

Ants, Lizards and the Edge of Town: An Invasive Species CER

Learning target: I can write a claim-evidence-reasoning argument, using data, that an invasive species changed native ant diversity and a native predator population, and I can test the argument against another explanation.

Claim, evidence, reasoning

About 45 min

Individual

MS-LS2-4 · practice

MS-LS2-5 · supports

writing

data analysis

Standards connections

MS-LS2-4 (practice): Students construct a written argument from field and feeding-trial data that a change to a biological component of an ecosystem (an invasive ant) changed populations of native ants and of a predator that depends on them, the central practice of the PE. The data are simulated, so this is practice rather than an assessment of real empirical evidence.

MS-LS2-5 (supports): The last question asks students to propose a change at the neighborhood edge and a way to measure whether it maintains biodiversity, background for evaluating design solutions.

Purpose: practice · **Time:** about 45 minutes · **Format:** individual

Answers with reasoning

The scenario

Sage Hill Preserve is a patch of coastal sage scrub in Southern California with a neighborhood of houses and watered yards along one side. A biology class helped a park scientist survey the preserve. They set out lines of sampling stations at six distances from the edge of the houses. At each distance they placed 20 small baits (cookie crumbs on cards) to see which ants came, collected ants to count how many native ant species lived there, measured soil moisture, and searched for coast horned lizards for 10 hours.

Background facts — Argentine ants come from South America and were carried around the world by people. In California they need moist ground, so they do best near watered lawns and gardens, where their huge colonies spread outward. They attack native ant colonies and take over their food. Coast horned lizards are native California lizards that eat mostly native ants, especially large harvester ants. The lizards rarely eat Argentine ants, which are tiny.

Survey of Sage Hill Preserve by distance from the edge of the houses (teaching dataset)

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

Distance from houses (m)	Baits visited by Argentine ants (out of 20)	Native ant species found	Soil moisture (percent)	Horned lizards seen per 10 hours
25	19	2	14	0.0
75	16	3	11	0.2
150	11	5	8	0.5
300	4	8	5	1.2
500	1	10	4	1.8
800	0	11	4	2.0

Simulated data for teaching. The pattern, with Argentine ants crowded near watered edges and native ants and horned lizards farther away, matches what researchers have reported in Southern California scrub.

Feeding trial: change in body mass of young horned lizards over 6 weeks (teaching dataset)

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

Diet	Number of young lizards	Average change in mass (g)
Native ants only	8	1.2
Argentine ants only	8	-0.1

Simulated data for teaching, modeled on the direction of a published feeding experiment: young lizards grew on native ants but barely grew, or lost mass, on Argentine ants.

Warm-up: organize the evidence

1. What percent of the baits did Argentine ants visit at 25 m and at 800 m? How many more native ant species were found at 800 m than at 25 m? Show your calculations.

Answer: 25 m: $19 \div 20 \times 100 = 95$ percent of baits. 800 m: $0 \div 20 \times 100 = 0$ percent. Native ant species: $11 - 2 = 9$ more species at 800 m (5.5 times as many).

Why: Percent of baits is visits divided by 20; the species difference is a subtraction.

Also acceptable: Accept '11 compared with 2' if the difference of 9 is stated.

2. Between which two distances do Argentine ants drop from visiting more than half the baits to fewer than half? What happens to native ant species and to horned lizards over the same distances?

Answer: Argentine ants drop from 11 of 20 baits (55 percent) at 150 m to 4 of 20 (20 percent) at 300 m. Over the same distances, native ant species rise from 5 to 8, and horned lizards rise from 0.5 to 1.2 per 10 hours, more than doubling.

Why: The crossover distance is where the invaded zone ends, and the native measures change at the same place.

Also acceptable: None.

- Identifies 150 m to 300 m
- Describes the rise in native ant species
- Describes the rise in lizards

3. Draw a chain with arrows that links four things in the tables: soil moisture, Argentine ants, native ants and horned lizards. Write 'more' or 'fewer' on each arrow.

Answer: More soil moisture → more Argentine ants → fewer native ant species (and fewer native ants) → fewer horned lizards.

Why: The chain organizes the mechanism for the reasoning section: moisture explains where the invaders live, competition and attacks explain the native ant loss, and food explains the lizard decline.

Also acceptable: Accept a chain that starts with 'watered yards'.

- Four linked items in the correct order
- Correct 'more' or 'fewer' on each arrow

Your argument

Answer: Claim: The spread of invasive Argentine ants from the watered edge of the neighborhood reduced the number of native ant species near the houses and, as a result, reduced the horned lizard population there. Evidence: (1) At 25 m, Argentine ants visited 19 of 20 baits (95 percent), and only 2 native ant species were found; at 800 m, Argentine ants visited none of the baits, and 11 native ant species were found. (2) Horned lizards were never seen at 25 m (0.0 per 10 hours) but were seen 2.0 times per 10 hours at 800 m. (3) The change happens in the same place for all three: between 150 m and 300 m, Argentine ant visits fell from 11 to 4 baits while native species rose from 5 to 8 and lizards from 0.5 to 1.2. (4) In the feeding trial, young lizards fed native ants gained an average of 1.2 g in 6 weeks, while lizards fed Argentine ants lost 0.1 g. Reasoning: Argentine ants are an invasive species that attack native ant colonies and take their food, so where Argentine ants are common, native ant species disappear. Horned lizards eat mostly native ants, so losing the native ants removes the lizards' food; this is an indirect effect, because the invader harms the lizards through their prey rather than by attacking them. The lizards cannot simply switch to Argentine ants: the tiny ants are rarely eaten, and the feeding trial shows that young lizards on that diet do not grow, so a lizard population cannot be supported by them. The ants are crowded near the houses because soil there is moist (14 percent at 25 m compared with 4 percent at 500 m and beyond), and Argentine ants in California need moist ground, which explains why the effects are strongest near the edge.

Why: This is the solved model response. Full credit needs the cause and both effects in the claim, three or more numerical pieces of evidence including the feeding trial and a near-versus-far comparison, and reasoning that explains the indirect effect, the failed diet switch and the moisture link.

Also acceptable: A claim limited to native ants earns partial credit on the claim. A student who notes that the data are a correlation and that the feeding trial supplies the mechanism is reasoning at the highest level.

- Claim names Argentine ants as the cause and both native ants and horned lizards as effects
- At least three numerical pieces of evidence
- Evidence includes a near-edge versus far comparison and the feeding trial
- Reasoning explains the indirect effect through food
- Reasoning uses the feeding trial to explain why lizards cannot switch prey
- Reasoning links ant distribution to soil moisture

Test your argument

4. A neighbor says, 'The lizards near the houses are gone because pet cats hunt them.' Explain why the survey alone cannot rule this out. Then describe one more piece of evidence or one study that could tell whether cats or ants matter more.

Answer: Cats, like Argentine ants, are most likely near the houses, so both explanations predict fewer lizards near the edge, and the survey cannot separate them. Evidence that could help: survey a neighborhood edge where yards are not watered and Argentine ants are absent; if lizards are common there despite cats, ants matter more. Or count cat visits with trail cameras at each distance and check whether lizards drop where cats are common but Argentine ants are not. The feeding trial already supports a food explanation, but it does not rule out cats as an extra cause.

Why: Two causes that vary together cannot be separated by one survey; students need a comparison where they come apart.

Also acceptable: Accept fencing out cats from some plots near the edge and comparing lizard counts, or radio-tracking lizards to find causes of death.

- Explains that cats and ants both concentrate near houses
- Proposes evidence or a study that separates the two causes
- States what result would favor one explanation

5. Propose one change the neighborhood could make along the edge that might shrink the invaded zone. Use the soil moisture data to explain why it could work, and describe what the class should measure next year to find out whether it maintained or improved biodiversity.

Answer: Example: replace lawns along the preserve edge with drought-tolerant native plants and fix sprinklers so no water runs into the scrub. Soil moisture is 14 percent at 25 m but only 4 to 5 percent beyond 300 m, where Argentine ants are rare; drier soil at the edge should make it harder for the ants to survive and spread. Next year, repeat the same survey at the same six distances: if fewer baits near the edge are visited by Argentine ants and the number of native ant species and lizard sightings rise there, the change is maintaining or improving biodiversity.

Why: Researchers have suggested that reducing urban runoff could limit Argentine ant invasion of scrub. Students must link the design to the moisture evidence and plan a before-and-after measurement.

Also acceptable: Accept a dry buffer strip of native plants, or ant baits placed only in yards, if the moisture or ant reasoning and the monitoring plan are present.

- A specific change that reduces moisture at the edge
- Uses the soil moisture numbers
- Plans a repeat measurement of ants, native species and lizards
- States the result that would show success

Scoring rubric

Criterion	4 • Exemplary	3 • Proficient	2 • Developing	1 • Beginning
Claim	Names the Argentine ant invasion as the cause and both effects (fewer native ant species, fewer horned lizards) in one clear statement about Sage Hill.	Names the cause and one effect clearly; the second effect is missing or vague.	States an effect without the cause, or blames the houses without naming the invasive ants.	No claim, or a claim unrelated to the data.

Evidence	Three or more specific values from the tables, including a near-edge versus far comparison and the feeding trial result.	Three pieces with numbers, but the feeding trial or the near-versus-far comparison is missing.	One or two pieces of evidence, or evidence described without numbers.	Evidence missing, invented, or contradicting the tables.
Reasoning	Explains the lizard decline as an indirect effect through native ants, uses the feeding trial to explain why lizards cannot switch prey, and links the ants' location to soil moisture.	Explains the indirect effect correctly and links evidence to the claim, but omits the diet-switch or the moisture link.	Restates the evidence, or says the ants 'kill the lizards' without the food link.	No reasoning, or reasoning that ignores how the species interact.
Scientific language and accuracy	Uses invasive species, native, population, species richness and indirect effect correctly; no scientific errors; distinguishes the survey pattern from proof of cause.	Uses most terms correctly with one minor error.	Uses everyday language in place of key terms or makes one significant error.	Several errors, or terms used incorrectly throughout.

Teacher notes

Both datasets are simulated but follow the direction of real findings: in Southern California coastal scrub, Argentine ants (*Linepithema humile*) are most abundant near developed, watered edges and replace most native ground-foraging ants (Suarez, Bolger and Case, 1998); coast horned lizards are scarcer where Argentine ants have invaded (Fisher, Suarez and Case, 2002); and in feeding trials, young lizards grew on native ants but had near-zero or negative growth on Argentine ants (Suarez and Case, 2002). Researchers have suggested that reducing runoff from irrigation along preserve edges could limit invasion, but treat q5 answers as proposals to be tested, not proven solutions. Expect students to want to say the ants 'kill' the lizards; push them to the food link, which is the indirect effect the PE emphasizes. In q4, the point is that two causes concentrated near houses cannot be separated by one survey; students who suggest comparing a dry-landscaped edge are thinking like ecologists. This sheet pairs with Lab 2's causal-chain reasoning, in a different ecosystem.

Scaffold offered to students: Building the reasoning

Reasoning connects your evidence to your claim with a science idea. Try these frames. 'Argentine ants affect horned lizards indirectly, because ____.' 'The feeding trial shows that even if lizards ate Argentine ants, ____.' 'The soil moisture column explains where the ants are, because ____.' Use the words *invasive species*, *native*, *population*, *indirect effect* and *species richness* at least once each.

Extension: Dry buffer strip or dry yards?

The preserve manager could build a strip of dry, native plants 100 m wide between the yards and the scrub, or stop all watering of the three yards closest to the preserve. Use the dataset to predict how far into the preserve each choice would move the edge of the Argentine ant zone. Then explain which choice you would test first, what you would measure, and how long you would need to wait before deciding whether it worked.