Unit 4: Earth's Structure

Content Area: **Science**
Course(s): **Science**
Time Period: **Marking Period 3**
Length: **8-10 Weeks**
Status: **Published**

Unit Overview

This unit will help students formulate answers the questions: "How do the materials in and on Earth's crust change over time?", "How do people figure out that Earth and life on Earth have changed over time?", and "How does the movement of tectonic plates impact the surface of Earth?". Students will understand how Earth's geosystems operate by modeling the flow of energy and the cycling of matter within and among different systems. Additionally, students will investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Important concepts in this unit are scale, proportion, and quantity and stability and change, in relation to the different ways geologic processes operate over the long expanse of geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth's systems.

Performance Expectations

MS-ESS1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6-billion-year-old history.
MS-ESS2-1	Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.
MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.
MS-ESS2-3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
MS-ESS2-4	Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.
MS-ESS3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Three Dimensions

Science and Engineering Practices

Developing and Using Models

Modeling in 6-8 builds on K-5 experiences and progreses 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. (MS-ESS2-1)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

Analyzing and Interpreting Data

Analyzing data 6-8 builds on K-5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4), (MS-ESS2-2), (MS-ESS3-1)

Scientific Knowledge Is Open to Revision in Light of New Evidence

- Science findings are frequently revised and/or reinterpreted on new evidence. (MS-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

- The geologic timescale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)
- Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. (MS-ESS2-3)

ESS2.A: Earth's Materials and Systems

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and the matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water's movements - both on land and underground - cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

ESS3.A: Natural Resources

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past

geologic processes. (MS-ESS3-1)

Crosscutting Concepts

Patterns

- Patterns in rates of change and other numerical relationships can provide information about natural systmes. (MS-ESS2-3)

Scale Proportion and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4), (MS-ESS2-2)

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1)

Energy and Matter

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1)

Knowledge, Skills, and Assessment

Essential Insights and Understandings/Guiding Questions	Critical Knowledge and Skills	Recomn
What is the structure of Earth?	The Earth system has four main spheres: the atmosphere, the hydrosphere, the geosphere, and the biosphere. As a major source of energy for Earth processes, the sun can be considered part of the Earth system as well. Lands are constantly being created and destroyed by competing forces. Constructive forces shape the land's surface by building up mountains and other landmasses. Destructive forces destroy and wear away landmasses through processes like erosion and weathering.	**Activity**: Mode modeling activ questions (1) H by the wind aff (2) How does t erosion on Eart
	Skill: SWBAT... • **Identify and describe the main components of the Earth system.** • **Summarize the effects of constructive and destructive forces.**	**Activity:** Mode Through an int able to recogni
	Geologists have used two main types of evidence to learn about Earth's interior: direct evidence from rock samples and indirect evidence from seismic waves. The deeper down inside Earth, the greater the pressure. The temperature inside Earth increases as depth increases. The three main layers of Earth are the crust, the mantle, and the core. The crust is a layer of solid rock that includes dry land and ocean floor. The mantle is about 3,000 km thick and is made of very hot, solid rock. The core is mostly iron and nickel. It consists of a liquid outer core and a	**Assessment:** T of data, student them or draw a scientific vocal **Activity:** Mode convection cur lithospheric pla students will be are convection

	solid inner core. **Skill: SWBAT...** • **Explain how geologists learn about Earth's inner structures.** • **Identify the characteristics of Earth's crust, mantle, and core, and describe how temperature and pressure change inside Earth.**	
	There are three types of heat transfer: radiation, convection, and conduction. Heating and cooling of fluid, changes in the fluid's density, and the force of gravity combine to set convection currents in motion. Heat from the core and the mantle itself causes convection currents in the mantle. **Skill: SWBAT...** • **Explain how heat is transferred.** • **Describe convection currents in Earth's mantle.**	
How do rocks form?	To study a rock sample, geologists observe the rock's mineral composition, color, and texture. Geologists have classified rocks into three major groups: igneous rock, sedimentary rock, and metamorphic rock. **Skill: SWBAT...** • **List the characteristics used to identify rocks, and identify the three major groups of rocks.**	**Activity:** Mod interactive mo rock cycle has move linearly t
	Forces deep inside Earth and at the surface produce a slow cycle that builds, destroys, and changes the rocks in the crust. **Skill: SWBAT...** • **Explain the rock cycle.**	
How do moving plates change Earth's crust?	Wegener's hypothesis was that all the continents were once joined together in a single landmass and have since drifted apart. **Skill: SWBAT...** • **Explain Alfred Wegener's hypothesis about the continents.**	**Assessment**: A imagine the ye They must try findings of plat **Activity:** Mapp examples used drift are given

	Mid-ocean ridges form long chains of mountains that rise up from the ocean floor. Magnetic poles that are unlike attract each other, and magnetic pols that are alike repel each other. Magnetic field lines spread out from one pole, curve around the magnet, and return to the other pole. Like a bar magnet, Earth has a magnetic field around it and two magnetic poles. Sea-floor spreading adds more crust to the ocean floor. At the same time, older strips of rock move outward from either side of the ridge. In a process taking tens of millions of years, part of the ocean floor sinks back into the mantle at deep-ocean trenches. **Skill: SWBAT...** • **Define and describe mid-ocean ridges.** • **Explain how magnetic poles interact.** • **Describe a magnetic field.** • **Describe Earth's magnetic field.** • **Explain how sea-floor spreading affects Earth's crust.** • **Explain deep-ocean trenches and the process of subduction.**	the map of Pan **Activity**: Mod demonstrate th boundary as w as you approac the mirror imag rocks on either
	The theory of plate tectonics states that Earth's plates are in slow, constant motion, driven by convection currents in the mantle. **Skill: SWBAT...** • **Explain the theory plate tectonics.**	
Why do earthquakes occur more often in some places than in others?	Tension, compression, and shearing work over millions of years to change the shape and volume of rock. When enough stress builds up in rock, the rock breaks, creating a fault. Plate movement can change a fault. Plate movement can change a flat plain into features such as folds, folded mountains, fault-block mountains, and plateaus. **Skill: SWBAT...** • **Explain how stress in the crust changes Earth's surface.** • **Describe the three major types of faults.** • **Compare and contrast the land features that result from plate movement.** Seismic waves carry energy produced by an earthquake. The	**Activity:** Mod information ab students will ca show understar **Activity:** Mod a modeling act direction, and b scientists about **Assessment:** L data from three between P and determine the d vs. time graph.

	amount of earthquake damage or shaking that is felt is rated using the Modified Mercalli scale. An earthquake's magnitude, or size, is measured using the Richter scale or moment magnitude scale. Geologists use seismic waves to locate an earthquake's epicenter. **Skill: SWBAT...** • **Describe how the energy of an earthquake travels through Earth.** • **Identify the scales used to measure the strength of an earthquake.** • **Explain how scientists locate the epicenter of an earthquake.**	**Activity:** Inter the height of p the measureme **Activity:** Mapp Students will a on a map, with Ring of Fire.
	Seismic waves cause a simple seismograph's drum to vibrate, which in turn causes a pen to record the drum's vibrations. From past seismographic data, geologists have created maps of where earthquakes occur around the world. The maps show that earthquakes often occur along plate boundaries. **Skill: SWBAT...** • **Explain how seismographs work.** • **Explain the patterns that seismographic data reveal.**	
How does a volcano erupt?	Volcanic belts form along the boundaries of Earth's plates. A volcano forms above a hot spot when magma erupts through the crust and reaches the surface. **Skill: SWBAT...** • **Identify where volcanic regions and hot spot volcanoes are found on Earth's surface, and why they are found there.**	**Activity:** Type students are int focusing on wh explosive, and volcanoes acro **Activity:** Mapp Students will a a map, with the of Fire.
	When a volcano erupts, the force of the expanding gases pushes magma from the magma chamber through the pipe until it flows or explodes out of the vent. Geologists classify volcanic eruptions as quiet or explosive. Geologists often use the terms active, dormant, or extinct to describe a volcano's stage of activity. **Skill: SWBAT...** • **Explain what happens when a volcano erupts and the two different types of eruptions that can occur.**	

	• **Describe the stages of volcanic activity.**	
	Volcanic eruptions create landforms made of lava, ash, and other materials. These landforms include shield volcanoes, cinder cone volcanoes, composite volcanoes, and lava plateaus. Other landforms include calderas, or the huge holes left by the collapse of volcanoes. Features formed by magma include volcanic necks, dikes, and sills, as well as dome mountains and batholiths. **Skill: SWBAT...** • **List the landforms that lava and ash create.** • **Explain how magma that hardens beneath Earth's surface creates landforms.**	
How do scientists study Earth's past?	Most fossils form when sediment hardens into rock, preserving the shapes of organisms. Fossils include molds, casts, petrified fossils, carbon films, trace fossils, and preserved remains. Fossils provide evidence about Earth's history. **Skill: SWBAT...** • **Explain how fossils form.** • **Identify the different kinds of fossils.** • **Describe what fossils tell about organisms and environments of the past.**	**Activity**: Class classify differe scientists can l **Activity:** Argu fuels - Humans the three main Students will r “best” for hum
	The three major fossil fuels are coal, oil, and natural gas. Since fossil fuels take hundreds of millions of years to form, they are considered nonrenewable resources. **Skill: SWBAT...** • **Name the three main fossil fuels.** • **Explain why fossil fuels are considered nonrenewable resources.**	**Activity:** Dete clues from igne activity student and understand relative age of existed to prod use of index fo geologic histor
	In horizontal sedimentary rock layers, oldest layer is generally at the bottom. Each layer is layer is younger than the layers below it. Gaps in the geologic record and folding can change the position in which rock layers appear. **Skill: SWBAT...** • **Describe how geologists determine the relative age of rocks.**	**Activity**: Interp will explore ex order of life on

- **Explain how unconformities and folding can alter the order of rock layers.**

Because the time span of Earth's past is so great, geologists use the geologic time scale to show Earth's history.

Skill: SWBAT...

- **Establish how and why the geologic time scale is used to show Earth's history.**

During the Paleozoic Era, a great number of different organisms evolved. Reptiles spread widely during the Mesozoic Era. During the Cenozoic Era, mammals evolved to live in the many different environments.

Skill: SWBAT...

- **Discuss the major events in the Paleozoic Era.**
- **Discuss the major events in the Mesozoic Era.**
- **Discuss the major events in the Cenozoic Era.**

Suggested Resources

ck12.org

Earth's Layers

- http://www.ck12.org/earth-science/Earths-Layers/

Earth's Outer Layers

- http://www.ck12.org/earth-science/Earths-Outer-Layers/

Earth's Inner Layers

- http://www.ck12.org/earth-science/Earths-Inner-Layers/

Convection

- http://www.ck12.org/physics/Convection/

Rocks and Processes of the Rock Cycle

- http://www.ck12.org/earth-science/Rocks-and-Processes-of-the-Rock-Cycle/

Continental Drift

- http://www.ck12.org/earth-science/Continental-Drift/

Seafloor Spreading Hypothesis

- http://www.ck12.org/earth-science/Seafloor-Spreading-Hypothesis/

Plate Tectonics

- http://www.ck12.org/earth-science/Theory-of-Plate-Tectonics/lecture/Plate-Tectonics/
- http://www.ck12.org/section/Plate-Tectonics-%3A%3Aof%3A%3A-MS-Plate-Tectonics-Assessments-%3A%3Aof%3A%3A-CK-12-Earth-Science-For-Middle-School-Quizzes-and-Tests/

Earthquakes

- http://www.ck12.org/section/Earthquakes-%3A%3Aof%3A%3A-MS-Earthquakes-Assessments-%3A%3Aof%3A%3A-CK-12-Earth-Science-For-Middle-School-Quizzes-and-Tests/

Earthquakes at Convergent Plate Boundaries

- http://www.ck12.org/earth-science/Earthquakes-at-Convergent-Plate-Boundaries/

Earthquakes at Transform Plate Boundaries

- http://www.ck12.org/earth-science/Earthquakes-at-Transform-Plate-Boundaries/

Locating Earthquake Epicenters

- http://www.ck12.org/earth-science/Locating-Earthquake-Epicenters/

Volcano Characteristics

- http://www.ck12.org/earth-science/Volcano-Characteristics/

Fossils

- http://www.ck12.org/biology/Fossils/

Fossil Fuel Formation

- http://www.ck12.org/earth-science/Fossil-Fuel-Formation/

Determining Relative Ages

- http://www.ck12.org/earth-science/Determining-Relative-Ages/

Geologic Time Scale

- http://www.ck12.org/earth-science/Geologic-Time-Scale/

Technology Integration

ck12 Flexbook

Chromebooks

iPads

Cellular Devices

Internet

SmartBoard

Differentiation

Differentiation for special education:

- General modifications may include:
  - Modifications & accommodations as listed in the student's IEP
  - Assign a peer to help keep student on task
  - Modified or reduced assignments
  - Reduce length of assignment for different mode of delivery
  - Increase one-to-one time
  - Working contract between you and student at risk
  - Prioritize tasks
  - Think in concrete terms and provide hands-on-tasks
  - Position student near helping peer or have quick access to teacher
  - Anticipate where needs will be
  - Break tests down in smaller increments
- Content specific modifications may include:
  - address misconceptions relating to earth's structure
  - pre-generated graphs
  - mathematical formulas provided
  - teach with visuals
  - scale models
  - lab demonstrations

Differentiation for ELL's:

- General modifications may include:
  - Strategy groups
  - Teacher conferences
  - Graphic organizers
  - Modification plan

    - Collaboration with ELL Teacher
- Content specific vocabulary important for ELL students to understand include: system, energy, atmosphere, geosphere, hydrosphere, biosphere, constructive force, destructive force, seismic wave, pressure, crust, basalt, granite, mantle, lithosphere, asthenosphere, outer core, inner core, radiation, convection, conduction, density, convection current, rock-forming mineral, grain, texture, igneous rock, sedimentary rock, metamorphic rock, rock cycle, continental drift, Pangaea, fossil, mid-ocean ridge, sea-floor spreading, deep-ocean trench, subduction, plate, divergent boundary, convergent boundary, transform boundary, plate tectonics, fault, rift valley, stress, tension, compression, shearing, normal fault, reverse fault, strike-slip fault, plateau, earthquake, focus, epicenter, P wave, S wave, surface wave, seismograph, Modified Mercalli scale, magnitude, Richter scale, moment magnitude scale, seismogram, volcano, magma, lava, Ring of Fire, island arc, hot spot, magma chamber, pipe, vent, lava flow, crater, silica, pyroclastic flow, dormant, extinct, caldera, cinder cone, composite volcano, shield volcano, volcanic neck, dike, sill, batholith, fossil, mold, cast, petrified fossil, carbon film, trace fossil, paleontologist, evolution, extinct, relative age, absolute age, law of superposition, extrusion, intrusion, fault, index fossil, unconformity, geologic time scale, era, period, fuel, fossil fuel, petroleum

Differentiation to extend learning for gifted students may include:

- **Human Impact** Brainstorm a list of what impact the increase in the amount of paved land has on the spheres of the Earth system, then research to add to and refine the list.
- **Signs** Devise a simple system of hand signals for *constructive forces* and *destructive forces* and explain why each sign represents that particular concept.
- **Xenolith and Xenocryst** Research the terms xenolith and xenocryst and how these materials reach Earth's surface and what can be learned about Earth's interior from them.
- **Magnetic Field and Aurorae** Research what aurorae are, how they are related to Earth's magnetic field, and when and where they are visible.
- **Texture Hunt** Locate rocks used as building materials around the school and describe the textures of the rocks observed.
- **Rock-Forming Minerals** Research the 20 rock-forming minerals and connect each mineral to the name of the rock in which it commonly occurs.
- **Create Sequence Drawings** Create sequence drawings that illustrate the various products and processes in the rock cycle.
- **Travel Log** Students will imagine they are exploring the ocean floor in a deep-ocean vessel then write a travel log describing what they see on the ocean floor, including both a mid-ocean ridge and deep-ocean trench.
- **Rift Valleys** Research more about the rift valleys in East Africa and Iceland to find out how these valleys are alike and different.
- **Appalachian Mountains** Research the geologic history of the Appalachians, along with how long this mountain system is and the names given to various sections of it.
- **Kaibab Plateau** Research the geologic history of the Kaibab Plateau, including information about the elevation and area of it.
- **The Denali Fault Earthquake** Research the Denali Faulth Earthquake, one of the largest ever recorded in the US, to find out some of the local and distant effects of the earthquake.
- **Earthquake Timeline** Investigate the ten largest earthquakes ever recorded around the world and find out if whether scientists know what cause each earthquake.
- **Locate a Seismograph** Students will research if they live near a seimograph's location.
- **New Madrid Fault** Research the New Madrid Fault and write about the earthquakes that occurred along this fault in 1811 and 1812.

- **Hot Spots** Research the different points of view regarding the characteristics of hot spots and the volcanic activity that occurs there.
- **Research Gases** Research the different types and relative abundances of gases that occur in magma and summarize what was learned.
- **Magma Viscosity** Research what viscosity is and which SI unit is used to measure it, then research and make a table showing the viscosities of common substances and different kinds of magma.
- **Predict Eruptions** How might geologist predict volcanic eruptions? Research to see if the inferences and answers were correct.
- **Illustrate Laccoliths** Research to learn about laccolith and draw a cross section illustrating its features.
- **The La Brea Tar Pits** Research the preserved remains discovered in the La Brea tar pits of Los Angeles.
- **Illustrate Burning Fossil Fuels** Create a detailed illustration of the process of burning fossil fuels.
- **Research Crude Oil Refining** Using reference materials, students will learn the basic processes involved in refining oil.
- **Research Pipelines** Use online sources to discover where most natural gas pipelines are located in the United States and how much natural gas moves through US pipelines each day.
- **Create a Timeline of Ice Ages** Research Earth's ice ages and create a timeline, noting the length of each ice age and some of the animal life that characterized each ice age.
- **Compare *Archaeopteryx* to Present-Day Birds** Using online resources, compare a bird skeleton with a dinosaur skeleton and research why many paleontologists think birds evolved from dinosaurs.

21st Century Skills

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.