

Seawall or Sand Dunes? Arguing From Five Winters of Evidence

Learning target: I can write a claim, evidence and reasoning argument that evaluates two competing solutions for protecting a coastal town, using criteria that include keeping ecosystem services and biodiversity.

Claim, evidence, reasoning

About 50 min

Individual

MS-LS2-5 · assesses

MS-ETS1-2 · practice

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario, the town's criteria and the box that explains how each solution works. Study the monitoring data; it is a teaching dataset, not a real survey. Complete the warm-up, then write your argument. A strong argument uses numbers and years, admits the evidence that does not fit your claim, and explains why the evidence supports your claim using how seawalls and dunes work.

You will need: This worksheet, Pencil, Calculator

The scenario

Arena Point is a small, made-up town on the central California coast. A two-lane road, Shore Drive, runs along the back of the beach, with about forty homes and the town's only route to the hospital just inland. Winter storms had been washing sand and seawater across the road more often each year. In 2020 the town divided its 2-kilometer beach into two sections to test two solutions. On the North section, engineers built a concrete seawall along the edge of the road. On the South section, crews piled sand into a line of dunes, removed invasive European beachgrass, and planted native dune plants such as beach bur and beach sagewort. A coastal scientist measured both sections every spring for five years. The winter of 2021 to 2022 had the biggest storms of the test.

What the town council agreed on — Criteria: (1) Keep storm water off Shore Drive, with a goal of no more than 1 day per winter. (2) Keep a sandy beach at least 20 meters wide at mid-tide, for visitors and the town's surf and beach businesses. (3) Keep nesting habitat for western snowy plovers, a threatened shorebird that lays its eggs on open sand above the high-tide line. **Constraint:** the total cost over five years must not exceed \$3 million.

How each solution works — A seawall is a hard barrier. It stops waves from reaching what is behind it, but it cuts the beach off from the sand stored behind it, and waves that strike it can scour sand from its base. Over years the beach in front of a seawall often narrows, and with less beach to slow them, waves hit the wall harder and splash over more often. A dune is a store of sand held in place by plants. In a big storm, waves cut into the front of the dune and carry sand offshore, where it can build sandbars that make later waves break farther out. In calmer months, waves bring sand back, wind blows it into the dune, plant stems trap it and roots hold it. Young dune plants are small, so a new dune is weakest in its first years.

Arena Point spring monitoring, 2020-2025 (teaching dataset)

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

Year	North (seawall): beach width (m)	South (dunes): beach width (m)	North: days with water on road	South: days with water on road	North: plover nests	South: plover nests
2020	35	35	-	-	4	4
2021	31	34	0	1	2	5
2022	26	32	0	2	1	7
2023	22	35	1	0	0	9
2024	18	34	2	1	0	10
2025	15	36	3	0	0	11

Simulated data for teaching. 2020 values were measured just after construction, before the first test winter. 'Days with water on the road' counts the days in the winter before each survey.

Five-year costs for each section (teaching dataset)

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

Cost item	North (seawall)	South (dunes)
Building or planting	2.4	0.9
Repairs, replanting, fencing and added sand over five years	0.2	0.6
Total	2.6	1.5

Simulated costs for teaching, in millions of dollars.

Warm-up: organize the evidence

1.

For each section, find the change in beach width from 2020 to 2025 in meters and as a percent of the 2020 width. Show the calculation.
2.

Add up the days with water on the road over the five winters for each section. In which years did the seawall do better than the dunes, and in which years did the dunes do better?
3.

Rate each solution on each criterion and the constraint. Write one number from the data in each cell to back up your rating.

North: seawall (meets, partly meets, or does not meet)	South: dunes (meets, partly meets, or does not meet)
Criterion 1: water off the road	
Criterion 2: beach at least 20 m wide	
Criterion 3: plover nesting habitat	
Constraint: no more than \$3 million	

Your argument

CLAIM

Claim: Which solution better meets the town's criteria while keeping the beach's ecosystem services and biodiversity? State your claim in one sentence.

EVIDENCE

Evidence: Give at least three pieces of evidence with years and numbers. At least one piece must be evidence that favors the solution you did not choose.

REASONING

Reasoning: Use the 'How each solution works' box to explain why the evidence supports your claim. Explain the trend in each section, not just the final year, explain why the dunes did worse in the early years, and explain why the evidence that favors the other solution does not change your claim.

After the argument

4. At a council meeting the mayor says, 'In the big storms of 2022 the seawall kept the road dry and the dunes let the water through twice. Case closed.' Use the data and the box to respond respectfully.

5. Name one limitation of this evidence (think about the length of the test, the two sections or the storms) and one more piece of data that would make you more confident in your claim.

6. Name one ecosystem service, other than protection from storms, that the dunes provide and the seawall does not. Which category of service is it?

Sentence frames for the argument

Claim: 'The ___ solution better meets the town's criteria because it ___ while also ___.' Evidence: 'From 2020 to 2025, the beach in front of the ___ changed from ___ m to ___ m.' 'In ___, the ___ had ___ days with water on the road.' 'One result that favors the other solution is ___.' Reasoning: 'This happened because a ___ ___. The early results were weaker because ___. Even though ___, the trend shows ___.'

Plan the next ten years

Sea level along the California coast is expected to keep rising over the coming decades, so storm waves will reach farther inland. Write a ten-year plan for Arena Point that uses what you learned. You may combine solutions (for example, dunes in front of a buried rock barrier, or moving part of Shore Drive inland). For each part of your plan, say which criterion it serves, what it would cost relative to the test sections, and what the town should measure each spring to know whether the plan is still working.