Desired Results: Students will integrate disciplinary knowledge with scientific practices to explain and model how Earth's internal structure, energy flow, and system interactions shape its dynamic surface over different spatial and temporal scales.

Title of Unit: *Our Changing Planet*

Enduring Understandings

1. The Earth's crust is solid at the surface, even though its materials (like magma) originate deep underground.
2. Internal and external Earth processes operate across varying scales in time and space to shape geological features.
3. Earth's interior materials and energy constantly cycle through rock types and Earth layers.
4. The geosphere, biosphere, hydrosphere, and atmosphere interact continuously to drive surface change.
5. The Earth's crust is solid at the surface, even though its materials (like magma) originate deep underground.
6. Internal and external Earth processes operate across varying scales in time and space to shape geological features.
7. Earth's interior materials and energy constantly cycle through rock types and Earth layers.
8. The geosphere, biosphere, hydrosphere, and atmosphere interact continuously to drive surface change.

Essential Questions

1. *Why does Earth's surface appear solid when its deeper layers are molten?*
2. *How do processes like volcanism, tectonics, and erosion shape continents and ocean floors over time?*
3. *What mechanisms drive the cycling of Earth's materials through different layers and forms?*
4. *How do living systems, water, air, and rock interact to produce dynamic surface conditions?*

Guiding Questions

1. *What are Earth's main layers, and where is molten material located?*
2. *How do molten materials become solid crust?*
3. *How do tectonic plates move and shape Earth's surface?*
4. *How do these types of crust differ in composition and behavior?*
5. *What mechanisms transfer heat inside Earth?*
6. *How do materials move and transform through Earth's systems?*
7. *In what ways do Earth's spheres influence surface geology and ecosystems?*
8. *How do external processes degrade and reshape the crust?*

Knowledge

- Describe the structure and composition of the Earth's crust, mantle, and core.
- Explain why Earth's crust is solid despite molten materials in the mantle.
- Identify the role of heat and pressure in producing igneous rocks.
- Identify major continental and oceanic features (mountain ranges, trenches, ridges).
- Explain how plate boundaries create different landforms.
- Distinguish between rapid (earthquakes, eruptions) and slow (mountain building, erosion) processes.
- Describe the rock cycle and pathways between rock types.
- Explain how heat from Earth's interior drives mantle convection and recycling of crust.
- Link tectonic activity to material cycling.
- Explain how the geosphere interacts with the atmosphere, biosphere, and hydrosphere.
- Provide examples of how these interactions shape the surface (e.g., glacial erosion, volcanic soil fertility).
- Describe feedback loops between Earth's systems.

Skills

- Formulate testable questions about Earth's internal structure and processes.
- Refine questions using geological data and system interaction examples.
- Create annotated models of Earth's layers, plate boundaries, and the rock cycle.
- Use digital simulations to test how different forces shape features over time.
- Conduct lab activities modeling convection currents and rock formation.
- Investigate rock samples to classify types and infer origin.
- Analyze seismic wave data to infer Earth's internal structure.
- Compare geologic feature maps to plate tectonic boundaries.
- Calculate rates of plate movement using data from GPS measurements.
- Use scale conversions to model Earth's layers accurately.
- Construct evidence-based explanations for how internal and external processes shape the Earth.
- Explain how Earth's systems interact to form and alter landforms.
- Debate the relative impact of internal vs. external processes on Earth's features.
- Defend claims about system interactions with case study evidence.
- Summarize and communicate findings from scientific articles on volcanic activity, earthquakes, or climate impacts on geology.
- Create presentations that synthesize multiple sources into coherent explanations.

Standards HS-ESS1-5, HS-ESS2-1, HS-ESS2-3, HS-ESS3-1

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. [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).]

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. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.]

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

Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.]

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea lev el, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

Assessment Evidence

Students will demonstrate their knowledge throughout the unit through the following:

Formative:

- Frequent feedback provided by checking student work and allowing them opportunity to clarify and correct
- Discussions during activities, questioning by teacher

Summative

- Unit Test Our Changing Planet
- Performance Task:

Learning Plan

Learning Activities

- Plotting Volcanoes and Earthquakes
- Investigating Tectonic Boundaries
- Investigating Earth's Interior using P and S Waves
- Real World Plate Tectonics
- Age of the Ocean Floor
- Mapping the Sea Floor and Discovering Magnetism
- Population of Canada

Resources