

Three Kinds of Variety: Reading About Genes, Species and Ecosystems

Learning target: I can use evidence from a passage to explain the three levels of biodiversity and how habitat loss and invasive species reduce biodiversity at more than one level.

Reading with evidence

About 40 min

Individual

MS-LS2-4 · practice

MS-LS2-5 · supports

MS-LS4-4 · supports

reading

writing

Standards connections

MS-LS2-4 (practice): Students cite evidence that changes to physical components (drained wetlands, freeways) and biological components (invasive iceplant and Argentine ants) of ecosystems change populations, practicing the evidence-based argument the PE calls for.

MS-LS2-5 (supports): The passage explains what conservation designs must protect (all three levels of biodiversity and the ecosystem services they provide) and gives one real design, a wildlife bridge, as background for evaluating solutions later.

MS-LS4-4 (supports): Paragraph 3 previews why genetic variation within a population raises the chance that some individuals survive and reproduce. This PE is taught in Grade 8 in the California sequence; here it is background only and is not assessed.

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

Answers with reasoning

Three Kinds of Variety

[1] When scientists measure biodiversity, they do more than count animals. Biodiversity is the variety of life, and it can be described at three levels. **Genetic diversity** is the variety within one species, the differences in inherited instructions that make individuals unlike one another. **Species diversity** is the variety of species living in one place. **Ecosystem diversity** is the variety of ecosystems in a region, from forests to marshes to reefs. A loss at one level often spreads to the others.

[2] Species diversity is not the same everywhere. Arctic tundra has long, freezing winters and a short growing season, so relatively few species can live there. Where there are few species, each one can matter a great deal. Polar bears hunting seals on the sea ice leave scraps that Arctic foxes and gulls feed on in winter, so when shrinking ice makes hunting harder, the scavengers lose food too. Tropical rainforests are the opposite. Warmth, rain and food last all year, so many species survive by doing one narrow job, such as an anteater that eats mainly ants and termites or an orchid that clings to high branches. Because these specialists compete less with one another, a small patch of rainforest can hold an enormous number of species.

[3] Genetic diversity matters even when a species still survives. Individuals with different genes may differ in how well they resist a disease, survive a drought or raise healthy young. New Zealand's kākāpō,

a flightless parrot, shows what happens when that variety is lost. By 1995 only 51 kākāpō were known, and every bird alive today descends from that small group. Many of their eggs never hatch because they are infertile, a problem scientists link to low genetic diversity. Since 2015, researchers have been reading the complete genes of the birds and using that information to pair mates that are not closely related.

[4] Ecosystem diversity is easy to see in California. In a few hours you can travel from kelp forests and salt marshes to oak woodlands, chaparral hills, redwood forests and deserts. Some species need more than one of these ecosystems. Chinook salmon hatch in rivers, grow up in the ocean and return to rivers to lay their eggs. If either the river or the ocean is badly damaged, the salmon cannot complete their life cycle.

[5] Two major threats to biodiversity are habitat loss, the leading cause of species decline worldwide, and invasive species. Habitat loss happens when the places organisms live are destroyed or changed, as when a wetland is drained for farms or houses. State wildlife scientists estimate that California has lost more than 90 percent of its historical wetlands. Habitat can also be broken into pieces, which is called fragmentation. Freeways surround the mountain lions of the Santa Monica Mountains near Los Angeles, and so few lions move in or out that the population has very low genetic diversity. Some young lions there have been born with kinked tails, a sign of inbreeding. A wildlife bridge over U.S. Highway 101 is being built so that animals can cross safely; it is scheduled to open in late 2026.

[6] An **invasive species** is one that people carried outside its natural range and that spreads and causes harm. Many invaders thrive because the predators, diseases and competitors that kept them in check at home are missing. Highway iceplant from South Africa was planted to hold soil along roads and coasts, and it now carpets dunes where native wildflowers once grew. Argentine ants from South America crowd out native ants near watered yards in Southern California. Coast horned lizards eat mainly native ants, and young lizards fed only Argentine ants barely grow, so where the invaders take over, the lizards decline.

[7] Protecting biodiversity protects people too. Wetlands filter water and soak up floodwater, insects pollinate crops, and some species give us medicines; chemicals from the Madagascar periwinkle are used to treat childhood leukemia. A species that disappears takes its genes and its role with it, and a paved-over marsh cannot simply be put back. That is why the strongest conservation plans protect variety at every level at once.

Original passage written for this worksheet. Facts were checked against New Zealand's Department of Conservation, the California Department of Fish and Wildlife, the National Park Service and published studies.

Questions: cite the passage

1. According to paragraph 1, what are the three levels of biodiversity? For one of them, give your own example from California that is **not** in the passage.

Answer: Genetic diversity (variety within one species), species diversity (variety of species in one place) and ecosystem diversity (variety of ecosystems in a region), all in paragraph 1. Example: valley oaks from different trees that differ in drought survival (genetic); a tide pool with many kinds of animals and seaweeds (species); the Sierra Nevada with meadows, forests and alpine slopes (ecosystem).

Why: Students must name all three levels and produce one new, correctly matched example.

Also acceptable: Accept any correctly matched example not taken from the passage.

- Names all three levels
- Cites paragraph 1
- Gives one correct new California example matched to its level

2. Using paragraph 2, explain why losing one species might change an Arctic tundra ecosystem more than losing one species would change a tropical rainforest. Quote one phrase that supports your answer.

Answer: The tundra has few species, so each species can matter a great deal and there may be no other species to fill a lost role; when sea ice shrinks and polar bears catch fewer seals, Arctic foxes and gulls lose the scraps they eat in winter. A rainforest has so many species, many of them specialists, that one loss usually affects a smaller share of the ecosystem. Supporting phrase: 'Where there are few species, each one can matter a great deal' (paragraph 2).

Why: Paragraph 2 contrasts low-diversity tundra, where links are few and important, with high-diversity rainforest. The answer should present this as a tendency, not a guarantee.

Also acceptable: A student who adds that a rainforest specialist can still be badly hurt by losing its one food is reasoning well and should not lose credit.

- Explains that tundra has few species so each matters more
- Uses the polar bear and scavenger example
- Quotes a phrase from paragraph 2

3. Paragraph 3 says genetic diversity 'matters even when a species still survives.' Explain how a kākāpō population that is growing can still have low genetic diversity, and describe what scientists are doing about it.

Answer: A population can grow in number while every new bird still descends from the same small group of 51 survivors, so the variety of genes stays low even as the count rises; many eggs are infertile, which scientists link to that low variety. Since 2015 researchers have been reading the complete genes of the birds and use that information to pair mates that are not closely related (paragraph 3).

Why: More individuals is not the same as more gene variety; new variety can only come from the genes already present.

Also acceptable: Accept 'they choose which birds breed so relatives do not mate'.

- Explains that growth comes from the same small group of ancestors
- Mentions infertile eggs as a consequence
- Describes gene reading and pairing unrelated mates
- Cites paragraph 3

4. Based on paragraph 4, why are Chinook salmon a good example of a species that depends on ecosystem diversity?

Answer: B. They need both river and ocean ecosystems to complete their life cycle.

Why: Paragraph 4 says salmon hatch in rivers, grow up in the ocean and return to rivers to lay eggs, so damage to either ecosystem breaks the life cycle. The other options are not stated in the passage.

Also acceptable: None.

5. Paragraph 5 describes two different ways habitat can be harmed. Explain the difference between habitat loss and habitat fragmentation, using the wetlands and the mountain lions. Then explain how a freeway can lower a population's genetic diversity even if no lion is ever hit by a car.

Answer: Habitat loss destroys or changes habitat, as when California's wetlands were drained, more than 90 percent of them, for farms and houses. Fragmentation breaks habitat into separated pieces; the Santa Monica Mountains are still wild, but freeways cut them off (paragraph 5). A freeway lowers genetic diversity because lions cannot move between populations: few new lions bring in new genes, so the lions inside breed with relatives, and the variety of genes shrinks with each generation. Kinked tails are a sign of this inbreeding.

Why: The key distinction is destroyed versus separated habitat; the genetic link is reduced movement and mating between populations.

Also acceptable: Accept 'gene flow is blocked' as a description of the genetic effect.

- Defines habitat loss with the wetland example
- Defines fragmentation with the mountain lion example
- Explains reduced movement leading to breeding among relatives and lower gene variety
- Cites paragraph 5

6. Paragraph 6 says many invaders thrive because something is 'missing.' What is missing, and why does that help an invasive species spread?

Answer: The predators, diseases and competitors that limited the species in its native range are missing in the new place (paragraph 6). Without them, more of the invaders survive and reproduce, so their population grows quickly and spreads into space and resources that native species were using.

Why: This is the enemy-release idea in student language; it explains why a species that was ordinary at home can become a problem elsewhere.

Also acceptable: Accept an answer that names any one of the three missing limits with the correct effect.

- Names missing predators, diseases or competitors
- Explains that this lets the invader survive, reproduce and spread
- Cites paragraph 6

7. Trace the chain in paragraph 6 that links Argentine ants to coast horned lizards. Argentine ants do not attack the lizards. Is the lizards' decline a direct or an indirect effect of the ants? Explain.

Answer: Argentine ants → crowd out native ants → fewer native ants for the lizards to eat → young lizards fed only Argentine ants barely grow → horned lizards decline. The lizards' decline is an **indirect effect** of the Argentine ants, because the ants harm the lizards by removing the lizards' food (the native ants), not by attacking them (paragraph 6).

Why: An indirect effect passes through a third population; here it passes through the native ants, the lizards' main prey.

Also acceptable: Accept 'Argentine ants replace the lizards' food with food the lizards cannot grow on' as the mechanism.

- Chain includes native ants as the link
- Labels the effect indirect
- Explains why with the food relationship
- Cites paragraph 6

8. Find one example in the passage where a change at one level of biodiversity causes a loss at a different level. Name both levels and give the paragraph number.

Answer: Example: Habitat fragmentation (the freeways splitting the ecosystem) caused a loss of **genetic diversity** in mountain lions (paragraph 5). Other acceptable examples: an invasive species (a change in species composition) caused a decline in another species, the coast horned lizard (paragraph 6); damage to one ecosystem would remove a species, Chinook salmon, that needs two ecosystems (paragraph 4).

Why: Paragraph 1 says a loss at one level often spreads to others; the passage gives several cases.

Also acceptable: Accept the kākāpō example if the student explains that a near loss at the species level left low genetic diversity (paragraph 3).

- Names a cause at one level and a loss at a different level
- Gives a correct paragraph number

9. Paragraph 7 says the strongest conservation plans 'protect variety at every level at once.' Imagine a plan that keeps 300 kākāpō alive in pens on one island, all closely related. Using evidence from at least **two** paragraphs, argue whether this plan should count as a conservation success.

Answer: Model response: The plan should count only as a partial success. It keeps the species from going extinct, which protects species diversity, but paragraph 3 explains that kākāpō with low genetic diversity lay many infertile eggs, so a population of close relatives may grow slowly and may not survive a new disease. Paragraph 7 says a species takes 'its genes and its role with it' when it disappears and that strong plans protect every level; birds kept in pens have no role in a wild forest ecosystem. Keeping all the birds on one island also means one fire or disease could reach all of them. A better plan would pair unrelated birds and establish wild populations in several places.

Why: The argument must weigh species survival against genetic and ecosystem levels and use evidence from two paragraphs.

Also acceptable: A student who argues it is a success because extinction is prevented can earn full credit if they acknowledge the genetic and ecosystem limitations with cited evidence.

- Takes a clear position (success, partial success or not a success)
- Uses evidence from at least two paragraphs, cited by number
- Addresses genetic diversity
- Addresses the ecosystem level or the species' role
- Suggests or implies what a stronger plan would include

Teacher notes

The passage is 684 words in 7 paragraphs. It extends the textbook, which treats biodiversity mostly as species diversity, to the three levels used by scientists. Fact checks: kākākō counts and gene sequencing from New Zealand's Department of Conservation (the Kākākō125 project began in 2015); 'more than 90 percent of historical wetlands lost' is the estimate used by the California Department of Fish and Wildlife; low genetic diversity and kinked tails in Santa Monica Mountains mountain lions are reported by National Park Service researchers; as of October 2026, the Wallis Annenberg Wildlife Crossing over U.S. 101 at Liberty Canyon in Agoura Hills was scheduled to open on 2 December 2026; if your class uses this sheet after that date, check whether it has opened and update the last sentence of paragraph 5 to match. The Argentine ant and horned lizard link comes from field and feeding studies by Suarez, Case and colleagues (2002); young lizards on an Argentine ant diet had near-zero or negative growth. Highway iceplant was introduced from South Africa for erosion control. Vincristine, from the Madagascar periwinkle, is used to treat childhood leukemia. The passage calls habitat loss the leading driver worldwide; the global assessment by IPBES (2019) ranks changes in land and sea use first, followed by direct exploitation, climate change, pollution and invasive species. Invasive species are often the leading driver on islands, which is why the kākākō and island fox stories feature them.

Scaffold offered to students: Find it, then say it

For each question, first find the paragraph that answers it and write its number in the margin. Then answer in two steps: one sentence that answers the question, and one sentence that begins 'Paragraph __ says...' or 'The passage explains that...'. For q7, draw the chain with arrows before you write: Argentine ants → native ants → coast horned lizards, and label each arrow with what happens.

Extension: Find the missing level

The passage gives California examples of genetic, species and ecosystem diversity, but it does not say how a single threat can hit all three levels at once. Choose one threat from paragraph 5 or 6 and write a paragraph that predicts its effect on genetic diversity, on species diversity and on ecosystem diversity in one California place. Then name one ecosystem service that would be lost and one measurement that could show whether your prediction is correct.