*Unless otherwise specified, "descriptions" referenced in the evidence statements could include but are not limited to written, oral, pictorial, and kinesthetic descriptions.

HS-ESS1-6

Students who demonstrate understanding can:

HS-ESS1-6. **Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.** [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

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

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.
- Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history.

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. *(secondary)*

Crosscutting Concepts

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

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

1	Articulating the explanation of phenomena		
	a	Students construct an account of Earth's formation and early history that includes that:	
		i.	Earth formed along with the rest of the solar system 4.6 billion years ago.
		ii.	The early Earth was bombarded by impacts just as other objects in the solar system were bombarded.
		iii.	Erosion and plate tectonics on Earth have destroyed much of the evidence of this bombardment, explaining the relative scarcity of impact craters on Earth.

2	Evidence		
	a	Students include and describe* the following evidence in their explanatory account:	
		i.	The age and composition of Earth's oldest rocks, lunar rocks, and meteorites as determined by radiometric dating;
		ii.	The composition of solar system objects;
		iii.	Observations of the size and distribution of impact craters on the surface of Earth and on the surfaces of solar system objects (e.g., the moon, Mercury, and Mars); and
		iv.	The activity of plate tectonic processes, such as volcanism, and surface processes, such as erosion, operating on Earth.
3	Reasoning		
	a	Students use reasoning to connect the evidence to construct the explanation of Earth's formation and early history, including that:	
		i.	Radiometric ages of lunar rocks, meteorites and the oldest Earth rocks point to an origin of the solar system 4.6 billion years ago, with the creation of a solid Earth crust about 4.4 billion years ago.
		ii.	Other planetary surfaces and their patterns of impact cratering can be used to infer that Earth had many impact craters early in its history.
		iii.	The relative lack of impact craters and the age of most rocks on Earth compared to other bodies in the solar system can be attributed to processes such as volcanism, plate tectonics, and erosion that have reshaped Earth's surface, and that this is why most of Earth's rocks are much younger than Earth itself.