Educational Resources from *Phenomenon Science Education*

Student Proficiency Goals for **NGSS HS-ESS1-5**

Information about HS-ESS1-5

NGSS Performance Expectation 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 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).

Assessment Limits.

No specific assessment limits are listed for this Performance Expectation.

Science and Engineering Practice (Engaging in Argument from Evidence)

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

Disciplinary Core Idea (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.

Disciplinary Core Idea (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).

Disciplinary Core Idea (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 Concept (Patterns)

- Empirical evidence is needed to identify patterns.

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Student Proficiency Goals

SEP (Engaging in Argument from Evidence):

- Students observe and describe the distribution of geologic ages in a group or sequence of continental and/or ocean floor rocks.
- Students identify explanations for geologic age distributions in groups or sequences of continental and/or ocean floor rocks that are consistent with current and/or past motions and/or interactions of tectonic plates.
- Students evaluate the ability of their described evidence to support or refute an explanation for the distribution of geologic ages in a group or sequence of continental and/or ocean floor rocks that is consistent with current and/or past motions and/or interactions of tectonic plates.

DCI (ESS1.C The History of Planet Earth):

- Students know that the rocks which make up Earth's continents span a range of ages, from rocks that are forming right now to rocks that are more than 4 billion years old.
- Students know that Earth's current ocean floor is made up of rocks that are less than 200 million years old.
- Students know that rocks which make up Earth's continents are often much older than the rocks which make up Earth's current ocean floor.

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CCC (Patterns):

- Students consider how observed distributions of geologic ages in groups or sequences of continental and/or ocean floor rocks can be explained by current and/or past tectonic plate motions and/or interactions.
- Students consider patterns that are revealed through observing and describing distributions of geologic ages in groups or sequences of continental and/or ocean floor rocks.
- Students consider how observations of distributions of geologic ages in groups or sequences of continental and/or ocean floor rocks are used as evidence to identify patterns that support or refute an explanation of the ages of crustal rocks.

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DCI (ESS2.B Plate Tectonics and Large-Scale System Interactions): • Students know that the rocks which make up Earth's crustal plates span a range of geologic ages, and that the distribution of these ages occurs in patterns. • Students know that patterns of geologic ages seen in Earth's crustal rocks can be explained by plate tectonics. • Students know that by explaining the ages and the past and current movements of Earth's crustal rocks, the Theory of Plate Tectonics provides the fundamental framework for our understanding of Earth's geologic history. **DCI (PS1.C Nuclear Processes):** • Students know that some isotopes of certain elements are unstable and change over time into more stable elements through the process of radioactive decay. • Students know that in the decay process, the unstable atoms are called parents and the more stable atoms that are the product of the decay of the parent atoms are called daughters. • Students know that the rates at which various parents decay into various daughters are known and are constant. • Students know that the amount of time needed for one-half of any number of original parent atoms to decay is called the half-life of that parent. • Students know that geologists use radioactive decay rates to obtain ages of geologic materials by comparing ratios of parents to daughters.	