Schoolyard Quadrats

Sampling & Biodiversity

Timeframe

1 Fifty minute class period

Target Audience

Middle School (6-8) Life Science but easily adapted to Grades 4-12

Materials

- 2 sets of cards labeled 1-10
- Small whiteboard
- Dry Erase Marker

Each Group Needs:

- Measuring tape (10 meters long) - can be subsituted for string marked in standardized units (feet/meters)
- One quadrat - can be made out of four plastic straws and yarn, or substituted for hula-hoops, or any other frame, but must be a standardized size

Each Student Needs:

- Student Worksheet
- Blank sheet of paper
- Clipboard

Contact:
SMILE Program
smileprogram@oregonstate.edu
http://smile.oregonstate.edu/

Description

In this activity, students practice the technique of measuring population density in quadrats by sampling the plant species that live in the lawn of the school. Students will gain an understanding of biodiversity, different sampling techniques (transect vs. random), and factors that impact population density.

Objectives

- Students will be able to define biodiversity, identify local plant species and calculate species abundance
- Students will utilize and compare common surveying techniques (random vs. transect sampling)

Teacher Background

Scientific methods taught in the classroom take on new meaning when students see (and experience) how "real science" is done by biologists who monitor the environment. Monitoring the environment means taking repeated samples in the same way at the same locations over time. To track changes over time, it is important to be able to quantify changes in abundance. Long-term monitoring increases sample number and allows scientists to detect change over time.

One common monitoring unit that is used in intertidal ecosystem studies (as well as other ecological/biodiversity studies) is the quadrat. Quadrats are square/rectangular frames within which species are counted and environmental qualities are measured. Scientists can place quadrats randomly in an area or quadrats may be placed at intervals along a transect line. Quadrats

are used because it is impossible to count every living and non-living thing in an ecosystem.

Preparation

Check out the lawn at your school to find an ideal place to set up a sampling experiment. Ideally, the area will be at least 10 m by 10 m, and have a lot of biodiversity. You may want to choose 4 species for your students to focus on. Additionally, note if there is a variety of soil and grass types that students could record on their datasheet.

Make sure the attached datasheet will match your needs/observations for the lesson

A list of common Oregon State lawn weed species is provided here: *http://horticulture.oregonstate.edu/content/welcome-pnw-weed-identification-module*

Activity Introduction

1. Explain how species are monitored using transects and quadrats – using Guiding questions. Introduce the activity:

   "Today we will apply methods that scientists use to monitor the biodiversity of an area to our own schoolyard. We will work in groups of 3-4 to make observations and count plant species using quadrats (or hula hoops)"
2. Divide students into groups of three or four. Each group will need a quadrat (or substitute). Each student needs a worksheet, sheet of paper, pencil, clipboard
3. Lead students out to the area of the school lawn you have designated.
4. Stand in the area to be surveyed. Each student should make a simple plan drawing of key features on the blank sheet of paper, including the direction of north, any nearby buildings, large plants (trees and shrubs), gravel or paths across the area. Explain that scientists always record detailed observations of their surroundings and characteristics of the day so they ensure the accuracy of their notes.
5. Lay one quadrat down on the ground. Ask students to look closely at the plants and observe how many different plants they can see. Collect samples of the most common plants (other than grass). Write their names on the whiteboard and attach a sample of each,

Key Vocabulary

Quadrat: Typically a square frame placed directly on top of vegetation used to survey biodiversity

Biodiversity: Measure of the number and variety of different plant and animal species that live in an ecosystem

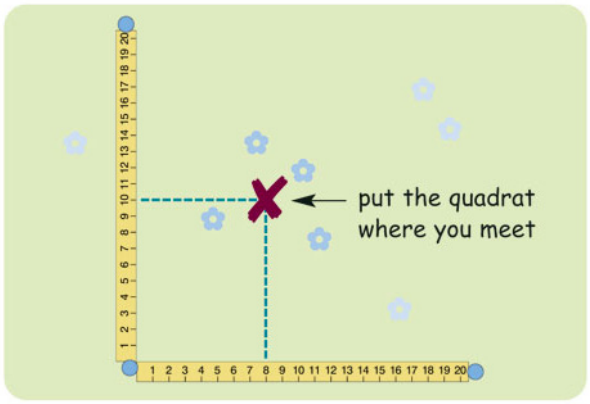
Population Density: Amount of a given species within a unit of area

Guiding Questions: Activity Introduction

- How do you think scientists monitor biodiversity in the field?
- Do you think it's practical to try to count every single organism in an area? Why not?
- Why do you think scientists need a standardized method of sampling?

or describe 1-2 identifying characteristics.

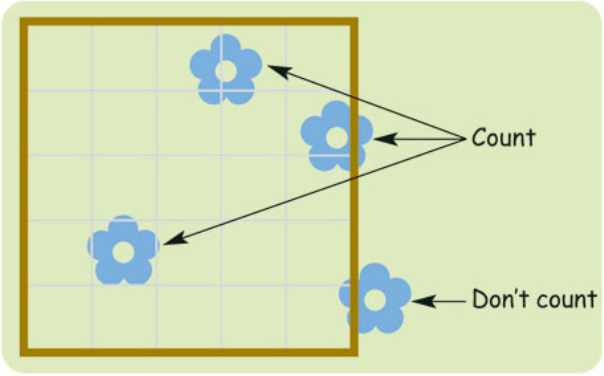
Activity Part One: Random Sampling



1. Lay out the tape measures or marked string at right angles along two edges of the area to survey. Lay the two bags of numbers near the point where the tapes meet.
2. As a group, have students pick one number from each bag. The students should walk to that number on each line. The place where the lines meet in the survey area with where they should place the quadrat. Numbers can get reused, but not the same combination.
3. On the worksheet (Figure 1), students draw any large features that happen to fall in the quadrat like trees, rocks, pavement, etc. Maybe divide quadrat into four equal areas (or quadrants) Figure 1 is 10 cm by 10 cm square - students can calculate the scaled ratio *(e.g. if quadrat is 1 square meter, it is a 1:10 scale to the quadrat)*

4. Using Figure 2 of common weed plant species found in Oregon, ask students to count the number of each plant species in their quadrat and record data in Table 1. *Note: If center of species/plant is outside of quadrat/frame, do not include in measurements.*

   Extension: Adapt worksheet to include percent of area covered, health of plants, ground coverage by gravel and/or dirt, soil types, etc. If working with younger students, presence or absence may be enough of an observation.
5. Using symbols shown alongside the plat diagrams (Figure 2), also plot the approximate location of the plants on your quadrat drawing in Figure 1.



6. Optional: If time allows, have each group repeat Steps 2-5 for a different part of the survey area. Another option for the second quadrat is to have students gently toss it over their shoulder instead of drawing numbers.

Activity Part Two: Transect Sampling

1. Each group needs a measuring tape. Have groups space evenly across sample area. Tell students that every meter/every

foot, they record what they find beneath the measuring tape. **OR** if more time, place quadrat every meter and record table measurements in Figure 3.

Activity Wrap Up:

1. Back in classroom, copy the class data into Table 2,. Total each column to get the class totals for the lawn. Instruct students to calculate average population density in count/ meter^2 (consider each quadrat's area and divide by total number of groups).
2. **Possible Extensions:**

- Produce bar graphs or other plots of the data collected
- Calculate the percentage of quadrats each species appears in

Wrap Up Discussion Questions:

1. What did you discover? How many different species of plants did you identify?
2. Comparison questions: **eg.** Are there more daisies in mown or unmown grass?
3. Which plant had the highest had the highest population density? The lowest?
4. What is the distribution of plants across the landscape? Did you notice clumps of a single species or were they mostly evenly distributed (heterogeneous vs. homogenous)?
5. How were results different between the two sampling methods?
6. How does the class average compare to measurements from an individual group? Which method is a better measure of population density than the other? Why?
7. What does the term Biodiversity mean? Why is biodiversity important?
8. What could change the types of species living in each area?
9. What would happen if one of the species disappeared?
10. What changes would humans need to make to increase the biodiversity here?

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:

LS4.D: Biodiversity and Humans

COMMON CORE STANDARDS:

6.RP.A.3: Use ratio and rate reasoning to solve real-world and mathematical problems.

6.SP.B.5: Summarize numerical data sets in relation to their context.

7.RP.A.2: Recognize and represent proportional relationships between quantities.

PRACTICES:

- Asking Questions and Defining Problems
- Analyzing and Interpreting Data

CROSSCUTTING CONCEPTS:

- Patterns
- Stability and change
- Scale, Proportion, & Quantity

VIDEO EXTENSION:

This teacher applied a similar project to her high school math class, using quadrats and M&M's to discuss statistics and biodiversity: http://www.cpalms.org/Public/PreviewResource/Preview/128604

POTENTIAL EXTENSION ACTIVITIES:

This lesson serves as a great introduction to using quadrats.It was created in conjunction with StreamWebs Seagrass Sampling Datasheet with help from Dr. Fiona Tomas Nash's Lab. To test this in the field, contact StreamWebs@oregonstate.edu or visit the StreamWebs Website.

To relate StreamWebs to your students, check out these **Eutrophication Lessons**:

- http://earthecho.org/uploads/files/lesson-plans/Dead_Zones_For_Dinner_Lesson_Plan.pdf
- http://ei.cornell.edu/watersheds/Eutrophication_Experiments.pdf

Background Information on **Eutrophication & Hypoxia** in the Pacific Northwest:

- http://www.piscoweb.org/files/hypoxia_general%20low-res.pdf
- http://www.piscoweb.org/files/Hypoxia_FAQ_06_09.pdf

This lesson could also be extended in conjunction to include a **Soil Survey** using StreamWebs Soil Sampling Data Sheet, found here: http://www.streamwebs.org/sites/streamwebs/files/files/Soil_Survey_OSU.pdf

Resources:

http://www.hawaii.edu/gk-12/opihi/classroom/measuring.pdf

http://www.explorebiology.com/documents/LE/LabPopulationDensity2008.pdf

http://gk12calbio.berkeley.edu/lessons/less_samplingbiodiversity.html

http://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%205(Density)/5_2_Plot-based_Techniques.htm

http://www.nuffieldfoundation.org/practical-biology/biodiversity-your-backyard

Schoolyard Quadrats: Student Worksheet

Name: _____ Date:_____

Figure 1. Your Quadrat
Population density of four weed species in the schoolyard lawn.
Note: Figure = 10 cm²

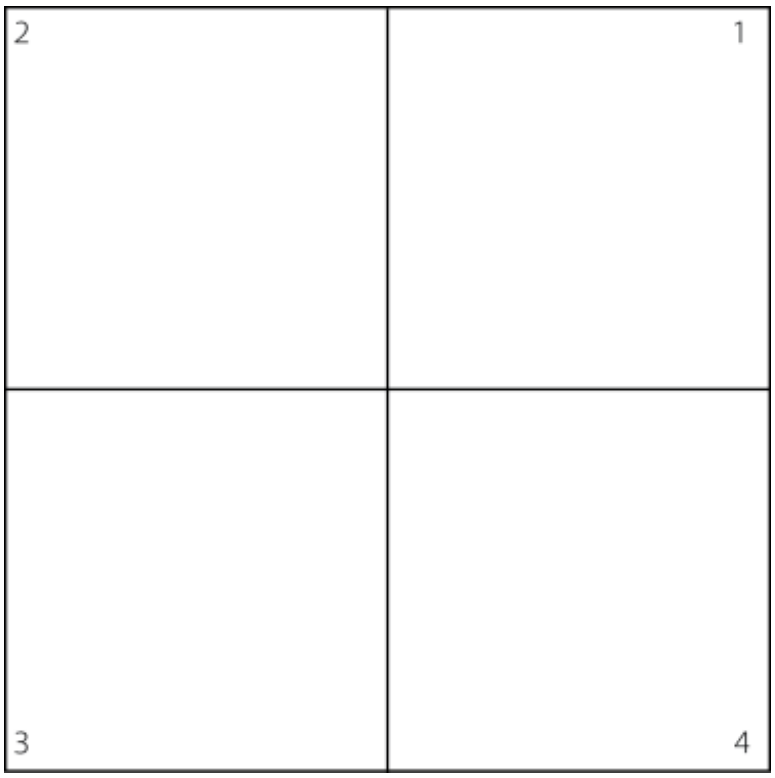


Table 1. Random Sampling Data

Quadrat location: _____ X _____

Number of Plants in each portion of quadrat.

Quadrat Section	Species 1 _____	Species 2 _____	Species 3 _____	Species 4 _____
1				
2				
3				
4				
Total				

Table 2. Transect Data Transect Location: _____

Number of Plants at each sampling point.

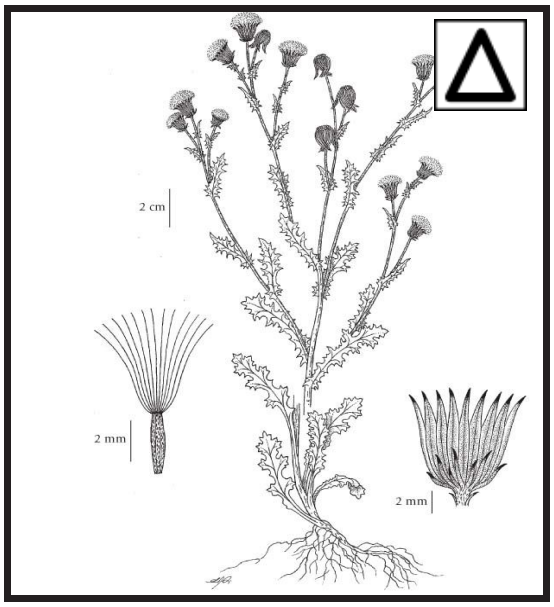
Transect Section	Species 1	Species 2	Species 3	Species 4
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Total				

Table 3. Class Data
Population Densities of Plants in a Community

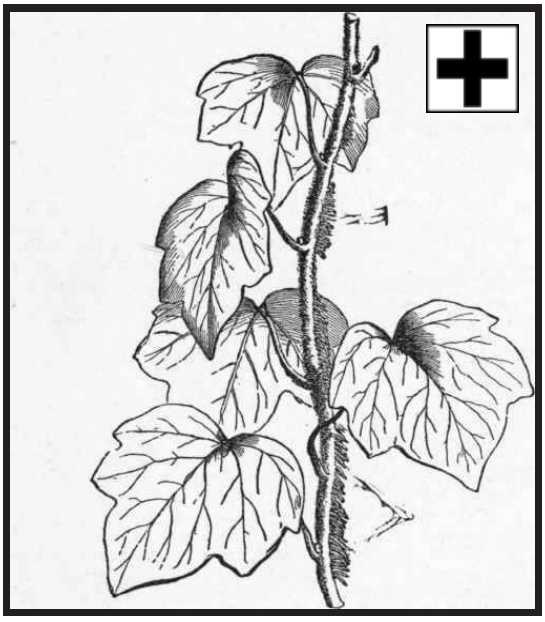
Class Group	Species 1 (Total)	Species 2 (Total)	Species 3 (Total)	Species 4 (Total)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Total				
Population Density	/m^2	/m^2	/m^2	/m^2

Figure 2. Common Western Oregon Lawn Weed Species

Amaranth



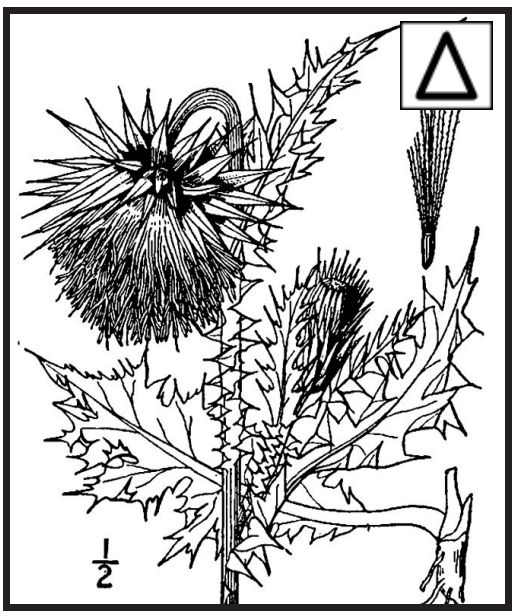
Common Groundsel



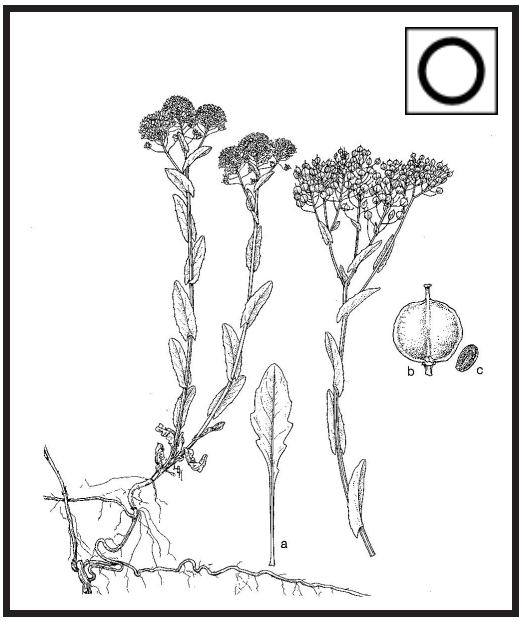
English Ivy

Dandelion

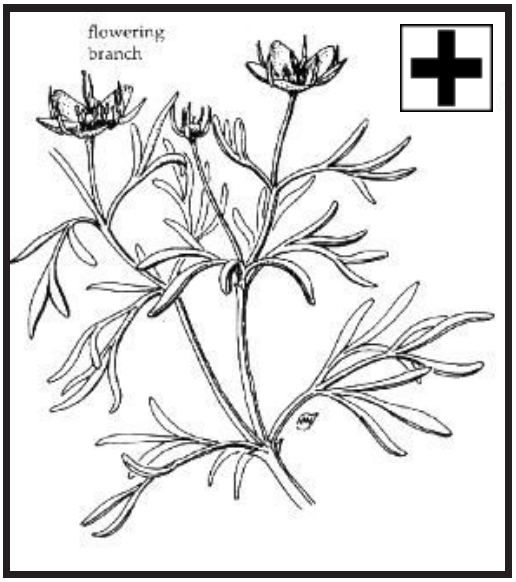
Figure 2. Common Eastern Oregon Lawn Weed Species



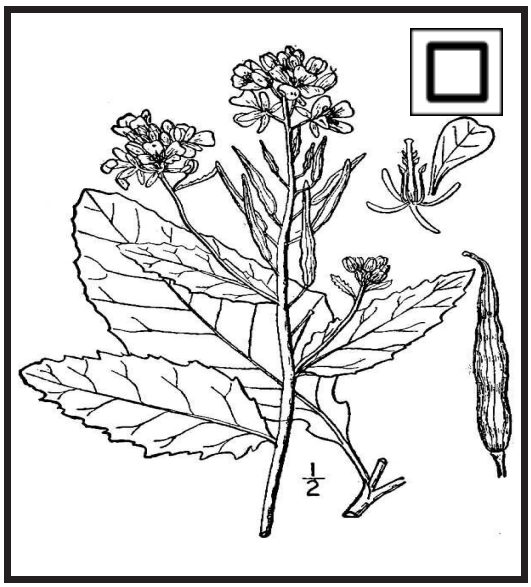
Musk Thistle



Whitetop



African Rue



Garlic Mustard

[1] Retrieved from http://nps.eddmaps.org, https://www.uapress.arizona.edu, http://plants.usda.gov