

Biodiversity Mastery Check: Variety, Threats and Solutions

Learning target: I can show what I know about the levels of biodiversity, measuring it, why some ecosystems are fragile, how habitat loss and invasive species reduce it, and how to judge solutions that protect it.

Retrieval and mastery check

About 40 min

Individual

MS-LS2-5 · assesses

MS-LS2-4 · practice

independent practice

writing

Standards connections

MS-LS2-5 (assesses, items 10 and 12 only): Items 10 and 12 ask students to evaluate competing solutions for maintaining biodiversity and ecosystem services against criteria and constraints, producing individual evidence toward the PE.

MS-LS2-4 (practice): Items 7, 9 and 11 ask students to explain, with a model or evidence, how a change to an ecosystem component (fragmentation, an invasive species, habitat loss) changes populations.

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

Answers with reasoning

Part A: Retrieval (items 1-11)

1. [1 point] Which observation is an example of **genetic** diversity? 1 pt

Answer: B. Valley oak seedlings from different parent trees differ in how well they survive drought.

Why: Genetic diversity is variety among individuals of one species. A and D describe species counts or abundance, and C describes ecosystem diversity.

Also acceptable: None.

2. [1 point] Why does an Arctic tundra ecosystem tend to be more fragile than a tropical rainforest? 1 pt

Answer: B. The tundra has fewer species, so losing one can affect many others and few species can take over its role.

Why: With few species and few feeding links, a change in one population, such as polar bears catching fewer seals as sea ice shrinks, spreads widely. Fragility is a tendency, not a guarantee.

Also acceptable: None.

3. [3 points] A leaf-litter sample contains 20 small animals: 10 ants, 6 beetles and 4 spiders. Calculate Simpson's index of diversity ($1 - \text{the sum of the squared proportions}$). Show each step. 3 pts

Answer: Proportions: ants $10 \div 20 = 0.5$, beetles $6 \div 20 = 0.3$, spiders $4 \div 20 = 0.2$. Squares: 0.25, 0.09, 0.04. Sum: $0.25 + 0.09 + 0.04 = 0.38$. Index: $1 - 0.38 = \mathbf{0.62}$.

Why: 1 point for proportions, 1 point for squares and sum, 1 point for the index.

Also acceptable: None.

4. [2 points] Explain the difference between **extirpation** and **extinction**, and give one example of each. 2 pts

Answer: Extirpation is the loss of a species from one place while it survives elsewhere, for example sea otters gone from Washington State around 1910 but surviving in Alaska and California. Extinction is the loss of a species everywhere, forever, for example the southern gastric-brooding frog of Australia.

Why: 1 point for the distinction, 1 point for two correct examples.

Also acceptable: Accept the passenger pigeon, the dodo or Haast's eagle as extinction examples, and any species lost from one region but surviving elsewhere (for example, grizzly bears, gone from California but living in other states) as extirpation.

- Correct distinction (one place versus everywhere)
- One correct example of each

5. [1 point] Which description best fits a **keystone species**? 1 pt

Answer: B. A species whose effect on its ecosystem is much larger than its numbers suggest.

Why: Keystone species, such as sea otters in many kelp forests, are defined by an outsized effect, not by being common or large. D describes an endemic species.

Also acceptable: None.

6. [2 points] True or false: 'Every species that is not native to an area is an invasive species.' Circle your answer and explain. 2 pts

Answer: False. A species is invasive only if it was carried outside its native range **and** spreads and causes harm. Many non-native species, such as tomatoes or most garden flowers, grow only where people plant them and do not harm native species.

Why: 1 point for false, 1 point for the two-part definition with an example.

Also acceptable: None.

- Circles false
- Explains that invasive requires spread and harm
- Gives or implies a non-native, non-invasive example

7. [3 points] Freeways surround the mountain lions of the Santa Monica Mountains. Explain how this habitat fragmentation can reduce the lions' genetic diversity over many generations, and name one solution being built to help. 3 pts

Answer: The freeways keep lions from moving in and out, so new lions with different genes rarely join the population and the lions inside mate with relatives. Each generation then carries less gene variety, and signs of inbreeding, such as kinked tails, have appeared. A wildlife bridge over U.S. Highway 101 at Liberty Canyon is being built so animals can cross safely between the mountains and wild land to the north.

Why: 1 point for blocked movement, 1 point for inbreeding and lost gene variety, 1 point for naming the crossing.

Also acceptable: Accept 'a wildlife crossing' or 'a wildlife bridge' without the place name. If the crossing has opened by the time students take the quiz (it was scheduled to open on 2 December 2026), accept 'a wildlife bridge that has opened'.

- Explains blocked movement between populations
- Links it to mating with relatives and lost genetic diversity
- Names the wildlife crossing over Highway 101

8. [2 points] The known kākāpō population was 51 birds in 1995 and 325 birds in September 2026. 2 pts
By what percent did it increase? Show the calculation and round to the nearest whole percent.

Answer: Change: $325 - 51 = 274$. Percent increase: $274 \div 51 \times 100 = 537.25\ldots \approx \mathbf{537 \text{ percent}}$.

Why: 1 point for the change, 1 point for dividing by the original value and converting to a percent.

Also acceptable: Accept 537.3 percent.

9. [4 points] Draw a model with labeled boxes and arrows that shows how invasive Argentine ants can 4 pts
reduce a population of coast horned lizards without ever attacking them. Include native ants. Label
each arrow 'more' or 'fewer' and write 'indirect effect' next to the part of your model that shows one.

Answer: Boxes: Argentine ants → native ants → coast horned lizards. Arrow 1, from Argentine ants to native ants: 'fewer' (Argentine ants attack native colonies and take their food). Arrow 2, from native ants to horned lizards: 'fewer' (lizards eat mainly native ants and cannot grow on Argentine ants). 'Indirect effect' written beside the ant-to-lizard path, because the invader harms the lizards through their prey.

Why: 1 point for three labeled boxes in the right order, 1 point for correct arrow labels, 1 point for marking the indirect effect, 1 point for showing that lizards do not benefit from eating Argentine ants (a note or a crossed-out arrow).

Also acceptable: Accept a model that adds watered yards and soil moisture as the starting box.

- Three labeled boxes including native ants
- Arrows labeled 'fewer' correctly
- Indirect effect marked
- Shows that Argentine ants do not replace native ants as lizard food

10. [2 points] A town must protect at least 90 homes from flooding and spend less than \$3 million. 2 pts
Plan X protects 100 homes, keeps 5 native bird species and costs \$2 million. Plan Y protects 95 homes, keeps 20 native bird species and costs \$2.5 million. Plan Z protects 40 homes, keeps 22 native bird species and costs \$1 million. Which plan best maintains biodiversity while meeting the constraints?

Answer: B. Plan Y, because it meets both constraints and keeps far more bird species than X.

Why: Plan Z fails the flood constraint (40 is fewer than 90 homes). Plans X and Y both meet the constraints (at least 90 homes, under \$3 million), so the biodiversity criterion decides it: 20 bird species versus 5.

Also acceptable: None.

11. [2 points] The lesser anteater eats mainly ants and termites, and some rainforest orchids grow only 2 pts
on high tree branches. Explain why species with specialized niches like these can be hit especially
hard when their habitat is cleared.

Answer: A specialist depends on one food or one kind of place. If habitat clearing removes the trees where the orchid grows, or the ants and termites the anteater eats, the specialist has no other food or home to switch to, while a generalist could use something else. Specialists also often live in small areas, so clearing one area can remove a large share of their population.

Why: 1 point for the dependence on one resource, 1 point for the lack of an alternative.

Also acceptable: None.

- Explains reliance on a single food or place
- Explains that specialists cannot switch when it is lost

Part B: Synthesis (item 12)

12. [7 points] Choose **one** threat, habitat loss or an invasive species, and one real example from this chapter (for example, drained wetlands, freeways and mountain lions, iceplant on dunes, Argentine ants, or feral pigs and the island fox). In one paragraph: (a) explain how the threat reduces biodiversity at **two** levels (genetic, species or ecosystem); (b) describe **two** competing solutions to it; (c) judge which solution is better using one criterion and one constraint, and name the trade-off. 7 pts

Answer: Model paragraph (invasive species, the island fox): Feral pigs brought to Santa Cruz Island fed golden eagles with their piglets, and the eagles that settled also hunted island foxes, which crashed from more than 1,400 to about 55. This lowered biodiversity at the species level, because an endemic species came close to extinction, and at the genetic level, because the recovered foxes descend from only a few survivors and carry less gene variety. One solution was captive breeding, which protected foxes quickly; a competing solution was removing the pigs, which took away the eagles' food supply. Judged by the criterion of removing the root cause, pig removal was better, because captive-bred foxes released while pigs and eagles remained could be killed. But a constraint mattered: removing the pigs was slow and costly, and some people objected to killing them, so it could not save the foxes in time on its own. The trade-off was accepting the cost of running both: captive breeding for speed and pig removal for a lasting fix.

Why: Scored out of 7: (a) 2 points for two levels with an accurate mechanism; (b) 2 points for two real, competing solutions; (c) 2 points for a judgment that uses one named criterion and one named constraint; 1 point for stating the trade-off.

Also acceptable: Strong answers on other examples: freeways and mountain lions (species and genetic levels; wildlife bridge versus protecting more land); iceplant (species and ecosystem levels; hand-pulling versus herbicide); drained wetlands (species and ecosystem levels; restoring tidal marsh versus keeping managed ponds).

- Names one threat and one real chapter example accurately
- Explains effects at two levels of biodiversity
- Describes two competing solutions
- Judges them with one criterion and one constraint
- States the trade-off

Teacher notes

Points: q1 1, q2 1, q3 3, q4 2, q5 1, q6 2, q7 3, q8 2, q9 4, q10 2, q11 2, q12 7 (total 30). All calculations were checked: q3 index 0.62; q8 $274 \div 51 \times 100 = 537.3$ percent. Items map to the chapter's learning targets: levels and measurement (q1, q3), natural levels and fragility (q2), keystone species and loss (q4, q5), specialized niches (q11), threats (q6, q7, q9), and evaluating solutions (q10, q12). Facts used: the kākāpō counts are from New Zealand's Department of Conservation (51 in 1995; 325 on 1 September 2026); the Santa Monica Mountains crossing over U.S. 101 at Liberty Canyon was scheduled (as of October 2026) to open on 2 December 2026; if the class uses this after that date, check whether it has opened and, if so, change 'being built' in q7 to 'built'. q12 accepts any accurate chapter example; do not require the island fox. Watch for students who calculate percent increase by dividing by the new value ($274 \div 325 = 84$ percent), and for students who add proportions without squaring in q3.

Scaffold offered to students: If you get stuck

For the calculation, find each proportion first ($\text{count} \div 20$), square each one, add the squares, then subtract from 1; your answer must be between 0 and 1. For the percent increase, find the change first ($\text{new} - \text{old}$), then divide by the old value and multiply by 100. For the synthesis, write one sentence for each of (a), (b) and (c) before turning them into a paragraph.

Extension: Make your own mastery item

Write one new multiple-choice item about biodiversity that uses a real California example and has one correct answer and three tempting wrong answers, each based on a misconception from this chapter. Write a one-sentence explanation for why each wrong answer is tempting. Trade with a classmate and answer each other's items.