



**Fontenelle Forest Nature Center**  
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*Welcome to the natural world of Fontenelle Forest and Neale Woods Nature Centers!  
Below is a guide to pre and post field trip activities that you can do with your students either indoors or on your school grounds. These fun activities will greatly enhance your students' field trip experience. We look forward to your students' arrival and are excited to provide them with a fun and educational experience.  
If you have any questions, please call us at 731-3140.*

## **Green's the Thing**

**The following activities meet Nebraska state standards**

**8.1.1, 8.1.2, 8.1.4. 8.2.1, 8.3.3, 8.4.5**

### **1) A piece of the puzzle**

Adapted from Biodiversity Activity, University of Wisconsin-Madison Arboretum. If you try it, let them know how it went by sending a note to [epp@mhub.facstaff.wisc.edu](mailto:epp@mhub.facstaff.wisc.edu).

ACTIVITY TIME: 45 minutes - 1 hour

MATERIALS: Each student group will need one hula hoop or set of four equal-length sticks to mark off quadrants, and two accessible "ecosystems" for comparison - one natural or restored and one cultivated, such as lawn.

OBJECTIVES: Students will:

- a. Understand issues related to species biodiversity and distribution
- b. Collect and interpret data to answer a question
- c. Graph data and extract, interpret and use information presented in the graph
- d. Explore and determine best data collection procedures

SUMMARY: Students compare the biodiversity of a natural or restored ecosystem with a lawn or other cultivated "ecosystem."

SPECIFIC BACKGROUND: This activity provides students with an opportunity to sample and compare the plant biodiversity of different sites. For this exercise, the plant biodiversity is defined as the number of different plant species on a site. Sites that would provide interesting comparisons include a lawn, an old field, a one-year restoration, an older restoration or a remnant.

The most direct way to inventory the number of different plant species on a site is to count them. However, usually one cannot count all species in an ecosystem and therefore must be content to sample a small portion of the system and use this sample to estimate the total. These sampling areas or quadrants can be of any known size or shape but need to be randomly distributed and sufficiently numerous so that the number of species found within the quadrants is representative of the entire population.

In many cases, a single prairie quadrant will have fewer species than will a quadrant taken from a lawn. However this is not due to a lower biodiversity in a prairie but rather the fact that prairie species tend to clump together whereas in a lawn species are distributed in a more homogeneous pattern. Therefore, a single quadrant may "capture" most of the lawn species but only a few of the species in the prairie. Subsequent quadrants in the lawn will reveal few new species while subsequent prairie quadrants will contain numerous new species.

The Species Area Curve helps examine this situation:

<http://www.marietta.edu/~biol/102/specarm.html>

**ACTIVITY DESCRIPTION:** Divide into research teams. Each team should take a field journal (notebook) with a large loop of tape on it and a hula hoop (or four sticks of equal length for a square quadrant). Randomly choose a spot in the prairie for the quadrant by throwing the hoop or a stick over your shoulder. If you are doing an annual survey of your restoration, you may have permanent sampling plots set up.

Count the number of different species of plants in your quadrant. If the plants are very small, place a small leaf of each species on the tape (generally appropriate for spring studies). If the plants are large, sketch the leaf and note any other identifying traits. Identification of the plant is not necessary. Repeat the process in a lawn.

Rejoin the class and examine the specimens and sketches. As a class, plot the number of species found in one group's quadrant on a Species Area Curve. (In ecology, a species-area curve is a relationship between the area of a habitat, or of part of a habitat, and the number of species found within that area). A second group should then examine their data to see if they found additional species that the previous group did not mention. Plot the second data point by taking the number of species found by the previous group and add to that the number of additional species found by the second group. For example, Group 1 found six species on the prairie. Group 2 found three species that Group 1 did not find. A dot would then be recorded at nine for Group 2 to represent the total number of species found by both groups. Group 2 need not have found all of the original six identified by Group 1. Plot the number of additional species this second group has found. Continue plotting the number of new species found by each group in the class. Create separate curves for each ecosystem sampled. Determine the average number of species per plot and the total number of species by the class. You can see that each research group has presented a piece of the puzzle, and as each group adds its data, the puzzle becomes clear.

Are there any missing pieces?

What is the difference in species distribution between the two ecosystems sampled?

How could misleading results arise from improper sampling methods?

**EXTENSIONS:** Record the number of insects, spiders and larger animals in each quadrant. Become a sleuth and find as many traces of animals as possible. Traces of

animals can include decayed leaf matter, a litter layer in the soil, a gnawed leaf, a spotted or slightly diseased leaf, a spider's web, etc.

Repeat this study each year in a restoration to monitor the change in the restoration as it matures.

Instead of randomly selecting the quadrant spot, sample a spot that you consider to be representative of the prairie. How does this change the results?

For older students: Identify the plants in your plot. Identification of plants prior to blooming is very difficult, but a good key should allow identification of all blooming plants

## **2) Do Plants Need Air?**

Materials: Small leafy plant (ex: a philodendron), petroleum jelly

Note: Petroleum jelly stains clothes.

Procedure:

1. Choose 5 leaves on the plant for part one. Coat just the top side of these leaves with petroleum jelly.
2. Choose 5 different leaves on the plant for part two. Coat just the underside of these leaves with petroleum jelly.
3. Place the plant outside in an area that is easily observable on a daily basis.
4. Make note of any changes for about a week.
5. Discuss your observations.

Discussion

1. Which side of the plant's leaves need to be exposed to the air and not covered by petroleum jelly?
2. What does the plant need to do to survive?
3. How does this process help humans?
4. Do plants need oxygen or carbon dioxide?
5. Do humans need oxygen or carbon dioxide?

Results: Students will discover how plants take in carbon dioxide.

### **3) What Does a Seed Need? Seed Stratification Experiments**

Adapted from Biodiversity Activity, University of Wisconsin- Madison Arboretum. If you try it, let them know how it went by sending a note to [epp@mhub.facstaff.wisc.edu](mailto:epp@mhub.facstaff.wisc.edu).

Note: This should be used as a post-trip activity: Ask your FNA educator to leave enough time at the end of your program to collect seeds from the Neale Woods prairie.

ACTIVITY TIME: Approximately 2 hours for designing the stratification experiment, 2-3 hours for setting up the experiments, one hour for setting up germination tests, and 1-2 hours for recording and writing up the results. The entire experiment must run for at least three months.

MATERIALS NEEDED: film cans or Ziploc bags, seed, 3-4 petri dishes or small plates per group, cotton absorbent paper towel or filter paper, thermometer, and cold space such as a refrigerator.

Equipment for various seed treatments might include: peat moss, vermiculite, sawdust (from non-treated wood), sand, sandpaper, rolling pin or other materials depending on experimental design.

SEASON: Late fall or early winter for seeds collected the previous growing season.

#### **OBJECTIVES:**

Students will:

Develop, design, and conduct a scientific investigation

Communicate the results of their investigations

Explore dormancy mechanisms and germination phase of a plant life cycle

SUMMARY: Students select one species and design an experiment to determine a stratification regime that will result in the highest germination percentage.

BACKGROUND: Seeds need appropriate environmental conditions to germinate. These conditions include appropriate oxygen concentrations, temperature, moisture and in some cases, light. Seeds from plants that bloom early in the growing season may germinate if the environmental conditions are suitable and they are planted immediately. However, most seeds will develop dormancy that prevents germination until certain environmental conditions are met. Biologically, this is a protection mechanism that prevents seeds from germinating when the conditions are not favorable for long-term growth. For instance, a seed that ripens in late fall may encounter a late, warm, wet spell ideal for germination but too late in the season for survival of the seedling. In this case the plant may only germinate if dormancy is "broken" with exposure to a prolonged cold spell delaying germination until after a cold "winter." This process of breaking dormancy by exposure to a cold spell is called cold stratification.

Some seeds will only germinate if wet stratified, that is, exposed to cold, wet conditions. Still others require warm, wet stratification. Another dormancy-breaking mechanism,

scarification, involves creating little cracks in the seed coat. In that case, germination is delayed until the seed coat has been broken.

Our current knowledge about what is necessary to break dormancy is based on practical experience in the field. However, a myriad of questions remains about the best treatments for individual species. For instance, if a seed demands cold stratification, what is the ideal temperature? How long should it stay at that temperature? Is longer better? Can germination percentages be increased by increasing the humidity? For wet stratification, how much water is ideal? What temperature? How long? What is the ideal cold stratification medium? For seeds that require scarification, what is the best way to scarify, and how much scarification is ideal? The answers to each of these questions vary from species to species. There are many opportunities for student-led investigation leading to information that might be of practical significance in the field of ecological restoration.

Film canisters or Ziploc bags are good for wet stratification. A refrigerator can provide cold temperatures. Slightly different temperatures are often found in different places in the refrigerator (the crisper, the butter shelf, etc.). Scarification can be done by rubbing the seed gently between two pieces of sandpaper, tumbling the seed in a canister of sand or rolling them lightly with a rolling pin. Students may come up with other scarification techniques but should bear in mind that the point is to create small fissures on the seed coat, and they must avoid breaking, crushing, or otherwise damaging the seed.

**ACTIVITY DESCRIPTION:** All seeds need appropriate environmental conditions to germinate. These conditions include appropriate oxygen concentrations, temperature, moisture and, in some cases, light. Seeds from plants that bloom early in the growing season may germinate if the environmental conditions are suitable and they are planted immediately. However, most seeds will develop dormancy that prevents germination until certain environmental conditions are met. Breaking seed dormancy is referred to as stratifying the seed.

The way those seeds are stratified will affect the number that germinate (the germination percentage). You are charged with conducting a research experiment to find more detailed information about how to stratify the seed of your species such that you maximize germination.

Design an experiment to get more information about one part of the stratification requirements. For instance, if your seed needs wet stratification, how wet? Is sawdust, sand, vermiculite, peat, or something else a better medium for the wet stratification? What storage temperature is best? What is the best length of time for storage? If they require only dry stratification, would wet stratification improve germination percentages? What temperature is best for dry stratification? These are just a few of the questions that you may ask.

In designing your experiment, clearly state your hypothesis. You should be testing only one variable while trying to keep all others constant. Consider how many seeds you need to test for each treatment. Remember, you will want to calculate a germination

percentage on your seeds at the end of the experiment, so you need enough treated seeds to be able to get an accurate percentage. Record as much information as possible about how you treated your seeds. Try to keep your experimental procedures simple.

After treating your seeds, you will want to try to germinate them to see if the treatment affected the germination percentage. Record your data carefully and report your results in a written paper, oral presentation, or scientific poster.

**EXTENSIONS:** Test germination conditions to determine ideal temperature and moisture conditions for a given species.

Create a class poster session for each student or group to report results at one time. Alternatively, a seminar of presentations or class data base could serve the same purpose.

Have students record their information to a data base containing information from previous years. Have students look at previous years' data to help them form their own questions.

For younger students, stratify seeds according to standard protocol, and determine a germination percentage.

In a petri dish lay down two pieces of filter paper. (Note: it may be possible to use a heavy-duty paper or cloth toweling as a substitute for filter paper. But, it needs to be able to hold up to repeated handling when wet and not contain any chemicals which would inhibit germination.)

On top of these papers place a sample of your seed. When testing prairie seed it is best to use 100 seeds, although as few as 50 may be adequate. A large number of seeds is necessary because there can be a great amount of variation in germination rates. (Note: It may be necessary to decrease this number even farther; if you do, expect less accurate results.) Try to spread out the seed as much as possible. Some seeds contain germination inhibitors, and closely spaced seeds may inhibit the germination of each other.

On top of the seed, lay down two more sheets of filter paper.

Wet the sandwich of filter paper and seed with distilled water. (Note: Chlorine and other chemicals in city water may adversely affect germination. Bottled drinking water and clean well water may be acceptable alternatives.) Use just enough water to soak the paper but not enough to produce standing puddles. This is easily done by using a squirt/spray bottle; although, flicking water with one's fingers can work well also.

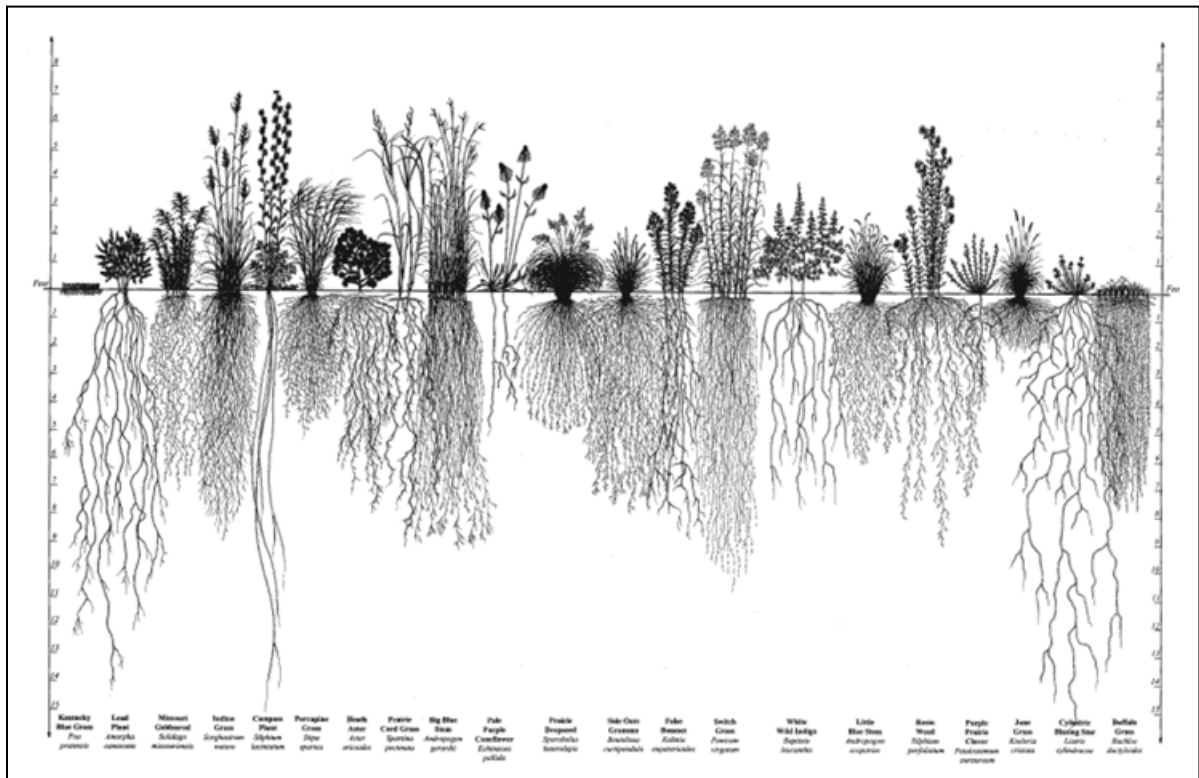
Place the petri dish in a well-lit area but out of direct sunlight. Many seeds need light to germinate; but watch out: too much bright light (such as direct sunlight) can turn your petri dish into a greenhouse oven! Room temperature is good for germination of most

prairie seed. Avoid hot spots such as radiators or heat ducts. Likewise, a cold drafty windowsill may be too cool to allow germination.

Keep the filter paper well moistened. Initially it is a good idea to check the moisture level a couple times a day until you know how quickly it is drying out and needs watering.

After several days, begin to look for emergence of the seedling root (or radicle). It is this event which defines germination. Keep an eye on the increase in percentage of seed germinated. When it becomes clear that no more seeds are germinating, count the number of seeds that have germinated, and determine the percentage. The time that it takes to reach this point can be affected by the species itself and the environmental conditions during the germination test. Have patience, and check your seed at least once a day!

### Example of a Prairie Plant Root System



Source: Illinois NRCS

### Example Root Depths of Prairie Plants

<b>Blazingstars tend to be colonizing plants that can thrive in degraded or recovering prairies. They are well adapted to drought because they have a deep root system for water absorption.</b>	<b>Root Depth</b>
Blazingstar, Thickspike <i>Liatris pycnostachya</i>	10-12 ft.
Goldenrod, Stiff <i>Solidago rigida</i>	up to 5 m.
<b>The large root systems of silphiums play an important role in a prairie. Thick taproots can reach depths of 3-4.5 m. and penetrate clay subsoils.</b>	
Compass Plant <i>Silphium laciniatum</i>	12-14 ft.
Prairie Dock <i>Silphium terebinthinaceum</i>	12-14 ft.
Cup Plant <i>Silphium perfoliatum</i>	12-14 ft.
Rosin Weed <i>Silphium integrifolium</i>	12-14 ft.
<b>Legume species aid in the soil building process by means of deep penetrating root systems as do the indigos, <i>Baptisia</i> spp.. They have long penetrating roots. Living within the root nodules is a bacteria that will convert inert nitrogen into usable compounds. The nitrogen-fixing bacteria are genus-specific for the plant. The deep root systems of legumes help in breaking up clay subsoils.</b>	
Big Bluestem <i>Andropogon gerardi</i>	1.5 - 2.2 m.
Indian Grass <i>Sorghastrum nutans</i>	1.6 - 1.8 m.
Little Bluestem <i>Andropogon scoparius</i>	1.4 - 1.8 m.
Porcupine Grass <i>Stipa spartea</i>	0.7 - 1 m.
Prairie Cordgrass <i>Spartina pectinata</i>	2.5 - 4 m.
Prairie Dropseed <i>Sporobolus heterolepis</i>	1 - 1.7 m.
Side Oats Grama <i>Bouteloua curtipendula</i>	0.5 m.
Switch Grass <i>Panicum virgatum</i>	2 - 3.7 m.

Source: Prairie Frontier