Clues in Stone

How geologists built and tested explanations of Earth's past

ESS.2B.1 "Research, analyze, and evaluate the contributions of William Smith, James Hutton, Nicolaus Steno, Charles Lyell, and others to physical geology."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline one observation or kind of evidence linked to each of the five researchers, then number those details in the order the researchers appear. Circle one stated limit of a method or explanation.

Reading the Rock Record

1. At a coastal cliff, rock beds can look like pages pressed together, but their order tells only part of the story. In the 1600s, Nicolaus Steno argued that sediment settles in nearly horizontal layers and that, in an undisturbed stack, lower layers formed before upper ones. His principles gave geologists a way to determine relative age, not a date in years. In the 1700s, James Hutton studied places where older rock layers were tilted and worn down before younger layers formed above them. Such gaps in the rock record pointed to repeated cycles of deposition, uplift, and erosion over immense spans of time.

2. In the early 1800s, William Smith traced rock layers while working on canals and surveying across Britain. He noticed that certain fossil groups appeared in a consistent order in the layers. By matching those groups, he could identify corresponding layers in places where the rocks looked different. His 1815 geological map of England and Wales showed the broad pattern of rock formations across the country. Fossils made his comparisons more reliable than rock color alone, but his method did not give the layers numerical ages. A missing layer or a poorly preserved fossil could also complicate a match.

3. Charles Lyell later argued that processes seen today, including erosion and sediment buildup, can help explain ancient rocks. In *Principles of Geology*, published beginning in 1830, he developed Hutton's view of deep time and pressed geologists to look for causes they could observe. However, some major changes in Earth's history, such as asteroid impacts, can happen suddenly. Steady change is not the whole story. Fossil collector Mary Anning uncovered marine reptiles in English coastal rocks, including animals now extinct. Her discoveries added evidence about past life to the story told by rock layers.

2 ANSWER WITH EVIDENCE

Use the passage

1. How did Hutton's observations extend what Steno's principles could reveal about layers of rock?

2. Why did Smith use fossils to link layers in different places, and what could his method not tell him?

3. How did Lyell build on Hutton's work, and what limit to Lyell's emphasis does the passage identify?

4. How did Anning's discoveries add to what Smith learned from fossils?

3 YOUR TURN

Your own words

Imagine two newly exposed rock walls. In four sentences, propose a specific observation you would make, explain how ideas from two named researchers in the passage would help you interpret it, and state one limit of your conclusion.

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PART 1 · READ AND MARK

Underline one observation or kind of evidence linked to each of the five researchers, then number those details in the order the researchers appear. Circle one stated limit of a method or explanation. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How did Hutton's observations extend what Steno's principles could reveal about layers of rock?	**Steno's principles established the relative order of undisturbed layers. Hutton's tilted, eroded layers showed that deposition could be followed by uplift and erosion before new layers formed.**
2	Why did Smith use fossils to link layers in different places, and what could his method not tell him?	**Fossil groups appeared in a consistent order, so matching groups could link layers even where the rocks looked different. They could not give the layers numerical ages.**
3	How did Lyell build on Hutton's work, and what limit to Lyell's emphasis does the passage identify?	**Lyell developed Hutton's view of deep time by using processes observable today to explain ancient rocks. Sudden events, such as asteroid impacts, also shape Earth's history.**
4	How did Anning's discoveries add to what Smith learned from fossils?	**Smith used the order of fossil groups to link rock layers. Anning's finds provided evidence of marine animals that are now extinct.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would compare fossil shells in two rock walls, one with much thicker beds than the other. Smith's work suggests that matching groups of fossils could identify corresponding layers despite the difference in thickness. Lyell's approach would lead me to investigate whether sediment accumulation today can help explain that difference. A fossil match would not reveal exactly how many years ago either layer formed.

Accept other well-supported comparisons that distinguish each researcher's evidence from the conclusion drawn from it. For Part 3, look for a specific proposed observation, accurate use of two named researchers, and a reasonable limit.