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# K-12 Partnership Lesson Plan

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# *Invasion: Total Take-Over!*

# *Exploring invasive species and the methods to control them*

## Overview

Invasive species are non-native, introduced species that have a negative impact on the habitats

they invade. Invasive species can be plants, animals, or microorganisms, and the damage they can cause to native ecosystems can be devastating. What is it about these species that allow them to successfully invade different habitats? Does the environment itself also play a role in how likely it is that an invasion will take place? In this lesson plan students will explore what it means to be an invasive species. They will learn what traits make a good invader as well as what environmental conditions favor invasion. Students will also get a chance to observe and interpret graphs and figures from real world research on invasive species. Finally, students will have the opportunity to play a game that simulates an invasive species spreading through Michigan, and students have to implement different methods to control its spread.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Explain what an invasive species is and provide several local examples of invasive species
* Understand what traits help invasive species spread
* Understand what environmental factors facilitate invasion
* Interpret graphs and figures of real world data from several invasive species
* Understand the different methods that have been used to control the spread of invasive species

**Length of Lesson**

50 minutes (10min for background presentation, 10min for graph interpretation worksheet, 30 min for game)- can be extended for multiple game plays

**Grade Levels**

Grades 6-12

**Standards covered (NGSS)**

Disciplinary Core Ideas:

*Middle School*

* **MS-LS2-4**: construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
* **MS-LS2-5**: evaluate competing design solutions for maintaining biodiversity and ecosystem services
* **MS-LS1-4**: use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively
* **MS-ESS3-4**: construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems

*High School*

* **HS-LS2-2:** use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales
* **HS-LS2-6**: evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may results in a new ecosystem
* **HS-LS4-6**: create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Cross Cutting Concepts:

* Patterns
* Cause and Effect
* Stability and Change of Systems

Science and Engineering Practices

* Developing and using models
* Analyzing and interpreting data
* Using mathematics and computational thinking
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **L3.p3**: interdependence of living systems: factors influencing ecosystems
* **L3.p4**: interdependence of living systems: human impact on ecosystems
* **B3.4**: interdependence of living systems: changes in ecosystems
* **B3.34x**: interdependence of living systems: human impact
* **B3.5x**: interdependence of living systems: environmental factors

**Materials**

* Data interpretation worksheet
* Michigan Monsters game board and control cards
* Michigan Monsters rule sheet
* 3 dice per game board used
* Pencils and erasers (it is important to have erasers for the game)

**Background**

One of the most challenging foes in the struggle to preserve natural ecosystems is invasive species. Invasive species are non-native, introduced species that have a negative impact on the habitats that they invade. They can be plants or animals, and once they have invaded the consequences for the native ecosystem can be disastrous. Invasive species can outcompete native species for limited resources such as food, light, or space. Invaders may also directly reduce native populations through predation or herbivory. Furthermore, if the invasive species happens to be toxic it may kill any native animals that try to consume the invader. On a broader scale, invasive species can alter the function of an ecosystem by changing important properties such as the fire regime or nutrient cycling.

Considering these negative impacts it is important to understand what makes a good invader. Invasive species tend to have several traits in common that help them successfully invade and spread through a habitat. Invasive species typically grow fast, reproduce at a high rate, and disperse very effectively. These traits allow the invader to spread very rapidly through a habitat. Additionally, invasive species tend to have a generalist diet, and flexible behaviors, so they can tolerate a wide range of environmental conditions. This allows the species to invade many different habitats.

In addition to traits directly possessed by the invasive species, several environmental factors can also play a role in determining how successful an invasion attempt will be. Habitats that have unused resources are more likely to be invaded by species that can exploit those resources. Habitats that are disturbed either through natural (e.g. fire) or human (e.g. construction) causes are easier to invade. Finally, if a habitat lacks natural predators or herbivores that can feed on the invasive species, it will be much easier for that species to spread.

In an effort to limit the damage caused by invasive species, scientists have developed a wide variety of methods and tactics used to control or eradicate invasive species. Invasive species may be actively killed using chemicals, predators, or direct human hunting/trapping. A different approach seeks to interfere with the invasive species! reproductive cycle by releasing sterilized males into the population or manipulating reproductive pheromones. Other control methods to try to actively block the spread of the invaders by constructing physical (walls) or nonphysical (electric fields) barriers. It is rare that a single method is completely effective at stopping an invasive species, often the best control strategies are those that combine a variety of different tactics to slow or eradicate the invasive species.

In this lesson, students will have the opportunity to observe and interpret real world data on invasive species and the control methods used to stop them. Additionally, students will step into the shoes of a conservation biologist when they play the Michigan Monsters game. In this game students, will have to use a variety of different techniques to try to stop the spread of an invasive species before it moves through all of Michigan.

### Activities of the session

1. Use the invasive species powerpoint presentation to introduce students to invasive species, traits that make an organism a good invader, and methods that can be used to control the spread of invasive species
2. Go over several examples of local invasive species, and invasives found around the world.
3. Hand out the data interpretation worksheet, have students look over the graphs and try to interpret the data they see
4. Have students play through the Michigan Monster’s game (see instructions “Michigan Monsters rule sheet” posted on the “Invasion: Total Take-over” lesson page on the KBS GK-12 website

**Resources**

* Powerpoint, Michigan Monsters rule sheet, invasive species control cards, Michigan Monsters follow-up questions, data interpretation exercise, and Michigan Monsters game map are all posted on the “Invasion: Total Take-Over!” lesson page on the KBS GK-12 website
* Information on other invasive species:
  + <http://www.invasivespeciesinfo.gov/aquatics/controlplans.shtml#ac>
  + <http://www.ontario.ca/page/wildlife-and-nature>
  + <https://en.wikipedia.org/wiki/Biological_pest_control#Biological_control_with_microorganisms>
  + <http://www.miseagrant.umich.edu/downloads/ais/fs-97-501_purple_loosestrife.pdf>
  + <http://www.hungrypests.com/the-threat/emerald-ash-borer.php>

**Extensions and Modifications**

1. Instead of using pencils, small tokens could be used to indicate invaded counties. Then game

boards can be re-used.

1. If computers are available (1 per student pair), the digital version of the Michigan Monsters

map can be opened using MS Paint or a similar program. Students can use the fill tool to

color invaded counties, or uncolor them if the species is removed. This is easier than erasing.

1. The game can be expanded to include adaptation and evolution. For example, native

predators could evolve to begin feeding upon the invasive species or the invasive species

could evolve resistance to different control methods.

**Assessment**

Students will be assessed with thought questions, discussion and graphical interpretation.