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# K-12 Partnership Lesson Plan

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# *Succession*

# *Patterns in the field and in seeds*

## Overview

This lesson will review what the students already know about succession, then develop their understanding of what may be driving the pattern. They will brainstorm hypotheses and predictions. They will walk the nature trail to practice recognizing different successional stages and to collect seeds from the plants in different stages. They will also think about seed dispersal and other plant adaptations. This lesson can be expanded to include a section where 8th grade students give 5th grade students a tour of the nature trail and teach them about succession.

**Objectives**

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

* Recognize successional patterns in plant communities in the field
* Recognize seeds and the structures in which they occur; describe the dispersal adaptations of those plants
* Brainstorm hypotheses explaining succession and generate predictions

**Length of Lesson**

Two 50-min class periods (depends on nature trail length and distance to nature trail)

**Grade Levels**

8th grade, optional extension to include 5th grade

**Standards covered**

Disciplinary Core Ideas:

* **MS-LS2-2**: construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
* **MS-LS1-4**: use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animals behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively

Cross Cutting Concepts:

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

Science and Engineering Practices

* Constructing explanations and designing solutions

***Previous Michigan Standards Met:***

* **B1.1A**: generate new questions that can be investigated in the laboratory or field
* **B1.1D**: identify patterns in data and relate them to theoretical models
* **B1.2D**: evaluate scientific explanations in a peer review process or discussion format
* **L3.p4A**: recognize that, and describe how, human beings are part of Earth’s ecosystems. Note that human activities can deliberately or inadvertently alter the equilibrium in ecosystems
* **B3.4A**: describe ecosystem stability. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one
* **B3.4C**: examine the negative impacts of human activities
* **B3.5d**: describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages

**Materials**

* Lots of ziplock bags, sharpies to label
* Nature area to walk
* Soil corer or trowel
* Clipboards

**Background**

Ecological succession was one of the first motivators for ecologists. The causes of the pattern, which somehow repeats itself again and again, every time there is a disturbance, are still under debate. There are many possible mechanisms (causes)—some of them are described below. Primary succession is when soil also needs to develop (eg. after a volcano or in the sand dunes); secondary succession is when just the plant community is changing (such as after a tilled field is abandoned)—but this dichotomy is artificial and soil changes go hand in hand with plant community changes in most situations. Both human-caused and natural disturbances can kick-start succession, such as farming, fires, landslides, blowouts in sand dunes, blowdowns in severe storms, tornadoes, etc.

### Activities of the session

1. **Day 1**: If you have already introduced succession (in terms of the diagram on the powerpoint slide), ask the students to review/repeat what they know. This should include the pattern that after a disturbance, plants move into an area in a specific order: annual plants, perennial plants, shrubs, softwood/short-lived/sun-loving trees, hardwood/shade-tolerant trees. If you have not already introduced succession, there are lots of photos and diagrams online that should help you develop a presentation.
2. Brainstorm some types of disturbance that can get succession started—these should include human-caused and natural disturbances.
3. Go to the nature trail and stop at various locations and ask the students what stage of succession they are in. It will probably help to simplify the trend to 3 stages: herbaceous (grasses and flowers), shrubby, and trees.
4. Collect seeds into the ziplock bags along the trail. Students should take some seeds from each location; keeping seeds from the stages in separate bags. Each group of students will need 3 bags (early, middle, late succession).
5. Collect soil samples at several locations of each stage; put all the samples from early stages into one bag, all samples from middle stages into a second bag, and all samples from late stages into a third bag. (3 bags per class).
6. Optional: Back in the classroom, if time remains, have students fill out the “drawing seeds.doc” worksheet by drawing their seeds and guessing about why seeds look so different and how they might be dispersed.
7. **Day 2:** Briefly review the pattern and open the powerpoint to view the diagram.
8. Ask the students what could possibly be causing this repeated pattern to happen the same way every time. Why do plants grow in that order? Why don’t shrubs always come in before grasses? Why don’t trees come up first? Split the students into groups, hand out the “hypotheses predictions.doc” worksheet, and have them brainstorm for 10 min. After 10 min, each group should be prepared to give 3 guesses to the class. Any answer is good. This will be difficult—the students may be too concerned with getting “the right answer” to provide any guesses. They may not be able to generate predictions until after the class discussion. What they are actually doing is generating hypotheses for what’s causing succession—but this terminology may confuse/intimidate them. A list of acceptable answers:
	1. Early successional plants grow faster than later successional plants—so if all seeds arrive at the same time, fast growers dominate the community first.
	2. Early successional plants arrive earlier than later successional plants—they produce more seeds and those seeds disperse farther than later successional species.
	3. Early successional plants enrich the soil and allow later successional plants to grow in the environment.
	4. Early successional plants help build up beneficial soil microbes to allow later successional plants to survive.
	5. Late successional plants can grow in shade, whereas early successional plants need more sun.
	6. There are more herbivores in late successional areas, and later successional plants are more resistant to being eaten that early successional plants.
	7. There are many, many more! Answers like “Rain” or “seasons” are not OK because they do not explain why some plants always show up before other plants. They do not explain what causes the predictable changes in plant communities that we associate with succession.
9. Ask the class how they could test these hypotheses IF they had infinite resources and time and the ability to measure anything they wanted. They can generate predictions too, and fill these out for the hypotheses they suggested. These might include things like:
	1. Collecting seeds from plants that live at different successional stages and measuring how far/how well they disperse. You could discuss this with the seeds you already collected and some information about dispersal adaptations. Prediction: early successional plants will disperse farther than late successional plants.
	2. Measuring the seeds that have already dispersed to different successional stages. You can actually test this by germinating the seeds already buried in the soil samples you dug up from the nature trail area. Just put the soil samples in shallow trays and water them. Seeds will germinate and plants will grow! Prediction: Early successional species will show up in all the samples; Late successional species will not show up in the early and mid successional samples because those seeds haven’t gotten there yet.
	3. Measure nutrients at different points along successional gradients. Prediction: nutrients should be higher in late successional sites.
	4. Measure the growth rates of plants that live in different successional sites. Prediction: early successional species should grow faster than late successional species.
	5. Measuring the abundance of beneficial microbes. Prediction: There should be more beneficial microbes in late successional areas.
10. Some of those predictions could be tested with the samples you already collected. The attached student worksheet “drawing seeds.doc” will help students carefully examine the dispersal adaptations of seeds from different stages. Wind dispersal (with parachutes like milkweed plants) might be common in early successional areas, whereas animal dispersal (in pinecones, acorns) might be more common in late successional areas. Seed size and number can also be very roughly estimated from the samples you collected—it will be much easier to find seeds in the early sites than the late sites!

**Resources**

* Presentation with background information, drawing seeds worksheet, hypotheses and predictions worksheets found on “Succession: patterns in the field and in seeds” lesson page on the GK-12 website.

**Extensions and Modifications**

This lesson can easily be adapted to co-teach 8th and 5th grade students. Prep the 8th graders with where to take the students, information on succession. You may wish to have an abbreviated hypotheses and predictions discussion (day 2 above) before the co-taught lesson so students are more knowledgeable about succession and so they can make more informed observations.

Split the students into groups so that there are 2-3 8th graders and 2-4 5th graders in a group. Give each student a seed worksheet “drawing seeds.doc” and each group 3 ziplock bags to collect seeds from each site. Walk the trail. The 8th grade students should be able to point out the different successional sites and also answer 5th graders’ questions about succession and the woods.

**Assessment**

Some assessment questions are listed above in the activities