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

HS-ESS1-5

Students who demonstrate understanding can:

HS-ESS1-5. **Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.** [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages of oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate (a result of past plate interactions).]

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

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. *(ESS2.B Grade 8 GBE) (secondary)*

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

Patterns

- Empirical evidence is needed to identify patterns.

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

1	Identifying the given explanation and the supporting evidence	
	a	Students identify the given explanation, which includes the following idea: that crustal materials of different ages are arranged on Earth's surface in a pattern that can be attributed to plate tectonic activity and formation of new rocks from magma rising where plates are moving apart.
	b	Students identify the given evidence to be evaluated.
2	Identifying any potential additional evidence that is relevant to the evaluation	
	a	Students identify and describe* additional relevant evidence (in the form of data, information, models, or other appropriate forms) that was not provided but is relevant to the explanation and to evaluating the given evidence, including:
		i. Measurement of the ratio of parent to daughter atoms produced during radioactive decay as a means for determining the ages of rocks;
		ii. Ages and locations of continental rocks;
		iii. Ages and locations of rocks found on opposite sides of mid-ocean ridges; and

		iv. The type and location of plate boundaries relative to the type, age, and location of crustal rocks.
3	Evaluating and critiquing	
	a	Students use their additional evidence to assess and evaluate the validity of the given evidence.
	b	Students evaluate the reliability, strengths, and weaknesses of the given evidence along with its ability to support logical and reasonable arguments about the motion of crustal plates.
4	Reasoning/synthesis	
	a	Students describe* how the following patterns observed from the evidence support the explanation about the ages of crustal rocks:
		i. The pattern of the continental crust being older than the oceanic crust;
		ii. The pattern that the oldest continental rocks are located at the center of continents, with the ages decreasing from their centers to their margin; and
		iii. The pattern that the ages of oceanic crust are greatest nearest the continents and decrease in age with proximity to the mid-ocean ridges.
	b	Students synthesize the relevant evidence to describe* the relationship between the motion of continental plates and the patterns in the ages of crustal rocks, including that:
		i. At boundaries where plates are moving apart, such as mid-ocean ridges, material from the interior of the Earth must be emerging and forming new rocks with the youngest ages.
		ii. The regions furthest from the plate boundaries (continental centers) will have the oldest rocks because new crust is added to the edge of continents at places where plates are coming together, such as subduction zones.
		iii. The oldest crustal rocks are found on the continents because oceanic crust is constantly being destroyed at places where plates are coming together, such as subduction zones.