Colorado Teacher-Authored Instructional Unit Sample

Science

High School – Earth Science

Unit Title: Earth's Changing Surface

Colorado's District Sample Curriculum Project

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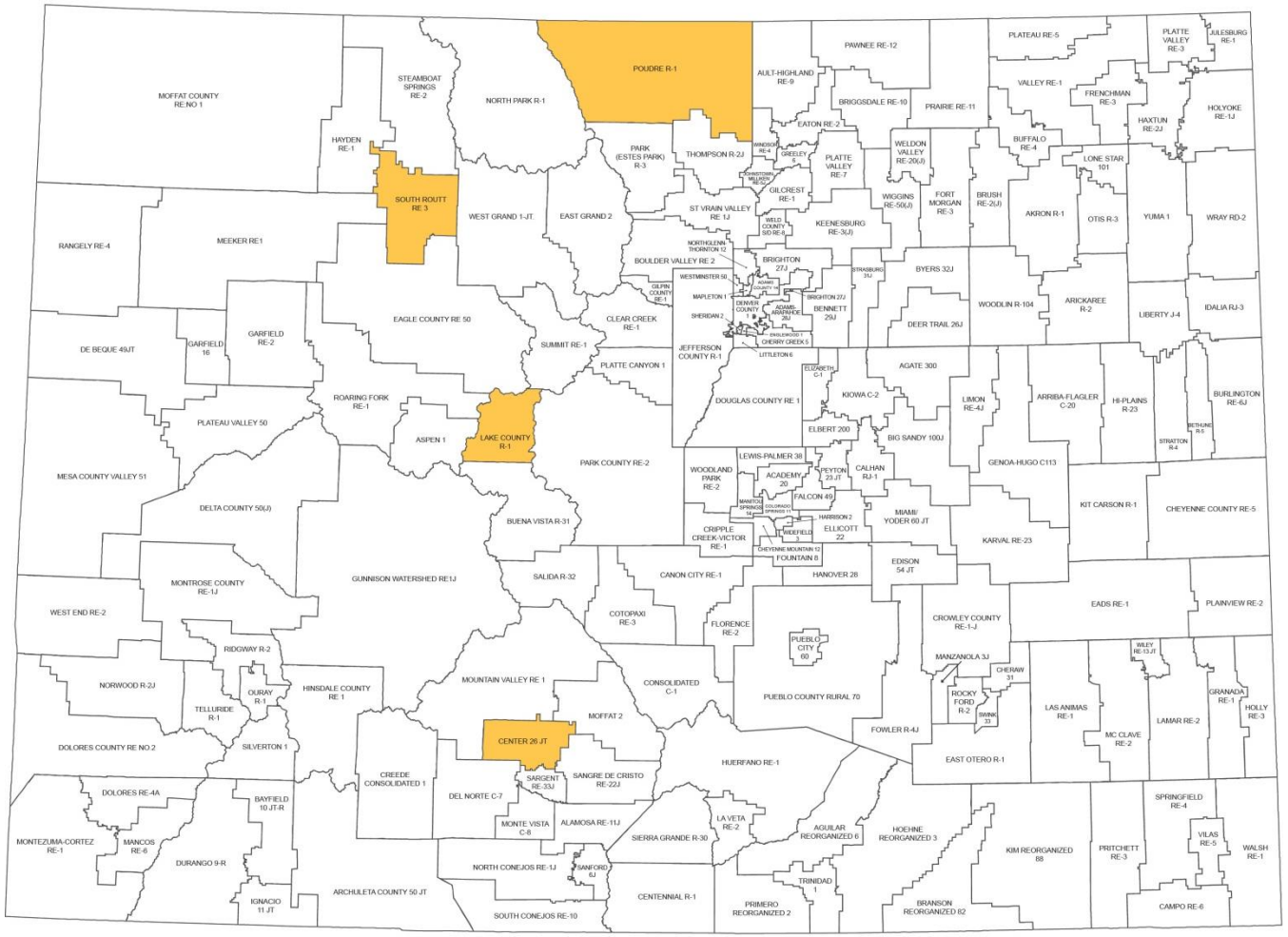

This unit was authored by a team of Colorado educators. The template provided one example of unit design that enabled teacher-authors to organize possible learning experiences, resources, differentiation, and assessments. The unit is intended to support teachers, schools, and districts as they make their own local decisions around the best instructional plans and practices for all students.

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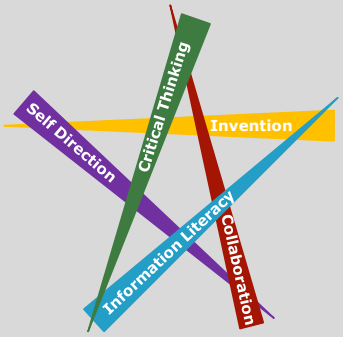
Colorado Teacher-Authored Sample Instructional Unit

Content Area	Science	**Grade Level**	High School
Course Name/Course Code	Earth Science		

Standard	**Grade Level Expectations (GLE)**	**GLE Code**
1. Physical Science	1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations	SC09-GR.HS-S.1-GLE.1
	2. Matter has definite structure that determines characteristic physical and chemical properties	SC09-GR.HS-S.1-GLE.2
	3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy	SC09-GR.HS-S.1-GLE.3
	4. Atoms bond in different ways to form molecules and compounds that have definite properties	SC09-GR.HS-S.1-GLE.4
	5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined	SC09-GR.HS-S.1-GLE.5
	6. When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases	SC09-GR.HS-S.1-GLE.6
2. Life Science	1. Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem	SC09-GR.HS-S.2-GLE.1
	2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem	SC09-GR.HS-S.2-GLE.2
	3. Cellular metabolic activities are carried out by biomolecules produced by organisms	SC09-GR.HS-S.2-GLE.3
	4. The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken.	SC09-GR.HS-S.2-GLE.4
	5. Cells use the passive and active transport of substances across membranes to maintain relatively stable intracellular environments	SC09-GR.HS-S.2-GLE.5
	6. Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments	SC09-GR.HS-S.2-GLE.6
	7. Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins	SC09-GR.HS-S.2-GLE.7
	8. Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome	SC09-GR.HS-S.2-GLE.8
	9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment	SC09-GR.HS-S.2-GLE.9

3. Earth Systems Science	1. The history of the universe, solar system and Earth can be inferred from evidence left from past events	SC09-GR.HS-S.3-GLE.1
	2. As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways	SC09-GR.HS-S.3-GLE.2
	3. The theory of plate tectonics helps to explain geological, physical, and geographical features of Earth	SC09-GR.HS-S.3-GLE.3
	4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere	SC09-GR.HS-S.3-GLE.4
	5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources	SC09-GR.HS-S.3-GLE.5
	6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes	SC09-GR.HS-S.3-GLE.6
	7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms	SC09-GR.HS-S.3-GLE.7

Colorado 21st Century Skills



Critical Thinking and Reasoning: *Thinking Deeply, Thinking Differently*

Information Literacy: *Untangling the Web*

Collaboration: *Working Together, Learning Together*

Self-Direction: *Own Your Learning*

Invention: *Creating Solutions*

Reading & Writing Standards for Literacy in Science and Technical Subjects 6 - 12

Reading Standards

- Key Ideas & Details
- Craft And Structure
- Integration of Knowledge and Ideas
- Range of Reading and Levels of Text Complexity

Writing Standards

- Text Types & Purposes
- Production and Distribution of Writing
- Research to Construct and Present Knowledge
- Range of Writing

Unit Titles	Length of Unit/Contact Hours	Unit Number/Sequence
Earth's Changing Surface	7-9 weeks	2

Colorado Teacher-Authored Sample Instructional Unit

Unit Title	Earth's Changing Surface		**Length of Unit**	7-9 weeks
Focusing Lens(es)	Systems	**Standards and Grade Level Expectations Addressed in this Unit**	SC09-GR.HS-S.3-GLE.3, SC09-GR.HS-S.3-GLE.6 SC09-GR.HS-S.1-GLE.1	
Inquiry Questions (Engaging-Debatable):	• Why would destroying natural coastal barriers (ex. mangrove swamps) contribute to extreme weather across many systems? • How would rebuilding places destroyed by natural hazards contribute to re-building of the system? • Why do people build cities along plate boundaries?			
Unit Strands	Earth Science, Physical Science			
Concepts	Change, Systems, Plate Tectonics, Structure, Impacts, Landforms			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
The structure of the Earth, shaped by plate tectonics, influences how organisms live, use resources and develop into communities (SC09-GR.HS-S.3-GLE.3-EO.a,b,c;IQ.1,2,4;N.2,4)	What are the types of plate boundaries and their associated landforms? What causes plate movement? (SC09-GR.HS-S.1-GLE.1;RA.3)	How has plate tectonics shaped biological systems (human civilization, biomes/ecosystems) (SC09-GR.HS-S.3-GLE.3-EO.a,b,c;IQ.1,4;N.4) What will the earth look like in the future? (SC09-GR.HS-S.3-GLE.3-EO.a,b,c;IQ.1,4;N.2,4)
Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock. (SC09-GR.HS-S.3-GLE.6-EO.a,b,c;IQ.1,2,3;RA.2,3;N.1,3)	What systems result in a change of landforms?	What are the positive and negative changes on Earth's geosphere due to water, air, gravity and biological activity? (SC09-GR.HS-S.3-GLE.6-EO.a,b,c,d;IQ.2,3;RA.3;N.3)
Plate tectonic theory allows for prediction of natural hazards and their impacts. (SC09-GR.HS-S.3-GLE.3-EO.a,b,c;IQ.4;N.3) and (SC09-GR.HS-S.3-GLE.7-EO.a,b,c;IQ.1,2,3;RA.1,2,3,4;N.1)	What natural hazards are associated with plate boundaries and landforms?	How do local, national and global organizations collaborate to plan for natural hazards caused by plate tectonics?
Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms. (SC09-GR.HS-S.3-GLE.3-EO.d;IQ.2;RA.1;N.1,4) and (SC09-GR.HS-S.3-GLE.6-EO.d;RA.1,2;N.3)	What technology has been used to develop the theory of plate tectonics?	How have scientists discovered the interior structure of the Earth?

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• The theory of plate tectonics and how it explains the Earth's geological features (SC09-GR.HS-S.3-GLE.3-EO.a,b,c,d;IQ.1,4;RA.1;N.2,4) • The causes of plate movement (slab pull, mantle convection, and?) (SC09-GR.HS-S.3-GLE.3-EO.b,d;IQ.3;RA.1;N.2,4) and (SC09-GR.HS-S.1-GLE.1;RA.3) • The interactions between tectonics plates and the resulting landforms and natural hazards (SC09-GR.HS-S.3-GLE.3-EO.b,d;IQ.3;RA.1;N.2,4) and (SC09-GR.HS-S.3-GLE.7-EO.a,b,c;IQ.1,2,3;RA.1,2,3,4;N.1) • Geophysical technology and its relationship to current theory of plate tectonics (SC09-GR.HS-S.3-GLE.3-EO.d;RA.1;N.4) • Layers of the Earth and how they are identified (SC09-GR.HS-S.3-GLE.3-EO.b;IQ.2) • The changes to Earth's surface that result from water, air, gravity and biological activity (SC09-GR.HS-S.3-GLE.6-EO.a,b,c,d;IQ.1,2,3;RA.1,2,3;N.1,2,3)	• Read a topographic map, geologic map and digital map resources (GIS) to interpret landforms and predict impacts of human activity (SC09-GR.HS-S.3-GLE.6-EO.b,d;RA.1,3;N.3) • Predict landforms and/or natural hazards found at a specific plate boundary (SC09-GR.HS-S.3-GLE.3-EO.b,d;IQ.3;RA.1;N.2,4) and (SC09-GR.HS-S.3-GLE.7-EO.a,b,c;IQ.1,2,3;RA.1,2,3,4;N.1) • Identify physical, chemical and human impacts on Earth's surface (ex. Soil erosion) (SC09-GR.HS-S.3-GLE.6-EO.a,b,c,d;IQ.1,2,3;RA.1,2,3;N.1,2,3) • Identify landforms created by geologic activity (SC09-GR.HS-S.3-GLE.3-EO.a,b,c,d;IQ.1,4;RA.1;N.2,4)

Critical Language: includes the Academic and Technical vocabulary, semantics, and discourse which are particular to and necessary for accessing a given discipline.
EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."*

A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	The Earth's surface changes in response to plate tectonics as well as physical, chemical and biological activity on the surface.
Academic Vocabulary:	interpret data, evidence-based explanation, evidence-based prediction, ethically use information, uncertainty, develop, communicate, justify, technology, assumption, natural phenomena, scientific claim, critically evaluate, computer model, consequences, testable question, falsifiable hypothesis, respectfully discuss, conceptual interpretations, innovation, fluctuation, agriculture, reproducible results, mitigate
Technical Vocabulary:	physical change, chemical change, geophysical, biological activity, plate tectonics, geosphere, remote sensing, GIS, landforms, plate boundaries, plate, geographical features, convergent, divergent, transform,

Unit Description:	This unit focuses on our restless planet. Beginning with plate tectonic theory, across the unit students will explore technological evidence/advances that have furthered knowledge of this theory, natural hazards associated with plate tectonics, and resources and landforms that result from tectonic forces. The unit culminates in a performance assessment that asks students to create a community proposal based on a specific role/perspective and present to a governing body for future planning of a geologically active area. They will need to consider potential hazards and implications of development based on technological evidence of plate tectonic theory.
Considerations	Teachers may need to consider the timing and location of this unit depending on the district high school scheduling.
Unit Generalizations	
Key Generalization:	Plate tectonic theory allows for prediction of natural hazards and their impacts
Supporting Generalizations:	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms
	The structures of the Earth, shaped by plate tectonics, influences how organisms live, use resources, and develop into communities
	Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock

Performance Assessment: *The capstone/summative assessment for this unit.*	
Claims: (Key generalization(s) to be mastered and demonstrated through the capstone assessment.)	Plate tectonic theory allows for prediction of natural hazards and their impacts.
Stimulus Material: (Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization)	You are a member of a community taskforce or someone very interested in the economic success of your community. You might, for example, be a Real Estate developer, a local Geologist, a homeowner, a Preservationist, someone representing the EPA, etc. Recently, a famous company has proposed future construction near a geologically active area. As a community member/interested party, you have a very strong opinion about the construction due to potential hazards and implications of development based on technological evidence of plate tectonic theory. You will present your opinion at the next upcoming city council meeting and need to include ideas around plate movement, the causal relationship between natural hazards and tectonic theory, persuasive evidence, and technological evidence that assisted you in defending a position.
Product/Evidence: (Expected product from students)	The student may research and take a role/perspective to create a community proposal (Power Point, Prezi, written report, video, etc.) to present to a governing body for future planning of an area to consider potential hazards and implications of development based on technological evidence of Plate tectonic theory. Teachers can either offer a selection of geologically active regions or choose one to examine as a whole class. Students must assume the perspective of their role and advocate their position. They may include persuasive evidence, plate movement within their given region, causal relationship between natural hazards and tectonic theory, and how technological evidence assisted them in forming their opinion. Geologically Active Region Options: Hawaii, Yellowstone, Ring of Fire, etc. Potential Student Roles: Developer/real estate, BLM/Geologist, housing authority, Mr. "Fair", Preservationist, Biologist, etc. Possible Governing Body Options: City Council, U.N., EPA, etc.

Differentiation: (Multiple modes for student expression)	The teacher may allow students to produce presentations that build upon their strengths (e.g., audio recording, poster, Power Point, etc.). The teacher may provide graphic organizer to help students plan their project. This can be used for all students or those who struggle. http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Graphic Organizer for Performance Assessment)

Texts for independent reading or for class read aloud to support the content

Informational/Non-Fiction	Fiction
What is the Theory of Plate Tectonics -Craig Saunders [lexile level 970] *Plate Tectonics* - Darlene Stille [lexile level 1090] *Shaping the Earth* - Dorothy Patent and William Munoz [lexile level 1120] *Earth's Continents*- Bruce McClish [lexile level 1000]	*Zero Hour (series)* -Clive Cussler [lexile level 970] *The Earth Cries Out* -Kevin McIntosh [lexile level 900] *Earth Alert*- Andrew Whitmore [lexile level 860] *Earth* David- Brin [lexile level 1020]

Ongoing Discipline-Specific Learning Experiences

1.	Description:	Working like a scientist: Analyzing, creating and Interpreting graphs, maps, and data tables	Teacher Resources:	http://prezi.com/w--pvbreketk/copy-of-graphing-data/ (Prezi on graphing Data)
			Student Resources:	http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Scientific Method Flowchart) http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Lab Write-Up Rubric)
	Skills:	Labeling and titling axes Identifying dependent and independent variables Determining the appropriate type of graph Interpreting data Identifying and fitting a trend line to data Reading different types of graphs and maps	Assessment:	The student will be assessed within the learning experience

2.	Description:	Reading and writing like a scientist: Reading critically and writing technically	Teacher Resources:	http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Multi-pass Reading Strategy for Case Studies)
			Student Resources:	http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Lab Template) http://science-curriculum.lakecounty-hs.schoolfusion.us/modules/locker/files/group_files.phtml?parent=24482304&gid=4402063&sessionid=c1305047b374753db7924f5a8ebb7b18 (Lab Write-Up Rubrics)
	Skills:	Comprehension of academic vocabulary Extracting main ideas Making predictions Identifying key points and themes Identify faults in research methods, logic, and statistical findings Scrutinize credibility of sources	Assessment:	The student will be assessed within the learning experience

Prior Knowledge and Experiences

Students must have an understanding of physical and chemical change, waves, rock and mineral identification, and basic plate tectonic theory.

Vertical Articulation: Students have last seen concepts within this unit in 8th, 6th, 5th, 3rd, and 2nd grades.

Learning Experiences # 1 – 3
Instructional Timeframe: Weeks 1-2

Learning Experience # 1

The teacher may introduce and facilitate an investigation of physical and chemical properties of rocks and minerals so that students can utilize new skills to identify and categorize various rocks and minerals.

Generalization Connection(s):	Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock
Teacher Resources:	http://prezi.com/7dzebh7lxqrk/rocks-of-the-lithosphere/ (Prezi on the Lithosphere) http://app.discoveryeducation.com/search?Ntt=Earth+Science+for+Students%3A+Minerals%2C+Gems%2C+and+Ores. (Discovery Education: Earth Science for Students: Minerals, Gems, and Ores -subscription required)

	http://gtm-media-1.discoveryeducation.com/videos//2/guides/72852-havtxtg.pdf ((Discovery Education: Earth Science for Students: Minerals, Gems, and Ores Teacher's Guide- subscription required) http://www.youtube.com/watch?v=8a7p1NFn64s&list=PLF4N7Mf2agICOvyfg0wkQfi-ayUx0MWo2 (A Brief Introduction to Minerals) http://www.youtube.com/watch?v=bGye6vlOpbY (Mid-Atlantic Ridge) http://geology.com/store/collections/rock-kit.shtml (Rock and Mineral Identification Kits, such as this one- kit must be purchased separately) http://prezi.com/wjnxs20irjf_/minerals/ (Prezi on minerals)	
Student Resources:	http://prezi.com/7dzebh7lxqrk/rocks-of-the-lithosphere/ (Prezi on the Lithosphere) http://app.discoveryeducation.com/search?Ntt=Earth+Science+for+Students%3A+Minerals%2C+Gems%2C+and+Ores. (Discovery Education: Earth Science for Students: Minerals, Gems, and Ores -subscription required) http://gtm-media-1.discoveryeducation.com/videos//2/guides/72852-havtxtg.pdf ((Discovery Education: Earth Science for Students: Minerals, Gems, and Ores Teacher's Guide- subscription required) http://www.youtube.com/watch?v=8a7p1NFn64s&list=PLF4N7Mf2agICOvyfg0wkQfi-ayUx0MWo2 (A Brief Introduction to Minerals) http://www.youtube.com/watch?v=bGye6vlOpbY (Mid-Atlantic Ridge) http://geology.com/store/collections/rock-kit.shtml (Rock and Mineral Identification Kits, such as this one- kit must be purchased separately) http://prezi.com/wjnxs20irjf_/minerals/ (Prezi on minerals)	
Assessment:	Students will complete a lab practical (lab write-up) to demonstrate their understanding of properties and identify and categorize different rocks and minerals.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to work with a partner who can help facilitate the process	The student may complete the blanks on a nearly completed lab write-up
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to investigate rocks and minerals within their local area	The student may compile a photo essay of their findings The student may write an essay about their finding
Critical Content:	• Metamorphic, igneous, sedimentary rocks, mineral identification, chemical and physical properties, periodic table	
Key Skills:	• Identify rock and minerals, identify metals on the periodic table	
Critical Language:	Metamorphic, igneous, sedimentary rocks, mineral, chemical and physical properties, periodic table, identify	

Learning Experience # 2	
The teacher may introduce the rock cycle visually (video, photos) so that students can understand the relationship between various rock forms.	
Generalization Connection(s):	Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock

<table>
<tr><td>Teacher Resources:</td><td colspan="2">http://prezi.com/rqd7auzrfvm-/rock-cycle/ (Prezi on the rock cycle)
DVD: How the Earth was Made
VHS: The Rock Cycle
https://www.youtube.com/watch?v=pm6cCg_Do6k#t=44 (Rock Cycle Video)
http://app.discoveryeducation.com/search?Ntt=%29%3A+Earth+Science+for+Students%3A+Rock+Cycle (Discovery Education: This site requires a subscription. “Earth Science for Students: Rock Cycle)
http://app.discoveryeducation.com/search?Ntt=Standard+Deviants+Teaching+Systems%3A+Earth+Science%3A+Module+02%3A+The+Earth%E2%80%99s+Past%3B+Forces+that+Shaped+the+Earth+ (Discovery Education: This site requires a subscription. “Standard Deviants Teaching Systems: Earth Science: Module 02: The Earth’s Past; Forces that Shaped the Earth”)
http://gtm-media.discoveryeducation.com/videos/10786/F708A007-FFEF-70A2-18B70765B6437BE5.pdf (“Forces that Change the Earth” Teacher’s Guide)
http://gtm-media.discoveryeducation.com/videos/10786/10786_BM.pdf (“Forces that Change the Earth” Blackline Masters -This allows for differentiation and formative and summative assessments)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">http://prezi.com/rqd7auzrfvm-/rock-cycle/ (Prezi on the rock cycle)
DVD: How the Earth was Made
VHS: The Rock Cycle
https://www.youtube.com/watch?v=pm6cCg_Do6k#t=44 (Rock Cycle Video)
http://app.discoveryeducation.com/search?Ntt=%29%3A+Earth+Science+for+Students%3A+Rock+Cycle (Discovery Education: This site requires a subscription. “Earth Science for Students: Rock Cycle)
http://app.discoveryeducation.com/search?Ntt=Standard+Deviants+Teaching+Systems%3A+Earth+Science%3A+Module+02%3A+The+Earth%E2%80%99s+Past%3B+Forces+that+Shaped+the+Earth+ (Discovery Education: This site requires a subscription. “Standard Deviants Teaching Systems: Earth Science: Module 02: The Earth’s Past; Forces that Shaped the Earth”)
http://www.learner.org/interactives/rockcycle/ (extra reinforcement for student on rock cycle)
http://www.y115.org/vimages/shared/vnews/stories/5033e2650a773/Rock%20Cycle%20Notes.pdf (extra resources for student on rock cycle)</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will complete a graphic organizer that distinguishes between the phases and processes of the rock cycle.

https://www.teachervision.com/tv/printables/concepts/es_visuals_4.pdf (Rock cycle template)</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may allow students to work with partners to complete the learning experience
The teacher may opt to print some of the diagrams in the Prezi for visual learners
The teacher may opt to use the “Blackline Masters” available through Discovery Ed contain resources that teachers can use to differentiate</td><td>The student may complete a graphic organizer that includes a word bank or is written in cloze format
The student may draw a picture of each phase in lieu of writing</td></tr>
</table>

Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to hypothesize what will happen if one stage of the rock cycle is removed and the implications upon landform creations	The student may orally report out their hypothesis
Critical Content:	• rock cycle; metamorphic, igneous, sedimentary rocks; erosion and weathering; sedimentation; heat and pressure; magmafication	
Key Skills:	• distinguish between phases and processes	
Critical Language:	Rock cycle, metamorphic, igneous, sedimentary rocks, erosion and weathering, sedimentation, heat and pressure, magmafication, distinguish	

Learning Experience # 3		
The teacher may introduce examples of the layers of the earth and demonstrate heat transfer (convection) within those layers so that students can visualize earth structure and energy transfer.		
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms	
Teacher Resources:	http://prezi.com/ondg8ctuxybg/copy-of-earths-interior-convection-in-mantle/ (Prezi on earth's convection within the mantle) http://prezi.com/2bjeaxorbkyt/convection-currents-in-the-mantle/ (Prezi on convection currents) http://app.discoveryeducation.com/search?Ntt=convection (Discovery Education, Subscription required) http://www.youtube.com/watch?v=N9ncfAsmiSg (Video of "Inside the Earth") http://www.ehow.com/how_12020097_make-model-earth-big-foam-ball.html (lesson plan on how to make a model of the earth layers) http://www.stevespanglerscience.com/lab/experiments/volcano-eruptions (volcano eruptions) http://www.youtube.com/watch?v=dzm-VkphoGw (Geology Kitchen – Create a tasty model of the Earth's layers)	
Student Resources:	http://app.discoveryeducation.com/search?Ntt=convection (Discovery Education, Subscription required) http://www.youtube.com/watch?v=N9ncfAsmiSg (Video of "Inside the Earth") http://prezi.com/ondg8ctuxybg/copy-of-earths-interior-convection-in-mantle/ (Prezi on earth's convection within the mantle) http://prezi.com/2bjeaxorbkyt/convection-currents-in-the-mantle/ (Prezi on convection currents) http://mjksciteachingideas.com/pdf/EarthFoldable.pdf (Earth layers foldable)	
Assessment:	Students will create a model to demonstrate the different layers of the earth and energy transfer within the earth. http://mjksciteachingideas.com/pdf/EarthFoldable.pdf (Earth layers foldable-modifyable)	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with a kit and diagram for them to use to build their model	The student may create a model from a kit The student may demonstrate their understanding of the layers of the earth using a coloring page or by drawing a picture

Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to predict plate movement based upon heat transfer	The student may create a poster of their predictions for a gallery walk
Critical Content:	• mantle convection, magma movement, layers of the earth, crust, lithosphere, asthenosphere, upper mantle, lower mantle, inner core, outer core, seismic waves, seismograph	
Key Skills:	• model the layers of the earth, explain energy transfer	
Critical Language:	Mantle convection, magma movement, layers of the earth, crust, lithosphere, asthenosphere, upper mantle, lower mantle, inner core, outer core, seismic waves, seismograph, model, explain	

Learning Experiences # 4 – 7
Instructional Timeframe: Weeks 3-5

Learning Experience # 4	
The teacher may lead a discussion using various resources regarding historical progressions leading to the development of plate tectonic theory so that students can begin to consider how scientific advances have continuously advanced our understandings of Earth processes.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms
Teacher Resources:	http://allfreeprintable.com/plate-tectonics-map (Basic, blank tectonic map – a great tool to use as the starting and reference point for the unit! Could be part of the assessment – to indicate with different colors: name of plate, volcanic activity, earthquake activity, and plate movement direction) http://www.teachinggeography.org/Plate%20Tectonics%20Rocks.pdf (Very comprehensive two-day lesson plan, with graphic organizers and activities included, to introduce plate tectonics and boundaries) http://www.scec.org/education/k12/learn/plate.htm (on-line introduction/informational text on plate tectonics – may need to create a study guide) http://prezi.com/giumytdly91s/plate-tectonics/ (Great overview Prezi of Plate Tectonics) http://prezi.com/b3mlmltvue69/plate-tectonics/ (Nice plate tectonic Prezi which outlines four different learning targets and elements which should be completed for their understanding) http://mediashare.discoveryeducation.com/assets/F17C72EC-F8DC-420E-90C9-7F5CA5B95D52/FA2CBF20-14C2-3F0D-1C3BBF232A9D803F.pdf (Tectonic plates construction activity. Students cut, paste, color, and label plates names, boundaries, speed, direction, etc...) http://www2.nature.nps.gov/geology/usgsnps/animate/pltecan.html (Animation of tectonic plate spreading over time) www.discoveryeducation.com (Discovery Education video entitled: *Faces of Earth: Shaping the Planet* (subscription required)) http://www2.nature.nps.gov/geology/usgsnps/animate/pltecan.html (Exhaustive maps of North America over 550 million years…) http://geology.com/pangea.htm (Maps of the general placement of continents over the past 225 million years ago up to the present) http://hyperphysics.phy-astr.gsu.edu/hbase/geophys/platevid.html (Fossil evidence documentation)

	http://wiki.answers.com/Q/How_have_technologies_such_as_sonar_and_the_GPS_been_used_to_provide_evidence_supporting_the_theory_of_plate_tectonics?#slide=1 (Though this has many advertisements, it has many resources on plate tectonics and technology used to support it) https://bpb.opendns.com/a/www.docstoc.com/docs/3753398/Map-Rubric?wc=EARoHg9xBxouAxFuBwoACxULThUBHA (Map grading rubric for map assessment) http://coe.jmu.edu/learningtoolbox/cornellnotes.html (Comprehensive tool box with Cornell notes as an ongoing teacher resource) http://freeology.com/wp-content/files/cornellnotetaker2-thumb.png (Great note-taker with Cornell notes for students to keep track of essential learnings, case studies, etc.) ** Perhaps have a running list of case studies examined during these learning experiences, so that by learning experience #7, the students have a list of possible places to research more in depth for their presentations.	
Student Resources:	http://www.scec.org/education/k12/learn/plate.htm (On-line introduction/informational text on plate tectonics) http://prezi.com/giumytdly91s/plate-tectonics/ (Great overview Prezi of Plate Tectonics) http://prezi.com/b3mlmltvue69/plate-tectonics/ (Nice plate tectonic Prezi which outlines four different learning targets and elements which should be completed for their understanding) www.discoveryeducation.com (Discovery Education video entitled: *Faces of Earth: Shaping the Planet* (subscription required) – general) www.discoveryeducation.com (Discovery Education video entitled: *Faces of Earth: Assembling America* (subscription required) – US specific)	
Assessment:	Students will create a timeline detailing how the technological advances and helped progress the theory of plate tectonics. http://www.timetoast.com/ (Timetoast)	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to work in group or partner	The student may use images to produce their historical timeline
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to take one type of evidence (fossil record, SONAR, seismic data, etc.) and interpret how it supports the overall theory	The student may create a Power Point presentation that explains the evidence chosen
Critical Content:	• Pangea, Laurasia, Gondwanaland, continental drift, Wegener, mid-ocean ridge, sea floor spreading, fossil record, radio-metric dating, SONAR, seismic data, plate tectonics, polar wandering, topographic maps, digital maps, geologic maps, geophysical data	
Key Skills:	• Read various kinds of maps, create maps, interpret evidence	
Critical Language:	Pangea, Laurasia, Gondwanaland, continental drift, Wegener, mid-ocean ridge, sea floor spreading, fossil record, radio-metric dating, SONAR, seismic data, plate tectonics, polar wandering, topographic maps, digital maps, geologic maps, geophysical data, read, create, interpret	

Learning Experience # 5		
The teacher may use simulations to demonstrate plate tectonics so that students can analyze the ways in which technology can advance understandings of theoretical principles.		
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms	
Teacher Resources:	http://phet.colorado.edu/en/simulations/category/earth-science (pHET simulations) http://facility.unavco.org/cgi-bin/GPSVelocityViewer/GPSVelocityViewer.html (In depth, live view of the US/world map which shows plate velocity (current!)) http://www.platetectonics.com/article.asp?a=74 (Trade article about technology used in plate tectonics) http://www.britannica.com/EBchecked/topic/176118/Earth-sciences/60427/The-theory-of-plate-tectonics (Encyclopedia article about plate tectonics, with links to the different technological evidence bases for plate tectonic theory –great starting point for research) http://geology.about.com/od/platetectonics/a/Measuring-Plate-Motion.htm (Geodetic plate motion article) http://coe.jmu.edu/learningtoolbox/cornellnotes.html (Comprehensive tool box with Cornell notes as an ongoing teacher resource) http://freeology.com/wp-content/files/cornellnotetaker2-thumb.png (Great note-taker with Cornell (or use another note-taking/graphic organizer system of choice) notes for students to keep track of essential learnings, case studies, etc.)	
Student Resources:	http://www.iris.edu/hq/files/programs/education_and_outreach/aotm/14/1.GPS_Background.pdf (Background information on how GPS can help measure tectonic activity) http://facility.unavco.org/cgi-bin/GPSVelocityViewer/GPSVelocityViewer.html (In depth, live view of the US/world map which shows plate velocity (current!)) http://www.platetectonics.com/article.asp?a=74 (Trade article about technology used in plate tectonics) http://www.britannica.com/EBchecked/topic/176118/Earth-sciences/60427/The-theory-of-plate-tectonics (Encyclopedia article about plate tectonics, with links to the different technological evidence bases for plate tectonic theory –great starting point for research) http://geology.about.com/od/platetectonics/a/Measuring-Plate-Motion.htm (Geodetic plate motion article) http://www.ck12.org/search/?q=Plate%20Tectonics%20through%20Earth%20History (On-line textbook builder and downloadable)	
Assessment:	The student will research one advanced technology and write a persuasive report out on its relevance to the theory. http://www.readwritethink.org/files/resources/printouts/persuasion%20map.pdf (Persuasive template)	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow group or partner work and provide research at independent reading level	The student may create a report that is strength-specific, and perhaps modified (shortened, etc.)
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to develop a project to demonstrate a chosen technology	The student may model/demonstrate applications of technology

Critical Content:	• SONAR, radio-metric dating, seismic data, fossil records, technology, mid-ocean ridge, continental drift, sea floor spreading, carbon dating, glaciation, hot spot
Key Skills:	• Interpret data, model applications, research technology
Critical Language:	Interpret, model, research, SONAR, radio-metric dating, seismic data, fossil records, technology, mid-ocean ridge, continental drift, sea floor spreading, carbon dating, glaciation, hot spot

Learning Experience # 6	
The teacher may use models and other visual resources to demonstrate various plate tectonic boundaries (and resultant features and landforms) so that students can begin modeling the outcomes of plate interactions.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms Plate tectonic theory allows for prediction of natural hazards and their impacts Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock
Teacher Resources:	https://www.khanacademy.org/science/cosmology-and-astronomy/earth-history-topic/plate-techtonics/v/plate-tectonics----geological-features-of-divergent-plate-boundaries (Kahn academy video on geographic features of divergent boundaries) http://phet.colorado.edu/files/teachers-guide/plate-tectonics-guide.pdf (Teacher's guide to link below) http://www.scec.org/education/k12/learn/plate.htm (Simulation to explore the boundaries and resultant features (may be used again in LE #8)) http://www.scec.org/education/k12/learn/activity.htm (Classroom activities relating to plate movement) http://coe.jmu.edu/learningtoolbox/cornellnotes.html (Comprehensive tool box with Cornell notes as an ongoing teacher resource) http://freeology.com/wp-content/files/cornellnotetaker2-thumb.png (Great note-taker with Cornell (or use another note-taking/graphic organizer system of choice) notes for students to keep track of essential learnings, case studies, etc.) http://www.iris.edu/hq/files/programs/education_and_outreach/aotm/2/FoamFaultModel_Activity.pdf (How to make a model of plate boundaries with foam) http://www.pbs.org/wgbh/aso/tryit/tectonics/ (On-line simulation and guideline which compares the earth's surface to a hard-boiled egg; each link below shows a different type of boundary) http://www.nature.nps.gov/geology/USGSNPS/deform/7modelsa.html (Paper model of plate boundaries)
Student Resources:	http://www.scec.org/education/k12/learn/plate.htm (Resource to visually see how plate boundaries create different landforms) http://www.scec.org/education/k12/learn/plate.htm (Simulation to explore the boundaries and resultant features (may be used again in LE #8)) http://app.discoveryeducation.com/search?Ntt=plate+tectonics#selItemsPerPage=60&intCurrentPage=0&No=0&N=18343%252B4294939055&Ne=&Ntt=plate%2Btectonics&Ns=&Nr=&browseFilter=&indexVersion=&Ntk=All&Ntx=mode%252Bmatchallpartial (Kahn academy video on geographic features of divergent boundaries) http://pubs.usgs.gov/gip/dynamic/Vigil.html (Cross-section visual which shows all plate boundaries and resultant landforms)
Assessment:	Students will create a model to explain the features, processes, and landforms associated with one type of plate boundary.

Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to work with a partner	The student may verbally present the features, processes and landforms to the teacher
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to analyze a regional tectonic structure or feature and the resulting landforms and processes	The student may create a demonstration of the formation of a regional landform
Critical Content:	• Convergent, divergent, transform, stike-slip, subduction, deep sea trench, volcanic island arc, volcano, earthquake, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, sial, sima, lithosphere, asthenosphere	
Key Skills:	• Create a model, analyze tectonic structures, demonstrate landforms, analyze tectonic boundaries, and explain features, processes, and landforms.	
Critical Language:	Convergent, divergent, transform, stike-slip, subduction, deep sea trench, volcanic island arc, volcano, earthquake, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, sial, sima, lithosphere, asthenosphere, create models, analyze, demonstrate, explain	

Learning Experience # 7	
The teacher may use case studies related to tectonic activity so that students can examine and utilize qualitative research to deepen their understandings of theoretical principles.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms The structure of the Earth, shaped by plate tectonics, influences how organisms live, use resources and develop into communities Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock
Teacher Resources:	http://www.rgs.org/NR/rdonlyres/74F03FB6-E499-4393-B1EF-99EB187EB60C/0/KS3_CPD_Hazards_TectonicsCaseStudies.pdf (Case studies of tectonic activities, including natural hazards) http://www.geography.learnontheinternet.co.uk/topics/earthquakes.html (Menu on the left has several different earthquake case studies) https://sites.google.com/a/apps.hopkinsschools.org/earth-science-case-studies/ (Another case-study site of tectonic activity) https://www.e-education.psu.edu/earth520/content/l3_p5.html (Article and video for Paleomagnetism, Polar Wander, and Plate Tectonics) http://coe.jmu.edu/learningtoolbox/cornellnotes.html (Comprehensive tool box with Cornell notes as an ongoing teacher resource) http://freeology.com/wp-content/files/cornellnotetaker2-thumb.png (Great note-taker with Cornell (or use another note-taking/graphic organizer system of choice) notes for students to keep track of essential learnings, case studies, etc.)

<table>
<tr><td></td><td colspan="2">http://cse.ssl.berkeley.edu/lessons/indiv/coe/details.html (The purpose of this lesson plan is to expose students to the breadth and depth of the Internet while they search for data pertaining to the world's volcanic and seismic activity. They then compile the data on a world map and make scientific inferences on the location of plate boundaries. Further investigation involves upper level students in the identification of boundary interaction. The lesson can be extended to include a comparison of stationary volcanic activity on Mars to that of dynamic volcanic activity of the Pacific Plate on Earth)
http://www.scec.org/education/k12/learn/activity.htm (Classroom activities/lesson plans relating to plate movement)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">http://www.rgs.org/NR/rdonlyres/74F03FB6-E499-4393-B1EF-99EB187EB60C/0/KS3_CPD_Hazards_TectonicsCaseStudies.pdf (Case studies of tectonic activities, including natural hazards)
http://www.geography.learnontheinternet.co.uk/topics/earthquakes.html (Menu on the left has several different earthquake case studies)
https://sites.google.com/a/apps.hopkinsschools.org/earth-science-case-studies/ (Another case-study site of tectonic activity)
http://underthevolcanobooks.com/ (Under the Volcano)</td></tr>
<tr><td>Assessment:</td><td colspan="2">The student will write an expository essay detailing how qualitative research adds to their understanding of tectonic theory.

http://teachers.colonelby.com/arbogastn/eng%201D/Writing/How%20to%20Write%20an%20Expository.htm (Expository paragraph)</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may find a case study at independent reading levels
The teacher may allow for group or partner process
The teacher may provide a graphic organizer for targeted data collection</td><td>The student may dictate their expository essay to a partner</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may allow students to conduct an extension of a current case study and make predictions of what activities may result in the tectonic area within the next century</td><td>The student may present (Prezi, video, info-graphics, etc.) their predictions</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Convergent, divergent, transform, strike-slip, subduction, deep sea trench, volcanic island arc, volcano, earthquake, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, lithosphere, asthenosphere</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• Examine findings of a case study, analyze graphs and charts</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Convergent, divergent, transform, strike-slip, subduction, deep sea trench, volcanic island arc, volcano, earthquake, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, lithosphere, asthenosphere, create, examine, analyze</td></tr>
</table>

Learning Experience # 8
Instructional Timeframe: Week 6

Learning Experience # 8	
Teachers may engage students in investigations of plate boundaries so that students can explore land formations and hazards that may result from plate interactions.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock
Teacher Resources:	The teacher may select from the following resources to set-up stations for all students to rotate through *or* a jigsaw activity whereby each small group becomes experts on one resource and then presents to the entire class: http://pubs.usgs.gov/publications/text/dynamic.html (Features easy-to-understand text about plate tectonics—historical perspective, the theory, plate movement, and more. Part of the United States Geological Survey site, this portion sports wonderful graphics) http://www.usgs.gov/ (Explore this comprehensive site of the experts. Click on "Geology" to access information about plate tectonics) http://www.eas.cornell.edu/ (Click on "Teachers" to gain access to lesson plan ideas about earthquakes, volcanoes, topography, plate tectonics, and sea level change) http://phet.colorado.edu/en/simulations/category/earth-science (Students should make connections from lesson 6 and use the gained understanding in this lesson. Describe the differences between oceanic and continental crust, including their respective properties of density, composition, temperature and thickness) http://www.ck12.org/earth-science (Free online textbooks) http://www.ck12.org/earth-science/Maps (Free online maps with your log in) http://www.colorado.edu/physics/phys2900/homepages/Marianne.Hogan/waves.html (S and P waves and evaluating earthquakes) http://www.colorado.edu/physics/phys2900/homepages/Marianne.Hogan/quakes.html (Plates and boundaries) http://ciese.org/curriculum/musicalplates3/en/studentactivities.shtml (Student activities on plate movements) http://earthquake.usgs.gov/research/modeling/puzzle/ (Overlaying Student Activity) http://earthquake.usgs.gov/research/modeling/puzzle/images/puzzle.pdf (Teacher Guide- Scroll to the bottom paragraph where it leads teachers through using maps and plate boundaries to map out volcano's and earthquakes. The map lets the students see that plate boundaries are the sites of most of the world's earthquakes and volcanoes. From the puzzle they see that plates interact along their boundaries. The map referenced in this teacher resource can be found here: http://pubs.usgs.gov/imap/2800/ (The USGS plate boundaries map)
Student Resources:	http://coe.jmu.edu/learningtoolbox/cornellnotes.html (Students will access the materials provided in "Teacher Resources" either through a jigsaw activity or learning stations. A template for Cornell Notes can be found here)
Assessment:	Students will complete a note catcher that helps them organize the interactions at each plate boundary and the resulting landform and potential hazards. OR Students may create a model that demonstrates their understanding of one specific plate boundary, resulting landform, and potential hazards.

Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may modify the note catcher to include word bank, additional images, or cloze format The teacher may allow students to work with pairs The teacher may assign a less complicated plate boundary The teacher may provide materials at independent reading level or in audio format	The student may complete a modified note catcher
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to use a topographical map to determine the plate movement that created that landform	The student may write a caption for a topographic map that includes the landforms shown and how plate movement created those landforms
Critical Content:	• Convergent, divergent, transform, subduction, oceanic crust, continental crust, volcano, mountain, trench, rift, hot spot, plate	
Key Skills:	• Interpret graphs and charts, summarize, synthesize, compare and contrast, identify relationships	
Critical Language:	Convergent, divergent, transform, subduction, oceanic crust, continental crust, volcano, mountain, trench, rift, hot spot, plate, Interpret graphs and charts, summarize, synthesize, compare and contrast, identify relationships	

Learning Experiences # 9 – 11
Instructional Timeframe: Weeks 7-8

Learning Experience # 9	
The teacher may present simulations and videos so that students can begin considering the connections between natural hazards and specific instances of tectonic activity.	
Generalization Connection(s):	Plate tectonic theory allows for prediction of natural hazards and their impacts
Teacher Resources:	http://cws.unavco.org:8080/cws/modules/regionalplatemotion_voyagerjr/ (Learners use the web-based data viewing tool, EarthScope Jr., or the included map packet to visualize relationships between earthquakes, volcanoes, and plate boundaries in the western United States) http://environment.nationalgeographic.com/environment/natural-disasters/forces-of-nature/?section=v (Videos and resources related to volcanos) http://www.pbs.org/wgbh/nova/earth/anatomy-tsunami.html (Interactive simulation of a tsunami (based on real data)) http://www.pbs.org/wgbh/nova/earth/past-future-tsunamis.html (Interactive simulation of the worst 8 tsunami's and predictions about the future) https://www.youtube.com/watch/?v=ryrXAGY1dmE (Relationship between plate boundaries and volcanos) https://www.youtube.com/watch?v=OS8lpsNM0Gs (Volcanos, Earthquakes, and Tsunami video (45 minutes)) http://www.villiers.ealing.sch.uk/uploads/downloads/GCSE_GEOGARPHY_OCR_B_-_natural_hazards.pdf (Page 5 includes a graphic organizer of each boundary type and the resultant hazard)

Student Resources:	http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::640::480::/sites/dl/free/0072402466/30425/16_19.swf::Fig.%2016.19%20-%20Formation%20of%20a%20Tsunami(Animation of a tsunami) https://www.youtube.com/watch?v=LQ9paipcXGY (Relationship between volcanos and plate boundaries) http://www.geology.sdsu.edu/how_volcanoes_work/ (How volcanos work. Includes links to over 400 images and animations) https://www.youtube.com/watch?v=JrBaiPN6AW8 https://www.youtube.com/watch?v=cavq2HFBa-U https://www.youtube.com/watch?v=VSgB1IWr6O4 (3 short videos on how earthquakes work)	
Assessment:	Students will label and annotate a teacher-provided graphic organizer. http://www.villiers.ealing.sch.uk/uploads/downloads/GCSE_GEOGARPHY_OCR_B_-_natural_hazards.pdf (Page 5 includes a graphic organizer of each boundary type and the resultant hazard)	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide labels The teacher may provide a word bank	The student may complete a modified diagram
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to watch a video about a "real" natural hazard	The student may summarize the event and determine how they would have responded if they were a scientist in this location
Critical Content:	• Volcano, seismic activity/earthquake, tsunami, Richter scale, hazard, atmospheric particulates, magma, ash, volcanic explosivity index (VEI), convergent, divergent, transform, subduction, oceanic crust, continental crust, mountain, trench, rift, hot spot, plate	
Key Skills:	• Interpret diagrams, annotate, identify relationships, label	
Critical Language:	Volcano, seismic activity/earthquake, tsunami, Richter scale, hazard, atmospheric particulates, magma, ash, volcanic explosivity index (VEI), convergent, divergent, transform, subduction, oceanic crust, continental crust, mountain, trench, rift, hot spot, plate, Interpret diagrams, annotate, identify relationships, label	

Learning Experience # 10	
The teacher may introduce research and case studies on regional catastrophic events so that students can analyze the relationship between plate movement and potential geologic hazards.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms Plate tectonic theory allows for prediction of natural hazards and their impacts The structure of the Earth, shaped by plate tectonics, influences how organisms live, use resources and develop into communities
Teacher Resources:	http://www.villiers.ealing.sch.uk/uploads/downloads/GCSE_GEOGARPHY_OCR_B_-_natural_hazards.pdf (Data table from earthquakes- Page 15 includes a data table of major earthquake activity from 1990-2008; Page 19 is a case study of the 1994 CA earthquake; and Page 20 is a case study of the 2008 China earthquake) http://pubs.usgs.gov/gip/dynamic/tectonics.html (Plate Tectonics and People-This article introduces each tectonically related

<table>
<tr><td></td><td colspan="2">natural hazard (volcanos, earthquakes, tsunamis) giving examples of each of these from around the globe. The article outlines the why's for each disaster, gives specific examples, and discusses the plate tectonics responsible for each disaster)
http://www.sfbayquakes.org/thumbnails.html (San Francisco Bay Case study (maps))
http://www.sfbayquakes.org/histeqs.html (San Francisco bay case study (map with seismic activity starred))
http://earthquake.usgs.gov/earthquakes/states/?region=California (Includes maps, notable earthquakes, recent activity, and live seismic data for California)
http://earthquake.usgs.gov/earthquakes/states/?region=Hawaii (Includes maps, live seismic data, and historic tectonic information, notable and recent data on earthquakes/volcanos)
http://earthquake.usgs.gov/earthquakes/states/?region=Wyoming (Maps, tectonic information, notable and recent data for Wyoming and Yellowstone)
http://ciese.org/curriculum/musicalplates3/en/studentenrichment2.shtml (Personal accounts written by individuals who experienced an earthquake)
http://serc.carleton.edu/NAGTWorkshops/hazards/events/SanFran1906.html (1906 San Francisco Earthquake)
http://www.ngdc.noaa.gov/hazard/recenttsunamis.shtml (Case studies of recent Tsunami's including data sets)
http://www.ngdc.noaa.gov/hazard/honshu_11mar2011.shtml (Great Tohoku, Japan Earthquake and Tsunami, 11 March 2011)
http://www.geology.sdsu.edu/how_volcanoes_work/Historical.html (7 historic volcanos)
http://www.iris.edu/hq/programs/education_and_outreach/animations/27 (animations-change the number after the forward slash to get to a different animation- /27 =Gulf of California animation; /31= 1964 Great Alaska Earthquake Animation; and /30= Soloman Islands)
http://earthquake.usgs.gov/earthquakes/eqarchives/ (Top ten lists and maps of earthquakes)
http://news.bbc.co.uk/2/hi/136248.stm (The ring of fire)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">http://volcanoes.usgs.gov/images/pglossary/index.php (Photo glossary of volcanic terms)
http://news.bbc.co.uk/2/hi/science/nature/4972366.stm (Animated guide to volcanos)
http://news.bbc.co.uk/2/hi/science/nature/7533950.stm (Animated guide to earthquakes)
https://www.youtube.com/watch?v=hReS4Fm94L4 (Video of The San Andres Fault)</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will complete a lab report which analyzes a particular region with respect to the geologic hazards and their impacts.</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may allow students to consult with a local Geologist around the impacts of the geologic hazards for their local region/state</td><td>The student may create a visual resource (brochure, flyer, presentation, etc.) for the local/state detailing potential geologic hazards</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Earthquakes, volcanoes, floods, tsunamis, landslides, geologic hazards, impacts, atmospheric particulate matter, catastrophic events, convergent, divergent, transform, strike-slip, subduction, deep sea trench, volcanic island arc, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, lithosphere, asthenosphere</td></tr>
</table>

Key Skills:	• Create visual resources, analyze data and charts, predict impacts based on research
Critical Language:	Earthquakes, volcanoes, floods, tsunamis, landslides, geologic hazards, impacts, atmospheric particulate matter, catastrophic events, convergent, divergent, transform, strike-slip, subduction, deep sea trench, volcanic island arc, seismic data, abyssal plain, mid-ocean ridge, continental drift, sea-floor spreading, orogeny, tectonic uplift, rift valley, triple junction, hot spot, tsunami, ring of fire, sea mounts, , lithosphere, asthenosphere, create, analyze, predict

Learning Experience # 11	
The teacher may provide data sets so that students can explore the predictive possibilities and limitations of seismic data/histories.	
Generalization Connection(s):	Advances in technology continually refine the theory of plate tectonics and improve measurement of changes to landforms Plate tectonic theory allows for prediction of natural hazards and their impacts
Teacher Resources:	http://www.unavco.org/edu_outreach/data-for-educators/data-for-educators.html (GPS data sets tracking the plate motion in California and the Pacific Northwest) http://seismo.berkeley.edu/seismo/Homepage.html (Data sets for California and the Pacific Northwest) http://usgsprojects.org/balkan/ (Seismic data for the Balkan countries) http://usgsprojects.org/balkan/earthquakes.html (You can click on each individual earthquake that occurred in this area to retrieve more information) http://earthquake.usgs.gov/earthquakes/states/?old=top_states.html (US Earthquake Information by State/Territory. Also includes maps, notable earthquakes, historic information, and *live seismic data*) http://pubs.usgs.gov/fs/2008/3017/pdf/FS08-3017_508.pdf (Seismic Hazard map (US)) http://ciese.org/curriculum/musicalplates3/en/studentactivity1.shtml (Plotting using real –time data sets from around the globe) http://www.geosociety.org/educate/LessonPlans/RealEvidence-SubductingPlate.pdf **(**The objective of this activity is to allow students to manipulate real data and understand how such data is interpreted and used in support of a theory. Page 9 includes a seismic data table from South America) Global Significant Earthquake Database, 2150 B.C. to present (Global significant earthquake database) http://www.ngdc.noaa.gov/hazard/volcano.shtml (Volcanic eruptions data base)
Student Resources:	https://geohazards.usgs.gov/eqprob/2009/index.php (Students can type in a zip code (or latitude/longitude) and a given time span and the USGS prediction of tectonic activity will be provided (based on prior data)) http://serc.carleton.edu/mathyouneed/graphing/bestfit.html (How to construct a line of best fit)
Assessment:	Students will create an info-graphic of past and present seismic data, predict future activity based on a trend line, and justify their answer. AND Students will work with a partner to compete a Pro/Con graphic organizer analyzing the cautions and benefits of trying to predict seismic activity. http://my.hrw.com/nsmedia/intgos/html/PDFs/Decision_Chart.pdf (Pro-con template)

Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a graph with axes labeled with independent and dependent variables. http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs)	The student may create a line of best fit using the graph the teacher provided
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide current news articles, current projections of plate movement, scientific literature for the student to investigate projections of future movement	The student may determine the probability of their prediction being realized based upon researched evidence
Critical Content:	• Line of best fit, trend line, Richter scale, seismology, data set, x-axis, y-axis, dependent and independent variable, prediction, probability	
Key Skills:	• Justify, predict, analyze	
Critical Language:	Line of best fit, trend line, Richter scale, seismology, data set, x-axis, y-axis, dependent and independent variable, prediction, probability, justify, predict, analyze	

Learning Experience # 12
Instructional Timeframe: Week 11

Learning Experience # 12	
The teacher may provide a case study of a particular area (e.g., Hawaii, Japan, San Andreas Fault, Yellowstone, and Ring of Fire) so that students can evaluate the area's resources, risks, and viability as a site for future/sustainable human settlement.	
Generalization Connection(s):	The structure of the Earth, shaped by plate tectonics, influences how organisms live, use resources and develop into communities Physical, chemical and biological processes change landforms by altering the chemical and physical structure of rock
Teacher Resources:	http://app.discoveryeducation.com/search?Ntt=+hawaii+plate+movement (Subscription required, video on Hawaii plate movement) http://app.discoveryeducation.com/search?Ntt=earthquakes+in+Japan#selItemsPerPage=20&intCurrentPage=1&No=20&N=0&Ne=&Ntt=earthquakes%2Bin%2BJapan&Ns=&Nr=&browseFilter=&indexVersion=&Ntk= (Japan proposes a hollow pyramid strong enough to stand up to earthquakes, typhoons, and tsunamis) http://www.lions.odu.edu/~ddepaor/Site/GES_1.html (Google Earth Science) http://www.youtube.com/watch?v=ZxPTLmg0ZCw (Discovery Channel describes the San Andreas Fault) http://www.geography.learnontheinternet.co.uk/topics/earthquakes_impact_response.html (This link is about how humans can be prepared to react to natural hazards to mitigate the damage) http://www.graphicorganizers.com/ (Graphic organizers students may be used to organize information)

Student Resources:	http://coe.jmu.edu/learningtoolbox/cornellnotes.html- (Cornell Notes Template)	
Assessment:	Students will create a product that informs about the features of this area and either encourages or discourages settlement based upon tectonic activity. Teacher note: This assessment provides a kind of draft outline for their final performance assessment. So teachers may encourage students to begin developing their perspective for their final performance assessment.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with a case study at students' independent reading levels that include extra visuals	The student may choose a format for their product that accommodates their strengths and needs
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with data tables, maps, graphs, and access to technology for further research and creation of product	The student may provide evidence and specific data from their research in their product
Critical Content:	• Resources, water quality, food supply, mineral deposits, energy sources, seismic activity, sustainability, biodiversity	
Key Skills:	• Interpret graphs and charts, summarize, synthesize, identify relationships, evaluate	
Critical Language:	Resources, water quality, food supply, mineral deposits, energy sources, seismic activity, sustainability, biodiversity, interpret graphs and charts, summarize, synthesize, identify relationships, evaluate	