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# K-12 Partnership Lesson Plan

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# *Weeds! Tricks of the Trade*

## Overview

This lesson will explore how plant traits like seed dispersal (e.g., wind-dispersed, animal-dispersed, etc.), seed hardiness, and land-use history influence the assembly of weed communities following a major disturbance (e.g., construction of a BEST plot, agricultural field, or garden plot). The focus will be on volunteer species (read: weeds) most commonly found in the BEST plots across the network. The lesson begins by providing students background information on seed traits and land use legacies. After covering this information, participants will do a brief activity that involves making predictions about which plant traits make weeds made most successful. Students will spend the remaining portion of the lesson analyzing and interpreting volunteer species abundance data from the BEST plot network.

**Objectives**

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

* List and describe four different plan dispersal mechanisms
* Describe three determinants of “how a plant got there” (dispersal mechanism, seed bank longevity, effect of landscape)
* Better interpret histograms and scatterplots

**Length of Lesson**

50-60 minutes

**Grade Levels**

Upper middle school, high school

**Standards covered (NGSS)**

Disciplinary Core Ideas:

 *Middle School*

* **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-LS1-5**: construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

*High School*

* **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 result in a new ecosystem
* **HS-LS4-4**: construct an explanation based on evidence for how natural selection leads to adaptation of populations

Cross Cutting Concepts:

* Patterns
* Structure and function
* Stability and change of systems

Science and Engineering Practices

* Planning and carrying out investigations
* Analyzing and interpreting data
* Using mathematics and computational thinking
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **S.IP.00.11**: make purposeful observation of the natural world using the appropriate senses
* **S.IP.00.12**: generate questions based on observations
* **S.IP.00.13**: plan and conduct simple investigations
* **S.IP.00.14**: manipulate simple tools (for example: hand lens, pencils, balances, non standard objects for measurement) that aid observation and data collection
* **S.IP.00.15**: make accurate measurements with appropriate (non-standard units for the measurement tool
* **S.IP.00.16**: construct simple charts from data and observations
* **S.IA.00.12**: share ideas about science through purposeful conversation
* **S.IA.00.13**: communicate and present findings of observations
* **S.RS.00.11**: demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities
* **L.OL.02.22**: describe the life cycle of familiar flowering plants including the following stages: seed, plant, flower, and fruit
* **L.OL.03.41**: classify plants on the basis of observable physical characteristics (roots, leaves, stems, and flowers)
* **L.EV.03.11**: relate characteristics and functions of observable parts in a variety of plants that allow them to live in their environment (leaf shape, thorns, odor, color)
* **L.EC.06.32**: identify the factors in an ecosystem that influence changes in population size
* **L.EC.06.41**: describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems
* **L.EC.06.42**: predict possible consequences of overpopulation of organisms, including humans (for example: species extinction, resource depletion, climate change, pollution)

**Materials**

* Powerpoint presentation: “Weeds- tricks of the trade”
* Mystery plant cards
* Handout
* Handout answer key (all materials found at “Weeds! Tricks of the Trade” lesson page on the KBS GK-12 website)

**Background**

Volunteer species, or weeds, are those plant species growing in a location where they are not desired. We most frequently concern ourselves with these species in areas where we are trying to cultivate other, more desirable vegetation (e.g., BEST plots, agricultural fields, garden plots, etc.) So how do weeds arrive in these newly disturbed places and persist at such impressive abundances? The story is one of, as is often the case in ecology, the interaction between biotic and abiotic factors.

**Dispersing across a landscape:** The tale of the distribution and abundance of weed species begins with a dispersal mechanism. Like other plant species, weeds need to move away from the mother plant in order to avoid competition for resources (e.g., space, light, nutrients, etc.). To accomplish this, these plants have evolved strategies for broadcasting their seeds across the landscape. Common strategies involve **sticking to animal fur, being carried by the wind, and being eaten and discarded or cached away by birds or other animals (e.g., fruits and nuts).** Weed species, as you are probably aware, are very successful at exploiting these strategies.

**Dispersing through time:** Not only do weed species effectively disperse their seeds, some of them have also mastered the “sit-and-wait” strategy. Some seeds are so hardy they can remain viable in the soil for long periods of time – up to, or possibly even more than several decades. Ecologists refer to this pool of dormant seeds in the soil as the **soil seed bank.** These seeds “sit-and-wait” in the soil seed bank until they have the opportunity to germinate. Such opportunities come when an area of soil is cleared of vegetation, like when you construct a garden plot, or at the beginning of the growing season when there is space and adequate light to grow.

**Landscape effects:** The assemblage of weed species we find growing in these recently disturbed areas is largely dictated by the surrounding landscape and the history of land-use in that area. Landscape context is important. The surrounding plant communities (think about surrounding forests, agricultural fields, etc.) determine which plant species are likely to disperse locally and which dispersal mechanisms might be most successful. Additionally, prior land-use like agricultural cultivation largely influence which plant species are in the soil seed bank.

### Activities of the session

1. **Weed sorting activity**- Following instructions on the first page of the worksheet, have small groups rank the mystery plant cards by whatever criteria they think will make it a successful weed. Record this ranking on page 1 for use later in the activity.

2.  **Part 1:** **Seed Dispersal**

a. Introduce the different methods of seed dispersal using the powerpoint slides.

b. Make a prediction on which dispersal strategies are most effective for weeds on page 1 of the worksheet.

c. Graphing activity- on pages 2-5 of the worksheet, graph the abundance of weed species using each dispersal strategy in our BEST plot network.

d. Answer the dispersal questions on page 6.

 3. **Part 2: Seed Banks**

a. Introduce seed banks using the powerpoint.

b. Make a prediction on page 7 on how a seed’s ability to survive in the seed might affect its skills as a weed.

c. Graphing activity- on page 8 graph the relationship between viability in the seed bank and abundance as a weed in our BEST plots.

d. Answer the seed bank questions on page 9.

 4. **Part 3: Other Strategies and Conclusion**

a. Discuss other strategies that might contribute to a weed’s success using the powerpoint slides.

b. Compare the mystery plant ranking predictions on page 1 to the real rankings on page 10.

c. Answer the wrap-up questions.

**Resources**

* Telewski, F. W. and J. A. D. Zeevaart. 2002. The 120-Yr Period for Dr. Beal's Seed Viability Experiment. *American Journal of Botan*y, Vol. 89, No. 8, pp. 1285-1288.
* http://msutoday.msu.edu/news/2000/120-year-old-experiment-sprouts-new-gardening-knowledge/

**Extensions and Modifications**

Seed bank activity- As an initial teaser activity or follow-up exercise students can germinate the seed bank from soil from the BEST plots (or any other interesting area!). **1.** Using a soil corer or deep trowel, collect samples from the top 10 cm of soil. If you wish to compare the seed bank of two or more areas (e.g., treatments in BEST plots, lawn vs. farm field), take multiple samples from each and mix them together. **2.** Place regular potting soil in a wide tray and then spread a thin layer of the field soil on the surface. **3.** Keep the soil moist and warm and in 2-3 weeks you should have baby seedlings!

**Assessment**

For each section of the activity, the worksheet contains areas for students to make predictions before the activity and then reflect on their results and predictions following the activity.