THE INVASIVE PLANT SPECIES EDUCATION GUIDE

A series of lessons to engage students in community science projects

Kevin Mason, Krista James, Kitrina Carlson, and Jean D'Angelo

Invasive plants can be defined as plants that are nonnative, grow aggressively, dominate ecosystems, and crowd out existing native plants (Clinton 1999). The invasion of nonnative plants has increasingly been recognized as one of the greatest threats to biodiversity and the management of natural areas in the United States (NWRA 2002). These plants have significant economic impacts as well: Nonnative invasive plant species cost the country an estimated $34.7 billion annually due to economic damages and control costs (Pimentel et al. 2005).

Local governments often lack the human and financial resources to monitor and control invasive plant species (NISC 2008). One strategy for addressing this issue is through formal education. Although most high school students have heard of invasive plant species, many have not had formal learning or instruction on the topic—which may be addressed in an environmental science course but is less likely to be included in general, Earth, agricultural, or life science. This topic is often not included in the science curriculum at the middle or high school level.

To help high school students gain a solid understanding of invasive plant species, university faculty and students from the University of Wisconsin–Stout (UW–Stout) and a local high school teacher worked together to develop the Invasive Plant Species (IPS) Education Guide (see "Working together" on p. 34 for more details about this collaboration). The IPS Education Guide includes nine lessons that give students an opportunity to engage in inquiry-based learning. These lessons provide a foundational knowledge about forest ecology and allow students to explore invasive plant species. They learn concepts related to ecology, botany, and technology; develop the observational skills needed to identify and investigate invasive plant species; and take action toward the control of invasive plant species. The lessons conclude with a project-based activity, in which students contribute to their community by identifying, removing, and controlling local invasive plant species.

This article provides short summaries of each of the nine lessons included in the IPS Education Guide, which is freely available online (see "On the web"). Although the guide references a kit that was made available to teachers in Wisconsin, it is not required. The lessons in this guide intentionally use materials that can be easily found around the house, in the school, or in a store—with the exception of the GPS unit. (**Editor's note**: A list of supplies and cost estimates is available "On the web.")

Teachers are encouraged to adapt and incorporate these lessons into their science course curricula. The IPS Education Guide is designed to offer teachers the flexibility to choose those lessons that meet the needs of their students and course curriculum.

Lesson 1: The forest odyssey

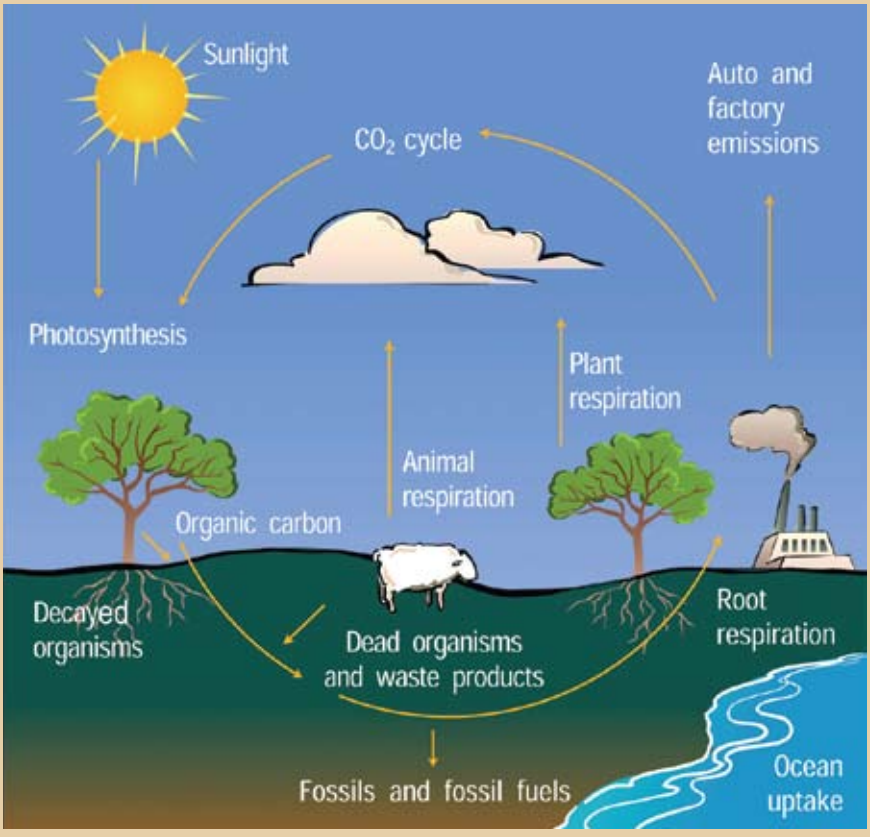
In the first lesson, students are introduced to the concept of ecology. They read Aldo Leopold's "Odyssey" essay, which follows the travels of atoms X and Y through an ecosystem (Leopold 1949). An alternate essay, "The Cyclic Journey of an Atom" (Pringle 2002), can also be used for teachers who prefer a shorter student reading.

Once students have finished this reading, a class discussion highlights the interconnectivity of an ecosystem and the importance of biodiversity in sustaining life. A list of discussion questions is available on the IPS Education Guide website (see "On the web").

Following the reading and discussion, students sit in a circle and are asked to pass around a large X-shaped cutout, representing atom X. (For example, X might represent oxygen.) The teacher begins the activity by stating where atom X originated (e.g., a tree, a tooth, the soil). As the X passes from student to student, each invents a story about where the atom will go next and how it will get there. Students apply their knowledge of the forest ecosystem to create a

FIGURE 1

Carbon cycle (UCAR 2010).



Working together.

The Invasive Plant Species (IPS) Education Guide is the result of a collaboration involving an agriscience teacher at Menomonie High School in Menomonie, Wisconsin, and two university students from the applied science program, two university students from the science education program, two university faculty members from the Biology Department, and one university faculty member from the school of education, all at the University of Wisconsin–Stout. The curriculum was developed in the summer of 2008.

All lessons were piloted and revised twice. The lessons were first piloted by Jean D'Angelo, the agriscience teacher at Menomonie High School, and her students during the fall 2008 semester with the help of four students from the University of Wisconsin–Stout. D'Angelo's high school students provided feedback throughout the teaching process and completed a survey focused on their use of the lessons. The results showed that students understood the material and were able to apply what they had learned during the restoration portion of the curriculum. Students also valued the opportunity to observe and interact with natural resource personnel, park managers, professors, and college students.

The lessons were tested a second time by 17 middle and high school teachers from local school districts who attended the January 2009 IPS Education Teachers Workshop. Several of D'Angelo's students were excited to spread the word about the project and volunteered their time to help out with the workshop.

Teachers who have used the lessons report that students enjoy the variety of activities available throughout the curriculum and seem excited about working on the invasive plant species removal project. In addition, teachers note that students tend to work hard on the projects, since they think their actions are having an immediate positive impact on their communities.

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Students use transect lines to monitor invasive plants.

narrative about what happens to the atom. While students understand many of the biological processes, they are surprised to learn how much each living organism is interconnected. Most have not thought about these concepts through the perspective of a single atom. Their misconceptions of nature as a collection of independent organisms and events is challenged. This lesson requires approximately two days.

Lesson 2: Exploring ecosystems

In the second lesson, students learn about two of the processes that transport atoms through the living and nonliving parts of an ecosystem: photosynthesis and the carbon cycle (Figure 1, p. 33). Students are also introduced to different types of biomes, such as grasslands, deserts, coniferous forests, deciduous forests, savannahs, rain forests, tundras, and wetlands. They use Google Earth to explore a wide variety of biomes—some within the United States, and others in different countries. While students explore, they are asked to identify the climate conditions, living organisms, nonliving components, and interactions that might exist in each biome. Based on their available resources, teachers may use satellite images, web-based photographs, or posters of biomes to help students accomplish this objective. This lesson requires approximately one day.

Lesson 3: Restoring biodiversity

The third lesson introduces students to the concept of biodiversity and allows them to observe species biodiversity through a hands-on activity. Before class begins, students are placed into groups of two to three and assigned a biodiversity location on the school grounds in which to collect data. The teacher should select locations that provide varying levels of biodiversity and are close enough to each other that students can be adequately supervised. (**Safety note**: Hats and long-sleeve shirts should be worn when participating in outdoor activities. Use sunscreen and lip balm with a sun protection factor [SPF] of 15 or higher.)

CAUTION

Students place a 1 m^2-quadrat, made of polyvinyl chloride (PVC) pipe, on the ground and estimate the number of plant organisms and different plant species found in it. When they return to the classroom, students calculate the biodiversity of their location by dividing the number of species by the total number of organisms and compare their results with those obtained from other locations. This lesson requires approximately two days.

Lesson 4: Outwit-outlast-outplant

In the next lesson, students play a game to increase their awareness and understanding of how invasive plant species occupy and damage native ecosystems.

Students role-play as invasive plants, native plants, and herbivores, such as mice or deer. The native and invasive plants compete for resources, such as water and sunlight, which are represented by game tokens. As the students playing mice and deer consume their usual diet of native seeds and plants, those who are invasive plants win every time because the herbivores do not recognize the invasive plants as food. This activity illustrates the competitive advantage of invasive plant species in an ecosystem and requires one to two days.

Lesson 5: Plant invaders

In the fifth lesson, students use internet and textbook resources to research how invasive plants are introduced into local ecosystems. With the information they collect, students create posters to detail the arrival and spread of a particular species. During a second class period, they present their posters to the class. A worksheet and grading rubric is provided in the lesson guide. This lesson requires approximately two days.

Lesson 6: Plant hunters

Students learn how to use plant identification guides in the next lesson. Working in groups, they apply this knowledge to identify local invasive plants, native wildflowers, and common trees. Students first identify specific plants brought into the classroom by the teacher. Once their confidence and skill level increases, they go outdoors to try to find and identify 10 trees and 10 herbaceous plants. This lesson requires approximately two days.

Lesson 7: Introduction to GIS and GPS

In this lesson, teachers can use the worksheets provided in the guide to help students learn the basics of geographic information system (GIS) and global positioning system (GPS) technology. Working in groups of two to four, students learn how to use a GPS receiver in an outside activity. Each group uses the GPS receiver—which can be purchased for less than $100—and the accompanying user guide to learn how to use this device. Local community foundations will sometimes help with this funding.

Student groups are then led to a nearby natural area where the teacher has previously "flagged" plants (using brightly colored flagging tape). When students find these plants, they use their field guides to identify them and record the GPS coordinates on "The Hunt Is On" worksheet, which is available on the IPS Education Guide website (see "On the web"). These combined skills can be applied in the next lesson. This lesson requires approximately two days.

Lesson 8: Monitoring invasive plant species

After learning about the impact of invasive plant species, students often want to know how they can make a positive contribution. Invasive plant species monitoring is an important service students can provide to local, state, and regional agencies. Land management agencies need to know the locations of specific invasive plant species, whether or not they are spreading, and the effectiveness of management practices. Monitoring helps provide this information.

Garlic mustard, an invasive plant species commonly found in the United States.

SCILINKS
THE WORLD'S A CLICK AWAY
Keywords: Classifying plants
at *www.scilinks.org*
Enter code: TST041001

In this lesson, students learn how to use transect lines and quadrats to determine percentage plant cover of invasive and native plant species in a natural area near their school. Students use the training tutorials at CitSci.org, a National Science Foundation–funded website, to learn about monitoring and managing invasive species (see "On the web"). The site also provides access to an invasive species mapping program that allows citizens, school groups, and professionals to enter invasive species observations into a global database. These observations are then used for natural resource management, scientific studies, and environmental education. Teachers can register for the online program through the IPS Education Guide website (see "On the web"). This lesson requires approximately one day.

Lesson 9: Invasive plant species control

The final lesson is the capstone activity. At this point, students have learned to identify and monitor invasive plants. Now, it is time for them to take action and make a difference for the environment.

In this lesson, teachers establish a partnership with an expert from a local government agency involved in the control of invasive plants,

such as the city's Department of Parks and Recreation, a National Resource Conservation Service office, or a university extension agency. This person can help identify strategically important sites, provide guidelines to ensure that students make a positive contribution, and provide background information to help students learn about their local environments. With this expert, teachers and their students can decide which control method to use, what materials or tools are needed to ensure student safety, and the frequency and time of year needed for removal of the invasive plant species. The IPS Education Guide website (see "On the web") contains links to short video clips that provide detailed information about establishing an invasive plant species control project. This lesson requires anywhere from 1 to 10 days.

Making connections

The development of the IPS Education Guide was a unique collaboration of UW–Stout students and faculty, along with a local high school science teacher. The curriculum provides an opportunity for high school students to learn more about ecology, botany, invasive plant species, and the use of technology in science. Students develop knowledge and understanding of organisms and their interdependence in a local ecosystem. Students then apply this knowledge in a culminating field project to remove invasive plant species at a local restoration site. This activity connects life science concepts to an important social and environmental issue. Through the IPS Education Guide, students are able to see how an understanding of scientific issues can lead to actions that improve their local community. ■

Common buckthorn, an invasive plant species found throughout the United States.

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On the web

Invasive Plant Species (IPS) Education Guide: *www.uwstout.edu/faculty/jamesk/Invasive_Plant/Invasive_Plant.htm*

IPS list of supplies and cost estimates: *www.uwstout.edu/faculty/jamesk/Invasive_Plant/2.8_Appendix_Kit_Supply_List.pdf*

National Science Foundation website: *www.citsci.org*

References

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Addressing the Standards.

The following National Science Education Standards (NRC 1996) are addressed by the IPS Education Guide:

- Content Standard B: Physical Science (p. 176)
- Content Standard C: Life Science (p. 155)
- Content Standard F: Science in Personal and Social Perspectives (p. 166)