

Two Road Cuts, One Story? A Claim-Evidence-Reasoning Case

Learning target: I can use fossils and an ash layer as evidence to claim which layers in two distant road cuts formed at about the same time, and explain my reasoning with the law of fossil succession and the idea of an index fossil.

Claim, evidence, reasoning

About 40 min

Individual

MS-ESS1-4 · practice

MS-LS4-1 · supports

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario and study the two layer logs and the fossil guide. Answer the warm-up questions first; they will organize your evidence. Then write your Claim, Evidence and Reasoning in the boxes. A strong response names specific layers by their labels, says which fossils and which rule connect them, and explains why rocks that look different can still be the same age. Finish with the follow-up question.

You will need: This worksheet, Pencil, Scrap paper for lining up the logs

The scenario

A county is planning a bike path beside a highway. Two road cuts along the route, the North Cut and the South Cut, are three kilometers apart. The contractor, Mr. Alvarez, looked at both and said, 'These rocks are completely different colors and types. They have nothing to do with each other, so we do not need the geologist to look at both.' The county geologist, Dr. Okafor, disagrees. She thinks some layers in the two cuts formed at about the same time, and that knowing which ones would help predict what the path's builders will dig into between the cuts. Her field logs and fossil guide are below. (The places and fossils are invented for this worksheet.)

Dr. Okafor's layer logs (teaching data; layers listed from top to bottom)

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

North Cut	Rock and thickness	Fossils	South Cut	Rock and thickness	Fossils
N1	Yellow sandstone, 2 m	none	S1	Pebbly conglomerate, 1 m	none
N2	Gray limestone, 3 m	Fossil K	S2	Red sandstone, 2 m	Fossil R
N3	Brown mudstone, 1 m	Fossils R and K	S3	White ash, 0.3 m	none
N4	White ash, 0.2 m	none	S4	Gray limestone, 2 m	Fossils K and M
N5	Black shale, 2 m or more	Fossil M	S5	Black shale, 1.5 m or more	Fossil M

All layers in both cuts are flat and unbroken. Nothing in either log has been dated in years yet.

Fossil guide (teaching dataset)

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

Fossil	What it was	How long the species existed (million years)	Where it has been found
K	A ribbed clam	150	Five continents
R	A tightly coiled sea shell	2	Four continents
M	A small sea snail	6	Only in this region

Teaching dataset: the three fossil species are invented; their time spans and ranges were chosen to be realistic.

Warm-up: organize the evidence

- Which of the three fossils is the best index fossil? Use two columns of the fossil guide to justify your choice, and say why the other two are weaker. 2 pts

- Which layer in the South Cut most likely formed at about the same time as N3 in the North Cut? Give two separate reasons from the logs. 2 pts

3. Mr. Alvarez says different rock types mean different times. Explain how a mudstone and a sandstone could form at the same time three kilometers apart. (Think about where mud settles and where sand settles along a shore.)

2 pts

Your argument

CLAIM

Claim: State whether Dr. Okafor is right, and name the specific pair (or pairs) of layers, one from each cut, that formed at about the same time.

EVIDENCE

Evidence: Give at least three specific pieces of evidence from the logs and the fossil guide. Use layer labels and fossil letters, and include the numbers from the guide where they matter (time spans, number of continents). Say what each piece of evidence rules in or rules out.

REASONING

Reasoning: Explain how the law of fossil succession and the definition of an index fossil connect your evidence to your claim. Your reasoning must explain why fossil R is stronger evidence than fossil K, what the ash layer adds, and why different rock types do not weaken the claim. Use the phrase 'about the same age', not 'exactly the same age', and say why.

Follow-up

4. Dr. Okafor can send both ash samples to a lab that compares the chemical 'fingerprint' of volcanic ash. What result would strengthen your claim, and what result would weaken it? Explain why an ash layer is such a useful time marker. 2 pts

Line up the logs

On scrap paper, write the North Cut layers in a column and the South Cut layers in a column beside it. Draw a line between any two layers that share a fossil, and a dashed line between the two ash layers. Then ask of each line: how long did that fossil species live? A short-lived species makes a tight connection; a long-lived species makes a loose one. The tightest connections are your strongest evidence.

A third cut

A new cut is opened ten kilometers away. From top to bottom it shows: gray limestone with fossil K; white ash; brown mudstone with fossils R and K; black shale with no fossils. Decide whether the ash in this cut is the same ash as N4 and S3, and explain your answer using fossil succession. Then explain what it would mean if the lab found that this ash has a different chemical fingerprint from the other two.