Mississippi CCSS 2018

E.8.9AStudents will demonstrate an understanding that physical processes and major geological events (e.g., plate movement, volcanic activity, mountain building, weathering, erosion) are powered by the Sun and the Earth's internal heat and have occurred over millions of years.
E.8.9A.1Investigate and explain how the flow of Earth's internal energy drives the cycling of matter through convection currents between Earth's surface and the deep interior causing plate movements.
E.8.9BStudents will demonstrate an understanding of natural hazards (volcanic eruptions, severe weather, earthquakes) and construct explanations for why some hazards are predictable and others are not.
E.8.9B.1Research and map various types of natural hazards to determine their impact on society.
E.8.9B.2Compare and contrast technologies that predict natural hazards to identify which types of technologies are most effective. (other tech will be discussed in future lessons to compare and contrast).
Building towards this standard
E.8.9B.3Using an engineering design process, create mechanisms to improve community resilience, which safeguard against natural hazards (e.g., building restrictions in flood or tidal zones, regional watershed management, Firewise construction).*

What cause earthquakes and can we prevent them?

<table>
<tr><td>Grade/ Grade Band: 8th grade</td><td>Topic: Plate tectonics/lithosphere</td><td>Lesson # __1___ in a series of __3___ lessons</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students will learn about the lithosphere and plate tectonics. During these lessons students will also learn about satellites and how they measure plate movement .</td></tr>
<tr><td colspan="3">Performance Expectation(s): Students will apply their knowledge of plate tectonics and the benefits of data from satellites to explain if we can predict earthquakes. We will start with a lesson on</td></tr>
<tr><td colspan="3">Specific Learning Outcomes: Students will comprehend, explain and apply their knowledge with respect to: layers of the earth, density, convection currents, plate movement, types of boundaries, earthquakes: cause and predictability, how to measure plate movement.</td></tr>
<tr><td colspan="3">Narrative / Background Information</td></tr>
<tr><td colspan="3">Prior Student Knowledge: Students have a rudimentary knowledge of the layers of the earth: core, mantle, and crust. Students know about earthquakes from news coverage (if they chose to read about them) or movies. Generally speaking they know the earth shakes and causes destruction.
Students have knowledge of density but do not understand the application of the concept. The underlying theme or big idea behind all things plate tectonics is density. Throughout this unit, TTW make sure students understand how density it the driving force behind each part of plate tectonics.</td></tr>
<tr><td>Science & Engineering Practices: for the whole lesson
1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information</td><td>Disciplinary Core Ideas: for the whole lesson
MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2.B: Plate Tectonics and Large-Scale System Interactions</td><td>Crosscutting Concepts: for the whole lesson
Math
• Rate is a speed of motion
• Velocity has both magnitude (rate = speed) and direction of motion
• Velocities are represented by vectors
• Vectors can be mathematically manipulated
• Vectors can be used to describe properties of motion
ELA social perspectives
• What would it be like to live near a boundary?</td></tr>
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<tr><td colspan="3">LESSON PLAN – 5-E Model</td></tr>
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ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: The teacher will (TTW) post the prompt: What are Earthquakes? TTW play the video https://www.youtube.com/watch?v=vm4xx6P56H4
The learner will (TLW) participate in a discussion about what they know about earthquakes. Teacher is looking for shaking of the earth…
(TTW) follow with students observing https://earthquake.usgs.gov/earthquakes/ earthquakes occurring in real time.
TTW & TLW explore the map and look at history till students conclude that earthquakes happen (predominately) in certain areas.
TTW conclude with the question: Why do they only occur in those areas?

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:
TLW (in groups) stack a chafing dish or thick (resist heat) plastic bin on books and place a heating lamp below.
TLW fill the dish with 2" of water and place 4 (styrofoam or wood) square blocks in the center forming a larger square.
TLW turn on the heat lamp and record observations for 10 to 15 minutes or until motion is detected and recorded.
TTW then ask learners what did the block do and discuss how is this related to earthquakes?
TTW keep the conversation focused on the blocks and earthquakes. High level learners may start looking deeper but keep them focused (have them write down questions or observations for later and assure the learner that this will be addressed).
TTW continue until learners conclude that movement only occurred in certain areas much like earthquakes only happen in certain areas.

EXPLAIN: Concepts Explained and Vocabulary Defined:
TLW use the following worksheets (except for V) to complete a web quest on plate tectonics.
https://www.madison-schools.com/cms/lib/MS01001041/Centricity/Domain/1994/Plate%20Tectonics%20Webquest.pdf (links are embedded in the pdf but here is the website to Dynamic Earth http://www.learner.org/interactives/dynamicearth/index.html)
TLW complete the web quest in groups of 2 or 3.
TLW be instructed to write down questions about anything they don't understand.
TT & TLW talk about the web quest.
TTW make sure learners understand the very important role density plays in how matter interacts at each of the boundaries.
TTW make sure learners are aware of all of the characteristics of the boundaries (even though we are focusing on earthquakes)
TTW ask formative monitoring question randomly to varying students during discussion.
TTW ask these questions about all boundaries.
Supplemental ppt. if needed (remove 5 and 6 at this point in the lesson) https://www.madison-schools.com/Page/10114#
Vocabulary: is embedded in the web quest.

ELABORATE: Applications and Extensions:
TT & TLW explore and discuss https://www.nasa.gov/audience/forstudents/5-8/features/F_Earth_Has_Faults.html
(make sure to click view site at the bottom of page and cover earthquakes)
TLW take notes using the Cornell Method
ELA-TLW respond to the prompt: What do you think life would be like if you lived next to a boundary (Compare and contrast to your day to day life).

EVALUATE: Formative: Give students part V of the web quest. or
Alternative fun assessment: (TO BE DONE IN THE CAFETERIA) get the cafeteria or a parent to make a big bowl of grits (chilled) and 2 rectangular pieces of yellow cheddar cheese and 2 pieces of white cheddar along with tiny pats of frozen butter. (bowls and spoons for each student). Give each student a small bowl of grits and 2 pieces of each cheese (you may pick which is continental and which is ocean). Ask students: If the cheese represents tectonic plates then what do the grits represent? (asthenosphere) Ask students to model each type of boundary and discuss the landforms (explain that frozen butter are volcanoes)….and when the assessment is over, heat everything up and have a snack!

Formative Monitoring (Questioning / Discussion): Why do some plates subduct. Where do earthquakes occur? What happened at this boundary.

Summative Assessment (Quiz / Project / Report): TLW take a summative assessment created from a district data base focused only on plate tectonics theory and boundaries**.**

Elaborate Further / Reflect: Enrichment:

Materials Required for This Lesson/Activity			
Quantity	**Description**	**Potential Supplier (item #)**	**Estimated Price**
4-6	Chafing dishes or thick plastic boxes		
Depends on container size	water		
16-24	Wood or Styrofoam blocks. Dimensions depend on the size of container		
4-6	Heat lamps or 150-200 w light bulbs		
4-6	Power sources (sockets or extension cords)		
24-32/per class (one for each student)	Small paper bowls and spoons		
2-3 bags of grits pre-prepared and chilled	grits		
48 to 64 pieces of each cheddar cheese cut into rectangles (2 each per student)	yellow & white cheddar cheese		
30-40	Tiny pats of frozen butter		

Grade/ Grade Band: 8th	**Topic:** Lithoshpere/plate tectonics	**Lesson # __2___ in a series of __3___ lessons**
Brief Lesson Description: In this lesson students will revisit lab to discover convection currents. Then conduct a separate lab and be assessed on comprehension of convection currents.		
Performance Expectation(s): Create a model of the Earth's interior forces that influence plate movement.		
Specific Learning Outcomes: TLW apply their knowledge of density to explain convection currents and how they influence the movement of plates.		
Narrative / Background Information		
Prior Student Knowledge: See previous lesson- learners know about plate tectonic theory and boundaries.		
Science & Engineering Practices: 1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data	**Disciplinary Core Ideas:** MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS2.B: Plate Tectonics and Large-Scale System Interactions	**Crosscutting Concepts:**
Possible Preconceptions/Misconceptions:		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: TTW post the prompt: What causes the plates to move. TLW revisit their observations from the first lab and discuss in small groups. TT & TLW discuss until everyone concludes that the lamp had a role in the movement.		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: TLW (in groups) do the lab in the first part and this time add food coloring between the "boundaries.". TLW record observations and discuss in group. TT & TLW discuss until learners can see and conclude that heat is causing the water to move. TTW will try to get the learners to conclude density.		
EXPLAIN: Concepts Explained and Vocabulary Defined: TTW show slide 5 & 6 from previous ppt. and explain convection currents (emphasis on density). TLW take notes using the Cornell Method. TTW show https://spaceplace.nasa.gov/tectonics-snap/en/ **Vocabulary: convection current**		
ELABORATE: Applications and Extensions: TTW fill a large beaker or large mason jar with water. TTW empty at least pencil sharpener into the water. TTW will stir the pencil shavings until most have settled to the bottom. TTW place the container on a heat source and not apply heat at this point. TTW ask students to predict in words and in a drawing what will the wood shavings do after the water gets hot. TTW walk the room making formative assessments and offering guidance as needed. Questions to consider for learners still needing some guidance: What will happen when I turn on the heat. Where will it start heating? What will happen to the particles of water closest to the bottom of the glass? What happens to matter as it heats up. TTW apply heat and the learner will record observations. Once the pencil shavings stop moving up and down the container TTW ask why did it stop. Discuss until students conclude temperature has reached near equilibrium.		
EVALUATE: TTW give quiz (attached below) **Formative Monitoring (Questioning / Discussion):** How does density affect the movement of matter? Which is more dense, hot matter or cold matter? In the same medium, how do less dense particles react? Why did this plate subduct? Why did these two plates push up? **Summative Assessment (Quiz / Project / Report):** TLW take a summative assessment created from a district data base focused only on plate tectonics theory and boundaries**.**		

Materials Required for This Lesson/Activity			
Quantity	**Description**	**Potential Supplier (item #)**	**Estimated Price**
4-6	Chafing dishes or thick plastic boxes		
Depends on container size	water		
16-24	Wood or Styrofoam blocks. Dimensions depend on the size of container		
4-6	Heat lamps or 150-200 w light bulbs		
4-6	Power sources (sockets or extension cords)		
2	Vials of food coloring		
4-6	Mason jars or beakers		
1-2	Heat sources (need hot water) Bunsen burner, hot plate		
2 -3 tsp	Pencil shavings (finely cut)		

Grade/ Grade Band: 8th grade science	**Topic:** Lithosphere/plate tectonics	**Lesson #** __3__**in a series of** _3_ **lessons**
Brief Lesson Description: Students will use evidence/data sets from satellites to prove plate tectonics. Students will use their knowledge to discuss the prompt: How can technology better prepare us for earthquakes? Can we predict earthquakes?		
Performance Expectation(s):		
Specific Learning Outcomes: Students will be able to explain how technology can better prepare us for certain phenomena but in the end, we cannot predict when they will occur.		
Narrative / Background Information		
Prior Student Knowledge:		
Science & Engineering Practices: 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**Disciplinary Core Ideas:** MS-ESS2.B: Plate Tectonics and Large-Scale System Interactions	**Crosscutting Concepts:** Math • Rate is a speed of motion • Velocity has both magnitude (rate = speed) and direction of motion • Velocities are represented by vectors • Vectors can be mathematically manipulated • Vectors can be used to describe properties of motion
Possible Preconceptions/Misconceptions:		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: TLW respond to the prompts in a discussion: What is the theory of plate tectonics? Why is it a theory? Do you know of any other theories? Do you know of any data we could use to prove that plates move…we can't feel it, we can't see it?		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: The teacher will ask what is GPS. What do the letters mean? TTW and TLW review and discuss https://www.e-education.psu.edu/earth520/content/l7_p7.html In math class TLW use the following resource to learn how to calculate plate movement http://ceo.scec.org/education/k12/learn/gpsact2.htm In science class TT & TLW view https://sideshow.jpl.nasa.gov/post/series.html TTW explain that GPS satellites combined with monitors on earth are able to use triangulation and measure movement of certain places. I would like each group to pick a site and in math class, calculate the rate of movement. TLW pick a site and TTW will give them the data to be calculated and graphed in math class. TLW check their calculation by clicking on the city and comparing data.		
EXPLAIN: Concepts Explained and Vocabulary Defined: TT & TLW Look at NASA https://visibleearth.nasa.gov/view.php?id=88415 (I WILL REPLACE THIS WITH ONE OF THE COOL ONES YOU SHOWED IN CLASS TONIGHT. I COULD NOT FIND THEM) to determine that plates move at different rates and directions. TLW identify convergent and divergent plates on the map based on landforms.		
ELABORATE: Applications and Extensions:. TLW in groups, view the web site https://earthquake.usgs.gov/research/earlywarning/overview.php and respond to the prompts: With all of this technology and information, can we predict earthquakes? Why or Why not? What technologies were used to measure and aid in predicting earthquakes? How does technology and or satellites aid humans with regard to earthquakes? TTW ask: What other information might be beneficial? TT & TTW discuss https://disasters.nasa.gov/earthquakes TT & TLW review notebook and highlight key information for future project.		

EVALUATE: After this we will begin our unit on hurricanes then EBD and TLW design a structure for either earthquake or hurricane preparedness. This will be our 2nd year with these new standards and our first time tackling this EBD project. **Formative Monitoring (Questioning / Discussion):** What landforms are featured at each convergent boundary? What landforms are formed at each divergent boundary? What is the force acting on the plates causing them to move? Does this force act on all plates equally? Is Hawaii a plate boundary? **Summative Assessment (Quiz / Project / Report):**
Elaborate Further / Reflect: Enrichment:

References

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Plate Tectonics and Convection Currents Quiz

Name____ Block___________

1. Describe the particles of matter at point A in terms of density.
____
____
____

2. Justify your answer.
____

3. What type of boundary is point B? ________________________________

4. Justify your answer.
____

5. What type of boundary is point C? ________________________________

6. Justify your answer.
____

7. Describe the particles of matter at point D.
____
____
____

8. Justify your answer ____