

Elements of Earth Science

The Earth: Inside and Out

Teacher's Guide

Grade Level: 6–12

Curriculum Focus: Earth Science

Lesson Duration: Two class periods

Program Description

Although Earth formed billions of years ago, it is still a work in progress. Learn about the forces that continue to change and shape Earth from deep within the planet. Explore the theories of plate tectonics and sea floor spreading, find out why some volcanoes and earthquakes cause great devastation but not others, and discover why even the tallest mountains will eventually shrink.

Onscreen Questions

- How does the heat in Earth's interior affect the surface of the planet?
 - What are the forces that shaped Earth's crust?
 - What causes massive changes on the surface of Earth?
 - Why are some volcanoes more destructive than others?
 - What causes an earthquake?
 - How do mountains form and change over time?
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Lesson Plan

Student Objectives

- Understand the forces that change Earth's surface from deep within the planet.
- Use the theories of plate tectonics and continental drift to explain the destructive power of earthquakes.
- Create a plan to help make earthquake-prone cities safer.

Materials

- *The Earth: Inside and Out* video
- Computer with Internet access
- Maps of Earth that include tectonic plates and major fault lines

Procedures

1. Explain to students that they will be creating a five-minute presentation on ways to better “earthquake-proof” new buildings. The students will imagine that they are engineers presenting their ideas to city planners.
2. Divide the class into groups and assign each group an earthquake-prone region of Earth. (You may want to assign each group to research one area per major plate). Using a map with major plates and fault lines outlined, choose a country or city that has experienced a devastating earthquake (e.g., San Francisco, Indonesia, Turkey, Colombia).
3. Have students research their assigned region. The following sites are good starting points for exploring plate tectonics and earthquakes online:
http://www.fema.gov/news/newsreleaes_print.fema?id=11407
<http://www.olympus.net/personal/gofamily/quake/recent.html>
<http://countrystudies.us/mexico/49.htm>
<http://pubs.usgs.gov/publications/text/understanding.html>
<http://www.weatherwizkids.com/earthquake1.htm>
<http://www.pbs.org/wgbh/aso/tryit/tectonics/>
4. Students should look for answers to the following questions:
 - What plate is the city/country/region on?
 - What type of rock or soil is it built on? (granite, sand, basalt)
 - Does it lie on or near a major fault line or plate boundary?
 - If so, what type of plate boundary – divergent, convergent, transform?
 - What was the magnitude of the earthquake? Where were the focus, epicenter, and focal depth?
 - What kind of damage did this earthquake do to the area’s infrastructure?
5. After students have completed their research, have each group compile their results into a report that describes the scope of the earthquake, resulting damage, and suggestions for rebuilding the city or region. Students can use their creativity, developing possible solutions for construction of new buildings, roads, transportations systems, and other infrastructure. Students may explore ideas incorporating a variety of building materials, methods, height or depth requirements, zoning regulations, etc.
6. Have a representative of each group present the group’s findings to the class, who will act as “city planners”.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

3 points: Students were highly engaged in class discussions; conducted thorough research; presented a creative and accurate report.

2 points: Students were somewhat engaged in class discussions; conducted adequate research; presented an acceptable report.

1 point: Students were not engaged in class discussions; did not conduct adequate research; did not present an acceptable report.

Vocabulary

asthenosphere

Definition: The semi-molten area of mantle rock beneath the lithosphere

Context: Convection currents slowly move the material in the asthenosphere, causing Earth's tectonic plates to shift.

continental drift

Definition: The slow movement of tectonic plates that causes continents to move toward and away from each other

Context: Alfred Wegener believed that all the continents once formed a giant land mass called Pangaea, but continental drift caused them to slowly break apart and drift away.

plate tectonics

Definition: The theory that the lithosphere is divided into about a dozen major sections, which float on and travel independently over the mantle

Context: Plate tectonics is responsible for Earth's volcanic and earthquake activity, as well as mountain formation.

Richter scale

Definition: The open-ended scale for expressing the magnitude of a seismic disturbance such as an earthquake

Context: Earthquakes that measure 6 or higher on the Richter scale can cause major damage.

seismic wave

Definition: The vibrations caused by earthquakes that radiate from deep within Earth

Context: The measurable energy created by seismic waves is used to determine the strength of an earthquake.

subduction

Definition: The process of one tectonic plate moving beneath another

Context: Subduction can cause massive ocean trenches along the plate boundaries.



Standards

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following national standards:

- Earth and Space Science: Structure of the Earth system; origin and evolution of the Earth system

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>

This lesson plan addresses the following national standards:

- Science: Earth and Space Sciences – Understands Earth's composition and structure
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into sections indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.

Video Index

I. The Earth's Interior and Crust (4 min.)

Earth is a planet in constant motion. Discover how Earth's surface changes over time and the forces that cause this movement.

Pre-viewing question

Q: What are signs of activity in Earth's interior?

A: Answers will vary, but two possibilities are volcanic eruptions and earthquakes.

Post-viewing question

Q: What do you think life would be like if there all the continents were still together as one large land mass?

A: Answers will vary.

II. The Earth's Crust (4 min.)

There are many differences between continental crust and sea floor crust. Explore these differences and learn how new crust is formed through sea floor spreading.

Pre-viewing question

Q: What forces shape Earth's crust?

A: Answers will vary.

Post-viewing question

Q: What does the theory of sea floor spreading prove?

A: That some tectonic plates are diverging, or moving apart, and that as lava rises to fill the gap between the plates and create new ocean floor, somewhere else pieces of crust are being forced back into Earth's interior. The new seafloor is also created in "stripes" of rock with alternating magnetic polarity, proving that Earth's magnetic poles have changed many times.

III. Plate Tectonics (4 min.)

Earth's crust is broken up into a number of tectonic plates. The constant movement and collisions these plates creates significant changes to Earth's surface.

Pre-viewing question

Q: What causes massive changes on the surface of Earth?

A: Answers will vary.

Post-viewing question

Q: What happens when plate boundaries collide or slide past each other?

A: At divergent plate boundaries, magma rises to the surface as the plates move apart, creating new ocean floor. At convergent plate boundaries, the heavier material sinks below the lighter one, pushing some of Earth's crust back into the mantle. At transform boundaries, plates sliding past each other can get stuck and then break apart suddenly and violently, causing earthquakes.

IV. Volcanoes (6 min.)

Volcanoes are one of the most visible signs of the constantly shifting crust of the Earth. Learn more about the different types of volcanoes and which are the most destructive.

Pre-viewing question

Q: Why are some volcanoes more destructive than others?

A: Answers will vary but the two main reasons are the type of volcano and its proximity to populated areas.

Post-viewing question

Q: What is a hot spot volcano?

A: While most volcanoes occur along plate boundaries, hot spot volcanoes can occur on the plate. A particularly hot region under an ocean plate pushes magma up through the surface creating a volcano. As the tectonic plate moves, the volcano moves off the hot spot, but another volcano will form behind it creating a chain.

V. Earthquakes (3 min.)

Earthquakes are caused when tectonic plates collide or move past each other and they can be extremely destructive. See how earthquakes are created and why some of the most dangerous occur on the ocean floor.

Pre-viewing question

Q: Have you ever experienced an earthquake?

A: Answers will vary.

Post-viewing question

Q: Why are some earthquakes so destructive?

A: Answers will vary, but should include information on transform boundaries, focus, epicenter, focal depth, the Richter scale, tsunamis, location relative to populated areas, and rock types.

VI. Mountains (5 min.)

Mountains are dramatic examples of plate tectonics, and vary in type depending upon specific plate activity and erosion processes.

Pre-viewing question

Q: How do mountains form and change over time?

A: Answers will vary.

Post-viewing question

Q: What are the different types of mountains?

A: There are four main types: fold mountains, created when an ocean plate is subducted under a continental plate; fault block mountains, formed by surface rock rising up along fault lines; dome mountains, created when magma forces surface rocks upwards in a dome shape; and volcanic mountains, formed when lava erupts from deep within Earth.