Standards (Content and Characteristics):

S6E5 Students will investigate the scientific view of how the earth’s surface is formed.
   f. Explain the effects of physical processes (plate tectonics, erosion, deposition, volcanic eruption, gravity) on geological features including oceans (composition, currents and tides).
   g. Describe how fossils show evidence of the changing surface and climate of the Earth.

S6CS1. Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
   a. Understand the importance of—and keep—honest, clear, and accurate records in science.
   b. Understand that hypotheses are valuable if they lead to fruitful investigations, even if the hypotheses turn out not to be completely accurate descriptions.

S6CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
   a. Follow correct procedures for use of scientific apparatus.
   b. Demonstrate appropriate techniques in all laboratory situations.
   c. Follow correct protocol for identifying and reporting safety problems and violations.

S6CS4. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.
   a. Use appropriate technology to store and retrieve scientific information in topical, alphabetical, numerical, and keyword files, and create simple files.
   b. Estimate the effect of making a change in one part of a system on the system as a whole.

S6CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.
   a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts. (For example: El Nino’s effect on weather).
b. Identify several different models (such as physical replicas, pictures, and analogies) that could be used to represent the same thing, and evaluate their usefulness, taking into account such things as the model’s purpose and complexity.

**S6CS6. Students will communicate scientific ideas and activities clearly.**

a. Write clear, step-by-step instructions for conducting scientific investigations, operating a piece of equipment, or following a procedure.
b. Understand and describe how writing for scientific purposes is different than writing for literary purposes.
c. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

**S6CS8. Students will investigate the characteristics of scientific knowledge and how it is achieved.**

Students will apply the following to scientific concepts:
a. When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as meaningful.
b. When new experimental results are inconsistent with an existing, well-established theory, scientists may require further experimentation to decide whether the results are flawed or the theory requires modification.
c. As prevailing theories are challenged by new information, scientific knowledge may change and grow.

**S6CS9. Students will investigate the features of the process of scientific inquiry.**

Students will apply the following to inquiry learning practices:
a. Scientific investigations are conducted for different reasons. They usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations.
b. Scientists often collaborate to design research. To prevent bias, scientists conduct independent studies of the same questions.
c. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator’s credibility with other scientists and society.
d. Scientists use technology and mathematics to enhance the process of scientific inquiry.

**S6CS10. Students will enhance reading in all curriculum areas by:**

a. Reading in All Curriculum Areas
b. Building vocabulary knowledge
d. Establishing context
Enduring Understanding:
1. Some changes in the earth’s surface are abrupt (such as earthquakes) while other changes happen very slowly (such as deposition, weathering and erosion)
2. Geologists can date rock layers within a bedrock by observing the sequence of its layers and studying the fossils present in each layer.

Essential Questions:
1. How do geologists infer what events (earthquakes, deposition, weathering and erosion) took place on earth’s surface?
2. What can fossils tell us about movements of the plates in the past?
Georgia Performance Standards Framework for Earth Science – Grade 6

ADMINISTRATION PROCEDURES

Pre-Assessment: Post a picture of a rock layer diagram in a prominent place in the classroom. The diagram should include a fault and fossils. Label the layers with letters to make it easier for students to sequence the layers. Have students list the layers from oldest to youngest and determine when the fault happened. An example of a simple rock layer diagram can be found on page 2 of the following document http://geosun.sjsu.edu/paula/103/exam1_and_answerkey.pdf

| Outcome / Performance Expectations: | ♦ Students will recognize that some changes in the earth’s surface are abrupt (earthquakes) while other changes happen very slowly (weathering and erosion).
♦ Students will describe how fossils show evidence of the changing surface of the Earth. |
| General Teacher Instructions: | ♦ Show students animations of plate movements and explain how earthquakes and volcanoes are related to plate movements. The following websites contain pictures of the Grand Canyon for an illustration of rock deposition as well as animations of plate movements: http://www.iris.edu/gifs/animations/faults.htm and http://www.americansouthwest.net/arizona/grand_canyon/national_park.html
♦ Familiarize students with the Principle of Superposition, Cross-Cutting Relationships, relative age of rock layers and the term “stratigraphy.” The following website explains the above concepts: http://www.classzone.com/books/earth_science/terc/content/investigations/es2903/es2903page01.cfm?chapter_no=investigation
♦ On the day prior to the activity, prepare the cake to represent rock layers.
♦ Divide the cake batter into four portions and color three of them a different color. Add chocolate chips to one color batter, pecans to the second, and raisins to the third. Do not add anything to the fourth portion of cake batter. Each cake batter should contain only one type of “fossil” (chocolate chips, raisins or pecans). Bake each batter separately into 4 cakes to be layered and cool.
♦ Assemble cake by stacking the layers. To model a fault, cut a section or half of the cake and stack it differently (see figure 1). Place the pieces together, wrap the sides with foil and ice the top.
♦ Provide oral instructions prior to activity. Divide students in groups of four. Provide each group with a piece of the cake. Monitor groups of students as they analyze their sample.
♦ Instruct students to exchange information with another group that has a different core sample. (Student directions are in section below) |
Obtain the core sample from one group. Cut half of the top layer and ask students what process was modeled (weathering – cake crumbling and erosion – removal of the partial layer). Add another layer over the “eroded” surface and ask students the name of the process (deposition). Lead students to conclude that these processes take a long time to happen (thousands to millions of years).

Using a plastic knife, cut only through the top layer that was just added. Ask students what was modeled (an earthquake that produced a fault). Explain that earthquakes, like volcanoes are events that change the earth’s surface quickly.

After activity is finished, prompt students to answer some questions about the task (see Post-Activity Questions). Emphasize that geologists can tell which parts of the earth were in different environments by using the fossil information. Marine fossils in a continental rock layer indicate that the layer was once under water. This was one of the clues that led scientists to conclude that the lithospheric plates are constantly moving.

**Materials Needed:**
Ingredients to make a large cake (3 packages of white cake mixes), chocolate frosting, 4 rectangular baking pans, food coloring, aluminum foil, raisins, chocolate chips, pecans, paper plates, transparencies, tape, color markers, color pencils, activity sheet (Figure 2).

**Safety Precautions:**
Make note of students who have food allergies before selecting ingredients. Change ingredients as appropriate. Students should not eat materials from a laboratory experience nor should they consume food while in an area designated as a laboratory.

**Task with Student Directions:**
- Groups of 4 students will make a coring device to take a sample of the bedrock (cake) by rolling a transparency sheet into a 2.5-cm diameter tube and fastening it with tape. This could also be done using a clear straw.
- One student will “drill” a section of the cake, place it on paper plate and take it to back to the group site.
- Students will sketch and color the rock layers of the sample on the activity sheet under the Rock Layers Diagram (Figure 2).
- Students will measure the thickness of the layers and record their data in the Rock Description Chart (Figure 2).
- Students will use the Fossil Key (Figure 3) to determine which fossils are present in each layer.
- Students will order the layers using the Principle of Superposition (bottom layers are older than top layers).
Students will determine when the fault happened by using the Principle of Cross-Cutting Relationships (the layers affected by the fault are older than the fault (layers A, B, C); the layers not affected by the fault are younger than the fault (layer D).

Students will “visit” another group with a different core sample and exchange information.

Students will answer the post-activity questions.

**Resources:**
- [http://www.iris.edu/gifs/animations/faults.htm](http://www.iris.edu/gifs/animations/faults.htm)
- [http://www.americansouthwest.net/arizona/grand_canyon/national_park.html](http://www.americansouthwest.net/arizona/grand_canyon/national_park.html)
- [http://geosun.sjsu.edu/paula/103exam1_and_answerkey.pdf](http://geosun.sjsu.edu/paula/103exam1_and_answerkey.pdf)
- [http://www.classzone.com/books/earth_science/terc/content/investigations/es2903/es2903page01.cfm?chapter_no=investigation](http://www.classzone.com/books/earth_science/terc/content/investigations/es2903/es2903page01.cfm?chapter_no=investigation)

**Homework / Extension:**
Students will describe both Principles (Superposition and Cross-Cutting relationships) and explain how they determined the order of the rock layers and fault. Students will predict which rock layers where marine or land environment in the past by using the Rock Key Chart (Figure 3).

**Instructional Task Accommodations for ELL Students:**
- Adjust teacher talk when explaining activity to increase comprehensibility (face the students, pause frequently, speak at a moderate speed)
- Decrease details needed to learn main concepts
- Reduce length of assignment
- Pair verbal directions with visual clues
- Provide additional examples

**Instructional Task Accommodations for Students with Specific Disabilities:**
- Reduce the number of questions answered about each website students investigate
- Provide quiet work space with minimal distractions
- Provide sentence/story starters for answering questions about each website
- Enlarge font size on student copies of website listings
- Record websites orally on data collecting instrument

**Instructional Task Accommodations for Gifted Students:**
- Students will design their own original children’s storybook to explain the results of the plates moving
- Students can conduct a “writer’s workshop” detailing the consequences of plate movement
- Students will write a skit based on interactive graphics, activities discovered and the researched websites; students will then cast and perform the skit for their peers
Figure 1. Rock Layers (Cake Layers)

- Layer D (shark tooth)
- Layer C (dinosaur bone)
- Layer B (trilobite)
- Layer A (no fossils)

Rock Layers Diagram:

<table>
<thead>
<tr>
<th>Color</th>
<th>Thickness of layer (cm)</th>
<th>Fossils present</th>
<th>Fault Yes/No</th>
<th>Order of deposition/event</th>
</tr>
</thead>
<tbody>
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</table>
Figure 3. Fossil Key Chart

<table>
<thead>
<tr>
<th>Fossil Symbol</th>
<th>Real Fossil</th>
<th>Approximate Age</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate Chip</td>
<td>Shark Tooth</td>
<td>18 million years ago</td>
<td>Marine</td>
</tr>
<tr>
<td>Pecan</td>
<td>Dinosaur Bone</td>
<td>65 million years ago</td>
<td>Land</td>
</tr>
<tr>
<td>Raisin</td>
<td>Trilobite</td>
<td>250-300 million years ago</td>
<td>Marine</td>
</tr>
</tbody>
</table>

Post-Activity Questions:

1. Which layer was deposited first? How do you know?
2. How does the principle of superposition explain your answer to question #1?
3. Were there any faults in your rock layer sample? How do you know?
4. Can you determine when the fault happened? Explain your thinking.
5. What caused the fault? What type of plate movement would best explain the fault?
6. Were there any fossils in any strata?
7. Can you infer whether in the past, the rock layers were in a marine or land environment? If so, what information from your sample supports your answer?
8. How is your core sample different from the other groups in your class?