

MS-ESS1-4 Earth's Place in the Universe

Students who demonstrate understanding can:

MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.

Crosscutting Concepts

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Observable features of the student performance by the end of the course:

1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including how events in the Earth's 4.6 billion-year-old history are organized relative to one another using the geologic time scale.
	b	Students use evidence and reasoning to construct an explanation. In their explanation, students describe* how the relative order of events is determined on the geologic time scale using:
		<ul style="list-style-type: none"> i. Rock strata and relative ages of rock units (e.g., patterns of layering). ii. Major events in the Earth's history and/or specific changes in fossils over time (e.g., formation of mountain chains, formation of ocean basins, volcanic eruptions, glaciations, asteroid impacts, extinctions of groups of organism).
2	Evidence	
	a	Students identify and describe* the evidence necessary for constructing the explanation, including:
		<ul style="list-style-type: none"> i. Types and order of rock strata. ii. The fossil record. iii. Identification of and evidence for major event(s) in the Earth's history (e.g., volcanic eruptions, asteroid impacts, etc.).
		b
Reasoning		

3	a	<p>Students use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for how the geologic time scale is used to construct a timeline of the Earth's history. Students describe* the following chain of reasoning for their explanation:</p>
		<p>i. Unless they have been disturbed by subsequent activity, newer rock layers sit on top of older rock layers, allowing for a relative ordering in time of the formation of the layers (i.e., older sedimentary rocks lie beneath younger sedimentary rocks).</p>
		<p>ii. Any rocks or features that cut existing rock strata are younger than the rock strata that they cut (e.g., a younger fault cutting across older, existing rock strata).</p>
		<p>iii. The fossil record can provide relative dates based on the appearance or disappearance of organisms (e.g., fossil layers that contain only extinct animal groups are usually older than fossil layers that contain animal groups that are still alive today, and layers with only microbial fossils are typical of the earliest evidence of life).</p>
		<p>iv. Specific major events (e.g., extensive lava flows, volcanic eruptions, asteroid impacts) can be used to indicate periods of time that occurred before a given event from periods that occurred after it.</p>
		<p>v. Using a combination of the order of rock layers, the fossil record, and evidence of major geologic events, the relative time ordering of events can be constructed as a model for Earth's history, even though the timescales involved are immensely vaster than the lifetimes of humans or the entire history of humanity.</p>