Marsh Decision Lab

Use simulation results to weigh biodiversity gains and costs.

HS-LS4-6 "Use a simulation to research and analyze possible solutions for the adverse impacts of human activity on biodiversity. (SEP: 5; DCI: LS4.C, LS4.D, ETS1.B; CCC: Cause/Effect) Alignment may include HS-ETS1-3, HS-ETS1-4"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the cause-and-effect chain linking farm activity to biodiversity loss. Then circle the table row for the affordable plan that predicts the most species.

Can Runoff Controls Protect a Marsh?

1. After spring storms, fertilizer from farms can wash into a nearby marsh. Extra phosphorus feeds algae, whose decay consumes dissolved oxygen. Fish and aquatic insects may decline, leaving fewer species in the marsh. A county team built a computer simulation to test whether reducing phosphorus runoff could limit this human-caused loss of biodiversity.

2. The model holds rainfall and farm area constant while changing runoff controls. A planted streamside buffer traps some phosphorus before water reaches the marsh. A constructed wetland slows runoff so sediment and nutrients can settle. The team also tests both controls together. The table reports projected yearly phosphorus entering the marsh, projected species richness, and estimated yearly costs.

SIMULATED MARSH OUTCOMES

Runoff control	Phosphorus entering marsh (kg/year)	Projected species richness	Estimated cost ($/year)
None	100	12	0
Streamside buffer	65	17	8,000
Constructed wetland	45	20	15,000
Both controls	30	23	21,000

3. Species richness means the number of different species, not the number of individual organisms. The county can spend at most $18,000 per year. A simulation predicts possible outcomes, not guaranteed results: plant survival, unusual storms, and other pollutants could change what happens. The team must weigh biodiversity gains against costs and check the model's predictions with field measurements.

2 ANSWER WITH EVIDENCE

Use the passage

1. Explain how fertilizer runoff could cause the marsh to lose species.

2. Compare the streamside buffer and constructed wetland. What additional species richness does the wetland predict, and what is its additional yearly cost?

3. Both controls predict the highest species richness. Why might the county choose the constructed wetland instead?

4. An unusually heavy storm occurs after the county installs a runoff control. How could the team check whether the simulation's biodiversity prediction holds?

3 YOUR TURN

Your own words

Design a new runoff solution not listed in the table. In four sentences, explain what you would change in the simulation, predict how phosphorus and species richness would respond, name one cost or limitation, and describe a field check.

ANSWER KEY

Marsh Decision Lab

HIGH SCHOOL · HS-LS4-6

PART 1 · READ AND MARK

Underline the cause-and-effect chain linking farm activity to biodiversity loss. Then circle the table row for the affordable plan that predicts the most species. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Explain how fertilizer runoff could cause the marsh to lose species.	**Fertilizer adds phosphorus that feeds algae. When algae decay, they consume dissolved oxygen, so fish and aquatic insects may decline.**
2	Compare the streamside buffer and constructed wetland. What additional species richness does the wetland predict, and what is its additional yearly cost?	**The wetland predicts 3 more species than the buffer, at an additional $7,000 per year.**
3	Both controls predict the highest species richness. Why might the county choose the constructed wetland instead?	**Both controls cost $21,000 per year, which exceeds the $18,000 budget. The wetland costs $15,000 and predicts the most species of any affordable option.**
4	An unusually heavy storm occurs after the county installs a runoff control. How could the team check whether the simulation's biodiversity prediction holds?	**The team could count species in the marsh and compare the measured species richness with the model's prediction. The storm may cause the measured result to differ.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would simulate using soil tests to decide when farms need fertilizer, while keeping rainfall and farm area unchanged. I predict less phosphorus would enter the marsh and species richness would rise as algal blooms decline. Soil tests could raise farm costs, and unusually heavy storms could limit the benefit. I would measure phosphorus entering the marsh and count species after farms adopt the practice.

Accept other feasible runoff controls if the predicted effects follow a sound cause-and-effect explanation. For Question 4, accept field measurements of species richness that can be compared with the prediction.