Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

UNIT OVERVIEW

STAGE ONE: Identify Desired Results

Established Goals/Standards

2.1b
2.1j
2.1k
2.1l
2.1m
2.1n
2.1o
3.1a
3.1b

Long-Term Transfer Goal

At the end of this unit, students will use what they have learned to independently…
Apply their understanding of the concepts of Earth's uplifting forces to engage in argumentation using evidence as support to answer the question: Is Rochester, NY tectonically active and should we be concerned?

Meaning

Enduring Understandings

Students will understand that…

U1: Geologic time is vast and Earth has changed dramatically over various time periods.

U2. Variation in densities creates change in and on Earth

U3. Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.

U4. Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

U5. Rocks and minerals give clues to the past

U6. Maps, tables and scale models can be used to make predictions of geologic phenomena

Essential Questions

Students will consider such questions as…

How has Rochester changed throughout time and how do I know?

- How does variation in density create change in Rochester, NY?
- Why do I see what I see in Rochester?
- How does Rochester's rocks and minerals talk to me?
- How can maps help me see the future?

Acquisition

What knowledge will students learn as part of this unit?

1. The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's interior results in the formation of regions of different densities. These density differences result in motion.
2. Properties of Earth's internal structure (crust, mantle, inner core, and outer core) can be inferred

What skills will students learn as part of this unit?

1. Scholars will be able to use classification charts and scientific tools such as a glass plate, unglazed ceramic tile, and HCl to identify a variety of rocks and minerals.
2. Scholars will be able to use abstraction and symbolic representation of movement created by density differences

		from the analysis of the behavior of seismic waves (including velocity and refraction). 3. Analysis of seismic waves allows the determination of the location of earthquake epicenters, and the measurement of earthquake magnitude; this analysis leads to the inference that Earth's interior is composed of layers that differ in composition and states of matter. 4. The outward transfer of Earth's internal heat drives convective circulation in the mantle that moves the lithospheric plates comprising Earth's surface 5. The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system 6. These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges. 7. Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges. 8. Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness 9. Many processes of the rock cycle are consequences of plate dynamics. These include the production of magma (and subsequent igneous rock formation and contact metamorphism) at	3. Scholars will be able to read a seismograph and use the information to locate epicenters. 4. Scholars will be able to locate epicenters through the use of triangulation. 5. Scholars will be able to use models to represent and revise their thinking overtime. 6. Scholars will be able to make qualitative and quantitative observations 7. Scholars will discuss how technology plays a role in predicting natural disasters 8. Scholars will be able to use and create models as simplified representations of geologic phenomena 9. Scholars will be able to make predictions based on evidence 10. Scholars will ask questions based on observation and data 11. Scholars will identify patterns of change and use it to support claims made about Rochester's past and make predictions about future geologic phenomena 12. Scholars will use and become proficient with certain tables and diagrams in the Earth Science Reference Tables

		both subduction and rifting regions, regional metamorphism within subduction zones, and the creation of major depositional basins through down-warping of the crust. 10. Many of Earth's surface features such as mid-ocean ridges/rifts, trenches/subduction zones/island arcs, mountain ranges (folded, faulted, and volcanic), hot spots, and the magnetic and age patterns in surface bedrock are a consequence of forces associated with plate motion and interaction. 11. Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution. 12. Minerals have physical properties determined by their chemical composition and crystal structure. 13. Minerals can be identified by well-defined physical and chemical properties, such as cleavage, fracture, color, density, hardness, streak, luster, crystal shape, and reaction with acid. 14. Chemical composition and physical properties determine how minerals are used by humans. 15. Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include: • cooling and solidification of magma • precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes • rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure.	

		16. Rocks are usually composed of one or more minerals. 17. Rocks are classified by their origin, mineral content, and texture. 18. Conditions that existed when a rock formed can be inferred from the rock's mineral content and texture 19. The properties of rocks determine how they are used and also influence land usage by humans.	

STAGE TWO: Determine Acceptable Evidence	
	Assessment Evidence
Criteria for/to assess understanding: *(This is used to build the scoring tool.)* **1. Understanding of the mechanism causing earthquakes** **2. Ability to identify evidence that supports the explanation of why earthquakes are occurring** **3. Understanding of Rochester, NY's geologic history and how it plays a role in explaining why the earthquakes occur** **4. Ability to use plate tectonics map to compare and contrast where most earthquakes occur** **5. Creation of effective science explanation**	Performance Task focused on Transfer: For this performance task scholars will apply their understanding of the concepts around Earth's uplifting forces to determine if Rochester, NY is tectonically active. To do this scholars will analyze data around earthquakes that originated in New York over the summer of 2017. They will also analyze data around earthquakes originating at various other locations. Based on inferences made from the analyzed data, scholars will engage in argumentation on whether Rochester, NY is tectonically active and should we be concerned. Other Assessment Evidence: • Daily bridge activities • Daily summary narratives (Claim/Evidence/Connections Sheet) • Ticket out the door, daily closure questions • Daily reflective tool • Two formal NYS style assessments • Bi-weekly NYS style quiz • Academic circles held in class (Think, Pair, Share) • Gallery Walks • BBKs

(Claim, Evidence, Analysis of Evidence) 6. **Effective Communication**	

Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

Stage 3 – Learning Experiences

	What will the students do in this learning experience?	What is quality evidence of learning and criteria for success?
U1-6	**Day 1-Intro to Earth Science:** Students will be introduced to the idea of "what is Earth Science?" Students will rotate through various stations that will assess prior knowledge about Earth Science, make observations about the various components of Earth Science and make predictions about the direction of the year. Students will then generate a list of norms that they agree on as a class that will guide the year.	Students are able to make quality observations and predictions at the various stations and can summarize their understanding of thein a written. Students will generate a list of norms for the room that is posted.
U1, U6	**Day 2:** Geologic Time. How long has Rochester and the Earth been around? What has changed? Students are introduced to the concept of geologic time and will make a make a model of the geologic time period through "experiencing" the relative amount of time per given experience. This will be coupled with page 8-9 of the Earth Science Reference Table. This is where we will introduce the long term performance task.	Students create geologic timescale that is representative of the geologic timescale on pages 8-9 of the ESRT.
U2, U4, U6	**Day 3:** What does the Earth look like deep beneath our feet in Rochester and why? Students are introduced to the formation of Earth and its structure. Students will explore the concepts of density through making observations and predictions using the ESRT. Students will then make observations of various density demonstrations and compare this to density profile and heat graphs in the ESRT and explain how density impacts the structure of the interior of Earth.	Students are able to successfully answer questions applying the concepts of density in a new format of Earth Science regents questions as well as a written summary outlining the connection between density and the interior of the Earth.
u2, U6	**Day 4:** What does the Earth look like deep beneath our feet in Rochester and why? Students will explore Earth's interior through a stationed activity where they utilize the Earth Science Reference Table, read articles about the Earth's Interior and assess their own understanding.	Students are successfully able to answer questions that apply the concepts from the meaning making workshop into a more formal context (i.e. regents style questions and a written summary with key vocabulary that shows a consolidation of understanding).

Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

U2, U6	**Day 5:** How can we use math to better understand the interior of the Earth beneath our feet? Students generate a scale model of the interior of the Earth using information from page 10 on the ESRT. Students will be scaffolded on the math skill of using proportions to create accurate scale drawings. Students use this model to make observations and inferences about the Earth and its processes.	The completion of an accurate interior of the Earth that incorporates the understandings from the past two lessons (concepts of density, etc). Using their model, they also answer regents style questions that demonstrate near transfer.
U2, U3, U6	**Day 6:** Plate Tectonics: How has the Earth's crust and Rochester changed over time? Students analyze and compare and contrast the different plate boundaries (convergent, divergent and transform) and observe the different lines of evidence that plate tectonics is occurring through a series of stations.	Students are able to generate a written summary of the relationship between plate movement and convection process in the mantle and how it causes the Earth and Rochester to change over geologic time.
U2, U3, U6	**Day 7:** Focus on the mantle, crust and convection: The students focus in on the mantle and crust of their scale models of the Earth's Interior. They will explore convection cells through students participating in predict, observe, explain (POE) of four different models of convection. Students will then apply this understanding to convection cells in the mantle and movement of plates on the crust through analyzing various maps over geologic time time showing the motion of plates.	Students are able to generate a written summary of the relationship between plate movement and convection process in the mantle and how it causes the Earth and Rochester to change over geologic time.
U2, U6, U3, u4	**Day 8:** What happens when these plates collide? Students investigate the different densities of the crust (oceanic v. continental) and predict what happens when they collide using their understanding of density. Features and events are indicated in diagrams.	A complete diagram and description that represents what happens when plates collide.

Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

U6	**Day 8:** How can we use maps (latitude/longitude) to help locate and study specific places and plate boundaries on Earth's crust? Students will use the ESRT's plate tectonics map in concert with a latitude/longitude coordinates to locate and study various geologic processes on Earth's crust. This will include locating Rochester, NY and indicating if it is in fact on a plate boundary or on a continental shield for use later for the project.	Students are able to answer questions and locate specific places on a map using the latitude and longitude coordinate system.
U1, U, U3	**Day 9:** Where on Earth do earthquakes and volcanoes happen? Is Rochester and the United States at risk? Students use the skills of latitude and longitude to map out historic Earthquakes and volcanoes around the world. The students then compare this map to a reading on historic Earthquakes. They summarize their understanding of where Earthquakes typically occur around the world using both their maps and their reading.	A written summary describing the typical location on the crust of earthquakes and volcanoes around the world and a claim related to if the continental US and Rochester is at risk citing evidence from workshop and readings.
U2, U3, U6	**Day 10:** Do all plates collide? Students compare and contrast convergent plate boundaries and describe the different features and events at each (highlighting the depth of Earthquakes) through analysis of models and maps. Students also compare these observations to Rochester, NY.	A graphic organizer comparing and contrasting convergent and divergent plate boundaries that con
U3, U2	**Day 11:** How do hotspots and the hawaiian islands give clues to plate motion in the middle of a crustal plate? Students map the changing location of the Hawaiian hotspot through a lab activity. They compare this hotspot to the Yellowstone hotspot.	Students are able to make a claim based on their mapping that the continents are in fact moving and provide directionality to this movement.
U3, U5	**Day 12:** Students are introduced to volcanoes, lava, magma and igneous rocks through a short video. They then participate in a station activity where they investigate the properties of minerals that make up igneous rocks. They then summarize the various properties of minerals and make conclusion using the Mineral Identification Chart.	Students can successfully answer regents style questions on the properties of minerals that make up igneous rocks and successfully determine the properties of various minerals using the Mineral Identification Chart on the ESRT.

Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

U3, U5	**Day 13:** How do we identify mystery minerals? Students participate in a mineral identification lab. This identification lab utilizes the ESRT's Mineral Identification Chart. The students will identify three mystery minerals that make up igneous rocks	Students can successfully use the various identification tools to correctly identify the three mystery minerals.
U3, U5, U6	**Day 14:** What types of rocks do we find at divergent boundaries? Student participate in a lab where they use the Igneous Rock Identification Chart in the ESRT and several rock samples to determine the characteristics of rocks found at mid-ocean ridges and their mineral composition.	Students are successfully able to use the Igneous Rock Chart in the ESRT to identify the names and and describe the various properties of igneous rocks found at mid-ocean ridges.
U3, U5, U6	**Day 15:** What types of rocks do we find at convergent boundaries? Student participate in a lab where they use the Igneous Rock Identification Chart in the ESRT and several rock samples to determine the characteristics of rocks found at convergent boundaries and their mineral composition.	Students are successfully able to use the Igneous Rock Chart in the ESRT to identify the names and and describe the various properties of igneous rocks found at convergent boundaries.
U3, U5	**Day 16:** Igneous Rock ID Performance Assessment: Students apply their ability to use the ESRT and make observations of rocks to identify mystery Igneous Rocks and predict where they came from (convergent and divergent)	Students can successfully identify and source all igneous rocks.
U3, U6	**Day 17:** What happens to rocks and rock layers when continents collide? Students participate is a POE where they observe the way rock layers fold and fault when placed under extreme heat and pressure. The students then participate in a station activity where they compare folds and faults to Rochester, NY and formalize their understanding of the POEs.	Explanation of the POE using the formalized language acquired throughout the lesson.

Subject: Earth Science	Grade:10	Unit #: 1	Title: Uplifting Forces

U3, U5	**Day 18:** What types of rocks do we find in areas that undergo extreme heat and/or pressure? Students use diagrams, rock and the Metamorphic Chart in the ESRT to identify and describe metamorphic rocks	Students can successfully identify and locate on a diagram where 2 specific metamorphic rocks form.
	Day 19: Earthquake P/S waves: How do we use the P and S Wave Travel Time Chart to determine the distance of a specific location from an earthquake's epicenter? Scholars will analyze and use the information P and S waves provide us about Earth's interior as well as distance from an Earthquake's epicenter. They will begin to think about how this information help scientists figure out where the earthquakes in New York originated	Students can successfully use the P and S wave chart to identify how far a specific location is from the epicenter
U3, U6	**Day 20: Locating Epicenter:** How can we determine where an earthquake originates? Scholars will use P/S wave data provided from 3 locations to determine the epicenter of an earthquake.	Scholars can accurately identify the location of an epicenter using triangulation
U1-U6	**Project** Scholars will analyze data around earthquakes that originated in New York over the summer of 2017. They will also analyze data around earthquakes originating at various other locations. Based on inferences made from the analyzed data, scholars will engage in argumentation on whether Rochester, NY is tectonically active and should we be concerned.	Scholars can construct an effective science explanation (Claim, evidence, analysis of evidence) that supports their claim on whether Rochester, NY is tectonically active or not
U1-U6	**Unit Test** Scholars will represent understanding of Earth's uplifting forces through an Earth Science Regents styled test	Scholars can accurately answer NYS regents styled questions