Unit 3: Composition of 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 conduct an in-depth analysis of Earth's geologic materials and processes. They will examine the origin, composition, and transformation of minerals and rocks—igneous, sedimentary, metamorphic, and transitional types—through the lens of chemistry, physics, and Earth systems science. This unit emphasizes how mineral and rock properties reflect internal and surface Earth processes, enabling scientists to reconstruct the planet's dynamic history. Students will integrate knowledge of plate tectonics, weathering, erosion, and the rock cycle to model Earth's continual evolution. A focus will also be placed on the role of geologic resources in modern society, challenging the misconception that Earth's surface has remained static since its formation. Honors students will apply scientific modeling, quantitative data analysis, and critical evaluation of geoscientific evidence to draw conclusions about planetary processes and resource sustainability.

Essential Questions

- Do preexisting rocks change form?
- How are igneous rocks formed?
- How are minerals used in everyday life?
- How can studying Earth's composition help predict natural disasters or resource availability?
- How can the properties of rocks and minerals help us interpret Earth's geologic history?
- How can the study of Earth's crust contribute to sustainable resource extraction and environmental stewardship?
- How do atomic structure and chemical bonding determine mineral properties?
- How do Earth's internal energy sources drive the formation of igneous, metamorphic, and sedimentary rocks?
- How do geologic maps and cross-sections help scientists reconstruct past tectonic and depositional

events?

- How do geologic processes recycle and transform Earth's materials over time?
- How does the rock cycle model Earth’s dynamic nature?
- In what ways do rock textures and mineral assemblages reveal their formation environment and history?
- What are the processes that form sedimentary and metamorphic rocks?
- What evidence supports the theory that Earth's surface is constantly changing?
- What role do plate tectonics and geochemical cycles play in the distribution of Earth’s resources?
- Why is mineral identification important in geology and industry?

Objectives

- Analyze geologic maps and cross sections to interpret geologic structures and reconstruct geologic history.
- Analyze sediment transport, deposition, and lithification to model sedimentary rock formation.
- Analyze the atomic structure and bonding of minerals to explain their physical and chemical properties.
- Apply isotopic and radiometric data to estimate rock and mineral ages and to support Earth history models.
- Apply plate tectonic theory to explain mineral resource distribution and geologic hazards.
- Assess the practical and economic uses of igneous rocks in construction, technology, and resource extraction.
- Classify igneous rocks using detailed textural, compositional, and geochemical criteria.
- Compare depositional environments through analysis of rock strata and fossil content.
- Conduct advanced mineral identification using a suite of diagnostic tools and field/lab techniques.
- Correlate mineral composition with geologic environments by analyzing phase diagrams and chemical data.
- Critically compare Earth's rock-forming processes with those of other planetary bodies using remote sensing data.
- Debate the environmental and ethical implications of mineral and resource extraction using scientific evidence.
- Design and conduct field investigations to identify rock types and analyze spatial relationships in outcrops.
- Differentiate between crystal systems and mineral classifications based on diagnostic tests (e.g., Mohs hardness, streak, cleavage, reactivity).
- Distinguish between types of metamorphism and correlate with specific tectonic environments.
- Evaluate textural and mineralogical changes in metamorphic rocks to infer pressure-temperature conditions.
- Evaluate the formation processes of minerals in various geologic settings using data from mineral composition and occurrence.
- Evaluate the stability and durability of different rock types for use in engineering and construction applications.
- Interpret geochemical data to infer tectonic settings and rock formation histories.

- Investigate the origin and differentiation of magma and its relationship to igneous rock diversity.
- Model the rock cycle using systems thinking to illustrate energy and matter flow within Earth's crust and mantle.
- Synthesize data and construct scientific arguments related to the origin, transformation, and utility of Earth's geologic materials.
- Synthesize knowledge of Earth's internal heat and pressure systems to explain metamorphic facies and mineral stability fields.
- Use GIS or geological mapping tools to analyze the spatial distribution of minerals and geologic features.

Standards

SCI.HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
9-12.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.
9-12.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.
9-12.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.

Instructional Tasks/Activities

- Common assessment chapter test
- Common assessment quiz
- Constructed response
- Do nows and/or exit slips
- Exit Cards (answer to daily objective questions)
- Graphic organizers or models
- Guided practice
- Homework
- Homework
- Individual, small, and large group work
- Laboratory investigations within small groups
- Mineral Identification Lab
- Mineral Project
- Mineral use article
- Review Activity
- Rock Identification lab
- Rock Identification Lab Conclusions
- Section Review Questions
- Study Guide Packets

- Types of rocks research
- Vocabulary flash cards or map (word, picture, sentence, example)

Assessment Procedure

- Classroom Total Participation Technique
- Classwork
- DBQ
- Essay
- Exit Ticket/Entrance Ticket/Do Now
- Journal / Student Reflection
- Kahoot
- Other named in lesson
- Peer Review
- Performance
- Problem Correction
- Project
- Quiz
- Rubric
- Teacher Collected Data
- Test
- Worksheet

Recommended Technology Activities

- 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

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