

HS-ESS2-5 Earth’s Systems

California Science Test—Item Content Specifications

# HS-ESS2-5 Earth’s Systems

Students who demonstrate understanding can:

Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

[Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

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 |
| --- | --- | --- |
| Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.  Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. | ESS2.C: The Roles of Water in Earth's Surface Processes  1. The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water’s exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. | Structure and Function The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. |

## 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.

3.1 Ability to clarify the goal of the investigation and identify the evidence needed to address the purpose of the investigation

3.2 Ability to develop, evaluate, and refine a plan for the investigation

3.3 Ability to collect the data for the investigation

### 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.

3.1.1 Ability to describe the purpose of the investigation

3.1.2 Ability to identify relevant independent and dependent variables and to consider possible confounding variables or effects

3.1.3 Ability to describe what and how much data need to be collected to provide sufficient evidence for the purpose of the investigation

3.1.4 Ability to describe how the observations and/or collected data can be used as evidence for the phenomenon under investigation

3.2.1 Ability to decide how to observe and/or measure relevant variables, considering the level of accuracy and precision required and the kinds of instrumentation and techniques best suited to making such measurements

3.2.2 Ability to describe a detailed experimental procedure (e.g., number of trials, identify the control) and experimental setup

3.2.3 Ability to compare and evaluate alternative methods to determine which design provides the evidence necessary to address the purpose of the investigation

3.3.1 Ability to use appropriate tools for accurate and precise measurements

3.3.3 Ability to evaluate the quality of data to determine if the evidence meets the goals of the investigation

### Disciplinary Core Idea Assessment Targets

#### ESS2.C.8

* Identify the properties of water (e.g., heat capacity, density of different states, polar nature due to molecular structure) that are central to Earth’s surface processes
* Describe the role of heat capacity of water to affect the temperature, movement of air, and movement of water on Earth’s surface and the transfer of thermal energy in Earth’s systems
  + Describe the role of flowing water (liquid or solid) in the transportation and deposition of sediments
  + Describe the role of the polarity of water (through cohesion) and soil saturation in erosion
  + Describe the role of the density of water in the liquid and solid states in the breakdown of rock
  + Describe the role of the polar nature of water in the dissolving and precipitation/crystallization of Earth materials
* Identify and describe the mechanical effects of water on Earth materials
* Describe the role of water as a component in chemical reactions that change Earth materials, such as the rusting of iron
* Describe the role of water in lowering the melting temperature of rock and decreasing the viscosity of melted rock, such as in volcanic eruptions
* Identify and describe the chemical effects of water on Earth materials

### Crosscutting Concept Assessment Target(s)

CCC6 Infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides an image of a landform, such as a landslide, a braided stream bed, or sand spit that has been formed by water:

* Formulates a scientific question based on the provided observation (3.1.1, ESS2.C.8, and CCC6)

Task provides an experimental design to investigate the impact of water on Earth’s surface:

* Identifies factors that might affect the result of the investigation (3.1.2, ESS2.C.8, and CCC6)

Task provides a list of variables related to a scientific investigation on the impact of water on Earth’s surface:

* Identifies the dependent and independent variables in the investigation (3.1.2, ESS2.C.8, and CCC6)

Task provides experimental designs to answer a scientific question about the impact of water on Earth’s surface:

* Identifies the design that will provide the best evidence to address the purpose of the investigation (3.1.3, ESS2.C.8, and CCC6)

Task provides a procedure and a list of rationales for using that procedure during an investigation on the impact of water on Earth’s surface:

* Selects the rationale that explains why the procedure supports the goal of the investigation (3.1.4, ESS2.C.8, and CCC6)

Task provides a scientific question about the impact of water on Earth’s surface and a list of tools and instrumentation:

* Identifies the tools and instrumentation that can help obtain accurate and precise data (3.2.1, ESS2.C.8, and CCC6)

Task provides a hypothesis/scientific question about the impact of water on Earth’s surface:

* Selects or describes a detailed experimental procedure, including how the data will be collected, the number of trials, the experimental setup, and the equipment and tools required (3.2.2, ESS2.C.8, and CCC6)

Task provides alternate experimental designs and/or a data from a flawed design to determine the impact of water on Earth’s surface:

* Evaluates alternative designs to determine which design provides the evidence necessary to better address the purpose of the investigation (3.2.3, ESS2.C.8, and CCC6)

Task provides a set of data relevant to the goal of the investigation on the impact of water on Earth’s surface:

* Evaluates the quality of data to determine if the data meet the goal of the investigation (3.3.3, ESS2.C.8, and CCC6)

## California Environmental Principles and Concepts

* EP3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter.
* EP4: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Erosion of hillsides after heavy storms differs based on soil type
* Formation of sand from erosion of larger rocks
* Creation of landforms due to translocation of rock and soil by water
* Rate of chemical weathering or physical weathering of material under different conditions
* Effect of manmade structures on erosion and deposition

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Rocks do not change.
* Weathering and erosion are the same thing.
* Erosion only happens quickly.
* Erosion only happens after big storms.
* Erosion is bad.
* Wind and water cannot wear away the rock of a mountain.
* Erosion did not occur in the past.
* Ice can only break rock when it moves (e.g., glaciers).

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-ESS2-5 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-ESS2-5 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)

California Environmental Principles and Concepts <http://californiaeei.org/abouteei/epc/>

California Education and the Environment Initiative <http://californiaeei.org/>

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>

Appendix 2: Connections to Environmental Principles and Concepts <https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix2.pdf>

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