What Secrets are Hiding in My School Yard?

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Background

Soils of many different ecosystems often contain viable seeds (seeds that are capable of germinating), often referred to as a seed bank. While we think of the vegetation that we can see as the only vegetation that exists in a location, seeds of different species are often present in the soil. Frequently, buried seeds will germinate when conditions are "right" (appropriate temperatures, enough water, etc.), however, sometimes the soil must also be disturbed in order for the seeds to germinate. In this activity, students will collect soil samples from their schoolyard, allow the seeds to germinate, and identify species that emerge from the sample soil. Students will learn that seeds can be "dormant", waiting for appropriate conditions in which to germinate. Students will also learn that other species may be present in an ecosystem, "hiding" in the soil.

Objectives

1. Students will comprehend that species can "wait" until appropriate conditions to germinate (i.e. temporal variation in life cycles).
2. Students will comprehend that species other than the ones they can see are present in an ecosytem.
3. Students will collect, analyze and interpret the data.
4. Students will synthesize the information gained from the investigation and literature searches.
5. Students will write a report of the investigation.

Grade Level

4-8

Background Knowledge

Students should be familiar with plant reproduction and dichotomous keys or be able to access information concerning species that are found in the area. Students should be familiar with vegetation protocol such as Ecology Explorers (caplter.asu.edu/explorers/protocol/veg/veg.htm). They should also be able to press plants (this can be learned while plants are maturing).

Standards

Science as Inquiry

1SC-E3 Organize and present data gathered from their own experiences, using appropriate mathematical concepts, analyses and graphical representations.

1SC-F4 Define relationships among parts of a familiar system.

Life Sciences

4SC-F4 Identify characteristics of plants and animals that allow them to live in specific environments.

4SC-E7 Explain and model the interaction and interdependence of living and non-living components of ecosystems, including the adaptations of plants and animals to their environment.

Materials
pots: 1 per student
potting soil
access to plant identification books for the area
soil corer (bulb planter)
baggies
ruler
scissors
plant press: see Web Sites for instructions on how to make a plant press
notebooks: 1 per student

Time
This activity will take several months (1 -2 quarters) to complete as seeds need time to germinate and mature into reproductive adults (i.e. Flower). The best time to begin this activity is in early spring as seeds of some spring germinating plants need to be exposed to the cool temperatures of winter before they will germinate.
1-2 days to survey vegetation and collect soil samples
Allow plants to emerge from soil until there is a marked decrease in the number of plants that emerge.
1-2 weeks to identify plants
1 day to complete analysis
2 weeks for students to complete and turn in reports

Procedures
Part 1
1)Engage
Teacher asks students to describe the types of plants that populate their schoolyard. After a list of species has been listed on the board, teacher asks if students are sure there are no more plants. Teacher asks the students to begin an investigation of plant diversity (here defined as the number of species) in the schoolyard.
2)Students will decide on what area of the schoolyard that they want to investigate (it should be fairly homogeneous). Students should pair-up for this exercise. Each pair will be responsible for a 1 m^2 sampling plot in the schoolyard. Each pair will also have a project notebook for this investigation. Students should record their methods, data, results, and analysis results in their notebooks.
3)Using vegetation description protocol such as Ecology Explorers, students conduct vegetation sampling of their plots.
4)Students record the list of plants in their project notebooks.
5)Using their soil corers, they collect two soil samples from each plot.
6)Students then mix the two samples together in a plastic bag.
7)Each pair of students fills one pot with potting soil (label each pot with plot #).
8)Sample soil is placed on top of the potting soil to a maximum depth of 2 cm.
9)Place pots under grow lights or outside.
10)Control pots (pots with just soil) are placed between sample pots to test for contamination of sample pots by other plants (seeds blow into pots).

11)Carefully water all pots, including control pots, so as not to disturb buried seeds.
12)The samples are watered frequently enough to keep the soil from completely drying out.
13)Students should monitor their pots weekly. As plants mature and flower, they should be carefully removed from the pots (use scissors to cut the plant immediately above the roots).
14)The plants that emerge from each plot should be recorded in each student's project book.
15)These plants should be placed in a plant press.
16)It will be the student's responsibility to try and identify the plants. Use local plant books, landscaping/gardening books, and online resources. Also, teacher may want to contact someone from their local college or botanical gardens to help them identify the plants.
17)After most of the plants have been collected and identified, students should categorize their plants in to growth form categories [i.e. grasses, forbs (not grasses or woody plants), shrubs/trees].
18)Each pair of students should record in their project notebook the total number of plants and species that emerged, a list of species, and the number of individuals and species for each growth form category.

Part II.

17)Teacher asks the students to determine the approximate number of individuals per sampling plot. To accomplish this task, students will need to determine the area of their soil corer. They will then scale up from the area of their soil corer to m^2 using the following formula.

Area of soil corer x 2 (the number of samples from each plot) = total sample area
Divide 10,000 cm^2 (total number of cm^2 in a m^2) by the total sample area
Multiply the number of plants that emerged from each plot by that number

For example, a soil corer with a diameter of 5 cm has an area of 19.63 cm^2.
19.63cm^2 x 2 = 39.26 cm^2
10,000 cm^2/39.26 cm^2 = 254.71
20 plants emerged from plot #1
20 x 254.71 = 5094.2
The number of seeds in plot #1 is approximately 5094 per m^2.

The class will then determine the average number of individuals per m^2 using the class data.

18)The class will compile a list of species found in soil of their schoolyard.
19)Students should then compare the list of species found in the soil vs. the species found in the extant (aboveground) vegetation.
20)Students should determine the number of species within each growth form category and the average number of individuals per m^2 within each category.
21)The class should determine the average number of individuals per m^2, the number of species within each growth form category, the average number of individuals per m^2

within each category, a list of species in extant vegetation, and a list of species located in soil.

22) Teacher should then ask the students to formulate hypotheses about why some species that are in the soil are not in extant vegetation. What could have caused the patterns they see in their data? The class should take some time to explore each of the proposed hypotheses. Teacher can then either discuss the role of seed banks in vegetation communities or ask students to research seed banks first and then have a class discussion.

Some possible theories to discuss are that seed banks contain species from the current vegetation community and from previous communities. Seed banks allow plants to wait for appropriate conditions to germinate (e.g. spring/summer, rain, etc.).

Some possible hypotheses proposed by kids are:

a) Seeds in the schoolyard soil are from species that were present before the school was built.
b) Seeds were buried in the soil by people or animals.
c) Seeds were always in soil, but by bringing them inside and watering them we made them germinate earlier than they would outside.
d) Seeds were always in soil, but the grass shades the soil so seeds can't germinate.

Evaluation

Each student or pair of students should write a report about the class investigation, using information from literature searches and information from the class investigation. Students should report the following based on the class data: the average number per m^2, the number of species within each growth form category, the average number of individuals per m^2 within each category, a list of species in extant vegetation, and a list of species located in soil.

Student's lab reports should be evaluated. Please see evaluation form.

Web Sites

Vegetation Protocol
caplter.asu.edu/explorers/protocol/veg/veg.htm
How to make a plant press
http://biology.arizona.edu/sciconn/lessons2/Barber/Activity3.htm

Seed Banks
www.geog.plym.ac.uk/research/environ/envseed.htm
www.as.wvu.edu/biology/faculty/JBMPersonalSite/SeedBank.html
Plant Identification/Information/Pressing Resources
plants.usda.gov
plants.usda.gov/links.html

Extensions

Before Exercise
Data Collection Skills at http://gk12.asu.edu/curriculum/general_science/index.html
Ecology Explorers Vegetation Protocol see Web Sites
After Exercise
Seed Germination Experiment at http://gk12.asu.edu/curriculum/life_science/index.html
The Floristic Relay: A Game to Teach Succession at
http://gk12.asu.edu/curriculum/life_science/index.html