

Interactions Among Organisms: Mastery Check

Learning target: I can classify interactions with plus, minus and zero codes, read and predict predator-prey patterns, predict ripple effects in an ecosystem I have not studied, and tell a criterion from a constraint.

Retrieval and mastery check

About 40 min

Individual

MS-LS2-2 · assesses

MS-ETS1-1 · practice

independent practice

writing

Standards connections

MS-LS2-2 (assesses, short explanations that predict interactions and population changes in new ecosystems, and the synthesis paragraph): Items 6, 7 and 10 ask students to predict population changes from stated interactions in a kelp forest, a coral reef and a desert, and the synthesis asks them to explain one interaction, predict a change, and name the same pattern in a different ecosystem. Together these give evidence of explaining and predicting patterns of interaction across ecosystems.

MS-ETS1-1 (practice, telling criteria from constraints and making a criterion measurable): Two items check that students can tell what a design must do from what limits it, and can rewrite a vague criterion so it can be tested, including a constraint that protects the animals being studied. This retrieves the practice from Lab 3 and W9 rather than assessing the full PE.

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

Answers with reasoning

Part A: Retrieval and application (items 1-11)

1. [2] A gray fox eats mice, insects and bird eggs in spring, and mostly berries and manzanita fruit in late summer and fall. Which word fits it best, in the way this lesson uses the words? 2 pts

Answer: C. Omnivore, because it regularly eats both plants and animals.

Why: An omnivore regularly eats both kinds of food; the mix does not have to be equal and can change with the season. A is wrong because the fox also eats a great deal of fruit; B is wrong because it regularly eats animals; D is wrong because in this lesson eating plant parts counts as predation.

Also acceptable: None.

2. [2] A leech attaches to a western pond turtle's leg, drinks a little blood for several hours, then drops off. The turtle swims away, weakened slightly but alive. Which interaction best describes this? 2 pts

Answer: B. Parasitism, because the leech feeds on a living host a little at a time without killing it.

Why: The leech attaches to a living host and takes a small amount over hours, leaving the host weakened but alive, which is parasitism (+ -). A is tempting because the leech does take part of the turtle, but a parasite is defined by staying on a living host and feeding on it over time, which is what the leech does; C ignores the harm to the turtle; D does not apply because the leech feeds on the turtle rather than sharing a resource with it.

Also acceptable: None.

3. [2] True or false: 'In competition, the species that wins most of the resource gets a +.' Circle your answer and explain. 2 pts

Answer: False. Both competitors get a minus, because each ends up with less of the shared resource than it would have if the other species were not there. The winner still loses some of the resource and spends time and energy competing.

Why: Competition is – –; 'winning' is measured against the other species, but the code compares each species with life without its competitor.

Also acceptable: Accept 'the winner would have even more without the other species, so it is still harmed.'

- Circles false
- Explains that each competitor gets less than it would alone

4. [2] A biologist counts barn owls and the meadow voles they mainly eat every year for twenty years. 2 pts
If the two populations are linked mainly by predation, which pattern should she expect?

Answer: B. Owl peaks that come a year or so after vole peaks, in a pattern that repeats but not on an exact schedule.

Why: Predators respond to prey after a delay because raising young takes time, and real cycles vary in timing and height. A ignores the lag, C reverses cause and effect, and D ignores that scarce prey reduce the predator.

Also acceptable: None.

5. [3] Teaching numbers for an island: winter 1 had 1,250 moose and 25 wolves; winter 4 had 800 moose and 20 wolves. (a) Calculate the percent change in moose from winter 1 to winter 4. (b) Calculate the moose per wolf in each winter. (c) What do your results predict about the wolf population over the next few winters, and why? 3 pts

Answer: (a) $(800 - 1,250) \div 1,250 \times 100 = -450 \div 1,250 \times 100 = -36$ percent (a 36 percent decrease). (b) Winter 1: $1,250 \div 25 = 50$ moose per wolf. Winter 4: $800 \div 20 = 40$ moose per wolf. (c) Each wolf has less prey available (40 moose per wolf instead of 50), so fewer wolf pups are likely to survive and the wolf population is likely to keep falling over the next few winters, trailing the moose decline.

Why: The prey fell faster (–36 percent) than the predator (–20 percent: $(20 - 25) \div 25 \times 100$), so food per predator dropped; the lag pattern predicts a further predator decline.

Also acceptable: Accept '36% decrease'. For (c), a student who adds that disease or winter conditions could also change the wolves is reasoning well; the main prediction is still a decline.

- Percent change –36% with work shown
- 50 and 40 moose per wolf
- Predicts a continuing wolf decline with the food-per-wolf reason

6. [3] Draw three boxes labeled sea otters, purple sea urchins and giant kelp. Draw an arrow for each interaction between them and label it with the interaction's name and its two codes. Then write ↑ or ↓ next to each box to show what happens to that population if the otters disappear. 3 pts

Answer: Arrow between otters and urchins labeled 'predation: otter +, urchin -'. Arrow between urchins and kelp labeled 'predation (an herbivore eating a plant, in this lesson): urchin +, kelp -'. No direct arrow between otters and kelp, or a dashed arrow labeled 'indirect'. If otters disappear: otters ↓, urchins ↑, kelp ↓.

Why: Losing the otters removes the urchins' predator, so urchins increase (direct), and more urchins eat more kelp, so kelp decreases (indirect), as on California reefs where otters were hunted out.

Also acceptable: Accept 'herbivory' for the urchin-kelp arrow if the codes are + -.

- Two predation arrows with correct codes
- Urchins ↑ and kelp ↓ (otters ↓ or absent)
- No claim that otters affect kelp directly

7. [3] A teaching scenario from a coral reef: groupers eat parrotfish; parrotfish scrape algae off rock and dead coral; algae compete with young corals for places to settle. Fishing boats remove most of the groupers. Predict what happens to the parrotfish, the algae and the young corals, and label each change as direct or indirect. 3 pts

Answer: Parrotfish increase: direct effect, because their predator (groupers) has been removed. Algae decrease: indirect effect, through the larger number of parrotfish grazing them. Young corals increase: indirect effect, because with less algae there is less competition for places to settle.

Why: The chain passes through predation (grouper-parrotfish), predation by a grazer (parrotfish-algae) and competition (algae-coral). Only the parrotfish share an arrow with the groupers.

Also acceptable: A student who adds that the effect on corals would take longer to appear because it passes through two other populations is giving a stronger answer.

- Parrotfish up, labeled direct
- Algae down, labeled indirect
- Young corals up, labeled indirect, with the competition reason

8. [2] A team is designing a shield that protects a frog-call recorder from highway noise. Which statement is a **constraint** rather than a criterion? 2 pts

Answer: C. The shield must cost no more than \$100 and use no plastic netting that could trap snakes.

Why: Cost and a ban on harmful materials limit which designs are allowed (constraints). A, B and D describe what the shield must achieve (criteria).

Also acceptable: None.

9. [2] A ranger writes this criterion for a new wildlife camera: 'It should work well at night.' Rewrite it so it can be tested, and add one constraint that protects the animals being filmed. 2 pts

Answer: Example criterion: 'Between sunset and sunrise, the camera records a clear, identifiable image of at least 9 out of 10 test animals (or people walking as stand-ins) that pass within 5 m of it.' Example constraint: 'It uses infrared light invisible to most mammals, with no bright white flash or sound, so the animals are not startled or driven away.'

Why: A testable criterion names what is measured, a number and the conditions; the constraint must protect the animals.

Also acceptable: Accept other measurable criteria (battery lasts at least 10 nights; detects motion at 8 m in darkness) and other protective constraints (no bait, mounted away from trails animals use to reach water, no strong scent).

- Criterion includes a measurable quantity and conditions (night, distance or count)
- Constraint limits the design to protect the animals

10. [3] In one desert valley, yucca moths are the only insects that pollinate the yuccas, and yucca moth caterpillars eat only yucca seeds. Pesticide drifting from nearby farms kills most of the moths. Using the interaction's code, predict what happens to the yucca population over the next twenty years, and explain why the change might be slow to show up in a count of adult yuccas. 3 pts

Answer: The yucca and the moth are mutualists (+ +) that depend only on each other. With most moths gone, few yucca flowers are pollinated, so few seeds form and few new yuccas start; over twenty years the yucca population should decline as old plants die without being replaced. Surviving moths have plenty of flowers, but their numbers can recover only if enough of them survive and the pesticide stops. The decline may be slow to show in a count of adult yuccas because adult yuccas can live for decades; the missing seedlings show up first, and the adult count falls only as old plants die.

Why: Partners that depend only on each other decline together; the lag comes from the long life of the adult plants, the same kind of delay seen in predator-prey graphs.

Also acceptable: Accept 'the yuccas would slowly die out in that valley' with the seed reason and the delay.

- Names mutualism with + +
- Predicts fewer seeds and a yucca decline
- Explains the delay with the long life of adult yuccas

11. [2] A cleaner fish eats algae and small parasites off a sea turtle's shell. Barnacles ride on a gray whale. One pair is a mutualism and the other is a commensalism. Identify each, and explain how the effect on the turtle and on the whale decides the label. 2 pts

Answer: Cleaner fish and sea turtle: mutualism, because the turtle is helped (+), its shell kept clean and its parasites removed, while the fish gets food (+). Barnacles and gray whale: commensalism, because the whale shows no measurable effect (0) while the barnacles gain a place to live and a ride to food (+).

Why: The partner that does not 'do' the feeding decides the label: helped means mutualism, unaffected means commensalism.

Also acceptable: Accept 'as far as scientists can tell' for the whale's 0.

- Turtle pair named mutualism with the turtle +
- Whale pair named commensalism with the whale 0

Part B: Synthesis (item 12)

Remember the bullhorn acacia from the start of the lesson. The tree grows hollow thorns that ant colonies live in, and it feeds the ants with sugary nectar and small food packets. The ants sting insects and grazing animals that touch the tree and chew away vines and seedlings that crowd it. Trees whose ants were removed were chewed, overgrown by vines and grew far less than trees that kept their ants.

12. [4] Write one paragraph that does all four of these things. (1) Names the interaction between the acacia and its ants, rates each partner with +, – or 0, and says what each partner gets. (2) Predicts what would happen to the acacia population, and to the ants, if a disease killed most ant colonies, and explains why some of the change could show up only after a delay. (3) Names an interaction with the same code from a different ecosystem and explains why the same pattern appears even though the species are completely different. (4) Names one thing that a first explanation of the acacia often gets wrong (for example, about why the tree 'pays' the ants) and corrects it. If you wrote a first explanation in Worksheet 1, use your own. 4 pts

Answer: Model paragraph: The acacia and its ants are a mutualism, + for the tree and + for the ants: the ants get food (nectar and food packets) and a home in the hollow thorns, and the tree gets guards that drive off leaf-eaters and clear away vines and crowding seedlings. If a disease killed most ant colonies, the acacias would be chewed and overgrown, grow less and make fewer seeds, so the acacia population would decline; the ants that survived would have plenty of trees, but if the trees decline, the ants lose food and homes too. Some of the change would appear only after a delay, because grown trees can survive several bad years, while the missing young trees show up later. The yucca and yucca moth in the desert have the same + + code: the moth pollinates the yucca and its caterpillars eat some of the seeds. The pattern repeats because the cause and effect come from what each partner gains, not from which species they are, so wherever two species each supply something the other needs, the same pattern, and the same risk when one partner is lost, appears. A common mistake in first explanations is saying the tree 'decides' to pay the ants or is being kind; in fact, over many generations, trees that happened to feed ants lost fewer leaves and left more seeds, so the trait became common.

Why: Grade against the four required parts, not the wording of the model. Each of the four parts is worth 1 point.

Also acceptable: Any accurate + + example from another ecosystem is acceptable (clownfish and anemone, fig and fig wasp, cleaner fish and sea turtle, lichen partners, bees and flowers). For part 4, a student who quotes and revises their own Worksheet 1 explanation earns full credit for that part.

- Names mutualism with + + and what each partner gets
- Predicts the acacia decline (and an effect on the ants) and explains a delay
- Names a + + interaction from a different ecosystem and explains that the pattern comes from the interaction, not the species
- Identifies and corrects a common error in the first explanation (intention, 'wasted' nectar, or ignoring the evidence)

Teacher notes

Points: q1 2, q2 2, q3 2, q4 2, q5 3, q6 3, q7 3, q8 2, q9 2, q10 3, q11 2, q12 4; total 30. Item map: classification and codes (q1, q2, q3, q11), predator-prey pattern and lag (q4, q5), ripple predictions in ecosystems not studied in class (q6, q7, q10), criteria versus constraints (q8, q9), and the synthesis (q12), which revisits the W1 phenomenon. q3 and q11 test the effect-on-each-partner rule from W7; q4, q5 and q10 test the two-way, delayed feedback rule. The moose and wolf numbers in q5 are teaching numbers, not Isle

Royale counts. The reef in q7 is stated as a teaching scenario so no outside knowledge is needed; real reefs have many grazers and predators. Common errors: in q5, dividing wolves by moose, or reporting +36 percent; in q6, drawing a direct otter-to-kelp arrow; in q7, labeling the coral change as direct.

Scaffold offered to students: Two rules to remember

Rule 1: rate each partner separately, helped (+), harmed (–) or no measurable effect (0), then read the pair: + + mutualism, + 0 commensalism, – – competition, + – predation (the gainer eats all or part of the other) or parasitism (the gainer lives on or inside a living host and takes a little at a time). Rule 2: populations linked by an interaction push on each other in both directions, and every change takes time, because populations grow through births and young growing up. When you are unsure about an item, ask which rule it is testing.

Extension: Write the thirteenth item

Write one new multiple-choice item for this quiz that tests the difference between predation and parasitism using organisms from a California ecosystem. Give four options, mark the correct one, and write one sentence for each wrong option explaining why a student might choose it. Then explain how your item would change if the parasite you chose sometimes kills its host.