Students engage in our changing landscapes by asking questions about local and global features, planning and carrying out investigations that elicit understanding of the role of physical and chemical processes that cause these features, and construct explanations through modeling and written/oral discussion.

Student Science Performance

6th Grade Earth Science	**Title**
Topic: Earth's Changing Landscape	Inside and Out

Performance Expectation for GSE:

S6E5. Obtain, evaluate, and communicate information to show how Earth's surface is formed.

a. Ask questions to compare and contrast the Earth's crust, mantle, inner and outer core, including temperature, density, thickness, and composition.

b. Plan and carry out an investigation of the characteristics of minerals and how minerals contribute to rock composition.

c. Construct an explanation of how to classify rocks by their formation and how rocks change through geologic processes in the rock cycle.

d. Ask questions to identify types of weathering, agents of erosion and transportation, and environments of deposition. (Clarification statement: Environments of deposition include deltas, barrier islands, beaches, marshes, and rivers.)

e. Develop a model to demonstrate how natural processes (weathering, erosion, and deposition) and human activity change rocks and the surface of the Earth.

f. Construct an explanation of how the movement of lithospheric plates, called plate tectonics, can cause major geologic events such as earthquakes and volcanic eruptions. (Clarification statement: Include convergent, divergent, and transform boundaries.)

g. Construct an argument using maps and data collected to support a claim of how fossils show evidence of the changing surface and climate of the Earth.

Students will continuously obtain, evaluate, and communicate information. This is not a linear process. Students will communicate through writing and discussions to allow for formative assessment. This benefits the teacher, student, and whole group to guide instruction to clarify misconceptions or extend content.

Engaging Learners: Earth's Exterior

Phenomenon: Land Surface Features

Georgia Land Surface Feature	**United States Land Surface Feature**
 **Providence Canyon**	 **Grand Canyon, Arizona**

Pigeon Mountain

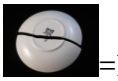
Mole Hill, Virginia

Coast along one of the Golden Isles

Black Sand Beach, Hawaii

Exfoliated Granite Slab on Panola Mountain

Balancing Rock in Red Rocks, Colorado

	Obtaining: After viewing the presentation of various surface features, students evaluate their own understandings for how these features formed. *Teacher Hint:* As each surface feature is presented, engage students in discussion about their own family trips that may have allowed them an opportunity to see these, or similar, land features. Additionally, engage students in thinking about what caused these features to form, their composition, and whether they have always looked like this. Structure student thinking by either providing picture cards that can be held up when asking each question or guiding students into coming up with their own symbols for each possible answer. For example: Causes -  = Weathering  = Human Activities  =Plate Tectonics Structure/Make Up-  = Minerals  = Rocks  = Organic Matter Stability & Change – Δ = Change  = Stable/Little Changes
	Obtaining Students choose one of the surface features to obtain and evaluate additional information to refine their initial models. *Teacher Hint:* Put students into eight groups (one for each feature) and provide varied resources (e.g. leveled text, video, infographic) for students to determine the cause and effect, rock/mineral composition, and relative age with supporting evidence of past and current features/characteristics.
	Evaluating Student groups combine with group that obtained information about a similar feature to compare/contrast how the features formed, their rock/mineral composition, and relative age based on evidence of past/current features. For example, the Providence Canyon group would combine with the Grand Canyon group. *Communicating* Students communicate their findings via a graphic organizer and present to the whole class. *Suggested Organizer:* Formation of Earth's Surface Features Organizer
Engaging Learners: Earth's Interior	**Phenomenon:** Ellison's Cave
	Obtaining From the videoed field trip through Ellison's Cave (see resource above),

	students obtain information about observations inside Georgia's mountains. Students discuss their thoughts on whether they would go spelunking and/or share any of their other experiences exploring Georgia's unique geological features. Students share their ideas for how geologic features such as mountains and caves came to be a part of Georgia's landscape. *Teacher Hint:* Use a map of Georgia to support student contributions.  Student Handout: Regions of Georgia
	Evaluating Students evaluate their thoughts on what it's like even deeper into Earth. Students develop a 2-dimensional model of what they think Earth's interior is like. *Communicating* Students share these models in small groups, adding labels and captions based on agreed upon understandings to a group model. For example, students in a group may agree that there is lava under the rocks and soil, so they would add this to their group model.
As previously stated, students will continuously obtain, evaluate, and communicate information about how earth's features are formed. This is not a linear process. Please note that the following options for exploration and explanation can be taught in any sequence. Most important to note is that each of the explore-explain segments allow an opportunity to concentrate on how both internal and external processes result in the features of earth. Students will communicate these understandings through modeling, writing, and discussions to allow for formative assessment.	
Exploring: Earth's Interior	*Obtaining* Students develop and use scale models to gain understanding of Earth's interior structure and its characteristics in order to ask questions about how these characteristics function to cause geologic events and provide rock, mineral and fossil evidence of Earth's changing landscape. *Teacher Hint:* Support students in retrieving information about the types of minerals, temperature, and density found in each layer.

	Resources: ● *A Virtual Journey to the Center of the Earth* contains background information. ● Research: Plate Tectonic Video Summary: Wegener's Theory of Continental Drift ● Earthquakes Living Lab--The Theory of Plate Tectonics After this exploration, students will 1. Identify and explain evidence of continental movement. 2. Explain plate movement and the consequences of that movement on landforms. 3. Describe how engineers design buildings for earthquake-prone areas. *Teacher Hint:* After students work through both the virtual journey and the earthquake living lab, support students in summarizing information via a graphic organizer: Organizing Your Research Handout. *Obtaining* Students develop and use models that illustrate the cause and effects of plate tectonic motion. *Resources:* ● *Hands On Activity: Soapy Stress* ● *Plate Kinematics* *Guiding Questions:* ● What geologic features might form when plates _____? ● What catastrophic events might be caused from _____? ● How do you think rocks and minerals are changed because of _____? *Teacher Hint:* Emphasize the importance of asking questions based on what is learned from observations in making the scale models. Prompt students to question how these characteristics may cause geologic events, drive the rock cycle, etc. Collect these questions on a class chart.
Explaining: Earth's Interior	*Obtaining* Students obtain information about Earth's past, present, and future. This can be viewed on a video by researching: Colliding Continents **(if you use the one on Youtube only show to 4:26**) from geologists' perspectives and animated models. *Communicating* Provide students time to talk to partner about the video and write questions that were raised as a result. Students add recently acquired answers to previously submitted questions from exploration phase. Students post new questions in a way for all students to read and discuss whole group. *Obtaining* Through an interactive teacher facilitated lecture using both visual representations and student models from the explore phases, students obtain

	scientific language associated with causes and effects of plate tectonic motion. *Teacher Hint:* Use the resource Plates, Plate Boundaries, and Driving Forces to develop a series of slides. The resource supports a chunk and check method for facilitating the lecture. *Teacher Hint:* Student take away points should emphasize that multiple factors result in the geologic features we see on Earth, but that there are typically very specific causes for natural disasters and catastrophic events that are sometimes experienced. *Teacher Hint:* Provide students a graphic organizer to record scientific language that is acquired. *Plate Tectonic Motion Organizer*
Evaluation	***Formative Assessment of Student Learning***
	For options of selected response questions use ConcepTest in Geology. Click the link to Time/Earth History and select questions to assess student learning.
Engaging in Earth's Interior Processes via Local Exterior Features ***(Transition Activity)***	*Evaluating/Communicating* Students now evaluate geology maps of Georgia to ask questions and propose explanations for how these features came to exist and what they might look like in the future. *Teacher Hint:* Guide student thinking in terms of past, present, and future. *Resources:* Geologic Map of Georgia-- Rock types Geologic Map of Georgia--History
Exploring Earth's Exterior Features via Internal Processes	**Phenomenon: Georgia's Geology -** Appalachian Mountains, Blue Ridge Mountains, Stone Mountain, Fossils, Volcanoes, Earthquakes… Overview: Students obtain, evaluate, and communicate information about any one of Georgia's unique geological or paleontological features via a map, with a plate tectonic model, and in terms of other natural processes that support a comprehensive historical and current presentation of the feature.
	Obtaining/Evaluating Students obtain/evaluate information about their selected geologic feature. *Sample Resources:* Paleontological History: *Club Corner: Paleontological Association of Georgia (a new organization)* Appalachian/Blue Ridge Mountains: 26 page booklet on the Birth of the Appalachian Mountains

<table>
<tr><td></td><td></td></tr>
<tr><td>Explaining Earth's Exterior Features</td><td>Communicating Students present their maps, models, and histories of the features.

Teacher Hint: Provide students with a performance rubric: Map and Model Rubric</td></tr>
<tr><td>Evaluation</td><td>Formative Assessment of Student Learning</td></tr>
<tr><td></td><td>Evaluating/Communicating
Students compete in a game of Jeopardy to evaluate/communicate information to construct an explanation for geologic features.

Resource: Geology Jeopardy Interactive Game</td></tr>
<tr><td>Engaging in Earth's Past (Fossil Evidence)</td><td>Phenomena: Fossils of Georgia
GPB Video -- Georgia Stories--Land and Fossils

<table><tr><td colspan="2">What do the fossils tell us about Georgia's geographical history?</td></tr><tr><td>Before</td><td>After</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table>
Teacher Hint: Before watching the video, students' ideas about what Georgia was like in prehistoric times is discussed and/or drawn. Students should think about different kinds of dinosaurs that may live in different regions based on what they understand about the geologic history of the state. During the video, pause to facilitate discussion that provides clarifying evidence to the students' initial thoughts. Students should evaluate and communicate what is obtained.</td></tr>
<tr><td>Exploring Earth's Past</td><td>Obtaining Students obtain and plot coordinates on a United States map of fossil evidence discovered for four different life forms.

Resource:
Information and Pictures of Fossils

Evaluating/Communicating Students evaluate the plotted locations to hypothesize why glossopteris was so widespread. Students also construct a counter argument to their hypothesis.</td></tr>
<tr><td>Explaining Earth's Past</td><td>Obtaining Students use a continental cut out model found on Where in the World was Lystrosaurus? to explore the hypothesis that the continents were</td></tr>
</table>

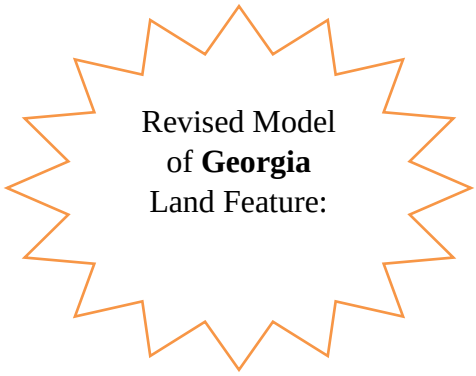
	a single continental body at one time frame in Earth's history.
	Communicating Students make connections from models in the explore/explain phase to provide explanation for the prehistoric fossils found in Georgia.
Engaging in Minerals	**Phenomenon: Indian Springs** *Obtaining* Through storytelling, investigations of water samples, and historical geologic data, students obtain information about the legend of healing water at Indian Springs State Park Big Sandy Creek). *Fictional Story based on Fact* (Disclaimer: This story is completely fictional but attempts to integrate aspects of history to give this context for learning.) Mary Musgrove, an interpreter for the Creek Indians, ran a trading post along Big Sandy Creek in Georgia. Mary's mother was a Creek Indian and her father was an English trader. Therefore, Mary was very good at helping the two cultures communicate. One day as she was walking to the trading post she noticed bubbles forming in the creek waters. She also noticed that it smelled similar to a rotten egg. Later that day in the trading post, she told some of the Creek tribesman about what she had observed. They were quite familiar with what she told them, explaining these were "healing waters" that their tribe had been using for many years to rejuvenate their bodies, spirits, and minds. It was known to heal toothaches, skin conditions, infections, etc. After the tribesman left, Mary talked to her father about bottling the water and selling it to the Englishman based on its healing properties. Her father thought this was ingenious and supported her wholeheartedly in this endeavor. *Resources* To develop understanding, a google search (mineral content and origin of springs) will provide the needed background information for teacher background information and student understanding. *Communicating:* Students use an organizer to communicate understandings about Sandy Creek's properties and development. Handout for Indian Springs Research *Evaluating* Students evaluate the obtained information from a social and cultural perspective to determine if there are measures that would sustain the quality and supply of this type of natural resource. (bundled *S6E6b*)
Exploring Minerals	**Phenomenon***:* Minerals of Georgia

	Obtaining Students use mineral map of Georgia to compile a list of minerals found in Georgia. *Resource:* *Mineral Resource Map of Georgia* *Evaluating* Students then evaluate many (approximately 5) of these minerals for their unique characteristics and uses in the same way that a geologists might. Students watch a video lecture to learn how geologists collect data about minerals, and then use an identification schema to determine its identify. *Teacher Hint:* Based on your available mineral samples, use more or less minerals in this process. *Video Resource:* Processes Involved in Characterizing Minerals (stop video at 5:05) *Organizer for Mineral Characteristics* *Resource:* Mineral Identification Chart *Communicating* Students communicate a summary of one mineral to include a visual representation with all observed properties labeled and a caption to include how it is formed, how it is used, and any related human impact to the surrounding environment associated with is uses.
Explaining Minerals → Rocks	*Obtaining* Students obtain information about how minerals contribute to rock formation and the rock cycle via the online resource: *If Rocks Could Talk*.
	Evaluating Students evaluate additional information (infographics, leveled text, video resources) to finalize explanation of how minerals in Georgia contribute to rock formations and the rock cycle. *Online Text Resource:* *Chapter 4: Earth Science for Middle School Students*
	Communicating From the perspective of a rock commonly found in Georgia, students construct an explanation of how to classify it, how it has changed through geologic processes, and what it might expect in the future.
Evaluation	***Formative Assessment of Student Learning***
	Variations of Jeopardy Jeopardy Game 1 Jeopardy Game 2
Final Evaluation	***Summative Performance Assessment of Student Learning***
Elaborating	**Phenomenon: Erosion Around You**

Applying Model to Solve a Problems	 
	Obtaining Students obtain information about the effect of erosion on Earth's features. After discussion prompted by the photos, students take a walk around their campus looking for additional signs of weathering and erosion. Students ask questions about the specific evidence they observe. For example, where might ___ (for blank - rock, soil or anything that is moved in the process) have originated? How do you think ___ (same as above for blank) got here? *Guiding Questions:* What is erosion? What other examples of erosion have you seen? What do you think caused this? *Obtaining/Evaluating/Communicating* Students explore five different types of erosion at stations, record their observations, and discuss outcomes whole group or as monitored by teacher. *Erosion Stations Worksheet from Teaching Engineering: Glaciers, Water and Wind, Oh My! Activity – Erosion Worksheet* *Resource:* *Teacher's Guide to Glaciers, Water and Wind, Oh My! Activity – Erosion Worksheet*
	Evaluating Students calculate the effect of erosion in each of the five scenarios. *Research: Erosion Math Worksheet*
	Communicating: Students develop visual models with an explanatory caption of the five types of erosion and its effect on earth's surface explored in each station.
SEP, CCC, DCI	**Science Essentials**
Science and Engineering Practices	• Planning and carrying out investigations • Constructing explanations and designing solutions • Analyzing and interpreting data
Crosscutting Concepts	• Causality: Cause and Effect • Cycling of Matter and Energy • Structure and Function • Patterns
Disciplinary Core Ideas	• The History of Planet Earth • Earth Materials and Systems • Plate Tectonics and Large-Scale System Interactions

Name _____ Period _____

Compare and Contrast Organizer



	DIFFERENT (**GA**)	SAME	DIFFERENT (**USA**)
How did the surface feature form?			
What kind of rocks/minerals make up the surface feature?			
About how old is the surface feature?			
How has the surface feature changed over time?			

Return to Instructional Segment

Regions of Georgia

Return to Instructional Segment

Organizing Your Research

	Newton	Seismic Waves	The Moho	Shadow Zones	Plate Tectonics
What was figured out?					
How was it figured out?					
What does this help explain?					
What questions do you still have about this?					

Return to Instructional Segment

Plate Tectonic Motion

Type of Motion	Types of Plates	Results	Cross Section Diagram
Convergent	Continental - Continental		
	Continental - Oceanic		
	Oceanic - Oceanic		
Divergent	Continental - Continental		
	Continental - Oceanic		
	Oceanic - Oceanic		
Transform	Continental - Continental		
	Continental - Oceanic		
	Oceanic - Oceanic		

Return to Instructional Segment

Map and Model Rubric

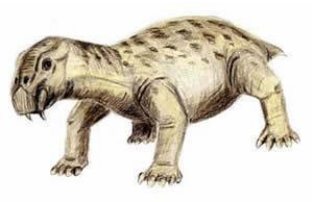
	Exceeds Expectations	Meets Expectations	Does Not Meet Expectations
Map of Geologic Feature	A colored and labeled topographic map is used to show the past and current location of the geologic feature.	A colored and labeled map is used to show the past and current location of the geologic feature.	The map is either inaccurate or not included in the presentation.
Model of Formation	Plate tectonics and other natural processes are used in the model to explain the feature.	A plate tectonics model is used to explain the feature.	Neither plate tectonics or other natural processes are used to explain the feature.
History of the Geologic Feature	A complete history of the geologic feature is presented using both a geologic timeline and written explanation.	A complete history of the geologic feature is presented as a written explanation.	The history of the feature is either incomplete and/or not written in a manner that supports comprehension.

Return to Instructional Segment

Where in the World was Lystrosaurus?

(And Cynognathus, Glossopteris, and Mesosaurus, too!)

For each of the following life forms, plot the coordinates on the map in a different color. Be sure to put the key on the map in that color with the organism's name. After you have done that, shade around the points, showing the approximate areas where that organism lived.



Lystrosaurus

land dwelling reptile

11˚S, 29˚E	8˚S, 31˚E
5˚S, 36˚E	3˚S, 40˚E
20˚N, 75˚E	22˚N, 81˚E
21˚N, 86˚E	70˚S, 105˚E
76˚S, 111˚E	68˚S, 119˚E
80˚S, 120˚E	69˚S, 135˚E
71˚S, 143˚E	

Glossopteris

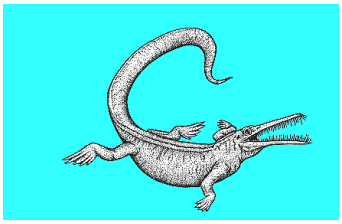
a type of fern

38˚S, 68˚W	37˚S, 62˚W
35˚S, 55˚W	20˚S, 13˚E
24˚S, 22˚E	18˚S, 31˚E
15˚S, 38˚E	22˚S, 46˚E
15˚N, 77˚E	18˚N, 81˚E
78˚S, 75˚E	69˚S, 90˚E
68˚S, 100˚E	79˚S, 96˚E
31˚S, 60˚W	19˚S, 21˚E
21˚S 28˚E	70˚S, 97˚E
25˚S, 135˚E	32˚S, 139˚E
75˚S, 85˚E	

Cynognathus

Mammal-like reptile, land dwelling

21˚S, 62˚W	25˚S, 61˚W
21˚S, 58˚W	19˚S, 51˚W
27˚S, 55˚W	25˚S, 50˚W
20˚S, 45˚W	3˚S, 11˚E
5˚S, 18˚E	10˚S, 15˚E
0˚, 22˚E	2˚S, 30˚E
5˚S, 25˚E	10˚S, 20˚E



Mesosaurus

freshwater swimming reptile

48˚S, 72˚W	45˚S, 70˚W
46˚S, 67˚W	31˚S, 19˚E
28˚S, 22˚E	27˚S, 23˚E
27˚S, 28˚E	32˚S, 26˚E
29˚S, 31˚E	

Fill in the chart after you have plotted the coordinates:

Fossil	Continents where fossils have been found
Lystrosaurus	
Glossopteris	
Cynognathus	
Mesosaurus	

Answer the following questions in *complete sentences:*

Give three hypotheses on why glossopteris was so widespread. (You can get creative, just stay within the realm of possibility)

1.

2.

3.

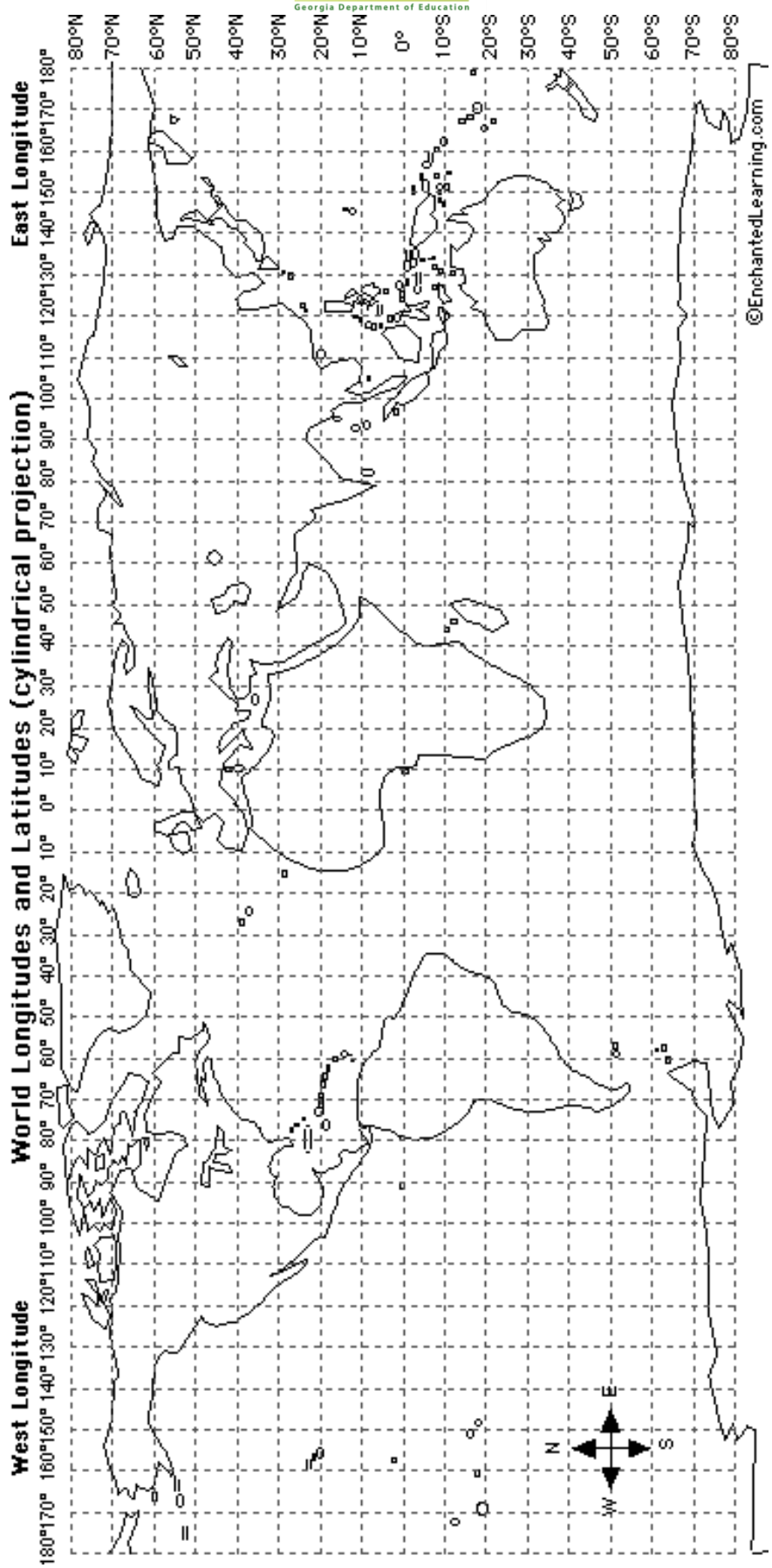
Take your most 'creative' hypothesis and describe observations or data that could refute it.

What new evidence would it take for your most reasonable hypothesis to become a theory? (Remember that a theory is a hypothesis that has been supported with repeated testing.)

4.

5.

6.


World Longitudes and Latitudes (cylindrical projection)
West Longitude
East Longitude
180° 170° 160° 150° 140° 130° 120° 110° 100° 90° 80° 70° 60° 50° 40° 30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70° 80°
80°N 70°N 60°N 50°N 40°N 30°N 20°N 10°N 0° 10°S 20°S 30°S 40°S 50°S 60°S 70°S 80°S
N
S
E
W
©EnchantedLearning.com

Continental Cut Out:

Shade the fossil ranges for Lystrosaurus, Mesosaurus, Glossopteris, and Cynognathus onto the continent shapes. Cut them out and glue them onto this paper so that the fossil ranges connect from one land mass to the next.

Return to Instructional Segment

Fictional Story based on Facts

Mary Musgrove, an interpreter for the Creek Indians, ran a trading post along Big Sandy Creek in Georgia. Mary's mother was a Creek Indian and her father was an English trader. Therefore, Mary was very good at helping the two cultures communicate.

One day as she was walking to the trading post she noticed bubbles forming in the creek waters. She also noticed that it smelled similar to a rotten egg.

Later that day in the trading post, she told some of the Creek tribesman about what she had observed. They were quite familiar with what she told them, explaining these were "healing waters" that their tribe had been using for many years to rejuvenate their bodies, spirits, and minds. It was known to heal toothaches, skin conditions, infections, etc.

After the tribesman left, Mary talked to her father about bottling the water and selling it to the Englishman based on its healing properties. Her father thought this was ingenious and supported her wholeheartedly in this endeavor.

Return to Instructional Segment

Indian Springs

Legendary Properties of the Water	Unique Scientific Properties of the Water	Scientific Explanation for Properties (Include a visual representation when possible)

Return to Instructional Segment

Organizer for Mineral Characteristics:

	Mineral 1	Mineral 2	Mineral 3	Mineral 4	Mineral 5
Color					
Luster					
Crystal Shape					
Streak Test					
Cleavage					
Fracture					
Hardness					
Acid Test					
Any Special Property					
	⇓	⇓	⇓	⇓	⇓
Identification					

Return to Instructional Segment