

Where Should the Drill Ship Go? Spend the Budget to Test Spreading

Investigation question: Six drill cores from a simulated ocean are already in hand. Which idea about the seafloor do they support, what ages do they predict elsewhere, and which four new drilling sites would test that prediction best within a fixed budget?

Data-driven decision

Groups of 4

1 session

Setup 5 · Activity 45 · Cleanup 3 min

MS-ESS2-3 · assesses

MS-ETS1-1 · practice

Name _____

Group _____

Date _____

Your role today

- ☐ **Data analyst:** Computes the rate for every existing core (distance divided by age), checks the west and east rates against each other, and reports the average.
- ☐ **Grapher:** Plots age against distance for the six cores, draws the best-fit line through the ridge, and reads predicted ages for the candidate sites from the line.
- ☐ **Budget officer:** Tracks the cost of every proposed set of sites, enforces the 14-unit limit, and records the final plan's total.
- ☐ **Reporter:** Writes the group's hypothesis decision and the reason for each chosen site, and presents the plan to the class in one minute.

Safety

- This is a paper-and-calculator activity with no physical hazards. If the floor ocean strip is used, keep the tape line clear of walkways and remove it at the end of class.

Procedure

1. Read the scenario and the two ideas on the recording sheet. In one sentence each, write what age pattern each idea predicts for cores at different distances from the ridge.
2. Data analyst: for each of the six existing cores, divide the distance from the ridge by the age to get a rate in kilometers per million years. Record the six rates and the average of the west rates and of the east rates.
3. Grapher: plot the six cores on the graph (west distances to the left of zero, east to the right). Draw a best-fit straight line for each side passing through the ridge at age 0.
4. Decide as a group which idea the six cores support. Write the decision in question 1 with two numbers from your table as evidence.
5. Predict: for each of the eight candidate sites, write the age that seafloor spreading predicts (distance divided by 20, or read from your line) and the age the ancient-ocean idea predicts. Note any site where the two ideas predict nearly the same thing, or where the site would not sample seafloor at all.

- Choose: pick the set of sites you would drill with 14 cost units. Budget officer checks the total. A good set gives the sharpest test of the prediction for the money: sites where the two ideas disagree most, on both sides of the ridge if possible, with at least one site near the ridge and one far from it.
- Post your chosen sites on the class ocean strip with sticky notes, and have the Reporter write a one-sentence reason for each site in the selection table.
- Answer the analysis questions individually, then compare within the group before the funding panel.

Record your observations

Lab 3 recording sheet: Where should the drill ship go?

Scenario. You are the science team on a drilling ship working in a simulated ocean basin 2,400 km wide. A ridge runs north to south 1,000 km from the west shore; a deep trench lies along the east edge, 1,400 km east of the ridge. The ship drills through the sediment into the lava rock beneath and brings up a core. The age you get is the age of the oldest sediment sitting directly on the lava, which settled soon after that seafloor formed. Six cores from the last leg are in hand. You have 14 cost units left for the next leg. This is a teaching dataset: the ocean, the sites, the ages and the costs are invented to behave like real ones.

The two ideas on trial — Idea 1, seafloor spreading: new seafloor forms at the ridge and moves outward, so age rises steadily with distance from the ridge and the two sides match. **Idea 2, the ancient ocean:** ocean basins are permanent and their floors are among the oldest rock on Earth, so every core should be very old (over 500 million years) with no relation to distance from the ridge.

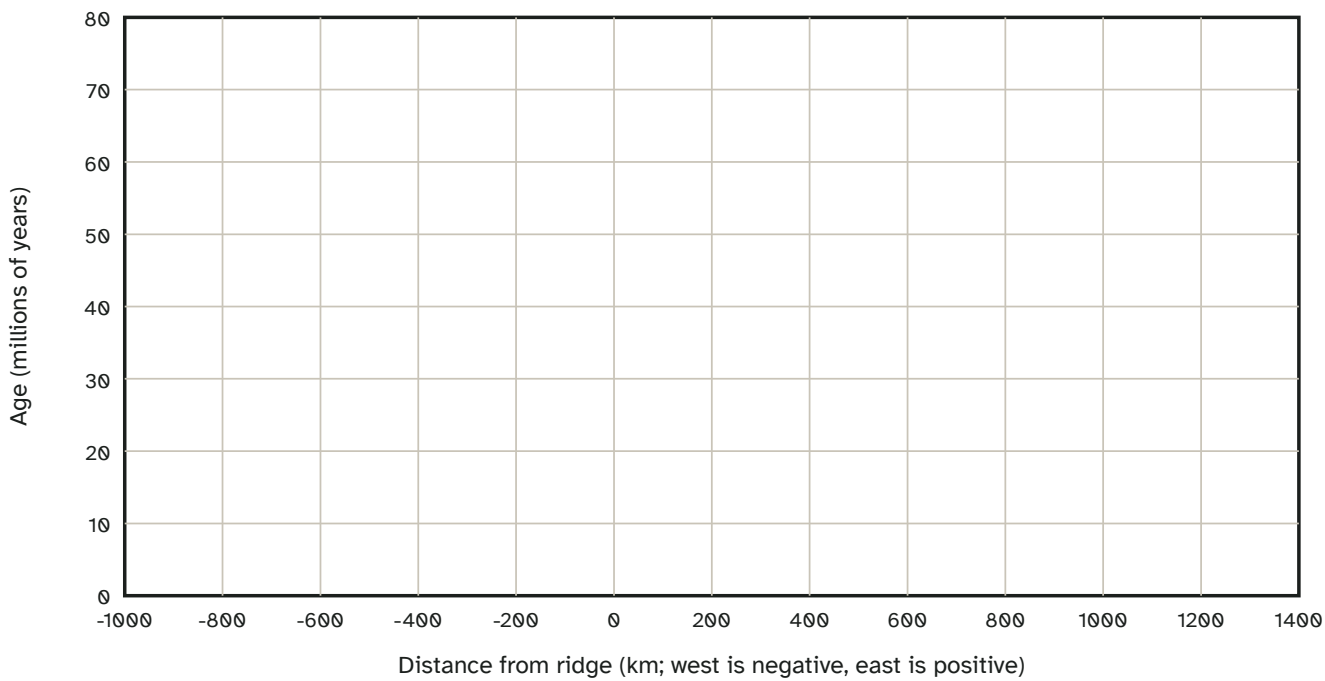
Existing cores from the last leg (simulated teaching data)

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

Core	Distance from ridge (km)	Side	Age of oldest sediment on the lava (millions of years)	Rate = distance ÷ age (km per million years)
H1	800	west	40	
H2	450	west	23	
H3	150	west	7	
H4	200	east	10	
H5	600	east	29	
H6	1100	east	56	

Fill in the rate column. Average of west rates: ____ Average of east rates: ____

Age of the seafloor against distance from the ridge



Candidate sites for the next leg (cost rises with water depth)

Site	Position	Water depth (m)	Cost (units)	Notes
S1	On the ridge crest, 0 km	2600	3	Thin sediment; quick to drill
S2	950 km west, near the west edge of the basin	4800	5	Thick sediment
S3	300 km west	3600	4	
S4	1,350 km east, just before the trench	5500	6	Deepest water on the list
S5	900 km east	4700	5	
S6	50 km east of the ridge	2800	3	Thin sediment
S7	On the west continental shelf, 980 km west (20 km off the west shore)	120	2	Shallow; the drill would enter continental rock, not seafloor lava
S8	700 km east	4300	4	100 km from existing core H5

Predictions and your selection

Site	Age if spreading (Myr)	Age if ancient ocean	Do the ideas disagree here? (yes/no)	Chosen? (yes/no)	Reason
S1					
S2					
S3					
S4					
S5					
S6					
S7					
S8					
TOTAL COST of chosen sites (must be 14 or less)					

1. Which idea do the six existing cores support? Give two numbers from your rate column and one feature of your graph as evidence.

2. List the sites you chose, their total cost, and the single most important reason for your set as a whole.

Analysis questions

3. Compute the spreading rate from core H1 and from core H6 in kilometers per million years, then convert the average of the two to centimeters per year. Show your work.

4. Using a rate of 20 km per million years, what age does seafloor spreading predict at S4 (1,350 km east) and at S2 (950 km west)? What does the ancient-ocean idea predict at the same two sites?

5. S7 is the cheapest site on the list. Explain why drilling it would tell you nothing about seafloor spreading, and what the shelf's position says about where the seafloor ends and the continent begins.

6. Which one of your chosen sites separates the two ideas most sharply, and why? Which candidate site would add the least new information even though the ideas disagree there?

7. A skeptic says: 'Ages rise away from the ridge only because the sediment is thicker out there, not because the rock is older.' Using how the ages were measured, explain why this objection fails, and why thicker sediment far from the ridge is actually what spreading predicts.

8. The oldest seafloor in this basin, near the trench, is only about 67 million years old, while the continents on both sides contain rocks over a billion years old. What happened to seafloor older than 67 million years, and how does the trench's position support your answer?

9. Write one criterion and one constraint from your drilling plan, and label which is which.
