Unit 8: Earth Systems

CONTENT AREA: General Physical Science	GRADES: 7	UNIT: 8 of 8
Pacing: Approx. 2 Months (April & May)		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models - Develop and use a model to describe phenomena. **(MS-ESS2-1)** **Constructing Explanations and Designing Solutions -** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. **(MS-ESS1-4),(MS-ESS2-2)** **Analyzing and Interpreting Data -** Analyze and interpret data to provide evidence for phenomena. **(MS-ESS2-3)**	ESS1.C: The History of Planet Earth ● The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4) 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 Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)	**Stability and Change** ● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1) **Scale Proportion and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4),(MS-ESS2-2) **Patterns** ● Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) - ***Connections to Nature of Science*** **Scientific Knowledge is Open to Revision in Light of New Evidence** ● Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)

Performance Expectations: MS-ESS2-1, MS-ESS2-2, MS-ESS2-3		
Evidence Statement(s): MS-ESS2-1, MS-ESS2-2, MS-ESS2-3		
Essential Question: If no one was there, how do we know the Earth's history? What provides the forces that drive Earth's systems?		
21st Century Skills: 9.2.8.B.3, 9.2.8.B.4		
Career Ready Practices: CRP4, CRP6, CRP7		
Technology:HS-ETS1-1 HS-ETS1-3		
Technical Terms (Suggested)	**Core Instructional Materials**	**Assessment Statement**
Geologic Time Scale Rock Formations Fossils Strata Relative Dates Melting Crystallization Weathering Deformation Atomic Scale Erosion Time ** All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.**	MS-ESS2-1 - Chromebook, internet access, smartboard, notebook, pen, pencil, whiteboard. MS-ESS2-2- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard. MS-ESS2-3- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard.	Students who understand the concepts are able to: • Construct a scientific explanation based on valid and reliable evidence from rock strata obtained from sources (including the students' own experiments). • Construct a scientific explanation based on rock strata and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Modifications

English Language Learners	Special Education	At Risk	Gifted & Talented
Scaffolding	Word walls	Teacher tutoring	Curriculum compacting
Word walls	Visual aides	Peer tutoring	Challenge assignments
Sentence/paragraph frames	Graphic organizers	Study guides	Enrichment activities
Bilingual dictionaries/translation	Multimedia	Graphic organizers	Tiered activities
Think alouds	Leveled readers	Extended time	Independent research/inquiry
Read alouds	Assistive technology	Parent communication	Collaborative teamwork
Highlight key vocabulary	Notes/summaries	Modified assignments	Higher level questioning
Annotation guides	Extended time	Counseling	Critical/Analytical thinking tasks
Think-pair-share	Answer masking		Self-directed activities
Visual aides	Answer eliminator		
Modeling	Highlighter		
Cognates	Color contrast		

5E Model	
Performance Expectation: MS-ESS2-1 **Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.**	
Engage: Anticipatory Set	Form small groups of students and distribute chart paper, markers, and rock samples. Each group will investigate its given rock samples and sort them according to common characteristics (crystallization, smooth, glassy, etc.). Then each group will record these characteristics on the chart paper. The teacher will circulate around the room and ask guiding questions (EX: Explain how you characterized your rock samples. Why did you sort these rocks the way you did?) One student representative from each group will visit another group and observe how that group categorized their rock samples. They will return to their original group and discuss the comparisons. The teacher will engage the students in a whole group discussion about the engagement activity. The teacher will help students build upon prior knowledge of the different types of rocks: sedimentary, igneous, and metamorphic. Then students will view a short video clip that further details the journey a rock takes through the rock cycle. Videos: https://www.khanacademy.org/partner-content/mit-k12/mit-k12-biology/v/rock-cycle (Grade level videos- also covers the flow of energy) http://studyjams.scholastic.com/studyjams/jams/science/rocks-minerals-landforms/rock-cycle.htm https://www.youtube.com/watch?v=uAAeFB7Tv5A
Exploration: Student Inquiry	Present the online PowerPoint: Energy in the Rock Cycle http://www.uen.org/Lessonplan/downloadFile.cgi?file=36937-2-43128-EnergyinCyclePPT_.pptx&filename=EnergyinCyclePPT_.pptx Ride the Rock Cycle http://teacherstryscience.org/lp/ride-rock-cycle In this mutli-day lesson, students will: Participate in a kinesthetic activity related to the rock cycle Compare/ contrast representations of data Design their own simulation of the rock cycle Activity 1: Ride the Rock Cycle In this interactive game, students will act as a rock going through the rock cycle. Students will track their journey using the Journey on the Rock Cycle worksheet. Students will synthesis the information gathered during the activity by creating a Comic Strip that outlines the process of the rock cycle. Activity 4: Design & Simulation Task Students will explore the environmental factors that can affect rocks including erosion/weathering, deposition, cementation/ compaction, heating, pressure, and cooling.
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 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.
Elaboration: Extension Activity	In this extension activity, students will describe which processes might be affecting a given region, using evidence from natural features presented on a map. Rock Cycle Roundabout http://www.calacademy.org/educators/lesson-plans/rock-cycle-roundabout
Evaluation: Assessment	Assessment Task A: Ride the Rock Cycle- Comic Strip Student Worksheets and Rubrics Assessment Task B: Environmental Factors Rubric Develop and use a model to describe phenomena. Student Worksheets and Rubrics

5E Model	
Performance Expectation: MS-ESS2-2 **Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.**	
Engage: Anticipatory Set	Weather and Erosion Introduction Activity: http://www.scoe.net/slypark/pdf/Pre_Sly_Park-Shaping_Earth's_Surface_Activity.pdf Plate Tectonics Video: http://education.nationalgeographic.org/media/plate-tectonics/
Exploration: Student Inquiry	Geological Timeline: Discovery The purpose of this lesson is to introduce students to the features of geologic timelines. http://betterlesson.com/lesson/637787/geologic-timeline-discovery Convection Current http://betterlesson.com/lesson/633215/convection-currents In this activity, students will identify that temperature change impacts the density of a substance, and the resulting change can cause movement inside the Earth. In completing these activities, students will have concrete experiences that they can refer to when constructing explanations about the big idea- how geoscience processes have changed Earth's surface. Have students construct an explanation to the following questions. Explanations should be based on evidence they gained from the activity, Scientists have estimated that the temperature of the Earth's core may be as warm as 10,800 degrees Fahrenheit - how is the Earth's mantle which lies just above the core affected by the temperature of the Earth's core? What happens as the mantle is heated? What happens as it becomes less dense?

	What happens to the mantle as the heated material rises? We call the circular motion created by the heating and cooling of fluids a convection current. How might this convection current cause tectonic plate movement?
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): ESS2.A: Earth's Materials and Systems 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. ESS2.C: The Roles of Water in Earth's Surface Processes Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.
Elaboration: Extension Activity	Related Activities Earth Science Week MS-ESS2-2 http://www.earthsciweek.org/ngss-performance-expectations/ms-ess2-2
Evaluation: Assessment	Assessment Task A: Construced-Responses Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.

5E Model	
Performance Expectation: 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.**	
Engage: Anticipatory Set	Fossil Evidence of Plate Tectonics https://prezi.com/plwzjedxstfi/fossil-evidence-of-plate-tectonics/
Exploration: Student Inquiry	The Theory of Plate Tectonics https://www.teachengineering.org/collection/csm_/activities/csm_platetectonics/csm_platetectonics_activity1_worksheet_v3_tedl_dwc.pdf Pangaea- Wegener's Puzzling Evidence

	In this activity, students will use fossil evidence and maps to write an evidence-based position statement defending or refuting the theory of continental drift. http://betterlesson.com/lesson/635197/pangaea-wegener-s-puzzling-evidence
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 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) 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 Earth's plates have moved great distances, collided, and spread apart.
Elaboration: Extension Activity	Plate Tectonics Puzzle American Museum of Natural History: Plate Tectonic Puzzle
Evaluation: Assessment	Assessment Task A: Theory of Plate Tectonics- Position Paper Analyze and interpret data to determine similarities and differences in findings. The Theory of Plate Tectonics: Using information learned from activity, students will determine whether they would support Wegener's hypothesis or not. Then students will construct a written explanation that explains their position. Assessment Task B: Pangaea - Wegener's Puzzling Evidence- Position Paper After modeling the stating of specific evidence as a whole class discussion, students write a position statement in their science journals. The requirement is to cite four pieces of compelling evidence that leads them to agree or disagree with Wegener's ideas about plate movement using their maps and fossil evidence.

If no one was there, how do we know the Earth's history?

What provides the forces that drive Earth's systems?

Students examine geoscience data in order to understand processes and events in Earth's history. Important crosscutting concepts in this unit are *scale, proportion, and quantity*, *stability and change*, and *patterns* in relation to the different ways geologic processes operate over geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth's systems. Students understand how Earth's geo-systems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Students are expected to demonstrate proficiency in *analyzing and interpreting* data and *constructing explanations*. They are also expected to use these practices to demonstrate understanding of the core ideas.

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING PEs and DCIs
1	**Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** *[Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.]* [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.*]*	**(MS-ESS1-4)**
2	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** *[Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.]* [Assessment Boundary: Assessment does not include the identification and naming of minerals.*]*	**(MS-ESS2-1)**
3	**Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** ***[Clarification Statement: Emphasis is 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 reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]***	(MS-ESS2-2)

4	**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).]* [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.*]***	**(MS-ESS2-3)**

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Evidence Statements: MS-ESS1-4 **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Evidence Statements: MS-ESS2-1 **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. Evidence Statements: MS-ESS2-2 **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence	**ESS1.C: The History of Planet Earth** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. **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.** **ESS2.A: Earth's Materials and Systems** **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.** **ESS2.C: The Roles of Water in Earth's Surface Processes** **Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.** **ESS1.C: The History of Planet Earth**	**Crosscutting Concepts** ESS1.4 **Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. ESS2.1 **Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. ESS2.2 **Scale Proportion and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. Evidence Statements: MS-ESS2-3 **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. **Connections to Nature of Science** **Scientific Knowledge is Open to Revision in Light of New Evidence** Science findings are frequently revised and/or reinterpreted based on new evidence.	**Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE),(secondary)** **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 Earth's plates have moved great distances, collided, and spread apart.**	ESS2.3 **Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems.

Connections to other DCIs in this grade-band: MS.LS4.A ; MS.LS4.C ; MS.PS1.A ; MS.PS1.B ; MS.PS3.B ; MS.LS2.B ; MS.LS2.C ; MS.ESS1.B ; MS.ESS3.C ; MS.PS1.B ; MS.LS2.B; MS.LS4.B
Articulation of DCIs across grade-bands: 3.LS4.A ; 3.LS4.C ; 3.LS4.D ; 4.ESS1.C ; HS.PS1.C ; HS.LS4.A ; HS.LS4.C ; HS.ESS1.C ; HS.ESS2.A ; 4.PS3.B ; 4.ESS2.A ; 5.ESS2.A ; HS.PS1.B ; HS.PS3.B ; HS.LS1.C ; HS.LS2.B ; HS.ESS2.A ; HS.ESS2.C ; HS.ESS2.E ; 4.ESS1.C ; 4.ESS2.A ; 4.ESS2.E ; 5.ESS2.A ; HS.PS3.D ; HS.LS2.B ; HS.ESS1.C ; HS.ESS2.A ; HS.ESS2.B ; HS.ESS2.C ; HS.ESS2.D ; HS.ESS2.E ; HS.ESS3.D ; 3.LS4.A ; 3.ESS3.B ; 4.ESS1.C ; 4.ESS2.B ; 4.ESS3.B ; HS.LS4.A ; HS.LS4.C ; HS.ESS1.C ; HS.ESS2.A ; HS.ESS2.B

Common Core State Standards Connections:

CCSS- ELA: RST.6-8.1, WHST.6-8.2, SL.8.5, RST.6-8.1, WHST.6-8.2, SL.8.5, RST.6-8.1, RST.6-8.7, RST.6-8.9
CCSS-
Math: 6.EE.B.6, 7.EE.B.6, MP.2, 6.EE.B.6, 7.EE.B.4, MP.2, 6.EE.B.6, 7.EE.B.4