Unit 4: Dynamic Earth

Content Area: **Template**
Course(s):
Time Period:
Length:
Status: **Published**

State Mandated Topics Addressed in this Unit

This unit aligns with the following NJ Student Learning Standards for Science (NJSLS-S) and supports geologic classification, modeling, and analysis:

NJSLS-S Performance Expectations:

- **HS-ESS2-1**: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- **HS-ESS2-3**: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- **HS-ESS1-5**: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- **HS-ESS1-6**: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

Integrated Mathematics Standards (NJSLS-M):

- **A-CED.A.2**: Create equations in two or more variables to represent relationships between quantities.
- **F-IF.C.7**: Graph functions expressed symbolically and show key features of the graph.

Science & Engineering Practices (SEPs):

- SEP 2: Developing and Using Models
- SEP 4: Analyzing and Interpreting Data
- SEP 6: Constructing Explanations and Designing Solutions
- SEP 7: Engaging in Argument from Evidence
- SEP 8: Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts:

- Stability and Change
- Energy and Matter
- Scale, Proportion, and Quantity
- Systems and System Models

These standards support instructional objectives including:

- Classifying minerals and identifying diagnostic properties
- Modeling the rock cycle across geologic settings
- Interpreting rock strata to determine geologic history
- Describing rock transformations driven by internal and surface processes
- Evaluating the use of Earth materials in technology and infrastructure
- Constructing scientific explanations of geologic phenomena using evidence

Unit Summary

In this unit, students will engage in an advanced exploration of Earth's compositional structure by analyzing the origin, classification, and transformation of minerals and rocks. Integrating concepts from chemistry, physics, and geoscience, students will investigate how internal and surface processes—including plate tectonics, thermal convection, weathering, and erosion—affect the formation and reformation of igneous, sedimentary, metamorphic, and transitional rock types. Through data-driven inquiry and model-based reasoning, students will evaluate how mineral properties reflect atomic structure and environmental conditions, and how rock characteristics serve as records of Earth's geologic activity and evolutionary history. Real-world applications of rocks and minerals in industry, construction, and resource management will be examined alongside sustainability challenges. Emphasis will be placed on using scientific models and geospatial tools to simulate the cycling of matter within Earth's systems. This unit directly supports NJSLS-S performance expectations and builds foundational competencies in systems thinking, quantitative analysis, and Earth system modeling.

Essential Questions

- How can geologic evidence from mountain belts and ocean basins be used to reconstruct past supercontinents?
- How can understanding plate tectonics inform the development of early-warning systems and engineering solutions in high-risk areas?
- How do convergent, divergent, and transform boundaries differ in the structures and hazards they produce?
- How do earthquakes form?
- How do internal and external processes shape landforms over time?
- How do scientists use models and data to predict geologic events?
- How do variations in mantle convection influence the speed and direction of tectonic plate

movement?

- How do volcanoes form?
- How does the analysis of seismic waves help scientists map Earth’s interior and understand tectonic processes?
- How does the interaction between plate tectonics and climate over geologic time influence planetary evolution?
- How does the theory of plate tectonics explain the movement of Earth’s crust?
- In what ways do earthquakes and volcanic eruptions impact human populations and infrastructure?
- In what ways does the theory of plate tectonics unify geological phenomena across Earth's history and geography?
- What causes mountains to form?
- What do volcanic island chains tell us about plate tectonics?
- What evidence supports the idea that Earth’s surface is constantly changing?
- What happens at plate boundaries?
- What is the relationship between hotspots, mantle plumes, and intraplate volcanism, and how does it challenge simple boundary-based models?
- Why are some regions more geologically active than others?

Objectives

- Analyze satellite imagery and seismic data to locate and assess areas of tectonic activity.
- Analyze the role of supercontinents in shaping Earth’s tectonic and climatic history
- Apply geophysical and geochemical data to assess volcanic eruption risks and fault dynamics
- Compare and contrast earthquake magnitude and intensity and the scales to measure each
- Correlate the depth and location of earthquake epicenters with plate boundaries and subduction zones.
- Describe how a seismometer works
- Describe how Earth’s crust responds to the addition and removal of mass
- Describe how Earth’s tectonic plates result in many geologic features
- Describe how plate tectonics influences the formation of volcanism
- Describe how stress builds and is released along faults, and how this process causes earthquakes.
- Design models or simulations to test variables influencing plate boundary interactions
- Discuss what continental drift is and why it was not accepted at first as a theory
- Distinguish among the three types of movements of faults
- Distinguish between the three types of plate boundaries and the geologic activity associated with each.
- Evaluate evidence supporting the theory of plate tectonics (e.g., fossil distribution, rock strata, GPS data).
- Evaluate the role of tectonics in the long-term carbon cycle and its implications for climate regulation
- Explain how magma type influences volcanic activity
- Explain how plate tectonics contributes to the formation and movement of ocean basins.
- Explain the process of convection

- Identify the major part of a volcano
- Interpret topographic and geologic maps to identify tectonic activity and features.
- Investigate feedback loops between tectonic uplift, erosion, and sedimentation
- Investigate how human populations are impacted by geologic hazards such as earthquakes, tsunamis, and volcanic eruptions.
- Summarize the evidence that the seafloor is spreading
- Synthesize data from multiple sources (satellite, field, historical) to predict tectonic trends and hazards
- Use models to demonstrate how convection currents drive lithospheric plate movement.

Standards

SCI.HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
SCI.HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
SCI.HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Instructional Tasks/Activities

- Absolute age vs Relative age assignment
- Board Game Presentation
- Common assessment chapter test
- Common assessment quiz
- Constructed response
- Do nows and/or exit slips
- Early Earth Notes/Questions/Activity
- Earthquake data and plates
- Exit Cards (answer to daily objective questions)
- Fossil Notes and Questions
- Fossil Research Assignment
- Fossil Research Project
- Geologic features identification
- Graphic organizers or models
- Guided practice
- Homework
- Hotspot Research and Data Analysis
- Individual, small, and large group work
- Intro to Geology (Big Picture)
- Laboratory investigations within small groups

- Midterm
- Midterm review day 1 scientific measurements
- Midterm review day 2 meteorology, atmosphere, climate
- Midterm review day 3 minerology, rocks, and geology
- Plate Boundary Research/assignment
- Plate Tectonics Research Project
- Relative age and Hotspots
- Section Review Questions
- Superposition and Original Horizontality Practice
- Vocabulary flash cards or map (word, picture, sentence, example)
- Volcanic Island Board Game Creation

Assessment Procedure

- Flashcards and/or drill and practice
- Inquiry based activities with reflective discussion
- Laboratory groups
- Lecture with note taking or guided notes
- Online models and simulators
- Power point presentations
- Whole and small group discussions

Recommended Technology Activities

- Appropriate Content Specific Online Resource
- Chromebook
- Copy/Paste Content Specific Link Here
- Copy/Paste Content Specific Link Here
- Copy/Paste Content Specific Link Here
- Gimkit
- GoGuardian
- Google Classroom
- Google Docs
- Google Forms
- Google Slides
- Kahoot
- MagicSchool AI
- Other- Specified in Lesson
- Quiziz

- Screencastify

Accommodations & Modifications & Differentiation

Accommodations and Modifications should be used to meet individual needs. Their IEP and 504 plans should be used in addition to the following suggestions.

Gifted and Talented

- Compare & Contrast
- Conferencing
- Debates
- Jigsaw
- Peer Partner Learning
- Problem Solving
- Structured Controversy
- Think, Pair, Share
- Tutorial Groups

Instruction/Materials

- alter format of materials (type/highlight, etc.)
- color code materials
- eliminate answers
- extended time
- extended time
- large print
- modified quiz
- modified test
- Modify Assignments as Needed
- Modify/Repeat/Model directions
- necessary assignments only
- Other (specify in plans)
- other- named in lesson
- provide assistance and cues for transitions
- provide daily assignment list
- read class materials orally
- reduce work load

- shorten assignments
- study guide/outline
- utilize multi-sensory modes to reinforce instruction

Environment

- alter physical room environment
- assign peer tutors/work buddies/note takers
- assign preferential seating
- individualized instruction/small group
- modify student schedule (Describe)
- other- please specify in plans
- provide desktop list/formula

Honors Modifications

Resources

- Resource 1
- Resource 2
- Resource 3
- Resource 4
- Resource 5