Scope and Sequence: "Earth's Changing Surface"

Unit Learning Goal: At any given point in time, Earth's surface is both building up and wearing down. Some processes build up Earth's surface, while other processes wear down Earth's surface. These processes include weathering, erosion, and deposition and cause Earth's surface to look different in different places.			
Unit Central Question: What can cause Earth's surface to look the way it does?			
Anchoring Phenomenon: The Mississippi delta has grown over thousands of years.			
Lesson	**Focus Question**	**Main Learning Goal**	**Science Content Storyline**
1	Has Earth's surface always looked this way? Why or why not?	Maps can help locate the different land and water features of Earth. While Earth's surface appears stable, it is changing over time. Observing land over time leads us to questions about how Earth's surface changes. **Science and Engineering Practices** Asking Questions: Ask questions that can be investigated and predict ~~reasonable outcomes~~ based on patterns such as cause and effect relationships. **Crosscutting Concepts** Stability and Change: Some systems appear stable, but over long periods of time will eventually change. Change is measured in terms of differences over time ~~and may occur at different rates~~.	Maps can be used to locate land and water features. Water from all over the United States runs off the land and eventually into the Mississippi River. Where the river meets the ocean, there is a delta. Maps from different time periods show that while a system can appear stable, it can actually change over time. The Mississippi delta has grown larger over thousands of years. The river has changed course several times, and at the end of the river, new land forms and other land disappears. We have a lot of questions about how new land can form at the end of a river.
2	What causes deltas to form?	Erosion and deposition are processes that change the surface of Earth by carrying and depositing earth materials from one place to another. These processes are the driver of delta formation. **Science and Engineering Practices** Developing and Using Models:	Moving water in rivers and streams shapes and reshapes Earth's surface by moving rocks and soil from higher elevations and depositing them at lower elevations. Erosion is the process by which weathered earth materials, such as rock fragments, sand, and soil, are removed from one place on Earth's surface and transported by wind and/or water. As the kinetic energy of the wind or water

		Develop and/or use models to describe and/or predict phenomena. **Crosscutting Concepts** Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change.	decreases, the earth materials are deposited, building up new land. Deltas form at the end of rivers when this new land builds up over time.
3	What can change how fast deltas grow?	The amount of water, vegetation, and slope of the land can speed up or slow down erosion and deposition. **Science and Engineering Practices** Planning and Carrying Out Investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. Analyzing and Interpreting Data: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. **Crosscutting Concepts** Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change. Stability and Change: Change ~~is measured in terms of differences over time and~~ may occur at different rates.	Rainfall, the amount of water flowing, vegetation, and the type and slope of the land can affect the rate of erosion and deposition, changing where soil and rock flow and deposit. The Mississippi River freely deposited soil and rock that flowed from other places, which created the delta originally.
4	What can cause a delta to shrink?	Erosion and deposition are ongoing processes that continue to shape and reshape the land. People can also change where the rock and soil flow. This has positive and negative effects. **Science and Engineering Practices** Constructing Explanations: Construct an explanation of observed relationships.	Increased flooding and rainfall caused humans to build walls to manage the flow of the river. This caused a steadier flow of water for communities and transportation along the river but limited how soil and rock could be deposited in the delta. Over time, the land seems to “disappear,” but really the soil and rocks are being swept away by the flow of water and wave currents faster than the land is

		Crosscutting Concepts Systems and System Models: A system can be described in terms of its components and their interactions. Stability and Change: Some systems appear stable, but over long periods of time will eventually change.	deposited from the river. Human activity can have both positive and negative effects on natural processes.
5	Where does the soil and rock in a delta come from, and where does it go? Does the rock and soil ever change?	Weathering is a process that changes Earth's surface by causing rock to fragment, crack, and crumble into smaller pieces. As rock and soil interact with water (rain, waves, ice), wind, or plants, they break apart into smaller pieces over time. Weathering and erosion are ongoing processes. **Science and Engineering Practices** Analyzing and Interpreting Data: Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Constructing Explanations: Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. **Crosscutting Concepts** Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change. Stability and Change: Some systems appear stable, but over long periods of time will eventually change. Systems and System Models: A system can be described in terms of its components and their interactions.	Smaller rocks were once part of bigger rocks. Rock breaks down all over the land because of rain, ice, vegetation, and wind. Weathering is a set of processes that cause rock to break into smaller and smaller pieces. Rocks that are carried away due to erosion previously came from bigger rocks. Rock and other weathered materials are transported between different land and water features. As rocks continue to be carried away (erosion) by gravity, water, and/or wind, the rocks continue to break down into smaller pieces (weathering). These smaller pieces can be deposited in different places, building up the surface of Earth.

6	What can cause Earth's surface to look the way it does?	At any given point in time, Earth's surface is both building up and wearing down. Some processes build up Earth's surface, while other processes wear down Earth's surface. These processes include weathering, erosion, and deposition and cause Earth's surface to look different in different places. **Science and Engineering Practices** Constructing Explanations: Construct an explanation of observed relationships. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. **Crosscutting Concepts** Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change. Stability and Change: Some systems appear stable, but over long periods of time will eventually change.	Weathering, erosion, and deposition are earth processes that have effects on many different types of landforms. This is part of the reason that Earth's surface looks different in different places. However, these three processes cannot explain all land changes, which leads us to wonder about other processes.

Fourth Grade "Earth's Changing Surface"
Relevant Standards

<table>
<tr><th colspan="3">NGSS 4th grade</th><th colspan="2">Tennessee Standards</th></tr>
<tr><td colspan="2">PEs</td><td>SEPs</td><td colspan="2">Earth Science (ESS)</td></tr>
<tr><td colspan="2" rowspan="2">4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features.</td><td>Planning and Carrying Out Investigations
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.</td><td rowspan="3">4.ESS2: Earth's Systems</td><td>Collect and analyze data from observations to provide evidence that rocks, soils, and sediments are broken into smaller pieces through mechanical weathering (frost wedging, abrasion, tree root wedging) and are transported by water, ice, wind, gravity, and vegetation.</td></tr>
<tr><td>Analyzing and Interpreting Data
Analyze and interpret data to make sense of phenomena using logical reasoning.</td><td>Provide examples to support the claim that organisms affect the physical characteristics of their regions.</td></tr>
<tr><td colspan="3">DCIs</td></tr>
<tr><td>ESS2.A Earth Materials and Systems</td><td colspan="2">Rainfall helps to shape the land ~~and affects the types of living things found in a region~~. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.</td><td>4.ESS3: Earth and Human Activity</td><td>Create an argument, using evidence from research, that human activity (farming, mining,</td></tr>
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			building) can affect the land and ocean in positive and/or negative ways.
ESS2.B: Plate Tectonics and Large-Scale System Interactions (partial only)	~~The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges.~~ Maps can help locate the different land and water features areas of Earth.		
ESS2.E: Biogeology	Living things affect the physical characteristics of their regions.		
CCCs			
Cause and Effect: Cause and effect relationships are routinely identified, tested, and used to explain change. **Stability and Change:** Some systems appear stable, but over long periods of time will eventually change. Change is measured in terms of differences over time and may occur at different rates. **Systems and System Models**: A system can be described in terms of its components and their interactions.			

"Earth's Changing Surface" Handouts and Materials

Materials

Item	Lesson						Notes	Descriptor
	1	2	3	4	5	6		
Communicating in Scientific Ways poster	X	X	X	X	X	X	1 color poster per classroom	Provided to teacher
Stream table setup • 1 plastic tray, 20 inches long with no drain holes • 1 empty gallon milk jug • 1 golf tee • books (covered in a plastic bag), wood block, or plastic container—to elevate jug • 8 cups of moist sand and/or soil • 1 cup of mixed gravel and small rock • 1 small container of dark-colored sand (blue or red) • 1 small shovel to move around sand in the stream table		X	X	X			6 setups	For lessons 2-4, consider reserving 1 stream table for teacher demonstrations. This would provide 5 stream tables for student use.
1 measuring cup or scoop to add sand into the stream tables		X	X					
1 large bucket with water (for rinsing hands or to carry water outside)		X	X	X				
1 sponge, paper towels to wipe up any spills		X	X	X				
6 plastic trash bags to cover the work areas		X	X	X				
aluminum foil to line tray		X	X	X				
Additional stream table materials			X					

• extra books (for steep slope condition) • 6 cups fine sand (play sand *without* rocks or pebbles) and 1 cup gravel and rocks to add to 5 cups of play sand (for different materials condition) • fake moss and plastic trees and shrubs (for vegetation condition) • 2 spray bottles (for precipitation condition) • 1 extra golf tee (for big river condition)								
1 block of wood or rock (to be the dam)				**X**				1 per setup
2 cans of soda					**X**		1 at room temperature and 1 frozen and deformed	1 set per group
1 small plastic bottle or tub with lid					**X**			1 per group
1 small bag of rocks					**X**		4–6 rocks in each bag, rocks should break apart when shaken in plastic bottle	1 bag per group

Student Handouts

Item	Lesson						Descriptor
	1	2	3	4	5	6	
HO1.1 *Communicating in Scientific Ways*	X						1 per student, color
HO1.2 *The Mississippi Delta*	X						1 per student, color
HO1.3 *How does land change to form a delta?*	X			X	X		1 per student, color
HO2.1 *Lesson 2 Analogy Chart*		X					1 per student
HO2.2 *Stream Model Observations*		X					1 per student
HO3.1 *Rate Investigation*			X				1 per student, stapled
HO4.1 *The Changing Delta*				X			1 per student
HO4.2 *Dams and Rivers*				X			1 per student or a laminated classroom set
HO5.1 *Investigation Directions*					X		1 per group
HO5.2 *Lesson 5 Analogy Chart*					X		1 per student
HO5.3 *Tree in Rock Photos*					X		1 per group or a laminated classroom set
HO5.4 *Soda Cans Photo*					X		optional; 1 per group or a laminated classroom set
HO6.1 *Earth's Changing Surface*						X	1 per student
HO6.2 *ECS Location Cards*						X	1 set per group, laminated

Teacher Resources

Item	Lesson						Notes	Descriptor
	1	2	3	4	5	6		
TE1.1 animation of the Mississippi delta	X			X	X		Gather a computer and projector and test playing the animation located here: http://www.watchthedeltagrow.com/mississippi-river-paths.	
TE2.1 *Lesson 2 Analogy Chart Answer Key*		X					In curriculum binder	
TE2.2 *Stream Table Setup Instructions*		X	X	X			In curriculum binder	
TE5.2 *Lesson 5 Analogy Chart Answer Key*					X		In curriculum binder	
TE6.1 *Earth's Changing Surface Cause and Effect Key*						X	In curriculum binder	

General Supplies

Item	Lesson						Notes
	1	2	3	4	5	6	
Student notebooks/ journals	X	X	X	X	X		
Chart paper, chart markers, painter's tape	X	X	X	X	X		
Transparent tape	X						
Fine-point markers (dark colors: black or dark blue)	X	X	X	X	X		These are used by students to write questions they have on sticky notes to place on the DQB. They need to be markers so that the words are visible to all.
Sticky notes	X	X	X	X	X		Students may use these in each lesson to add questions to the DQB and for other tasks. The 3" x 3" square ones are fine.
Scissors				X			to cut aluminum foil