Tectonic Fury:
Unlocking Earth's Geologic Mysteries

Investigate Earth's past, present, and future to unlock its geologic mysteries and explore the constructive and destructive forces that have created the features we see today on land and underwater. Includes connections to engineering design and math with STEM Professionals:

Mike Wise, Geologist The Smithsonian Institute
Virginia Dale, Director, Center for BioEnergy Sustainability Oak Ridge National Laboratories
George Guthrie, Focus Area Leader for Geosciences NETL
Walter Smith, Geophysicist NOAA

- ***Mission 1: The Building Blocks - Earth's Rock and Minerals***
- ***Mission 2: Our Planet's Changing Face - Erosion, Weathering, and Soils***
- ***Mission 3: Piecing Together the Evidence - Dating, Fossils, and Geologic Time***
- ***Mission 4: Earth on the Move - Plate Tectonics, Earthquakes, and Volcanoes***

Cross-Curricular Connections

Reading & Writing for Technical Subjects:

LST.1: Read and comprehend science and technical texts independently and proficiently and write effectively for a variety of discipline-specific tasks, purposes, and audiences
LST.2:Extract and construct meaning from science and technical texts using a variety of comprehension skills
LST.2.2: Determine the central ideas or conclusions of a text; provide an accurate, objective summary of the text.
LST.2.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
LST.3.1: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to texts and topics.
LST.4.1: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LST.7.1: Conduct short research assignments and tasks to answer a question (including a self generated question), or test a hypothesis, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Literature Selections: *Over Sea Under Stone by Susan Cooper, Out of the Dust by Karen Hess, Storm Warriors by Elisa Carbone, Journey to the Center of the Earth by Jules Vern, Into the Volcano by Don A. Wood, Troubling a Star by madeleine L'Engle, The Highest Tide by Jim Lynch*

Math: Analyzing Data, Algebraic Problem Solving, Using Ratios, Creating and Analyzing Graphs, Unit Conversions, Number Sense

Social Studies: Geography, Global Change, Innovations- Supercomputers, History of Earth, Ancient Civilizations, Culture

Art: Mold and Cast Fossils

Grades 3-5 Science Content & Engineering Standards

3.ESS.3 Observe the detailed characteristics of rocks and minerals. Identify and classify rocks as being composed of different combinations of minerals. (Mission 1)
3.ESS.4 Determine how fossils are formed, discovered, layered over time, and used to provide evidence of the organisms and the environments in which they lived long ago. (Mission 3)
4.ESS.3 Describe how geological forces change the shape of the land suddenly and over time. (Missions 1, 2, 3, 4)

5.ESS.4 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (Missions 1, 2, 3, 4)

Grades 6-8 Science Content & Engineering Standards

7.ESS.1 Identify and investigate the properties of minerals. Identify and classify a variety of rocks based on physical characteristics from their origin, and explain how they are related using the rock cycle. (i.e. Sedimentary, igneous, and metamorphic rocks) (Missions 1, 3, 4)
7.ESS.3 Using simulations or demonstrations, explain continental drift theory and how lithospheric (tectonic) plates have been and still are in constant motion resulting in the creation of landforms on the Earth's surface over time. (Missions 3, 4)
8.LS.8 Explore and predict the evolutionary relationships between species looking at the anatomical differences among modern organisms and fossil organisms. (Mission 3)

Grades 9-12 Science Content Standards

HS Earth Science
ES. 5.1: Construct a lab to analyze minerals based on their physical and chemical properties. Explain how rocks may contain many minerals, one mineral, or no minerals, and minerals can be made of either single elements (such as gold) or compounds (such as silicates). (Mission 1)
ES 5.2: Create a rock cycle flowchart or diagram that demonstrates the processes involved in the formation, breakdown, and reformation of igneous, sedimentary, and metamorphic rock. Show how each type can melt and reform igneous rock, undergo the various metamorphic processes, and undergo physical and chemical weathering to form sedimentary rock.ES 5.5: Create a timeline detailing the processes that have occurred in Indiana to create mostly sedimentary bedrock. Explain how changing sea levels, climate, and glaciation have shaped Indiana geology. (Missions 1, 2, 3, 4)
ES 5.3: Construct a model that demonstrates the difference between weathering, erosion, transportation of material, deposition, and new soil and sedimentary rock formation. Differentiate between types of physical and chemical weathering. Mission 2, 3)
ES 5.4: Differentiate between relative and absolute geologic time. Detail how sedimentary rock can be dated based on relative-age dating and positioning, while igneous formations can be radiometrically dated. Differentiate between radiocarbon dating used for organic materials and other types of radiometric dating for inorganic rock formation. (Mission 3)
ES 5.6 Create models or diagrams to show how plate movement and sea level changes have changed continental land masses over time. Include the creation and destruction of inland seas, sedimentary rock formations including evaporites and biochemical formations, and the shaping and destruction of surface features. (Mission 4)
ES 6.1: Construct a diagram or model that identifies and describes the physical and chemical properties of the crust, mantle, outer core, and inner core of Earth. (Missions 1, 2)
ES 6.2: Explain how Earth's fluid outer core creates the magnetosphere and how this helps protect both humans and technology (such as satellites) from solar winds. (Missions 1, 2)
ES 6.3: Construct a diagram and explanation showing the convection of Earth's mantle and its impact on the movements of tectonic plates. Explain how the decay of radioactive isotopes and residual energy from Earth's original formation provide the heat to fuel this convective process, which, along with ridge push and slab pull, drive the movements of tectonic plates. (Missions 3, 4)
ES. 6.4: Create a timeline to show the development of modern tectonic plate theory. Identify and explain how the evidence from the theory of continental drift, seafloor spreading, and paleomagnetism built upon each other to support tectonic plate theory. (Mission 3, 4)
ES. 6.5: Create models that demonstrate different types of orogeny resulting from plate tectonics. Show how the interactions between oceanic and continental plates create different geological features (such as volcanic island arcs or high altitude plateaus) depending on what types of plates are involved in the motions along different plate boundaries. (Mission 3, 4)
ES. 6.6: Create models and differentiate between shield, composite, and cinder cone volcanoes. Explain how volcanoes form, how the chemical composition of lava affects the type of volcanoes formed, and how the location (such as hot spots or along continental or oceanic margins) can affect the types of magma present. (Mission 4)
ES. 6.7: Use models, diagrams, and captions to explain how tectonic motion creates earthquakes and tsunamis. Using resources such as indianamap.org, analyze how close the school is to known faults and liquefaction potential. Differentiate between intraplate fault zones such as the Wabash Valley Fault System and the more commonly discussed faults along tectonic margins. Missions 3, 4)
HS Environmental Science
Env.8.3 Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter. (Mission 2)