

# Owls or Poison? Designing Rodent Control for a California Vineyard

**Learning target: I can evaluate competing solutions to a farm pest problem against criteria and constraints, choose a plan that keeps biodiversity and a natural pest-control service, and justify it with evidence.**

Transfer and design

About 55 min

Pairs

MS-LS2-5 · assesses

MS-ETS1-2 · assesses

MS-ETS1-1 · practice

engineering design

data analysis

writing

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

## Directions

Work with a partner. Read the problem, the facts box and the options table; the costs and results are teaching estimates, not real measurements. In Part A, use what you know about food chains and ecosystem services. In Part B, calculate costs, apply the constraint and score the options with the rules given. In Part C, make and defend a recommendation and plan how to check whether it works. Each partner writes their own answer to q7.

**You will need:** This worksheet, Pencil, Calculator

## The problem

Ridgeline Vineyard is a made-up 40-acre wine-grape vineyard in a California valley. Pocket gophers chew grapevine roots underground, and voles gnaw the bark at the base of young vines. Last year rodents killed about 600 vines, and every one had to be replanted. A strip of oak woodland and grassland borders the vineyard on two sides. The owners want a rodent-control plan for the next three years, and they have heard that barn owls might help.

**What growers and biologists know** — Barn owls hunt at night, mostly for small rodents such as voles, pocket gophers and mice. They do not build nests; they use tree hollows, barns or wooden nest boxes, and many California vineyards and farms put up boxes for them. A pair raising chicks must catch many rodents every night. Owls hunt over open ground, and studies in California vineyards found they often hunt over nearby grassland as well as among the vines. Most rodent baits are anticoagulant poisons: a rodent that eats bait may live for days, and an owl, hawk, fox or bobcat that eats a poisoned rodent can be poisoned too, which is called secondary poisoning. Trapping in gopher tunnels works but takes labor for every animal caught. Owls rarely remove every pest, so growers often combine nest boxes with spot trapping.

## Ridgeline Vineyard options and estimates (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

| Option                          | What is done                                                                                        | Program cost over 3 years (\$) | Vines lost: year 1, year 2, year 3 | Effect on other wildlife                                            | Labor  |
|---------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------|---------------------------------------------------------------------|--------|
| A Poison bait                   | Bait stations along every row, refilled monthly                                                     | 9000                           | 150, 150, 150                      | Risk of secondary poisoning of owls, hawks, foxes, bobcats and pets | Low    |
| B Trapping crew                 | A trapper sets traps in gopher tunnels two days a week                                              | 24000                          | 220, 200, 180                      | Little effect                                                       | High   |
| C Owl boxes                     | Ten barn owl boxes on poles, cleaned each winter                                                    | 6000                           | 300, 220, 180                      | Supports owls; no poison risk                                       | Low    |
| D Owls, strip and spot trapping | Ten owl boxes, a 2-acre strip of native grasses and flowers, and trapping only where damage appears | 15000                          | 250, 170, 120                      | Supports owls, hawks and pollinators; strip also holds soil         | Medium |
| E Do nothing                    | Replant whatever dies                                                                               | 0                              | 600, 600, 600                      | No direct effect                                                    | None   |

Simulated estimates for teaching. Replanting a vine killed by rodents costs \$30 in this scenario. Program cost covers equipment, materials and labor for three years.

**Criteria and constraint — Constraint:** the program cost (not counting replanting) must be no more than \$20,000 over three years. **Criteria and weights:** (1) vine losses by year 3, weight 3; (2) protects biodiversity and natural predators, weight 3; (3) low total three-year cost including replanting, weight 2; (4) low labor, weight 1. **Scoring rules:** Losses in year 3: 3 = under 150, 2 = 150 to 199, 1 = 200 or more. Biodiversity: 3 = supports predators or habitat, 2 = no effect, 1 = puts wildlife at risk. Total cost: 3 = under \$25,000, 2 = \$25,000 to \$35,000, 1 = over \$35,000. Labor: 3 = low or none, 2 = medium, 1 = high.

## Part A: Understand the system

1. What ecosystem service would barn owls provide to the vineyard, and which category does it belong to? Explain one way the oak woodland and grassland next to the vineyard help provide it.

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2. Draw or describe a food chain that shows how bait put out for gophers could end up harming an owl or bobcat that never touched the bait. Explain each link.

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3. The owners first wrote their goal as 'Have fewer pests.' Rewrite it as a criterion precise enough to measure, and say how they would measure it.

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## Part B: Calculate, apply the constraint and score

4. Complete the table. Replanting cost = vines lost  $\times$  \$30. Three-year total = replanting cost + program cost.

| Vines lost in 3 years           | Replanting cost (\$) | Program cost (\$) | Three-year total (\$) |
|---------------------------------|----------------------|-------------------|-----------------------|
| A Poison bait                   |                      |                   |                       |
| B Trapping crew                 |                      |                   |                       |
| C Owl boxes                     |                      |                   |                       |
| D Owls, strip and spot trapping |                      |                   |                       |
| E Do nothing                    |                      |                   |                       |

5. Which option fails the constraint and is removed before scoring? Explain.

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6. Use the scoring rules to give each remaining option a score of 1 to 3 on each criterion. Write the score and the weighted points in each cell (for example '2  $\rightarrow$  6'), then add the weighted total.

| Losses in year 3 (score $\times$ 3) | Biodiversity (score $\times$ 3) | Total cost (score $\times$ 2) | Labor (score $\times$ 1) | Weighted total |
|-------------------------------------|---------------------------------|-------------------------------|--------------------------|----------------|
| A Poison bait                       |                                 |                               |                          |                |
| C Owl boxes                         |                                 |                               |                          |                |
| D Owls, strip and spot trapping     |                                 |                               |                          |                |
| E Do nothing                        |                                 |                               |                          |                |

## Part C: Decide, justify and plan the test

7. Recommend one option to the owners. Justify it with at least two numbers from your tables, explain how your choice maintains biodiversity and the pest-control service, and name one trade-off you are accepting.

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8. Plan the test. Name two things the vineyard should measure each year to know whether the plan is working, what result at the end of year 2 would make you change the plan, and what change you would make.

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9. Option C's losses fall from 300 to 180 over three years, while option A's stay at 150. Use what you know about populations and resources to explain why an owl solution gets better over time while poison works right away but never improves.

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### Order of work and one worked row

Work in this order: constraint first, then costs, then scores. Worked example for option E: vines lost =  $600 + 600 + 600 = 1,800$ ; replanting =  $1,800 \times \$30 = \$54,000$ ; program =  $\$0$ ; total =  $\$54,000$ .

Scores for E: losses  $600 \rightarrow 1 \rightarrow 1 \times 3 = 3$ ; biodiversity no effect  $\rightarrow 2 \rightarrow 2 \times 3 = 6$ ; cost over  $\$35,000 \rightarrow 1 \rightarrow 1 \times 2 = 2$ ; labor none  $\rightarrow 3 \rightarrow 3 \times 1 = 3$ ; weighted total 14.

### **Change the weights**

A neighbor who sells wine labeled 'farmed for wildlife' would weight biodiversity 5 instead of 3. Another neighbor, short on money this year, would weight total cost 4 instead of 2. Recalculate the weighted totals for options A, C and D under each neighbor's weights. Does the ranking change? Write a paragraph explaining what this shows about who decides the weights in a decision matrix, and why science can inform the decision but does not make it by itself.