

The Boulder Field at Kestrel Creek: Sudden, Gradual, or Both?

Learning target: I can use several kinds of landscape evidence and a measured rate to construct an explanation of how a landform was made, at what time scale, and by which processes.

Claim, evidence, reasoning About 45 min Individual MS-ESS2-2 · assesses writing data analysis

Name

Date

Period

Directions

Read the scenario and the six pieces of evidence. Study the stream dataset; the valley and the numbers are a teaching scenario, invented to be realistic. Answer the warm-up questions first; they will help you sort the evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response names specific evidence with numbers, says what each piece shows about time scale, and explains how processes we can watch today connect the evidence to the claim.

You will need: This worksheet, Pencil, Calculator, Scrap paper for the evidence grid

The scenario

Kestrel Creek runs down a steep mountain valley. Where the valley opens out, the creek crosses a strange field of boulders about 600 m wide and 400 m long. Some boulders are the size of cars. A geology club spent a summer collecting evidence to answer one question: how and when was the boulder field made? Their notes are below.

Evidence collected by the club

— **A.** The boulders are angular (sharp-edged, not rounded) and are mixed with gravel, sand and mud in no particular order. There are no layers and no sorting by size. **B.** On the cliff directly above the field there is a scar about 300 m wide where the rock is pale and bare. The cliffs on either side of the scar are darker and covered with lichen (a slow-growing crust of living things). **C.** The oldest trees growing on top of the boulders have 310 rings (cores taken in 2025). **D.** A church record from the valley, dated spring 1711, says that 'the mountain fell in the night and buried the lower meadow.' **E.** Kestrel Creek has cut a channel straight through the boulder field. The channel is now 1.500 m deep. The club measured its depth every year for ten years (dataset below). **F.** Downstream of the field, the creek has built a fan of rounded pebbles that grows a little after every spring flood.

Depth of the creek channel through the boulder field (teaching dataset)

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

Year	Channel depth (m)
2016	1.455
2017	1.46

Year	Channel depth (m)
2018	1.464
2019	1.47
2020	1.475
2021	1.479
2022	1.485
2023	1.49
2024	1.495
2025	1.5

Simulated measurements for teaching; depth measured each August at the same marked spot.

Warm-up: sort the evidence

- Which pieces of evidence suggest the boulder field was made **suddenly**? For each, say in a few words what it shows.

- Which pieces of evidence show **gradual** change happening at the field today? For each, name the process (weathering, erosion or deposition) and the agent.

- Use the dataset. Calculate the rate at which the creek deepens its channel, in millimeters per year. Then estimate how many years the creek has needed to cut the full 1.500 m channel at that rate. Show your work, and compare your estimate with evidence C and D.

Your argument

CLAIM

Claim: State how the boulder field was made, about when, and what has been happening to it since. Your claim must name a time scale for each part.

EVIDENCE

Evidence: List at least four specific pieces of evidence from the notes and the dataset, with numbers where they exist. For each one, say whether it points to a sudden event, a gradual process, or an age.

REASONING

Reasoning: Explain how the evidence supports the claim. Your reasoning must use the idea that processes we can watch today (landslides, stream erosion) also explain what happened here centuries ago, and must explain how three different clocks (tree rings, the record, the channel rate) fit together.

4. Suppose next summer the club finds a tree growing on the boulders with 450 rings. Would that force you to change your claim? Explain what the new evidence would mean and what you would check next.

An evidence grid before writing

On scrap paper, make a table with the six letters A to F down the side and three columns: 'Sudden?', 'Gradual?', 'Tells the age?'. Put a check in every column each piece of evidence supports and write two or three words saying why (for example, A: sudden, 'no sorting, no layers'). Evidence that tells an age gives you a number of years; write that number. Your claim is the story that fits every row, and each row becomes one evidence sentence in your CER.

What the creek will do next

The boulder field is about 400 m long and the creek channel through it is 1.5 m deep after about 300 years. The mountain above still has steep, cracked rock. Write a prediction for the valley 3,000 years from now that uses the measured rate (how deep would the channel be, and why might the rate not stay constant?) and includes the possibility of another sudden event. Then explain which of the two futures (another landslide, or 3,000 more years of slow cutting) would change the valley more, and why that is not a simple question.