

Path or No Path? A Disturbed-Versus-Undisturbed Plot Survey

Investigation question: Does trampling, a disturbance we can find on our own campus, change the plant and small-animal populations living in the ground, and which nonliving condition changes along with them?

Classroom field investigation

Groups of 4

2 sessions

Setup 10 · Activity 85 · Cleanup 10 min

MS-LS2-4 · assesses

MS-LS2-1 · supports

Scientific purpose

Students collect their own empirical evidence for the chapter's performance expectation. Each group surveys a matched pair of 50 cm square plots: one on ground people walk on every day (D) and one a few meters away that is rarely walked on but has the same sun and slope (U). In each plot they measure plant cover with a 25-point grid, count the kinds of plants, measure the tallest plant, search for small animals, and time how fast 100 mL of water soaks into the soil, which is an indirect measure of how packed the soil is. The class pools every pair, computes means, graphs them, and writes an argument about how a change to a physical component (packed soil) and to the plants themselves affected the populations living there.

Why this helps students with this chapter

Every other piece of evidence in this chapter belongs to someone else: the Mount St. Helens records, the prairie dog surveys, the beaver studies. Here students build the with-and-without comparison themselves and run straight into what makes real field evidence hard: no two plots are exactly alike, one pair may disagree with the rest, and a single pair proves little. Pooling the class's pairs shows why repetition matters, and the water soak test gives students a measured physical change to connect to the biological one, which is the mechanism a strong argument needs.

Standards connections

MS-LS2-4 (assesses, the full PE: an argument supported by students' own field data that a disturbance changed a physical component and the populations that depend on it): Students construct an argument from empirical evidence they collected themselves: paired-plot counts and soak times, pooled across the class, showing that trampling changed a physical component (soil compaction) and the plant and animal populations living in the plots. This is the chapter's main evidence for the PE.

MS-LS2-1 (supports, soil water as a resource for plants and soil animals): Water that soaks into the soil is a resource for plants and small animals. Students link slower soaking on packed ground to lower plant cover, using the resource-population relationship from Lesson 20 as part of their mechanism.

Roles (rotate each session)

- **Plot keeper:** Places the string square at the teacher's flags, keeps everyone's feet outside it, and makes sure both plots are treated exactly the same way.

- **Plant counter:** Runs the 25-point cover count, counts plant kinds and measures the tallest plant. Swaps jobs with the Animal searcher at the second plot.
- **Animal searcher:** Runs the timed animal search and the litter shake with a hand lens and returns every animal unharmed to where it was found.
- **Recorder and timekeeper:** Times each search and the soak test, writes every number in the tables as it is called out, and reads it back to the group.

Materials

Item	Quantity	Per	Note
String square: 2.1 m of string knotted into a loop and marked every 50 cm, plus 4 small stones or bean bags to hold the corners	1	group	
Meter stick or 50 cm ruler	1	group	The 25-point grid is read along it at 5, 15, 25, 35 and 45 cm.
Hand lens	2	group	
White paper plate	2	group	For the litter shake.
Clear plastic cup, about 270 mL (9 oz), with the bottom cut off by the teacher and the cut edge taped (the soak ring)	2	group	
Measuring cup or bottle marked at 100 mL	1	group	
Water in a bottle	1 L	group	
Timer or stopwatch	1	group	
Garden gloves or disposable gloves	1 pair	student	
Clipboard and pencil	1	student	
Picture key of common campus plants and small animals (teacher-made or printed)	1	group	
Numbered flags or small cones marking the plot pairs	1 set	class	
Indoor tray version only: 4 shallow aluminum trays about 30 by 23 cm with drain holes, 8 L of potting soil, untreated radish, ryegrass (or wheat) and clover seeds, a brick or heavy book sealed in a plastic bag, a spray bottle	1 set	class	Started 10 to 14 days ahead; see prep.
Recording sheet	1	student	

Estimated cost: 10 to 20 per class for the field version; add 15 to 25 for the indoor trays (an estimate; Estimate. String, a sleeve of plastic cups, paper plates and a box of disposable gloves (or garden gloves at about 1 to 2 dollars a pair); hand lenses about 1 to 2 dollars each if the school has none. Meter sticks, timers and clipboards are classroom stock. The trays add aluminum pans (about 1 to 2 dollars each), a bag of potting soil (about 8 dollars) and three seed packets (about 2 to 3 dollars each).)

Safety

- Poison oak grows on and near many California campuses. The teacher checks every site first; never touch an unknown plant with bare hands, and wear gloves for the litter shake.
- Bees, wasps and ants: look before you kneel, do not disturb nests or mounds, and do not swat. Students with sting allergies tell the teacher before going out, and the teacher follows the school's emergency plan.
- Do not pick up glass, metal, needles or animal droppings; tell the teacher. Wash hands with soap and water after the survey and before eating.
- Sun and heat: wear a hat, carry water, and rest in shade between measurements.
- Stay inside the marked area and within sight of the teacher; walk, do not run, and watch for traffic, sports equipment and sprinklers.
- Observe small animals and return them exactly where you found them. No collecting and no tasting; nothing goes in your mouth.
- Indoor trays: potting soil can carry bacteria and fungi that cause illness if its dust is breathed in. Keep the soil moist, do not stir up dust, wear gloves, and wash hands afterward. Use untreated seeds, and wipe up spills so no one slips.

Teacher preparation and setup

1. One or two days ahead, walk the campus and choose four to eight plot pairs. Plot D is on a worn path edge, a trampled shortcut across grass, or the busy edge of a field; plot U is 2 to 5 meters away on ground that is rarely walked on, with the same sun, slope and kind of ground cover. Mark each pair with numbered flags.
2. Check every site for hazards: poison oak, ant mounds, bees or wasps, broken glass, animal droppings, sprinkler heads and traffic. Ask the grounds staff whether herbicide, pesticide or fertilizer has been applied in the last two weeks and when the sprinklers run, and choose other sites if needed.
3. Cut the bottoms off the plastic cups and tape over the cut edges. Knot the string squares and mark every 50 cm.
4. Make a one-page picture key of the plants and small animals students are likely to find (lawn grasses, clover, dandelion, plantain, ants, beetles, spiders, pill bugs, earthworms), or print a free field guide page.
5. Check the allergy list (bee stings, grass pollen) and the school's outdoor supervision rules; bring the first-aid kit and any student emergency medication the school plan requires.
6. Indoor version: 10 to 14 days ahead, fill four trays with the same moistened potting soil, sow the same seed mix in each, and water them equally. From day 3, press two trays (D) firmly with the bagged brick, ten presses spread across the surface, once every school day. Keep all four trays in the same light.
7. Draw the class data table on the board or in a shared spreadsheet for session 2, and do not survey within a day after rain or watering, which ruins the soak test.

Investigation design

Independent variable Disturbance: a plot on a walked-on path or worn area (D) versus a nearby plot that is rarely walked on (U).

Dependent variable	Plant cover (percent of 25 points), number of plant kinds, height of the tallest plant (cm), number of small animals seen, and the time for 100 mL of water to soak in (s).
Controlled	The same plot size and the same 25-point method in every plot; The same search times (3 minutes plus a 30-second litter shake); The same water volume and ring depth for every soak test; Plots in each pair matched for sun, slope and original ground cover; Both plots in a pair surveyed by the same people on the same day
Trials	One pair per group, two if time allows; the class pools four to eight pairs so the comparison is repeated across sites.
Comparison	In each pair the U plot is the comparison for the D plot; all the pairs together make the class's with-and-without comparison.

Student procedure

1. Session 1. Before going out, read the question and write your predictions (q2).
2. At your numbered pair, decide which plot is D (walked on) and which is U (rarely walked on). Record the evidence of disturbance and the sun and slope of each plot in Table 1, answer q1, and sketch a map of the pair.
3. Lay the string square on plot D and hold the corners with stones. Everyone stays outside the square.
4. Plant cover: lay the meter stick across the square 5 cm from one edge. Look straight down at the 5, 15, 25, 35 and 45 cm marks and say 'plant' or 'no plant' for each. Move the stick to 15, 25, 35 and 45 cm and repeat: 25 points in all. Cover (%) = points touching a living plant $\times$ 4.
5. Plant kinds and height: count the kinds of plants that look different from each other (leaf shape, size, flowers) and describe each kind in Table 3; names are not needed, and nothing is pulled up. Measure the tallest plant in centimeters.
6. Animal search: for 3 timed minutes, search the surface and gently part the plants, counting every animal you see and noting its kind. Then, wearing gloves, pick up one handful of loose litter or plant material from the edge of the square, shake it over a white plate for 30 seconds, count the animals, and put everything back.
7. Water soak test: just outside the square, on ground like that inside it, twist the soak ring 1 cm into the soil and press soil against its outside. Pour in 100 mL of water and time how long the standing water takes to disappear. Stop at 300 seconds and record '300+' if water remains.
8. Move to plot U and repeat steps 3 to 7 in the same order, with the same times and the same amount of water. The Plant counter and Animal searcher swap jobs.
9. Indoor tray version: mark a 10 cm square on each tray and read a 25-point grid inside it at 1, 3, 5, 7 and 9 cm in each direction (cover = points $\times$ 4). Count seedlings by kind, measure the tallest seedling, and run the soak test with 50 mL. Skip the animal search unless the trays have outdoor leaf litter.
10. Pick up every flag, stone and cup, wash your hands, and return to class.
11. Session 2. Add your pair's results to the class table and copy the whole table. Compute the class mean for each measurement in the D and U plots, and count how many pairs had lower values in D.

12. Practice the calculation method on the practice dataset (q3 and q4), then graph the class means for plant cover and soak time.
13. Write your argument and answer the analysis questions.

Expected observations

- On most worn paths and shortcuts, plot D has lower plant cover, often half of plot U's or less, fewer plant kinds and shorter plants; the plants that remain tend to be low, tough kinds such as plantain, knotweed, clover or short lawn grasses.
- Water usually soaks into walked-on soil several times more slowly, and on a hard path the 100 mL may still be standing at 300 seconds.
- Animal counts vary the most. Many pairs show more animals in U, where litter and plant cover give shelter, but ants can be common on bare packed ground, and counts of zero to two are frequent in small plots.
- Usually most, but not all, pairs agree; one or two may reverse because of shade, watering, or a path that is used less than it looks.
- Indoor trays: the pressed trays usually have fewer and shorter seedlings and slower soaking than the unpressed trays.

Likely difficulties

- Plots that differ in more than trampling, such as one in shade and one in sun. The prepared pairs prevent most of this; ask the Plot keeper to record any difference in Table 1 rather than hide it.
- The point count drifts into guessing cover by eye. Insist on looking straight down at each mark and saying 'plant' or 'no plant' aloud.
- Water escapes under the soak ring on hard ground. Twist the ring in, press soil around the outside and pour slowly; if it still leaks, note it and repeat with the second cup in a new spot.
- Plant kinds are hard to tell apart without names. 'Looks different' is enough; consistency within the group matters more than botanical accuracy.
- Wet ground after rain or sprinklers makes the soak test meaningless. Postpone it, use the practice dataset, or run the indoor trays.

Structured debrief

1. Put the class table up and ask what repeats across pairs. Count the pairs that agree for each measurement before anyone talks about means.
2. Ask for a mechanism: how do feet change the soil, and how could packed soil change plants and animals? Lead to fewer and smaller spaces between soil grains, so less water and air soak in, roots push through hard ground with difficulty, and there is less litter and cover for small animals; feet also crush plants directly.
3. Discuss pairs that disagreed. A reversed pair is not a mistake to delete; it is the reason scientists want many pairs and look for differences such as shade or watering.
4. Connect to the chapter: this is the same with-and-without comparison scientists use for prairie dog colonies and beaver ponds. Use slide 22 to rate the class argument, and ask what would add before-and-

after evidence (survey a new shortcut before and after it forms, or a fenced path over months).

5. Close with succession: if the path were closed, the soil and the seeds in it would remain, so this would be secondary succession, starting with low, fast-growing plants that tolerate packed soil.

Recording sheet: what students fill in

Lab 3 recording sheet: Path or no path?

Pair number: _____. Plot **D** is on ground people walk on. Plot **U** is a few meters away on ground that is rarely walked on. Treat both plots exactly the same way, in the same order.

1. What evidence shows that plot D is disturbed and plot U is not, or is less? Name the disturbance, and say whether it changes a living part of the ecosystem, a nonliving part, or both.

Answer: Answers depend on the site. Typical: plot D is on a worn shortcut with bare, hard soil, flattened or missing plants and footprints, while plot U a few meters away has continuous plant cover and loose litter. The disturbance is trampling by people. It changes both a living part (plants are crushed or removed) and a nonliving part (the soil is packed down).

Why: Students should point to observable evidence rather than assume, and recognize that one disturbance can change living and nonliving components at once.

- Names the disturbance
- Gives at least two pieces of visible evidence
- Says it changes both living and nonliving parts (or explains which one)

2. Predict: for each measurement in Table 2, will plot D be higher, lower or about the same as plot U? Give a reason for your soak-time prediction.

Answer: Typical predictions: D lower in plant cover, plant kinds, plant height and animal counts; D longer in soak time, because feet press soil grains together and leave fewer and smaller spaces for water to enter.

Why: Any prediction earns credit when it is reasoned; the soak-time reason should involve compaction or pore space.

- A prediction for each measurement
- A compaction or pore-space reason for the soak-time prediction

Table 1. Site description

	Plot D (walked on)	Plot U (rarely walked on)
Sun or shade at survey time		
Slope (flat, gentle, steep)		
What covers the surface (bare soil, worn grass, plants, litter)		
Signs of people or other disturbance		

- ✎ Sketch a map of your plot pair from above: both squares, the path or worn area, one landmark (building, tree, fence), the direction of the sun, and where you did each soak test.

Answer: An overhead sketch showing both squares labeled D and U, the path or worn area running through or beside D, a named landmark, an arrow for the sun's direction, and marks for the two soak-test spots just outside the squares.

Why: The map documents the comparison and lets the group and teacher check later whether D and U really differed only in trampling.

- Both plots labeled with the path shown
- Landmark and sun direction
- Soak-test spots marked

Table 2. Measurements

Measurement	Plot D	Plot U	Difference (D – U)
Points touching a living plant (out of 25)			
Plant cover (%) = points × 4			
Number of plant kinds			
Tallest plant (cm)			
Animals seen in the 3-minute search			
Animals in the litter shake			
Kinds of animals seen			
Time for 100 mL to soak in (s)			

Table 3. Plant kinds

Kind	Description (leaf shape, size, flowers)	In D?	In U?
1			
2			
3			
4			
5			
6			

Session 2: the class data

Class data table

Pair	Cover D (%)	Cover U (%)	Kinds D	Kinds U	Animals D	Animals U	Soak D (s)	Soak U (s)
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Pair	Cover D (%)	Cover U (%)	Kinds D	Kinds U	Animals D	Animals U	Soak D (s)	Soak U (s)
1								
2								
3								
4								
5								
6								
7								
8								
Class mean								
Pairs where D was lower								

Practice data from another school

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Pair	Plant cover D (%)	Plant cover U (%)	Soak time D (s)	Soak time U (s)
1	28	84	240	45
2	40	76	285	60
3	12	92	210	38
4	52	64	150	70
5	36	84	270	52
6	48	44	135	95

Simulated teaching dataset, invented for practice. Use it to check your calculation method and to compare with your own class's results.

3. Practice data: calculate the mean plant cover for the D plots and for the U plots, and the difference between the means. In how many of the six pairs was cover lower in D? Suggest one reason pair 6 might not fit the pattern.

Answer: Mean cover in D = $(28 + 40 + 12 + 52 + 36 + 48) \div 6 = 216 \div 6 = 36.0$ percent. Mean cover in U = $(84 + 76 + 92 + 64 + 84 + 44) \div 6 = 444 \div 6 = 74.0$ percent. Difference = $74.0 - 36.0 = 38.0$ percentage points (D lower). Cover was lower in D in 5 of the 6 pairs (pairs 1 to 5). Pair 6 has slightly more cover in D (48) than in U (44); possible reasons: plot U was shaded by a tree or a building, that path is used only lightly, plot U was recently dug or mowed short, or tough trampling-tolerant grass fills the path.

Why: Mean = sum $\div$ number of pairs. The pair 6 question checks that students treat a reversed pair as information about other factors, not as a reason to throw out the pattern.

Also acceptable: Accept any physical reason for pair 6 that would lower cover in U or raise it in D.

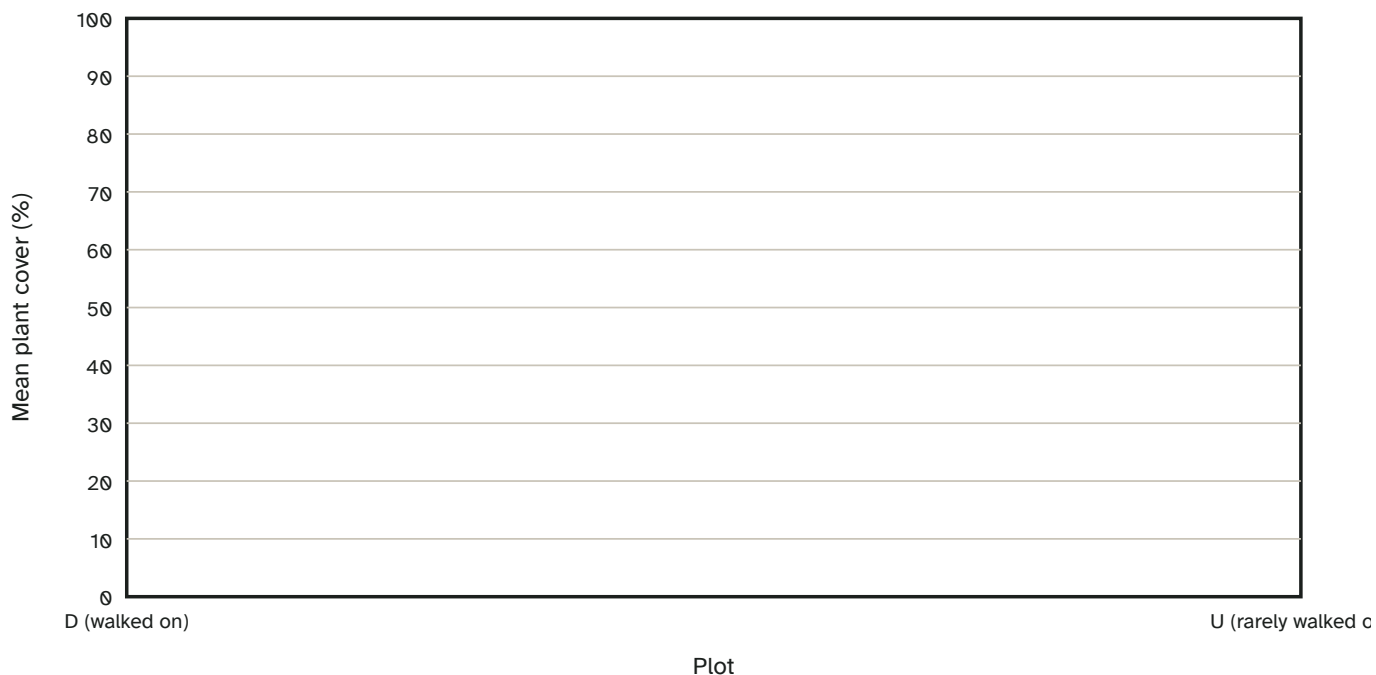
4. Practice data: calculate the mean soak time for the D plots and for the U plots. About how many times longer did water take to soak in on the walked-on plots?

Answer: Mean soak time in D = $(240 + 285 + 210 + 150 + 270 + 135) \div 6 = 1290 \div 6 = 215$ seconds. Mean soak time in U = $(45 + 60 + 38 + 70 + 52 + 95) \div 6 = 360 \div 6 = 60$ seconds. $215 \div 60 \approx 3.6$, so water took about 3.6 times as long (between 3 and 4 times) to soak in on the walked-on plots.

Why: Every pair, including pair 6, had a longer soak time in D, so the physical change is more consistent than the plant change in this dataset.

Also acceptable: Accept 'about 3.5 to 4 times'.

Class mean plant cover



Class mean soak time for 100 mL



Analysis questions: answer key

5. Using your **class** data, write a claim about how trampling affected the plant populations in the plots. Support it with at least two class means and the number of pairs that agree with the pattern.

Answer: Depends on the class data. Model response: Trampling reduced the plant populations in the plots. Across our 7 pairs, mean plant cover was 31 percent in walked-on plots and 72 percent in rarely walked-on plots, and the walked-on plots averaged 2.4 kinds of plants compared with 5.1. Cover was lower in D in 6 of the 7 pairs.

Why: This is the PE: a claim supported by empirical evidence. The specific numbers will differ; the claim must match the class data, even if the data show little or no difference.

Also acceptable: If the class data show no clear pattern, full credit goes to a claim that says so honestly and suggests why (few pairs, lightly used paths, mowing).

- A claim about plant populations that matches the class data
- At least two class means with units
- The number of pairs that agree, out of the total

6. Which nonliving condition did you measure, and how did it differ between D and U plots? Explain a mechanism that connects that difference to your plant results (and to your animal results, if they showed a pattern).

Answer: The soak time. Water typically took several times longer to soak into the walked-on soil. Mechanism: feet press soil grains together, leaving fewer and smaller spaces, so less water and air get into the soil. Roots get less water and oxygen and have trouble pushing through hard ground, seedlings fail to establish, and the plants that are left are crushed often, so cover and the number of kinds go down. With less plant cover and litter, small animals have less food, shade and shelter, so counts are often lower too.

Why: A strong mechanism links the measured physical change (compaction shown by slow soaking) to a resource (water, air, space for roots) and then to populations. Direct crushing is a second, biological cause and should be credited.

- Names the soak-time difference with direction
- Explains compaction reducing water (and air) in the soil
- Links that to plant (or animal) populations through a resource

7. Did the animal counts follow the same pattern as the plants? Give one possible reason they did or did not, and one way to collect better animal data.

Answer: Depends on the data. Often the animal counts are less consistent than the plants. Reasons: counts in a small plot are low, so chance matters; some animals, such as ants, do well on bare, packed, sunny ground; animals move, and counts change with time of day and temperature; a 3-minute surface search misses animals underground. Better data: more plots, repeated searches at the same time of day on several days, or pitfall traps (cups sunk level with the ground and checked within a few hours, with animals released).

Why: This tests whether students can explain a messy result instead of forcing it into the expected pattern.

- Answers yes or no from the data
- Gives a plausible reason
- Proposes a specific improvement

8. Name one difference between your D and U plots, other than trampling, that could have affected your results. How could you control it in a better study?

Answer: Examples: one plot got more shade or more sprinkler water; one plot was on a slope where water runs off; one plot was mowed and the other not; soil type differed; dogs used one area. Control: choose pairs matched for sun, slope, watering and mowing; measure the factor (soil moisture, light) and include it in the table; or survey many pairs so that random differences average out.

Why: Naming a confounding factor and a control is part of evaluating empirical evidence, which the PE's clarification emphasizes.

- A specific factor other than trampling
- A specific way to control or measure it

9. Suppose the path beside plot D were fenced off for five years. What kind of succession would happen there, primary or secondary? Predict what you would see first and what later, and explain why.

Answer: Secondary succession, because the soil and the seeds and roots in it are still there. First, low, fast-growing plants that tolerate packed soil and sun (common lawn weeds, clover, annual grasses) would spread from seeds in the soil and from the plants at the edges. Later, taller grasses and wildflowers, and in a garden bed perhaps shrubs, would move in as roots, earthworms and freezing and drying loosen the soil and litter builds up; small animals would return as cover increases. Cover would rise fastest in the first year or two and then more slowly.

Why: This connects the campus disturbance to the chapter's succession ideas: survivors and a seed bank make recovery fast, and early plants change conditions for later ones.

- Secondary succession with the soil-and-seeds reason
- An early stage and a later stage
- An explanation of what changes in between (soil loosening, litter, shade)

10. A strong argument uses before-and-after data, with-and-without comparisons, a mechanism, and repetition. Which of these did your class's evidence have, which was missing, and how could you add the missing one?

Answer: With-and-without: yes, every pair compared a walked-on plot with a nearby one that is rarely walked on. Repetition: yes, if the class pooled several pairs. Mechanism: partly, because the soak test measured a physical change that explains the plant results. Before-and-after: missing, because no plot was surveyed before it was trampled. To add it: survey a spot before a new shortcut forms and again after, or fence off a path and survey it every month for a season.

Why: This applies the four features from slide 22 to the students' own evidence. Students who say the mechanism is missing earn credit if they explain that the soak test is indirect and propose a direct test of compaction.

- Judges each of the four features
- Correctly identifies before-and-after as missing
- A practical way to add it

Individual evidence of learning

Each student keeps their own site tables, map, class data table and graphs and answers q1 to q10. The written argument in q5, built from the pooled class data, together with the mechanism in q6 and the evaluation of the evidence in q8 and q10, is the individual evidence for MS-LS2-4.

Assessment criteria

Criterion	Proficient looks like
Field measurements	Both plots measured the same way with every value recorded, including '300+' soak times and notes on anything unusual at the site.
Data analysis	Class means calculated correctly, agreeing pairs counted, practice calculations correct with units, and both graphs labeled.
Argument from evidence	A claim about plant (and, where supported, animal) populations backed by at least two class means and the count of agreeing pairs, with reasoning that links the soil change to the population results.

Evaluating the evidence	Names a real confounding factor and a way to control it, and judges the class argument against the four features of a strong argument.
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Accessibility adaptations

- Students who cannot go outside or cannot walk on uneven ground run the indoor tray version at a desk with the same measurements, or take the Recorder role at the plot edge from a paved path.
- Provide a meter stick with the five reading points highlighted and a printed 25-dot overlay for students who find the point count confusing.
- Hand lenses and a large-print picture key for students with low vision; a phone or tablet camera with zoom also works for the animal search.
- Sentence frames for the argument ('In __ of __ pairs, the walked-on plot had less __. The class means were __ and __. This happened because __.') and a bilingual word card (disturbed, packed, cover, soak, plot, mean) for multilingual learners.
- Students who need movement can take the Plot keeper and Animal searcher roles; students who need a quieter role can record and time.

Low-cost alternative

Run the indoor tray version only: two pairs of aluminum trays, a bag of potting soil and three packets of untreated seeds, with half the trays pressed daily by a bagged brick for about ten school days. Students read a 25-point grid in a 10 cm square, count seedlings by kind, measure the tallest, and time a 50 mL soak in each tray. Plastic produce clamshells or milk cartons cut lengthwise can replace the trays.

Model limitations

A 50 cm square is a tiny sample of a campus, and one survey on one day cannot show how the plots change over a season. D and U plots differ in more than trampling: paths often follow drier or sunnier ground, and lawns are mowed, watered and sometimes treated, so other factors may add to or hide the effect; matched pairs and pooling reduce this problem but cannot remove it. The soak test is an indirect measure of compaction and depends on how wet the soil was beforehand. Plant kinds sorted by appearance are not species. A 3-minute search misses most soil animals, and counts change with time of day and weather. The indoor trays model trampling with a brick and a few kinds of seedlings, not a real community. This lab has not been physically tested; the soak times, counts and timing given here are estimates, and the teacher's own trial at the chosen sites is the best guide.

Teacher notes

The practice dataset is simulated; its sums are 216 and 444 for cover (means 36.0 and 74.0 percent) and 1290 and 360 for soak time (means 215 and 60 s). Pair 6 is reversed for cover on purpose, but its soak times still follow the pattern. Keys for q1, q2 and q5 to q10 depend on the class's own data, so grade them by the criteria; credit honest claims that match weak or mixed data over claims that ignore the data. The q5 model response uses invented class numbers only to show the form of a full-credit answer. If weather prevents the field survey, run the indoor trays or use the practice dataset for the argument, and say that it is simulated. Bare, compacted path soils commonly hold water at the surface for minutes; if most D plots read '300+', report the soak result as 'at least 300 s' and compare the number of pairs instead of the means.