Eyes on Earth: Teaching Earth Science from Space - Sphere 2 Lesson Plan

Lesson Title: Take a Deeper Look into Earth's Lithosphere

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Topic: *Students will learn the main topics of:*

- Earth's Lithosphere
- Earth's plate tectonic movements
- Natural geologic events & natural disasters

Targeted Grade Level: *7th Grade Science*

Time Needed: This 5E lesson plan would need about a week to complete, so about roughly 5-7 hours. Specific times will be expressed in each section.

Subject Integration: For math connections, students will be able to calculate the slopes of volcanoes to predict what type of volcano is being observed. This knowledge can then be transferred to volcanos on other planets or moons, which would then allow us to predict the properties of that celestial body. Students will also be able to be given word problems surround plate tectonic movement where they will calculate rate of movement.

Possible Student Preconceptions:

- Students might not understand the concept of plate tectonics.
- Students might think that present-day Earth is no longer changing as it did in the past.
- Students might think that the continents have moved into new locations but only because of earthquakes.

Connections to the Nature of Science:

- The theory of Continental Drift exposes students to the idea that science findings are frequently revised and/or reinterpreted based on new evidence.

Standards:

NGSS Performance Expectations **MS-ESS2-3** Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Developing & Using Models Students will do this when working with volcano models in the math sections when finding slope. ***Analyzing & Interpreting Data*** This is happening as students review NASA data from earthquake damages, volcanic activity, etc. They are almost constantly doing this throughout the unit.	**ESS2.B: Plate Tectonics & Large-scale system interactions**	***Patterns*** Ring of fire patterns with earthquake sites, etc. Plate tectonic movements and the natural things that come from their movements. ***Systems & System Models*** Earth broken down into its Lithosphere systems. Volcanos being broken down into how they work, along with earthquakes, etc.

Common Core State Standards:

Math: Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships. (Found here http://www.corestandards.org/Math/Content/7/introduction/)

Math extensions could be: Students calculate plate movement per year.

Cross-Curricular Connections:

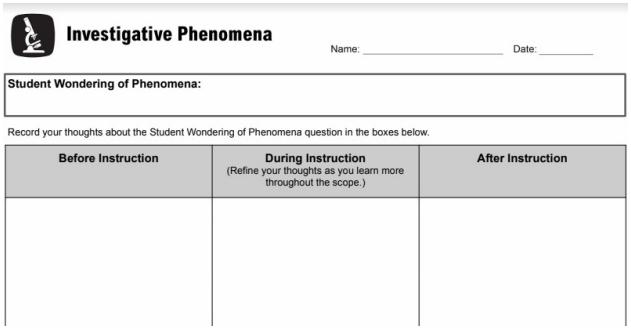
National Geography Standards:
Physical Systems – Standard 7 The physical processes that shape the patterns of Earth's surface.
The Uses of Geography – Standard 17 How to apply geography to interpret the past.

ITEEA Standards

- Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. (Siesmographs, NASA satellites, etc.)

5E Model	5E Objectives
Engage (approx. 30-45 mins.) ***Anchoring Phenomena Driving Question:*** *Show students fossils and ask them "how can the same species of fossil be found on different continents?".* ***Everyday phenomena***	**Materials & Resources:** • Enough mini trilobite fossils for each group (13) or pictures of them placed on the group's desk. • Each student receives a copy of the hook paper . (175 copies are made in total) This paper was made by the curriculum we used. I never had the opportunity to try this hook activity with my classroom, so I will not have made changes to it. • Each student receives a copy of the world map. (175 copies are made in total) • 5 laminated, blown up copies of the phenomena table for each class period. **Procedure:** Teacher's role during this phase –

Question: *Where were trilobites found?*	1. Have the copies ready at the door for students to pick up as they come into the classroom. 2. Have the fossils inside the blue container on the group's desk. Students know not to touch activity/lab materials before instructions have been given. 3. Project this link on the screen to the class - https://www.nationalgeographic.org/encyclopedia/fossil/. Ask students what they think they are seeing. Describe what a fossil is. 4. Explain to students that today they will be observing a specific fossil, the Trilobite, and they will be plotting where they have been discovered on the current world map. 5. Show the world map either on the screen or pull down the map that is rolled up on the white board. Ask for volunteers of the names of the major continents, countries, etc. (Make sure that the teacher has already memorized where the Trilobite fossils have been found so you know how to help students during the hook activity). 6. Have students examine the trilobite fossil/picture amongst their group. Ask for observations, then show on the screen what kind of organism it was long ago. https://www.pinterest.com/pin/299348706452861075/ 7. Give students time to complete their hook paper. Walk around the classroom ensuring they're on task and writing full sentences 8. After the hook activity is done, have a class discussion on the questions they answered. Accept all answers. 9. Have students open their interactive science notebooks and fill in the phenomenon question in the chart and their first ideas of the answer in the before instruction box (document is seen below). 10. Hang up a blown up, laminated version of the phenomena table in front of the classroom. With an expo marker, fill in ideas from certain groups that can be added into the before instruction box that answers the anchoring phenomena question.

<table>
<tr>
<td></td>
<td>

Investigative Phenomena Name: _____ Date: _____
Student Wondering of Phenomena:
Record your thoughts about the Student Wondering of Phenomena question in the boxes below.
<table>
<tr><th>Before Instruction</th><th>During Instruction
(Refine your thoughts as you learn more throughout the scope.)</th><th>After Instruction</th></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Formative/Summative Assessments Students will be formatively assessed by their oral discussions in class and their written work on their phenomena table. Since this is the hook/engage section, it is okay if there are misconceptions. Note those misconceptions, and make sure they are addressed in appropriate parts in the future lesson.
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<tr>
<td><u>Explore Activities</u></td>
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SWBAT: Explain what a volcano and earthquake is, describe patterns observed between continent shapes, and make connections to evidence found round the globe that leads to the idea of plate tectonics.

Procedure:

Teacher’s & students’ role -

(Part 1) (30-45 minutes)

1. Teacher instructs students to log into their chrome books and join the Nearpod lesson.
2. Embedded in the Nearpod lesson is websites for the students to explore. When the time comes to switch back to the lesson though, it automatically kicks the students off the website and back into the virtual lesson.
3. Have students explore this link https://earthquake.usgs.gov and have them click on the ‘latest earthquakes’ section, which will take them to see all registered 2.5+ earthquakes that have occurred in the past two days. Have discussions with students and listen to their observations of the daily amount of global earthquakes that have been recorded recently. Why is this happening? What causes them? Why don’t we hear about this daily on the news?
</td>
</tr>
</table>

4. What is a volcano? How are they formed? Why do they erupt? How frequently do they erupt?
5. Have students visit this link https://volcano.si.edu/gvp_currenteruptions.cfm and discuss the same questions that you did for earthquakes.
6. https://volcano.si.axismaps.io/ Show students this data set, which is a continuous loop of earthquakes, eruptions, and emissions over a span of 50+ years. Have students make observations, see if they make connections to where the earthquakes take places, versus the volcanoes. Accept all answers and thoughts, but don't dive too deeply into correct answers.

(Part 2) (45 minutes-1 hour) Phenomena Question – How are the continents like puzzle pieces?

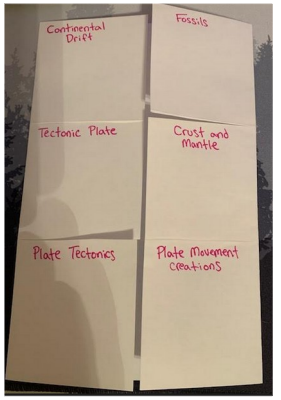
1. Ask students if our planet has always looked the way it does today? – Accept all ideas
2. Ask what happens on our planet daily, some things that they may have already discovered in the Hook/Engage section. – accept all answers (earthquakes, volcanic eruptions, weather patterns, etc.)
3. Show students world map, do they see any patterns with the continents?
4. Have students pull out Ziplock bag of continent shapes out. (they should have been cut by teacher to ensure that no major mistakes were made in their shapes.)
5. As a group, have students try to piece together the continents. The continents could have been cut out from something like this paper seen on the right.

6. Have students carefully draw a sketch of their pieces in their ISN's and have each student take a picture on their cell phones (if they have one) for future use.
7. Discuss if the continents fit together like a puzzle or not. (some did, some did not). Discuss if this would be enough evidence to conclude that the continents were once in a different location? (no, more evidence will be needed).
8. Have students fill in their during instruction box on their phenomena tables inside their ISN's, and gather their main thoughts and write it on their blown up version for their class period.

(Part 3) (1 hour – hour and a half) Phenomena Question: What can we infer from examining the distribution of fossils, rock formations, and continental shapes? Students will analyze and interpret

	data on distribution of rock formations, fossils, and continental shapes to provide evidence of past plate movements. 1. Reflect on previous explore activity of continental puzzle piece fittings. Introduce Wegener and his continental drift theory. 2. Have students complete this super evidence explore activity in their groups. Here is the link to the answer key so you know what the students are working on and what answers they should be getting to. This activity was given to me by my curriculum. I will have added to the lesson by making connections to the data sets we looked at in the engage sections and will later be connected to the NASA resources reviewed in the Explain section. 3. After completing this engage, have students add more into their during instruction box on their phenomena table in their ISN's. Add to their during instruction box for the blown up version. Materials: • Student work sheet • Student evidence • Tectonic Plates (Part 4) (1-2 Hours) Phenomena Question: What evidence do we have to support Wegener's theory of continental drift? This is another STEMscopes explore that would be necessary for students to complete in order to build the connections that are needed for this unit. I will not be going into detail about this because it is not needed in this assignment, but will mark it here that it is needed so in the future I can go into my curriculum and tweak what I'd need to. **Formative/Summative Assessments** Teacher will hold class discussions and see if students still hold misconceptions or not. Students will be writing in their phenomena tables, which are looked over by the teacher to see as they progress through the scope of learning. Teacher will also reflect on the class period phenomena table charts that students have added to. By now, their answers should reflect a more clear understanding of the standard. If not, in the Explain section they will be addressed.

Explain (2 hours)	**Procedure:** 1. Teacher would show this NASA video resource to the class. https://spaceplace.nasa.gov/tectonics-snap/en/ which would summarize what they have already learned and would make last minute connections for students. 2. Students would fill in their answers to this My NASA Data question sheet which goes along with the video. It's titled "What are plate tectonics student questions". 3. Have students explore this NASA website and have students take notes on key facts found on the website. 4. Have students then click on this link https://spaceplace.nasa.gov/volcanoes/en/ so they make the connections that more than just our planet has volcanoes found on it. 5. Instruct students to put away their chrome books an show this NASA video link on the screen https://nasaeclips.arc.nasa.gov/video/realworld/real-world-planetary-volcanoes 6. More connections will be made on volcanoes and plate tectonics, and students will now have a chance to make math connections. 7. Students will learn that the slope of a volcano says a lot about its properties. Have students observe and measure the different volcanic models that are shown around the classroom and have them find out the slope, and therefore have them make connections to its volcanic properties. 8. Show students the NASA image of earthquake damage in California. Have students observe the data being shown and ask why it is important for NASA to document where earthquakes are occurring and the aftermath. ("These datasets are helping local authorities assess damage and will also provide useful information to engineers for designing resilient structures that can withstand ruptures like the ones created by the latest quakes.") The image in particular is extremely interesting to me and connects to me because I grew up in the city of

	Fresno that is pictured in the NASA image. 9. Have students then take out the piece of white printer paper they picked up at the door and create a 6-door foldable with it. Example is shown here of the words I want them to have written down. 10. Tell students that this foldable will be their homework, and they will have to study it and bring it to class in their ISN to study from before the test. 11. Have students pull out all the laminated vocab cards from their table box and have the students work in groups to play charades on guessing the vocab word/definition. Teacher will need to walk around to formatively assess the students on how they're doing with the vocab words. (ELA connections)  During this entire section, the teacher must be formatively assessing the students by listening in to conversations, reading to responses, etc. that will determine if students are ready to be evaluated. If not, some elaboration lessons will be needed, or some lessons will need to be differentiated to where the students are broken down into groups who understand and those who do not. Teacher will need to work more closely with struggling students, while the other students may have opportunities to explore the elaborate lessons on their own. (There are plenty that can be done by students on their own).
Elaborate (If there is more time or a day before the exam, these activities can be done).	**Elaborate:** 1. http://ceo.scec.org/education/k12/learn/plate1.htm Allow students to access this interactive website where they can dive deeper into activities surrounding Earth's lithosphere. 2. Discuss the career of a Geologist and what it takes to become one, and what their roles are in society. This would be a great way to introduce diverse geologists 3. Have students do a one pager on a geologist of their choice (allow students to choose from a list) 4. Have students calculate tectonic plate movements per year by giving them a word problem

Evaluate	with facts to sort through. 5. https://volcano.si.axismaps.io/ students use the data found from this website (that they already explored) and plot data on a graph of their choosing that would make the most sense to create for the types of things being discussed. 6. Have another charade game where volunteers come to the front of the classroom and try to get the class to guess what vocab word they're describing. 7. Do a partner vocab foldable study session. If students are not doing well in the charade game or vocab study, bring it back to whole group and go over weaker areas. **Evaluate – All types of assessments are aligned to the standard that was taught for this scope.** I got this idea from a classmate in the group discussion board and I absolutely loved it. My original idea was to do a CER on a map labeled with fossils found around the world and they had to support Wegner's theory with evidence. What I went with though was forming this CER around a real-world problem such as where should we store nuclear waste. So in this Evaluation, students would be given a 15 minute discussion on what nuclear waste is (unless we had already talked about this in a previous human impact lesson). This link http://standleyfrankenscience.weebly.com/uploads/5/9/9/3/59932823/plate_tectonics_book_2020.pdf takes you to the scenario that is presented to students which pairs up with what they have already learned for the unit. I would use pdf pages 54-58 and would print off my own versions of the exam. This CER would be real-world based and would require students to pull in all info they have learned and use map data in the process of answering it. I would probably change it though to only have it be a personal exam. If it was group based, I would fear that one or two students would rely on others to guide them. I might have some class periods take it in a group, and some by themselves and then compare the test result data, to see how to plan for future years. I would also give them a 30-question multiple choice assessment for quick analysis. Any students who did not pass the first time will receive small group instruction and then be required to take it a second time. (That was a requirement at my old school site. It was in their opinion that it didn't matter at what point along the way the student learned, but the fact that they did learn the standards before

	proceeding to the next unit).

Citations:

- Global Volcanism Program, 2013. Volcanoes of the World, v. 4.9.1 (17 Sep 2020). Venzke, E (ed.). Smithsonian Institution. Downloaded 09 Nov 2020. https://doi.org/10.5479/si.GVP.VOTW4-2013.
- Global Volcanism Program, 2016. Eruptions, Earthquakes & Emissions, v. 1.0 (internet application). Smithsonian Institution. Accessed 09 Nov 2020 (https://volcano.si.edu/E3/).
- http://standleyfrankenscience.weebly.com/uploads/5/9/9/3/59932823/plate_tectonics_book_2020.pdf (Downloaded from ebooks.lab-aids.com) (This resource was given to me by another student from class, and seems to be a section from a text book).
- https://www.stemscopes.com/ (2020 Accelerate Learning) I do not see a correct way to properly site an online school curriculum.