called a sea of grass. Grasslands are called by different names around the world including savannas, plains, steppes, prairies, pampas, and veldts. For example, in Africa, grasslands are called savannas.

Grasslands are divided into two types depending on geographic location:

- Tropical grasslands are located near to the equator. Temperatures are hot all year with wet seasons of heavy rainfall.
- Temperate grasslands are located in the middle latitudes. Temperatures are hot in the summer and cool or cold in the winter. These grasslands have rich soils. In the United States, temperate grasslands are called prairies.

Grasslands occur in two distinct areas of the Southern Appalachian region—in grassy balds and in valleys and coves.

- Grassy balds are patches of grass and shrubs that occur at high elevations (i.e., over 1,500 meters or 5,000 feet) in the Southern Appalachian Mountains. Grassy balds occur from Virginia south to Northern Georgia, but they are rare. They are rocky, cold, and windswept. Evidence suggests that some grassy balds are the result of human disturbances such as logging and fire over a century ago.
- Valley floors (such as along the Oconaluftee River) and coves (such as Cades Cove) have grassland communities. These areas may have been forested many years ago before they were cleared by humans.

Grasslands, “grassy balds,” or “prairies” are important ecosystems within the Southern Appalachian region. Like other ecosystems, they are habitats for diverse populations of plants and animals. Delicate balances exist between the producers in an ecosystem and the consumers that depend upon them.

“Grassy balds are dominated by grasses, such as mountain oat grass, and sedges occasionally interrupted by small rock outcrops. The largest of these balds occur at elevations over 5,000 feet along the North Carolina-Tennessee state line on the Roan Mountain Massif, the Unaka Mountains, the Great Smoky Mountains, and in the Nantahala Mountains of southwestern North Carolina. While there are no species recognized as being unique to these communities, they harbor regionally

endemic and rare species of mammals, birds, and vascular plants associated with grasslands and high-elevation climates.”

(Source: Forest Encyclopedia Network, Grassy Balds, available online at <[http://www.forestencyclopedia.net/Encyclopedia/Appalachian/the\\_southern\\_appalachian\\_lands\\_cape/naturalcommunities/southern\\_appalachian\\_biomes.htm/Encyclopedia\\_Page.2004-04-30.1845/document\\_view](http://www.forestencyclopedia.net/Encyclopedia/Appalachian/the_southern_appalachian_lands_cape/naturalcommunities/southern_appalachian_biomes.htm/Encyclopedia_Page.2004-04-30.1845/document_view)>, accessed 12/05.)

Grassland communities occur in the open fields of Cades Cove, Cataloochee Valley, parts of the area along the Oconaluftee River, and other scattered low-elevation areas. Grasslands in the Southern Appalachian Region are susceptible to invasive species. Scientists study how exotic invasive species impact native Southern Appalachian Grassland communities.

(Source: Discover Life in America, Great Smoky Mountains ATBI, Cultivated Meadow, Nature Serve Identifier: CEGLO04048, available online at <[http://www.dlia.org/atbi/grsmnp\\_habitats/CEGL004048.shtml](http://www.dlia.org/atbi/grsmnp_habitats/CEGL004048.shtml)>, accessed 12/05.)

“Cades Cove, Great Smoky Mountains National Park, U.S.A., was historically cleared largely for pastoral purposes; it is now comprised of recently abandoned pastures dominated by non-native pasture species. To investigate the potential for reducing non-native species relative to native species, park managers initiated an experiment in 1995 that included mowing, herbicide application, planting of seed, and burning of replicate 20-50 meter plots at each of two sites within Cades Cove.”

(Source: Charles A. Price and Jake F. Weltzin (2003). “Managing Non-Native Plant Populations through Intensive Community Restoration in Cades Cove, Great Smoky Mountains National Park, U.S.A.,” *Restoration Ecology* Vol. 11 No. 3, pp. 351–358, available online at <<http://eebweb.arizona.edu/Grads/Price/Price%20and%20Weltzin%202003.pdf>>, accessed 12/05.)

A project carried out in greenhouses studies how young (emerging) grassland plant species compete for light and water. This study compares how plant species compete for light and water within their own populations and between species.

“Understanding the processes by which plants compete for limited resources is of critical importance to gaining a better understanding of how ecological systems will respond to environmental changes and disturbances. Competitive outcomes are driven by the availability of multiple resources; for example, the early stages of secondary succession are often driven by the availability of light and water.”

(Source: Allison Fortner. “Interspecific and intraspecific competition in old-field plant communities,” available online at <[http://eeb.bio.utk.edu/weltzin/Home/undergraduate\\_students.htm](http://eeb.bio.utk.edu/weltzin/Home/undergraduate_students.htm)>, accessed 12/05.)

**Objectives:**

Review and reinforce concepts of healthy ecosystems.

Apply concepts of healthy ecosystems to reclaim an ecosystem.

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**Prepare in advance:**

- The teacher should thoroughly explore and experience the Web site (<http://www.bellmuseum.org/distancelearning/prairie/build/>) prior to engaging the students (*time: 20 - 45 minutes*).
- Each student needs a copy of either Handout 1a (Tall Grasslands Guide) or Handout 1b (Short Grasslands Guide)
- Supply students with the URL for the “Build a Prairie” Web site (Handout 2).
- Bookmark the *Build a Prairie* Web site on the Web browser.

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**Materials:**

One computer connected to the Internet for every two students

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**Description:**

Ecosystems all have certain species that interact together to form a balanced community. When we learn more about basic changes on ecological systems and the impacts of those changes, we can apply that learning to other ecosystems that work the same way. When we learn about processes like competition for resources and environmental disturbances such as exotic invasive plant species, we can apply our learning to other ecosystems that work the same way.

In this interactive, online task, students choose either a tall-grassland or a short-grassland ecosystem to restore. Prompts imbedded in the program guide students in their selection of producers and consumers to reintroduce. They will venture into the Great Plains of North America’s vanishing grasslands to learn about balanced grassland communities. This well-developed program provides gentle feedback to assure success. A field guide is available at each decision-making point. Using the guides helps students to make correct choices in restoring their ecosystem and gain greater depth of understanding.

Students can engage in interaction during this activity at various levels, depending upon the level of accountability the teacher requires. The optional “*Grasslands Guide*” is designed for students to record observations, reason, make decisions, and reflect. Students can just as easily use their lab notebooks for this same purpose. The goals of this exercise are to encourage students to read about native and exotic species and to use this knowledge to understand the structure of a healthy ecosystem.

**Instructional sequence:**

(5- 10 minutes)

- **Escort** students to the computer lab
- **Distribute** the URL for the “Build a Prairie” Web site.  
(Source: Build a Prairie,” available online at <<http://www.bellmuseum.org/distancelearning/prairie/build/>> is part of the BellLIVE (<http://www.bellmuseum.org/distancelearning/belllive.html>) 1999 “On the Prairie” program <<http://www.bellmuseum.org/distancelearning/prairie/index.html>> developed by Bell LIVE! and Educational Web Adventures, College of Natural Resources, © 1998 by the Regents of the University of Minnesota.)
- **Instruct** students to open the Web browser to <<http://www.bellmuseum.org/distancelearning/prairie/build>> and bookmark it.
- **Instruct** students to read the first Web page and decide which type of grassland they choose to restore.
- **Request** students to complete a “Tall Grassland Guide” or a “Short Grassland Guide” while building a prairie.

(25 – 35 minutes)

- **Distribute** the *Grasslands Guide* sheet appropriate for the grassland chosen.
- **Direct** students to proceed through the restoration process using the *optional Grasslands Guide* sheets provided. The teacher should be available for clarification and guidance. If the guide sheets are *not* used, it may be necessary to remind students to use the on-site “*Field Guide to the Prairie*” to assist them in the decision-making process.

(20 – 30 minutes)

- **Online Extension:** students can restore an additional ecosystem.

(10 – 15 minutes)

- **Generate** a discussion about the grassland ecosystem with students. On a map, **Point out** the location of grassland ecosystems within the Southern Appalachian Region (e.g., Cades Cove and various balds in the Southern Smoky Mountains). Help students recognize native plants in this region as well as animals that depend upon specific plants for survival (e.g., cover and food).

***Optional Assessment Task:***

Create an exhibit/diorama to demonstrate life within an ecosystem. Include a brief description of how the sun affects an ecosystem and patterns of relationships between living, non-living, and dead things found within it.

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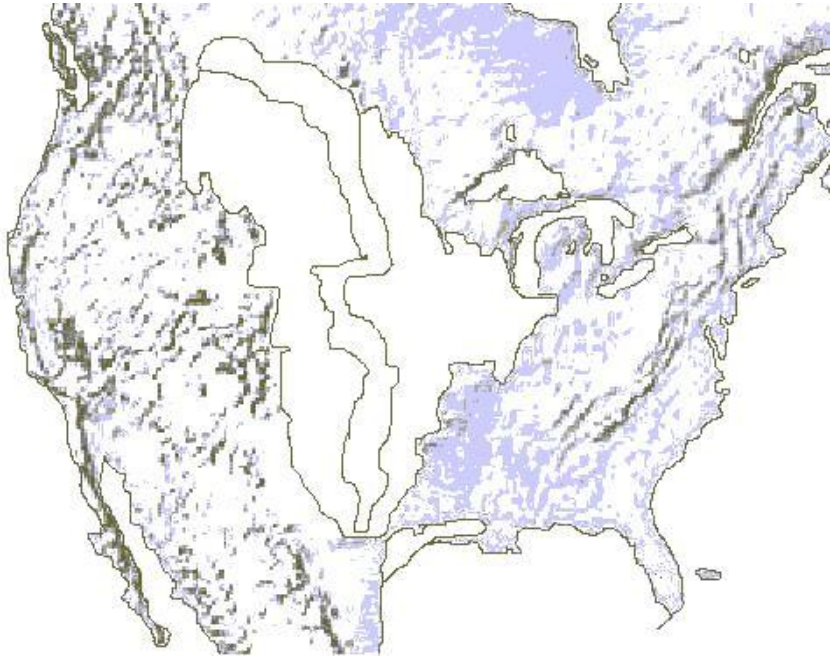
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## ***Handout 1: Tall Grasslands Guide***

Build a Prairie Web Site:

<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

Color the tall grass prairie  
area green



How can you tell the difference between a mesic prairie and a wet prairie?

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Why is couch grass considered an “invader” on the mesic prairie?

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Which other grass is a “weed” on the tall grass prairie?

---

Which of the six forbes are the exotic invasive plants?

---

Which forb is on the endangered species list?

---

Face of an owl and body of a hawk – it must be a

---

Which raptor of the tall grass prairie was the most surprising to you?

---

What surprised you about that particular bird?

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Do you think coyotes and red foxes would compete for prey in a tall grass prairie? \_\_\_\_\_

Explain your answer:

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Which reptile would go hungry in the tall grass prairie?

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Explain your answer:

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Describe why the two invasive insect species are unwanted guests in the tall grass prairie.

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How are prairie plants adapted to survive prairie fires?

Hint: see <<http://www.abnc.org/stewardship/prescribed-burns.php>> and <<http://www.fpdwc.org/burning.cfm>> (Natural History of Fire and Why Prescribed Fire?)

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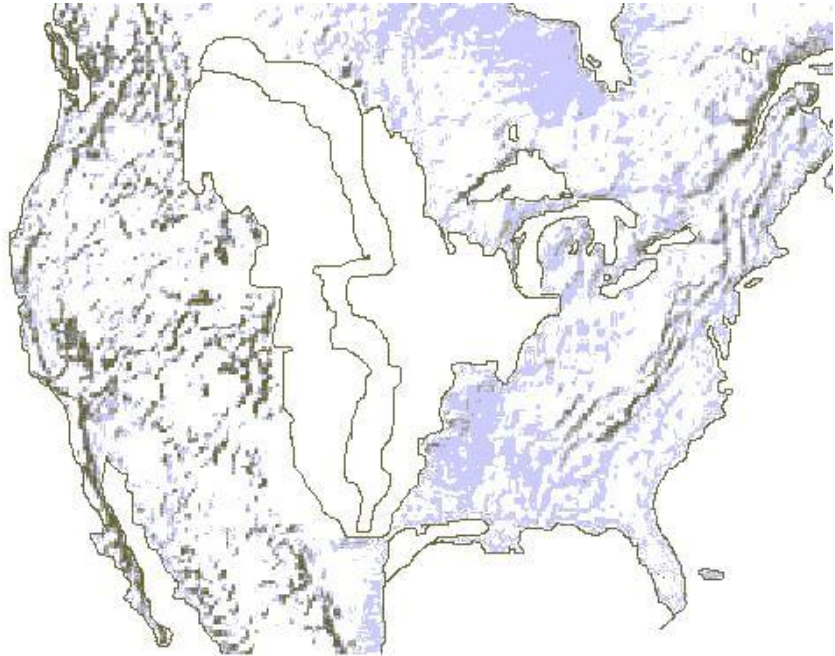
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## ***Handout 1: Short Grasslands Guide***

Build a Prairie Web Site:

<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

Color the short grass prairie  
area yellow



In the valleys of dry prairies, you would probably find another type of prairie.

Which type? \_\_\_\_\_ Describe how is this type is different from a dry prairie.

---

---

What are the two grasses considered “invaders” on the short grass prairie?

1. \_\_\_\_\_ 2. \_\_\_\_\_

What makes them unwanted species on the short grass prairie?

---

---

Which of the six forbes are the exotic invasive plants?

---



Describe how each exotic invasive plant is a danger to other short grass native plants.

---

---

Which of the birds you have to choose from would be much happier near a wet prairie?

---

What do you think would happen to the number of rabbits and mice in the short grass prairie if the ferruginous hawk became extinct?

---

Do you think anything would happen to the plant populations if the ferruginous hawk became extinct? \_\_\_\_\_

Explain your answer:

---

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Which short grass prairie mammal often gives birth to twins?

---

What is another unique fact about this species?

---

Why do you think there is a large number of snake species in the short grass prairie?

---

---

Describe why the two insect species are unwanted guests in the short grass prairie.

---

---

How are prairie plants adapted to survive prairie fires?

Hint: see <<http://www.abnc.org/stewardship/prescribed-burns.php>> and <<http://www.fpdwc.org/burning.cfm>> (Natural History of Fire; Why Prescribed Fire?)

1. \_\_\_\_\_

2. \_\_\_\_\_

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*Handout 2: Build a Prairie Web Site*

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<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

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<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

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<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

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<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

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<<http://www.bellmuseum.org/distancelearning/prairie/build/>>

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*Organisms found in Southern Appalachia*



Tussock Sedge



Stinging Nettle



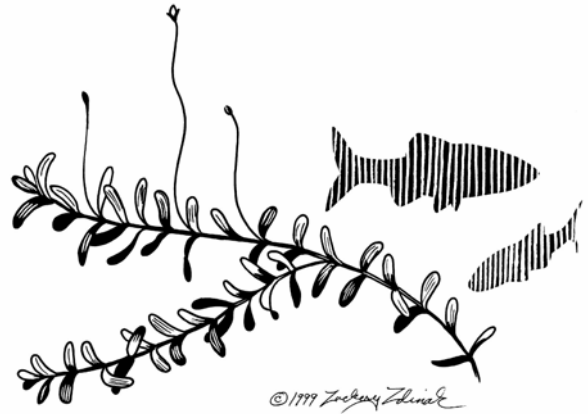
Wild Strawberry



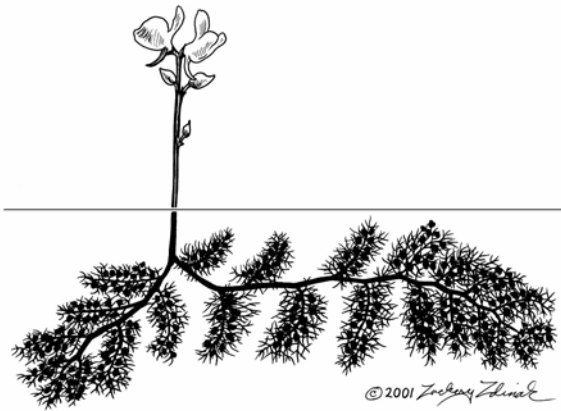
May Apple



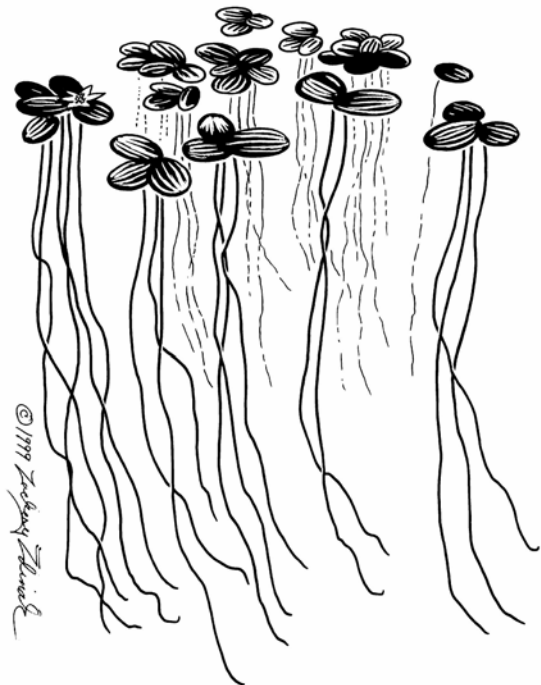
Jack-in-the-Pulpit



Elodea



Baldderwort



Duckweed



Black-eyed Susan



Little Bluestem



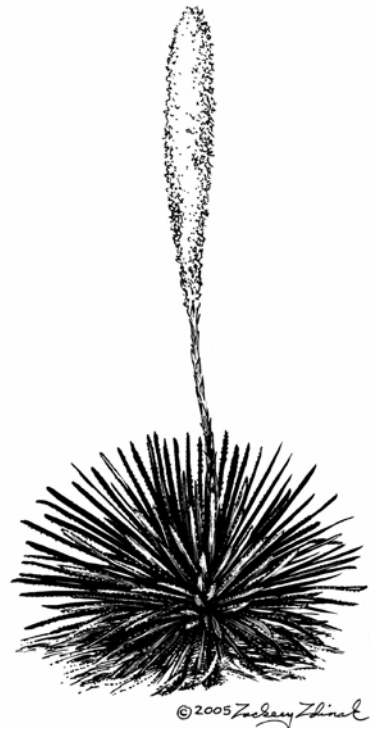
Trout Lily



Butterflyweed



Indian Grass

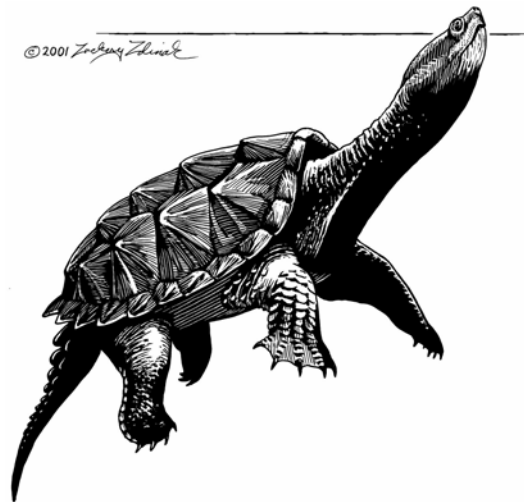


Sotol

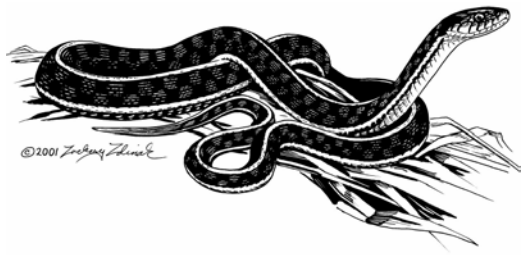
Consumers



Raccoon



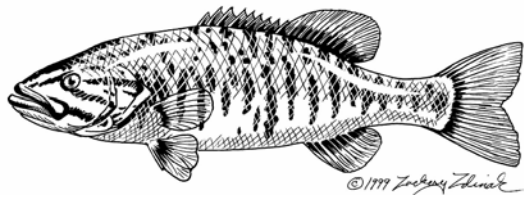
Snapping Turtle



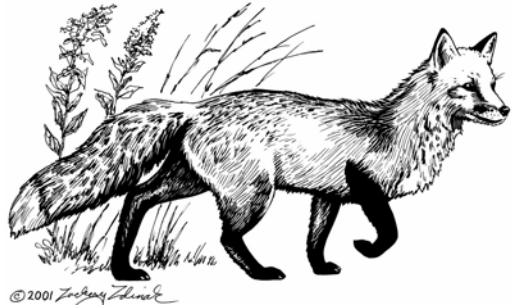
Eastern Garter Snake



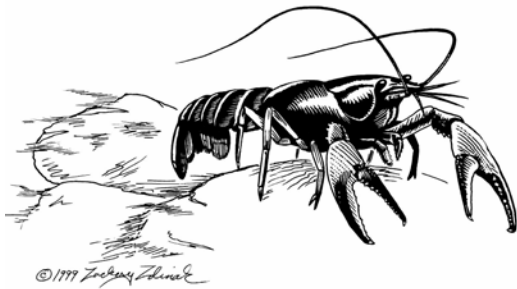
Wood Frog



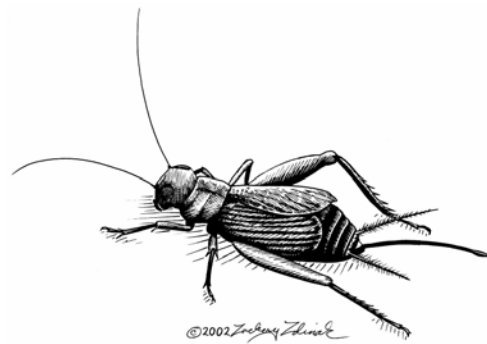
Small-mouthed Bass



Red Fox



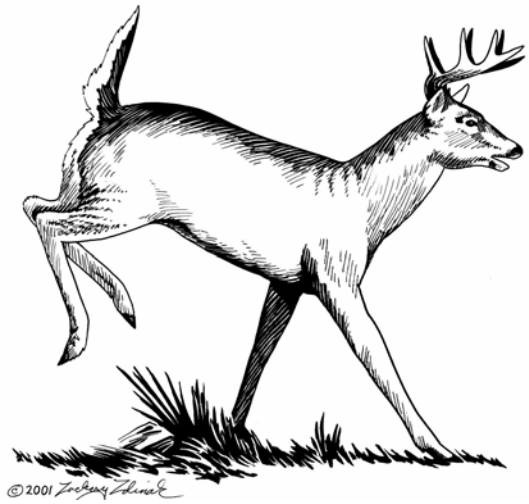
Northern Crayfish



Field Cricket



Otter



White-tailed Deer (Buck)



Great Horned Owl

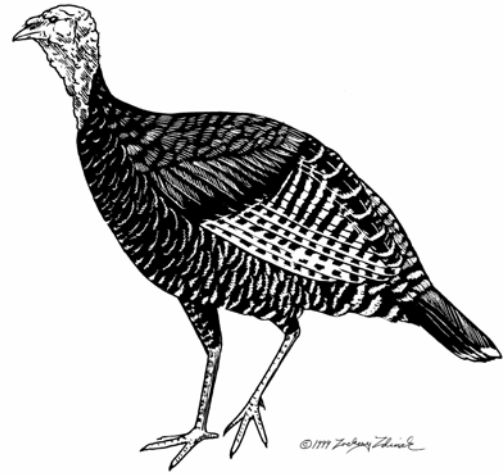


5-lined Skink

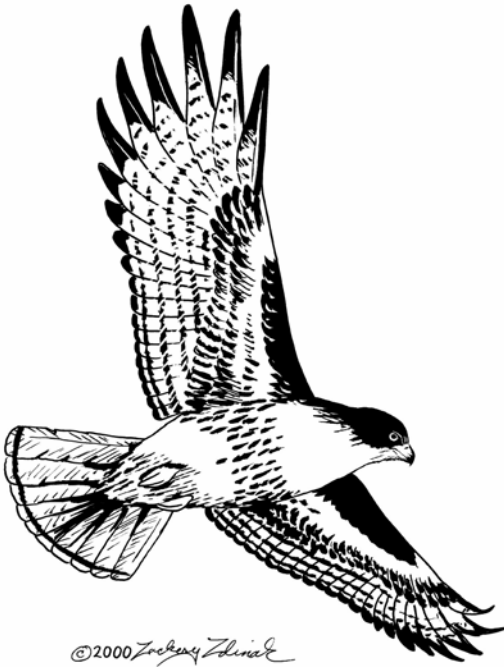




Eastern Cottontail



Wild Turkey



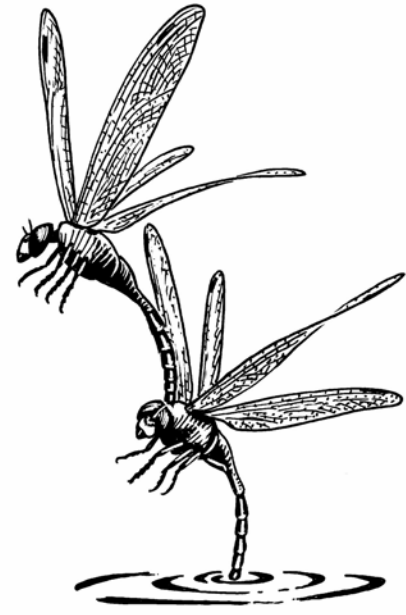
Red-tailed Hawk



Giant Water Bug

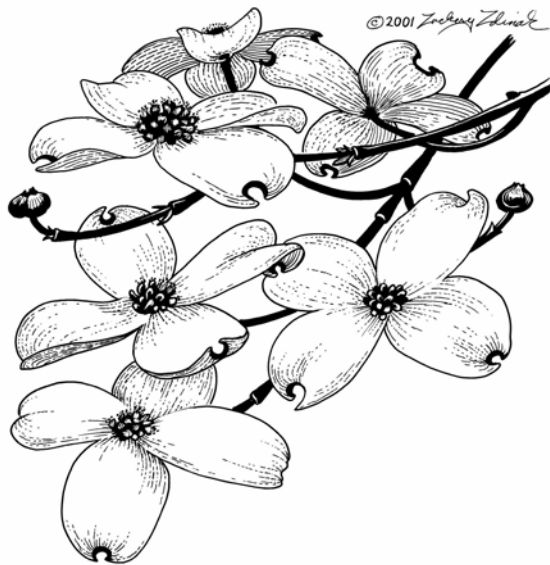


Pileated Woodpecker

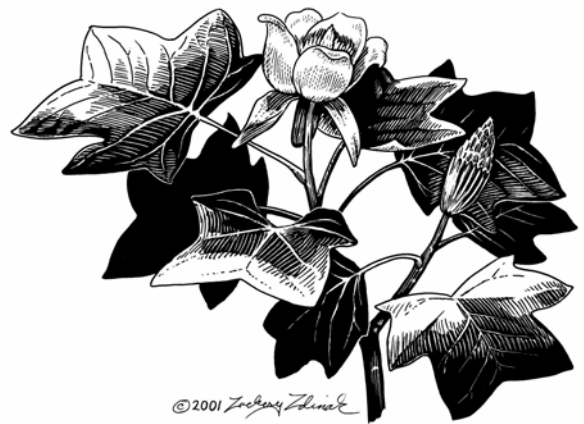


©1999 Zockney Zdival

Dragonfly



Dogwood



Tulip Tree



©2001 Zoology Zlinek

Red Cedar



Swamp Azalea

Decomposers



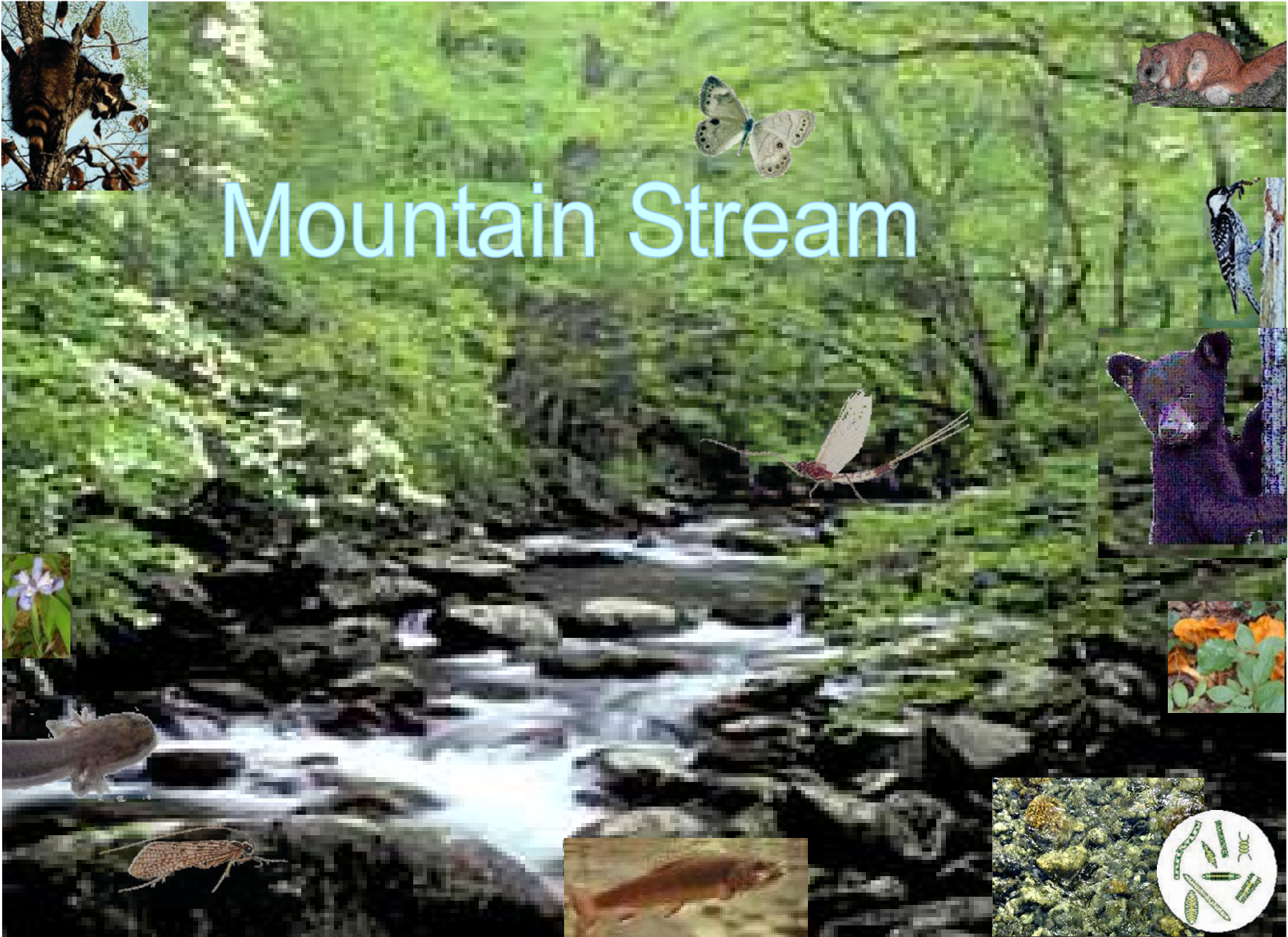
Amanita Caesarea



Ink Cap Mushroom



Boletus



# Mountain Stream

## LESSON 2: NATIVE PLANT SPECIES WEB QUEST

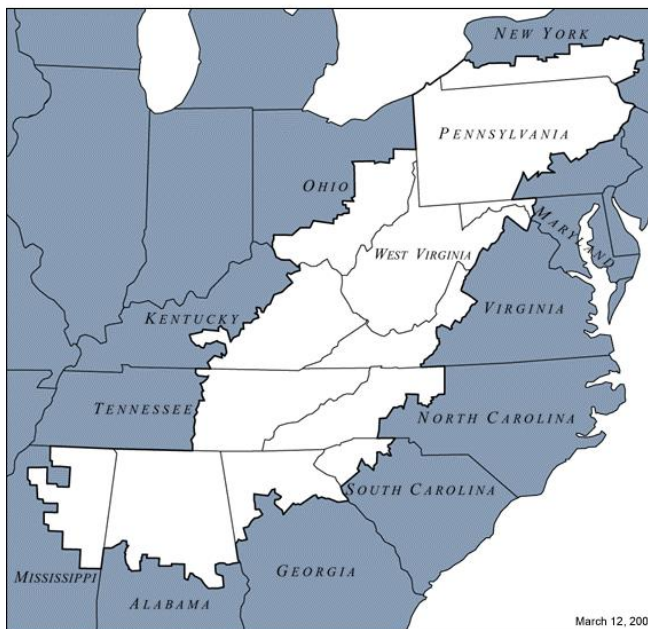
**Duration:** One or two 45-minute class periods

### **Background information:**

The Appalachian chain of mountains, hills, and highlands stretches for 1,500 miles from Quebec southwest to Alabama. The Appalachians are divided into three general regions: northern, central and southern. The southern region of the Appalachians generally stretches from Virginia to Alabama and includes parts of the Allegheny Mountains, the Blue Ridge Mountains, the Unakas, the Great Smoky Mountains, and the Cumberland Mountains.

Many spectacular areas within the Southern Appalachian Region are contained within the Great Smoky Mountains National Park. At one time, the

*The Appalachian Region*



Source: Appalachian Regional Commission

entire Appalachian system was almost entirely covered by forest. Today the Southern Appalachian Region contains six national forests (George Washington, Jefferson, Cherokee, Chattahoochee, Nantahala, and Pisgah) centered around the Great Smoky Mountains National Park. These areas form the largest contiguous expanse of wilderness remaining in the eastern U.S.

The Southern Appalachians also include Shenandoah National Park, which extends along the Blue Ridge Mountains. Overall, this region has high species diversity.

“The independent system of southern plant growth known as the ‘Appalachian forest’ is highly complex. It forms one of the great floral provinces of the Earth. There are the trees that bear luxuriant bloom, such as serviceberry, redbud, hawthorn, tulip poplar, dogwood, locus, sourwood, and many others. Among the numerous shrubs with particularly showy flowers are the rhododendron, azalea, and mountain laurel. Certain summits of the Southern Appalachians are ‘heath-balds’—open meadows or grasslands

interspersed with thick growths of heath. It is estimated that of some 2,000 species of Appalachian flora, perhaps 200 are native to and wholly confined to the Southern Appalachians” (The New Encyclopedia Britannica 1985, p. 995).

(Source: *Overview of the Southern Appalachian Mountains*, available online at <http://www.unc.edu/~dcrawfor/overap.htm>)

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**Objectives:**

- Identify native plant species found in healthy Southern Appalachian ecosystems.
- Briefly describe the main characteristics of native plant species found in healthy Southern Appalachian Region ecosystems.

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**Prepare in advance:**

If possible, have these links on the Invasive Species Curriculum site bookmarked on the Web browser in advance:

- Handout 1—Native Plant Species List
- Handout 2—Student Instructions for Native Species Web Quest
- Handout 3—Sample Native Species Notebook Entry

Otherwise, make a copy for each student in the class

---

**Materials:**

- lab/field notebook for each student
- one computer connected to the Internet for every two students
- colored pencils

---

**Description:**

Students will visit USDA Plants Database Web site at <http://plants.usda.gov/> to identify native species of the Southern Appalachian Region. Students will name and describe each species in general terms in their field notebooks for the purpose of plant identification.

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**Instructional sequence:**

(5 – 10 minutes)

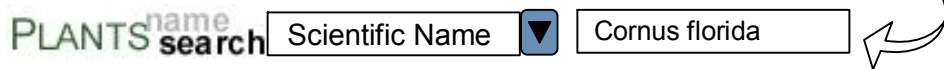
**Instruct** students to:

- **Choose** a plant native to the Southern Appalachian Region from the “Native Plant Species List.”

- **Find** the Web address for the *USDA Plants Database* Web site on *Student Instructions for Native Species Web Quest*.
  - **Type** in this address in the address bar on the monitor screen, and press the “Enter” key on the computer keyboard. Or, activate the <http://plants.usda.gov/> link on the online PDF of the Student Instructions.
- **Find** the drop down menu:



- **Type** the scientific name of the chosen native plant in the “name search” box.



- **Click** “Go,” or press the “Enter” key on the computer keyboard.
- **Scroll down** the page, below or beside the “Plant Profile.”
- **Click** on “PDF”





There are typically 3-5 pages of information in these USDA/NRCS Plant Guides. You will see a page that looks like this:

Plant Guide

## FLOWERING DOGWOOD

*Cornus florida* L.  
Plant symbol = COFL2

Contributed by: USDA NRCS National Plant Data Center

C. W. Cook, 2003  
Trees, Shrubs, and Woody Vines of Central North Carolina

**Alternate Names**  
American boxwood, arrowwood, *Banhamia florida*, boxwood, cornel, cornelian tree, *Cornus canadensis*, *Cornus florida* forma *pendula*, *Cornus florida* forma *pluribracteata*, *Cornus florida* forma *sambocarpa*, *Cornus florida* var. *pendula*, *Cornus florida* var. *rosea*, *Cornus florida* var. *rubra*, *Cymoxylon floridanum*, dogwood, eastern flowering dogwood, white cornel, white dogwood.

**WARNING: The fruit of flowering dogwood is poisonous to humans.**

**Uses**  
*Ethnobotanic:* Flowering dogwood root bark was used by Native Americans as a fever reducer, skin astringent, an antidiarrheal agent, and as a pain reliever for headaches, sores, and muscle inflammations. It was also used to counteract the effects of many poisons and as a general tonic for unspecified ailments. The bark was used for headache and backache relief, as a throat aid for hoarseness, and as an infusion for childhood diseases like worms and measles. Flowers were infused to

reduce fever and relieve colic pains. Compound infusions of several plant parts were used as blood purifiers and as medicine for blood diseases like malaria.

*Ornamental:* The showy blossoms and attractive fall foliage make flowering dogwood a valuable ornamental species. It is commonly used in landscape and street plantings. As a garden tree, it is used for shade around patios, as a shrub border or backdrop species, or as single specimens in the lawn. It is best suited for plantings receiving less than full-day sun.

*Restoration:* Flowering dogwood is a *soil improver* because its leaf litter decomposes more rapidly than most other species. For this reason flowering dogwood has been planted on abandoned strip mines and used for urban forestry projects.

*Wildlife:* Flowering dogwood is a valuable food plant for wildlife because high calcium and fat contents make it palatable. Many bird types including songbirds, forest edge species, and upland game birds (e.g. wild turkey) consume the seeds. The eastern chipmunk, white-footed mouse, gray fox, gray squirrel, black bear, beaver, white-tailed deer, and skunk readily consume flowering dogwood seeds as well. Beaver, rabbits, and deer browse the leaves and sprouts of the plant. Flowering dogwood also provides shelter and habitat for many wildlife species.

*Wood production:* The wood of flowering dogwood has been harvested for the manufacture of tool handles, charcoal, wheel cogs, hayforks, and pulleys. It is occasionally used to make specialty items like golf club heads, roller skate wheels, knitting needles, and spools. The wood is hard, strong, and shock resistant, making it suitable for wood products that need to withstand rough use.

**Legal Status**  
Flowering dogwood is endangered in Maine, exploitably vulnerable in New York, and threatened in Vermont. Please consult the PLANTS Web site (<http://plants.usda.gov>) and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Information in the Guides includes:

- General Description
  - Bark
  - Leaves
  - Flowers
  - Fruit
  - Key characteristics
- Distribution
- Habitat
- Adaptation
- Establishment
- Management

- Pests and Potential Problems
- Seeds and Plant Production

(35 – 80 minutes)

- **Instruct** students to create an entry in their field notebook, as follows:
- **Name and describe** each species on the “Native Plant Species List” (included as an attachment to this lesson) in general terms in field notebooks for the purpose of plant identification
  - **List** the plant by common name first and scientific name in parentheses, e.g., flowering dogwood (*Cornus florida*)
  - **Give a general description** of the plant and flower. Include information about the plant’s habitat and growing season. Include a line drawing—also available on the USDA Plants Database Web site. (Please refer to the “Sample Native Species Notebook Entry” included as an attachment to this lesson.)

**Optional assessment task:**

PREPARE IN ADVANCE: The teacher tags native plant species on the school grounds.

Instructional Sequence: Escort the students outside and have them use their field notebooks to identify plants from the native plant list, which the teacher tagged, and others.

Reference Note: USDA, Plants Database <http://plants.usda.gov/>

The images on the USDA, Plants Database site are not copyrighted and may be freely used for any purpose. Please credit the artist, original publication if applicable, and the USDA-NRCS PLANTS Database.

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## ***Handout 1: Native Plant Species List***

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### ***TREES***

- Red maple (*Acer rubrum*)
- White ash (*Fraxinus Americana*)
- Black walnut (*Juglans nigra*)
- Red cedar (*Juniperus virginiana*)
- Sycamore (*Platanus occidentalis*)
- Northern red oak (*Quercus rubra*)
- Sassafras (*Sassafras albidum*)

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### ***SMALL TREES***

- Flowering Dogwood (*Cornus florida*)
- Redbud (*Cercis Canadensis*)
- Silverbell (*Halesia Carolina*)
- Sourwood (*Oxydendrum arboreum*)
- Staghorn sumac (*Rhus typhina*)

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### ***SHRUBS***

- Wild hydrangea (*Hydrangea arborescens*)
- Mountain laurel (*Kalmia latifolia*)
- Rosebay Rhododendron (*Rhododendron maximum*)

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### ***FLOWERS***

- Later purple aster (*Aster patens*)
- Bleeding heart (*Dicentra eximia*)
- Solomon's seal (*Polygonatum biflorum*)
- Bird-foot violet (*Viola pedata*)

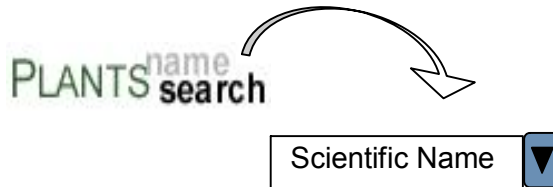
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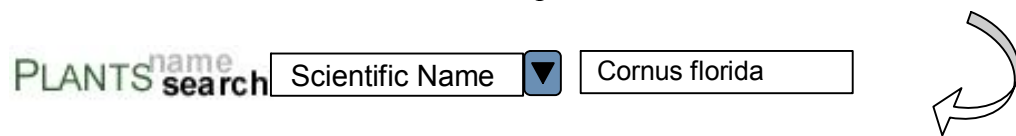
## *Handout 2: Student Instructions for Native Species Web Quest*

1. Choose a plant native to the Southern Appalachian Region from the “Native Plant Species List.”
2. Open your Web browser, type <http://plants.usda.gov/>in the address bar, and press the “Enter” key on the computer keyboard (or activate the link).

- a. Find the drop down menu:



- b. Type the scientific name of the chosen native plant in the “name search” box.



- c. Click “Go,” or press the “Enter” key on the computer keyboard.
- d. Scroll down the page, below or beside the “Plant Profile.”
- e. Click on “PDF”



There are typically 3-5 pages of information in these USDA/NRCS Plant Guides. You will see a page that looks like this:

Information in the Guides includes:

- General Description:
  - bark
  - leaves
  - flowers
  - fruit
  - Key characteristics
- Distribution
- Habitat
- Adaptation
- Establishment
- Management
- Pests and Potential Problems
- Seeds and Plant Production



**FLOWERING DOGWOOD**  
*Cornus florida* L.  
Plant symbol = COFL2

Contributed by: USDA NRCS National Plant Data Center



© 2004, 2005  
Tress, Shrubs, and Woody Vines of Central North Carolina

**Alternate Names:** American boxwood, arrowwood, *Banethamia florida*, boxwood, cornet, cornelian tree, *Cornus canadensis*, *Cornus florida* forma *pendula*, *Cornus florida* forma *pluribracteata*, *Cornus florida* forma *santhocarpa*, *Cornus florida* var. *pendula*, *Cornus florida* var. *racosa*, *Cornus florida* var. *radix*, *Corymbium floridanum*, dogwood, eastern flowering dogwood, white cornel, white dogwood.

**WARNING:** The fruit of flowering dogwood is poisonous to humans.

**Uses:**  
*Ethnobotanic:* Flowering dogwood root bark was used by Native Americans as a fever reducer, skin astringent, an antidiarrheal agent, and as a pain reliever for headaches, sores, and muscle inflammations. It was also used to counteract the effects of many poisons and as a general tonic for unspecified ailments. The bark was used for headache and backache relief, as a throat aid for hoarseness, and as an infusion for childhood diseases like worms and measles. Flowers were infused to

*reduce fever and relieve colic pains. Compound infusions of several plant parts were used as blood purifiers and as medicine for blood diseases like malaria.*

*Ornamental:* The showy blossoms and attractive fall foliage make flowering dogwood a valuable ornamental species. It is commonly used in landscape and street plantings. As a garden tree, it is used for shade around patios, as a shrub border or backdrop species, or as single specimens in the lawn. It is best suited for plantings receiving less than full-day sun.

*Restoration:* Flowering dogwood is a soil improver because its leaf litter decomposes more rapidly than most other species. For this reason flowering dogwood has been planted on abandoned strip mines and used for urban forestry projects.

*Wildlife:* Flowering dogwood is a valuable food plant for wildlife because high calcium and fat contents make it palatable. Many bird types including songbirds, forest edge species, and upland game birds (e.g. wild turkey) consume the seeds. The eastern chipmunk, white-footed mouse, gray fox, gray squirrel, black bear, beaver, white-tailed deer, and skunk readily consume flowering dogwood seeds as well. Beaver, rabbit, and deer browse the leaves and sprouts of the plant. Flowering dogwood also provides shelter and habitat for many wildlife species.

*Wood production:* The wood of flowering dogwood has been harvested for the manufacture of tool handles, charcoal, wheel caps, hayforks, and pulleys. It is occasionally used to make specialty items like golf club heads, roller skate wheels, kumming needles, and spoons. The wood is hard, strong, and shock resistant, making it suitable for wood products that need to withstand tough use.

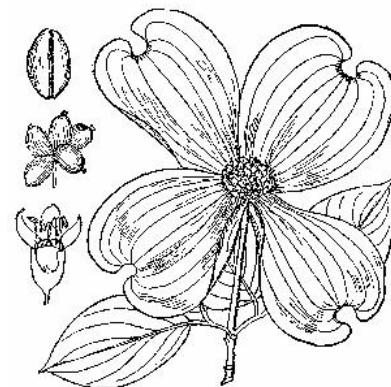
**Legal Status:**  
 Flowering dogwood is endangered in Maine, explosively vulnerable in New York, and threatened in Vermont. Please consult the PLANTS Web site (<http://plants.usda.gov>) and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

3. Name and describe each species in general terms in field notebooks for the purpose of plant identification.
  - a. List the plant by common name first and scientific name in parentheses, e.g., flowering dogwood (*Cornus florida*)
  - b. Give a general description of the plant and flower. Include information about the plant's habitat and growing season. Include a line drawing, which is also available on the USDA Plants Database Web site. Please refer to the sample entry (Handout 3) for complete example.)

Example:

*Flowering dogwood (Cornus florida) is native to the southeastern United States. The showy blossoms and attractive fall foliage make flowering dogwood a valuable ornamental species.*

*Flowering dogwood is a small deciduous tree, characterized by branches that spread wider than its height. Flowering dogwood is typically 15 to 45 ft. tall.*



**Flowering Dogwood  
(*Cornus florida*)**

*Source: USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. Illustrated flora of the northern states and Canada. Vol. 2:664.*

## **Flowering dogwood (*Cornus florida*)**

Flowering dogwood is native to the southeastern United States. The showy blossoms and attractive fall foliage make flowering dogwood a valuable ornamental species.

Flowering dogwood is a small deciduous tree, characterized by branches that spread wider than its height. Flowering dogwood is typically 15 to 45 ft. tall.

Leaves are opposite, simple, medium-green in color, 3 to 5 in. long, and less than 3 in wide. The veins follow the oval curve of the leaf. Autumn foliage turns red or purple.

The flowers are yellow, very small, and clustered in the center of 4 large white (or pink) bracts. Each bract has a rounded notch on the outer edge. Flowers appear between March and June, with or before the leaves, and persist for 2 to 4 weeks.

The fruit are yellow to red berrylike drupes that contain one to two cream-colored, oval seeds. Fruits ripen in September and October. The fruit of flowering dogwood is poisonous to humans.

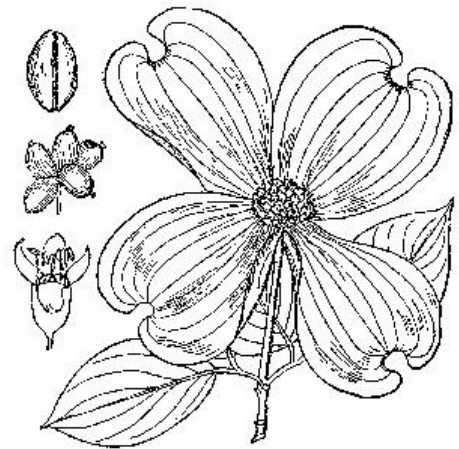
Flowering dogwood is an important understory species in the eastern deciduous and southern coniferous forests. It is also found on floodplains, slopes, bluffs, ravines, gum swamps, along fencerows, and in old-field communities.

Partial or broken shade is best, but flowering dogwood can tolerate full sun. It does best with some shade in the south and full sun in the north.

Flowering dogwood trees grow best in coarse to medium textured, well-drained soils with a pH range of 6 to 7. They are sensitive to rapidly changing soil temperature and are most abundant in temperature-consistent woodland soils.

Although they are tolerant of seasonal dry periods, they are not tolerant of severe drought or heavy, saturated soils. The inability to grow on extremely dry sites is attributed to their shallow root system.

Flowering dogwood is not tolerant of stresses such as heat, drought, pollution, or salt. These stresses make flowering dogwood more susceptible to disease, pests, and other problems.



**Flowering Dogwood  
(*Cornus florida*)**

*Source: USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. Illustrated flora of the northern states and Canada. Vol. 2:664.*

## LESSON 3: WEEDS GONE WILD

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**Duration:** One 45-minute class period

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**Objectives:**

- Sort information to discern relevant details.
- Summarize major points of a reading selection.
- Clearly describe major points of a reading selection.

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**Prepare in advance:**

- Handout 1—one copy (Weeds Gone Wild brochure) per student
- Overhead transparency of “Contrasting Types of Information”

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**Materials:**

- colored pencils or crayons
- overhead projector
- red, green, and blue overhead markers for teacher use

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**Description:**

- Students learn to differentiate types of information in a brochure.
- Students read about invasive plants and then write a summary.

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**Instructional sequence:**

*(5-10 minutes)*

- **Instruct** students to skim the Weeds Gone Wild brochure, then
  - Circle in red: the description of the Web site;
  - Circle in blue: the list of exotic invasive plants; and
  - Circle in green: the description of the Weeds Gone Wild project.

*(5-10 minutes)*

- **Contrast** the difference between information specifically about exotic invasive species and information about the project itself. Use the “Contrasting Types of Information” overhead transparency to help students clarify which information is relevant for a summary of information regarding the threat of exotic invasive plants.
- **Lead** a brief discussion about summarizing the brochure.

- For example: Does the description of the Website have information in it that you would use to inform someone about the threat of exotic invasive plants? Why or why not?
- For example: Does the explanation of the project itself have information in it that you would use to **describe** the threat of exotic invasive plants? Why? Why not?

*(10-20 minutes)*

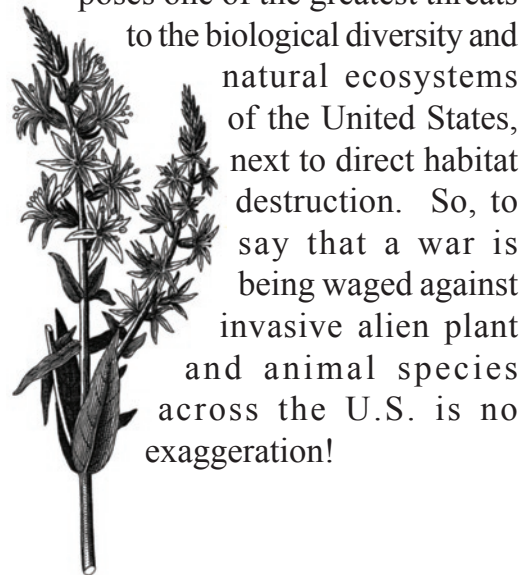
- **Instruct** students to read the brochure, paying close attention to information they can use to tell someone else about the threat of exotic invasive plant species; then write a one-two paragraph summary of the key points. Students should clearly describe the main message of the reading selection.

*Source:*

*Weeds Gone Wild: Alien Plant Invaders of Natural Areas; online at <<http://www.nps.gov/plants/alien/pubs/index.htm>>, accessed 10/26/05*



**L**egions of alien invaders are silently creeping into the United States and taking over our native plants and animals at an alarming rate. Does this sound like a plot lifted from X-Files or Star Trek? Unfortunately, the story is not science fiction. Invasive weeds are taking over public lands at the rate of 4,300 acres a day according to one source! With growth like this, it's not surprising that this tide of invaders poses one of the greatest threats



to the biological diversity and natural ecosystems of the United States, next to direct habitat destruction. So, to say that a war is being waged against invasive alien plant and animal species across the U.S. is no exaggeration!

<http://www.nps.gov/plants/alien/>



***Weeds Gone Wild:***

***Alien Plant Invaders of Natural Areas*** is a project of the Alien Plant Working Group (APWG), a subcommittee of the Plant Conservation Alliance. It is a cooperative effort intended to provide educational materials on the threat posed by invasive exotic plants to the native flora, fauna, and ecosystems of the United States. Additional fact sheet authors are needed, please contact the Chair of the APWG at: [jil\\_swearingen@nps.gov](mailto:jil_swearingen@nps.gov) for more information.

<http://www.nps.gov/plants/alien/>

**Weeds Gone Wild**

**Alien  
Plant  
Invaders  
of  
Natural  
Areas**

Alien plants are those introduced by people into an area where they have never occurred before naturally. They are also known as exotic, non-indigenous, and non-native. Over eleven hundred plant species have been identified as threats to our native flora and fauna because of their aggressive, invasive characteristics. Invasive plants are species that reproduce rapidly and produce abundantly. Their phenomenal growth allows them to overwhelm and displace existing native plants by reducing the availability of light, water, nutrients and space available. Invasive plants can be found on land and in water.

**W**eeds Gone Wild: Alien Plant Invaders of Natural Areas is a website dedicated to educating the general public, natural resource managers, and others on the threats posed by invasive plant species. Moderately technical fact sheets include photos, plant descriptions, ecological threat, U.S. distribution and habitat, methods of reproduction and spread, management options, expert contacts, suggestions for native plants and non-invasive substitutes for landscaping, and references. A comprehensive list of invasive plants affecting natural areas in the U.S., links to over 100 relevant organizations, a

section on exotic invasives in the news, a printable calendar, a meetings & events calendar and other information can also be found on the site. Keep visiting - new fact sheets and other information will be continually added to the website!

<http://www.nps.gov/plants/alien/>

The fifty-four plant invaders with fact sheets currently available on the site are:



- **Annual bastard-cabbage** (*Rapistrum rugosum*) •
- **Asiatic colubrina** (*Colubrina asiatica*)
- **Asiatic sand sedge** (*Carex kobomugi*) •
- **Australian pine** (*Casuarina equisetifolia*)
- **Black locust** (*Robinia pseudoacacia*) •
- **Burma reed** (*Neyraudia reynaudiana*)
- **Bush honeysuckles, exotic** (*Lonicera* cultivars and species) •
- **Canada thistle** (*Cirsium arvense*)
- **Carrotwood** (*Cupaniopsis anacardioides*) •
- **Chinese lespedeza** (*Lespedeza cuneata*)
- **Climbing euonymus** (*Euonymus fortunei*) •
- **Cogon grass** (*Imperata cylindrica*) •
- **Common buckthorn** (*Rhamnus cathartica*)
- **Common mullein** (*Verbascum thapsus*) •
- **Common reed** (*Phragmites australis*) •
- **English ivy** (*Hedera helix*) •
- **Eurasian watermilfoil** (*Myriophyllum spicatum*) •
- **Fire tree** (*Morella faya*)
- **Fiveleaf akebia** (*Akebia quinata*) •
- **Fountain grass** (*Pennisetum setaceum*) •
- **Garlic mustard** (*Alliaria petiolata*) •
- **Giant reed** (*Arundo donax*)
- **Goutweed** (*Aegopodium podagraria*) •
- **Japanese barberry** (*Berberis thunbergii*) •
- **Japanese honeysuckle** (*Lonicera japonica*) •
- **Japanese knotweed** (*Polygonum cuspidatum*)
- **Japanese spiraea** (*Spiraea japonica*) •
- **Japanese stilt grass** (*Microstegium vimineum*) •
- **Kudzu** (*Pueraria montana* var. *lobata*) •
- **Leafy spurge** (*Euphorbia esula*)
- **Lesser celandine** (*Ranunculus ficaria*) •
- **Melaleuca** (*Melaleuca quinquenervia*) •
- **Mile-a-minute** (*Polygonum perfoliatum*) •
- **Multiflora rose** (*Rosa multiflora*)
- **Musk thistle** (*Carduus nutans*) •
- **Oriental bittersweet** (*Celastrus orbiculatus*) •
- **Paper mulberry** (*Broussonetia papyrifera*) •
- **Porcelainberry** (*Ampelopsis brevipedunculata*)
- **Princess tree** (*Paulownia tomentosa*) •
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- **Russian-olive** (*Elaeagnus angustifolia*) •
- **Salt cedar** (*Tamarix* species)
- **Siberian elm** (*Ulmus pumila*) •
- **Silk tree** (*Albizia julibrissin*) •
- **Spotted knapweed** (*Centaurea biebersteinii*) •
- **Strawberry guava** (*Psidium cattleianum*)
- **Tall fescue** (*Lolium arundinaceum*) •
- **Tree-of-heaven** (*Ailanthus altissima*) •
- **Velvet tree** (*Miconia calvescens*) •
- **White poplar** (*Populus alba*)
- **Wineberry** (*Rubus phoenicolasius*) •
- **Wisterias, exotic** (*Wisteria floribunda* and *sinensis*)
- **Yellow Himalayan raspberry** (*Rubus ellipticus*) •
- **Yellow starthistle** (*Centaurea solstitialis*)



# Weeds Gone Wild

Alien Plant Invaders of Natural Areas

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# Weeds Gone Wild

## Alien Plant Invaders of Natural Areas

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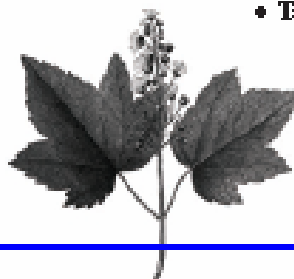


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## LESSON 4: SPACE INVADERS—UNWANTED NEIGHBORS

NOTE: This lesson was developed by the Center for Environmental Education at Middle Tennessee State University. See “A Date with Freddie Kudzu” in *Noxious Neighbors: Exotics in Our Backyard* (Murfreesboro: Middle Tennessee State University, 1998). It has been adapted for incorporation into this curriculum.

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**Duration:** Two 45-minute class periods

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**Background information:**

“Exotic species tend to be destructive because they usually have no controls (such as insects or other predators) that keep them in check . . . because they have not evolved within the native ecosystem. For this reason, [exotic invasives] have a competitive edge over native species. Exotics tend to take over and force out native populations. Many invasive exotic plants thrive not only in native plant communities but on disturbed sites, such as abandoned fields and construction sites.”

“Biological diversity (biodiversity) is reduced as native species are displaced by [exotic invasive plants]. Biodiversity is further impacted when exotic plants harbor invasive pathogens (harmful microorganisms), fungi, or other organisms that decimate native species. For example, the American chestnut blight was caused by a fungus introduced with the Chinese chestnut. The blight destroyed one of the most important hardwoods in eastern North America.”

“Most introductions of exotic plants are intentional and usually relate to aquaculture, horticulture, or conservation purposes. When problems occur later, exotics are not as economical as they first seemed. Awareness of the problem caused by [exotic invasives] is the first step in preventing their continued widespread use. Public awareness will increase responsible landscaping practices. Awareness by resource managers will help prevent introductions on public lands and preserve our natural heritage.”

“Characteristics of [exotic invasive] plants are that they:

- grow and mature rapidly
- have prolific reproductive capacities
- are highly successful in seed dispersal, germination, and colonization
- rampantly spread and out-compete native plants
- are difficult and costly to remove and control”
- originate from similar climate as the ecosystems they invade
- quickly colonize open spaces
- have few natural consumers present in the ecosystems they invade

The seeds of some exotic invasive species can lie dormant in the ground for many years. For example, garlic mustard seed can remain viable for up to ten years. When conditions are right for growth, the seeds germinate. Suddenly, many exotic invasives appear where there had been none for years.

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**Vocabulary:**

Community	All populations living in an ecosystem
Competition	More than one species tries to use the same resource for survival
Ecosystem	All the living things plus the non-living things in an area
Exotic plant	A plant brought into an area and planted by people, or brought in by storms or wildlife; plants that are not part of the native or naturally existing landscape
Exotic invasive plant	An exotic plant that has no natural limits on its growth and reproduction
Habitat	Place providing the types of food, shelter, moisture, and temperature needed for survival of a living organism
Monoculture	Occurrence or cultivation of one type of plant, excluding all other types of plants
Population	All organisms that are the same species living in one community

*Sources: Some vocabulary and other definitions are adapted from "Glossary," Glencoe Science: Ecology, McGraw-Hill Companies, 2002. (See their "Online Learning Center" at <<http://www.glencoe.com/sites/wisconsin/teacher/science/index.html>>, under "Classroom Tools," "Student," click on "Multilingual Glossary MS," (accessed 09/05).*

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**Objectives:**

- Identify characteristics of exotic invasive plants.
- Describe how exotic invasive plants are injurious to ecosystems.

**Day One—Video** (one – 45-minute class period)**Prepare in advance:**

- Copy Handout 1 (Video Activity Sheet—Notes) for each student
- Copy Handout 2 (Video Activity Sheet—Assignment) for each student
- Obtain a copy of the DVD “If It’s Green, It’s Good?” by contacting the SAMAB office at 865-974-5912.

**Materials:**

- DVD: “If It’s Green, It’s Good?”
- DVD player

**Description:**

After viewing a short film (“If It’s Green, It’s Good?”) students review characteristics of a healthy ecosystem, then contrast a healthy ecosystem with an “unhealthy” ecosystem invaded by exotic plants.

**Instructional sequence:**

(10 minutes)

- **Review** the components of a *healthy* ecosystem (write these on the chalkboard):
  - sunlight (energy source)
  - characteristic living organisms (producers, consumers, decomposers; predator/prey)
  - characteristic non-living things (land forms, water sources, soil, rocks)
  - dead organisms
  - natural boundaries, set by the living and non-living things within
- **Hand out** video activity sheets. Students will need the information from the guide to do the film follow-up activity.
- **Introduce video**—sometimes a healthy ecosystem is upset by invaders that don’t belong there. This video talks about some of the consequences of exotic plant invasion.

(20 minutes)

- **Video presentation:** “If It’s Green, It’s Good?”

(10 – 15 minutes)

- **Recall** the components of a *healthy* ecosystem.

- **Discuss and clarify** points students wrote down in their notes during the film.
- **Guide** discussion of the contrast between a healthy and an unhealthy ecosystem. For example:
  - How do exotic plant species compete for important resources (like water, sunlight and soil) in an ecosystem?
  - Why does the animal community change when exotic plants invade?

(10 minutes)

- **Assignment:** Using their notes from the video, students write a paragraph describing consequences of exotic plant invasion (page 2 of the Video Activity Sheet)

### **Day Two—Chain Tag Game** (one – 45-minute class period)

Note: This activity is a simulation of an exotic invasive plant taking over a native ecosystem and crowding out the native plants. Although plants are not mobile as they are in this simulation, plants compete for sun, water, space, and soil nutrients. In this game *running away from the students playing the role of an invasive exotic* substitutes for the *competition that exists* for sun, water, space, and soil nutrients.

#### **Prepare in advance:**

- Mark off a large field for running, using cones or other highly visible boundary markers.
- Optional:
  - student copies of the “Space Invaders Game Rules” (handout 3)
  - overhead transparency of “Space Invaders Game Rules” (handout 3)

#### **Materials:**

- *large* outdoor area (i.e., large enough for students to play chain tag) with defined boundaries (e.g., mark off the area with brightly colored cones)
- flip chart (for class discussion after the simulation)
- marker for flip chart

#### **Description:**

Students simulate exotic invasive plants by taking part in a fun group game.



**Instructional sequence:**

(10 minutes)

- **Review** the types of requirements plants need: sun, water, space, and soil nutrients.
- **Review** the characteristics of an exotic invasive plant: they grow and mature rapidly, they reproduce prolifically, they colonize new areas, they out compete native plants.
- Introduce game/simulation:
  - **Tell** the students that they are about to play a game of chain tag that simulates an exotic invasive plant crowding out native plants in an ecosystem. At the beginning of the game, one student will represent an exotic invasive plant (kudzu) and the others represent native plants. The boundaries for their ecosystem are the markers are the outer edges of the ecosystem.
  - **Explain** that the kudzu is going to grow fast, spread rapidly, and reproduce a lot in the ecosystem. This growth is simulated by tagging native plants and forming a long kudzu vine. (Students who have been tagged form a chain by holding hands.)
  - **Explain** that the game starts with the student representing kudzu running to tag a student representing a native plant. Then, the two students join hands. Together, they form a chain and run to tag another student representing a native plant. That third student will join hands at the end of the line becoming part of the kudzu vine.
  - **Explain** that when a student joins the kudzu vine this represents a native plant being crowded out by kudzu. The kudzu vine will continue to grow until it reaches ten students, and then the vine splits into two parts.
  - **Explain** that this splitting apart represents reproduction. The game ends when there are no native plants left.
  - **Explain** that there is no natural defense against kudzu in the Southern Appalachian Region.

(5 minutes)

- **Explain** the game rules using the overhead transparency “Space Invaders Game Rules”

(25 minutes)

- **Escort** students to game area.
- **Direct** students to go and stand anywhere they wish to grow in the ecosystem.
- **Select** one student to be the exotic invasive plant kudzu.
- **Play** the game.

(10 minutes)

- **Lead a discussion** to help the students process the simulation and connect the game to their knowledge of concepts.

- **Review** vocabulary as needed.
- **Ask:**
  - What did you learn? (For example: Kudzu spreads slowly at first and faster later.)
  - How is this simulation like reality? (For example: The kudzu takes over an ecosystem, crowding out native species.)
  - How is this simulation not like reality? (For example: Plants cannot run; they stay in one place.)

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## ***Handout 1: Video Activity Sheet—Notes***

Think about what you already know about healthy ecosystems. You can learn about how exotic invasive plants can injure a healthy ecosystem from the video “If It’s Green, its Good?” Use these categories to organize your notes about exotic invasive plants from the film:

Native Plants

Exotic Plants

Natural Boundaries

Habitats

Sunlight

Water

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***Handout 2: Video Activity Sheet—Assignment***

INSTRUCTIONS: Use your notes from the film to write a paragraph to answer the question: “If it’s green, is it good?” In your paragraph, describe two (2) ways exotic invasive plants can injure a healthy ecosystem.

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- **Stay within the marked boundaries.**
- **Plants are not allowed to leave the ecosystem.**
- **Native plants can run to get away from the student(s) representing the exotic invasive plants.**
- **Students who represent native plants are allowed to run anywhere within the boundaries to escape the effects of competition with the invading exotic plant.**
- **The invading exotic plant chain must stay together by holding hands.**
- **Only the two students on the outside of the invading exotic plant vine/chain can tag native plants.**
- **The vine will continue to grow until it reaches ten students, and then the vine splits into two parts.**
- **Vines that split from the original can also tag other native plants, using the same limitations as before.**
- **The last native plant tagged becomes a new exotic invasive plant (such as Chinese Yam) in the next round. (Play as many rounds as time will permit.)**

## LESSON 5: MOST TROUBLESOME EXOTIC INVASIVE PLANT SPECIES WEB QUEST

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**Duration:** Two 45-minute class periods

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**Background information:**

“Introduction and Spread of Nonnative Species: As many as 50,000 nonnative species are estimated to have been introduced [into the United States]; of these, at least 4,500 are established. Approximately 675 species in the United States cause severe economic or environmental harm. On National Forest System rangelands, 6 to 7 million acres are infested with noxious weeds and invasive plants. Infestations are increasing at an estimated rate of 8% to 14% per year. Estimates of the economic losses due to nonnative invasive species are as high as \$125 billion per year.”

“The unintentional introduction of nonnative invasive species into the United States is a byproduct of travel, immigration, and global commerce. Invasive species may enter:

- In timber, produce seeds or nursery stock
- In wood used for packing crates
- In freight via railway cars, tractors, aircraft, automobiles, bicycles, ships, and other vehicles
- In ballast water dumped from ships
- On hiking boots, camping equipment, and lawn furniture
- In or on soil”

“Non-native (exotic) plants can invade woodlands and out-compete native plants, resulting in:

- slower tree growth
- loss of biological diversity
- threats to native plant populations
- degraded wildlife habitat
- poor hiking conditions”

*Sources:*

*Forest Encyclopedia Network, Southern Appalachian Forest Ecosystems/ Forest Health/ Non-native Invasive Species, online at < <http://www.forestryencyclopedia.net/Encyclopedia/>>*

*Rural Action, Forest Sustainability Program/ Invasive Exotic Plants, online at < [http://www.ruralaction.org/forestry\\_invasive\\_plants.html](http://www.ruralaction.org/forestry_invasive_plants.html)>*

**Objectives:**

Identify (by sight) exotic invasive plant species found Southern Appalachian Region ecosystems.

**Day One—Online Research** (one – 45-minute class period)**Prepare in advance:**

Make copies of Handout 1 (Student Instructions for Exotic Invasive Plant Species Web Quest) and Handout 2 (Sample Exotic Invasive Species Notebook Entry) for each student

**Materials:**

- one computer connected to the Internet for every two students
- lab/field notebooks
- colored pencils

**Description:**

Students visit several Web sites and identify common exotic invasive species of the Southern Appalachian Region.

**Instructional sequence:**

(35 – 40 minutes)

- **Distribute** Handout 1 and Handout 2.
- **Direct** students to use the Web Sites listed to find the ten threatening exotic invasives in the Southern Appalachian Region listed on the “Instruction” handout.
- **Instruct** students to list the plants by the common name shown on the “Instruction” handout and then find the scientific name and put it in parentheses, for example, Chinese Yam (*Dioscorea batatas*).

**Teacher’s Key:**

Name	Description
Coltsfoot ( <i>Tussilago farfara</i> L.)	Flowers and leaves can grow directly from the roots. Coltsfoot reproduces from both separated plant parts and seeds. The roots can remain dormant underground for long periods. Coltsfoot has been known to grow back after soil disturbance, and very small fragments of roots can produce new plants. Usually found in moist areas.

<p>English Ivy <i>Hedera helix</i> L.</p>	<p>Is toxic and can cause intestinal problems. This helps guarantee spread of the seeds by many native songbirds that are attracted to the black berries in spring when other food sources are limited. English ivy is an aggressive invader that threatens all vegetation. The leaves form a thick canopy just above the ground, preventing sunlight from reaching other plants. Generally this ivy only produces seeds when it climbs trees.</p>
<p>Japanese Honeysuckle <i>Lonicera japonica</i> Thunb.)</p>	<p>A woody vine originally used to control erosion, protect wildlife, and decorate landscapes. It can out-compete native ground cover and smother shrubs and small trees. Its green leaves thrive through winter, increasing its ability to take over areas. It is the widest occurring invasive plant in the southeastern U.S.</p>
<p>Japanese Knotweed <i>Polygonum cuspidatum</i> (Sieb. &amp; Zucc.)</p>	<p>Has bamboo-like stems that form dense thickets and crowd native plants. It can tolerate poor growing conditions and quickly spread in natural areas. Japanese Knotweed threatens areas around moving water, rapidly colonizing weathered shores and islands. It spreads by plant parts and growth, but not by seeds.</p>
<p>Japanese Spirea <i>Spiraea japonica</i> L.)</p>	<p>Can rapidly take over disturbed areas. Spirea grows rapidly and forms dense stands that out-compete existing native herbs and shrubs. Seeds of Japanese spirea last for many years in the soil, making its control and the return of native plants especially difficult.</p>
<p>Kudzu <i>Pueraria montana</i> (Lour.) Merr.)</p>	<p>Is a fast-growing vine originally from Asia. Before 1953, it was grown as livestock forage and erosion control. Park crews have largely contained the spread of kudzu in the Smokies; however they still check over a hundred sites and treat them as needed.</p>
<p>Multiflora Rose <i>Rosa multiflora</i> (Thunb. ex Murr.)</p>	<p>Spreads rapidly and can form thickets, which displace native species. Multiflora rose is native to China and Japan, introduced over 40 years ago for wildlife cover, living fences, and windbreaks. Birds and other wildlife spread its prolific seeds (up to 1 million per plant).</p>



<p>Oriental Bittersweet (<i>Celastrus orbiculatus</i> Thunb.)</p>	<p>Native to Japan, Korea, and China, it is a serious threat to native plant communities due to its ability to reproduce and grow rapidly. As a climbing vine, it damages or kills native plants by choking and shading. It can also cross-pollinate with American bittersweet, leading to the native's loss of genetic integrity. Its seeds are spread by birds and by people selling wreaths made from vines that have the bright red seeds on them.</p>
<p>Privet (<i>Ligustrum</i> spp.)</p>	<p>Is native to Europe, Asia, and North Africa, but still planted widely in this region as a hedge. Birds and other wildlife spread the seeds everywhere. Once sprouted, privet can form dense thickets that displace native plants. Privet is the fastest spreading of all species in the southeastern U.S.</p>
<p>Tree of Heaven (<i>Ailanthus altissima</i> (Mill.) Swingle)</p>	<p>Is most common along open areas and forest edges, at lower to middle elevations. This native of China is a prolific seed producer (possibly 325,000 seeds per year) and grows thickly, preventing native species from growing. Roots give off chemicals that push out native plants, and are destructive enough to cause damage to sewers and foundations.</p>
<p>Sources: Southeast Exotic Pest Council, online at &lt;<a href="http://www.se-eppc.org/manual/TUFA.html">http://www.se-eppc.org/manual/TUFA.html</a>&gt; National Park Service Fact Sheets, online at &lt;<a href="http://www.nps.gov/plants/alien/fact/">http://www.nps.gov/plants/alien/fact/</a>&gt; Southern Appalachian Man and Biosphere, online at &lt;<a href="http://samab.org/Focus/Invasive/">http://samab.org/Focus/Invasive/</a>&gt;</p>	

(5 – 10 minutes)

- **Instruct** students to select one of the top 10 exotic invasives to research in depth.

**Day Two—Field Notebook Entries** (one – 45-minute class period)

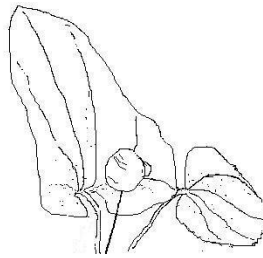
**Description:**

Students name, describe, and draw each exotic invasive plant species in general terms in their lab/field notebooks for the purpose of plant identification.

**Instructional sequence:**

(35 – 40 minutes)

- **Direct** students to visit the Southeast Exotic Pest Council Invasive Plant Manual Web site <<http://www.invasive.org/eastern/eppc/>> to learn about exotic invasive plants.
- **Assign** students to make a notebook entry for five exotic plants. Notebook entries should include:
  - (a) The common and scientific names of each exotic invasive plant; for example: Chinese Yam (*Dioscorea batatas*)
  - (b) A general description of the plant, flower, and any berries or fruit; for example: “Chinese Yam is a long-climbing vine with 2- to 3-inch wide shiny heart-shaped leaves having arc-shaped veins. Leaves may vary in shape to arrowhead-like with lobes at the leaf base. Pea-to marble-sized bulbils like small potatoes occur at leaf nodes in late summer. These may become potato-sized in other regions. Ripe bulbils drop readily at slightest touch.”
  - (c) The origin of the exotic invasive plant; for example: “Chinese Yam is originally from Asia.”
  - (d) Threats to native plants; for example: “The vine is fast-growing (up to 1 inch/day at its peak). It covers trees, shrubs, ground vegetation, and structures. Reproduces fast starting in late June, and can spread rapidly along forest edges and openings.”
  - (e) A sketch of the plant (no print outs, tracing is acceptable); For example:

**Optional assessment task:**

**Prepare in advance:** Teacher tags exotic invasive plant species on the school grounds.

**Lead** the students outside and **direct** them to identify tagged exotic invasives using their lab/field notebooks.

**Sources:**

Forestry Encyclopedia Network/ Southern Appalachian Forest Ecosystems/ Forest Health/Non-native Invasive Species, online at <<http://www.forestryencyclopedia.net/Encyclopedia/>>

Southern Appalachian Man and the Biosphere, online at

<<http://samab.org/Focus/Invasive/about.html>>, accessed 10/12/05

Southeast Exotic Pest Plant Council Invasive Plant Manual drawing adapted by Leslie Marra from a photo by Jack Ranney, online at <<http://www.invasive.org/eastern/eppc/DIOP.html>>, accessed 10/12/05

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## Handout 1: Student Instructions for Exotic Invasive Plant Species Web Quest

1. **Name and describe** each exotic invasive species listed below in general terms in your lab/field notebook (All 10 exotic invasives must be included in your lab/field notebook.) List each plant by common name first and scientific name in parentheses (for example, Chinese Yam (*Dioscorea batatas*)).

**Coltsfoot**

**Japanese Honeysuckle**

**Japanese Spirea**

**Multiflora Rose**

**Privet**

**English Ivy**

**Japanese Knotweed**

**Kudzu**

**Oriental Bittersweet**

**Tree of Heaven**

2. You may use the following Web sites for your Web Quest:

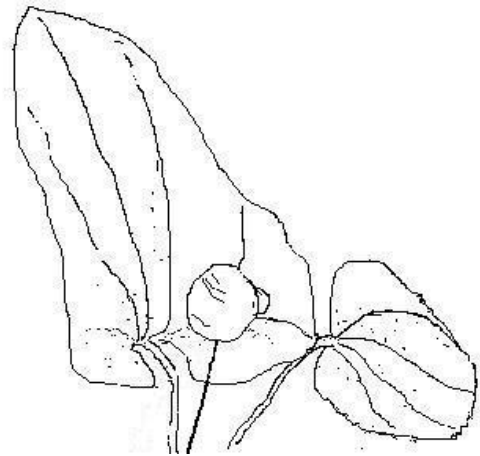
Forest Encyclopedia Network	<a href="http://www.forestryencyclopedia.net/Encyclopedia">http://www.forestryencyclopedia.net/Encyclopedia</a>
Southeast Exotic Pest Council—"Invasive Plant Manual"	<a href="http://www.invasive.org/eastern/eppc">http://www.invasive.org/eastern/eppc</a>
North Carolina Botanical Garden—Invasive Exotic Plants	<a href="http://www.ncbg.unc.edu/exotic.htm">http://www.ncbg.unc.edu/exotic.htm</a>
National Park Service Fact Sheets	<a href="http://www.nps.gov/plants/alien/factmain.htm">http://www.nps.gov/plants/alien/factmain.htm</a>
Southern Appalachian Man and the Biosphere—Invasive Species Focus Area	<a href="http://samab.org/Focus/Invasive/about.html">http://samab.org/Focus/Invasive/about.html</a>
Tennessee Exotic Pest Plant Council—"Invasive Exotic Plants in Tennessee"	<a href="http://www.tneppc.org/Invasive_Exotic_Plant_List/The_List.htm">http://www.tneppc.org/Invasive_Exotic_Plant_List/The_List.htm</a>

3. **Select** one of the top 10 exotic invasives to research in depth. **Give a general description** of the *plant* and *flower*. Include information about the plant's *habitat* and *growing season*. Include a *line drawing* (also available on the USDA/NRCS Plants Database Web site at < <http://plants.usda.gov/> > . (See Handout 2 for a Sample Exotic Invasive Plant Species Notebook Entry.)

***Chinese Yam (Dioscorea batatas)***

“Chinese Yam is a creeping and long-climbing vine that may reach up to 5 meters in height given support from trees and shrubs. The vines twine from left to right with 2- to 3-inch wide shiny heart-shaped leaves having arc-shaped veins.

- Leaves may vary from heart-shaped to arrowhead-like with lobes at the leaf base. The stems are purplish to red.
- The small yellowish-white flowers arise from base of the leaves. They are bell-shaped and may have a spicy fragrance like cinnamon.
- Pea-to marble-sized bulbils like small potatoes occur at leaf nodes in late summer. These may become potato-sized in other regions.
- Ripe bulbils drop readily at slightest touch.
- The seeds are in a triangle shaped capsule.



Chinese Yam is originally from Asia.  
Chinese Yam is a threat because:

- The vine is fast-growing (up to 1 inch/day at peak).
- It covers trees, shrubs, ground vegetation, and structures.
- It reproduces fast starting in late June, and can spread rapidly along forest edges and openings.”

*Source: Southeast Exotic Pest Plant Council Invasive Plant Manual drawing adapted by Leslie Marra from a photo by Jack Ranney, online at <<http://www.invasive.org/eastern/eppc/DIOP.html>>, accessed 10/11/05*

*Source: Southern Appalachian Man and the Biosphere, online at <<http://samab.org/Focus/Invasive/about.html>>, accessed 10/12/05*

## LESSON 6: EXOTIC INVASIVE PLANTS WIPE OUT THEIR NATIVE NEIGHBORS

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**Duration:** One 45-minute class period

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**Background information:**

(Repeated from Lesson 4)

Why is it that invasive plants crowd out native plants and can take over an ecosystem?

“Exotic Invasive Plants:

- grow and mature rapidly
- have prolific reproductive capacities
- are highly successful in seed dispersal, germination, and colonization
- rampantly spread and out-compete native plants
- are difficult and costly to remove and control
- originate from similar climate as the ecosystems they invade
- quickly colonize open spaces
- have few natural consumers present in the ecosystems they invade”

*Source: “A Date With Freddie Kudzu.” Noxious Neighbors: Exotics in Our Backyard, Center for Environmental Education, MTSU 1998*

The seeds of some exotic invasive species can lie dormant in the ground for many years. For example, garlic mustard seed can remain viable for up to ten years. When conditions are right for growth, the seeds germinate. Suddenly, many exotic invasives appear where there had been none for years.

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**Objectives:**

Examine characteristics of exotic invasive plant species that allow them to out compete and crowd out native plant species.

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**Prepare in advance:**

- Make one copy of the Activity Sheets (Handout 1—word search, cryptogram, and concept web) for each student
- Copy the Answer Key (or make an overhead transparency)

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**Materials:**

- colored pencils
- lab/field notebooks

**Description:**

Students do a word search and complete a cryptogram using technical terms related to how invasive species out compete native species.

**Instructional sequence:**

(5 minutes)

**Explain** the characteristics of invasive plants that allow them to out-compete native species. (This information is contained in the background information above.)

(10 minutes)

**Instruct** students to complete the word search puzzle successfully prior to completing the concept map/web.

(15 minutes)

**Instruct** students to neatly color in the line drawings inside each octagon and write in the correct characteristic of exotic invasive species using the list below the concept map/web.

(10 minutes)

**Instruct** students to solve the cryptogram.

(10 minutes)

**Debrief** students on the characteristics of exotic invasive plant species as a review. For example: What do you think is the most threatening characteristic of exotic invasive plants? Why?

**Instruct** students to write in their lab/field notebooks the eight characteristics of invasive plant species that allow them to out-compete native plants.

**Optional assessment task:**

**Direct** students to complete the cryptogram without help from their notes.

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## Handout 1: Activity Sheets

**Find and circle these terms that describe exotic invasive plants:**

adapt easily

many seeds survive

similar climate

few consumers

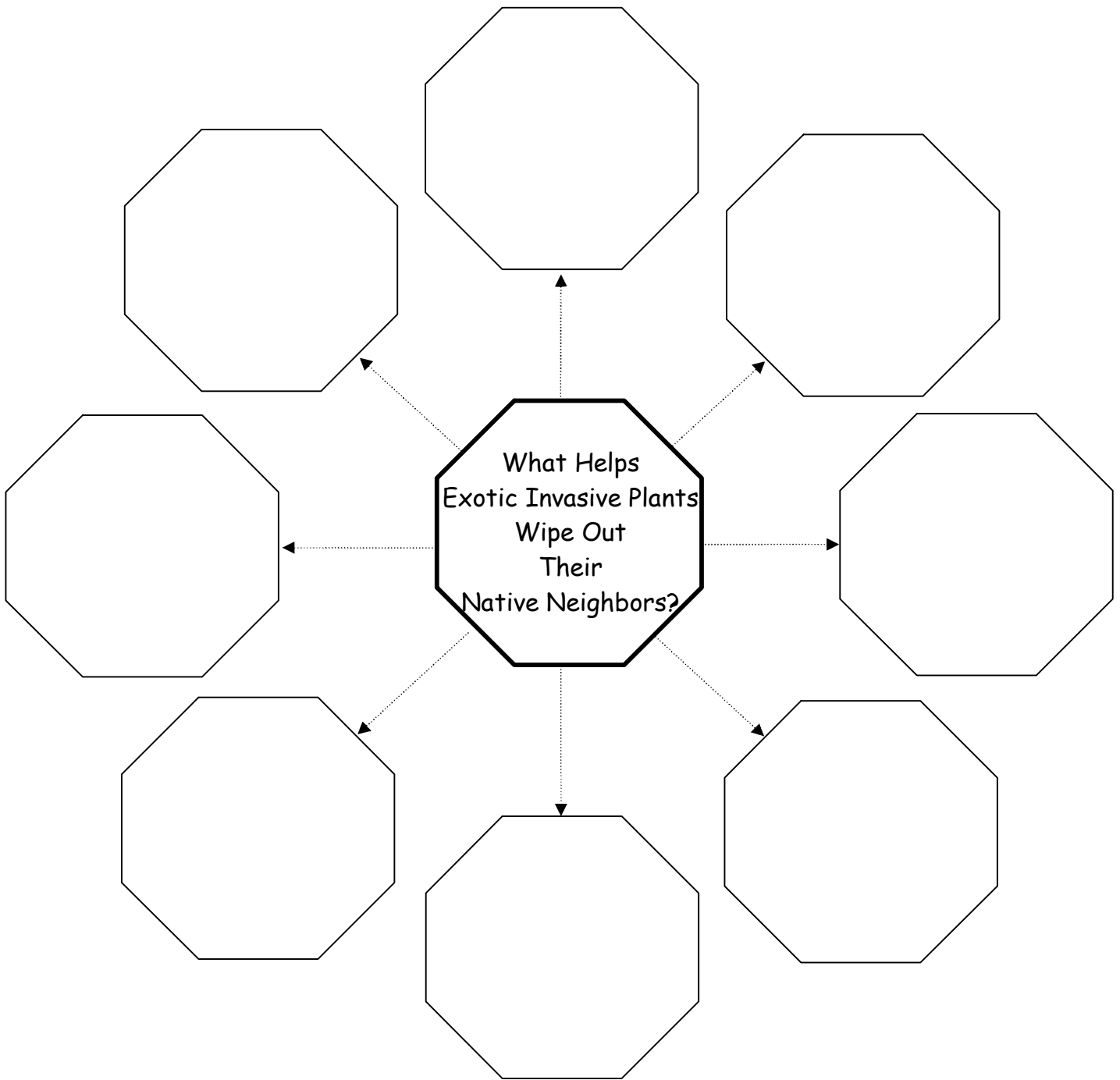
invade open spaces

reproduce rapidly

long lived

toxic chemicals

Q A L K D L P Y T I E T Z T S O X S Y E  
T W L X H P F F A P W M T A E G O L L W  
E O B I C L B C Q M C U D K C Y D F V S  
M V X H F G V L H S O A B J A I C E L Q  
C P I I A W V O C X P J K J P C V W A T  
L S W V C T T T X T L P S A S W H C B O  
Z N C U R C R O E W E T R W N M P O Q Z  
C E Z S U U H A O Q K E H G E X W N B J  
I N Q I N Z S E H K C M W Q P U J S H M  
A K Z C M I K S M U I M F X O A B U A H  
O M V Q L H Z G D I Z T N J E V N M V B  
R X G Y R Q X O Q E C H L V D L Q E N J  
J E Z U Y I R J U Y E A L U A D G R S Q  
D B N B N P X T A V Q S L Y V M L S Y V  
W O M D E V I L G N O L Y S N C Q T J I  
O K N R L M Z T B F R P G N I V F S S E  
Q X Y F I O X V M N X C S T A U B F M H  
S I M I L A R C L I M A T E W M M X K M  
P U L T H P N G T R E W H V O M O B E S  
R P A C C D O N C I F W G R G W I K L H



In four (4) or more stop signs (octagons), draw a picture that represents a characteristic of exotic invasive plants that allows them to crowd out native species. The characteristics are listed below. Write the remaining characteristics in the other octagons.

- invade *open spaces*
- *adapt easily to habitats* similar to their original habitat
- new habitat has a “familiar” *climate*
- *many seeds* survive
- *few consumers* depend on them as a food source
- reproduce from a *young age*
- live a *long time*
- roots *release toxic chemicals* into the soil



*Solve the cryptogram to describe what helps exotic invasive plants wipe out their native neighbors.*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
26							25				8		17		3		4	18	24						14

N A S P A P T A S Y  
 7 17 12 26 18 7 12 23 18 9 23 19 7 23 18 26 15 26 3 24 23 26 18 7 8 14  
 T H A S T H L  
 24 2 25 26 22 7 24 26 24 18 20 7 24 25 26 19 8 7 13 26 24 23  
 S L R T R  
 26 17 15 18 2 7 8 18 7 13 7 8 26 4 24 2 24 25 23 7 4  
 N A L H N S R S  
 2 4 7 11 7 17 26 8 25 2 13 23 17 26 24 21 4 26 8 19 2 17 18 21 13 23 4 18  
 P R T N A S  
 26 4 23 17 2 24 3 4 23 18 23 17 24 18 2 7 17 12 26 18 7 12 23 18  
 A P L R  
 18 9 4 23 26 15 4 26 3 7 15 8 14 24 25 23 14 3 4 2 15 21 19 23  
 T H S N S S R Y  
 24 25 2 21 18 26 17 15 18 2 16 18 23 23 15 18 23 12 23 4 14 14 23 26 4  
 R A R Y  
 16 4 2 13 24 25 23 24 7 13 23 24 25 23 14 26 4 23 12 23 4 14  
 Y N T H R L S  
 14 2 21 17 11 24 25 23 7 4 4 2 2 24 18 4 23 8 23 26 18 23  
 H N  
 24 2 9 7 19 19 25 23 13 7 19 26 8 18 7 17 24 2 24 25 23 18 2 7 8  
 S A T  
 7 17 12 26 18 7 12 23 18 8 7 12 23 26 8 2 17 11 24 7 18 23

Source: Puzzles created by Puzzlemaker at [DiscoverySchool.com](http://DiscoverySchool.com)

## ANSWER KEY

Find and circle the following phrases:

adapt easily  
similar climate

long-lived  
few consumers

many seeds survive  
reproduce rapidly

toxic chemicals  
invade open spaces

Q A L K D L P Y T I E T Z T S O X S Y E  
T W L X H P F F A P W M T A E G O L L W  
E O B I C L B C Q M C U D K C Y D F V S  
M V X H F G V L H S O A B J A I C E L Q  
C P I I A W V O C X P J K J P C V W A T  
L S W V C T T T X T L P S A S W H C B O  
Z N C U R C R O E W E T R W N M P O Q Z  
C E Z S U U H A O Q K E H G E X W N B J  
I N Q I N Z S E H K C M W Q P U J S H M  
A K Z C M I K S M U I M F X O A B U A H  
O M V Q L H Z G D I Z T N J E V N M V B  
R X G Y R Q X O Q E C H L V D L Q E N J  
J E Z U Y I R J U Y E A L U A D G R S Q  
D B N B N P X T A V Q S L Y V M L S Y V  
W O M D E V I L G N O L Y S N C Q T J I  
O K N R L M Z T B F R P G N I V F S S E  
Q X Y F I O X V M N X C S T A U B F M H  
S I M I L A R C L I M A T E W M M X K M  
P U L T H P N G T R E W H V O M O B E S  
R P A C C D O N C I F W G R G W I K L H

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
26							25				8		17		3		4	18	24						14

N A S P A P T A S Y  
 7 17 12 26 18 7 12 23 18 3 23 19 7 23 18 26 15 26 3 24 23 26 18 7 8 14  
 T H A S T H L  
 24 2 25 26 22 7 24 26 24 18 20 7 24 25 26 19 8 7 13 26 24 23  
 S L R T R  
 26 17 15 18 2 7 8 18 7 13 7 8 26 4 24 2 24 25 23 7 4  
 N A L H N S R S  
 2 4 7 11 7 17 26 8 25 2 13 23 17 26 24 21 4 26 8 19 2 17 18 21 13 23 4 18  
 P R T N A S  
 26 4 23 17 2 24 3 4 23 18 23 17 24 18 2 7 17 12 26 18 7 12 23 18  
 A P L R  
 18 3 4 23 26 15 4 26 3 7 15 8 14 24 25 23 14 3 4 2 15 21 19 23  
 T H S N S S R Y  
 24 25 2 21 18 26 17 15 18 2 16 18 23 23 15 18 23 12 23 4 14 14 23 26 4  
 R A R Y  
 16 4 2 13 24 25 23 24 7 13 23 24 25 23 14 26 4 23 12 23 4 14  
 Y N T H R L S  
 14 2 21 17 11 24 25 23 7 4 4 2 2 24 18 4 23 8 23 26 18 23  
 H N  
 24 2 9 7 19 19 25 23 13 7 19 26 8 18 7 17 24 2 24 25 23 18 2 7 8  
 S A T  
 7 17 12 26 18 7 12 23 18 8 7 12 23 26 8 2 17 11 24 7 13 23

**Invasive species adapt easily  
 to habitats with a climate  
 and soil similar to their  
 original home. Natural consumers  
 are not present, so invasives  
 spread rapidly. They produce  
 thousands of seeds every year,  
 from the time they are very  
 young. Their roots release  
 toxic chemicals into the soil.  
 Invasives live a long time.**

*Puzzles created by Puzzlemaker at DiscoverySchool.com*

## LESSON 7: MOST WANTED EXOTIC INVASIVE PLANT POSTER

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**Duration:** One or two 45-minute class periods

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**Background information:**

“As a global threat of extinction, bioinvasion may already rank just behind habitat loss” (p21).

For some organisms exotic invasive plant species are a major threat for extinction. In most cases, exotic species suppress native species without making them totally extinct. Successful invasions often cause “functional extinctions” in that native species may exist but grow at such low densities that they cannot fulfill their ecological roles, such as providing forage for native fauna.

*Source: Bright, Chris. 1998. Life Out of Bounds: Bioinvasion in a Borderless World. New York: W.W. Norton & Company.*

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**Objectives:**

- Convey research findings regarding the history of an exotic invasive plant species.
- Convey research findings regarding the consequences of an exotic invasive plant species’ presence in an ecosystem.

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**Prepare in advance:**

- Copy Handout 1 (Exotic Invasive Species Web Quest Web Sites). Cut into fourths and give one to each student.
- Copy Handout 2 (blank “Wanted” poster template) for each student.
- Copy Handout 3 (Rubric for Most Wanted Exotic Invasive Plant Poster) for each student.
- Optional: make a transparency of the Example Poster provided

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**Materials:**

- one computer connected to the Internet for every two students
- colored pencils
- drawing paper
- lab/field notebooks

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**Description:**

Students will visit several Web sites and choose an exotic invasive species of the Southern Appalachian Region. Students will then gather information about their chosen exotic plants and use it to create a WANTED poster.

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**Instructional sequence:**

(10 minutes)

- **Request** students find their field notebooks and locate their entries about exotic invasive species.
- **Review** some of the species for which they did online research.
- **Instruct** students to create a poster describing an exotic invasive plant of the Southern Appalachian Region using the Wanted Poster template. Posters should include:
  - a simple, line drawing of the plant
  - common and scientific names
  - brief description (leaf shape, flower color )
  - place of origin of the invasive plant
  - why it is a threat (a description of its crime)
  - possible ways to fight/control it
  - reference listing of Websites where information was found for student's poster

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**Optional assessment task:**

**Direct** students to present their poster to the rest of the class.

**Encourage** students to give a creative, entertaining presentation of their “culprit.”

*Sources:*

*Southern Appalachian Man and the Biosphere*, online at <

<http://samab.org/Focus/Invasive/about.html>>, accessed 10/12/05.

*Invasive and Exotic Species*, available online at <<http://www.invasive.org/weeds.cfm>>, accessed 10/12/05

*Image of Ailanthus leaves adapted from photograph by Chris Evans, The University of Georgia*, online at <<http://www.invasive.org/browse/detail.cfm?imgnum=1330079>>, accessed 10/14/05

*National Park Service Fact Sheets, Ailanthus altissima*, available online at <<http://www.nps.gov/plants/alien/fact/aial1.htm>>, accessed 10/12/05

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***Handout 1: Exotic Invasive Plant Species Web Quest Web Sites***

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You may use the following Web sites for your Web Quest:

Exotic and Invasive Species	<a href="http://www.invasive.org/eastern/">http://www.invasive.org/eastern/</a>
Southern Appalachian Man and the Biosphere	<a href="http://samab.org/Focus/Invasive/about.html">http://samab.org/Focus/Invasive/about.html</a>
Tennessee Exotic Pest Plant Council	<a href="http://www.tneppc.org/">http://www.tneppc.org/</a>

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***Handout 1: Exotic Invasive Plant Species Web Quest Web Sites***

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You may use the following Web sites for your Web Quest:

Exotic and Invasive Species	<a href="http://www.invasive.org/eastern/">http://www.invasive.org/eastern/</a>
Southern Appalachian Man and the Biosphere	<a href="http://samab.org/Focus/Invasive/about.html">http://samab.org/Focus/Invasive/about.html</a>
Tennessee Exotic Pest Plant Council	<a href="http://www.tneppc.org/">http://www.tneppc.org/</a>

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***Handout 1: Exotic Invasive Plant Species Web Quest Web Sites***

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You may use the following Web sites for your Web Quest:

Exotic and Invasive Species	<a href="http://www.invasive.org/eastern/">http://www.invasive.org/eastern/</a>
Southern Appalachian Man and the Biosphere	<a href="http://samab.org/Focus/Invasive/about.html">http://samab.org/Focus/Invasive/about.html</a>
Tennessee Exotic Pest Plant Council	<a href="http://www.tneppc.org/">http://www.tneppc.org/</a>

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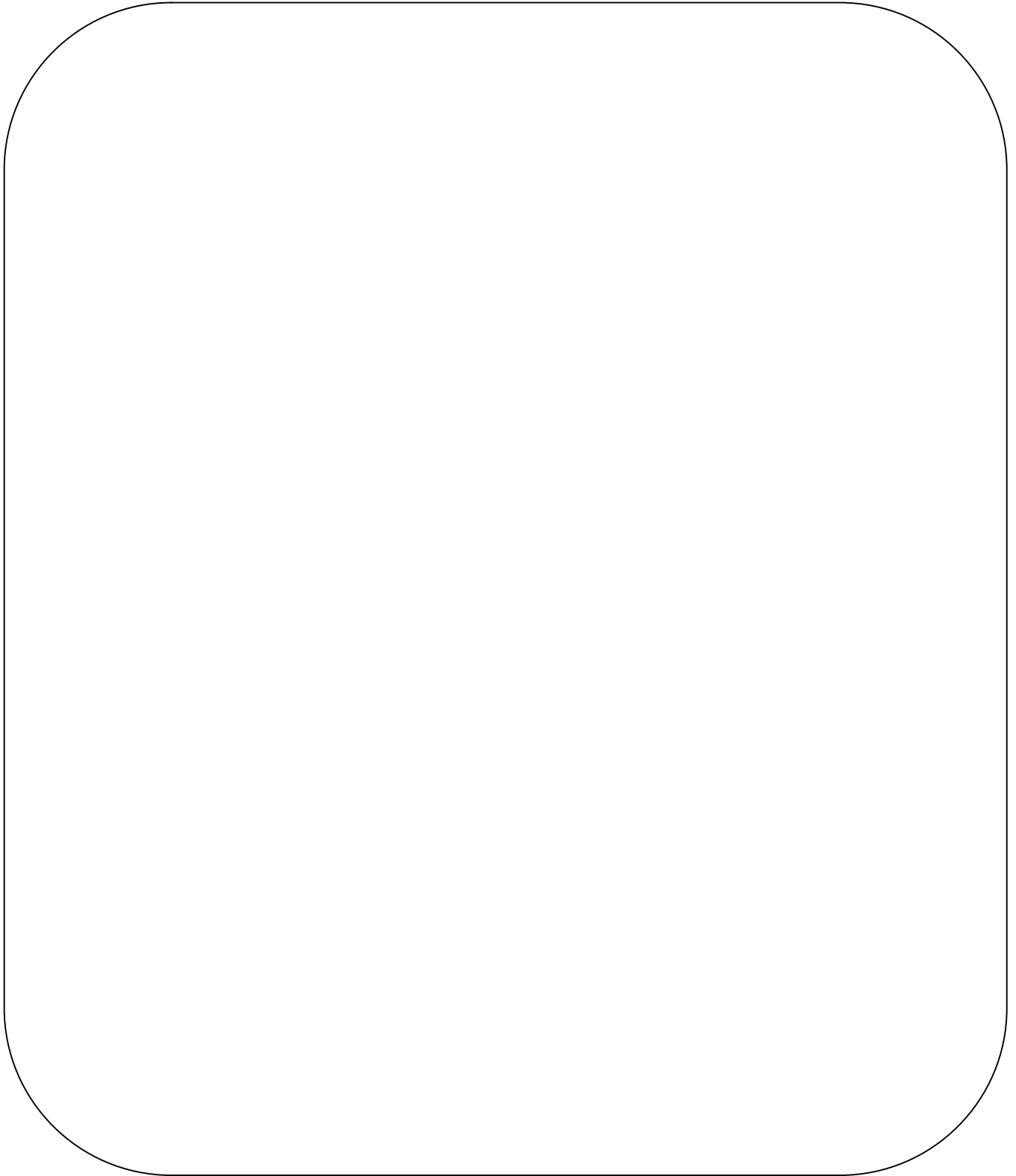
***Handout 1: Exotic Invasive Plant Species Web Quest Web Sites***

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Exotic and Invasive Species	<a href="http://www.invasive.org/eastern/">http://www.invasive.org/eastern/</a>
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Tennessee Exotic Pest Plant Council	<a href="http://www.tneppc.org/">http://www.tneppc.org/</a>

WANTED!



### Handout 3: Rubric for Most Wanted Exotic Invasive Plant Poster

Possible Points	Criteria	Points Earned
93–100	All parts of the poster are complete, including reference listing. Clear and complete explanations show a thorough understanding of characteristics of the exotic invasive plant represented. Common and scientific names are used properly and effectively. Clearly drawn pictures or line diagrams are included. Origin of exotic invasive is clearly explained/described. Threat of exotic invasive to native habitats is clearly described. Possible method(s) of control are clearly stated.	
85–92	All parts of the poster are complete, including reference listing. Clear language demonstrates a good understanding of the key concepts; <i>however, explanations could be more detailed.</i> Common and scientific names are included. Clearly drawn pictures or diagrams are included. Origin of exotic invasive is identified. Threat of exotic invasive to native habitats is clearly described. Possible method(s) of control are clearly stated.	
76–84	Poster is basically complete, including references. Descriptions are <i>satisfactory, however sometimes show confusion (lack of effort in seeking information) about a concept.</i> Common and scientific names are included. Pictures or diagrams are included; <i>however, they may be sloppy and/or unfinished.</i> Origin of exotic invasive is identified. Threat of exotic invasive to native habitats is included. Possible method(s) of control are given.	
70–75	Assignment <i>is not complete.</i> Descriptions <i>are often unclear and show confusion (lack of effort in seeking information) about a concept.</i> Common or scientific names are <i>not used or are not used properly.</i> Pictures are included; <i>however, they may be sloppy and/or unfinished.</i> <i>Attempts to communicate information about the origin, threat to native habitat and possible method of control are somewhat successful.</i>	
10–69	Assignment <i>is not complete.</i> <i>Incomplete descriptions indicate poor understanding of concepts.</i> Common or scientific names are <i>not used or are not used properly.</i> Picture(s) are <i>sloppy and/or unfinished.</i> <i>Attempts to communicate information about the origin, threat to native habitat and possible method of control are somewhat successful.</i>	
-0-	No work was completed.	



# WANTED!

## tree-of-heaven

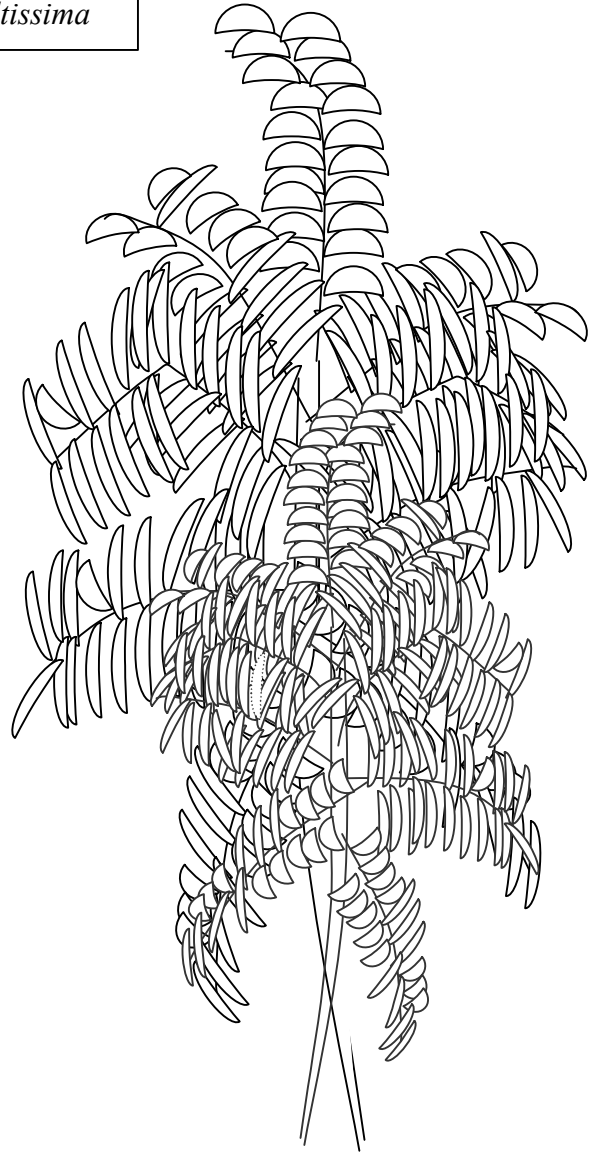
Alias: *Ailanthus altissima*

**Menancing Space Invader!**

**Roots give off chemicals that push out native plants!**

**HAND PULL** freshly germinating seedlings, removing entire root!

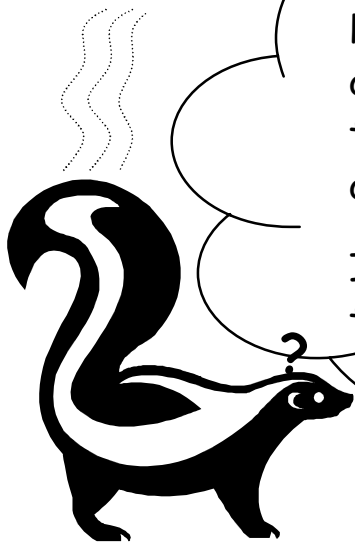
**CUT DOWN** bigger trees in September and immediately spray and inject stump with herbicide!



**Help save native trees and plants!**

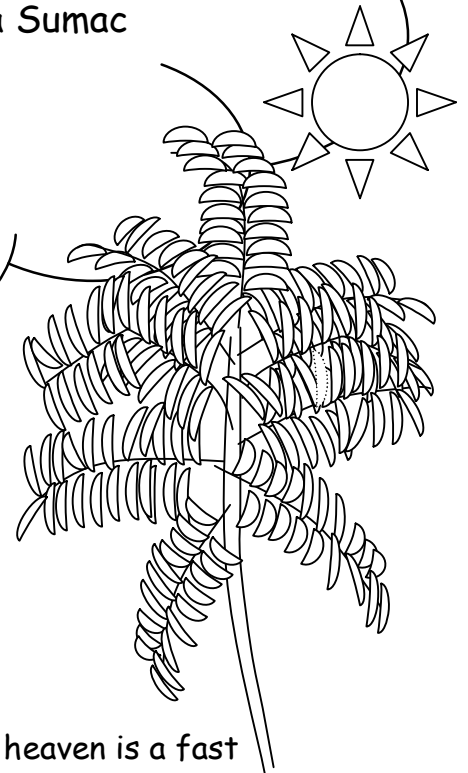
Tree of heaven, native to China, was first brought into America in the 1700's by a Pennsylvania gardener. It was often planted in cities because of its ability to grow in poor soil conditions. It has even been known to grow in cement cracks!

It cannot grow in the shade. Look for tree of heaven at the edge of forests and along open areas. Thick groups will crowd out native species and can quickly take over fields and meadows.



The green leaflets on my long leaves are long and narrow. They have a small notch on both sides, close to the stem - this is how to tell me apart from a Sumac or Hickory tree!

If you crush my leaflets, they give off a **SKUNKY ODOR!**



Tree of heaven is a fast growing small tree that can grow up to 80 feet tall and have a trunk 6 feet thick! Yellow-green flowers cluster at end of limbs in July, turn to gray seed clusters in the winter.

## LESSON 8: ETHI-REASONING—EXOTIC INVASIVE PLANT SPECIES TOPICS

NOTE: This lesson was developed by Project Wild (<http://www.projectwild.org/index.htm>) for their ethi-reasoning and ethi-thinking activities. It has been adapted for incorporation into this curriculum.

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**Duration:** One 45-minute class period

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**Background information:**

An open discussion of personal opinion in the classroom entreats student preparation. An atmosphere of effective communication, in which students are comfortable expressing their ideas appropriately, involves various interactive skills:

- *Active listening* shows interest in others, and in what they are saying.
- *Constructive Feedback* allows one's teammate(s) to know how they are doing.
- *Responsibilities of each team member* to team success:
  - *contribute/stay* involved
  - *take turns* speaking
  - *offer positive* comments/assistance
  - *focus on the issue*, not the person speaking
  - *support your opinion* with factual information
- *Freedoms* inherent in discussing opinions
  - everyone has an individual opinion/viewpoint
  - may express an opinion without fear of ridicule
  - may express an opinion respectfully
  - may respond to others' opinions respectfully
  - may agree to disagree

A *collaborative atmosphere* helps fulfill students' needs to feel safe in making mistakes, and exploring possible solutions. Clear expectations replace barriers to effective communication. Development of a non-threatening working relationship is critical to the success of a discussion involving opinions or ethics such as the one in this valuable activity.

Source: *Effective Communication in Schools*, online at <  
<http://para.unl.edu/para/Communication/Intro.html>>

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**Objectives:**

Students will clarify their own values related to exotic invasive species and hear the values of others.

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**Prepare in advance:**

Copy Handout 1—Ethi-Reasoning Scenarios—for each student

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**Description:**

The purpose of this lesson is to give students the opportunity to examine, express, and clarify their own opinions and reasoning.

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**Instructional sequence:**

(10 minutes)

- **Review** the difference between OPINION and FACT with the students.
- **Instruct** students that this is an opportunity for them to reflect on what they believe about some exotic invasive species issues. Everyone will have a chance to voice their opinions on each issue. Common ground may or may not be reached. Participants may have to “agree to disagree.”

(5-10 minutes)

- **Hand out** a short exotic invasive species scenario to the students.
- **Give** students time to read the scenario.

(5-10 minutes)

- **Divide** class into small groups for discussion. If students are reticent to speak, **begin** the discussion with a question:
  - What is the main problem you see in this scenario?
  - Which solution do you like best? Why?

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**Optional assessment task:**

After two scenario discussions, have students write a personal opinion paragraph about a new, third scenario.

After three scenario discussions, have students write an opinion paragraph to express the personal values they have (and/or have not) expressed in discussion.

## Foul Forage

Long ago, large numbers of deer and elk roamed the Southern Appalachian Region. They rarely had problems finding food. Both elk and deer chose to eat only certain plants. They roamed over a very large range.

White-tailed deer like open meadows and forest glades near dense woods and thickets. Forest edges, orchards, and farmland usually provide excellent habitat.<sup>1</sup> White-tailed deer are picky vegetarians. They choose the healthiest forage they can find each season. During the spring and summer, they eat leaves, twigs, mushrooms, fruits, grasses, honeysuckle, and tree seedlings. White-tailed deer eat mostly acorns and other seeds in the fall.

Elk usually go to high, open mountain pastures in summer and move to lower, dense woods in winter. They graze mostly in spring and summer. Elk like to eat grasses and low-growing flowers (forbs). Sometimes they feed on small trees and shrubs in winter if they cannot find grasses and forbs. Elk also eat lichens.<sup>1</sup>

The amount of forage for white-tailed deer and elk changed when pioneers moved into the Southern Appalachians. Pioneers cut down parts of the forest to make room for their cabins. They brought along sheep for wool and meat. People kept their sheep in much smaller areas on their farms. The sheep were not as picky about what they ate as the elk and deer were.

Sheep ate the same plants year after year. The “favorite” forage of elk and deer could not produce seeds quickly. The sheep ate

faster than the plants could grow and reproduce. Many kinds of plants became hard to find in the meadows and groves.

Soon, settlers brought familiar forage plants from Europe for their sheep to graze on. The new plants grew well. Meadows and thickets were a familiar habitat. The new exotic (alien) plants could grow and reproduce faster than the native plants. This provided much needed forage for the settlers’ herds.

Exotic plants from Europe spread across the Southern Appalachian Region. *Musk thistle* (page background) is one example. It spreads faster than native meadow plants. New musk thistle seedlings can sprout and grow during warm times in late fall and early winter. Musk thistle doesn’t taste good to deer and elk. *Garlic Mustard* is another example. One garlic mustard plant can quickly replace native plants growing in an area. Originally from Europe, a single plant can enter an area, quickly replace the existing vegetation, and plant a seed bank that lasts from five to 10 years. Some native plants like *white trillium*, *Jacob’s ladder* and other forbs have a hard time growing because of garlic mustard.

### Should you:

- **Write a report blaming the pioneers for bringing exotic plants into the Southern Appalachian Region.**
- **Ignore the problem because it started long ago.**
- **Help to restore the ecosystem by joining a weed-pull team.**
- **Donate money to restore elk to the Smoky Mountains.**
- **Other?**

## Backyard Blunder

Mr. Simpson finally finished fixing the backyard landscape. For years, the view was not very pleasant. At last he hid the neighbors' huge, red propane gas tank.

Mr. Simpson was especially excited. He planted three lush, flowering shrubs while Mrs. Simpson visited her mother in Texas. He just knew she would be thrilled to find the new, sweet-smelling backyard plants. The shrubs were blooming. Lovely butterflies were enjoying the flowers' delicious nectar.

Mrs. Simpson was indeed surprised when she arrived home. It was so nice to look out back and *not* see that big, ugly, red tank! She and Mr. Simpson walked over to admire their new landscape. The aroma of the flowering shrubs was inviting. What a surprise she got when she saw the kind of shrub her husband had worked so hard to plant. It was *Bush Honeysuckle!*

Mrs. Simpson knew her husband labored to prepare the rocky, red clay soil. She knew he spent all day Saturday planting those large bushes. She also knew bush honeysuckle was one of the worst exotic pest plants in western North Carolina! She knew it could quickly spread throughout the neighborhood. She had to tell him. They would decide together what to do next.

### They should:

- **Take out the bush honeysuckle.**
- **Talk to the neighbor about moving the propane tank.**
- **Leave the bush honeysuckle where Mr. Simpson planted it.**
- **Other?**



## Wretched Winding Weed

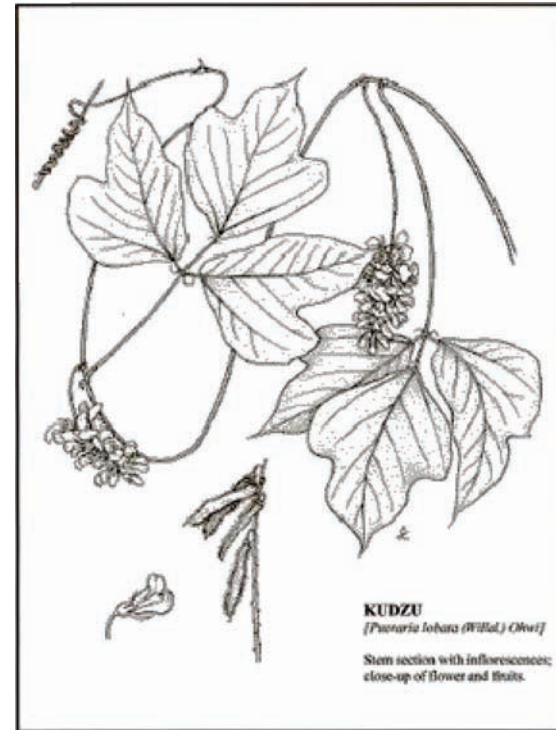
Kudzu has been called “the plant that ate the south”. This vine grows up to *one foot a day* and can cover everything in its path. Kudzu belongs to the Pea or Bean family. It has become very destructive in the South. Kudzu vines have pulled down power poles, collapsed buildings, and killed trees. A cold winter will kill young leaves and vines back to the root joints. But the vine starts growing again in spring. Freeze and frost does not kill vines that are ½ inch thick and larger. Kudzu also survives very well through drought and hot temperatures.

Only older vines that climb above the ground in full sun will flower. Few flowers make seeds that will sprout. The few healthy seeds may be how the weed has traveled such long distances. It is possible the seed pods fall into streams and rivers. The pods float downstream and begin to grow new vines.

Under good growing conditions, kudzu can grow a mass of vines impossible to walk through. This thick, heavy covering chokes out native plants that provide food and habitat for native animals. The result is a major change of living communities.

Kudzu was originally imported from Japan in 1876 to landscape a garden. In the early 1900’s, this vine was discovered to be excellent forage for cows, pigs, and goats in the South’s acidic soils during dry seasons. It was also advertised to stop soil erosion. By 1953 the United States Department of Agriculture (USDA)

removed kudzu from its list of groundcover plants, because the soil continued to erode underneath the vines.



### How should kudzu be controlled today?

- Use kudzu as grazing forage for livestock.
- Spray all areas with kudzu growing in them with diazinon (a highly toxic herbicide) from a crop-duster airplane.
- Develop a gourmet kudzu cookbook.
- Only let professional landscapers plant kudzu.
- Hire people to cut kudzu down and dig it out.

## LESSON 9: CHOOSE A VIEWPOINT AND STRUCTURE AN ARGUMENT

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**Duration:** One 45-minute class period

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**Background information:**

“Several factors make Great Smoky Mountains National Park especially vulnerable to invasions by exotic species. The Park’s climate is relatively mild with abundant rainfall. Mountains, with their varying elevations and aspects, offer diverse habitats suitable for a wide variety of plants, both native and exotic. Climate and habitats in the Smokies also closely resemble those in parts of Eastern Europe and central Asia. Consequently, plants introduced from these areas usually thrive in the Great Smoky Mountains.”

“In fact, botanists have identified over 380 species of exotic plants in the park. Some were brought in by early settlers; others were transported by wind, water, or animals from infested areas. Still others came in on fill dirt used in construction projects or were accidentally transported in by Park visitors.”

“While the majority of the Park’s exotic plants do not significantly alter the landscape or spread rapidly, 35 species are aggressive and do pose serious threats to the Park’s natural ecosystems. Some are capable of growing and spreading rapidly and can completely dominate natural landscapes. Certain exotics also have the potential to cross-pollinate with similar native plants, thereby threatening the genetic integrity of the natives” (NPS, 2005).

“It is difficult to predict which exotic species will die, barely live, thrive, or invade an ecosystem. People who study bioinvasions use a rough rule of thumb—the “tens rule”—for looking at the large picture. About 10% of exotics introduced into a new place will succeed in establishing a breeding population. The others die or continue to live with no detectable ecological effects. Of that 10%, only 10% will go on to launch an invasion. To become an invasive, a plant has to escape predators and disease and live in a climate that will not kill it. In the new ecosystem an invasive species has to escape all of the things that kept its population growth in check in its nature ecosystem” (Bright, 1998).

*Sources:*

National Park Service, *Great Smoky Mountains*, online at  
<<http://www.nps.gov/grsm/pphtml/subplants29.html>>

Bright, Chris. 1998. *Life Out of Bounds: Bioinvasion in a Borderless World*. New York: W.W. Norton & Company.



**Objectives:**

Construct and support an argument related to exotic invasive species.

**Prepare in advance:**

Make a copy of Handout 1 (Threat or Not a Threat?) for each student.

**Description:**

Students read a brief description of an exotic plant and then construct an argument as to whether or not it will become an invasive plant in the Southern Appalachian Region.

**Instructional sequence:**

*(5 minutes)*

**Present** background information about the vulnerability of the Great Smoky Mountains to invasive species and the “tens rule.”

*(5 minutes)*

**Review** how to write a persuasive paragraph. (For example, state viewpoint [pro or con], give examples, state facts.)

*(5 minutes)*

**Instruct** students to read the description of Cogon grass in Handout 1 and determine their viewpoint on the issue.

**Assignment:** Students will write a one-paragraph structured argument stating whether or not the exotic plant will become invasive. They must defend their position using their knowledge of invasive species.

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## ***Handout 1: Threat or not a threat?***

Does anyone know when (if) an exotic plant species will become an invasive exotic?

Cogon grass (*Imperata cylindrica*)

Cogon grass is a perennial grass that grows about two to four feet high. The leaves are about an inch wide, end in a sharp point, and have finely toothed edges that hold silica crystals. Cogon grass forms a dense mat of thatch and leaves, which makes it very difficult for other plants to sprout and grow. This mat also provides fuel for intense and frequent fires. These fires are hard on native species. A single plant of Cogon grass can produce several thousand very small seeds that may be carried great distances by the wind.



Cogon grass grows throughout the southeastern United States in many types of ecosystems. Cogon grass is hardy and tolerant of shade and drought. Cogon grass can be found growing in many places, like on sand dunes, along roadsides, forests, open fields, and up to the edge of standing water. Cogon grass moves quickly into newly disturbed areas such as ploughed or burned fields.

Cogon grass came to the United States from East and Southeast Asia by accident as a packing material for shipping crates. It arrived in the port of Mobile, Alabama. Nurseries also sold Cogon grass for its attractive foliage and hardiness. The U.S. Department of Agriculture promoted it as forage and erosion control.

*Sources:*

<http://www.nps.gov/plants/alien/fact/imcy1.htm>

<http://samab.org/Focus/Invasive/warning.html>

## LESSON 10: WALK TO SCHOOL

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**Duration:** Two 45-minute class periods

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**Day One—The Walk** (*one – 45-minute class period*)

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**Objectives:**

Identify exotic invasive species in the local/neighborhood landscape.

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**Prepare in advance:**

- Copy Handout 1 (Exotic Invasive Plants in My Neighborhood: Individual Student Tally Sheet), cut in half to make one for each student
- Overhead transparency of Handout 1

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**Materials:**

- overhead projector
- overhead marker
- lab/field notebooks
- glue sticks
- pen/pencil

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**Description:**

Students use their knowledge of exotic invasive species plants and their field notebooks with plant descriptions to identify and tally exotic invasive species—either on their way to school or in their own neighborhood. As an option, you might schedule a day for a walk through a local greenway or recreational area.

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**Instructional sequence:**

(5 minutes)

**Instruct** students to glue their data collection sheet onto a page in their field notebooks.

(10 minutes)

**Lead** a short discussion reviewing exotic invasive plant species common to the community the school serves. In a brainstorming session with students, **list** five or six common invasive plants on the chart on the overhead transparency of Handout 1.

(5 minutes)

**Direct** students to list the most pervasive invasives on Handout 1. Leave two lines on the chart open for invasive species *not* on the brainstorm list.

(10 minutes)

**Ask** students for suggestions on how to “spot” exotic invasives as they take a walk in their neighborhood or to school. Help them **clarify** using identification information (e.g., leaf type) from their Web quests and posters.

(10–15 minutes)

**Escort** students outside. **Practice** identifying exotic invasive plants and tallying their occurrence while strolling around the school grounds.

**Assignment:** Students will identify exotic invasive plant species as they walk to school or on a 20-minute walk through their neighborhood. Students will use their individual student tally sheets to tally exotic invasive species as they walk.

Teacher note: Give students a reasonable deadline for bringing in their completed charts.

### **Day Two—The Analysis** (one – 45-minute class period)

#### **Objectives:**

Quantify exotic invasive species’ occurrence in the local/neighborhood landscape.

#### **Prepare in advance:**

- Copy the following for each student:
  - Handout 2—Small group tally sheets
  - Handout 3—Class tally sheets with graph
  - Handout 4—Analysis
- Make overhead transparencies of Handouts 2 and 3

#### **Materials:**

- overhead projector
- five or six different colors of overhead pens
- students’ lab/field notebooks with Handout 1 pasted in
- rulers

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**Description:**

Students share the results of their inventory and tally of exotic species on their walk to school. Then, student data are compiled to do a larger-scale analysis of exotic invasives in local neighborhoods.

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**Instructional sequence:**

(5 minutes)

- **Lead** a brief discussion regarding students' experiences on their walks.
- **Encourage** stories relative to abundance and location of exotic invasives.

(15 minutes)

- **Divide** students into small groups based on the locale of their walk.
- **Direct** students to list and tally the most pervasive invasives found on their *combined* walks, using Handout 2—Small Group Tally Sheets

(20 minutes)

- **Lead** the entire class group in a short discussion highlighting small group results.
- **Complete** Handout 3 (Class Tally Sheet and graph) on the overhead projector. Use a different color pen for each species name and number of sightings (tallies).
- **Direct** students to enter the data on their sheets as it is being constructed on the overhead.
- **Review** how to make a bar graph.
- **Create** a bar graph on the overhead for two of the most common exotic invasive species.
- **Lead** the entire class in an analysis discussion using the questions provided for analysis in Handout 4—Most Common Exotic Invasive Plants in Our Community—An Analysis
- **Assignment:** Students will construct a bar graph illustrating the data from the entire class. Instruct the students to draw a graph that shows the six most common species. Students should label each bar with the name of the species.

***Handout 1: Individual Student Tally Sheet***

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***Exotic Invasive Plants in My Neighborhood***

<b>Name of Invasive</b>	<b>Location of FIRST sighting</b>	<b>Tally</b>

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***Exotic Invasive Plants in My Neighborhood***

<b>Name of Invasive</b>	<b>Location of FIRST sighting</b>	<b>Tally</b>

*Handout 2: Small Group Tally Sheet*

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***Exotic Invasive Plants in Our Community***

<b>Name of Invasive</b>	<b>Location of FIRST sighting</b>	<b>Tally</b>





*Handout 4: Analysis Sheet*

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***Exotic Invasive Plants in Our Community***

Name: \_\_\_\_\_

1. Which three exotic invasive plant species were found most often in this study?

**Invader 1** \_\_\_\_\_

**Invader 2** \_\_\_\_\_

**Invader 3** \_\_\_\_\_

2. What do the different locations for each invader have in common and how are they different?

The places we found **Invader 1**: \_\_\_\_\_ have these things in common:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

The places we found **Invader 1**: \_\_\_\_\_ have these differences:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

The places we found **Invader 2**: \_\_\_\_\_ have these things in common:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

The places we found **Invader 2**: \_\_\_\_\_ have these differences:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

The places we found **Invader 3**: \_\_\_\_\_ have these things in common:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

The places we found **Invader 3**: \_\_\_\_\_ have these differences:

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

3. Do you find any patterns in the characteristic habitats of the invasive plants? \_\_\_\_\_

Please describe the pattern(s) you found.

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4. Could you alter a habitat *without chemicals* to prevent an invader's growth? \_\_\_\_\_

What could be done?

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5. What other useful information can you find in your invasive exotic plant survey?

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6. How will you use the information you have found?

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## LESSON 11: EMPOWERMENT—WHAT CAN YOU DO?

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**Duration:** One or two 45-minute class periods

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**Background information:**

Encroachment of invasive exotic plant species is a real issue in the Southern Appalachian region. Not only do invasive exotics infringe upon native plant and animal habitats, they are also very expensive to eradicate. Many hours are necessary to locate and rid invasive exotics from natural ecosystems in our area. In many cases, exotic invasive species are so tenacious that eradication efforts have to be repeated. Costs for eradication include human resources, chemicals, machinery, etc.

The economics of exotic invasive species have not been completely studied in the United States, but the U. S. Forest Service estimates that economic impacts to agriculture, natural areas, and gardens are \$35 billion a year.

Often students feel powerless to create solutions to major environmental issues. In part, this disenfranchisement stems from their inability to change governmental policy or the large expense involved in many solutions. The problem of exotic invasive plant species is one that easily allows small-scale solutions by youth.

*Sources:*

National Park Service, Great Smoky Mountains, online at  
<<http://www.nps.gov/grsm/pphtml/subplants29.html>>

Bright, C. 1998. Life Out of Bounds: Bioinvasion in a Borderless World. New York: W.W. Norton & Company, Inc.

U. S. Forest Service, Southern Research Station. Compass 2005, Volume 1, number 2 (spring).

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**Objectives:**

Raise students' awareness of action they can take at their age to address the environmental issue of exotic plants invading Southern Appalachian ecosystems.

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**Prepare in advance:**

- Copy Handout 1—Possibilities—for each student and make an overhead transparency
- Have multiple copies of Handout 2 (Outreach Contacts) and Handout 3 (Opportunities) available

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**Materials:**

- overhead projector
- overhead markers

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**Description:**

Students will envision and discuss solutions to the local exotic invasive species problem.

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**Instructional sequence:**

(10–15 minutes)

- **Break** students into groups of four.
- **Explain** to students that they will brainstorm ideas for solutions to the local exotic invasive plant problems the students can engage in.
- **Instruct** students to discuss possible ideas for interventions and solutions within their small groups. One student will record the ideas.
- **Request** reports from each small group and **write** all ideas on the board.
- **Discuss** viable options.

(5–10 minutes)

- **Give** each student a copy of Handout 1 (Possibilities).
- **Instruct** students to read thoroughly the possibilities for action(s) they might consider taking.
- Direct students to place a check mark beside ideas they are interested in.

(10–15 minutes)

- **Display** transparency of Handout 1 (Possibilities) on the overhead projector.
- **Request** feedback from small groups and individuals.
- **Indicate** level(s) of interest in various ideas with tallies.
- **Discuss** viable options for action as: a class, a small group, an individual
- **Encourage** students to choose realistic goals.
- **Distribute** copies of Handout 2 (Outreach Contacts) and Handout 3 (Opportunities) to students to use to begin planning their actions.

Teacher note: The discussion of possibilities will most likely carry over to the next class meeting.

- **Assignment:** Students will create an action plan to deal with the local exotic invasive plant problem. As students create the plan they should consider the availability of the following: time, money, political connections, community connections, transportation needs, tools, laborers, etc.

*Source: Hungerford, H.R., Litherland, R.A., Peyton, R. Ben, Ramsey, J.M. & Volk, T. L. 1996. Investigating and Evaluating Environmental Issues and Actions: Skills Development Program. Champaign IL: Stipes Publishing Company.*

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## ***Handout 1: Possibilities***

### ***Awareness and understanding: You and your community***

- Conduct a *community awareness survey* on exotic invasive plant species.
- Conduct a *public awareness campaign* on the threats of exotic invasive species.
- Write an article for the school newspaper to tell others about exotic invasive plant species.
- Write a newspaper column for a local paper to educate members of the community about exotic invasive plant species.
- Produce public service announcements about exotic invasive plant species and distribute them to the media.
- Develop and distribute an invasive species awareness brochure.
- Sponsor an exotic invasive plant species seminar for both students and the community. Topics could include exotic invasive plants, endangered plant species, sources of exotic invasives (e.g., local nurseries and mail order catalogs), and environmentally sound alternatives to harmful practices.

### ***Habitat restoration***

- Hold a school native plant species Arbor Day planting. Invite local officials.
- Replant river or creek banks with native plants to anchor the soil and provide wildlife habitat.
- Plant a native species garden on your school grounds to attract native wildlife, birds, and butterflies.
- Adopt an area of your school's playground, and then develop a plan to improve it with native plant species.
- Participate in a native plant habitat restoration project sponsored by your local community.
- Find old and new aerial photographs of a habitat near where you live and compare them. Find out if exotic invasive plants threaten sensitive habitats in your area.

*Source:*

*U.S. Fish and Wildlife Service, Endangered Species, Kids' Corner, How Kids Can Help, online at [http://www.fws.gov/endangered/kids/resources/how\\_help.html#Habitat](http://www.fws.gov/endangered/kids/resources/how_help.html#Habitat)*

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## ***Handout 2: Outreach Contacts***

1. Southeast Exotic Pest Plant Council  
North Carolina Chapter  
Contact: Johnny Randall, NC Botanical Garden  
Phone: 919/962-0522. FAX 919/962-3531. Email: [jrandall@email.unc.edu](mailto:jrandall@email.unc.edu)  
<http://www.se-eppc.org/northcarolina/>  
Tennessee Chapter  
Contact: Tennessee Exotic Pest Plant Council, P.O. Box 936, Fairview, TN 37062  
<http://www.tneppc.org/>
2. USGS contacts available for expert assistance  
EASTERN REGIONAL OFFICE  
1700 Leetown Road,  
Kearneysville, WV 25430.  
Contact: David E. Bornholdt, Deputy Regional Chief Biologist  
Phone: 304 725 8461 ext: 502. Fax: 304 728 4534. Email: [david\\_bornholdt@usgs.gov](mailto:david_bornholdt@usgs.gov)  
Alternate: Anthony M. Frank.  
Phone: 304 724 4503. Fax: 304 724 4505. Email: [anthony\\_frank@usgs.gov](mailto:anthony_frank@usgs.gov).  
  
USGS Emeritus  
Dr. William (Bill) P. Gregg  
U.S. Geological Survey, MS 301, 12201 Sunrise Valley Drive, Reston, VA 20192  
Phone: 703 648 4067. Fax: 703 648 4238. Email: [william\\_gregg@usgs.gov](mailto:william_gregg@usgs.gov)  
<http://biology.usgs.gov/invasive/expertise.htm>
3. Blue Ridge Parkway  
A Ranger in Your Classroom! Contact: <http://www.nps.gov/blri/>
4. Big South Fork Educational Program  
Off-Site Programs  
Contact: [http://www.nps.gov/biso/bsf\\_ed.htm](http://www.nps.gov/biso/bsf_ed.htm)
5. North Carolina Division of Parks and Recreation  
Office of Environmental Education, Outreach Programs  
Contact:  
NC Dept. of Environment and Natural Resources  
Division of Parks and Recreation.  
1615 Mail Service Center, Raleigh, North Carolina 27699-1615  
Phone: 919 - 733-4181  
<http://www.eenorthcarolina.org/edresources/denrprograms/outreachprograms.htm>
6. NC Museum of Natural Sciences  
Contact: Linda Sach, 11 West Jones Street, Raleigh, North Carolina 27601-1029  
Phone: 919 - 733-7450

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## ***Handout 3: Opportunities***

- Southern Appalachian Volunteer Environmental Monitoring (SAVEM)**  
**Mission:** Help save our biological treasures! SAMAB is training volunteers from around the southern Appalachian area to monitor ecological health in their community. The volunteers are involved in hands-on invasive exotic plant and water quality surveys. Resulting data are used to determine the best approaches for effective management as well as improve public awareness of the threats. If you are interested in volunteering for SAMAB's SAVEM Program, contact Andy Brown, the program coordinator, at [andy@equinoxenvironmental.com](mailto:andy@equinoxenvironmental.com)
- The Asheville Weed Team**  
**Mission:** The Asheville Weed Team's primary goal is to take action to control invasive exotic plants in the Asheville area. It is a diverse group of volunteers who conduct invasive plant control efforts at various locations on both public and private land. This group is augmented by funding from the National Fish and Wildlife Foundation's "Pulling Together Initiative." The group has been coordinating field projects, providing training to volunteers, and providing materials for training, education, and field work. Participants are from the nursery industry, volunteer organizations, universities, general citizenry, environmental organizations, and state and federal agencies. If you have any questions, news, or information on invasive plants, please contact Jack Ranney ([jwranney@utk.edu](mailto:jwranney@utk.edu) or 865-974-3938).
- Appalachian Highlands Science Learning Center at Purchase Knob**  
P.O. Box 357, Lake Junaluska, NC 28745-0357  
**Mission:** The purpose of the Appalachian Highlands Science Learning Center at Purchase Knob is to integrate educational opportunities for students and teachers into the substantial research that occurs at Great Smoky Mountains National Park and the Blue Ridge Parkway.  
Contact Information: Phone: 828-926-6251 Fax: 828-452-0767, Email: [Susan\\_Sachs@nps.gov](mailto:Susan_Sachs@nps.gov), online at [www.nps.gov/grsm/pksite/index.htm](http://www.nps.gov/grsm/pksite/index.htm)
- Great Smoky Mountains Institute at Tremont**  
Great Smoky Mountains National Park, 9275 Tremont Road • Townsend, TN 37882  
**Program/Site Features:** The Great Smoky Mountains National Park is our classroom. In this classroom, visitors gain a better appreciation not only of the Park, but also of their world in general and their responsibility toward it. Natural historians and educators may attend weekend or weeklong educational workshops. School groups may attend a 3- or 5-day residential program to investigate nature via their own custom-made schedule. Adventure Camp and Discovery Camp are summer programs that provide outdoor experiences for young campers. Specialty workshops include Photography, Bird Identification, Geology or Environmental Education and the Arts, and Adult Backpacking programs occur throughout the year.  
Contact information: Jennifer Arnold, School Program Director  
Phone: 865-448-6709 • Fax: 865-448-9250, E-mail: [mail@gsmmit.org](mailto:mail@gsmmit.org), online at [www.gsmmit.org](http://www.gsmmit.org)



5. **Clemmons Educational State Forest**  
2411 Old US 70 West, Clayton, NC 27520  
Program/Site Features: Clemmons Educational State Forest offers 20 Ranger conducted classes on topics relating to the ecology of managed forests (contact office for a program guide), Project Learning Tree Workshops and Investigating Your Environment Workshops (for teachers, natural resource professionals, scout leaders, etc.).  
Contact Information: Phone: 919-553-5651 Fax: 919-550-8050, Email: clemmons esf@mindspring.com, online at <<http://www.dfr.state.nc.us/education/esf.htm>>
  
6. **North Carolina Museum of Natural Sciences**  
11 West Jones Street, Raleigh, North Carolina 27601-1029  
Video Available: *Plant It and They Will Come...Using Native Trees and Shrubs to Attract Wildlife*. A joint effort between the Museum and Pettigrew State Park, this publication is designed to provide information about our native species of trees and shrubs that have value for attracting wildlife. Over 30 species of woody plants are discussed with information on how to propagate them and where best to plant them. For each plant, teaching tidbits for educators are included. It provides valuable information for those wishing to enhance their grounds as both a place for wildlife and for learning. Cost: \$7.00.  
Contact: Mike Dunn, Coordinator of Teacher Education, Phone: 919 - 733-7450 ext. 620, online at <<http://www.naturalsciences.org>>
  
7. **Southeast Exotic Plant Management Team**  
In order to manage invasive plants on National Park lands, 17 Exotic Plant Management Teams (EPMTs) have been formed across the country. The Southeast team is based at the Blue Ridge Parkway. For information visit  
<<http://www.nature.nps.gov/biology/invasivespecies/>> or  
<[http://www.nature.nps.gov/biology/invasivespecies/presentations/SE\\_EPMT.pdf](http://www.nature.nps.gov/biology/invasivespecies/presentations/SE_EPMT.pdf)>  
National Park Service Biological Resource Management Division

## LESSON 12: WEED PULL PREPARATION

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**Duration:** One 45-minute class period

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**Background information:**

Most plants can be identified by common characteristics such as leaf shape and color. Monocots (plants with one emergent sprout leaf) have grass-like leaves, with veins running the vertical length. Dicots (plants with two sprout emergent leaves) have rounded leaves, with veins that are webbed from a central mid-vein. Typically, plants have characteristic roots as well. Grasses and other monocots usually have a fibrous root system. Broad-leafed dicots usually have either a tap root, or adventitious roots that trail just under the surface of the soil.

Many invasive plants can sprout and continue to grow if the top is chopped off or if a small fragment of root remains in the ground. As a result, invasive plant species are difficult to remove permanently.

---

**Objectives:**

- Practice field identification of exotic invasive species.
- Identify and tag exotic invasive species.

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**Prepare in advance:**

- Locate an area within walking distance of the school grounds and arrange for students to perform a weed pull as a community service.
- Investigate the location you choose carefully, identifying exotic invasives in advance of your students' visit.
- Cut brightly colored crepe paper streamers or surveyor's tape into 12"-long pieces.
- Download [invasive species flash cards](http://www.se-eppc.org/pubs/cards.cfm) for students from the Southeast Exotic Pest Plant Council Web Site at <<http://www.se-eppc.org/pubs/cards.cfm>>
- Print flash cards corresponding to common, local invasives onto cardstock or regular paper and laminate for student use. Laminating the cards makes them weather and dirt resistant.

---

**Materials:**

- Lab/field notebooks
- Flash cards
- Crepe paper streamers

**Description:**

Students use their knowledge of exotic invasive plant and species descriptions from their field notebooks, Web quests, posters, and invasive species flash cards to identify and tag invasive species in a pre-selected area.

**Instructional sequence:**

(10 – 15 minutes)

- **Remind** students of outdoor safety rules (e.g., work with a buddy, do not leave the area, do not eat any plant or plant part, and report all injuries to the teacher.)
- **Solicit** suggestions from students on how to “spot” exotic invasives as you walk to the weed-pull location.
- **Direct** students to locate their “*Exotic Invasives in My Neighborhood*” sheet in their lab/field notebooks.
- **Encourage** recollection of exotic species that were more abundant.
- **Distribute** invasive species flash cards.
- **Lead** a short discussion recalling students’ experiences identifying exotic invasives on their walk (lesson 10).

(5 – 10 minutes)

- **Lead** students to an area you know has a good variety and number of invasive plants.
- **Model tagging an exotic invasive** by tying a crepe paper streamer around the stem or branch of a plant.

(10 – 20 minutes)

- **Instruct** students to identify and tag exotic invasive plants in the immediate area.
- **Help** students use information in their notebooks and images on the flash cards to identify exotic invasive plants.

Source: Southeast Exotic Pest Plant Council, *Invasive Species flash cards*, online at <<http://www.se-eppc.org/pubs/cards.cfm>>

## LESSON 13: CAMPUS/COMMUNITY WEED PULL

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**Duration:** Two 45-minute class periods

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**Background information:**

(Repeated from lesson 12):

Most plants can be identified by common characteristics such as leaf shape and color. Monocots (plants with one emergent sprout leaf) have grass-like leaves, with veins running the vertical length. Dicots (plants with two sprout emergent leaves) have rounded leaves, with veins that are webbed from a central mid-vein. Typically, plants have characteristic roots as well. Grasses and other monocots usually have a fibrous root system. Broad-leafed dicots usually have either a tap root, or adventitious roots that trail just under the surface of the soil.

Many invasive plants can sprout and continue to grow if the top is chopped off or if a small fragment of root remains in the ground. As a result, invasive plant species are difficult to remove permanently.

---

**Objectives:**

- Practice field identification of exotic invasive species.
- Remove exotic invasive species as a community service.

---

**Prepare in advance:**

- Collect plastic grocery bags (request students bring them to school).
- Make a copy of Handout 1 (Types of Roots) for each student.

---

**Materials:**

- lab/field notebooks
- glue sticks
- trowels
- plastic grocery bags

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**Description:**

Students use their knowledge of exotic invasive species, their identification key, and invasive plant species flash cards to identify and dig up exotic invasive species in a pre-selected area.

**Instructional sequence:***(5 – 10 minutes)*

- **Direct** students to glue the root identification diagram into their lab/field notebooks.
- **Remind** students of the different kinds of roots plants can have.
- **Remind** students of outdoor safety rules (e.g., work with a buddy, do not leave the area, do not eat any plant or plant part, and report all injuries to the teacher.)

*(10 – 15 minutes)*

- **Escort** students to the pre-selected location, where students previously tagged exotic invasives (Lesson 12).
- **Demonstrate** using a trowel to completely remove roots of an invasive plant.

*(20 – 55 minutes)*

- **Instruct** students to practice digging up weeds.
- **Monitor and assist** students with root extraction as needed.
- **Remind** students to *completely remove the plant and root*. Many invasive plants can grow from a small fragment of root left behind.
- **Supervise** while students extract tagged exotic invasive species.

**Optional assessment task:**

Collect and save species of invasive plants in separate bags for population monitoring.

Chart and graph your data and submit to Southeast Exotic Pest Plant Council.

Point out correlations between leaf types and root types.

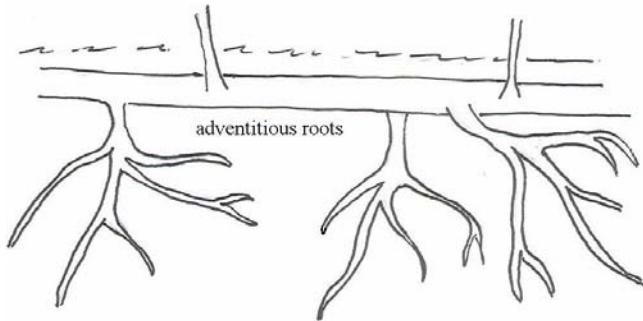
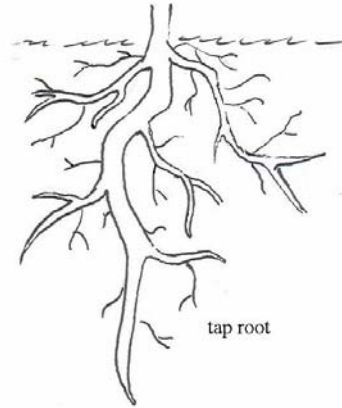
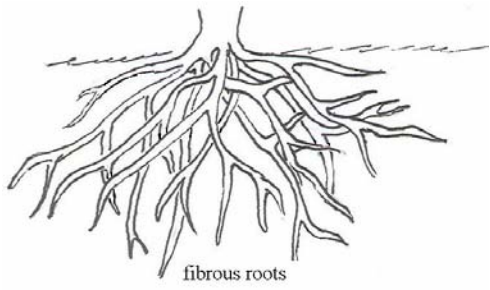
Some students may be interested in a follow-up, restoration project. (See lesson 11.)

Source: Southeast Exotic Pest Plant Council, *Invasive Species flash cards*, online at <<http://www.se-eppc.org/pubs/cards.cfm>>

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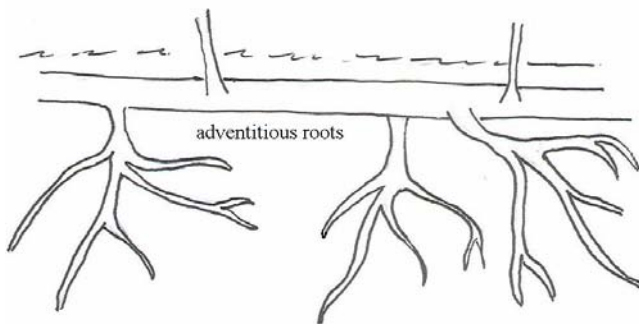
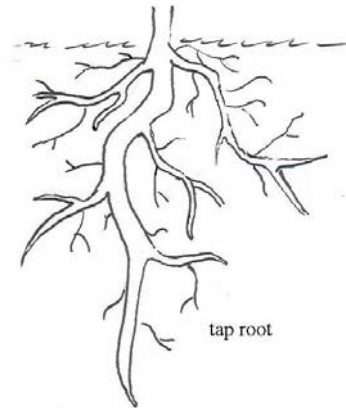
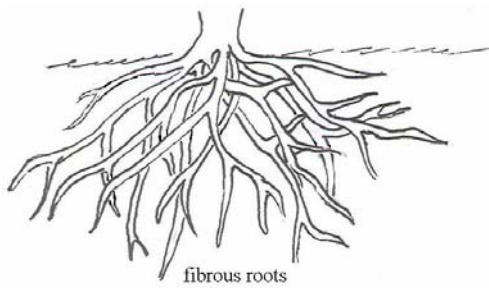
**Handout 1: Types of Roots**



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**Handout 1: Types of Roots**



## LESSON FOURTEEN: INVASIVE SPECIES JEOPARDY

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**Duration:** One 45-minute class period

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**Objectives:**

To test students' knowledge of exotic invasive plant species taught in this unit.

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**Prepare in advance:**

Practice using PowerPoint presentation before using in class

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**Materials:**

- Computer and multimedia projector with Microsoft PowerPoint installed
- A copy PowerPoint Jeopardy game installed on computer.

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**Instructional sequence:**

- **Remind** students of Jeopardy rules: *students supply a question* for a statement (the answer) given to them. For example, Answer – the number of days in one week; student would supply the question, “What is 7?”
- Operating Instructions (from first slide on PowerPoint Jeopardy):
  - Click anywhere on this screen to start the game.
  - Select a category value and click on it.
  - Click on the **ANSWER** button ***FIRST***.
  - **THIS IS VERY IMPORTANT!** Your first click **ANYWHERE** will reveal the answer (clue).
  - Click on **QUESTION TO REVEAL CORRECT STUDENT RESPONSE**.
  - Click on the **PINK HOUSE BUTTON** to return to the category screen.
  - To **END** the PowerPoint, double click on any area of the screen.

## OPERATING INSTRUCTIONS

Remember than in the game of jeopardy *students supply a question* for a statement (the answer) that the teacher gives them.

The teacher gives the answer and the student formulates a question for that answer.

E.g.: Answer – the number of days in one week  
 Student would supply the question, “What is 7?”

### PRACTICE USING THIS POWERPOINT BEFORE USING IT IN CLASS!

1. Click anywhere on this card to start the game.
2. Select a category value and click on it.
3. Click on the **ANSWER** button ***FIRST***.
4. **THIS IS VERY IMPORTANT!** *Your first click **ANYWHERE** will reveal the answer (clue).*
5. Click on **QUESTION TO REVEAL CORRECT STUDENT RESPONSE**.
6. Click on the **PINK HOUSE BUTTON** to return to the category screen.
7. To END the PowerPoint, double click on any area of the screen.



## Invasive Species Jeopardy

Healthy Ecosystems	Relationships	Appalachian Invaders	Successful Strategies	Empower Me!
<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>
<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>
<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>
<u>400</u>	<u>400</u>	<u>400</u>	<u>400</u>	<u>400</u>
<u>500</u>	<u>500</u>	<u>500</u>	<u>500</u>	<u>500</u>
<u><b>Final Jeopardy</b></u>				



## Healthy Ecosystems

-100-

- **QUESTION:** “What is *the sun?*”  
» “What is *sunlight?*”
- **ANSWER:** the *energy source* on which everything in a healthy land or water ecosystem depends

Answer

Question



## Healthy Ecosystems

-200-

- **QUESTION:** What are *producers, consumers, and decomposers?*
- **ANSWER:** the kinds of living organisms in a healthy ecosystem (3)

Answer

Question



## Healthy Ecosystems

**-300-**

- **QUESTION:** What are *land forms, water sources, soil, and rocks*?
- **ANSWER:** the non-living things in a healthy ecosystem (4)

Answer

Question



## Healthy Ecosystems

**-400-**

- **QUESTION:** What are *natural boundaries*?
- **ANSWER:** *physical limits* of a healthy ecosystem set by the living and non-living things in the ecosystem

Answer

Question



## Healthy Ecosystems

-500-

- **QUESTION:** What is *biodiversity*?
- **ANSWER:** the number of *different species* in a particular habitat

Answer

Question



## Relationships

-100-

- **QUESTION:** What is a *producer*?
- **ANSWER:** a plant that can *change* the sun's radiant energy *into chemical energy*

Answer

Question



## Relationships

-200-

- **QUESTION:** What are predators?  
» What is a predator?
- **ANSWER:** animals that hunt, kill and eat other animals

Answer

Question



## Relationships

-300-

- **QUESTION:** What is a *habitat*?
- **ANSWER:** the place that provides food, shelter, and a suitable climate for an organism to live

Answer

Question



## Relationships

-400-

- **QUESTION:** What is a *food chain*?
- **ANSWER:** a [model](#) that shows *only one-to-one links* between the levels of producers and consumers

[Answer](#)

[Question](#)



third level consumer



secondary consumer



primary consumer



producer

hawk



owl



mouse



grass

[back](#)

[Answer](#)

[Question](#)



## Relationships

-500-

- **QUESTION:** What are *exotic invasive plants*?
- **ANSWER:** rapid growth rates and reproduction rates allow *them* to overpower and displace existing native plants by using up valuable light, space, water, and nutrients

Answer

Question



## Appalachian Invaders

-100-

- **QUESTION:** What is *kudzu*?
- **ANSWER:** a fast-growing Asian vine from the *pea family*. Before 1953 it was often grown as *livestock forage* and to *stop erosion*.

Answer

Question



## Appalachian Invaders

-200-

- **QUESTION:** What is *tree of heaven*?
- **ANSWER:** definitely *not* angelic! a tree most common along forest edges, often mistaken for *native sumac*

Answer

Question



## Appalachian Invaders

-300-

- **QUESTION:** What is *mimosa*?
- **ANSWER:** a small tree that re-sprouts quickly when cut, and seeds from *lacey pink flower* “puffs” may remain viable for 50 years or more

Answer

Question



## Appalachian Invaders

-400-

- **QUESTION:** What is *Japanese honeysuckle*?
- **ANSWER:** a vine with sweet-smelling flowers. Its evergreen *leaves photosynthesize in winter* and its dense branches strangle small trees and shrubs

Answer

Question



## Appalachian Invaders

!!!DOUBLE JEOPARDY!!!

- **QUESTION:** What is *oriental bittersweet*?
- **ANSWER:** a *not so tasty climbing vine* that reproduces often and grows so rapidly it damages or kills native plants by choking and shading them

Answer

Question





## Successful Strategies

**-100-**

- **QUESTION:** What is *adaptation*?  
»What is *adapt*?
- **ANSWER:** the *ability* of a species to survive in a particular habitat, especially because of *changes* of form or behavior

Answer

Question



## Successful Strategies

**-200-**

- **QUESTION:** What is a *toxin*?
- **ANSWER:** the *deadly substance* given off by *roots* of some exotic invaders

Answer

Question



## Successful Strategies

-300-

- **QUESTION:** What are *natural consumers*?
- **ANSWER:** Exotic invasive plants survive in new ecosystems because there are none of *these*.

Answer

Question



## Successful Strategies

-400-

- **QUESTION:** What are *tap roots and adventitious roots*?
- **ANSWER:** broad-leafed invaders often have one of *these two kinds of roots* that are very difficult to completely remove

Answer

Question



## Successful Strategies

### !!!DOUBLE JEOPARDY!!!

- **QUESTION:** What is  
*‘intentional habitat destruction’*?
- **ANSWER:** Second only to *this*, invasive exotic plants are the greatest threat to natural ecosystems of the United States.

Answer

Question



## Empower Me!

**-100-**

- **QUESTION:** What is *identify*  
an exotic invasive plant?
- **ANSWER:** By *knowing* some of these things about a plant:
  - location (habitat)
  - leaf shape
  - flowers and/or seeds
  - root type

*I can . . .*

Answer

Question



## Empower Me!

-200-

- **QUESTION:**  
– What is *get advice from an expert*?
- **ANSWER:** If I am *unsure* about planting an imported plant in my garden, I can . . .

Answer

Question



## Empower Me!

-300-

- **QUESTION:** What is *tell her what you know about exotic invasives*?  
» What is *alert/inform others*?
- **ANSWER:** If my *next door neighbor* is getting ready to plant an invader in her garden, I can . . .

Answer

Question



## Empower Me!

-400-

- **QUESTION:** What is a *volunteer*?
- **ANSWER:** a *person who gives time freely* to help identify and remove plant invaders in the Southern Appalachian Region

Answer

Question



## Empower Me!

-500-

- **QUESTION:**  
What is an *Invasive Species club*?
- **ANSWER:** interested students who meet in a *group* to help find solutions to the exotic invasive species problems in the Southern Appalachian Region

Answer

Question



## FINAL JEOPARDY

- **ANSWER:** all the living things in an area plus the non-living things in the surrounding environment

[question](#)

