

Count the Kinds: Measuring Schoolyard Biodiversity with Quadrats

Investigation question: Does a regularly mowed lawn or a less-managed patch of the schoolyard hold more plant biodiversity, and how many quadrats does it take to find out?

Classroom field investigation

Groups of 4

2 sessions

Setup 10 · Activity 80 · Cleanup 10 min

MS-LS2-4 · practice

MS-LS2-5 · supports

Name _____

Group _____

Date _____

Your role today

- ☐ **Site setter:** Rolls the dice, measures out each quadrat position from the baseline, lays the frame, and rerolls if the spot lands on a path, a hazard or an earlier quadrat.
- ☐ **Point reader:** Lowers the pointer, blunt end down, through each of the 25 string intersections and calls the code of the first plant touched, or 'bare'.
- ☐ **Recorder:** Tallies each call in the hits table, keeps the presence list for each quadrat, and checks that every quadrat totals 25 points.
- ☐ **Kind keeper:** Sketches and describes each new plant kind with a hand lens, assigns it the next class code, and checks the group's key against the class chart.

Safety

- Work only in the teacher-checked patches. Poison oak grows at the edges of many California school grounds and causes a severe rash; nettles, thistles and some weeds sting or prick. Do not touch plants you have not been told are safe, and never put plants or fingers in your mouth.
- Bees and wasps visit flowers in less-managed patches, and yellowjackets nest in the ground. Move slowly, do not swat, and step away from any nest. Students allergic to stings carry their prescribed epinephrine auto-injector outdoors, and the teacher knows who they are.
- Skewers have a sharp point: lower them blunt end down, never point them at anyone, and carry them point down. Unsharpened pencils are a safer substitute.
- Do not touch animal droppings, broken glass, needles or other litter; tell the teacher. Do not survey any area that has been sprayed recently.
- On sunny days wear a hat and sunscreen, bring water and take breaks from kneeling in the sun. Watch for sprinkler heads and holes when walking.
- Stay inside the marked patches and within sight of the teacher. Do not pull up or pick plants, and wash hands after the field session.

Procedure

1. Session 1, in class (5 minutes): write your prediction in q1 and answer q2. Look at the starter kind key and agree how your group will tell kinds apart (leaf shape, edges, hairs, how the leaves attach, flowers).

2. At the first patch, the Site setter rolls one die for the position along the baseline (the roll times 50 cm) and the second die for the distance into the patch (the roll times 50 cm, measured with the meter stick), then lays the frame with its corner on that spot. If the frame lands on a path, a flagged hazard or an earlier quadrat, roll again; never move the frame to a spot that looks more interesting.
3. Kind keeper and Recorder list every plant kind rooted inside the frame (the presence list). Each new kind gets the next class code, a sketch and a description in the kind key. Use the hand lens and do not pick the plant.
4. Point reader lowers the pointer, blunt end down, straight through each of the 25 string intersections and calls the code of the first plant it touches; if it reaches soil, mulch or dead leaves without touching a living plant, call 'bare'. Recorder tallies every call. A partner watches that the pointer stays vertical.
5. Repeat steps 2 to 4 for quadrats 2 and 3 in the same patch, then sample three quadrats in the second patch. Note the time, the weather and whether the lawn looks freshly mowed.
6. Session 2: total each patch's hits by kind and leave 'bare' out of the plant total. For each kind compute $p = \text{hits} \div \text{plant total}$, square it, add the squares, and compute Simpson's index $D = 1 - (\text{sum of } p^2)$.
7. Count each patch's richness: all kinds on your presence lists, whether or not the pointer hit them. Fill the accumulation table by counting how many kinds each quadrat added that earlier quadrats of the same patch had not.
8. Copy your group's totals to the class chart. Using the class data in the order groups sampled, plot total kinds found against number of quadrats sampled for each patch on one graph, one color per patch. Compute the class Simpson's index for each patch from the pooled hits.
9. Answer q3 and q4 on the recording sheet as a group, then the analysis questions individually.

Record your observations

Lab 1 recording sheet: Count the Kinds

You will sample **three quadrats in Patch A** (mowed lawn) and **three in Patch B** (less-managed patch). In each quadrat, list every plant kind you see (the presence list), then record the **first plant touched** at each of the 25 grid points. A point that touches only soil, mulch or dead leaves is **bare**. Use the class codes (K1, K2, ...) so every group means the same plant by the same code.

1. Prediction: which patch will have more plant kinds, and which will have a more even mix? Explain your reasoning using what mowing does to plants.

2. Why does the Site setter place quadrats by dice roll instead of choosing spots that look interesting? What would go wrong otherwise?

Kind key (add each new kind the first time you see it)

Code	Description (leaf shape, edges, hairs, flowers)	Quick sketch	In Patch A?	In Patch B?
K1				
K2				
K3				
K4				
K5				
K6				
K7				
K8				
K9				
K10				

Point-intercept hits (tally the first plant touched at each of the 25 points)

Kind	A: Q1	A: Q2	A: Q3	A total	B: Q1	B: Q2	B: Q3	B total
K1								
K2								
K3								
K4								
K5								
K6								
K7								
K8								
K9								
K10								
Bare (soil, mulch, dead leaves)								
Check: all points	25	25	25	75	25	25	25	75

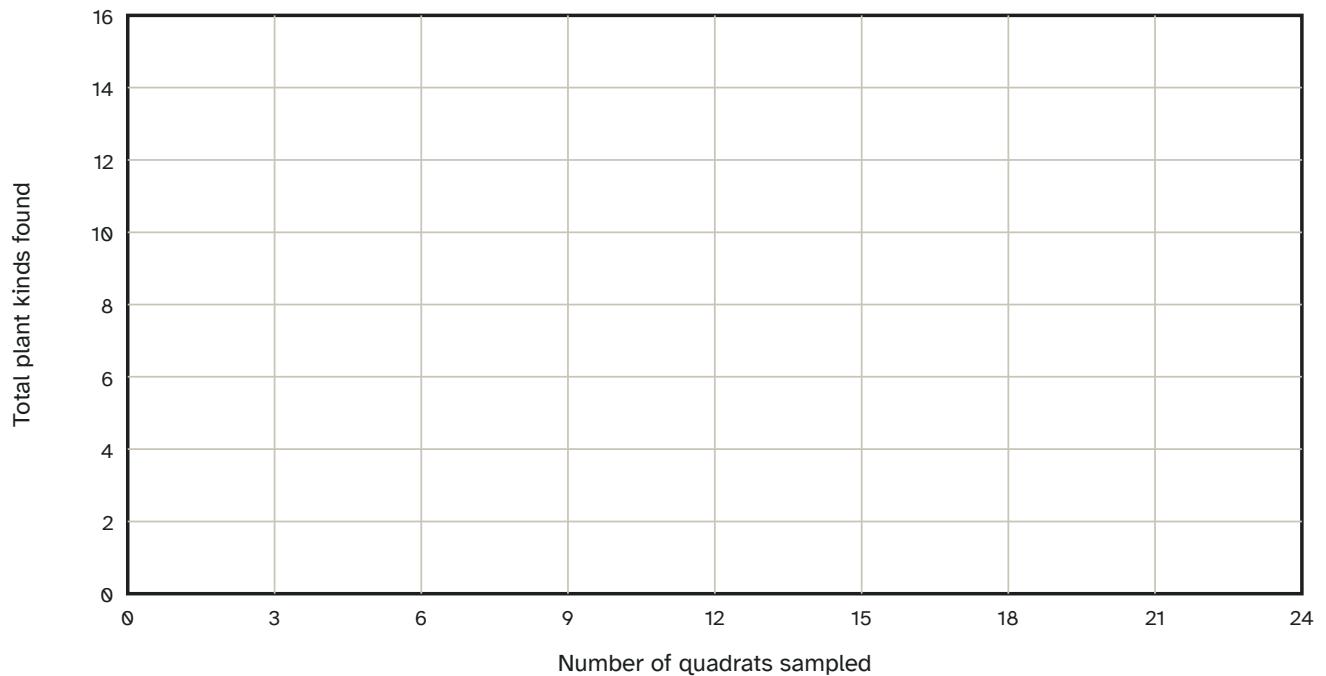
Presence lists and accumulation

Patch and quadrat	Codes of kinds present	Number present	New kinds (not in earlier quadrats of this patch)	Total kinds found so far in this patch
A, quadrat 1				
A, quadrat 2				
A, quadrat 3				
B, quadrat 1				
B, quadrat 2				
B, quadrat 3				

Simpson's index: $p = \text{hits} \div \text{plant total (leave out bare)}$; $D = 1 - \text{sum of } p^2$

Kind	Patch A hits	A: p	A: p^2	Patch B hits	B: p	B: p^2
K1						
K2						
K3						
K4						
K5						
K6						
K7						
K8						
K9						
K10						
Plant total (no bare)		1.00			1.00	
Sum of p^2						
Simpson's index D						

Kinds found as more quadrats are sampled (class data)



3. Report richness and Simpson's index for each patch, from your group's data and from the class data. Which patch has higher biodiversity by each measure?

4. Look at the accumulation curves. Did each curve level off? What does that tell you about whether the class found most of the kinds in each patch?

Analysis questions

5. Another class surveyed two patches with the same four plant kinds. Patch X had 40, 20, 10 and 10 plant hits; Patch Y had 74, 2, 2 and 2. Compute Simpson's index for each patch, showing your work, and explain which has higher biodiversity even though both have a richness of 4.

6. Compare your two patches using both richness and Simpson's index from the class data. Is the difference between the patches bigger than the differences among quadrats within one patch? Use numbers.

7. Your group's three quadrats and the class's 18 or more quadrats probably gave different richness for the same patch. Explain why, and say which value you trust more.

8. Write an argument: does mowing change which plants grow and how evenly they are mixed? State a claim, cite at least two numbers, explain the cause (what mowing does to tall plants compared with low-growing ones), and name one other difference between the patches that could also explain your result.

9. A classmate says the patch with the higher Simpson's index is 'healthier'. What else would you need to know before agreeing? Think about native and invasive plants.

10. The school plans to turn half of the lawn into a native pollinator garden. Design a before-and-after survey to judge whether the change increases biodiversity: what you would measure, how many quadrats, when, and one measurable criterion for success.

11. Name two limitations of the point-intercept method for measuring plant biodiversity, and say how each could bias your result.
