

MS-ESS2-6 Earth's Systems

California Science Test—Item Content Specifications

# MS-ESS2-6 Earth's Systems

Students who demonstrate understanding can:

Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

[Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [*Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.*]

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 |
| --- | --- | --- |
| Developing and Using ModelsModeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.Develop and use a model to describe phenomena. | ESS2.C: The Roles of Water in Earth's Surface Processes1. Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

ESS2.D: Weather and Climate1. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
2. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.
 | Systems and System ModelsModels can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. |

## 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.

2.1 Ability to develop models

2.2 Ability to use models

### 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.

2.1.1 Ability to determine components of a scientific event, system, or design solution

2.1.2 Ability to determine the relationships among multiple components of a scientific event, system, or design solution

2.1.4 Ability to represent mechanisms, relationships, and connections to illustrate, explain, or predict a scientific event

2.2.1 Ability to use models to identify concepts and relationships represented in the models

2.2.2 Ability to use a model to generate explanations and predictions about a scientific phenomenon

### Disciplinary Core Idea Assessment Targets

#### ESS2.C.6

* Identify and describe how variations in temperature and salinity affect the density of fluids, driving convection currents that can act both vertically and horizontally

#### ESS2.D.4

* Identify the components that affect climate including the rotating Earth, the atmosphere, the ocean, energy, and the distribution of continents, landforms, ice, and living things
* Identify and describe relationships between components affecting climate including differences in the distribution of solar energy and temperature changes, the motion of ocean waters and air masses, factors affecting the motion of winds and currents, and thermal energy transfer
* Describe the differing climate patterns due to changes in latitude and altitude

#### ESS2.D.6

* Describe the differing climate patterns in the center of continents versus marine coasts due to water being able to absorb more solar energy for every degree change in temperature than land can

### Crosscutting Concept Assessment Target(s)

CCC4 Use a model to represent a system and its interactions—such as inputs, processes and outputs—and energy, matter, and information flows within the system

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides an incomplete model for the mixing of air cells from Mexico and Canada as they interact on the plains of Tornado Alley:

* Adds labels to the model such as Earth’s rotation, the temperature of the interacting air cells, and the topology of the region (2.1.1, ESS2.D.4, and CCC4)
* Completes the model to explain why tornados have their characteristic strength, why tornados rotate, and/or why tornados are more likely in the plains rather than in mountainous or coastal regions (2.1.1, ESS2.D.4, and CCC4)

Task provides a scenario in which air over the sea is cooler in daytime than the air on the coast, with the pattern reversing at night:

* Uses a representation to illustrate the flow of air during daytime and nighttime (2.1.3, ESS2.D.4, and CCC4)

Task provides an interactive model that details coastal temperatures along the Atlantic and Mediterranean coasts of North America and Europe:

* Identifies evidence in the model needed to support (or refute) that oceanic water temperatures have an impact on the climate of city pairs like Montreal-London or New York-Madrid, accounting for the milder temperatures or climates of the European cities over the American ones (2.2.1, ESS2.D.6, and CCC4)

Task provides several maps showing the path and strength (in wind speed and diameter) of several large hurricanes:

* Identifies the role of the Coriolis effect in hurricane rotation (2.2.1, ESS2.D.4, and CCC4)
* Identifies that hurricanes increase in strength as they pass over large, warm bodies of water and taper off as they pass over landmasses (2.2.1, ESS2.D.4, and CCC4)

Task provides two models for oceanic circulation currents, one which reflects modern cycles with ice caps intact, and another in which the circulation is diminished due to the influx of freshwater after the ice caps melt:

* Identifies the source of the freshwater and salinity-based convection currents as the mechanism which has been altered due to climate change (2.2.2, ESS2.C.6, and CCC4)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Sea breeze created from temperature and pressure differentials between land and bodies of water near the coastline
* The rotation and strength of hurricanes as a function of pressure, the solar energy stored in the ocean, and the rotation of Earth
* The different climates of two cities on the same latitude (e.g. 40°N)
* The effect on weather and the climate caused by the differences in reflectivity of oceans and ice caps
* Prevailing winds (due to uneven heating of Earth by the Sun) and their effects on climate systems

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Solar energy absorbed by water in the ocean is trapped there permanently.
* Weather and climate are synonymous.
* Small climate changes can only have small impacts.
* Human activity only has small impacts on surface features and, therefore, cannot have a meaningful effect on climate patterns.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

MS-ESS2-6 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/MS-ESS2-6 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS2-6%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>

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