Invasive Species

LESSON PLAN

Prepared by the Pennsylvania Integrated Pest Management Program
to complement their video *BugMobile vs. the Invasive Species*

ASIAN LONGHORNED BEETLE

PURPLE LOOSESTRIFE

PLUM POX

ZEBRA MUSSEL

PA IPM

The video, *BugMobile vs. the Invasive Species*, is hosted by the Pennsylvania IPM Program's The BugMobile!™, the one-and-only talking car. The BugMobile!™ is a roving educational unit—painted to resemble a ladybug and equipped with speakers that allow it to "talk"—that travels to schools, fairs, and other public events to promote IPM and teach basic biological concepts about insects and other potential pests. See back cover for more details.

COVER PHOTO CREDITS

Zebra mussel: Michigan Sea Grant, University of Michigan, Ann Arbor, MI
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Asian longhorned beetle: USDA
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The Pennsylvania IPM program is collaboration between the Pennsylvania State University and the Pennsylvania Department of Agriculture aimed at promoting integrated pest management in both agricultural and non-agricultural situations. For more information, contact the program at 814-865-2839, or visit the Web site **http://paipm.cas.psu.edu**.

The BugMobile!™ is a traveling, interactive exhibit designed to increase public awareness about Integrated Pest Management (IPM) and minimizing the effects of pesticides on human health and the environment. Now it stars in a video—*BugMobile vs. the Invasive Species*!

The BugMobile!™ is a fun and innovative way to attract the public to a learning opportunity. The car, a 1970 Volkswagen Beetle painted to look like a ladybug, is equipped with audio-visual equipment so it can engage passers-by in conversation. At public appearances, the person who is the "Voice of The BugMobile!™" can see, hear, and talk to spectators but cannot be seen.

In its feature debut, The BugMobile!™ travels around Pennsylvania. Along the way, The BugMobile!™ talks to experts—and some unusual friends—as it seeks out invasive species that threaten our environment.

The BugMobile!™ is more than just a gimmick—it is literally and figuratively a "vehicle" that helps people learn specific IPM concepts:

- Applying the six simple steps of IPM
- Reducing personal and environmental risks associated with pesticide use
- Identifying alternatives to pesticides
- Proper pest identification
- Protecting yourself against serious pests and public health threats

and much more!

The BugMobile!™ is sponsored by the Pennsylvania IPM Program (PA IPM), a collaborative effort of Penn State's College of Agricultural Sciences and the Pennsylvania Department of Agriculture. Seed funding for The BugMobile!™ has been provided by the Environmental Protection Agency, Penn State's College of Agricultural Sciences, and the Pennsylvania IPM Program. The BugMobile!™ is available for use by nonprofit educational organizations.

If you would like to host The BugMobile!™ at your school or event, or would be interested in becoming a sponsor, contact Ed Rajotte, Penn State IPM coordinator, or Lyn Garling at 814-865-1895.

Visit Penn State's College of Agricultural Sciences on the Web: http://www.cas.psu.edu

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Invasive Species

LESSON FORMAT

STANDARD STATEMENT(S)

4.1.10 E: Identify the effects of humans and human events on watersheds.

4.3.10 C: Explain species diversity.

4.5.10 A: Identify introduced species that are classified as pests in their new environment.

4.5.10 C: Analyze the benefits to the environment and society associated with alternative practices used in Integrated Pest Management (IPM).

CONTENT OBJECTIVE(S)

Students will be able to:

1. Describe ways invasive species have affected the environment.
2. Explain how invasive species can decrease biodiversity.
3. Identify some of the better known invasive species and tell why they are considered pests.
4. Explain how different IPM tactics may be needed to manage the spread of invasive species.
5. Recognize why it is unwise to bring exotic species into the United States.

ASSESSMENT STRATEGIES

Students should be able to:

1. Name five invasive species and tell how each may affect the ecosystem.
2. Define words such as: exotic, invasive, noxious, opportunist, and quarantine.
3. List three ways they can help prevent exotic species from becoming established.
4. Explain the different levels of IPM tactics and give examples of each level.

PROCEDURES

1. Prior to showing the video in class, preview the video, review the background information (pages 2 to 6), and prepare copies of the pre- and post-tests (pages 11 and 12).
2. Hand out the pre-test for the students to complete.
3. Show the video to the class.
4. Discuss the discussion questions on page 7.
5. Complete the post-test.
6. Assign other extension activities as appropriate (see page 7).

Suggested Level

Secondary

Standard Category

4.1: Watersheds and Wetlands

4.3: Environmental Health

4.5: Integrated Pest Management

Materials

- *BugMobile vs. the Invasive Species* video
- Copies of pre- and post-tests
- List of glossary terms
- Pictures of invasive species (from Web sites)

Instructional Strategies

- Observing
- Discussing

Other Academic Areas

Science and Technology

INTRODUCTION

The Pennsylvania Integrated Pest Management Program (PA IPM) has produced this video and lesson plan manual for use in the classrooms of Pennsylvania. It is designed to help teachers address the Academic Standards for Environment and Ecology, particularly in the section on Integrated Pest Management (IPM). It is designed for the upper secondary grade levels.

In this manual, you will find the standard statements, content objectives, assessment strategies, and procedures in an easy-to-use format. Background information on four important invasive species (the zebra mussel, plum pox virus, Asian longhorned beetle, and purple loosestrife) is provided in addition to information explaining IPM tactics. Ready-to-copy pre- and post-tests, discussion questions, and extension activities are included along with suggestions for students to become actively involved in the management of invasive species. An extensive glossary and listing of additional references including the Web site address for copies of the Pennsylvania Noxious Weed Law and weed list complete the manual.

Additional information on the video or invasive species can be obtained by contacting either address on the bottom of the contents page. A limited number of videos and lesson plans will be available on a first-come, first-served basis from the Pennsylvania Departments of Agriculture and Education, Office of Environment and Ecology.

Copies will also be available for purchase from: Publications Distribution Center, The Pennsylvania State University, 112 Ag Administration Building, University Park, PA 16802-2602. Phone: 814-865-6713, Fax: 814-863-5560.

BACKGROUND INFORMATION

Invasive Species

Invasive species are those organisms that adapt quickly to a new environment and reproduce and spread rapidly into new locations, often displacing the organisms that were originally there.

Many invasive species are exotic—not native to our environment. Other invasive species may be native, but may also rapidly reproduce and become nuisances.

When a species is introduced into a new locale where it doesn't have any natural enemies, it can quickly take over the area and pose a real threat to the environment by knocking the whole system out of balance. Plants, animals, and pathogens may all become invasive.

Disturbances such as strip-mining, logging, or leveling land at construction sites create opportunities for invasive species to move in. Or, you may have a relatively undisturbed area, introduce a new species into it, and the natural balance may begin to shift.

For centuries, humans have intentionally introduced new plant and animal species to different parts of the world. Some of these have been very beneficial, such as wheat from Egypt, or cattle from Asia. Other introductions haven't worked out so well.

Intentional Introductions

The starling was originally brought to North America by a fan of William Shakespeare. He released 60 to 100 birds in New York City's Central Park in the 1890s. His desire was to introduce all the birds ever mentioned in the works of William Shakespeare. It turned out to be a poor tribute—by 1970, millions of these highly adaptive and prolific birds had reached as far as Alaska. Today, most people view these birds as nuisances because they outcompete native birds for food and nesting sites.

Some introductions have been downright disastrous. Giant Hogweed, a member of the parsley and carrot family, is a tall, majestic plant originally brought to the United States around 1920 as a landscape plant. It "escaped" out of the garden into the wild and is still spreading across northwestern Pennsylvania. It also can cause painful skin rashes when you come in contact with it, and it is now listed on Pennsylvania's noxious weed list (see page 15).

Multiflora rose is another foreign species run amok. It was originally promoted by the United States Department of Agriculture (USDA) as an excellent plant for erosion control and living fences for livestock and wildlife cover. So, thousands of free cuttings were given out to create hedgerows. Today, millions of dollars are spent trying to eradicate it. It *does*

provide excellent habitat and food source for many birds and small mammals. However, it is extremely hardy and difficult to get rid of because it can self-seed and quickly take over an area. Birds scatter the seeds widely, then it takes over pasture land, and cows become unwilling to graze in fields containing the thorny plant. It has also been added to the federal and state noxious weed lists.

In the South, kudzu was originally introduced as a forage crop, like hay, for feeding animals. It also traveled beyond its originally intended boundaries and virtually took over huge pieces of the Southern landscape, crowding out all other plants and many animal habitats.

Many more invasive species are brought into the country and transplanted from place to place accidentally. In North America, it is estimated that there are about 50,000 species of exotic plants, animals, and pathogens currently established, and that more than 3 million acres of land in the United States are lost to invasive species. Invasive species cost our economy an estimated $138 billion per year.

Vectors

In ecology, a vector is an organism or a force of nature associated with the spread of a species to a new area. Vectors can be humans, wind, floods, insects, or other factors.

Because of their ability to spread rapidly using vectors, invasive species may represent a serious threat to agriculture, forests, parks, urban areas, and human health.

Unwelcome plants, animals, or disease-causing microorganisms may hitchhike to a new location as a "passenger" on a boat, train, airplane, or automobile. A strange seed may come loose from a car tire tread, bounce off a train, or be eaten by a bird and deposited somewhere else.

Because of the rapid expansion of world trade, the number of opportunities for accidental introductions of exotic species is greater than ever. Every ship coming into port, every plane landing, and every truck crossing a border is a potential vector for invasive species.

This video looks at just four different exotic organisms that have become invasive in the Northeast: the Asian longhorned beetle, purple loosestrife, plum pox virus, and zebra mussels. They illustrate problems we might face with other invasive insects, plants, diseases, and aquatic animal life.

The Asian Longhorned Beetle—*Anoplophora glabripennis* (Motschulsky)
The Asian longhorned beetle is a voracious feeder. It chews its way into trees and chews its way back out. The telltale signs of Asian longhorned beetle infestation are the beetles themselves and the large exit holes they leave in trees. What people don't usually see are the huge channels called "galleries" they carve inside the tree. These tunnels weaken and eventually kill the tree.

The Asian longhorned beetle is native to China. It was first discovered in New York City in 1996 and later found in Chicago in 1998. Scientists believe this pest came to the United States on Asian ships. The vectors for this spread were wooden shipping crates made from trees that already contained Asian longhorned beetle larvae. When they arrived here, the insects left the dead scrap lumber and went looking for live trees to feed on. The beetles found they really liked maple trees, attacking at least six species. Many other tree species are also targeted by the beetles.

A little insect can cause some big problems. The arrival of the Asian longhorned beetle resulted in loss of trees and the wildlife that used those trees for habitat. The loss of trees also means loss of shade, potentially, leading to higher city temperatures. Limbs or entire trees weakened by the beetle are dangerous because they could fall on people. Since Asian longhorned beetles prefer maple trees, this means a loss of maple syrup products and furniture wood. It can even be a threat to tourism if the beautiful fall leaf colors are reduced.

The presence of invasive species means that the natural system is out of balance. So how do we correct it, or at least *manage* it? Just spraying poisons won't necessarily restore the balance—and it could cause even greater problems. Chemical treatments should be the last resort, rather than the first thing we reach for. Problems this complex require a more sophisticated approach—one we call Integrated Pest Management, or IPM.

Instead of a one-shot approach, with Integrated Pest Management scientists and public workers employ a "pyramid" of IPM tactics—starting with the simplest prevention techniques and moving up the scale to more complicated interventions.

At the bottom of the pyramid are **cultural** tactics, such as changing the environment so that it is not suitable for the pest. Then come the **physical-mechanical** tactics—things like screens, barriers, traps, or plant removal. Next come the **biological** tactics—introducing predators, parasites, or other living organisms to combat the pests; get the good bugs to kill the bad ones and restore a balance. Finally come the **chemical** tactics—using pesticides such as insecticides, herbicides, fungicides, or other chemical controls.

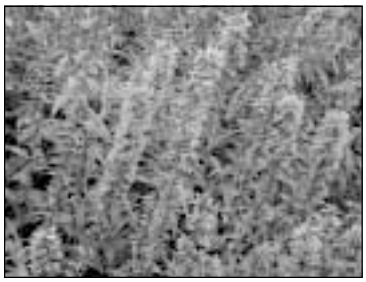
Part of the cultural tactics for the Asian longhorned beetle were regulatory: the United States has placed an embargo on untreated wood shipping crates from China and has requested that other materials, such as plastic or cardboard, be used instead. They have also requested using higher-quality wood, but this would be more expensive because the cheapest wood for building crates isn't much good for anything else—since it's already been damaged by beetles.

The physical-mechanical tactic for Asian longhorned beetle damage is to identify affected trees, chop them down, chip them up, and burn the chips so that the beetles can't spread farther. A death sentence isn't a happy outcome, but it's the only way to save other trees that haven't been invaded yet.

There are currently *no* known natural predators or parasites to serve as biological controls of Asian longhorned beetle in the United States. And we've already heard that there aren't any effective chemical controls for this pest. However, there are other cultural options for the future.

Entomologists and horticulturists are working to determine which species of trees are likely to *resist* the Asian longhorned beetle. We already know they like maples, but we don't know whether they like other valuable trees, such as oak or ash.

In New York and Chicago, aborists are trying to replace every tree removed with another species that won't serve as a host for the Asian long-horned beetle. They also don't want to use all the same kind of tree as replacements. In case there is another disease or pest that targets a specific kind of tree, they want the population to be diverse, so that all the *replacement* trees don't get wiped out. Research from Penn State and the Pennsylvania Department of Agriculture could help indicate which varieties of trees should be replanted.



Purple Loosestrife—*Lythrum salicaria* (Linnaeus)

Purple loosestrife is a pretty plant, but what it does to wetlands is pretty ugly—it chokes out most of the other vegetation around it. Purple loosestrife spreads mostly by seeds that can float downstream or be carried in mud on birds' feet, wildlife fur, boats, vehicle tires, and footwear. Its perennial roots are long-lived, sending up more shoots each year. A mature plant with many stalks can produce over one million seeds in a season.

Beekeepers love purple loosestrife because it provides lots of nectar for bees. But ecologists don't like it because it destroys biodiversity. Invasive species often take up so many resources that there aren't enough left for the native species to survive. Loss of biodiversity means we may also lose many species of fish, birds, deer, plants, and other wildlife.

Scientists believe that purple loosestrife also came to the United States on a ship. This time,

the ship came from the Middle East; instead of insects hiding in the packing material, a few loose seeds were probably sloshing around in the ship's hold. When the bilge was pumped from the ship, plant material made it to our shores. Purple loosestrife *thrives* along American waterways.

On the IPM pyramid of tactics, the only cultural approaches are regulatory—propagating or selling any of the related varieties of purple loosestrife in Pennsylvania is now unlawful. It's already here and well-established growing in the wild. In terms of physical-mechanical controls, there is weeding or burning, but this isn't always a cost-effective option because purple loosestrife lives off the beaten path—it's sometimes tough to get to it in remote or marshy areas. Chemical controls are problematic because loosestrife is usually so close to waterways. We always want to keep chemicals away from aquatic habitats and drinking water whenever possible.

However, some decent biological controls are available. Three kinds of introduced beetles love to eat only loosestrife—*Hylobius* (root weevil), *Nanophyes* (flower weevil), and *Galerucella* (leaf beetle).

Plum Pox Virus—*Sharka*: Family Potyviridae, Group *potyvirus*

Plum pox virus was first found in North America in 1999 in several peach orchards in Adams County, Pennsylvania. Plum pox—or *Sharka*—is a disease that affects peaches, plums, apricots, nectarines, and almonds. The virus causes the fruit to develop blotches, which lower their value. The disease doesn't kill the tree, but it eventually stops producing any fruit whatsoever. But long before this happens, the infected tree already poses a great danger to other nearby trees because it is a disease *reservoir*—harboring the virus which can be more readily spread.

Plum pox virus is spread from tree to tree by tiny insects called aphids. The aphid picks up the virus as it feeds from an infected tree, and when it goes to a different spot, it releases virus from its feeding tube and infects the next tree.

While aphids are definitely the vectors that transmit plum pox virus from tree to tree and orchard to orchard, they don't fly well enough—or live long enough—to have flown by themselves from Europe or South America to southern Pennsylvania, especially without touching down first anywhere else in the United States.

The leap of the disease from continent to continent was caused by a human vector—probably transported nursery stock that was already infected before it was imported here and then unknowingly grafted onto a healthy tree or placed in a landscape. The insects took it from there. Since it takes several years after infection for the fruits to show any symptoms, the disease was already firmly entrenched by the time it was detected.

Chemical controls aren't a great option because we're dealing with foodstuffs; we don't want pesticides on our produce. They also aren't very effective because they are expensive and the life cycle of the aphid is so short—it would take continuous application. Biological controls don't exist for viruses. Lady beetles are good bio-controls for aphids, but there are a lot more aphids than lady beetles, and they just can't eat enough of them. And it only takes a *few* aphids to infect *many* trees.

The physical-mechanical controls are the strongest defense against the spread of disease—identify suspect trees, quarantine, bulldoze, and burn the entire orchard containing any infected trees; save the rest of the nearly $2 billion industry by sacrificing a few thousand acres in Pennsylvania. Weed areas between orchards to remove other habitat for aphids. There is a possibility of damaging the local watershed by removing and burning this vegetation in large areas, because erosion can reduce the water quality.

We also have several cultural options to manage this problem—develop fruit tree varieties that are resistant to disease or aphid attacks, and prevent future introduction of diseased plant material by requiring that all nursery stock be inspected and certified to be disease-free.

Zebra Mussels—*Dressena polymorpha* (Pallas)

Zebra mussels arrived in the United States in the mid 1980s in the Great Lakes region. They were probably in the ballast water in a ship from the Middle East. When the water was discharged into our fresh waters, the zebra mussels found a universe full of food and devoid of predators. They spread rapidly throughout the Great Lakes and down the Illinois River to the Mississippi River.

Zebra mussels have byssal threads that allow them to cling to almost any surface. That's precisely what they do: attach to any solid object, including each other. As zebra mussels accumulate on machinery, they tend to interfere with its operation, whether it is a propeller, a pump, the water intake to a power plant, or the supply intake to Erie's fresh drinking water.

Zebra mussels filter plankton out of the water and they outcompete other animals at this level of the food chain, thus decreasing biodiversity. Their incessant filtering makes the water clearer, which has dramatically increased underwater visibility. It has also allowed more light to penetrate to greater depths, which has given rise to much hardier weeds and water plants closer to the surface. This, in turn, impedes fishing and water skiing.

Looking at the IPM pyramid, there is nothing that can be done culturally. They are very well-established in their own world—underwater. In terms of physical-mechanical tactics, little can be done to *control the spread* of zebra mussels. However, we can undo some of the harm done to human-made items by scraping the zebra mussels off and restoring equipment to working order.

In terms of biological control, there is a very peculiar mixed blessing in the round goby. The round goby turned up around 1990, a native of the Black Sea—once again probably through ballast—but it's a natural predator of zebra mussels. The problem is that the goby has replaced other fish of the same size, and it's very aggressive. It only grows to about 8 inches, steals bait, and annoys fishermen. In addition, round gobies eating zebra mussels increases the transfer of harmful chemicals up the food chain. This is because zebra mussels filter water to feed, thus absorbing suspended particles that may contain contaminants. These contaminants, such as PCBs, accumulate in the mussels' bodies. When gobies eat a lot of mussels, the fish collect even more contaminants. These chemicals move up to the next level and are concentrated even more when another predator eats the gobies. This is called *biomagnification* of chemicals and can be toxic to top predators.

The goby is just as invasive as the zebra mussel, so the net effect between the actions of these two invasive species is still a net loss in biodiversity. One might wish to believe that this is biological control for the zebra mussel, but it wasn't planned, and the result is still a system out of balance.

Chemical controls for zebra mussels are limited in some instances. Since they live in waterways, strong chemicals are out of the question. However, in certain targeted areas—such as the fresh water intake for Erie's water supply—a small pulse of relatively harmless diluted chlorine can be sent back out through the collection pipe, and this prevents zebra mussels from attaching to the inside surface of the pipe.

Even if the zebra mussels don't cling to the inside of the pipe, there is still no light at the end of the tunnel. These aquatic invaders could pose a dramatic threat to Pennsylvania's aquatic biodiversity. Just a few miles south of Lake Erie is Lake Edinboro—now the first *inland* lake to have zebra mussels. Lake Edinboro is tributary to French Creek—one of Pennsylvania's most biodiverse waterways—and the zebra mussels are a threat to the native clams that inhabit it.

Invasive species are opportunists. Once they get established in their new environment, they spread and multiply. If they are exotic, they sometimes outcompete native species for resources such as space, light, and food. There may be no natural enemies present to help keep exotic populations in check, making it easier for them to multiply and expand their range.

Not all exotic species are bad and not all exotic species are invasive. It's often a matter of balancing the benefits to us against the costs to the environment. But when the system gets really out of balance, we have to worry about it.

WHAT YOU CAN DO

- Obey quarantine restrictions; don't bring things back from travels abroad that are listed as forbidden items.
- Learn to identify invasive species of concern in your area. Don't plant invasive materials such as purple loosestrife. Despite its beauty, it's federally classified as a noxious weed.
- Never release pets into the wild.
- Be aware of regulations for plants and animals.
- Talk to your family, friends, and neighbors about what you have learned about invasive species.
- Volunteers are always welcome and needed in nature preserves and state and local parks. A good set of sharp eyes is the public's best weapon for identifying invasive pests. Become a volunteer and join the effort to keep invasive plants and animals at bay.
- Report incidences of invasive species to the proper authorities. Report noxious weed or insect sightings to the Pennsylvania Department of Agriculture's Bureau of Plant Industry, and exotic aquatic animals to the Pennsylvania Fish and Boat Commission.
- For more information on invasive species, contact:

  The Pennsylvania Department of Agriculture, Bureau of Plant Industry
  2301 North Cameron Street
  Harrisburg PA 17110-9408
  717-772-5203
  http://sites.state.pa.us/PA_Exec/Agriculture/bureaus/plant_industry/pests/pests.html

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  717-787-2869
  http://www.dcnr.state.pa.us/

  Penn State Cooperative Extension
  http://www.extension.psu.edu/

DISCUSSION QUESTIONS

1. What are some ways to prevent vectors from transporting the exotics?
2. Explain how invasive species can decrease biodiversity. How might a decrease in the biodiversity in Pennsylvania affect you?
3. What problems might be encountered by bringing in exotic insects to help control an invasive weed like purple loosestrife?
4. Explain why different tactics of pest management may be needed to manage the spread of plum pox virus.
5. How can you help prevent invasive species from spreading?

EXTENSION ACTIVITIES

1. Choose an invasive species, then research how and when it arrived, how it has affected biodiversity and the environment, what adaptations enabled it to become established, and whether it is beneficial or harmful. (4.5.10A: Identify introduced species that are classified as pests in their new environment; 4.7.10B: Describe an organism's adaptations for survival in its habitat.)
2. Research North American species that have become invasive elsewhere in the world. (4.5.10A: Identify environmental effect(s) of pests on different regions of the world.)
3. Prepare a range map showing the dispersal of an invasive pest. Explain how the establishment of that new species might affect the ecosystem. (4.7.10A: Identify a species and explain what effects its increase or decline might have on the ecosystem.)
4. Prepare a report on an exotic species that was intentionally introduced here and became established in the United States. (4.8.10C: Analyze how human activities may cause changes in an ecosystem.)
5. Prepare a poster (a bulletin board display) showing how to identify an invasive species of your choice. (4.5.10A: Identify introduced species that are classified as pests in their new environment.)

APHIS Acronym for Animal Plant Health Inspection Service; a section of the United States Department of Agriculture (USDA) whose goal is to prevent harmful species from entering the United States.

Arborist Tree specialist.

Ballast Water carried in special tanks (ballast tanks) of ships used to provide stability needed when carrying less than a full load of freight and to keep a ship at the proper depth in the water.

Bilge Another term for ballast water.

Biodiversity (biological diversity) The variety of species, their genetic make-up, and the natural communities in which they occur. All the different kinds of organisms living in an area.

Biological control (bio-control) Using one kind of organism to help manage a harmful species. For example, some beetles feed on purple loosestrife and help control its spread.

Biological tactic Introducing predators, parasites, or other living organisms to combat pests; biological control.

Biomagnification When pollutants such as PCBs that are not concentrated in the environment are taken in by an organism with its food, accumulate in its body, and are passed on until they become more concentrated near the top of the food chain.

Byssal threads Adhesive proteinaceous threads secreted by zebra mussels by which the mussels adhere to hard surfaces. The threads are produced by a special gland in the foot (the byssal gland) and are attached to byssal retractor muscles that can pull them into the animal or enable the threads to pull the mussel down close to the surface to which they adhere.

Certified Plants or seeds that have been inspected or tested to show they are free of disease or weed seeds.

Chemical tactic Use of pesticides such as insecticides, herbicides, fungicides, or other chemical controls for pests.

Cultural tactic Changing the environment to make it less suitable for a pest. This includes regulatory actions such as establishing quarantines or making propagating or transporting a pest unlawful.

Defoliation Removal of leaves (foliage) from a plant. Large numbers of gypsy moths can defoliate trees.

Disease reservoir An infected individual harboring a pathogen that can be spread to another individual.

Ecologist Scientist who studies the interactions between the species of organisms and their environment (studies the ecosystem).

Ecosystem A community of living organisms and their interrelated physical and chemical environment.

Embargo Banning certain products from import. For example, there is an embargo on untreated wood shipping crates being imported into the United States.

Entomologist Scientist who studies insects.

Eradication Total elimination of a pest organism from an area.

Exotic Species of plants, animals, or pathogens not native to our environment.

Horticulturist Scientist who studies the cultivation and care of small fruits, vegetables, flowers, and/or ornamental plants.

Insectary A place where insects are reared to increase their numbers. When releasing biocontrol insects for purple loosestrife, one goal is to establish insectaries where excess *Hylobius* and *Galerucella* beetles can be collected to move to new areas.

Intake pipe Pipe that conducts water from a lake or other body of water to a power plant or other equipment.

Integrated Pest Management (IPM) The scientific approach to pest management using multiple tactics to manage pests. These are cultural, physical-mechanical, biological, and chemical tactics. Proper identification and monitoring for pest abundance and distribution are key components of IPM.

Invasive species Any organism that adapts quickly to a new environment and reproduces and spreads rapidly into new locations.

Noxious weed list A list of plants determined to be harmful to public health, crops, livestock, agricultural land or other property, regulated by state or federal law. Currently, Pennsylvania lists 13 species as noxious weeds.

Opportunist Species that take advantage of any opportunity to thrive. An abundant food supply, disturbed soil, and lack of natural enemies all provide opportunities for invasive species to multiply rapidly in an area.

(continued next page)

PCB (polychlorinated biphenyls) A family of chemicals used mainly as plasticizers, flame retardants, and insulating materials. PCBs are potentially toxic and carcinogenic. Toxic effects generally involve damage to the skin and liver. PCBs have been found to cause reproductive problems in humans and cancer in laboratory animals. Further sale and new use of PCBs in the United States was banned in 1979. PCBs are long-lived in the environment and common in many aquatic sediments. PCBs are passed up the food chain when one organism eats another.

Perennial Plant that lives and produces seeds for many years.

Pest An organism in competition with humans for some resource.

Physical-mechanical tactic Using screens, barriers, traps, or other means to exclude or eliminate pests.

Quarantine Restricting the movement of plants or animals into or out of a designated area.

Resource Food, water, and shelter; things an organism needs to survive in an area.

Sanitize Removal or destruction of any living organism unintentionally attached to transported materials. For example, wooden pallets from some foreign countries must be sanitized to prevent entry of wood-boring insects into our country.

Species A group of individuals or populations that are similar in structure and physiology and are capable of interbreeding and producing fertile offspring.

Succession The gradual replacement of one type of biotic community with another. For example, in Pennsylvania a field left unfarmed would eventually develop into a forest community over a number of years.

Vector An organism or force of nature that spreads an organism to a new area. (Humans might carry plants from one place to another; wind might carry a microscopic pest to a new area; aphids can spread plum pox virus.)

Watershed The land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water; also called a drainage basin.

Wetlands Lands where water saturation is the dominant factor determining the nature of the soil development and plant and animal communities (such as sloughs, estuaries, marshes).

1. What is meant by the term “invasive species”? _____

2. Give three examples of invasive species. _____

3. How might invasive species get here? _____

4. What human activities might encourage the spread of invasive species? _____

5. How can the Asian longhorned beetle be harmful? _____

6. How can invasive species be harmful to native species? _____

7. How could invasive species cost us money? _____

8. What is Integrated Pest Management (IPM)? _____

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1. What is meant by the term "invasive species"?

Any organism that adapts quickly to a new environment and reproduces and spreads rapidly into new locations.

2. Give three examples of invasive species.

Starling, Giant Hogweed, multiflora rose, kudzu, Asian longhorned beetle, purple loosestrife, plum pox virus, zebra mussel, gypsy moth, round goby, and so on.

3. How might invasive species get here?

Wind, ballast water, humans, hitchhike in wood crates, and so forth.

4. What human activities might encourage the spread of invasive species?

Planting non-native plants, bringing in fruits and vegetables from other countries, shipping materials in untreated wood crates, dumping ballast water in United States ports, disturbing the environment (such as strip mining), and so on.

5. How can the Asian longhorned beetle be harmful?

Destroy trees, loss of shade, increase temperatures, loss of furniture wood.

6. How can invasive species be harmful to native species?

Exotic species can outcompete native species for food, water, and space; they may be predators on native species; upset the natural balance; destroy native plants.

7. How could invasive species cost us money?

They can be harmful to our health, destroy crops, harm livestock, kill trees, and so forth.

8. What is Integrated Pest Management (IPM)?

IPM aims to manage pests—such as insects, diseases, weeds, and animals—by combining physical, biological, and chemical tactics that are safe and environmentally compatible.

9. What can you do to help prevent invasive species from arriving in Pennsylvania?

Obey quarantine regulations, learn to identify invasive species, never release pets into the wild, help pull out noxious weeds, report incidences of invasive species.

10. What might be done to lessen the problems invasive species can cause?

Prevention, exclusion, remove noxious weeds, plant resistant trees, and so on.

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List of Noxious Weeds of Pennsylvania (Correct as of July 2001)

1. *Cannabis sativa*	marijuana
2. *Lythrum salicaria* (and cultivars)	purple loosestrife
3. *Cirsium arvense*	Canada thistle
4. *Rosa multiflora*	multiflora rose
5. *Sorghum halepense*	Johnsongrass
6. *Carduus nutans*	musk thistle
7. *Cirsium vulgare*	bull thistle
8. *Datura stramonium*	jimsonweed
9. *Polygonum perfoliatum*	mile-a-minute
10. *Pueraria lobata*	kudzu
11. *Sorghum bicolor* spp. *drummondii*	shattercane
12. *Heracleum mantegazzianum*	Giant Hogweed
13. *Galega officinalis*	Goatsrue

NOTES