

Fixing Talia's Field Notebook: Nine Claims About Interactions

Learning target: I can find the errors in another student's graph and claims about species interactions, explain which idea went wrong, and rewrite each claim so it is scientifically accurate.

Error analysis

About 40 min

Individual

MS-LS2-2 · practice

writing

independent practice

visual modeling

Standards connections

MS-LS2-2 (practice, the cause-and-effect reasoning an explanation of interaction patterns depends on): Diagnosing and repairing a flawed account of predator-prey timing, interaction labels and population consequences exercises the reasoning students need before they can construct explanations that predict patterns of interaction across ecosystems. No new cross-ecosystem prediction is assessed on this sheet.

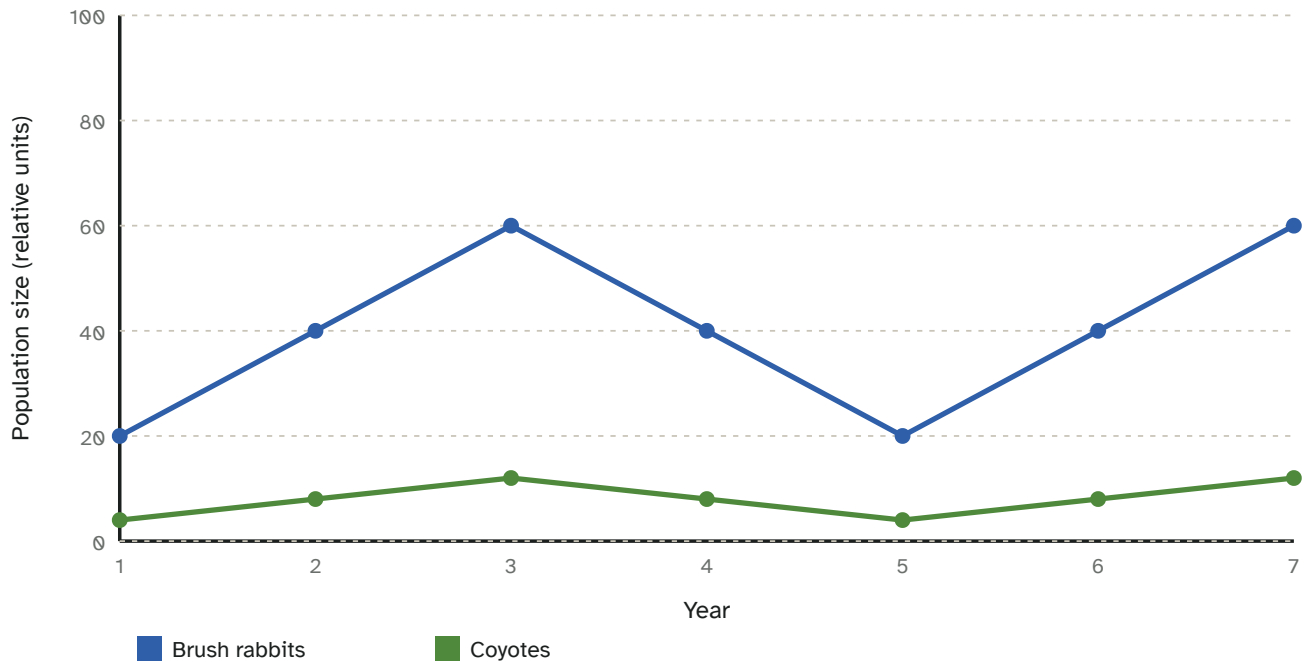
Purpose: practice · **Time:** about 40 minutes · **Format:** individual

Answers with reasoning

Camp facts Talia was given — Coyotes hunt brush rabbits in the coastal scrub; rabbits and small rodents make up much of their diet. Black-tailed deer browse the leaves and twigs of shrubs; inside fenced plots where deer cannot reach, the same shrubs grow taller and make more seeds. Gray whales pass the coast each spring with barnacles fixed to their skin; scientists have found no measurable harm to the whales. Ticks wait on grass stems, climb onto deer and drink their blood for several days before dropping off. Bees visit sage flowers for nectar and pollen, and pollen stuck to their bodies is carried to the next flower. European starlings and western bluebirds both nest in tree holes, and there are fewer holes than pairs of birds. Raccoons at camp ate crayfish, frog eggs, blackberries and fallen plums; about three-quarters of their food was fruit.

Talia's sketch: brush rabbits and coyotes over seven years

simulated data



Talia drew this sketch from memory to show what she thinks happens. It is not real data, and it contains a mistake.

1. My graph shows rabbits and coyotes rising and falling at the same time. That makes sense: the moment rabbits increase, coyotes increase too.
2. Coyotes are predators, so if nothing stops them they will keep eating rabbits until the last rabbit is gone. Predators always win in the end.
3. The best way to protect the brush rabbits would be to remove every coyote. Then no rabbits would be eaten, and the rabbit population would grow and stay healthy forever.
4. The barnacles on the gray whale are parasites, because they live on another animal's body.
5. Ticks are insects. They are predators of deer, because they feed on the deer.
6. Bees visit the sage flowers in order to help the plants make seeds. Mutualism means two species decide to cooperate.
7. When a deer browses a shrub, that is not predation, because the shrub does not die. So deer have no real effect on the shrub population.
8. Starlings usually win the nest holes, so for starlings the interaction is + and for bluebirds it is -. That is the same code as predation.
9. The raccoons are omnivores, even though most of what they ate was fruit, because they regularly eat both plants and animals.

Part A: Diagnose

1. Complete the table for all nine claims. If a claim is partly right, mark it incorrect and name only the part that is wrong.

Answer: 1: incorrect; no lag (predator changes follow prey changes). 2: incorrect; scarce prey makes the predator population fall, so the prey can recover. 3: incorrect; prey without predators outgrow their food supply and crash. 4: incorrect; labeled by where it lives, not by its effect (barnacles are commensals). 5: incorrect; ticks are arachnids, not insects, and they are parasites, not predators. 6: incorrect; mutualism needs no intention; each partner is getting food or a service for itself. 7: incorrect; in this lesson browsing is predation, and deer reduce shrub growth and seeds. 8: incorrect; competition is – –, because the winner also gets less than it would alone. 9: correct.

Why: Eight of the nine claims contain an error drawn from the chapter's misconception list; claim 9 is correct on purpose so that students judge each claim instead of marking everything wrong.

Also acceptable: Accept 'partly correct' for claim 4 or 5 if the wrong part is named. Accept 'forgets that predators depend on prey' for claim 2.

- Claims 1-8 marked incorrect and claim 9 marked correct
- Each error named as an idea (lag, feedback, effect test, intention, herbivory counts, both lose in competition), not just 'wrong'
- Claim 5 flagged for both errors

Part B: Explain, rewrite and redraw

2. Claim 1: Explain why the coyote population cannot rise at the same moment the rabbit population rises. Describe what has to happen inside the coyote population first.

Answer: Coyotes become more numerous only when more pups are born and survive (or when coyotes move in from elsewhere). A season with plenty of rabbits lets coyote pairs feed and raise more pups, but those pups must grow before they are counted as hunting adults, so the coyote rise comes after the rabbit rise, often by about a year.

Why: The mechanism of the lag is reproduction and growth, which take time; this is the same reasoning as the lynx, fox and owl examples elsewhere in the chapter.

Also acceptable: Accept 'coyotes need time to have babies and for the babies to grow up.' Accept coyotes moving in from nearby as a faster but still delayed response.

- Says predator numbers rise through more young being born and surviving
- Says raising young to adulthood takes time, so the predator rise comes later

- ✎ Redraw Talia's graph correctly. Copy her rabbit line (lows in years 1 and 5, peaks in years 3 and 7). Then draw a coyote line, below the rabbit line, that keeps the same up-and-down shape but shows the lag. Mark one rabbit peak with R and the coyote peak that follows it with C, draw a bracket for the lag and write its length, and add a key.

Answer: Rabbit line copied from the sketch: low in years 1 and 5, peaks in years 3 and 7. Coyote line drawn lower with the same shape shifted about one year later: low about year 2, peak about year 4, low about year 6, rising again at year 7. R on the year-3 rabbit peak, C on the year-4 coyote peak, a bracket between them labeled 'lag about 1 year', axes labeled and a key.

Why: The redraw keeps Talia's prey line and shifts only the predator line, which isolates the one idea she missed. Exact heights are not assessed; order, the lag and the lower predator line are.

Also acceptable: A lag of one to two years is acceptable. A coyote peak drawn in the same year as a rabbit peak is the error to flag.

- Rabbit line matches the sketch
- Coyote peaks and lows placed after the matching rabbit peaks and lows
- Coyote line below the rabbit line
- R, C, lag bracket with a length, and a key

3. Claim 2: Describe what usually happens to a predator population as its prey becomes scarce, and how that lets the prey recover. Rewrite the claim, and name one kind of situation in which a predator really can wipe out its prey.

Answer: As rabbits become scarce, each coyote finds less food, fewer pups survive, and some adults starve or leave, so the coyote population falls. With fewer coyotes hunting, more rabbits survive and breed, and the rabbit population rises again. Rewrite: 'Coyotes eat rabbits, but when rabbits become scarce the coyote population usually falls too, which lets the rabbits recover. A predator does not usually eat its prey down to the last one.' Situation where it can: a new predator arrives in a place where the prey has no defenses and nowhere to hide, such as a predator brought to an island, or a predator that can switch to other food and so stays common while the prey disappears.

Why: Claim 2 follows only one arrow of the loop. The textbook notes that carnivores can sometimes eliminate prey, so the rewrite should say 'usually' rather than 'never'.

Also acceptable: A student who adds that coyotes also eat rodents and fruit, so they might not decline when rabbits do, is reasoning well; that makes the rabbits more vulnerable, which is exactly the exception case.

- Predator population falls as prey become scarce
- Fewer predators lets prey recover
- Rewrite says predators usually do not wipe out prey
- Names a real kind of exception (island, new predator, predator with other food)

4. Claim 3: Predict what would happen over several years to the rabbits, and to the plants they eat, if every coyote were removed. Then rewrite the claim.

Answer: Without coyotes, more rabbits survive and breed each year, so the rabbit population grows fast at first. Eventually there are more rabbits than the shrubs and grasses can feed. The rabbits overgraze, food runs short, rabbits weaken and disease spreads more easily in a crowded population, and the population crashes. The plants are damaged along the way. Rewrite: 'Removing every coyote would let the rabbit population grow for a while, but without predators the rabbits would eat plants faster than they can regrow, and the population would later crash from hunger and disease. Predators help keep prey numbers within what the habitat can feed.'

Why: This is the chapter's 'remove the predators' misconception (slide 23). Yellowstone elk without wolves and sea urchins without otters are real examples of prey overeating their food.

Also acceptable: Accept an answer that uses Yellowstone elk or urchins and kelp as supporting evidence. Accept 'the rabbits would run out of food' as the core idea.

- Predicts an increase followed by overgrazing
- Predicts a later crash from food shortage or disease
- Mentions harm to the plants
- Rewrite states that predators help keep prey within what the habitat can feed

5. Claims 4 and 5 label an interaction using the wrong clue. State the test that decides the label, then rewrite both claims correctly. Claim 5 also has a second error that is not about the interaction; fix it too.

Answer: Test: ask what the interaction does to each partner (helped +, harmed –, or no measurable effect 0), not where the organism lives or what it does. Claim 4 rewrite: 'The barnacles on the gray whale are commensals: they gain a place to live and a ride to new feeding water, and scientists have found no measurable effect on the whale (+ 0).' Claim 5 rewrite: 'Ticks are arachnids, relatives of spiders and mites, not insects. They are parasites of deer: they stay on a living host and drink small amounts of its blood over several days, which can weaken the deer but usually does not kill it (+ –).'

Why: Living on another organism is shared by commensals, parasites and some mutualists, so it cannot decide the label. A parasite takes a little at a time from a living host; a predator eats all or part of its prey. The tick fix also corrects the textbook caption that calls a tick an insect.

Also acceptable: Accept 'ticks have eight legs, so they are not insects' as the second fix. Accept 'as far as scientists can tell' wording for the whale.

- States the effect-on-each-partner test
- Barnacles relabeled commensalism with + 0
- Ticks relabeled parasites with + – and the host-feeding reason
- Ticks identified as arachnids, not insects

6. Claim 6: Say what each partner actually gets, and explain why neither one has to 'decide' anything for the interaction to be a mutualism. Rewrite the second sentence as an accurate definition.

Answer: The bees get food (nectar and pollen); the sage gets pollen carried to other flowers, so it can make seeds. Each partner is getting something for itself: the bee is feeding, and pollen moves as a side effect. Over many generations, plants whose flowers fed bees well and bees that used those flowers left more offspring, so the partnership became common without anyone choosing it. Rewrite: 'Mutualism is an interaction in which both species end up better off (+ +), whether or not either one is trying to help.'

Why: Mutualism describes outcomes, not intentions. Plants have no intentions at all, and a bee's visit is driven by its own need for food.

Also acceptable: A student who says the traits spread by natural selection is giving a strong, correct explanation.

- Names the benefit to each partner
- Explains that no decision or kindness is needed
- Rewritten definition is outcome-based (+ +)

7. Claim 7: Use the camp facts to show that deer do affect the shrub population, and explain why this lesson counts browsing as predation. Rewrite the claim.

Answer: The camp facts say that inside fences where deer cannot reach, the same shrubs grow taller and make more seeds. So deer outside the fences reduce shrub growth and seed production, which means fewer new shrubs in later years. This lesson counts any organism that gets food by eating all or part of another living thing as a predator, so a browsing deer is a predator (an herbivore) of the shrub even though the shrub survives. Rewrite: 'When a deer browses a shrub, that counts as predation in this lesson: the deer gains food (+) and the shrub loses leaves and grows less (–). Deer reduce shrub growth and seed production even when the shrub survives.'

Why: The fenced-plot comparison is the evidence; the broad meaning of predator is the lesson's rule (many biology texts call this herbivory as a separate category).

Also acceptable: Accept 'herbivory, which this lesson treats as a kind of predation.'

- Uses the fenced-plot fact as evidence
- States that eating part of a living plant counts as predation in this lesson
- Rewrite gives + for deer and – for shrub

8. Claim 8: Explain why the species that usually wins a competition still gets a minus. Give the correct code and name for this interaction, and rewrite the claim.

Answer: In competition each species ends up with less of the shared resource than it would have if the other species were absent. Starlings would have even more nest holes without bluebirds, and they spend time and energy fighting for the holes they take, so starlings get a minus too. The code is – –, competition. Predation (+ –) would require one species to eat the other, and starlings do not eat bluebirds. Rewrite: 'Starlings and bluebirds compete for nest holes. Starlings usually win, but both species end up with fewer holes than they would have alone, so the code is – – (competition).'

Why: Students confuse 'winning' with 'benefiting'. The comparison is to life without the competitor, not to the other species.

Also acceptable: Accept 'both lose something, even the one that gets more' with the comparison to having no competitor.

- Explains the winner still gets less than it would alone
- Code – – and the name competition
- Rewrite is accurate

9. Claim 9 is correct. Explain why an animal does not have to eat equal amounts of plant and animal food to be an omnivore.

Answer: An omnivore is defined by regularly eating both plants and animals, not by eating them in equal amounts. The raccoons ate crayfish and frog eggs as well as fruit, so even with three-quarters fruit they regularly eat animals and are omnivores, just as black bears that eat mostly plant food are omnivores.

Why: This corrects the textbook's 'similar amounts' wording; the key is regular use of both food types.

Also acceptable: Accept any correct example of a mostly-plant omnivore.

- States that both foods must be regular, not equal
- Uses the raccoon evidence

Part C: The rules behind the mistakes

10. Claims 1, 2 and 3 all come from the same missing idea about how predator and prey populations affect each other. Name that idea, and write a two-sentence rule Talia could tape inside her notebook that would prevent all three mistakes.

Answer: Missing idea: predator and prey populations affect each other in both directions (feedback), and every change takes time. Example rule: 'Predator and prey numbers push on each other both ways, with a delay: plenty of prey brings more predators a season or more later, many predators bring the prey down, and scarce prey bring the predators down. Take the predators away and the prey grow until their own food runs short.'

Why: Claim 1 misses the delay, claim 2 misses the arrow from scarce prey back to predators, and claim 3 misses the limit set by the prey's own food. A two-way, delayed loop with a food limit blocks all three.

Also acceptable: Accept 'it is a loop, not a one-way street' if each part of the loop and the delay are stated.

- Names two-way cause and effect (feedback) between predator and prey
- Includes the delay
- Includes that prey without predators are limited by food
- Rule is two sentences and would prevent claims 1, 2 and 3

11. Claims 4, 5, 7 and 8 each name an interaction from a misleading clue: where an organism lives, what it eats, whether the other partner dies, or who wins. Write the one question Talia should ask about each partner every time she labels an interaction, and say what she should do with the two answers.

Answer: Question for each partner: 'Is this partner better off, worse off, or unaffected because of the interaction (+, – or 0), and what is the evidence?' Then put the two answers together and look up the pair: + + mutualism, + 0 commensalism, – – competition, + – predation or parasitism (predation if the gainer eats all or part of the other, parasitism if it lives on or inside a living host and takes a little at a time).

Why: One effect question per partner, answered with evidence, replaces all four misleading clues.

Also acceptable: Accept 'helped, harmed or no change?' asked twice with the lookup described.

- A question about the effect on each partner
- Combining the two answers into a code that names the interaction
- The extra step for + – (eats versus lives on a host)

Teacher notes

Talia's page is built from the chapter's misconception list: predator and prey moving together (claim 1, linked from slide 9), predators always winning (2), removing predators to help prey (3, linked from slide 23), 'lives on

it means parasite' (4), the textbook caption's 'tick is an insect' plus predator-for-parasite (5), mutualism as intention (6), herbivory not counting (7) and the competition winner as plus (8). Claim 9 is correct and reinforces the accurate omnivore definition. The camp facts are simplified but realistic for the California coast: coyotes do take brush rabbits, deer exclosures commonly show more shrub growth and seed, and gray whale barnacles have no measured cost to the whale, which is why the commensal label is given 'as far as scientists can tell'. The figure is labeled simulated because it is an invented sketch. In the extension, the brown tree snake on Guam (most native forest birds lost after the snake's accidental introduction in the 1940s-1950s) and cheating cleaner wrasse are real, well-documented cases; the point is that exceptions have special causes (a predator new to an island; a partner that sometimes takes more than it gives). Use q10 and q11 as the closing discussion; they are the two rules that W10 tests.

Scaffold offered to students: Three checks for every claim

Run each claim through three checks. **Timing:** does it say two populations change 'at the same time' or 'the moment' something happens? Populations grow through births and young growing up, which takes time. **Feedback:** does it follow only one arrow (predators lower prey) and forget the arrow back (scarce prey lower predators; prey without predators run short of food)? **Effect:** does it label an interaction by where an organism lives, what it is called or who wins, instead of by whether each partner ends up helped (+), harmed (–) or unaffected (0)? A claim that fails any check is incorrect.

Extension: When the real world seems to agree with Talia

Some real cases look as if they support Talia's claims. Choose one. (a) Brown tree snakes, carried by accident to the island of Guam after World War II, wiped out most of the island's native forest birds. (b) A small reef fish called a cleaner wrasse usually eats parasites off larger fish, but it sometimes bites off a mouthful of the client's protective skin mucus instead. Write a paragraph explaining which of Talia's claims your case seems to support, what makes the case unusual, and why it does not prove her claim is true in general.