

HS-ESS1-6 Earth's Place in the Universe

California Science Test—Item Content Specifications

# HS-ESS1-6 Earth's Place in the Universe

Students who demonstrate understanding can:

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.]

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 |
| --- | --- | --- |
| 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. | ESS1.C: The History of Planet Earth  1. 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  1. 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-ESS1-6)* | Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. |

## 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.

6.1 Ability to construct explanations of phenomena

### 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.

6.1.1 Ability to construct quantitative and/or qualitative explanations of observed relationships based on valid and reliable evidence

6.1.2 Ability to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world phenomenon

6.1.3 Ability to use models and representations in scientific explanations

### Disciplinary Core Idea Assessment Targets

#### ESS1.C.6

* Describe Earth’s formation and early history using evidence from ancient Earth materials, Moon rocks, and meteorites, and observations of other planetary surfaces
* Describe the composition of the celestial objects in the solar system
* Compare the size and distribution of impact craters on the surface of Earth and on the surfaces of other solar system objects (e.g., the Moon, Mercury, and Mars)
* Describe the effects of plate tectonic processes (e.g., volcanism) and surface processes (e.g., erosion) operating on Earth

#### PS1.C.1

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

### Crosscutting Concept Assessment Target(s)

CCC7 Identify that much of science deals with constructing explanations of how things change and how they remain stable

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides information about hypothetical element X of extraterrestrial origin that was found at a location of a new meteor impact:

* Describes the link between the presence of element X and Earth’s formation and history (6.1.1, ESS1.C.6, and CCC7)
* Identifies the roles of various earth processes (e.g., plate tectonics and erosion) in the preservation and destruction of evidence about Earth history (6.1.1, ESS1.C.6, and CCC7)

Task provides a scenario where a virtual mass spectrometer can be used to quickly determine the composition of samples of different rock layers of the Earth’s crust:

* Uses radiometric dating and the half-life law to support a claim about the age of the rock samples taken from different depths (6.1.1, ESS1.C.6, PS1.C.1, and CCC7)

Task provides a representation of the distribution of marine fossils in areas that are not presently covered by ocean:

* Identifies the roles of various earth processes (e.g., plate tectonics and erosion) in altering the Earth’s surface throughout Earth history (6.1.2, ESS1.C.6, and CCC7)

Task provides students with an animated model of the formation of the solar system from an accretion disk:

* Identifies that the cooling down of the solar system as the accretion disk slowed allowed for the atmosphere and water to exist on the Earth (6.1.3, ESS1.C.6, and CCC7)
* Identifies that planetesimals and meteorites are sources of water and atmosphere on Earth (6.1.3, ESS1.C.6, and CCC7)

Task describes a scenario where a researcher cannot relocate a surface fossil bed that was studied the previous field season:

* Explains, by using a representation or model, how various earth processes (e.g., plate tectonics and erosion) can alter the Earth’s surface throughout Earth’s history (6.1.3, ESS1.C.6, and CCC7)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* The relative abundance of certain elements in meteorites and samples of Earth’s crust from different locations and geologic periods as evidence of impacts
* The ages of samples of ancient Earth rocks, lunar rocks, and meteorites to construct an account of formation of Earth and the solar system (e.g., comparing silicon isotopes)
* The geologic record (e.g., first appearance of photosynthetic organisms or banded iron formations) to construct a history of Earth’s atmosphere
* Effects of tectonics and other processes operating on Earth’s surface

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Water and the modern atmosphere existed on Earth as it was formed.
* The Moon was formed as a separate entity when the solar system was formed.
* The landmasses on Earth do not move.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS1-6 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS1-6 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-6%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>

Posted by the California Department of Education, March 2021 (updated February 2024)