EarthComm Correlations to South Carolina
Grades 9-12 Earth Science Content Standards

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	G1	**G2**	**G3**	**U1**	**U2**	**U3**	**F1**	**F2**	**F3**	**N1**	**N2**	**N3**	**E1**	**E2**	**E3**
I. Inquiry: Inquiry is not an isolated unit of instruction and should be embedded throughout the content areas. The nature of science and technology is incorporated within this area. **A. Identify Questions and Concepts that Guide Scientific Investigations:** Experimental design should demonstrate logical connections between a knowledge base and conceptual understanding.															
1. Formulate a testable hypothesis based on literary research and previous knowledge.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
2. Identify and select experimental variables (independent and dependent) and controlled conditions.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
B. Design and Conduct Investigations: Prior knowledge about major concepts, laboratory apparatus, laboratory techniques, and safety should be used in designing and conducting a scientific investigation.															
1. Design a scientific investigation based on the major concepts in the area being studied.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
2. Select and use appropriate instruments to make the observations necessary for the investigation, taking into consideration the limitations of the equipment.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
3. Identify technologies that could enhance the collection of data.	XX	XX	XX		X	XX	X	XX	X	X	XX	X	XX	XX	X
4. Select the appropriate safety equipment needed to conduct an investigation (e.g., goggles, aprons, etc.).	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
5. Suggest safety precautions that need to be implemented for the handling of materials and equipment used in an investigation.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
6. Describe the proper response to emergency situations in the laboratory.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	XX
7. Conduct a laboratory investigation with repeated trials and systematic manipulation of variables.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	

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8. Identify possible sources of error inherent in an experimental design.	**XX**	**X**	**X**	**X**	**X**	**XX**	**X**	**X**	**X**	**XX**	**X**	**X**	**X**	**X**	**X**
9. Organize and display data in useable and efficient formats, such as tables, graphs, maps, and cross sections.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
10. Draw conclusions based on qualitative and quantitative data.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
11. Discuss the impact of sources of error on experimental results.	**XX**	**X**	**X**	**X**	**XX**	**XX**	**X**	**X**	**XX**	**X**	**XX**	**X**	**X**	**X**	**X**
12. Communicate and defend the scientific thinking that resulted in conclusions.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
C. Use Technology and Mathematics to Improve Investigations and Communications: Scientific investigations can be improved through the use of technology and mathematics. While it is acknowledged that the SI system is the accepted measurement system in science, opportunities to use the English System are encouraged.															
1. Select and use appropriate technologies (e.g., computers, calculators, CBL’s) to enhance the precision and accuracy of data collection, analysis, and display.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**X**	**X**	**X**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
2. Discriminate between data that may be valid or anomalous.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
3. Select and use mathematical formulas and calculations to extend the usefulness of laboratory measurements.	**XX**	**XX**	**X**	**XX**	**XX**	**X**	**XX**	**X**	**XX**	**XX**	**XX**	**X**	**XX**	**XX**	
4. Draw a “best fit” curve through data points.	**X**					**X**			**XX**	**XX**			**X**	**X**	
5. Calculate the slope of the curve and use correct units for the value of the slope for linear relationships.	**X**				**X**	**X**			**X**				**X**		
6. Calculate interpolated and predict extrapolated data points.	**X**	**X**			**X**	**X**			**XX**	**XX**		**X**	**XX**	**X**	
7. Perform dimensional analysis calculations.	**XX**	**XX**	**X**	**X**	**X**	**XX**	**X**	**X**	**X**	**XX**	**X**	**XX**	**XX**		
D. Formulate and Revise Scientific Explanations and Models Using Logic and Evidence: Scientific explanations and models are developed and revised through discussion and debate.															
1. Construct experimental explanations or models through discussion, debate, logic, and experimental evidence.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
2. Develop explanations and models that eliminate bias and demonstrate the use of ethical principles.	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

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3. Revise explanations or models after review.	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**

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E. Recognize and Analyze Alternative Explanations and Models: Scientific criteria are used to discriminate among plausible explanations.															
1. Compare current scientific models with experimental results.	XX	XX	X	X	X	XX	XX	X	X	XX	X	X	X	X	X
2. Select and defend, based on scientific criteria, the most plausible explanation or model.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	X
F. Communicate and Defend a Scientific Argument: Experimental processes, data, and conclusions should be communicated in a clear and logical manner.															
1. Develop a set of laboratory instructions that someone else can follow.	XX	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2. Develop a presentation to communicate the process and conclusion of a scientific investigation.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
G. Understandings about Scientific and Technological Inquiry: Historical scientific knowledge, current research, technology, mathematics and logic should be the basis for conducting investigations and drawing conclusions.															
1. Analyze how science and technology explain and predict relationships.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
a. Defend the idea that conceptual principles and knowledge guide scientific and technological inquiry.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
b. Explain how historical and current scientific knowledge influences the design, interpretation, and evaluations of investigations.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
1. Discuss the reasons scientists and engineers conduct investigations.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
2. Defend the use of technology as a method for enhancing data collection, data manipulation, and advancing the fields of science and technology.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
3. Explain how mathematics is important to scientific and technological inquiry.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
4. Explain why scientific models and explanations need to be based on historical and current scientific knowledge.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
5. Understand that scientific explanations must be logical, supported by the evidence, and open to revision.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX

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III. Earth Science **A. Energy in the Earth System** ***1. Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from the Earth original formation.***															
a. Describe how the decay of radioactive isotopes produces internal heat in the Earth.	**X**	**X**		**X**						**X**					
b. Describe how gravitational forces led to the production of heat in the early history of the Earth and to the differentiation of the Earth into a core, mantle, and crust.	**X**	**X**													
c. Give evidence that some of that heat is still escaping from the Earth's interior.	**XX**	**XX**													
2. The outward transfer of Earth's internal heat drives convection circulation in the mantle that propels the plates comprising Earth's surface across the face of the globe.															
a. Examine how internal heat produces convection currents that are the driving force for plate tectonics.	**X**	**XX**													
b. Analyze the pros and cons of living in areas affected by natural hazards such as earthquakes, and volcanic eruptions.	**XX**	**XX**	**XX**												
3. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere. Global climate is determined by energy transfer from the sun at and near the Earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the Earth's rotation, and static conditions such as the position of mountain ranges and oceans.															
a. Analyze the effects of atmospheric convection, atmospheric dust and cloud cover, rotation of the Earth, revolution of the Earth, and tilt of the Earth's rotational axis on global climates and seasons.	**X**												**XX**	**XX**	
b. Explain the factors that affect geographic variations in climate including distribution of land and water, physiographic (geologic) features, and latitude effects.							**X-**							**XX**	

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c. Relate the transfer of heat energy to the patterns of wind belts.							**XX**	**X**						**X**	

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d. Compare and contrast the formation of high- and low-pressure systems, the formation of fronts, and the movement of weather systems across the surface of the Earth.	**X**							**XX**							
e. Analyze the pros and cons of living in areas affected by natural hazards such as hurricanes, tornadoes, and other severe weather.						**X**	**X**	**XX**							
4. The hydrosphere is affected by both internal and external sources of energy. Solar energy drives the hydrologic cycle and produces convection in the hydrosphere. The outward transfer of Earth's internal heat drives hydrothermal processes.															
a. Describe how solar energy is transferred to ocean currents and waves.							**XX**						**X**		
b. Investigate and describe the formation of waves and the effects of the transfer of energy as waves interact with the shore.							**XX**						**X**		
c. Evaluate the effectiveness of human interventions designed to reduce the effects of rising sea level and waves on coastal erosion.							**X**	**X**	**X**						
d. Examine the influence of heat from the Earth's interior on chemosynthesis in the marine hydrosphere.	**X**														
B. Geochemical Cycles *1. The Earth is a system containing essentially a fixed amount of each stable chemical atom, or element. Each element can exist in several different chemical reservoirs. Each*															
a. Illustrate and explain how elements, such as carbon, oxygen, and nitrogen, cycle through the atmosphere, oceans, rocks, and living organisms.	**X**	**X**		**X**						**XX**		**X**		**XX**	
b. Analyze how the use and recovery of fossil fuels impacts the environment.										**XX**				**X**	
c. Evaluate the importance of limiting consumption of nonrenewable resources.										**XX**	**XX**	**XX**			

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2. Movement of matter between reservoirs is driven by the Earth’s internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.															
a. Describe how the Earth’s internal and external energy drives the physical and chemical changes carbon undergoes as it moves through its geochemical cycle.	**X**	**X**								**X**				**X**	
b. Discuss how these changes affect the reservoirs.		**X**								**X**					
C. The Origin and Evolution of the Earth System ***1. Scientists theorize that the sun, the Earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. The early Earth was very different from the planet we live on today.***															
a. Describe how scientists theorize that the Solar system formed from a nebular cloud of dust and gas.													**XX**		
b. Describe changes in atmospheric conditions over time and infer possible causes including the greenhouse effect and ice age cycles.									**X**					**XX**	
2. Geologic time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations. Current methods include using the known decay rates of radioactive isotopes present in the rock to measure the time since the rock was formed.															
a. Trace the historical development of relative dating using rock sequences and fossils including the contributions of Hutton (uniformitarianism) and Lyell (crosscutting relationships and inclusions).				**XX**											**X**
b. Describe techniques of relative dating using rock sequences and fossils to establish a sequence of geologic events, including the age of fossils.				**XX**											**X**
c. Describe radioactive decay as a means of dating events in the Earth’s history.				**X**							**X**			**X**	

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3. Interactions among the solid Earth, the oceans, and organisms have resulted in the ongoing evolution of the Earth system. We can observe some changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years.															
a. Explain how scientists conclude that processes take place and change occurs, even when the change is too slow to observe directly.	**XX**	**XX**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
b. Infer from surface features shown on aerial, satellite, and topographic maps the underlying subsurface conditions resulting from past geologic events.	**XX**	**XX**	**X**	**X**	**X**	**X**			**X**	**X**				**X**	
c. Infer how interactions between the atmosphere, hydrosphere, and solid Earth result in the formation of sedimentary rocks.				**XX**		**X**				**XX**					**X**
d. Predict changes in the Earth's surface based on past and current geologic events (e.g., earthquakes, volcanic activity, mountain building, weathering, erosion, and impact craters).	**XX**	**XX**	**XX**	**X**	**X**				**XX**			**X**	**X**	**X**	
e. Trace the historical development of the theory of plate tectonics including the contributions of Wegener.		**XX**													
4. Evidence for one-celled forms of life – the bacteria – extends back more than 3.5 billion years. The evolution of life caused dramatic changes in the composition of the Earth's atmosphere, which did not originally contain oxygen.															
a. Relate the dramatic changes in the composition of the Earth's atmosphere (introduction of oxygen) to the evolution of single-celled life forms.	**X**														**X**

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D. The Origin and Evolution of the Universe *1. The origin of the universe remains one of the greatest questions in science. The big bang theory places the origin between 10 and 20 billion years ago, when the universe began in a hot dense state; according to this theory, the universe has been expanding ever since.*															
a. Trace the historical development of scientific theories for the formation of and changes in the universe including the contributions of Copernicus, Kepler, and Galileo.													**X**		
b. Discuss the evidence for an expanding universe.													**XX**		
c. Give examples of the technology used to provide evidence about the history and origin of the universe.													**XX**		
2. Early in the history of the universe, matter, primarily the light atoms hydrogen and helium clumped together by gravitational attraction to form countless trillions of stars. Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe.															
a. Infer how gravity and motion affect the formation of different types of galaxies.													**X**		
b. Identify the location of our Sun in the Milky Way galaxy.													**XX**		
3. Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.															
a. Describe the life cycle of stars.													**XX**		
b. Explain the formation of elements by fusion in stars and supernova explosions.													**XX**		