

Prairie Dog Evidence Sort: Who Gains, Who Loses, and How Do We Know?

Learning target: I can sort evidence about prairie dogs by the population it describes and by how strong it is, and use the strongest evidence to argue how losing a keystone species affects other populations.

Collaborative investigation

About 50 min

Small group

MS-LS2-4 · assesses

MS-LS2-1 · supports

collaboration

discussion

writing

Standards connections

MS-LS2-4 (assesses, evaluating empirical evidence (group sort) and constructing an argument from it (individual section, q5 to q7)): The clarification statement emphasizes evaluating empirical evidence about changes to ecosystems. Groups rank published studies, teaching data, single observations and opinions, and each student then writes an argument, backed by the strongest cards, that removing a biological component (prairie dogs) changes other populations. The individual argument is scored with the rubric.

MS-LS2-1 (supports): Most of the cascading effects on the cards run through resources prairie dogs provide or remove: burrows for shelter, prey for ferrets, short nutritious grass for grazers, and bare ground for plovers.

Purpose: practice · **Time:** about 50 minutes · **Format:** small-group

Answers with reasoning

Black-tailed prairie dogs are ground squirrels that gather in big colonies, called towns, on the grasslands of the Great Plains. Plowing, poisoning and disease have shrunk their range to a small fraction of what it once was. A rancher says prairie dogs ruin grassland. A biologist says many grassland species depend on them, which would make them a **keystone species**. Your group will sort the evidence and decide what it actually shows.

Twelve evidence cards about prairie dogs

1 Card 1: Owl survey (teaching data)

Biologists searched 10 prairie dog colonies and 10 grasslands without prairie dogs, matched for size, soil and grass type. They found burrowing owl nests on 8 of the 10 colonies and on 1 of the 10 grasslands without prairie dogs. (Invented numbers that follow a pattern real surveys have found.)

2 Card 2: What ferrets eat (published fact)

Prairie dogs make up about 90 percent of the black-footed ferret's diet, and ferrets sleep and raise their young in prairie dog burrows. (U.S. Fish and Wildlife Service; National Park Service)

3 Card 3: Ferrets nearly lost (published history)

As prairie dog colonies shrank during the 1900s, black-footed ferrets became so rare that in 1986 and 1987 the last 18 known wild ferrets were captured in Wyoming to start a breeding program. Ferrets raised in captivity have been released at prairie dog colonies since 1991.

4 Card 4: Shrub experiment (published study)

In a desert grassland in Chihuahua, Mexico, scientists removed prairie dogs from some fenced plots and left them in others. After five years, mesquite shrubs were three to five times more abundant where prairie dogs had been removed. Prairie dogs clip shrubs and eat their seedlings. (PLOS ONE, 2016)

5 Card 5: Grazers (published observation)

Prairie dogs clip the grass on their colonies again and again, so the plants keep putting out fresh growth that is more nutritious. Bison and pronghorn often choose to graze on prairie dog colonies. (National Park Service)

6 Card 6: Mountain plovers (published study)

Mountain plovers are ground-nesting birds that need short grass and patches of bare ground. A study in eastern Colorado found many more plovers on prairie dog colonies than on nearby grassland without colonies.

7 Card 7: Plague (published fact)

Sylvatic plague is a bacterial disease that arrived in North America around 1900 and spreads among prairie dogs through flea bites. An outbreak can kill 90 percent or more of the prairie dogs in a colony. (U.S. Geological Survey)

8 Card 8: After an outbreak (teaching data)

Plague killed almost all the prairie dogs in one monitored colony in 2019. Burrowing owl nests on the colony: 12 in 2018, 2 in 2021. With no prairie dogs clipping the plants, taller grass and young shrubs grew over the old burrows. (Invented numbers.)

9 Card 9: A rancher's view (opinion and experience)

'I've run cattle here for thirty years. Prairie dogs eat the grass my cows need, and the pastures with colonies always look worse to me. I'd rather they were gone.'

10 Card 10: Grass amount and quality (teaching data)

In six pastures, researchers clipped and weighed the grass in squares on and off prairie dog colonies in July. Colonies had 40 percent less grass by weight, but each kilogram of colony grass contained more protein. (Invented numbers that follow a pattern real studies report.)

11 Card 11: One sighting (single observation)

A hiker photographed a prairie rattlesnake sliding into a prairie dog burrow on a cool morning and posted the picture online.

12 Card 12: A website claim (no evidence given)

A pest-control company's website says: 'Prairie dogs destroy grasslands and have no value to any other wildlife.'

Part A: Expert round (on your own)

1. Write the numbers of your three cards in the first column. For each card, name the population or resource it is about, whether that population gains or loses when prairie dogs are present, and what kind of evidence it is: a measured comparison or experiment, a measured fact that explains a mechanism, a single observation, or an opinion or unsupported claim.

Answer: Card 1: burrowing owls; gain; measured comparison (strong). Card 2: black-footed ferrets; gain (food and dens); measured fact about a mechanism (supporting). Card 3: black-footed ferrets; lose when prairie dogs decline; historical before-and-after record (supporting to strong). Card 4: mesquite shrubs; lose (fewer with prairie dogs); experiment (strong). Card 5: bison and pronghorn; gain (more nutritious grass); measured observation of a mechanism (supporting). Card 6: mountain plovers; gain; measured comparison (strong). Card 7: prairie dogs themselves (plague kills them); measured fact (supporting; it is the cause in the cascade). Card 8: burrowing owls lose and tall grass and shrubs gain after prairie dogs die; before-and-after record from one colony (weak to supporting, one site). Card 9: cattle forage; rancher says cattle lose; opinion and experience (not evidence, though it raises a testable question). Card 10: grass amount loses, grass quality gains; measured comparison across six pastures (strong). Card 11: rattlesnakes; gain (shelter); single observation (weak). Card 12: 'all wildlife'; claim with nothing measured (not evidence, and contradicted by other cards).

Why: Each student completes only their three rows; the full list is the teacher's reference for checking the group table.

Also acceptable: Card 3 can be rated supporting or strong: it is a well-documented historical decline, but other causes (disease in the ferrets themselves) also played a part. Card 8 can be rated weak or supporting because it is one colony.

- Population or resource identified correctly for each of the student's three cards
- Direction (gain or lose) correct
- Kind of evidence classified sensibly

Part B: Group sort

1. Each expert teaches their three cards in under a minute per card: what it says, which population it is about, and what kind of evidence it is.
2. As a group, give every card a strength. **Strong:** a measured comparison of many places, an experiment, or a before-and-after record. **Supporting:** a measured fact that explains how prairie dogs could affect another species but does not compare places. **Weak:** a single observation or a very small sample. **Not evidence:** an opinion or a claim with nothing measured.
3. Record every card in the group table. If the group disagrees about a card's strength, write both views and the reason for each.
4. Answer q2 to q4 together. Every member must be ready to explain one answer to the teacher.

Group evidence record

Card	Population or resource	Gains or loses with prairie dogs	Kind of evidence	Strength
1				
2				
3				

Card	Population or resource	Gains or loses with prairie dogs	Kind of evidence	Strength
4				
5				
6				
7				
8				
9				
10				
11				
12				

2. Group answer: Which **two** cards are the strongest evidence that prairie dogs affect another population? For each, explain what makes it strong.

Answer: Best choices: card 4, because it is an experiment in which only prairie dog presence was changed and shrubs were three to five times more abundant where they were removed; and card 1 or card 6, because they compare many matched places with and without prairie dogs (owl nests on 8 of 10 colonies versus 1 of 10 grasslands; many more plovers on colonies). Card 10 is also strong (six pastures measured on and off colonies).

Why: Strength comes from measurement, a comparison or experiment, and repetition across places, not from how dramatic the card sounds.

Also acceptable: Card 8 is acceptable as one choice if the group explains that it is before-and-after evidence but notes it comes from only one colony.

- Two cards from 1, 4, 6 or 10
- Each justified by comparison, experiment or sample size

3. Group answer: The rancher (card 9) and the biologist both say they are right. Use card 10 and at least one other card to explain how both could be describing real effects. Then say what the rancher would need to measure to turn the claim into strong evidence.

Answer: Both can be describing real effects on different things. Card 10 shows colonies had 40 percent less grass by weight, which supports the rancher's concern that there is less forage for cattle. The same card shows the colony grass had more protein, and card 5 says bison and pronghorn often choose to graze there because the regrowth is more nutritious, which supports the biologist. Cards 1, 2 and 6 add populations that gain (owls, ferrets, plovers). So prairie dogs reduce the amount of grass but raise its quality and support several other species. To make the rancher's claim strong evidence, the rancher would need measurements, such as cattle weight gain or forage per hectare in many pastures with and without colonies over several years.

Why: This resolves the slide 16 discussion: 'ruin' and 'depend on' are both partial descriptions; the scientific answer names which populations go up and down.

Also acceptable: Accept an answer that notes cattle might also benefit from the higher protein; the cards do not settle the cattle question, which is exactly why it needs measuring.

- Uses card 10's amount-versus-quality result
- Uses at least one other card for the biologist's side
- Names a measurement that would test the rancher's claim

4. Group answer: Use cards 2, 6, 7 and 8 to write the chain of effects (the cascading change) that follows a plague outbreak in a colony. Include at least four links, written as 'A leads to B because...'.

Answer: Plague kills 90 percent or more of a colony's prairie dogs (card 7). That leads to fewer black-footed ferrets, because prairie dogs are about 90 percent of their food and their burrows are ferret dens (card 2). Losing the prairie dogs also leads to fewer owl nests (12 to 2), because the burrows fill in and grass grows over them (card 8). With no prairie dogs clipping the plants, taller grass and young shrubs grow back (card 8), which leads to fewer mountain plovers, because plovers need short grass and bare ground (card 6). Shrubs gain, which matches the experiment on card 4.

Why: This is a cascading change: one biological change (prairie dogs lost) alters resources (food, burrows, short grass), which shifts several other populations in both directions.

Also acceptable: A chain drawn as boxes and arrows with labeled links earns full credit.

- Starts with plague killing prairie dogs
- At least four links, each with a resource-based 'because'
- Includes at least one population that declines and one that increases

Part C: On your own

5. Write an argument that answers this question: **Does losing prairie dogs from a grassland affect other populations?** Make a claim, support it with at least three cards (at least one must be a card your group rated strong), and for each card explain the mechanism: what prairie dogs provide or remove that the other population depends on.

Answer: Model: Claim: Yes. Losing prairie dogs from a grassland changes several other populations, lowering some and raising others. Evidence and mechanism: (1) In a comparison of 10 colonies and 10 matched grasslands, burrowing owls nested on 8 colonies but only 1 grassland (card 1), and after plague emptied one colony its owl nests fell from 12 to 2 (card 8); owls need the burrows for nests, so losing the burrows lowers the owl population. (2) Black-footed ferrets get about 90 percent of their food from prairie dogs and use their burrows as dens (card 2), and as colonies shrank in the 1900s the ferrets nearly vanished (card 3). (3) In an experiment, removing prairie dogs led to three to five times more mesquite after five years (card 4), because prairie dogs clip shrubs and eat their seedlings; without them, shrubs increase. So losing prairie dogs is a change to a biological component that spreads through shelter, food and plant cover to other populations.

Why: Full credit needs a claim, three or more cards including a strong one, a mechanism for each, and at least one population that increases as well as one that decreases (the honest picture).

Also acceptable: A student may argue from cards 5, 6 and 10 instead; any three cards with sound mechanisms earn credit. An argument resting only on cards 9, 11 and 12 does not meet the strong-evidence requirement.

- A clear claim answering the question
- At least three cards cited, at least one rated strong
- A resource-based mechanism for each card
- Recognizes that some populations increase (for example shrubs) while others decrease

6. Choose card 11 or card 12. Explain why it is weak or not evidence at all, and describe what someone would have to measure to test the idea it raises.

Answer: Card 11 is a single sighting: it shows that a rattlesnake used one burrow once, but not whether snakes are more common where prairie dogs live. To test it, count rattlesnakes (or snakes using burrows) on many colonies and many similar grasslands without colonies. Card 12 is a claim with nothing measured, and it is contradicted by measured cards (1, 2, 4, 6); to test 'no value to any other wildlife', count other species on and off colonies.

Why: Students practice turning an anecdote or assertion into a testable comparison.

Also acceptable: Accept a before-and-after design (count snakes before and after a colony is lost) as the test.

- Explains why the chosen card is weak or not evidence
- Describes a measurement with a comparison

7. Card 1 compares places that already exist; card 4 is an experiment in which scientists removed prairie dogs on purpose. Explain why the experiment gives stronger evidence that prairie dogs **cause** a difference.

Answer: Places that already have prairie dogs might differ in other ways, such as soil, slope or rainfall, that prairie dogs chose or that affect owls and shrubs too, so a comparison cannot fully separate the prairie dogs from the place. In the experiment, the plots started alike and the scientists changed only one thing, prairie dog presence, so a difference that develops afterward is best explained by the prairie dogs.

Why: An experiment controls the other variables that a comparison of existing places cannot.

Also acceptable: Accept 'in an experiment you control everything else' if the student also names what could differ between existing places.

- Names a way existing places could differ besides prairie dogs
- Explains that the experiment changes one variable on purpose

Scoring rubric

Criterion	4 • Exemplary	3 • Proficient	2 • Developing	1 • Beginning
Expert explanation (Part A and teaching the group)	Explains all three cards accurately, with the population, the direction of the effect and the kind of evidence, so that groupmates can record them without rereading.	Explains all three cards with one small error or omission.	Explains some cards, or reads them aloud without classifying them.	Does not explain the assigned cards.
Judging evidence strength (group table and q2)	Every card rated sensibly, with reasons based on measurement, comparison, experiment and sample size; opinion and single observation clearly separated from measured evidence.	Most cards rated sensibly; one or two ratings unjustified.	Ratings follow how convincing a card sounds rather than what was measured.	Cards not rated, or opinions rated as strong evidence.
Group reasoning (q3 and q4)	Reconciles the rancher and biologist with card 10 and another card, names a test for the rancher's claim, and traces a four-link cascade with a resource at every link.	Both tasks done with one link or one piece of the reconciliation missing.	Picks a side instead of reconciling, or the cascade has links with no reasons.	Group answers missing or unrelated to the cards.
Individual argument (q5 to q7)	Claim answers the question; at least three cards including a strong one; a mechanism for each; recognizes that some populations rise while others fall; q6 and q7 show clear understanding of evidence quality.	Claim and three cards with mechanisms, but no strong card or no recognition of mixed effects.	Claim with one or two cards, or cards listed without mechanisms.	No argument, or an argument based only on opinion cards.

Teacher notes

Cards 2 to 7 report real findings: prairie dogs are about 90 percent of the black-footed ferret's diet (U.S. Fish and Wildlife Service, National Park Service); the last 18 known wild ferrets were captured in Wyoming in 1986 and 1987, and captive-bred ferrets have been released since 1991; the Chihuahua shrub experiment is Ponce-Guevara and others, PLOS ONE, 2016; the National Park Service describes grazers drawn to the more nutritious regrowth on colonies; mountain plovers are strongly associated with prairie dog colonies in

eastern Colorado (published occupancy and density studies); sylvatic plague arrived in North America around 1900 and outbreaks commonly kill 90 percent or more of a colony (U.S. Geological Survey). Cards 1, 8 and 10 use invented numbers that follow published patterns, and say so. The textbook's claim that prairie dogs make grass 'more abundant' and cause pronghorn to decline is not used; card 10 shows the more defensible pattern (less grass, better grass) and card 5 lists pronghorn among the grazers that use colonies. Cut the cards apart before class. Listen during the expert round for students who rate a card strong because it is dramatic (card 12) or published-sounding; the scaffold's three questions fix most of these. The individual section (q5 to q7) is the evidence of learning for each student.

Scaffold offered to students: A quick test for each card

Ask three questions of every card. Was something measured or counted? If not, it is an opinion or claim. Were places with and without prairie dogs compared, or was one place followed before and after a change, or did scientists change something on purpose? If yes, it is a comparison or experiment. Is it one sighting or one place? Then it is weak by itself. For the cascade in q4, start with 'Plague kills most prairie dogs' and follow each resource they provided: prey, burrows, short grass.

Extension: Keystone or just common?

Some ecologists argue that a species should be called a keystone only if its effect on the community is large compared with how much of the community it makes up. Prairie dogs are very abundant where they live, so a critic might say they are simply a dominant species, not a keystone. Using the cards, write a paragraph taking a side. Then compare prairie dogs with sea otters in kelp forests: which case fits the keystone idea more clearly, and why?