LESSON SEED FOR INTEGRATING CONTENT STANDARDS IN A MIDDLE SCHOOL STEM-CENTRIC LEARNING EXPERIENCE
(Grades 6 through 8 with appropriate adjustments, as necessary)

Teacher	Content Standards	Potential Activities	Real-World Connection
 **Attributes of a STEM-centric minded middle school teacher**: • Collaborate with educators in other disciplines to develop integrated lessons. • Facilitate student engagement and questioning – this includes asking questions that promote higher order thinking and guiding students through the problem solving process. • Involve students in the real-world application of content. • Provide opportunities for students to design and conduct investigations to address the real-world connection. • Facilitate learning experiences that allow for the intentional and purposeful integration and application of content. • Provide support to students in their use of technology for exploration of the real-world connection. • Conduct ongoing assessments of students' performance, both formally and informally, to guide instruction and raise the quality of teaching.	**Mathematics** **6.NS.8** Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. **7.SP.7:** Develop a probability model and use it to find probabilities of events; compare probabilities from a model to observed frequencies; and if the agreement is not good, explain possible sources of the discrepancy. **7a.** Develop a **uniform probability model** by assigning equal **probability** to all **outcomes**, and use the model to determine probabilities of events. **8.F.5:** Describe qualitatively the **functional relationship** between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	**Mathematics** Students can graph data on earthquakes and look for patterns that relate location and magnitude to crustal plates. Students can infer correlations that may have a relationship to people's decisions to live in certain places both now and through history. Students can determine the relationships between dependent and independent variables. Students can also create or analyze graphs of relevant earthquake data to describe functional relationships between numbers and/or trends seen in the graphs.	**Earthquake in Maryland on August 23, 2011**: A 5.8 earthquake struck the D.C. area and beyond, shaking buildings, shattering windows and causing major traffic delays in the region. **Read more:** http://www.wjla.com/articles/2011/08/earthquake-felt-in-washington-d-c-area-65531.html#ixzz32yVZGFGh **Earthquake Resources:** Resources on earthquakes are provided in a separate document titled, "Earthquake Resources." This document gives the URLs for web sites featuring data, articles, animations, simulations, and other resources may be useful in this lesson seed. **Essential Questions**: • How do the physical characteristics and history of a region determine where and how people live? • How do plate tectonics affect the location of the occurrences of earthquakes? • What is the evidence that convention currents inside of the Earth are responsible for plate tectonics and the incidence of earthquakes and volcanic eruptions? **Culminating Activity**: • Given an assortment of materials, students will design two or more experiments or demonstrations that illustrate the circualtion of material due to convention of heat (thereby illustrating convention currents occurring within the earth that move the crustal plates). • Students will construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Emphasis should be on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical
	Science **ESS1.C: The History of Planet Earth** Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. *(HS.ESS1.C GBE),(secondary to MS-ESS2-3)* **ESS2.A: Earth's Materials and Systems** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how	**Science** Students will use the concept of flow of matter and energy to explain the movement of crustal plates, which not only generate new ocean floor, destroy old sea floor, and build mountains, but also form the underlying cause of earthquakes and volcanic eruptions. Students will use maps showing the locations of earthquakes and volcanic activity as well as data on location and frequency of earthquakes to identify the edges of the crustal plates. Teachers should also emphasize the Science and Engineering Practices and Cross-Cutting Concepts referenced below: **Science and Engineering Practices** • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations	

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NOTE: Feel free to use other content standards <u>as appropriate</u> that have a <u>natural fit</u> – for example, Visual Arts.

<u>STEM Standards of Practice</u> (SOPs)

1. Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content
2. Integrate Science, Technology, Engineering, and Mathematics Content
3. Interpret and Communicate STEM Information
4. Engage in Inquiry
5. Engage in Logical Reasoning
6. Collaborate as a STEM Team
7. Apply Technology Appropriately

Please be sure to incorporate the SOPs appropriate to the STEM learning experience you are creating. You may or may not be able to incorporate all seven STEM SOPs into every aspect of a lesson. However, in a STEM unit, which is typically longer and more global in scope, the expectation is that all seven STEM Standards of Practice will be addressed.

Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

<u>English Language Arts</u>

SL1.a Students come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

- Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. (CCSS 7 RL1, RI1)
- Identify the main ideas under discussion and apply higher order questions that yield a deeper analysis of those ideas.
- Conduct focused research as necessary to prepare for discussions. (See CCSS 6 W7; MD SLM 6-8 1A.)

W1 Students write arguments to support claims with clear reasons and relevant evidence.

<u>Social Studies</u>

D2.Geo.1.6-8. Construct maps to represent and explain the spatial patterns of cultural and environmental characteristics.

D2.Geo.2.6-8. Use maps, satellite images, photographs, and other representations to explain relationships between the locations of places and regions, and changes in their environmental characteristics.

D2.Geo.3.6-8. Use paper based and electronic mapping and graphing techniques to represent and analyze spatial patterns of different environmental and cultural characteristics.

D2.Civ.6.6-8. Describe the roles of political, civil, and economic organizations in shaping people's lives.

<u>Cross-Cutting Concepts</u>

- Patterns
- Cause and Effect
- Scale Proportion and Quantity
- Systems and System Models
- Energy and Matter

<u>English Language Arts</u>

Students will read informational text and examine various types of data, photographs, maps, and other types of digital and non-print text to develop an argument that supports the concept of convection of material below the earth's surface as the cause of crustal movement and subsequent occurrence of earthquakes. Students will then write an argument to support their claim and cite specific and relevant evidence.

<u>Social Studies</u>

Students will examine maps and various other representations to explain the relationship between the physical characteristics of an area and their impact on where and how people live. For example, if people are considering an earthquake-prone zone, what impact does that have on their decision to live there and/or distance to live from fault lines, the materials they use for construction, their way of life, etc., – **OR** does none of this make a difference. Also, does this impact regulations and guidelines for building, parameters for insurance claims, government services, etc.

<u>Engineering Design Process</u>

Teachers should take students through the engineering design process. Use a model that is most appropriate for your needs (*e.g.*, the ITEEA engineering design model which can be found on *msde.blackboard.com*. Look on the left menu under "Professional Learning Resources – "2013 Educator Effectiveness Academy Resources" – "Engineering").

reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events.

- Students will then communicate with students at a lower grade to answer the question of what is the natural cause of earthquakes.

NOTE: Make sure that you facilitate the students' understanding of the relationships between these activities and the standards being referenced.

<u>Career Connections</u>: Seismologist; Architect; Geoscientist; Surveyor; City Planner; Cartographer; Historian; Volcanologist; Environmental Geophysicist; Geologist; Geodynamicist; Geodesist; Geophysical Modeler; and others that are appropriate