

The Cleanup Crew: What India Learned When Its Vultures Vanished

Learning target: I can use evidence from a reading to explain how losing a scavenger disrupted an ecosystem service, tell a correlation from a cause, and compare the solutions people tried to bring the service back.

Reading with evidence

About 45 min

Individual

MS-LS2-4 · practice

MS-LS2-5 · practice

reading

writing

Standards connections

MS-LS2-4 (practice): Students trace how a change to one biological component (vultures) affected other populations (feral dogs, rats) and judge which evidence supports a causal argument, the reasoning this PE asks for. The evidence comes from a passage rather than data students analyze themselves, so this is practice.

MS-LS2-5 (practice): The last questions ask students to weigh four real solutions (a drug ban, a safe substitute drug, captive breeding, safe zones) for restoring a species and the disease-control service it provides, which builds toward evaluating competing solutions for maintaining biodiversity and ecosystem services.

Purpose: build · **Time:** about 45 minutes · **Format:** individual

Answers with reasoning

The Cleanup Crew

[1] In much of India, cattle that die of old age or illness are not eaten. For centuries, the bodies of cows and buffalo were hauled to the edge of a village or to a dump and left in the open. Within hours, dozens of vultures would glide down from the sky, and a large flock could strip a carcass to bare bone in well under an hour. Nobody paid these birds, and few people thought of them as workers, yet they were doing a job that kept towns cleaner and safer.

[2] In the 1990s, bird scientists noticed something alarming. Three kinds of vultures that had been among the most common large birds of prey on Earth were vanishing. Surveys repeated over about fifteen years showed that their numbers had dropped by more than 95 percent, and one species had lost more than 99 percent. They tested ideas such as a new infection, a shortage of food and poisoning by crop pesticides, and none of those explanations fit the evidence.

[3] The answer came in the early 2000s from studies in Pakistan and then India. Veterinarians had begun treating sick or injured cattle with diclofenac, an inexpensive drug that eases pain and swelling. The drug does cattle no harm. But when a vulture feeds on an animal that died within a few days of a dose, the leftover drug damages the bird's kidneys, and the vulture can die within days. Only a tiny fraction of carcasses needed to contain the drug to cause the crash, because each vulture feeds on many carcasses over its life.

[4] With the vultures gone, the carcasses did not disappear. They rotted slowly, and other animals moved in to eat them. Rats and feral dogs, dogs that live on their own without owners, suddenly had extra food. One study estimated that the number of feral dogs in India grew by millions during the years the vultures declined. That mattered for people, because dog bites cause nearly all human rabies cases in India. Rabies is a deadly infection of the brain, and sales of rabies vaccine rose as more people were bitten.

[5] Here a careful reader should slow down. A graph showing vultures falling while dogs rose does not, by itself, prove that one change caused the other. Dog numbers might also have grown because towns were growing and making more garbage. To test the idea, economists in a 2024 study compared districts of India that had been home to many vultures with districts where vultures had always been rare. After diclofenac came into wide use, human death rates rose by more than 4 percent in the former vulture districts but not in the others. Because both kinds of districts went through the same national changes, the difference points to the loss of vultures, and the poorer sanitation that followed, as a cause. Rabies was probably one pathway; germs from rotting carcasses washing into water may have been another.

[6] India and its neighbors tried several solutions. In 2006 the governments of India, Pakistan and Nepal banned diclofenac for use in animals. Scientists tested other painkillers on vultures in captivity and found that one, meloxicam, did not harm them, so veterinarians could switch to it. Conservation groups built breeding centers where vultures are raised safely and later released, and some regions set up vulture safe zones where farmers are helped to use only safe drugs. Each solution has limits. Some people kept giving cattle diclofenac made for humans after the ban, and other livestock painkillers were later found to be dangerous to vultures too.

[7] Recovery is slow. A pair of these vultures raises at most one chick a year, and young birds take about five years to begin breeding, so numbers can climb only gradually even when the food is safe. Recent surveys suggest the steep declines have slowed or stopped in some areas, but the populations remain a small fraction of what they once were. The vultures' story shows how a service that no one counted, cleaning up dead animals, can turn out to be worth a great deal once it is gone.

Questions: cite the passage

1. According to paragraph 1, what job did vultures do, and why does the writer call them workers that nobody paid?

Answer: Vultures ate the bodies of dead cattle left near villages and dumps, stripping a carcass in well under an hour. They are called unpaid workers because they did a useful cleanup job for people without anyone hiring them or noticing the value of the work.

Why: Paragraph 1 describes the service and frames it as unrecognized work.

Also acceptable: Accept 'cleaning up dead animals so they do not rot'.

- Names eating or removing carcasses
- Explains the 'unpaid worker' idea (a useful job done free and unnoticed)
- Cites paragraph 1

2. Paragraph 2 says researchers tested several explanations that did not fit. Why is ruling out other explanations an important step before naming a cause?

Answer: Several causes could produce the same result (dead vultures), so scientists must test and eliminate the other possibilities. If they named a cause without ruling out disease, food shortage or pesticides, they might blame the wrong thing and pick a solution that does not work.

Why: Ruling out alternatives is how a correlation becomes a convincing causal claim.

Also acceptable: Accept 'so they don't fix the wrong problem'.

- Recognizes that other causes could explain the deaths
- Connects ruling them out to choosing the right cause or solution

3. Using paragraph 3, explain how a drug that is safe for cattle could kill vultures, and why only a small fraction of carcasses had to contain it.

Answer: Cattle were given diclofenac, which does not hurt them. Some of the drug was still in the body when a treated animal died, and vultures that ate the meat took it in; it damages vulture kidneys, so they died within days. Because a single vulture eats at many different carcasses during its life, even a tiny fraction of contaminated carcasses meant that most vultures eventually met one.

Why: Paragraph 3 gives both the mechanism (kidney damage from leftover drug) and the reason a small fraction was enough (many feedings per bird).

Also acceptable: Accept 'vultures share carcasses and eat a lot of them' for the last point.

- Leftover drug in carcasses of recently treated animals
- Kidney damage in vultures
- Each vulture eats many carcasses, so a small fraction reaches many birds

4. Use paragraphs 3 and 4 to complete the chain of effects, one step per row.

Answer: Step 1: cattle are treated with diclofenac. Step 2: vultures that eat treated carcasses die, and populations fall by more than 95 percent. Step 3: carcasses are left to rot instead of being eaten quickly. Step 4: feral dogs and rats have extra food, and feral dog numbers grow by millions. Step 5: more people are bitten by dogs and exposed to rabies; vaccine sales rise.

Why: This is the chain of effects described in paragraphs 3 and 4.

Also acceptable: Accept 'death rates rose' for step 5 if the student cites paragraph 5.

- Each step in the correct order
- Step 4 names more food for dogs and rats
- Step 5 connects dog bites to rabies risk

5. Which step in your chain is a direct effect of the drug, and which steps are indirect effects? Explain the difference using this example.

Answer: The direct effect is on vultures: the drug they eat kills them. The effects on carcasses, dogs, rats and people are indirect, because they happen only through the change in vultures; the drug never touched the dogs or the people.

Why: A direct effect acts on an organism itself; an indirect effect travels through another population.

Also acceptable: Accept the cattle step described as 'no effect' on cattle.

- Vulture deaths identified as the direct effect
- Dogs and people identified as indirect effects
- Explains that indirect effects pass through another population

6. Paragraph 5 says a graph of falling vultures and rising dogs does not by itself prove cause. Explain why. Name the other possible cause the writer gives, and explain how the 2024 comparison of districts made the evidence stronger.

Answer: Two trends changing at the same time is a correlation; something else could be causing one or both. The writer suggests that growing towns making more garbage could also have fed more dogs. The 2024 study compared districts that had many vultures with districts that never did. Both sets of districts lived through the same national changes, such as town growth, but death rates rose only where vultures had been lost, after the drug spread. That comparison removes many other explanations and points to vulture loss as a cause.

Why: Paragraph 5 models how a comparison group strengthens a causal claim.

Also acceptable: Accept any correct explanation that the comparison districts act like a control group.

- Explains correlation versus cause
- Names growing towns or more garbage as another possible cause
- Explains the comparison of vulture and non-vulture districts
- Explains why the comparison rules out shared causes

7. Use paragraphs 6 and 7 to evaluate the four solutions. Fill every cell.

Answer: Ban: stops the main cause at its source / strength: removes the poison from most carcasses / limit: some people kept using human diclofenac on cattle. Meloxicam: gives vets a safe painkiller / strength: farmers can still treat sick animals, so they have less reason to break the ban / limit: costs or habits may slow the switch, and other harmful drugs exist. Captive breeding: raises vultures safely for release / strength: adds birds faster than wild breeding alone and protects a back-up population / limit: slow, because each pair raises at most one chick a year, and released birds still need safe food. Safe zones: help farmers in an area use only safe drugs / strength: gives released and wild birds a safe area to feed / limit: covers only some regions.

Why: Each strength and limit must come from or be consistent with paragraphs 6 and 7.

Also acceptable: Reasonable strengths and limits beyond the passage earn credit if they are logical (for example, 'safe zones depend on farmers trusting the program').

- What each solution does is accurate
- At least one sensible strength per solution
- At least one limit per solution supported by the passage or by reasoning about it

8. Which solution do you think does the most to bring back the cleanup service? Use evidence from paragraphs 6 and 7, and explain why the solutions probably work better together than alone.

Answer: Example: The ban matters most, because as long as treated carcasses contain diclofenac, every other effort fails; released vultures would just be poisoned. But the ban works better with meloxicam, which gives farmers a safe choice so they follow the ban, and with safe zones that check drugs locally. Captive breeding then speeds recovery, which paragraph 7 says is slow because pairs raise at most one chick a year. Together the solutions remove the cause and rebuild the population.

Why: The strongest answers recognize that removing the cause is necessary but not sufficient when the population breeds slowly.

Also acceptable: A student may choose captive breeding or safe zones if the argument still explains why the ban or safe drugs are needed alongside it.

- A clear choice of one solution
- Evidence from paragraphs 6 and 7
- Explains why combining solutions works better (one removes the cause, others rebuild or enforce)

9. Classify the vultures' cleanup job as a provisioning, regulating, supporting or cultural service, and explain your choice.

Answer: Regulating service. By removing carcasses quickly, vultures keep disease-spreading animals and germs in check, which regulates the spread of disease rather than supplying a product or an experience.

Why: Disease regulation and waste removal are regulating services in the four-category framework.

Also acceptable: Accept 'supporting' for partial credit if the student argues that vultures recycle nutrients; full credit needs the disease-control reason.

- Names regulating
- Explains that the service controls disease or waste

Teacher notes

Passage length is about 684 words. The facts were checked against published sources: the three Gyps species declined by more than 95 percent (one by more than 99 percent) between the early 1990s and mid-2000s; diclofenac residues cause kidney failure in Gyps vultures (studies in Pakistan, 2004, then India); veterinary diclofenac was banned in India, Pakistan and Nepal in 2006; meloxicam was tested and found safe for these vultures; Frank and Sudarshan (American Economic Review, 2024) found human death rates rose by more than 4 percent in districts that had been vulture habitat compared with districts that had not. The textbook's figure plots vultures and feral dogs only and its caption implies cause; this sheet deliberately separates correlation from cause (q6). Rabies is described as deadly and spread mostly by dog bites; it is preventable with prompt care after a bite, so avoid telling students it is always fatal. The extension is open-ended; look for a sensible comparison site and named confounders.

Scaffold offered to students: Reading guide

Before answering, write one short label in the margin beside each paragraph: 1 the job, 2 the mystery, 3 the cause, 4 the chain of effects, 5 testing the cause, 6 the solutions, 7 recovery. When a question names a paragraph, go back to that label and reread just that paragraph. For q6, look for the words 'does not, by itself, prove' and 'compared'.

Extension: Design the comparison

The 2024 study compared places that lost vultures with places that never had many. Design a similar comparison for a different question: does losing turkey vultures in part of California change how long roadkill stays on the road? Describe which places you would compare, what you would measure, what other differences between the places could fool you, and what result would support the idea that vultures provide a cleanup service there.