

8th Grade Earth Science Forces that Shape the Earth

Big Idea: The earth's surface is shaped by climate, gravity and heat from the earth's interior.

Teacher Background Information

The surface of the Earth is constantly changing. No surface feature is permanent. Heat left over from the formation of the Earth and from the radioactive decay of elements sets up convection currents in the mantle. This causes movement of the Earth's surface layers or plates resulting in mountain building, ocean trenches, volcanoes, earthquakes, and the formation of new crust and the melting of old. Our understanding of plate tectonics has helped us make sense of earthquakes and volcanic eruptions. Seismologists use waves generated by earthquakes and explosions to help understand the interior of the Earth. Weathering and gravity also work together to change the surface, wearing down mountains and redistributing sediments. Rock is constantly being changed into other kinds of rock in a process known as the rock cycle. Human activity can also cause significant changes to the Earth's surface.

Instructional Implications:

- A major goal of science in the middle grades is for students to investigate interacting components of the earth system (geosphere, hydrosphere, atmosphere, and biosphere) and the solar system. Their study of earth's history provides some evidence about how the planet's main features evolved—the distribution of land and sea, features of the crust, the composition of the atmosphere, global climate, and populations of living organisms in the biosphere.
- At this level, students are able to complete most of their understanding of the factors that shape the face of the earth. Students should see as great a variety of landforms and soils as possible. The process of sedimentation is understandable and observable. Gravity can by now be thought of as acting toward the center of the spherical earth.
- Students can investigate the rock cycle as an introductory example of a geophysical/geochemical cycles. Students should come to understand how sedimentary rock is formed periodically, embedding plant and animal remains and leaving a record of the sequence in which the plants and animals appeared and disappeared.
- By plotting the locations of volcanoes and earthquakes, students can see a pattern of geological activity. Students should learn what causes earthquakes, volcanoes, and floods and how those events shape the surface of the earth. Catastrophic phenomena will catch students interest, and teachers should take advantage of that to work toward the science. Students may find it harder to take seriously the less-obvious, less-dramatic, long-term effects of erosion by wind and water, annual deposits of sediment, the creep of continents, and the rise of mountains. Students' recognition of those effects will depend on an improving sense of long time periods and familiarity with the effect of multiplying tiny fractions by very large numbers (in this case, slow rates by long times).
- Students can now improve their ability to handle scale. An inevitable paradox of the large scales involved is that an ocean that is difficult to imagine being 7 miles deep also can be considered a "relatively thin" layer on the earth's surface. Students should exercise their understanding of the paradox, perhaps by debating provocative questions such as "Is the ocean amazingly deep or amazingly shallow?"
- It is also time for students to begin to look at the planet's role in sustaining life—a complex subject that involves many different issues and benchmarks.

Essential Questions

- ✓ How does climate affect Earth's surface?
- ✓ How do processes inside the earth affect the surface features that we can see?_

AAAS Benchmarks/National and Science Education Standards

Exterior Processes that Shape the Earth: Changes in the Earth's Surface

- Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down of mountains). 4C/M2a
- Land forms (such as coastlines, rivers, mountains, deltas, and canyons) are the result of a combination of constructive and destructive forces. (NSES)
- Climates (and landscapes) have sometimes changed abruptly in the past as a result of volcanic eruptions or impacts of huge rocks from space. 4B/M6*
- Rivers and glacial ice carry off soil and break down rock, eventually depositing the material in sediments or carrying it in solution to the sea. 4C/M2b*
- Sediments of sand and smaller particles (sometimes containing the remains of organisms) are gradually buried and are cemented together by dissolved minerals to form solid rock again. 4C/M3
- Thousands of layers of sedimentary rock confirm the long history of the changing surface of the earth and the changing life forms whose remains are found in successive layers. The youngest layers are not always found on top, because of folding, breaking, and uplift of layers. 4C/M5
- Some changes in the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues. (NSES)
- Soil consists of weathered rocks and decomposed organic material

Interior Processes that Shape the Earth: Plate Tectonics

- The interior of the earth is hot. Heat flow and movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins. 4C/M1
- The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core. (NSES)
- The outer layer of the earth—including both the continents and the ocean basins—consists of separate plates. 4C/M11** (BSL)
- Lithospheric platesconstantly move at rates of centimeters per year Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions.
- Matching coastlines and similarities in rock types and life forms suggest that today's continents are separated parts of what was long ago a single continent. (SFAA pp152-153)
- The earth's plates sit on a dense, hot, somewhat melted layer of the earth. The plates move very slowly, pressing against one another in some places and pulling apart in other places, sometimes scraping alongside each other as they do. Mountains form as two continental plates, or an ocean plate and a continental plate, press together. 4C/M12** (BSL)

Student Difficulties and Misconceptions

- Imagining the span of geologic time will be difficult for students.
- Students of all ages may hold the view that the world was always as it is now, or that any changes that have occurred must have been sudden and comprehensive.

Materials/Resources

DSE Foldout landscape
SeaGrant Tsunami DVD (1964 Earthquake)
Google Earth
Science Explorer Books
Earth's Changing Surface
Inside Earth
Geology of SE Alaska by Harold Stowell

Assessments

Science Probes, Volume 1

Science Probe #22 Beach Sand
Science Probe #23 Mountain Age

Science Notebooks

Grade Level Scientists

Louis Agassiz, Charles Lyell, William Smith, Alfred Wegener, Florence Bascom

Local Connections

Sedimentation from glacier, filling in Gastineau channel

Alaska Earthquakes and volcanoes,

Earthquake and volcano safety

Destructive forces: Weathering, Glacier, River, Tidal erosion

Constructive forces: volcanic eruptions, mountain uplift, buildup of sediment

Alaska GLE's

The student demonstrates an understanding of geochemical cycles by

[6] **SD1.1** exploring the rock cycle in its relationship to igneous, metamorphic, and sedimentary rocks (L)

[7] **SD1.1** describing the rock cycle and its relationship to igneous, metamorphic, and sedimentary rocks

[8] **SD1.1** making connections between components of the locally observable geologic environment and the rock cycle

[10] **SD1.1** using a model to explain the processes (i.e., formation, sedimentation, erosion, reformation) of the rock cycle.

The student demonstrates an understanding of the forces that shape Earth by

[6] **SD2.1** describing the formation and composition (i.e., sand, silt, clay, organics) of soils

[6] **SD2.2** identifying and describing its layers (i.e., crust, mantle, core)

[6] **SD2.3** describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches)

[7] **SD2.1** identifying strategies (e.g., reforestation, dikes, wind breaks, off road activity guidelines) for minimizing erosion

[7] **SD2.2** describing how the movement of the tectonic plates results in both slow changes (e.g., formation of mountains, ocean floors, and basins) and short-term events (e.g., volcanic eruptions, seismic waves, and earthquakes) on the surface

[8] **SD2.1** interpreting topographical maps to identify features (i.e., rivers, lakes, mountains, valleys, islands, and tundra)

[8] **SD2.2** using models to show the relationship between convection currents within the mantle and the large scale movement of the surface (L)

9] [10] [11] **SD2.1** recognizing the dynamic interaction of erosion and deposition including human causes.

Connections to other content areas :

*Ecology: Although weathered rock is the basic component of soil, the composition and texture of soil and its fertility and resistance to erosion are greatly influenced by plant roots and debris, bacteria, fungi, worms, insects, rodents, and other organisms. 4C/M6

* Evolution: Besides the relative age of the rock layers, the absolute age of (fossil) remains is central to the argument that there has been enough time for evolution of species.

* Physical Science: similarity of earthquake waves to sound waves.