

Were They Ever One? A Claim-Evidence-Reasoning Case for Two Continents

Learning target: I can use fossil, rock, shape and seafloor evidence to argue whether South America and Africa were once joined and are still moving apart, and explain why independent lines of evidence make the argument strong.

Claim, evidence, reasoning

About 45 min

Individual

MS-ESS2-3 · assesses

writing

data analysis

Name _____

Date _____

Period _____

Directions

You are on a review panel that must decide whether the evidence supports a bold claim: that South America and Africa were once a single landmass, split apart, and are still moving away from each other today. Read the six evidence items. One of them is not useful evidence for the claim; part of your job is to spot it. Answer the warm-up questions, which help you organize the evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response uses at least three evidence items from at least two different families (fossils and rocks, shapes, seafloor) and explains why each one is expected if the continents moved and hard to explain if they did not.

You will need: This worksheet, Pencil, Scrap paper for the expected-or-not table, Calculator

The evidence file

Evidence A: Fossils (real distributions). The table lists three organisms whose fossils occur in rocks of the same age on both continents.

Evidence A: Fossils found on both sides of the South Atlantic (real distributions)

Fossil	What it was	Where found	Could it cross 3,000 km of open ocean?
Mesosaurus	Reptile about 1 m long that lived in shallow coastal and inland waters, about 280 million years ago	Southern Brazil and Uruguay; South Africa and Namibia	No; built for shallow water, not open sea
Glossopteris	Extinct seed plant (a tree) with tongue-shaped leaves, 250 to 300 million years ago	South America, Africa, India, Australia, Antarctica	No; its seeds were too large and heavy to blow across an ocean
Cynognathus	Dog-sized land reptile with mammal-like teeth, about 240 million years ago	Argentina; South Africa	No; it lived on land and did not swim

Evidence B: Rocks (real). Belts of old rock on the two coasts match in type, age and the order of their layers. Rock layers in eastern Brazil and in Gabon, in West Africa, were laid down in the same kind of lakes at the same time, about 130 million years ago, and contain the same fish fossils. Both continents also hold

deposits left by ice sheets about 300 million years ago, with scratches on the bedrock showing which way the ice moved. When the continents are placed side by side, the scratches point outward from one common center, as if a single ice sheet had covered the joined lands.

Evidence C: Shapes (real). The coastlines of the two continents fit roughly, but coastlines move whenever sea level changes. In 1965 a team at Cambridge University used a computer to fit the continents along the edge of the continental shelf, at a water depth of about 900 meters. That edge is the true rim of each landmass. The shelf edges of South America and Africa fit with only small gaps and overlaps along more than 5,000 kilometers.

Evidence D: Seafloor ages (simulated drill cores). A drilling ship took cores along a line from the Brazilian shelf to the West African shelf. The dataset gives the age of the oldest sediment resting on the volcanic rock at each site. These numbers are a teaching dataset; the pattern is the one real drilling found.

Evidence D: Seafloor age along a line from Brazil to West Africa (teaching dataset)

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

Site	Distance from ridge crest (km)	Side	Age of seafloor (Ma)
B1	1400	west (toward Brazil)	70
B2	1000	west	50
B3	600	west	30
B4	200	west	10
R0	0	ridge crest	0
A4	200	east (toward Africa)	10
A3	600	east	30
A2	1000	east	50
A1	1400	east	70

Simulated for teaching. Distances are measured from the crest of the Mid-Atlantic Ridge; the pattern matches real drilling results, the values are invented.

Evidence E: Seafloor structures (real). Sonar mapping shows a continuous mid-ocean ridge running down the middle of the South Atlantic, about halfway between the two continents, and its bends follow the bends of both coasts. A narrow valley runs along the ridge crest. Nearly all the earthquakes in the South Atlantic happen in a thin belt along that crest. Satellite measurements show the two continents moving apart today at about 3 to 4 centimeters a year.

Evidence F: Climate today (real). Both the Amazon basin in Brazil and the Congo basin in Africa have hot, wet climates and tropical rainforests today, and both lie near the equator.

Warm-up: organize the evidence

1. Which evidence item is **not** useful for deciding whether the continents were once joined? Explain why it does not help, even though it is true.

2. Using Evidence D, calculate the spreading rate on one side of the ridge in km per million years, then convert it to cm per year. Show your work. Does the result agree with the satellite rate in Evidence E? (Remember that the satellite rate is for both sides together.)

3. Evidence A, B and C were all available to Wegener by 1915. Evidence D and E were not. For each of the three older items, write one other explanation someone in 1915 could have offered that does **not** require the continents to move. Then say which of the newer items (D or E) is hardest to explain without moving plates, and why.

Your argument

CLAIM

Claim: State whether South America and Africa were once one landmass that split apart, and whether they are still moving apart today. Make both parts of your claim clear.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from at least two different families (fossils and rocks; shapes; seafloor). Use names, numbers and distances from the file. For each piece, say what it shows.

REASONING

Reasoning: For each piece of evidence, explain why it is exactly what you would expect if the continents moved apart, and why it is hard to explain if they never moved. Then explain why several independent lines of evidence pointing the same way make the claim stronger than any one line alone.

4. A member of your panel says, 'The fossils alone prove it; we do not need the seafloor data.' Explain why Wegener's experience shows that fossils alone were not enough, and name the one thing the seafloor evidence added that the fossils could not.

5. Describe one new measurement that could **weaken** your claim if it came out a certain way, and say what result would do the damage.

An expected-or-not table

Before writing, make a table on scrap paper with the evidence letters A to F down the side and two columns: 'Expected if the continents moved apart?' and 'Easy to explain if they never moved?' Fill each cell with yes or no and three or four words of reason. Every row with yes in the first column and no in the second is a piece of evidence you can use. The row with yes in both columns is the item to leave out. Your Reasoning section is simply those rows written as sentences.

Argue the other side, then answer it

Write the strongest case a careful scientist in 1926 could make against the claim using only Evidence A, B and C, including the mechanism problem. Then write a reply from a scientist in 1970 that uses Evidence D and E to answer each objection point by point. Finish with two sentences on what the exchange shows about why scientists ask for a mechanism and a testable prediction before accepting an idea.