

GEOGRAPHY STANDARD 7: The physical processes that shape the patterns of Earth's surface



Image credit: D.J. Zeigler

Geologic, atmospheric, and coastal processes along with gravity are at work shaping the painted cliffs on Maria Island in Tasmania.

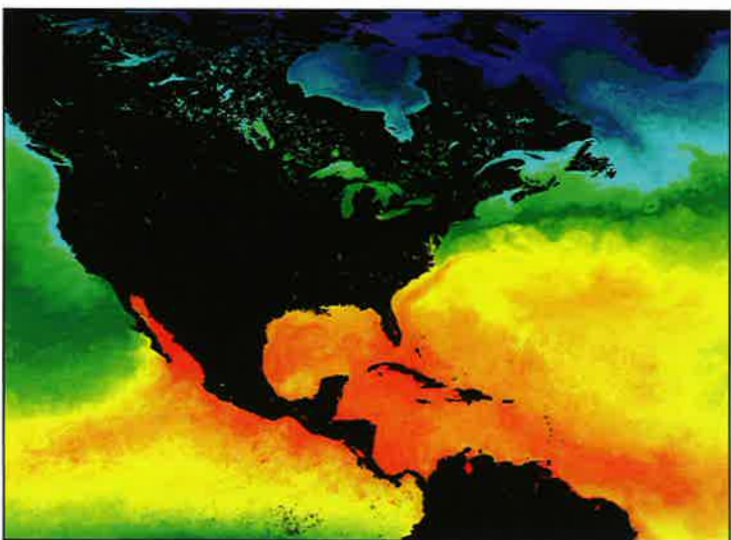


Image credit: University of North Alabama/Lisa Keys-Mathews

The geographically informed person must understand that physical systems create, maintain, and modify the features that constitute Earth's surface. The physical environment provides the essential background for all human activity on Earth.

Therefore, Standard 7 contains these themes: Components of Earth's Physical Systems, Earth–Sun Relationships, and Physical Processes.

There are four physical systems: the atmosphere, the biosphere, the hydrosphere, and the lithosphere. These constitute the essential units of the planet's physical systems. Recognizing the interactions within and among these four components offers insights on how Earth serves as the home of all living things—plants, animals, and humans.

Almost all of Earth's energy comes from the Sun. The synchronized Earth–Sun relationships are essential for the planet to be habitable and capable of supporting life as we know it. Earth's position relative to the Sun affects events and conditions in every part of the world. The amount of solar energy a place receives depends on the cyclically changing angles of the Sun's rays. The seasons result from the tilt of Earth and its revolution around the Sun causing variable heating patterns, and thus significantly influences climate and weather as well as human activity.

The physical processes on Earth create constant change. These processes—including movement in the tectonic plates in the crust, wind and water erosion, and deposition—shape features on Earth's surface.

Understanding how physical systems work can influence the choices people make about where they live, the types of buildings they construct, the travel networks they develop, and how they generally conduct their lives. Given the uncertain trajectory and effects of global climate change, knowledge about the factors that affect weather and climate is important for both personal and governmental decision-making. Global climate change is a public policy issue that must be addressed by governments, resulting in actions that determine the health, safety, and economic well-being of people across the world. Reasoned and responsible political decisions must derive from a clear understanding of the interactions among Earth's physical systems, as well as the processes creating them.

Students must understand the effects of physical systems on Earth's surface. Understanding these themes enables students to see how the changing physical environment is the stage for all human activity.

Satellite thermal imaging of sea surface temperatures often displays the uneven heating between the tropic and the arctic regions. These images can be used in oceanographic research including the prediction of tropical storms. Data source: NASA Aqua MODIS Sea Surface Temperature September 2011.

GEOGRAPHY STANDARD 7: The physical processes that shape the patterns of Earth's surface

4th GRADE

the student knows and understands:

Components of Earth's Physical Systems

1. There are four components of Earth's physical systems (the atmosphere, biosphere, hydrosphere, and lithosphere)

Therefore, the student is able to:

A. Identify attributes of Earth's different physical systems, as exemplified by being able to

- ▶ Identify different attributes of physical systems in photographs (e.g., sky, clouds, plants, soil, oceans, lakes, mountains).
- ▶ Identify examples of water features on Earth's surface that comprise the hydrosphere (e.g., oceans, rivers, lakes, water vapor, ground water, different types of precipitation).
- ▶ Identify examples of landforms on Earth's surface (e.g., mountains, volcanoes, valleys, plains).



Image credit: Susan Gallagher Heffron

Wind, water, and freeze-thaw erosion has resulted in unusual rock formations including the spires or "hoodoos" in Utah's Bryce Canyon National Park.

8th GRADE

the student knows and understands:

Components of Earth's Physical Systems

1. The four components of Earth's physical systems (the atmosphere, biosphere, hydrosphere, and lithosphere) are interdependent

Therefore, the student is able to:

A. Identify and describe patterns in the environment that result from the interaction of Earth's physical processes, as exemplified by being able to

- ▶ Identify and describe the connections between ocean circulation system and climate (e.g., North Atlantic Drift and the mild climate of Western Europe, the climatic effects of El Niño or La Niña).
- ▶ Identify and describe the patterns that result from the connections between climate and vegetation (e.g., examples of patterns of ecosystems and biomes).
- ▶ Identify and describe the patterns of physical features that result from erosion and deposition (e.g., estuaries and deltas, canyons, alluvial plains, sand dunes).

B. Analyze and explain patterns of physical features resulting from the interactions of Earth's physical processes, as exemplified by being able to

- ▶ Analyze maps of tectonic plates to predict the location of physical features (e.g., mountain ranges, volcanoes, rift valleys).
- ▶ Analyze the pattern of glacial features as a result of glacial retreat (e.g., moraines, kettle lakes, cirques).
- ▶ Analyze and explain factors influencing precipitation patterns and predict where the patterns will occur (e.g., convectional, orographic, frontal).

12th GRADE

the student knows and understands:

Components of Earth's Physical Systems

1. The interactions of Earth's physical systems (the atmosphere, biosphere, hydrosphere, and lithosphere) vary across space and time

Therefore, the student is able to:

A. Explain how the effects of physical processes vary across regions of the world and over time, as exemplified by being able to

- ▶ Explain the changing relationships among climate, vegetation, and landforms (e.g., desertification and soil degradation, glacial advances and retreats).
- ▶ Analyze and explain the differential effects on climate of the relationship between water and wind at different latitudes (e.g., cold currents influence the creation of deserts at 20 and 30 degrees north and south latitudes, the formation of hurricanes and tropical storms).
- ▶ Analyze and explain the relationships between physical processes and the location of land features (e.g., river valleys, canyons, deltas, glaciated lakes and moraines, limestone deposits, caves, alluvial fans, canyons).

B. Explain the ways in which Earth's physical processes are dynamic and interactive, as exemplified by being able to

- ▶ Explain how volcanic eruptions and forest fires change atmospheric conditions and disrupt the nitrogen and carbon cycles.
- ▶ Explain how increasing surface temperatures result in melting ice sheets and rising sea levels.
- ▶ Construct a diagram illustrating how El Niño and La Niña form and how these influence weather in different locations on Earth.

GEOGRAPHY STANDARD 7: The physical processes that shape the patterns of Earth's surface

4th GRADE

the student knows and understands:

Earth – Sun Relationships

2. Earth–Sun relationships affect conditions on Earth

Therefore, the student is able to:

- A. Describe how Earth's position relative to the Sun affects conditions on Earth, as exemplified by being able to
- ▶ Describe the relationship between the cycle of seasons and months in the Northern and Southern hemispheres.
 - ▶ Describe the differences in seasons based on latitude (e.g., first and last frost in different locations, length of growing season, bird migrations).
 - ▶ Describe the changes in daily sunrise and sunset and length of daylight hours by recording the change in times over the span of the school year.

Physical Processes

3. Physical processes shape features on Earth's surface

Therefore, the student is able to:

- A. Identify examples of physical processes, as exemplified by being able to
- ▶ Identify different cycles in Earth's systems (e.g., water cycle, carbon cycle, wind or water erosion, weathering, deposition, mass wasting).
 - ▶ Identify the components and relationships in the water cycle.
 - ▶ Identify the components and relationships in the erosion cycle (e.g., water carving canyons, wind sculpting mesas, landslides, avalanches).
- B. Describe how physical processes shape features on Earth's surface, as exemplified by being able to
- ▶ Describe **landforms** by constructing 3-D physical models and organize the models into groups formed by similar processes.
 - ▶ Describe the physical processes that shaped particular landform features using pictures of landforms such as canyons, mesas, and deltas.
 - ▶ Describe how **freeze–thaw** processes erode rock (e.g., potholes on local streets, rock slides in mountain regions).

8th GRADE

the student knows and understands:

Earth – Sun Relationships

2. Earth–Sun relationships drives physical processes that follow an annual cycle and create patterns on Earth

Therefore, the student is able to:

- A. Explain how Earth–Sun relationships drive Earth's physical processes and create annual patterns, as exemplified by being able to
- ▶ Explain the occurrences of weather phenomena in different locations due to annual changes in the Earth–Sun relationship (e.g., hurricanes in the fall in subtropical areas, monsoon rainfall, tornadoes in the mid-latitudes during the spring and summer).
 - ▶ Explain why the hours of visible sunlight changes with seasons (e.g., the equatorial region experiences approximately 12 hours of sunlight year round while places in the Arctic and Antarctic circles vary from 0 to 24 hours of visible sunlight).
 - ▶ Describe how the angle of the Sun's rays changes at different latitudes by shining a light directly on the equator of a globe and noting the change in the location (on the tropic lines) and angle of the direct rays as the tilted globe is moved to represent the different seasons.

Physical Processes

3. Physical processes generate patterns of features across Earth's surface

Therefore, the student is able to:

- A. Analyze and explain the patterns that occur on Earth's surface as a result of physical processes, as exemplified by being able to
- ▶ Explain the effects of variations in seasonal precipitation on rivers or vegetation (e.g., amount of snowfall, flash floods, 100-year rain event on rivers, lakes, shorelines, forests).
 - ▶ Explain how physical processes related to plate tectonics form islands (e.g., Hawaiian Islands) or increase the elevation of mountains (e.g., Himalayan Mountains).
 - ▶ Explain the effects of erosion processes on landscape features over time (e.g., Chimney Rock, Devil's Tower, Grand Canyon, Arches National Park).

12th GRADE

the student knows and understands:

Earth – Sun Relationships

2. Earth–Sun relationships are variable over long periods of time resulting in changes in physical processes and patterns on Earth

Therefore, the student is able to:

- A. Explain how variability in Earth–Sun relationships affect Earth's physical processes over time, as exemplified by being able to
- ▶ Explain how cyclic changes (e.g., precession or Milankovich cycle) in Earth's orbit are responsible for changes in heating that result in climatic changes such as an ice age and glaciation of Earth's surface.
 - ▶ Describe the variability in climate over historic periods of time (e.g., over the last 1,500 years or during epochs such as the Pleistocene).
 - ▶ Explain how changes in sea coral (including current observations and fossil records) are due to sea level rise or fall as a result of climate variability.

Physical Processes

3. Physical processes interact over time to shape particular places on Earth's surface

Therefore, the student is able to:

- A. Analyze and explain the results of interactions of physical processes over time, as exemplified by being able to
- ▶ Identify the landforms that comprise much of Bangladesh and explain the physical processes that make the country susceptible to river flooding, monsoon flooding, and cyclonic storms.
 - ▶ Analyze and explain the landscape of Iceland in terms of physical processes (e.g., volcanism, glaciation, plate tectonics of the mid-Atlantic ridge).
 - ▶ Compare and contrast the Great Lakes of East Africa and the Great Lakes of North America and describe physical processes that created each of these lake systems.

GEOGRAPHY STANDARD 7: The physical processes that shape the patterns of Earth's surface



Image credit: Lydia J. Lewis

Glaciers, such as the Monacobreen Glacier in Spitzbergen, Svalbard, move and sculpt the land surface resulting in landforms including lakes, valleys, cirques, and moraines.