

Changing Ecosystems: how a damaged place stages its comeback

28 slides · about 140 minutes of class time · Resources in Ecosystems

Each entry gives what to say or ask, the expected responses, misconceptions to listen for, the worksheet or lab it connects to, and pacing. Slide text is intentionally short; the explanation lives here.

Slide 1 · Changing Ecosystems · title · 2 min

This lesson sits at the end of the ecosystems unit. Students already know that resources limit populations (Lesson 20) and that organisms interact through feeding, competition and partnership (Lesson 21). Now we put those ideas in motion: what happens to populations when the ecosystem itself changes? Tell students the anchor is a real volcano in Washington State and that they will run three investigations: a sequencing mystery with evidence cards, a string model of a grassland that they can 'break', and a survey of a disturbed patch of ground on our own campus. The skill we are building all week is making an argument from evidence, not just telling a story.

Connects to: Overview of Lab 1, Lab 2 and Lab 3; W1 opens on the next slide.

Slide 2 · The mountain that blew its top and grew back green · Phenomenon · 8 min

On the slide: Notice: compare the 1980 photo with the recent one. What is different? What is the same? · Wonder: where did the first living things come from? · Predict: will the valley ever look exactly like it did before 1980?

Show two public-domain U.S. Geological Survey photographs of the pumice plain or Spirit Lake area, one from summer 1980 and one recent. Give two silent minutes for a notice and a wonder, then collect on the board without judging. Push on three things. First, the ground: in 1980 it was hot pumice and ash with no soil, so what could possibly grow? Second, the arrivals: if plants came back, did they walk in, blow in, or were they already there? Third, the endpoint: is the green valley 'back to normal' or something new? Write the strongest student questions on a parking lot; the lesson answers most of them. Teacher background: the collapse was the largest landslide in recorded history, 57 people died, and the sideways blast caused devastation as far as about 30 kilometers (19 miles) from the volcano. Keep the human loss brief and respectful.

Expected responses: Notice: trees gone, everything gray, then purple flowers and bushes; the mountain shape changed; the lake is still there. Wonder: how long did it take; did animals survive; did people help. Predict: split class; most say 'eventually' or 'never the same'.

Listen for: 'Everything died' and 'people must have replanted it.' Park both claims; slides 10, 11 and 26 return to them with evidence.

Connects to: W1 phenomenon worksheet records the notice, wonder and first explanation. W3 reading passage tells the recovery story in detail.

Slide 3 • What you will be able to do · Learning targets · 2 min

On the slide: Describe gradual and sudden changes and explain why every ecosystem is a dynamic system. · Explain how succession rebuilds a community, and tell primary succession from secondary. · Trace how changing one living or nonliving part shifts other populations, including cascades. · Build an argument from empirical evidence that a change affected populations. · Identify criteria and constraints in an engineering plan to restore a damaged ecosystem.

Read the targets aloud. Ask students to star the one that sounds hardest. Point out that target 4 is the big one: on the last day they will write an argument using data, and every lab this week produces data they could use. Targets 1 and 2 belong to the first two days, 3 to the middle of the week, and 5 to the engineering story at the end.

Connects to: Targets map to W2 (1), Lab 1 and W4 (2), Lab 2 (3), Lab 3, W5 and W6 (4), W9 (5).

Slide 4 • Every ecosystem is a dynamic system · content · 4 min

On the slide: Nonliving parts change: water, light, soil, temperature, sediment. · Living parts change: a species arrives, booms, crashes or disappears. · The changes are linked: alter one part and others follow.

Start with a place students know: the schoolyard, a local creek, a park. Ask what is different there in August versus February. Then ask what was there 100 years ago and what might be there in 100 years. The goal is to replace the picture of an ecosystem as scenery with the picture of a system in motion. Introduce the two categories we will use all lesson: nonliving (physical) parts and living (biological) parts. The performance expectation uses exactly those words: physical or biological components. Ask for one example of each kind of change from the Mount St. Helens photos.

Listen for: 'If it is changing, something is wrong.' Counter with seasons: change is the normal state; the interesting questions are how fast and caused by what.

Connects to: W2 Part B concept map starts from a change in an ecosystem and links it to its effects.

Slide 5 • Gradual change: a pond becomes a forest · Model · 5 min

Walk the chain and at each arrow ask: which populations lose and which gain? When the pond gets shallow, fish and ducks lose; cattails, frogs and dragonflies gain. When the marsh dries to a meadow, frogs lose; voles, rabbits and foxes gain. When trees shade the meadow, sun-loving grasses lose; deer and tree-nesting birds gain. The key move: the living things cause the next change. Dead cattails are what fill the pond; dead meadow plants are what build the soil. That is why this is succession and not just weather. Do not give year numbers; the textbook's figure uses tidy labels, but real ponds vary enormously.

Listen for: Students read the arrows as 'eats'. Say explicitly: these arrows mean 'becomes, over time'.

Connects to: W4 Figure 1 shows another gradual path (forest recovery after a fire); Lab 1 uses the same stage-by-stage reasoning.

Slide 6 • Sudden change: disturbances · content · 4 min

On the slide: Natural: volcano, fire, flood, storm, landslide, drought. · Human-caused: land clearing, pollution, dams and levees, new species. · Both kinds reset the ecosystem; what happens next depends on what survived.

Ask students to call out disturbances they have seen or heard about in California: wildfires are the obvious one, plus floods, mudslides and droughts. Sort them live into natural and human-caused, then complicate it: a fire started by a power line, or a flood made worse by paved ground, is both. Land the final bullet hard, because it sets up the next three slides: the question after any disturbance is not 'is everything gone' but 'what is left and what can arrive'.

Listen for: Students may treat all human-caused change as sudden and all natural change as gradual. A glacier melting is natural and gradual; a hurricane is natural and sudden; draining a marsh is human and can be either.

Connects to: W2 vocabulary; Lab 3 asks students to identify the disturbance on the campus plot.

Slide 7 • Quick check: gradual or sudden, natural or human? · Check for understanding · 4 min

On the slide: For each change, hold up G (gradual) or S (sudden), then N (natural) or H (human-caused). Be ready to defend one.

On the slide: A glacier melts back and leaves bare gravel. · A bulldozer clears a hillside for new houses. · A wildfire burns a chaparral slope in one afternoon. · Cattails slowly fill a pond over many decades. · A ship releases water carrying mussels from another continent.

Run it fast. The glacier and the pond are gradual and natural. The bulldozer is sudden and human. The wildfire is sudden; its cause can be either, which is a good 30-second argument. The mussels are human-caused; whether the change is sudden or gradual is debatable: the release is one event, but the population takes years to spread. Use that last item to preview invasive species on slide 23.

Expected responses: 1 G/N, 2 S/H, 3 S/N or S/H, 4 G/N, 5 H with S or G both defensible.

Listen for: Students who think 'human' always means 'bad' and 'natural' always means 'fine'. A natural eruption can erase a forest; a human-built diversion can rebuild a wetland.

Connects to: W2 Part A uses a similar sort for primary versus secondary succession.

Slide 8 • Succession: how living things rebuild a place · content · 5 min

On the slide: Pioneers tolerate harsh ground: lichens, mosses, lupine, fireweed. · Each community changes the soil, shade and shelter for the next. · Later stages have more species, more soil and bigger plants.

Connect this to the lesson's opening image of the glacier: gravel first, then mosses and small flowers, then soil, then meadow. Ask why a Douglas fir seed landing on fresh pumice in 1981 would probably fail while a lupine seed could succeed. (The lupine can get nitrogen from the air with the help of bacteria in its roots and tolerates poor, dry ground; the fir seedling needs soil moisture and nutrients.) Stress the engine of succession: organisms change their own environment. That is why succession is not the same as a place simply getting older.

Listen for: 'Pioneer species are the strongest.' They are the most tolerant of harsh conditions, and they are often pushed out later by species that outcompete them once conditions improve.

Connects to: Lab 1 sequencing mystery; W3 reading passage.

Slide 9 • Two starting lines: primary and secondary succession · Model · 6 min

Use Mount St. Helens as the single example for both, because the 1980 eruption created both kinds side by side. North of the crater, hot pumice buried everything and built the pumice plain: new ground, no soil, primary succession. Farther out, the blast knocked down the forest but left the soil, roots, buried seeds and animals in burrows: secondary succession. Ask students to predict which zone turned green first, then tell them: the blowdown zone, by years, because it started with soil and survivors. The shared column matters as much as the differences: both kinds run on living things improving conditions, and neither is guaranteed to rebuild the original forest.

Listen for: Students assume 'primary' means 'more important' or 'first in time'. It means starting from scratch, with no soil.

Connects to: Lab 1 q4 asks groups which zone shows primary and which secondary succession, citing cards. W4 Figure 2 uses the same comparison.

Slide 10 • Words for a place that is recovering · Vocabulary in context · 4 min

Have students write each term with their own example, not the one on the slide. Spend the most time on biological legacy, because it is the idea that corrects the 'everything died' picture. At Mount St. Helens the survivors included pocket gophers in burrows, plants pressed flat under late snowbanks, seeds and fungi in the soil, and frogs and salamanders in lakes. Gophers turned out to matter a lot: their digging mixed old soil up into the ash, making small patches where seeds could take hold. Ask: which kind of succession has more biological legacies, primary or secondary? (Secondary, by definition.)

Connects to: W2 vocabulary worksheet; Lab 1 cards G, I and A show legacies in the blowdown zone.

Slide 11 • Four decades on the pumice plain • Model • 6 min

Show this slide after Lab 1 as its reveal: the pumice-zone evidence cards follow these stages. Walk the timeline and keep pointing at the mechanism: each stage made the next possible. Spiders arrived first because they travel on silk threads in the wind and could eat the insects that also blew in; they did not need plants. The lupine mattered because it is a legume: bacteria in its roots take nitrogen from the air, so the plant can grow in ash that has almost none, and when it dies it leaves nitrogen behind. Scientists measured more nutrients and more seedlings inside old lupine patches than outside them. Elk returning to graze added droppings carrying seeds and nutrients. Make the last entry explicit: forty years is early in primary succession, and the pumice plain today is a meadow-and-shrub ecosystem, not the old forest. This is real data from long-term studies, but the deck gives no counts; counts in the worksheets are simulated. Sources differ on the year of the first lupine (1981 in a university account, June 1982 in a magazine account of the ecologist credited with the find), so the slide gives both.

Listen for: 'Forty years is a long time, so it must be finished.' On bare pumice, forty years is the beginning.

Connects to: Lab 1 reveal (run Lab 1 before this slide). W3 reading passage tells the full recovery story; W6 CER uses lupine plot data from the pumice plain.

Slide 12 • Quick check: primary or secondary? • Check for understanding • 4 min

On the slide: Decide whether each place will recover by primary or secondary succession, and name the clue that told you.

On the slide: A fresh lava flow that cooled into black rock last year. • A chaparral hillside burned in a fast-moving wildfire. • Gravel exposed by a melting glacier in the Sierra Nevada. • A cornfield abandoned by a farmer. • A forest knocked flat by a volcanic blast, soil still in place.

Hold up P or S. Lava: primary, no soil. Burned chaparral: secondary; many chaparral shrubs resprout from roots and some seeds need fire to open, which is a nice California aside. Glacier gravel: primary. Abandoned cornfield: secondary, with soil and a seed bank full of weeds. Blown-down forest: secondary. After the vote, ask which of the five will take longest to reach shrubs and trees, and why.

Expected responses: 1 P (no soil), 2 S (soil and roots survive), 3 P (bare gravel), 4 S (soil and seeds), 5 S (soil in place). Longest: the lava flow, then the glacier gravel.

Listen for: Students who call the burned hillside primary because it 'looks dead'. Looks are not the clue; soil is.

Connects to: Lab 1 analysis question q4 asks the same decision with evidence.

Slide 13 • Changing a living part: the prairie dog town · content · 5 min

On the slide: Burrows shelter burrowing owls, rabbits, snakes and black-footed ferrets. · Digging mixes the soil and lets water and air in. · Clipping produces fresh regrowth that grazers like bison seek out. · Clipping also holds back shrubs, so shrub-dependent animals lose. · Prairie dogs themselves are the main food of black-footed ferrets.

Shift from the ground to the living things. Prairie dogs are small, but they change the place in at least four ways: shelter (burrows), soil (digging), plants (clipping) and food (their own bodies). Ask students to predict what happens to each listed population if prairie dogs disappear from a valley. Then state how scientists actually know: not by guessing, but by comparing many grasslands with and without colonies and seeing the same differences again and again. That repeated comparison is the evidence. Note on accuracy: the textbook says prairie dogs make more grass for bison and reduce flowering plants for pronghorn; park sources say the clipping produces more nutritious regrowth that attracts both bison and pronghorn, and that shrubs are what prairie dogs really hold back. Use the slide's wording.

Listen for: 'Prairie dogs are good for everything.' Shrub-dependent species lose; the last two bullets set up the discuss slide.

Connects to: Lab 2 builds this grassland community as a string web.

Slide 14 • One species, many threads · Model · 5 min

Have students trace each spoke and say aloud whether the population at the end gains or loses when prairie dogs are present. Then ask the reverse: if prairie dogs vanish, flip every arrow. Introduce the term keystone species here: a species whose removal changes far more than its own numbers would predict, like pulling the keystone out of a stone arch. Ask what evidence would show that a species is a keystone, and lead them to 'compare places with and without it'. Mention that the species is in real trouble: the species' range has shrunk to about 5 percent of its original size, mainly from land clearing, deliberate poisoning and plague, and the black-footed ferret, which eats almost nothing else, nearly went extinct.

Listen for: Every common species is a keystone. Abundance is not the test; the size of the ripple when it is removed is.

Connects to: Lab 2 turns these threads into strings and counts what changes when one card is removed.

Slide 15 • Words for ripples through a community · Vocabulary in context · 4 min

Pair the first two terms: a keystone species is the kind of species whose loss starts a cascade. Resilience is the counterweight: some ecosystems absorb a shock and bounce back; others flip into a different state and stay there. Ask students which of the two Mount St. Helens zones showed more resilience (the blowdown zone, because its soil and survivors let it recover faster). Have them write all three terms with an example that is not on the slide.

Connects to: W2 vocabulary; the connection slide (21) applies all three to a California kelp forest.

Slide 16 • Discuss: are prairie dogs good or bad for a grassland? • Think • pair • share • 6

min

On the slide: A rancher says prairie dogs ruin grassland. A biologist says the grassland depends on them. Can both be looking at real evidence? What would you need to measure to settle it?

Run as a two-minute pair argument, each partner taking one side, then switch. Collect the best point from each side. Steer toward the lesson's real answer: 'good or bad' is not a scientific question. The scientific questions are which populations go up, which go down, by how much, and whether the pattern repeats across many sites. The rancher may be seeing real losses of some forage plants near colonies; the biologist is seeing real gains in owls, ferrets and soil. Close by asking what measurement each person should make to test their claim, and point out that the same with-and-without comparison serves both.

Expected responses: Both can be right about different populations; measure plant cover, grazer use, owl and ferret numbers, soil moisture, in colonies versus matched sites without colonies; need several sites, not one.

Listen for: Settling the argument by majority vote or by who sounds more confident. Insist on what would be measured.

Connects to: W8 prairie dog evidence sort includes the rancher's view and the evidence to weigh it; W6 (CER) practices the written argument.

Slide 17 • Changing a nonliving part: the beaver's pond • content • 5 min

On the slide: Deep, slow water: pond plants, fish, frogs and insects move in. • Fast-water species lose their habitat in the flooded stretch. • More light on the ground: small plants grow, feeding moose and elk. • Wetter soil downstream: lush plant communities support more animals.

Point out the twist: the beaver is a living thing, but the change it makes is mostly to nonliving parts: water and light. Ask students to classify each bullet as a physical change and name the population that responds. Then ask how scientists would know beavers caused the lush downstream growth rather than, say, a rainy year. Lead them to the comparison: streams with beaver ponds versus similar streams without them, in the same region and the same years. The second bullet matters: species that need cold, fast, oxygen-rich water, such as some trout and stonefly larvae, lose that stretch of stream. Every change has losers.

Listen for: Students call the beaver dam a change to a living part because a beaver built it. Ask what changed for the fish: the water, not the beaver.

Connects to: W5 data worksheet analyzes with-and-without and before-and-after beaver stream surveys. W2 Part D applies these ideas to a park creek.

Slide 18 • How one dam travels through the ecosystem • Model • 5 min

Trace the chain, then ask students to build the losing chain on the board: fast water lost, stonefly larvae decline, trout that eat them lose food in that stretch, kingfishers that eat small fish shift elsewhere. Then ask what happens if the beavers are trapped out and the dam breaks: the pond drains, the cascade runs in reverse. This is the same structure as the prairie dog map but drawn as a chain, which is the form a cascading change usually takes. Ask: where in the chain would you measure to test whether the dam really caused the heron increase?

Listen for: Reading the arrows as a food chain only. The first arrow is a physical change, not eating.

Connects to: Lab 2 traces chains like this one, wave by wave, in a grassland web.

Slide 19 • Quick check: which part changed? • Check for understanding • 4 min

On the slide: For each event, say whether a living (biological) or nonliving (physical) part changed first, then name one population that would respond.

On the slide: A levee stops a river from spreading sediment onto a marsh. • Black-footed ferrets return to a valley after decades of absence. • A beaver dam floods a stream. • A new fungus kills most of the bats in a cave. • A drought dries a pond to half its size.

Quick votes with one reason each. Levee: physical (sediment and water); marsh plants respond. Ferrets: biological; prairie dogs respond. Beaver dam: physical (water depth and speed); fast-water insects and pond frogs respond. Fungus: biological; the insects bats eat respond. Drought: physical (water); fish and frogs respond. Push on the levee: it is human-built, but what it changed is physical. Then ask students which of these five is a cascading change (all of them can be, which is the point).

Expected responses: 1 physical, marsh grass or crabs; 2 biological, prairie dogs decline; 3 physical, frogs up and trout down in that stretch; 4 biological, night insects increase; 5 physical, fish and frogs decline.

Listen for: Calling the beaver dam and the levee biological because a living thing built them. The test is what changed for the other organisms.

Connects to: W10 q6 asks the same question about a beaver dam.

Slide 20 • Task: what does the evidence support? • Apply it • 10 min

The numbers are a teaching dataset, invented to look like a real marsh survey; say so. Give groups six minutes. The pattern is clear: marsh plants and the animals that live among them fell while open water and an open-water fish rose. A supported claim: the marsh changed from mostly plants to mostly open water, and populations that depend on the grass declined. An unsupported claim: the levee caused it. The data show a before-and-after pattern, not the cause; the canal, sea level, storms or something else could also matter. What they still need: a similar marsh nearby that kept its sediment supply and had no canal, surveyed in the same years, or surveys from several years in between. Egrets staying the same is a good trap: ask why a bird that hunts in shallow water might not care whether the shallows are grass or open water. Collect the three statements from each group on the board and label each one supported, unsupported, or needs more.

Expected responses: Supported: grass cover, snails and young shrimp decreased while open water and mullet increased; populations tied to the grass declined. Not supported: that the levee alone caused it, or that the marsh is 'dead' (egrets and mullet are doing fine). Still needed: a comparison marsh without the levee and canal; data from the years between; sediment and salt measurements.

Listen for: Treating one before-and-after comparison as proof of cause. The next slides show how scientists strengthen it.

Connects to: W5 (data) works with a dataset of this kind; W6 (CER) asks for the full written argument.

Slide 21 • California connection: the kelp forest that lost its keystones • Real-world connection • 6 min

On the slide: Keystone predators lost: sea stars died, and otters were already absent north of San Francisco. • Cascade: fewer predators, far more urchins, more than 90 percent of the bull kelp gone by 2016. • Ripple: red abalone starved, and the recreational abalone fishery closed in 2018. • Resilience test: urchin barrens can persist for years even after conditions improve.

This is a documented cascading change in our own state, studied by the California Department of Fish and Wildlife and university scientists. Walk the chain: a change to a living part (the sea star die-off) plus a change to a nonliving part (warm water) removed the brake on urchins; urchins ate the kelp; everything that lived in the kelp lost habitat; abalone, which eat drifting kelp, starved. Ask students to identify the keystone species, the cascade and the resilience question. Point out that the evidence came from divers counting urchins and measuring kelp at the same sites year after year, plus aerial surveys of kelp canopy. Where sea otters still live, around Monterey, urchin outbreaks have been less severe, which is a with-and-without comparison in real life. If students ask about recovery: divers and volunteers have been removing urchins from some coves, and kelp has returned in patches, but scientists say the barrens are stubborn.

Listen for: Blaming the urchins. Urchins were always there; what changed was the loss of the predators that held their numbers down.

Connects to: W10 q7 and q8 use a sea star, urchin and kelp cascade; W2 q5 uses otters, urchins and kelp; the chapter extension follows the northern California kelp collapse.

Slide 22 • What makes an argument strong? · content · 5 min

On the slide: Before and after: the same place, the same counts, repeated over time. · With and without: many similar places that differ mainly in the one change. · A mechanism: a reason the change should affect that population, which you can test. · Repetition: the pattern shows up at many sites, not just one.

Return to the marsh task. The table was before-and-after only. Ask students how to add each of the other three. With-and-without: find marshes that still get sediment. Mechanism: cordgrass needs sediment to keep up with sinking ground and cannot tolerate too much salt; test it by measuring salt and ground height. Repetition: survey several marshes with levees and several without. Then connect to the labs: Lab 2 proposes mechanisms in a model and then checks one against real survey data, Lab 3 gives with-and-without comparisons repeated across many plot pairs, and W6 asks for all of it in writing. The PE's exact words are 'argument supported by empirical evidence', and this slide is the checklist.

Listen for: 'More data points from the same place' is not the same as 'more places'. Both help, for different reasons.

Connects to: Checklist for W6 (CER), W7 (Jordan's dam argument, which lacks a comparison creek) and Lab 3 q10, which rates the class argument against these four features.

Slide 23 • When people move a species: invasive species · content · 4 min

On the slide: Introduced: moved by people outside its native range. · Invasive: introduced, spreading, and causing harm. · California example: water hyacinth mats choke Delta channels and shade native plants. · A new species is a change to a living part, with cascades like any other.

Keep the definitions sharp, because students use 'invasive' for any unwanted animal. Ask them to name introduced species they know in California (eucalyptus trees, European starlings, nutria in the Delta, zebra and quagga mussels in reservoirs). Then ask which are invasive by the slide's test. Point out the contrast with the cattle egret in the textbook's Gulf of Mexico example: that bird crossed the Atlantic on its own and spread with farmland, so it is a newly arrived species, not an introduced one. The accuracy point is small but worth making, because the definition is the whole idea.

Listen for: 'Introduced' and 'invasive' used as synonyms, and 'invasive' used for any native pest.

Connects to: W7 q7 applies the definition of invasive; W10 q10 asks about cattle egrets.

Slide 24 • Engineering a comeback: criteria and constraints · Model · 6 min

Set up the problem: Louisiana's coastal marshes were built by river sediment, and levees that protect towns also starve the marshes, so they sink and shrink. Engineers want them back for wildlife and storm protection. Define criteria (what counts as success) and constraints (what the design cannot violate). Then show the two answers. Wax Lake is an open channel: the river built about a square kilometer of new land per year on average, with big variation from floods and storms, but it only works because the area is lightly settled. Caernarvon is a door in a levee: it can be shut when the river is high. Accuracy notes: the textbook's map label says Mississippi, but the Wax Lake Outlet carries Atchafalaya water; the state agency says Caernarvon's main purpose is holding back salt water, and how much land it builds is debated. Ask students which constraint forced the New Orleans design to be different.

Listen for: Thinking the best design is the one that builds the most land. The best design is the one that meets the criteria inside the constraints of its place.

Connects to: W9 (transfer): criteria and constraints for the Arroyo Verde creek restoration.

Slide 25 • Discuss: what would restoring a creek near us require? · Think · pair · share · 6 min

On the slide: Imagine a channelized, concrete-lined creek near school being restored to a natural streambed. List two criteria for success and two constraints, and say which one would be hardest to satisfy.

Many California creeks were lined with concrete for flood control. Give pairs three minutes. Criteria students usually propose: native fish and frogs return; shade trees along the bank; water stays cool. Constraints: the creek must still carry a flood without flooding homes; the land next to it belongs to someone; cost; the creek is only a few meters wide. Push for precision: 'fish come back' is vague; 'steelhead or native minnows seen in three of five years' is a criterion someone could check. Then connect to the PE: how would they gather evidence that the restoration affected populations? Before-and-after counts plus a similar unrestored creek.

Expected responses: Criteria: native species return, cooler water, bank plants, less erosion. Constraints: flood capacity, space, cost, property, time. Hardest: flood capacity, because a natural bed carries less water than a concrete channel of the same width.

Connects to: W9 (transfer) turns this discussion into a written creek restoration design, decision and justification.

Slide 26 • Is this right? • Misconception check • 5 min

Statement shown: “A student says: 'The 1980 eruption killed everything on Mount St. Helens, so the new ecosystem had to be built entirely by seeds and animals that arrived from outside.'”

Give students one minute to decide and find the evidence. The statement is partly right and importantly wrong. Right: the pumice plain really was sterile, new ground, and its first plants and spiders did arrive from outside. Wrong: 'everything' and 'entirely'. Across the blast zone, gophers survived in burrows, plants survived under snow, seeds and fungi survived in soil, and amphibians survived in lakes. These biological legacies drove the fast recovery of the blowdown zone and even seeded the edges of the pumice plain. Ask students to rewrite the statement so that it is accurate, and to say which kind of succession each zone shows. Then ask the harder question: what evidence would you need to know whether a plant on the pumice plain came from a survivor or an arrival? (Where it is growing, whether nearby survivors exist, and its seed type.)

Expected responses: Mostly wrong. Rewrite: the blast killed most living things, but survivors in burrows, under snow, in soil and in lakes helped recovery alongside new arrivals; the pumice plain shows primary succession and the blowdown zone secondary.

Listen for: Students who swing to the opposite error: 'so nothing really died'. The blast flattened hundreds of square kilometers of forest; both survivors and arrivals matter.

Connects to: W7 misconception worksheet repairs a fictional student's argument; W10 q5 tests the same claim.

Slide 27 • Putting it together • Putting it together • 5 min

On the slide: Ecosystems are dynamic systems: change is normal, gradual or sudden, natural or human-caused. • Succession rebuilds a place as living things improve it; primary starts without soil, secondary with it. • Survivors (biological legacies) plus new arrivals drive recovery, which may end somewhere new. • Change one living part (prairie dogs, sea stars) or one physical part (a dam, sediment) and populations shift. • Keystone species and cascades mean small changes can cause large ones. • A strong argument uses before-and-after, with-and-without, a mechanism and repetition.

Have students pick the bullet they could explain best and the one they could explain least, then pair up so each explains their best to someone who picked it as their least. Return to the parking lot from slide 2 and resolve each question with a bullet from this slide. Finally, name the four pieces of evidence they generated this week: the Lab 1 timeline and cover data, the Lab 2 removal counts and owl survey, the Lab 3 plot counts, and the marsh table. Each is the kind of evidence a written argument needs; W6 asks for one built from the lupine plot data.

Connects to: W6 CER as the written argument; W10 mastery as the quiz; W8 prairie dog evidence sort as review.

Slide 28 • Exit ticket • Exit ticket • 5 min

On the slide: A wildfire burns a forest but leaves the soil. Primary or secondary succession? Give the clue. · Name one living and one nonliving change to an ecosystem, and a population each change would affect. · A friend shows one before-and-after graph as proof that a dam caused a fish decline. What is missing?

Three questions on an index card, five minutes, collected at the door. Question 1 checks the succession distinction, question 2 checks the physical-biological split the PE uses, and question 3 checks whether students can name what a single before-and-after comparison lacks. Sort cards into three piles for tomorrow: secure, partly there, needs the reteach. Students who miss question 3 should revisit their W7 corrections before writing W6.

Expected responses: 1: secondary, because the soil (and roots and seeds) survived. 2: e.g., living: prairie dogs removed, burrowing owls decline; nonliving: a dam deepens water, fast-water insects decline. 3: a comparison river without a dam, more years of data, a mechanism, and other possible causes ruled out.

Listen for: Question 3 answers that say 'more data from the same river' only; ask for a comparison site too.

Connects to: W10 mastery check revisits all three; W6 CER and W7 repair follow.