

Changing Ecosystems: Mastery Check

Learning target: I can recall and apply the main ideas of changing ecosystems, from succession to cascading change, and argue with evidence why one disturbed landscape recovered faster than another.

Retrieval and mastery check

About 40 min

Individual

MS-LS2-4 · assesses

MS-LS2-1 · supports

MS-ETS1-1 · practice

independent practice

writing

Standards connections

MS-LS2-4 (assesses, evaluating evidence (q9) and a short argument from evidence (q12)): Item 9 asks students to judge which empirical evidence best supports a claim about a population, and item 12 asks for a short argument, with evidence from the eruption, that a change to physical components (burial under pumice versus ash over surviving soil) shaped which populations returned and how fast. The other items check the ideas that argument rests on.

MS-LS2-1 (supports): Items 4, 6 and 12 rely on the link between resources (usable nitrogen, still water, soil) and the populations they support, from Lesson 20.

MS-ETS1-1 (practice): Item 11 checks that students can tell a criterion from a constraint and connect a design choice to a local constraint, as in the lesson's wetland-rebuilding spread.

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

Answers with reasoning

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

1. Why do ecologists call every ecosystem a **dynamic system**?

1 pt

Answer: A. Its populations and conditions are always changing, slowly or quickly.

Why: A dynamic system is one in constant change. B is wrong because natural changes happen without people; C confuses change with movement; D describes the misconception that recovery ends in a fixed, unchanging state.

Also acceptable: None.

2. Which of these is a **sudden** change caused by **people**?

1 pt

Answer: C. Bulldozers clearing a forest for a new housing tract.

Why: Clearing is sudden and human-caused. An eruption (B) is sudden but natural; pond filling (A) and glacier retreat (D) are gradual.

Also acceptable: None.

3. Classify each as primary or secondary succession and give the clue that decides it. (a) A landslide strips a mountainside down to bare bedrock. (b) A forest is logged, but the soil, stumps and roots are left behind. 2 pts

Answer: (a) Primary succession: the landslide left bare bedrock with no soil and no survivors. (b) Secondary succession: the soil, stumps and roots remain, so plants can regrow from what survived.

Why: The deciding clue is always soil and survivors. One point for each correct classification with its clue.

Also acceptable: For (b), accept 'biological legacies such as roots and seeds remain' as the clue.

- (a) primary with the no-soil clue
- (b) secondary with the soil or roots clue

4. Prairie lupine was one of the first plants to grow on the Mount St. Helens Pumice Plain. Which feature made it a successful pioneer species there? 1 pt

Answer: B. Bacteria in its roots change nitrogen from the air into a form plants can use.

Why: Fresh pumice has almost no usable nitrogen; a plant that brings its own supply can survive where others cannot, and it enriches the ground for later plants. A, C and D describe the opposite of pioneer traits or a dispersal method irrelevant to an inland volcano.

Also acceptable: None.

5. True or false: 'The 1980 eruption killed every living thing in the blast zone, so all of the recovery came from organisms that arrived later.' Circle your answer and support it with one piece of evidence. 2 pts

Answer: False. Many organisms survived the eruption, including pocket gophers in their burrows, plants and young trees under late-spring snow, seeds, roots and fungi in buried soil, and frogs, toads and salamanders underground or in ice-covered ponds. These survivors (biological legacies) started recovery in the blowdown zone right away.

Why: One point for 'false' and one for a specific survivor as evidence. This corrects the textbook's statement that an eruption kills everything.

Also acceptable: Accept 'the Pumice Plain had no survivors, but the blowdown zone did' as the evidence.

- Marks false
- Names at least one documented survivor

6. A beaver is a living thing, but the change its dam makes to a stream is mostly a change to **physical** components. Name two physical components a dam changes, and for each one name a population that responds. 2 pts

Answer: Examples: water depth (deeper pond: frog tadpoles and dragonfly larvae increase); water speed (slower water: stonefly larvae that need fast water decrease); light on the forest floor where the beaver cut trees (small plants grow, feeding moose or elk); water temperature (warmer pond water: cold-water fish such as trout may decline in that stretch).

Why: One point per physical component paired with a responding population. This is the physical-versus-biological distinction the PE uses.

Also acceptable: Accept soil moisture downstream with lush streamside plants as a pair.

- Two physical components
- A responding population for each

7. Teaching numbers (invented for this quiz): On one reef, divers counted 2 purple sea urchins per square meter before a disease killed most of the sea stars that eat urchins, and 18 per square meter three years later. Kelp covered 60 percent of the reef before and 6 percent after. (a) How many times as many urchins were there after? (b) By what percent did kelp cover decrease? Show both calculations. 2 pts

Answer: (a) $18 \div 2 = 9$ times as many urchins. (b) $(60 - 6) \div 60 \times 100 = 54 \div 60 \times 100 = 90$ percent decrease.

Why: One point for each correct calculation shown. The numbers are invented but the direction of change matches the northern California kelp collapse described on slide 21.

Also acceptable: Accept 'an increase of 16 per square meter' only together with the ratio. A kelp answer of 54 percent has confused percentage points with percent change.

8. Draw a flow diagram of the cascading change in item 7, starting with the sea star disease. Use at least four boxes joined by arrows, and label each arrow with what changes (for example, 'fewer predators eat urchins'). 3 pts

Answer: A full-credit diagram: Disease kills most sea stars → (fewer predators eat urchins) → purple urchins multiply → (urchins graze more kelp) → kelp cover falls → (less food and shelter) → fish and abalone that depend on kelp decline. At least four boxes, arrows pointing in the direction of cause, and a label on every arrow.

Why: Three points: one for four or more correct boxes in order, one for arrows pointing from cause to effect, one for labels that name the change at each link.

Also acceptable: Accept 'urchin barren forms' or 'sea otters absent' as boxes if they fit the chain.

- At least four boxes in the correct order
- Arrows run from cause to effect
- Each arrow labeled with what changes

9. Which evidence would most strongly support the claim that prairie dog colonies increase burrowing owl populations? 1 pt

Answer: C. Owl nest counts on 20 colonies and on 20 similar grasslands without prairie dogs.

Why: C is a measured with-and-without comparison repeated across many matched places. A and D are single observations with no comparison; B is a memory, not a measurement.

Also acceptable: None.

10. Cattle egrets crossed the Atlantic Ocean from Africa to South America on their own in the late 1800s, then spread into North America, helped by farmland and livestock. Which description fits them best? 1 pt

Answer: C. A species that expanded its range on its own, so people did not introduce it.

Why: Introduced means moved by people, and invasive means introduced, spreading and harmful. Cattle egrets crossed the ocean on their own, so neither A nor B fits, even though the textbook calls them introduced. D confuses following cattle with having a community-wide effect.

Also acceptable: None.

11. Engineers rebuilding a coastal marsh write two goals: 'New marsh land forms every year' and 'The project must not raise flood risk for homes behind the levee.' Which is a criterion and which is a constraint? Then explain why a gated diversion that can be closed during floods might be chosen next to a city, while an open channel might work where few people live. 2 pts

Answer: 'New marsh land forms every year' is a criterion: a measure of success that can be met well or less well. 'Must not raise flood risk for homes' is a constraint: a limit every acceptable design must meet. Next to a city, an open channel would let river water flow toward homes whenever the river rose, breaking the flood constraint, so a gate that can be closed during floods meets the constraint while still letting water and sediment in at other times. Where few people live, an open channel can run all the time and deliver more sediment, because no homes would be flooded.

Why: One point for the correct classification, one for linking the design choice to the local constraint, as in the lesson's Wax Lake and Caernarvon examples.

Also acceptable: Accept an answer that notes a gate also costs more or delivers less sediment, as long as the constraint logic is present.

- Criterion and constraint identified correctly
- Explains the gate as a way to meet the flood constraint near homes

Part B: Synthesis (item 12)

12. Look back at the first explanation you wrote on Worksheet 1 (Part C). Now write an improved argument that answers this question: **Why did the blowdown zone at Mount St. Helens recover faster than the Pumice Plain?** Make a claim, give at least two pieces of evidence about what each zone had or lacked after the eruption, and explain your reasoning using at least three of these terms: disturbance, primary succession, secondary succession, pioneer species, biological legacy. End with one sentence about how your thinking changed since Worksheet 1.

5 pts

Answer: Model: Claim: The blowdown zone recovered faster because the eruption left soil and survivors there, while the Pumice Plain had to start from bare new ground. Evidence: In the blowdown zone, the blast flattened the forest and covered it with ash, but the old soil remained underneath, with roots, seeds and fungi, and pocket gophers survived in their burrows and mixed old soil up through the ash; plants under late snow and amphibians also survived. On the Pumice Plain, hot pumice buried the ground many meters deep, leaving no soil and nothing alive, and most windblown seeds died on dry pumice with almost no usable nitrogen; even the first lupine did not appear until a year or two after the eruption, and the plain is still open and patchy today. Reasoning: The eruption was a disturbance that changed physical components differently in each zone. Where soil and biological legacies remained, recovery was secondary succession and could start at once from survivors. On the Pumice Plain, recovery was primary succession: every organism had to arrive, and pioneer species such as lupine first had to add usable nitrogen and trap seeds before other plants could establish, which takes much longer. Change in my thinking: on Worksheet 1 I thought everything had to come back from outside; now I know survivors mattered as much as new arrivals.

Why: Five points: claim (1), evidence about each zone (2: one for each zone), reasoning that uses at least three terms correctly and connects the physical difference to the speed of recovery (1), and a genuine reflection on changed thinking (1).

Also acceptable: Accept evidence drawn from the Worksheet 3 passage or the Worksheet 6 plots. A student whose Worksheet 1 explanation was already accurate may say their thinking grew more precise (for example, by adding the terms or the role of nitrogen).

- Claim names soil and survivors as the reason
- Evidence describes what the blowdown zone had
- Evidence describes what the Pumice Plain lacked
- Reasoning uses at least three listed terms correctly, linking primary and secondary succession to the two zones
- Reflection on how thinking changed since Worksheet 1

Teacher notes

Point values total 23: items 1, 2, 4, 9 and 10 are 1 point; items 3, 5, 6, 7 and 11 are 2 points; item 8 is 3 points; item 12 is 5 points. Every factual item is accurate where the textbook simplifies: item 5 tests the survivors the textbook omits, item 10 uses the documented natural arrival of cattle egrets (the textbook calls them introduced), and item 4 uses the lupine's nitrogen fixation. The item 7 numbers are invented and labeled as such; slide 21 has the real northern California kelp story. Item 12 is the planned return to Worksheet 1, item 6; collect both sheets together to see each student's growth. A score of 18 or more suggests the targets are met; students below 12 should revisit W2 and W3 before moving on.

Scaffold offered to students: Open-notes option and a planning box

If your teacher allows notes, you may use the Worksheet 2 word bank and your Worksheet 3 answers. Before writing item 12, make a two-column list headed 'Blowdown zone' and 'Pumice Plain', and under each write what was left after the eruption (soil? survivors?) and what had to arrive. Then write your claim from the difference between the columns.

Extension: Write the next exam question

Write one new question that would test whether a classmate really understands the difference between a pattern in data and a cause. It must include a small invented data table (label it as invented), four answer choices or a short-answer prompt, and a full answer key that explains why the wrong choices are wrong. Swap with a partner and solve each other's questions.