

HS-ESS1-5 Earth's Place in the Universe

California Science Test—Item Content Specifications

# HS-ESS1-5 Earth's Place in the Universe

Students who demonstrate understanding can:

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).]

Continue to the next page for the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Engaging in Argument from EvidenceEngaging 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. | ESS1.C: The History of Planet Earth1. 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 Interactions1. 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 to HS-ESS1-5)*

PS1.C: Nuclear Processes1. 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 to HS-ESS1-5)*
 | PatternsEmpirical evidence is needed to identify patterns. |

## Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

### Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

7.2 Ability to compare, evaluate, and critique competing arguments

### Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

7.2.1 Ability to evaluate arguments about a natural phenomenon based on scientific concepts, principles, and big ideas

7.2.2 Ability to respond to a critique from others by revising an argument after analysis of the reasoning and evidence

7.2.3 Ability to evaluate competing perspectives/claims using reasoning and evidence

### Disciplinary Core Idea Assessment Targets

#### ESS1.C.5

* Describe the observed pattern of the continental crust being older than the oceanic crust
* Describe the observed pattern of the oldest continental rocks being located at the center of continents with the ages of the rocks decreasing from their centers to their margins
* Describe the pattern of the ages of oceanic crust being greatest nearest the continents and decreasing in age with proximity to the mid-ocean ridges

#### ESS2.B.4

* Identify and describe the motion of tectonic plates based on the types, ages, and locations of crustal rocks
* Describe that new oceanic crust is formed at mid-ocean ridges, resulting in the observed pattern of ages of oceanic rock
* Describe that new continental crust is added to the margins of continents at subduction zones, resulting in the observed pattern of ages of continental rock
* Describe that oceanic crust is constantly being destroyed at subduction zones, resulting in the observed pattern of continental crust being older than oceanic crust

#### PS1.C.1

* Describe that ages of rocks can be determined using radiometric dating based on the half-lives of isotopes that undergo radioactive decay

### Crosscutting Concept Assessment Target(s)

CCC1 Use empirical evidence to identify patterns

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides evidence of tectonic plate movement, such as a representation of the pattern of crustal rock ages, and a flawed explanation for the pattern:

* Identifies the flaw in the explanation (7.2.1, ESS1.C.5, and CCC1)
* Describes how to correct the explanation (7.2.1, ESS1.C.5, and CCC1)

Task provides an explanation of the pattern of crustal rock ages and a critique of the explanation:

* Explains why the evidence supports the explanation (7.2.2, ESS2.B.4, and CCC1)
* Identifies how to construct a stronger explanation (e.g., additional evidence, better reasoning) (7.2.2, ESS2.B.4, and CCC1)

Task provides competing explanations about tectonic plate movement using evidence, such as the ages of rocks based on radiometric dating:

* Identifies which explanation is correct (7.2.3, ESS2.B.4, PS1.C.1, and CCC1)
* Describes the evidence that supports the correct explanation (7.2.3, ESS2.B.4, PS1.C.1, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* The relative ages of islands in a hotspot volcanic chain
* Observable lateral displacement along a fault during an earthquake
* The formation of mountains along subduction zones
* Similar rock strata on different continents
* The difference in age between oldest continental crust and oldest ocean crust or between oceanic crust near a ridge and oceanic crust near a trench

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Carbon dating is the only method of radiometric dating.
* Carbon dating is used to determine the ages of ancient rocks.
* Rocks farther from a divergent plate boundary are always younger than rocks near a divergent plate boundary.
* All coastlines are plate boundaries.
* All mountains in existence today have existed since the formation of the Earth.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS1-5 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS1-5 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)

The *2016 Science Framework for California Public Schools Kindergarten through Grade 12*

Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade 12 <https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix1.pdf>

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